GE Consumer & Industrial

Power Protection

VAT300

GP AC Drive

User Manual

GE imagination at work

GE Consumer & Industrial

GE
AC SPEED CONTROL EQUIPMENT
VAT300

200V System 0.75 to 45 kW Normal Duty
400V System 0.75 to 475 kW Normal Duty

INSTRUCTION MANUAL

NOTICE

1. Read this manual thoroughly before using the VAT300, and store in a safe place for reference.
2. Make sure that this manual is delivered to the final user.

GE Consumer & Industrial

ST-3450C January 2008

Contents

Preface

Thank you for purchasing the “GE AC Speed Control Equipment VAT300”.
VAT300 is a highly functional inverter that is easy to use.
Please read this manual thoroughly before use, and keep the manual at hand for later reference. Also make sure that this manual is delivered to the final users.

WARNING

ALWAYS READ THIS MANUAL THOROUGHLY BEFORE USING THE VAT300.

THIS INVERTER CONTAINS HIGH VOLTAGE CIRCUITS THAT MAY BE FATAL TO HUMANS. USE EXTREME CAUTION DURING INSTALLATION. MAINTENANCE MUST BE PERFORMED BY QUALIFIED TECHNICIANS, AND ALL POWER SOURCES MUST BE DISCONNECTED BEFORE ANY MAINTENANCE. SUFFICIENT NOTICE MUST BE GIVEN TO THE GENERAL OPERATORS AND WORKERS BEFORE STARTING.

- ELECTRIC SHOCK MAY OCCUR IF THE FOLLOWING POINTS ARE NOT OBSERVED.
  (1) DO NOT OPEN THE FRONT COVER WHILE THE POWER IS ON.
  (2) A CHARGE STILL REMAINS IN THE INVERTER WHILE THE INDICATOR IS LIT EVEN IF THE POWER HAS BEEN TURNED OFF. DO NOT OPEN THE FRONT COVER IN THIS CASE. WAIT AT LEAST 10 MINUTES AFTER THE INDICATOR GOES OUT.
  (3) DO NOT CONTACT THE ELECTRICAL CIRCUIT WHILE THE "CHARGE" LED ON THE UNIT IS LIT. PERFORM SERVICING, ETC., AFTER WAITING AT LEAST 10 MINUTES AFTER THE LAMP GOES OUT.
  (4) ALWAYS GROUND THE INVERTER CASE. THE GROUNDING METHOD MUST COMPLY WITH THE LAWS OF THE COUNTRY WHERE THE INVERTER IS BEING INSTALLED.

- THE INVERTER MAY BE DESTROYED BEYOND REPAIR IF THE FOLLOWING POINTS ARE NOT OBSERVED.
  (1) OBSERVE THE INVERTER SPECIFICATIONS.
  (2) CONNECT ADEQUATE CABLES TO THE INPUT/OUTPUT TERMINALS.
  (3) ALWAYS KEEP THE INVERTER INTAKE/OUTTAKE PORTS CLEAN, AND PROVIDE ENOUGH VENTILATION.
  (4) ALWAYS OBSERVE THE CAUTIONS LISTED IN THIS INSTRUCTION MANUAL.

- THERE MAY BE SOURCES OF NOISE AROUND THIS INVERTER AND MOTOR DRIVEN BY THIS INVERTER. CONSIDER THE POWER SUPPLY SYSTEM, INSTALLATION PLACE AND WIRING METHOD BEFORE INSTALLATION.
  INSTALL THIS INVERTER AWAY FROM DEVICES THAT HANDLE MINUTE SIGNALS, SUCH AS MEDICAL EQUIPMENT IN PARTICULAR. ALSO SEPARATE THE DEVICES ELECTRICALLY, AND TAKE SUFFICIENT NOISE MEASURES.

- TAKE SUFFICIENT SAFETY MEASURES WHEN USING THIS INVERTER FOR PASSENGER TRANSPORTATION, SUCH AS IN LIFTS (ELEVATORS).

- PRODUCT LIFE MAY DECREASE WHEN APPLIED IN HIGH TEMPERATURE ENVIRONMENTS, OR IN SPECIFIC APPLICATIONS WITH FREQUENT CURRENT OVERLOADS LIKE ELEVATORS, CRANES, ETC.
  IN SUCH APPLICATIONS, COUNTERMEASURES LIKE DERATING THE VAT300, LIMITING CURRENTS AT STARTING OR STOPPING, OR LOWERING CARRIER FREQUENCY ARE NEEDED. PLEASE ASK YOUR DEALER FOR SPECIFIC DETAILS.

PRECAUTIONS FOR SAFETY

Items to be observed to prevent physical damage or property damage and to ensure safe use of this product are noted on the product and in this instruction manual.

- Please read this instruction manual and enclosed documents before starting operation to ensure correct usage. Thoroughly understand the device, safety information and precautions before starting operation. After reading, always store this manual where it can be accessed easily.

- The safety precautions are ranked as "**DANGER**" and "**CAUTION**" in this instruction manual.

DANGER	: When a dangerous situation may occur if handling is mistaken leading to fatal or major injuries.
CAUTION	: When a dangerous situation may occur if handling is mistaken leading to medium or minor injuries, or physical damage.

Note that some items described as **CAUTION** may lead to major results depending on the situation. In any case, important information that must be observed is described.

- This instruction manual is written on the premise that the user has an understanding of the inverter. Installation, operation, maintenance and inspection of this product must be done by a qualified person. Even qualified persons must undergo periodic training.

Qualified refers to satisfying the following conditions.

- The person has thoroughly read and understood this instruction manual.
- The person is well versed in the installation, operation, maintenance and inspection of this product, and understands the possible dangers.
- The person is informed on matters related to starting, stopping, installation, locks and tag displays, and has been trained in the operation and remedies.
- The person has been trained on the maintenance, inspection and repairs of this product.
- The person has been trained on protective tools used to ensure safety.

1. Transportation and installation

⚠ CAUTION

- Always transport the product with an appropriate amount according to the products weight.
  Failure to observe this could lead to injuries.
- Install the inverter, dynamic braking unit and resistor, and other peripheral devices on non-combustible material such as metal.
  Failure to observe this could lead to fires.
- Do not place the product near inflammable items.
  Failure to observe this could lead to fires.
- Do not hold the front cover while transporting the product.
  Failure to observe this could lead to injuries from dropping.
- Do not let conductive materials such as screws or metal pieces and inflammable materials such as oil enter the product.
  Failure to observe this could lead to fires.
- Install the product in a place that can withstand the weight of the product, and follow the instruction manual.
  Failure to do so could lead to injuries from dropping.
- Do not install and operate an inverter that is damaged or that has missing parts.
  Failure to observe this could lead to injuries.
- Always observe the conditions described in the instruction manual for the installation environment.
  Failure to observe this could lead to faults.

2. Wiring

⚠ DANGER

- Always turn the device's input power OFF before starting wiring.
  Failure to do so could lead to electric shocks or fires.
- Carry out grounding that complies with the standards of the country where the inverter is being installed.
  Failure to do so could lead to electric shocks or fires.
- When using the PM motor, even if the inverter is stopped, the voltage will be generated at the output terminal (U, V, W) during rotation. Always carry out wiring while the motor is stopped.
  Failure to do so could lead to electric shocks or injuries.
- Wiring must always be done by a qualified electrician.
  Failure to observe this could lead to electric shocks or fires.
- Always install the device before starting wiring.
  Failure to do so could lead to electric shocks or injuries.
- Prepare a breaker such as an MCCB or fuses that matches the capacity for the inverter's power supply side.
  Failure to do so could lead to fires.

⚠ CAUTION

- Do not connect an AC power supply to the output terminals (U, V, W).
  Failure to observe this could lead to injuries or fires.
- Confirm that the product's rated voltage and frequency match the power supply voltage and frequency.
  Failure to do so could lead to injuries or fires.
- Install an overheating protection device on the dynamic braking unit and resistor, and shut off the power with this fault signal.
  Failure to do so could lead to fires in the event of abnormal overheating.
- Do not directly connect a resistor to the DC terminals (between L+1, L+2, and L–).
  Failure to observe this could lead to fires.
- Tighten the terminal screws with the designated tightening torque.
  Failure to do so could lead to fires.
- Correctly connect the output side (U, V, W).
  Failure to do so could cause the motor to rotate in reverse and the machine to be damaged.
- Always correctly connect when using the encoder.
  The signal polarity specifications differ according to the encoder. Refer to sections 3-4-2 (4) and 3-4-3(1) on test operation, and adjust the signal polarity with the parameter settings (C50, C51).
  Failure to observe this could lead to reverse rotation or abnormal acceleration of the motor, and to injuries or machine damage.

3. Operation

DANGER

- Always install the front cover before turning the input power ON. Never remove the cover while the power is ON. There are sections in the front PCB that are charged with high voltages.
  Failure to observe this could lead to electric shocks.
- Never touch the switches with wet hands.
  Failure to observe this could lead to electric shocks.
- Never touch the inverter's terminals while the inverter power is ON even if the operation is stopped.
  Failure to observe this could lead to electric shocks.
- Selection of the retry function could lead to unexpected restarting when alarm stops. The machine may start suddenly if the power is turned ON when the automatic start function is selected. Do not go near the machine.
  (Design the machine so that physical safety can be ensured even if the machine restarts.)
  Failure to do so could lead to injuries.
- The machine may not stop when a stop command is issued if the deceleration stop function is selected and the overvoltage/overcurrent limit function is activated. Prepare a separate emergency stop switch.
  Failure to do so could lead to injuries.
- To prevent unexpected operation, ensure that the operation signal is no longer being input, and reset the alarm.
  Failure to do so could lead to injuries.

CAUTION

- The heat sink and dynamic braking resistor are heated to high temperatures, so never touch them.
  Failure to observe this could lead to burns.
- Do not block the inverter's ventilation holes.
  Failure to observe this could lead to fires.
- The inverter operation can easily be set from low speeds to high speeds, so confirm that the operation is within the tolerable range for the motor or machine before making settings.
  Failure to do so could lead to injuries.
- Prepare holding brakes when necessary. Holding is not possible with the inverter's brake functions.
  Failure to do so could lead to injuries.
- Confirm the operation of the motor as a single unit before operating the machine.
  Failure to do so could lead to injuries or machine damage due to unforeseen movements.
  Always prepare a safety backup device so that the machine is not placed in a hazardous situation when an error occurs in the inverter.
  Failure to do so could lead to injuries or machine damage or fires.

4. Maintenance, inspection and part replacement

⚠ DANGER

- Always wait at least 10 minutes after turning the input power OFF before starting inspections.
  Wait at least 10 minutes after turning the input power OFF before starting work. Make sure that the displays on the operation panel have gone out before removing the front cover.
  Remove the front cover, and confirm that the "CHARGE" LED on the unit has gone out. Also check that the voltage between terminals L+1 or L+2 and L– is 15V or less before starting the inspections. (Check with the "CHARGE" LED if the unit is not provided with the L– terminal.)
  Failure to observe this could lead to electric shocks.
- Maintenance, inspections and part replacement must be done by a designated person.
  (Remove all metal accessories such as watches, bracelets, etc., before starting the work.)
  (Always use an insulation measure tool.)
  Failure to observe this could lead to electric shocks and injuries.
- Always turn the power OFF before inspecting the motor or machine. A potential is applied on the motor terminal even when the motor is stopped.
  Failure to do so could lead to electric shocks and injuries.
- Do not use parts other than those designated for the replacement parts.
  Contact your inverter dealer for replacement parts.
  Failure to observe this could lead to fires.

⚠ CAUTION

- Vacuum the inverter with a vacuum cleaner to clean it. Do not use water or organic solvents.
  Failure to observe this could lead to fires or damage.

5. Others

⚠ DANGER

- Never modify the product.
  Failure to observe this could lead to electric shocks or injuries.

⚠ CAUTION

- Dispose of this product as industrial waste.

<Names of each part>

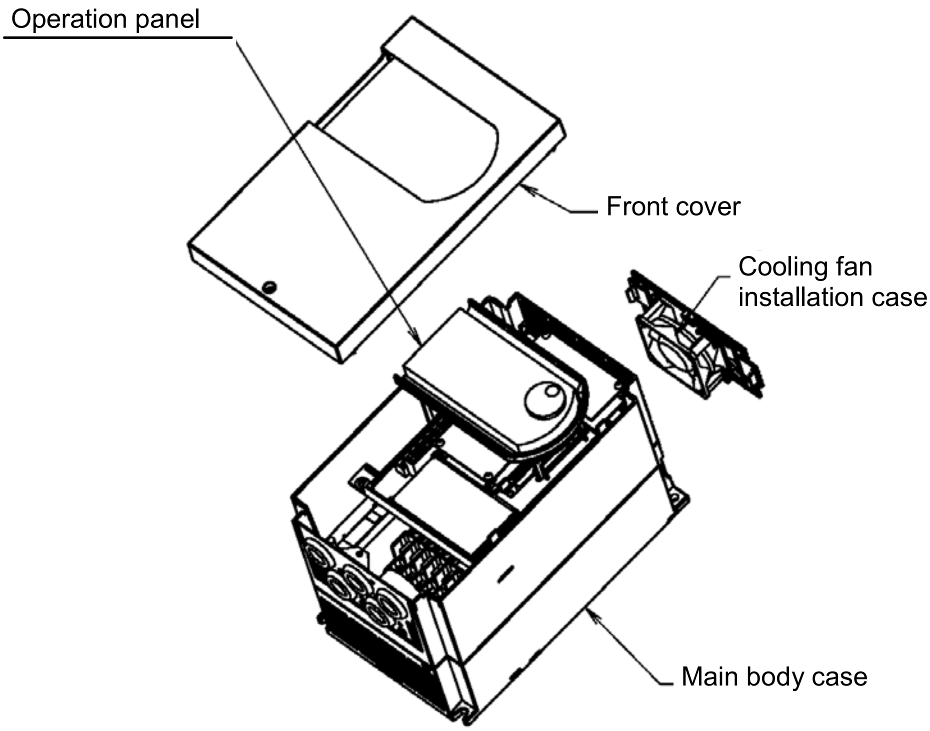


Fig. 1 For N018K5, H030K0 and smaller

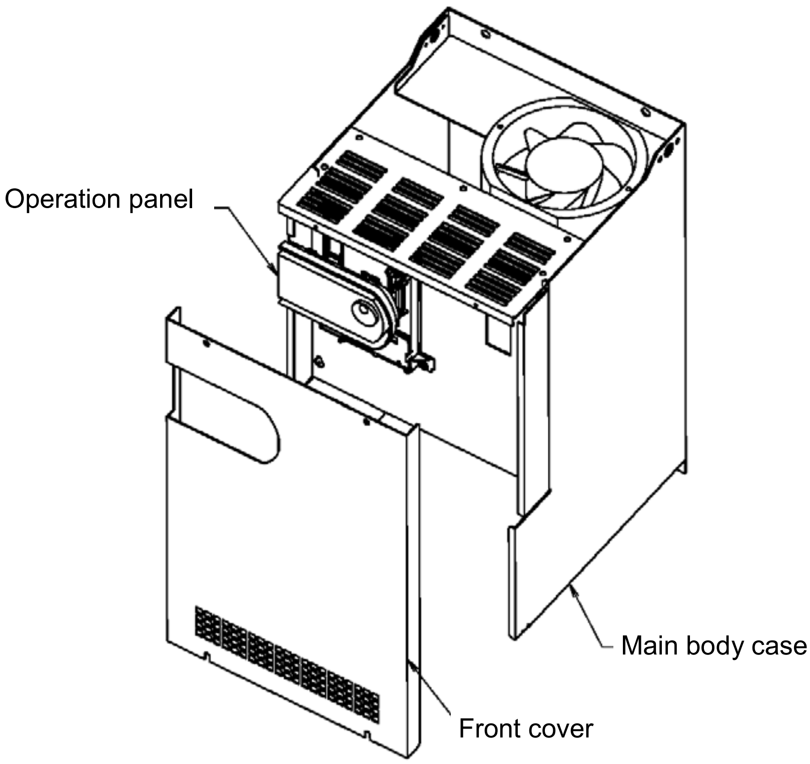


Fig. 2 For N022K0, X037K0 and larger

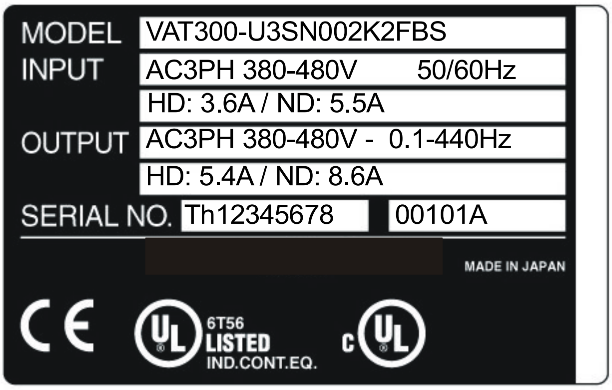
(The presence and quantity of cooling fans will differ according to the capacity.)

Chapter 1 Delivery Inspection and Storage

1-1 Delivery inspection and storage

(1) Remove the inverter from the packaging, and check the details on the rating nameplate to confirm that the inverter is as ordered. The rating nameplate is on the left side of the unit.
(2) Confirm that the product has not been damaged.
(3) If the inverter is not to be used for a while after purchasing, store it in a place with no humidity or vibration in the packaged state.
(4) Always inspect the inverter before using after storing for a long period. (Refer to 8-1.)

1-2 Details of rating nameplate and type display method



(1) The following details are listed on the rating nameplate.

(Note 1) Refer to Chapter 9 for details on UL Instruction.

(2) Using the above type as an example, the type is displayed as follows:

VAT300- U3S N002K2 F B S X 0 0 0

- X 0 0 0: Control No.
- U3S: Type Unit
  U3S : VAT300
- S: Indicates future Options.
- N002K2: Input voltage and capacity
  (Refer toAppendix 1)
- B: Indicates if DB is built in the drive.
  B : DB Built in
  N : Without Built in DB
- F: Indicates built in EMC filter
  F : EMC filter built in
  S : Without EMC Filter

Chapter 2 Installation and Wiring

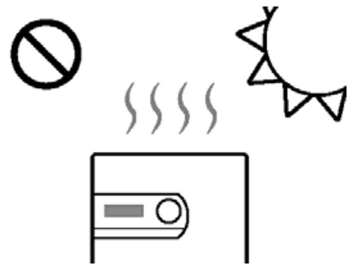
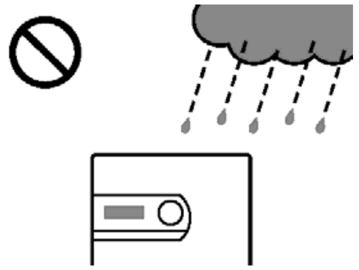
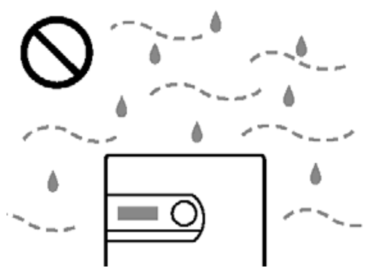
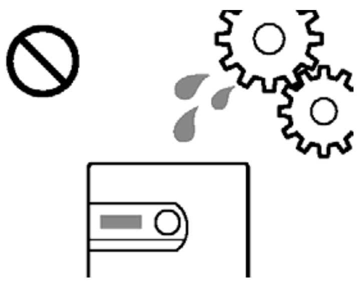
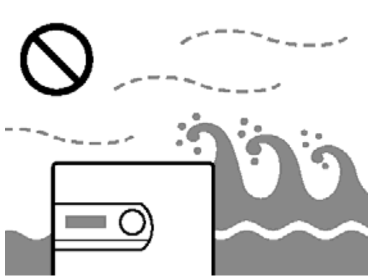
CAUTION

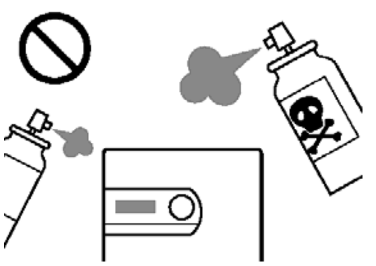
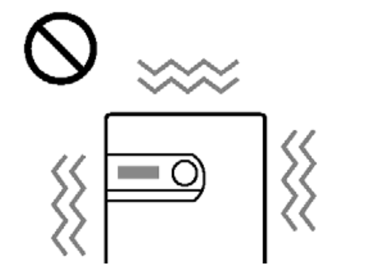
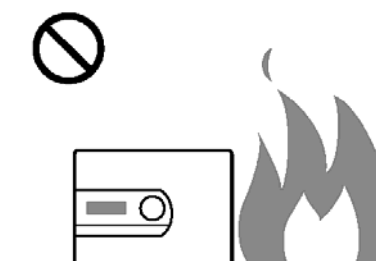
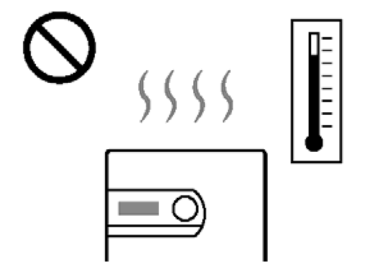
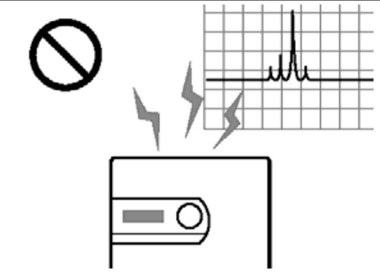
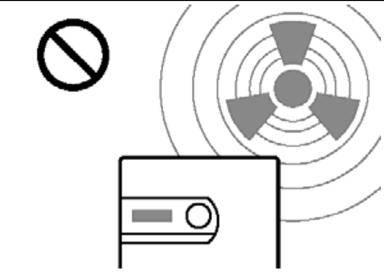
- Always transport the product with an appropriate amount according to the products weight.
  Failure to observe this could lead to injuries.
- Install the inverter, dynamic braking unit and resistor, and other peripheral devices on non-combustible material such as metal.
  Failure to observe this could lead to fires.
- Do not place the product near inflammable items.
  Failure to observe this could lead to fires.
- Do not hold the front cover while transporting the product.
  Failure to observe this could lead to injuries from dropping.
- Do not let conductive materials such as screws or metal pieces and inflammable materials such as oil enter the product.
  Failure to observe this could lead to fires.
- Install the product in a place that can withstand the weight of the product, and follow the instruction manual.
  Failure to do so could lead to injuries from dropping.
- Do not install and operate an inverter that is damaged or that has missing parts.
  Failure to observe this could lead to injuries.
- Always observe the conditions described in the instruction manual for the installation environment.
  Failure to observe this could lead to faults.

2-1 Installation environment

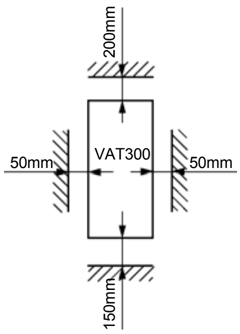
Observe the following points when installing the inverter.

(1) Install the inverter vertically so that the cable lead-in holes face downward.
(2) Make sure that the ambient temperature is –10°C to 50°C. (Refer to Appendix 1.)
(3) Avoid installation in the following environment.

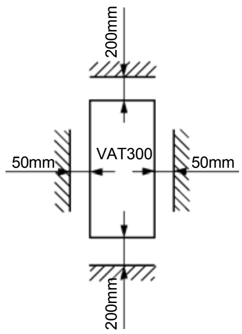
Place subject to direct sunlight	Place subject to wind, rain or water	Place with high levels of humidity
		
Place subject to oil drops	Place where dust, cotton lint or iron chips, etc., are present	Place with high levels of salt
		

Place with harmful corrosive or explosive gases or fluids are present	Place near sources of vibration such as dollies or press machines	Place where flammable materials are present
		
Place with high levels of ambient temperature	Places with high levels of magnetic noise	Places where radioactive substances are present
		

(4) Ensure ventilation space around the inverter. (Refer to Fig. 2-1.)



For N018K5, X030K0 and smaller

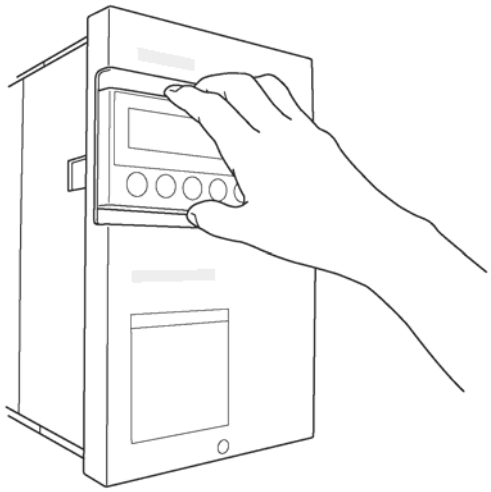


For N022K0, X037K0 and larger

Fig. 2-1

2-2 Installation and wiring method

Installation and wiring for the N018K5S and X030K0 and below, and the wiring for the N022K0 and X037K0 and above are carried out with the front cover removed. The operation panel is fixed with the latches for the operation panel mounting holder, so the front cover can be removed with the operation panel attached.
To remove the operation panel, securely hold the panel with a thumb on the lower side and another finger on the top side as shown in Fig. 2-2-a, and pull the panel forward and off. To mount the operation panel, hold it the top and bottom sides with five fingers, and press the panel on horizontally. Confirm that the operation panel is securely fixed with the latches for the operation panel mounting holder.
The operation panel mounting holder opens and closes with the right side as a base point as shown in Fig. 2-2-b. When wiring to the control terminal block, open the left side of the main body case outward, and open the folder to 90°. When closing after wiring, confirm that the jaw on the left end of the holder is securely fit into the hole on the main body case.



(1) N018K5S, X030K0 and smaller (Fig. 2-2-c)

Fix the VAT300 at four places when installing. The lower two installation sections are notched. Remove the front cover, and wire to the main circuit and control terminal block.

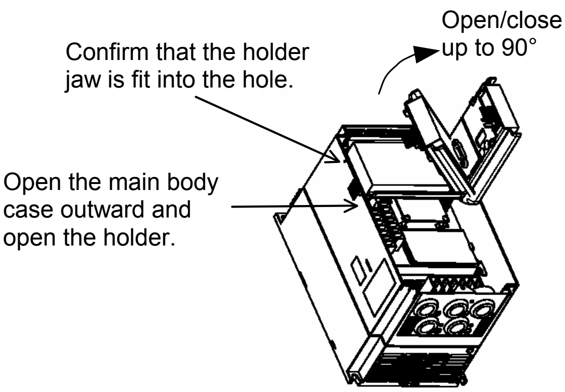


Fig. 2-2-b

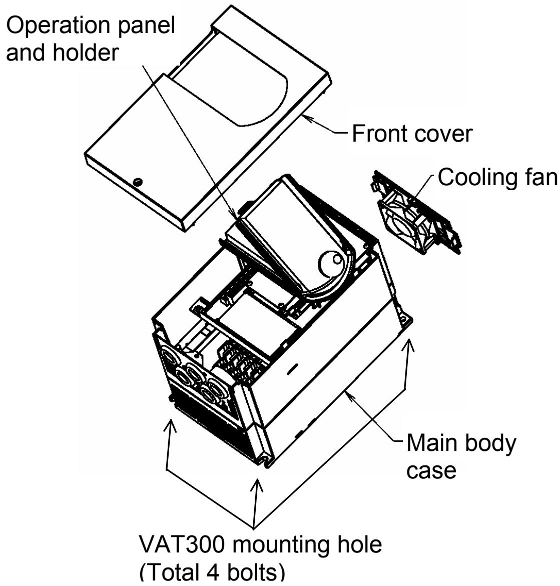


Fig. 2-2-c

(2) N022K0, X037K0 and larger (Fig. 2-2-d)

Fix the VAT300 at four places when installing. The VAT300 mass is more than 25kg, so installation by two workers is recommended. When two workers are installing the unit, they should confirm each step with signals. Wire in the same manner as step (1).

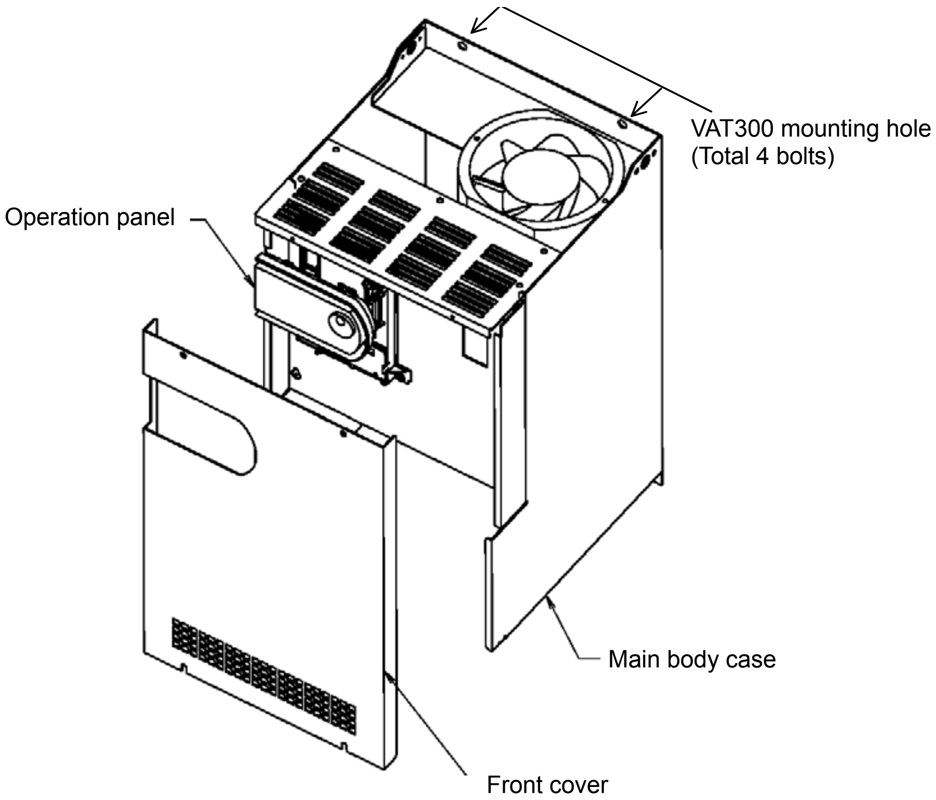


Fig. 2-2-d

2-3 Precautions for power supply and motor wiring

⚠ DANGER

- Always turn the device's input power OFF before starting wiring.
  Failure to do so could lead to electric shocks or fires.
- Carry out grounding that complies with the standards of the country where the inverter is being installed.
  Failure to do so could lead to electric shocks or fires.
- When using the PM motor, even if the inverter is stopped, the voltage will be generated at the output terminal (U, V, W) during rotation. Always carry out wiring while the motor is stopped.
  Failure to do so could lead to electric shocks or injuries.
- Wiring must always be done by a qualified electrician.
  Failure to observe this could lead to electric shocks or fires.
- Always install the device before starting wiring.
  Failure to do so could lead to electric shocks or injuries.
- Prepare a breaker such as a Molded Case Circuit Breaker(MCCB) or fuse that matches the capacity for the inverter's power supply side.
  Failure to do so could lead to fires.

⚠ CAUTION

- Do not connect an AC power supply to the output terminals (U, V, W).
  Failure to observe this could lead to injuries or fires.
- Confirm that the product's rated voltage and frequency match the power supply voltage and frequency.
  Failure to do so could lead to injuries or fires.
- Install an overheating protection device on the dynamic braking resistor, and shut off the power with an error signal.
  Failure to do so could lead to fires in the event of abnormal overheating.
- Do not directly connect a resistor to the DC terminals (between L+1, L+2 and L–).
  Failure to observe this could lead to fires.
- Tighten the terminal screws with the designated tightening torque.
  Failure to do so could lead to fires.
- Correctly connect the output side (U, V, W).
  Failure to observe this could lead to reverse rotation of the motor, and to injuries or machine damage.
- Always correctly connect when using the encoder.
  The signal polarity specifications differ according to the encoder. Refer to sections 3-4-2 (4) and 3-4-3(1) on test operation, and adjust the signal polarity with the parameter settings (C50, C51).
  Failure to observe this could lead to reverse rotation or abnormal acceleration of the motor, and to injuries or machine damage.

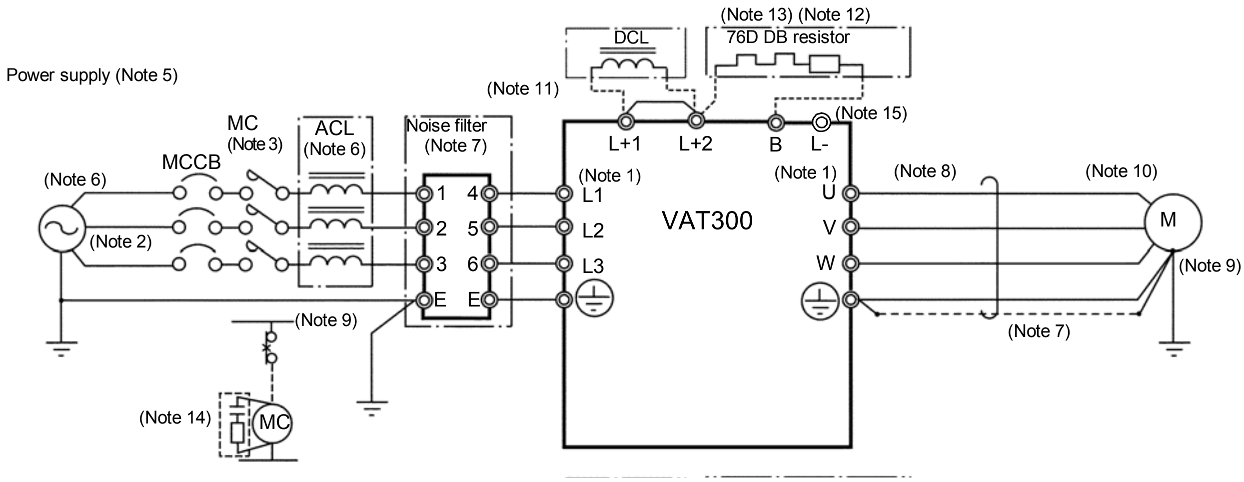
Refer to Fig. 2-3-a and wire the main circuits for the power supply and motor, etc.
Always observe the following precautions for wiring.

⚠ CAUTION

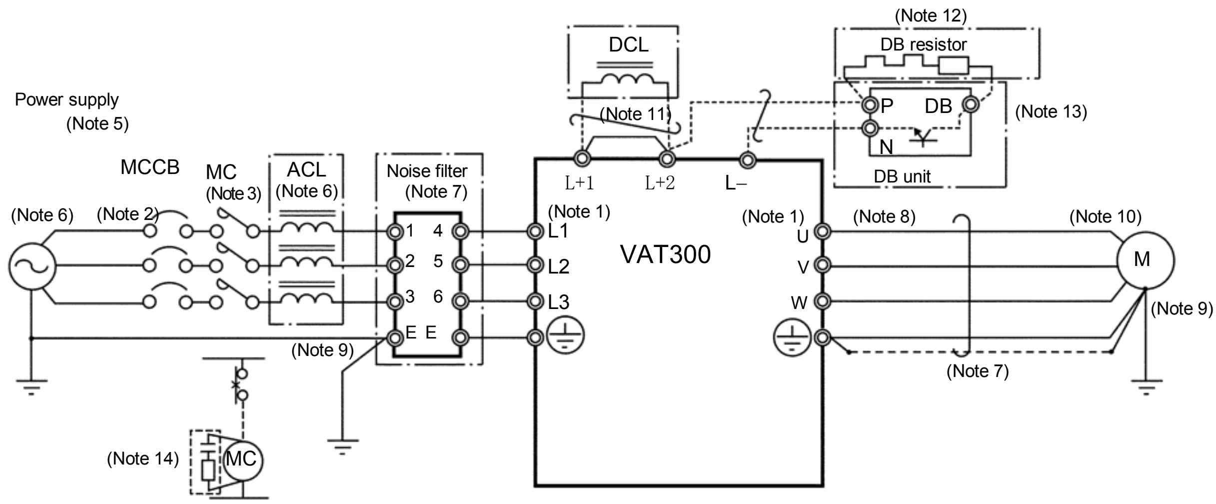
There is a risk of electric shocks.
The VAT300 has a built-in electrolytic capacitor, so a charge will remain even when the inverter power is turned OFF. Always observe the followings before carrying out wiring work.

- Wait at least 10 minutes after turning the power OFF before starting work. Make sure that the displays on the operation panel have gone out before removing the cover.
- After removing the cover, confirm that the "CHARGE" LED in the unit has gone out. Also check that the voltage between terminals L+1 or L+2 and L– is 15V or less before starting the wiring work. (Check with the "CHARGE" LED if the unit is not provided with the L– terminal.)

(a) N018K5, X022K0 and smaller



(b) N022K0 to N045K0, X030K0 to X055K0



(c) X075K0 to X475K0

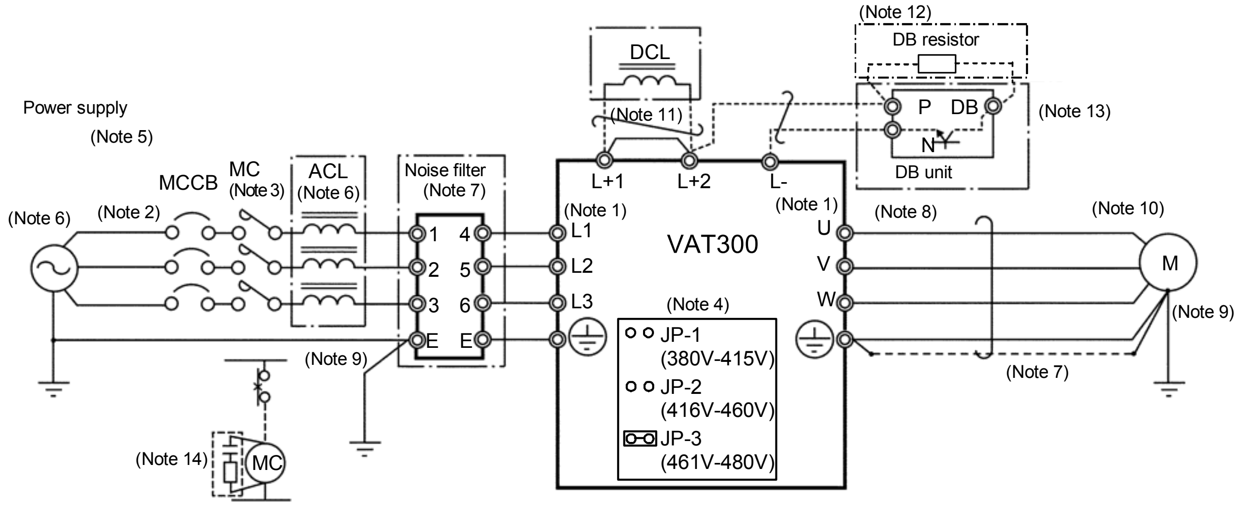


Fig. 2-3-a Example of main circuit wiring

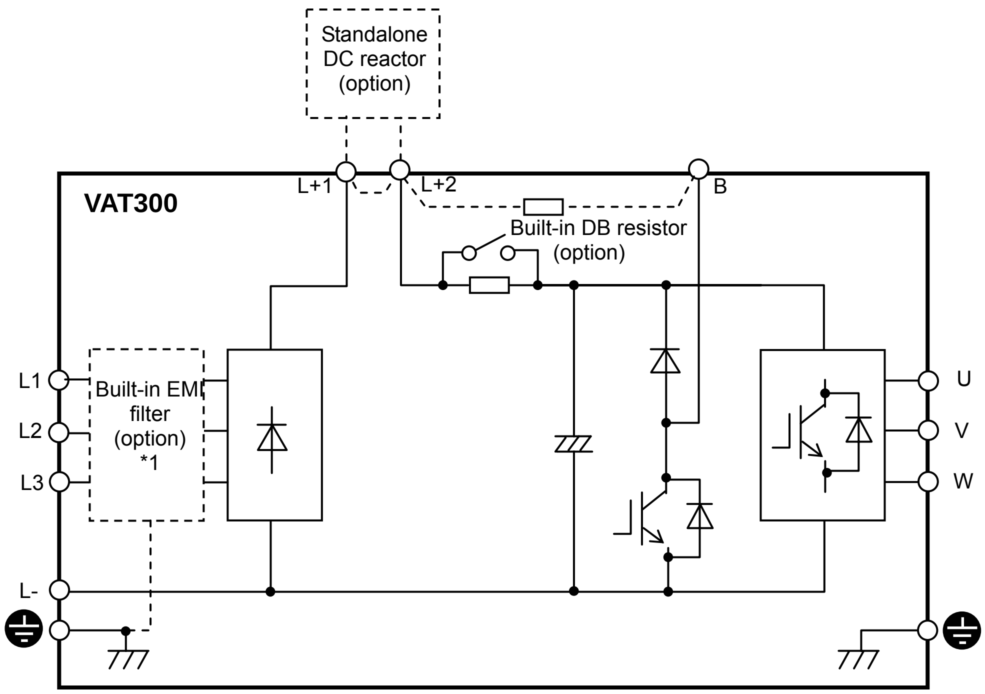
(Note 1) Configuration of inverter's main circuit

The inverter input terminals are L1, L2 and L3. The output terminals to the motor are U, V and W. Do not connect the power supply to the U, V, W terminals. Incorrect wiring will lead to inverter damage or fires.
The VAT300 main circuit configuration is largely divided into three types according to the capacity zone.

(1) The first type is the N011K0/X015K0 and smaller capacities. The L+1 and L+2 terminals are located in the step before the pre-charge circuit. The DB circuit is built-in, and the use of the built-in DB resistor can be selected with options. The use of the built-in EMI filter can also be selected with options. Note that the external EMI filter must be used for the N007K5 and N011K0 capacity.
With the N011K0/X015K0 and smaller capacity, the L+2 and L- terminals for connecting the PWM converter are provided as a standard. Contact the inverter dealer when using the PWM converter.

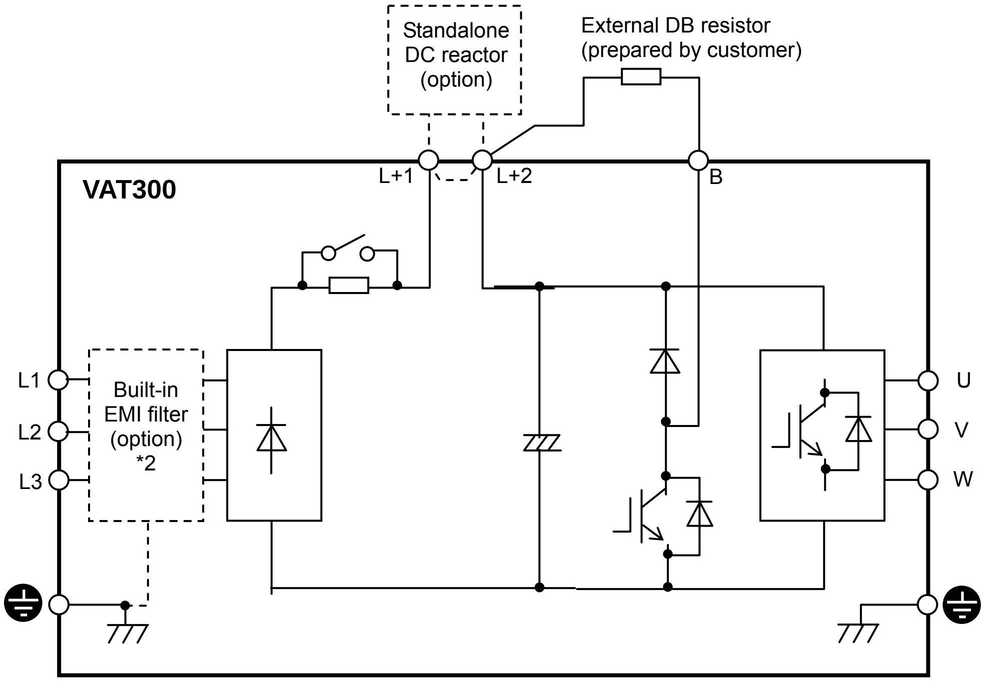
(2) The second type is the N015K0, N018K5/X018K5, and X022K0 capacities. The L+1 and L+2 terminals are located in the step after the pre-charge circuit. The DB circuit is built-in, but the DB resistor must be prepared by the customer. With the X018K5 and X022K0 capacities, the use can be selected with the built-in EMI filter options. Use an external EMI filter with the N015K0 and N018K5 capacities.

(3) The third type is the N022K0/X030K0 and larger capacities. The L+1 and L+2 terminals are located in the step after the pre-charge circuit. The built-in DCL can be selected as an option. A standalone DCL can also be selected. With the X030K0, the use of the built-in EMI filter can be selected with options. Use an external EMI filter with the N022K0/X037K0 and larger capacities.



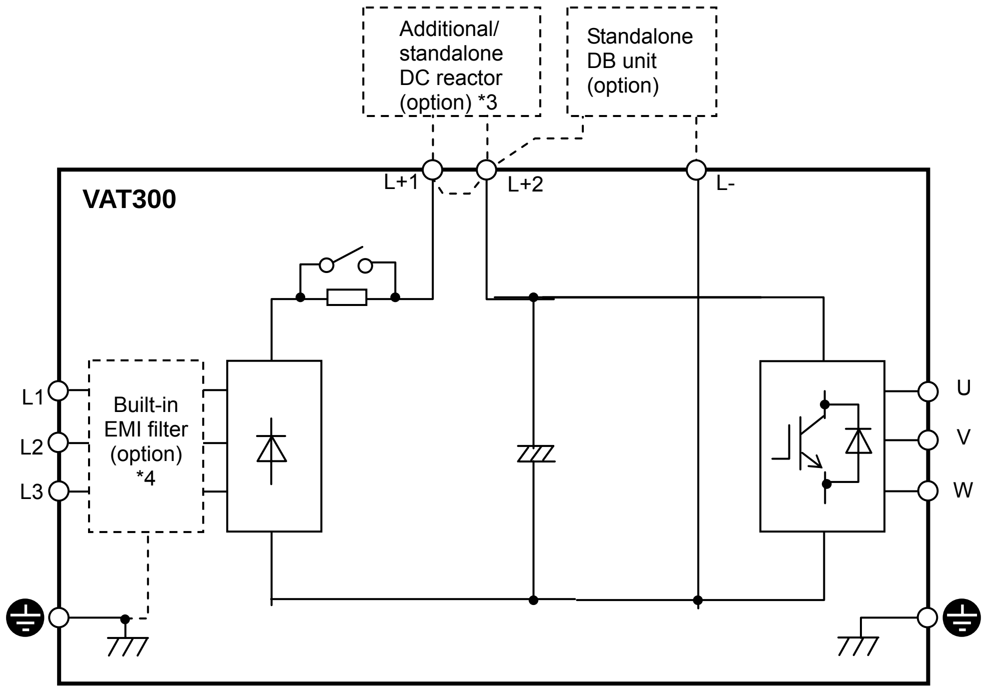
*1) Incompatible with N007K5 and N011K0

(1) N011K0/X015K0 and smaller capacities



*2) Incompatible with N015K0 and N018K5

(2) N015K0, N018K5/X018K5, X022K0



*3) Only standalone type is available for X030K0
*4) Only compatible with X030K0

(3) N022K0/X030K0 and larger capacities

(Note 2) Wire size

Use wires having the wire size shown in Table 2-3-a and Table 2-3-b for the main circuit wiring shown in Fig. 2-3-a.

Table 2-3 gives the screw sizes, applicable wire sizes and tightening torque for the main circuit terminal shown in Fig. 2-3-b.

Table 2-3-a Terminal and applicable wire (for normal-duty)

	Power supply, motor, DCL wiring					Dynamic braking wiring				
Inverter type VAT300 U3S_	Terminal screw size	Wire size		Tightening torque		Terminal screw size	Wire size		Tightening torque	
		AWG	mm^2	N • m	lb-in		AWG	mm^2	N • m	lb-in
N000K7	M4	14	2.1	1.8	15.9	M4	14	2.1	1.8	15.9
N001K5	M4	14	2.1	1.8	15.9	M4	14	2.1	1.8	15.9
N002K2	M4	14	2.1	1.8	15.9	M4	14	2.1	1.8	15.9
N004K0	M4	10	5.3	1.8	15.9	M4	14	2.1	1.8	15.9
N005K5	M4	8	8.4	1.8	15.9	M4	14	2.1	1.8	15.9
N007K5	M5	8	8.4	3.0	26.5	M5	14	2.1	3.0	26.5
N011K0	M5	6	13.3	3.0	26.5	M5	14	2.1	3.0	26.5
N015K0	M6	3	26.7	4.5	39.8	M6	14	2.1	4.5	39.8
N018K5	M8	2	33.6	9.0	79.7	M8	12	3.3	9.0	79.7
N022K0	M8	1	42.4	9.0	79.7	M8	10	5.3	9.0	79.7
N030K0	M8	1/0×2P	53.5×2P	9.0	79.7	M8	10	5.3	9.0	79.7
N037K0	M10	1/0×2P	53.5×2P	10.0	88.5	M5 (L-) M10 (L+2)	6	13.3	2.0 28.9	17.4 255.7
N045K0	M10	1/0×2P	53.5×2P	10.0	88.5	M5 (L-) M10 (L+2)	6	13.3	2.0 28.9	17.4 255.7
X000K7	M4	14	2.1	1.8	15.9	M4	14	2.1	1.8	15.9
X001K5	M4	14	2.1	1.8	15.9	M4	14	2.1	1.8	15.9
X002K2	M4	14	2.1	1.8	15.9	M4	14	2.1	1.8	15.9
X004K0	M4	14	2.1	1.8	15.9	M4	14	2.1	1.8	15.9
X005K5	M4	12	3.3	1.8	15.9	M4	14	2.1	1.8	15.9
X007K5	M4	10	5.3	1.8	15.9	M4	14	2.1	1.8	15.9
X011K0	M4	8	8.4	1.8	15.9	M4	14	2.1	1.8	15.9
X015K0	M5	8	8.4	3.0	26.5	M5	14	2.1	3.0	26.5
X018K5	M5	6	13.3	2.0	17.4	M5	14	2.1	2.0	17.4
X022K0	M5	6	13.3	2.0	17.4	M5	14	2.1	2.0	17.4
X030K0	M6	4	21.2	4.5	39.8	M6	12	3.3	4.5	39.8
X037K0	M8	2	33.6	9.0	79.7	M8	10	5.3	9.0	79.7
X045K0	M8	1	42.4	9.0	79.7	M8	6	13.3	9.0	79.7
X055K0	M8	1/0	53.5	9.0	79.7	M8	6	13.3	9.0	79.7
X075K0	M10	1/0×2P	53.5×2P	28.9	255.7	M10	6	13.3	28.9	255.7
X090K0	M10	1/0×2P	53.5×2P	28.9	255.7	M10	6	13.3	28.9	255.7
X110K0	M10	1/0×2P	53.5×2P	28.9	255.7	M10	6	13.3	28.9	255.7
X132K0 Power supply	M10	3/0×2P	85.0×2P	28.9	255.7	M10	6	13.3	28.9	255.7
X132K0 Motor		2/0×2P	67.4×2P							
X160K0	M10	4/0×2P	107.2×2P	28.9	255.7	M10	6	13.3	28.9	255.7
X200K0	M10	300×2P	152×2P	28.9	255.7	M10	6	13.3	28.9	255.7
X250K0	M16	400×2P	203×2P	125	1106	M16	4	21.2	125	1106
X315K0 Power supply	M16	300×4P	152×4P	125	1106	M16	4	21.2	125	1106
X315K0 Motor		4/0×4P	107.2×4P							
X400K0 Power supply	M16	400×4P	203×4P	125	1106	M16	4	21.2	125	1106
X400K0 Motor		350×4P	177×4P							
X475K0	M16	400×4P	203×4P	125	1106	M16	4	21.2	125	1106

Table 2-3-b Terminal and applicable wire (for heavy-duty)

Inverter type VAT300-□	Power supply, motor, DCL wiring					Dynamic braking wiring				
	Terminal screw size	Wire size		Tightening torque		Terminal screw size	Wire size		Tightening torque	
		AWG	mm^2	N • m	lb-in		AWG	mm^2	N • m	lb-in
N000K7	M4	14	2.1	1.8	15.9	M4	14	2.1	1.8	15.9
N001K5	M4	14	2.1	1.8	15.9	M4	14	2.1	1.8	15.9
N002K2	M4	14	2.1	1.8	15.9	M4	14	2.1	1.8	15.9
N004K0	M4	14	2.1	1.8	15.9	M4	14	2.1	1.8	15.9
N005K5	M4	10	5.3	1.8	15.9	M4	14	2.1	1.8	15.9
N007K5	M5	8	8.4	3.0	26.5	M5	14	2.1	3.0	26.5
N011K0	M5	8	8.4	3.0	26.5	M5	14	2.1	3.0	26.5
N015K0	M6	6	13.3	4.5	39.8	M6	14	2.1	4.5	39.8
N018K5	M8	3	26.7	9.0	79.7	M8	14	2.1	9.0	79.7
N022K0	M8	2	33.6	9.0	79.7	M8	12	3.3	9.0	79.7
N030K0	M8	1	42.4	9.0	79.7	M8	10	5.3	9.0	79.7
N037K0	M10	1/0×2P	53.5×2P	10.0	88.5	M5 (L-) M10 (L+2)	10	5.3	2.0 28.9	17.4 255.7
N045K0	M10	1/0×2P	53.5×2P	10.0	88.5	M5 (L-) M10 (L+2)	6	13.3	2.0 28.9	17.4 255.7
X000K7	M4	14	2.1	1.8	15.9	M4	14	2.1	1.8	15.9
X001K5	M4	14	2.1	1.8	15.9	M4	14	2.1	1.8	15.9
X002K2	M4	14	2.1	1.8	15.9	M4	14	2.1	1.8	15.9
X004K0	M4	14	2.1	1.8	15.9	M4	14	2.1	1.8	15.9
X005K5	M4	14	2.1	1.8	15.9	M4	14	2.1	1.8	15.9
X007K5	M4	12	3.3	1.8	15.9	M4	14	2.1	1.8	15.9
X011K0	M4	10	5.3	1.8	15.9	M4	14	2.1	1.8	15.9
X015K0	M5	8	8.4	3.0	26.5	M5	14	2.1	3.0	26.5
X018K5	M5	8	8.4	2.0	17.4	M5	14	2.1	2.0	17.4
X022K0	M5	6	13.3	2.0	17.4	M5	14	2.1	2.0	17.4
X030K0	M6	6	13.3	4.5	39.8	M6	14	2.1	4.5	39.8
X037K0	M8	4	21.2	9.0	79.7	M8	12	3.3	9.0	79.7
X045K0	M8	2	33.6	9.0	79.7	M8	10	5.3	9.0	79.7
X055K0	M8	1	42.4	9.0	79.7	M8	6	13.3	9.0	79.7
X075K0	M10	1/0	53.5	28.9	255.7	M10	6	13.3	28.9	255.7
X090K0	M10	1/0×2P	53.5×2P	28.9	255.7	M10	6	13.3	28.9	255.7
X110K0	M10	1/0×2P	53.5×2P	28.9	255.7	M10	6	13.3	28.9	255.7
X132K0	M10	1/0×2P	53.5×2P	28.9	255.7	M10	6	13.3	28.9	255.7
X160K0 Power supply	M10	3/0×2P	85.0×2P	28.9	255.7	M10	6	13.3	28.9	255.7
X160K0 Motor		2/0×2P	67.4×2P							
X200K0	M10	4/0×2P	107.2×2P	28.9	255.7	M10	6	13.3	28.9	255.7
X250K0	M16	300×2P	152×2P	125	1106	M16	6	13.3	125	1106
X315K0	M16	400×2P	203×2P	125	1106	M16	4	21.2	125	1106
X400K0 Power supply	M16	300×4P	152×4P	125	1106	M16	4	21.2	125	1106
X400K0 Motor		4/0×4P	107.2×4P							
X475K0 Power supply	M16	400×4P	203×4P	125	1106	M16	4	21.2	125	1106
X475K0 Motor		350×4P	177×4P							

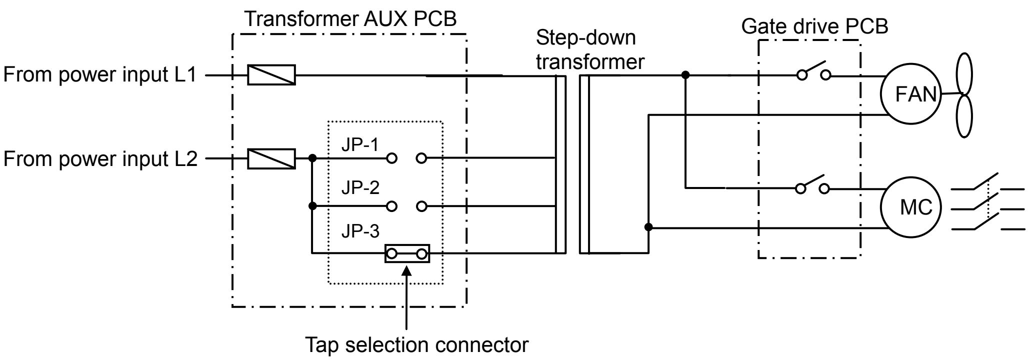
(Note 3) Breaker for wiring

Install a Molded Case Circuit Breaker(MCCB), fuse or magnetic contact (MC) on the inverter's power supply side. Refer to Table 7-1-b and select the MCCB or Fuses.
When using as a UL/cUL Standard certified product, install the UL certified fuse as explained in section 9-1.

(Note 4) Selection of power voltage for auxiliary equipment power supply

For the 400V Series (X075K0 and larger), switch the auxiliary equipment power supply selection connector according to the rated voltage of the power being used. If the following settings do not apply to the power voltage being used, select the closest power voltage.

For 380V to 415V, short circuit across JP-1
For 416V to 460V, short circuit across JP-2
For 461V to 480V, short circuit across JP-3 (factory setting state)



(Note 5) Power voltage/frequency

Prepare the power supply to match the following power voltage and frequency.

Voltage system	Type	Power voltage	Frequency
L series	N000K7 to N011K0	200 to 240V ± 10%	50/60Hz ± 5%
	N015K0 to N045K0	200 to 230V ± 10%	50/60Hz ± 5%
H series	X000K7 to X475K0	380 to 480V ± 10%	50/60Hz ± 5%

(Note 6) Power supply capacity

Make sure that capacity of the transformer used as the inverter's power supply is within the following range. (For 4% impedance transformer)

Heavy-duty rating (N045K0, X055K0 and smaller) .... 500kVA or less
Heavy-duty rating (X075K0 and larger), Normal-duty .... Capacity that is 10-times or less inverter capacity

If the above values are exceeded, install an ACL on the inverter's input side.
(Refer to Table 7-1-b.)

(Note 7) Noise measures

The inverter will generate high harmonic electromagnetic noise, so using the following noise measures is recommended.

a) Insert an EMC filter on the input side of the inverter. Refer to Table 7-1-b and select the EMC filter. A unit with built-in noise filter is available as an option.
b) Keep the length of the wire between the EMC filter and inverter as short as possible, and wire it as far away from the noise filter's power supply side.
c) Use a shield cable for the inverter and motor wiring, and connect the shield to the inverter's ⏚ terminal and motor grounding terminal. Note that if the cable is long, the higher harmonic leakage current may increase, the overcurrent limit function may malfunction, and in extreme cases, the current detector in the unit could be damaged. In this case, lower the carrier frequency as low as possible, and increase the inverter capacity as required.
d) Separate the main circuit wiring from the control circuit wiring. Do not place the wires in the same conduit, lay them in parallel or bundle them, etc. If the wires must be laid in parallel, separate them by 30cm or more, and pass each through a metal conduit. If the wires need to be intersected, make sure that they intersect at a right angle.

(Note 8) Inverter output

a) Do not insert a power factor improvement capacitor on the output side of the inverter.
b) When inserting a magnetic contactor on the output side of the inverter, prepare a sequence control circuit so that the magnetic contactor will not open and close when the inverter runs.
c) Directly connect the motor to the inverter's load. Do not connect relay it through a transformer or Slidac, etc.

(Note 9) Grounding

Always ground the inverter unit grounding terminal and the ground. Ground according to the regulations of the country where the inverter is being used.

(Note 10) Inverter output surge voltage (For 400V series)

If the wiring between the inverter and motor is long (20m or more), the surge voltage applied on the motor will increase, and the motor insulation could deteriorate. In this case, lower the carrier frequency as low as possible (4kHz or less), and use a motor with reinforced insulation for inverter drive, or connect a surge absorber dedicated for the inverter output.

(Note 11) DCL

Always short circuit across L+1 and L+2 when not using the DCL. (Factory setting state)
When connecting the optional DCL, connect it to L+1 and L+2.
Always remove the short-circuit bar at this time.
Twist the wiring to DCL, and keep it as short as possible.

(Note 12) DB (Dynamic Braking) unit (N022K0, X030K0 or more)

When connecting the optional DB unit, follow Fig. 2-3-a (b) (c) and connect the L+2 and L–.
The DB unit and inverter unit will both be damaged if the connection is incorrect.
Twist the wiring to the DB unit, and keep it as short as possible (3m or less).
Refer to Section 7-3 for details.

(Note 13) DB resistor protection

When using the thermal relay(76D) or the optional DB unit, use the overload detection reply of the DB unit in order to protect the DB unit and the inverter unit. For the details, please refer to section 7-3.

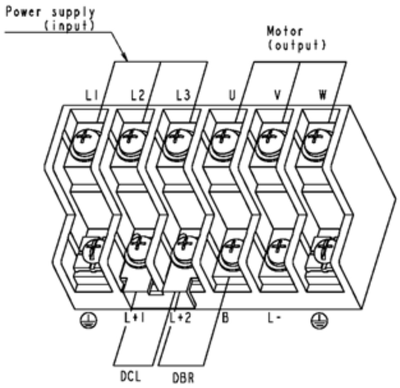
(Note 14) Installation of surge absorber

Install a surge absorber on the magnetic contactor and relay coils installed near the inverter.

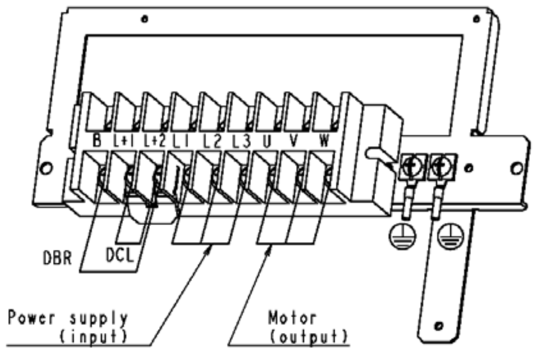
(Note 15) L- terminal

N015K0,N018K5,X018K0 and X022K0 doesn’t mount L- terminal.

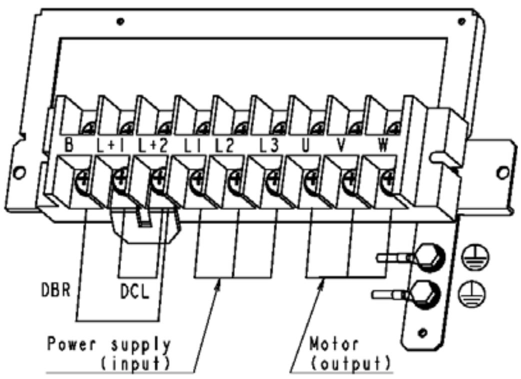
(a) N000K7 to N011K0
X000K7 to X015K0



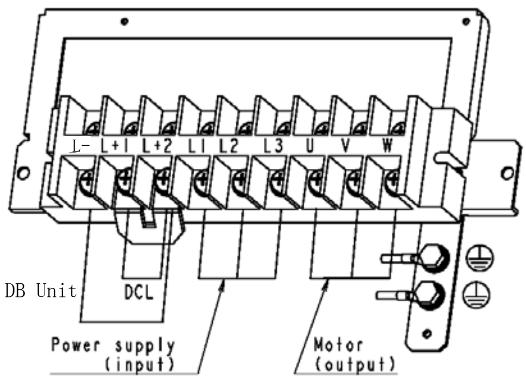
(b) X018K5, X022K0



(c) N015K0



(d) X030K0



(e) N018K5

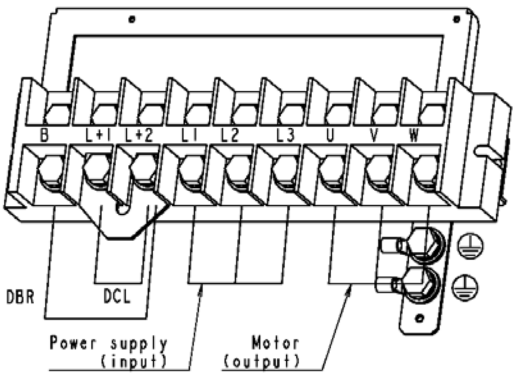
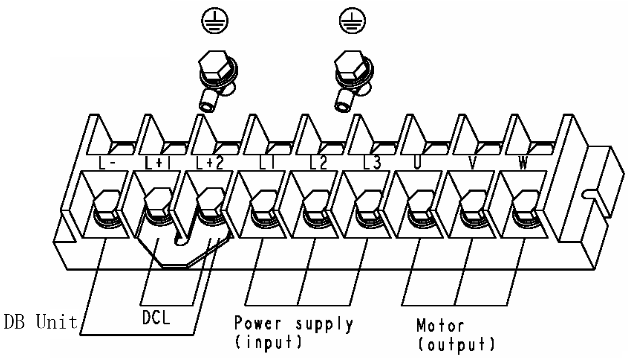
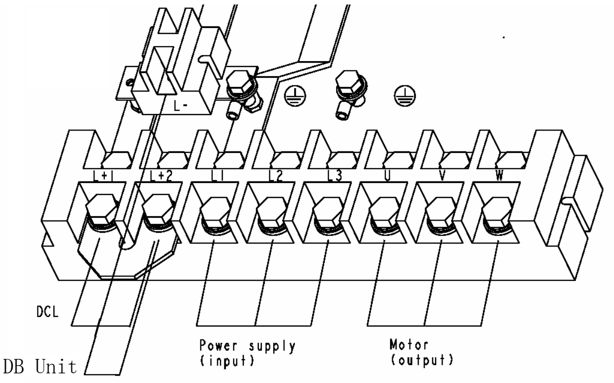


Fig. 2-3-b Terminal block wiring

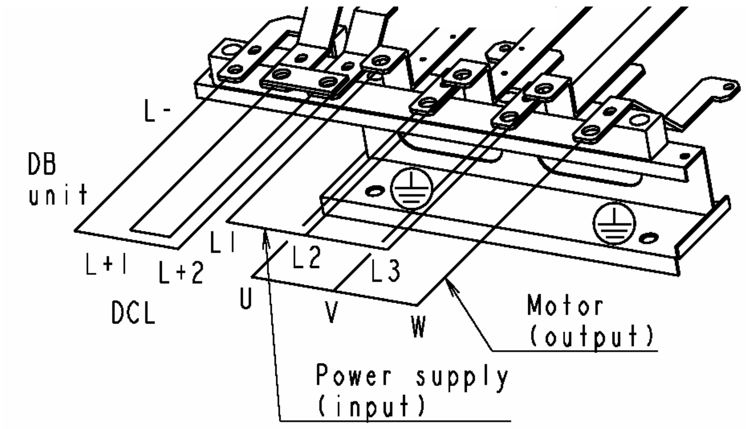
(f) N022K0, N030K0
X037K0 to X055K0



(g) N037K0, N045K0



(h) X075K0, X090K0



(i) X110K0, X132K0

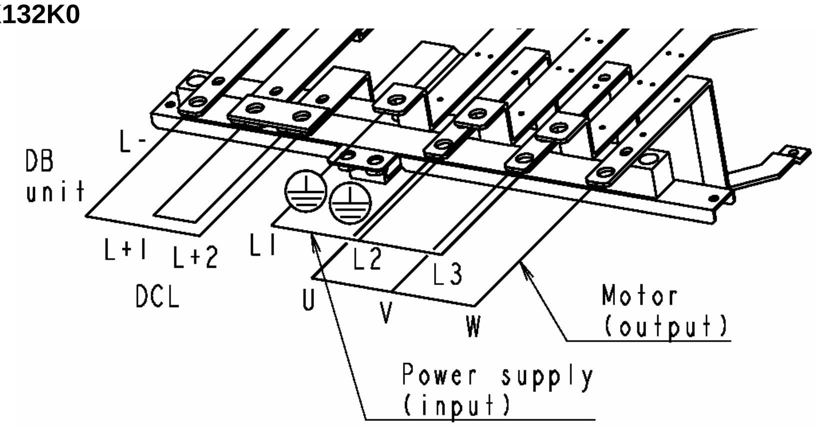
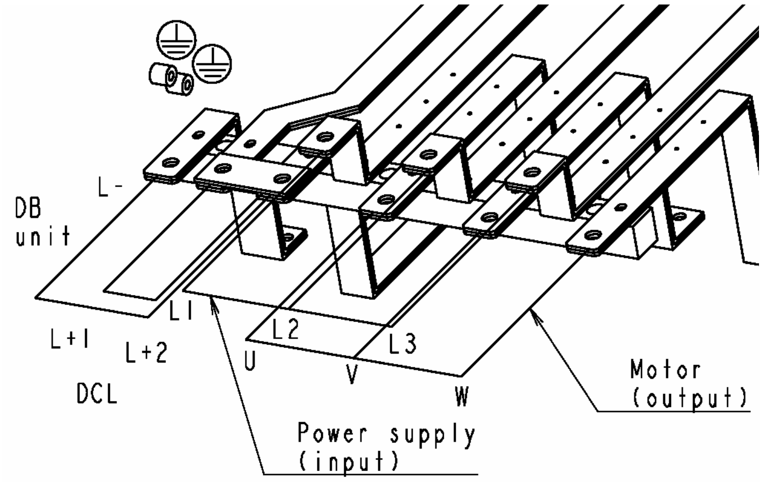
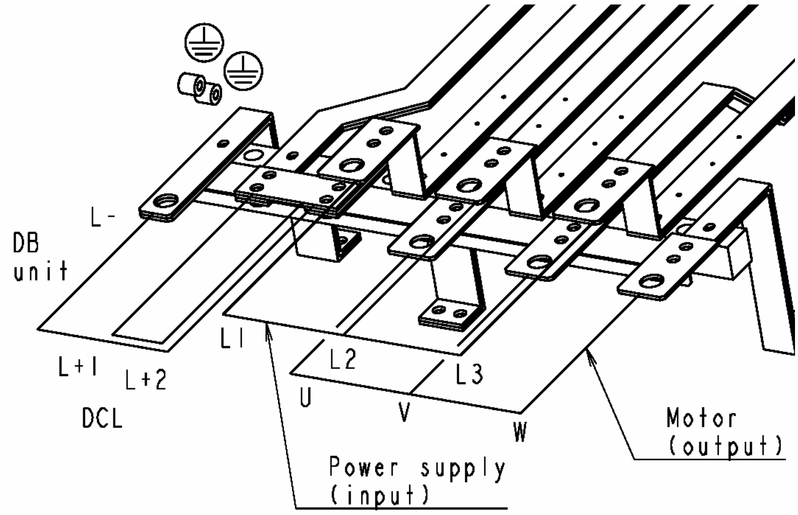


Fig. 2-3-b (cont.) Terminal block wiring

(j) X160K0, X200K0



(k) X250K0



(l) X315K0 to X475K0

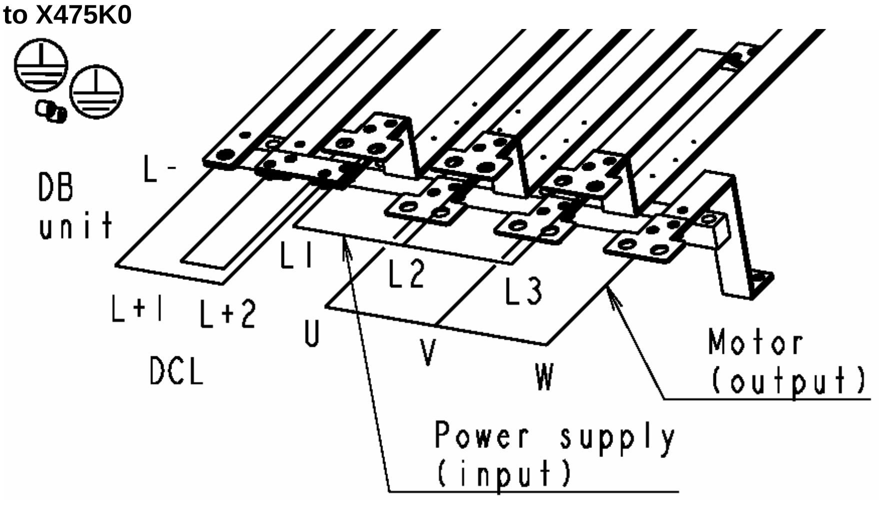


Fig. 2-3-b (cont.) Terminal block wiring

2-4 Precautions for wiring to the control signal

(1) When wiring (control circuit wiring) to the control terminal block, separate the main circuit wiring (terminals L1, L2, L3, L+1, L+2, L–, B, U, V, W) and the other drive wires and power wires. Do not place the wires in the same conduit, lay them in parallel or bundle them, etc.

(2) Use a 0.13 to 0.8mm² wire for wiring to the control circuit.
In this case, tighten TB1 and TB2 with a 0.6N·m tightening torque.
The TB3 tightening torque must be 0.25N·m.

(3) The length of the sequence input/output contact wire must be 30m or less.

(4) The sequence output PSO3 can output the pulse output (max.: 6kHz) by changing DS1-4 and setting the pulse output.
When using the speed detection option, do not set the pulse output if using the pulse output function provided with the option.

(5) Use a twisted pair wire or twisted pair shield wire for wiring to the analog signal circuit such as the setters and meter. (Refer to Fig. 2-4-a.) Connect the shield wire to the TB1 COM terminal of the VAT300.
The wire length must be 30m or less.

(6) The analog output is dedicated for the indicators such as the speedometer and ammeter.
It cannot be used for control signals such as the feedback control.

(7) RY24 and RY0 are designed exclusively for the drive's internal sequence circuits.
These are not designed to supply power to any external devices.

(8) After wiring, always check the mutual wiring.
At this time do not carry out a megger check or buzzer check on the control circuit.
- Are there any wire scraps or foreign matter left around the terminals?
- Are any screws loose?
- Is the wiring correct?
- Is any terminal contacting any other terminal?
- Is the setting of the EL-BIT and the dip switch correct?

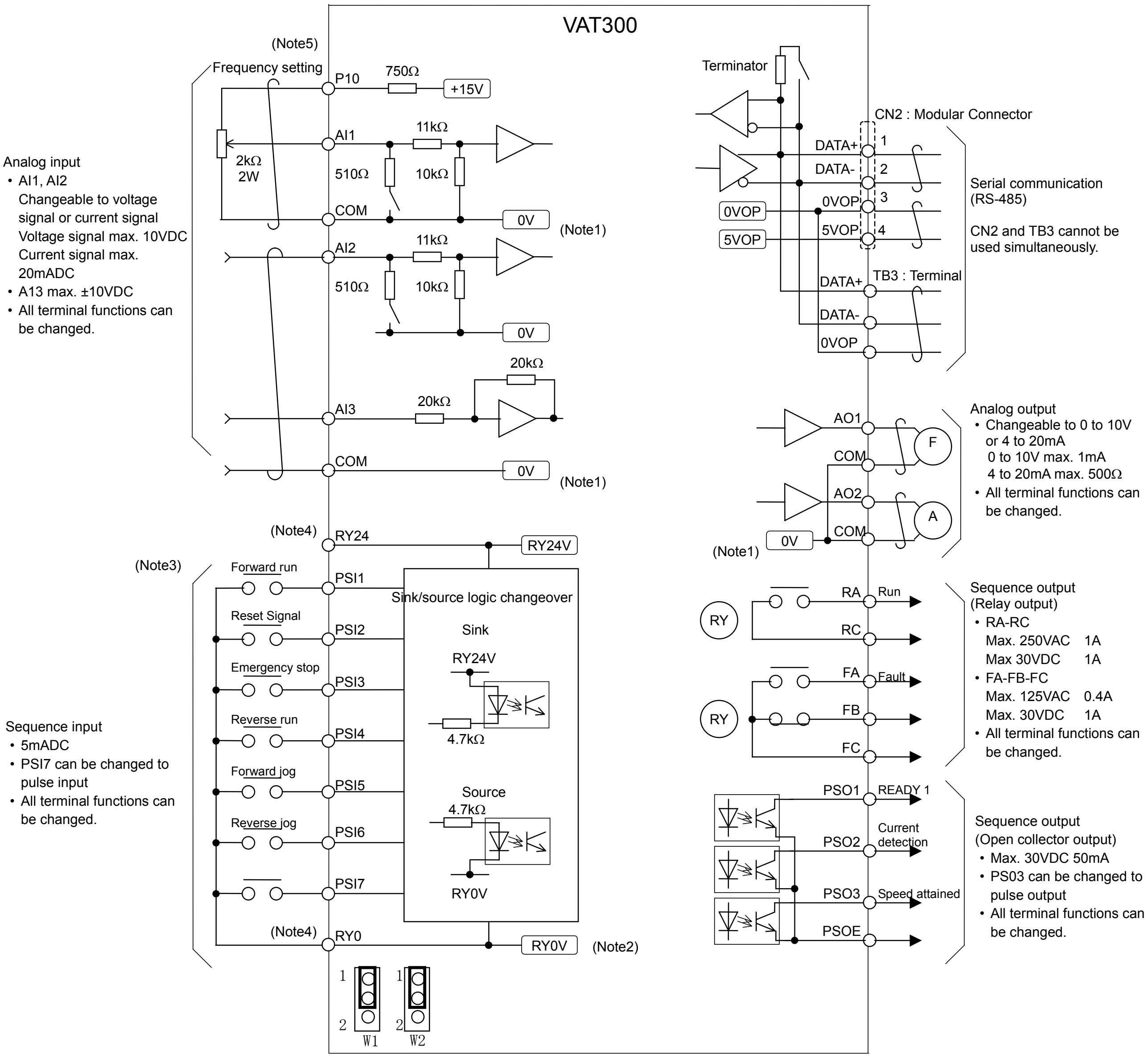


Fig. 2-4-a

(Notes)

1. Four COM terminals are internally connected.
2. No connection shall be made between RY0, COM and 0VOP since this section is insulated.
3. This diagram is an example of the sink logic connection.
4. RY24 and RY0 must not be shorted.
5. P10 and COM must not be shorted.

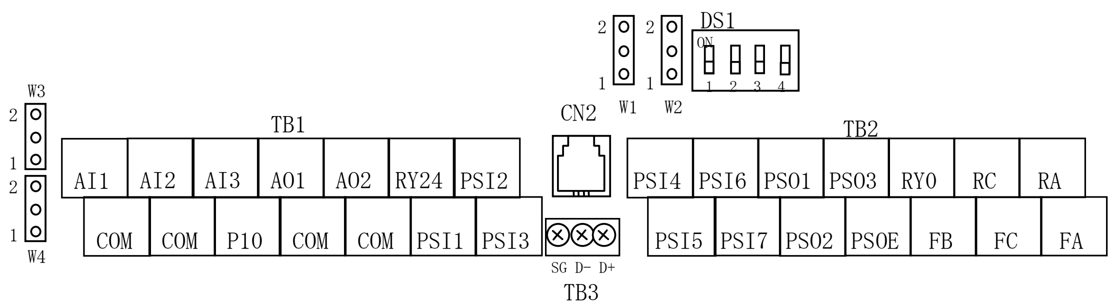


Fig. 2-4-b

1) Control terminal TB1,TB2
- The terminal block is laid out in two rows.
- Terminal screw size is M3.

2) Dip switches DS1

No.	OFF	ON	Signal
1	OPEN	120Ω	Standard serial terminator changeover
2	V1	I1	AI1 voltage, current changeover
3	V2	I2	AI2 voltage, current changeover
4	PS03	PULSE	Sequence output, pulse train output changeover

All switches are set to OFF as the default.

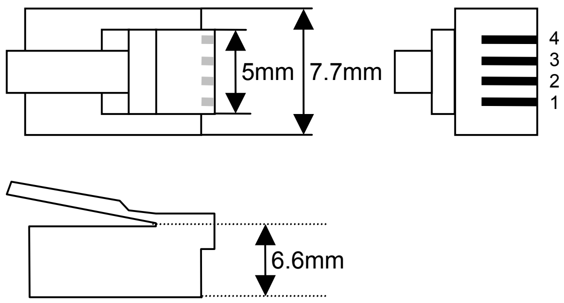
3) EL-BIT W1,W2,W3,W4

No.	1	2	Signal
W1	SINK	SOURCE	PSI1～6 sink, source changeovers
W2	SINK	SOURCE	PSI7 sink, source changeover
W3	voltage	current	AO1 voltage, current changeover
W4	voltage	current	AO2 voltage, current changeover

All EL-BITs are set to 1 as the default.

4) Standard serial or Modbus transmission
CN2 (Connector type: 4-pole modular, Hirose Electric TM3P-44P or equivalent)
- A signal level is based RS-485. The terminus resistance (120Ω) can set up on/off in DS1-1. ((DS1-1=120Ω): Connected, (DS1-1=OPEN): Not connected)
- The direction of a signal is based on VAT300.
- 5VOP and 0VOP are not designated to supply power externally.

Terminal No.	Signal
1	DATA+
2	DATA-
3	0VOP
4	5VOP

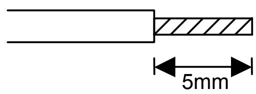


Outline drawing of connector

5) Standard serial or Modbus transmission TB3
- CN2 and TB3 DATA+, DATA- and 0VOP are connected in the PCB.
- The terminal size is M2.
- The applicable wire size is AWG26 to AWG16.

Terminal No.	Symbol	Signal
1	D+	DATA+
2	D-	DATA-
3	SG	0VOP

Wire peeling size



Notes for moving Operation panel holder

Do not raise the operation panel holder with an angle of larger than 90°, so that the holder should not be fallen off.

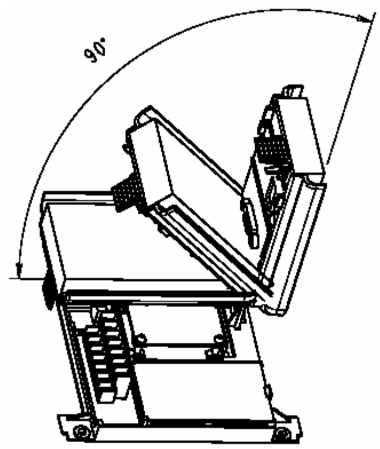


Fig. 2-4-c

If the operation panel holder should be taken off, push the hinges of the holder lightly and insert them into the original positions.

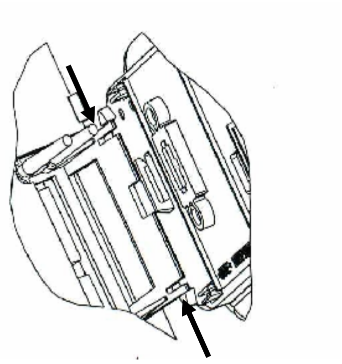


Fig. 2-4-d

Chapter 3 Test Operation and Adjustment

DANGER

- Always install the front cover before turning the input power ON. Never remove the cover while the power is ON. There are sections in the front PCB that are charged with high voltages.
  Failure to observe this could lead to electric shocks.
- Never touch the switches with wet hands.
  Failure to observe this could lead to electric shocks.
- Never touch the inverter's terminals while the inverter power is ON even if the operation is stopped.
  Failure to observe this could lead to electric shocks.
- Selection of the retry function could lead to unexpected restarting when alarm stops. The machine may start suddenly if the power is turned ON when the automatic start function is selected. Do not go near the machine.
  (Design the machine so that physical safety can be ensured even if the machine restarts.)
  Failure to do so could lead to injuries.
- The machine may not stop when a stop command is issued if the deceleration stop function is selected and the overvoltage/overcurrent limit function is activated. Prepare a separate emergency stop switch.
  Failure to do so could lead to injuries.
- The unit will not suddenly restart even if the alarm is reset with the operation signal input, however, in order to prevent unexpected operation, ensure that the operation signal is no longer being input, and reset the alarm.
  Failure to do so could lead to injuries.

CAUTION

- The heat sink and resistor are heated to high temperatures, so never touch them.
  Failure to observe this could lead to burns.
- Do not block the inverter's ventilation holes.
  Failure to observe this could lead to fires.
- The inverter operation can easily be set from low speeds to high speeds, so confirm that the operation is within the tolerable range for the motor or machine before making settings.
  Failure to do so could lead to injuries.
- Prepare holding brakes when necessary. Holding is not possible with the inverter's brake functions.
  Failure to do so could lead to injuries.
- Confirm the operation of the motor as a single unit before operating the machine.
  Failure to do so could lead to injuries or machine damage due to unforeseen movements.
  Always prepare a safety backup device so that the machine is not placed in a hazardous situation when an error occurs in the inverter.
  Failure to do so could lead to injuries or machine damage or fires.
- When using the 400V Series (X075K0 or higher) set the power changeover connector on the transformer auxiliary PCB according to the power voltage.
  Failure to do so could lead to fires.

The VAT300 has various setting items. Some of these include settings that must be made according to the power supply and motor before actually starting operation.
The methods for the VAT300 basic test operation and adjustment are explained in this section.

3-1 Flow of test operation

Carry out test operation according to the flow shown in Fig. 3-1.
The procedures above the dotted line in Fig. 3-1 are explained in this section.

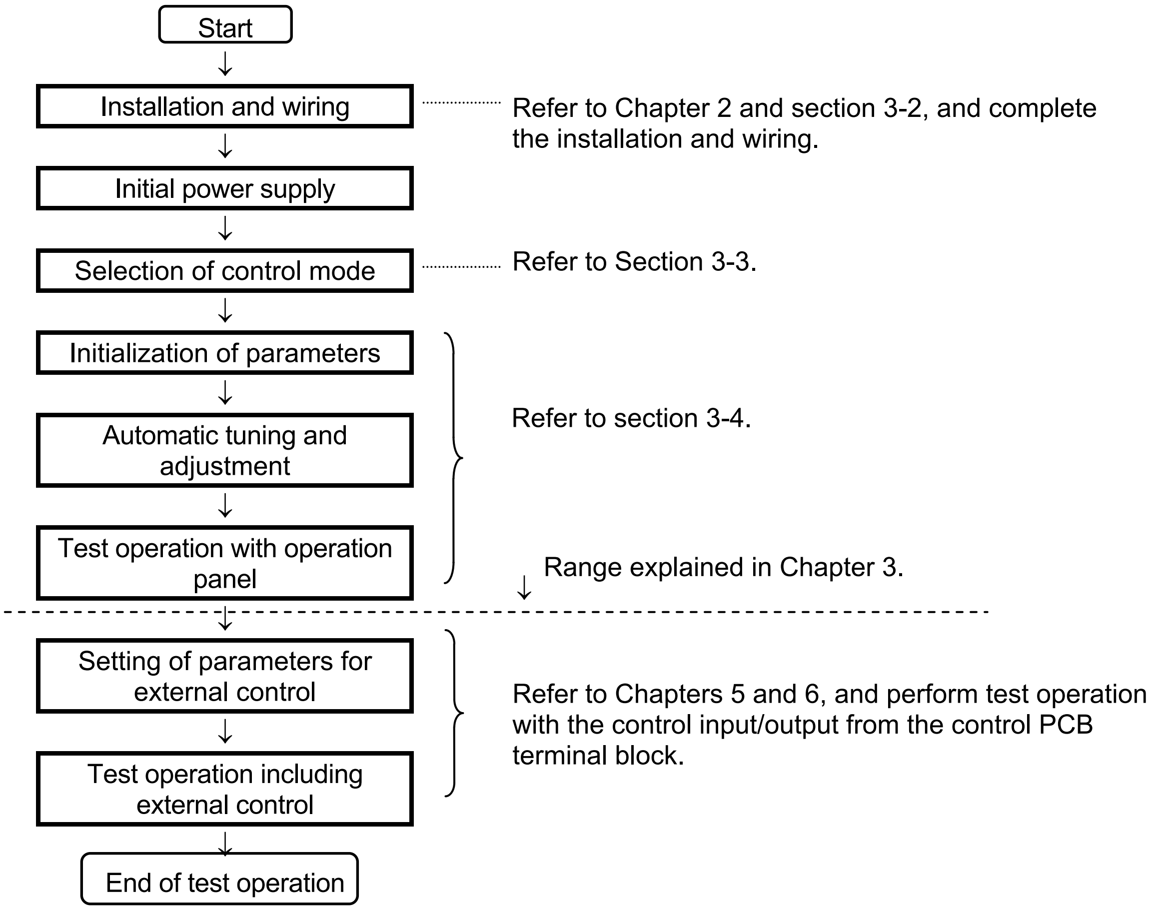


Fig. 3-1 Flow of test operation

⚠ CAUTION

- Check that the wiring is correct.
- The power supply must always be kept in the tolerable range.
- Confirm that the motor rating is within the inverter's rating range.
- Always correctly install the front cover before turning the power on.
- Assign one worker to operate the switches, etc.

3-2 Preparation before turning power ON

Always confirm the following points before turning ON the power after completing wire.

(1) Remove the coupling and belt coupling the motor and machine, so that the machine can be run as a single unit.

(2) Confirm that the power supply wire is correctly wired to the input terminals (L1, L2, L3).

(3) With the 400V Series (X075K0 or higher), there are some sections in the inverter which operate with an AC power supply, such as fan and magnetic contactor. In this case, set the power changeover connector on the transformer auxiliary PCB according to the power voltage.
If this connector is not set correctly, the fan and magnetic contactor could burn.
For 380V to 415V, short circuit across JP-1
For 416V to 460V, short circuit across JP-2
For 461V to 480V, short circuit across JP-3 (factory setting state)

(4) Make sure that the power voltage and frequency are within the tolerable range.

Voltage system	Type	Power voltage	Frequency
200V series	N000K7 to N011K0	200 to 240V ± 10%	50/60Hz ± 5%
	N015K0 to N045K0	200 to 230V ± 10%	50/60Hz ± 5%
400V series	X000K7 to X475K0	380 to 480V ± 10%	50/60Hz ± 5%

(5) Refer to section 2-3, and correctly connect the main circuit wiring.

(6) Securely fix the motor with the specified method.

(7) Make sure that none of the terminal section screws are loose.

(8) Make sure that there is no short circuit state in the terminals caused by wire scraps, etc.

(9) Always correctly install the front cover and outer cover before turning the power ON.

(10) Assign an operator, and make sure that the operator operates the switches.

⚠ CAUTION

Make sure that there is no abnormal noise, smoke or odors at this time.
If any abnormality is found, turn the power OFF immediately.

3-3 Control modes

With the VAT300, four control modes and two overload modes can be selected. These are set with the parameter C30-0 (control mode selection). Refer to the Appendix Table 1 Table of control specifications for details.
* C30-0 is set with a 2-digit value ($\boxed{f0}$, $\boxed{f1}$). Refer to section 3-4 for the setting methods.

(1) Control modes

There are four VAT300 motor control modes. Refer to the following table, and select the mode which suits the application.

Control mode	Explanation	C30-0 $\boxed{f0}$
1) V/f control	The voltage - frequency ratio is controlled.	1
2) IM speed sensor-less vector control	The IM is vector-controlled without a speed sensor. The speed can be controlled.	2
3) IM vector control with speed sensor	The IM is vector-controlled with a speed sensor. This mode is used when a fast speed response or torque response is required. The speed detection option 1 is required. **(Note 1)**	3
4) PM motor control with sensor	The PM motor is vector-controlled. The motor can be operated at a higher efficiency than IM. A speed detection option which matches the sensor (encoder) being used is required. **(Note 1)**	4

(Note 1) : Refer to Table 7-1-a (Chapter 7) for details on the speed detection options.

(2) Device overload mode selection

The following two modes can be selected according to the load being used. If the load and device capacity do not differ, the device could be overloaded. Refer to the following table, and select the mode that matches the load being used.

Control mode	Explanation	C30-0 $\boxed{f1}$
1) Normal-duty setting	Select this when the maximum load rate in respect to the rated load is low. The overload standard will be 120% of the motor's rated current for one minute.	1
2) Heavy-duty setting	Select this when the maximum load rate in respect to the rated load is high. The overload standard will be 150% of the motor's rated current for one minute.	2

3-4 Automatic tuning and test operation

Automatic tuning measures the constants of the connected motor, and automatically adjusts the parameters so that the system is used to the fullest.

The VAT300 automatic tuning function performs differ measurements for each of the four control modes. Carry out automatic tuning each time the motor being used or the applicable control mode is changed. The automatic tuning mode is set with parameter B19-0 (automatic tuning selection).

Control mode	Automatic tuning mode
• V/f control	B19-0 = 1,2
• IM speed sensor-less vector control	B19-0 = 3, 4, 5
• IM vector control with speed sensor	B19-0 = 1, 3, 4, 5
• PM motor control with sensor	B19-0 = 6, 7

B19-0	Name
1	Simple adjustment mode
2	V/f control high-function adjustment mode
3	Vector control basic adjustment mode
4	Vector control expanded adjustment mode
5	No-load voltage operation mode
6	Encoder phase adjustment mode **(Note 1)**
7	Magnetic pole position estimation mode **(Note 2)**

Carry out parameter initialization and automatic tuning as shown in the following flow chart. Refer to Chapter 4 for details on changing the parameters and operating the operation panel.

An adjustment mode dedicated for elevators (with brakes) is provided for the PM motor vector control with speed sensor. Refer to section 3-4-4 when using this mode for elevator applications.
Refer to section 3-4-3 when using for applications other than elevators.

(Note 1) B19-0=6 : The encoder phase adjustment mode automatically adjusts the parameters which set the phase angle between the encoder Z phase pulses and PM motor U-phase coil. The motor circuit constants are not adjusted automatically.

(Note 2) B19-0=7 : The magnetic pole position estimation mode is used to adjust the PM motor control magnetic pole position estimation function. This mode does not automatically adjust the parameters.

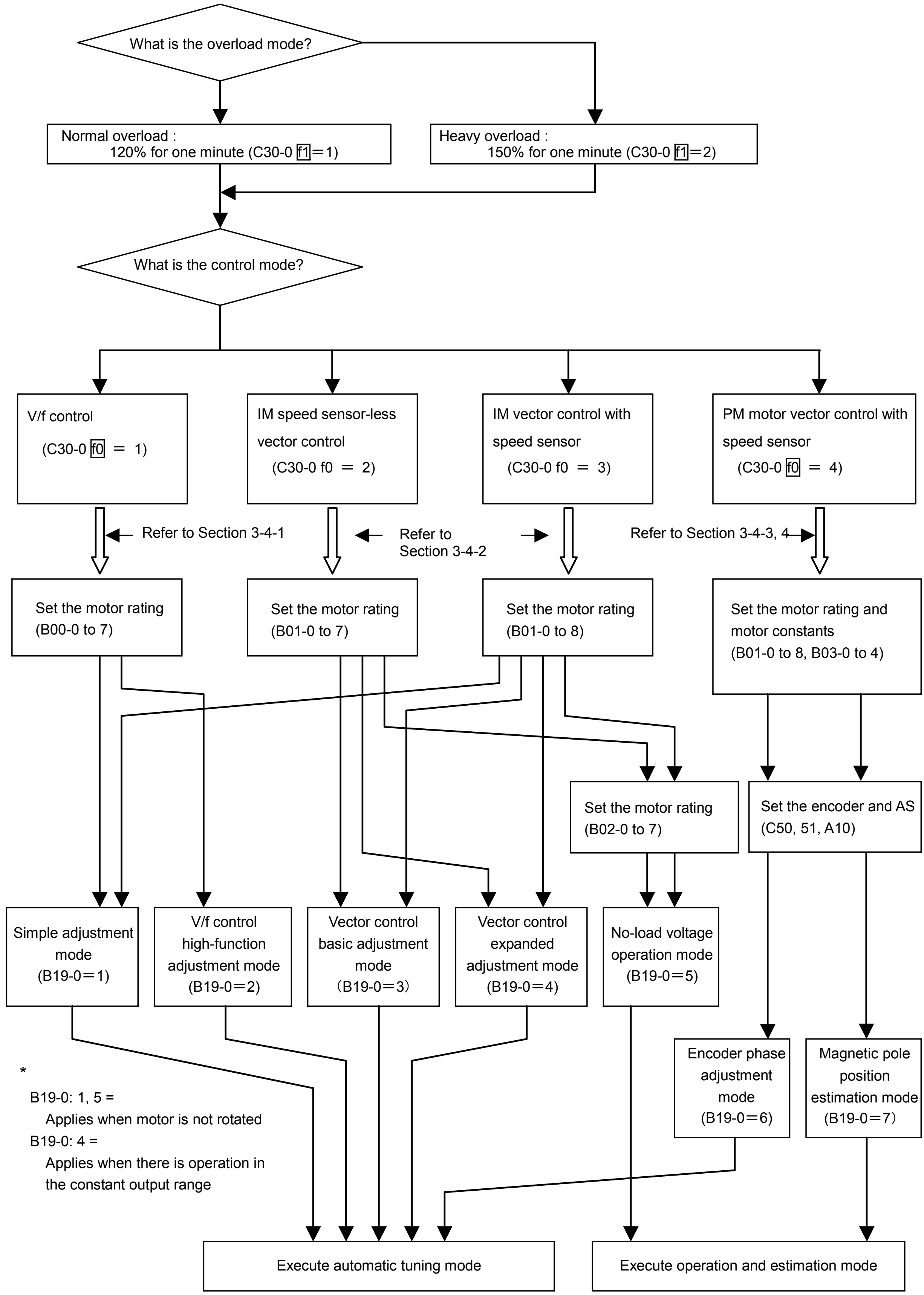


Fig. 3-4 Selection of automatic tuning mode

3-4-1 V/f control (C30-0 $\boxed{\text{f0}}$ = 1) automatic tuning and test operation

(1) Automatic tuning (V/f control mode)

The following two modes can be selected for the V/f control automatic tuning.
Using B19-0 (automatic tuning selection), select the automatic tuning mode that matches the working conditions.

1) B19-0 = 1: Mode 1: simple adjustment mode (Execution time: approx. 10 seconds)

The basic parameters, such as boost voltage and brake voltage, are adjusted without rotating the motor.
The following parameters shown in Table 3-4-1-a are automatically adjusted by executing Mode 1.

Table 3-4-1-a

Applicable mode	Parameter No.	Name
C30-0 $\boxed{\text{f0}}$ = 1 B19-0 = 1	A02-2	Manual torque boost setting
	A03-0	DC brake voltage
	B02-0, 1	R1: Primary resistance
	B02-4, 5	Lσ: Leakage inductance

2) B19-0 = 2: Mode 2: V/f control high-function adjustment mode (Execution time: approx. 1 minute)

The parameters related to the slip compensation and max. torque boost are adjusted while rotating the motor.
The magnetic saturation characteristics are measured at the voltage boost, and are adjusted to match the max. torque boost.
The following parameters shown in Table 3-4-1-b are automatically adjusted by executing Mode 2.

Table 3-4-1-b

Applicable mode	Parameter No.	Name
C30-0 $\boxed{\text{f0}}$ = 1 B19-0 = 2	A02-2	Manual torque boost setting
	A03-0	DC brake voltage
	B02-0, 1	R1: Primary resistance
	B02-4, 5	Lσ: Leakage inductance
	A02-5	Slip compensation gain
	A02-6	Max. torque boost gain

(Note 1) When the V/f control mode (C30-0 $\boxed{\text{f0}}$ = 1) is selected, modes other than B19-0=1, 2 cannot be used. If B19-0 is set incorrectly, set it again.

(Note 2) If the base frequency of the motor is applied on a motor exceeding 120Hz, select Mode 1 (B19-0 = 1). Adjust the slip compensation gain (A02-5) and max. torque boost gain (A02-6) manually.

CAUTION

Precautions for executing V/f control automatic tuning

- Even when Mode 1 is executed, the motor may rotate due to vibration, etc.
- If the vibration is large, press the STOP key immediately to stop operation.
- With Mode 2, the motor will automatically start rotating.
- Always check the safety on the load side before executing automatic tuning, regardless of the Mode 1 or 2 setting.
- During automatic tuning, the motor may rotate, so always confirm safety before starting automatic tuning.
- If the automatic tuning function does not end correctly, always turn the inverter power OFF before investigating or confirming the operation.
- Automatic tuning can be started only in the local operation mode (when "LCL" LED on operation panel is ON). Confirm that the "LCL" LED is ON.
- If the motor has an unstable frequency band, automatic tuning may not end normally. In this case, the maximum torque boost function cannot be used.
- If the load is less than 10% and the fluctuation does not occur, automatic tuning can be carried out with the load and machine connected. However, the performance may not be complete.
- Always carry out automatic tuning before using the maximum torque boost function.
- The contact output FLT will function if the automatic tuning does not end correctly. In equipment that uses this contact, keep the operation of the related devices in mind.

(2) Automatic tuning operation procedures (V/f control mode)

Carry out V/f mode automatic tuning with the following procedures.
Refer to Chapter 4 for details on using the operation panel.

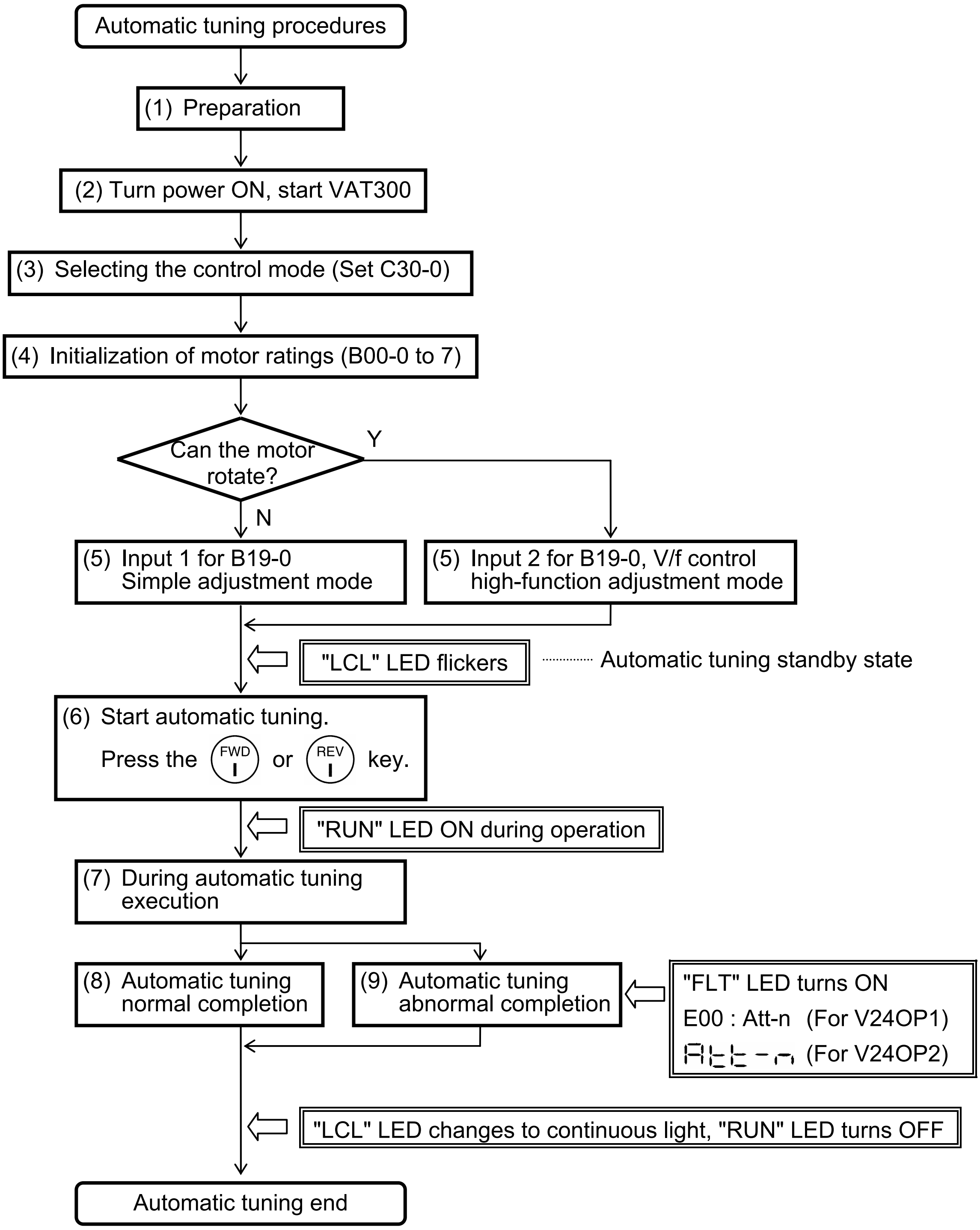
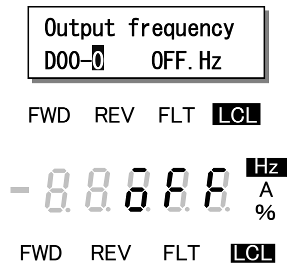


Fig. 3-4-1 V/f control automatic tuning procedures

1) Preparation

Separate the motor and load, machine, etc., and confirm the safety on the load side.

2) Turning the power ON and starting VAT300



Turn the power ON.

(For U30 V24OP1)

After carrying out an initial check of the operation panel for approx. 5 seconds, the display changes as shown on the right. The "LCL" LED also turns ON.

(For U30 V24OP2)

All LEDs on the numeric display will turn ON for a short time, and then "------", "d00-0" and " oFF " will appear.

The "LCL" and "Hz" LEDs will also turn ON.

3) Selecting the control mode

- Set A05-2 to 1. (Set the hardware option function display ON.)
- Set the control mode selection: C30-0 f1 f0.
  This parameter must be set first. **(Note 1)**
  V/f control mode is to be used, so set C30-0 f0 =1.
  Set c30-0 f1 f0 as shown below according to the load.

  Normal-duty setting: C30-0 f1 f0 = 1 1

  Heavy-duty setting: C30-0 f1 f0 = 2 1

  (Note 1) The default value is set to V/f control and Normal-duty setting (C30-0=11).
  There are some parameters which will change automatically when C30-0 is changed, so also set this first.

4) Initialization of motor constants

Input the motor rating parameters. Set the parameters shown in Table 3-4-1-c. Automatic tuning will automatically change the parameters, so it is recommended to write down the values set in Table 3-4-1-a or Table 3-4-1-b.

Table 3-4-1-c

Applicable mode	Parameter No.	Name	
C30-0 f0 = 1 B19-0 = 1, 2	B00-0	Rated input voltage setting	[No.]
	B00-1	Max/base frequency simple setting	[Hz]
	B00-2	Motor rated output	[kW]
	B00-3	Rated output voltage	[V]
	B00-4	Max. frequency **(Note 1)**	[Hz]
	B00-5	Base frequency **(Note 1)**	[Hz]
	B00-6	Motor rated current	[A]
	B00-7	Carrier frequency	

(Note 1) The max. frequency cannot be set below the base frequency, and the base frequency cannot be set above the max. frequency.

5) Selecting and executing the automatic tuning mode

Select the automatic tuning mode and execute automatic tuning.

- The operation panel's operation mode must be set to "Local" to execute automatic tuning. Make sure that the "LCL" LED is ON. If not, press the LCL/SET + STOP keys, and confirm that the "LCL" LED turns ON.
- Set A05-0 to 1. (Set the expanded setting display ON.)
- Using B19-0 (automatic tuning selection), select the automatic tuning mode according to the working conditions. Refer to section 3-4-1 (1) for details on the automatic tuning mode.
- The automatic tuning standby state will be entered when the LCL/SET key is pressed.

- During the automatic tuning standby state and the automatic tuning execution state, the LCL LED will flicker.
- To exit the automatic tuning standby state, press the STOP key.

6) Starting automatic tuning

Automatic tuning will start when the FWD key or REV key is pressed according to the required rotation direction.

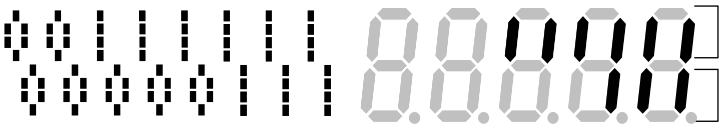
To stop, press the STOP key or input the emergency stop signal (EMS) from the terminal block.

* Once automatic tuning starts, all panel operations other than the STOP, RST/MOD or ▲ ▼ keys (knobs with U30V24OP1) are disabled until the operation ends.

7) During automatic tuning execution

The progression state can be confirmed with D22-0.

(ForU30 V24OP1) (For U30 V24OP2)



Upper level : The steps required for tuning are indicated (lit).

Lower level : The finished steps are indicated (lit). The step currently being executed is indicated with a flicker.

8) Normal completion of automatic tuning

When the automatic tuning ends normally, the "LCL" LED will change from a flicker to a stable light. The “RUN” LED will change from a flicker to the OFF state.
Refer to section 3-4-1 (1) for the adjustment items.

9) Abnormal completion of automatic tuning

If automatic tuning ends abnormally, the "FLT" LED will turn ON and a message will appear.
Investigate and check according to the error codes.
Refer to section 3-4-5 for details on the error codes.

(3) Test operation (V/f control mode)

When finished with automatic tuning, test run the isolated motor, and make sure that there are no errors.
An example for when the maximum frequency (B00-4) and base frequency (B00-5) are 50Hz is given below.
Use the following procedures to test the operation with the operation panel.
Refer to Chapter 4 for details on using the operation panel.

⚠ CAUTION
To prevent incorrect operation during the test operation, make sure that signals are not input into the sequence input terminal.

1) To enable operation with the operation panel, confirm that the "LCL" LED is ON. If not, press the LCL/SET + STOP keys, and confirm that the "LCL" LED turns ON.

2) Set speed setting input point selection: C02-0= 3 (panel fixed).

⚠ CAUTION
The motor will rotate with the next step. Confirm the safety around the motor before starting the next step.

3) Press the RST/MOD and display D00-0 on the monitor. Then press the FWD key. Operation will start. The "FWD" lamp will turn ON, and the display will change from "OFF" to a value display. The value will gradually increase, and after several seconds, will change to "10.00". This is because as the factory settings, the direct setting frequency (A00-0) is set to 10Hz and the acceleration ramp time 1 (A01-0) is set to 10sec.

CHECK
1. Did the motor run?
2. Is the run direction correct? Check the wiring and operation if abnormal.
3. Is the rotation smooth?

4) Press the REV key and confirm that the motor runs in reverse.

(Note) Do not carry out this step if a load which cannot be run in reverse is connected.

5) Press the STOP key and stop the motor.

6) Press the FWD key. The motor will forward run at the output frequency 10Hz.

Change the frequency to 50Hz with the following operation.

7) Press the RST/MOD key several times. The Display will alternate between "A00-0" and "10.00" (with the U30V24OP1, the 0 section of "A00-0: 10.00Hz" will flicker).

8) Press the LCL/SET key once.

The display will stop at "10.00", and the last digit will flicker. (With the U30V24OP1, the flicker will move to the 2nd decimal digit of the frequency display.)
This completes the preparation for changing the output frequency. The digit to change can be moved with the ◄ key. The output frequency can be incremented/decremented with the ▲ ▼ keys (knobs with U30V24OP1).

9) Move the digit with the ◄ key, and using the ▲ key (knob with U30V24OP1), raise the frequency to "50.00Hz". Then, press the LCL/SET key. The output frequency will rise to 50Hz.

(Note) The operation panel frequency change operation is set to "Change in real time" (C11-2=1) with the factory shipment settings. Thus, even if the LCL/SET key is not pressed, the frequency will change in real time using the ▲ ▼ keys (knobs with U30V24OP1).
When the LCL/SET key is pressed, the current setting value will be saved.

CAUTION

A 10-second acceleration and 20-second deceleration ramp time are set as defaults. The motor will slowly increase its speed to the set value.

When making a setting (using the ▲ ▼ keys, or knobs with (U30-V24OP1), check that the motor operates correctly at each increment of approx. 10Hz.

10) Press the RST MOD key several times, and display D00-0. When the output frequency ("D00-0" display) reaches 50Hz, press the STOP key.
The display will decrease to "0.00" in several seconds. The "FWD" or "REV" LED will flicker for two seconds while the DC-brake is applied and the motor will stop.

11) Press the REV I key, and test the reverse run at 50Hz.
(Note) Do not carry out this step if a load which cannot be run in reverse is connected.

This completes the test operation with the operation panel.
After this, refer to Chapter 4 and carry out the settings and adjust the load operation to match the user's application.

3-4-2 IM speed sensor-less vector control (C30-0 $\boxed{\text{f0}}$ = 2) and IM vector control with speed sensor (C30-0 $\boxed{\text{f0}}$ = 3) automatic tuning test operation

(1) Before automatic tuning

When using IM vector control with speed sensor, the speed detection option is required in addition to the VAT300 standard unit.
When using the IM vector control with speed sensor, use with FWD, F.RUN as forward run and Rev, R.RUN as reverse run.
With the VAT300, the counterclockwise rotation (CCW) looking from the motor shaft is defined as forward run, and clockwise rotation (CW) is defined as reverse run.

Forward run (CW) **Reverse run (CW)**

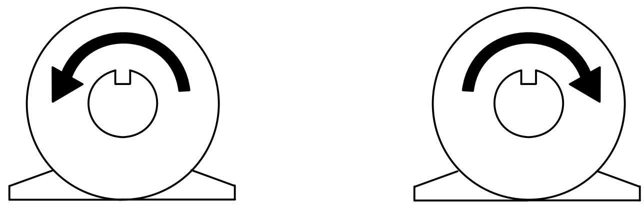


Fig. 3-4-2-a Definition of VAT300 motor rotation direction

Refer to Table 3-4-2-a, and confirm that the speed detection option compatible with the encoder in use has been prepared. Refer to Chapter 7 for details on the speed detection option.

Table 3-4-2-a

Encoder type	Speed detection option (Instruction Manual No.)
1) Complementary output method	U30V24DN1 (PCST-3453)
2) Line driver output method	U24V24DN2 (PCST-3454)

(2) Outline of automatic tuning (IM vector control mode)

The following four modes can be selected for the IM speed sensor-less vector control or IM vector control with speed sensor automatic tuning.
Using B19-0 (automatic tuning selection), select the automatic tuning mode according to the load conditions. **(Note 1)**

1) B19-0 = 1: Mode 1: simple adjustment mode (Execution time: approx. 10 seconds) **(Note 1)**
The basic parameters for IM vector control with speed sensor are automatically adjusted without rotating the motor.
The following parameters shown in Table 3-4-2-b are automatically adjusted by executing Mode 1.

Table 3-4-2-b

Applicable mode	Parameter No.	Name
C30-0 $\boxed{\text{f0}}$ = 3 B19-0 = 1	B01-9	No-load output voltage
	B02-0, 1	R1 : Primary resistance
	B02-2, 3	R2’ : Secondary resistance **(Note 2)**
	B02-4, 5	$L\sigma$: Leakage inductance
	B02-6, 7	M' : Excitation inductance **(Note 2)**

2) B19-0 = 3: Mode 3: Vector control basic adjustment mode (Execution time: approx. 30 seconds)
The motor is rotated and the basic parameters for vector control are automatically adjusted.
The following parameters shown in Table 3-4-2-c are automatically adjusted by executing Mode 3.

Table 3-4-2-c

Applicable mode	Parameter No.	Name
C30-0 $\boxed{f0}$ = 2, 3 B19-0 = 3	B01-9	No-load output voltage
	B02-0, 1	R1 : Primary resistance
	B02-2, 3	R2' : Secondary resistance
	B02-4, 5	Lσ : Leakage inductance
	B02-6, 7	M' : Excitation inductance

3) B19-0 = 4: Mode 4: Vector control extended adjustment mode (Execution time: approx. 1 minute)
This mode is selected to carry out constant output range operation.
The following parameters in Table 3-4-2-d are automatically adjusted by executing Mode 4.

Table 3-4-2-d

Applicable mode	Parameter No.	Name
C30-0 $\boxed{f0}$ = 2, 3 B19-0 = 4	B01-9	No-load output voltage
	B02-0, 1	R1 : Primary resistance
	B02-2, 3	R2' : Secondary resistance
	B02-4, 5	Lσ : Leakage inductance
	B02-6, 7	M' : Excitation inductance
	B33-0 to 7	M variable reference speed table
	B34-0 to 7	M variable compensation table

* When carrying out constant output operation, the fluctuation compensation for the excitation inductance is adjusted in this mode, however, the motor will rotate to the maximum speed during automatic tuning, so special attention must be paid to safety.

4) B19-0=5: Mode 5: No-load voltage operation mode (Execution time; approx. 10 seconds)
This mode automatically calculates and adjusts the motor's no-load voltage from the motor rated constants given in Table 3-4-2-f. When mode 5 is executed, the Table 3-4-2-e parameters are automatically adjusted.
Use this mode when the motor rated constants cannot be set with the motor design materials, etc.

Table 3-4-2-e

Applicable mode	Parameter No.	Name
C30-0 $\boxed{f0}$ = 2 B19-0 = 5	B01-9	No-load output voltage

Table 3-4-2-f

Parameter No.	Name
B02-0, 1	R1 : Primary resistance
B02-2, 3	R2' : Secondary resistance
B02-4, 5	Lσ : Leakage inductance
B02-6, 7	M' : Excitation inductance

(Note 1) In the IM vector control mode (C30-0 $\boxed{f0}$ = 2, 3), modes other than B19-0=1, 3, 4 or 5 cannot be used. If B19-0 is set incorrectly, set it again. When using IM speed sensor-less vector control, the simple adjustment mode (mode 1) cannot be used.

(Note 2) In the simple adjustment mode (mode 1), the excitation inductance is estimated using the motor rated value, so there could be an error in the output voltage. In applications which require a high actual output torque accuracy in respect to the torque command (within ±10% of the rated output torque), make the following adjustments after automatic tuning.

1) Carry out rated speed operation with a 10% or less load, and adjust B02-6, 7 (M': excitation inductance) so that B01-9 (no-load output voltage) and output voltage (D03-1) match.
2) Carry out rated speed operation with a 100% load, and adjust B02-2, 3 (secondary resistance) so that the rated voltage (B01-3) and output voltage (D03-1) match.

Refer to section 3-4-2(6) for details.

⚠ CAUTION

Precautions for executing IM speed sensor-less vector control or IM vector control with speed sensor automatic tuning

- Always check the safety around the motor before starting automatic tuning.
- The motor could vibrate or start running.
  The motor will automatically start rotating during automatic tuning.
- If the vibration is large during automatic tuning, press the STOP key immediately and stop the operation.
- Separate the motor from the load and machine, etc., and carry out automatic tuning with the isolated motor.
  Automatic tuning can be performed with a non-fluctuating load of 10% or less or if a machine is connected. However, if the applications require an accurate actual output torque in respect to the torque command, a sufficient performance may not be attained.
- The contact output FLT will function if the automatic tuning does not end correctly.
  In equipment that uses this contact, keep the operation of the related devices in mind.
- Automatic tuning cannot be used if the load is 10% or more or if the load fluctuates.
  Refer to the motor design materials, etc., and input the R1: primary resistance, R2': secondary resistance, Lσ: leakage inductance and M': excitation inductance. Then, when automatic tuning for the B19-0=5 no-load voltage operation mode is performed, the no-load voltage (B01-9) will be automatically set and operation with vector control will be possible.
  (Refer to section 6-6 Function explanation $\boxed{\text{B02-0 to 9}}$ Motor circuit constants for details on calculating R2', Lσ and M'.)
- If the automatic tuning function does not end correctly, always turn the inverter power OFF before investigating or confirming the operation.

(3) Automatic tuning operation procedures (IM vector control mode)

Carry out automatic tuning with the following procedures.
Refer to Chapter 4 for details on using the operation panel.

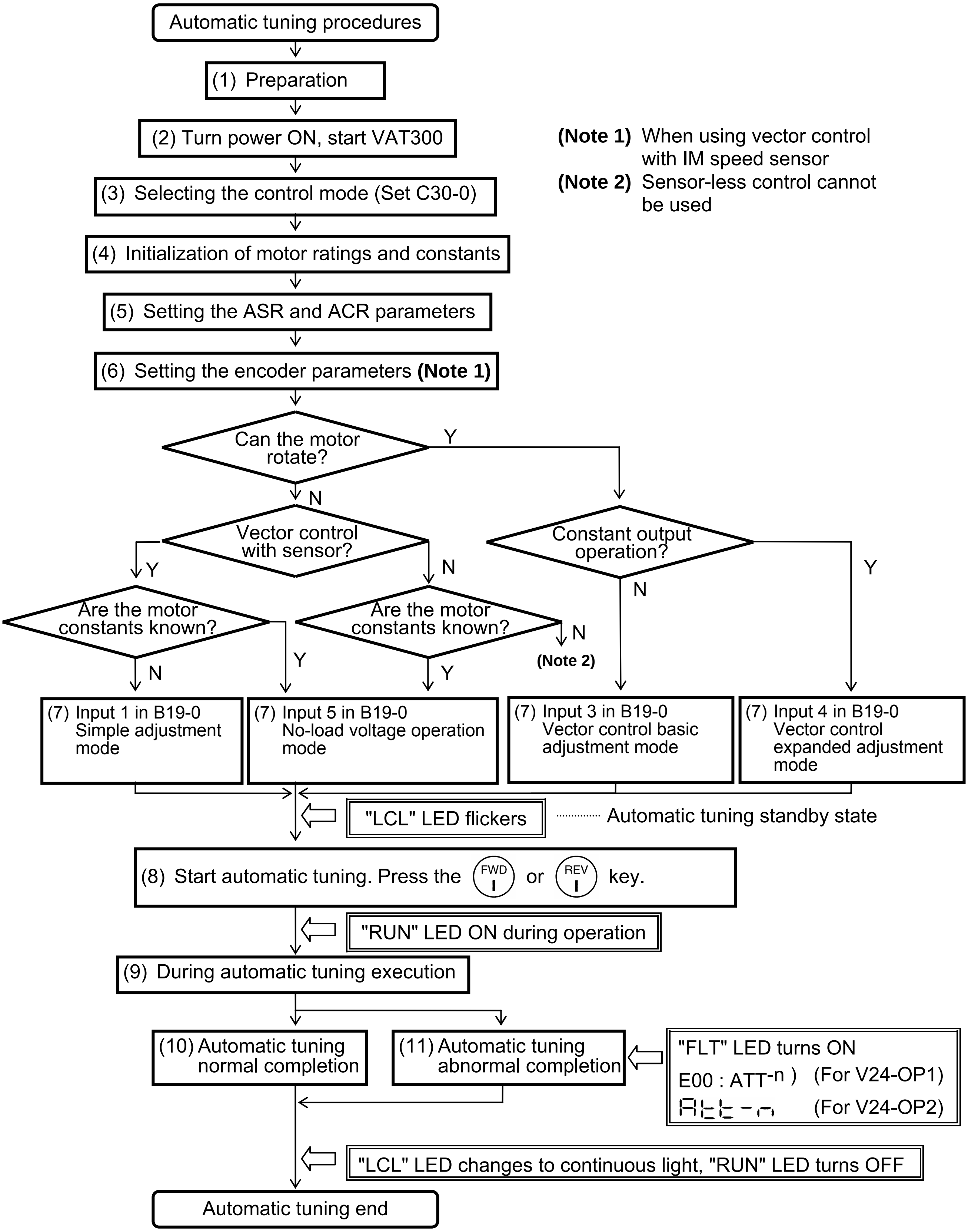
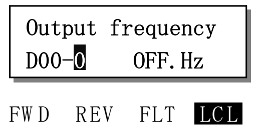


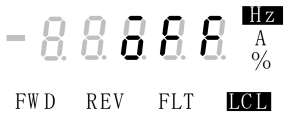
Fig. 3-4-2-b IM speed sensor-less vector control and IM vector control with speed sensor automatic tuning procedures

1) Preparation

Separate the motor and load, machine, etc., and confirm the safety on the load side.
When using the IM vector control with speed sensor mode, make sure that the speed detection option PCB is correctly mounted on the control PCB, and that the encoder signal cable is correctly connected to the speed detection option.

2) Turning the power ON and starting VAT300





Turn the power ON.
(In the case of U30V24OP1)
After carrying out an initial check of the operation panel for approx. 5 seconds, the display changes as shown on the right. The "LCL" LED also turns ON.
(In the case of U30V24OP2)
All LEDs on the numeric display will turn ON for a short time, and then "-----", "d00-0" and " oFF " will appear.
The "LCL" and "Hz" LEDs will also turn ON.

(Note) When the power is turned ON next (after setting C30-0 f0 = 2, 3), "D00-2" will appear on the numeric display, and the "Hz" LED will not turn ON. This is because the mode is set to the IM vector control mode.

3) Selecting the control mode

- Set A05-2 to 1. (Set the hardware option function display ON.)
- Set the control mode selection: C30-0 f1 f0.
  This parameter must be set first. **(Note 1)**

Tabele 3-4-2-g

	Normal-duty setting	Heavy-duty setting
IM speed sensor-less vector control	C30-0 = 1 2	C30-0 = 2 2
IM vector control with speed sensor	C30-0 = 1 3	C30-0 = 2 3

(Note 1) The default value is set to V/f control and Normal-duty setting (C30-0=11), so always change C30-0.
There are some parameters which will change automatically when C30-0 is changed, so also set this first.

4) Initialization of motor ratings and constants

Input the motor rating parameters. Set the parameters shown in Table 3-4-2-h. Automatic tuning automatically changes the parameters, so the setting value shown in Table 3-4-2-b to f should be written down according to the automatic tuning mode being used.

Table 3-4-2-h

Parameter No.	Name	
B01-0	Rated input voltage setting	[No.]
B01-1	Motor rated output	[kW]
B01-2	No. of motor poles	[Pole]
B01-3	Rated output voltage	[V]
B01-4	Max. speed	[min^{-1}]
B01-5	Base speed	[min^{-1}]
B01-6	Motor rated current	[A]
B01-7	Carrier frequency	
B01-8	No. of encoder pulses	[P/R] : **(Note 1)**

* The max. speed cannot be set below the base speed, and the base speed cannot be set above the max. speed.
(Note 1) Always input B01-8 when using the vector control mode with speed sensor.

Set the motor circuit constant parameters shown in Table 3-4-2-i only when using the automatic tuning mode 5. Refer to the motor design documents and calculate and set these parameters.

Table 3-4-2-i

Parameter No.	Name
B02-0, 1	R1 : Primary resistance
B02-2, 3	R2' : Secondary resistance
B02-4, 5	Lσ : Leakage inductance
B02-6, 7	M' : Excitation inductance

5) Setting the ASR and ACR parameters

When performing automatic tuning, do not change the ASR (speed control) and ACR (current control) parameters shown in Table 3-4-2-j from the default values.

Table 3-4-2-j

Parameter No.	Name	Standard value
A10-0	ASR response	10.0 [rad/s]
A10-1	Machine time constant	1000 [s]
A10-2	Integral time constant compensation coefficient	100 [%]
A10-3	ASR drive torque limiter	100 [%]
A10-4	ASR regenerative torque limiter	100 [%]
A11-0	ACR response	1000 [rad/s]
A11-1	ACR time constant	20.0 [ms]

Use the following expression and set A10-1: machine time constant according to the inertia of the isolated PM motor being used. The machine time constant (Tm) refers to the time required to accelerate to the base rotation speed from the zero speed at the rated torque.

$$Tm\,[ms] = 10.97 \times J\,[kg\cdot m^2] \times (Nbase\,[min^{-1}])^2 / Power[W]$$

J : Total inertia $[kg\cdot m^2]$ (= 1/4 × GD^2 $[kg\cdot m^2]$)
Nbase : Base rotation speed $[min^{-1}]$
Power : Motor rated output [W]

6) Setting the encoder parameter

The parameters to be set are listed in Table 3-4-2-k. IM vector control with speed sensor mode

Table 3-4-2-k

Parameter No.	Name
C50-1	2-phase, 1-phase encoder selection
C50-2	Encoder AB phase advance direction

(1) C50-1: 2-phase, 1-phase encoder selection

Set the number of signals (2-phase, 1-phase) of the encoder to be used.

C50-1=1: Select this for an encoder which outputs a 2-phase signal (A, B phase) which has a 90° phase difference.
The rotation direction can be judged, and stable speed control can be realized even at low speeds.

C50-1=2: Select this when using an encoder which outputs a 1-phase signal.
Connect the input signal to the A or B phase input, and leave the other phase unconnected. The 1-phase pulse signal validates functions which convert into 2-phase signals.
In the 1-phase signal mode, the rotation direction is recognized as the operation command direction. Forward run and reverse run cannot be determined.
In low-speed ranges, the speed detection error may occur because of chattering. When using low-speed operation or forward/reverse operation, use the 2-phase encoder.

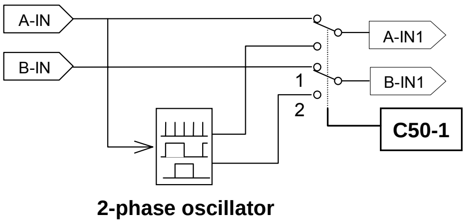


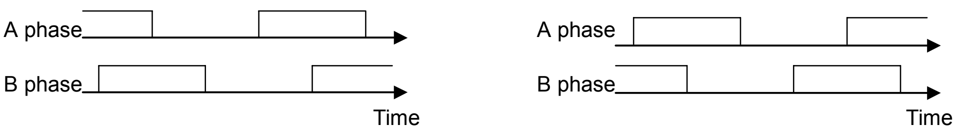
Fig. 3-4-2-c 2-phase, 1-phase encoder selection

(Note 1) When 1-phase input is selected, the speed detection direction (sign) is determined by the operation direction.

(Note 2) When 1-phase input is selected and ACR control is being conducted with IM vector control with speed sensor, the direction is recognized with the rotation direction indicated in (Note 1). Pay attention to the acceleration direction.

(2) C50-2: Encoder AB phase advance direction selection

With the VAT300, the rotation in the counterclockwise direction (CCW) looking from the motor shaft is defined as forward run, and in the clockwise direction (CW) is defined as reverse run. Determine this parameter’s setting value according to the phase relation of the encoder AB phase signals during forward run.



(a) When C50-2=1 (b) When C50-2=2

Fig. 3-4-2-d Encoder AB phase advance direction

7) Selecting and executing the automatic tuning mode

Select the automatic tuning mode and execute automatic tuning.

- The operation panel's operation mode must be set to "Local" to execute automatic tuning. Make sure that the "LCL" LED is ON. If not, press the + keys, and confirm that the "LCL" LED turns ON.
- Set A05-0 to 1. (Set the expanded setting display ON.)
- Using B19-0 (automatic tuning selection), select the automatic tuning mode according to the working conditions. Refer to section 3-4-2 (2) for details on the automatic tuning mode.
- The automatic tuning standby state will be entered when the key is pressed.
- During the automatic tuning standby state and the automatic tuning execution state, the "LCL" LED will flicker.
- To exit the automatic tuning standby state, press the key.

8) Starting automatic tuning

Automatic tuning will start when the key or key is pressed according to the required rotation direction.

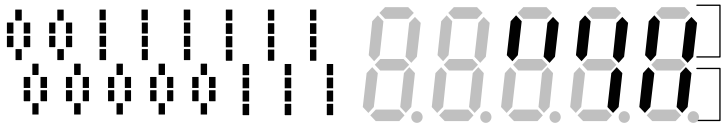
To stop, press the key or input the emergency stop signal (EMS) from the terminal block.

* Once automatic tuning starts, all panel operations other than operations other than the , or keys (knobs with U30V24OP1) are disabled until the operation ends.

9) During automatic tuning execution

The progression state can be confirmed with D22-0.

(For U30V24OP1) (For U30V24OP2)



Upper level : The steps required for tuning are indicated (lit).
Lower level : The finished steps are indicated (lit). The step currently being executed is indicated with a flicker.

10) Normal completion of automatic tuning

When the automatic tuning ends normally, the "LCL" LED will change from a flicker to a stable light. The "RUN" LED will change from a flicker to the OFF state.
Refer to section 3-4-2 (2) for the automatically adjusted items.

11) Abnormal completion of automatic tuning

If automatic tuning ends abnormally, the "FLT" LED will turn ON and a message will appear. Investigate and check according to the error codes.
Refer to section 3-4-5 for details on the error codes.

(4) Test operation (IM vector control mode)

When finished with steps (1) to (3), test the isolated motor and check for abnormalities.
An example for when the maximum speed (B01-4) and base speed are 600min^{-1} is given below.
The procedures for test operation using the operation panel are explained below.
Refer to Chapter 4 for details on using the operation panel.

⚠ CAUTION

To prevent incorrect operation during the test operation, make sure that signals are not input into the sequence input terminal.

1) To enable operation with the operation panel, confirm that the "LCL" LED is ON. If not, press the LCL/SET + STOP O keys, and confirm that the "LCL" LED turns ON.

2) Set speed setting input point selection: C02-0= 3 (panel fixed).

⚠ CAUTION

- The motor will rotate with the next step.
  Confirm the safety around the motor before starting the next step.
- The moment of inertia differs for isolated motor operation and load (machine) operation. Set the machine time constants (A10-1) according to the motor and load. The motor will vibrate if the settings are too high.

3) Press the RST/MOD and display D00-2 on the monitor. Then press the FWD I key.
   The "FWD" lamp will turn ON, and the display will change from "OFF" to a value display. The value will gradually increase, and after several seconds, will change to "300.0". This is because as the factory settings, the direct setting frequency (A00-2) is set to 300min^{-1} and the acceleration ramp time -1 (A01-0) is set to 10sec.

CHECK

1. Did the motor run?
2. Is the run direction correct? Check the wiring and operation if abnormal.
3. Is the rotation smooth?

4) Press the REV I key and confirm that the motor runs in reverse.
   (Note) Do not carry out this step if a load which cannot be run in reverse is connected.

5) Press the STOP O key and stop the motor.

6) Press the FWD I key. The motor will forward run at 300min^{-1}.
   Change the frequency to 600min^{-1} with the following operation.

7) Press the RST/MOD key several times. The Display will alternate between "A00-2" and "300.0" (with the U30V24OP1, the 2 section of "A00-2: 300.0min^{-1}" will flicker).

8) Press the LCL/SET key once.

   The display will stop at "300.0", and the last digit will flicker.
   This completes preparation for changing the motor speed. The digit to be changed can be moved with the ◄ key. The speed can be increased or lowered with the ▲ ▼ keys (knobs with U30V24OP1).

9) Move the digit with the ◄ key, and using the ▲ key (knob with U30V24OP1), raise the frequency to "600.0"min^{-1}. Then, press the LCL/SET key. The motor speed will gradually increase to 600min^{-1}.

   (Note) The operation panel frequency change operation is set to be changed (C11-2=1) in real time at the factory shipment settings, and therefore the output frequency is changed in real time using the ▲ ▼ keys (knobs with U30V24OP1), without having to press the LCL/SET key.
   When the LCL/SET key is pressed, the current setting value will be saved.

⚠ CAUTION
A 10-second acceleration and 20-second deceleration ramp time are set as defaults. The motor will slowly increase its speed to the set value. When making a setting (using the ▲ ▼ keys, or knobs with U30V24OP1), check that the motor operates correct at each increment of approx. 100min^{-1}.

10) When the motor speed (D00-2 display) increases to 600min^{-1}, press the STOP key.
   The display will decrease to "0.0" in several seconds. The "FWD" or "REV" LED will flicker for two seconds while the DC-brake is applied and the motor will stop.

11) Press the REV key, and test the reverse run at the maximum speed.

   (Note) Do not carry out this step if a load which cannot be run in reverse is connected.

This completes the test operation with the operation panel.

(5) Manual adjustment when torque accuracy is required (IM vector control mode)

In applications which require a high actual output torque accuracy in respect to the torque command (within ±10% of the rated output torque), the following manual adjustments may be required.

1) Adjusting the exciting inductance when performing automatic tuning with B19-0=1

- When there is no constant output range
  Run the motor at the base speed with no load (10% load or less), and adjust B02-6, 7 so that the no-load output voltage (B01-9) attained with automatic tuning and the output voltage (monitor D03-1 if measurement with rectified voltmeter is difficult) approximately match. In the same manner, the motor must be run at the base speed with 100% load, and the secondary resistance (B02-2, 3) adjusted so that the rated voltage (B01-3) and output voltage (monitor D03-1 if measurement with rectified voltmeter is difficult) approximately match. If the setting value of secondary resistance (B02-2,3) is made to increase during operation, output voltage will decrease. Moreover, if the setting value of secondary resistance (B02-2,3) is made to decrease during operation, output voltage will increase.

- When there is a constant output range
  When running with a constant output range, the M fluctuation compensation must be adjusted. Set the speed table (B33-0 to 7) beforehand. The speed table should be set as shown below except in special cases.

Parameter No.	Recommended setting values
B33-0	B33-1 × (1/2)
B33-1	Base speed : Same setting value as B01-5
B33-2	Set so that B33-1 to B33-7 are at an equal pitch
B33-3	
B33-4	
B33-5	
B33-6	
B33-7	Maximum speed : Same setting value as B01-4

Run the motor at the base speed with no load (10% load or less), and adjust B02-6, 7 so that the no-load output voltage (B01-9) attained with automatic tuning and the output voltage (monitor D03-1 if measurement with rectifying voltmeter is difficult) approximately match. The motor must be run at the base speed with 100% load, and the secondary resistance (B02-2, 3) adjusted so that the rated voltage (B01-3) and output voltage (monitor D03-1 if measurement with rectified voltmeter is difficult) approximately match. In the same manner, adjust the M fluctuation compensation coefficient (B34-2 to 7) so that the output voltage matches the no-load voltage (B01-9) at each speed in B33-2 to 7. B34-0, 1 is the M fluctuation compensation coefficient at the B33-0, 1 speed, and normally is approx. 100%. This does not need to be adjusted except in special cases.

* If manual adjustment is difficult after the simple adjustment mode, execute automatic tuning with the automatic tuning mode 3, 4 (B19-0=3, 4). Note that the motor will rotate in this mode.

2) Adjusting the IM speed sensor-less vector control (when C30-0 $\boxed{f0}$ = 2 mode is selected)
When using IM speed sensor-less vector control, the following items must be adjusted.

- Adjusting the ASR response
  The ASR control response must be set to approx. 5rad/s for IM speed sensor-less vector control. Adjust ASR response (A10-0) to below the default value. Refer to section (3) for details on adjusting this item.

- Finely adjusting the primary resistance
  Carry out test operation at the minimum speed to be used in the no-load (only inertial load) state, and finely adjust the primary resistance value. Adjust the primary resistance value (D02-0, 1) so that the speed amplifier output (D11-4) is approximately zero during forward run. Make sure that the output is not a negative value. In rare cases, if the output is a minus value, the operation may not stop because of the regenerative limiter (B31-3, 4, 5, 6).

  (Note 1) The primary resistance value mantissa section (B02-0) can be changed during operation, but the B02-1 exponential section cannot be changed during operation.

- Finely adjusting the leakage inductance and exciting inductance
  After automatic tuning, run the motor with a rated load at the motor's rated speed, and adjust the leakage inductance (B02-4, 5) and exciting inductance (B02-6, 7) so that the output voltage (D03-1) is approximately the same as the rated voltage. (If a rated load cannot be set, adjust so that the voltage matches the load.) If the output voltage drops during the load operation, increase the leakage inductance [mH] in increments of 10% (+ΔL[mH]), and decrease the exciting inductance by -ΔL[mH]. If an overcurrent, etc., occurs in low-speed ranges after the above adjustment, decrease the above ΔL adjustment amount, or adjust the ACR response (A11-0, 1).

  (Note 2) The B02-4 and B02-6 mantissa section can be changed during operation, but the B02-5, and B02-7 exponential section cannot be changed during operation.

- Adjusting the speed estimation
  Confirm that the motor speed % display (D00-3) is stable (±1% or less) during test operation. If not stable, adjust the speed estimation proportional gain (B31-1) and speed estimation integral gain (B31-2).

3) Adjusting ASR
   Adjust the control parameters to match the user's system.
   The main adjustment parameters are explained below.

- A10-0: ASR response : Set the speed control response with a [rad/s] unit.
  If the speed tracking is slow, increase this value.
  If this is set to high, the motor speed will hunt.
- A10-1: Machine time constant 1 : Set the time required to accelerate from zero to the base speed at the rated torque.

  $$Tm\ [ms] = 10.97 \times J\ [kg\cdot m^2] \times (Nbase[min^{-1}])^2 / Power\ [W]$$

  J : Total inertial $[kg\cdot m^2]$ (= 1/4 × GD^2 $[kg\cdot m^2]$)
  Nbase : Base speed $[min^{-1}]$
  Power : Motor rated output [W]
- A10-2: Integral time constant compensation coefficient:
  Increase the compensation coefficient if overshooting is large during speed control.
- A10-3: ASR drive torque limiter : Increase this value when drive torque is required.
- A10-4: ASR regenerative torque limiter:
  Increase this value when regenerative torque is required.

Refer to Section 6-8 for details on adjusting these parameters.

(Note) When the test operation of the isolated motor is finished, the parameter A10-1: machine time constant setting is set to match the isolated motor's inertia. After connecting the motor to the load, always reset this parameter to match the inertia of the user's machine.

After this, refer to Chapter 4 and carry out the settings and adjust the load operation to match the user's application.
Refer to Section 6-8 for details on adjusting the vector control system parameters.

3-4-3 Automatic tuning and test operation for PM motor with sensor control (C30-0 $\boxed{\text{f0}}$ =4)

> ⚠ **CAUTION**
>
> Refer to Section 3-4-4 when driving a PM motor and the motor is locked with mechanical brakes when stopped together with the magnetic pole position estimation function.

(1) Before automatic tuning

For PM motor with sensor control, the speed detection option is required in addition to the VAT300 standard unit.
When using the PM motor with sensor control, use with FWD, F.RUN as forward run and Rev, R.RUN as reverse run.
With the VAT300, the counterclockwise rotation (CCW) looking from the motor shaft is defined as forward run, and clockwise rotation (CW) is defined as reverse run.

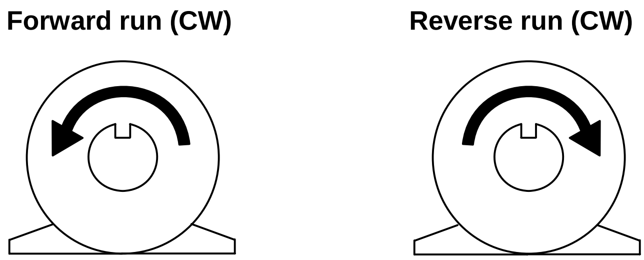


Fig. 3-4-3-a Definition of VAT300 motor rotation direction

Refer to Table 3-4-3-a, and confirm that the speed detection option compatible with the encoder in use has been prepared. Refer to Chapter 7 for details on the speed detection option.

Table 3-4-3-a

Encoder type	Speed detection option (Instruction Manual No.)
1) A, B, Z phase + U, V, W phase signals	U30V24DN3 (PCST-3482)
2) A, B, Z phase + serial absolute signals	U30V24DN2 (PCST-3481)
3) A, B, Z phase + U, V, W phase signals (reduced-wiring type)	U30V24DN2 (PCST-3481)
4) Sine wave signal	U30V24DN4 (PCST-3483)

1) A, B, Z phase + U, V, W phase signals
This incremental encoder outputs the A, B, Z phase and U, V, W phase pulse signals.

2) A, B, Z phase + serial absolute signals
This encoder outputs the A, B, Z phase pulse signals and serial absolute signal.

3) A, B, Z phase + U, V, W phase signals (reduced-wiring type)
With this encoder, the output signals are the same as the 1) type, but there are three output signal wires, and the A, B, Z phase and U, V, W phase output signals can be interchanged.

4) Sine wave signal
This encoder outputs a multi-cycle (i.e., 2048 cycle) 2-phase sine wave signals SIN, COS (equivalent to A, B phases) with one rotation, and outputs the Z-phase pulse and 1-cycle 2-phase sine wave signals SIN and COS with one rotation.

This automatic tuning must be carried out with the motor isolated from the load and machine.
If mechanical brakes are applied on the motor, make sure that the brakes can be released during automatic tuning.

(2) Outline of automatic tuning (PM motor control mode)

This automatic tuning is a function with automatically adjusts the phase angle (C51-4) of the encoder Z phase pulse and PM motor U phase coil. Automatic tuning in the PM motor control mode does not have the PM motor circuit constant measurement function. The number of encoder pulses and the encoder signal type selection must be set.
When C51-4 is automatically adjusted with this automatic tuning function, the phase does not need to be adjusted when installing this encoder onto the PM motor. Even if the adjustment has been completed, it should be readjusted to increase the adjustment accuracy.

B19-0=6: Mode 6: PM motor control encoder phase adjustment mode (Execution time: approx. 7 sec.)

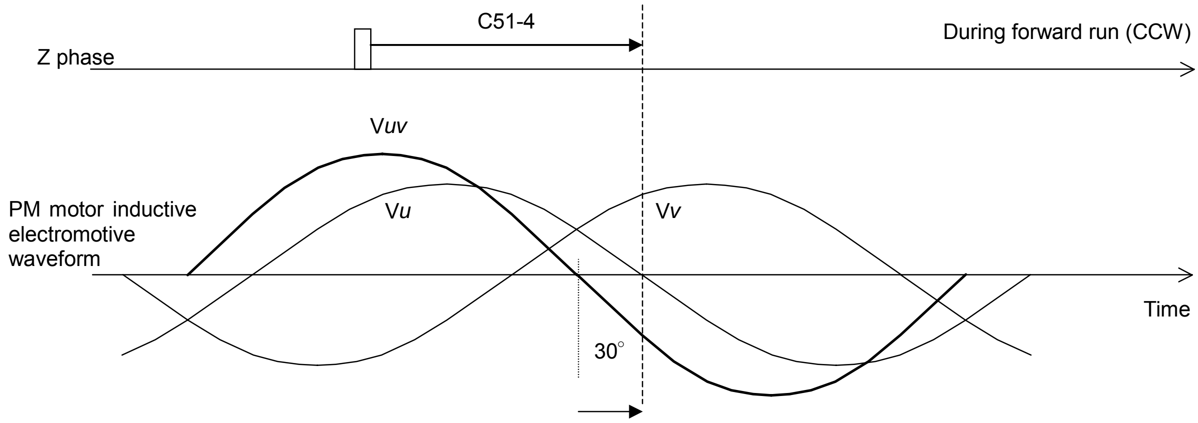


Fig. 3-4-3-b Relation of encoder Z phase pulse and PM motor inductive electromotive waveform phase

(Note) When using the PM motor with sensor control (C30-0 $\boxed{f0}$ = 4), the automatic tuning function will not start even if B19-0 = 0 to 5 is selected.

⚠ CAUTION

Precautions for executing encoder phase adjustment mode (PM motor control)

- Do not carry out maintenance, such as wiring or mounting the option PCB while the PM motor is running. Even if the inverter power is not turned ON, the PM motor could rotate by the connected load or machine and cause a high voltage to be generated in the motor terminals. If the PM motor is connected to the inverter, the inverter could be powered when the PM motor rotates.
- Before mounting the PCB for the speed detection option onto the control PCB, always turn the inverter power OFF and wait at least 10 minutes. Confirm that all displays on the operation panel are OFF and that the "CHARGE" LED in the unit is OFF before starting the mounting work.
  Note that the main circuit terminals are charged to a high voltage.
- Always ground the motor and inverter.
- When executing automatic tuning, the motor must be isolated from the load and machine, etc.
  The motor will automatically rotate in the forward and reverse run directions during automatic tuning.
  Always check the safety around the motor before starting automatic tuning.
- If the load is less than 10% and the fluctuation does not occur, automatic tuning can be carried out with the load and machine connected. However, the performance may not be complete.
- Automatic tuning can be started only in the local operation mode. Confirm that the "LCL" LED is ON.
- The motor could vibrate and rotate during automatic tuning.
  If the vibration is large, turn the STOP key immediately to stop operation.
- If the automatic tuning function does not end correctly, always turn the inverter power OFF before investigating or confirming the operation.
- The contact output FLT will function if the automatic tuning does not end correctly. In equipment that uses this contact, keep the operation of the related devices in mind.
- After setting the encoder parameters or after automatic tuning, do not move the position at which the encoder is fixed onto the motor, or interchange the motor's U, V, W phase wires.

(3) Automatic tuning operation procedures (PM motor control mode)

Adjust the magnetic pole position estimation function with the following procedure.
Refer to Chapter 4 for details on using the operation panel.

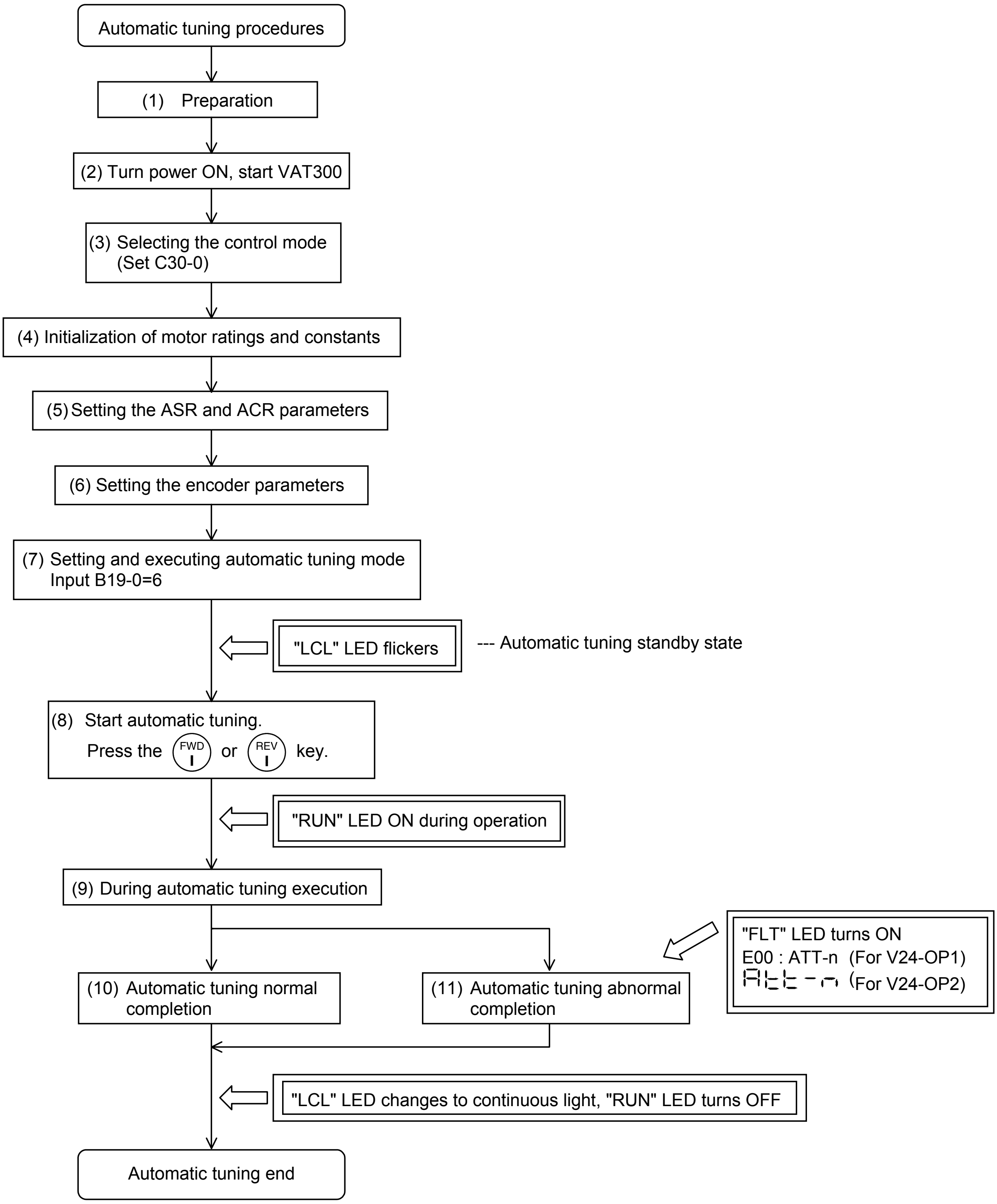
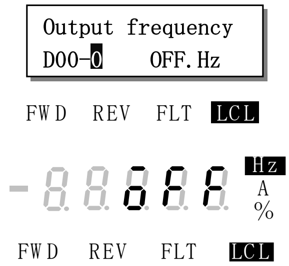


Fig. 3-4-3-c Procedures for automatically tuning the encoder phase for PM motor control

1) Preparation (Before turning the power ON)

Separate the motor and load, machine, etc., and confirm the safety on the load side.
Confirm at the speed detection option PCB is correctly mounted on the control PCB, and that the encoder signal wire is correctly connected to the speed detection option. Refer to the instruction manual of the speed detection option being used for details on connecting the encoder signal wire.

2) Turning the power ON and starting VAT300



Turn the power ON.
(In the case of U30V24OP1)
After carrying out an initial check of the operation panel for approx. 5 seconds, the display changes as shown on the right. The "LCL" LED also turns ON.
(In the case of U30V24OP2)
All LEDs on the numeric display will turn ON for a short time, and then "-----", "d00-0" and "oFF" will appear.
The "LCL" and "Hz" LEDs will also turn ON.

(Note) When the power is turned ON next (after setting C30-0 $\boxed{f0}$ =4), "D00-2" will appear on the display, and the "Hz" LED will not light. This is because the mode is set to the PM motor vector control mode.

3) Selecting the control mode

- Set A05-2 to 1. (Set the hardware option function display ON.)
- Set the control mode selection: C30-0 $\boxed{f1}$ $\boxed{f0}$.
  This parameter must be set first. **(Note 1)**
  PM motor with sensor control mode is to be used, so set C30-0 $\boxed{f0}$ = 4.
  Set c30-0 $\boxed{f1}$ $\boxed{f0}$ as shown below according to the load.
  Normal overload setting : C30-0 $\boxed{f1}$ $\boxed{f0}$ = 1 4
  Heavy overload setting : C30-0 $\boxed{f1}$ $\boxed{f0}$ = 2 4

(Note 1) The default value is set to V/f control and normal overload setting (C30-0=11), so always change C30-0.
There are some parameters which will change automatically when C30-0 is changed, so also set this first.

(Note 2) If the fault "SP-5" occurs when the C30-0 setting is changed, the following causes can be considered.
- The speed detection option is not mounted correctly.
- The encoder signal wire is not connected correctly, or is broken.

Turn the inverter power OFF and check the state.

4) Initialization of motor rating and motor constants

Input the parameters required for PM motor control. Set the parameters shown in Table 3-4-3-b.

Table 3-4-3-b

Parameter No.	Name	
B01-0	Rated input voltage setting	[No.]
B01-1	Motor rated output	[kW]
B01-2	No. of motor poles	[Pole]
B01-3	Rated output voltage	[V]
B01-4	Max. speed	[min–1]
B01-5	Base speed	[min–1]
B01-6	Motor rated current	[A]
B01-7	Carrier frequency	
B01-8	No. of encoder pulses	[P/R]
B03-0	R1: PM motor primary resistance (Mantissa section)	[mΩ]
B03-1	R1: PM motor primary resistance (Exponent section)	
B03-2	Ld: PM motor d axis inductance (Mantissa section)	[mH]
B03-3	Lq: PM motor q axis inductance (Mantissa section)	[mH]
B03-4	Ld, Lq: PM motor inductance (Exponent section)	

* The max. speed cannot be set below the base speed, and the base speed cannot be set above the max. speed.

5) Setting the ASR and ACR parameters

When performing automatic tuning, do not change the ASR (speed control) and ACR (current control) parameters shown in Table 3-4-3-c from the default values. Note that A10-1 must be set to the value obtained with the following expression.

Table 3-4-3-c

Parameter No.	Name	Standard value
A10-0	ASR response	10.0 [rad/s]
A10-1	Machine time constant	1000 [s]
A10-2	Integral time constant compensation coefficient	100 [%]
A10-3	ASR drive torque limiter	100 [%]
A10-4	ASR regenerative torque limiter	100 [%]
A20-0	ACR response	1500 [rad/s]
A20-1	ACR time constant	10.0 [ms]

Use the following expression and set A10-1: machine time constant according to the inertia of the isolated PM motor being used. The machine time constant (Tm) refers to the time required to accelerate to the base rotation speed from the zero speed at the rated torque.

$$Tm\ [ms] = 10.97 \times J\ [kg \cdot m^2] \times (Nbase\ [min^{-1}])^2 / Power\ [W]$$

J : Total inertia [kg•m^2] (= 1/4 × GD^2 [kgf•m^2])
Nbase : Base rotation speed [min^{-1}]
Power : Motor rated output [W]

The parameters shown in Table 3-4-3-d are used for automatic tuning. Set these parameters to the default values when executing automatic tuning.

Table 3-4-3-d

Parameter No.	Name	Standard value
A03-2	DC brake current	50 [%]

6) Setting the encoder parameters

Four types of encoders can be used with the VAT300 PM motor with sensor control. The types and corresponding speed detection options are shown in Table 3-4-3-e.

Table 3-4-3-e

Encoder type	Speed detection option (Instruction Manual No.)
1) A, B, Z phase + U, V, W phase signals	U30V24DN3
2) A, B, Z phase + serial absolute signals	U30V24DN2
3) A, B, Z phase + U, V, W phase signals (reduced-wiring type)	U30V24DN2
4) Sine wave signal	U30V24DN4

The parameters must be set to match the encoder being used.
The parameters which must be set for each encoder are shown below.

1) A, B, Z phase + U, V, W phase signals

Parameter No.	Name
C50-2	Encoder AB advance direction selection
C50-3	Encoder ABZ pulse type selection
C51-0	Encoder selection
C51-1	AB phase-Z phase type selection
C51-2	Encoder Z signal reversal
C51-3	Encoder UVW advance direction selection
C51-4	Z-IN → U phase winding phase angle
C51-5	Z-IN → U phase angle
C51-6	Encoder UVW pulse type selection

2) A, B, Z phase + serial absolute signals

Parameter No.	Name
C50-2	Encoder AB advance direction selection
C50-3	Encoder ABZ pulse type selection
C51-0	Encoder selection
C51-1	AB phase-Z phase type selection
C51-2	Encoder Z signal reversal
C51-4	Z-IN → U phase winding phase angle
C51-5	Z-IN → U phase angle

3) A, B, Z phase + U, V, W phase signals (reduced-wiring type)

Parameter No.	Name
C50-2	Encoder AB advance direction selection
C50-3	Encoder ABZ pulse type selection
C51-0	Encoder selection
C51-1	AB phase-Z phase type selection
C51-2	Encoder Z signal reversal
C51-3	Encoder UVW advance direction selection
C51-4	Z-IN → U phase winding phase angle
C51-5	Z-IN → U phase angle
C51-6	Encoder UVW pulse type selection
C51-7	UVW measurement start wait time
C51-8	UVW measurement time
C51-9	ABZ measurement start wait time

4) Sine wave signal

Parameter No.	Name
C50-2	Encoder AB advance direction selection
C50-3	Encoder ABZ pulse type selection
C51-0	Encoder selection
C51-1	AB phase-Z phase type selection
C51-2	Encoder Z signal reversal
C51-4	Z-IN → U phase winding phase angle
C51-5	Z-IN → U phase angle

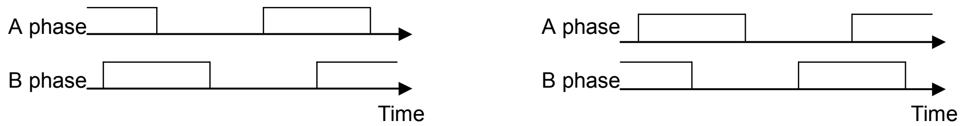
(Note) C51-4: Z-IN → U phase winding phase angle is automatically adjusted with automatic tuning. Refer to section 6-6 and set only when automatic tuning cannot be executed.
The method for setting each parameter is shown below. Set these in order. When automatic tuning is executed, the parameters in Table 3-4-3-f are automatically changed, so the setting values should be noted down.

Table 3-4-3-f

Applicable mode	Parameter No.	Name
B19-0 = 6	C51-4	Z-IN → U phase winding phase angle

[1] C51-0: Encoder selection
Select the type of encoder signal to be used.
=1 : A, B, Z phase + U, V, W phase signals
=2 : A, B, Z phase + serial absolute signals
=3 : A, B, Z phase + U, V, W phase signals (reduced-wiring type)
=4 : Sine wave signal

[2] C50-2: Encoder AB advance direction selection
With the VAT300, the rotation in the counterclockwise direction (CCW) looking from the motor shaft is defined as forward run, and in the clockwise direction (CW) is defined as reverse run. Determine this parameter's setting value according to the phase relation of the encoder AB phase signals during forward run.



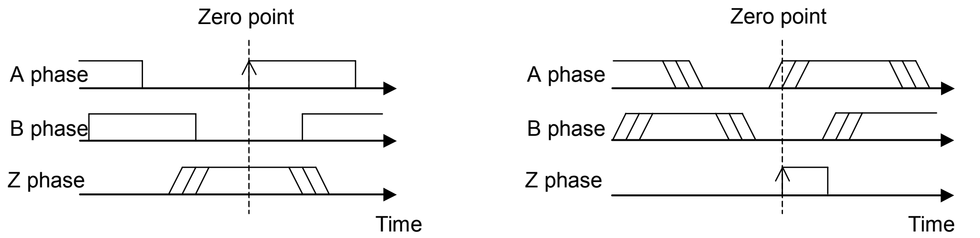
(a) When C50-2=1 (b) When C50-2=2

Fig. 3-4-2-d Encoder AB advance direction selection

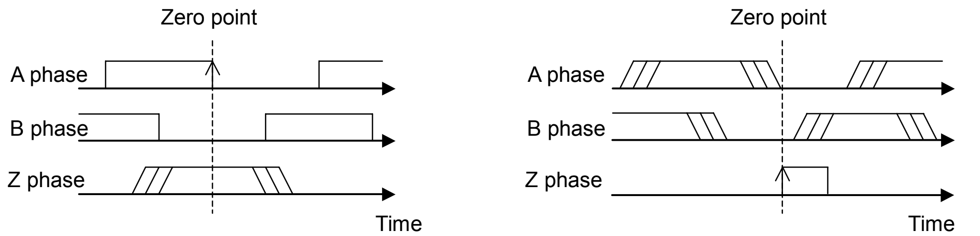
(Note) If C50-2 is set to 2, set C50-3 to 0.

[3] C51-1 : AB phase-Z phase type selection

[4] C51-2 : Encoder Z signal reversal
With the VAT300, the four patterns shown in Fig.-3-4-3-e are estimated for the A, B and Z phase pulse encoder signals.
C51-1 is set based on the phase relation of the A phase signal's rising edge and the Z phase signal. With this setting and at a time of reverse running, the A phase signal's down edge during the Z phase being high is the zero point.
To generate the A phase signal rising edge when the Z phase signal is High (Fig. (a)), set C51-1 to 0. In this case, the A phase signal rising edge will be the zero point (magnetic pole position). In all other cases, set C51-1 to 1. In this case, the Z phase signal's rising edge will be the zero point. (Fig. (b)). In this case, the Z phase rising edge is the zero point even at a time of the reverse running.
If the Z phase signal needs to be reversed to match the following signal definition, set C51-2 to 1.



(a) When C51-1=0 (during CCW rotation) (b) When C51-1=1 (during CCW rotation)



(c) When C51-1=0 (during CW rotation) (d) When C51-1=1 (during CW rotation)

Fig. 3-4-3-e A, B and Z phase pulse encoder signals

(Note) If C51-2 is set to 1, set C50-3 to 0.

[5] C50-3 : Encoder ABZ pulse type selection
Only when using an encoder with signal specifications that cannot be handled with the C50-2 and C51-2 settings, set C50-3 to reverse or interchange the signals.
The signal conversion circuit will function with the combination shown in the table below according to the C50-3 setting value.

(Note) Set C50-3 to 0 (no signal reversal/interchange) when C50-2 and C51-2 have been set.

C50-3 setting value	A-IN forward/ reverse run	B-IN forward/ reverse run	Z-IN forward/ reverse run	AB inter-change
0	–	–	–	No inter-change
1	Reverse	–	–	
2	–	Reverse	–	
3	Reverse	Reverse	–	
4	–	–	Reverse	
5	Reverse	–	Reverse	
6	–	Reverse	Reverse	
7	Reverse	Reverse	Reverse	
8	–	–	–	AB inter-change
9	Reverse	–	–	
10	–	Reverse	–	
11	Reverse	Reverse	–	
12	–	–	Reverse	
13	Reverse	–	Reverse	
14	–	Reverse	Reverse	
15	Reverse	Reverse	Reverse	

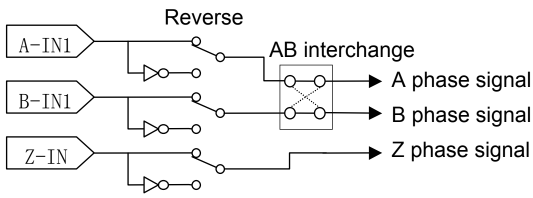
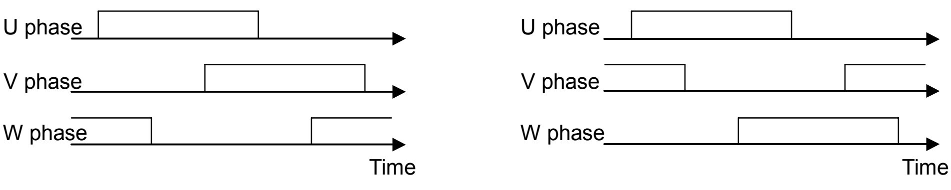


Fig. 3-4-3-f Signal conversion circuit

[6] C51-3 : Encoder UVW advance direction selection

[7] C51-6 : Encoder UVW pulse type selection
Set these parameters when using an A, B, Z phase + U, V, W phase signal or wire-reduced type A, B, Z phase + U, V, W phase signal encoder.
When using the wire-reduced type A, B, Z phase + U, V, W phase signal encoder, the VAT300 defines the first signal input in the A, B, Z phase signal wire as the U, V, W phase signals respectively.

Refer to the following figure and set C51-3 according to the phase relation of the encoder's U, V, W phase signals during forward run (CCW rotation).



(a) When C51-3=1 (b) When C51-3=2

Fig. 3-4-3-g Relation of UVW signal phases

Only when using an encoder with signal specifications that cannot be handled with the C51-3 setting, refer to the following figure and table, and set C51-6 to reverse the signals.

(Note) Set C51-6 to 0 (no interchange) when C51-3 is set to 2.

C51-6 setting value	U-IN forward/ reverse run	V-IN forward/ reverse run	W-IN forward/ reverse run
0	–	–	–
1	Reverse	–	–
2	–	Reverse	–
3	Reverse	Reverse	–
4	–	–	Reverse
5	Reverse	–	Reverse
6	–	Reverse	Reverse
7	Reverse	Reverse	Reverse

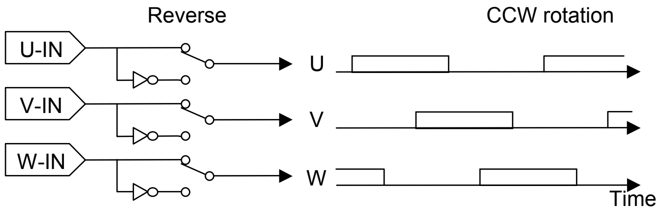


Fig. 3-4-3-h Signal conversion circuit

[8] C51-5 : Z-IN → U phase angle

1) For A, B, Z phase + U, V, W phase signal or wire-reduced type A, B, Z phase + U, V, W phase signal
   If there is a phase difference between the Z phase pulse and U phase pulse of the encoder being used, set that phase difference in C51-5.
   If there is no phase difference between the Z phase pulse and U phase pulse, set "0°".

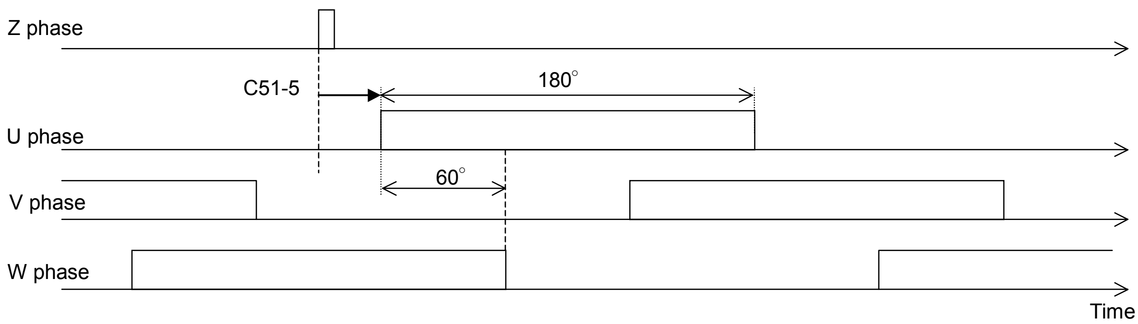


Fig. 3-4-3-i Encoder Z phase and U, V, W phase signals (during CCW rotation)

2) For A, B, Z phase + serial absolute
   Only when there is a phase difference between the Z phase pulse and serial absolute signal zero point, set that phase difference with an angle unit.

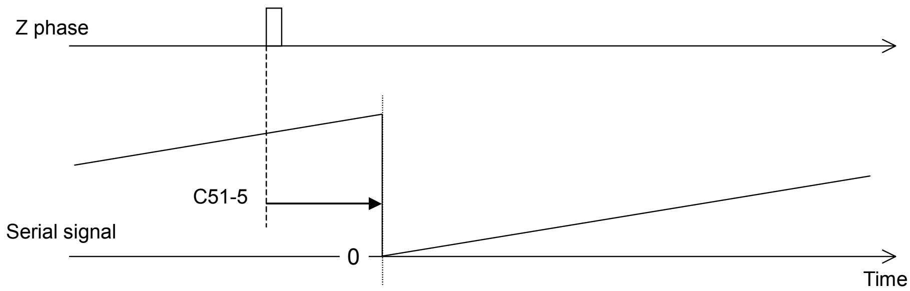


Fig. 3-4-3-j Encoder Z phase and serial absolute signal (during CCW rotation)

3) For sine wave signal
Set the phase of the sine wave signal generated by the Z phase pulse of the encoder in use in C51-5.

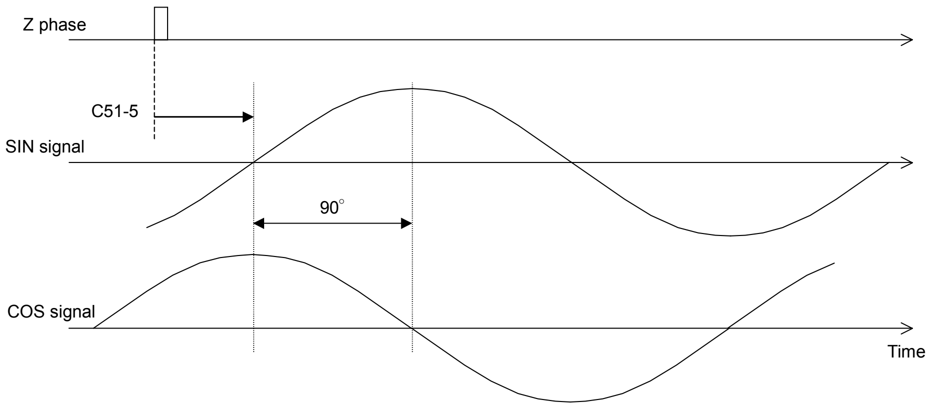


Fig. 3-4-3-k Encoder Z phase and sine wave signal (during CCW rotation)

(9) Setting the parameters for the wire-reduced type A, B, Z phase + U, V, W phase signal encoder
When using a wire-reduced type A, B, Z phase + U, V, W phase signal encoder, set the parameters shown below according to the specifications of the encoder in use.

Parameter No.	Name
C51-7	UVW measurement start wait time
C51-8	UVW measurement time
C51-9	ABZ measurement start wait time

The A, B, Z phase signal wires have a high impedance (hereafter, HI-Z) when the encoder power is turned ON. Set the UVW signal measurement start time in C51-7 based on the time that all three wires are released from the high impedance state.
Set the UVW signal measurement end time in C51-8 based on the UVW signal measurement start time (C51-7).
(If the UVW signal cannot be measured before this time elapses, the fault "SP-6" will be output.)
Set the time to wait before starting control with the ABZ signal in C51-9 based on the UVW signal measurement end time (C51-8).

(Note) The timer runs at a 2ms cycle, so all times set here must be as even umber.

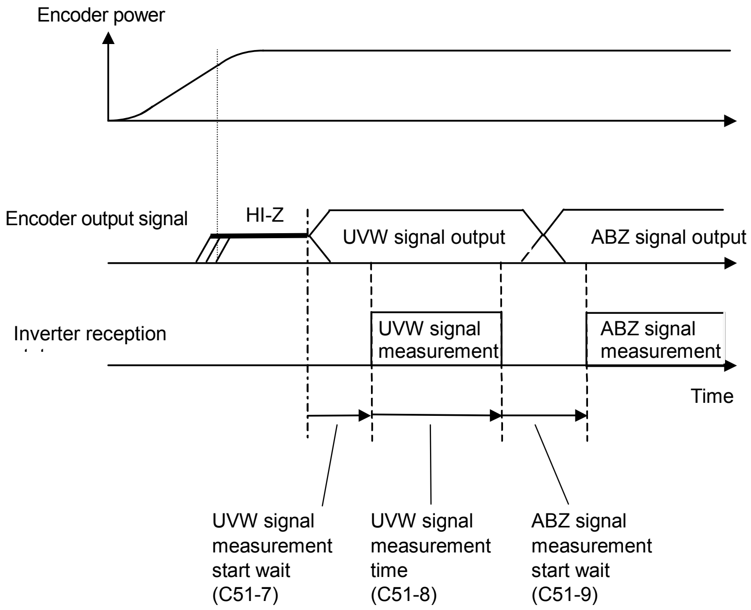


Fig. 3-4-3-I Output signals for wire-saving type encoder

7) Selecting and executing the automatic tuning mode

Select the automatic tuning mode and execute automatic tuning.

- The operation panel's operation mode must be set to "Local" to execute automatic tuning. Make sure that the "LCL" LED is ON. If not, press the LCL/SET + STOP keys, and confirm that the "LCL" LED turns ON.
- Set A05-0 to 1. (Set the expanded setting display ON.)
- Set B19-0 (automatic tuning selection) to 6.
- The automatic tuning standby state will be entered when the LCL/SET key is pressed.
- During the automatic tuning standby state and the automatic tuning execution state, the "LCL" LED will flicker.
- To exit the automatic tuning standby state, press the STOP key.

8) Starting automatic tuning

Automatic tuning will start when the FWD key or REV key is pressed according to the required rotation direction.

To stop, press the STOP key or input the emergency stop signal (EMS) from the terminal block.

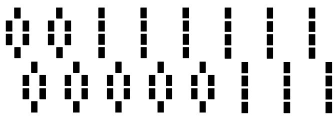
* Once automatic tuning starts, all panel operations other than the STOP, RST/MOD and ▲▼ keys (knobs with U30V24OP1) are disabled until the operation ends.

(Note) If mechanical brakes are applied on the motor, make sure that the brakes can be released during automatic tuning.

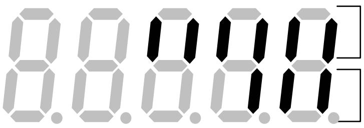
9) During automatic tuning execution

The progression state can be confirmed with D22-0.

(For U30 V24OP1)



(For U30V24OP2)



Upper level : The steps required for tuning are indicated (lit).
Lower level : The finished steps are indicated (lit). The step currently being executed is indicated with a flicker.

10) Normal completion of automatic tuning

When the automatic tuning ends normally, the "LCL" LED will change from a flicker to a stable light. The "RUN" LED will change from a flicker to a stable light.

11) Abnormal completion of automatic tuning

If automatic tuning ends abnormally, the "FLT" LED will turn ON and a message will appear. Investigate and check according to the error codes.
Refer to section 3-4-5 for details on the error codes.

(4) Test operation (PM motor control mode)

After completing steps (1) to (3) above, perform test operation with the isolated motor, and make user there are no abnormalities.
An example for when the maximum speed (B01-4) and base speed are 600min^{-1} is given below.
Use the following procedures to test the operation with the operation panel.
Refer to Chapter 4 for details on using the operation panel.

⚠ CAUTION
To prevent incorrect operation during the test operation, make sure that signals are not input into the sequence input terminal.

1) To enable operation with the operation panel, confirm that the "LCL" LED is ON. If not, press the (LCL/SET) + (STOP) keys, and confirm that the "LCL" LED turns ON.

2) Set speed setting input point selection: C02-0= 3 (panel fixed).

⚠ CAUTION
The motor will rotate with the next step. Confirm the safety around the motor before starting the next step.

3) Press the (RST/MOD) and display D00-2 on the monitor. Then press the (FWD I) key. Operation will start. The "FWD" lamp will turn ON, and the display will change from "OFF" to a value display. The value will gradually increase, and after several seconds, will change to "300.0". This is because as the factory settings, the direct setting frequency (A00-2) is set to 300min^{-1} and the acceleration ramp time 1 (A01-0) is set to 10sec.

CHECK
1. Did the motor run? 2. Is the run direction correct? Check the wiring and operation if abnormal. 3. Is the rotation smooth?

4) Press the REV key and confirm that the motor runs in reverse.

   (Note) Do not carry out this step if a load which cannot be run in reverse is connected.

5) Press the STOP key and stop the motor.

The operations for changing the speed during motor rotation are started next.

6) Press the FWD key. The motor will forward run at the output frequency 300min^{-1}.

7) Press the RST/MOD key several times. The Display will alternate between "A00-2" and "300.0" (with the U30V24OP1, the 2 section of "A00-2: 300.0min^{-1}" will flicker).

8) Press the LCL/SET key once.

   The display will stop at "300.0", and the last digit will flicker.
   This completes preparation for changing the motor speed. The digit to be changed can be moved with the ◀ key. The speed can be increased or lowered with the ▲ ▼ keys (knobs with U30V24OP1).

9) Move the digit with the ◀ key, and using the ▲ key (knobs with U30V24OP1), raise the frequency to "600.0"min^{-1}. Then, press the LCL/SET key. The motor speed will increase to 600min^{-1}.

   (Note) The operation panel motor speed change operation is set to be changed (C11-2=1) in real time at the factory shipment settings, and therefore the motor speed is changed in real time using the ▲ ▼ keys (knobs with U30V24OP1), without having to press the LCL/SET key.

   When the LCL/SET key is pressed, the current setting value will be saved.

⚠ CAUTION
A 10-second acceleration and 20-second deceleration ramp time are set as defaults. The motor will slowly increase its speed to the set value. Carry out the setting operations (▲ ▼ key, knobs with U30V24OP1) at an approx. 100min^{-1} interval.

10) When the motor speed (D00-2 display) increases to 600min^{-1}, press the STOP key.

   The D00-2 display will drop to "0.0" in several seconds. The "FWD" or "REV" LED will flicker for two seconds while the DC-brake is applied and the motor will stop.
   This is because the default setting is A03-1=2.0 and A03-2=50 (DC brake setting).

11) Press the REV key, and test the reverse run at the maximum speed.

(Note) Do not carry out this step if a load which cannot be run in reverse is connected.

This completes the test operation with the operation panel.
After this, refer to Chapter 4 and carry out the settings and adjust the load operation to match the user's application.
Refer to Section 6-9 for details on adjusting the PM motor vector control system parameters.

(Note) When the operation of the isolated motor ends, the parameter A10-1: machine time constant setting matches the motor unit's inertia. Refer to Section 6-8 and reset this parameter to match the inertia of the user's machine.

3-4-4 Magnetic pole position estimation function and test operation for PM motor with sensor control (C30-0 f0 = 4)

⚠ CAUTION

This function can be used only with a system that drives a PM motor and which the motor is locked with mechanical brakes when stopped.
Refer to Section 3-4-3 for all other cases.

(1) Before adjusting magnetic pole position estimation function

For PM motor with sensor control, the speed detection option is required in addition to the VAT300 standard unit.
When using the PM motor control mode, use with FWD, F.RUN as forward run and Rev, R.RUN as reverse run.
With the VAT300, the counterclockwise rotation (CCW) looking from the motor shaft is defined as forward run, and clockwise rotation (CW) is defined as reverse run.

Forward run (CW) **Reverse run (CW)**

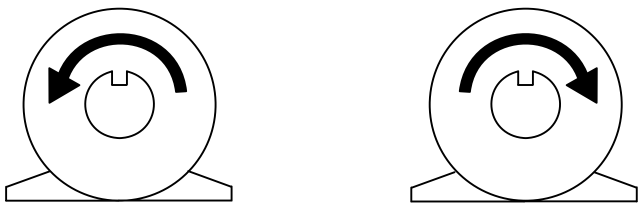


Fig. 3-4-4-a Definition of VAT300 motor rotation direction

Refer to Table 3-4-4-a, and confirm that the speed detection option compatible with the encoder in use has been prepared. Refer to Chapter 7 for details on the speed detection option.

Table 3-4-4-a

Encoder type	Speed detection option (Instruction Manual No.)
A, B, Z phase signals	U30V24DN1 (PCST-3480) U30V24DN2 (PCST-3481) U30V24DN3 (PCST-3482) U30V24DN4 (PCST-3483)

(2) Outline of magnetic pole position estimation function

The magnetic pole position estimation function is a special function for driving the PM motor with an incremental encoder has only the A, B, Z phase signals instead of the U, V, W signals or absolute value signals. This function searches for the stopped PM motor's magnetic pole position in approx. two seconds when starting operation for the first time after turning the power ON.
After the motor starts running, the estimated magnetic pole position information is used for several rotations until the encoder's correct Z phase signal is detected. Once the Z phase signal is detected, the motor runs using that Z phase signal as a reference. If a fault occurs, the magnetic pole position is estimated again when operation starts again.
It may be necessary to adjust the magnetic pole position estimation function depending on the PM motor being used. When B19-0 is set to 7, the magnetic pole position estimation adjustment mode which executes the magnetic pole position estimation operation only once is enabled. Adjust the magnetic pole position estimation with this mode before starting the motor operation.

(Note) The parameters are not automatically adjusted just by setting B19-0 to 7 and pressing the FWD I and REV I keys. This mode executes magnetic pole position estimation operation just once for adjustment purposes.

⚠ CAUTION

Precautions for executing magnetic pole position estimation adjustment mode (PM motor control)

- Do not carry out maintenance, such as wiring or mounting the option PCB while the PM motor is running. Even if the inverter power is not turned ON, the PM motor could rotate by the connected load or machine and cause a high voltage to be generated in the motor terminals. If the PM motor is connected to the inverter, the inverter could be powered when the PM motor rotates.
  Confirm that the PM motor is fixed with brakes before starting wiring work, etc.
- Before mounting the PCB for the speed detection option onto the control PCB, always turn the inverter power OFF and wait at least 10 minutes. Confirm that all displays on the operation panel are OFF and that the "CHARGE" LED in the unit is OFF before starting the mounting work.
  Note that the main circuit terminals are charged to a high voltage.
- Always ground the motor and inverter.
- Always confirm the safety around the motor before starting the magnetic pole position estimation adjustment.
- The magnetic pole position estimation adjustment mode can be executed only in the local operation mode.
  Confirm that the "LCL" LED on the operation panel is ON.
- If magnetic pole position estimation operation does not end properly, always turn the inverter power OFF before investigating and confirming the state.
- The contact output FLT will activate if magnetic pole position estimation ends abnormally.
  In equipment that uses this contact, keep the operation of the related devices in mind.
- After setting the parameters or after adjusting the magnetic pole position estimation, do not move the position at which the encoder is fixed onto the motor, or interchange the motor's U, V, W phase wires.

(3) Adjusting magnetic pole position estimation function

Carry out automatic tuning with the following procedures.
Refer to Chapter 4 for details on using the operation panel.

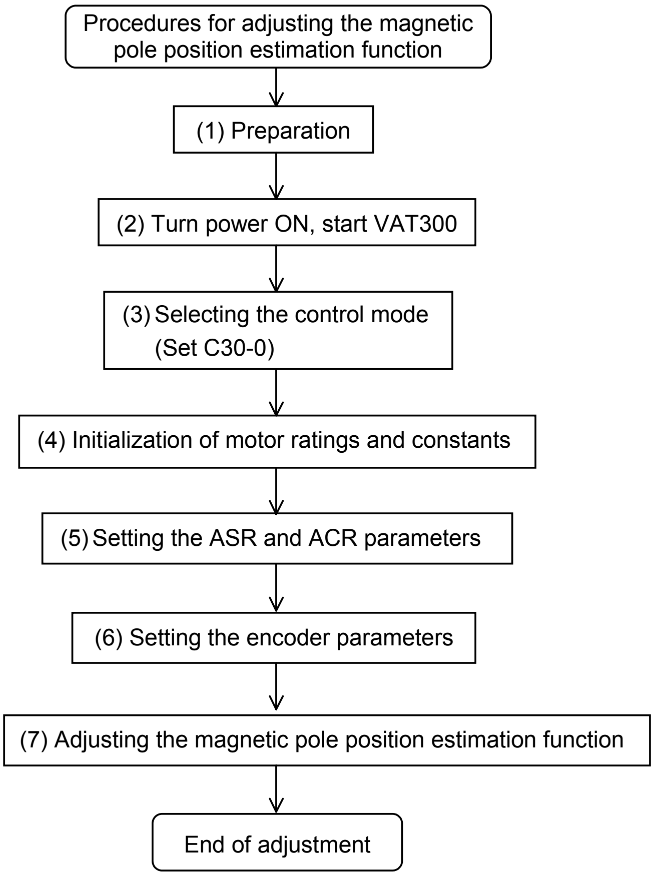
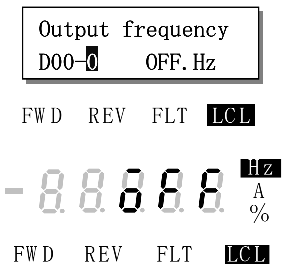


Fig. 3-4-4-b Procedures for adjusting magnetic pole position estimation function for PM motor control

1) Preparation (Before turning the power ON)

Confirm that the motor is locked with mechanical brakes.
Confirm at the speed detection option PCB is correctly mounted on the control PCB, and that the encoder signal wire is correctly connected to the speed detection option. Refer to the instruction manual of the speed detection option being used for details on connecting the encoder signal wire.

2) Turning the power ON and starting VAT300



Turn the power ON.
(In the case of U30V24OP1)
After carrying out an initial check of the operation panel for approx. 5 seconds, the display changes as shown on the right. The "LCL" LED also turns ON.
(In the case of U30V24OP2)
All LEDs on the numeric display will turn ON for a short time, and then "-----", "d00-0" and " oFF " will appear.
The "LCL" and "Hz" LEDs will also turn ON.

(Note) When the power is turned ON next (after setting C30-0 $\boxed{f0}$ = 4), "D00-2" will appear on the display, and the "Hz" LED will not light. This is because the mode is set to the PM motor vector control mode.

3) Selecting the control mode

- Set A05-2 to 1. (Set the hardware option function display ON.)
- Set the control mode selection: C30-0 $\boxed{f1}$ $\boxed{f0}$.
  This parameter must be set first.
  PM motor with sensor control mode is to be used, so set C30-0 $\boxed{f0}$ = 4.
  Set c30-0 $\boxed{f1}$ $\boxed{f0}$ as shown below according to the load.

  Normal overload setting : C30-0 $\boxed{f1}$ $\boxed{f0}$ = 1 4
  Heavy overload setting : C30-0 $\boxed{f1}$ $\boxed{f0}$ = 2 4

  (Note 1) The default value is set to V/f control and normal overload setting (C30-0=11), so always change C30-0.

  (Note 2) If the fault "SP-5" occurs when the C30-0 setting is changed, the following causes can be considered.
  - The speed detection option is not mounted correctly.
  - The encoder signal wire is not connected correctly, or is broken

  Turn the inverter power OFF and check the state.

4) Initialization of motor rating and motor constants

Input the parameters required for PM motor control. Set the parameters shown in Table 3-4-4-b.

Table 3-4-4-b

Parameter No.	Name	
B01-0	Rated input voltage setting	[No.]
B01-1	Motor rated output	[kW]
B01-2	No. of motor poles	[Pole]
B01-3	Rated output voltage	[V]
B01-4	Max. speed	[min^{-1}]
B01-5	Base speed	[min^{-1}]
B01-6	Motor rated current	[A]
B01-7	Carrier frequency	
B01-8	No. of encoder pulses	[P/R]
B03-0	R1: PM motor primary resistance (Mantissa section)	[mΩ]
B03-1	R1: PM motor primary resistance (Exponent section)	
B03-2	Ld: PM motor d axis inductance (Mantissa section)	[mH]
B03-3	Lq: PM motor q axis inductance (Mantissa section)	[mH]
B03-4	Ld, Lq: PM motor inductance (Exponent section)	

* The max. speed cannot be set below the base speed, and the base speed cannot be set above the max. speed.

5) Setting the ASR and ACR parameters

Do not change the ASR (speed control) and ACR (current control) parameters shown in Table 3-4-4-c from the default values before adjusting the magnetic pole position.
Note that A10-1 must be set to the value obtained with the following expression.

Table 3-4-4-c

Parameter No.	Name	Standard value
A10-0	ASR response	10.0 [rad/s]
A10-1	Machine time constant	1000 [s]
A10-2	Integral time constant compensation coefficient	100 [%]
A10-3	ASR drive torque limiter	100 [%]
A10-4	ASR regenerative torque limiter	100 [%]
A20-0	ACR response	1500 [rad/s]
A20-1	ACR time constant	10.0 [ms]

Refer to the following expression, and set the A10-1: machine time constant setting to match the inertia of the entire load connected with the PM motor. The machine time constant (Tm) refers to the time required to accelerate to the base rotation speed from the zero speed at the rated torque.

$$Tm\ [ms] = 10.97 \times J\ [kg \cdot m^2] \times (Nbase\ [min^{-1}])^2 / Power\ [W]$$

J : Total inertia $[kg \cdot m^2]$ (= 1/4 × GD^2 $[kgf \cdot m^2]$)
Nbase : Base rotation speed $[min^{-1}]$
Power : Motor rated output [W]

6) Setting the encoder parameters

The encoder parameters shown in Table 3-4-4-d must be set.

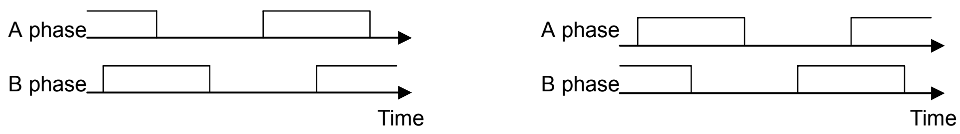
Table 3-4-4-d

Parameter No.	Name
C50-2	Encoder AB advance direction selection
C50-3	Encoder ABZ pulse type selection
C51-0	Encoder selection
C51-1	AB phase-Z phase type selection
C51-2	Encoder Z signal reversal
C51-4	Z-IN → U phase winding phase angle

The method for setting each parameter is shown below. Set these in order.

[1] C51-0: Encoder selection
Use the default value when using the magnetic pole position estimation function.

[2] C50-2: Encoder AB advance direction selection
With the VAT300, the rotation in the counterclockwise direction (CCW) looking from the motor shaft is defined as forward run, and in the clockwise direction (CW) is defined as reverse run. Determine this parameter's setting value according to the phase relation of the encoder AB phase signals during forward run.



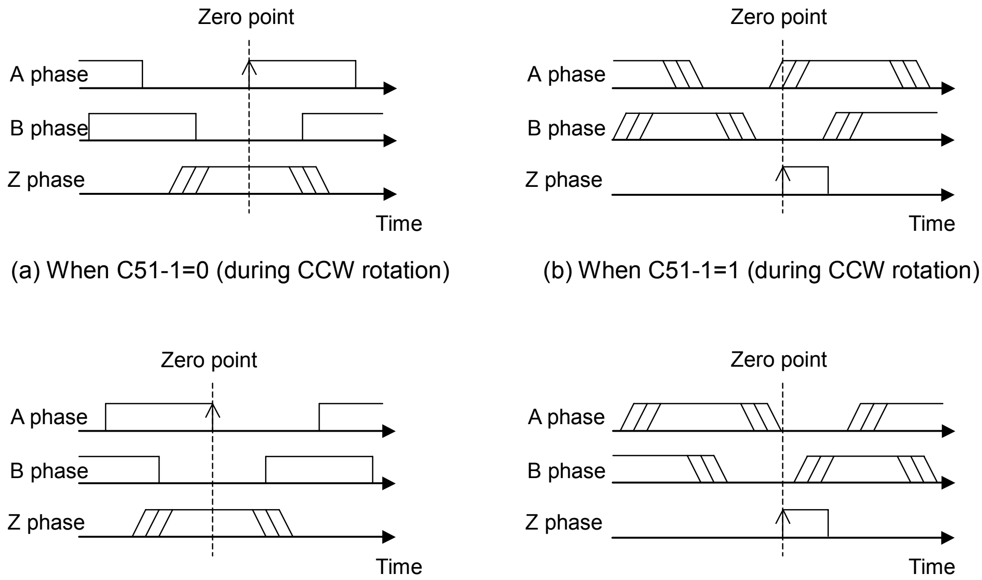
(a) When C50-2=1 (b) When C50-2=2

Fig. 3-4-2-c Encoder AB advance direction selection

(Note) If C50-2 is set to 2, set C50-3 to 0.

[3] C51-1 : AB phase-Z phase type selection

[4] C51-2 : Encoder Z signal reversal
With the VAT300, the four patterns shown in Fig.-3-4-3-c are estimated for the A, B and Z phase pulse encoder signals.
C51-1 is set based on the phase relation of the A phase signal's rising edge and the Z phase signal. With this setting and at a time of reverse running, the A phase signal's down edge during the Z phase being high is the zero point.
To generate the A phase signal rising edge when the Z phase signal is High (Fig. (a)), set C51-1 to 0. In this case, the A phase signal rising edge will be the zero point (magnetic pole position). In all other cases, set C51-1 to 1. In this case, the Z phase signal's rising edge will be the zero point. (Fig. (b)). In this case, the Z phase rising edge is the zero point even at a time of the reverse running.
If the Z phase signal needs to be reversed to match the following signal definition, set C51-2 to 1.



(a) When C51-1=0 (during CCW rotation) (b) When C51-1=1 (during CCW rotation)

(c) When C51-1=0 (during CW rotation) (d) When C51-1=1 (during CW rotation)

Fig. 3-4-4-d A, B and Z phase pulse encoder signals

(Note) If C51-2 is set to 1, set C50-3 to 0.

[5] C50-3 : Encoder ABZ pulse type selection
Only when using an encoder with signal specifications that cannot be handled with the C50-2 and C51-2 settings, set C50-3 to reverse or interchange the signals.
The signal conversion circuit will function with the combination shown in the table below according to the C50-3 setting value.

(Note) Set C50-3 to 0 (no signal reversal/interchange) when C5-2 and C51-2 have been set.

C50-3 setting value	A-IN forward/ reverse run	B-IN forward/ reverse run	Z-IN forward/ reverse run	AB inter-change
0	–	–	–	No inter-change
1	Reverse	–	–	
2	–	Reverse	–	
3	Reverse	Reverse	–	
4	–	–	Reverse	
5	Reverse	–	Reverse	
6	–	Reverse	Reverse	
7	Reverse	Reverse	Reverse	
8	–	–	–	AB inter-change
9	Reverse	–	–	
10	–	Reverse	–	
11	Reverse	Reverse	–	
12	–	–	Reverse	
13	Reverse	–	Reverse	
14	–	Reverse	Reverse	
15	Reverse	Reverse	Reverse	

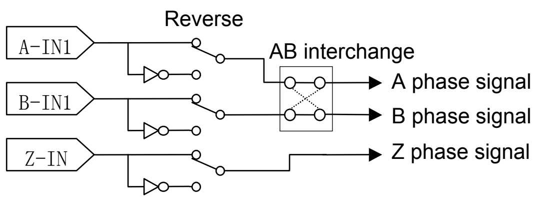


Fig. 3-4-4-e Signal conversion circuit

[6] C51-4: Z-IN → U phase winding phase angle
This can be automatically adjusted with automatic tuning when the motor can be run in an isolated state without a load connection. Release the external brakes, and refer to Section 3-5-3 and carry out step 7 and following of the Fig. 3-4-3-c flow chart.
In other cases, this parameter is adjusted after the magnetic pole position estimation function has been adjusted. Proceed to adjustment of the magnetic pole position estimation.

7) Adjusting the magnetic pole position estimation function
The magnetic pole position estimation function is adjusted.

[1] Select the magnetic pole position estimation mode with the magnetic pole position estimation selection (B39-0 $\boxed{f0}$).
When the magnetic pole position estimation function is used, normally $\boxed{f0}$ = 2 should be selected.
If the motor has a reverse inductance (Ld<Lq), select $\boxed{f0}$ = 3.
(Refer to Section 6-9 for an explanation on the PM motor circuit constant.)
Select $\boxed{f0}$ = 3, when not using a magnetic pole position estimation function, or when you stop use.

[2] When B19-0 is set to 7 and the LCL/SET key is pressed, the magnetic pole position estimation mode which executes the magnetic pole position estimation operation once will start.
To carry out the same operation again, repeat the above step.
When the magnetic pole position estimation function starts normally, the operation will end in approx. two seconds.

(Note) The parameters are not automatically adjusted just by setting B19-0 to 7 and pressing the FWD I and REV I keys. This mode executes magnetic pole position estimation operation just once for adjustment purposes.

[3] Adjust the magnetic pole position estimation function
The parameters required for adjusting the magnetic pole position estimation function are shown in Table 3-4-4-e. The parameters which indicate the magnetic pole position estimation results are shown in Table 3-4-4-f.

Table 3-4-4-e

Parameter No.	Name
B39-1	Magnetic pole position estimation voltage
B39-2	Magnetic pole position estimation time
B39-3	Voltage error correction current
A20-0	ACR response (PM motor control)
A20-1	ACR time constant (PM motor control)

Table 3-4-4-f

Parameter No.	Name	Adjustment reference
D16-0	Characteristic amount during magnetic pole position estimation 1	Adjust to 120% or more.
D16-1	Characteristic amount during magnetic pole position estimation 2	Adjust to 120% or more.
D16-2	Magnetic pole position estimation current	Make sure the current does not exceed 120%. If too high, the inverter could stop with an overcurrent (OCT) fault.
D16-3	Magnetic pole position estimation error	Adjust to within 10°.

If B39-1, 2 (magnetic pole position estimation voltage) is increased, D16-0, 1 will increase. Adjust to match the adjustment reference conditions given in Table 3-4-4-f.
When D16-0, 1 is at the adjustment reference value, normally, the D16-3 value will be within the adjustment reference range.
If B39-1, 2 is too large, the noise during estimation will increase. If the generated noise is too large, decrease D39-1, 2 within the range that the adjustment reference given in Table 3-4-4-f is satisfied.
To decrease B39-1, 2, first decrease B39-1. If the noise is still large even after B39-1 is decreased by 20%, then decrease B39-2.

If D16-0 to 3 do not stabilize even after carrying out the magnetic pole position estimation operation repeatedly, it might stabilize by increasing B39-3 by approx. 20%. However, normally B39-3 can be set to the default value without problem.

If the magnetic pole position estimation function operation takes more than two seconds, ACR must be adjusted. Increase A20-0 (ACR response) or decrease A20-1 (ACR time constant) so that the magnetic pole position estimation operation ends in approx. two seconds.

If the magnetic pole position estimation results are not stable for any reason, the magnetic pole position estimation function cannot be used. Use an encoder with a magnetic pole position detection signal, such as a UVW signal or serial absolute signal. Refer to Section 3-5-3, set the encoder, and carry out test operation.

[4] When finished adjusting the magnetic pole position estimation function, return the setting to B19-0=0.

(Note 1) When the magnetic pole position estimation adjustment mode is carried out with B19-0 set to 7, the SFP (magnetic pole position established) flag is set so the magnetic pole position will not be estimated the next item operation is set.
B19-0 must be returned to 0.

(Note 2) After setting these parameters, do not move the encoder fixed onto the motor, or interchange the motor's U, V, W phase wires.

(4) Setting the parameters for the external brake function, etc.

1) Setting the external brake control function

The external brakes can be turned ON and OFF following the inverter's internal sequence. The external brake function has various wait time settings and interlock functions.
This function is set. The parameters which need to be set are shown in Table 3-4-4-g.

Table 3-4-4-g

Parameter No.	Name
B46-0	External brake selection
B46-1	Brake open wait time (LB)
B46-2	Acceleration start wait time (BL)
B46-3	Brake close wait time (DB)
B46-4	RUN error judgment time at brake closed
B46-5	Brake answer error judgment time

[1] B46-0: External brake selection
Set B46-0 $\boxed{f0}$ to 2 to use the external brake control function.
When B46-0 $\boxed{f1}$ is set to 2, the interlock function using IDET is enabled. If IDET does not turn ON when the brakes are released (immediately after LB), the motor will stop with a fault "IO-C".
Set the control mode for the acceleration wait time (LB, BL) with B46-0 $\boxed{f2}$.
When $\boxed{f2}$ is set to 1, the normal operation mode is enabled.
When $\boxed{f2}$ is set to 2, the DC brake mode is enabled.

[2] B46-1: Brake open wait time (LB)
Set the time to wait (LB) from RUN to brake open.

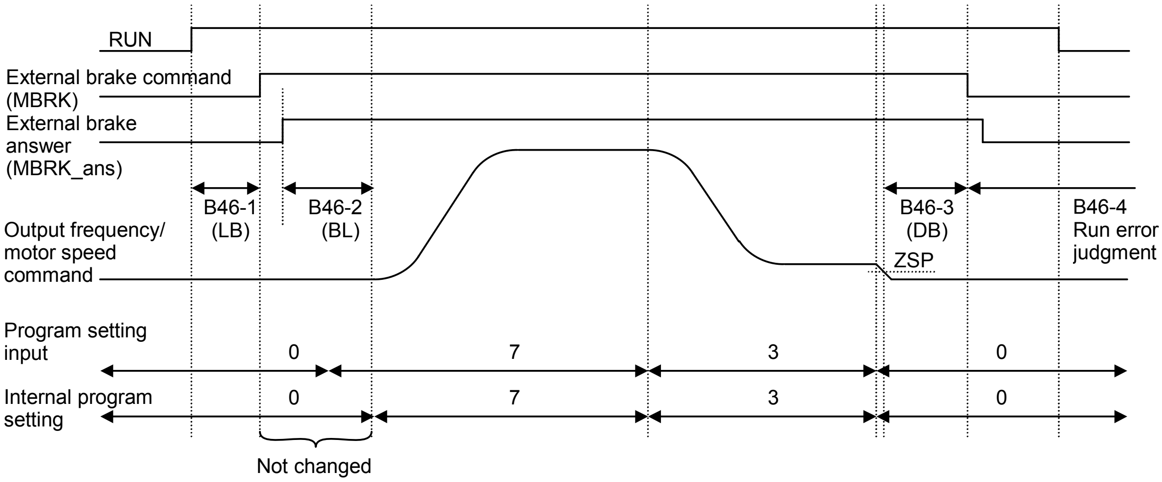
[3] B46-2: Acceleration start wait time (BL)
Set the wait time (LB) from brake open to start of acceleration.
If brake answer is enabled (B46-5≠0.0sec) set the time after brake answer. If brake answer is disabled (B46-5=0), set the time from the brake open command.
When using normal operation mode setting, the program settings will not be changed during BL, and instead the settings prior to BL will be held.

[4] B46-3: Brake close wait time (DB)
Set the wait time (DB) from time from ZSP (zero speed) ON to brake close.

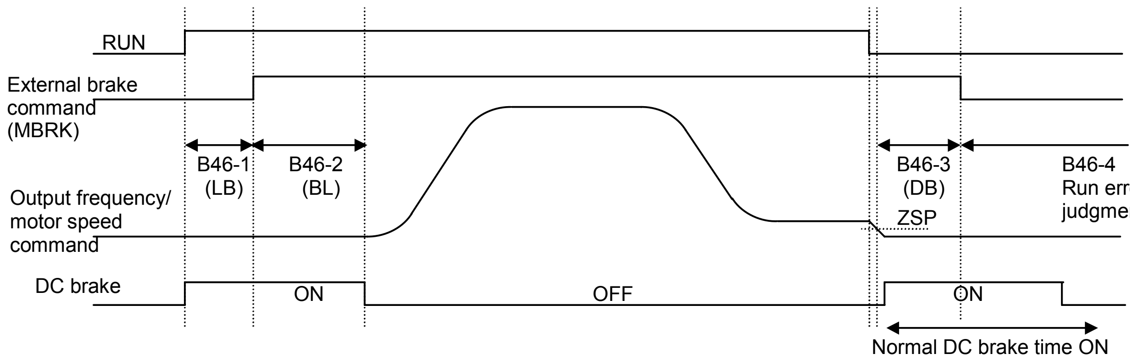
[5] B46-4: RUN error judgment time at brake closed
If RUN does not turn OFF at the time set in D46-4 after the brakes are closed, the host controller will judge that there is an error, and will stop the motor with the external brake RUN error (IO-D) fault. RUN error judgment can be turned OFF by setting 0.0sec.

[6] B46-5: Brake answer error judgment time
If brake command (MBRK) and brake answer (MBRK_ans) do not match for longer than the time set in B46-5, it will be judged as an external brake fault, and the motor will stop with the external brake answer error (IO-E) fault. Brake answer error judgment can be turned OFF by setting 0.0sec.

An example of the external brake sequence is shown below.



(a) Example of external brake sequence when using program settings (B46-0 f2=1) and with brake answer (B46-5≠0.0)



(b) Example of external brake sequence when using DC brake (B46-0 f2=2) and no brake answer (B46-5=0.0.)

Fig. 3-4-4-f Example of external brake sequence

External brake control (B46) is sequenced with magnetic pole position estimation function. The external brake control starts after the magnetic pole position estimation is completed. Thus, the magnetic pole position estimation time does not need to be considered for the external brake function.

2) Setting the external brake control sequence

[1] The J1 setting must be turned ON to use external brake control or the other sequence functions. Set C00-5 to 2.

[2] Set the external brake signal (MBRK) sequence output function. Refer to the following table, and set "27" for the parameter corresponding to the output terminal being used. Set "-27" to reverse the signal.

Control PCB output terminal	Corresponding parameter
RC-RA	C13-2
PS01	C13-3
PS02	C13-4
PS03	C13-5
FA-FC	C13-6

[3] Set the external rake answer signal (MBRK_ans) sequence input function. Refer to the following table and set the value corresponding to the input terminal (control PCB PSI1 to 11) in C04-E. Set a negative value to reverse the signal.

Control PCB input terminal	C04-E setting value (Note 2)
PSI1	1
PSI2	2
PSI3	3
PSI4	4
PSI5	5
PSI6	6
PSI7	7
PSI8 **(Note 1)**	8
PSI9 **(Note 1)**	9
PSI10 **(Note 1)**	10
PSI11 **(Note 1)**	11

(Note 1) PSI8 to 11 are the relay option PCB's sequence input terminals. Prepare the relay option to use these.
(Note 2) Do not set C04-E to "0" or "16". The MBRK_ans signal input will be fixed to OFF or fixed to ON.

3) Setting the ACR reverse run prevention function
If the motor must not rotate in the reverse direction of the run command, set the reverse run detection error level in C24-7. If the motor rotates in the reverse direction, it will stop with a fault. Set this parameter as a percentage of the error detection level speed using the base speed as 100%. This function is invalid when "0" is set.

(5) Setting the C51-4: Z-IN → U phase winding phase angle parameter

In the PM motor control mode, the C51-4: Encoder Z-IN → U phase winding phase angle parameter must be set. Set this parameter.
If the settings up to this point have not been completed, refer to the previous section and complete the settings.

(Note) This can be automatically adjusted with automatic tuning when the motor can be run in an isolated state. Release the external brakes, and refer to Section 3-4-3 and carry out step 7 and following of the Fig. 3-4-3 flow chart. This step can be skipped if the parameter is set with automatic tuning.

This parameter must be set only once at the very start of operation.
After setting this parameter, do not move the encoder fixed onto the motor, or interchange the motor's U, V, W phase wires.

1) The motor must be rotated to set this parameter.
First, set the speed and ramp time parameters required for rotating the motor. Refer to Table 3-4-4-h and set each parameter.

Table 3-4-4-h

Parameter No.	Name	Setting method
A00-2	Direct setting speed	Set the motor speed with a [min^{-1}] unit.
A01-0	Acceleration ramp time	Set the acceleration time from stop to maximum speed, and the deceleration time from maximum speed to stop.
A01-1	Deceleration ramp time	

⚠ CAUTION
The motor will rotate with the next step. Confirm the safety around the motor before starting the next step.

2) When issuing the run/stop commands from the operation panel (local operation mode), confirm that "LCL" is ON. When using sequence input (remote operation mode), confirm that "LCL" on the operation panel is OFF. Press the (LCL/SET) + (STOP) keys to change the operation mode.

3) Set B39-0 $\boxed{f1}$ to 2. With this setting, the encoder's Z phase is not used, and the motor is run with the estimated magnetic pole phase. Start and stop in this mode.
4) Set the speed with the operation panel.
   Set the speed setting input point selection C02-0 to 3 (panel fixed).
   Set the motor speed in A00-2.
5) Open the external brakes to rotate the motor.
6) Input the forward run command.
   To issue the command from the operation panel, press the (FWD I) key.
7) Input the stop command, and stop the motor.
   To issue the command from the operation panel, press the (STOP) key.
8) After stopping, set the value displayed at D26-0 in C51-4.
9) Set B39-0 $\boxed{f1}$ to 1. The mode will return to the normal operation mode.

(6) Test operation

When finished with automatic tuning, test run the isolated motor, and make sure that there are no errors.
Use the following procedures to test the operation with the operation panel.
Refer to Chapter 4 for details on using the operation panel.
When issuing the run/stop commands from the operation panel (local operation mode), confirm that "LCL" is ON. When using sequence input (remote operation mode), confirm that "LCL" on the operation panel is OFF. Press the (LCL/SET) + (STOP) keys to change the operation mode.

1) Set the speed from the operation panel.
   Set speed setting input point selection: C02-0= 3 (panel fixed).
   Set the motor speed in A00-2.

⚠ CAUTION
The motor will run. Confirm the safety around the motor before starting the next step.

2) Open the external brakes to rotate the motor.
3) Press the (RST/MOD) key to display the D00-2 on the monitor, and then input the forward run command
   To issue the command from the operation panel, press the (FWD I) key.
   The "FWD" lamp will turn ON, and the display will start increasing from " oFF ".
   Confirm the speed with D00-2, and make sure that it is equal to the A00-2 setting value.

⚠ CHECK

1. Did the motor run?
2. Is the run direction correct? Check the wiring and operation if abnormal.
3. Is the rotation smooth?

4) Input a reverse run command and confirm that the motor runs in reverse.
   To issue the command from the operation panel, press the REV key.
5) Input the stop command, and stop the motor.
   To issue the command from the operation panel, press the STOP key.

The operations for changing the speed during motor rotation are started next.

6) Input the forward run command.
   To issue the command from the operation panel, press the FWD key.
7) Press the RST/MOD key several times. Set so that "A00-2" and the current speed setting value appear alternately on the display (with the U30V24OP1, the 2 section of "A00-2: current speed setting value min^{-1}" will flicker).
8) Press the LCL/SET key once.

   The display will stop at the current setting value, and the first decimal digit will flicker.
   This completes preparation for changing the motor speed. The digit to be changed can be moved with the ◄ key. The speed can be increased or lowered with the ▲ ▼ keys (knobs with U30V24OP1).
9) Change the A00-2 setting value and press the LCL/SET key. Display D00-2 and confirm that the motor speed has changed to the set value.

   (Note) The operation panel frequency change operation is set to be changed (C11-2=1) in real time at the factory shipment settings, and therefore the output frequency is changed in real time using the ▲ ▼ keys (knobs with U30V24OP1), without having to press the LCL/SET key.
   When the LCL/SET key is pressed, the current setting value will be saved.

⚠ CAUTION

A 10-second acceleration and 20-second deceleration ramp time are set as defaults. The motor will slowly increase its speed to the set value. (When the set value is not changed)
Change the A00-2 setting value with an interval of 10% or less of the maximum speed. (Use the ▲ ▼ keys or knobs with U30V24OP1.)

10) Confirm that the motor speed (D00-2 display) is the same as the setting value, and then input the stop command. Press the STOP key when using the operation panel.
The display will decrease to "0.0" in several seconds. The "FWD" or "REV" LED will flicker for two seconds while the DC-brake is applied and the motor will stop.

This completes the test operation.

(Note) When the test operation ends, the parameter A10-1: machine time constant setting matches the motor unit's inertia. Refer to Section 6-8 and reset this parameter to match the inertia of the user's machine.

(7) Other functions of magnetic pole position estimation

1) Magnetic pole position estimation retry function

If the characteristics amount measured during magnetic pole position estimation do not reach the reference value, the magnetic pole position estimation will be retried. The retry conditions are shown in Table 3-4-4-i.
The estimation is retried up to three times. If the reference is not reached after three retries, the operation will stop with a fault (ATT-9).
If this fault occurs, adjust the magnetic pole position estimation function again.

Table 3-4-4-i

Parameter No.	Name	Adjustment reference
D16-0	Characteristic amount during magnetic pole position estimation 1	110% or less
D16-1	Characteristic amount during magnetic pole position estimation 2	110% or less
D16-3	Magnetic pole position estimation error	20° or more

2) Sequence output

The magnetic pole position setting flag can be sequence output. If C13-2 to 6 is set to 40 (FPOS), when the magnetic pole position is set the output will turn ON from the control PCB terminal corresponding to each parameter. If C13-2 to 6 is set to -40, a signal with the sequence logic reversed will be output.
Whether to output the sequence output RUN signal during the magnetic pole position estimation period can be selected with parameter B39-0 $\boxed{f3}$. (ON when 1 is set, OFF when 2 is set.)

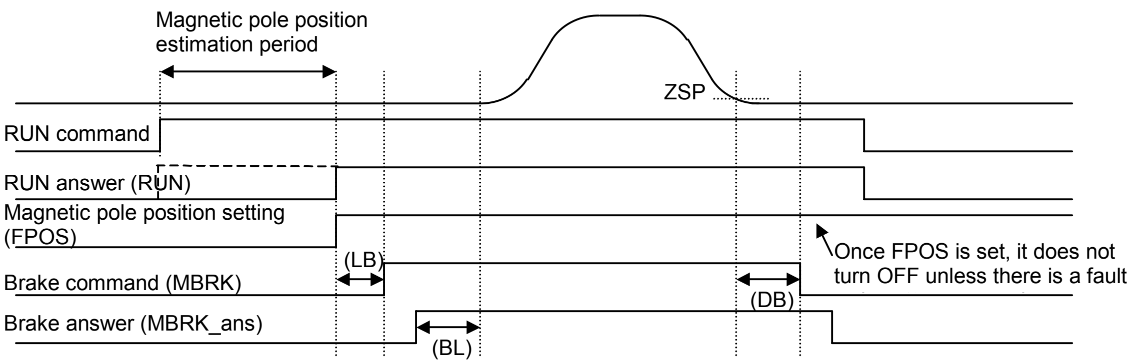


Fig. 3-4-4-g Sequence outputs related to magnetic pole position estimation

(8) Other settings and adjustments

This completes the adjustment of the magnetic pole position estimation function, setting of the external brake control function, and test operation.
Refer to Chapter 4 and set or adjust the sequence, etc., to match the user's application.
Refer to Section 6-9 for details on adjusting the PM motor vector control system parameters.

3-4-5 Automatic tuning error messages

If automatic tuning ends abnormally, the following message will appear. Investigate and confirm the state following the error code.

E00:ATT-n (for U30V24OP1), Att-n (for U30V24OP2) n: Automatic tuning step

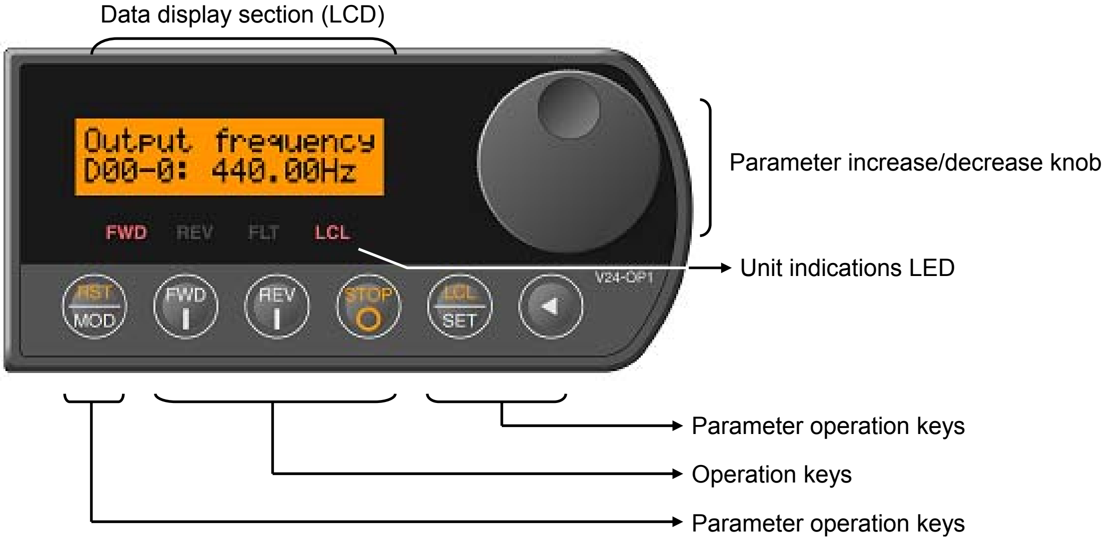
No.	Cause and remedy
n=1	The motor may not be connected correctly. Check the connection. The B00 and B01 parameters may not be set correctly. Check the parameter setting. The motor with the special circuit constants may be applied. Change B19-1and B19-2 parameters.
n=2	The B00 and B01 parameters may not be set correctly. Check the parameter setting.
n=3	The load and machine may not be separated. Separate the load and machine. Lengthen the acceleration time (A01-0). Lengthen the deceleration time (A01-1). If the motor vibrates, adjust the torque stabilizing gain (B18-2).
n=4	The load and machine may not be separated. Separate the load and machine. If the motor vibrates, increase the torque stabilizing gain (B18-2).
n=5	When the motor does not stop Increase the acceleration/deceleration time (A01-0, A01-1). When the motor does stop The B00 and B01 parameters may not be set correctly. Check the parameter setting.
n=6	The B00 and B01 parameters may not be set correctly. Check the parameter setting.
n=8	Indicates that the output voltage did not stabilize for 1 second or more during magnetic pole position estimation for the PM motor. Adjust the magnetic pole position estimation voltage (B39-1) and magnetic pole estimation time (B39-2).
n=9	Indicates that the PM motor magnetic pole estimation did not end normally even after retrying three times. Adjust the magnetic pole position estimation voltage (B39-1) and magnetic pole estimation time (B39-2).

Chapter 4 Operation Panel

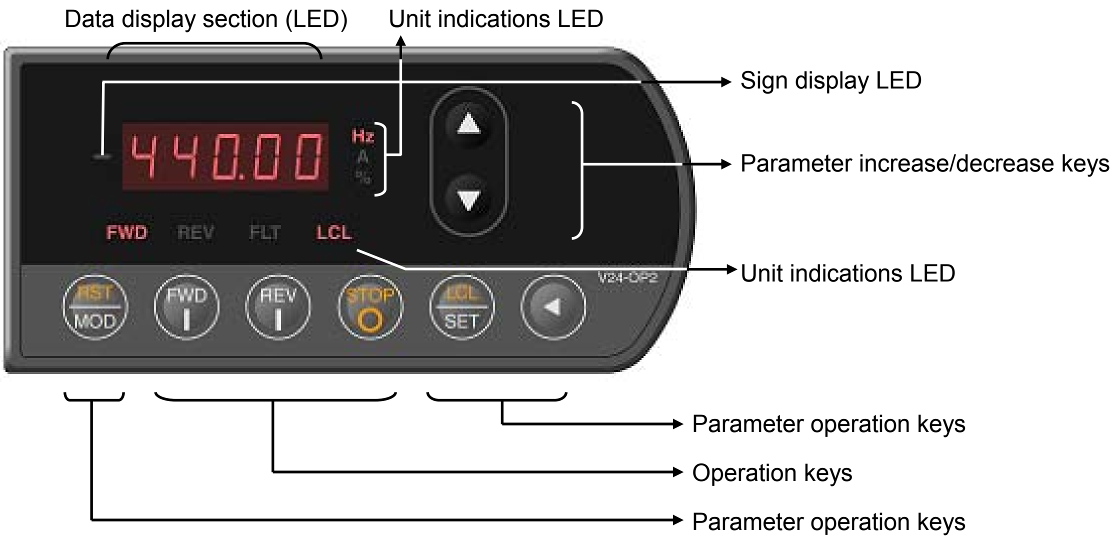
4-1 Outline of operation panel types and functions

There are two types of operation panels which can be used with the VAT300, the LCD panel U30V24OP1 and LED panel U30V24OP2. The configuration of the operation panels are indicated below.

LCD panel (U30V24OP1)



LED panel (U30V24OP2)



The functions of each section are shown in Table 4-1.

CAUTION

- A protective sheet is attached to the surface of the panel when shipped. Peel of this sheet before starting use.
- When peeling the protective sheet, press the knob lightly so that it should not be dropped.
- Do not drop the panel. The panel could break if strong impact is applied.
- If the display does not appear even when the inverter power is turned ON, the cable between the panel and inverter might not be connected properly. Check the connection.
- When using the operation panel away from the inverter by using an extension cable, do not place objects on the panel. The connector section could be damaged.

Table 4-1 (1) Functions and operations of each operation panel section

Status indications LEDs			
FWD (Forward)	The drive is running in the forward direction.	When both LEDs flicker simultaneously, it indicates that DC Brake or pre-excitation is in action. If only the "FWD" or "REV" LED is flickering, this indicates that a command in the reverse direction has been received, and the drive is decelerating. Refer to section 4-1-3 for the relation with the operation keys.	
REV (Reverse)	The drive is running in the reverse direction.		
FLT (Fault)	The drive has detected a fault and has stopped. Turns OFF when the STOP O + RST/MOD keys are pressed or the sequence input RESET signal is input.		
LCL (Local)	The drive is in the Local Mode and can be operated from the Operation Panel (FWD, REV and STOP only). When LED is off, the drive is in the Remote Mode and can be controlled from the terminal block (sequence input signals). To change Modes between Local and Remote, press STOP O + LCL/SET . Change this setting while operation is stopped.		
Unit indication LEDs (LED panel dedicated)			
Hz･A･%	Indicates the unit of the parameter value shown on the display.		
Minus polarity indication LED (LED panel dedicated)			
——	Lights when the number on the display is a minus number.		
Operation keys			
FWD I	Starts the drive in the forward direction. (in Local Mode only)		
REV I	Starts the drive in the reverse direction. (in Local Mode only)		
STOP O	Stops the drive. The motor will either coast to a stop or ramp down to a stop as selected on C00-1.		
STOP O Held down for 2 sec.	When this key is held down for two seconds or longer during operation, the motor will coast to stop regardless of Local Mode or Remote Mode.		
STOP O + LCL/SET	Changes control Modes from Local to Remote, or vice-versa. When the drive is in Local Mode, "LCL" LED is on. The drive is default set so that a Local/Remote selection is disabled while the drive is running. Even while the drive is at a stop, this selection cannot be made if operating commands such as RUN, JOG, etc., are being received at the terminal. This lock can be released with Parameter C09-2.		
STOP O + RST/MOD	If these keys are pressed simultaneously when the FLT LED is ON, the FLT LED will turn OFF. (Fault is reset.)		
Parameter operation keys ･ Parameter operation knob			
RST/MOD	Changes the block No. mode displayed on the indicator in the following order each time the key is pressed: Monitor → Parameter A → Parameter B → Parameter C → Utility Mode U.		
LCL/SET	Fixes Parameter number or set its values.		
◄	Param. Select	When main & sub-No. selection method (C11-7=2) is selected for parameter setting method, moves from sub-No. selection to main No. selection.	
	Valve change	Moves the digit to increment or decrement.	

Table 4-1 (2) Functions and operations of each operation panel section

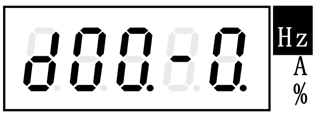
Parameter increase/decrease key, parameter increase/decrease knob	
▲ or ↻	Increases the parameter No. or parameter setting value.
▼ or ↺	Decreases the parameter No. or parameter setting value.
◀ + ▲ or ↻	When the parameter is being set with the sub-No. selection method (C11-7=1), increases the parameter's main No.
◀ + ▼ or ↺	When the parameter is being set with the sub-No. selection method (C11-7=1), decreases the parameter's main No.
Operations dedicated for LED panel	
▲ Held down	Increases the parameter No. or setting value at a fast speed.
▼ Held down	Decreases the parameter No. or setting value at a fast speed.

4-1-1 Data display section on each panel

Each value display is explained in this section.
The LCD panel displays the characters, parameters and setting values with a 5*8 dot, 16-digit * 2-line LCD.
The LCD panel's LCD section is expressed with the following box in this manual.

```
Output frequency
D00-0:    OFF.Hz
```

The LED panel displays the parameters and setting values with a 7-segment 5-LED + sign display LED.
The LED panel's 7-segment section is expressed with the following display in this manual.



4-1-2 Relation of RUN operation keys and status display LED

The status display LED turns ON, OFF or flickers according to the FWD and REV operation status.
Each operation is shown in the following figure.
Refer to the right drawing for the status of FWD and REV in the figure.

Status	Display
OFF	FWD REV
ON	FWD REV
Flicker	FWD REV

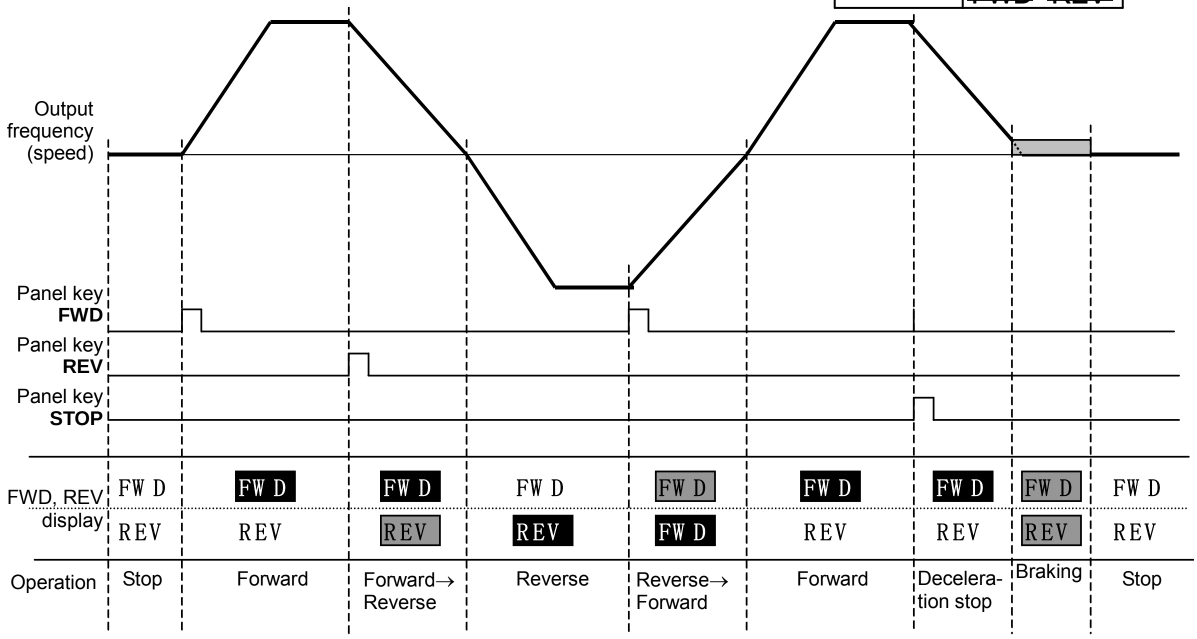


Fig 4-1-2 Relation of panel key, RUN operation and FWD, REV

4-1-3 Selecting the operation method

Two operation methods can be selected with the operation panel by setting the parameters.
The parameters to be set and the operation methods are explained below.

C11-7: Operation panel operation method selection

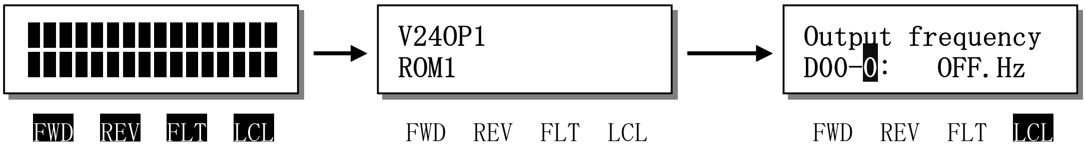
=1: Sub-No. selection method
Increase or decrease the parameter's sub-No. with the ▲▼ keys or .
If the sub-No. exceeds the maximum value or minimum value, the main No. will increase or decrease by 1.
This method is easy to use when holding the panel in hand and operating.
* This method is the default method.

=2: Main & sub-no. selection method
The parameter is set by setting both the main No. and sub-No.
After entering the main No., press the LCL SET key to enter the sub-No. selection.
If the sub-No. exceeds the maximum value or minimum value, the number will loop within the sub-No.

4-1-4 Panel display at power ON

(1) LCD operation panel (U30V24OP1)

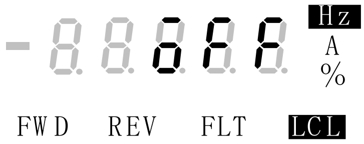
The following display appears when the power is turned ON.



Operation panel operation check | Operation panel ROM version display | Normal display

(2) LED operation panel (U30V24OP2)

When the power is turned ON, all LEDs on numeric display will light momentarily, and then "-----", "d00-0" will appear. Finally, " oFF " will appear.



With either operation panel, the initial operation mode (C11-0) at power ON and the initially displayed parameters can be set (C11-3). In the above example, C11-0 is set to 1, and C11-3 is set to 0.00.0.

⚠ CAUTION

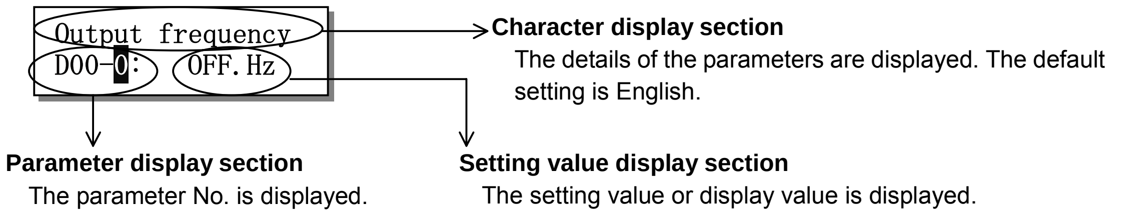
- If the normal end or initial fault occurrence screen does not appear even after 10 seconds, check the following points.
  1) Are the panel and inverter connected correctly?
     Remove the panel once, and securely connect it.
  2) Is the cable connecting the PCB in the inverter and the panel disconnected?
     Check and securely insert the connector.
- If the problem cannot be resolved with method 1) or 2), there may be an error in the inverter's internal circuit. Turn the power OFF immediately.

4-2 Various operations and displays when LCD panel is connected

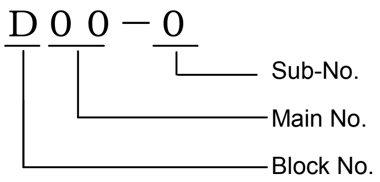
The various LCD panel operations and displays are displayed.
First, the various operation methods and displayed for the sub-No. selection method (C11-7=1) are explained.

4-2-1 Details of data display section

The outline of the Main screen is shown below.

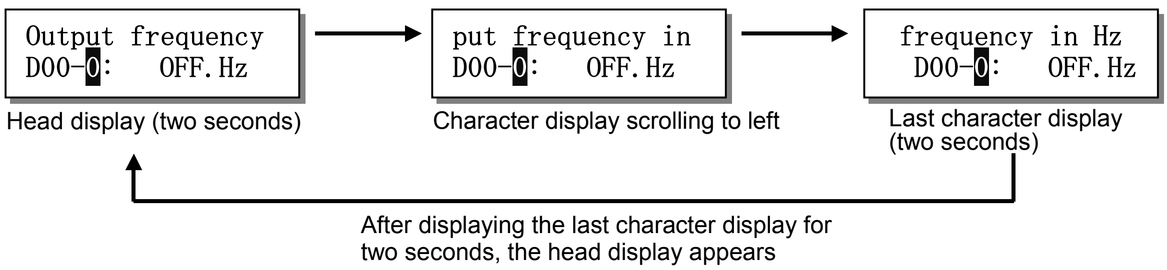


The parameter numbers are categorized in the following manner in this manual.



4-2-2 Operating and displaying the character display section

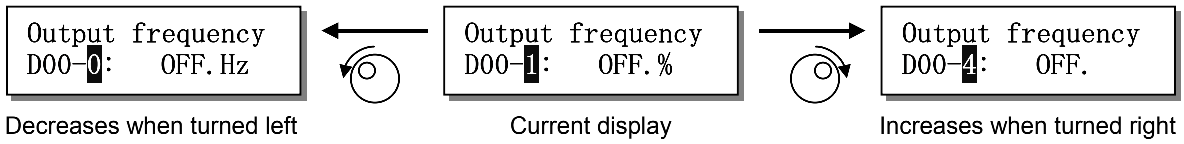
The character display section starts left scrolling after two seconds.
When the last character is displayed, the display remains for two seconds, and then the first display appears.



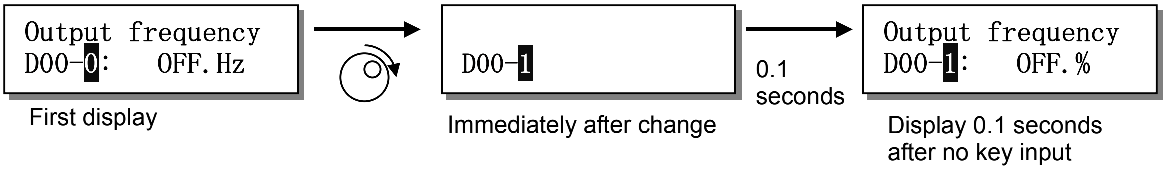
The character display can be selected from five languages, English, French, Italian, Spanish or German.
Change the language with the parameter C11-4 setting value.
The default language is English.
Refer to section 4-2-5 Setting value operation and display for details on changing the setting value.

4-2-3 Operating and displaying parameter numbers

The flicking character can be displayed. The parameter No. will increase when the parameter increase/decrease knob is turned to the right, and will decrease when the knob is turned to the left.

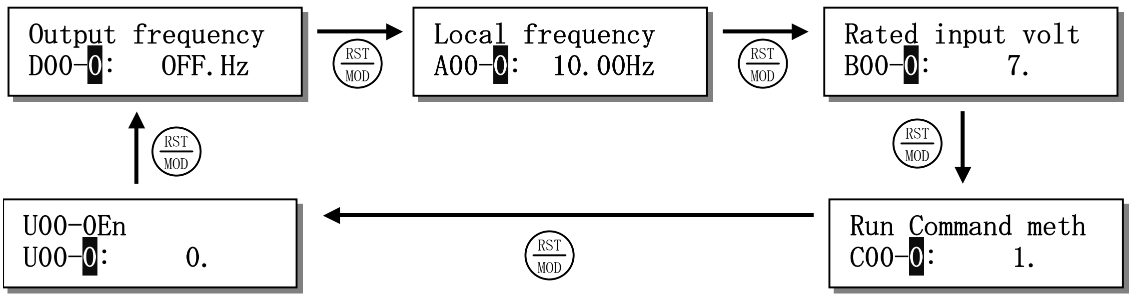


Only the parameter No. is displayed when the parameter increase/decrease knob is being turned. The setting value appears 0.1s after the knob is stopped. The characters on the upper line will start to scroll at the same time.



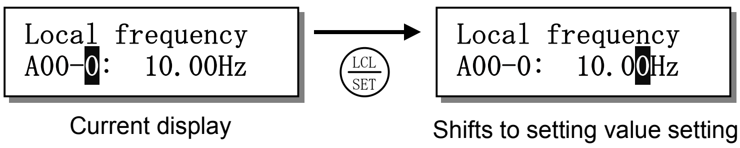
4-2-4 Changing the block No.

If the RST/MOD key is pressed when the parameter No. is displayed or when setting the setting value, the block will change in the order of D → A → B → C → U → D.

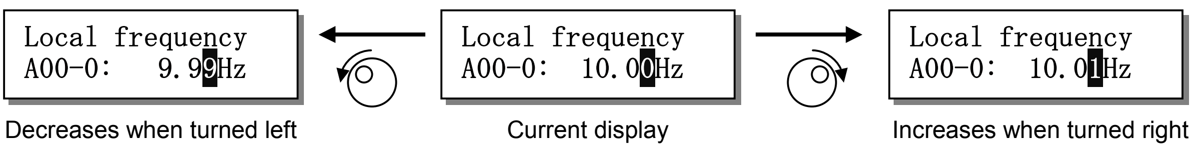


4-2-5 Operating and displaying setting values

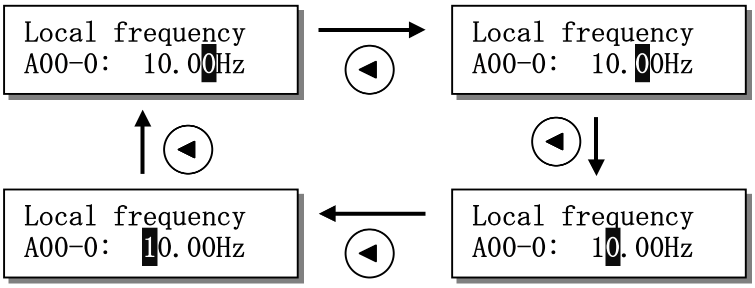
If the LCL/SET key is pressed when the Block- A, B, C or U is displayed, the operation will shift to the setting value setting.
The flickering character moves to the setting value side.



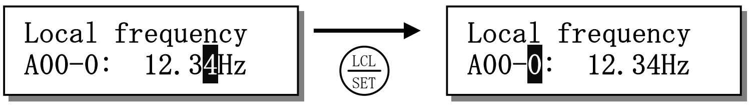
When setting the setting value, the value can be increased and decreased by turning the parameter increase/decrease knob.



When the ◄ key is pressed, the digit to be changed (flickering character) can be moved one digit to the left.
If the ◄ key is pressed when the flickering character is at the top digit, it will move to the last digit.



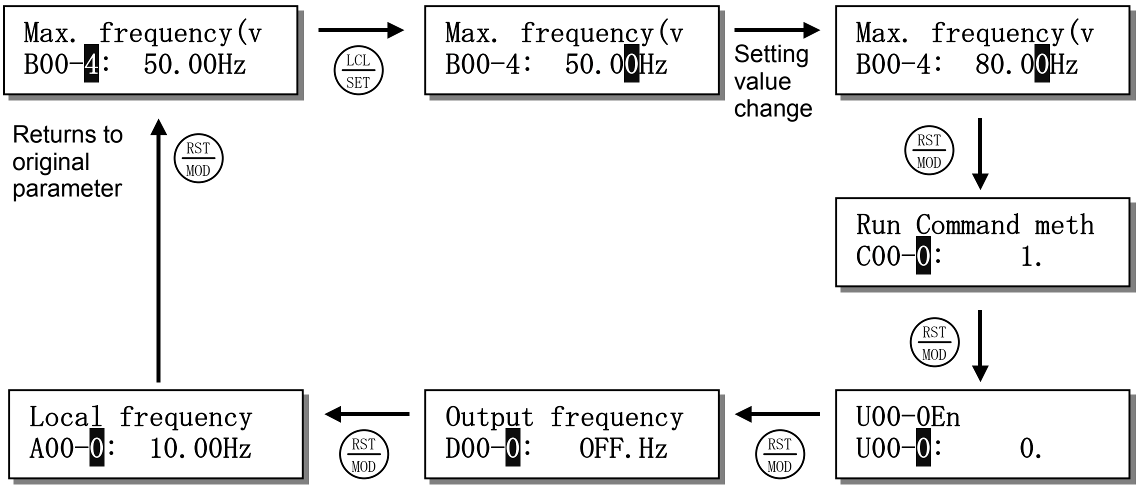
When the setting value has been decided, press the LCL/SET key again to enter the setting value.
The character to be changed will also move to the parameter No.



Current display

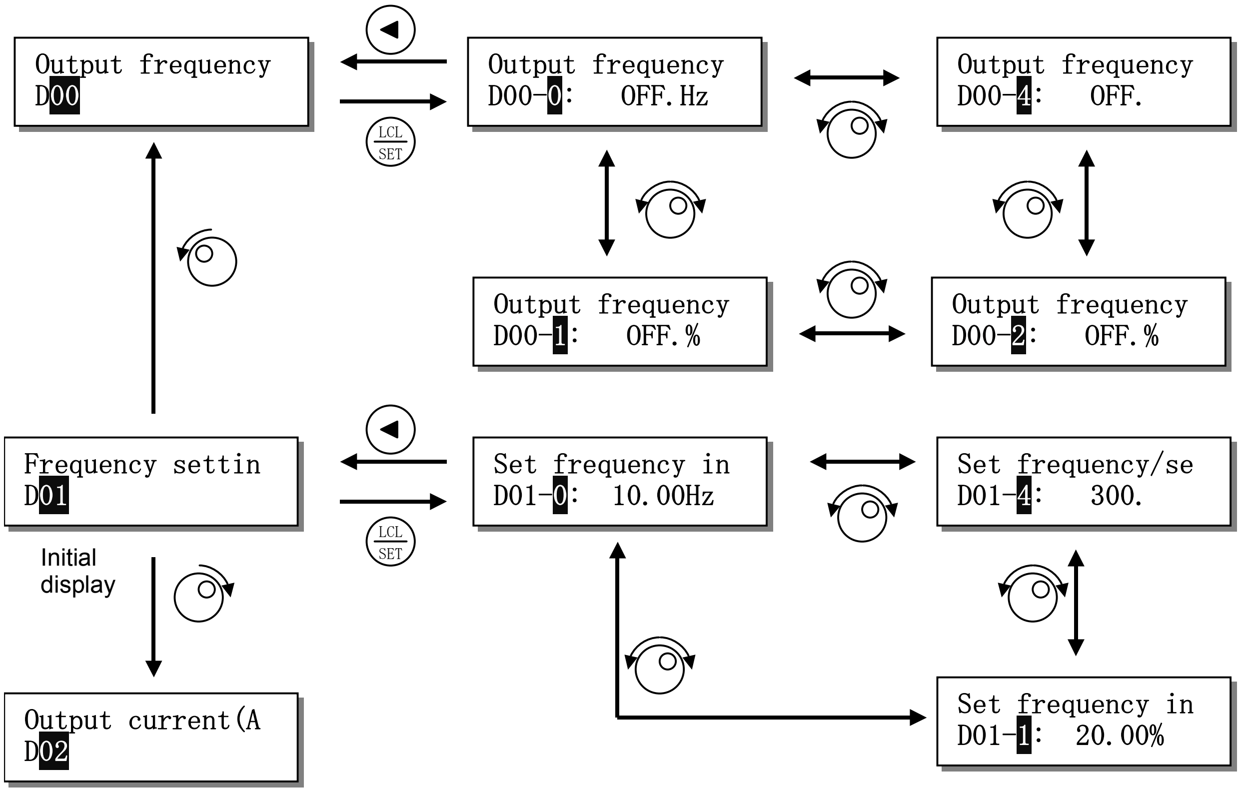
Moves to parameter No. selection

To return to the parameter No. selection without changing the parameter with setting value setting, press the RST/MOD key.
The display will change to the next block No. If the parameter for which the setting value was being changed is moved to, the setting value will return to the original value.
Note that the value will not return for A00-0: direct frequency setting and A00-2: direct speed setting.



4-2-6 Operating and displaying parameter numbers with main and sub-No. selection method

An example of operations when C11-7=2: main & sub-No. selection method is explained in this section.



With this method, if the digit to be changed (flickering character) is at the parameter number's sub-No. and the parameter increase/decrease knob is turned, the main No. will not change, and only the sub-No. will change.

To move from the sub-No. selection to the main No., press the key. The digit to be changed will move to the main No.

If the parameter increase/decrease knob is turned when the digit to be changed is at the main No., the main No. will be changed.

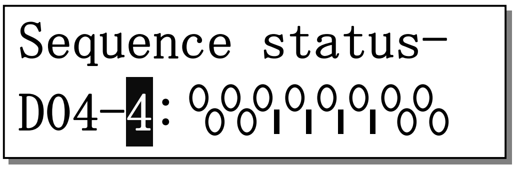
To move from the main No. selection to the sub-No. selection, press the key. The digit to be changed will move to the sub-No.

If the key is pressed again when the sub-No. is selected, the display will change to the setting value setting.

Refer to section 4-2-5 operating and displaying the setting value, and set the setting value.

4-2-7 Displaying the sequence

With the LCD panel, the D04-0 to 3: sequence input and D04-4 to 7: sequence output are displayed as shown below. The D04-4: Sequence output 1 is shown as a display example.



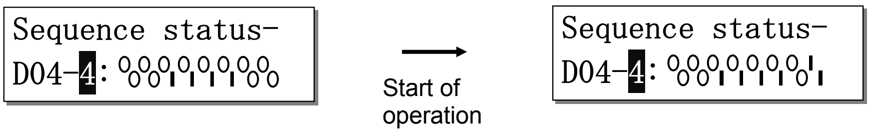
○ and ｜ indicate the status of the corresponding sequence.

○ : Sequence OFF

｜ : Sequence ON

○ and ｜ are updated immediately when the sequence status changes.

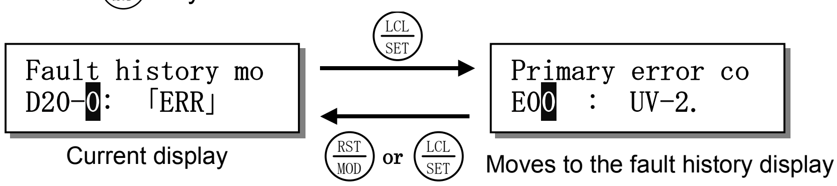
Example : Start of operation (Sequence output: RUN, ATN ON)



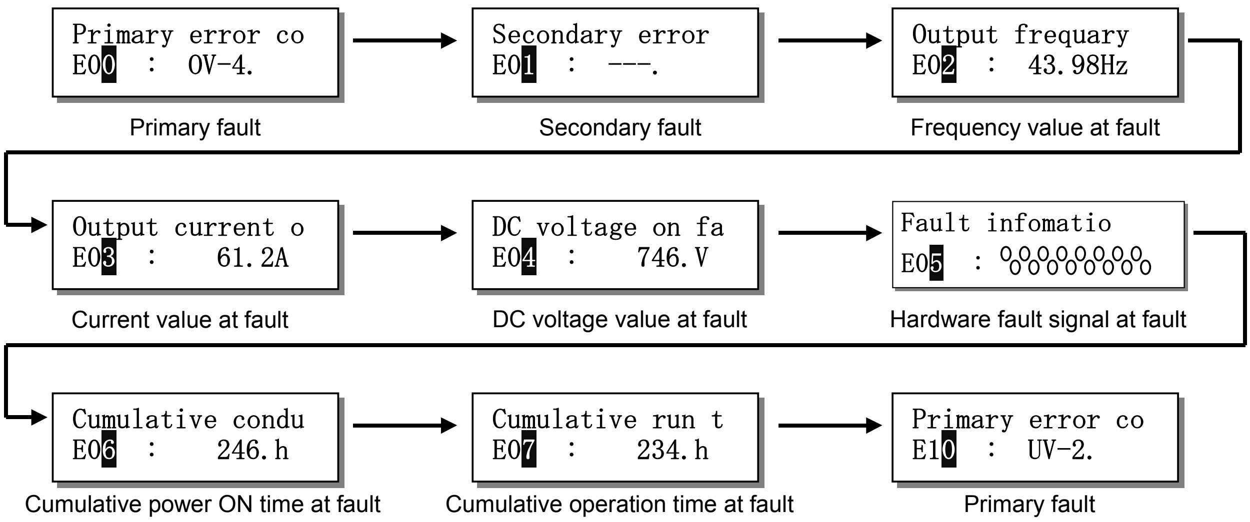
4-2-8 Displaying the fault history

When the parameter is set to D20-0 and the LCL/SET key is pressed, the fault history display will appear.

To return to the parameter selection from the fault history display status, press the LCL/SET key again, or press the RST/MOD key.



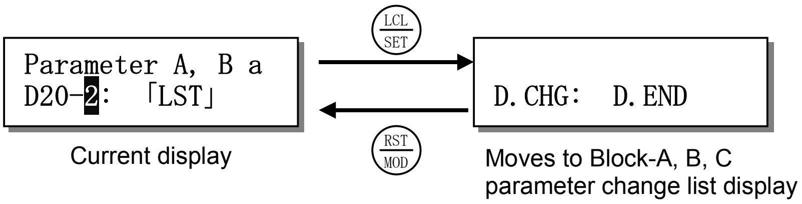
If the parameter increase/decrease knob is turned in the fault history display status, the numbers will loop between E00 and E37, and the fault corresponding to the number will display. Refer to section 4-3-7 Fault history display for details on E00 to E37.



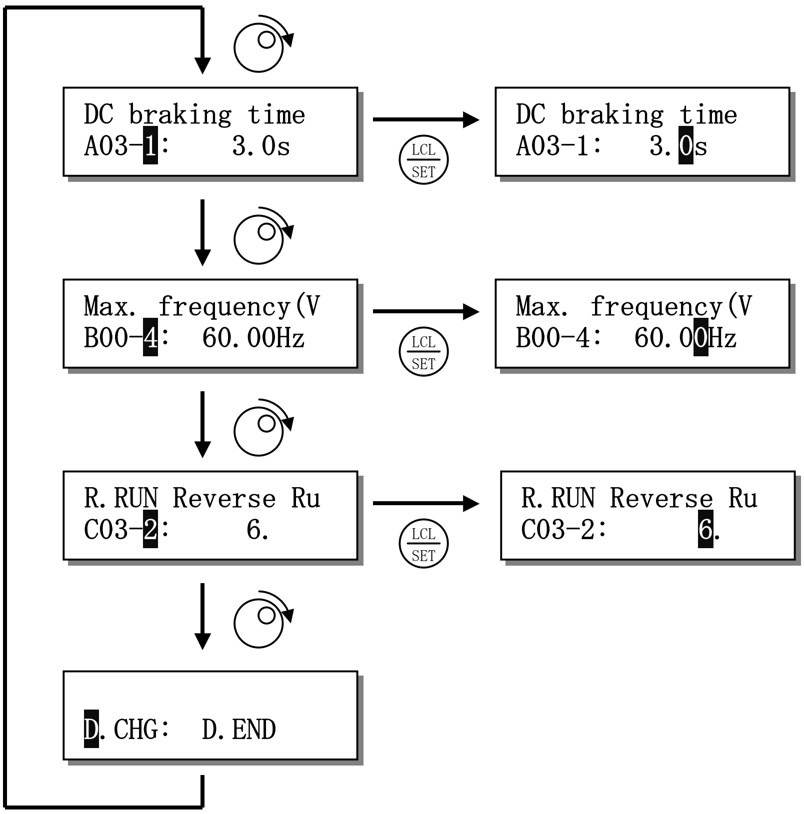
4-2-9 Operating and displaying during Block-A, B, C parameter change list selection

If the LCL SET key is pressed when the parameter is set to D20-2, the Block-A, B, C parameter change list will appear.

Press the RST MOD key to return to the parameter selection from the Block-A, B, C parameter change list display.



If the parameter increase/decrease knob is turned while the Block-A, B, C parameter change list is displayed, the parameters which were set or changed after power ON will appear in sequence.
If the LCL SET key is pressed in this state, the display will change to parameter setting value setting.
The setting value can be changed in this state.
If the LCL SET key is pressed again, the change list will reappear.
If the parameter increase/decrease knob is pressed to the last of the changed parameters, "D.CHG: D.END" will appear.
If the parameter increase/decrease knob is pressed further, the first parameter will appear.



4-2-10 Displaying the LCD panel dedicated sequence characters

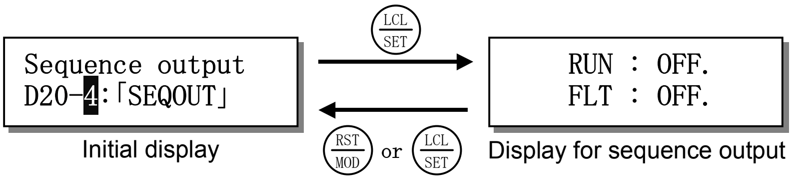
If the LCL/SET key is pressed when the parameter is set to D20-3 or 4, the sequence input or output display will appear. The parameter No. and target are shown below.

D20-3 : Sequence input

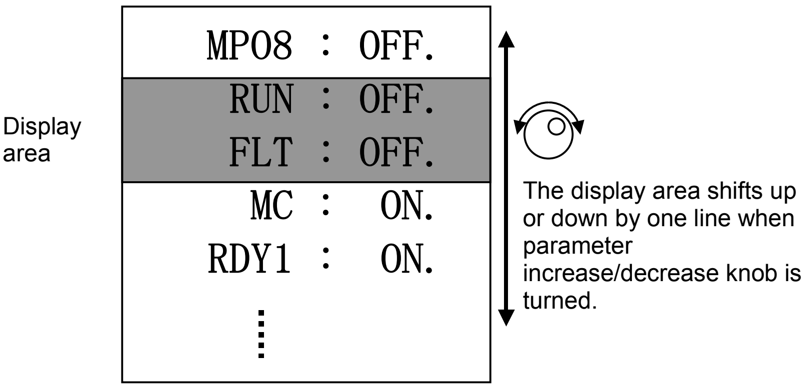
D20-4 : Sequence output

The D20-4 sequence output is explained as an example in the following section. The operations are the same for D20-3 and 4.

To return to parameter selection, press the LCL/SET key or RST/MOD key.



If the parameter increase/decrease knob is turned while the sequence details are displayed, the display will move up and down.



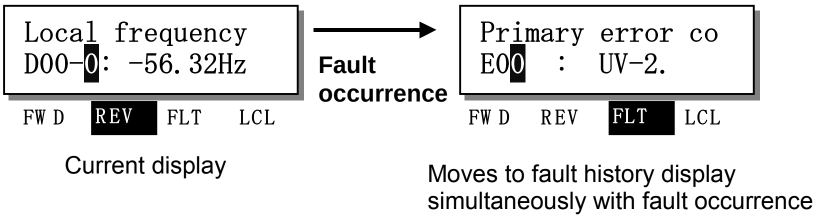
Refer to Chapter 6 List of Parameters for the names of the displayed sequences.

The ON and OFF status is updated immediately when the sequence status changes.

Example : Start of operation (Sequence output: RUN is ON)

4-2-11 LCD panel display at fault occurrence, and resetting methods

When a fault occurs in the inverter, the following type of display will appear on the LCD panel.

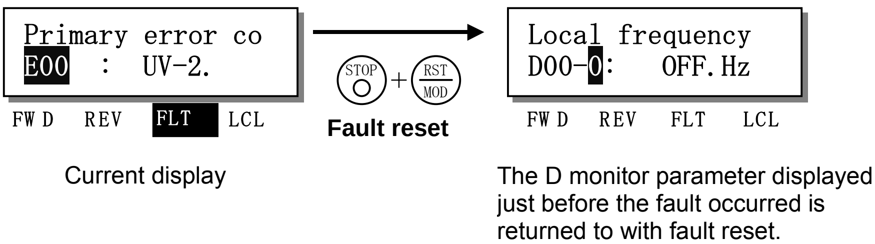


When a fault occurs, the inverter operation stops, and the "FLT" LED on status display LED turns On.
At the same time, the head "E00" for the fault history and the fault code appear on the LCD panel.
The cause of the fault is indicated at the fault code displayed at E00 to E07.
Refer to Appendix Table 3 Fault codes for details on the fault codes.
In the above figure, an undervoltage occurred during constant speed operation and a fault occurred.
If the parameter increase/decrease knob is turned while the history is displayed, the fault details can be displayed in the range of E00 to E37.

To return to the normal parameter selection from the fault history display, press the RST MOD key.

Resetting a fault:

Refer to the details of E00 to E07 in the fault history display and the Appendix Table 3 Fault code table, and remove the cause of the fault.
The FLT LED will turn OFF when the STOP + RST MOD keys are pressed or the sequence input RESET is turned ON.
Refer to Chapter 5 section 5-3 Programmable sequence input function (PSI) for details on resetting the fault with the sequence input RESET.
The display in this case is shown below.



When the fault is reset, the LCD panel display will return to the D monitor parameter from the fault history state.
Confirm that the cause of the fault has been removed, and then resume operation.

4-3 Various operations and displays when LED panel is connected

The various LED panel operations and displays are displayed.
First, the various operation methods and displayed for the sub-No. selection method (C11-7=1) are explained.

4-3-1 Operating and displaying the parameter No.

The methods for operating the parameter No. are shown below.
Refer to Table 4-1 for details on the key functions.

<Keys>	<Display, unit LED>	<Explanation>
After viewing the output current with a [%] unit, the parameter which displays the output frequency with a [Hz] unit is displayed.		
	60.00 [Hz]	D00-0 : Output frequency
◄ + ▲	d01.-0 [Hz]	The main No. increases.
◄ + ▲	d02.-0 [A]	The main No. increases.
▲	d02.-1 [%]	The sub-No. increases. D02-1 is displayed.
	↓	
	80.5 [%]	After one second, the display will show the output current as a percentage.
◄ + ▼	d01.-0 [Hz]	The main No. decreases.
◄ + ▼	d00.-0 [Hz]	The main No. decreases.
	↓	
	60.00 [Hz]	After one second, the display will show the output frequency as Hz.

When operating with the sub-No. selection method, the decimal point dot for the third digit from the right turns ON while the ◄ key is pressed to indicate that the main No. is being changed.
Press the LCL/SET key to check the parameter No. with the monitor display.

4-3-2 Operating and displaying the setting value

Refer to Sections 6-2 to 6-5, for the details of the Block-A, B and C parameters.

<Keys>	<Display, unit LED>	<Explanation>
Change the Parameter: B00-4 maximum output frequency (Fmax) from 50.0 to 60.0		
	60.00 Hz	(In Monitor Mode)
RST/MOD	A00-0 Hz	Changes to the Block-A Parameter setting Mode.
RST/MOD	b00-0	Changes to the Block-B Parameter setting Mode.
▲ Three times	b00-4 Hz ↓ ↑	Increase the parameter No. from parameter B00-0 to B00-4.
LCL/SET	50.00 Hz	The display will alternate between Parameter Number B00-4 and the present setting value 50.00.
	50.00 Hz	Enable the value to be changed. The preset setting value will display.
◄ Three times	50.00 Hz	Press ◄ three times to move the flicker to the digit that is to be changed. (**Note:** Parameter B00-4 cannot be changed while the inverter is running.)
▲	60.00 Hz	Change the flicker digit from 5 to 6.
LCL/SET	60.00 Hz ↓ ↑	Fix the data. Changing of Parameter B00-4 to 60.0 will be completed.
	b00-4 Hz	The display will alternate between parameter No.: B00-4 and current setting value: 60.00.

<Keys>	<Display, unit LED>	<Explanation>
Change the parameter A03-1 (DC Breaking Time) from 2.0 (default value) to 3.5.		
	b00-4 (Hz)	(In B00-4 Parameter Setting Mode)
RST/MOD	C00-0	Changes to the Block-C Parameter Setting Mode.
RST/MOD	U00-0	Changes to the Utility Mode. (For future use)
RST/MOD	d00-0 (Hz)	Changes to the Monitor Mode.
RST/MOD	A00-0 (Hz)	Changes to the Block-A Parameter Setting Mode.
◀ + ▲	A01-0 (Hz)	
◀ + ▲	A02-0	Increase the Parameter Block Number from A00-0 to A03-1. Increase the Parameter Number.
◀ + ▲	A03-0 (%)	
▲	A03-1	
	↓ ↑ 2.0	The display will alternate between Parameter Number A03-1 and the present value 2.0.
LCL/SET	2.0	Enable the value to be changed. The preset setting value will display.
▲ Five times	2.5	Change the flicker digit from 0 to 5.
◀	2.5	Move the flickering digit to the digit to be changed
▲	3.5	Change the flicker digit from 2 to 3.
LCL/SET	3.5	Fix the data. Changing of parameter A03-1 to 3.5 will be completed.
	↓ ↑ A03-1	The display will alternate between the Parameter Number A03-1 and the present value. (Parameter Number Changing Mode.)

(Note) If the rUn. (RUN) display appears when changing from the parameter No. to the setting No. change state, the parameter is one that can be changed only while the inverter is stopped.

4-3-3 Operating the monitor parameters with the main & sub-No. selection method

An example of the operations when the main & sub-No. selection method (C11-7=2) is selected is given below.

<Keys>	<Display, unit LED>	<Explanation>
After viewing the output current with a [%] unit, the parameter which displays the output frequency with a [Hz] unit is displayed.		
	60.00 Hz	D00-0 : Output frequency
	d00. Hz	Changes to the main No. selection.
	d01. Hz	The main No. increases.
	d02. A	The main No. increases.
	d02.-0. A	Changes to the sub-No. selection.
	d02.-1. %	The sub-No. increases. D02-1 is displayed.
	↓	
	80.5 %	After one second, the display will show the output current as a percentage.
	d02. A	The main No. decreases.
	d01.-0. Hz	The main No. decreases.
	d00.-0. Hz	
	↓	
	60.00 Hz	After one second, the display will show the output frequency as Hz.

When operating the parameters with the main & sub-No. selection method, the third decimal dot turns ON while the parameter is selected to differentiate between the sub-No. selection method.

Press the LCL SET key to check the parameter No. during the monitor display.

4-3-4 Changing the Block-A, B, C parameters with main & sub-No. selection method

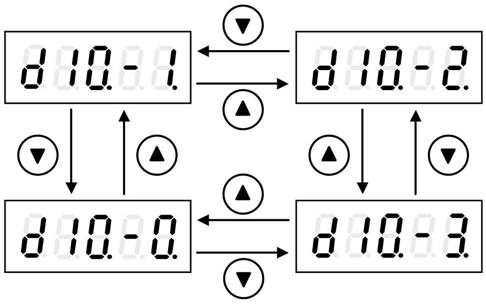
Refer to Sections 6-2 to 6-5, for the details of the Block-A, B and C parameters.

<Keys>	<Display, unit LED>	<Explanation>
Change the parameter A03-1 (DC Breaking Time) from 2.0 (default value) to 3.5.		
	d00-0	(In D00-0 Parameter Setting Mode)
RST/MOD	A00-0	Changes to the Block-A Parameter Setting Mode.
◀	A00	Changes to the main No. selection.
▲	A01	The main No. increases.
▲	A02	The main No. increases.
▲	A03	The main No. increases.
LCL/SET	A03-0	Changes to the sub-No. selection.
▲	A03-1	The sub-No. increases.
	↓ ↑	
	2.0	The display will alternate between Parameter Number A03-1 and the present value 2.0.
LCL/SET	2.0	Enable the value to be changed. The preset setting value will display.
▲ Five times	2.5	Change the flicker digit from 0 to 5.
◀	2.5	Move the flickering digit to the digit to be changed
▲	3.5	Change the flicker digit from 2 to 3.
LCL/SET	3.5	Fix the data. Changing of parameter A03-1 to 3.5 will be completed.
	↓ ↑	
	A03-1	The display will alternate between the Parameter Number A03-1 and the present value. (Parameter Number Changing Mode.)

(Note) If the rUn (RUN) display appears when changing from the parameter No. to the setting No. change state, the parameter is one that can be changed only while the inverter is stopped.
With the main & sub-No. selection method, if the sub-No. increases from the maximum state or decreases from the minimum state, it will lop within the same main No.
The operation is summarized in the following figure. (D10: Simple PLC monitor is shown as an example.)

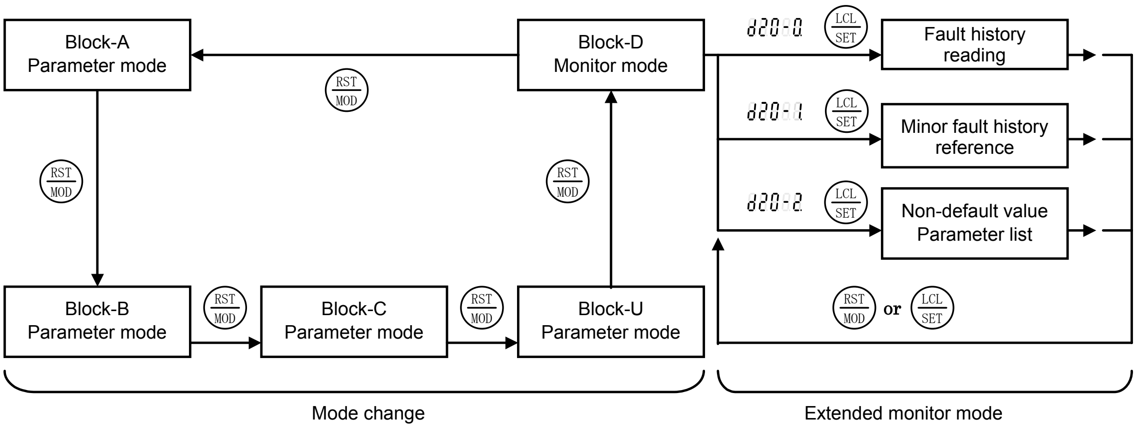
Press the ◄ key to return to the main No. selection.

Press the LCL/SET key to move to the setting value setting.



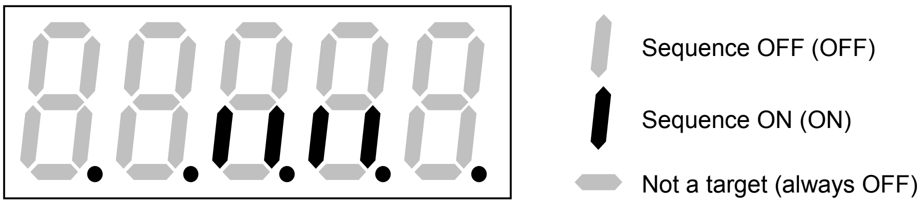
4-3-5 Changing the block No.

The operation panel block No. will change between five modes each time the RST/MOD key is pressed.
The monitor mode D20-0, 1, 2 is the entry to the extended monitor mode.



4-3-6 Displaying the sequence

With the LED panel, the D04-0 to 3: sequence input and D04-4 to 7: sequence output are displayed as shown below. The D04-4: Sequence output 1 is shown as a display example.



When the corresponding sequence turns ON, the vertical segment on the LED panel turns ON.
The decimal point LED flickers at a one-second cycle.
Each segment is updated as soon as the sequence status changes.

4-3-7 Fault History Display

Refer to Appendix Table 3 Fault Code Table for the fault codes and details.

<Keys>	<Display, unit LED>	<Explanation>
	d00-0 (Hz, A, %)	(d00-0 will display in the Monitor Mode.)
◄ + ▲	d20-0	Select Monitor Parameter d20-0.
	↓	
	rErr1	The [ERR] symbol will display after one second.
LCL/SET	E00	Enter the Faulty History Reference Mode by pressing the LCL/SET key.
	↓ ↑	
	oC-2	The fault history number (E00 to E37) and the fault code will display alternately.
▲	E01	Refer to the contents of the fault buffer by pressing the ▲▼ keys.
	↓ ↑	
	Io-4	
RST/MOD or LCL/SET	d20-0	End the Fault history Mode and return to the Monitor Mode by pressing the RST/MOD key or LCL/SET key.
	↓	
	rErr1	The [ERR] symbol will display after one second.

The fault history display has the following type of configuration.
The faults up to the previous faults are listed as display examples.

Fault sequence	Fault history No.	Display	Explanation
Fault 1 (The latest)	E00	oC-2.	Primary fault (overcurrent)
	E01	Io-4.	Secondary fault (retry over)
	E02	52.24	Output frequency at fault
	E03	104.9	Output current at fault
	E04	404.	DC voltage at fault
	E05	. . . . 1.	Hardware detection fault at fault
	E06	13582.	Cumulative power ON time at fault
	E07	9284.	Cumulative run time at fault
Fault 2	E10	Uu-2.	Primary fault (undervoltage)
	E11	-----	Secondary fault (none)
	E12	60.00	Output frequency at fault
	E13	87.0	Output current at fault
	E14	210.	DC voltage at fault
	E15	. . . . .	Hardware detection fault at fault (no display)
	E16	8632.	Cumulative power ON time at fault
	E17	3657.	Cumulative run time at fault
Fault 3	E20	-----	
	E21	-----	
	E22	0.00	"----" indicates that a fault is not recorded. The frequency value, voltage value, current value, cumulative power ON time and cumulative run time values are all 0 when no fault is recorded.
	E23	0.0	
	E24	0.	
	E25	. . . . .	* E00 to E37 are all ---- or 0 in the default state.
	E26	0.	
	E27	0.	
Fault 4	E30	-----	
	E31	-----	
	E32	0.00	
	E33	0.0	
	E34	0.	
	E35	. . . . .	
	E36	0.	
	E37	0.	

4-3-8 Operations and display when Block-A, B, C parameter change list is selected

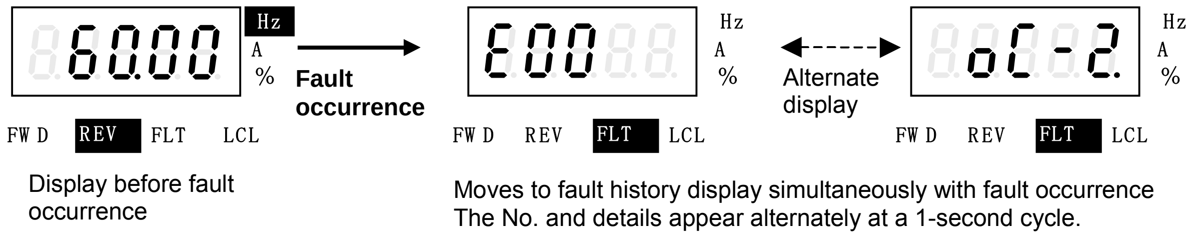
Monitor parameter D20-2 is an entry into the Block-A, B, C parameter change list mode.
In this change list mode, only the Block-A, B, C parameters which differ from the default values can be referred to and changed.

<Keys>	<Display, unit LED>	<Explanation>
An example of referring to the change list and changing C14-0 (A01 output gain) is shown below.		
	d00-0 (Hz A %)	(Monitor mode initial display)
	d20-2 ↓	The block No. and parameter No. increases from parameter D00-0 to D20-2. Refer to sections 4-3-3 or 4-3-5 for these operations.
	rLSt1	One second after D20-2 is selected, "LST" will appear.
LCL/SET	A03-1 ↓ ↑	The change list mode is entered when the LCL/SET key is pressed.
	3.5	The number of the parameter (A03-1) which has been changed from the first setting value and the current setting value will alternately display.
▲	b00-4 (Hz A %) ↓ ↑	Next, the changed parameter will appear.
	60.00 (Hz A %)	The parameters which differ from the setting values can be displayed in order by pressing the ▲ key.
▲	C14-0 ↓ ↑	Display parameter: C14-0 (A01 output gain).
LCL/SET	1.05	Select parameter C14-0. The setting value change status will be entered.
◄	1.05	
▼	0.95	
LCL/SET	0.95	Set the data. Change parameter C14-0 to 0.95.

<Keys>	<Display, unit LED>	<Explanation>
	C14-0. ↓ ↑ 0.95	The parameter No. and current setting value will alternately display.
▲	C20-0. (Hz A %) ↓ ↑ 1.8 (Hz A %)	The parameters which differ from the setting values can be displayed in order by pressing the ▲ key.
▲	d.CHG d.End	d.CHG and d.END will alternately display to indicate the end of the change list. When the ▲ key is pressed, the change list will display from the start.
RST/MOD	d20-2. ↓ rLST1.	If the RST/MOD key is pressed in the parameter change state, the change list display mode will end. The monitor parameter selection status will be entered. ("LST" will appear after one second.)

4-3-9 LED panel display at fault occurrence, and resetting methods

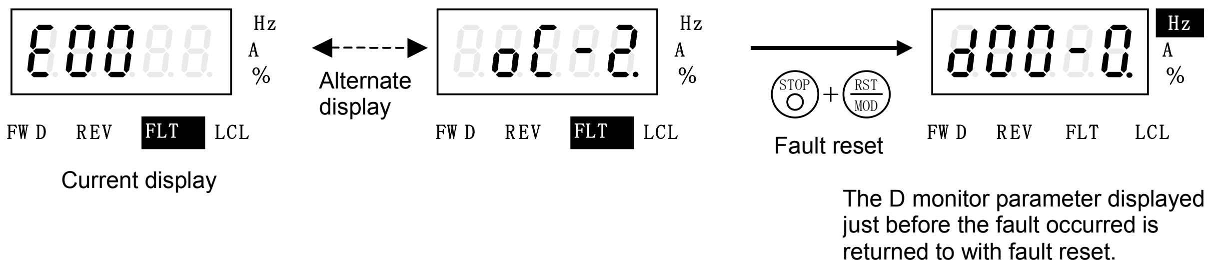
When a fault occurs in the inverter, the following type of display will appear on the LED panel.



When a fault occurs, the inverter stops operation, and the "FLT" status display LED on the panel will turn ON.
At the same time, the head "E00" for the fault history and the fault code appear on the LED panel.
The cause of the fault code displayed at E00 to E07 is saved.
Refer to Appendix Table 3 Fault codes for details on the fault codes.
In the above figure, an overvoltage occurred during constant speed operation and a fault occurred.
If the ▲▼ keys are pressed while the history is displayed, the fault details can be displayed in the range of E00 to E37.
To return to the normal parameter selection from the fault history display, press the RST/MOD key.

Resetting a fault:

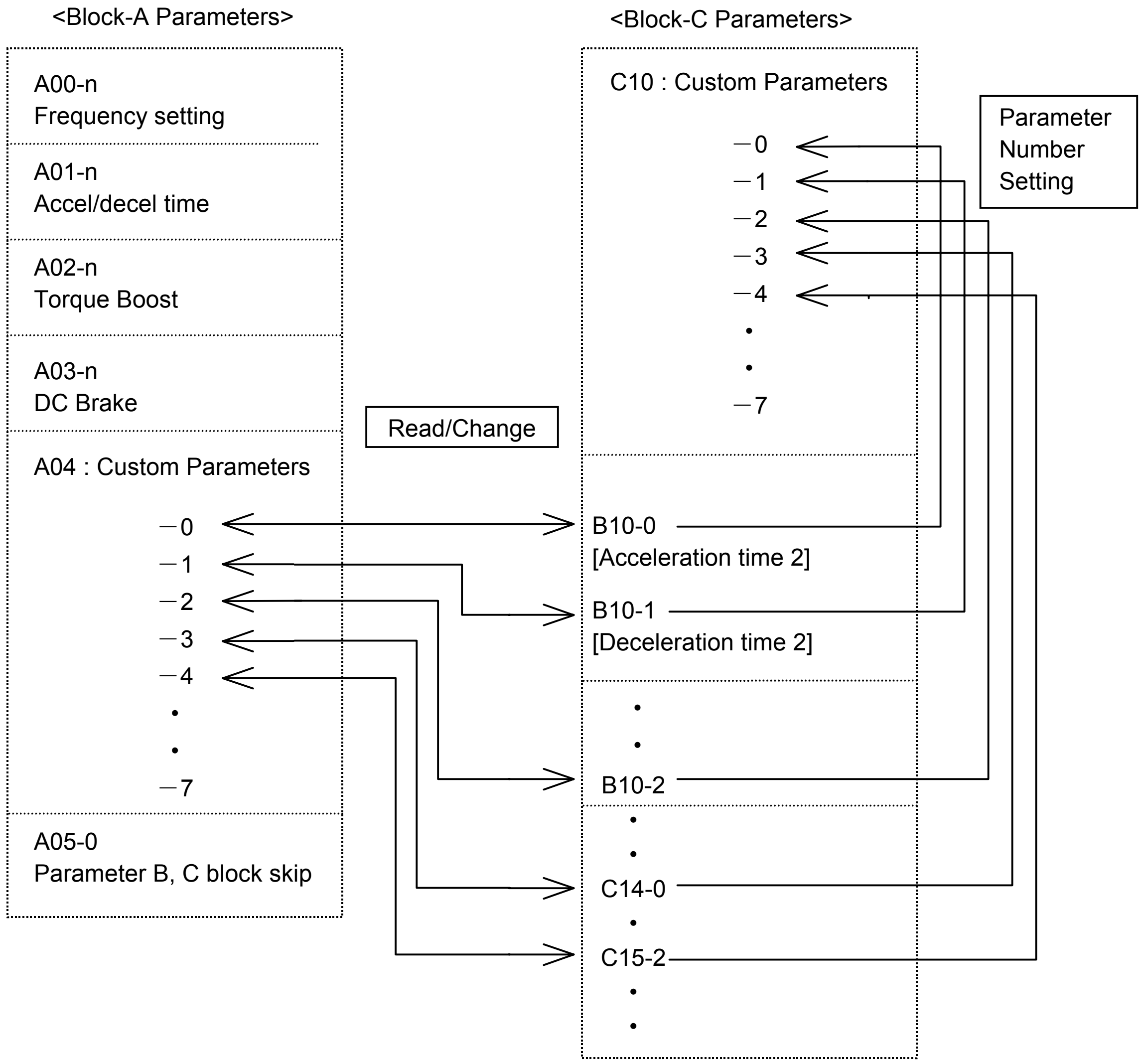
Refer to the details of E00 to E07 in the fault history display and the Appendix Table 3 Fault code table, and remove the cause of the fault.
The FLT LED will turn OFF when the STOP+RST/MOD keys are pressed or the sequence input RESET is turned ON.
Refer to Chapter 5 section 5-3 Programmable sequence input function (PSI) for details on resetting the fault with the sequence input RESET.
The display in this case is shown below.



When the fault is reset, the LED panel display will return to the D monitor parameter from the fault history state.
Confirm that the cause of the fault has been removed, and then resume operation.

4-4 Customizing block-B, C parameter

Block-B, C parameters can be assigned to any Block-A Parameter in the range of A04-0 to A04-7, and can be read and changed in the Block-A Parameter Setting Mode.
To use this function, set parameter No. to be displayed in A04-0 to 7 in parameter C10-0 to 7.
The case for the V/f control (C30-0 $\boxed{\text{f0}}$ = 1) of control selection (C30-0:f0) is shown below.
The operation example applies when the LED panel is connected.



An example of selecting the custom parameter and changing the selected custom parameter setting value is given on the following page.

<Keys>	<Display, unit LED>	<Explanation>
Register parameter B10-0 on Parameter C10-0 (Custom Setting).		
	C10-0	(Mode and Parameter Number Change to C10-0)
	↓ ↑	
LCL/SET	1.9F.F	The display shows Parameter C10-0. (Setting value 1.9F.F is the initial setting, and indicates that nothing has been selected.)
	1.9F.F	The C10-0 setting value setting is started by pressing the LCL/SET key.
▲	1.9F.0	Set the parameter B10-0 sub-No. to "0".
◄	1.10.0	The flickering digit will move when the ◄ key is pressed.
LCL/SET	1.10.0	Set so that the high-order digit is block No. 10. When the LCL/SET key is pressed, the data will be set, and the parameter selection screen will appear.
	↓ ↑	
	C10-0	**(Note)** For parameter C, set as 2.xx.x.
Change parameter B10-0 that has been assigned to A04-0.		
	A00-0 Hz	Enter the Block-A Parameter Setting Mode.
◄ + ▲	A04-0	The Custom Parameter Number A04-0 will display.
	↓ ↑	
LCL/SET	10.0	The display will alternate between Parameter Number A04-0 and the value of Parameter Number B10-0 (Acceleration cushion time 2). Parameter Number A04-0 is the same value as that of Parameter Number B10-0.
	10.0	When the LCL/SET key is pressed, the B10-0 setting value setting state will be entered.
▲	10.5	Change the value.
LCL/SET	10.5	When the LCL/SET key is pressed, the data will be set, and the parameter selection screen will appear.
	↓ ↑	
	A04-0	

Note) If an undefined parameter No. such as the default 1.9F.F is set for C10-n, it will be interpreted that a custom setting has not been made, and the A04-n display will be automatically set.

4-5 Changing modes

The parameters used differ according to the control mode (C30-0:f0).
The parameters include the V/f control, the IM vector control (sensor-less, with sensor) and the PM motor control with sensor.
These parameters are divided into the block No. (mode), main No. and sub-No. for each function.

4-5-1 V/f control (C30-0 $\boxed{\text{f0}}$ = 1) mode

The configuration of the parameters is shown in Fig. 4-5-1.

Mode

RST/MOD Key

- **Monitor mode** : Monitors (displays) the internal status.

  Knob or ▲ ▼ Key

  - Output frequency monitor (d00-0, 1, 4, 5)
  - Frequency setting monitor (d01-0, 1, 4)
  - Current monitor (d02-0 to 4, 7 to 9)
  - Voltage monitor (d03-0 to 3)
  - Sequence status (d04-0 to 7)
  - Minor fault monitor (d05-0, 1)
  - Pattern run monitor (d06-0, 1)
  - Pump operation status monitor (d07-0 to 4)
  - Analog input random scale display (d08-0 to 2)
  - Input display (d08-3 to C)
  - Built-in PLC monitor (d10-0 to 3)
  - STP run monitor (d13-0 to 5)
  - Extended monitor (d20-0 to 4)
    - Fault history monitor
    - Minor failure past record indication
    - Parameter A, B and C modification list entry
    - Sequence input display (dedicated for LCD panel)
    - Sequence output display (dedicated for LCD panel)
  - Maintenance monitor (d21-0 to 3)
  - Automatic tuning (d22-0)
  - Hardware monitor (d30-0 to 5)

- **Block-A Parameter Mode** : Parameters changed frequently during the normal usage state.

  Knob or ▲ ▼ Key

  - Frequency setting (A00-0, 1)
  - Acceleration/deceleration time (A01-0, 1)
  - Torque boost (A02-0 to 6)
  - DC Brake (A03-0, 1)
  - Custom parameters (A04-0 to 7)
  - Parameter B and C indicatory skip (A05-0 to 2)

(Continued on next page)

Fig. 4-5-1 (1) Parameter configuration

RST/MOD Key

Block-B Parameter Mode : Parameters changed infrequently during the normal usage state

Knob or ▲ ▼ Key

Basic function settings

Output rating	(B00-0 to 7)
Motor circuit constant (IM)	(B02-0, 1, 4, 5)
Frequency skip	(B05-0 to 5)
Gearing comparative setting	(B06-0, 1, 3, 4, 6, 7, 9, A, C, D)
Upper/Lower limit setting	(B07-0, 1)

Extended function settings

Acceleration/deceleration time setting	(B10-0 to 6)
Program frequency (speed) setting	(B11-0 to 8)
Automatic braking on power failure setting	(B12-0 to 6)
V/f middle point setting	(B17-0 to B)
Current limit	(B18-0 to 8)
Automatic tuning function	(B19-0 to 2)
Auxiliary drive 0 exclusive setting	(B20-0 to B23-4)
Auxiliary drive 1 exclusive setting	(B24-0 to B27-4)
Auxiliary drive 2 exclusive setting	(B28-0 to B2B-4)
Auxiliary drive 3 exclusive setting	(B2C-0 to B2F-4)
Speed control extended function	(B30-4)

Software option function settings

Software option function	(B40-0)
Program ramp – acceleration	(B41-0 to 7)
Program ramp – deceleration	(B42-0 to 7)
PID control	(B43-0 to A)
Multi-pump control	(B44-0 to 6)
Traverse run	(B45-0 to 6)
External brake control	(B46-0 to 5)
Simple ASR control	(B47-0 to 6)
Pattern run	(B50-0 to B59-3)
Spinning frame operation	(B60-0 to B76-6)

(Continued on next page)

Fig. 4-5-1 (2) Parameter configuration

RST/MOD Key

Knob or ▲ ▼ Key

- **Block-C Parameter Mode** : Parameters changed infrequently during the normal usage state
  - Basic function settings
    - Control methods (C00-0 to 7)
    - Start/stop frequency (C01-0, 1)
    - Various setting input selection (C02-0, 1)
    - Sequence input terminal function – 1 (C03-0 to F)
    - Sequence input terminal function – 2 (C04-0 to F)
    - Sequence input terminal function – 3 (C05-0 to F)
    - Analog input terminal function (C07-0 to 5)
    - Automatic start setting (C08-0)
    - Parameter protection/operation locks (C09-0 to 4, 6, 7)
    - Custom parameter register (C10-0 to 7)
    - Operation panel mode setting (C11-0 to 7)
    - Setting input terminal function (C12-0 to F)
    - Output terminal function (C13-0 to F)
    - Meter output gain (C14-0 to B)
    - Status output detection level (C15-0 to E)
  - Extended function setting
    - Start interlock (C20-0 to 3)
    - Retry/pick-up (C21-0 to 4)
    - Overload (C22-0 to 7)
    - Speed detection error monitor (C24-1 to 3)
    - High-efficiency operation (C25-0 to 2)
    - Standard serial (C26-0 to 7)
    - Password No. (C28-0, 1)
  - Hardware option function setting
    - Control mode selection (C30-0)
    - Main circuit option selection (C31-0 to 3)
    - PC (parallel) interface (future) (C32-0 to 2)
    - Sequence output terminal function (C33-0 to 3)
    - Field network interface (C34-0 to 7)
    - Encoder setting 1 (C50-0 to 3)
- **Utility mode U**
  - Parameter Control (U00-0)
  - Password No. setting (U00-1)
  - Built-in PLC setting (U10-0 to U67-7)

(Note) At the default setting, only the basic functions are displayed. The extended function, software option function, hardware option function parameters are skipped.
Thus, to change these parameters, change parameter A05-0 to 2 (parameter B, C block skip setting), so that the target parameters are displayed.

Fig. 4-5-1 (3) Parameter configuration

4-5-2 IM speed sensor-less vector control (C30-0 $\boxed{f0}$ = 2), IM vector control with speed sensor (C30-0 $\boxed{f0}$ = 3)

The configuration of the parameters is shown in Fig. 4-5-2.

Mode

RST/MOD Key

- **Monitor mode** : Monitors (displays) the internal status.

  Knob or ▲ ▼ Key
  - Output frequency monitor (d00-0 to 5)
  - Frequency setting monitor (d01-2 to 4)
  - Current monitor (d02-0 to 9)
  - Voltage monitor (d03-0 to 3)
  - Sequence status (d04-0 to 7)
  - Minor fault monitor (d05-0, 1)
  - Pattern run monitor (d06-0, 1)
  - Analog input random scale display (d08-0 to 2)
  - Input display (d08-3 to C)
  - Built-in PLC monitor (d10-0 to 3)
  - Torque setting monitor (d11-0 to 5)
  - Slip (d12-0)
  - Automatic torque bias (d14-0)
  - Extended monitor (d20-0 to 4)
    - Fault history monitor
    - Minor failure past record indication
    - Parameter A, B and C modification list entry
    - Sequence input display (dedicated for LCD panel)
    - Sequence output display (dedicated for LCD panel)
  - Maintenance monitor (d21-0 to 3)
  - Automatic tuning (d22-0)
  - Hardware monitor (d30-0 to 5)
- **Block-A Parameter Mode** : Parameters changed frequently during the normal usage state.

  Knob or ▲ ▼ Key
  - Frequency setting (A00-2 to 3)
  - Acceleration/deceleration time (A01-0, 1)
  - DC Brake (A03-1 to 2)
  - Custom parameters (A04-0 to 7)
  - Parameter B and C indicatory skip (A05-0 to 2)
  - ASR control constant (A10-0 to 5)
  - ACR control constant (A11-0 to 3)

(Continued on next page)

Fig. 4-5-2 (1) Parameter configuration

RST/MOD Key

Knob or ▲ ▼ Key

Block-B Parameter Mode : Parameters changed infrequently during the normal usage state

- Basic function settings
  - Output rating (B01-0 to 9)
  - Motor circuit constant (IM) (B02-0 to 9)
  - Gearing comparative setting (B06-0, 2, 3, 5, 6, 8, 9, B, C, E)
  - Upper/Lower limit setting (B07-2, 3)
- Extended function setting
  - Acceleration/deceleration time setting (B10-0 to 6)
  - Program frequency (speed) setting (B11-0 to 8)
  - Automatic braking on power failure setting (B12-0, 1)
  - Local setting (B13-0 to 9)
  - ASR dead band setting (B14-0)
  - Machine time constant setting 2 (B15-0)
  - Automatic torque bias setting (B16-0 to B)
  - Current limit (B18-0 to 8)
  - Automatic tuning function (B19-0 to 2)
  - Auxiliary drive 0 exclusive setting (B20-0 to B23-4)
  - Auxiliary drive 1 exclusive setting (B24-0 to B27-4)
  - Auxiliary drive 2 exclusive setting (B28-0 to B2B-4)
  - Auxiliary drive 3 exclusive setting (B2C-0 to B2F-4)
  - Speed control extended function (B30-0 to 8)
  - Sensor-less control function (B31-0 to 6)
  - Vector control compensation selection (B32-0 to 4)
  - M fluctuation compensation table reference speed (B33-0 to 7)
  - M fluctuation compensation (B34-0 to 7)
- Software option function settings
  - Software option function (B40-0)
  - Program ramp – acceleration (B41-0 to 7)
  - Program ramp – deceleration (B42-0 to 7)
  - PID control (B43-0 to A)
  - Traverse run (B45-0 to 6)
  - External brake control (B46-0 to 5)
  - Pattern run (B50-0 to B59-3)

(Continued on next page)

Fig. 4-5-2 (2) Parameter configuration

RST/MOD Key

Knob or ▲ ▼ Key

Block-C Parameter Mode : Parameters changed infrequently during the normal usage state

Basic function settings

Control methods	(C00-0 to 7)
Various setting input selection	(C02-0 to 8)
Sequence input terminal function – 1	(C03-0 to F)
Sequence input terminal function – 2	(C04-0 to F)
Sequence input terminal function – 3	(C05-0 to F)
Sequence input terminal function – 4	(C06-0 to A)
Analog input terminal function	(C07-0 to A)
Automatic start setting	(C08-0)
Parameter protection/operation locks	(C09-0 to 7)
Custom parameter register	(C10-0 to 7)
Operation panel mode setting	(C11-0 to 7)
Setting input terminal function	(C12-0 to F)
Output terminal function	(C13-0 to F)
Meter output gain	(C14-0 to B)
Status output detection level	(C15-0 to E)

Extend function settings

Start interlock	(C20-0 to 3)
Retry/pick-up	(C21-0 to 3, 5 to 7)
Overload	(C22-0 to 7)
Speed detection error monitor	(C24-0 to 7)
High-efficiency operation	(C25-0 to 2)
Standard serial	(C26-0 to 7)
Password No.	(C28-0, 1)

Hardware option function settings

Control mode selection	(C30-0)
Main circuit option selection	(C31-0 to 3)
PC (parallel) interface (future)	(C32-0 to 2)
Sequence output terminal function	(C33-0 to 3)
Field network interface	(C34-0 to 7)
Encoder setting	(C50-0 to 3)

Utility mode U

Parameter Control	(U00-0)
Password No. setting	(U00-1)
Built-in PLC setting	(U10-0 to U67-7)

(Note) At the default setting, only the basic functions are displayed. The extended function, software option function, hardware option function parameters are skipped.
Thus, to change these parameters, change parameter A05-0 to 2 (parameter B, C block skip setting), so that the target parameters are displayed.

Fig. 4-5-2 (3) Parameter configuration

4-5-3 PM motor control mode with sensor (C30-0 $\boxed{f0}$ = 4)

The configuration of the parameters is shown in Fig. 4-5-3.

Mode

RST/MOD Key

- **Monitor mode** : Monitors (displays) the internal status.

  Knob or ▲ ▼ Key

Output frequency monitor	(d00-0 to 5)
Frequency setting monitor	(d01-2 to 4)
Current monitor	(d02-0 to 9)
Voltage monitor	(d03-0 to 3)
Sequence status	(d04-0 to 7)
Minor fault monitor	(d05-0, 1)
Pattern run monitor	(d06-0, 1)
Analog input random scale display	(d08-0 to 2)
Input display	(d08-3 to C)
Built-in PLC monitor	(d10-0 to 3)
Torque setting monitor	(d11-0 to 5)
Automatic torque bias	(d14-0)
Electric angle monitor	(d15-0)
Magnetic pole position estimation monitor	(d16-0 to 3)
Extended monitor	(d20-0 to 4)
Maintenance monitor	(d21-0 to 3)
Hardware monitor	(d30-0 to 5)

  Extended monitor (d20-0 to 4):
  - Fault history monitor
  - Minor failure past record indication
  - Parameter A, B and C modification list entry
  - Sequence input display (dedicated for LCD panel)
  - Sequence output display (dedicated for LCD panel)

- **Block-A Parameter Mode** : Parameters changed frequently during the normal usage state.

  Knob or ▲ ▼ Key

Frequency setting	(A00-2, 3)
Acceleration/deceleration time	(A01-0, 1)
DC Brake	(A03-1, 2)
Custom parameters	(A04-0 to 7)
Parameter B and C indicatory skip	(A05-0 to 2)
ASR control constant	(A10-0 to 5)
ACR control constant	(A11-2, 3)
ACR control constant (PM motor)	(A20-0 to 3)

(Continued on next page)

Fig. 4-5-3 (1) Parameter configuration

Block-B Parameter Mode : Parameters changed infrequently during the normal usage state

RST/MOD Key

Knob or ▲ ▼ Key

Basic function settings

Output rating	(B01-0 to 9)
Motor circuit constant (PM)	(B03-0 to 5)
Gearing comparative setting	(B06-0, 2, 3, 5, 6, 8, 9, B, C, E)
Upper/Lower limit setting	(B07-2, 3)

Extended function setting

Acceleration/deceleration time setting	(B10-0 to 6)
Program frequency (speed) setting	(B11-0 to 8)
Automatic braking on power failure setting	(B12-0, 1)
Local setting	(B13-0 to 9)
ASR dead band setting	(B14-0)
Machine time constant setting 2	(B15-0)
Automatic torque bias setting	(B16-0 to B)
Current limit	(B18-0 to 8)
Automatic tuning function	(B19-0)
Auxiliary drive 0 exclusive setting	(B20-0 to B23-4)
Auxiliary drive 1 exclusive setting	(B24-0 to B27-4)
Auxiliary drive 2 exclusive setting	(B28-0 to B2B-4)
Auxiliary drive 3 exclusive setting	(B2C-0 to B2F-4)
Speed control extended function	(B30-0 to 8)
Vector control compensation selection	(B32-4 to 6)
Voltage saturation prevention control constant	(B35-0 to 4)
Field weakening electric current table	(B36-0 to 6)
Torque to Iq conversion adjustment coefficient table	(B38-0 to 6)
Pole position presumption	(B39-0 to 5)

Software option function settings

Software option function	(B40-0)
Program ramp – acceleration	(B41-0 to 7)
Program ramp – deceleration	(B42-0 to 7)
PID control	(B43-0 to A)
Traverse run	(B45-0 to 6)
External brake control	(B46-0 to 5)
Pattern run	(B50-0 to B59-3)

(Continued on next page)

Fig. 4-5-3 (2) Parameter configuration

RST/MOD Key

Knob or ▲ ▼ Key

- **Block-C Parameter Mode** : Parameters changed infrequently during the normal usage state
  - Basic function settings
    - Control methods (C00-0 to 7)
    - Various setting input selection (C02-0 to 8)
    - Sequence input terminal function – 1 (C03-0 to F)
    - Sequence input terminal function – 2 (C04-0 to F)
    - Sequence input terminal function – 3 (C05-0 to F)
    - Sequence input terminal function – 4 (C06-1 to A)
    - Analog input terminal function (C07-0 to A)
    - Automatic start setting (C08-0)
    - Parameter protection/operation locks (C09-0 to 7)
    - Custom parameter register (C10-0 to 7)
    - Operation panel mode setting (C11-0 to 7)
    - Setting input terminal function (C12-0 to F)
    - Output terminal function (C13-0 to F)
    - Meter output gain (C14-0 to B)
    - Status output detection level (C15-0 to E)
  - Extend function settings
    - Start interlock (C20-0 to 3)
    - Retry/pick-up (C21-0 to 3)
    - Overload (C22-0 to 7)
    - Speed detection error monitor (C24-0 to 2, 4 to 7)
    - High-efficiency operation (C25-0 to 2)
    - Standard serial transmission setting (C26-0 to 7)
    - Password No. (C28-0, 1)
  - Hardware option function settings
    - Control mode selection (C30-0)
    - Main circuit option selection (C31-0 to 3)
    - PC (parallel) interface (future) (C32-0 to 2)
    - Sequence output terminal function (C33-0 to 3)
    - Field network interface (C34-0 to 7)
    - Encoder setting (C50-0, 2, 3)
    - Encoder setting (PM motor) (C51-0 to 9)
- **Utility mode U**
  - Parameter Control (U00-0)
  - Password No. setting (U00-1)
  - Built-in PLC setting (U10-0 to U67-7)

(Note) At the default setting, only the basic functions are displayed. The extended function, software option function, hardware option function parameters are skipped.
Thus, to change these parameters, change parameter A05-0 to 2 (parameter B, C block skip setting), so that the target parameters are displayed.

Fig. 4-5-3 (3) Parameter configuration

Chapter 5 Control Input/Output

5-1 Input/output terminal function

The terminal block and input/output functions related to control are as shown in Tables 5-1.

Table 5-1 Terminal block functions (TB1, TB2)

	Symbol	Name	Features
Sequence input	PSI1 to PSI7	Programmable input	These commands can be arbitrarily led to the input signal circuit in the control PCB through sequence input selective setting (C03 to C06). The pulse train input uses input terminal PSI7.
	RY0, RY24	Sequence input common	These are common terminals for sequence input signals. There are two kinds for the change of the sink / source logic. RY24 and RY0 must not be shorted.
Analog input	AI1, 2	Programmable input	These are the analog input terminal in which the voltage input of the range of 0 to 10V and the current input of the range of 0 to 20mA are possible. These signals can be arbitrarily led to the input signal circuit in the control PCB through analog input selective setting (C07). AI1: Set C12-0 to 1 and DIP SW (DS1-2) to OFF for Voltage input. Set C12-0 to 2 and DIP SW (DS1-2) to ON for Current input. AI2 :Set C12-4 to 1 and DIP SW (DS1-3) to OFF for Voltage input. Set C12-4 to 2 and DIP SW (DS1-3) to ON for Current input. The converter resolution is 12 bits.
	AI3		This is the analog input terminal in which the voltage input of the range of -10 to 10V is possible. This signal can be arbitrarily led to the input signal circuit in the control PCB through analog input selective setting (C07). The analog/digital converter resolution is 12 bits within the range of -10 to +10V.
	COM	Analog input common	This is the common terminal for AI1, AI2 and AI3 signals.
	P10	AI1 or AI2 source	This is a terminal for supplying a power supply to an analog input VR. This terminal is connected to 15V power supply through 750-ohm resistance.
Analog output	A01, A02	Programmable output	These are the analog output terminals for meter, and are switched to a voltage output and a current output. Arbitrary internal signals can be outputted by setup of an output terminal function (C13-0, C13-1). AO1: Set W3 to 1 and set C14-7 to 1 or 2 for Voltage output. Set W3 to 2 and set C14-7 to 3 for Current output. AO2: Set W4 to 1 and set C14-8 to 1 or 2 for Voltage output. Set W4 to 2 and set C14-8 to 3 for Current output. The converter resolution is 10 bits.
	COM	Analog output common	This is the common terminal for the AO1 and AO2 signals.
Sequence output	RA, RC	Programmable output (1a contact)	This is a relay contact output. Internal signals can be output with the C13-2 setting.
	FA, FB, FC	Programmable output (1c contact)	This is a relay contact output. Internal signals can be output with the C13-6 setting.
	PSO1 to PSO3	Programmable output (Open collector)	This is the open collector output. Internal signals can be output with the C13-3,4,5 setting.
	PSOE	Open collector output common	These are the common terminals for the PSO1, 2 and 3 signals.

5-2 Control input/output circuit

Examples of the control input/output circuit wiring are shown in table 5-2. The precautions must be observed during wiring.

Table 5-2 Control input/output circuit

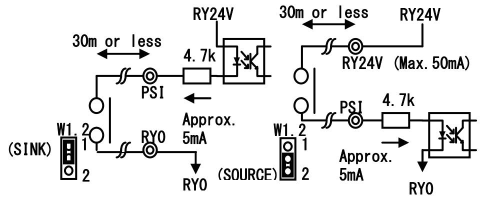
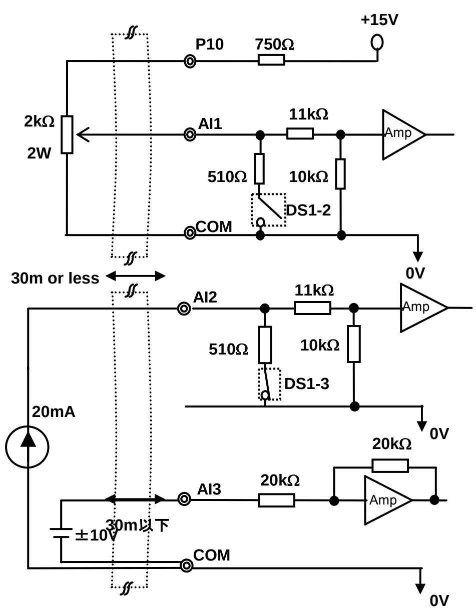
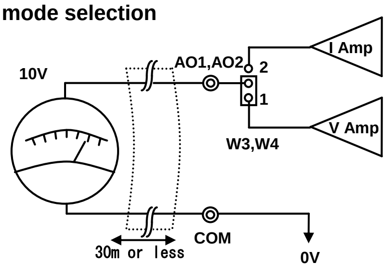
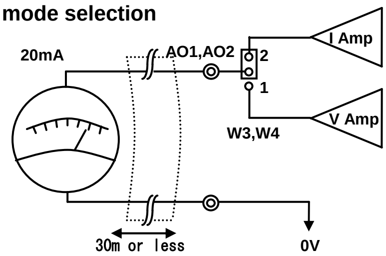
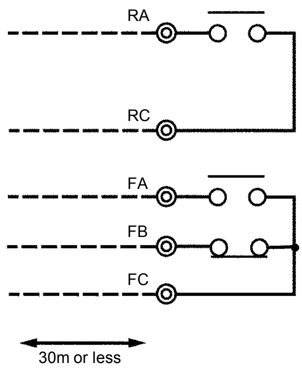
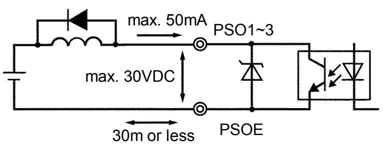
Function	Example of wirings	Precautions
Sequence input	**(a) Sink logic** **(b) Source logic**  (W1 is for PSI1 to PSI6, W2 is dedicated for PSI7.)	1. Wiring must not be longer than 30m. 2. The allowable leakage current is 0.5mA. 3. Use a minute current contact. 4. Do not connect to the analog input/output. 5. The sink/source logic can be changed with W1 and W2. (1: Sink 2: Source)
Analog input and P10 output	 	1. Use 2kΩ/2W rating setter for the external variable resistor. (Only when using AI1 or AI2) 2. The AI1 and AI2 input mode is changed with the DIP switch (DS1) and parameter. Check the DIP switch setting before turning the power ON. The default setting is OFF (voltage mode). 3. The maximum input rating for AI1, AI2 and AI3 (voltage mode) is 10.5V (±10.5V for AI3). (Internal impedance: approx. 20kΩ) 4. The maximum input rating for AI1 and AI2 (current mode) is 0 to 20.5mA. (Internal impedance: approx. 500kΩ) 5. Use a shielded wire shorter than 30m for the signal wire. 6. For shield connections connect the screen to VAT300´s terminal COM. 7. Do not connect to the sequence input/output circuit.
Analog output	**Voltage mode selection**  **Current mode selection**  **(W3: for A01, W4: for A02)**	1. Use a 10V full scale (impedance 10kΩ or more) meter (voltage mode selection). Note) The maximum output current is 1mA. 2. Use a 20mA full scale (impedance 500Ω or less) meter (current mode selection). 3. The mode is changed with the EL-BIT connector (W3, W4) and parameter. (1: Voltage output, 2: Current output) 4. Use a shielded wire shorter than 30m for the signal wire. 5. For shield connections, open the mate side, and connect VAT300 side to COM.

Table 5-2 Control input/output circuit (continued)

<table>
<tr><th>Function</th><th>Example of wirings</th><th>Precautions</th></tr>
<tr><td>Sequence output
(Relay output)</td><td>
</td><td>1. Use within the rated range shown below. To comply with UL/CE, use at 30VAC/DC or less.
<table>
<tr><th></th><th>RUN</th><th>FLT</th></tr>
<tr><td>Rated capacity (resistance load)</td><td>250VAC 3A
30VDC 3A</td><td>250VAC 30VDC
5A (NO)
3A (NC)</td></tr>
<tr><td>Rated capacity (induction load)</td><td>2A
cosφ=0.4</td><td>3A (NO)
1.8A (NC)
cosφ=0.7</td></tr>
<tr><td>Max. voltage</td><td>277VAC
30VDC</td><td>250VAC
150VDC</td></tr>
<tr><td>Max. current</td><td>3A</td><td>5A (NO)
3A (NC)</td></tr>
<tr><td>Switching capacity</td><td>750VA
90W</td><td>1250VA(NO)
750VA (NC)</td></tr>
</table>
2. The wire must be shorter than 30m.</td></tr>
<tr><td>Sequence output
(Open collector output)</td><td>
</td><td>1. To drive an inductive load, such as a coil, insert the free wheeling diode shown in the drawing.
2. Keep the wiring length to 30m or less.
3. Use within the following rating range. 30VDC, 50mA</td></tr>
</table>

5-3 Programmable sequence input function (PSI)

The sequence signal's input points include the base PCB terminal block input, panel and transmission data sent from the host controller.
The reset signals (RESET) are all input at logical OR from the input point, and the emergency stop signal (EMS) is input at the logical OR of the terminal block and serial transmission data.
For the other sequence signals, the input point can be determined with the input point changeover command (COP) or system parameter settings (J1, J2) from the operation panel.

The sequence input from the basic PCB terminal block is a 7-point programmable sequence input. For the programmable input, the function can be selected from Table 5-3 and randomly assigned. By connecting the relay interface option (U30V24RY0), extension up to eleven points is possible. The programmable input terminals are PSI1 to PSI7. When extended, the terminals are PSI1 to PSI11. The default settings are as shown below.

Default settings

Symbol	Setting
PSI1	Forward run
PSI2	Reset signal
PSI3	Emergency stop
PSI4	Reverse run
PSI5	Forward jogging
PSI6	Reverse jogging
PSI7	None

The programmable input signal functions are given in Table 5-3.

The general control block diagram of the IM speed sensor-less vector control and the IM vector control with speed sensor is shown in Fig.5-3.

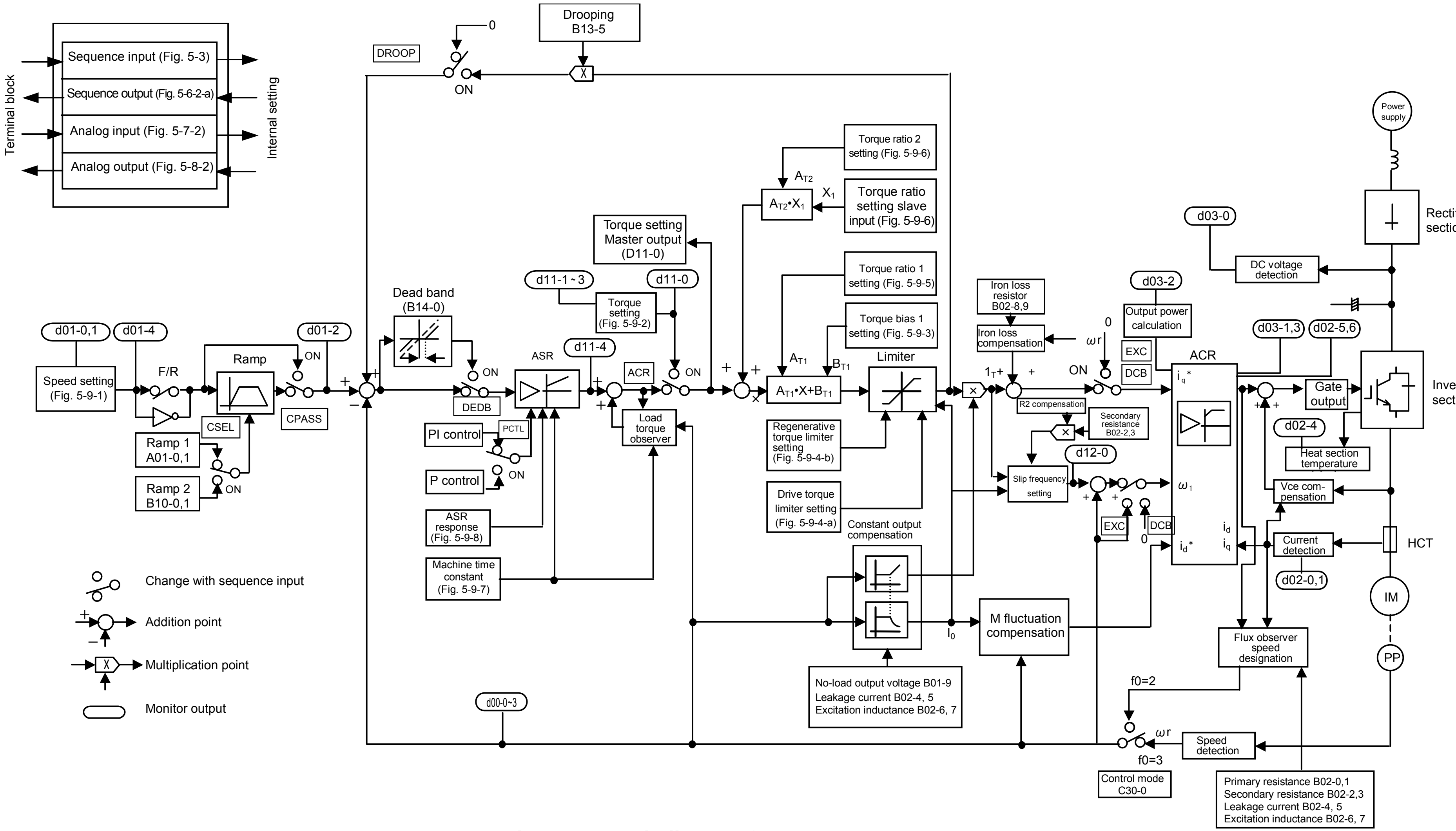


Fig. 5-3 Block diagram for IM vector control

Table 5-3 Programmable sequence input functions (1)

Connection of PSI1 to PSI11 is possible. Note that PSI8 to PSI11 are options.
The connection is done with data Nos.: C03 to C06

<table>
<tr><th>Symbol</th><th>Name</th><th>Function</th></tr>
<tr><td>F RUN</td><td>Forward run</td><td>This is the forward run command for the remote operation mode (when LCL LED is not ON). The operation command or self-hold mode can also be selected. (C00-0)</td></tr>
<tr><td>EMS</td><td>Emergency Stop</td><td>This stops all run commands when stopped. If turn ON during operation, the operation stops. The operation can be stopped with ramp deceleration stop or coast to stop. This signal can also be output as a fault (FLT). (C00-4)</td></tr>
<tr><td>R RUN</td><td>Reverse run</td><td>This is a command for reverse run. A command of reverse run mode (C00-0=2) is available in the run/reverse mode.</td></tr>
<tr><td>F JOG</td><td>Forward jogging</td><td rowspan="2">These are jogging commands. If this signal is ON while RUN is OFF, operation then conforms to the setting of jogging (A00-1 or 3) made within the control circuit. For stoppage, either ramp down stop or coast-stop is available. (C00-2)</td></tr>
<tr><td>R JOG</td><td>Reverse jogging</td></tr>
<tr><td>HOLD</td><td>Hold</td><td>This is a stop signal generated when the setting is to be the self-hold mode (C00-0=3) during the operating mode. The VAT300 stops with this signal turned off. Input of F RUN or R RUN can be held with this signal turned on.</td></tr>
<tr><td>BRAKE</td><td>DC brake</td><td>DC brake can be operated with this signal.
In the case of PM motor control, DC excitation takes place. Shaft torsion will occur according to the load torque.</td></tr>
<tr><td>RESET</td><td>Fault reset</td><td>This resets the fault state. The fault output (FLT LED ON, FAULT relay) can be turned OFF and operation resumed with this signal.</td></tr>
<tr><td>COP</td><td>Serial transmission selection</td><td>The sequence commands from serial transmission are validated.
By selecting the control changeover method (C00-6), the input point of the auxiliary operation sequence during COP ON can be selected.
<table>
<tr><td>COP</td><td>C00-6</td><td>Input point</td></tr>
<tr><td rowspan="2">ON</td><td>1</td><td>Terminal block input</td></tr>
<tr><td>2</td><td>Serial transmission input</td></tr>
</table>
For resetting and emergency strop, the terminal block and serial transmission are both valid regardless of the C00-6 setting.</td></tr>
<tr><td>CSEL</td><td>Ramp selection</td><td>Accel./decel. ramp performance is switched over. Accel./decel. time 2 (B10-0, 1) is available with ON, and accel./decel. time 1 (A01-0, 1) is available with OFF.</td></tr>
<tr><td>I PASS</td><td>Ratio interlock bypass</td><td>Ratio interlock operation is bypassed.</td></tr>
<tr><td>CPASS</td><td>Ramp bypass</td><td>The ramp function is bypassed.</td></tr>
<tr><td>PIDEN</td><td>PID control selection</td><td>The PID control is validated.</td></tr>
</table>

Table 5-3 Programmable sequence input functions (2)

<table>
<tr><th>Symbol</th><th>Name</th><th colspan="2">Function</th></tr>
<tr><td>AFS1</td><td>Speed setting 1 selection</td><td>The frequency (speed) setting is carried out with the input selected with C07-0.</td><td rowspan="5">When inputs are entered simultaneously, setting is selected in accordance with following preference order.
JOG>CFS>PLS_IN>PROG> AFS3> AFS2>AFS1</td></tr>
<tr><td>AFS2</td><td>Speed setting 2 selection</td><td>The frequency (speed) setting is carried out with the input selected with C07-1.</td></tr>
<tr><td>AFS3</td><td>Speed setting 3 selection</td><td>The frequency (speed) setting is carried out with the input selected with C07-2.</td></tr>
<tr><td>PROG</td><td>Program function enable</td><td>Used for multiple setting. Selection of 8 steps (PROG0~PROG7) is made with S0~S3, SE.</td></tr>
<tr><td>CFS</td><td>Serial communication setting select</td><td>Selects settings from the serial or parallel transmission option.</td></tr>
<tr><td>S0 to S3
SE</td><td>Program setting selection</td><td colspan="2">When PROG is ON, the program frequency (speed) 0~7 are selected (B11-0~7). The BCD/Direct input mode can be selected with B11-8.</td></tr>
<tr><td>FUP</td><td>Frequency (speed) increase</td><td colspan="2" rowspan="2">The currently selected direct frequency (speed) setting (A00-0) or program frequency (speed) setting 0 to 7 (B11-0~7) is increased or decreased.
When the ON state continues, the frequency is incremented/decremented with the currently valid ramp rate.</td></tr>
<tr><td>FDW</td><td>Frequency (speed) decrease</td></tr>
<tr><td>BUP</td><td>Ratio interlock bias increase</td><td colspan="2" rowspan="3">When IVLM is ON and the BUP, BDW ON state continues, the sequential ratio bias will increase/decrease at the currently valid ramp rate.
When IVLM turns OFF, the bias increase/decrease value will be cleared to zero.
The BUP, BDW operation will be invalidated.</td></tr>
<tr><td>BDW</td><td>Ratio interlock bias decrease</td></tr>
<tr><td>IVLM</td><td>Ratio interlock bias increase/ decrease selection</td></tr>
<tr><td>AUXDV</td><td>Auxiliary drive selection</td><td colspan="2">The auxiliary drive setting is validated with this signal. This operation is valid during the inverter stopping.</td></tr>
<tr><td>PICK</td><td>Pick-up</td><td colspan="2">While this signal is ON, pick-up operation is effected as soon as F RUN or R RUN is ON.</td></tr>
<tr><td>MBRK_ans</td><td>External brake answer</td><td colspan="2">Inputs an answer in response to the external brake command.</td></tr>
<tr><td>PRST</td><td>STP reset</td><td colspan="2">Inputs the pattern operation reset signal when performing spinning frame operation.</td></tr>
<tr><td>S5 to S7</td><td>Digital torque bias 0 to 4</td><td colspan="2">Selects a digital torque bias value (B16-1 to 5) by inputting.</td></tr>
<tr><td>AUXSW0</td><td>Auxiliary drive No. selection L</td><td colspan="2" rowspan="2">Using the input, select the parameter to be applied from the four auxiliary drive operation control parameters.</td></tr>
<tr><td>AUXSW1</td><td>Auxiliary drive No. selection H</td></tr>
<tr><td>PLS_IN</td><td>Pulse train input selection</td><td colspan="2">This validates the pulse train input.</td></tr>
<tr><td>OCLLV1</td><td>OCL level setting 1</td><td colspan="2">The overcurrent limit level 2 (B18-7) is validated during main drive operation.</td></tr>
<tr><td>OCLLV2</td><td>OCL level setting 2</td><td colspan="2">The overcurrent limit level 3 (B18-8) is validated during main drive operation.</td></tr>
</table>

Table 5-3 Programmable sequence input functions (3)

Symbol	Name	Function
E.FLT1 to 8	External fault	This function is valid only when input from the terminal block. When turned ON, a fault will occur. If turned ON during operation, a fault will occur, and the operation will stop. Only coast to stop can be selected for the stopping method. Even if this input when a fault has already occurred, the input will be invalid.
EXC	Pre-excitation	Pre-excitation operation takes place. Pre-excitation operation refers to establishing only the flux in the motor without generating toque. If torque is required immediately from the start of operation, use pre-excitation operation beforehand to establish the flux in the motor.
ACR	ACR	ACR operation is selected.
PCTL	P Control	ASR control is changed from the PI control to the P control.
LIM1	Drive torque limiter changeover	The drive torque limiter reduction setting by the analog input or serial transmission is validated.
LIM2	Regenerative torque limiter changeover	The regenerative torque limiter reduction setting by the analog input or serial transmission is validated.
MCH	Machine time constant changeover	During ASR operation, ASR gain is changed over. Machine time constant 2 (B15-0) is available with ON, and machine time constant 1 (A10-1) is available with OFF.
RF0	0 setting	The speed setting is changed to 0min^{-1}.
DROOP	Drooping changeover	Drooping function is validated. (B13-5)
DEDB	Dead band setting	The dead band setting of ASR is validated. (B14-0)
TRQB1	Torque bias setting 1	The torque bias input 1 is valid.
TRQB2	Torque bias setting 2	The torque bias input 2 is valid.

5-4 Programmable sequence output function (PSO)

As a standard, the sequence outputs include five points (1c contact output: one point, 1a contact output: one point, open collector output: three points). The signals shown in Table 5-4 can be randomly output from the five channels. By connecting the relay or PC interface option (U30V24RY0, U30V24PI0), extension up to nine points is possible. The standard programmable output terminals are FA-FB-FC, RA-RC and PSO1 to PSO3. The default settings are shown on the right. When extended, the terminals are the four points PSO4A-PSO4B-PSO4C to PSO7A-PSO7B- PSO7C for the U30V24RY0. With the U30V24PI0, the two points PSO4 and PSO5 have been added.

Default values

Terminal symbol	Setting
FA-FB-FC	Fault
RA-RC	Run
PSO1-PSOE	Ready (1)
PSO2-PSOE	Current detection
PSO3-PSOE	Frequency (speed) attainment

Table 5-4 Programmable sequence output functions

Symbol	Name	Function
RUN	Run	This turns ON during running, jogging or DC braking. Turning ON or OFF during pre-excitation can be selected. At C00-7=1, run output is ON during pre-excitation . At C00-7=2, run output is OFF during pre-excitation .
FLT	Fault	This turns ON during a fault.
MC	Charge completed	This turns ON when the DC main circuit voltage reaches a voltage higher than the MC ON level.
RDY1	Ready (1)	This turns ON when there is no fault, EMS is not activated, pre-charging is complete and the encoder signal is detected (only in PM motor control with sensor mode).
RDY2	Ready (2)	This turns ON when there is no fault, pre-charging is complete and the encoder signal is detected (only in PM motor control with sensor mode).
LCL	Local	This turns ON when the operation mode is local (operation from the operation panel).
REV	Reverse run	V/f: This turns ON while the output frequency is reverse running. VEC, PM: This turns ON while the motor is reverse running.
IDET	Current detection	This turns ON when the output current reaches the detection level (C15-1) or higher.
ATN	Frequency (speed) attainment	This turns ON when the output frequency (speed) reaches the set frequency (speed). The detection reach width is set with C15-0.
SPD1	Frequency(speed) detection (1)	This turns ON when the output frequency (speed) absolute value reaches a frequency(speed) higher than the speed set with the detection level (C15-2).
SPD2	Frequency(speed) detection (2)	This turns ON when the output frequency (speed) absolute value reaches a frequency(speed) higher than the speed set with the detection level (C15-3).
COP	Transmission selection	This turns ON when serial transmission operation is selected.
EC0~EC3	Specific fault output	This turns ON when the fault set up by C15-6,7,8,9 occurs.
ACC	Acceleration	This turns ON during acceleration.
DCC	Deceleration	This turns ON during deceleration.
AUXDV	Auxiliary drive selection	This turns ON when the auxiliary drive parameter setting is validated by the sequence input AUXDV.
ALM	Minor fault	This turns ON during a minor fault.
FAN	Fan control	This turns ON during running, jogging, pre-excitation and DC braking. A three minute off delay is provided, so even if the above operations turn OFF, this control will not turn OFF for three minutes. This is used for external fan control.
ASW	Automatic start wait	When C08-0 is selected and the automatic start function is used, this will turn ON while waiting for automatic start.
ZSP	Zero speed	This turns ON when the output frequency (speed) absolute value is below the level set with zero speed (C15-4).
LL MT	PID lower limit output	This turns ON when the feedback value exceeds the lower limit value (<B43-4) during PID control.
ULMT	PID upper limit output	This turns ON when the feedback exceeds the upper limit value (>B43-3) during PID control.
Doff-End	Doff-End alarm output	This turns ON only at the point going back the set time (B60-5) from the moment auto stoppage is engaged after completing the final step when performing spinning frame operation.
MBRK	External brake output	Outputs an external brake command.
DVER	Speed deviation error	This turns ON during a speed deviation error.
BPF	Stoppage deceleration output	This turns ON when the DC voltage is the set value (B12-1) or under during automatic braking on power failure function.
RDELAY	Run delay answer	This signal delays(C15-5) the turning OFF of the sequence output RUN.
MPO1 to 8	Multi-pump output	Output signal for multi-pump control
PLC1 to 8	Built-in PLC output	Sequence output signal of Built-in PLC

(Note) "ON" indicates that the contact is closed when + is set, and the contact is open when - is set.

5-5 Sequence input logic

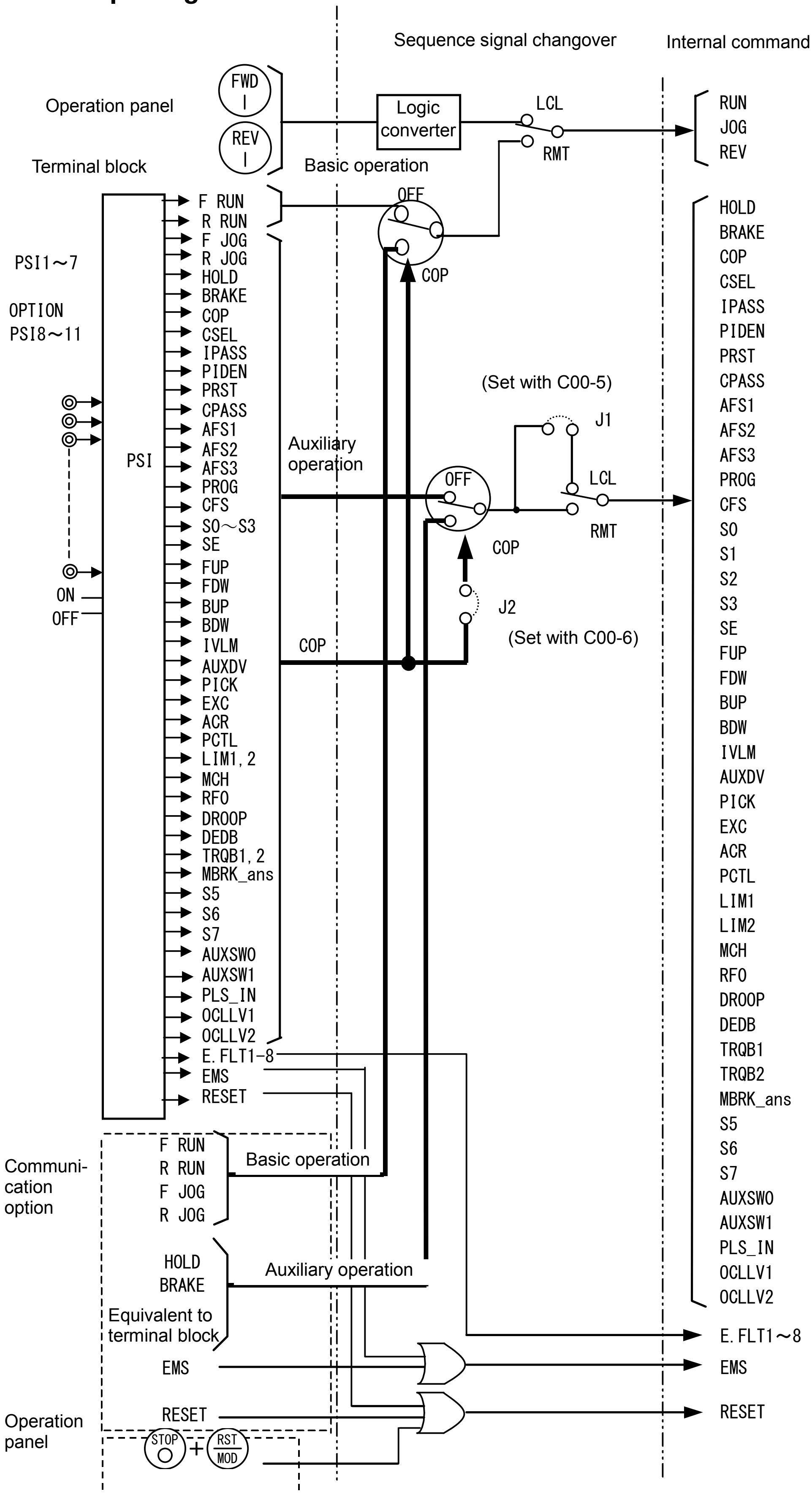


Fig. 5-5 Sequence input logic

5-6 Changing of terminal functions

The programmable input terminals (PSI1 to PSI11) can be connected to arbitrarily internal commands. The internal state can be connected to the programmable output terminal (FA-FB-FC, RA-RC and PSO1 to PSO7) to lead in the ON/OFF signals.

5-6-1 Sequence input terminal assignment and monitoring

The parameters can be assigned to the terminal block as shown in Fig. 5-6-1-a according to the parameter Nos. C03 to C06. Each internal signal can be fixed to ON (set value to 16) or OFF (set value to 0). Fig. 5-6-1-b shows the case when the ON state of each internal signal is shown on the D04 monitor. This monitoring is performed with D04-0 to 3. F RUN, R RUN, F JOG and R JOG are displayed with a combination of RUN, REV and JOG converted into an internal command.

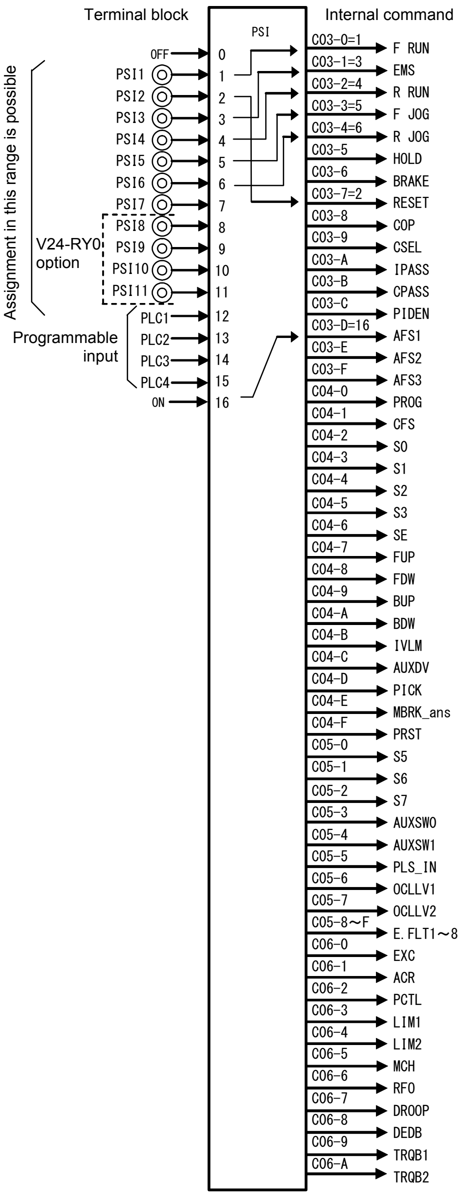


Fig. 5-6-1-a Assignment of sequence input

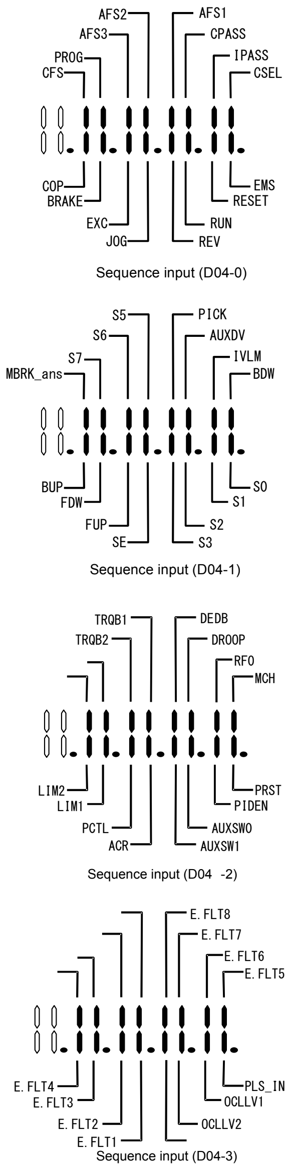
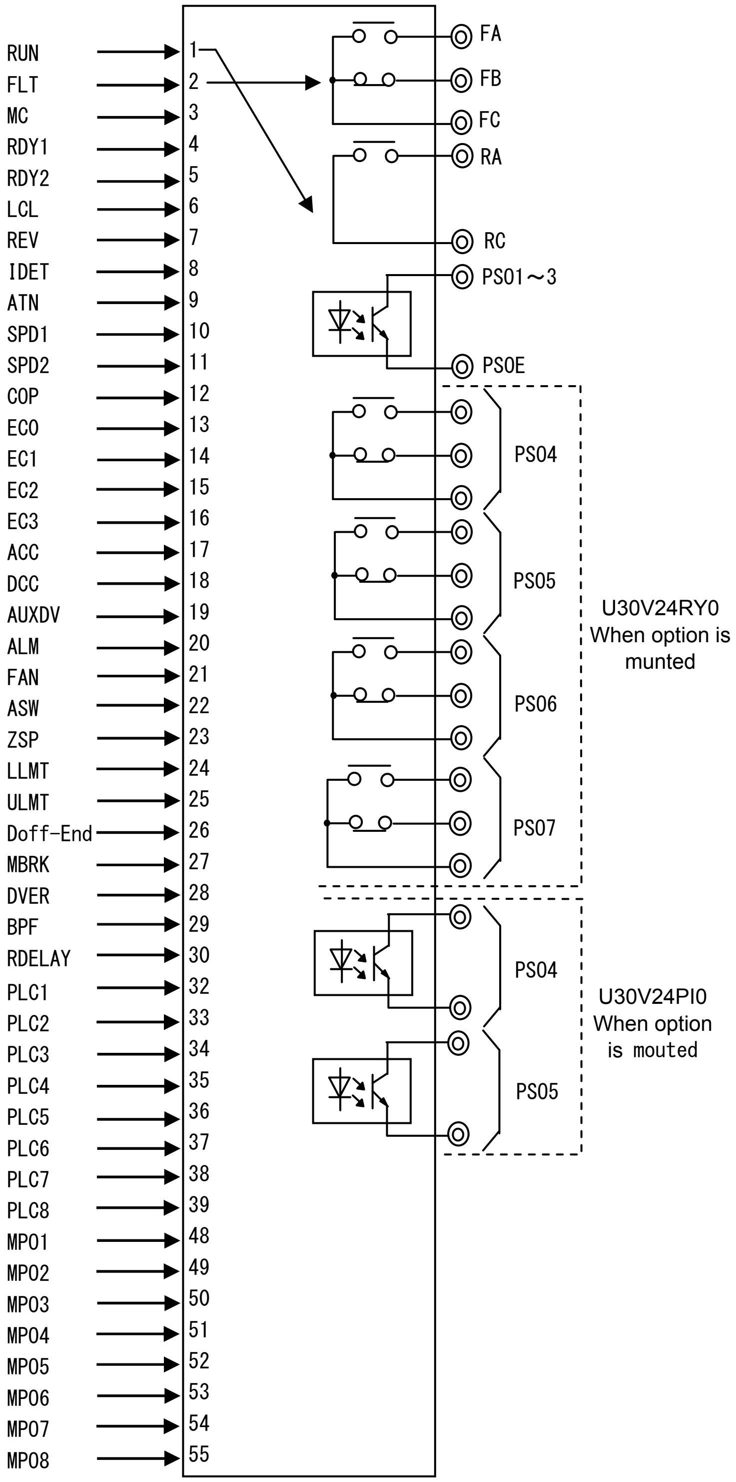


Fig. 5-6-1-b Sequence input monitor

5-6-2 Sequence output terminal assignment and monitoring

The ON/OFF of the internal signals can be output to the FA-FB-FC, RA-RC and PSO1 to 7 terminals as shown in Fig. 5-6-2-a with the parameter Nos. C13-2 to 6 and C33-0 to 3. The ON/OFF of each signal can be monitored as shown in Fig. 5-6-2-b. This monitoring is executed with D04-4, 5,6, 7.



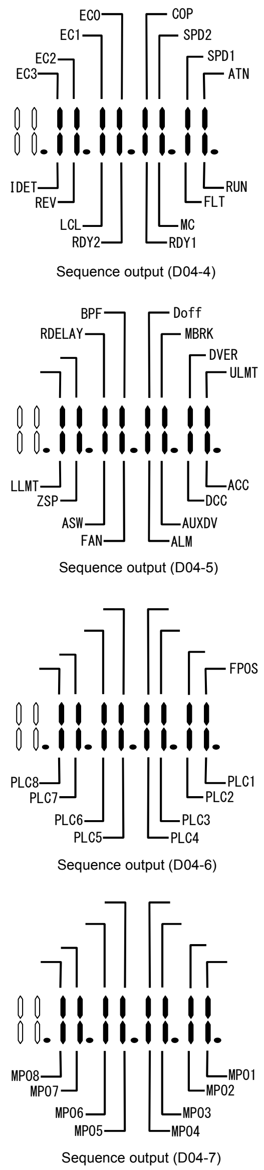


Fig. 5-6-2-b Sequence output

Fig. 5-6-2-a Assignment of sequence output

Note) "ON" indicates that the contact is closed when + is set, and the contact is open when - is set.

5-7 Programmable input function (PI)

5-7-1 Types of analog inputs

As a standard, there are three channels for the analog input. Each analog input can be connected to the internal setting signals shown in Table 5-7-1 by using the programmable input function.

Table 5-7-1 Types of internal setting signals assigned to analog input

<table>
<tr><th rowspan="4">Signal name</th><th colspan="3">Setting range (Note1)(Note3)</th><th rowspan="4">Function</th></tr>
<tr><th colspan="2">AI1, 2</th><th>AI3</th></tr>
<tr><th>Voltage mode</th><th>Current mode</th><th rowspan="2">–10~10V
–5~5V
1~5V</th></tr>
<tr><th>0~10V
0~5V
1~5V</th><th>4~20mA
0~20mA</th></tr>
<tr><td rowspan="2">Speed setting 1
Speed setting 2
Speed setting 3</td><td colspan="2" rowspan="2">0~100%</td><td>–100~100%</td><td rowspan="2">This is the speed setting.
The + polarity is the forward run setting, and the – polarity is the reverse run setting.
If the analog input is selected with the speed setting, the speed setting can be changed between 1, 2 and 3 with the sequence input (AFS1,AFS2,AFS3).</td></tr>
<tr><td>0~100%</td></tr>
<tr><td rowspan="2">Ratio interlock bias setting</td><td colspan="2" rowspan="2">0~100%</td><td>–100~100%</td><td rowspan="2">This is the bias setting for the sequential ratio operation.</td></tr>
<tr><td>0~100%</td></tr>
<tr><td rowspan="2">Traverse center frequency setting</td><td colspan="2" rowspan="2">0~100%</td><td>(0~10V 0~5V)
0~100%
(Note 2)</td><td rowspan="2">This is the center frequency setting for traverse operation.</td></tr>
<tr><td>0~100%</td></tr>
<tr><td rowspan="2">PID feedback</td><td colspan="2" rowspan="2">0~100%</td><td>(0~10V 0~5V)
0~100%
(Note 2)</td><td rowspan="2">This can be used as the feedback input to configure a feedback loop. Do not use the programmable analog output (AO1,AO2) as the PID feedback signal.</td></tr>
<tr><td>0~100%</td></tr>
<tr><td rowspan="2">Torque setting</td><td colspan="2" rowspan="2">0~300%</td><td>–300~300%</td><td rowspan="2">This is the torque setting for ACR operation.
The + polarity is the forward run direction torque, and the – polarity is the reverse run direction torque. The torque setting can be limited by using the torque limiter (A11-2, 3).</td></tr>
<tr><td>0~300%</td></tr>
<tr><td rowspan="2">Drive torque limiter reduction setting</td><td colspan="2" rowspan="2">0~100%</td><td>(0~10V 0~5V)
0~100%
(Note 2)</td><td rowspan="2">The drive torque limit (A10-3 or A11-2) is multiplied using 0V to +10V as 0 to 100%, and the limit value is reduced.
This function is valid when the drive limiter changeover (LIM1) is turned ON with the sequence input.</td></tr>
<tr><td>0~100%</td></tr>
<tr><td rowspan="2">Regenerative torque limiter reduction setting</td><td colspan="2" rowspan="2">0~100%</td><td>(0~10V 0~5V)
0~100%
(Note 2)</td><td rowspan="2">The regenerative torque limit (A10-4 or A11-3) is multiplied using 0V to +10V as 0 to 100%, and the limit value is reduced.
This function is valid when the regenerative limiter changeover (LIM2) is turned ON with the sequence input.</td></tr>
<tr><td>0~100%</td></tr>
<tr><td rowspan="2">Torque bias 1 setting</td><td colspan="2" rowspan="2">0~300%</td><td>–300~300%
0~300%</td><td rowspan="2">This is added to ASR output during ASR operation, or to the torque setting during ACR operation.
This function is valid when the torque bias 1 (TRQB1) is turned ON with the sequence function.</td></tr>
<tr><td>0~300%</td></tr>
<tr><td rowspan="2">Analog torque bias setting</td><td colspan="2" rowspan="2">0~100%</td><td>–100~100%</td><td rowspan="2">This is the torque bias setting when the auto torque bias selection (B16-0) is analog.</td></tr>
<tr><td>0~100%</td></tr>
</table>

(Note 1) Select each analog input mode with C12-0 to A.
(Note 2) AI3 : The setting is limited to 0% during the –10 to 0V and –5 to 0V input.
(Note 3) Setting range/Resolution: AI1, 2 (Voltage input mode) 0 to 10V/12 bit,
AI1, 2 (Current input mode) 0 to 20mA/12 bit,
AI3 -10V to 10V/12 bit
The resolution is reduced according to setting range.
Example) AI1 (Voltage input mode) 0 to 5V/11 bit

Example 5-1) Set as shown below for voltage input mode 0 to 10V.

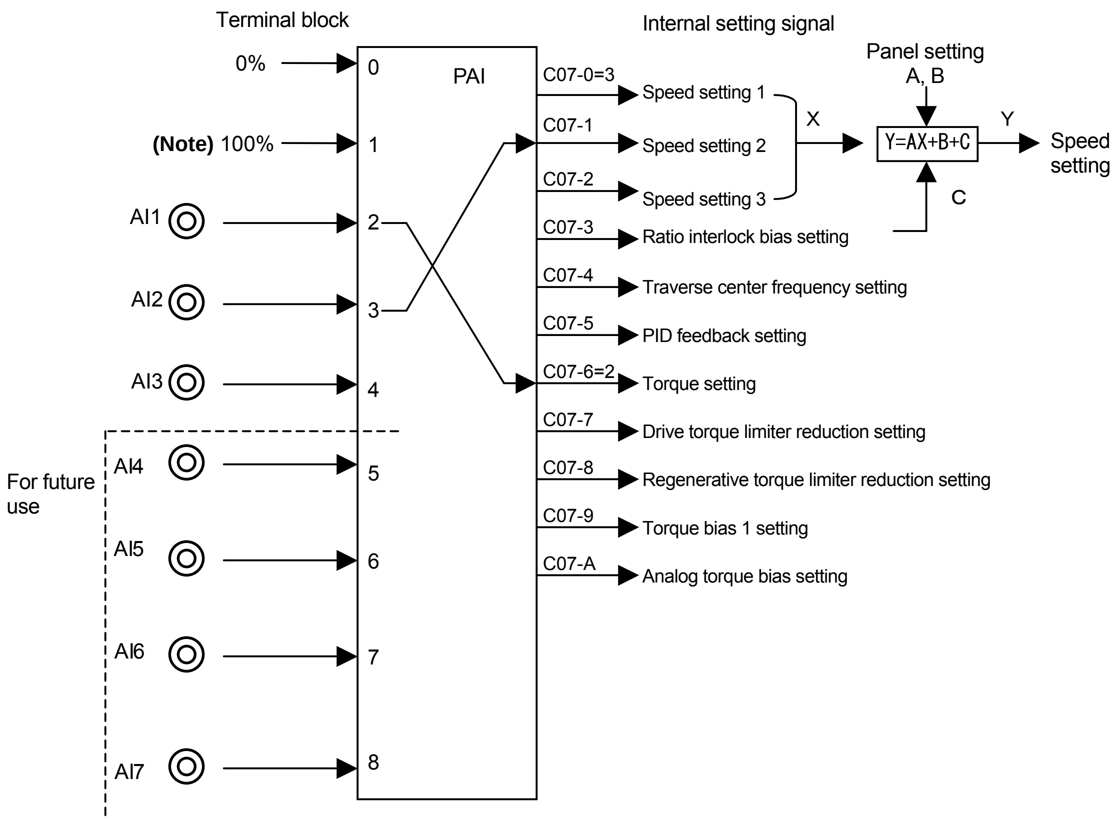
AI1 : C12-0=1 (voltage input mode selection) C12-1=1 (0 to 10V selection) DIP switch DS1-2 OFF
AI2 : C12-4=1 (voltage input mode selection) C12-1=1 (0 to 10V selection) DIP switch DS1-3 OFF

Example 5-2) Set as shown below for current input mode 4 to 20mA

AI1: C12-0=2 (Current input mode selection), C12-2=1 (4 to 20mA selection), DIP switch DS1-2 ON
AI2: C12-4=2 (Current input mode selection), C12-2=1 (4 to 20mA selection), DIP switch DS1-3 ON

5-7-2 Setting the analog input

The analog input can be assigned to the random internal setting signals given in Table 5-7-1 by setting parameter C07-0 to A as shown in Fig. 5-7-2.
Set the number corresponding to the analog input (AI1, AI2, AI3) in C07-0 to A.
Set "0" for the internal setting signals that are not to be used.



(Note) The torque setting is 300% when C07-6 is 1.

Fig. 5-7-2 Analog input assignment

The sequential ratio operation can be carried out in respect to speed settings 1 to 3. (Refer to 6-6, B06.)

5-7-3 Pulse train input

The pulse train input is one channel and uses input terminal PSI7. When using the pulse train input function, PSI7 cannot be used as the sequence input.

The settings and precautions for the control PCB used with the pulse train input function are given below.

1) Set the EL-BIT connector W2 to source logic (2 side) before turning ON the power.
2) Connect the pulse train signal to PSI7 and the common to RY0.
3) Keep the pulse train input signal voltage at a High level of 20V or more and the Low level of 5V or less.
4) Keep the pulse train input signal frequency at 10kHz or less.

The pulse train input can be connected to the internally set signals shown in Table 5-7-3 using the programmable input function.

Table 5-7-3 Types of internally set signals for assigning pulse train input

Signal name	Setting method	Setting range	Function
		F_1Hz to F_2Hz	
Speed setting	C02-0 = 5	0 to 100%	This is the speed setting.
Traverse center frequency setting	C02-1 = 5	0 to 100%	This is the center frequency setting for traverse operation.
Torque setting	C02-2 = 5	0 to 300%	This is the torque setting for ACR operation. The torque setting can also be limited with the torque limiter (A11-2, 3).

(Note 1) These signals cannot be used at the same time. Set only one of C02-0 to C02-2 to "5" when using the pulse train input function.

Refer to Fig.5-7-3-a and set the setting range (F_1Hz to F_2Hz) with parameters C12-C and C12-D.

(Note 2) When assigning to the torque setting, the maximum setting input value is 300%.

(Note 3) If a frequency less than F_1Hz or more than F_2Hz is input, the speed setting and traverse center frequency will be limited to 0 to 100%, and the torque setting will be limited to 0 to 300%.

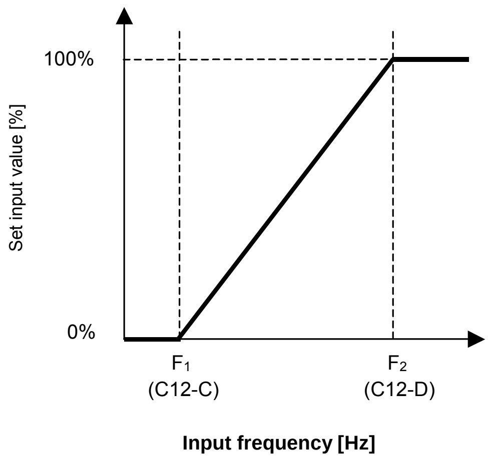


Fig. 5-7-3-a

The pulse train input circuit diagram in shown in Fig. 5-7-3-b.
After the pulse train input signal frequency is detected with the frequency detector, the LPF processed value is set as the setting input. Set this LFP time constant with C12-E. If C12-E is set to "0", the LPF process will be invalid.
If the pulse train signal is not detected for the time set in C12-F, it will be judged that the pulse train input signal has turned OFF, and the setting input value will be set to "0".
Set the C12-F setting time larger than (1/F1)[s].

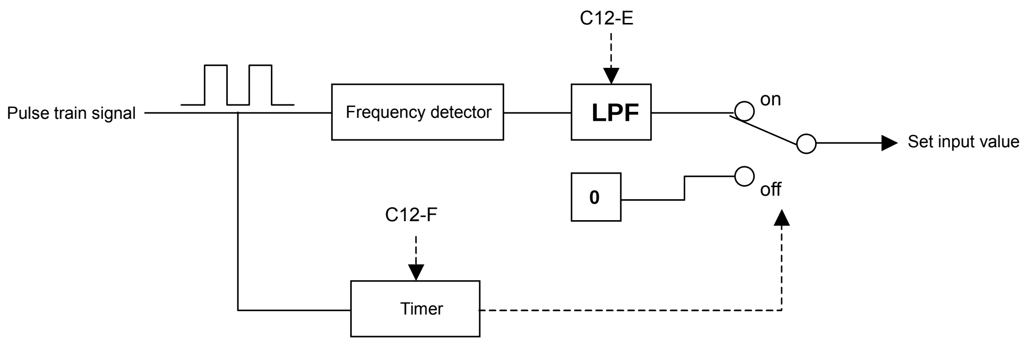


Fig. 5-7-3-b Pulse train input circuit diagram

5-8 Programmable output function (PO)

5-8-1 Types of analog outputs

As a standard, there are 2 channels for the analog output.
The voltage output and current output can be selected for AO1 and AO2 by setting parameter C14-7, 8 and EL-BIT W3, W4. The output resolution is 0 to 10V/10bit for the voltage output and 0 to 20mA/10bit for the current output.
The default setting is shown below.

Default settings

Terminal symbol	Setting	
AO1	Output frequency	0 to 10V voltage output mode
AO2	Output current (Motor)	0 to 10V voltage output mode

Example 5-3) Set as shown below for voltage output mode 0 to 10V.

AO1: C14-7=1 (0 to 10V voltage output mode selection), Set W3 to 1 (voltage mode)
AO2: C14-8=1 (0 to 10V voltage output mode selection), Set W4 to 1 (voltage mode)

Example 5-4) Set as shown below for current output mode 4 to 20mA

AO1: C14-7=3 (4 to 20mA output mode selection), Set W3 to 2 (current mode)
AO2: C14-8=3 (4 to 20mA output mode selection), Set W4 to 2 (current mode)

5-8-2 Setting the analog output

A following internal data can be output to AO1, AO2 terminals with parameters C13-0 and 1 as shown in Fig. 5-8-2. Set the number corresponding to the internal data in C13-01, 1. If the gain needs to be adjusted, set C14-0, 1 appropriately. Signed data can be output by setting the offset voltage with C14-3, 4 and setting the offset current with C14-5, 6.

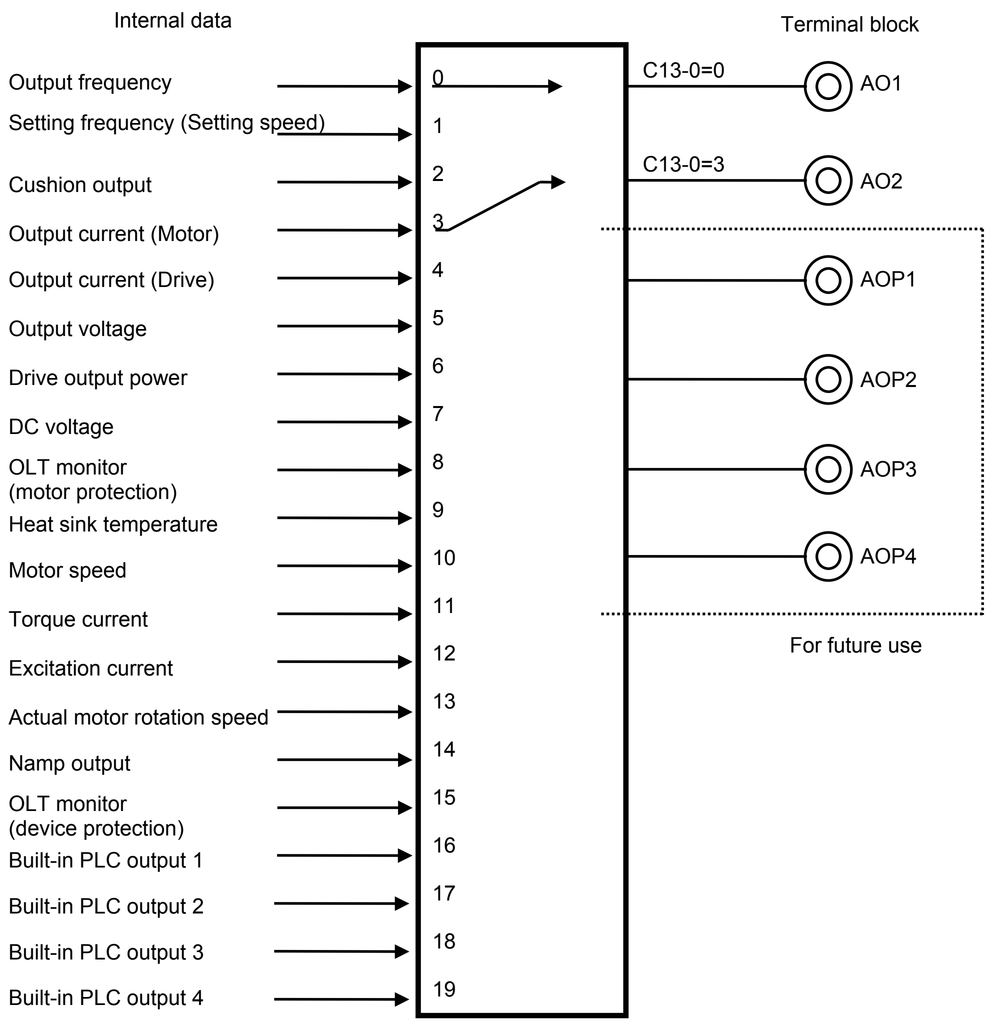


Fig. 5-8-2 Analog output assignment

5-8-3 Pulse train output

The pulse train output is one channel, and uses the terminal block output PS03. When using the pulse train output function, PS03 cannot be used as a sequence output. Note that when this function is used, the speed detection option I pulse division function (C50-0) cannot be used.

The settings and precautions for the control PCB used with the pulse train output function are given below.

1) Turn the DIP switch (DS1-4) ON before turning the power ON.
2) Connect the PS03 to the device while observing the precautions for the sequence output (open collector output).
3) Set PS03 terminal output selection to OFF fixed (C13-5=0).
4) The maximum output frequency is 6kHz (25°C). Use the falling edge.
5) Faults could occur if the DS1-4 and C13-5 settings are mistaken.

The settings for using the pulse train output function are shown below.

1) Enable the pulse train output function.

Parameter No.	Name	Function
C13-B	Pulse train output function	=1 : Pulse train output function Valid =2 : Pulse train output function Invalid

2) Set PS03 terminal output selection to OFF fixed (C13-5=0).
3) Select the internal data to be output as a pulse train with C13-E as shown in Fig. 5-8-3-a.

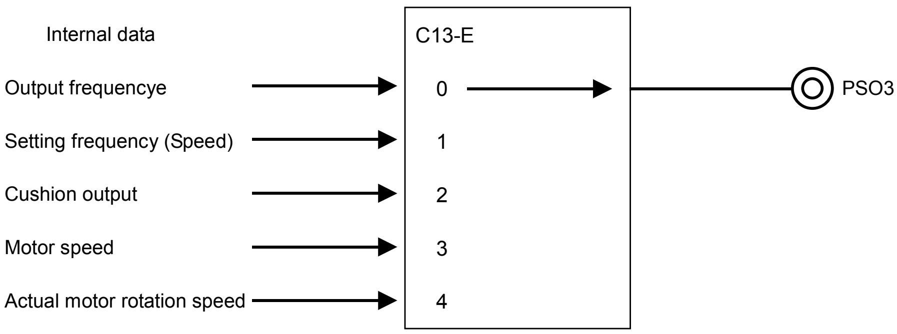


Fig. 5-8-3-a Pulse train output assignments

4) Refer to Fig. 5-8-3-b, and set the frequency of the pulses output with C13-C, D.
To output the absolute value of the internal data, set C13-F to 2.

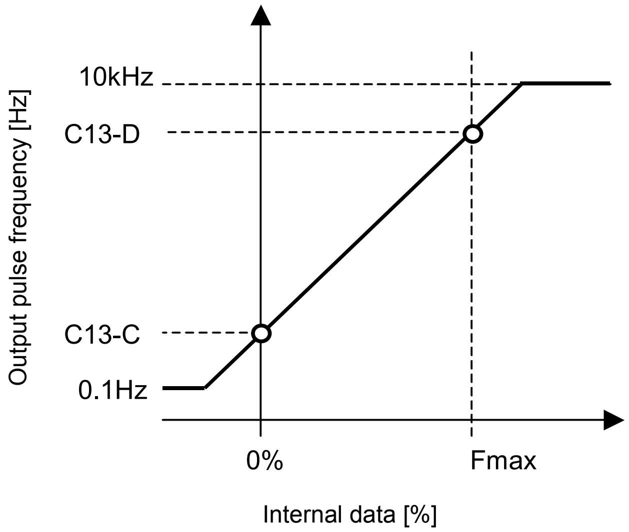


Fig. 5-8-3-b

(Note) The output pulse frequency range is 0.1 to 10kHz.
A pulse less than 0.1Hz cannot be output even during reverse run.
When outputting from the sequence output PS03, only a pulse frequency of 6kHz or less (25°C, maximum current = 50mA) can be output. Set C13-C, D to 6000Hz or less.

Parameter No.	Name	Function
C13-F	Output parameter absolute value operation selection	=1 : Internal data absolute value operation function Valid =2 : Internal data absolute value operation function Invalid

5-9 Selecting the setting data

5-9-1 Speed setting

(1) Speed setting selection

The ten types of speed setting inputs shown below can be used.
One of the ten types of inputs can be selected by setting a parameter or with the sequence input.

Setting input point	Setting data	Explanation
Analog	Analog speed setting 1 Analog speed setting 2 Analog speed setting 3	This is a setting value issued with an analog input.
Serial	Serial speed setting	This is a setting value issued from the host computer with serial transmission. Setting is possible with the following serial transmission. • Communication interface option (Type: U30V24SL0/1/2/3/4) • Standard serial transmission •Modbus communication
Parallel	Parallel speed setting	This is a setting value issued from the host sequencer with parallel transmission. A PC interface option (type: U30V24PI0) is required.
Sequence	Pulse train speed setting	This is the setting value issued from the pulse train input.
Panel	Panel speed setting	This is the setting value issued from the parameter (A00-0, 2).
	Panel jogging setting	This is a setting value issued from the parameter (A00-1, 3).
	Traverse pattern operation	This is the traverse pattern operation setting value with parameter (B45-0 to 6).
	Pattern operation	This is the pattern operation setting value with parameter (B50-0 to B59-3).

(2) Speed setting selection sequence

The relation of the speed setting and changeover sequence is as shown below.

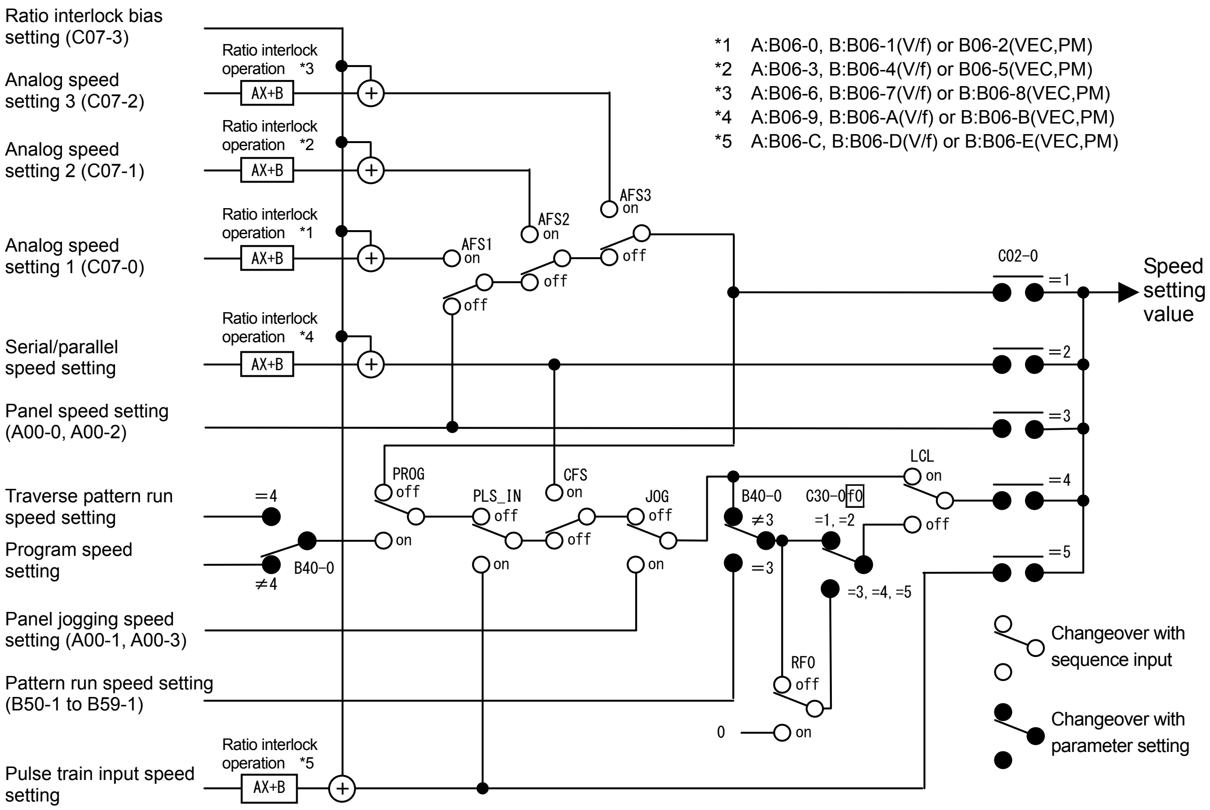


Fig. 5-9-1 Speed setting selection

5-9-2 Torque setting

(1) Torque setting selection

The following four types of torque setting inputs can be used.
One of the four types of inputs can be selected by setting a parameter or with the sequence input.

Setting input point	Setting data	Explanation
Analog	Analog torque setting	This is a setting value issued from the analog input.
Serial	Serial torque setting	This is a setting value issued from the host computer with serial transmission. Setting is possible with the following serial transmission. • Communication interface option (Type: U30V24SL0/1/2/3/4) • Standard serial transmission •Modbus communication
Sequence	Pulse train Torque setting	This is the setting value issued from the pulse train input.
Panel	Panel torque setting	This is a setting value issued from the parameter (B13-0).

(2) Torque setting selection sequence

The relation of the torque setting and changeover sequence is as shown below.

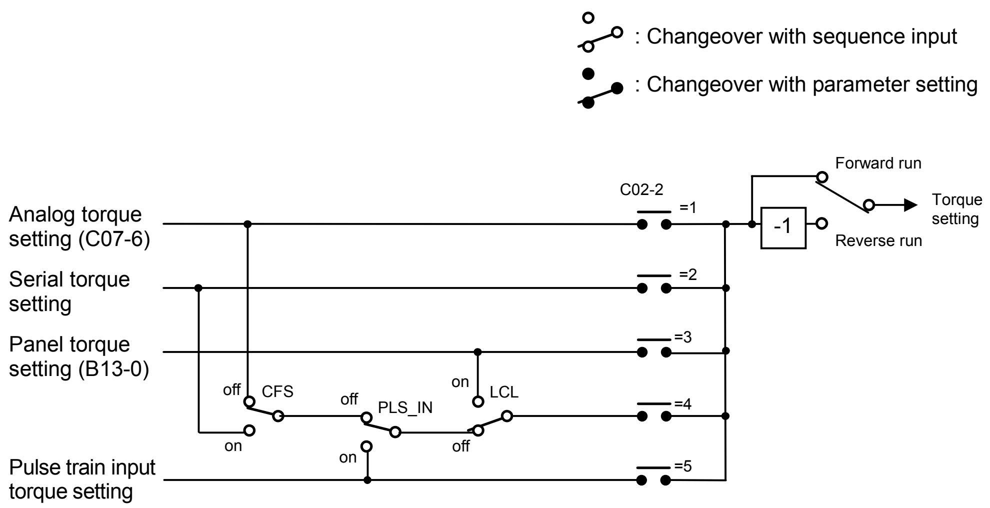


Fig. 5-9-2 Torque setting selection

5-9-3 Torque bias 1 setting

(1) Torque bias 1 setting selection

The following three types of torque bias 1 setting inputs can be used.
One of the three types of inputs can be selected by setting a parameter or with the sequence input.

Setting input point	Setting data	Explanation
Analog	Analog torque bias 1 setting	This is a setting value issued from the analog input.
Serial	Serial torque bias 1 setting	This is a setting value issued from the host computer with serial transmission. Setting is possible with the following serial transmission. • Communication interface option (Type: U30V24SL0/1/2/3/4) • Standard serial transmission •Modbus communication
Panel	Panel torque bias 1 setting	This is a setting value issued from the parameter (B13-2).

(2) Torque bias 1 setting selection sequence

The relation of the torque bias 1 setting and changeover sequence is as shown below.

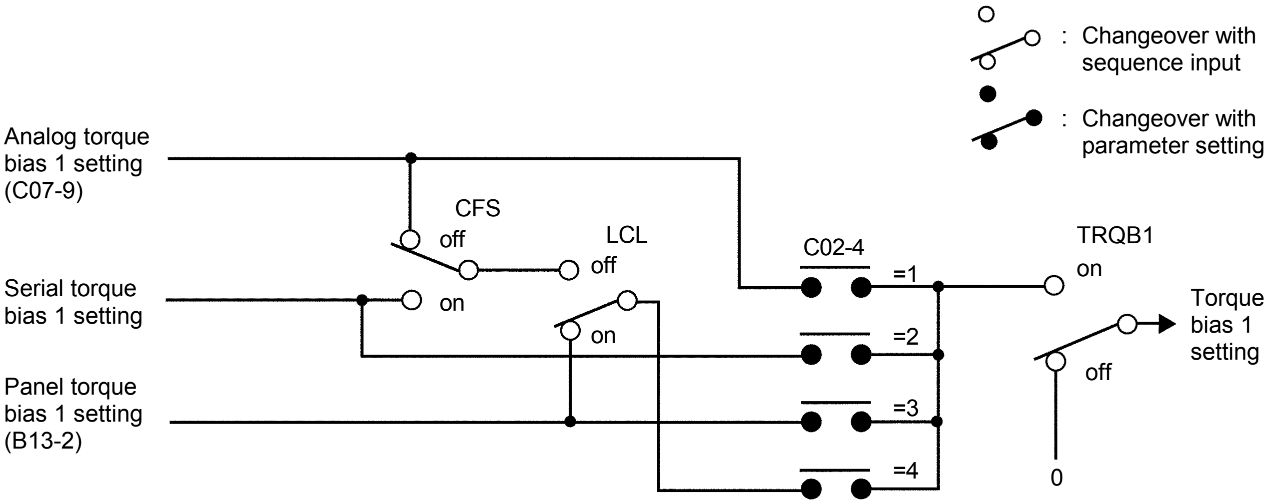


Fig. 5-9-3 Torque bias 1 setting selection

5-9-4 Torque limiter setting

(1) Torque limiter reduction setting selection

The torque limiter can be set independently for the drive side and regeneration side in the ASR mode and ACR mode. The setting parameters are as shown below. If the emergency stop sequence is valid, the regeneration side limiter value will become the emergency stop limiter value.

A10-3 : ASR drive torque limiter setting
A10-4 : ASR regenerative torque limiter setting
A10-5 : Emergency stop regenerative torque limiter setting
A11-2 : ACR drive torque limiter setting
A11-3 : ACR regenerative torque limiter setting

For each limiter input, the limiter value can be reduced by external or internal settings. The final limiter value is the results of multiplying the above panel setting values with the reduction ratio.

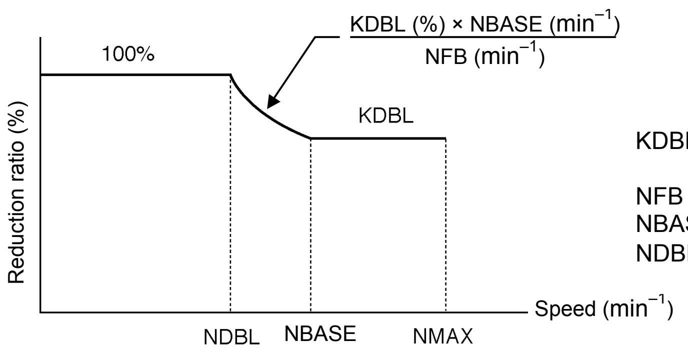
(1-1) External reduction setting

The limiter reduction setting input from an external source includes the following two types independently for the drive and regeneration.
One of the two types of inputs can be selected by setting a parameter or with the sequence input.

Setting input point	Setting data	Explanation
Analog	Analog drive torque limiter reduction setting	This is a setting value issued with an analog input. The drive torque limit (A10-3 or A11-2) is multiplied using 0V to +10V as 0 to 100%, and the limit value is reduced. This function is valid when the drive limiter changeover (LIM1) is turned ON with the sequence input.
	Analog regenerative torque limiter reduction setting	This is a setting value issued with an analog input. The regenerative torque limit (A10-4, A10-5 or A11-3) is multiplied using 0V to +10V as 0 to 100%, and the limit value is reduced. This function is valid when the regenerative limiter changeover (LIM2) is turned ON with the sequence input.
Serial	Serial driver torque limiter reduction setting	This is a setting value issued from the host computer with serial transmission. Setting is possible with the following serial transmission. • Communication interface option (Type: U30V24SL0/1/2/3/4) • Standard serial transmission •Modbus communication The data is set in the range of 0 to 100%, is multiplied with the drive torque limiter value (A10-3, A11-2), and the limiter value is reduced. This function is valid when the drive limiter changeover (LIM1) is turned ON with the sequence input.
	Serial regenerative torque limiter reduction setting	This is a setting value issued from the host computer with serial transmission. Setting is possible with the following serial transmission. • Communication interface option (Type: U30V24SL0/1/2/3/4) • Standard serial transmission •Modbus communication The data is set in the range of 0 to 100%, is multiplied with the regenerative torque limiter value (A10-4, A10-5, A11-3), and the limiter value is reduced. This function is valid when the regenerative limiter changeover (LIM2) is turned ON with the sequence input.

(1-2) Internal reduction setting

When the double rating speed ratio setting (B13-4) is changed, the torque limiter reduction pattern will be generated as shown below, and will be multiplied with the drive torque limiter value (A10-3 or A11-2) and regenerative torque limiter value (A10-4, A10-5, A11-3).



KDBL : B13-4
Double rating speed ratio (%)
NFB : Speed detection (min^{-1})
NBASE : Base speed (min^{-1})
NDBL : NBASE × KDBL (min^{-1})

(2) Torque limiter setting selection sequence

The relation of the torque limiter setting and changeover sequence is as shown below.

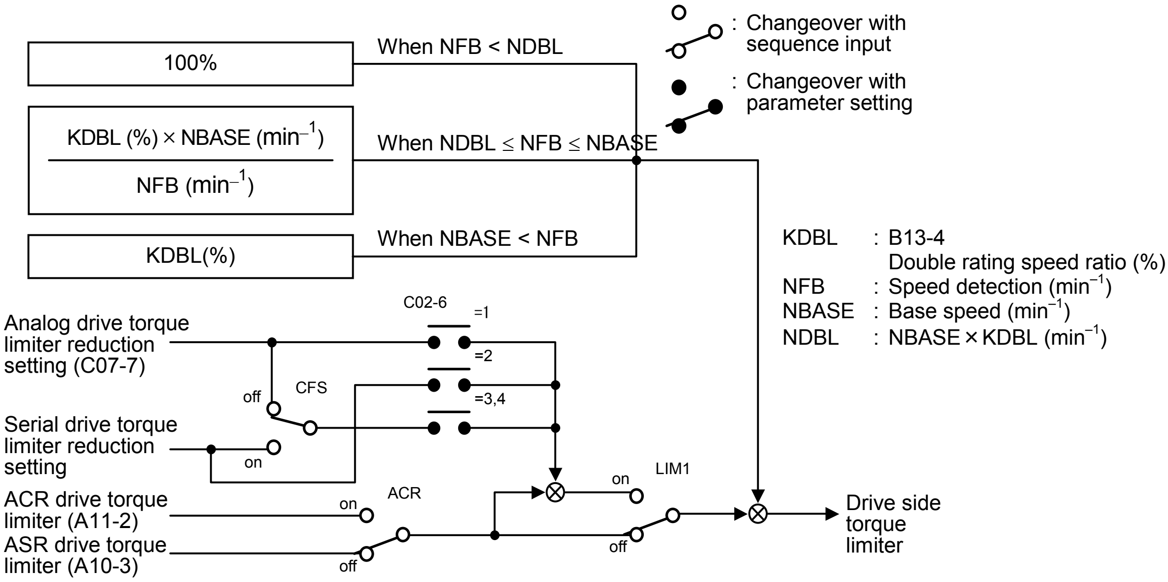


Fig. 5-9-4-a Drive torque limiter setting selection

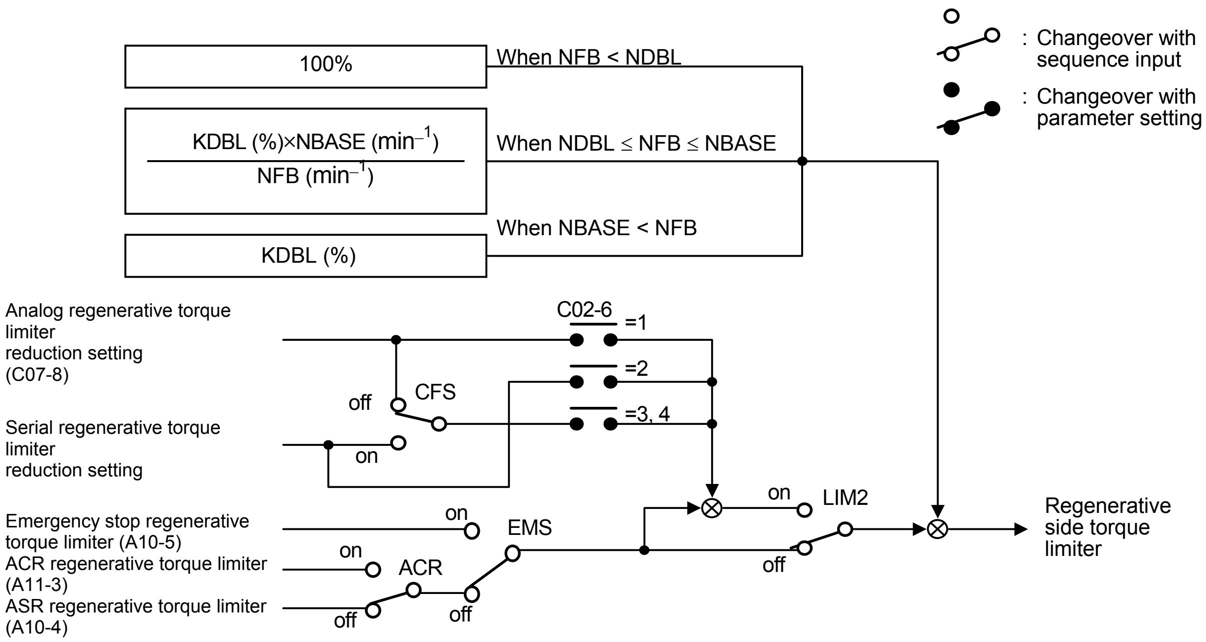


Fig. 5-9-4-b Regenerative torque limiter setting selection

5-9-5 Torque ratio 1 setting

(1) Torque ratio 1 setting selection

The following two types of torque ratio 1 setting inputs can be used.
One of the two types of inputs can be selected by setting a parameter or with the sequence input.

Setting input point	Setting data	Explanation
Serial	Torque ratio 1 setting	This is a setting value issued from the host computer with serial transmission. Setting is possible with the Communication interface option (Type: U30V24SL0/1/2/3/4).
Panel	Panel torque ratio 1 setting	This is a setting value issued from the parameter (B13-1).

(2) Torque ratio 1 setting selection sequence

The relation of the torque ratio 1 setting and changeover sequence is as shown below.

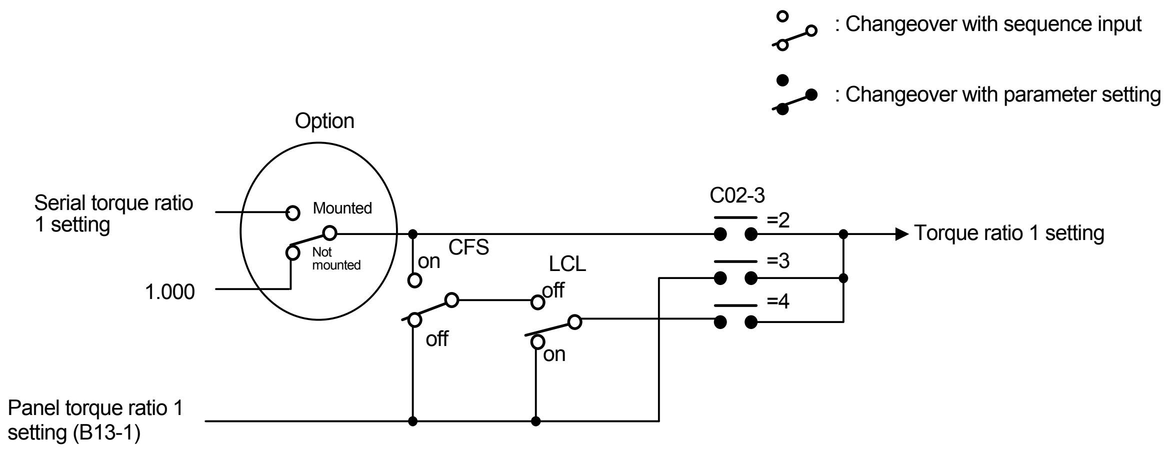


Fig. 5-9-5 Torque ratio 1 setting selection

5-9-6 Torque ratio 2, torque bias 2 setting

(1) Torque ratio 2 setting selection

The following two types of torque ratio 2 setting inputs can be used.
One of the two types of inputs can be selected by setting a parameter or with the sequence input.

Setting input point	Setting data	Explanation
Serial	Torque ratio 2 setting	This is a setting value issued from the host computer with serial transmission. Setting is possible with the Communication interface option (Type: U30V24SL0/1/2/3/4).
Panel	Panel torque ratio 2 setting	This is a setting value issued from the parameter (B13-3).

(2) Torque ratio 2 setting selection sequence

The relation of the torque ratio 2 setting and changeover sequence is as shown below.

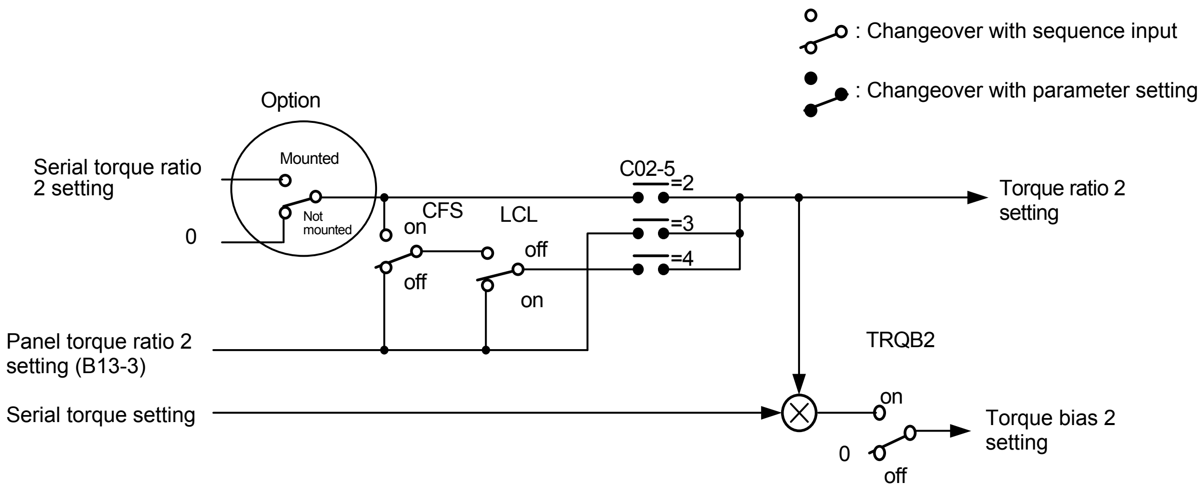


Fig. 5-9-6 Torque ratio 2 setting selection

5-9-7 Machine time constant setting

(1) Machine time constant setting

The following three types of machine time constant setting inputs can be used.
One of the three types of inputs can be selected by setting a parameter or with the sequence input.

Setting input point	Setting data	Explanation
Serial	Machine time constant	This is a setting value issued from the host computer with serial transmission. Setting is possible with the Communication interface option (Type: U30V24SL0/1/2/3/4).
Panel	Panel machine time constant –1	This is a setting value issued from the parameter (A10-1).
	Panel machine time constant –2	This is a setting value issued from the parameter (B15-0).

(2) Machine time constant setting and changeover sequence

The relation of the machine time constant setting and changeover sequence is as shown below.

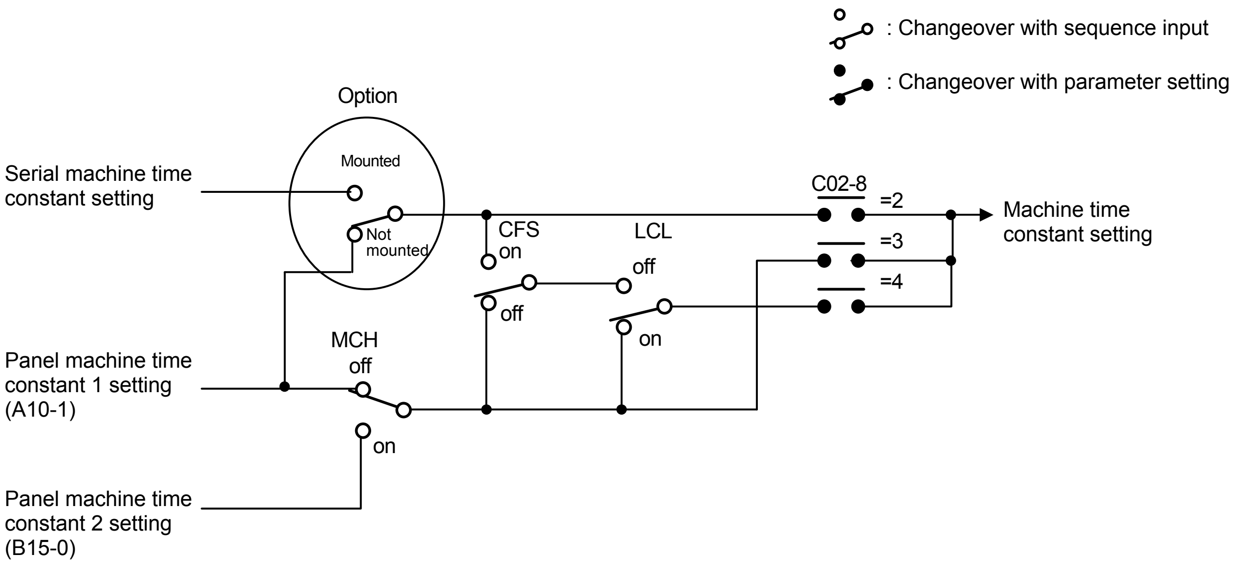


Fig. 5-9-7 Machine time constant setting selection

5-9-8 ASR response setting

(1) ASR response setting selection

The following two types of ASR response setting inputs can be used.
One of the two types of inputs can be selected by setting a parameter or with the sequence input.

Setting input point	Setting data	Explanation
Serial	ASR response setting	This is a setting value issued from the host computer with serial transmission. Setting is possible with the Communication interface option (Type: U30V24SL0/1/2/3/4).
Panel	Panel ASR response setting	This is a setting value issued from the parameter (A10-0).

(2) ASR response setting and changeover sequence

The relation of the ASR response setting and changeover sequence is as shown below.

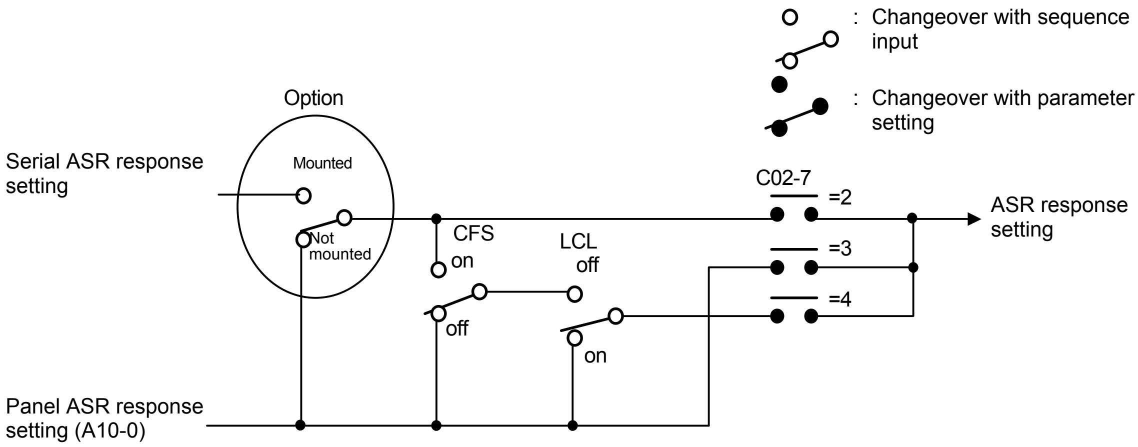


Fig. 5-9-8 ASR response setting selection

Chapter 6 Control Functions and Parameter Settings

6-1 Monitor parameters

The monitor mode sequentially displays the frequency, power supply, etc., parameters recognized by the VAT300.

The symbols shown at the right of the list show the application of each parameter as shown below.

V/f : Indicates parameters that apply for V/f control (constant torque, variable torque) (C30-0: f0 = 1).

VEC : Indicates parameters that apply for IM speed sensor-less vector control and IM speed vector control with sensor (C30-0: f0 = 2, 3).

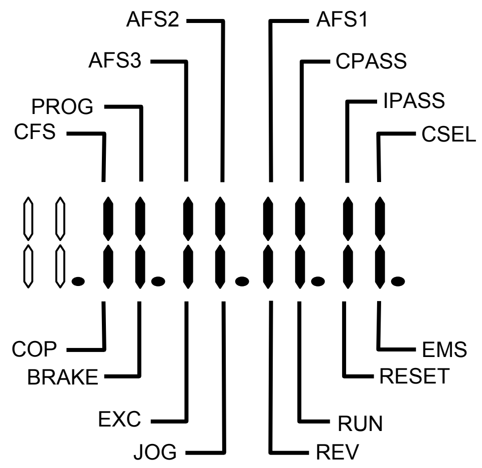
PM : Indicates parameters that apply for control mode with PM motor sensor (C30-0: f0 = 4).

Monitor parameters list

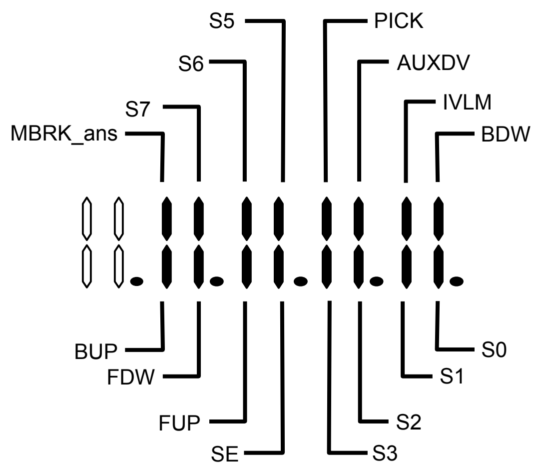
No.	Parameter	Unit	Remarks	Application V/f	VEC	PM
D00 – Output frequency monitor						
0	Output frequency in Hz	Hz	oFF will display when the gate is closed. br displays while the DC brake is in action. PU is displayed during pick up.	○	○	○
1	Output frequency in %	%				
2	Motor speed in min^{-1}	min^{-1}	The forward run direction is displayed with the + polarity, and the reverse run direction with the – polarity. (This is displayed even when stopped.)		○	○
3	Motor speed in %	%				
4	Output frequency/motor speed random scale display		When V/f control operation (C30-0: f0 = 1) or auxiliary drive operation is selected, a value obtained by multiplying D00-0: output frequency with the random scale display coefficient: C14-2 will be displayed. When IM vector control or PM motor control (C30-0: f0 = 2 to 4) is selected, a value obtained by multiplying D00-2: motor speed with the random scale display coefficient, C14-2 will be displayed. If the value exceeds the range of -99999 to 99999, oUEr will be displayed.	○	○	○
5	Motor rotation speed	%	This displays the detected rotation speed for V/f or sensorless vector control in the case where the unit is equipped with a speed detection option.	○	○	○
D01 – Frequency setting monitor						
0	Set frequency in Hz	Hz	The currently selected frequency setting value is displayed.	○		
1	Set frequency in %	%	The max. frequency is displayed as 100%.	○		
2	Ramp function output speed	min^{-1}	The set speed at ASR input point is displayed. The forward run direction is displayed with the + polarity, and the reverse run direction with the – polarity.		○	○
3	Ramp function input speed	min^{-1}	The set speed at the ramp function's input point is displayed. The forward run direction is displayed with the + polarity, and the reverse run direction with the – polarity.		○	○
4	Set frequency/input speed /ramp function input Random scale display		When V/f control operation (C30-0: f0 = 1) or auxiliary drive operation is selected, a value obtained by multiplying D01-0: setting frequency with the random scale display coefficient: C14-2 will be displayed. When IM vector control or PM motor control (C30-0: f0 = 2 to 4) is selected, a value obtained by multiplying D01-3: input speed with the random scale display coefficient, C14-2 will be displayed. If the value exceeds the range of -99999 to 99999, oUEr will be displayed.	○	○	○
D02 – Current monitor						
0	Output current (Amps)	A	oFF will display when the gate is closed.	○	○	○
1	Output current (%)	%	The motor rated current is displayed as 100%.	○	○	○
2	Overload (OLT-1) monitor	%	OL-1 functions when this value reaches 100%.	○	○	○
3	Motor overload (OL-3) monitor	%	The OL-3 operates when at 100%.	○	○	○
4	Heatsink temperature	°C	Depending on the capacity, OHT.1 functions at 95°C or 120°C or more.	○	○	○
5	Torque current detection	%	The torque current detection value is displayed using the motor rated current as 100%.		○	○

Monitor parameters list

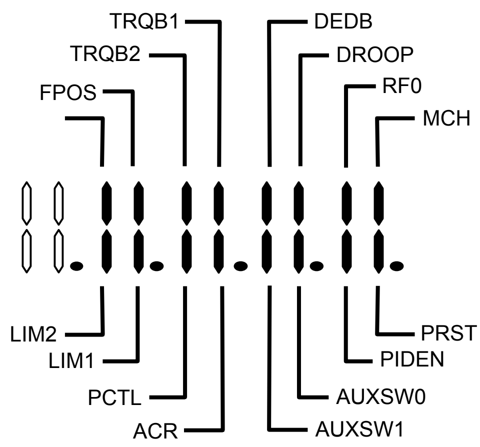
No.	Parameter	Unit	Remarks	Application V/f	Application VEC	Application PM
D02 – Current monitor						
6	Excitation current detection	%	The excitation current's detection value is displayed using the motor rated current as 100%. With the PM motor control, the demagnetizing current is indicated with negative polarity.		○	○
7	U phase output current amps	A	oFF will display when the gate is closed. The correct value is not displayed during pick-up or during automatic tuning.	○	○	○
8	V phase output current amps	A	oFF will display when the gate is closed. The correct value is not displayed during pick-up or during automatic tuning.	○	○	○
9	W phase output current amps	A	oFF will display when the gate is closed. The correct value is not displayed during pick-up or during automatic tuning.	○	○	○
D03 – Voltage monitor						
0	DC voltage	V	Displays the voltage of the DC link circuit in the main circuit.	○	○	○
1	Output voltage (command)	V	Displays output voltage command. The display may differ from the actual output voltage. It depends on the power supply voltage. oFF will display when the gate is closed.	○	○	○
2	Output power	kW	Displays the inverter's output power. oFF will display when the gate is closed.	○	○	○
3	Carrier frequency	kHz	The current carrier frequency is displayed.	○	○	○
D04 – Sequence status						
0-3	Sequence status-Input 1 to 4		The ON/OFF state of the internal sequence data will display. The correspondence of each LED segment and signal is shown in the next page.	○	○	○
4-7	Sequence status-Output 1 to 4			○	○	○
D05 – Minor fault monitor						
0	Minor fault monitor		The internal minor fault status will display. The correspondence of each LED segment and signal is shown in the next page.	○	○	○
1	Hardware detection fault status		The status of the fault signal detected by the hardware is displayed.	○	○	○
D06 – Pattern run monitor						
0	Step No. monitor		The current step No. will display.	○	○	○
1	Remaining time monitor	s	The remaining time of current step will display	○	○	○
D07 – Pump operation status monitor						
0	Pump operation status monitor		This indicates the ON/OFF status of the pump. The correspondence of the LED segments and signals is shown below.	○		
1	Current inverter drive pump No. monitor		This displays the number of the pump currently driven by the inverter.	○		
2	Next ON pump No. monitor		0 is displayed when all pumps are ON.	○		
3	Next OFF pump No. monitor		0 is displayed when all pumps are OFF.	○		
4	Elapsed time		The main pump's operation time is displayed.	○		
D08 –Analog input random scale display						
0	AI1 input scale display (max. frequency/speed reference)		Value to which coefficient set at C14-9 displays for AI1 input. [OVER] displays if the coefficient exceeds the –99999. to 99999. range.	○	○	○
1	AI2 input scale display (max. frequency/speed reference)		Value to which coefficient set at C14-A displays for AI2 input. [OVER] displays if the coefficient exceeds the –99999. to 99999. range.	○	○	○
2	AI3 input scale display (max. frequency/speed reference)		Value to which coefficient set at C14-B displays for AI3 input. [OVER] displays if the coefficient exceeds the –99999. to 99999. range.	○	○	○



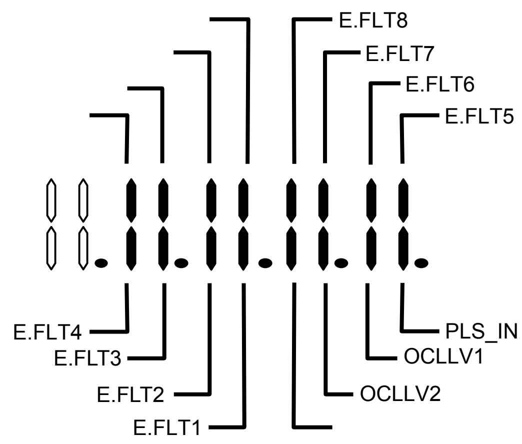
Sequence input (D04-0)



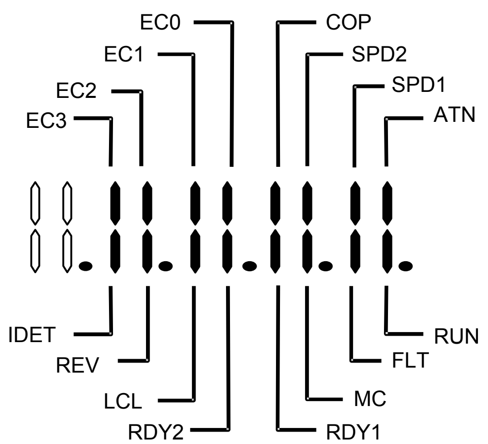
Sequence input (D04-1)



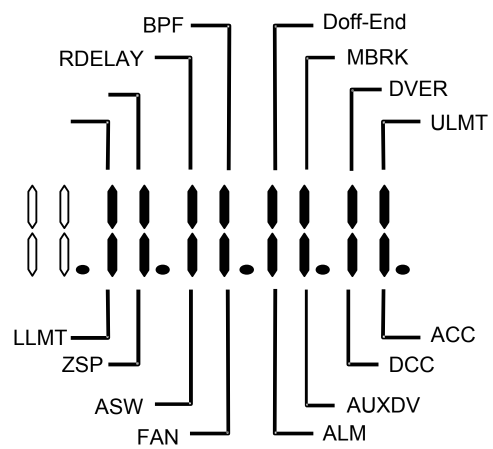
Sequence input (D04-2)



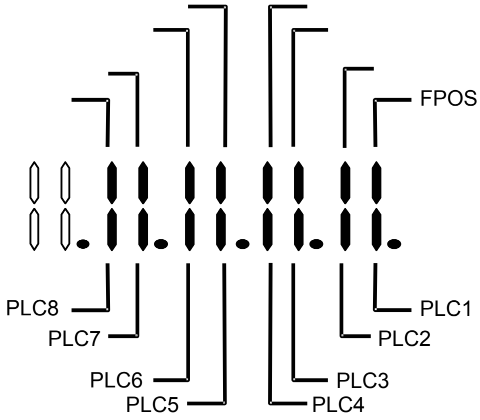
Sequence input (D04-3)



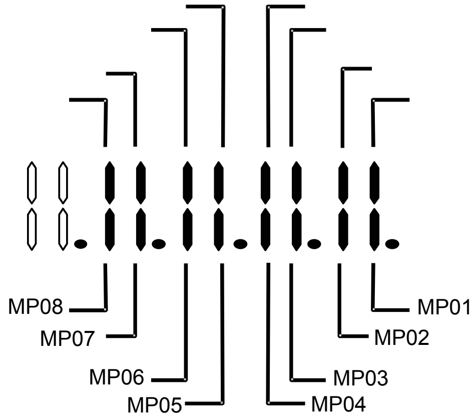
Sequence output (D04-4)



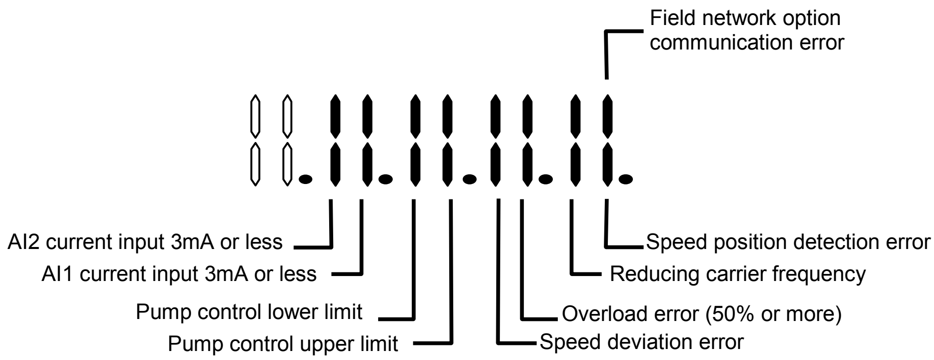
Sequence output (D04-5)



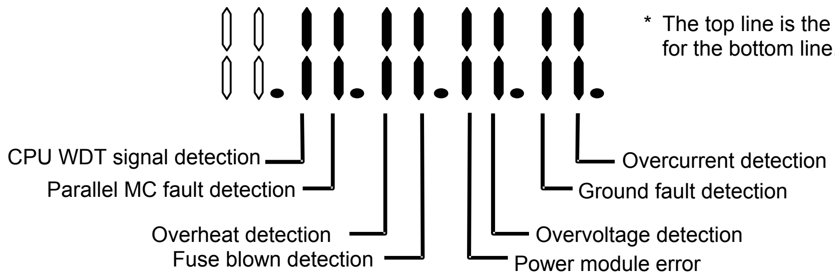
Sequence output (D04-6)



Sequence output (D04-7)

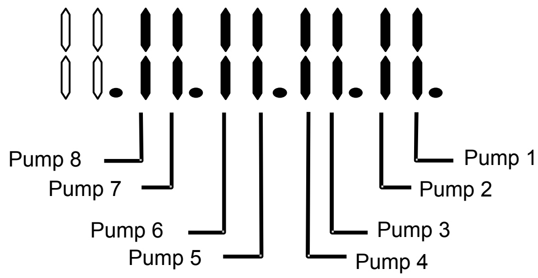


Minor fault monitor (D05-0)



* The top line is the latch signal for the bottom line.

Hardware detection fault status displays (D05-1)



Pump operation status monitor (D07-0)

Monitor parameters list

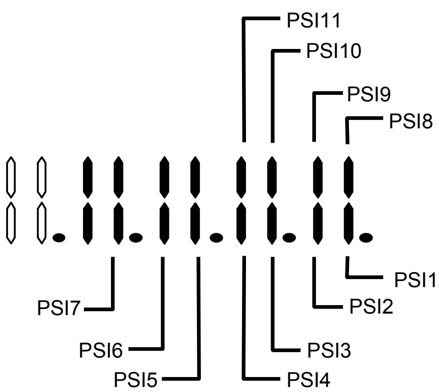
No.	Parameter	Unit	Remarks	Application V/f	Application VEC	Application PM
D08 – Input display						
3	AI1 input voltage display	V	The voltage on AI1, 2 and 3 terminals will be displayed in a unit of 0.01V. When the AI terminals are for current setting, “0” will be displayed.	○	○	○
4	AI2 input voltage display					
5	AI3 input voltage display					
6	AI1 input current display	mA	The current on the AI1 and A2 terminals will be displayed in a unit of 0.01mA. When the AI terminals are for voltage setting, “0” will be displayed.	○	○	○
7	AI2 input current display					
8	AI1 input display (in %)	%	The current or voltage on the AI1, 2 and 3 terminals will be displayed in % against 10V and 20mA as 100%.	○	○	○
9	AI2 input display (in %)					
A	AI3 input display (in %)					
B	Sequence input terminal status display		The input status of the sequence input terminals (PSI1~7) and the sequence input terminals on the option PCB (PSI8~11) will be displayed.	○	○	○
C	Speed detection signal input status display		Encoder signal input status will be displayed.	○	○	○
D10– Built-in PLC monitor						
0	Built-in PLC display 1		The contents of address 32h for the built-in PLC memory are displayed.	○	○	○
1	Built-in PLC display 2		The contents of address 32h for the built-in PLC memory are displayed.	○	○	○
2	Built-in PLC display 3		The contents of address 32h for the built-in PLC memory are displayed.	○	○	○
3	Built-in PLC display 4		The contents of address 32h for the built-in PLC memory are displayed.	○	○	○
D11 – Torque setting monitor						
0	Torque setting input monitor	%	The currently selected torque setting of the current control input points is selected.		○	○
1	Analog torque setting monitor	%	The setting value input from the analog torque setting is displayed.		○	○
2	Serial communication torque setting monitor	%	The setting value input from the serial communication torque setting is displayed.		○	○
3	Operation panel torque setting monitor	%	The torque set with the operation panel (B13-0) is displayed.		○	○
4	ASR output monitor	%	The ASR output is displayed.		○	○
5	Torque setting monitor (after torque limiter)	%	The final torque command value after limiting with the torque limiter is displayed.		○	○
D12 – Slip						
0	Slip monitor	%	The slip is displayed as a percentage in respect to the base speed.		○	
D13 – STP run monitor						
0	STP step No. monitor		oFF displays during stoppage.	○		
1	STP remaining pattern time monitor	min	Displays the time remaining until the end of the current pattern.	○		
2	STP No. monitor		Displays the currently selected STP.	○		
3	STP average spindle frequency monitor	Hz	Displays the average frequency for each spindle.	○		
4	STP hank count monitor		Displays the current Hank count. The display is limited at a maximum of 6553.5. This is cleared to zero when the power is turned OFF.	○		
5	STP total patter operating time monitor	min	Displays the operation time until now. The display is limited at a maximum of 65535. This is cleared to zero when the power is turned OFF.	○		
D14 – Automatic torque bias						
0	Automatic torque bias setting	%	Displays the currently set torque bias value at the analog/digital auto torque bias setting.		○	○
D15 – Electric angle monitor						
0	Z-phase electric angle	°	The Z-phase electric angle is displayed. Use this to adjust the Z-phase when using magnetic pole position estimation.			○
D16 – PM tuning monitor						
0	Judgment standard 1	%	The characteristics amount in the estimation results is displayed.			○
1	Judgment standard 2	%	The characteristics amount in the estimation results is displayed.			○
2	Judgment standard 3	%	The current measured for the N pole phase in the estimation results is displayed.			○
3	Judgment standard 4	°	The error of the phase angles in the magnetic pole position estimate is displayed.			○

Note) D08-3 to D08-C available from the version 9457.0+9458.4

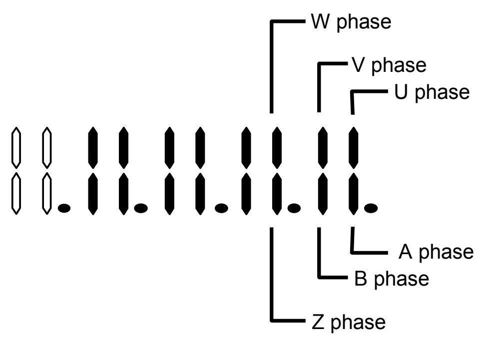
Monitor parameters list

No.	Parameter	Unit	Remarks	Application V/f	Application VEC	Application PM
D20 – Extended monitor						
0	Fault history monitor		The fault history reference mode will display when [SET] is pressed.	○	○	○
1	Minor failure past record indication		The minor fault history reference mode will display when [SET] is pressed.	○	○	○
2	Parameter A, B and C modification list entry		The mode for referring to and changing parameters that differ from the default value will display [SET] is pressed.	○	○	○
3	Sequence input display (dedicated for LCD panel)		The sequence input reference mode will display when [SET] is pressed. This parameter does not appear when the LED panel is connected.	○	○	○
4	Sequence output display (dedicated for LCD panel)		The sequence output reference mode will display when [SET] is pressed. This parameter does not appear when the LED panel is connected.	○	○	○
D21 – Maintenance monitor						
0	Cumulative conductivity time	h.	The cumulative power ON time after product shipment will be counted and displayed.	○	○	○
1	Cumulative run time	h.	The cumulative run time after product shipment will be counted and displayed.	○	○	○
2	CPU version		Display for maker control.	○	○	○
3	ROM version		Display for maker control.	○	○	○
D22 – Automatic tuning						
0	Automatic tuning progression display		The progression state of automatic tuning is displayed. The correspondence of the LED's segments and signals is shown in the previous section.	○	○	
D30 – Hardware monitor						
0	Inverter type		This indicates the inverter type.	○	○	○
1	Option PCB		Displays the mounted option PCB. The correspondence of the LED segments and signals is shown in the previous page.	○	○	○
2	Field network option failure monitor 1 (status)		These parameters will be displayed when the field network optional PCB is installed. The segment corresponding to the error on the PCB will be turned on, and will be turned off when the error is eliminated.	○	○	○
3	Field network option failure monitor 2 (status)					
4	Field network option failure monitor 1 (latch)		These parameters will be displayed when the field network optional PCB is installed. If transmission error is detected as failure (C34-1=2), the segment corresponding to the error on the PCB will be turned on, and will not be turned off even when the error is eliminated. The segment will be turned off by the failure reset. If transmission error is not detected as failure or is detected as minor failure, each segment will not be turned on.	○	○	○
5	Field network option failure monitor 2 (latch)					

Note) D30-2 to D30-5 available from the version 9457.0+9458.3

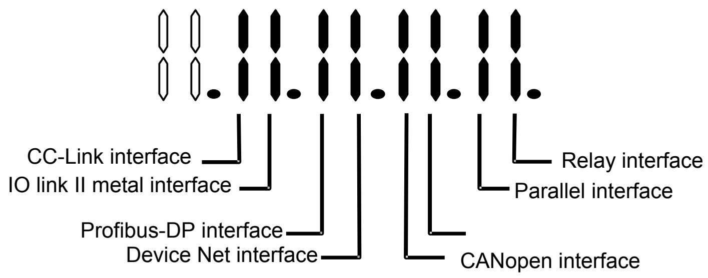


Sequence input terminal status(D08-B)

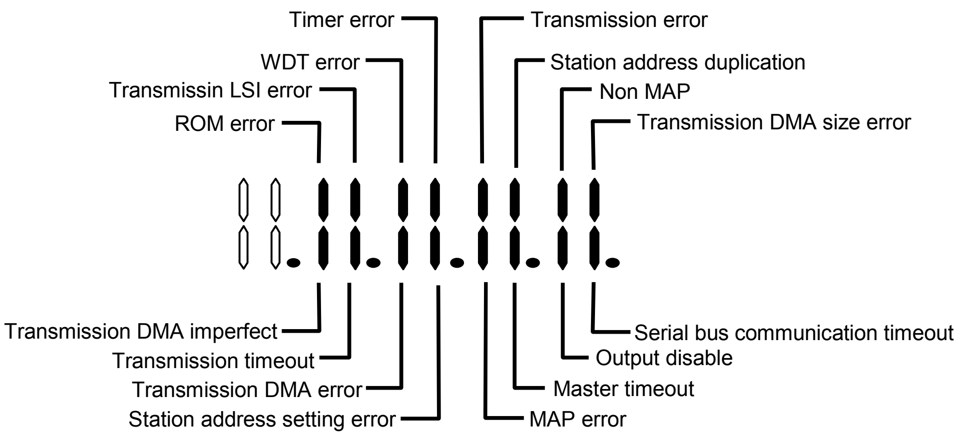


Speed detection signal input status(D08-C)

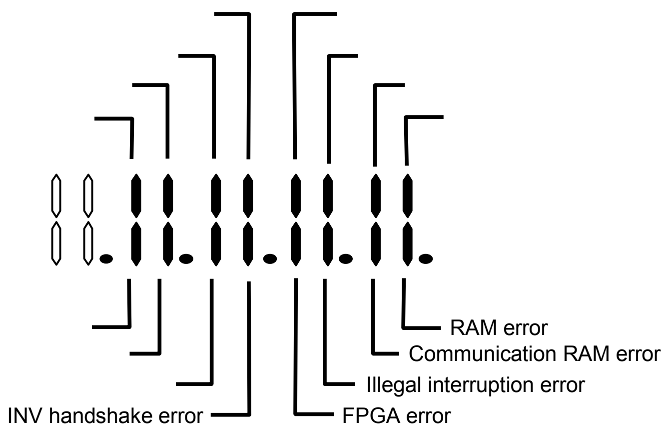
Automatic tuning progress state (D22-0)



Option P.C.B. monitor (D30-1)



Field network option failure monitor 1(D30-2,4)



Field network option failure monitor 1(D30-3,5)

6-2 Block-A parameters

The parameters used most frequently have been grouped in Block-A.

V/f : Indicates parameters that apply for V/f control (constant torque, variable torque) (C30-0: f0 = 1).

VEC : Indicates parameters that apply for IM speed sensor-less vector control and IM speed vector control with sensor (C30-0: f0 = 2, 3).

PM : Indicates parameters that apply for control mode with PM motor sensor (C30-0: f0 = 4).

*△ indicates a parameter which functions during auxiliary drive operation or when the V/f control is active during automatic tuning.

RWE : Displays the parameters that can be changed during operation.

Reference page: The number of the page providing detailed explanations is indicated.

Block-A parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	VEC	PM	RWE	Ref. page
A00 – Frequency setting										
0	Local frequency setting	0.10	Max. fre-quency	10.00 (Hz)	This is the frequency set from the operation panel.	○			○	6-87
1	Jogging frequency	0.10	Max. fre-quency	5.00 (Hz)	This is the frequency setting for jogging.	○			○	6-87
2	Local speed setting	-Max. speed	Max. speed	300. (min^{-1})	This is the speed set from the operation panel.		○	○	○	6-87
3	Jogging speed	-Max. speed	Max. speed	100. (min^{-1})	This is the speed setting for jogging		○	○	○	6-87
A01 – Acceleration/deceleration time										
0	Acceleration time – 1	0.1	6000.0	10.0 (s)	The value can be displayed in units of 0.1 or 10 times as set on B10-5. The time to reach the max. frequency or max. speed from 0 is set.	○	○	○	○	6-87
1	Deceleration time – 1	0.1	6000.0	20.0 (s)		○	○	○	○	6-87
A02 – Torque boost										
0	Manual torque boost selection	1.	2.	2.	1: Disable = 2: Enable	○				6-88
1	Automatic torque boost selection	1.	2.	1.	1: Disable = 2: Enable	○				6-88
2	Manual torque boost setting	0.00	20.00	Inverter rating (%)	Set the boost voltage at 0Hz. This is automatically adjusted by the automatic tuning.	○			○	6-90
3	Square reduction torque setting	0.00	25.00	0.00 (%)	Set the reduced voltage at Base frequency/2.	○			○	6-90
4	R1 drop compensation gain	0.0	100.0	100.0 (%)	Set how much to compensate the voltage drop caused by R1 measured with automatic tuning.	○			○	6-90
5	Slip compensation gain	0.00	20.00	0.00 (%)	Set the motor's rated slip. This is automatically adjusted by the automatic tuning.	○			○	6-91
6	Maximum torque boost gain	0.00	50.00	0.00 (%)	This is automatically adjusted by the automatic tuning. The optimum boost amount for outputting the maximum torque is set.	○				6-91
A03 – DC Brake										
0	DC braking voltage	0.01	20.00	Inverter rating (%)	This is automatically adjusted by the automatic tuning. When setting manually, monitor the output voltage and change the setting in increments of 1% or less.	○			○	6-87
1	DC braking time	0.0	20.0	2.0 (s)	Set the time to apply the DC brakes.	○	○	○	○	6-87
2	DC braking current	0.	150.	50. (%)	This is used instead of the DC brake voltage in the vector mode and PM mode. This is not adjusted with automatic tuning.		○	○	○	6-87

Block-A parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application				Ref. page
						V/f	VEC	PM	RWE	
A04 – Custom parameters										
0	Custom parameters – 0				Set the parameter Nos. to be displayed in this block in C10-0~7. This block displays when the above settings are not made.	○	○	○	○	6-91
1	Custom parameters – 1					○	○	○	○	6-91
2	Custom parameters – 2					○	○	○	○	6-91
3	Custom parameters – 3					○	○	○	○	6-91
4	Custom parameters – 4					○	○	○	○	6-91
5	Custom parameters – 5					○	○	○	○	6-91
6	Custom parameters – 6					○	○	○	○	6-91
7	Custom parameters – 7					○	○	○	○	6-91
A05 – Parameter B and C indicatory skip										
0	Parameter B and C extended setting	1.	2.	2.	= 1: Display, = 2: Skip	○	○	○	○	6-91
1	Parameter B and C software option function	1.	2.	2.	= 1: Display, = 2: Skip	○	○	○	○	6-91
2	Parameter B and C hardware option function	1.	2.	2.	= 1: Display, = 2: Skip	○	○	○	○	6-91
A10 – ASR control constant 1										
0	ASR response	1.0	300.0	10.0 (rad/s)	The required ASR response radian frequency is set.		○	○	○	6-91
1	ASR machine time constant – 1	10.	20000.	1000 (ms)	The time to accelerate the motor and load's torque inertia to the base speed at the rated torque is set.		○	○	○	6-92
2	ASR integral time constant compensation coefficient	20.	500.	100. (%)	The compensation coefficient applied on the integral time constant of the speed regulator (ASR) is set.		○	○	○	6-92
3	ASR drive torque limiter	0.1	300.0	100.0 (%)	The limit values for the ASR drive side and regenerative side are set.		○	○	○	6-92
4	ASR regenerative torque limiter	0.1	300.0	100.0 (%)			○	○	○	6-92
5	ASR emergency stop regenerative torque limiter	0.1	300.0	100.0 (%)	The ASR regenerative side limit value applied during the emergency stop mode is set.		○	○	○	6-92
A11 – ACR control constant										
0	ACR response	100.	6000.	1000. (rad/s)	The ACR gain and time constant are set. This will affect the current response. If the gain is too low or too high, the current will become unstable, and the over current protection will function. Normally adjust the response between 500 and 1000, and the time constant between 5 and 20ms.		○		○	6-92
1	ACR time constant	0.1	300.0	20.0 (ms)			○		○	6-92
2	ACR drive torque limiter	0.1	300.0	100.0 (%)	The ACR drive side and regenerative side limit values are set.		○	○	○	6-92
3	ACR regenerative torque limiter	0.1	300.0	100.0 (%)			○	○	○	6-92
A20 – ACR control constant (PM)										
0	ACR response (PM)	100.	6000.	1500. (rad/s)	The ACR gain and time constant are set. This will affect the current response. If the gain is too low or too high, the current will become unstable, and the over current protection will function. Normally adjust the response between 500 and 2000, and the time constant between 5 and 20ms.			○	○	6-93
1	ACR time constant (PM)	0.1	300.0	10.0 (ms)				○	○	6-93
2	d axis current command cushion time (PM)	0.1	100.0	2.0 (ms)	This is the cushion setting to prevent instability caused by overshooting, etc., when the current command changes suddenly. Set at how many ms to change the current command value equivalent to the motor rated current. Normally, a value 5ms or more is set.			○	○	6-93
3	q axis current command cushion time (PM)	0.1	100.0	2.0 (ms)				○	○	6-93

6-3 Block-B parameters

The Block-B parameters are divided into the basic functions, extended functions and software option functions.

V/f : Indicates parameters that apply for V/f control (constant torque, variable torque) (C30-0: f0 = 1).

VEC : Indicates parameters that apply for IM speed sensor-less vector control and IM speed vector control with sensor (C30-0: f0 = 2, 3).

PM : Indicates parameters that apply for control mode with PM motor sensor (C30-0: f0 = 4).

*△ indicates a parameter which functions during auxiliary drive operation or when the V/f control is active during automatic tuning.

RWE : Displays the parameters that can be changed during operation.

Reference page: The number of the page providing detailed explanations is indicated.

Block-B parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	VEC	PM	RWE	Ref. page
B00 – Output rating (V/f control)										
0	Rated input voltage setting (V/f control)	1.	7.	7.	Select the rated input voltage from the following table.	○				6-94

When this data is changed, the output voltage data will be changed to the same value.

Small size (Note 1)

Value	200V system	400V system
1	to 200V	to 380V
2	to 200V	381 to 400V
3	201 to 220V	401 to 415V
4	201 to 220V	416 to 440V
5	221 to 230V	441 to 460V
6	231 to 240V	461 to 480V
7	221 to 230V	381 to 400V

Large size (Note 2)

Value	200V system	400V system
1	to 200V	to 380V
2	to 200V	381 to 400V
3	201 to 220V	401 to 415V
4	201 to 220V	416 to 440V
5	221 to 230V	441 to 460V
6	231 to 240V	461 to 480V
7	221 to 230V	381 to 400V

No.	Parameter	Min.	Max.	Default (Unit)	Function	V/f	VEC	PM	RWE	Ref. page
1	Max./base frequency simple setting (V/f control)	0.	9.	1.	Select the output frequency rating from the combination below.	○				6-94

Value	Ftrq [Hz]	Fmax [Hz]
0	Free setting on B00-4 and B00-5	
1	50	50
2	60	60
3	50	60
4	50	75

Value	Ftrq [Hz]	Fmax [Hz]
5	50	100
6	60	70
7	60	80
8	60	90
9	60	120

No.	Parameter	Min.	Max.	Default (Unit)	Function	V/f	VEC	PM	RWE	Ref. page
2	Motor rated output (V/f control)	0.10	750.00	Inverter rating (kW)	The motor rated output at the base frequency is set.	○				6-94
3	Motor rated voltage (V/f control)	39.	480.	230. or 400. (V)	DC-AVR does not operate when set to 39. The input voltage equals the output voltage at the base frequency. DC-AVR operates so that the set voltage is attained at the base frequency when not set to 39. When the rated input voltage setting (B00-0) is changed, this data is also changed to the rated input voltage value. This cannot be set above the rated input voltage.	○				6-95
4	Max. frequency (Fmax) (V/f control)	Fbase or 3.00	Fbase *7 or 440.00	50.00 (Hz)	When "B00-1" is a value other than 0, this will be rewritten with the data set in the simple setting.	○				6-95
5	Base frequency (Fbase) (V/f control)	Fmax/7 or 1.00	Fmax or 440.00	50.00 (Hz)		○				6-95
6	Motor rated current (V/f control)	Inverter rating × 0.3	Inverter rating	Inverter rating (A)	This is the reference value for the overcurrent limit, OLT, current % display, analog input and output.	○				6-95

Note 1) Small size: N000K7 to N045K0, X000K7 to X055K0

Note 2) Large size: X075K0 to X475K0

Block-B parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
B00 – Output rating (V/f control)										
7	Carrier frequency (Small size) (V/f control)	1.0	21.0	17.0	The noise can be lowered by changing the PWM carrier frequency and control method, and changing the sound of the magnetic noise generated from the motor. This can be changed while running. 1.0 to 15.0: Monotone sound method (Carrier frequency: 1.0 to 15.0kHz) 15.1 to 18.0: Soft sound method 1 (Basic carrier frequency: 2.1 to 5.0kHz) 18.1 to 21.0: Soft sound method 2 (Basic carrier frequency: 2.1 to 5.0kHz)	○			○	6-96
7	Carrier frequency (Large size) (V/f control)	1.0	14.0	10.0	1.0 to 8.0: Monotone sound method (Carrier frequency: 1.0 to 8.0kHz) 8.1 to 11.0: Soft sound method 1 (Basic carrier frequency: 2.1 to 5.0kHz) 11.1 to 14.0: Soft sound method 2 (Basic carrier frequency: 2.1 to 5.0kHz)	○			○	6-96
B01 – Output rating (Vector control)										
0	Rated input voltage setting (Vector control)	1.	7.	7.	Select the rated input voltage from the following table.		○	○		6-94
		When this data is changed, the output voltage data will be changed to the same value.								
1	Motor rated output (Vector control)	0.10	750.00	Inverter rating (KW)	The motor's rated output at the base speed is set.		○	○		6-94
2	No. of motor poles (Vector control)	2.	32.	4.	Set the number of poles indicated on the motor nameplate.		○	○		6-94
3	Motor rated voltage (Vector control)	40.	480.	230. or 400. (V)	DC-AVR functions to attain the set voltage at the base frequency. If the rated input voltage setting (B01-0) is changed, this value is also changed to the rated input voltage value. This cannot be set higher than the rated input voltage.		○	○		6-95
4	Max. speed (Nmax) (Vector control)	150.	9999.	1800. (min^{-1})	The max. motor speed is set. Set a value that is 4-times or less of the base speed. In the case of PM motor control, set a value 1.5 times or less of the base speed. The maximum value is determined by the number of motor poles. The speed is limited where the synchronous frequency is 180Hz (210Hz at PM motor control).		○	○		6-95
5	Base speed (Nbase) (Vector control)	150.	Max. speed	1800. (min^{-1})	The motor base speed is set. When higher than this speed, the flux control during vector control will be weakened.		○	○		6-95
6	Motor rated current (Vector control)	Inverter rating × 0.3	Inverter rating	Inverter rating (A)	The motor current during full load at the base speed is set.		○	○		6-95

Small size (Note 1)

Value	200V system	400V system
1	to 200V	to 380V
2	to 200V	381 to 400V
3	201 to 220V	401 to 415V
4	201 to 220V	416 to 440V
5	221 to 230V	441 to 460V
6	231 to 240V	461 to 480V
7	221 to 230V	381 to 400V

Large size (Note 2)

Value	200V system	400V system
1	to 200V	to 380V
2	to 200V	381 to 400V
3	201 to 220V	401 to 415V
4	201 to 220V	416 to 440V
5	221 to 230V	441 to 460V
6	231 to 240V	461 to 480V
7	221 to 230V	381 to 400V

Note 1) Small size: N000K7 to N045K0, X000K7 to X055K0
Note 2) Large size: X075K0 to X475K0

Block-B parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
B01 – Output rating (Vector control)										
7	Carrier frequency (Small size) (Vector control)	1.0	21.0	17.0	The noise can be lowered by changing the PWM carrier frequency and control method, and changing the tone of the magnetic noise generated from the motor. This can be changed while running. 1.0 to 15.0: Monotone sound method (Carrier frequency: 1.0 to 15.0kHz) 15.1 to 18.0: Soft sound method 1 (Basic carrier frequency: 2.1 to 5.0kHz) 18.1 to 21.0: Soft sound method 2 (Basic carrier frequency: 2.1 to 5.0kHz)		○	○	○	6-96
7	Carrier frequency (Large size) (Vector control)	1.0	14.0	10.0	1.0 to 8.0: Monotone sound method (Carrier frequency: 1.0 to 8.0kHz) 8.1 to 11.0: Soft sound method 1 (Basic carrier frequency: 2.1 to 5.0kHz) 11.1 to 14.0: Soft sound method 2 (Basic carrier frequency: 2.1 to 5.0kHz)		○	○	○	6-96
8	No. of encoder pulses (Vector control)	30.	10000.	1000. (P/R)	The number of pulses per rotation of the encoder in use is set.		○	○		6-97
9	No-load output voltage (Vector control)	20.	500.	160. (V)	The motor terminal voltage during no-load at the base speed is set.		○	○		6-97
B02 – Motor circuit constant										
0	R1: Primary resistance (IM: Mantissa section)	0.010	90999	Inverter rating (mΩ)	The motor circuit constant is set.	○	○		○	6-97
1	R1: Primary resistance (IM: Exponent section	-3	4	Inverter rating		○	○			6-97
2	R2': Secondary resistance (IM : Mantissa section)	0.010	90999	1.000 (mΩ)	This combination means below R2' = 1.000 × 10^0 [mΩ]		○		○	6-97
3	R2': Secondary resistance (IM: Exponent section)	-3	4	0.			○			6-97
4	Lσ: Leakage inductance (IM: Mantissa section)	0.100	9.999	1.000 (mH)		○	○		○	6-97
5	Lσ: Leakage inductance (IM: Exponent section)	-3	4	0.		○	○			6-97
6	M': Excitation inductance (IM: Mantissa section)	0.100	90999	1.000 (mH)			○		○	6-97
7	M': Excitation inductance (IM: Exponent section)	-3	4	0.			○			6-97
8	Rm: Iron loss resistance (IM: Mantissa section)	0.100	90999	1.000 (mΩ)			○		○	6-97
9	Rm: Iron loss resistance (IM: Exponent section)	-3	5	0.			○			6-97

Block-B parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
B03 – Motor circuit constant (PM)										
0	R1: PM motor winding resistance (Mantissa section)	0.001	9.999	1.000 (mΩ)	This combination means below R1 = 1.000 × 10^0 [mΩ]			○	○	6-97
1	R1: PM motor winding resistance (Exponent section)	-1.	4.	0.				○	○	6-97
2	Ld: PM motor d axis inductance (Mantissa section)	0.001	9.999	1.000 (mH)	This combination means below Ld = 1.000 × 10^0 [mH]			○	○	6-97
3	Lq: PM motor q axis inductance (Mantissa section)	0.001	9.999	1.000 (mH)				○	○	6-97
4	Ld, Lq: PM motor inductance (Exponent section)	-1.	4.	0.				○	○	6-97
5	Rated torque electric current (PM)	20.0	200.0	100.0 (%/I1M)	The torque current (q axis current) element required to generate the rated torque at the base speed is set as a ratio in respect to the rated current.			○		6-97
B05 – Frequency skip										
0	Skip frequency - 1	0.10	440.00	0.10 (Hz)	The set frequency avoids the jump width, during the jump frequency as a center point.	○			○	6-98
1	Skip band - 1	0.00	10.00	0.00 (Hz)		○			○	6-98
2	Skip frequency - 2	0.10	440.00	0.10 (Hz)		○			○	6-98
3	Skip band - 2	0.00	10.00	0.00 (Hz)		○			○	6-98
4	Skip frequency - 3	0.10	440.00	0.10 (Hz)		○			○	6-98
5	Skip band - 3	0.00	10.00	0.00 (Hz)		○			○	6-98

Block-B parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
B06 – Gearing comparative setting										
0	Analog speed setting-1: Coefficient	-10.000	10.000	1.000	The coefficient and panel bias value for sequential ratio operation is set with the analog speed setting selected with C07-0: Speed setting 1.	○	○	○	○	6-99
1	Analog speed setting-1: Bias (V/f)	-fmax*5 or -440.00	fmax*5 or 440.00	0.00 (Hz)		○			○	6-99
2	Analog speed setting-1: Bias (Vector & PM)	-Nmax*5 or -9999.	Nmax*5 or 9999.	0. (min^{-1})			○	○	○	6-99
3	Analog speed setting-2: Coefficient	-10.000	10.000	1.000	The coefficient and panel bias value for sequential ratio operation is set with the analog speed setting selected with C07-1: Speed setting 2.	○	○	○	○	6-99
4	Analog speed setting-2: Bias (V/f)	-fmax*5 or -440.00	fmax*5 or 440.00	0.00 (Hz)		○			○	6-99
5	Analog speed setting-2: Bias (Vector & PM)	-Nmax*5 or -9999.	Nmax*5 or 9999.	0. (min^{-1})			○	○	○	6-99
6	Analog speed setting-3: Coefficient	-10.000	10.000	1.000	The coefficient and panel bias value for sequential ratio operation is set with the analog speed setting selected with C07-2: Speed setting 3.	○	○	○	○	6-99
7	Analog speed setting-3: Bias (V/f)	-fmax*5 or -440.00	fmax*5 or 440.00	0.00 (Hz)		○			○	6-99
8	Analog speed setting-3: Bias (Vector & PM)	-Nmax*5 or -9999.	Nmax*5 or 9999.	0. (min^{-1})			○	○	○	6-99
9	Serial speed setting: Coefficient	-10.000	10.000	1.000	The coefficient and panel bias value for sequential ratio operation are set for when serial speed setting is valid.	○	○	○	○	6-99
A	Serial speed setting: Bias (V/f)	-fmax*5 or -440.00	fmax*5 or 440.00	0.00 (Hz)		○			○	6-99
B	Serial speed setting: Bias (Vector & PM)	-Nmax*5 or -9999.	Nmax*5 or 9999.	0. (min^{-1})			○	○	○	6-99
C	Pulse train input speed setting: Coefficient	-10.000	10.000	1.000	The coefficient and panel bias value for sequential ratio operation are set for when pulse train input speed setting is valid.	○	○	○	○	6-99
D	Pulse train input speed setting: Bias (V/f)	-fmax*5 or -440.00	fmax*5 or 440.00	0.00 (Hz)		○			○	6-99
E	Pulse train input speed setting: Bias (Vector & PM)	-Nmax*5 or -9999.	Nmax*5 or 9999.	0. (min^{-1})			○	○	○	6-99
B07 – Upper/Lower limit setting										
0	Upper limit (V/f, main)	-440.00	440.00	440.00 (Hz)	The upper limit is larger than the lower limit.	○			○	6-100
1	Lower limit (V/f, main)	-440.00	440.00	0.10 (Hz)		○			○	6-100
2	Upper limit (Vector&PM)	-9999.	9999.	7200. (min^{-1})	The upper limit is larger than the lower limit.		○	○	○	6-100
3	Lower limit (Vector&PM)	-9999.	9999.	-7200. (min^{-1})			○	○	○	6-100
B10 – Acceleration/deceleration time setting										
0	Acceleration time - 2 setting	0.1	6000.0	10.0 (s)	The acceleration/deceleration ramp time valid when the sequence input ramp 2 selection is ON (CSEL=ON) is set. Set a time between 0 and the max. frequency or max. speed. The unit can be changed to ×0.1s, ×10s with the time unit setting (B10-5).	○	○	○	○	6-100
1	Deceleration time - 2 setting	0.1	6000.0	20.0 (s)		○	○	○	○	6-100
2	Acceleration time for jogging setting	0.1	6000.0	5.0 (s)	The acceleration/deceleration time value when the JOG sequence (F JOG, R JOG) is valid is set. Set a time between 0 and the max. frequency or max. speed. The unit can be changed to ×0.1s, ×10s with the time unit setting (B10-5).	○	○	○	○	6-100
3	Deceleration time for jogging setting	0.1	6000.0	5.0 (s)		○	○	○	○	6-100

Block-B parameters list

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Parameter</th><th rowspan="2">Min.</th><th rowspan="2">Max.</th><th rowspan="2">Default (Unit)</th><th rowspan="2">Function</th><th colspan="4">Application</th><th rowspan="2">Ref. page</th></tr>
<tr><th>V/f</th><th>VEC</th><th>PM</th><th>RWE</th></tr>
<tr><td colspan="11">B10 – Acceleration/deceleration time setting</td></tr>
<tr><td>4</td><td>S-shape characteristics (Ts) acceleration and deceleration time setting</td><td>0.0</td><td>5.0</td><td>0.0 (s)</td><td>Set to 1/2 or less of the ramp time.
S-shape pattern is possible by setting this parameter.</td><td>○</td><td>○</td><td>○</td><td>○</td><td>6-101</td></tr>
<tr><td>5</td><td>Acceleration and deceleration cushion time unit setting</td><td>1.</td><td>3.</td><td>1.</td><td>=1:(Standard) =2: ×0.1 =3: ×10
The acceleration/deceleration ramp time setting unit can be changed by setting an acceleration/deceleration ramp time with a wider range. This parameter will affect all acceleration/
deceleration ramp time parameters.</td><td>○</td><td>○</td><td>○</td><td></td><td>6-101</td></tr>
<tr><td>6</td><td>S-shape ramp pass function setting</td><td>1.</td><td>3.</td><td>1.</td><td>=1: OFF =2: For program 0
=3: For RUN-OFF</td><td>○</td><td>○</td><td>○</td><td></td><td>6-101</td></tr>
<tr><td colspan="11">B11 – Program frequency (speed) setting</td></tr>
<tr><td>0</td><td>Program frequency (speed) - 0 setting</td><td>0.00</td><td>100.00</td><td>10.00 (%)</td><td rowspan="8">Select as follows with S0, S1, S2, S3 and SE.
(1) For binary mode (B11-8=1)
<table>
<tr><th colspan="5">Sequence command</th><th rowspan="2">Selected frequency</th></tr>
<tr><th>SE</th><th>S3</th><th>S2</th><th>S1</th><th>S0</th></tr>
<tr><td rowspan="8">*</td><td rowspan="8">*</td><td>OFF</td><td>OFF</td><td>OFF</td><td>B11-0</td></tr>
<tr><td>OFF</td><td>OFF</td><td>ON</td><td>B11-1</td></tr>
<tr><td>OFF</td><td>ON</td><td>OFF</td><td>B11-2</td></tr>
<tr><td>OFF</td><td>ON</td><td>ON</td><td>B11-3</td></tr>
<tr><td>ON</td><td>OFF</td><td>OFF</td><td>B11-4</td></tr>
<tr><td>ON</td><td>OFF</td><td>ON</td><td>B11-5</td></tr>
<tr><td>ON</td><td>ON</td><td>OFF</td><td>B11-6</td></tr>
<tr><td>ON</td><td>ON</td><td>ON</td><td>B11-7</td></tr>
</table>
* : SE and S3 are not used.
(2) For direct select mode (B11-8=2)
<table>
<tr><th colspan="5">Sequence command</th><th rowspan="2">Selected frequency</th></tr>
<tr><th>SE</th><th>S3</th><th>S2</th><th>S1</th><th>S0</th></tr>
<tr><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>Previous values</td></tr>
<tr><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td><td>B11-0</td></tr>
<tr><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td><td>OFF</td><td>B11-1</td></tr>
<tr><td>OFF</td><td>OFF</td><td>ON</td><td>OFF</td><td>OFF</td><td>B11-2</td></tr>
<tr><td>OFF</td><td>ON</td><td>OFF</td><td>OFF</td><td>OFF</td><td>B11-3</td></tr>
<tr><td>ON</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>Previous values</td></tr>
<tr><td>ON</td><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td><td>B11-4</td></tr>
<tr><td>ON</td><td>OFF</td><td>OFF</td><td>ON</td><td>OFF</td><td>B11-5</td></tr>
<tr><td>ON</td><td>OFF</td><td>ON</td><td>OFF</td><td>OFF</td><td>B11-6</td></tr>
<tr><td>ON</td><td>ON</td><td>OFF</td><td>OFF</td><td>OFF</td><td>B11-7</td></tr>
</table>
When S0 to S3 are all OFF, or when two or more are set between S0 and S3, the previous values will be held. If there are no previous values because the power has been turned ON, etc., "0" will be set.</td><td>○</td><td>○</td><td>○</td><td>○</td><td>6-102</td></tr>
<tr><td>1</td><td>Program frequency (speed) - 1 setting</td><td>0.00</td><td>100.00</td><td>10.00 (%)</td><td>○</td><td>○</td><td>○</td><td>○</td><td>6-102</td></tr>
<tr><td>2</td><td>Program frequency (speed) - 2 setting</td><td>0.00</td><td>100.00</td><td>10.00 (%)</td><td>○</td><td>○</td><td>○</td><td>○</td><td>6-102</td></tr>
<tr><td>3</td><td>Program frequency (speed) - 3 setting</td><td>0.00</td><td>100.00</td><td>10.00 (%)</td><td>○</td><td>○</td><td>○</td><td>○</td><td>6-102</td></tr>
<tr><td>4</td><td>Program frequency (speed) - 4 setting</td><td>0.00</td><td>100.00</td><td>10.00 (%)</td><td>○</td><td>○</td><td>○</td><td>○</td><td>6-102</td></tr>
<tr><td>5</td><td>Program frequency (speed) - 5 setting</td><td>0.00</td><td>100.00</td><td>10.00 (%)</td><td>○</td><td>○</td><td>○</td><td>○</td><td>6-102</td></tr>
<tr><td>6</td><td>Program frequency (speed) - 6 setting</td><td>0.00</td><td>100.00</td><td>10.00 (%)</td><td>○</td><td>○</td><td>○</td><td>○</td><td>6-102</td></tr>
<tr><td>7</td><td>Program frequency (speed) - 7 setting</td><td>0.00</td><td>100.00</td><td>10.00 (%)</td><td>○</td><td>○</td><td>○</td><td>○</td><td>6-102</td></tr>
<tr><td>8</td><td>Selection mode setting</td><td>1.</td><td>2.</td><td>1.</td><td>Select the program frequency setting (B11-0 to 7) and program ramp (B41, B42) selection mode.
= 1: Binary mode
= 2: Direct select mode</td><td>○</td><td>○</td><td>○</td><td></td><td>6-102</td></tr>
</table>

Block-B parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
B12 – Automatic braking on power failure setting (Main)										
0	Braking on power failure enable setting (Main)	1.	2.	1.	=1: C00-0, 1 compliant, =2: Decelerate stop at power failure	○	Δ	Δ	○	6-103
1	Power failure determination level setting (Main)	65.	90.	80. (%)	Sequence output: BPF turns ON when the DC voltage value is less than this level.	○	Δ	Δ	○	6-103
2	Deceleration ramp time-1 setting (Main)	0.1	6000.0	10.0 (s)	Motor decelerates from max. frequency value to 0Hz at the time set here.	○			○	6-103
3	Deceleration ramp time-2 setting (Main)	0.0	6000.0	10.0 (s)	Motor decelerates from max. frequency value to 0Hz at the time set here. When 0.0 is set, the motor decelerates at the deceleration ramp time -1.	○			○	6-103
4	Subtraction frequency setting (Main)	0.00	20.00	0.00 (Hz)	Subtraction is not executed when 0.00Hz is set. If the results of output frequency - subtraction frequency are 0 or less, the frequency is 0Hz and the brakes are applied.	○			○	6-103
5	Subtraction start frequency setting (Main)	0.00	Max fre-quency or 999.99	0.00 (Hz)	If the output frequency increases above this value, the motor decelerates from the results of output frequency - subtraction frequency. Subtraction is always executed when 999.99 is set.	○			○	6-103
6	Switching frequency setting (Main)	0.00	Max fre-quency	0.00 (Hz)	Changeover is not executed between 0.00 and the stopping frequency or less.	○			○	6-103
B13 – Local setting										
0	Torque setting	-300.0	300.0	0.0 (%)	This is the torque setting from the operation panel. Set C02-2 to 3 when using this setting.		○	○	○	6-104
1	Torque ratio 1 setting	0.001	5.000	1.000	This is the torque setting from the operation panel. Set C02-3 to 3 when using this setting.		○	○	○	6-104
2	Torque bias 1 setting	-300.0	300.0	0.0 (%)	This is the torque setting from the operation panel. Set C02-4 to 3 when using this setting.		○	○	○	6-104
3	Torque ratio 2 setting	-5.000	5.000	1.000	This is the torque setting from the operation panel. Set C02-5 to 3 when using this setting.		○	○	○	6-104
4	Double rating speed ratio setting	0.1	100.0	100.0 (%)	This sets the torque limiter reduction pattern changeover point. Set as a percentage in respect to the base speed.		○	○		6-104
5	Drooping setting	0.00	20.00	0.00 (%)	By adjusting this parameter, the torque-motor speed drooping characteristics can be achieved.		○	○	○	6-104
6	ASR gain compensation in constant power range	0.0	150.0	100.0 (%)	This sets the ASR gain compensation value at the max. speed. By adjusting this parameter, the ASR gain can be compensated in the constant power range. If ASR hunting occurs in the sensor-less vector control's constant output range, set a smaller value.		○	○	○	6-105
7	ACR gain compensation in constant power range	0.0	150.0	100.0 (%)	This sets the ACR gain compensation value at the max. speed. By adjusting this parameter, the ACR gain can be compensated in the constant power range.		○	○	○	6-105
8	Linear torque limit 1 (at 100% torque)	0.	450.	400. (%)	The linear torque limiter for operation of the PM motor in the weak magnetic field range is set. Refer to section 6-9-5 for details.		○	○	○	6-105
9	Linear torque limit 2 (at 100% torque)	0.	450.	450. (%)			○	○	○	6-105

Block-B parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application				Ref. page
						V/f	VEC	PM	RWE	
B14 – ASR dead band setting										
0	ASR dead band setting	0.0	100.0	0.0 (%)	The non-sensitive range of the ASR input is set.		○	○	○	6-105
B15 – Machine time constant setting										
0	Machine time constant setting 2	10.	20000.	1000. (ms)	The time to accelerate the motor and load's torque inertia to the base speed at the rated torque is set. This is valid when the sequence command machine time constant changeover is ON (MCH = ON).		○	○	○	6-105
B16 – Automatic torque bias setting										
0	Automatic torque bias selection	0.	2.	0.	=0: Not used =1: Digital =2: Analog		○	○		6-106
1	Digital bias setting 0	-150.0	150.0	-100.0 (%)	These settings are selected according to the state of sequence input: S5, S6 and S7 (C05-0, 1, 2).		○	○		6-106
2	Digital bias setting 1	-150.0	150.0	-50.0 (%)	S7 / S6 / S5 / 0 / 0 / 0 / setting0 0 / 0 / 1 / Setting1 0 / 1 / 0 / Setting2 0 / 1 / 1 / Setting3 1 / x / x / Setting4		○	○		6-106
3	Digital bias setting 2	-150.0	150.0	0.0 (%)			○	○		6-106
4	Digital bias setting 3	-150.0	150.0	50.0 (%)			○	○		6-106
5	Digital bias setting 4	-150.0	150.0	100.0 (%)			○	○		6-106
6	Bias direction selection	1.	2.	1.	Set the bias direction. =1: Clockwise drive direction =2: Counterclockwise drive direction		○	○		6-106
7	Analog bias voltage 0	-100.0	100.0	0.0 (%)	Set the input voltage lower limit value.		○	○		6-106
8	Analog bias voltage 1	-100.0	100.0	50.0 (%)	Set the input voltage at the balance point.		○	○		6-106
9	Analog bias voltage 2	-100.0	100.0	100.0 (%)	Set the input voltage upper limit value.		○	○		6-106
A	Output bias torque 0	-150.0	150.0	-100.0 (%)	Set the bias torque at the input voltage lower limit value.		○	○		6-106
B	Output bias torque 1	-150.0	150.0	100.0 (%)	Set the bias torque at the input voltage upper limit value.		○	○		6-106
B17 – V/f middle point setting										
0	V/f middle point setting-Frequency 1	0.00	Max. frequency	0.00 (Hz)	The following rule applies to each frequency. Fmax≥frequency-5≥frequency-4≥frequency -3≥frequency-2≥frequency-1≥0 If the setting exceeds this rule, the excessive frequency will be set to the same value as the changed setting value. Set the frequency value to 0.00 when using 4 points or less. Note that there is no need to set 0.00 from frequency -1. If all frequency settings are set to 0.00, the voltage at the base frequency will be 100%, and the B17-A setting value V/f characteristics will be applied at the max. frequency value.	○				6-107
1	V/f middle point setting-Voltage 1	0.0	200.0	0.0 (%)		○				6-107
2	V/f middle point setting-Frequency 2	0.00	Max. frequency	0.00 (Hz)		○				6-107
3	V/f middle point setting-Voltage 2	0.0	200.0	0.0 (%)		○				6-107
4	V/f middle point setting-Frequency 3	0.00	Max. frequency	0.00 (Hz)		○				6-107
5	V/f middle point setting-Voltage 3	0.0	200.0	0.0 (%)		○				6-107
6	V/f middle point setting-Frequency 4	0.00	Max. frequency	0.00 (Hz)		○				6-107
7	V/f middle point setting-Voltage 4	0.0	200.0	0.0 (%)		○				6-107
8	V/f middle point setting-Frequency 5	0.00	Max. frequency	0.00 (Hz)		○				6-107
9	V/f middle point setting-Voltage 5	0.0	200.0	0.0 (%)		○				6-107
A	V/f middle point setting-Voltage Fmax	0.0	200.0	100.0 (%)		○				6-107
B	V/f middle point use selection	1.	2.	1.	=1: Function invalid =2: Function valid	○				6-107

Block-B parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	VEC	PM	RWE	Ref. page
B18 – Current limit										
0	Over current limit	50.	300.	125. (%)	The default value is 155. when heavy-duty is set.	○	○	○	○	6-109
1	Regenerative current limit	5.	300.	10. (%)	Set to 10% when not using the DBR option.	○	△	△	○	6-110
2	Torque stabilization gain	0.00	4.00	1.00	The disturbance symptoms which occur if the current abnormally vibrates after motor operation is suppressed. Increase or decrease by 0.05 units if the motor vibrates.	○	△	△	○	6-110
3	Current limit function gain	0.00	2.00	0.25	Decrease if current hunting occurs.	○	△	△	○	6-109
4	Current stabilization gain	0.00	2.00	0.25		○	△	△	○	6-109
5	Current stall prevention gain	0.00	2.50	1.00	Decrease if current hunting occurs.	○	△	△	○	6-109
6	Stall prevention time constant	10.	1001.	100.	Increase if current hunting occurs. P control will be applied if 1001 is set.	○	△	△	○	6-109
7	Drive current limit level 2	50.	300.	200. (%)	When sequence input: OCLLV1 is ON, this parameter value is selected for the overcurrent limit. This function is not applied on the auxiliary drive.	○	○	○	○	6-109
8	Drive current limit level 3	50.	300.	250. (%)	When sequence input: OCLLV2 is ON, this parameter value is selected for the overcurrent limit. This function is not applied on the auxiliary drive.	○	○	○	○	6-109
B19 – Automatic tuning function										
0	Automatic tuning selection	0.	7.	0.	=1: Basic adjustment =2: Extended adjustment for V/f Control =3: Basic adjustment for Vector Control =4: Extended adjustment for Vector Control =5: Calculation of no load voltage for Vector Control =6: Encoder phase adjustment (PM) =7: Flux position estimation	○	○	○		6-110
1	Initial proportion compensation gain (Automatic tuning function)	0.	500.	100. (%)	When the motor with special circuit parameters is applied, the initial condition of automatic tuning is set. Change these value if auto tuning is completed incorrectly and try to auto tuning again. Set these values to increase or decrease with 50% step.	○	○			6-110
2	Initial time constant compensation gain (Automatic tuning function)	0.	500.	100. (%)		○	○			6-110

Block-B parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
B20 – Output rating (Auxiliary drive 0)										
0	Max./base frequency simple setting (Auxiliary drive 0)	0.	9.	1.	Select the output frequency rating from the combination below.	○	△	△		6-110

Value	Ftrq [Hz]	Fmax [Hz]
0	Free setting on B20-4, 5	
1	50	50
2	60	60
3	50	60
4	50	75

Value	Ftrq [Hz]	Fmax [Hz]
5	50	100
6	60	70
7	60	80
8	60	90
9	60	120

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
1	Rated output voltage (Auxiliary drive 0)	40.	480.	230. or 400. (V)	DC-AVR functions to attain the set voltage at the base frequency. If the rated input voltage setting (B00-0) is changed, this value is also changed to the rated input voltage value. This cannot be set higher than the rated input voltage.	○	△	△		6-110
2	Max. frequency (Fmax_AU0) (Auxiliary drive 0)	Fbase _AU0 or 3.00	FBASE _AU0*7 or 440.00	50.00 (Hz)	When "B20-0" is a value other than 0, this will be rewritten with the data set in the simple setting.	○	△	△		6-110
3	Base frequency (Fbase_AU0) (Auxiliary drive 0)	Fmax _AU0/7 or 1.00	Fmax _AU0 or 440.00	50.00 (Hz)		○	△	△		6-110
4	Motor rated current (Auxiliary drive 0)	Inverter rating × 0.3	Inverter rating	Inverter rating (A)	This is the reference value for the overcurrent limit, OLT, current % display, analog input and output.	○	△	△		6-110
5	Carrier frequency (Small size) (Auxiliary drive 0)	1.0	21.0	17.0	Refer to B00-7 for details on the settings.	○	△	△	○	6-110
5	Carrier frequency (Large size) (Auxiliary drive 0)	1.0	14.0	10.0		○	△	△	○	6-110
6	Start frequency (Auxiliary drive 0)	0.10	60.00	1.00 (Hz)	Operation starts from this frequency value when the motor starts.	○	△	△	○	6-110
7	Stop frequency (Auxiliary drive 0)	0.10	60.00	1.00 (Hz)	The DC brakes are applied when the frequency value is less than this frequency value.	○	△	△	○	6-110
8	Upper limit (Auxiliary drive 0)	-440.00	440.00	440.00 (Hz)	Make sure that the upper limit is greater than the lower limit.	○	△	△	○	6-110
9	Lower limit (Auxiliary drive 0)	-440.00	440.00	0.10 (Hz)		○	△	△	○	6-110
B21 – Frequency setting (Auxiliary drive 0)										
0	Local frequency setting (Auxiliary drive 0)	0.10	Fmax _AU0	10.00 (Hz)	This is the frequency set from the operation panel.	○	△	△	○	6-110
1	Frequency setting for jogging (Auxiliary drive 0)	0.10	Fmax _AU0	5.00 (Hz)	This is the frequency setting for jogging.	○	△	△	○	6-110
2	Acceleration time - 1 (Auxiliary drive 0)	0.1	6000.0	10.0 (s)	The unit can be changed to ×0.1s, ×10s with the time unit setting (B10-5). The time to reach the max. frequency or max. speed from 0 is set.	○	△	△	○	6-110
3	Deceleration time - 1 (Auxiliary drive 0)	0.1	6000.0	20.0 (s)		○	△	△	○	6-110

Block-B parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
B21 – Frequency setting (Auxiliary drive 0)										
4	Acceleration time - 2 (Auxiliary drive 0)	0.1	6000.0	10.0 (s)	This is the acceleration/deceleration ramp time setting made valid when the sequence command ramp 2 switch is ON (CSEL=ON). Set a time between 0 and the max. frequency or max. speed. The unit can be changed to ×0.1s, ×10s with the time unit setting (B10-5).	○	△	△	○	6-110
5	Deceleration time - 2 (Auxiliary drive 0)	0.1	6000.0	20.0 (s)		○	△	△	○	6-110
6	Acceleration time for jogging (Auxiliary drive 0)	0.1	6000.0	5.0 (s)	The acceleration/deceleration ramp time value when the JOG sequence (F JOG, R JOG) is valid is set. Set a time between 0 and the max. frequency. The unit can be changed to ×0.1s, ×10s with the time unit setting (B10-5).	○	△	△	○	6-110
7	Deceleration time for jogging (Auxiliary drive 0)	0.1	6000.0	5.0 (s)		○	△	△	○	6-110
B22 – Torque boost, DC Brake, DC Brake setting, Overcurrent setting, Overload setting (Auxiliary drive 0)										
0	Manual torque boost setting (Auxiliary drive 0)	0.00	20.00	Inverter rating (%)	Set the boost voltage at 0Hz.	○	△	△	○	6-110
1	Square reduction torque setting (Auxiliary drive 0)	0.00	25.00	0.00 (%)	Set the reduced voltage at Base frequency/2.	○	△	△	○	6-110
2	DC braking voltage (Auxiliary drive 0)	0.01	20.00	Inverter rating (%)	When setting manually, monitor the output voltage and change the setting in increments of 1% or less.	○	△	△	○	6-110
3	DC braking time (Auxiliary drive 0)	0.0	20.0	2.0 (s)	Set the time to apply the DC brakes.	○	△	△	○	6-110
4	Over current limit (Auxiliary drive 0)	50.	300.	125. (%)	The default value is 155. when heavy-duty is set.	○	△	△	○	6-110
5	Regenerative current limit (Auxiliary drive 0)	5.	300.	10. (%)	Set to 10% when not using the DBR option.	○	△	△	○	6-110
6	Torque stabilization gain (Auxiliary drive 0)	0.00	4.00	1.00	Increase or decrease by 0.05 units if the motor vibrates.	○	△	△	○	6-110
7	Motor overload reference (Auxiliary drive 0)	50.0	105.0	100.0 (%)	When this data is changed, the B22-8, 9 data is limited to this value. Take care when decreasing and then increasing this value.	○	△	△		6-110
8	0Hz overload (Auxiliary drive 0)	20.0	105.0	100.0 (%)	The max. value is the B22-9 value.	○	△	△		6-110
9	0.7Base freq. overload (Auxiliary drive 0)	50.0	105.0	100.0 (%)	The min. value is the B22-8 value.	○	△	△		6-110
B23 – Braking on power failure setting (Auxiliary drive 0)										
0	Braking on power deceleration ramp time-1 (Auxiliary drive 0)	0.1	6000.0	10.0 (s)	Set the deceleration time from the maximum frequency value to 0Hz.	○	△	△	○	6-110
1	Braking on power deceleration ramp time-2 (Auxiliary drive 0)	0.0	6000.0	10.0 (s)	Set the deceleration time from the maximum frequency value to 0Hz. Deceleration is performed at deceleration ramp time-1 when 0.0.	○	△	△	○	6-110
2	Braking on power subtraction frequency (Auxiliary drive 0)	0.00	20.00	0.00 (Hz)	No subtraction made when 0.00Hz. 0Hz and brake engaged when the result of output frequency – subtraction frequency is 0 or less.	○	△	△	○	6-110
3	Braking on power subtraction start frequency (Auxiliary drive 0)	0.00	Fmax _AU0 or 999.99	0.00 (Hz)	If the output frequency is higher than this value, deceleration is performed from the result of output frequency – subtraction frequency. Subtraction is always performed when 999.9.	○	△	△	○	6-110
4	Braking on power switching frequency (Auxiliary drive 0)	0.00	Fmax _AU0	0.00 (Hz)	Switching is not performed when 0.00 to stoppage frequency or less.	○	△	△	○	6-110

Block-B parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
B24 – Output rating (Auxiliary drive 0)										
0	Max./base frequency simple setting (Auxiliary drive 0)	0.	9.	1.	Select the output frequency rating from the combination below.	○	△	△		6-110

Value	Ftrq [Hz]	Fmax [Hz]
0	Free setting on B24-4, 5	
1	50	50
2	60	60
3	50	60
4	50	75

Value	Ftrq [Hz]	Fmax [Hz]
5	50	100
6	60	70
7	60	80
8	60	90
9	60	120

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
1	Rated output voltage (Auxiliary drive 0)	40.	480.	230. or 400. (V)	DC-AVR functions to attain the set voltage at the base frequency. If the rated input voltage setting (B00-0) is changed, this value is also changed to the rated input voltage value. This cannot be set higher than the rated input voltage.	○	△	△		6-110
2	Max. frequency (Fmax_AU1) (Auxiliary drive 0)	Fbase _AU1 or 3.00	FBASE _AU1*7 or 440.00	50.00 (Hz)	When "B24-0" is a value other than 0, this will be rewritten with the data set in the simple setting.	○	△	△		6-110
3	Base frequency (Fbase_AU1) (Auxiliary drive 0)	Fmax _AU1/7 or 1.00	Fmax _AU1 or 440.00	50.00 (Hz)		○	△	△		6-110
4	Motor rated current (Auxiliary drive 0)	Inverter rating × 0.3	Inverter rating	Inverter rating (A)	This is the reference value for the overcurrent limit, OLT, current % display, analog input and output.	○	△	△		6-110
5	Carrier frequency (Small size) (Auxiliary drive 0)	1.0	21.0	17.0	Refer to B00-7 for details on the settings.	○	△	△	○	6-110
5	Carrier frequency (Large size) (Auxiliary drive 0)	1.0	14.0	10.0		○	△	△	○	6-110
6	Start frequency (Auxiliary drive 0)	0.10	60.00	1.00 (Hz)	Operation starts from this frequency value when the motor starts.	○	△	△	○	6-110
7	Stop frequency (Auxiliary drive 0)	0.10	60.00	1.00 (Hz)	The DC brakes are applied when the frequency value is less than this frequency value.	○	△	△	○	6-110
8	Upper limit (Auxiliary drive 0)	-440.00	440.00	440.00 (Hz)	Make sure that the upper limit is greater than the lower limit	○	△	△	○	6-110
9	Lower limit (Auxiliary drive 0)	-440.00	440.00	0.10 (Hz)		○	△	△	○	6-110
B25 – Frequency setting (Auxiliary drive 1)										
0	Local frequency setting (Auxiliary drive 1)	0.10	Fmax _AU1	10.00 (Hz)	This is the frequency set from the operation panel.	○	△	△	○	6-110
1	Frequency setting for jogging (Auxiliary drive 1)	0.10	Fmax _AU1	5.00 (Hz)	This is the frequency setting for jogging.	○	△	△	○	6-110
2	Acceleration time - 1 (Auxiliary drive 1)	0.1	6000.0	10.0 (s)	The unit can be changed to ×0.1s, ×10s with the time unit setting (B10-5). Set a time between 0 and the max. frequency or max. speed.	○	△	△	○	6-110
3	Deceleration time - 1 (Auxiliary drive 1)	0.1	6000.0	20.0 (s)		○	△	△	○	6-110

Block-B parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	VEC	PM	RWE	Ref. page
B25 – Frequency setting (Auxiliary drive 1)										
4	Acceleration time - 2 (Auxiliary drive 1)	0.1	6000.0	10.0 (s)	This is the acceleration/deceleration ramp time setting made valid when the sequence command ramp 2 switch is ON (CSEL=ON). Set a time between 0 and the max. frequency or max. speed. The unit can be changed to ×0.1s, ×10s with the time unit setting (B10-5).	○	△	△	○	6-110
5	Deceleration time - 2 (Auxiliary drive 1)	0.1	6000.0	20.0 (s)		○	△	△	○	6-110
6	Acceleration time for jogging (Auxiliary drive 1)	0.1	6000.0	5.0 (s)	The acceleration/deceleration ramp time value when the JOG sequence (F JOG, R JOG) is valid is set. Set a time between 0 and the max. frequency. The unit can be changed to ×0.1s, ×10s with the time unit setting (B10-5).	○	△	△	○	6-110
7	Deceleration time for jogging (Auxiliary drive 1)	0.1	6000.0	5.0 (s)		○	△	△	○	6-110
B26 – Torque boost, DC Brake, DC Brake setting, Overcurrent setting, Overload setting (Auxiliary drive 1)										
0	Manual torque boost setting (Auxiliary drive 1)	0.00	20.00	Inverter rating (%)	Set the boost voltage at 0Hz.	○	△	△	○	6-110
1	Square reduction torque setting (Auxiliary drive 1)	0.00	25.00	0.00 (%)	Set the reduced voltage at Base frequency/2.	○	△	△	○	6-110
2	DC braking voltage (Auxiliary drive 1)	0.01	20.00	Inverter rating (%)	When setting manually, monitor the output voltage and change the setting in increments of 1% or less.	○	△	△	○	6-110
3	DC braking time (Auxiliary drive 1)	0.0	20.0	2.0 (sec)	Set the time to apply the DC brakes.	○	△	△	○	6-110
4	Over current limit (Auxiliary drive 1)	50.	300.	125. (%)	The default value is 155. when heavy-duty is set.	○	△	△	○	6-110
5	Regenerative current limit (Auxiliary drive 1)	5.	300.	10. (%)	Set to 10% when not using the DBR option.	○	△	△	○	6-110
6	Torque stabilization gain (Auxiliary drive 1)	0.00	4.00	1.00	Increase or decrease by 0.05 units if the motor vibrates.	○	△	△	○	6-110
7	Motor overload reference (Auxiliary drive 1)	50.0	105.0	100.0 (%)	When this data is changed, the B26-8, 9 data is limited to this value. Take care when decreasing and then increasing this value.	○	△	△		6-110
8	0Hz overload (Auxiliary drive 1)	20.0	105.0	100.0 (%)	The max. value is the B26-9 value.	○	△	△		6-110
9	0.7Base freq. overload (Auxiliary drive 1)	50.0	105.0	100.0 (%)	The min. value is the B26-8 value.	○	△	△		6-110
B27 – Braking on power failure setting (Auxiliary drive 1)										
0	Braking on power deceleration ramp time-1 (Auxiliary drive 1)	0.1	6000.0	10.0 (s)	Set the deceleration time from the maximum frequency value to 0Hz.	○	△	△	○	6-110
1	Braking on power deceleration ramp time-2 (Auxiliary drive 1)	0.0	6000.0	10.0 (s)	Set the deceleration time from the maximum frequency value to 0Hz. Deceleration is performed at deceleration ramp time-1 when 0.0.	○	△	△	○	6-110
2	Braking on power subtraction frequency (Auxiliary drive 1)	0.00	20.00	0.00 (Hz)	No subtraction made when 0.00Hz. 0Hz and brake engaged when the result of output frequency – subtraction frequency is 0 or less.	○	△	△	○	6-110
3	Braking on power subtraction start frequency (Auxiliary drive 1)	0.00	Fmax _AU1 or 999.99	0.00 (Hz)	If the output frequency is higher than this value, deceleration is performed from the result of output frequency – subtraction frequency. Subtraction is always performed when 999.99.	○	△	△	○	6-110
4	Braking on power switching frequency (Auxiliary drive 1)	0.00	Fmax _AU1	0.00 (Hz)	Switching is not performed when 0.00 to stoppage frequency or less.	○	△	△	○	6-110

Block-B parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
B28 – Output rating (Auxiliary drive 2)										
0	Max./base frequency simple setting (Auxiliary drive 2)	0.	9.	1.	Select the output frequency rating from the combination below.	○	△	△		6-110

Value	Ftrq [Hz]	Fmax [Hz]
0	Free setting on B28-4, 5	
1	50	50
2	60	60
3	50	60
4	50	75

Value	Ftrq [Hz]	Fmax [Hz]
5	50	100
6	60	70
7	60	80
8	60	90
9	60	120

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
1	Rated output voltage (Auxiliary drive 2)	40.	480.	230. or 400. (V)	DC-AVR functions to attain the set voltage at the base frequency. If the rated input voltage setting (B00-0) is changed, this value is also changed to the rated input voltage value. This cannot be set higher than the rated input voltage.	○	△	△		6-110
2	Max. frequency (Fmax_AU2) (Auxiliary drive 2)	Fbase _AU2 or 3.00	FBASE _AU2*7 or 440.00	50.00 (Hz)	When "B28-0" is a value other than 0, this will be rewritten with the data set in the simple setting.	○	△	△		6-110
3	Base frequency (Fbase_AU2) (Auxiliary drive 2)	Fmax _AU2/7 or 1.00	Fmax _AU2 or 440.00	50.00 (Hz)		○	△	△		6-110
4	Motor rated current (Auxiliary drive 2)	Inverter rating × 0.3	Inverter rating	Inverter rating (A)	This is the reference value for the overcurrent limit, OLT, current % display, analog input and output.	○	△	△		6-110
5	Carrier frequency (Small size) (Auxiliary drive 2)	1.0	21.0	17.0	Refer to B00-7 for details on the settings.	○	△	△	○	6-110
5	Carrier frequency (Large size) (Auxiliary drive 2)	1.0	14.0	10.0		○	△	△	○	6-110
6	Start frequency (Auxiliary drive 2)	0.10	60.00	1.00 (Hz)	Operation starts from this frequency value when the motor starts.	○	△	△	○	6-110
7	Stop frequency (Auxiliary drive 2)	0.10	60.00	1.00 (Hz)	The DC brakes are applied when the frequency value is less than this frequency value.	○	△	△	○	6-110
8	Upper limit (Auxiliary drive 2)	-440.00	440.00	440.00 (Hz)	Make sure that the upper limit is greater than the lower limit	○	△	△	○	6-110
9	Lower limit (Auxiliary drive 2)	-440.00	440.00	0.10 (Hz)		○	△	△	○	6-110
B29 – Frequency setting (Auxiliary drive 2)										
0	Local frequency setting (Auxiliary drive 2)	0.10	Fmax _AU2	10.00 (Hz)	This is the frequency set from the operation panel.	○	△	△	○	6-110
1	Frequency setting for jogging (Auxiliary drive 2)	0.10	Fmax _AU2	5.00 (Hz)	This is the frequency setting for jogging.	○	△	△	○	6-110
2	Acceleration time - 1 (Auxiliary drive 2)	0.1	6000.0	10.0 (s)	The unit can be changed to ×0.1s, ×10s with the time unit setting (B10-5). The time to reach the max. frequency from 0 is set.	○	△	△	○	6-110
3	Deceleration time - 1 (Auxiliary drive 2)	0.1	6000.0	20.0 (s)		○	△	△	○	6-110

Block-B parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
B29 – Frequency setting (Auxiliary drive 2)										
4	Acceleration time - 2 (Auxiliary drive 2)	0.1	6000.0	10.0 (s)	This is the acceleration/deceleration ramp time setting made valid when the sequence command ramp 2 switch is ON (CSEL=ON). Set a time between 0 and the max. frequency or max. speed. The unit can be changed to ×0.1s, ×10s with the time unit setting (B10-5).	○	△	△	○	6-110
5	Deceleration time - 2 (Auxiliary drive 2)	0.1	6000.0	20.0 (s)		○	△	△	○	6-110
6	Acceleration time for jogging (Auxiliary drive 2)	0.1	6000.0	5.0 (s)	The acceleration/deceleration ramp time value when the JOG sequence (F JOG, R JOG) is valid is set. Set a time between 0 and the max. frequency. The unit can be changed to ×0.1s, ×10s with the time unit setting (B10-5).	○	△	△	○	6-110
7	Deceleration time for jogging (Auxiliary drive 2)	0.1	6000.0	5.0 (s)		○	△	△	○	6-110
B2A – Torque boost, DC Brake, Dc Brake setting, Overcurrent setting, Overload setting (Auxiliary drive 2)										
0	Manual torque boost setting (Auxiliary drive 2)	0.00	20.00	Inverter rating (%)	Set the boost voltage at 0Hz.	○	△	△	○	6-110
1	Square reduction torque setting (Auxiliary drive 2)	0.00	25.00	0.00 (%)	Set the reduced voltage at Base frequency/2.	○	△	△	○	6-110
2	DC braking voltage (Auxiliary drive 2)	0.01	20.00	Inverter rating (%)	When setting manually, monitor the output voltage and change the setting in increments of 1% or less.	○	△	△	○	6-110
3	DC braking time (Auxiliary drive 2)	0.0	20.0	2.0 (sec)	Set the time to apply the DC brakes.	○	△	△	○	6-110
4	Over current limit (Auxiliary drive 2)	50.	300.	125. (%)	The default value is 155. when heavy-duty is set.	○	△	△	○	6-110
5	Regenerative current limit (Auxiliary drive 2)	5.	300.	10. (%)	Set to 10% when not using the DBR option.	○	△	△	○	6-110
6	Torque stabilization gain (Auxiliary drive 2)	0.00	4.00	1.00	Increase or decrease by 0.05 units if the motor vibrates.	○	△	△	○	6-110
7	Motor overload reference (Auxiliary drive 2)	50.0	105.0	100.0 (%)	When this data is changed, the B2A-8, 9 data is limited to this value. Take care when decreasing and then increasing this value.	○	△	△		6-110
8	0Hz overload (Auxiliary drive 2)	20.0	105.0	100.0 (%)	The max. value is the B2A-9 value.	○	△	△		6-110
9	0.7Base freq. overload (Auxiliary drive 2)	50.0	105.0	100.0 (%)	The min. value is the B2A-8 value.	○	△	△		6-110
B2B – Braking on power failure setting (Auxiliary drive 2)										
0	Braking on power deceleration ramp time-1 (Auxiliary drive 2)	0.1	6000.0	10.0 (s)	Set the deceleration time from the maximum frequency value to 0Hz.	○	△	△	○	6-110
1	Braking on power deceleration ramp time-2 (Auxiliary drive 2)	0.0	6000.0	10.0 (s)	Set the deceleration time from the maximum frequency value to 0Hz. Deceleration is performed at deceleration ramp time-1 when 0.0.	○	△	△	○	6-110
2	Braking on power subtraction frequency (Auxiliary drive 2)	0.00	20.00	0.00 (Hz)	No subtraction made when 0.00Hz. 0Hz and brake engaged when the result of output frequency – subtraction frequency is 0 or less.	○	△	△	○	6-110
3	Braking on power subtraction start frequency (Auxiliary drive 2)	0.00	Fmax _AU2 or 999.99	0.00 (Hz)	If the output frequency is higher than this value, deceleration is performed from the result of output frequency – subtraction frequency. Subtraction is always performed when 999.99.	○	△	△	○	6-110
4	Braking on power switching frequency (Auxiliary drive 2)	0.00	Fmax _AU2	0.00 (Hz)	Switching is not performed when 0.00 to stoppage frequency or less.	○	△	△	○	6-110

Block-B parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
B2C – Output rating (Auxiliary drive 3)										
0	Max./base frequency simple setting (Auxiliary drive 3)	0.	9.	1.	Select the output frequency rating from the combination below.	○	△	△		6-110

Value	Ftrq [Hz]	Fmax [Hz]
0	Free setting on B2C-4, 5	
1	50	50
2	60	60
3	50	60
4	50	75
5	50	100
6	60	70
7	60	80
8	60	90
9	60	120

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
1	Rated output voltage (Auxiliary drive 3)	40.	480.	230. or 400. (V)	DC-AVR functions to attain the set voltage at the base frequency. If the rated input voltage setting (B00-0) is changed, this value is also changed to the rated input voltage value. This cannot be set higher than the rated input voltage.	○	△	△		6-110
2	Max. frequency (Fmax_AU3) (Auxiliary drive 3)	Fbase _AU3 or 3.00	FBASE _AU3*7 or 440.00	50.00 (Hz)	When "B2C-0" is a value other than 0, this will be rewritten with the data set in the simple setting.	○	△	△		6-110
3	Base frequency (Fbase_AU3) (Auxiliary drive 3)	Fmax _AU3/7 or 1.00	Fmax _AU3 or 440.00	50.00 (Hz)		○	△	△		6-110
4	Motor rated current (Auxiliary drive 3)	Inverter rating × 0.3	Inverter rating	Inverter rating (A)	This is the reference value for the overcurrent limit, OLT, current % display, analog input and output.	○	△	△		6-110
5	Carrier frequency (Small size) (Auxiliary drive 3)	1.0	21.0	17.0	Refer to B00-7 for details on the settings.	○	△	△	○	6-110
5	Carrier frequency (Large size) (Auxiliary drive 3)	1.0	14.0	10.0		○	△	△	○	6-110
6	Start frequency (Auxiliary drive 3)	0.10	60.00	1.00 (Hz)	Operation starts from this frequency value when the motor starts.	○	△	△	○	6-110
7	Stop frequency (Auxiliary drive 3)	0.10	60.00	1.00 (Hz)	The DC brakes are applied when the frequency value is less than this frequency value.	○	△	△	○	6-110
8	Upper limit (Auxiliary drive 3)	-440.00	440.00	440.00 (Hz)	Make sure that the upper limit is greater than the lower limit	○	△	△	○	6-110
9	Lower limit (Auxiliary drive 3)	-440.00	440.00	0.10 (Hz)		○	△	△	○	6-110
B2D – Frequency setting (Auxiliary drive 3)										
0	Local frequency setting (Auxiliary drive 3)	0.10	Fmax _AU3	10.00 (Hz)	This is the frequency set from the operation panel.	○	△	△	○	6-110
1	Frequency setting for jogging (Auxiliary drive 3)	0.10	Fmax _AU3	5.00 (Hz)	This is the frequency setting for jogging.	○	△	△	○	6-110
2	Acceleration time - 1 (Auxiliary drive 3)	0.1	6000.0	10.0 (s)	The unit can be changed to ×0.1s, ×10s with the time unit setting (B10-5). Set a time between 0 and the max. frequency or max. speed.	○	△	△	○	6-110
3	Deceleration time - 1 (Auxiliary drive 3)	0.1	6000.0	20.0 (s)		○	△	△	○	6-110

Block-B parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application				Ref. page
						V/f	VEC	PM	RWE	
B2D – Frequency setting (Auxiliary drive 3)										
4	Acceleration time - 2 (Auxiliary drive 3)	0.1	6000.0	10.0 (s)	This is the acceleration/deceleration ramp time setting made valid when the sequence command ramp 2 switch is ON (CSEL=ON). Set a time between 0 and the max. frequency or max. speed. The unit can be changed to ×0.1s, ×10s with the time unit setting (B10-5).	○	△	△	○	6-110
5	Deceleration time - 2 (Auxiliary drive 0)	0.1	6000.0	20.0 (s)		○	△	△	○	6-110
6	Acceleration time for jogging (Auxiliary drive 3)	0.1	6000.0	5.0 (s)	The acceleration/deceleration ramp time value when the JOG sequence (F JOG, R JOG) is valid is set. Set a time between 0 and the max. frequency. The unit can be changed to ×0.1s, ×10s with the time unit setting (B10-5).	○	△	△	○	6-110
7	Deceleration time for jogging (Auxiliary drive 3)	0.1	6000.0	5.0 (s)		○	△	△	○	6-110
B2E – Torque boost, DC Brake, DC Brake setting, Overcurrent setting, Overload setting (Auxiliary drive 3)										
0	Manual torque boost setting (Auxiliary drive 3)	0.00	20.00	Inverter rating (%)	Set the boost voltage at 0Hz.	○	△	△	○	6-110
1	Square reduction torque setting (Auxiliary drive 3)	0.00	25.00	0.00 (%)	Set the reduced voltage at Base frequency/2.	○	△	△	○	6-110
2	DC braking voltage (Auxiliary drive 3)	0.01	20.00	Inverter rating (%)	This is automatically adjusted by the automatic tuning.	○	△	△	○	6-110
3	DC braking time (Auxiliary drive 3)	0.0	20.0	2.0 (s)	Set the time to apply the DC brakes.	○	△	△	○	6-110
4	Over current limit (Auxiliary drive 3)	50.	300.	125. (%)	The default value is 155. when heavy-duty is set.	○	△	△	○	6-110
5	Regenerative current limit (Auxiliary drive 3)	5.	300.	10. (%)	Set to 10% when not using the DBR option.	○	△	△	○	6-110
6	Torque stabilization gain (Auxiliary drive 3)	0.00	4.00	1.00	Increase or decrease by 0.05 units if the motor vibrates.	○	△	△	○	6-110
7	Motor overload reference (Auxiliary drive 3)	50.0	105.0	100.0 (%)	When this data is changed, the B2E-8, 9 data is limited to this value. Take care when decreasing and then increasing this value.	○	△	△		6-110
8	0Hz overload (Auxiliary drive 3)	20.0	105.0	100.0 (%)	The max. value is the B2E-9 value.	○	△	△		6-110
9	0.7Base freq. overload (Auxiliary drive 3)	50.0	105.0	100.0 (%)	The min. value is the B2E-8 value.	○	△	△		6-110
B2F – Braking on power failure setting (Auxiliary drive 3)										
0	Braking on power deceleration ramp time-1 (Auxiliary drive 3)	0.1	6000.0	10.0 (s)	Set the deceleration time from the maximum frequency value to 0Hz.	○	△	△	○	6-110
1	Braking on power deceleration ramp time-2 (Auxiliary drive 3)	0.0	6000.0	10.0 (s)	Set the deceleration time from the maximum frequency value to 0Hz. Deceleration is performed at deceleration ramp time-1 when 0.0.	○	△	△	○	6-110
2	Braking on power subtraction frequency (Auxiliary drive 3)	0.00	20.00	0.00 (Hz)	No subtraction made when 0.00Hz. 0Hz and brake engaged when the result of output frequency – subtraction frequency is 0 or less.	○	△	△	○	6-110
3	Braking on power subtraction start frequency (Auxiliary drive 3)	0.00	Fmax _AU3 or 999.99	0.00 (Hz)	If the output frequency is higher than this value, deceleration is performed from the result of output frequency – subtraction frequency. Subtraction is always performed when 999.99.	○	△	△	○	6-110
4	Braking on power switching frequency (Auxiliary drive 3)	0.00	Fmax _AU3	0.00 (Hz)	Switching is not performed when 0.00 to stoppage frequency or less.	○	△	△	○	6-110

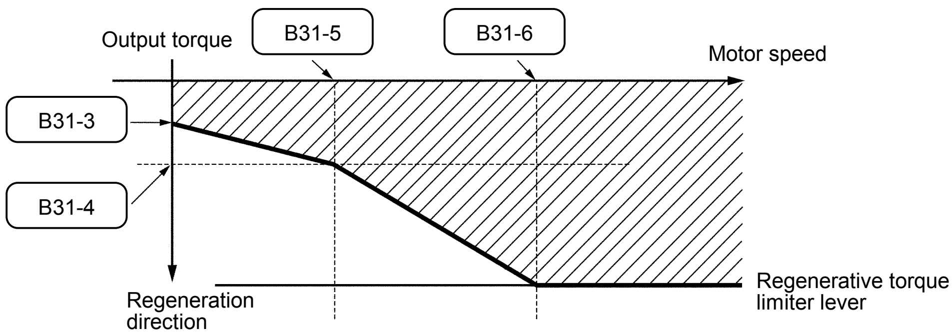
Block-B parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
B30 – Speed control extended function										
0	Load torque observer gain (Speed control extended function)	0.0	200.0	0.0	Set the observer gain for the load torque observer. To increase the responsiveness of the external disturbance response characteristics, set a large gain. Note that if the gain is set too high, the output torque could hunt. When set to zero, the load torque observer will not function.		○	○	○	6-110
1	Model machine time constant (Speed control extended function)	10.	20000.	500. (ms)	Set the model machine time constant used by the load torque observer.		○	○	○	6-110
2	ASR proportional item change rate limit (Speed control extended function)	1.0	400.0	50.0 (%)	If the speed setting value or motor speed change suddenly, this will prevent the ASR's P item from suddenly changing.		○	○	○	6-110
3	Speed setting LPF time constant (Speed control extended function)	0.	1000.	0. (ms)	Overshooting can be suppressed by setting this to the filter time constant equivalent to the speed response.		○	○	○	6-111
4	Speed detection LPF time constant (Speed control extended function)	0.	1000.	2. (ms)	The speed detection noise is cut.	○ *1)	○	○	○	6-111
5	Speed detection LPF time constant for ASR (Speed control extended function)	0.	1000.	5. (ms)	Set the low path filter time constant used for the speed detection value input into the speed regulator.		○	○	○	6-111
6	Speed detection LPF time constant for compensation (Speed control extended function)	0.	1000.	20. (ms)	Set the low path filter time constant used for the speed detection value for constant output range compensation or iron loss compensation, etc.		○	○	○	6-111
7	Torque current command setting LPF time constant (Speed control extended function)	0.	1000.	0. (ms)	Set the low path filter time constant used for the torque current command.		○	○	○	6-111
8	LPF time constant for drooping (Speed control extended function)	0.	1000.	100. (ms)	Set the low path filter time constant used for drooping value input into the speed regulator.		○	○	○	6-111

*1) This parameter is used by simple ASR control.

Block-B parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
B31 – Sensor-less control function										
0	Flux observer gain (Sensor-less control function)	0.50	1.50	1.00	This is the feedback gain for the flux observer. If hunting occurs at the estimated speed in the high-speed operation range, adjust within the range of 1.2 to 0.9.		○		○	6-111
1	Speed estimated proportional gain (Sensor-less control function)	0.00	100.00	10.00 (%)	This is the proportional gain for the adaptive speed estimation mechanism. To increase the speed estimation response, set a large value. Note that if the value is too high, the speed estimation value will hunt.		○		○	6-111
2	Speed estimated integral gain (Sensor-less control function)	0.00	100.0	0.10 (%)	This is the integral gain for the adaptive speed estimation mechanism. To increase the speed estimation response, set a large value. Note that if the value is too high, the speed estimation value will hunt.		○		○	6-111
3	Regenerative compen-sation torque limiter 1 (Sensor-less control function)	0.1	100.0	10.0 (%)	The regenerative torque limiter can be changed in the low-speed area. The shaded section shows the operation range. If operation is unstable within the shaded line range, set the parameter so that the unstable point is not within the shaded line area.		○		○	6-112
4	Regenerative compen-sation torque limiter 2 (Sensor-less control function)	0.1	100.0	20.0 (%)			○		○	6-112
5	Regenerative compen-sation low-speed area setting 1 (Sensor-less control function)	0.1	100.0	10.0 (%)			○		○	6-112
6	Regenerative compen-sation low-speed area setting 2 (Sensor-less control function)	0.1	100.0	20.0 (%)			○		○	6-112



Block-B parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application				Ref. page
						V/f	VEC	PM	RWE	
B32 – Vector control compensation selection • Extended function control										
0	High-speed flux control gain	1.	50.	1.	= 1: Disable = 2 to 50: Enable This is the control gain used for high-speed control of the secondary flux when starting operation. Use this to control the secondary flux at a high speed at the start of operation or during operation in a constant output range. High speed control is possible by increasing the gain, but if increased too high, the magnetizing current may hunt.		○			6-112
1	Temperature compensation selection	1.	2.	1.	= 1: Disable = 2: Enable If torque accuracy is required when vector control with sensor is selected (C30-0: f0 = 3), or if speed accuracy is required when sensor-less vector control is selected (C30-0: f0 = 2), the parameter fluctuation of the primary resistance value and secondary resistance value caused by a rise in temperature can be compensated.		○			6-112
2	Voltage saturation compensation selection	1.	2.	1.	= 1: Disable = 2: Enable If the output voltage in control is larger than the voltage that can be output by the inverter, select this control to limit the exciting current to prevent the current or torque from hunting. Select this when raising the output voltage to near the input voltage, or when the input voltage changes. Note that if voltage saturation occurs, some torque ripple will occur. In this case, lower the B01-9 no-load voltage setting to avoid voltage saturation.		○		○	6-112
3	Iron loss compensation selection	1.	2.	1.	= 1: Disable = 2: Enable This compensates the torque error caused by iron loss. The iron loss resistance value (B02-8, 9) must be set.		○		○	6-113
4	ACR voltage model FF selection	1.	2.	2.	= 1: Disable = 2: Enable The voltage fluctuation caused by the leakage inductance is feed forward controlled. The current regulator (ACR) response speed will be increased. Select this if the current hunts in the high-speed operation range during sensor-less control.		○	○		6-113
5	ACR model voltage FF compensation	0.0	200.0	0.0 (%)	dq axis current non-interference voltage Set this when the ASR proportional gain is high. Set the value between approx. 50.0 and 80.0%.			○	○	6-113
6	ACR proportional section dead time compensating factor	0.0	200.0	0.0 (%)	If a 3ms cycle current vibration is generated at 120Hz or more, set a value between approx. 50.0 and 80.0%.			○	○	6-113

Block-B parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application				Ref. page
						V/f	VEC	PM	RWE	
B33 – M fluctuation compensation table reference speed										
0	Table reference speed 0 (M fluctuation compensation)	100.	9999.	200 (min^{-1})	This is the reference speed for changing the compensation amount according to the operation speed. If all of B34 is set to the default value (100.0), these will be automatically set when adjusted with automatic tuning mode 4 (B19-0=4).		○			6-113
1	Table reference speed 1 (M fluctuation compensation)	100.	9999.	400 (min^{-1})			○			6-113
2	Table reference speed 2 (M fluctuation compensation)	100.	9999.	600 (min^{-1})			○			6-113
3	Table reference speed 3 (M fluctuation compensation)	100.	9999.	800 (min^{-1})			○			6-113
4	Table reference speed 4 (M fluctuation compensation)	100.	9999.	1000 (min^{-1})			○			6-113
5	Table reference speed 5 (M fluctuation compensation)	100.	9999.	1200 (min^{-1})			○			6-113
6	Table reference speed 6 (M fluctuation compensation)	100.	9999.	1400 (min^{-1})			○			6-113
7	Table reference speed 7 (M fluctuation compensation)	100.	9999.	1600 (min^{-1})			○			6-113
B34 – M fluctuation compensation										
0	M fluctuation compensation coefficient 0	50.0	150.0	100.0 (%)	This compensates the exciting inductance fluctuation according to the B33 table reference speed. Set the compensation table so that the output voltage is constant during no-load operation through the entire operation range. * This is adjusted with the automatic tuning mode 4 (B19-0 = 4).		○		○	6-113
1	M fluctuation compensation coefficient 1	50.0	150.0	100.0 (%)			○		○	6-113
2	M fluctuation compensation coefficient 2	50.0	150.0	100.0 (%)			○		○	6-113
3	M fluctuation compensation coefficient 3	50.0	150.0	100.0 (%)			○		○	6-113
4	M fluctuation compensation coefficient 4	50.0	150.0	100.0 (%)			○		○	6-113
5	M fluctuation compensation coefficient 5	50.0	150.0	100.0 (%)			○		○	6-113
6	M fluctuation compensation coefficient 6	50.0	150.0	100.0 (%)			○		○	6-113
7	M fluctuation compensation coefficient 7	50.0	150.0	100.0 (%)			○		○	6-113
B35 – Voltage saturation prevention control constant										
0	Voltage saturation prevention current voltage allowance	0.0	100.0	10.0 (%/V1)	Refer to section 6-9 for details.			○	○	6-114
1	Largest voltage setting	50.0	200.0	100.0 (%/V1)				○	○	6-114
2	Weak field current limit value	10.0	200.0	50.0 (%/I1)				○	○	6-114
3	Voltage saturation prevention current proportional gain	0.01	99.99	0.10				○	○	6-114
4	Voltage saturation prevention control integral time constant	2.	1000.	10. (ms)				○	○	6-114

Block-B parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
B36 – Field weakening electric current table (PM motor control)										
0	Field weakening electric current table 0 (at torque command 0%)	-100.0	100.0	0.0 (%/I1)	Refer to section 6-9 for details.			○	○	6-114
1	Field weakening electric current table 1 (at torque command 25%)	-100.0	100.0	0.0 (%/I1)				○	○	6-114
2	Field weakening electric current table 2 (at torque command 50%)	-100.0	100.0	0.0 (%/I1)				○	○	6-114
3	Field weakening electric current table 3 (at torque command 75%)	-100.0	100.0	0.0 (%/I1)				○	○	6-114
4	Field weakening electric current table 4 (at torque command 100%)	-100.0	100.0	0.0 (%/I1)				○	○	6-114
5	Field weakening electric current table 5 (at torque command 125%)	-100.0	100.0	0.0 (%/I1)				○	○	6-114
6	Field weakening electric current table 6 (at torque command 150%)	-100.0	100.0	0.0 (%/I1)				○	○	6-114
B38 – Torque to Iq conversion adjustment coefficient table (PM)										
0	Torque to Iq conversion adjustment coefficient (at Id command -100%)	0.	200.	100. (%/I1)	Refer to section 6-9 for details.			○	○	6-114
1	Torque to Iq conversion adjustment coefficient (at Id command -75%)	0.	200.	100. (%/I1)				○	○	6-114
2	Torque to Iq conversion adjustment coefficient (at Id command -50%)	0.	200.	100. (%/I1)				○	○	6-114
3	Torque to Iq conversion adjustment coefficient (at Id command -25%)	0.	200.	100. (%/I1)				○	○	6-114
4	Torque to Iq conversion adjustment coefficient (at Id command 0%)	0.	200.	100. (%/I1)				○	○	6-114
5	Torque to Iq conversion adjustment coefficient (at Id command 25%)	0.	200.	100. (%/I1)				○	○	6-114
6	Torque to Iq conversion adjustment coefficient (at Id command 50%)	0.	200.	100. (%/I1)				○	○	6-114

Block-B parameters (S/W option constants) list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
B39 – Pole position presumption (PM)										
0	Pole presumption selection (PM)	1111.	2223.	1111.	1 1 1 1 . f0=1: Magnetic pole position estimation OFF =2: Estimation with secondary phase =3: Estimation with primary phase (only special SPM) f1=1: Run at Z pulse reference =2: Run at estimation phase reference f2=1: Magnetic pole position estimation using sequence prohibited =2: Magnetic pole position estimation using sequence enabled f3=1: Sequence output during magnetic pole position estimation: RUN output invalid =2: Sequence output during magnetic pole position estimation: RUN output valid			○	○	6-114
1	PM tuning voltage	10.	200.	50. (%)	Set the voltage amplitude for measurement. The motor's rated voltage is 100%.			○	○	6-114
2	PM tuning time	2.	32.	4.	Set the voltage width for measurement.			○	○	6-114
3	Voltage error correction current (PM)	0.	50.	10. (%)	Set the current amplitude for correcting the voltage error. The motor's rated voltage is 100%.			○	○	6-114
4	ACR response for magnetic pole position estimation	100.	6000.	1500. (rad/s)	Set the ACR gain and time constant for magnetic pole position estimation. This setting is applied even during PM motor circuit constant automatic tuning.			○	○	
5	ACR time constant for magnetic pole position estimation	0.1	300.0	10.0 (%)				○	○	
B40 – Software option function										
0	Function selection - 1 (Software option function)	1.	8.	1.	= 1: Following functions are not used. = 2: Program ramp function use = 3: Pattern run use = 4: Traverse run use = 5: PID use = 6: PID, multi-pump control use (No main pump rotation) = 7: PID, multi-pump control use (Main pump rotation performed, 1-contact method) = 8: PID, multi-pump control use (Main pump rotation performed, 2-contact method)	○	○	○		6-114
B41 – Program ramp – acceleration										
0	Acceleration ramp time – 0	0.1	6000.0	10.0 (s)	Select as follows with S0, S1, S2, S3 and SE.	○	○	○	○	6-115
1	Acceleration ramp time – 1	0.1	6000.0	10.0 (s)		○	○	○	○	6-115
2	Acceleration ramp time – 2	0.1	6000.0	10.0 (s)		○	○	○	○	6-115
3	Acceleration ramp time – 3	0.1	6000.0	10.0 (s)		○	○	○	○	6-115
4	Acceleration ramp time – 4	0.1	6000.0	10.0 (s)		○	○	○	○	6-115
5	Acceleration ramp time – 5	0.1	6000.0	10.0 (s)		○	○	○	○	6-115
6	Acceleration ramp time – 6	0.1	6000.0	10.0 (s)		○	○	○	○	6-115
7	Acceleration ramp time – 7	0.1	6000.0	10.0 (s)		○	○	○	○	6-115

Block-B parameters (S/W option constants) list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
B42 – Program ramp – deceleration										
0	Deceleration ramp time – 0	0.1	6000.0	20.0 (s)	Select as follows with S0, S1, S2, S3 and SE.	○	○	○	○	6-115
1	Deceleration ramp time - 1	0.1	6000.0	20.0 (s)		○	○	○	○	6-115
2	Deceleration ramp time – 2	0.1	6000.0	20.0 (s)		○	○	○	○	6-115
3	Deceleration ramp time – 3	0.1	6000.0	20.0 (s)		○	○	○	○	6-115
4	Deceleration ramp time – 4	0.1	6000.0	20.0 (s)		○	○	○	○	6-115
5	Deceleration ramp time – 5	0.1	6000.0	20.0 (s)		○	○	○	○	6-115
6	Deceleration ramp time – 6	0.1	6000.0	20.0 (s)		○	○	○	○	6-115
7	Deceleration ramp time – 7	0.1	6000.0	20.0 (s)		○	○	○	○	6-115

The binary mode or direct input mode is selected with B11-8.

(1) For binary mode (B11-8=1)

Sequence command SE	S3	S2	S1	S0	Selected ramp time
*	*	OFF	OFF	OFF	B41-0 B42-0
		OFF	OFF	ON	B41-1 B42-1
		OFF	ON	OFF	B41-2 B42-2
		OFF	ON	ON	B41-3 B42-3
		ON	OFF	OFF	B41-4 B42-4
		ON	OFF	ON	B41-5 B42-5
		ON	ON	OFF	B41-6 B42-6
		ON	ON	ON	B41-7 B42-7

* : SE and S3 are not used.

(2) For direct select mode (B11-8=2)

Sequence command SE	S3	S2	S1	S0	Selected ramp time
OFF	OFF	OFF	OFF	OFF	Previous values
OFF	OFF	OFF	OFF	ON	B41-0 B42-0
OFF	OFF	OFF	ON	OFF	B41-1 B42-1
OFF	OFF	ON	OFF	OFF	B41-2 B42-2
OFF	ON	OFF	OFF	OFF	B41-3 B42-3
ON	OFF	OFF	OFF	OFF	Previous values
ON	OFF	OFF	OFF	ON	B41-4 B42-4
ON	OFF	OFF	ON	OFF	B41-5 B42-5
ON	OFF	ON	OFF	OFF	B41-6 B42-6
ON	ON	OFF	OFF	OFF	B41-7 B42-7

When S0 to S3 are all OFF, or when two or more are set between S0 and S3, the previous values will be held. If there are no previous values because the power has been turned ON, etc., "0" will be set.

Block-B parameters (S/W option constants) list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	VEC	PM	RWE	Ref. page
B43 – PID control										
0	Proportional gain	0.01	10.00	1.00	The control constant of the PID control is set.	○	○	○	○	6-116
1	Integral time constant	0.0	30.0	10.0 (s)		○	○	○	○	6-116
2	Differential time constant	0.000	1.000	0.000 (s)		○	○	○	○	6-116
3	Upper limit	5.0	100.0	100.0 (%)	The maximum frequency and maximum speed are 100%	○	○	○	○	6-116
4	Lower limit	0.0	50.0	0.0 (%)		○	○	○	○	6-116
5	Detected error determination start level	0.0	100.0	0.0 (%)	Error determination is commenced if the command value is this value or higher.	○	○	○	○	6-116
6	Detected error level	0.0	100.0	0.0 (%)	An error occurs if the detected value is this value or lower.	○	○	○	○	6-116
7	Detected error determination time	0.0	25.0	0.5 (s)	A breakdown (I0-B.) occurs if the error continues this length of time or longer.	○	○	○		6-116
8	Polarity reverse flag	1.	2.	1.	The command and detection polarity is reversed. =1: Normal =2: Reversed	○	○	○		6-116
9	PID operation method	11.	22.	11.	1 1 f0: PID operation conditions =1: RUN and PIDEN AND conditions =2: PIDEN f1: RUN conditions =1: RUN operation (normal operation) =2: Stop occurs when the PID output reaches the lower limiter.	○	○	○		6-116
A	Hysteresis when restarting operation	1.0	10.0	3.0 (%)	Set the PID output hysteresis width when restarting operation when B43-9=22.	○	○	○		6-116
B44 – Multi-pump control										
0	No. of controlled pumps (Multi-pump control)	1.	8.	3.	Set the No. of pumps to be ON/OFF controlled.	○				6-118
1	Pump start holding time (Multi-pump control)	0.1	3600.0	60.0 (s)	If the time that the PID output is applied on the upper limiter is longer than this setting, the pump's ON control will be carried out.	○				6-118
2	Pump stop holding time (Multi-pump control)	0.1	3600.0	60.0 (s)	If the time that the PID output is applied on the lower limiter is longer than this setting, the pump's OFF control will be carried out.	○				6-118
3	Maximum continuous operation time (Multi-pump control)	0.0	168.0	8.0 (h)	If the pump's ON/OFF control is not carried out for longer than the time set here, the pumps will change from that operating to the longest to that operating the shortest so that the operation time of each pump is equal. Changing is prohibited when =0.0 is set.	○				6-118
4	Changeover time (Multi-pump control)	1.0	120.0	3.0 (s)	Set the time for changing from the pump that has been operating the longest to the pump that has been operating the shortest.	○				6-118
5	INV/main switching dead time setting (Multi-pump control)	0.2	10.0	1.0 (s)	Set the dead time for switching the INV and main power supply during main pump rotation.	○				6-118
6	Inverter control method at lower limit (Multi-pump control)	1.	2.	1.	Select whether to stop the INV or continue operation when the other auxiliary motor is stopped and the lower limit state is continued. =1: Stop =2: Continue running	○				6-118

Block-B parameters (S/W option constants) list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application				Ref. page
						V/f	VEC	PM	RWE	
B45 – Traverse run										
0	Traverse run: Center frequency (speed) (FH)	5.00	100.00	20.00 (%)	Set the center frequency for traverse operation.	○	○	○	○	6-124
1	Traverse run: Amplitude (A)	0.1	20.0	10.0 (%)	Set the upper/lower peak frequency from the traverse center frequency.	○	○	○	○	6-124
2	Traverse run: Drop (D)	0.0	50.0	0.0 (%)	When a value other than 0.0 is set, the frequency is dropped by the set amount after reaching the peak.	○	○	○	○	6-124
3	Traverse run: Acceleration time (B)	0.5	60.0	10.0 (s)	Set the time from the lower peak to the upper peak.	○	○	○	○	6-124
4	Traverse run: Deceleration time (C)	0.5	60.0	10.0 (s)	Set the time from the upper peak to the lower peak.	○	○	○	○	6-124
5	Traverse run: Deviated traverse (X)	0.0	20.0	10.0 (%)	When sequence input: S0 is ON, the center frequency will increase by the set amount.	○	○	○	○	6-124
6	Traverse run: Deviated traverse (Y)	0.0	20.0	10.0 (%)	When sequence input: S1 is ON, the center frequency will decrease by the set amount.	○	○	○	○	6-124
B46 – External brake control										
0	External brake selection (External brake selection)	111.	222.	111.	1 1 1. f0 = External brake function selection =1: OFF =2: ON f1= IDET interlock =1: OFF =2: ON f2 = Acceleration wait time =1: Program frequency output =2: DC brake output	○	○	○		6-126
1	Brake release wait time (LB) (External brake selection)	0.00	2.50	0.00 (s)	Set the wait time from the RUN command to the brake release command.	○	○	○	○	6-126
2	Acceleration start wait time (BL) (External brake selection)	0.00	2.50	0.00 (s)	Set the wait time from the point the brakes are released until the motor accelerates. If there is a brake answer (MBRK_ans), set from answer, and if none, set time from command.	○	○	○	○	6-126
3	Brake engage wait time (DB) (External brake selection)	0.00	2.50	0.00 (s)	Set the wait time (cumulative) from the point the frequency (speed) command value reaches the zero speed setting or below until the brake is engaged.	○	○	○	○	6-126
4	RUN error judgment time when engaging brake (External brake selection)	0.0	25.0	0.0 (s)	A fault stoppage occurs if ON for the RUN setting time or longer when engaging the brake. Error judgment is turned OFF at 0.00.	○	○	○	○	6-126
5	Brake answer error judgment time (External brake selection)	0.0	25.0	0.0 (s)	The brake command and brake answer do not match for the set time or longer, and a fault stoppage occurs. Error judgment is turned OFF at 0.00.	○	○	○	○	6-126
B47 – Simple ASR control										
0	Simple ASR control selection	11.	22.	21.	2 1. f0: Simple ASR selection =1: OFF =2: ON f1: Integral mask processing when accelerating/decelerating =1: OFF =2: ON	○				6-128
1	Simple ASR proportional gain	0.00	10.00	0.10	Set with response for machine time constant of 1s.	○			○	6-128
2	Simple ASR integral time constant	0.00	10.00	1.00 (s)	Set the simple ASR integral time constant.	○			○	6-128
3	Proportional variation rate limit	0.01	50.00	1.00 (%)	Set the proportional variation rate control value.	○			○	6-128
4	Compensation torque limiter	0.1	300.0	100.0 (%)	Set the slippage compensation limit value.	○			○	6-128
5	Simple ASR pole count	2.	32.	4.	Set the motor pole count.	○				6-128
6	Simple ASR pulse count	30.	10000.	1000.	Set the encoder pulse count.	○				6-128

Block-B parameters (S/W option constants) list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	VEC	PM	RWE	Ref. page
B50 – Pattern run step-0										
0	Mode (Pattern run step-0)	0.	2.	0.	= 0: Stop = 1: Forward run = 2: Reverse run	○	○	○	○	6-129
1	Frequency (speed) (Pattern run step-0)	0.00	100.00	10.00 (%)	Set the step 0 frequency. 100% is the max. frequency (speed).	○	○	○	○	6-129
2	Time (Pattern run step-0)	0.1	6000.0	1.0 (s)	Set the time for operating at this step.	○	○	○	○	6-129
B51 – Pattern run step-1										
0	Mode (Pattern run step-1)	0.	2.	0.	= 0: Stop = 1: Forward run = 2: Reverse run	○	○	○	○	6-129
1	Frequency (speed) (Pattern run step-1)	0.00	100.00	10.00 (%)	Set the step 1 frequency. 100% is the max. frequency (speed).	○	○	○	○	6-129
2	Time (Pattern run step-1)	0.1	6000.0	1.0 (s)	Set the time for operating at this step.	○	○	○	○	6-129
B52 – Pattern run step-2										
0	Mode (Pattern run step-2)	0.	3.	0.	= 0: Stop = 1: Forward run = 2: Reverse run =3: Return	○	○	○	○	6-129
1	Frequency (speed) (Pattern run step-2)	0.00	100.00	10.00 (%)	Set the step 2 frequency. 100% is the max. frequency (speed).	○	○	○	○	6-129
2	Time (Pattern run step-2)	0.1	6000.0	1.0 (s)	Set the time for operating at this step.	○	○	○	○	6-129
3	Return destination step (Pattern run step-2)	0.	1.	0.	If a value other than 0 is set, the operation will start from the designated step No. once this step is finished.	○	○	○	○	6-129
B53 – Pattern run step-3										
0	Mode (Pattern run step-3)	0.	3.	0.	= 0: Stop = 1: Forward run = 2: Reverse run =3: Return	○	○	○	○	6-129
1	Frequency (speed) (Pattern run step-3)	0.00	100.00	10.00 (%)	Set the step 3 frequency. 100% is the max. frequency (speed).	○	○	○	○	6-129
2	Time (Pattern run step-3)	0.1	6000.0	1.0 (s)	Set the time for operating at this step.	○	○	○	○	6-129
3	Return destination step (Pattern run step-3)	0.	2.	0.	If a value other than 0 is set, the operation will start from the designated step No. once this step is finished.	○	○	○	○	6-129
B54 – Pattern run step-4										
0	Mode (Pattern run step-4)	0.	3.	0.	= 0: Stop = 1: Forward run = 2: Reverse run =3: Return	○	○	○	○	6-129
1	Frequency (speed) (Pattern run step-4)	0.00	100.00	10.00 (%)	Set the step 4 frequency. 100% is the max. frequency (speed).	○	○	○	○	6-129
2	Time (Pattern run step-4)	0.1	6000.0	1.0 (s)	Set the time for operating at this step.	○	○	○	○	6-129
3	Return destination step (Pattern run step-4)	0.	3.	0.	If a value other than 0 is set, the operation will start from the designated step No. once this step is finished.	○	○	○	○	6-129
B55 – Pattern run step-5										
0	Mode (Pattern run step-5)	0.	3.	0.	= 0: Stop = 1: Forward run = 2: Reverse run =3: Return	○	○	○	○	6-129
1	Frequency (speed) (Pattern run step-5)	0.00	100.00	10.00 (%)	Set the step 5 frequency. 100% is the max. frequency (speed).	○	○	○	○	6-129
2	Time (Pattern run step-5)	0.1	6000.0	1.0 (s)	Set the time for operating at this step.	○	○	○	○	6-129
3	Return destination step (Pattern run step-5)	0.	4.	0.	If a value other than 0 is set, the operation will start from the designated step No. once this step is finished.	○	○	○	○	6-129

Block-B parameters (S/W option constants) list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application				Ref. page
						V/f	VEC	PM	RWE	
B56 – Pattern run step-6										
0	Mode (Pattern run step-6)	0.	3.	0.	= 0: Stop = 1: Forward run = 2: Reverse run =3: Return	○	○	○	○	6-129
1	Frequency (speed) (Pattern run step-6)	0.00	100.00	10.00 (%)	Set the step 6 frequency. 100% is the max. frequency (speed).	○	○	○	○	6-129
2	Time (Pattern run step-6)	0.1	6000.0	1.0 (s)	Set the time for operating at this step.	○	○	○	○	6-129
3	Return destination step (Pattern run step-6)	0.	5.	0.	If a value other than 0 is set, the operation will start from the designated step No. once this step is finished.	○	○	○	○	6-129
B57 – Pattern run step-7										
0	Mode (Pattern run step-7)	0.	3.	0.	= 0: Stop = 1: Forward run = 2: Reverse run =3: Return	○	○	○	○	6-129
1	Frequency (speed) (Pattern run step-7)	0.00	100.00	10.00 (%)	Set the step 7 frequency. 100% is the max. frequency (speed).	○	○	○	○	6-129
2	Time (Pattern run step-7)	0.1	6000.0	1.0 (s)	Set the time for operating at this step.	○	○	○	○	6-129
3	Return destination step (Pattern run step-7)	0.	6.	0.	If a value other than 0 is set, the operation will start from the designated step No. once this step is finished.	○	○	○	○	6-129
B58 – Pattern run step-8										
0	Mode (Pattern run step-8)	0.	3.	0.	= 0: Stop = 1: Forward run = 2: Reverse run =3: Return	○	○	○	○	6-129
1	Frequency (speed) (Pattern run step-8)	0.00	100.00	10.00 (%)	Set the step 8 frequency. 100% is the max. frequency (speed).	○	○	○	○	6-129
2	Time (Pattern run step-8)	0.1	6000.0	1.0 (s)	Set the time for operating at this step.	○	○	○	○	6-129
3	Return destination step (Pattern run step-8)	0.	7.	0.	If a value other than 0 is set, the operation will start from the designated step No. once this step is finished.	○	○	○	○	6-129
B59 – Pattern run step-9										
0	Mode (Pattern run step-9)	0.	3.	0.	= 0: Stop = 1: Forward run = 2: Reverse run =3: Return	○	○	○	○	6-129
1	Frequency (speed) (Pattern run step-9)	0.00	100.00	10.00 (%)	Set the step 9 frequency. 100% is the max. frequency (speed).	○	○	○	○	6-129
2	Time (Pattern run step-9)	0.1	6000.0	1.0 (s)	Set the time for operating at this step.	○	○	○	○	6-129
3	Return destination step (Pattern run step-9)	0.	8.	0.	If a value other than 0 is set, the operation will start from the designated step No. once this step is finished.	○	○	○	○	6-129
B60 – Spinning frame operation setting										
0	STP function selection (Spinning frame operation setting)	11.	22.	11.	1 1. f0= STP function selection = 1: Not selected =2: Selected f1= Operation mode after final step selection = 1: Operation stop = 2: FRQ SP operation	○				6-131
1	STP0 step count (Spinning frame operation setting)	0.	14.	14.	Set the step number to STP0.	○			○	6-131
2	STP1 step count (Spinning frame operation setting)	0.	14.	14.	Set the step number to STP1.	○			○	6-131
3	STP2 step count (Spinning frame operation setting)	0.	14.	14.	Set the step number to STP2.	○			○	6-131
4	STP3 step count (Spinning frame operation setting)	0.	14.	14.	Set the step number to STP3.	○			○	6-131
5	Doff-End alarm time (Spinning frame operation setting)	0.1	3000.0	1.0 (s)	Outputs alarm signal for the set time from completion of the final step until directly before stoppage.	○			○	6-131

Block-B parameters (S/W option constants) list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	VEC	PM	RWE	Ref. page
B60 – Spinning frame operation setting										
6	STP time unit setting (Spinning frame operation setting)	1.	2.	1.	1 = ×1, 2 = ×10 This is valid for the STP time (B63, 64, 67, 68, 71, 72, 75, 76) and Doff-End alarm time (B60-5).	○			○	6-131
7	Hank count gain (Spinning frame operation setting)	0.001	30.000	1.000	This is the Hank count calculation gain.	○			○	6-131
8	Hank count gain unit (Spinning frame operation setting)	1.	3.	1.	=1: ×1.0, =2: ×0.1, =3: ×10	○			○	6-131
9	FRQ_SP frequency setting (Spinning frame operation setting)	0.00	100.00	10.00 (%)	Set the frequency after the step is completed. This is valid when B60-0[f1]=2.	○			○	6-131
B61 – STP0 frequency										
0	STP0 frequency 0	0.00	100.00	10.00 (%)	Set the STP0 step 0 frequency.	○			○	6-131
1	STP0 frequency 1	0.00	100.00	10.00 (%)	Set the STP0 step 1 frequency.	○			○	6-131
2	STP0 frequency 2	0.00	100.00	10.00 (%)	Set the STP0 step 2 frequency.	○			○	6-131
3	STP0 frequency 3	0.00	100.00	10.00 (%)	Set the STP0 step 3 frequency.	○			○	6-131
4	STP0 frequency 4	0.00	100.00	10.00 (%)	Set the STP0 step 4 frequency.	○			○	6-131
5	STP0 frequency 5	0.00	100.00	10.00 (%)	Set the STP0 step 5 frequency.	○			○	6-131
6	STP0 frequency 6	0.00	100.00	10.00 (%)	Set the STP0 step 6 frequency.	○			○	6-131
7	STP0 frequency 7	0.00	100.00	10.00 (%)	Set the STP0 step 7 frequency.	○			○	6-131
B62 – STP0 frequency										
0	STP0 frequency 8	0.00	100.00	10.00 (%)	Set the STP0 step 8 frequency.	○			○	6-131
1	STP0 frequency 9	0.00	100.00	10.00 (%)	Set the STP0 step 9 frequency.	○			○	6-131
2	STP0 frequency 10	0.00	100.00	10.00 (%)	Set the STP0 step 10 frequency.	○			○	6-131
3	STP0 frequency 11	0.00	100.00	10.00 (%)	Set the STP0 step 11 frequency.	○			○	6-131
4	STP0 frequency 12	0.00	100.00	10.00 (%)	Set the STP0 step 12 frequency.	○			○	6-131
5	STP0 frequency 13	0.00	100.00	10.00 (%)	Set the STP0 step 13 frequency.	○			○	6-131
6	STP0 frequency 14	0.00	100.00	10.00 (%)	Set the STP0 step 14 frequency.	○			○	6-131
B63 – STP0 time										
0	STP0 time 0	0.1	6000.0	1.0 (s)	Set the STP0 step 0 time.	○			○	6-131
1	STP0 time 1	0.1	6000.0	1.0 (s)	Set the STP0 step 1 time.	○			○	6-131
2	STP0 time 2	0.1	6000.0	1.0 (s)	Set the STP0 step 2 time.	○			○	6-131
3	STP0 time 3	0.1	6000.0	1.0 (s)	Set the STP0 step 3 time.	○			○	6-131
4	STP0 time 4	0.1	6000.0	1.0 (s)	Set the STP0 step 4 time.	○			○	6-131
5	STP0 time 5	0.1	6000.0	1.0 (s)	Set the STP0 step 5 time.	○			○	6-131
6	STP0 time 6	0.1	6000.0	1.0 (s)	Set the STP0 step 6 time.	○			○	6-131
7	STP0 time 7	0.1	6000.0	1.0 (s)	Set the STP0 step 7 time.	○			○	6-131

Block-B parameters (S/W option constants) list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	VEC	PM	RWE	Ref. page
B64 – STP0 time										
0	STP0 time 8	0.1	6000.0	1.0 (s)	Set the STP0 step 8 time.	○			○	6-131
1	STP0 time 9	0.1	6000.0	1.0 (s)	Set the STP0 step 9 time.	○			○	6-131
2	STP0 time 10	0.1	6000.0	1.0 (s)	Set the STP0 step 10 time.	○			○	6-131
3	STP0 time 11	0.1	6000.0	1.0 (s)	Set the STP0 step 11 time.	○			○	6-131
4	STP0 time 12	0.1	6000.0	1.0 (s)	Set the STP0 step 12 time.	○			○	6-131
5	STP0 time 13	0.1	6000.0	1.0 (s)	Set the STP0 step 13 time.	○			○	6-131
6	STP0 time 14	0.1	6000.0	1.0 (s)	Set the STP0 step 14 time.	○			○	6-131
B65 – STP1 frequency										
0	STP1 frequency 0	0.00	100.00	10.00 (%)	Set the STP1 step 0 frequency.	○			○	6-131
1	STP1 frequency 1	0.00	100.00	10.00 (%)	Set the STP1 step 1 frequency.	○			○	6-131
2	STP1 frequency 2	0.00	100.00	10.00 (%)	Set the STP1 step 2 frequency.	○			○	6-131
3	STP1 frequency 3	0.00	100.00	10.00 (%)	Set the STP1 step 3 frequency.	○			○	6-131
4	STP1 frequency 4	0.00	100.00	10.00 (%)	Set the STP1 step 4 frequency.	○			○	6-131
5	STP1 frequency 5	0.00	100.00	10.00 (%)	Set the STP1 step 5 frequency.	○			○	6-131
6	STP1 frequency 6	0.00	100.00	10.00 (%)	Set the STP1 step 6 frequency.	○			○	6-131
7	STP1 frequency 7	0.00	100.00	10.00 (%)	Set the STP1 step 7 frequency.	○			○	6-131
B66 – STP1 frequency										
0	STP1 frequency 8	0.00	100.00	10.00 (%)	Set the STP1 step 8 frequency.	○			○	6-131
1	STP1 frequency 9	0.00	100.00	10.00 (%)	Set the STP1 step 9 frequency.	○			○	6-131
2	STP1 frequency 10	0.00	100.00	10.00 (%)	Set the STP1 step 10 frequency.	○			○	6-131
3	STP1 frequency 11	0.00	100.00	10.00 (%)	Set the STP1 step 11 frequency.	○			○	6-131
4	STP1 frequency 12	0.00	100.00	10.00 (%)	Set the STP1 step 12 frequency.	○			○	6-131
5	STP1 frequency 13	0.00	100.00	10.00 (%)	Set the STP1 step 13 frequency.	○			○	6-131
6	STP1 frequency 14	0.00	100.00	10.00 (%)	Set the STP1 step 14 frequency.	○			○	6-131
B67 – STP1 time										
0	STP1 time 0	0.1	6000.0	1.0 (s)	Set the STP1 step 0 time.	○			○	6-131
1	STP1 time 1	0.1	6000.0	1.0 (s)	Set the STP1 step 1 time.	○			○	6-131
2	STP1 time 2	0.1	6000.0	1.0 (s)	Set the STP1 step 2 time.	○			○	6-131
3	STP1 time 3	0.1	6000.0	1.0 (s)	Set the STP1 step 3 time.	○			○	6-131
4	STP1 time 4	0.1	6000.0	1.0 (s)	Set the STP1 step 4 time.	○			○	6-131
5	STP1 time 5	0.1	6000.0	1.0 (s)	Set the STP1 step 5 time.	○			○	6-131
6	STP1 time 6	0.1	6000.0	1.0 (s)	Set the STP1 step 6 time.	○			○	6-131
7	STP1 time 7	0.1	6000.0	1.0 (s)	Set the STP1 step 7 time.	○			○	6-131

Block-B parameters (S/W option constants) list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	VEC	PM	RWE	Ref. page
B68 – STP1 time										
0	STP1 time 8	0.1	6000.0	1.0 (s)	Set the STP1 step 8 time.	○			○	6-131
1	STP1 time 9	0.1	6000.0	1.0 (s)	Set the STP1 step 9 time.	○			○	6-131
2	STP1 time 10	0.1	6000.0	1.0 (s)	Set the STP1 step 10 time.	○			○	6-131
3	STP1 time 11	0.1	6000.0	1.0 (s)	Set the STP1 step 11 time.	○			○	6-131
4	STP1 time 12	0.1	6000.0	1.0 (s)	Set the STP1 step 12 time.	○			○	6-131
5	STP1 time 13	0.1	6000.0	1.0 (s)	Set the STP1 step 13 time.	○			○	6-131
6	STP1 time 14	0.1	6000.0	1.0 (s)	Set the STP1 step 14 time.	○			○	6-131
B69 – STP2 frequency										
0	STP2 frequency 0	0.00	100.00	10.00 (%)	Set the STP2 step 0 frequency.	○			○	6-131
1	STP2 frequency 1	0.00	100.00	10.00 (%)	Set the STP2 step 1 frequency.	○			○	6-131
2	STP2 frequency 2	0.00	100.00	10.00 (%)	Set the STP2 step 2 frequency.	○			○	6-131
3	STP2 frequency 3	0.00	100.00	10.00 (%)	Set the STP2 step 3 frequency.	○			○	6-131
4	STP2 frequency 4	0.00	100.00	10.00 (%)	Set the STP2 step 4 frequency.	○			○	6-131
5	STP2 frequency 5	0.00	100.00	10.00 (%)	Set the STP2 step 5 frequency.	○			○	6-131
6	STP2 frequency 6	0.00	100.00	10.00 (%)	Set the STP2 step 6 frequency.	○			○	6-131
7	STP2 frequency 7	0.00	100.00	10.00 (%)	Set the STP2 step 7 frequency.	○			○	6-131
B70 – STP2 frequency										
0	STP2 frequency 8	0.00	100.00	10.00 (%)	Set the STP2 step 8 frequency.	○			○	6-131
1	STP2 frequency 9	0.00	100.00	10.00 (%)	Set the STP2 step 9 frequency.	○			○	6-131
2	STP2 frequency 10	0.00	100.00	10.00 (%)	Set the STP2 step 10 frequency.	○			○	6-131
3	STP2 frequency 11	0.00	100.00	10.00 (%)	Set the STP2 step 11 frequency.	○			○	6-131
4	STP2 frequency 12	0.00	100.00	10.00 (%)	Set the STP2 step 12 frequency.	○			○	6-131
5	STP2 frequency 13	0.00	100.00	10.00 (%)	Set the STP2 step 13 frequency.	○			○	6-131
6	STP2 frequency 14	0.00	100.00	10.00 (%)	Set the STP2 step 14 frequency.	○			○	6-131
B71 – STP2 time										
0	STP2 time 0	0.1	6000.0	1.0 (s)	Set the STP2 step 0 time.	○			○	6-131
1	STP2 time 1	0.1	6000.0	1.0 (s)	Set the STP2 step 1 time.	○			○	6-131
2	STP2 time 2	0.1	6000.0	1.0 (s)	Set the STP2 step 2 time.	○			○	6-131
3	STP2 time 3	0.1	6000.0	1.0 (s)	Set the STP2 step 3 time.	○			○	6-131
4	STP2 time 4	0.1	6000.0	1.0 (s)	Set the STP2 step 4 time.	○			○	6-131
5	STP2 time 5	0.1	6000.0	1.0 (s)	Set the STP2 step 5 time.	○			○	6-131
6	STP2 time 6	0.1	6000.0	1.0 (s)	Set the STP2 step 6 time.	○			○	6-131
7	STP2 time 7	0.1	6000.0	1.0 (s)	Set the STP2 step 7 time.	○			○	6-131

Block-B parameters (S/W option constants) list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	VEC	PM	RWE	Ref. page
B72 – STP2 time										
0	STP2 time 8	0.1	6000.0	1.0 (s)	Set the STP2 step 8 time.	○			○	6-131
1	STP2 time 9	0.1	6000.0	1.0 (s)	Set the STP2 step 9 time.	○			○	6-131
2	STP2 time 10	0.1	6000.0	1.0 (s)	Set the STP2 step 10 time.	○			○	6-131
3	STP2 time 11	0.1	6000.0	1.0 (s)	Set the STP2 step 11 time.	○			○	6-131
4	STP2 time 12	0.1	6000.0	1.0 (s)	Set the STP2 step 12 time.	○			○	6-131
5	STP2 time 13	0.1	6000.0	1.0 (s)	Set the STP2 step 13 time.	○			○	6-131
6	STP2 time 14	0.1	6000.0	1.0 (s)	Set the STP2 step 14 time.	○			○	6-131
B73 – STP3 frequency										
0	STP3 frequency 0	0.00	100.00	10.00 (%)	Set the STP3 step 0 frequency.	○			○	6-131
1	STP3 frequency 1	0.00	100.00	10.00 (%)	Set the STP3 step 1 frequency.	○			○	6-131
2	STP3 frequency 2	0.00	100.00	10.00 (%)	Set the STP3 step 2 frequency.	○			○	6-131
3	STP3 frequency 3	0.00	100.00	10.00 (%)	Set the STP3 step 3 frequency.	○			○	6-131
4	STP3 frequency 4	0.00	100.00	10.00 (%)	Set the STP3 step 4 frequency.	○			○	6-131
5	STP3 frequency 5	0.00	100.00	10.00 (%)	Set the STP3 step 5 frequency.	○			○	6-131
6	STP3 frequency 6	0.00	100.00	10.00 (%)	Set the STP3 step 6 frequency.	○			○	6-131
7	STP3 frequency 7	0.00	100.00	10.00 (%)	Set the STP3 step 7 frequency.	○			○	6-131
B74 – STP3 frequency										
0	STP3 frequency 8	0.00	100.00	10.00 (%)	Set the STP3 step 8 frequency.	○			○	6-131
1	STP3 frequency 9	0.00	100.00	10.00 (%)	Set the STP3 step 9 frequency.	○			○	6-131
2	STP3 frequency 10	0.00	100.00	10.00 (%)	Set the STP3 step 10 frequency.	○			○	6-131
3	STP3 frequency 11	0.00	100.00	10.00 (%)	Set the STP3 step 11 frequency.	○			○	6-131
4	STP3 frequency 12	0.00	100.00	10.00 (%)	Set the STP3 step 12 frequency.	○			○	6-131
5	STP3 frequency 13	0.00	100.00	10.00 (%)	Set the STP3 step 13 frequency.	○			○	6-131
6	STP3 frequency 14	0.00	100.00	10.00 (%)	Set the STP3 step 14 frequency.	○			○	6-131
B75 – STP3 time										
0	STP3 time 0	0.1	6000.0	1.0 (s)	Set the STP3 step 0 time.	○			○	6-131
1	STP3 time 1	0.1	6000.0	1.0 (s)	Set the STP3 step 1 time.	○			○	6-131
2	STP3 time 2	0.1	6000.0	1.0 (s)	Set the STP3 step 2 time.	○			○	6-131
3	STP3 time 3	0.1	6000.0	1.0 (s)	Set the STP3 step 3 time.	○			○	6-131
4	STP3 time 4	0.1	6000.0	1.0 (s)	Set the STP3 step 4 time.	○			○	6-131
5	STP3 time 5	0.1	6000.0	1.0 (s)	Set the STP3 step 5 time.	○			○	6-131
6	STP3 time 6	0.1	6000.0	1.0 (s)	Set the STP3 step 6 time.	○			○	6-131
7	STP3 time 7	0.1	6000.0	1.0 (s)	Set the STP3 step 7 time.	○			○	6-131

Block-B parameters (S/W option constants) list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	VEC	PM	RWE	Ref. page
B76 – STP3 time										
0	STP3 time 8	0.1	6000.0	1.0 (s)	Set the STP3 step 8 time.	○			○	6-131
1	STP3 time 9	0.1	6000.0	1.0 (s)	Set the STP3 step 9 time.	○			○	6-131
2	STP3 time 10	0.1	6000.0	1.0 (s)	Set the STP3 step 10 time.	○			○	6-131
3	STP3 time 11	0.1	6000.0	1.0 (s)	Set the STP3 step 11 time.	○			○	6-131
4	STP3 time 12	0.1	6000.0	1.0 (s)	Set the STP3 step 12 time.	○			○	6-131
5	STP3 time 13	0.1	6000.0	1.0 (s)	Set the STP3 step 13 time.	○			○	6-131
6	STP3 time 14	0.1	6000.0	1.0 (s)	Set the STP3 step 14 time.	○			○	6-131

6-4 Block-C parameters

The Block-C parameters are divided into the basic functions, extended functions and hardware option functions.

V/f : Indicates parameters that apply for V/f control (constant torque, variable torque) (C30-0: f0 = 1).

VEC : Indicates parameters that apply for IM speed sensor-less vector control and IM speed vector control with sensor (C30-0: f0 = 2, 3).

PM : Indicates parameters that apply for control mode with PM motor sensor (C30-0: f0 = 4).

*△ indicates a parameter which functions during auxiliary drive operation or when the V/f control is active during automatic tuning.

RWE : Displays the parameters that can be changed during operation.

Reference page: The number of the page providing detailed explanations is indicated.

Block-C parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application				Ref. page
						V/f	VEC	PM	RWE	
C00 – Control methods										
0	Run command method	1.	3.	1.	Run command method is set. = 1: F･RUN, R･RUN = 2: RUN, REV = 3: Self hold (Pulse inputs for F･RUN and R･RUN)	○	○	○		6-135
1	Run/stop methods	1.	2.	2.	Set the stopping method for RUN operation. = 1: Coast to stop = 2: Ramp down to stop	○	○	○		6-136
2	Jog stop method	1.	2.	2.	Set the stopping method for JOG operation. = 1: Coast to stop = 2: Ramp down to stop	○	○	○		6-136
3	Emergency stop (EMS) input logic	1.	2.	1.	Emergency stop input logic is set. = 1: Close to stop = 2: Open to stop	○	○	○		6-136
4	Emergency stop (EMS) mode	1.	3.	1.	Set the stopping method for the emergency stop. = 1: Coast to stop without a fault output = 2: Coast to stop with a fault output = 3: Ramp down to stop	○	○	○		6-136
5	Control source switchover method (J1 setting)	1.	2.	1.	Set whether to validate the remote auxiliary operation sequence for the local operation mode. = 1: Disables = 2: Enables	○	○	○		6-137
6	Control source switchover method (J2 setting)	1.	2.	1.	Select the No. of auxiliary operation sequence input points when the COP command is ON. = 1: Terminal block input = 2: Serial input	○	○	○		6-137
7	Run contact output condition selection	1.	2.	1.	The conditions for turning the sequence RUN output ON are set. = 1: ON at pre-excitation = 2: OFF at pre-excitation	○	○	○		6-137
C01 – Start/stop frequency										
0	Start frequency	0.10	Fmax or 60.00	1.00 (Hz)	When RUN is started, operation starts from this frequency.	○			○	6-87
1	Stop frequency (DC brake start)	0.10	Fmax or 60.00	1.00 (Hz)	The DC brakes are applied when the output frequency value is less than this frequency value.	○			○	6-87

Block-C parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application				Ref. page
						V/f	VEC	PM	RWE	
C02 – Various setting input selection										
0	Speed setting input points selection	1.	5.	4.	= 1: Analog fixed = 2: Serial/parallel fixed = 3: Panel fixed = 4: Sequence = 5: Pulse train input fixed	○	○	○		6-137
1	Traverse center frequency input points selection	1.	5.	3.	= 1: Analog fixed = 2: Analog fixed = 3: Panel fixed = 4: Sequence = 5: Pulse train input fixed	○	○	○		6-137
2	Torque setting input points selection	1.	5.	3.	= 1: Analog fixed = 2: Serial fixed = 3: Panel fixed = 4: Sequence = 5: Pulse train input fixed		○	○		6-137
3	Torque ratio 1 setting input points selection	2.	4.	3.	= 2: Serial fixed = 3: Panel fixed = 4: Sequence		○	○		6-137
4	Torque bias 1 setting input points selection	1.	4.	3.	= 1: Analog fixed = 2: Serial fixed = 3: Panel fixed = 4: Sequence		○	○		6-137
5	Torque ratio 2 setting input points selection	2.	4.	3.	= 2: Serial fixed = 3: Panel fixed = 4: Sequence		○	○		6-137
6	Drive/regenerative torque limit input points selection	1.	4.	4.	= 1: Analog fixed = 2: Serial fixed = 3: Sequence = 4: Sequence		○	○		6-137
7	ASR response input points selection	2.	4.	3.	= 2: Serial fixed = 3: Panel fixed = 4: Sequence		○	○		6-137
8	Machine time constant input points selection	2.	4.	3.	= 2: Serial fixed = 3: Panel fixed = 4: Sequence		○	○		6-137

Block-C parameters list

No.	Parameter		Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
C03 – Sequence input terminal function – 1											
0	F·RUN	Forward run	-11.	16.	1.		○	○	○	○	6-137
1	EMS	Emergency stop	-11.	16.	3.		○	○	○	○	6-137
2	R·RUN	Reverse run	-11.	16.	4.		○	○	○	○	6-137
3	F·JOG	Forward jogging	-11.	16.	5.		○	○	○	○	6-137
4	R·JOG	Reverse jogging	-11.	16.	6.		○	○	○	○	6-137
5	HOLD	Hold signal	-11.	16.	0.		○	○	○	○	6-137
6	BRAKE	DC brake	-11.	16.	0.		○	○	○	○	6-137
7	RESET	Breakdown reset	-11.	16.	2.		○	○	○	○	6-137
8	COP	Serial transmission selection	-11.	16.	0.		○	○	○	○	6-137
9	CSEL	Ramp selection	-11.	16.	0.		○	○	○	○	6-137
A	IPASS	Ratio interlock bypass	-11.	16.	0.		○	○	○	○	6-137
B	CPASS	Ramp bypass	-11.	16.	0.		○	○	○	○	6-137
C	PIDEN	PID control selection	-11.	16.	0.		○	○	○	○	6-137
D	AFS1	Speed setting 1	-11.	16.	16.		○	○	○	○	6-137
E	AFS2	Speed setting 2	-11.	16.	0.		○	○	○	○	6-137
F	AFS3	Speed setting 3	-11.	16.	0.		○	○	○	○	6-137
C04 – Sequence input terminal function – 2											
0	PROG	Program function enable	-11.	16.	0.		○	○	○	○	6-137
1	CFS	Serial communication setting select	-11.	16.	0.		○	○	○	○	6-137
2	S0	Program speed selection	-11.	16.	0.		○	○	○	○	6-137
3	S1	Program speed selection	-11.	16.	0.		○	○	○	○	6-137
4	S2	Program speed selection	-11.	16.	0.		○	○	○	○	6-137
5	S3	Program speed selection	-11.	16.	0.		○	○	○	○	6-137
6	SE	Program speed selection	-11.	16.	0.		○	○	○	○	6-137
7	FUP	Frequency (speed) increase	-11.	16.	0.		○	○	○	○	6-137
8	FDW	Frequency (speed) decrease	-11.	16.	0.		○	○	○	○	6-137
9	BUP	Ratio interlock bias increase	-11.	16.	0.		○	○	○	○	6-137
A	BDW	Ratio interlock bias decrease	-11.	16.	0.		○	○	○	○	6-137
B	IVLM	Ratio interlock bias increase/ decrease selection	-11.	16.	0.		○	○	○	○	6-137
C	AUXDV	Auxiliary drive selection	-11.	16.	0.		○	△	△	○	6-137
D	PICK	Pick-up	-11.	16.	0.		○	○	○	○	6-137
E	MBRK_ans	External brake answer	-11.	16.	0.		○	○	○	○	6-137
F	PRST	STP reset	-11.	16.	0.		○	○	○	○	6-137

Value	Input terminal	
-11 -10 -9 -8	PSI11 PSI10 PSI9 PSI8	Relay option (reversed)
-7 -6 -5 -4 -3 -2 -1	PSI7 PSI6 PSI5 PSI4 PSI3 PSI2 PSI1	Base section terminal block (reversed)
0	OFF fixed	
1 2 3 4 5 6 7	PSI1 PSI2 PSI3 PSI4 PSI5 PSI6 PSI7	Base section terminal block
8 9 10 11	PSI8 PSI9 PSI10 PSI11	Relay option
12 13 14 15	PLC1 PLC2 PLC3 PLC4	Built-in PLC output
16	ON fixed	

Block-C parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
C05 – Sequence input terminal function – 3										
0	S5 Digital torque bias 1	-11.	16.	0.		○	○	○	○	6-137
1	S6 Digital torque bias 2	-11.	16.	0.		○	○	○	○	6-137
2	S7 Digital torque bias 3	-11.	16.	0.		○	○	○	○	6-137
3	AUXSW0 Auxiliary drive No selection L	-11.	16.	0.		○	△	△	○	6-137
4	AUXSW1 Auxiliary drive No selection H	-11.	16.	0.		○	△	△	○	6-137
5	PLS_IN Pulse train input selection	-11.	16.	0.		○	○	○	○	6-137
6	OCLLV1 OCL Level setting 1	-11.	16.	0.		○	○	○	○	6-137
7	OCLLV2 OCL Level setting 2	-11.	16.	0.		○	○	○	○	6-137
8	E.FLT1 External Fault 1	-11.	16.	0.		○	○	○	○	6-229
9	E.FLT2 External Fault 2	-11.	16.	0.		○	○	○	○	6-229
A	E.FLT3 External Fault 3	-11.	16.	0.		○	○	○	○	6-229
B	E.FLT4 External Fault 4	-11.	16.	0.		○	○	○	○	6-229
C	E.FLT5 External Fault 5	-11.	16.	0.		○	○	○	○	6-229
D	E.FLT6 External Fault 6	-11.	16.	0.		○	○	○	○	6-229
E	E.FLT7 External Fault 7	-11.	16.	0.		○	○	○	○	6-229
F	E.FLT8 External Fault 8	-11.	16.	0.		○	○	○	○	6-229
C06 – Sequence input terminal function – 4										
0	EXC Pre-excitation	-11.	16.	0.			○		○	6-137
1	ACR ACR	-11.	16.	0.			○	○	○	6-137
2	PCTL P control	-11.	16.	0.			○	○	○	6-137
3	LIM1 Drive torque limiter changeover	-11.	16.	0.			○	○	○	6-137
4	LIM2 Regenerative torque limiter changeover	-11.	16.	0.			○	○	○	6-137
5	MCH Machine time constant changeover	-11.	16.	0.			○	○	○	6-137
6	RF0 0 setting	-11.	16.	0.			○	○	○	6-137
7	DROOP Drooping changeover	-11.	16.	0.			○	○	○	6-137
8	DEDB Dead band setting	-11.	16.	0.			○	○	○	6-137
9	TRQB1 Torque bias setting 1	-11.	16.	0.			○	○	○	6-137
A	TRQB2 Torque bias setting 2	-11.	16.	0.			○	○	○	6-137

Function (C05, C06):

Value	Input terminal	
-11	PSI11	Relay option (reversed)
-10	PSI10	
-9	PSI9	
-8	PSI8	
-7	PSI7	Base section terminal block (reversed)
-6	PSI6	
-5	PSI5	
-4	PSI4	
-3	PSI3	
-2	PSI2	
-1	PSI1	
0	OFF fixed	
1	PSI1	Base section terminal block
2	PSI2	
3	PSI3	
4	PSI4	
5	PSI5	
6	PSI6	
7	PSI7	
8	PSI8	Relay option
9	PSI9	
10	PSI10	
11	PSI11	
12	PLC1	Built-in PLC output
13	PLC2	
14	PLC3	
15	PLC4	
16	ON fixed	

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
C07 – Analog input terminal function										
0	Speed setting 1	0.	11.	2.		○	○	○	○	6-137
1	Speed setting 2	0.	11.	3.		○	○	○	○	6-137
2	Speed setting 3	0.	11.	0.		○	○	○	○	6-137
3	Ratio interlock bias setting	0.	11.	0.		○	○	○	○	6-137
4	Traverse center frequency	0.	11.	0.		○	○	○	○	6-137
5	PID feedback	0.	11.	0.		○	○	○	○	6-137
6	Torque setting	0.	11.	0.			○	○	○	6-137
7	Drive torque limiter reduction setting	0.	11.	1.			○	○	○	6-137
8	Regenerative torque limiter reduction setting	0.	11.	1.			○	○	○	6-137
9	Torque bias 1 setting	0.	11.	0.			○	○	○	6-137
A	Analog torque bias setting	0.	11.	0.			○	○	○	6-137

Function (C07):

Value	Input terminal
0	0% fixed
1	100% fixed
2	AI1
3	AI2
4	AI3
5	PAI4 (OP)
6	PAI5 (OP)
7	PAI6 (OP)
8	Built-in PLC output 1
9	Built-in PLC output 2
10	Built-in PLC output 3
11	Built-in PLC output 4

PAI4 to PAI6 are for future.

Block-C parameters list

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Parameter</th><th rowspan="2">Min.</th><th rowspan="2">Max.</th><th rowspan="2">Default (Unit)</th><th rowspan="2">Function</th><th colspan="4">Application</th><th rowspan="2">Ref. page</th></tr>
<tr><th>V/f</th><th>VEC</th><th>PM</th><th>RWE</th></tr>
<tr><td colspan="11">C08 – Automatic start setting</td></tr>
<tr><td>0</td><td>Auto start
(To F·RUN/R·RUN)</td><td>1.</td><td>3.</td><td>1.</td><td>= 1: off
= 2: on without pick-up
= 3: on with pick-up (re-start after a momentary power loss)</td><td>○</td><td>○</td><td>○</td><td></td><td>6-138</td></tr>
<tr><td colspan="11">C09 – Parameter protection/operation locks</td></tr>
<tr><td>0</td><td>Parameter protection</td><td>1.</td><td>9.</td><td>1.</td><td>Set to prevent unintentional operation from the operation panel (OPU).
Set whether to enable or prohibit data changing for each parameter function unit as shown above.
Parameter protection:
○ : Unprotected (changeable)
× : Protected (unchangeable)
<table>
<tr><th rowspan="2">Value</th><th rowspan="2">Block A</th><th colspan="4">Block B, C</th></tr>
<tr><th>Basic</th><th>Extn.</th><th>S/W</th><th>H/W</th></tr>
<tr><td>1</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>2</td><td>×</td><td>×</td><td>×</td><td>×</td><td>×</td></tr>
<tr><td>3</td><td>○</td><td>×</td><td>×</td><td>×</td><td>×</td></tr>
<tr><td>4</td><td>○</td><td>×</td><td>○</td><td>×</td><td>×</td></tr>
<tr><td>5</td><td>○</td><td>×</td><td>○</td><td>○</td><td>×</td></tr>
<tr><td>6</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>7, 8</td><td>×</td><td>×</td><td>×</td><td>×</td><td>×</td></tr>
<tr><td>9</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
</table></td><td>○</td><td>○</td><td>○</td><td></td><td>6-139</td></tr>
<tr><td>1</td><td>Operation panel lock</td><td>1.</td><td>3.</td><td>1.</td><td>= 1: Enable control from Operation Panel
= 2: Disable control from Operation Panel (except for STOP key, if pressed for 2 seconds, will stop the drive)
= 3: Only STOP key is available</td><td>○</td><td>○</td><td>○</td><td>○</td><td>6-139</td></tr>
<tr><td>2</td><td>LCL switchover protection</td><td>1.</td><td>2.</td><td>1.</td><td>= 1: Disables switchover while the drive is running
= 2: Enables switchover while the drive is running</td><td>○</td><td>○</td><td>○</td><td>○</td><td>6-139</td></tr>
<tr><td>3</td><td>Reveres run sequence (R·RUN) prohibit</td><td>1.</td><td>2.</td><td>1.</td><td>Set this to prevent unintentional reverse run operation.
When set to "2", the sequence input "R RUN" operation command will be disabled.
Note that if the reverse run setting (negative value) is input into the speed setting during "F·RUN" operation, reverse run will start.
= 1: Enable   = 2: Prohibit</td><td>○</td><td>○</td><td>○</td><td>○</td><td>6-139</td></tr>
<tr><td>4</td><td>Reverse run jogging sequence (R·JOG) prohibit</td><td>1.</td><td>2.</td><td>1.</td><td>Set this to prevent unintentional reverse jogging operation.
When set to “2”, the “R·JOG” operation command will be disabled.
Note that if the reverse run setting (negative value) is input into the jogging setting during “F·JOG” operation, reverse run will start.
= 1: Enable   = 2: Prohibit</td><td>○</td><td>○</td><td>○</td><td>○</td><td>6-139</td></tr>
<tr><td>5</td><td>Reverse run during ACR mode prohibit</td><td>1.</td><td>2.</td><td>1.</td><td>Set this to prevent unintentional reverse run operation.
When set to “2”, reverse run during ACR operation will be prohibited.
The reverse run speed will be limited to approx. 1% if reverse run is started.
This setting is ignored in the V/f mode.
= 1: Enable
= 2: Prohibit</td><td></td><td>○</td><td>○</td><td></td><td>6-140</td></tr>
</table>

Block-C parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application				Ref. page
						V/f	VEC	PM	RWE	
6	Fault history buffer clear	0	9999	0.	Set 1 for the setting value to clear the fault history details. The clearing operation will not take place at a setting other than 1. 1: Clear fault history	○	○	○	○	6-140
7	Default value load	0	9999	0.	9: All default values load 10: Parameter A 11: Parameters B, C basic functions 12: Parameters B, C extended functions 13: Parameter B software option function Parameter C hardware option function 14: Parameters B basic functions 15: Parameters B extended functions 16: Parameter B software option function 17: Parameters C basic functions 18: Parameters C extended functions 19: Parameter C hardware option function	○	○	○		6-140
C10 – Custom parameter register										
0	Custom – 0	1.00.0	2.FF.F	1.9F.F	Set for each parameter No. to be displayed and changed as an A04-0 to 7 custom parameter. **Example)** To set B13-0 (torque setting), set as 1. 1 3. 0. □.□□.□ Sub No. Main No. 1: B block 2: C block	○	○	○	○	6-140
1	Custom – 1	1.00.0	2.FF.F	1.9F.F		○	○	○	○	6-140
2	Custom – 2	1.00.0	2.FF.F	1.9F.F		○	○	○	○	6-140
3	Custom – 3	1.00.0	2.FF.F	1.9F.F		○	○	○	○	6-140
4	Custom – 4	1.00.0	2.FF.F	1.9F.F		○	○	○	○	6-140
5	Custom – 5	1.00.0	2.FF.F	1.9F.F		○	○	○	○	6-140
6	Custom – 6	1.00.0	2.FF.F	1.9F.F		○	○	○	○	6-140
7	Custom – 7	1.00.0	2.FF.F	1.9F.F		○	○	○	○	6-140
C11 – Operation panel mode setting										
0	Initial mode	1.	2.	1.	The initial operation mode for when the power is turned ON is set = 1: Local = 2: Remote	○	○	○	○	6-141
1	Run command status	1.	3.	1.	The initial operation mode for when the power is turned ON, if using the automatic start function (when C08-0 =2 or 3) during the local operation mode (operation from operation panel) is set. If =2 is set, forward run will start when the run enable state is entered after the power is turned ON. = 1: Stop = 2: Forward run = 3: Reverse run	○	○	○	○	6-141
2	Operation panel frequency change operation	1.	2.	1.	Used to prevent changes to the frequency/rotation speed settings in real time. =1: Change in real time =2: Change using the Set key.	○	○	○	○	6-141
3	Operation panel monitor parameter	0.00.0	1.9F.F	0.00.0	Select the parameters displayed first when the power is turned ON. □.□□.□ Sub No. Main No. 0 : D block 1 : A block	○	○	○	○	6-141

Block-C parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application				Ref. page
						V/f	VEC	PM	RWE	
4	LCD panel: Language setting	0.	4.	0.	Select the language displayed on the LCD panel. =0: English =1: French =2: German =3: Spanish =4: Italian (This is displayed only when the LCD panel is connected)	○	○	○	○	6-141
5	LCD panel: Contrast adjustment	-10.	5.	0.	Adjust the contrast of the characters displayed on the LCD panel. (This is displayed only when the LCD panel is connected)	○	○	○	○	6-141
6	LCD panel: Backlight OFF timer setting	0.	255.	0. (s)	Set the time to turn ON the LCD panel's backlight. =0: Always ON =Other than 0: Turns OFF when there is no operation for set time (This is displayed only when the LCD panel is connected)	○	○	○	○	6-142
7	Panel operation method selection	1.	2.	1.	=1: Sub No. selection method =2: Main No. selection method	○	○	○	○	6-142
C12 – Setting input terminal function										
0	AI1 Terminal input mode selection	1.	2.	1.	= 1: Voltage input, = 2: Current input	○	○	○		6-142
1	AI1 Voltage input mode selection	1.	3.	1.	= 1: 0 to 10V, = 2: 0 to 5V, = 3: 1 to 5V	○	○	○		6-142
2	AI1 Current input mode selection	1.	2.	1.	= 1: 4 to 20mA, = 2: 0 to 20mA	○	○	○		6-143
3	Filter time constant for AI1 input	2.	250.	8. (ms)	A time constant of setting value/2ms is applied on the input value.	○	○	○		6-144
4	AI2 terminal input mode	1.	2.	1.	= 1: Voltage input, = 2: Current input	○	○	○		6-142
5	AI2 voltage input mode	1.	3.	1.	= 1: 0 to 10V, = 2: 0 to 5V, = 3: 1 to 5V	○	○	○		6-142
6	AI2 current input mode	1.	2.	1.	= 1: 4 to 20mA, = 2: 0 to 20mA	○	○	○		6-143
7	Filter time constant for AI2 input	2.	250.	8. (ms)	A time constant of setting value/2ms is applied on the input value.	○	○	○		6-144
8	AI3 terminal input mode	1.	3.	1.	= 1: 0 to ±10V, = 2: 0 to ±5V, = 3: 1 to 5V	○	○	○		6-144
9	AI3 input gain	0.000	5.000	1.000	A magnification gain is applied on the AI3 input value.	○	○	○	○	6-144
A	Filter time constant for AI3 input	2.	250.	8. (ms)	A time constant of setting value/2ms is applied on the input value.	○	○	○		6-144
B	Program setting filter	0.00	1.00	0.01 (s)	The program setting inputs are filtered with the setting terminal batch. (Prevents incorrect setting caused by chattering.)	○	○	○	○	6-144
C	Pulse train input F1 setting frequency	0.1	1000.0	10.0 (Hz)	There is the following restriction. C12-C x 2 ≤ C12-D Refer to section 5-7-3 for details on the parameters related to the pulse train input function.	○	○	○	○	6-145
D	Pulse train input F2 setting frequency	1.	10000.	1000. (Hz)		○	○	○	○	6-145
E	Pulse train input frequency LPF time constant	0.	2000.	1. (ms)		○	○	○	○	6-145
F	Pulse train input judgment time	0.01	20.00	1.00 (s)		○	○	○	○	6-145

Block-C parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	VEC	PM	RWE	Ref. page
C13 – Output terminal function										
0	A01 terminal output	0.	21.	0.	Select the setting value from the following table, and output.	○	○	○	○	6-145
1	A02 terminal output	0.	21.	3.		○	○	○	○	6-145

Value	Parameter	Terminal voltage
0	Output frequency	10V at Max. frequency
1	Setting frequency Setting speed	10V at Max. frequency 10V at Max. speed
2	Ramp output	10V at Max. frequency 10V at Max. speed
3	Output current (Motor)	5V at Motor rated current
4	Output current (Drive)	5V at drive rated current
5	Output voltage	10V at Motor rated voltage
6	Motor output power	5V at (Rated output voltage × Motor rated current)
7	DC voltage	5V at 300V (200V Series) 5V at 600V (400V Series)
8	Overload monitor (unit protection)	10V at 100%
9	Heat sink temperature	10V at 100°C
10	Motor speed	10V at Max. speed
11	Torque current	5V at Motor rated current
12	Excitation current	5V at Motor rated current
13	Actual motor rotation speed	10V at Max. speed
14	Namp output	10V at Rated torque
15	Overload monitor (motor protection)	10V at 100%
16	Built-in PLC output 1	10V/1000h
17	Built-in PLC output 2	10V/1000h
18	Built-in PLC output 3	10V/1000h
19	Built-in PLC output 4	10V/1000h
20	DM1 for maker maintenance	10V/1000h
21	DM2 for maker maintenance	10V/1000h

No.	Parameter	Min.	Max.	Default (Unit)	Function	V/f	VEC	PM	RWE	Ref. page
2	RA-RC output parameters	-55.	55.	1.	Select the setting value from the following table, and output. -1 to -55 are the reverse output of 1 to 55.	○	○	○	○	6-145
3	PSO1 output parameters	-55.	55.	4.		○	○	○	○	6-145
4	PSO2 output parameters	-55.	55.	8.		○	○	○	○	6-145
5	PSO3 output parameters	-55.	55.	9.		○	○	○	○	6-145
6	FA-FB-FC output parameters	-55.	55.	2.		○	○	○	○	6-145

Value	Output signal	Value	Output signal	Value	Output signal	Value	Output signal	Value	Output signal	Value	Output signal	Value	Output signal
0	Fixed to OFF	8	IDET	16	EC3	24	LLMT	32	PLC1	40	FPOS	48	MP01
1	RUN	9	ATN	17	ACC	25	ULMT	33	PLC2	41	For future use	49	MP02
2	FLT	10	SPD1	18	DCC	26	Doff-End	34	PLC3	42	For future use	50	MP03
3	MC	11	SPD2	19	AUXDV	27	MBRK	35	PLC4	43	For future use	51	MP04
4	RDY1	12	COP	20	ALM	28	DVER	36	PLC5	44	For future use	52	MP05
5	RDY2	13	EC0	21	FAN	29	BPF	37	PLC6	45	For future use	53	MP06
6	LCL	14	EC1	22	ASW	30	RDELAY	38	PLC7	46	For future use	54	MP07
7	REV	15	EC2	23	ZSP	31	Fixed to ON	39	PLC8	47	For future use	55	MP08

Value	Output signal	Value	Output signal	Value	Output signal	Value	Output signal	Value	Output signal	Value	Output signal	Value	Output signal
	------	-8	IDET	-16	EC3	-24	LLMT	-32	PLC1	-40	FPOS	-48	MP01
-1	RUN	-9	ATN	-17	ACC	-25	ULMT	-33	PLC2	-41	For future use	-49	MP02
-2	FLT	-10	SPD1	-18	DCC	-26	Doff-End	-34	PLC3	-42	For future use	-50	MP03
-3	MC	-11	SPD2	-19	AUXDV	-27	MBRK	-35	PLC4	-43	For future use	-51	MP04
-4	RDY1	-12	COP	-20	ALM	-28	DVER	-36	PLC5	-44	For future use	-52	MP05
-5	RDY2	-13	EC0	-21	FAN	-29	BPF	-37	PLC6	-45	For future use	-53	MP06
-6	LCL	-14	EC1	-22	ASW	-30	RDELAY	-38	PLC7	-46	For future use	-54	MP07
-7	REV	-15	EC2	-23	ZSP	-31	Fixed to ON	-39	PLC8	-47	For future use	-55	MP08

Block-C parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. Page
C13 – Output terminal function										
7	Built-in PLC input selection 1	0.	19.	0.	Select the details set in address 10h of the built-in PLC memory.	○	○	○	○	6-145
8	Built-in PLC input selection 2	0.	19.	0.	Select the details set in address 11h of the built-in PLC memory.	○	○	○	○	6-145
9	Built-in PLC input selection 3	0.	19.	0.	Select the details set in address 12h of the built-in PLC memory.	○	○	○	○	6-145
A	Built-in PLC input selection 4	0.	19.	0.	Select the details set in address 13h of the built-in PLC memory.	○	○	○	○	6-145
B	Pulse train output function	1.	2.	1.	Set "2" when using the pulse train output function. Refer to section 5-8-3 for details.	○	○	○	○	6-146
C	Pulse frequency at 0%	1.	32000.	100. (Hz)	There is the following restriction. C13-C + 1 ≤ C13-D Refer to section 5-8-3 for details.	○	○	○	○	6-146
D	Pulse frequency at maximum frequency/ speed	1.	32000.	1000. (Hz)		○	○	○	○	6-146
E	Pulse train output parameter selection	0.	4.	0.	Select the setting value from the following table, and output. Refer to section 5-8-3 for details. Value / Output 0: Output frequency 1: Setting frequency, Setting speed 2: Ramp output 3: Motor speed 4: Actual motor rotation speed	○	○	○	○	6-146
F	Output parameter absolute value calculation selection	1.	2.	1.	Refer to section 5-8-3 for details.	○	○	○	○	6-146
C14 – Meter output gain										
0	Output gain for A01	0.20	2.00	1.00	10V at Max. frequency when this is set to 1.00. 20mA (5V) at the rated current when this is set to 1.00. (Max. 11V)	○	○	○	○	6-146
1	Output gain for A02	0.20	2.00	1.00		○	○	○	○	6-146
2	Random scale (AS) display coefficient	0.01	100.00	30.00	Set the coefficient for the D00-4 and D01-5 random scale display.	○	○	○	○	6-148
3	A01 output offset (Voltage)	-8.00	8.00	0.00 (V)	When C14-7 or 8 is set to 1 or 3, the offset can be fluctuated with this setting value. If the offset is set to a value other than 0V, the output which can be displayed with ±, such as the output frequency, can be ± output in the range of 0 to 10V centering on this setting value. The absolute value is output when 0.00 is set.	○	○	○	○	6-146
4	A02 output offset (Voltage)	-8.00	8.00	0.00 (V)		○	○	○	○	6-146
5	A01 output offset (Current)	-15.0	15.0	0.0 (mA)	When C14-7 or 8 is set to 2, the offset can be fluctuated with this setting value.	○	○	○	○	6-146
6	A02 output offset (Current)	-15.0	15.0	0.0 (mA)		○	○	○	○	6-146
7	A01 output method selection	1.	3.	1.	=1: Voltage 0V to 10V =3: Current 4mA to 20mA =2: Voltage 0V to 10V (5V offset) When =2 is set, the gain will be set to a 0.5-fold setting using the 5V point as the reference point.	○	○	○		6-146
8	A02 output method selection	1.	3.	1.		○	○	○		6-146
9	AI1 random scale coefficient	0.01	100.00	30.00	Analog input: Random scale coefficient dedicated for AI1	○	○	○	○	6-148
A	AI2 random scale coefficient	0.01	100.00	30.00	Analog input: Random scale coefficient dedicated for AI2	○	○	○	○	6-148
B	AI3 random scale coefficient	0.01	100.00	30.00	Analog input: Random scale coefficient dedicated for AI3	○	○	○	○	6-148

Block-C parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	VEC	PM	RWE	Ref. page
C15 – Status output detection level										
0	Attainment (ATN) detection width	0.0	20.0	1.0 (%)	The attained output (ATN) operation width is set.	○	○	○	○	6-149
1	Current (IDET) detection level	5.	300.	100. (%)	The current detection (IDET) operation level is set.	○	○	○	○	6-149
2	Speed detection (SPD1) level – 1	1.0	105.0	95.0 (%)	The speed detection (SPD1, SPD2) operation level is set.	○	○	○	○	6-149
3	Speed detection (SPD2) level – 2	1.0	105.0	50.0 (%)		○	○	○	○	6-149
4	Zero speed detection (ZSP) level	0.00	50.00	1.00 (s)	The zero speed detection (ZSP) operation level is set.	○	○	○	○	6-149
5	RDELAY delay time	0.0	1000.0	1.0 (s)	Set the delay time for RDELAY output.	○	○	○	○	6-150
6	EC0 output fault selection	0.00.0	1.FF.F.	0.00.0.	When only a specific fault is to be output, this parameter can be set so that only the fault with the set conditions is output with sequence output:EC0 to EC3. 0. 00. 0 : Sub No. : Fault No. : 0 : Normal fault 1 : Monitor fault	○	○	○	○	6-150
7	EC1 output fault selection	0.00.0	1.FF.F.	0.00.0.		○	○	○	○	6-150
8	EC2 output fault selection	0.00.0	1.FF.F.	0.00.0.		○	○	○	○	6-150
9	EC3 output fault selection	0.00.0	1.FF.F.	0.00.0.		○	○	○	○	6-150

Normal fault No. table

No.	Corresponding fault	No.	Corresponding fault	No.	Corresponding fault	No.	Corresponding fault	No.	Corresponding fault
00	None	04	OV	08	SP	0C	GRD	10	BPFLT
01	EMS	05	UV	09	CONV	0D	IO	11	E.FLT
02	PM	06	PHL	0A	ATT	0E	CPU	12	For future use
03	OC	07	UOH	0B	OL	0F	FUSE	13	For future use

Minor fault No. table

No.	Corresponding fault	No.	Corresponding fault
00	None	05	Pump control upper limit
01	Speed (position) detection error	06	Pump control lower limit
02	Carrier f decelerating	07	AI1 current input 3mA or less
03	Overload error (50% or more)	08	AI2 current input 3mA or less
04	Speed deviation error	09	Field network option communication error

No.	Parameter	Min.	Max.	Default (Unit)	Function	V/f	VEC	PM	RWE	Ref. page
A	EC0 OFF delay timer	0.0	600.0	0.1 (s)	When a minor fault occurs, delay is applied for the set time if the minor fault occurrence conditions are reset. Note that if 0.00 is set, the operation will not turn OFF and instead will remain ON. In either case, this will turn OFF regardless of the setting when RST is turned ON.	○	○	○	○	6-150
B	EC1 OFF delay timer	0.0	600.0	0.1 (s)		○	○	○	○	6-150
C	EC2 OFF delay timer	0.0	600.0	0.1 (s)		○	○	○	○	6-150
D	EC3 OFF delay timer	0.0	600.0	0.1 (s)		○	○	○	○	6-150
E	ALM OFF delay timer	0.0	600.0	0.1 (s)		○	○	○	○	6-150

Block-C parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	VEC	PM	RWE	Ref. page
C20 – Start interlock										
0	Start/stop frequency (speed)	0.0	20.0	0.0 (%)	The motor will stop when below this frequency setting.	○	○	○	○	6-151
1	Start/stop frequency (speed) hysteresis	0.0	20.0	1.0 (%)	If the motor stops when the set frequency is set to C20-0 or less, the set frequency must be raised to a level which exceeds C20-0 plus this setting value in order to resume operation.	○	○	○	○	6-151
2	Interlock frequency (speed)	0.0	20.0	0.0 (%)	The motor will not start when the setting is above this frequency. (When using with the setting start, set a value that is larger than the setting start frequency.) When C20-0=0, the setting start/stop will not operate. When C20-2=0, the setting interlock will not operate.	○	○	○	○	6-151
3	RUN delay timer	0.00	10.00	0.00 (s)	Operation is started when the time corresponding to the setting value has elapsed from the run command.	○	○	○	○	6-151
C21 – Retry/pick-up										
0	Number of retries	0.	10.	0.	Set the number of times to retry. Retry is not executed when set to 0.	○	○	○		6-152
1	Retry wait time	1.	30.	5. (s)	Set the time from fault occurrence to the start of retry.	○	○	○		6-152
2	Pick-up wait time	0.5	10.0	2.0 (s)	Set the time to wait before starting pick-up operation after the output has been cut off.	○	○	○		6-152
3	Pick-up current limit value	50.	300.	100. (%)	Set within the following range only if the output torque is to be limited when restarting. C21-3 setting value ≥ applicable motor exciting current +10%	○	○	○		6-153
4	V/f pick-up function selection	1.	3.	1.	Select the pick-up operation for the reverse run direction. =1: No reverse run pick-up =2: Reverse run pick-up enabled (FMAX) =3: Reverse run pick-up enabled (estimated speed)	○				6-154
5	Sensor-less pick-up function selection	1.	3.	1.	Select the pick-up function for sensor-less vector control. =1: Reverse run pick-up disabled, start search from NMAX =2: Reverse run pick-up disabled, start search from setting value =3: Reverse run pick-up enabled, start search from NMAX		○		○	6-154
6	Speed estimation proportional gain for sensor-less pick-up	0.00	100.00	10.00 (%)	Set the speed estimation proportional gain used for pick-up during sensor-less vector control.		○		○	6-154
7	Speed estimation integral gain for sensor-less pick-up	0.00	300.00	1.00 (%)	Set the speed estimation integral gain used for pick-up during sensor-less vector control.		○		○	6-154

Block-C parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application				Ref. page
						V/f	VEC	PM	RWE	
C22 – Overload										
0	Motor overload reference	50.0	105.0	100.0 (%)	Note that when this parameter is changed, Parameters C22-1 and C22-2 will automatically be adjusted to the value of this setting. Take care when decreasing and then increasing this value.	○	○	○		6-155
1	0Hz overload	20.0	105.0	100.0 (%)	The maximum value is as set on C22-2.	○	○	○		6-155
2	0.7Base freq. overload	50.0	105.0	100.0 (%)	The minimum value is as set on C22-1.	○	○	○		6-155
3	Motor overload breakdown reference	110.0	300.0	120.0 (%)	Set the trip overload breakdown reference at 1 minute. A breakdown stoppage (OL-3) will occur after 1 minute with the motor rated reference current value at this value. The default value is 150.0 when heavy-duty is set.	○	○	○		6-155
4	DBR overload	0.0	10.0	1.6 (%)	This parameter is for setting %ED of DBR operation. When DBR transistor or DBR built in the unit is used, set the parameter within the specification. When 0.0 is set, the protection function is disabled. When the external DBR unit is used, set to 0.0.	○	○	○		6-155
5	Motor power loss braking setting	0.	70.	50. (%)	This function is valid when control mode selection is C30-0:f0=1 or auxiliary drive is selected and main circuit option selection is C31-0:f0=2	○	○	○		6-156
6	Carrier frequency automatic reduction function selection	1.	2.	1.	=1: Reduction enabled =2: Reduction disabled	○	○	○	○	6-156
7	Phase failure detection function selection	11.	22.	11.	1 1 . f0: Input phase failure detection function selection =1: Function valid =2: Function invalid f1: Output phase failure detection function selection =1: Function valid =2: Function invalid	○	○	○	○	6-156
C24 – Speed detection error monitor										
0	Over speed protection level	20.0	200.0	105.0 (%)	The over speed protection operation level is set.		○	○		6-157
1	Control mode changeover during speed detection error	1.	3.	1.	Select control at speed detection error =1: Speed detection error not monitored =2: Speed detection error monitored (Do not change to sensorless vector control) =3: Speed detection error monitored (Switch to sensorless vector control) Set whether to monitor speed detection errors, such as wire breakage of the speed detector circuit, and to change over from vector control to sensorless vector control. There will be no switch to sensorless control for other than vector control. In this case, select 1 or 2.	○ *1)	○	○		6-157
2	Speed detection error level	1.0	100.0	10.0 (%)	The conditions for judging the speed detection error are set. Set as C24-2 ≥ C24-3.	○ *1)	○	○	○	6-157
3	Speed detection error recovery level	1.0	100.	5.0 (%)	When the speed detection value deviation is less than this setting value, it is determined that the speed detection has been reset properly.	○ *1)	○		○	6-157

*1) This parameter is used by simple ASR control.

Block-C parameters list

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Parameter</th><th rowspan="2">Min.</th><th rowspan="2">Max.</th><th rowspan="2">Default (Unit)</th><th rowspan="2">Function</th><th colspan="4">Application</th><th rowspan="2">Ref. page</th></tr>
<tr><th>V/f</th><th>VEC</th><th>PM</th><th>RWE</th></tr>
<tr><td colspan="11">C24 – Speed detection error monitor</td></tr>
<tr><td>4</td><td>Control mode changeover during speed deviation error</td><td>1.</td><td>3.</td><td>1.</td><td>Select speed deviation control error.
=1: No error monitoring performed, no ALM output, no FLT output
=2: Error monitoring performed, no ALM output, FLT output performed
=3: Error monitoring performed, ALM output performed, no FLT output</td><td></td><td>○</td><td>○</td><td></td><td>6-158</td></tr>
<tr><td>5</td><td>Speed deviation error level</td><td>1.0</td><td>50.0</td><td>10.0 (%)</td><td>Set the error judgment command and the deviation level for detection.</td><td></td><td>○</td><td>○</td><td>○</td><td>6-158</td></tr>
<tr><td>6</td><td>Speed deviation error judgment time</td><td>0.1</td><td>20.0</td><td>10.0 (s)</td><td>Set the time for judging speed deviation.</td><td></td><td>○</td><td>○</td><td>○</td><td>6-158</td></tr>
<tr><td>7</td><td>Reverse error detection level</td><td>0.</td><td>100.</td><td>0. (%)</td><td>Set the error detection level for when the motor rotates in the reverse direction of the speed command.
Set using the base speed as 100%.
The error is not detected when 0 is set.</td><td></td><td>○</td><td>○</td><td>○</td><td>6-158</td></tr>
<tr><td colspan="11">C25 – High-efficiency operation</td></tr>
<tr><td>0</td><td>Voltage reduction time</td><td>0.1</td><td>30.0</td><td>10.0 (s)</td><td>Set the time for the output voltage to drop from the V/f setting value to 0V.</td><td>○</td><td>○</td><td>○</td><td></td><td>6-158</td></tr>
<tr><td>1</td><td>Voltage lower limit setting value</td><td>50.</td><td>100.</td><td>100. (%)</td><td>When selecting a high-efficiency operation function, set 50 to 99.</td><td>○</td><td>○</td><td>○</td><td></td><td>6-158</td></tr>
<tr><td>2</td><td>Cooling fan ON/OFF control</td><td>1.</td><td>2.</td><td>2.</td><td>=1: ON / OFF control is enabled. FAN is ON when inverter runs. The fan runs for 10s when starting.
=2: ON / OFF control is disabled. FAN is always ON.</td><td>○</td><td>○</td><td>○</td><td></td><td>6-159</td></tr>
<tr><td colspan="11">C26 – Standard serial transmission setting</td></tr>
<tr><td>0</td><td>Function selection</td><td>0.</td><td>1.</td><td>0.</td><td>0: Standard serial 1: MODBUS</td><td>○</td><td>○</td><td>○</td><td></td><td>6-159</td></tr>
<tr><td>1</td><td>Parameter change protection</td><td>1.</td><td>5.</td><td>1.</td><td>The parameters with a ○ mark below can be changed.
<table>
<tr><th rowspan="2">Setting value</th><th rowspan="2">Block A Parameter</th><th colspan="4">Block B, C Parameter</th></tr>
<tr><th>Basic</th><th>Extend</th><th>S/W</th><th>H/W</th></tr>
<tr><td>1</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>2</td><td>×</td><td>×</td><td>×</td><td>×</td><td>×</td></tr>
<tr><td>3</td><td>○</td><td>×</td><td>×</td><td>×</td><td>×</td></tr>
<tr><td>4</td><td>○</td><td>×</td><td>○</td><td>×</td><td>×</td></tr>
<tr><td>5</td><td>○</td><td>×</td><td>○</td><td>○</td><td>×</td></tr>
</table>
○: Changeable ×: Unchangeable</td><td>○</td><td>○</td><td>○</td><td></td><td>6-159</td></tr>
<tr><td>2</td><td>Station No.</td><td>0.</td><td>247.</td><td>1.</td><td>Set the local station No.</td><td>○</td><td>○</td><td>○</td><td></td><td>6-159</td></tr>
<tr><td>3</td><td>Response timer</td><td>0.00</td><td>2.00</td><td>0.00 (s)</td><td>Set the minimum time from receiving command to returning an answer.</td><td>○</td><td>○</td><td>○</td><td>○</td><td>6-159</td></tr>
<tr><td>4</td><td>CN2 standard serial communication baud rate setting</td><td>1.</td><td>7.</td><td>2.</td><td>=1: 4800 =2: 9600 =3: 14400
=4: 19200 =5: 38400 =6*: 1200
=7*: 2400 * : =6 & =7 can be used from the version 9457.0+9458.2.</td><td>○</td><td>○</td><td>○</td><td>○</td><td>6-159</td></tr>
<tr><td>5</td><td>CN2 standard serial communication stop bit setting</td><td>1.</td><td>2.</td><td>2.</td><td>=1: 1 bit =2: 2 bit</td><td>○</td><td>○</td><td>○</td><td>○</td><td>6-160</td></tr>
<tr><td>6</td><td>CN2 standard serial communication parity setting</td><td>1.</td><td>3.</td><td>3.</td><td>=1: None =2: Even =3: Odd</td><td>○</td><td>○</td><td>○</td><td>○</td><td>6-160</td></tr>
<tr><td>7</td><td>Base section serial communication frequency (speed) unit setting</td><td>0.</td><td>5.</td><td>0.</td><td>=0: 0.01Hz or 0.1min^{-1} unit: signed
=1: 0.1Hz or 1min^{-1} unit: signed
=2: 0.01% unit: signed
=3: 0.01Hz or 0.1min^{-1} unit: unsigned
=4: 0.1Hz or 1min^{-1} unit: unsigned
=5: 0.01% unit: unsigned</td><td>○</td><td>○</td><td>○</td><td>○</td><td>6-160</td></tr>
<tr><td colspan="11">C28 – Password No.</td></tr>
<tr><td>0</td><td>Password No. function valid</td><td>1.</td><td>2.</td><td>1.</td><td>=1: Function invalid =2: Function valid</td><td>○</td><td>○</td><td>○</td><td>○</td><td>6-160</td></tr>
<tr><td>1</td><td>Password No. setting</td><td>0.</td><td>9999.</td><td>0.</td><td>Set the password No. Once set the display will return to 0, so make sure not to forget the set number.</td><td>○</td><td>○</td><td>○</td><td>○</td><td>6-160</td></tr>
</table>

Block-C parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
C30 – Control mode selection										
0	Control mode selection	11.	25.	11.	1 1. f0: The control mode is set. =1: V/f control =2: IM speed sensor-less vector control =3: IM speed vector control with sensor =4: PM motor control with sensor =5: For future addition f1: The overload mode is set. =1: Normal-duty (120%1min) =2: Heavy-duty (150%1min)	○	○	○		6-161
C31 – Main circuit option selection										
0	Main circuit option selection	1111.	1222.	1221.	1 2 2 1. f0: Motor loss braking (1=OFF, 2=ON) f1: DB selection (1=OFF, 2=ON) f2: OVL selection (1=OFF, 2=ON) f3: (For future use)	○ ○ ○	Δ ○ Δ	Δ ○ Δ		6-161
1	Ground fault detection function	1.	2.	1.	=1: Enabled =2: Disabled	○	○	○		6-161
2	UVL proportional gain	0.00	1.00	0.00 (%)	Set the gain for lowering the frequency at the start of UVL operation. The UVL function will be turned OFF if 0 is set. Set a value approx. half of the motor's rated slip.	○	○	○	○	6-161
3	UVL integral time constant	2.	200.	10. (ms)	Set the integral time constant for UVL operation. Reduce the value if UVT occurs.	○	○	○	○	6-161
C33 – Output terminal function (Option)										
0	PSO4 output parameters	-55.	55.	10.	Select the setting value from the following table, and output. -1 to -55 are the reverse output of 1 to 55.	○	○	○	○	6-161
1	PSO5 output parameters	-55.	55.	11.		○	○	○	○	6-161
2	PSO6 output parameters	-55.	55.	12.		○	○	○	○	6-161
3	PSO7 output parameters	-55.	55.	13.		○	○	○	○	6-161

Value	Output signal	Value	Output signal	Value	Output signal	Value	Output signal	Value	Output signal	Value	Output signal	Value	Output signal
0	Fixed to OFF	8	IDET	16	EC3	24	LLMT	32	PLC1	40	FPOS	48	MP01
1	RUN	9	ATN	17	ACC	25	ULMT	33	PLC2	41	For future use	49	MP02
2	FLT	10	SPD1	18	DCC	26	Doff-End	34	PLC3	42	For future use	50	MP03
3	MC	11	SPD2	19	AUXDV	27	MBRK	35	PLC4	43	For future use	51	MP04
4	RDY1	12	COP	20	ALM	28	DVER	36	PLC5	44	For future use	52	MP05
5	RDY2	13	EC0	21	FAN	29	BPF	37	PLC6	45	For future use	53	MP06
6	LCL	14	EC1	22	ASW	30	RDELAY	38	PLC7	46	For future use	54	MP07
7	REV	15	EC2	23	ZSP	31	Fixed to ON	39	PLC8	47	For future use	55	MP08

Value	Output signal	Value	Output signal	Value	Output signal	Value	Output signal	Value	Output signal	Value	Output signal	Value	Output signal
	------	-8	IDET	-16	EC3	-24	LLMT	-32	PLC1	-40	FPOS	-48	MP01
-1	RUN	-9	ATN	-17	ACC	-25	ULMT	-33	PLC2	-41	For future use	-49	MP02
-2	FLT	-10	SPD1	-18	DCC	-26	Doff-End	-34	PLC3	-42	For future use	-50	MP03
-3	MC	-11	SPD2	-19	AUXDV	-27	MBRK	-35	PLC4	-43	For future use	-51	MP04
-4	RDY1	-12	COP	-20	ALM	-28	DVER	-36	PLC5	-44	For future use	-52	MP05
-5	RDY2	-13	EC0	-21	FAN	-29	BPF	-37	PLC6	-45	For future use	-53	MP06
-6	LCL	-14	EC1	-22	ASW	-30	RDELAY	-38	PLC7	-46	For future use	-54	MP07
-7	REV	-15	EC2	-23	ZSP	-31	Fixed to ON	-39	PLC8	-47	For future use	-55	MP08

Block-C parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	VEC	PM	RWE	Ref. page
C34 – Field network interface (PROFIBUS)										
0	Station number	0.	126.	1.	Set the station address. 01 to 126 (Slave station)	○	○	○		
1	Transmission error detection	1.	2.	1.	Select the transmission error detection =1：Without detection =2：Detection (fault output) =3：Detection (minor fault) When set =1 or COP is Off, no fault is detected and the present operation is kept even if any transmission error is occurred。 When set = 2 and COP is On, IO-8 or IO-9 is output for any transmission error. When set = 3 and COP is On, minor fault is output for any transmission error and the inverter operation follows C34-2 setting.	○	○	○		
2	HOLD/CLR/Emergency stop	0.	2.	0.	Set HOLD / CLEAR /Emergency stop when C34-1=3 and COP is On. =0：Hold (hold the set value as it is) =1：Clear (clear all the set values) =2：Emergency stop ※ When emergency stop occurs, the inverter operation should be resumed after the fault reset.	○	○	○		
3	Master timeout time	0.0.	10.0	5.0	Set the master timeout time. [0.1 s/LSB]	○	○	○		
6	Data range selection	0.	11.	0.	Select the data range for the transmission input/output data. Refer to the "Data Range Selection Table" for details.	○	○	○		6-162
C34 – Field network interface (CC-Link)										
1	Transmission error detection	1.	2.	1.	Select the transmission error detection =1：Without detection =2：Detection (fault output) =3：Detection (minor fault) When set =1 or COP is Off, no fault is detected and the present operation is kept even if any transmission error is occurred。 When set = 2 and COP is On, IO-8 or IO-9 is output for any transmission error. When set = 3 and COP is On, minor fault is output for any transmission error and the inverter operation follows C34-2 setting.	○	○	○		
2	HOLD/CLR/Emergency stop	0.	2.	0.	Set HOLD / CLEAR /Emergency stop when C34-1=3 and COP is On. =0：Hold (hold the set value as it is) =1：Clear (clear all the set values) =2：Emergency stop ※ When emergency stop occurs, the inverter operation should be resumed after the fault reset.	○	○	○		
3	Master timeout time	0.0	10.0	5.0	Set the master timeout time. [0.1 s/LSB]	○	○	○		
6	Data range selection	0.	11.	0.	Select the data range for the transmission input/output data. Refer to the "Data Range Selection Table" for details.	○	○	○		
7	CC-Link transmission version selection	1.	2.	1.	Set the version of the CC-Link transmission protocol. (For future use) (This parameter setting is invalid when using other communication options.) =1: Ver1 =2: Ver2	○	○	○		

Block-C parameters list

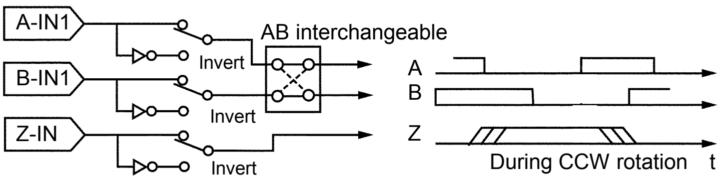
No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	VEC	PM	RWE	Ref. page
C34 – Field network interface (IO link II)										
0	Station number	0.	126.	1.	Set the station address. 02 to 31 (Remote station)	○	○	○		
1	Transmission error detection	1.	2.	1.	Select the transmission error detection =1：Without detection =2：Detection (fault output) =3：Detection (minor fault) When set =1 or COP is Off, no fault is detected and the present operation is kept even if any transmission error is occurred。 When set = 2 and COP is On, IO-8 or IO-9 is output for any transmission error. When set = 3 and COP is On, minor fault is output for any transmission error and the inverter operation follows C34-2 setting.	○	○	○		
2	HOLD/CLR/Emergency stop	0.	2.	0.	Set HOLD / CLEAR /Emergency stop when C34-1=3 and COP is On. =0：Hold (hold the set value as it is) =1：Clear (clear all the set values) =2：Emergency stop ※ When emergency stop occurs, the inverter operation should be resumed after the fault reset.	○	○	○		
3	Master timeout time	0.0	10.0	5.0	Set the master timeout time. [0.1 s/LSB]	○	○	○		
4	Transmission speed	1.	4.	1.	Set the IO link II metal transmission speed. (This parameter setting is invalid when using other communication options.) =1: 125 kbps =3: 500 kbps =2: 250 kbps =4: 1M bps	○	○	○		
5	Transmission size	1.	2.	1.	Set the IO link II transmission size. (This parameter setting is invalid when using other communication options.) =1: 16W =2: 32W	○	○	○		
6	Data range selection	0.	11.	0.	Select the data range for the transmission input/output data. Refer to the "Data Range Selection Table" for details.	○	○	○		

Block-C parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
C50 – Encoder setting										
0	Encoder pulse divided output setting	1.	1023.	4.	The pulse input from the encoder can be divided in half, and output to an external source from PAOUT and PBOUT on the speed detection PCB. Adjust the setting value so that the output pulse is up to 70kHz.	○ *1)	○	○		6-162
1	Encoder output pulse No. selection	1.	2.	1.	= 1 : 2-phase input = 2 : 1-phase input When using vector control with speed sensor, set whether the number of pulses input from the encoder is a 2-phase input or 1-phase input.	○ *1)	○		○	6-162
2	Encoder AB advance direction selection	1.	2.	1.	Select the advance direction of the AB signal input from the encoder. =1: Forward =2: Reverse	○ *1)	○	○		6-163
3	Encoder ABZ pulse type selection	0.	15.	0.	Set this only when the signal type cannot be selected with C50-2, C51-2. Take special care when setting.	○ *1)	○	○		6-163

Setting No.	A-IN1 Non invert / Invert	B-IN1 Non invert / Invert	Z-IN Non invert / Invert	AB inter-change
0	–	–	–	No inter-change
1	Invert	–	–	
2	–	Invert	–	
3	Invert	Invert	–	
4	–	–	Invert	
5	Invert	–	Invert	
6	–	Invert	Invert	
7	Invert	Invert	Invert	

Setting No.	A-IN1 Non invert / Invert	B-IN1 Non invert / Invert	Z-IN Non invert / Invert	AB inter-change
8	–	–	–	AB inter-change
9	Invert	–	–	
10	–	Invert	–	
11	Invert	Invert	–	
12	–	–	Invert	
13	Invert	–	Invert	
14	–	Invert	Invert	
15	Invert	Invert	Invert	

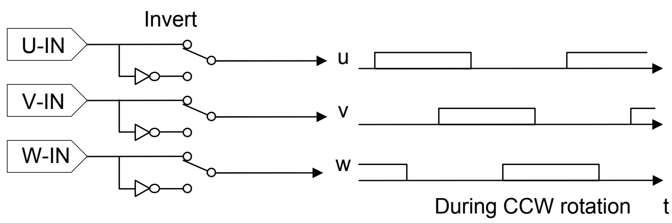


*1) This parameter is used by simple ASR control.

Block-C parameters list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
C51 – Encoder setting (PM)										
0	Encoder selection	1.	4.	1.	Select the type of signal input from the encoder. =1: A, B, Z-phase + U, V, W-phase signal =2: A, B, Z-phase + serial absolute signal =3: A, B, Z-phase + U, V, W-phase signal (reduced wiring) =4: SIN, COS signal			○		6-163
1	AB phase-Z phase type selection	0	1.	0.	=0: Normal =1: When the AB phase and Z phase edge is identical			○		6-164
2	Encoder Z signal reversal	1.	2.	1.	Select whether to reverse the Z signal input from the encoder. =1: Do not reverse =2: Reverse			○		6-164
3	Encoder UVW advance direction selection	1.	2.	1.	Select the advance direction of the UVW signal input from the encoder. =1: Forward =2: Reverse			○		6-164
4	Z-IN → U phase winding phase angle	0.0	359.9	0.0 (°)	Electrical angle from Z-IN to U phase			○	○	6-165
5	Z-IN → U phase angle	0.0	359.9	0.0 (°)	Electrical angle from Z-IN to u phase			○	○	6-166
6	Encoder UVW pulse type selection	0.	7.	0.	Set this only when the signal type cannot be selected with C51-3. Take special care when setting.			○		6-164

Setting No.	U-IN Non invert / Invert	V-IN Non invert / Invert	W-IN Non invert / Invert	UV inter-change
0	–	–	–	No inter-change
1	Invert	–	–	
2	–	Invert	–	
3	Invert	Invert	–	
4	–	–	Invert	
5	Invert	–	Invert	
6	–	Invert	Invert	
7	Invert	Invert	Invert	



No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
7	UVW measurement start wait time [For reduced wiring ABZUVW]	0.	1000.	2. (ms)	When using the reduced wiring ABZUVW encoder, set the time to wait from the setting of the UVW signal to the measurement of UVW. The timer functions at a 2ms cycle, so set an integer-fold of 2.			○	○	6-167
8	UVW measurement time [For reduced wiring ABZUVW]	0.	1000.	2. (ms)	When using the reduced wiring ABZUVW encoder, set the interval to measure the UVW signal. If UVW cannot be measured within this time, a fault will be output. The timer functions at a 2ms cycle, so set an integer-fold of 2.			○	○	6-167
9	ABZ measurement start wait time [For reduced wiring ABZUVW]	0.	1000.	2. (ms)	When using the reduced wiring ABZUVW encoder, set the time to wait before starting control with the ABZ signal. The timer functions at a 2ms cycle, so set an integer-fold of 2.			○	○	6-167

6-5 Block-U parameters

The block-U parameters are for the utility mode.

V/f : Indicates parameters that apply for V/f control (constant torque, variable torque) (C30-0: f0 = 1).
VEC : Indicates parameters that apply for IM speed sensor-less vector control and IM speed vector control with sensor (C30-0: f0 = 2, 3).
PM : Indicates parameters that apply for control mode with PM motor sensor (C30-0: f0 = 4).
RWE : Displays the parameters that can be changed during operation.
Reference page: The number of the page providing detailed explanations is indicated.

Block-U parameters (Utility mode) list

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application				Ref. page
						V/f	VEC	PM	RWE	
U00 – Parameter Control										
0	Parameter copy function	0.	9999.	0.	The parameter copy function is executed while the inverter is stopped. = 1001 : Save The parameter data is saved from the inverter to the operation panel. = 2002 : Load The parameter data is loaded from the operation panel to the inverter. If parameter data outside the setting range, such as for a different inverter capacity, could be loaded, the settings of the parameters not within the setting range may be uncertain. In this case, always turn the power OFF and ON once. If dEt appears when the power is turned ON, enter D20-2 and set the uncertain data. = 3003 : Verify check The operation panel and inverter parameter data contents are verified and checked. If the parameters differ, EP. Ett will appear. = 4004 : Clear The parameter data of operation panel is cleared.	○	○	○		6-168
1	Password No. setting	0.	9999.	0.	When C09-0 is locked, it can be unlocked by inputting the 4-digit parameter set with C28-0 in this parameter.	○	○	○		6-168

Block-U parameter built-in PLC function settings

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	VEC	PM	RWE	Ref. page
U10 – Built-in PLC setting										
0	No. of execution banks	0.	20.	0.	Set the number of banks to be executed at 1 bank/2ms. The built-in PLC is turned OFF when 0 is set. If a fault (CPU.B) occurs in the built-in PLC, 0 is forcibly set. Confirm the built-in PLC command and then set U10-0 again.	○	○	○	○	6-168 6-189 / 6-195
1	Built-in PLC parameter 1	0.	FFFF.	0. (hex)	Set the user parameters which can be used by the built-in PLC.	○	○	○	○	6-168 6-189 / 6-195
2	Built-in PLC parameter 2	0.	FFFF.	0. (hex)						
3	Built-in PLC parameter 3	0.	FFFF.	0. (hex)						
4	Built-in PLC parameter 4	0.	FFFF.	0. (hex)						
5	Built-in PLC parameter 5	0.	FFFF.	0. (hex)						
6	Built-in PLC parameter 6	0.	FFFF.	0. (hex)						
7	Built-in PLC parameter 7	0.	FFFF.	0. (hex)						
8	Built-in PLC parameter 8	0.	FFFF.	0. (hex)						
U20 – Built-in PLC command bank 1										
0	Command 1-0	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 1 or more.	○	○	○	○	6-169 6-189 / 6-195
1	Command 1-1	0.	FFFF.	0. (hex)						
2	Command 1-2	0.	FFFF.	0. (hex)						
3	Command 1-3	0.	FFFF.	0. (hex)						
4	Command 1-4	0.	FFFF.	0. (hex)						
5	Command 1-5	0.	FFFF.	0. (hex)						
6	Command 1-6	0.	FFFF.	0. (hex)						
7	Command 1-7	0.	FFFF.	0. (hex)						
U21 – Built-in PLC command bank 1										
0	Command 1-8	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 1 or more.	○	○	○	○	6-169 6-189 / 6-195
1	Command 1-9	0.	FFFF.	0. (hex)						
2	Command 1-10	0.	FFFF.	0. (hex)						
3	Command 1-11	0.	FFFF.	0. (hex)						
4	Command 1-12	0.	FFFF.	0. (hex)						
5	Command 1-13	0.	FFFF.	0. (hex)						
6	Command 1-14	0.	FFFF.	0. (hex)						
7	Command 1-15	0.	FFFF.	0. (hex)						

Block-U parameter built-in PLC function settings

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
U22 – Built-in PLC command bank 2										
0	Command 2-0	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 2 or more.	○	○	○	○	6-169 6-189 / 6-195
1	Command 2-1	0.	FFFF.	0. (hex)						
2	Command 2-2	0.	FFFF.	0. (hex)						
3	Command 2-3	0.	FFFF.	0. (hex)						
4	Command 2-4	0.	FFFF.	0. (hex)						
5	Command 2-5	0.	FFFF.	0. (hex)						
6	Command 2-6	0.	FFFF.	0. (hex)						
7	Command 2-7	0.	FFFF.	0. (hex)						
U23 – Built-in PLC command bank 2										
0	Command 2-8	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 2 or more.	○	○	○	○	6-169 6-189 / 6-195
1	Command 2-9	0.	FFFF.	0. (hex)						
2	Command 2-10	0.	FFFF.	0. (hex)						
3	Command 2-11	0.	FFFF.	0. (hex)						
4	Command 2-12	0.	FFFF.	0. (hex)						
5	Command 2-13	0.	FFFF.	0. (hex)						
6	Command 2-14	0.	FFFF.	0. (hex)						
7	Command 2-15	0.	FFFF.	0. (hex)						
U24 – Built-in PLC command bank 3										
0	Command 3-0	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 3 or more.	○	○	○	○	6-169 6-189 / 6-195
1	Command 3-1	0.	FFFF.	0. (hex)						
2	Command 3-2	0.	FFFF.	0. (hex)						
3	Command 3-3	0.	FFFF.	0. (hex)						
4	Command 3-4	0.	FFFF.	0. (hex)						
5	Command 3-5	0.	FFFF.	0. (hex)						
6	Command 3-6	0.	FFFF.	0. (hex)						
7	Command 3-7	0.	FFFF.	0. (hex)						

Block-U parameter built-in PLC function settings

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
U25 – Built-in PLC command bank 3										
0	Command 3-8	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 3 or more.	○	○	○	○	6-169 6-189 / 6-195
1	Command 3-9	0.	FFFF.	0. (hex)						
2	Command 3-10	0.	FFFF.	0. (hex)						
3	Command 3-11	0.	FFFF.	0. (hex)						
4	Command 3-12	0.	FFFF.	0. (hex)						
5	Command 3-13	0.	FFFF.	0. (hex)						
6	Command 3-14	0.	FFFF.	0. (hex)						
7	Command 3-15	0.	FFFF.	0. (hex)						
U26 – Built-in PLC command bank 4										
0	Command 4-0	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 4 or more.	○	○	○	○	6-169 6-189 / 6-195
1	Command 4-1	0.	FFFF.	0. (hex)						
2	Command 4-2	0.	FFFF.	0. (hex)						
3	Command 4-3	0.	FFFF.	0. (hex)						
4	Command 4-4	0.	FFFF.	0. (hex)						
5	Command 4-5	0.	FFFF.	0. (hex)						
6	Command 4-6	0.	FFFF.	0. (hex)						
7	Command 4-7	0.	FFFF.	0. (hex)						
U27 – Built-in PLC command bank 4										
0	Command 4-8	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 4 or more.	○	○	○	○	6-169 6-189 / 6-195
1	Command 4-9	0.	FFFF.	0. (hex)						
2	Command 4-10	0.	FFFF.	0. (hex)						
3	Command 4-11	0.	FFFF.	0. (hex)						
4	Command 4-12	0.	FFFF.	0. (hex)						
5	Command 4-13	0.	FFFF.	0. (hex)						
6	Command 4-14	0.	FFFF.	0. (hex)						
7	Command 4-15	0.	FFFF.	0. (hex)						

Block-U parameter built-in PLC function settings

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
U30 – Built-in PLC command bank 5										
0	Command 5-0	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 5 or more.	○	○	○	○	6-169 6-189 / 6-195
1	Command 5-1	0.	FFFF.	0. (hex)						
2	Command 5-2	0.	FFFF.	0. (hex)						
3	Command 5-3	0.	FFFF.	0. (hex)						
4	Command 5-4	0.	FFFF.	0. (hex)						
5	Command 5-5	0.	FFFF.	0. (hex)						
6	Command 5-6	0.	FFFF.	0. (hex)						
7	Command 5-7	0.	FFFF.	0. (hex)						
U31 – Built-in PLC command bank 5										
0	Command 5-8	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 5 or more.	○	○	○	○	6-169 6-189 / 6-195
1	Command 5-9	0.	FFFF.	0. (hex)						
2	Command 5-10	0.	FFFF.	0. (hex)						
3	Command 5-11	0.	FFFF.	0. (hex)						
4	Command 5-12	0.	FFFF.	0. (hex)						
5	Command 5-13	0.	FFFF.	0. (hex)						
6	Command 5-14	0.	FFFF.	0. (hex)						
7	Command 5-15	0.	FFFF.	0. (hex)						
U32 – Built-in PLC command bank 6										
0	Command 6-0	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 6 or more.	○	○	○	○	6-169 6-189 / 6-195
1	Command 6-1	0.	FFFF.	0. (hex)						
2	Command 6-2	0.	FFFF.	0. (hex)						
3	Command 6-3	0.	FFFF.	0. (hex)						
4	Command 6-4	0.	FFFF.	0. (hex)						
5	Command 6-5	0.	FFFF.	0. (hex)						
6	Command 6-6	0.	FFFF.	0. (hex)						
7	Command 6-7	0.	FFFF.	0. (hex)						

Block-U parameter built-in PLC function settings

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	VEC	PM	RWE	Ref. page
U33 – Built-in PLC command bank 6										
0	Command 6-8	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 6 or more.	○	○	○	○	6-169 6-189 / 6-195
1	Command 6-9	0.	FFFF.	0. (hex)						
2	Command 6-10	0.	FFFF.	0. (hex)						
3	Command 6-11	0.	FFFF.	0. (hex)						
4	Command 6-12	0.	FFFF.	0. (hex)						
5	Command 6-13	0.	FFFF.	0. (hex)						
6	Command 6-14	0.	FFFF.	0. (hex)						
7	Command 6-15	0.	FFFF.	0. (hex)						
U34 – Built-in PLC command bank 7										
0	Command 7-0	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 7 or more.	○	○	○	○	6-169 6-189 / 6-195
1	Command 7-1	0.	FFFF.	0. (hex)						
2	Command 7-2	0.	FFFF.	0. (hex)						
3	Command 7-3	0.	FFFF.	0. (hex)						
4	Command 7-4	0.	FFFF.	0. (hex)						
5	Command 7-5	0.	FFFF.	0. (hex)						
6	Command 7-6	0.	FFFF.	0. (hex)						
7	Command 7-7	0.	FFFF.	0. (hex)						
U35 – Built-in PLC command bank 7										
0	Command 7-8	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 7 or more.	○	○	○	○	6-169 6-189 / 6-195
1	Command 7-9	0.	FFFF.	0. (hex)						
2	Command 7-10	0.	FFFF.	0. (hex)						
3	Command 7-11	0.	FFFF.	0. (hex)						
4	Command 7-12	0.	FFFF.	0. (hex)						
5	Command 7-13	0.	FFFF.	0. (hex)						
6	Command 7-14	0.	FFFF.	0. (hex)						
7	Command 7-15	0.	FFFF.	0. (hex)						

Block-U parameter built-in PLC function settings

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
U36 – Built-in PLC command bank 8										
0	Command 8-0	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 8 or more.	○	○	○	○	6-169 6-189 / 6-195
1	Command 8-1	0.	FFFF.	0. (hex)						
2	Command 8-2	0.	FFFF.	0. (hex)						
3	Command 8-3	0.	FFFF.	0. (hex)						
4	Command 8-4	0.	FFFF.	0. (hex)						
5	Command 8-5	0.	FFFF.	0. (hex)						
6	Command 8-6	0.	FFFF.	0. (hex)						
7	Command 8-7	0.	FFFF.	0. (hex)						
U37 – Built-in PLC command bank 8										
0	Command 8-8	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 8 or more.	○	○	○	○	6-169 6-189 / 6-195
1	Command 8-9	0.	FFFF.	0. (hex)						
2	Command 8-10	0.	FFFF.	0. (hex)						
3	Command 8-11	0.	FFFF.	0. (hex)						
4	Command 8-12	0.	FFFF.	0. (hex)						
5	Command 8-13	0.	FFFF.	0. (hex)						
6	Command 8-14	0.	FFFF.	0. (hex)						
7	Command 8-15	0.	FFFF.	0. (hex)						

Block-U parameter built-in PLC function settings

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	VEC	PM	RWE	Ref. page
U40 – Built-in PLC command bank 9										
0	Command 9-0	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 9 or more.	○	○	○	○	6-169 6-189 / 6-195
1	Command 9-1	0.	FFFF.	0. (hex)						
2	Command 9-2	0.	FFFF.	0. (hex)						
3	Command 9-3	0.	FFFF.	0. (hex)						
4	Command 9-4	0.	FFFF.	0. (hex)						
5	Command 9-5	0.	FFFF.	0. (hex)						
6	Command 9-6	0.	FFFF.	0. (hex)						
7	Command 9-7	0.	FFFF.	0. (hex)						
U41 – Built-in PLC command bank 9										
0	Command 9-8	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 9 or more.	○	○	○	○	6-169 6-189 / 6-195
1	Command 9-9	0.	FFFF.	0. (hex)						
2	Command 9-10	0.	FFFF.	0. (hex)						
3	Command 9-11	0.	FFFF.	0. (hex)						
4	Command 9-12	0.	FFFF.	0. (hex)						
5	Command 9-13	0.	FFFF.	0. (hex)						
6	Command 9-14	0.	FFFF.	0. (hex)						
7	Command 9-15	0.	FFFF.	0. (hex)						
U42 – Built-in PLC command bank 10										
0	Command 10-0	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 10 or more.	○	○	○	○	6-169 6-189 / 6-195
1	Command 10-1	0.	FFFF.	0. (hex)						
2	Command 10-2	0.	FFFF.	0. (hex)						
3	Command 10-3	0.	FFFF.	0. (hex)						
4	Command 10-4	0.	FFFF.	0. (hex)						
5	Command 10-5	0.	FFFF.	0. (hex)						
6	Command 10-6	0.	FFFF.	0. (hex)						
7	Command 10-7	0.	FFFF.	0. (hex)						

Block-U parameter built-in PLC function settings

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
U43 – Built-in PLC command bank 10										
0	Command 10-8	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 10 or more.	○	○	○	○	6-169 6-189 / 6-195
1	Command 10-9	0.	FFFF.	0. (hex)						
2	Command 10-10	0.	FFFF.	0. (hex)						
3	Command 10-11	0.	FFFF.	0. (hex)						
4	Command 10-12	0.	FFFF.	0. (hex)						
5	Command 10-13	0.	FFFF.	0. (hex)						
6	Command 10-14	0.	FFFF.	0. (hex)						
7	Command 10-15	0.	FFFF.	0. (hex)						
U44 – Built-in PLC command bank 11										
0	Command 11-0	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 11 or more.	○	○	○	○	6-169 6-189 / 6-195
1	Command 11-1	0.	FFFF.	0. (hex)						
2	Command 11-2	0.	FFFF.	0. (hex)						
3	Command 11-3	0.	FFFF.	0. (hex)						
4	Command 11-4	0.	FFFF.	0. (hex)						
5	Command 11-5	0.	FFFF.	0. (hex)						
6	Command 11-6	0.	FFFF.	0. (hex)						
7	Command 11-7	0.	FFFF.	0. (hex)						
U45 – Built-in PLC command bank 11										
0	Command 11-8	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 11 or more.	○	○	○	○	6-169 6-189 / 6-195
1	Command 11-9	0.	FFFF.	0. (hex)						
2	Command 11-10	0.	FFFF.	0. (hex)						
3	Command 11-11	0.	FFFF.	0. (hex)						
4	Command 11-12	0.	FFFF.	0. (hex)						
5	Command 11-13	0.	FFFF.	0. (hex)						
6	Command 11-14	0.	FFFF.	0. (hex)						
7	Command 11-15	0.	FFFF.	0. (hex)						

Block-U parameter built-in PLC function settings

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	VEC	PM	RWE	Ref. page
U46 – Built-in PLC command bank 12										
0	Command 12-0	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 12 or more.	○	○	○	○	6-169 6-189 / 6-195
1	Command 12-1	0.	FFFF.	0. (hex)						
2	Command 12-2	0.	FFFF.	0. (hex)						
3	Command 12-3	0.	FFFF.	0. (hex)						
4	Command 12-4	0.	FFFF.	0. (hex)						
5	Command 12-5	0.	FFFF.	0. (hex)						
6	Command 12-6	0.	FFFF.	0. (hex)						
7	Command 12-7	0.	FFFF.	0. (hex)						
U47 – Built-in PLC command bank 12										
0	Command 12-8	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 12 or more.	○	○	○	○	6-169 6-189 / 6-195
1	Command 12-9	0.	FFFF.	0. (hex)						
2	Command 12-10	0.	FFFF.	0. (hex)						
3	Command 12-11	0.	FFFF.	0. (hex)						
4	Command 12-12	0.	FFFF.	0. (hex)						
5	Command 12-13	0.	FFFF.	0. (hex)						
6	Command 12-14	0.	FFFF.	0. (hex)						
7	Command 12-15	0.	FFFF.	0. (hex)						

Block-U parameter built-in PLC function settings

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
U50 – Built-in PLC command bank 13										
0	Command 13-0	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 13 or more.	○	○	○	○	6-169 6-189 / 6-195
1	Command 13-1	0.	FFFF.	0. (hex)						
2	Command 13-2	0.	FFFF.	0. (hex)						
3	Command 13-3	0.	FFFF.	0. (hex)						
4	Command 13-4	0.	FFFF.	0. (hex)						
5	Command 13-5	0.	FFFF.	0. (hex)						
6	Command 13-6	0.	FFFF.	0. (hex)						
7	Command 13-7	0.	FFFF.	0. (hex)						
U51 – Built-in PLC command bank 13										
0	Command 13-8	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 13 or more.	○	○	○	○	6-169 6-189 / 6-195
1	Command 13-9	0.	FFFF.	0. (hex)						
2	Command 13-10	0.	FFFF.	0. (hex)						
3	Command 13-11	0.	FFFF.	0. (hex)						
4	Command 13-12	0.	FFFF.	0. (hex)						
5	Command 13-13	0.	FFFF.	0. (hex)						
6	Command 13-14	0.	FFFF.	0. (hex)						
7	Command 13-15	0.	FFFF.	0. (hex)						
U52 – Built-in PLC command bank 14										
0	Command 14-0	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 14 or more.	○	○	○	○	6-170 6-189 / 6-195
1	Command 14-1	0.	FFFF.	0. (hex)						
2	Command 14-2	0.	FFFF.	0. (hex)						
3	Command 14-3	0.	FFFF.	0. (hex)						
4	Command 14-4	0.	FFFF.	0. (hex)						
5	Command 14-5	0.	FFFF.	0. (hex)						
6	Command 14-6	0.	FFFF.	0. (hex)						
7	Command 14-7	0.	FFFF.	0. (hex)						

Block-U parameter built-in PLC function settings

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	VEC	PM	RWE	Ref. page
U53 – Built-in PLC command bank 14										
0	Command 14-0	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 14 or more.	○	○	○	○	6-170 6-189 / 6-195
1	Command 14-1	0.	FFFF.	0. (hex)						
2	Command 14-2	0.	FFFF.	0. (hex)						
3	Command 14-3	0.	FFFF.	0. (hex)						
4	Command 14-4	0.	FFFF.	0. (hex)						
5	Command 14-5	0.	FFFF.	0. (hex)						
6	Command 14-6	0.	FFFF.	0. (hex)						
7	Command 14-7	0.	FFFF.	0. (hex)						
U54 – Built-in PLC command bank 15										
0	Command 15-0	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 15 or more.	○	○	○	○	6-170 6-189 / 6-195
1	Command 15-1	0.	FFFF.	0. (hex)						
2	Command 15-2	0.	FFFF.	0. (hex)						
3	Command 15-3	0.	FFFF.	0. (hex)						
4	Command 15-4	0.	FFFF.	0. (hex)						
5	Command 15-5	0.	FFFF.	0. (hex)						
6	Command 15-6	0.	FFFF.	0. (hex)						
7	Command 15-7	0.	FFFF.	0. (hex)						
U55 – Built-in PLC command bank 15										
0	Command 15-8	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 15 or more.	○	○	○	○	6-170 6-189 / 6-195
1	Command 15-9	0.	FFFF.	0. (hex)						
2	Command 15-10	0.	FFFF.	0. (hex)						
3	Command 15-11	0.	FFFF.	0. (hex)						
4	Command 15-12	0.	FFFF.	0. (hex)						
5	Command 15-13	0.	FFFF.	0. (hex)						
6	Command 15-14	0.	FFFF.	0. (hex)						
7	Command 15-15	0.	FFFF.	0. (hex)						

Block-U parameter built-in PLC function settings

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	VEC	PM	RWE	Ref. page
U56 – Built-in PLC command bank 16										
0	Command 16-0	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 16 or more.	○	○	○	○	6-170 6-189 / 6-195
1	Command 16-1	0.	FFFF.	0. (hex)						
2	Command 16-2	0.	FFFF.	0. (hex)						
3	Command 16-3	0.	FFFF.	0. (hex)						
4	Command 16-4	0.	FFFF.	0. (hex)						
5	Command 16-5	0.	FFFF.	0. (hex)						
6	Command 16-6	0.	FFFF.	0. (hex)						
7	Command 16-7	0.	FFFF.	0. (hex)						
U57 – Built-in PLC command bank 16										
0	Command 16-8	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 16 or more.	○	○	○	○	6-170 6-189 / 6-195
1	Command 16-9	0.	FFFF.	0. (hex)						
2	Command 16-10	0.	FFFF.	0. (hex)						
3	Command 16-11	0.	FFFF.	0. (hex)						
4	Command 16-12	0.	FFFF.	0. (hex)						
5	Command 16-13	0.	FFFF.	0. (hex)						
6	Command 16-14	0.	FFFF.	0. (hex)						
7	Command 16-15	0.	FFFF.	0. (hex)						

Block-U parameter built-in PLC function settings

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
U60 – Built-in PLC command bank 17										
0	Command 17-0	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 17 or more.	○	○	○	○	6-170 6-189 / 6-195
1	Command 17-1	0.	FFFF.	0. (hex)						
2	Command 17-2	0.	FFFF.	0. (hex)						
3	Command 17-3	0.	FFFF.	0. (hex)						
4	Command 17-4	0.	FFFF.	0. (hex)						
5	Command 17-5	0.	FFFF.	0. (hex)						
6	Command 17-6	0.	FFFF.	0. (hex)						
7	Command 17-7	0.	FFFF.	0. (hex)						
U61 – Built-in PLC command bank 17										
0	Command 17-8	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 17 or more.	○	○	○	○	6-170 6-189 / 6-195
1	Command 17-9	0.	FFFF.	0. (hex)						
2	Command 17-10	0.	FFFF.	0. (hex)						
3	Command 17-11	0.	FFFF.	0. (hex)						
4	Command 17-12	0.	FFFF.	0. (hex)						
5	Command 17-13	0.	FFFF.	0. (hex)						
6	Command 17-14	0.	FFFF.	0. (hex)						
7	Command 17-15	0.	FFFF.	0. (hex)						
U62 – Built-in PLC command bank 18										
0	Command 18-0	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 18 or more.	○	○	○	○	6-170 6-189 / 6-195
1	Command 18-1	0.	FFFF.	0. (hex)						
2	Command 18-2	0.	FFFF.	0. (hex)						
3	Command 18-3	0.	FFFF.	0. (hex)						
4	Command 18-4	0.	FFFF.	0. (hex)						
5	Command 18-5	0.	FFFF.	0. (hex)						
6	Command 18-6	0.	FFFF.	0. (hex)						
7	Command 18-7	0.	FFFF.	0. (hex)						

Block-U parameter built-in PLC function settings

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	VEC	PM	RWE	Ref. page
U63 – Built-in PLC command bank 18										
0	Command 18-8	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 18 or more.	○	○	○	○	6-170 6-189 / 6-195
1	Command 18-9	0.	FFFF.	0. (hex)						
2	Command 18-10	0.	FFFF.	0. (hex)						
3	Command 18-11	0.	FFFF.	0. (hex)						
4	Command 18-12	0.	FFFF.	0. (hex)						
5	Command 18-13	0.	FFFF.	0. (hex)						
6	Command 18-14	0.	FFFF.	0. (hex)						
7	Command 18-15	0.	FFFF.	0. (hex)						
U64 – Built-in PLC command bank 19										
0	Command 19-0	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 19 or more.	○	○	○	○	6-170 6-189 / 6-195
1	Command 19-1	0.	FFFF.	0. (hex)						
2	Command 19-2	0.	FFFF.	0. (hex)						
3	Command 19-3	0.	FFFF.	0. (hex)						
4	Command 19-4	0.	FFFF.	0. (hex)						
5	Command 19-5	0.	FFFF.	0. (hex)						
6	Command 19-6	0.	FFFF.	0. (hex)						
7	Command 19-7	0.	FFFF.	0. (hex)						
U65 – Built-in PLC command bank 19										
0	Command 19-8	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 19 or more.	○	○	○	○	6-170 6-189 / 6-195
1	Command 19-9	0.	FFFF.	0. (hex)						
2	Command 19-10	0.	FFFF.	0. (hex)						
3	Command 19-11	0.	FFFF.	0. (hex)						
4	Command 19-12	0.	FFFF.	0. (hex)						
5	Command 19-13	0.	FFFF.	0. (hex)						
6	Command 19-14	0.	FFFF.	0. (hex)						
7	Command 19-15	0.	FFFF.	0. (hex)						

Block-U parameter built-in PLC function settings

No.	Parameter	Min.	Max.	Default (Unit)	Function	Application V/f	Application VEC	Application PM	Application RWE	Ref. page
U66 – Built-in PLC command bank 20										
0	Command 20-0	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 20.	○	○	○	○	6-170 6-189 / 6-195
1	Command 20-1	0.	FFFF.	0. (hex)						
2	Command 20-2	0.	FFFF.	0. (hex)						
3	Command 20-3	0.	FFFF.	0. (hex)						
4	Command 20-4	0.	FFFF.	0. (hex)						
5	Command 20-5	0.	FFFF.	0. (hex)						
6	Command 20-6	0.	FFFF.	0. (hex)						
7	Command 20-7	0.	FFFF.	0. (hex)						
U67 – Built-in PLC command bank 20										
0	Command 20-8	0.	FFFF.	0. (hex)	Set the built-in PLC command. The commands are executed in order from smallest number. This is valid when U10-0 is 20.	○	○	○	○	6-170 6-189 / 6-195
1	Command 20-9	0.	FFFF.	0. (hex)						
2	Command 20-10	0.	FFFF.	0. (hex)						
3	Command 20-11	0.	FFFF.	0. (hex)						
4	Command 20-12	0.	FFFF.	0. (hex)						
5	Command 20-13	0.	FFFF.	0. (hex)						
6	Command 20-14	0.	FFFF.	0. (hex)						
7	Command 20-15	0.	FFFF.	0. (hex)						

6-6 Function explanation

6-6-1 Explanation of monitor parameters (Block-D parameter) functions

D00-0 **Output frequency in Hz**

D00-1 **Output frequency in %**

This indicates the frequency currently being output.
With D00-1, the maximum frequency is indicated as 100%.
oFF will display when the gate is closed.
bk displays while the DC brake is in action.
PU is displayed during pick-up.

D00-2 **Motor speed in min^{-1}**

D00-3 **Motor speed in %**

This indicates the current motor speed.
(This is displayed even when operation is stopped.)
With D00-3, the maximum speed is indicated as 100%.
The motor forward run is indicated with a positive polarity, and reverse run is indicated with a negative polarity.

D00-4 **Output frequency/motor speed random scale display**

The result of the C14-2 random scale display coefficient multiplied by the D00-0: output frequency is displayed for V/f control operation or auxiliary drive operation, and the random scale display coefficient multiplied by the D00-2: motor speed is displayed for IM vector control and PM motor control.
If the value exceeds the range of -99999 to 99999, "OVER." will be displayed.

D00-5 **Motor rotation count in %**

The motor speed detected with the speed detection option is displayed as a percentage in respect to the maximum speed.
If the speed detection option is provided, the motor speed is displayed even during V/f control or sensor-less vector control.

D01-0 **Set frequency in Hz**

D01-1 **Set frequency in %**

The currently selected frequency setting value is displayed
With D01-1, the maximum frequency is displayed as 100%.

D01-2 **Ramp function output speed in min^{-1}**

The set speed at ASR input point is displayed.
The motor forward run is indicated with a positive polarity, and reverse run is indicated with a negative polarity.

D01-3 **Ramp function input speed in min^{-1}**

The set speed at the ramp function's input point is displayed.
The motor forward run is indicated with a positive polarity, and reverse run is indicated with a negative polarity.

D01-4

Set frequency/input speed Random scale display

The result of the C14-2 random scale display coefficient multiplied by the D01-0: set frequency is displayed for V/f control operation or auxiliary drive operation, and the random scale display coefficient multiplied by the D01-3: ramp function input speed is displayed for IM vector control and PM motor control.
If the value exceeds the range of -99999 to 99999, "OVER." will be displayed.

D02-0

Output current in Amps

D02-1

Output current in %

The output current is displayed. With D02-1, the motor rated current is displayed as 100%.
OFF will display when the gate is closed.

D02-2

Overload (OL-1) monitor

If the output current exceeds the unit's rated current, the display value counts up from 0%.
In the normal-duty mode (Normal-duty, C30-0 $\boxed{f1}$ = 1), the display counts up at rate of 120%/minute in respect to the unit's rated current. In the heavy-duty mode (Heavy-duty, C30-0 $\boxed{f1}$ = 2), the display counts up at a rate of 150%/minute.
When this display value reaches 100%, a fault "OL-1" (unit overload) occurs.

(Note) The unit rated current value differs for the normal-duty mode and heavy-duty mode. Check the levels in Appendix Table 1.

D02-3

Motor overload (OL-3) monitor

If the output current exceeds the motor overload reference set with C22-0 to C22-3, the display counts up from 0%.
When this display value reaches 100%, a fault "OL-3" (motor overload) occurs.

D02-4

Heatsink temperature in °C

The heat sink temperature is displayed.
If this temperature exceeds the fault judgment value, the fault "UOH.1" (overheat) will occur.
The fault judgment temperature is either 95°C or 120°C, depending on the capacity.

D02-5

Torque current detection in %

The output current detection value's torque current element is displayed using the motor rated current as 100%.
The polarity is positive during forward run drive, negative during forward run regeneration, negative during reverse run drive, and positive during reverse run regeneration.

D02-6

Excitation current detection in %

During the IM vector control mode, the output current detection value's excitation current element is displayed using the motor rated current as 100%.
During the PM motor control mode, the output current detection value's weak magnetic field current element is displayed using the motor rated current as 100%. This is a negative polarity while the weak magnetic field current is passing.

D02-7
U phase output current in Amps
D02-8
V phase output current in Amps
D02-9
W phase output current in Amps

The output current of each phase is displayed.
oFF will display when the gate is closed.
The correct value is not displayed during pick-up or during automatic tuning.

D03-0
DC voltage in V

The voltage value of the DC middle circuit in the inverter's main circuit is displayed.

D03-1
Output voltage (command) in V

The output current command value is displayed. The display may differ from the actual output voltage. It depends on the power supply voltage. oFF will display when the gate is closed.

D03-2
Output power in kW

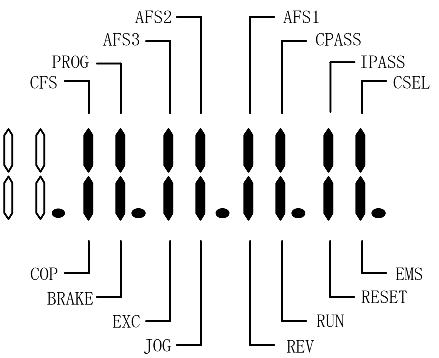
The output current command value is displayed. The display may differ from the actual output voltage. It depends on the power supply voltage. oFF will display when the gate is closed.

D03-3
Carrier frequency in kHz

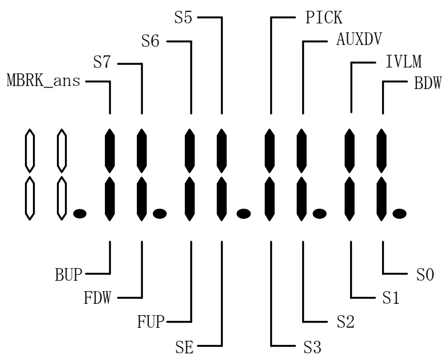
The current carrier frequency is displayed.
When the carrier frequency automatic reduction function is activating, the carrier frequency after reduction is displayed.

D04-0~3
Sequence status-Input

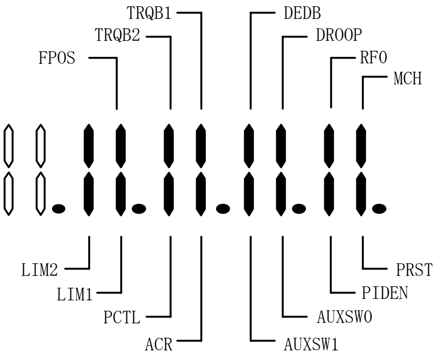
The ON/OFF status of the input sequence data is displayed.
Each segment of the LED and the signal correspond as shown below.



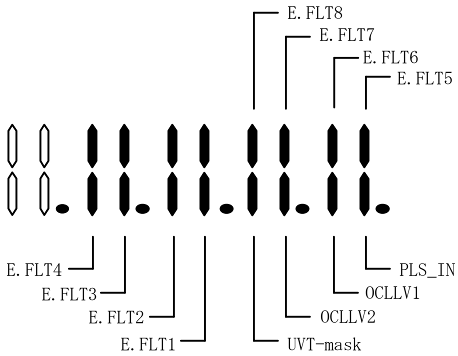
Sequence input (D04-0)



Sequence input (D04-1)



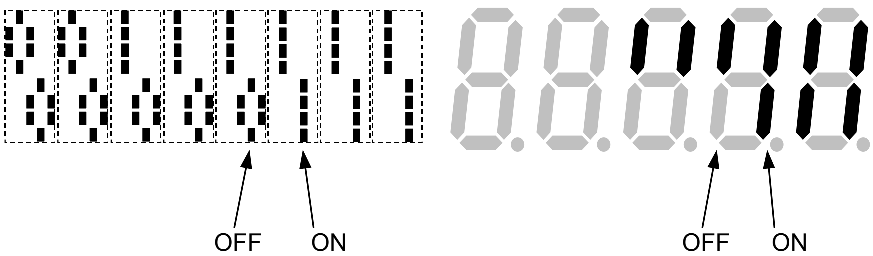
Sequence input (D04-2)



Sequence input (D04-3)

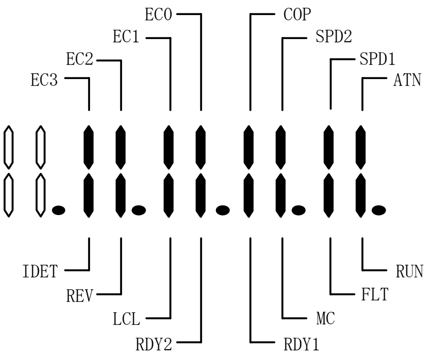
(Note) The D04-0 to 7 and D05-0, 1 displays are examples of the LED operation panel (U30V240P2).
The following display appears on the LCD operation panel (U30V240P1).

LCD operation panel (V240P1) **LED operation panel (V24OP2)**

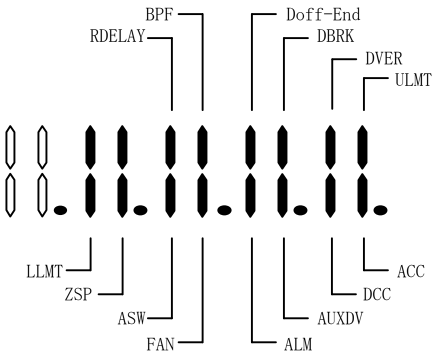


D04-4~7 Sequence status-Output

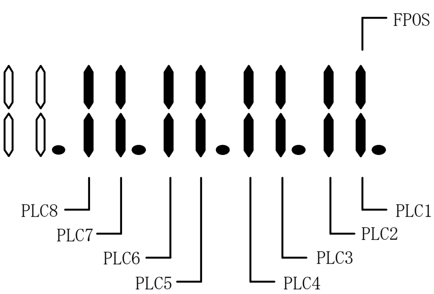
The ON/OFF status of the output sequence data is displayed.
Each segment of the LED and the signal correspond as shown below.



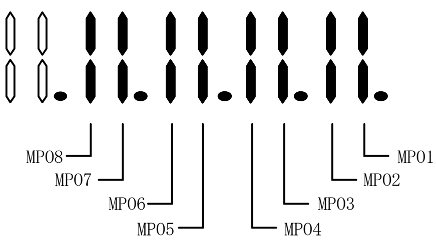
Sequence output (D04-4)



Sequence output (D04-5)



Sequence output (D04-6)

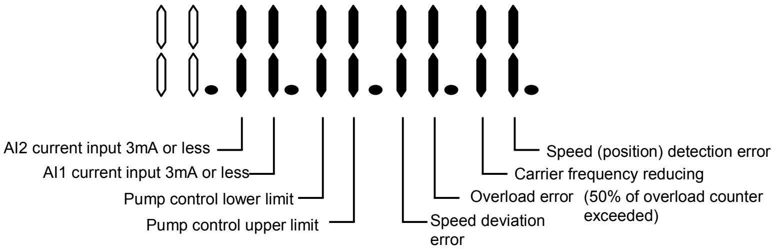


Sequence output (D04-7)

D05-0

Minor fault monitor

The ON/OFF status of the minor fault is displayed.
Each segment of the LED and the signal correspond as shown below.

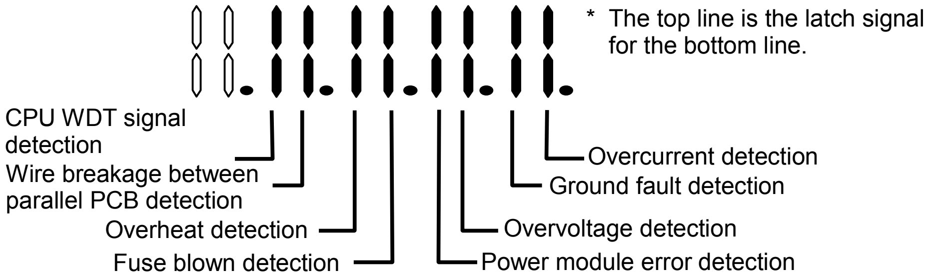


Minor fault (D05-0)

D05-1

Hardware detection fault status

The status of the fault signal detected by the hardware is displayed.
Each segment of the LED and the signal correspond as shown below.



Hardware detection fault status display (D05-1)

D06-0

Pattern run Step No. monitor

The current step No. will display.

D06-1

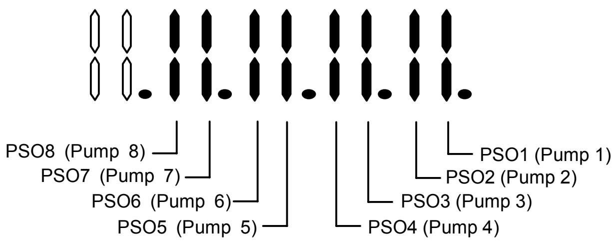
Pattern run Remaining time monitor in s

The remaining time of current step will display

D07-0

Pump operation status monitor

When using multi-pump control, the ON/OFF status of the pump is displayed.
Each segment of the LED and the signal correspond as shown below.



Pump operation status monitor (D07-0)

D07-1

Current inverter drive pump No. monitor

This displays the number of the pump currently driven by the inverter.

D07-2

Next ON pump No. monitor

0 is displayed when all pumps are ON.

D07-3

Next OFF pump No. monitor

0 is displayed when all pumps are OFF.

D07-4

Elapsed time in h

The time that the pump currently driven by the inverter has stayed ON continuously is displayed.
This is cleared when the pump operation changes over.

D08-0

Analog input random scale display/AI1

D08-1

Analog input random scale display/AI2

D08-2

Analog input random scale display/AI3

The result of the AI1, 2, 3 setting multiplied by the coefficient set in C14-5, 6, 7 is displayed.
If the value exceeds the range of -99999 to 99999, "OVER." will be displayed.

D10-0

Built-in PLC display 1

D10-1

Built-in PLC display 2

D10-2

Built-in PLC display 3

D10-3

Built-in PLC display 4

The details of address 36 to 39 of the built-in PLC memory are displayed.

D11-0

Torque setting input monitor in %

The currently selected torque setting of the current control input points is selected.
This is displayed as a percentage in respect to the motor's rated torque.

D11-1

Analog torque setting monitor in %

The setting value input from the analog torque setting is displayed.
If the sequence input ACR is ON and the torque setting input point selection C02-2 is set to 1, the torque command value will be displayed here.
This is displayed as a percentage in respect to the motor's rated torque.

D11-2

Serial communication torque setting monitor in %

The setting value input from the serial communication torque setting is displayed.
If the sequence input ACR is ON and the torque setting input point selection C02-2 is set to 2, the torque command value will be displayed here.
This is displayed as a percentage in respect to the motor's rated torque.

D11-3

Operation panel torque setting monitor in %

The torque setting value (B13-0) input from the operation panel is displayed.
If the sequence input ACR is ON and the torque setting input point selection C02-2 is set to 3, the torque command value will be displayed here.
This is displayed as a percentage in respect to the motor's rated torque.

D11-4

ASR output monitor in %

The ASR output is displayed.
The polarity is positive during forward run drive, negative during forward run regeneration, negative during reverse run drive, and positive during reverse run regeneration.
This is displayed as a percentage in respect to the motor's rated torque.

D11-5

Torque setting monitor (after torque limiter) in %

The final torque command value after limiting with the torque limiter is displayed.
The polarity is positive during forward run drive, negative during forward run regeneration, negative during reverse run drive, and positive during reverse run regeneration.
This is displayed as a percentage in respect to the motor's rated torque.

D12-0

Slip monitor in %

The IM slip frequency is displayed as a percentage in respect to the base frequency.

D13-0

STP run monitor / STP step No. monitor

The step No. for STP operation is displayed.
oFF displays during stoppage.

D13-1

STP run monitor / STP remaining pattern time monitor in min

Displays the time remaining until the end of the current pattern.

D13-2

STP run monitor / STP No. monitor

The currently selected STP No. is displayed.

D13-3

STP run monitor / STP average spindle frequency monitor in Hz

Displays the average frequency for each spindle.

D13-4

STP run monitor / STP hank count monitor

Displays the current Hank count. The display is limited at a maximum of 6553.5.
This is cleared to zero when the power is turned OFF.

D13-5

STP run monitor / STP total patter operating time monitor in min

Displays the operation time until now. The display is limited at a maximum of 65535.
This is cleared to zero when the power is turned OFF.

D14-0

Automatic torque bias setting in %

Displays the currently set torque bias value [B16-0 to B] at the analog/digital auto torque bias setting.

D15-0

Z-phase electric angle (PM motor drive) in °

The Z-phase electric angle is displayed.
Use this to adjust the Z-phase when using magnetic pole position estimation.

D16-0

Magnetic pole position estimation: Judgment standard 1 (PM motor drive)

D16-1

Magnetic pole position estimation: Judgment standard 2 (PM motor drive)

D16-2

Magnetic pole position estimation: Judgment standard 3 (PM motor drive)

D16-3

Magnetic pole position estimation: Judgment standard 4 (PM motor drive)

These parameters are used to adjust the magnetic pole position estimation function.
Refer to section 3-4-4 for details.

D20-0

Fault history monitor

The fault history reference mode is entered by pressing the LCL/SET key.
The details are shown below.

Fault history No.	Displayed details	Explanation
E * 0	Details of primary fault	The error code for the primary fault cause is displayed.
E * 1	Details of secondary fault	The error code for the fault occurring secondarily is displayed.
E * 2	Output frequency at fault occurrence	Displayed with 0.01Hz unit.
E * 3	Output current value at fault occurrence	Displayed with 0.1A unit.
E * 4	DC voltage value at fault occurrence	Displayed with 1V unit.
E * 5	Hardware detection fault at fault occurrence	Display item is same as D05-1.
E * 6	Cumulative power ON time at fault occurrence	Displayed with 1 hour unit.
E * 7	Cumulative operation time at fault occurrence	Displayed with 1 hour unit.

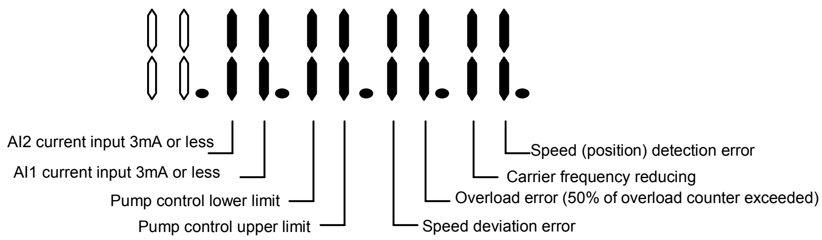
(Note) A number between 0 and 3 is substituted for * in the table to indicate faults up to three prior faults. * = 0 indicates the latest fault.
Refer to section 4-2-8 LCD Panel and section 4-3-7 LED Panel for details on operations in this mode.

D20-1 Minor failure past record indication

Press the key to enter the minor fault history reference mode.
The details are shown below.

Fault history No.	Displayed details	Explanation
M * 0	Current minor fault	The newly detected minor fault is displayed as shown below.
M * 1	All minor faults	All minor faults at M*0 occurrence are displayed as shown below.
M * 2	Output frequency at fault occurrence	Displayed with 0.01Hz unit.
M * 3	Output current value at fault occurrence	Displayed with 0.1A unit.
M * 4	DC voltage value at fault occurrence	Displayed with 1V unit.
M * 5	Hardware detection fault at fault occurrence	Display item is same as D05-0.
M * 6	Cumulative power ON time at fault occurrence	Displayed with 1 hour unit.
M * 7	Cumulative operation time at fault occurrence	Displayed with 1 hour unit.

(Note) A number between 0 and 3 is substituted for * in the table to indicate faults up to three prior faults. * = 0 indicates the latest fault.



Monitor fault (D05-0)

D20-2 Parameter A, B and C modification list entry

Press to enter the mode for referring to and changing parameters which differ from the default values.

D21-0 Cumulative conductivity time

The inverter power ON time after product shipment is counted and shown with a 1-hour unit.

D21-1 Cumulative run time

The inverter operation time after product shipment is counted and shown with a 1-hour unit.

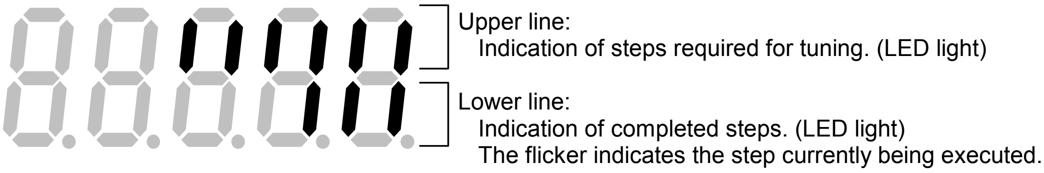
D21-2 CPU version
D21-3 ROM version

Display for maker control.

D22-0

Automatic tuning progression display

The progress of automatic tuning is displayed as shown below.



D30-0

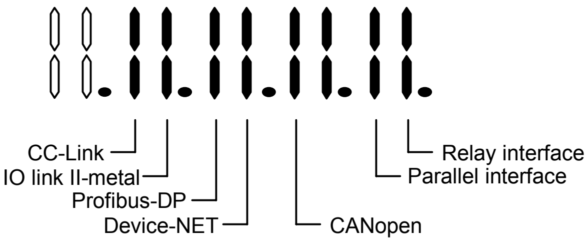
Inverter type

The inverter capacity type is displayed.

D30-1

Option PCB

The mounted optional PCB is displayed.
Each segment of the LED corresponds to the optional PCB as shown below.



Option P.C.B. monitor (D30-1)

6-6-2 Explanation of Block-A parameter functions

A00-0	**Local frequency setting**
A00-2	**Local speed setting**

This is the frequency (V/f control mode) and speed (other control modes) set with the operation panel.

(Note 1) The operation panel speed change operation is set to "change at real time" (C11-2=1) as the factory setting, so the frequency and speed will change in real time when the ▲ ▼ keys (LED panel) are pressed or knob (LCD panel) are turned even without pressing the LCL/SET key. If the LCL/SET key is pressed, the setting value at that point will be saved.

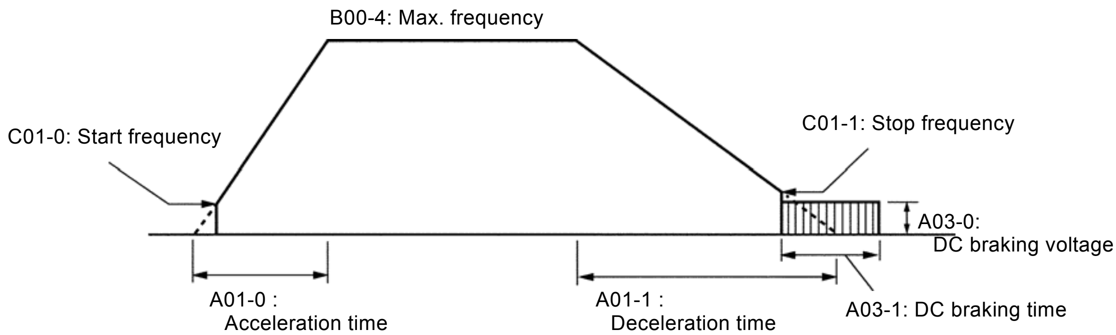
(Note 2) This frequency and speed setting is validated when the speed setting input point is set in the panel. Refer to section 5-9-1 for details on the speed setting input point.

A00-1	**Jogging frequency**
A00-3	**Jogging speed**

This is the frequency (V/f control mode) and speed (other control modes) for carrying out jogging with the sequence command F.JOG and R.JOG.

A01-0, 1	**Acceleration/deceleration time - 1**
A03-0~2	**DC brake setting**
C01-0, 1	**Start/stop frequency**

- **For V/f control mode (C30-0 $\boxed{\text{f0}}$=1)**



A01-1 sets the acceleration time from stop to the maximum frequency, and A01-1 sets the deceleration time from the maximum frequency to stopping. This is the acceleration/deceleration ramp time which is valid when the sequence command CSEL is OFF (factory setting). If the time is too short, the operation could trip with an overcurrent or overvoltage, so set an appropriate value which matches the motor and load inertia.

(Note) The acceleration/deceleration time for jogging (F.JOG, R.JOG) is set with the B10-2, 3 setting value.

For A03-0: DC brake voltage setting, set the output voltage for DC braking at stopping as a percentage in respect to the motor rated voltage.
This parameter is automatically adjusted with automatic tuning (mode 1 and mode 2).
When adjusting this parameter, monitor the output current and adjust in increments of 1% or less. An excessive setting could result in tripping.

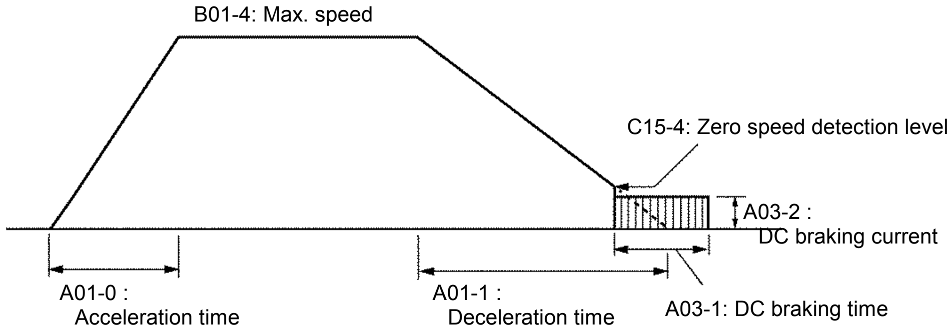
* Refer to section 3-4-1 for details on automatic tuning in the V/f control mode.

For A03-1: DC brake time setting, set the time for carrying out DC braking during operation stop. If this parameter is 0.0, the motor will stop without DC braking.

C01-0: Start frequency setting is the output frequency setting value for starting operation. The output frequency is increased from this setting value.

When the output frequency reaches the C01-1:
Stop frequency setting when decelerating after the operation stop command (RUN=OFF), DC braking operation will start. When not using DC braking (A03-1 = 0.0), the motor will stop when this setting value is reached.

- **For IM sensor-less vector control, IM vector control with sensor, PM motor control mode (C03-0 $\boxed{f0}$ = 2 to 4)**



A01-1 sets the acceleration time from stop to the maximum frequency, and A01-1 sets the deceleration time from the maximum frequency to stopping. This is the acceleration/deceleration ramp time which is valid when the sequence command CSEL is OFF (factory setting). If the time is too short, the operation could trip with an overcurrent or overvoltage, so set an appropriate value which matches the motor and load inertia.

(Note) The acceleration/deceleration time for jogging (F.JOG, R.JOG) is set with the B10-2, 3 setting value.

For A03-1: DC brake time setting, set the time for carrying out DC braking during operation stop.
When the speed reaches the zero speed detection level (C15-4) setting value or less while decelerating after the operation stop command (RUN=OFF), DC braking will start. If this parameter is set to 0.0, the motor will stop without DC braking.

For A03-2: DC brake current setting sets the current value output during DC braking.

A02-0

Manual torque boost selection

This parameter selects the manual torque boost function.
This function is valid when A02-0 is set to 2, and is invalid when A02-0 is set to 1.
When manual torque boost is selected, the manual torque boost setting will be valid regardless of the automatic torque boost selection state.

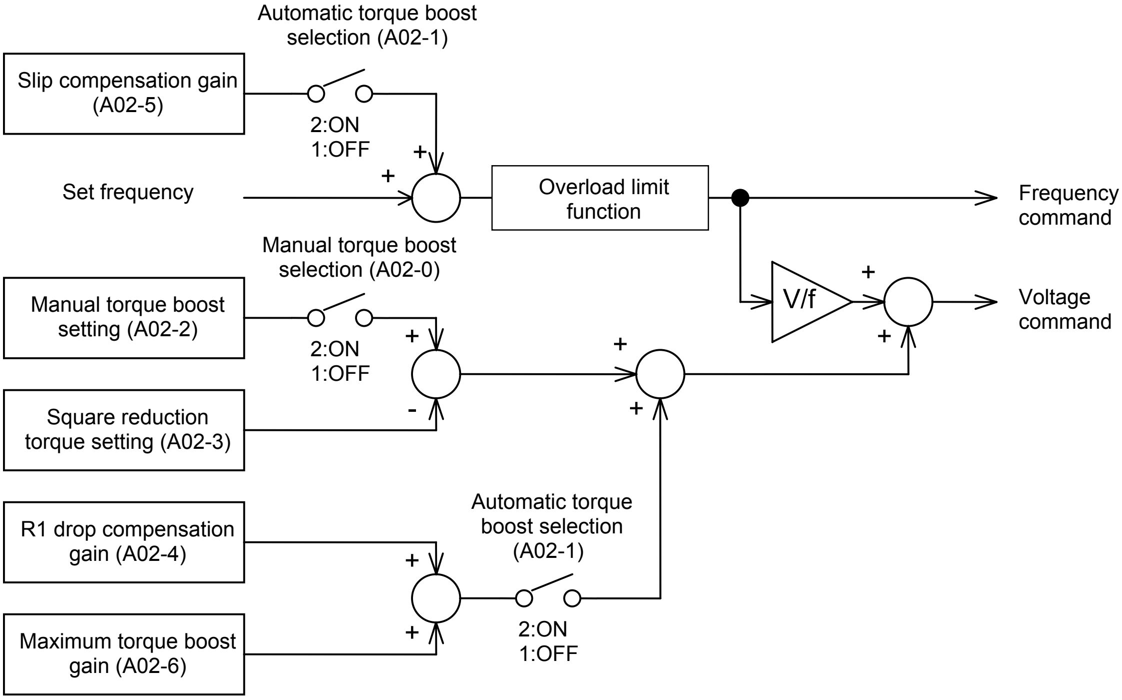
A02-1

Automatic torque boost selection

This parameter selects the automatic torque boost function.
This function is valid when A02-1 is set to 2, and is invalid when A02-1 is set to 1.
When automatic torque boost is selected, the R1 drop compensation, slip compensation and maximum torque boost functions will be valid.

(Note 1) To validate only the slip compensation function when manual torque boost is selected, set all settings other than the slip compensation function (A02-5) to 0 (set A02-3, 4, 6 to 0).

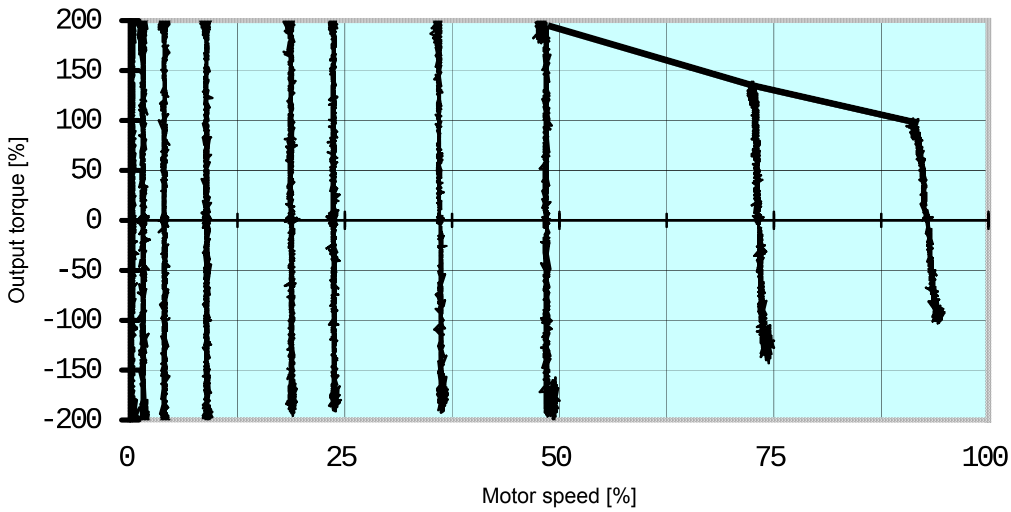
(Note 2) The square reduction torque setting is always valid regardless of the torque boost selection state.
To invalidate the square reduction torque setting, set (A02-3) to 0.



Torque boost selection block diagram

- **Automatic torque boost function**

The automatic torque boost function carries out voltage boosting and slip compensation using the current detection value. This allows the torque to be improved when starting and at low speed regions. By carrying out automatic turning, the gain, etc., for the automatic torque boost function will be automatically adjusted. Using this function, a 200% starting torque can be output with a standard 3-phase induction motor during a 150% output current. Even with a motor that cannot output a 200% torque due to design, the maximum torque of the motor can be output. The main characteristics with the standard 3-phase induction motor are shown below.



Output torque - motor speed characteristics

<Standard 3-phase induction motor 30kW-4P>

CAUTION

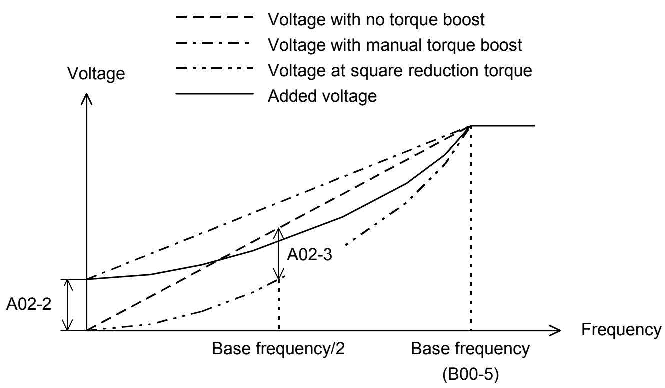
- When using only manual torque boost, carry out automatic tuning (B19-0 = 1).
- When using automatic torque boost, always carry out automatic tuning (B19-0 = 2).
- The maximum torque is not output instantly. It takes approx. 3 seconds for the maximum torque to be reached.
- If the motor vibrates abnormally, etc., the automatic torque boost cannot be used.
- If the parameters automatically set with automatic tuning are set manually, the motor rotation could become unstable.
- With a motor with which the base frequency greatly exceeds the commercial frequency, or with a motor with a large constant output range, the rotation may be unstable and a sufficient torque may not be output.
- When outputting the maximum torque continuously, consider the heat generated on the motor side, etc.

A02-2 Manual torque boost setting [%]

This parameter is automatically adjusted with automatic tuning (mode 1 and mode 2).
When adjusting this parameter, set the boost voltage at 0Hz as a percentage in respect to the rated output voltage (B00-3).
* Refer to section 3-4-1 for details on automatic tuning in the V/f control mode.

A02-3 Square reduction torque setting [%]

Set the reduction torque at the base frequency (B00-5)/2 as a percentage in respect to the rated output voltage (B00-3).



When both A02-2 and A02-3 are set, the voltage will be added as shown below.

A02-4 R1 drop compensation gain [%]

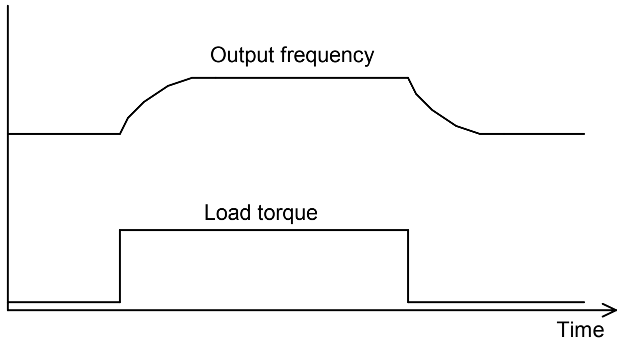
Set how much to compensate the voltage drop caused by R1 (B02-0, 1: Motor primary resistance value) measured with automatic tuning. Normally set 100% of the default value.

(Note 1) If the setting is too high, the rotation may become unstable, and the inverter may trip.
(Note 2) Sufficient torque might not be attained if the setting is too small.

A02-5

Slip compensation gain [%]

This parameter is automatically adjusted with automatic tuning (mode 2).
When setting manually, set the slip frequency for the motor rated load as a percentage in respect to the base frequency (B00-5).
The output frequency changes according to the motor rated torque as shown below.



(Note 1) The output frequency will respond with a time constant of approx. 500ms in respect to the changes in the load torque.
(Note 2) When set too high, the motor rotation could become instable.

* Refer to section 3-4-1 for details on automatic tuning in the V/f control mode.

A02-6

Maximum torque boost gain [%]

This parameter is automatically adjusted with automatic tuning (mode 2).
Set the optimum boost amount for the maximum torque output as a percentage in respect to the rated output voltage (B00-3).
Normally, a value of 10 to 30% is set by automatic tuning.

(Note 1) When adjusted manually, the sufficient torque may not be attained.
(Note 2) If set too high, the rotation may become unstable and may trip.
* Refer to section 3-4-1 for details on automatic tuning in the V/f control mode.

A04-0~7

Custom parameters

C10-0~7: The parameters selected with the custom parameter selection can be displayed.
This parameter does not appear if this setting is not made.
Refer to section 4-4 for details.

A05-0~2

Parameter B and C indicatory skip

The parameter display is skipped for each function in the extended functions, software option functions and hardware option functions.
Unnecessary displays can be reduced with this parameter, allowing operation to be simplified.
All displays are set to skip as the default.

A10-0

ASR response

This is used to calculate the gain of the ASR.
The computing expression for the ASR gain and integral time constant is shown below.
ASR gain :

$$Kp = \text{ASR response (A10-0) [rad/s]} \times \frac{\text{Machine time constant Tm (A10-1 or B15-0) [ms]}}{1000}$$

ASR integral time constant :

$$Ti = \frac{4}{\text{ASR response (A10-0) [rad/s]}} \times \frac{\text{Compensation coefficient (A10-2)[\%]}}{100}$$

A10-1

Machine constant – 1

This is used to calculate the ASR gain.
This parameter is valid when the sequence command MCH is OFF. The B15-0 setting value is valid when MCH is ON.

$$Tm\ [msec] = \frac{10.97 \times J\ [kgm^2] \times (Nbase[min^{-1}])^2}{Power\ [W]}$$

Tm : Machine time constant
J : Total inertia (=1/4 X GD^2[$kgfm^2$])
Nbase : Base speed
Power : Motor rated output

A10-2

ASR integral time constant compensation coefficient

Set the compensation coefficient for the ASR integral time constant calculated with ASR response (A10-0). Refer to the computing expression for the ASR integral time constant and set.

A10-3
A10-4
A10-5
A11-2
A11-3

ASR drive torque limiter
ASR regenerative torque limiter
ASR emergency stop regenerative torque limiter
ACR drive torque limiter
ACR regenerative torque limiter

Set the limit value for each torque limiter in ASR control.
If the sequence command ACR is OFF, the A10-3 and A10-4 setting values are the torque limit value, and if ACR is ON, the A11-2 and A11-3 setting values are the torque limit value.
If the emergency stop method is set to deceleration stop (C00-4=3) and the sequence command EMS turns ON, the A10-5 setting value will be the torque limit value.
The acceleration/deceleration time may be longer than the set value depending on these torque limiter values.

(Note) The inverter output current is limited by the overcurrent limit value (B18-0), so the torque may not be generated until the value set in this parameter is reached.

A11-0

ACR response (vector control with IM sensor, sensor-less vector control)

Set the response angle frequency for the current regulator (ACR) with a [rad/s] unit.
If this setting value is too high or too low, the current will become unstable, and the overcurrent protection will function.

A11-1

ACR time constant (vector control with IM sensor, sensor-less vector control)

Set the time constant for the current regulator (ACR).
If the time constant is too long or too short, the current will become unstable, and the overcurrent protection will function.

A20-0 ACR response (PM motor control)

Set the response angle frequency for the current regulator (ACR).
If the ACR response is too high, hunting will occur at a cycle of several ms.
If it is too low, the gain for the speed control system cannot be high.
Normally, this should be set between 500 and 1500rad/s.

A20-1 ACR time constant (PM motor control)

Set the time constant for the current regulator (ACR).
If the time constant is too long or too short, the current will become unstable, and the overcurrent protection will function.
Normally, this should be set between 5 and 20ms.

A20-2 d axis current command cushion time in ms/I1 (PM motor control)
A20-3 q axis current command cushion time in ms/I1 (PM motor control)

This is the cushion setting to prevent instability caused by overshooting, etc., when the current command changes suddenly. Set at how many ms to change the current command value equivalent to the motor rated current. Normally, a value 5ms or more is set.

6-6-3 Explanation of Block-B parameter functions

B00-0
B01-0

Rated input voltage setting

B00-0 is used to select the rated input voltage from the following table in the V/f control mode (C30-0 f0 = 1), and B01-0 is used to select the rated input voltage in all other control modes (C30-0 f0 = 2 to 4).

Small (X000K7 to X055K0, N000K7 to N045K0)

B00-0 or B00-1 Setting value	200V system	400V system
1	to 200V	to 380V
2	to 200V	381 to 400V
3	201 to 220V	401 to 415V
4	201 to 220V	416 to 440V
5	221 to 230V	441 to 460V
6	231 to 240V	461 to 480V
7	221 to 230V	381 to 400V

Large size (X075K0 or more)

B00-0 or B00-1 Setting value	200V system	400V system
1	to 200V	to 380V
2	to 200V	381 to 400V
3	201 to 220V	401 to 415V
4	201 to 220V	416 to 440V
5	221 to 230V	441 to 460V
6	231 to 240V	461 to 480V
7	221 to 230V	381 to 400V

When the B00-0 setting value is changed (when parameter change is entered and LCL SET key is pressed), the B00-3 setting value is changed to the same value.
In the same manner, if B01-0 is changed, the B01-3 setting value is changed.

B00-1

Max./base frequency simple setting

The base frequency and maximum frequency combination can be selected as shown below.
To set a combination not shown in the table, set B00-1 to 0.

Value	Ftrq [Hz]	Fmax [Hz]
0	Free setting on B00-4 and B00-5	
1	50	50
2	60	60
3	50	60
4	50	75

Value	Ftrq [Hz]	Fmax [Hz]
5	50	100
6	60	70
7	60	80
8	60	90
9	60	120

B00-2
B01-1

Motor rated output

Select the motor's rated output at the base frequency and rotation speed.

B01-2

No. of motor poles

Set the number of poles indicated on the motor nameplate.

B00-3
B01-3

Motor rated voltage

Set the rated voltage indicated on the motor nameplate.
If B00-3 is set to 39, the output voltage at the base frequency will be the input voltage.
If a value other than 39 is set, the output voltage at the base frequency will be controlled to the value set with this parameter.
If the rated input voltage setting (B00-0, B01-0) is changed, this value is also changed to the rated input voltage value. This cannot be set higher than the rated input voltage.

B00-4
B01-4
B00-5
B01-5

Max. frequency (Fmax)
Max. speed (Nmax)
Motor rated frequency (Fbase)
Base speed (Nbase)

Set the motor's base/maximum frequency and speed.

- **V/f control mode (C30-0 $\boxed{\text{f0}}$ = 1)**
  Set B00-4, B00-5. This parameter setting is valid only when B00-1 is set to 0.
  The B00-5 minimum value is B00-4/7 Hz or 1.0 Hz, whichever is larger, and the maximum value is B00-4 Hz or 440.0 Hz, whichever is smaller.
  The B00-4 minimum value is B00-5 Hz or 3.0 Hz, whichever is larger, and the maximum value is B00-5x7 Hz or 440.0 Hz, whichever is smaller.
- **IM sensor-less vector control mode (C30-0 $\boxed{\text{f0}}$ = 2)**
  Set B01-4, B01-5. The B01-5 minimum value is B01-4/2 or 150 min^{-1}, whichever is larger, and the maximum value is B01-4 or 9999 min^{-1}, whichever is smaller.
  The B01-4 minimum value is B01-5 or 150 min^{-1}, whichever is larger, and the maximum value is B01-5x2 or 9999 min^{-1}, whichever is smaller. And the maximum value is determined by the number of motor poles. The speed is limited where the synchronous frequency is 180Hz.
- **IM vector control with sensor mode (C30-0 $\boxed{\text{f0}}$ = 3)**
  Set B01-4, B01-5. The B01-5 minimum value is B01-4/4 or 150 min^{-1}, whichever is larger, and the maximum value is B01-4 or 9999 min^{-1}, whichever is smaller.
  The B01-4 minimum value is B01-5 or 150 min^{-1}, whichever is larger, and the maximum value is B01-5x4 or 9999 min^{-1}, whichever is smaller. And the maximum value is determined by the number of motor poles. The speed is limited where the synchronous frequency is 180Hz.
- **PM motor control mode (C30-0 $\boxed{\text{f0}}$ = 4)**
  Set B01-4, B01-5. The B01-5 minimum value is B01-4/1.5 or 150 min^{-1}, whichever is larger, and the maximum value is B01-4 or 9999 min^{-1}, whichever is smaller.
  The B01-4 minimum value is B01-5 or 150 min^{-1}, whichever is larger, and the maximum value is B01-5x1.5 or 9999 min^{-1}, whichever is smaller. And the maximum value is determined by the number of motor poles. The speed is limited where the synchronous frequency is 210Hz.

B00-6
B01-6

Motor rated current

Set the rated current indicated on the motor nameplate.
This is the reference for the overcurrent limit, motor overload standard and analog output, etc.

(Note) The minimum of this parameter is a value of “inverter rating current × 0.3 in a Heavy-Duty overload setting”.

B00-7
B01-7

Carrier frequency

The PWM carrier frequency and control method can be changed to change the tone of the magnetic sound generated from the motor. The relation of the setting range and control method is shown below.

1) For X000K7～X055K0, N000K7～N045K0
  1.0 to 15.0 : Mono sound method (Actual carrier frequency: 1.0 to 15.0kHz)
  15.1 to 18.0 : Soft sound method 1 (Basic carrier frequency: 2.1 to 5.0kHz)
  18.1 to 21.0 : Soft sound method 2 (Basic carrier frequency: 2.1 to 5.0kHz)

2) For X075K0 and larger
  1.0 to 8.0 : Mono sound method (Actual carrier frequency: 1.0 to 8.0kHz)
  8.1 to 11.0 : Soft sound method 1 (Basic carrier frequency: 2.1 to 5.0kHz)
  11.1 to 14.0 : Soft sound method 2 (Basic carrier frequency: 2.1 to 5.0kHz)

[Mono sound method]

This control method has a constant PWM carrier frequency. When a low carrier frequency is set, an annoying magnetic sound may be generated.

[Soft sound method]

This control method changes the PWM carrier frequency at a set cycle. As the frequency elements of the magnetic sound is dispersed, the tone is similar to a cicada. If the beat sound that is generated due to the operation frequency is annoying, there may be cases when the beat sound can be suppressed by changing between method 1 and 2.

(Note 1) When the carrier frequency automatic reduction function is used, the carrier frequency may be reduced automatically by 2.0kHz depending on the output current or inverter temperature. This function is valid only when c22-6 is set to 1. The reduction function is enabled as the factory setting. The setting value and actual carrier frequency may differ, so check the actual carrier frequency with D03-3. The reduction conditions according to each capacity are shown below.

- X000K7 to X005K5, N000K7 to N005K5
  When the power module temperature exceeds 110°C, the carrier frequency is automatically decreased by 2.0kHz.
- X007K5 to X022K0, N007K5, N011K0
  When the power module temperature exceeds 85°C, the carrier frequency is automatically decreased by 2.0kHz.
- X030K0 or more, N015K0 or more
  When the heat sink temperature exceeds 75°C and the output current is 110% or more of the inverter rating, or when the heat sink temperature exceeds 95°C, the carrier frequency is automatically decreased by 2.0kHz.
  * Check the power module and heat sink temperature with D02-4.

(Note 2) If the output voltage is low (output frequency is low), the actual carrier frequency may be lower than the set carrier frequency. Check the actual carrier frequency with D03-3.

(Note 3) There are cases when the effect of noise onto the inverter's peripheral devices can be reduced by lowering the carrier frequency.

(Note 4) If set to higher than the specified carrier frequency, the output current must be deleted. Refer to Fig. 1-2 and Fig. 1-3 in Appendix 1 for details.

B01-8

No. of encoder pulses

The number of pulses per rotation of the encoder in use is set.

B01-9

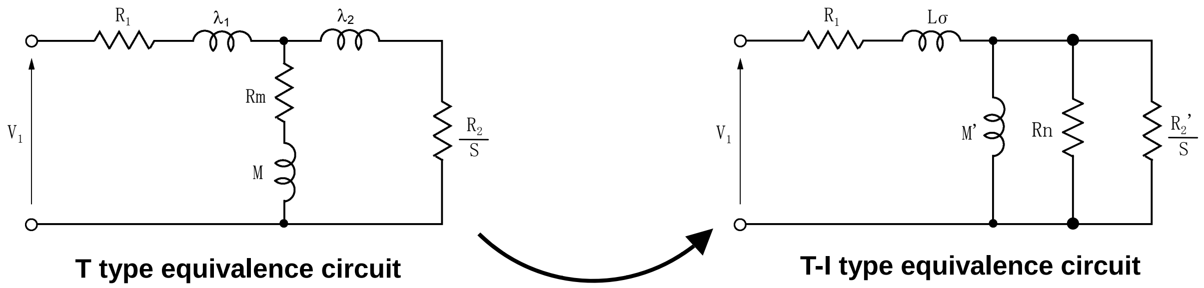
No-load output voltage

The The motor terminal voltage during no-load at the base speed is set.

B02-0~9

Motor circuit constant (IM)

The IM equivalence circuit: T type and T-I type equivalence circuit, and the T type equivalence circuit → T-I type equivalence circuit conversion expression is shown below.



T type equivalence circuit **T-I type equivalence circuit**

$$M' = M^2/(\lambda_2 + M)$$

$$L\sigma = (\lambda_1 + M) - M^2/(\lambda_2 + M)$$

$$R_2' = \left(\frac{M}{\lambda_2 + M}\right)^2 \cdot R_2$$

With the VAT300, the circuit constants for the T-I type equivalence circuit are set.
The parameters set according to the circuit constants are shown below.

Symbol	Name	Setting parameter
R1	Primary resistance	B02-0, B02-1
R2’	Secondary resistance	B02-2, B02-3
Lσ	Leakage inductance	B02-4, B02-5
M’	Excitation inductance	B02-6, B02-7
Rm	Iron loss resistance	B02-8, B02-9

Note 1) Set the circuit constant as a one-phase value converted into a 3-phase Y connection.
Note 2) If the wiring is long, add the wiring path resistance and inductance elements to the motor constants.
Note 3) Iron loss resistance uses Rm of T type equivalence circuit.

Of these parameters, B02-0 to B02-7 can be automatically adjusted with automatic tuning. Refer to Chapter 3 for details on automatic tuning.
If automatic tuning is not possible, and for the iron loss resistance: B02-8, 9, refer to the above diagram and expression, and the motor design value, and set the appropriate value.

B03-0~5

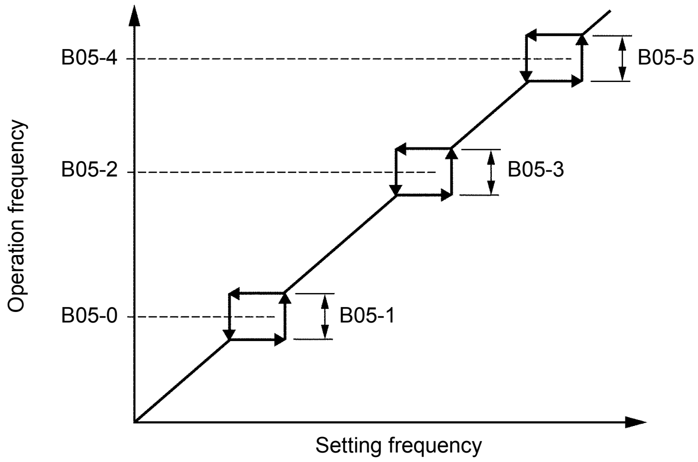
Motor circuit constant (PM)

Refer to section 6-9-3 for details on setting the PM motor circuit constants.

B05-0~5

Frequency skip

By setting this parameter, the motor's mechanical resonance point at a specific frequency can be skipped. Valid only during V/f control.
Refer to the following diagram, and set each parameter.



(Note) This function controls the frequency setting, so the above skip frequency area will be passed with a ramp function.

B06-0~E

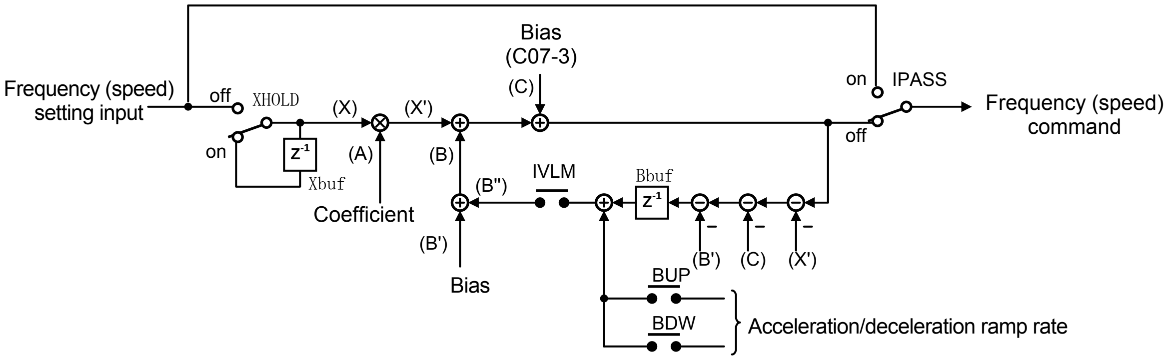
Ratio interlock setting

The ratio interlock operation executes the following expression and corresponds to each speed setting input signal.

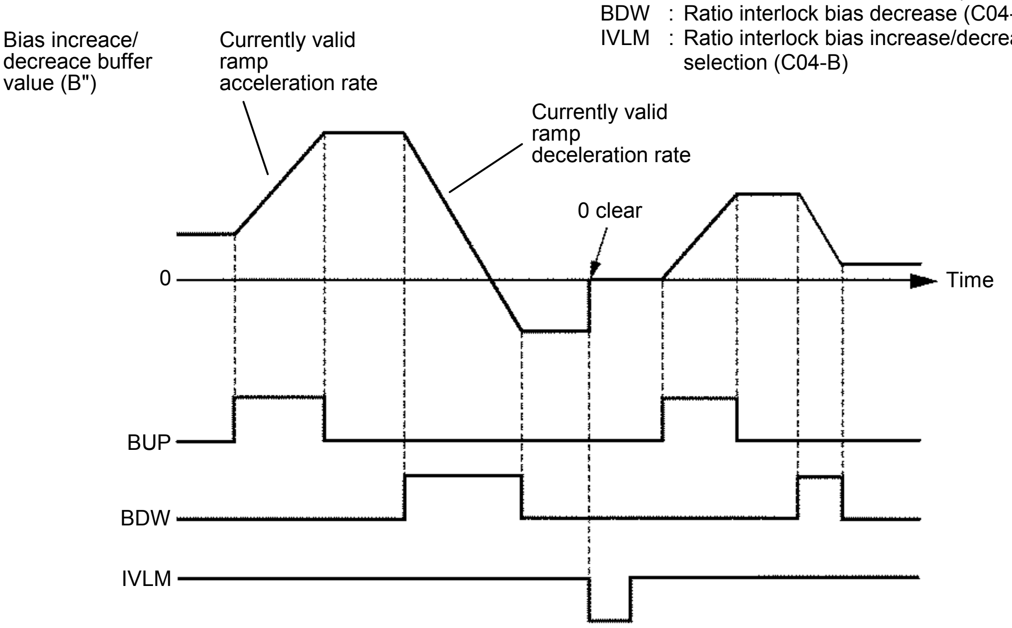
$Y = AX + B + C$

X: Frequency (speed) setting input
Y: Frequency (speed) command (operation results)

A: Coefficient
B: Bias 1
C: Bias 2



Sequence input
IPASS : Ratio interlock bypass (C03-A)
BUP : Ratio interlock bias increase (C04-9)
BDW : Ratio interlock bias decrease (C04-A)
IVLM : Ratio interlock bias increase/decrease selection (C04-B)



(Ratio interlock bias increace/decreace function)

- When IVLM turns ON, the bias value increaced or decreaced by BUP/BDW is added to the ratio interlock bias value (B') as the above (B").
- If BUP turns ON while IVLM is ON, the bias increace/decreace buffer value (B") increaces with the currently valid acceleration ramp rate. When BDW turns ON, the bias increace/decreace buffer value (B") decreaces with the currently valid deceleration ramp rate.
- If both BUP and BDW turn OFF while IVLM is ON, the current bias increace/decreace buffer value (B") is held.
- If IVLM turns OFF, the current bias increace/decreace buffer value (B") is cleared to zero, and the BUP and BDW operations are ignored.
- Even when the operation command (RUN) turns OFF, the current bias increace/decreace buffer value (B") is cleared to zero. The BUP and BDW operations are also ignored in this case.

The frequency and speed setting to which the ratio interlock setting is applied, and the set parameters are shown below.

	Coefficient (A)	Bias (B)	
		During V/f control	During IM vector, PM motor control
Analog speed setting 1	B06-0	B06-1	B06-2
Analog speed setting 2	B06-3	B06-4	B06-5
Analog speed setting 3	B06-6	B06-7	B06-8
Serial speed setting	B06-9	B06-A	B06-B
Pulse train input speed setting	B06-C	B06-D	B06-E

Refer to section 5-9-1 for details on selecting the frequency and speed setting value.

(Note 1) If the frequency and speed command value is incremented or decremented by this function, the upper limit and lower limit are the maximum frequency and speed.

(Note 2) When using the auxiliary drive function, this function is automatically passed, and cannot be used.

B07-0~3

Upper/Lower limit setting

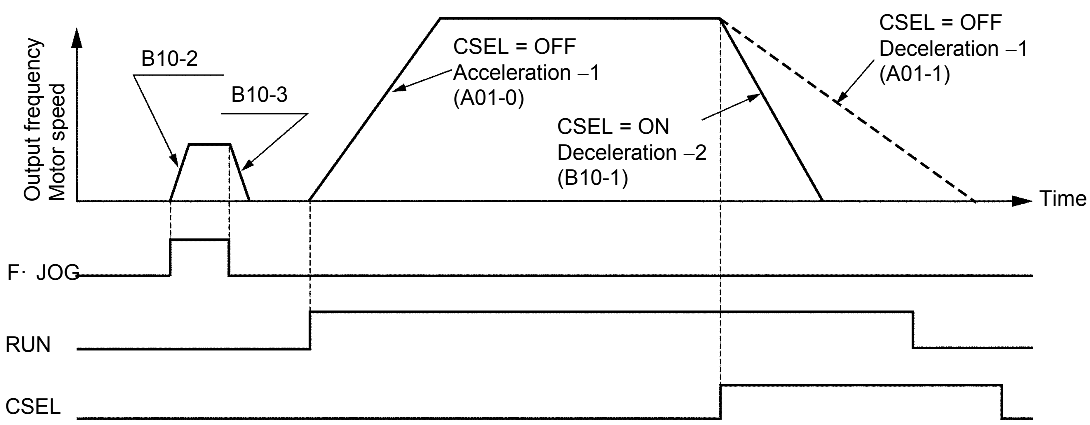
Set the upper limit and lower limit for the frequency and speed command value. This setting is valid for all speed command values including analog inputs and serial inputs.

	During V/f control	During IM vector control, PM motor control
Upper limit setting value	B07-0	B07-2
Lower limit setting value	B07-1	B07-3

B10-0
B10-1
B10-2
B10-3

Acceleration ramp time –2
Deceleration ramp time –2
Acceleration ramp time for jogging
Deceleration ramp time for jogging

The acceleration/deceleration ramp time can be switched by turning the sequence command CSEL ON. Set the CSEL command input terminal with C03-9.
The ramp time for jogging (F•JOG, R•JOG) can be set independently with B10-2 and -3.

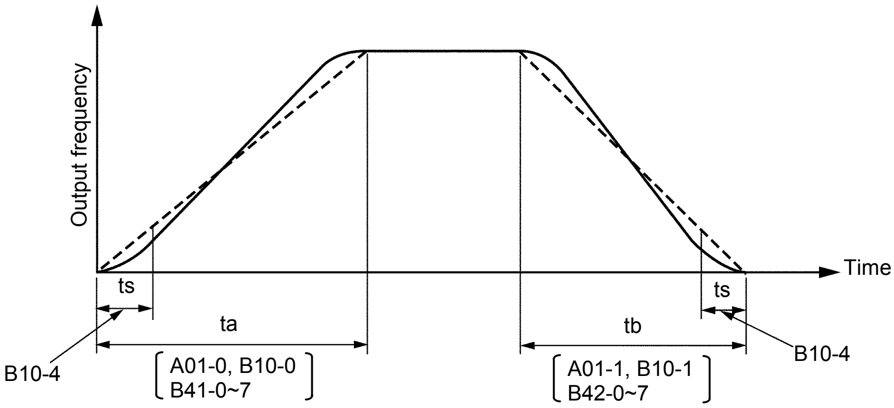


(Note) The ramp time is set as the acceleration/deceleration time for 0Hz to maximum frequency (B00-4) and 0 to maximum speed (B01-4) in either case.

B10-4

S-shape characteristics

Acceleration/deceleration with the S-shape pattern is possible by setting this parameter.



This parameter indicates the time of the section shown with ts above.
The total acceleration/deceleration times ta and tb will not change.
When this parameter is set, all acceleration and deceleration will be as shown above.

(Note 1) Set so that the relation of the B10-4 setting and acceleration/deceleration time is as shown below.

B10-4 Setting value (ts) × 2 ≤ acceleration/deceleration time (ta, tb)

(Note 2) When the rotation direction command has been changed, or when the polarity of the frequency or speed command value has ben reversed, the zero frequency and zero speed are passed through. The acceleration/deceleration time will be smaller than the set acceleration/deceleration ramp time (ta, tb).

B10-5

Time unit multiplier

The acceleration/deceleration time setting unit can be changed when an acceleration/ deceleration time in a wider range is to be set.

B10-5 = 1 (standard): × 1
2 : × 0.1
3 : × 10

This parameter will affect all acceleration/deceleration time parameters.

B10-6

S-shape ramp pass function

This function is valid only when the external brake function selection is turned ON with B46-0. If this parameter is validated when using the S-shape ramp function (when B10-4 setting value is not 0), the S-shape will be passed during specific operations, and instead the normal ramp operation will take place.

B10-6 = 1 This function is disabled.
= 2 The S-shape is passed when the program frequency setting function is used and the sequence command S0 to SE is selecting the B11-0 frequency.
= 3 S-shape is used only during the acceleration at the start of operation or acceleration/deceleration when the frequency is changed. The S-shape is passed in all other cases.

B11-0~7
B11-8

Program frequency (speed) setting
Selection mode setting

This is the frequency • speed setting for when running program run (multi-step frequency • speed setting) by turning the sequence command PROG ON. Set B11-0 to B11-7 using the maximum frequency (B00-4) or maximum speed (B01-4) as 100%. When using the auxiliary drive function, set each maximum frequency setting value as 100%.
The set frequency and speed are selected according to the following table by sequence command S0, S1, S2, S3, SE and B11-8.

(1) For binary mode (B11-8 = 1)

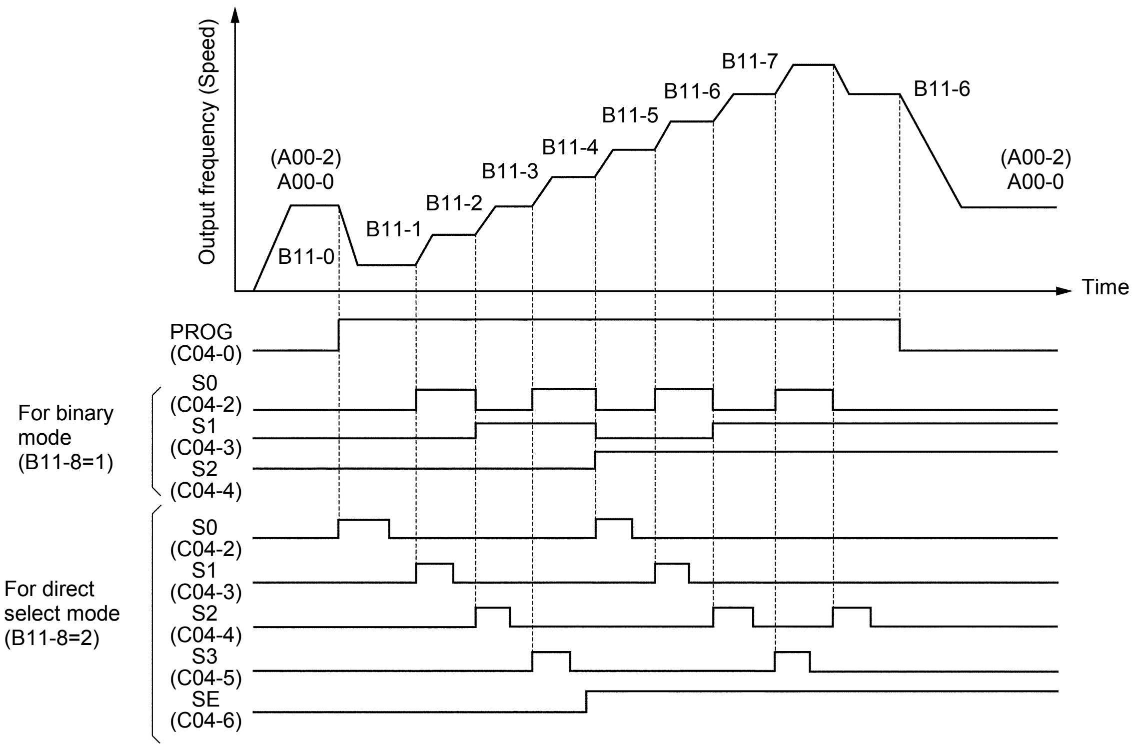
Sequence command					Selected frequency
SE	S3	S2	S1	S0	
*	*	OFF	OFF	OFF	B11-0
		OFF	OFF	ON	B11-1
		OFF	ON	OFF	B11-2
		OFF	ON	ON	B11-3
		ON	OFF	OFF	B11-4
		ON	OFF	ON	B11-5
		ON	ON	OFF	B11-6
		ON	ON	ON	B11-7

* : SE and S3 are not used.

(2) For direct select mode (B11-8 = 2)

Sequence command					Selected frequency
SE	S3	S2	S1	S0	
OFF	OFF	OFF	OFF	OFF	Previous values
OFF	OFF	OFF	OFF	ON	B11-0
OFF	OFF	OFF	ON	OFF	B11-1
OFF	OFF	ON	OFF	OFF	B11-2
OFF	ON	OFF	OFF	OFF	B11-3
ON	OFF	OFF	OFF	OFF	Previous values
ON	OFF	OFF	OFF	ON	B11-4
ON	OFF	OFF	ON	OFF	B11-5
ON	OFF	ON	OFF	OFF	B11-6
ON	ON	OFF	OFF	OFF	B11-7

When S0 to S3 are all OFF, or when two or more are set between S0 and S3, the previous values will be held.
If there are no previous values because the power has been turned ON, etc., "0" will be set.



Program run example (When RUN is ON)

Set the sequence command PROG input terminal with C04-0. Set the S0, S1, S2, S3 and SE input terminals with C04-2 to C04-6.
The B11-8 setting is also reflected on the program ramp function (B41-x, B42-x) program mode settings.

B12-0~6

Automatic braking on power failure function

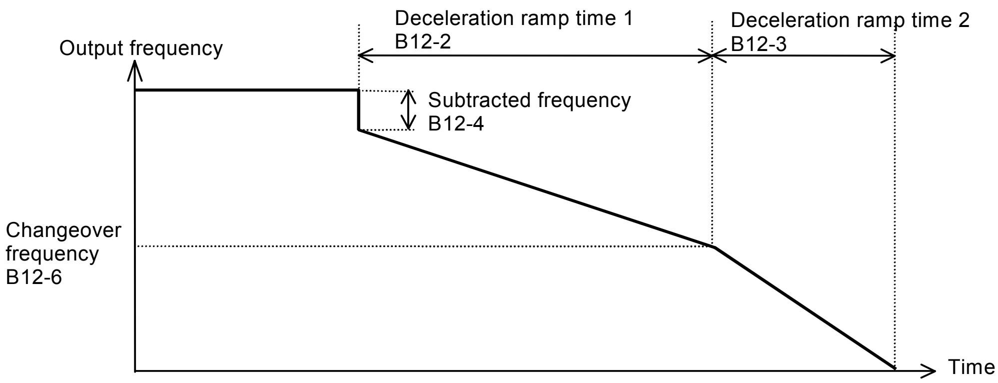
The decelerate at power failure function is valid when B12-0 is set to 2. This setting is also applied when using the auxiliary drive function. This function executes the following operations automatically.

(1) Operation starts when a power failure occurs, and the DC voltage drops below the value (%) set with B12-1.
(2) The value set with B12-4 is subtracted from the output voltage when the power failure occurs, and is set as the output frequency.
(3) Note that if the output frequency at the power failure is less than the value set with B12-5, the value will not be subtracted.
(4) The motor decelerates to the frequency set with B12-6 at the time set with B12-2.
(5) The motor decelerates and stops at the time set with B12-3.
(6) Note that if the frequency set with B12-6 is less than the stop frequency, the motor will decelerate and stop at the time set with B12-2.

(Note 1) Once this operation is started, the VAT300 will continue this even after the power is restored.

(Note 2) To restart after stopping, cancel the RUN command once.

(Note 3) The "FWD", "REV" and "STOP" commands during this operation are invalid from both the operation panel and sequence terminal block. "EMS" is valid.



When using the auxiliary drive function, substitute the parameter No. as shown below, and set according to each auxiliary drive mode.

(Note 4) When using this function and the auxiliary drive function during vector control or PM motor control, set B12-0 and B12-1.

Main drive	Auxiliary drive 0	Auxiliary drive 1	Auxiliary drive 2	Auxiliary drive 3
B12-2	B23-0	B27-0	B2B-0	B2F-0
B12-3	B23-1	B27-1	B2B-1	B2F-1
B12-4	B23-2	B27-2	B2B-2	B2F-2
B12-5	B23-3	B27-3	B2B-3	B2F-3
B12-6	B23-4	B27-4	B2B-4	B2F-4

B13-0

Torque setting

This is the torque set by the operation panel.
This setting value is used as the torque command value when C02-2 is set to 3 (default value).
Refer to section 5-9-2 for details on selecting the torque setting.

B13-1

Torque ratio 1 setting

Set the torque ratio for the panel parameter (B13-0).
Refer to section 5-9-5 for details on selecting the torque ratio 1 setting.

B13-2

Torque bias 1 setting

Set the torque bias for the panel parameter (B13-0).
Refer to section 5-9-3 for details on selecting the torque bias 1 setting.

B13-3

Torque ratio 2 setting

Refer to section 5-9-6 for details on selecting the torque ratio 2 setting.

B13-4

Double rating speed ratio setting

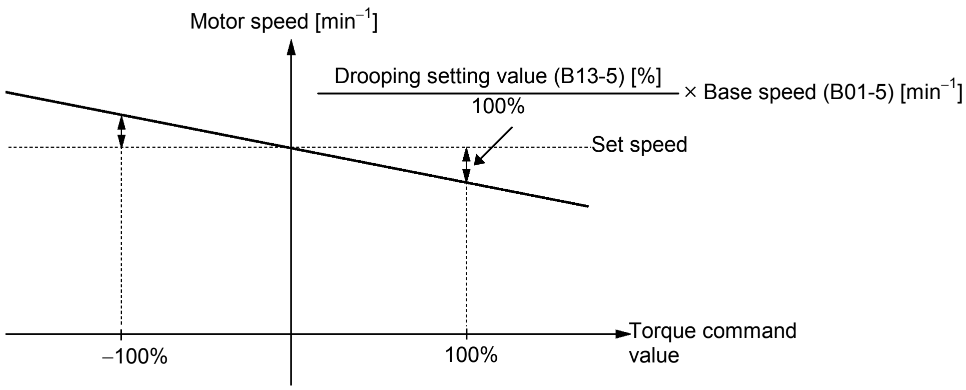
Refer to section 5-9-4 for details.

B13-5

Drooping setting

Set the drooping value within the range of the following expression. If it becomes unstable, adjust the drooping setting value or the related parameters.

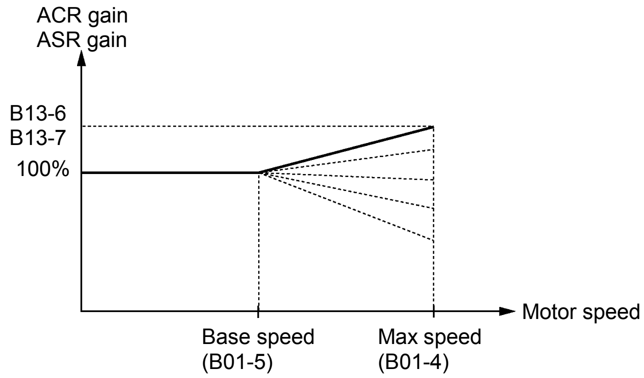
$$\frac{\text{Drooping setting value (B13-5) [\%]}}{\text{100 [\%]}} \times \text{ASR response (A10-0) [rad/s]} \times \frac{\text{Machine time constant (A10-1 or B15-0) [ms]}}{1000} < 0.5$$



B13-6
B13-7

ASR gain compensation in constant power range
ACR gain compensation in constant power range

This setting compensates the ASR and ACR gain in the constant output range (speed above base speed).
Refer to the following diagram and set the ASR gain compensation with B13-6 and the ACR gain compensation with B13-7.



B13-8, 9

Linear torque limit

Refer to section 6-9-5 for details on these parameters.

B14-0

ASR dead band setting

A dead band zone can be set for the speed control amplifier input with this parameter.
Set this dead band zone parameter as a percentage in respect to the base speed.
Refer to Fig. 5-3 for details on the speed control.

B15-0

Machine time constant 2

This is used to calculate the ASR amplifier gain. When the relay input machine time constant changeover is ON (MCH is ON), the machine time constant set with this parameter is valid.

$$Tm\,[\mathrm{msec}] = 10.97 \times \frac{J\,[\mathrm{kg{\bullet}m^2}] \times (Nbase[\mathrm{min}^{-1}])^2}{Power\,[\mathrm{W}]}$$

Tm : Machine time constant
J : Total inertia (=1/4 × GD^2[$kgfm^2$])
Nbase : Base speed
Power : Motor rated output

When MCH is OFF, the A10-1 (machine time constant -1) setting value is valid.

B16-0~B

Automatic torque bias control

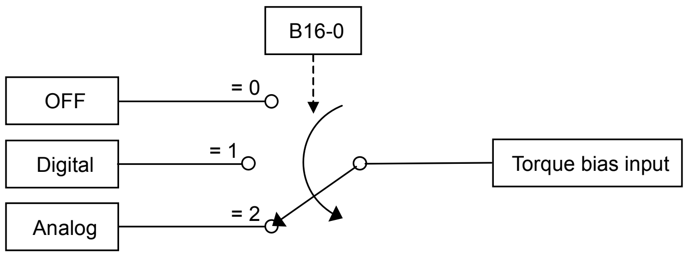
This function is used to apply torque bias from the start of operation based on the load feedback prior to operation. This prevents rotation due caused by the load that results when releasing the elevator brake. Either analog or digital load feedback can be selected.
Auto torque bias control calculates the torque bias value from the load feedback (digital/analog). The torque bias is then fixed when performing operation. The torque bias does not vary during operation, and is revised gradually during stoppage.

(1) Setting the automatic torque bias function

When the load feedback is obtained as a digital value using a limit switch, etc., use the digital torque bias.

When the load feedback is obtained as an analog value, use the analog torque bias.

Refer to the following diagram and set B16-0.

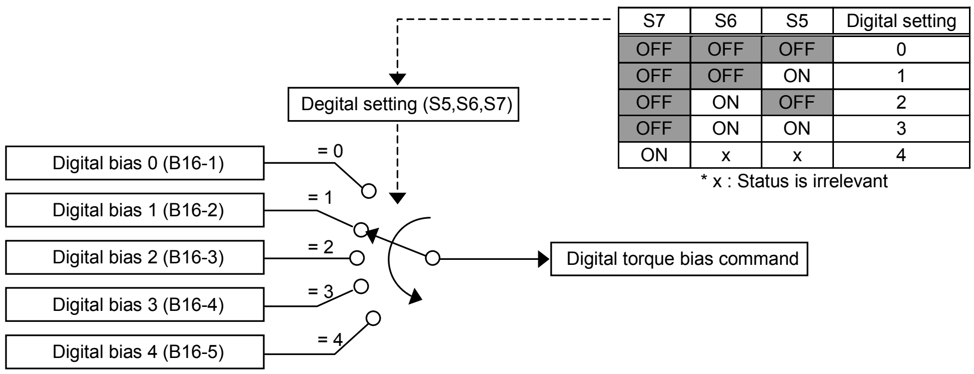


(2) Selecting the torque bias direction

The torque bias direction can be selected with B16-6. If the motor forward runs when the elevator rises, set B16-6 to 1. If the motor reverse runs, set B16-6 to 2.

(3) Setting the parameters for digital torque bias selection

The torque bias value is set with the digital input using sequence inputs S5 to S7 as shown below.



S7	S6	S5	Digital setting
OFF	OFF	OFF	0
OFF	OFF	ON	1
OFF	ON	OFF	2
OFF	ON	ON	3
ON	x	x	4

* x : Status is irrelevant

Set the torque bias value with B16-1 to B16-5.

Set the input terminals for the S5 to S7 signals with C05-0 to 2 as shown below.

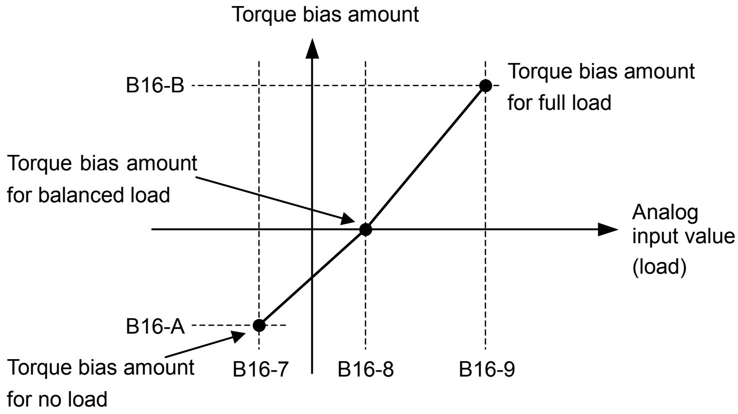
Sequence input	Setting parameter
S5	C05-0
S6	C05-1
S7	C05-2

(4) Setting the parameters for analog torque bias selection

When the load feedback is obtained as an analog value, use the analog torque bias.

Set the analog torque bias input terminals (AI1, AI2, AI3) with C07-A. Set the voltage and current input, full scale and filter time constants for the input terminals used with C12-0 to C12-A.

Refer to the following diagram and set B16-7 to B. B16-7 to 9 (analog bias voltage) is set as a ratio in respect to the full scale of the input terminal being used.

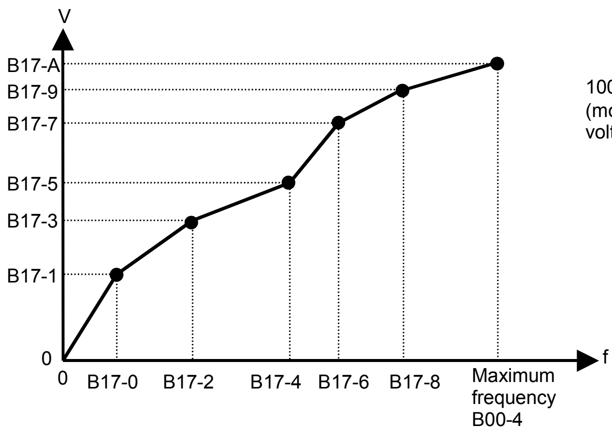


Example of analog input and torque bias amount relation

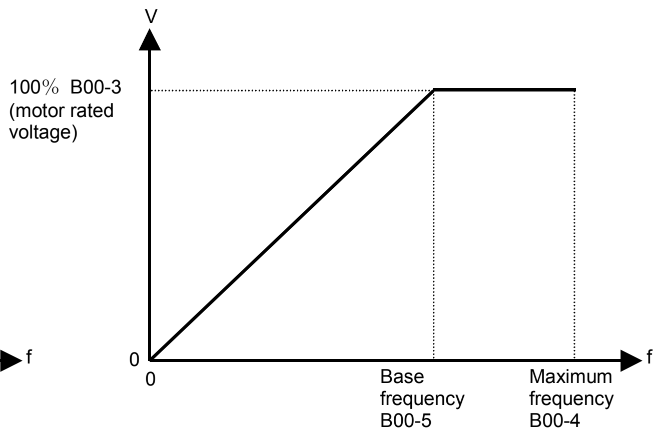
B17-0~B

V/f middle point

When using a motor with special V/f characteristics, the special V/f characteristics can be set as shown below by using this function.



V/f characteristics when using middle V/f function



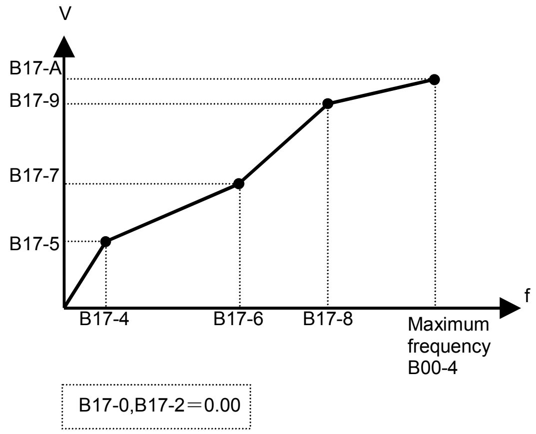
Normal V/f characteristics

Set B17-B to 2 to use this function.

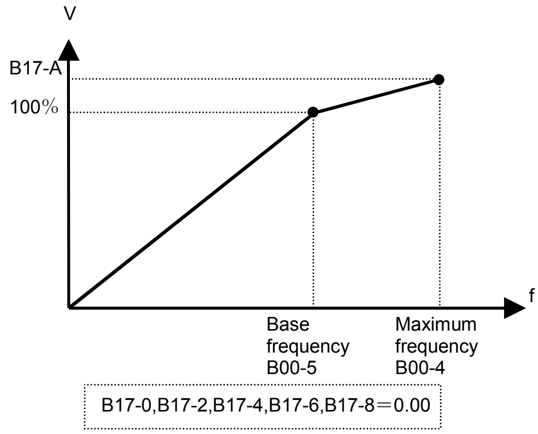
Refer to the upper left diagram, and set the frequency and voltage in B17-0 to A. Set the voltage as a percentage in respect to the motor rated voltage (B00-3).

If this function is OFF (normal V/f control), the base frequency will be 100% voltage (motor rated voltage), and the maximum frequency will be 100% voltage as shown in the upper right diagram.

When using four or less V/f changeover points, set the setting value to "0.00" in the order of B17-0 → B17-2 → B17-4 → B17-6.
If all of the frequency settings (B17-0, 2, 4, 6, 8) are set to "0.00", the V/f characteristics will be the 100% voltage (motor rated voltage) at the base frequency, and the B17-A setting voltage at the maximum frequency.
A setting example is shown below.



When using 3 V/f changeover points



When not setting a V/f changeover point

The range for each frequency setting value is limited so that the relation B17-0 ≤ B17-2 ≤ B17-4 ≤ B17-6 ≤ B17-8 ≤ B00-4 is established.

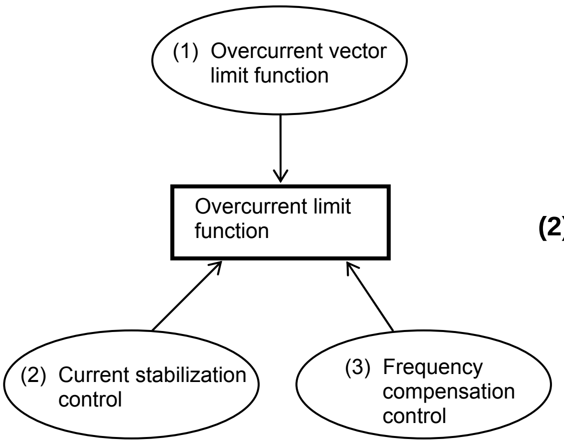
(Note) The V/f middle point function cannot be used with the auxiliary drive function.

B18-0	**Over current limit**
B18-3	**Over current limit function gain**
B18-4	**Current stabilization gain**
B18-5	**Over current stall prevention gain**
B18-6	**Over current stall prevention time constant**
B18-7	**Drive current limit level 2**
B18-8	**Drive current limit level 3**

The over current limit is a function that lowers the output frequency and suppresses the current so that the motor current does not exceed this parameter setting value during starting or constant running. The setting uses the motor rated current (B00-6) as 100%.

(Note) Set a value larger than the motor no-load current.

The overcurrent limit function is configured of the following three control blocks.



(1) Overcurrent vector limit function

This uses the overcurrent as a vector, and generates a suppressing voltage vector instantly to suppress the current. The response is adjusted with the over current limit gain (B18-3).
Normally, set the default value (0.25).
If the setting value is increased, the response will become faster, but the operation may become unstable.

(2) Current stabilization control

This suppresses the sudden changes in the current phase during overcurrent suppression by controlling the output frequency. The response is adjusted with the over current stabilization gain (B18-4).
Normally, set the default value (0.25).
If the setting value is increased, the torque vibration will be reduced, but the operation may become unstable.

(3) Frequency compensation control

This feeds back the voltage suppressed with the overcurrent vector limit function to the frequency command and prevents stall. The response is adjusted with the over current stall prevention gain (B18-5) and over current stall prevention time constant (B18-6).
Normally, set the default value (B18-5 = 1.00, B18-6 = 100).
If the gain setting value (B18-5) is increased or the time constant value (B18-6) is decreased, the response will become faster, but the operation may become unstable.

(Note) The overcurrent limit function is valid at all times regardless of whether automatic tuning has been executed.

B18-1

Regenerative current limit

The regenerative torque to deceleration running is limited. Set to 10% when not using the DB option. When using the DB option, calculate the value with the following formula and set.

$$\text{B18-1 setting value} = \left[\left(\frac{V2}{\text{DBR resistance value}} \right) / \text{Motor capacity [kW]} \right] \times 100\ [\%]$$

where V2=148.2 for the 200V system and V2=593 for the 400V system.

B18-2

Torque stabilization gain

This function suppresses the hunting phenomenon that causes the current to abnormally vibrate during motor operation.
Normally, the default value (1.00) is set, but increase the setting value in increments of approx. 0.05 according to the state of hunting.
Please return to regulated value (1.00) of a set value once, and reduce it by carving about 0.05 when the hunting phenomenon is not controlled even in case of maximum value (4.00) .
Note that the hunting phenomenon occurs easily in the following cases.

- During a light load or no load
- When the system inertia is low
- When the motor's secondary time constant is high (high-efficiency motor)
- When carrier frequency is high

(Note) The hunting phenomenon at a frequency exceeding 66Hz cannot be suppressed.

B19-0

Automatic tuning function

Refer to Chapter 3 for details on automatic tuning

B19-1
B19-2

Initial proportion compensation gain (Automatic tuning function)
Initial time constant compensation gain (Automatic tuning function)

When the motor with special circuit parameters is applied, the initial condition of automatic tuning is set. Change these value if auto tuning is completed incorrectly and try to auto tuning again. Set these values to increase or decrease with 50% step.

B20-0 ~ B2F-4

Various settings for auxiliary drive 0 to 3

Refer to section 6-10 for details on the auxiliary drive function.

B30-0
B30-1

Load torque observer gain
Model machine time constant

B30-0 sets the observer gain for the load torque observer.
To increase the responsiveness of the external disturbance response characteristics, set a large gain.
Note that if the gain is set too high, the output torque could hunt.
When set to zero, the load torque observer will not function.
Set the model machine time constant used with the B30-1 load torque observer.
Refer to section 6-8-7 for details on the load torque observer function.

B30-2

ASR proportional item change rate limit

If the speed setting value or motor speed change suddenly, this will prevent the ASR's P item from suddenly changing.

B30-3

Speed setting LPF time constant

Set the low path filter time constant for the speed setting value.
Overshooting can be suppressed by setting this to the filter time constant equivalent to the speed response.

B30-4

Speed detection LPF time constant

The speed detection noise is cut at the set time constant.

B30-5

Speed detection LPF time constant for ASR

Set the low path filter time constant used for the speed detection value input into the speed regulator.

B30-6

Speed detection LPF time constant for compensation

Set the low path filter time constant used for the speed detection value for constant output range compensation or iron loss compensation, etc.

B30-7

Torque current command setting LPF time constant

Set the low path filter time constant used for the torque current command.

B30-8

LPF time constant for drooping

Set the low path filter time constant used for drooping value input into the speed regulator.

B31-0

Flux observer gain

This is the feedback gain for the flux observer.
If hunting occurs at the estimated speed in the high-speed operation range, adjust within the range of 1.2 to 0.9.

B31-1

Speed estimated proportional gain

This is the proportional gain for the adaptive speed estimation mechanism. To increase the speed estimation response, set a large value. Note that if the value is too high, the speed estimation value will hunt.

B31-2

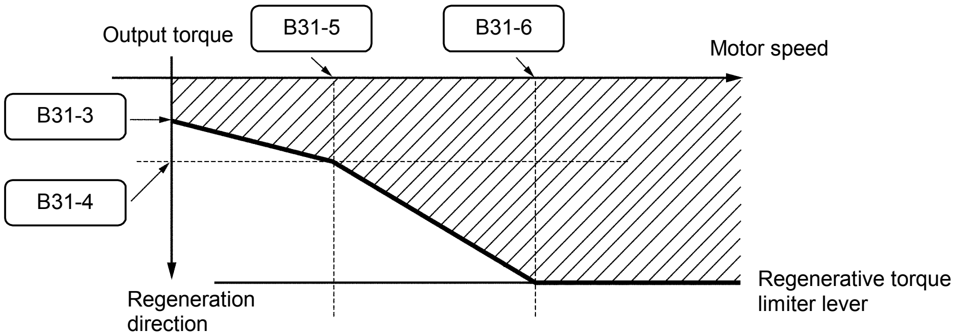
Speed estimated integral gain

This is the integral gain for the adaptive speed estimation mechanism. To increase the speed estimation response, set a large value. Note that if the value is too high, the speed estimation value will hunt.

B31-3~4
B31-5~6

Regenerative compensation torque limiter 1, 2
Regenerative compensation low-speed area setting 1, 2

The regenerative torque limiter can be changed in the low-speed area.
The shaded section shows the operation range. If operation is unstable within the shaded line range, set the parameter so that the unstable point is not within the shaded line area.



B32-0

High-speed flux control gain
(IM sensor-less vector control, IM vector control with sensor)

= 1: Disable = 2 to 50: Enable
This is the control gain used for high-speed control of the secondary flux when starting operation.
Use this to control the secondary flux at a high speed at the start of operation or during operation in a constant output range.
High speed control is possible by increasing the gain, but if increased too high, the magnetizing current may hunt.

B32-1

Temperature compensation selection
(IM sensor-less vector control, IM vector control with sensor)

= 1: Disable = 2: Enable
If torque accuracy is required when vector control with sensor is selected (C30-0 f0 = 3, 4), or if speed accuracy is required when sensor-less vector control is selected (C30-0 f0 = 2, 5), the parameter fluctuation of the primary resistance value and secondary resistance value caused by a rise in temperature can be compensated.

B32-2

Voltage saturation compensation selection
(IM sensor-less vector control, IM vector control with sensor)

= 1: Disable = 2: Enable
If the output voltage in control is larger than the voltage that can be output by the inverter, select this control to limit the exciting current to prevent the current or torque from hunting.
Select this when raising the output voltage to near the input voltage, or when the input voltage changes.
Note that if voltage saturation occurs, some torque ripple will occur. In this case, lower the B01-9 no-load voltage setting to avoid voltage saturation.

B32-3

Iron loss compensation selection (IM sensor-less vector control, IM vector control with sensor)

= 1: Disable = 2: Enable
This compensates the torque error caused by iron loss. The iron loss resistance value (B02-8, 9) must be set.

B32-4

ACR voltage model FF selection (IM sensor-less vector control, IM vector control with sensor, PM motor control)

= 1: Disable = 2: Enable
The voltage fluctuation caused by the leakage inductance is feed forward controlled.
The current regulator (ACR) response speed will be increased. Select this if the current hunts in the high-speed operation range during sensor-less control.
Use this function if the current hunts at a high-speed operation range during the IM sensor-less vector control mode.
When using this function with the PM motor control mode, set B32-4 to 2 and B32-5.

B32-5

ACR model voltage FF compensation (PM motor control)

dq axis current non-interference voltage
Set this when the ASR proportional gain is high.
Set the value between approx. 50.0 and 80.0%.
This function is invalid when 0% is set.

B32-6

ACR proportional section dead time compensating factor (PM motor control)

Set a value of approx. 50 to 80% if current vibration at a 3ms cycle occurs at an output frequency of 120Hz or more.

B33-0~7

M fluctuation compensation table reference speed

This is the reference speed for changing the compensation amount according to the operation speed.
If all of B34 is set to the default value (100.0), these will be automatically set when adjusted with automatic tuning mode 4 (B19-0=4).

B34-0~7

M fluctuation compensation

This compensates the exciting inductance fluctuation according to the B33 table reference speed.
Set the compensation table so that the output voltage is constant during no-load operation through the entire operation range.

* This is adjusted with the automatic tuning mode 4 (B19-0 = 4).
Refer to Chapter 3 for details on automatic tuning.

B35-0~4
B36-0~6
B38-0~6

Voltage saturation prevention control constant (PM motor control)
Field weakening electric current table (PM motor control)
Torque to Iq conversion adjustment coefficient table (PM motor control)

Refer to section 6-9 for details on these parameters.

B39-0~3

Magnetic pole position estimation (PM motor control)

Refer to section 3-4-4 for details on these parameters.

B40-0

Software option function

One of the following functions, program ramp, pattern operation, traverse operation, PID or multi-pump can be selected as a software option function.
Set the parameters as shown below to use these functions.

Parameter No.	Setting value	Function	Parameter related to function
B40-0	1	Function not used	-
	2	Program ramp	B41-0 to B42-7
	3	Pattern run	B50-0 to B59-3
	4	Traverse run	B45-0 to 6
	5	PID control	B43-0 to A
	6	Multi-pump control No main pump rotation	B43-0 to B44-6
	7	Multi-pump control (1-contact method) No main pump rotation	
	8	Multi-pump control (2-contact method) No main pump rotation	

B41-0~7 Program ramp – acceleration
B42-0~7 Program ramp – deceleration

The motor can be run with program frequency (speed) setting 0 to 7 using the sequence commands PROG and S0, S1, S2, S3, SE and selection mode setting (B11-8). The program ramp time can also be switched at this time and the motor run.
When the sequence command PROG is OFF, only the RAMP time is changed by S0, S1, S2, S3 and SE. The acceleration/deceleration ramp time selected with S0, S1, S2, S3 or SE is as shown below.
This function operates even when using the auxiliary drive function.

(1) For binary mode (B11-8 = 1)

Sequence command					Selected frequency
SE	S3	S2	S1	S0	
*	*	OFF	OFF	OFF	B41-0 B42-0
		OFF	OFF	ON	B41-1 B42-1
		OFF	ON	OFF	B41-2 B42-2
		OFF	ON	ON	B41-3 B42-3
		ON	OFF	OFF	B41-4 B42-4
		ON	OFF	ON	B41-5 B42-5
		ON	ON	OFF	B41-6 B42-6
		ON	ON	ON	B41-7 B42-7

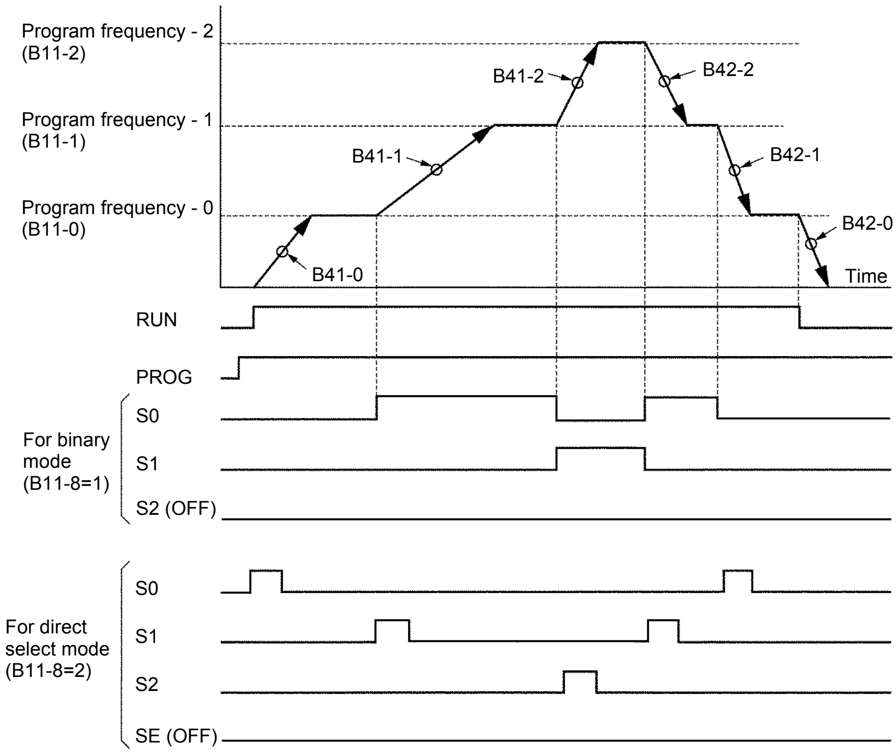
* : SE and S3 are not used.

(2) For direct select mode (B11-8 = 2)

Sequence command					Selected frequency
SE	S3	S2	S1	S0	
OFF	OFF	OFF	OFF	OFF	Previous values
OFF	OFF	OFF	OFF	ON	B41-0 B42-0
OFF	OFF	OFF	ON	OFF	B41-1 B42-1
OFF	OFF	ON	OFF	OFF	B41-2 B42-2
OFF	ON	OFF	OFF	OFF	B41-3 B42-3
ON	OFF	OFF	OFF	OFF	Previous values
ON	OFF	OFF	OFF	ON	B41-4 B42-4
ON	OFF	OFF	ON	OFF	B41-5 B42-5
ON	OFF	ON	OFF	OFF	B41-6 B42-6
ON	ON	OFF	OFF	OFF	B41-7 B42-7

When S0 to S3 are all OFF, or when two or more are set between S0 and S3, the previous values will be held.
If there are no previous values because the power has been turned ON, etc., "0" will be set.

An example of combination with the program frequency (speed) setting is shown below.



(Note) The acceleration/deceleration ramp time-2 (B10-0, 1) will be selected by turning the sequence command CSEL ON even when using the program ramp (B40-0=2).

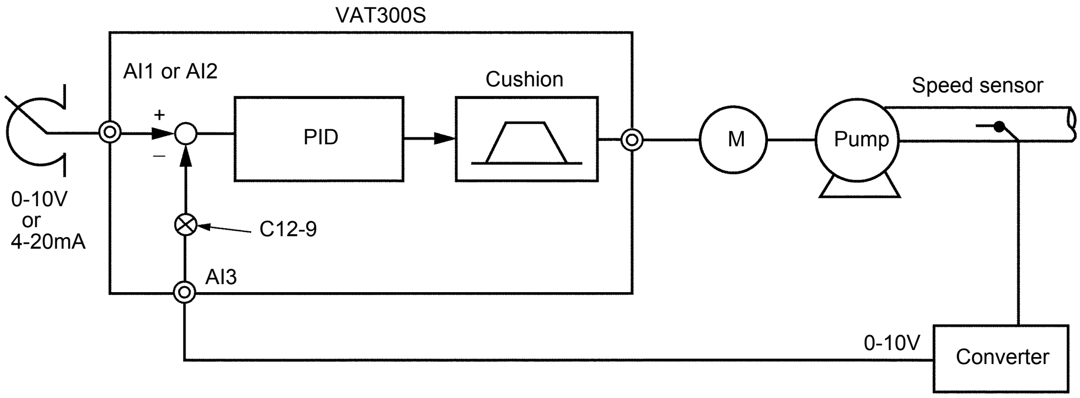
f

B43-0~A

PID control

1) Basic PID control operation

The following type of feedback loop can be configured by using the analog input (AI1, AI2, AI3) as a feedback input.



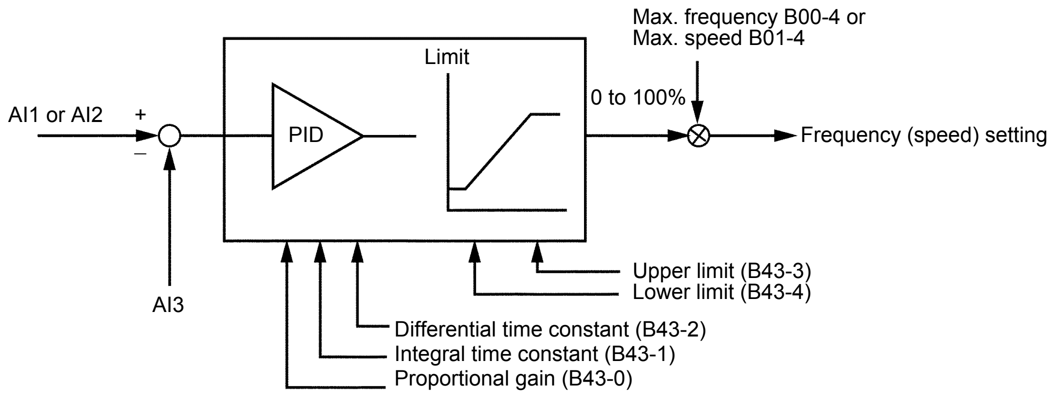
Example of PID control configuration

(Note 1) PID control functions only in the remote mode (LCL OFF). It does not function during the local mode (LCL ON). In this case, the normal operation mode is entered.

(Note 2) For PID control, either the mode which operates with the sequence command PIDEN and RUN, or the mode which operates with only PIDEN can be selected with B43-9.

(Note 3) When using the mode which operates with the sequence command PIDEN and RUN, the PID control will not start even if JOG or BRAKE are turned ON.

The PID operation block is shown below.



(1) To validate or invalidate PID control during operation, turn the sequence input command PIDEN ON or OFF. The sequence input command PIDEN is assigned to the sequence input terminals with C03-C.

(2) Refer to Fig. 5-9-1 and select the setting input. The speed setting input can be changed between the parameter setting and sequence input.
If the setting value is a Hz unit, the percentage conversion value using the maximum frequency B00-4 as 100% will be input.

(3) Set the analog input to be used as the feedback input with C07-5.
Set the level of the analog input to be used with C12-1, 2 for AI1 and C12-5, 6 for AI2.
When inputting AI3 input, set the feedback input between 0 and 10V when C12-8 is 1, and between 0 and 5V when C12-8 is 2.

(4) The internal signal (lower limit over: LLMT, upper limit over: ULMT), which indicates that the feedback value has exceeded the upper limit (B43-3) and lower limit (B43-4) can be output as a sequence. Set either 24 (LLMT) or 25 (ULMT) for C13-2 to 6.

2) Detected error determination

If PID detection is defective, an error is determined and a breakdown stop (IO-C) occurs.
An error is determined if when the command value is the same or higher than the error determination start level (B43-5), the detected value is the same or lower than the detected error level (B43-6), and the error condition continues for just the detected error determination time (B43-7), and a breakdown stop occurs.

3) Polarity invert flag

The PID input polarity can be inverted using B43-8. The normal PID input is the command value – the detected value, however, this changes to detected value – command value when the polarity is inverted.

4) PID operation selection method

The PID operation conditions can be changed using B43-9 $\boxed{f0}$.
f0=1: PID operates when PIDEN=ON and RUN=ON.
f0=2: PID operates when PIDEN only is ON.
(PID operation continues even during stop)
PID output based operation/stop can be performed using B43-9 $\boxed{f1}$.
f1=1: Normal operation (Operation stop not performed by PID)
f1=2: PID output is used to stop operation.
Stop occurs when the PID output reaches the lower limiter.
Stop occurs when the PID output reaches the lower limitter in the case when B43-9 $\boxed{f1}$ $\boxed{f0}$ = 21. Set RUN=OFF and then RUN=ON once again in order to restart operation.
Stop occurs automatically when the PID output reaches the lower limitter in the case when B43-9 $\boxed{f1}$ $\boxed{f0}$ =22. Furthermore, operation is restarted when the PID output exceeds the lower limitter + hysteresis (B43-A). Set RUN=OFF to completely stop the motor.

B44-0~6

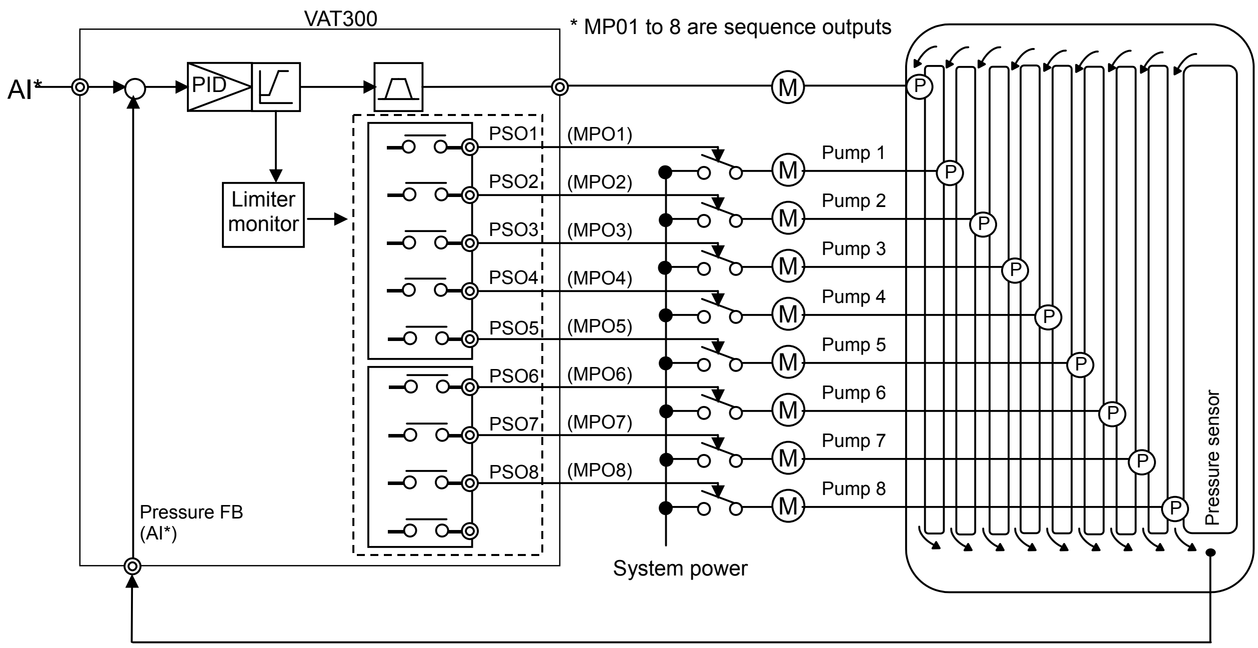
Multi-pump control

Multi-pump control refers to a function which controls the flow passage pressure at a constant level by running pumps in parallel using one VAT300 and the VAT300' internal relay output (standard 5 points, option 4 points).
The pressure step of the ON/OFF controlled pumps is interpolated by a pump that is variable-speed controlled by the VAT300, which has the PID control function. This maintains the pressure's continuation.
Three types of VAT300 multi-pump control can be selected with the B40-0 setting.

- B40-0=6: Main pump with no rotation function
- B40-0=7: Main pump with rotation function, 1-contact method
- B40-0=8: Main pump with rotation function, 2-contact method

1) B40-0=6: Main pump with no rotation function

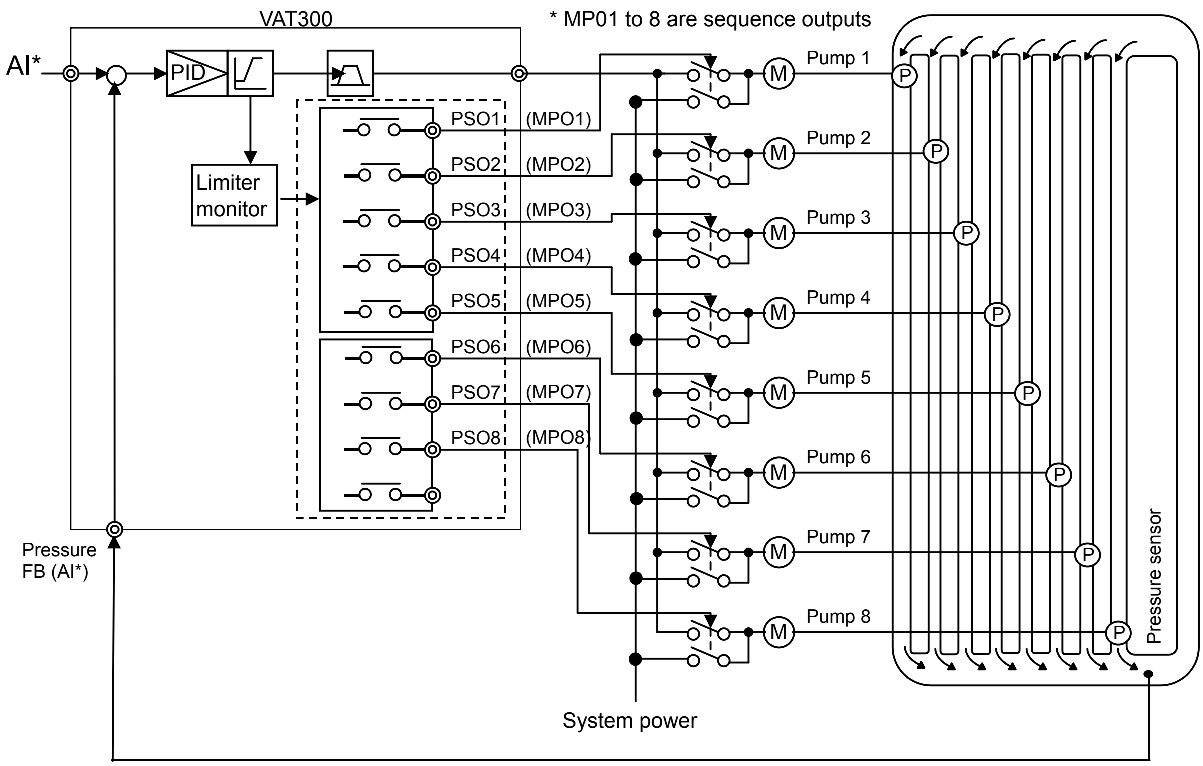
Up to 9 pumps are run in parallel using one VAT300 and the VAT300' internal relay output's 8 points. When main pump with no rotation is selected, the pump controlled with variable speed is fixed.
The system configuration is shown below.



Example of system configuration (When operating nine ON/OFF control pumps)

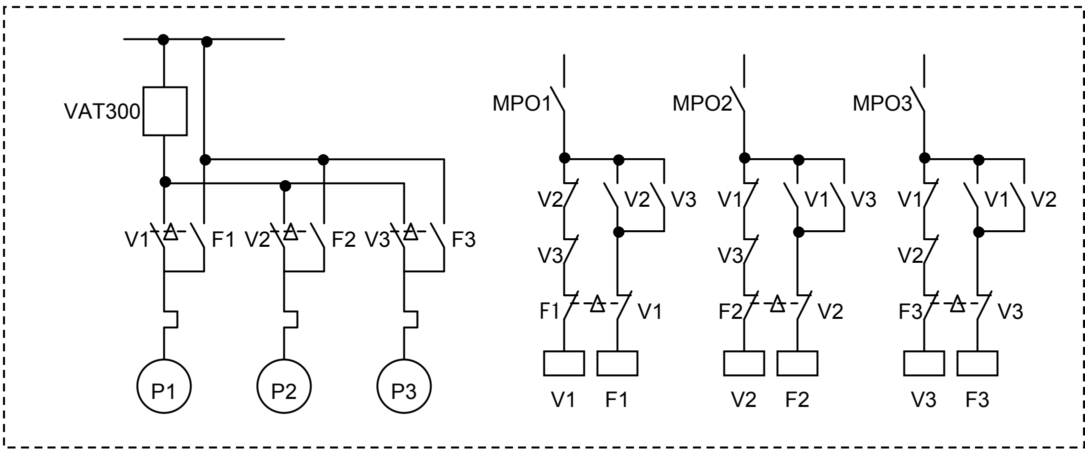
2) B40-0=7: Main pump with rotation function, 1-contact method

Up to 8 pumps are run in parallel using one VAT300 and the VAT300' internal relay output's 8 points. When main pump with rotation is selected, the pump controlled with variable speed is switched to the least operating pump only when all pumps are stopped.
The system configuration is shown below.



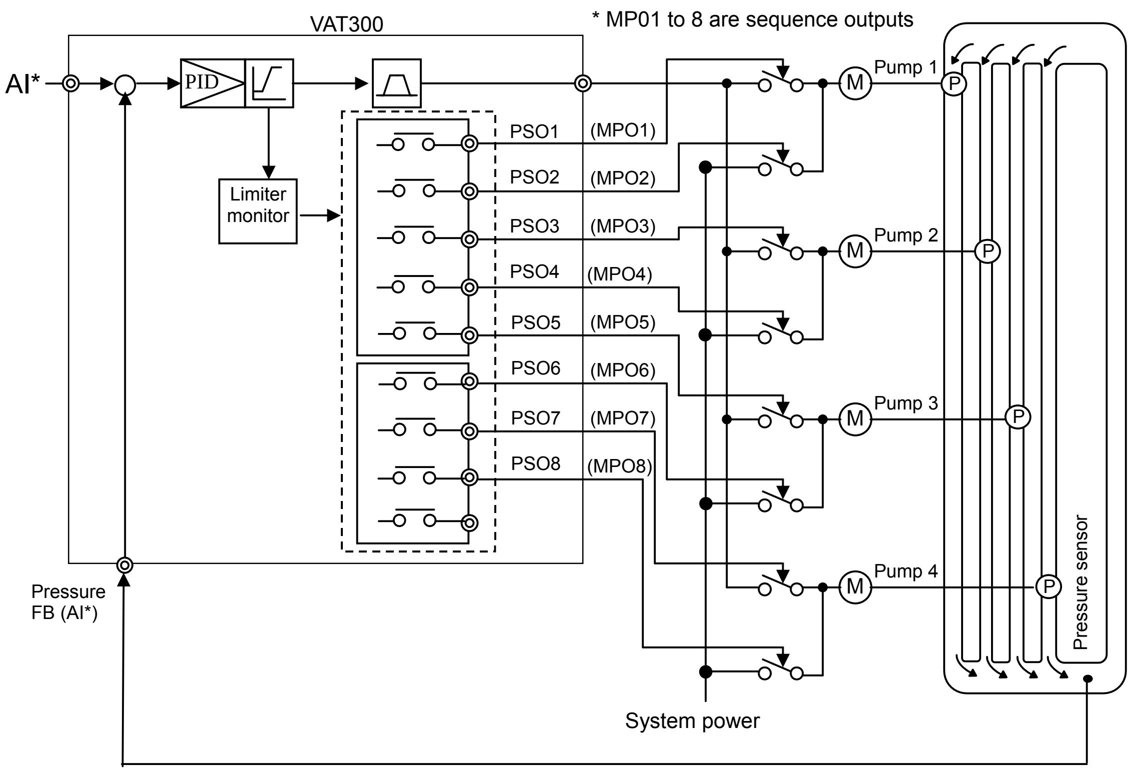
Example of system configuration (When operating eight ON/OFF control pumps)

In the above system, if the INV/commercial changeover interlock is required, an external sequence circuit must be structured. Refer to the following diagram.



3) B40-0=8: Main pump with rotation function, 2-contact method

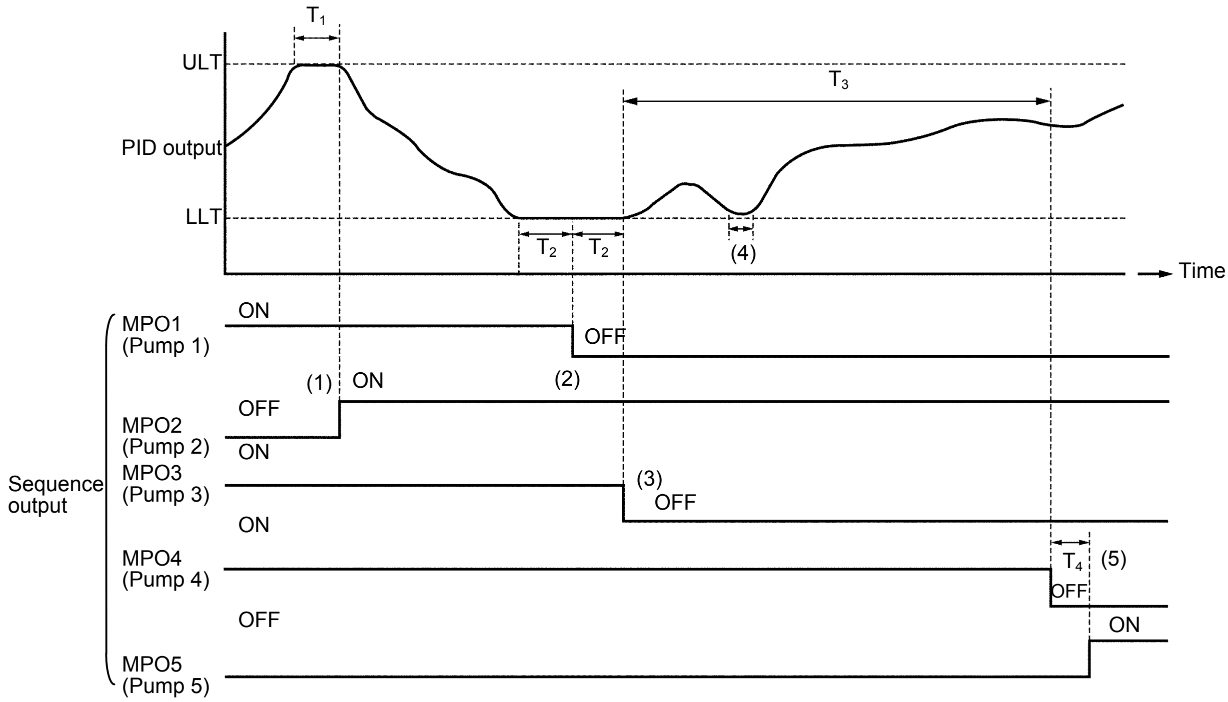
Up to 4 pumps are run in parallel using one VAT300 and the VAT300' internal relay output's 8 points. When main pump with rotation is selected, the pump controlled with variable speed is switched to the least operating pump only when all pumps are stopped.
The system configuration is shown below.



Example of system configuration (When operating four ON/OFF control pumps)

1) Multi-pump control operation

An example of actual operation for the multi-pump control is shown below.



ON/OFF control pump changeover operation (when operating five pumps)

ULT : PID output upper limit value in VAT300 (B43-3).
LLT : PID output lower limit value in VAT300 (B43-4).
T_1 : Pump start holding time (B44-1)
T_2 : Pump stop holding time (B44-2)
T_3 : Continuous operation limit time (B44-3)
T_4 : Changeover time (B44-4)

The ON/OFF control of multiple pumps is carried out so that the operation time of each pump is equal.

(1) When the PID output reaches ULT and T_1 is passed, the auxiliary pump 2 (MPO2) with the shortest operation time turns ON.

(2) When the PID output reaches ULT and T_2 is passed, the auxiliary pump 1 (MPO1) with the shortest operation time turns OFF.

(3) Following (2), when the PID output matches LLT for the time of T_2, the auxiliary pump 3 (MPO3) with the longest operation time turns OFF.

(4) When the time that the PID output and LLT match does not reach T_2, the pump OFF control will not be carried out.

- Pump changeover function using continuous operation limit (B44-3)

(5) When the time that the auxiliary pump's ON/OFF control is not carried out reaches T_3, the pump 4 (MPO4) with the longest operation time within all of the auxiliary pumps turns OFF, and the pump 5 (MPO5) with the shortest operation time will turn ON after T_4.
If B44-3 is set to 0, changeover following the continuous operation limit is prohibited. The variable speed control pump will not change even if the continuous operation limit time is exceeded.

- Main pump rotation function

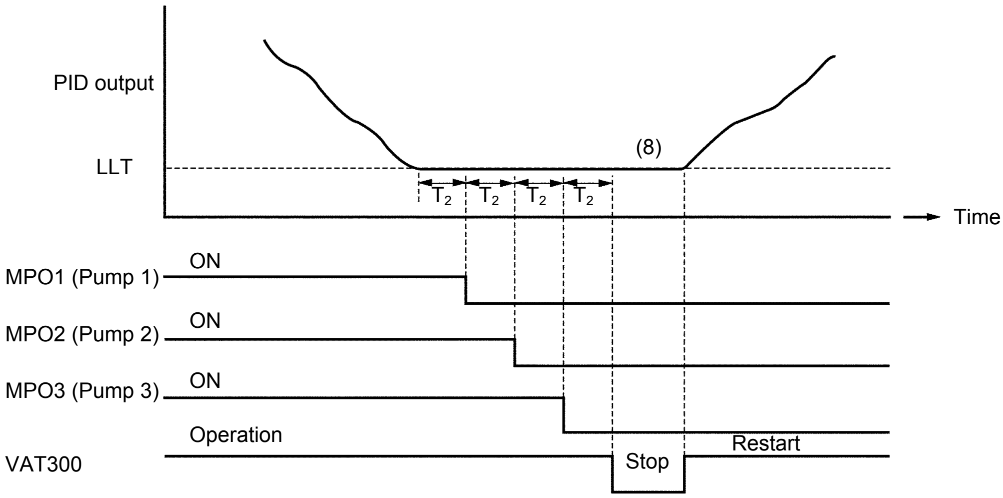
(6) When the main pump rotation function is enabled, the variable speed control pump will change to the pump with the shortest operation time of all pump only when all pumps are stopped. When the power is turned ON, pump 1 is always set as the variable speed control pump.

(7) Only when B40-0=8 (2-contact method) is selected, and the INV drive pump changes to the commercial power drive or vice versa, a dead time is provided to prevent a current back flow from the motor. Both commercial power relay contacts are OFF during the dead time zone. The dead time zone can be set with B44-5.

Other restrictions related to the pump's ON/OFF control are given below.

(8) When the PID output reaches ULT, the pumps turn ON in order of the shortest running time upwards based on the regulation in (1). However, when all pumps are ON, and the pump operation run time has been exceeded, a minor fault turns ON as an upper limit alert. The minor fault signal is displayed at D05-0 at this time.

(9) When the PID output reaches LLT, the pumps will sequentially turn OFF from the pump having the longest operation time following the restriction (2) in the previous page. However, if there are no pumps to turn OFF, the VAT300 will stop. After the pump stop hold time has passed, the minor fault turns ON as a lower limit alert, and is displayed at D05-0 as the monitor. When the PID output rises and leaves LLT, the VAT300 will resume operation.
The FWD and REV LEDs will flicker during the automatic stop operation.



VAT300 automatic operation/stop (when there are three ON/OFF control pumps)

(10) When B43-9: f0=1 (PID operation method = PIDEN + RUN), all commands to the pump are turned OFF at the same time the operation command (RUN) to the inverter is turned OFF.

(11) When B43-9: f0=2 (PID operation method = PIDEN only), only the INV drive pump stops, even when the operation command (RUN) to the inverter is turned OFF, and the control pump continues to turn ON and OFF with PID output.

(12) The following operations are performed when a fault occurs at the inverter.
When B43-9: f0=1 (PID operation method = PIDEN + RUN):
- The pump ON/OFF commands are maintained provided that the operation command (RUN) ON status is maintained.
  The control pump is not turned ON and OFF, and neither is pump switching performed as time passes.
- When the operation command (RUN) is turned OFF, all commands to the pump are turned OFF.

When B43-9: f0=2 (PID operation method = PIDEN):
- The pump ON/OFF commands are maintained regardless of whether the operation command (RUN) is turned ON or OFF, and the control pump continues to turn ON and OFF with PID output.
- All commands to the pump are turned OFF when PIDEN is turned OFF.

(13) When the inverter's power is turned OFF, the operation time history for each pump will be lost.

2) Preparation for operation

(1) Set the number of pumps to be ON/OFF controlled in parameter B44-0.
One to eight units (four units when B40-0 is 8) can be set. The functions of the output signals MP01 to MP08 for multi-pump control are as follows according to the multi-pump control method.

Pump No. (application)		Output signal
When B40-0 = 6, 7	**When B40-0 = 8**	
Pump 1	Pump 1 (INV drive)	MP01
Pump 2	Pump 1 (Commercial drive)	MP02
Pump 3	Pump 2 (INV drive)	MP03
Pump 4	Pump 2 (Commercial drive)	MP04
Pump 5	Pump 3 (INV drive)	MP05
Pump 6	Pump 3 (Commercial drive)	MP06
Pump 7	Pump 4 (INV drive)	MP07
Pump 8	Pump 4 (Commercial drive)	MP08

Outputs MP01 to MP08 can be set to a programmable relay output terminal. Using the parameters (from C13-2 to C13-6, and from C33-0 to C33-3), set the VAT300 standard relay outputs PS01 to PS03, RA-RC, FA-FC, and the relay interface option (U30V24RYO) in relay outputs from PS04 to PS07
The pumps are turned on in the order of pump No. 1 to 8.
The option (U30V24RY0) is required to use relay outputs PS04 to 7.
Refer to the Instruction Manual (ST-3477) for details on U30V24RY0.

(2) The PID control function is used with the multi-pump control.
- Refer to the explanation on B43-0 to A for details on setting the PID control related parameters (B43-0 to A), selecting the pressure command input, and selecting the feedback input.
- Multi-pump control is always carried out in the remote mode (LCL = OFF).
- The operating command is issued from the external sequence input terminal (RUN).
- Do not perform operation from R.RUN, F.JOG, R.JOG. If these sequence commands are turned ON, operation is possible as PID, however, the relay outputs for each pump all turn OFF.
- Turn the sequence input command PIDEN ON to validate PID control.

(3) Refer to the operation explanation drawing in section (1) and set the parameters B44-1 to 5.

(4) By using the setting interlock function (C20-0 to 3), the VAT300 run/stop can be controlled by the pressure command input (AI1, AI2). In this case, the operation command (RUN) is always ON. Refer to the explanation on C20-0 to 3.

B44-6

Multi-pump control: INV control method at lower limit selection

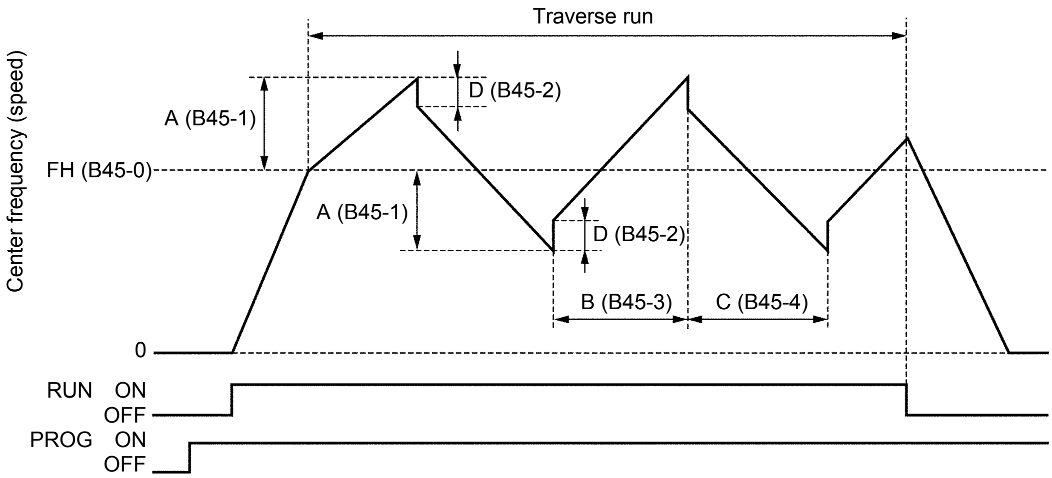
Select whether to stop the INV or continue operation when the PID output lower limit state continues.

When B44-6=2: Continue is selected, the INV will continue operation without stopping in the "VAT300 automatic operation/STOP" state shown in the previous figure.

B45-0~6

Traverse run

Traverse is operation in which the frequency fluctuates with the pattern shown below. This is effective for evenly winding up the thread on a bobbin in a weaving system.



Traverse operation

(1) Traverse run

To carry out traverse run, turn the sequence command PROG ON. (Normal operation will take place if PROG is OFF.)

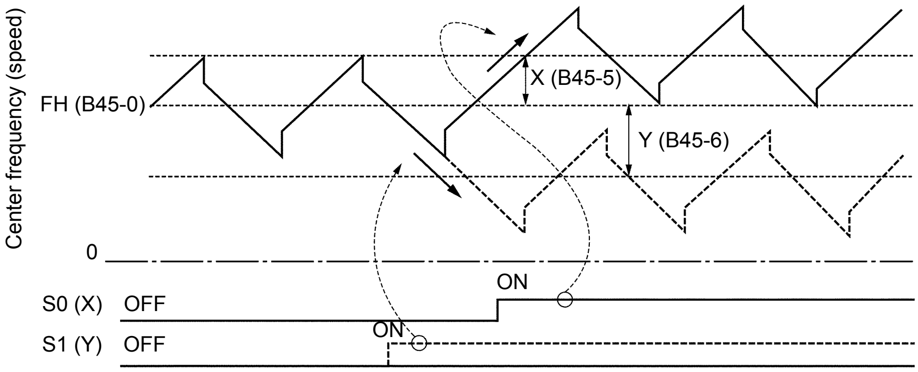
1) If the sequence command RUN or R RUN is turned ON, first, the frequency (speed) will increased as high as the center frequency (speed) in ramp mode (A01-0) at the center frequency (speed), and then traverse run will start.
2) When RUN (or R RUN) is turned OFF, the frequency (speed) will decreased to a stop in ramp mode (A01-1) .
3) During traverse operation, the conventional ramp, S-shape ramp, overcurrent limit (OCL) and overvoltage limit (OVL) will not function. However, these will function while accelerating or decelerating during start or stop.
4) The traverse center frequency (rotation speed) input point can be selected with C02-1.

C02-1 = 1,2: Analog fixed (C07-4)
= 3 : Panel fixed (B45-0)
= 4 : Sequence (S0, S1)
= 5 : Pulse train input fixed

When using traverse run, set B11-8 to 1 (selection mode setting: binary mode).
If C02-1 is set to 1 or 2, the setting from an external source selected with C07-4 will be the center frequency (speed).
When C02-1 is set to 4, and traverse run is being carried out by turning the PROG command ON, the following operations (2) and (3) will take place when the sequence command S0 and S1 signals are input.

(2) Deviated traverse X, Y operation

The deviated traverse operation shown below takes place with the sequence commands S0 (X) and S1 (Y) when carrying out traverse operation with the PROG command ON.



Deviated traverse (X, Y) operation

The center frequency (speed) rises by X (B45-5) only while S0 (X) is ON.
The center frequency (speed) lowers by Y (B45-6) only while S1 (Y) is ON.
The rising and lowering timing is the traverse rising and lowering extension operation as shown above.

(3) Changing the center frequency (speed) with settings from an external source

While the PROG command is ON and the traverse operation is taking place, when the sequence commands S0 and S1 both turn ON, the center frequency value (speed) value will be the value set from an external source selected with C07-4.
If only S0 or S1 is ON, the deviated traverse X, Y operation explained in section (2) will take place.
If both S0 and S1 are turned ON, the center frequency (speed) will be the value set from the external terminal. However, the frequency will first return to the center frequency (speed) before rising or lowering to the newly set value. After that, the same operation will take place even when the setting value is changed from an external source.

(4) Precautions for application

1) If the parameter No. B45-0 to 6 setting data is changed during traverse operation, the output frequency (speed) will return to the center frequency (speed) once. Then, traverse operation based on the newly set data will take place.
   When returning to the center frequency (speed), the output frequency (speed) will change in ramp mode (A01-0, 1).

2) The overcurrent limit (OCL) and overvoltage limit (OVL) functions will not activate during traverse operation, so carefully consider the inverter capacity, motor capacity and traverse related setting values when designing the system.

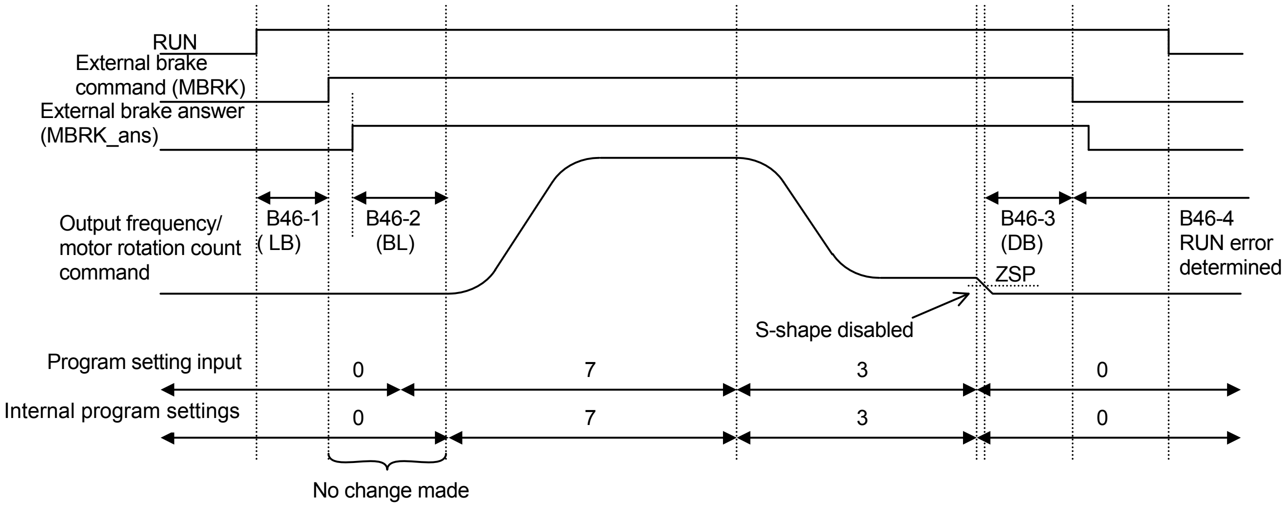
3) The output frequency (speed) is limited between 5.00 and 100.00% during traverse operation.

4) When carrying out deviated traverse, take care not to turn the S0 (X) and S1 (Y) commands ON simultaneously.
   If turned ON simultaneously, the (3) center frequency (speed) will change.

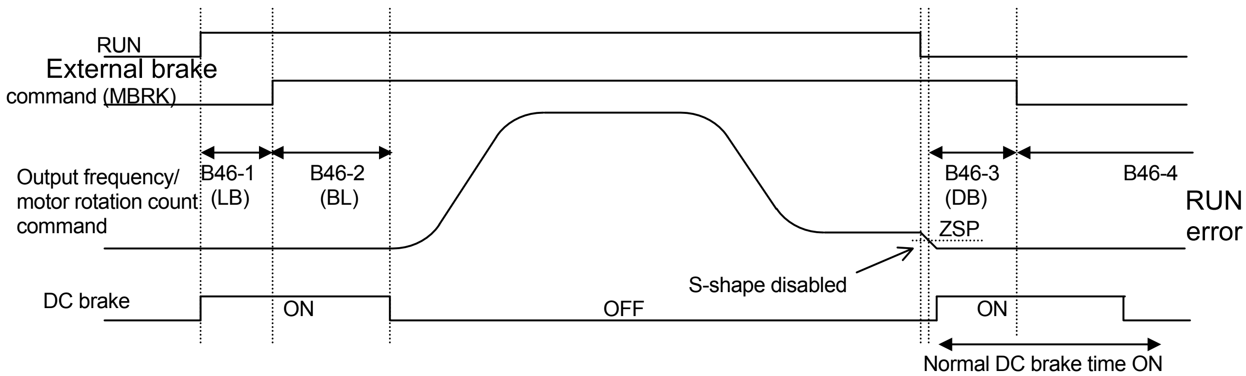
B46-0~5

External brake control

The inverter brake can be turned ON and OFF in accordance with the inverter internal sequence. The external brake function contains all types of waiting time settings and an interlock function.



External brake sequence example with program settings used (B46-0 f2=1), and brake answer (B46-5≠0.0)



External brake sequence example with DC brake used (B46-0 f2=2), and no brake answer (B46-5=0.0)

(1) External brake selection

1) Select the external brake function using B46-0 f0.
2) Select the IDET based interlock function using B46-0 f1. If B46-0 f1 = 2, a breakdown stop occurs at IO-C if IDET is not ON at the point the brake is released (immediately after LB).
3) Set the control mode during acceleration waiting time (LB, BL) using B46-0 f2.
   The normal operation mode is enabled when B46-0 f2 = 1.
   The mode changes to DC brake mode when B46-0 f2 = 2.

(2) All types of waiting time

Set the waiting time when using external brake control.

1) Use B46-1 to set the waiting time (LB) from RUN until the brake is released.
2) Use B46-2 to set the waiting time (BL) from the point the brake is released until acceleration is commenced. When there is a brake answer (B46-5≠0.0sec), set the waiting time from after the brake answer, and if there is no brake answer (B46-5=0), set the waiting time from the point the brake release command is issued.
   In the case of the normal operation mode setting, changes are not made to the settings during BL, and the settings prior to BL are used.
3) Use B46-3 to set the waiting time (DB) from the point ZSP turns ON until the brake is engaged.

(3) Error determination

The following error determination can be made in cases other than IDET based interlock set at B46-0 $\boxed{f1}$.

1) RUN error determination when engaging brake
   In the case where RUN does not turn OFF in the time set at B46-4 from the time the brake is engaged, a breakdown stop occurs at the end controller due to an external brake RUN error (IO-D). Set to 0.0 sec to turn the RUN error determination OFF.
2) Brake answer error determination
   In the case where (MBRK) brake command and (MBRK_ans) brake answer do not match above the time set at B46-5, an external brake answer error (I0-E) occurs as an external brake breakdown, and a breakdown stop occurs. Set to 0.0 sec to turn the brake answer error determination OFF.

(4) S-shape cushion pass function

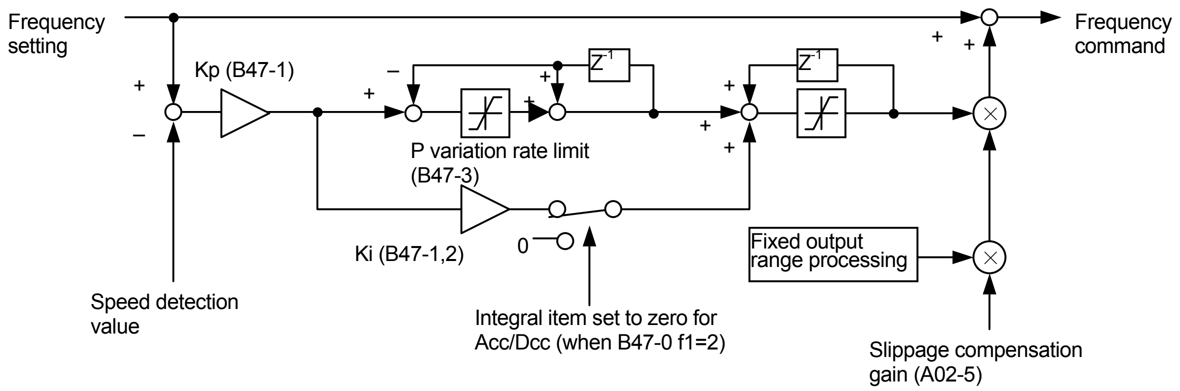
If the S-shape characteristics (B10-4) have been set, the S-shape characteristics are applied when engaging the external brake, and therefore there are cases when the frequency does not drop immediately. In order to avoid this, set B10-6=2 or 3 to disable the S-shape characteristics when stopping.

B10-6=2: S-shape passed when program setting is 0.
B10-6=3: S-shape passed when RUN command is OFF.

B47-0~6

Simple ASR control

If the speed detection option preset board (U30V24DN1, DN2, DN3 0r DN5) is installed when V/f control is selected (C30-0=1, 2), simple ASR can be used. Simple ASR involves comparing the frequency command value and motor rotation count (frequency calculation value), and controlling the slippage frequency so that the frequency command matches the motor rotation count.



Simple ASR control block diagram

(1) Simple ASR control is performed when B47-0 $\boxed{f0}$ = 2.

(2) The integral operation is stopped when accelerating if B47-0 $\boxed{f1}$ = 2. The overshoot when the frequency is attained can be curtailed.

(3) The proportional gain is set at B47-1. Increase the proportional gain to raise the motor count compliance, however, motor hunting will occur if increased too much.

(4) Set the integral time constant at B47-2. Shorten the integral time constant to raise the rotation count compliance when the motor has a load, however, the overshoot will increase when the frequency is attained.

(5) Set the proportional variation rate control at B47-3. Set a small value in order to avoid excess proportional rotational variations.

(6) Set the compensating torque limitter at B47-4. Simple ASR output is output in a simple torque form. Set a small value for the compensating torque limitter to avoid overcompensating.

(7) Set the simple ASR pole count at B47-5.

(8) Set the simple ASR speed detection unit pulse count a B47-6.

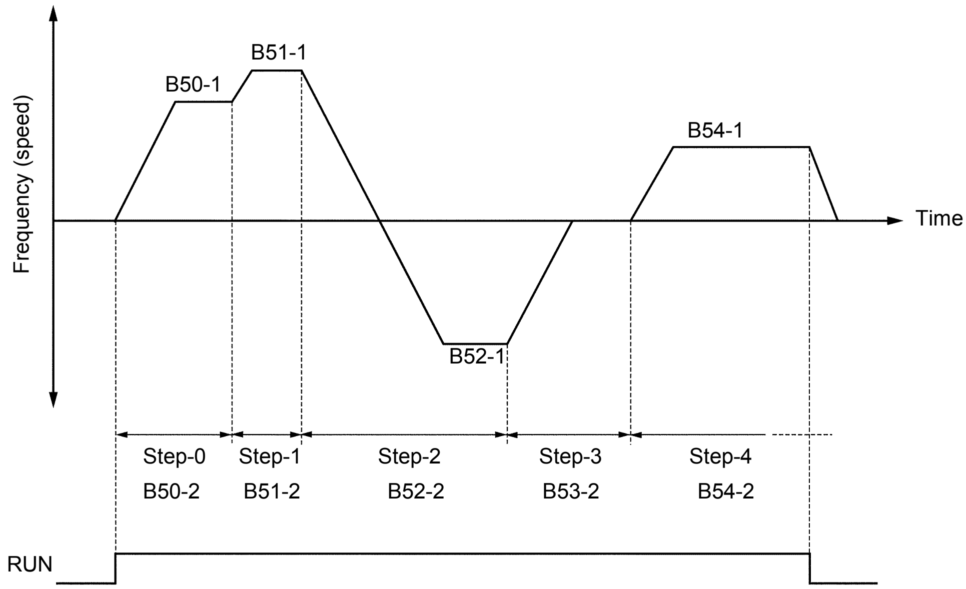
(9) The pick-up operation is required when restarting operation while the motor is rotating. This differs from vector control in that magnetic flux control is not performed. In order to pick up, 500msec finishing time is required in addition to pick-up standby time (C21-2).

(Note 1) Simple ASR differs from vector control in that torque limit control is not possible.
(Note 2) The speed detection value displays at D00-5.

B50-0 ~B59-3

Pattern run function

The frequency (speed), run direction and time can be changed automatically with the pattern run function.



(1) A max. of ten patterns can be set. Program in the B50-B59 blocks as shown below.
The speed setting input point is selected with C02-0 = 4 (sequence).
n is the step No. from 0 to 9.

B5n-0: Run mode
= 0: Stop
= 1: Forward run
= 2: Reverse run
= 3: Final step (set when repeating before B59)

B5n-1: Run frequency (speed) [%]

B5n-2: Run time [sec.]

B5n-3: Return destination step
= 0 ~ 8
(Set the No. of the step to be executed next when B5n-0 = 3.)

(2) The sequence command functions will be as shown below during pattern running.

RUN: Pattern run starts when this turns ON, and operation starts from the run frequency (speed) and operation time applied when the operation was previously stopped. The inverter will stop when this is turned OFF.

(Note 1) The pattern running operates with the remote mode (LCL OFF).
(Note 2) The R.RUN, F.JOG, and R.JOG commands are invalid during pattern running.

S0: Proceeds to the next step at the edge from OFF to ON. (Skip)
By turning this signal ON/OFF with S1 ON (hold), the step can be proceeded in synchronization with the peripheral machine regardless of the internal timer.

S1: The internal timer operation will stop when ON. (Hold).
Use this to pause the pattern run.

S2: When this is turned ON, the operation will be reset to step 0.
The S0 and S1 functions are valid only when RUN is ON.
The S2 function is not related to the ON/OFF setting of RUN, and is valid at all times.
When the mode is changed to the local mode (LCL ON), this will be reset to step 0.
During pattern run, set B11-8 to 1 (selection mode setting: binary mode).

(3) When using pattern run, the sequence status output (D04-4) ACC and DCC functions will change as shown below.

ACC: Turns ON when the last step of the pattern run is being executed. (EOS)

DCC: Operates with the reverse logic of the above ACC. (EOS)

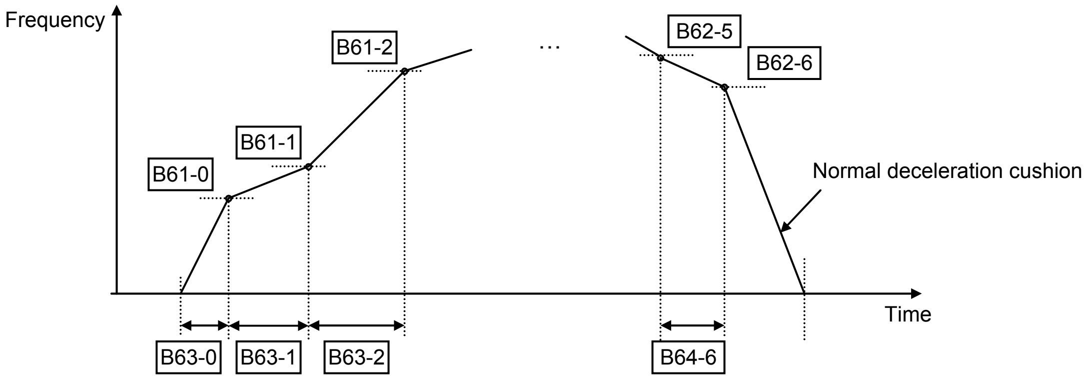
B60-0 ~B76-6

Spinning frame function

This function is used to perform spinning pattern operation. This differs from the previous pattern operation in that acceleration/deceleration is performed in a straight line cushion (auto setting) until the setting point is reached. Set the parameter selection B60-0 f0 to 2 (selection) to enable the spinning frame function.

(Note 1) The spinning frame function is a V/f control function. Select control mode selection C30-0 f0=1.

(1) Up to four Speed-Time Patterns (STP) can be set up to a maximum of fifteen steps.
Each step is set at the target frequency and time taken to attain that frequency from the previous step. Set each STP end step number at B60-1~4.
The time unit can be set at B60-6. This settings is valid for the STP time settings (B63-0~B64-6, B67-0~B68-6, B71-0~B72-6, B75-0~B76-6) and Doff-End alarm time (B60-5).
The frequency and time setting in each step of STP can be changed. Note that changes made to the STP settings during the step will be reflected when the step is updated.



When STP0 is selected, and B60-1=14

(2) STP switching can be performed using the external terminal
There are four Speed-Time Patterns (STP), and they are selected at external terminal input (S0, S1, S2, S3). Use parameters B11-8 to select the binary mode and direct input mode.

Binary mode (B11-8=*1)

Sequence command				Selection STP No.
S3	S2	S1	S0	
*	*	OFF	OFF	STP0
		OFF	ON	STP1
		ON	OFF	STP2
		ON	ON	STP3

Direct input mode (B11-8=*2)

Sequence command				Selection STP No.
S3	S2	S1	S0	
OFF	OFF	OFF	OFF	Previous value
OFF	OFF	OFF	ON	STP0
OFF	OFF	ON	OFF	STP1
OFF	ON	OFF	OFF	STP2
ON	OFF	OFF	OFF	STP3

(Note 2) STP switching cannot be performed during operation. If STP switching is performed during operation, the current pattern is maintained, and switching is performed after pattern operation is complete.

(3) Speed-Time Pattern (STP) operation

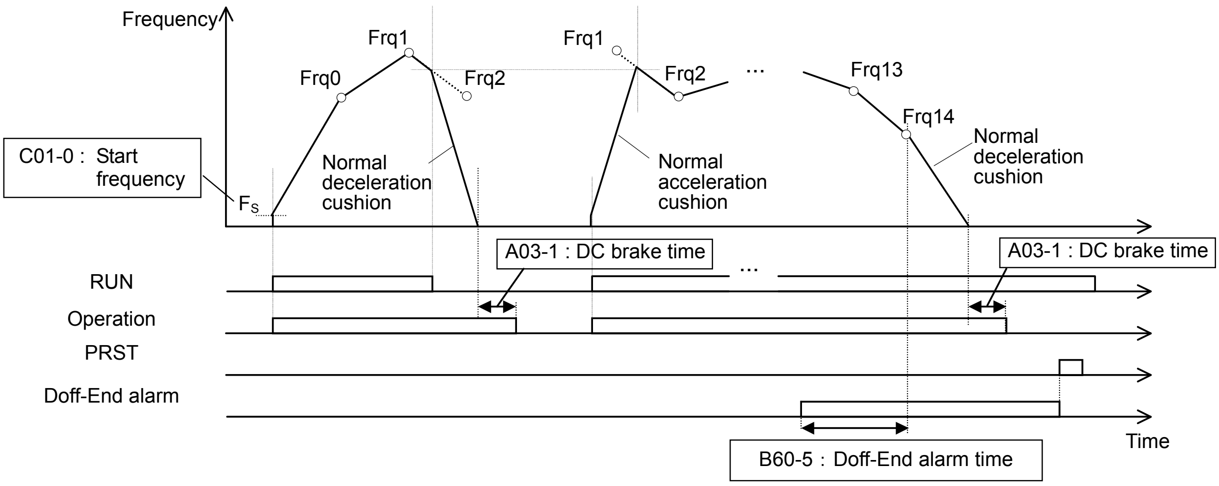
1) STP operation is performed when the sequence command RUN is issued. (F.JOG, R.JOG inching operation cannot be performed.) Operation is commenced from the selected STP Step 0.
2) The method of stopping after the pattern ends can be selected with the function selection B60-0 f1.

B60-0: $\boxed{\text{f1}}$ = 1 (automatic stop)

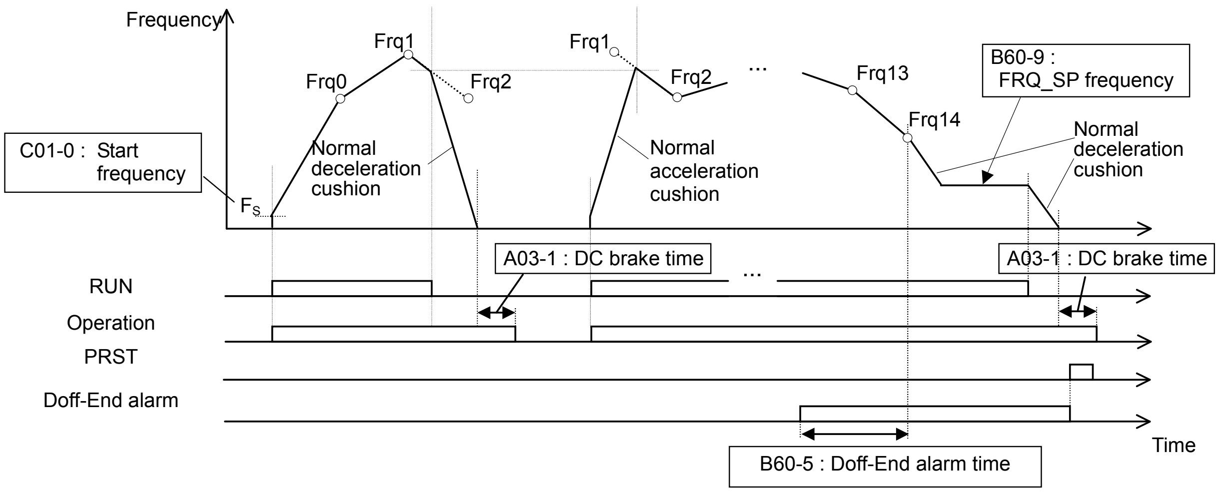
- The inverter automatically stops after the last step is finished. Either normal deceleration ramp or coast to stop can be selected with the operation stop method (C00-1).

B60-0: $\boxed{\text{f1}}$ = 2 (FRQ_SP operation)

- After the last step is finished, the inverter shifts to special frequency (FRQ_SP) at the normal deceleration ramp, and continuous running. Operation at FRQ_SP continuous until the Run command turns OFF.
- When the RUN command turns OFF, the inverter stops with the normal deceleration ramp or coast to stop depending on the operation stop method (C00-1).
- The special frequency (FRQ_SP) can be set with parameter B60-9.



For automatic stop selection (B60-0=12)



For FRQ_SP operation selection (B60-0=22)

3) If the operation command is turned OFF during STP operation, normal deceleration cushion or free-run stop is performed. When restarting operation, after accelerating with the normal acceleration cushion until the previous stop frequency is reached, STP operation is restarted from the previous stop step and operation time.
4) When operation is stopped due to a power outage, after resuming the power, pattern operation is restarted from the frequency and time when the stop occurred.

(4) Pattern operation can be reset by the external terminal input (PRST).

Select the input terminal by selecting sequence input (C03-9). A stop occurs when the PRST is turned ON during STP operation. Operation is commenced from STEP0 when restarting operation.
The method for stopping at pattern reset can be selected with function selection B60-0 f1.

B60-0: $\boxed{\text{f1}}$ = 1 (automatic stop)

- The inverter will automatically stop if PRST is turned ON during STP operation. Either normal deceleration ramp or coast to stop can be selected with the operation stop method (C00-1).

B60-0: $\boxed{\text{f1}}$ = 2 (FRQ_SP operation)

- If PRST is turned ON during STP operation, the inverter will shift to special frequency (FRQ_SP) at the normal deceleration ramp, and will continue running. Operation at FRQ_SP continuous until the RUN command turns OFF.
- When the RUN command turns OFF, the inverter stops with the normal deceleration ramp or coast to stop depending on the operation stop method (C00-1).

(5) A Doff-End alarm is output at the final stage of the pattern.

By setting the Doff-End alarm time (B60-5), the Doff-End alarm is output from the point after completion of the final step to the point going back the set time.
The Doff-End alarm remains ON even after the pattern is completed. The Doff-End alarm is cleared by the PRST.
Select the output terminal for the Doff-End alarm with the output selection (C13-2 to 6, C33-0 to 3).

(Note 3) Even if the Doff-End alarm is ON, when the RUN signal is input, the Doff-End alarm will turn OFF and operation will start from Step 0.

(Note 4) Normal acceleration/deceleration cushion switching can be performed using CSEL.
The Doff-End alarm time and average frequency calculation is always performed with cushion 1 even if cushion 2 is selected.

(6) Spindle average frequency display (D13-3)

The currently selected STP average frequency is displayed at monitor D13-3.
The average frequency is obtained using the following formulae.

$$S_0 = \frac{(F_S[\%] + F_0[\%]) \times T_0[sec]}{2}$$

$$S_n = \frac{(F_{n-1}[\%] + F_n[\%]) \times T_n[sec]}{2} \quad \text{(n: Step no.)}$$

$$S_D = \frac{F_n[\%] \times T_D[sec]}{2}$$

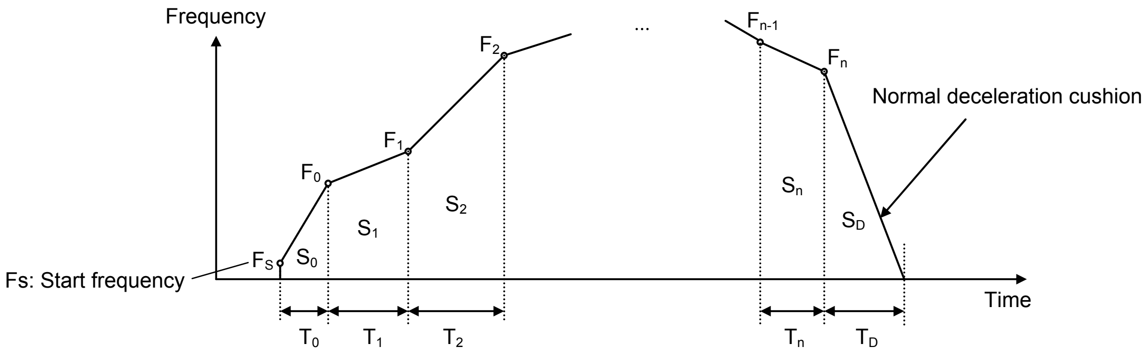
1) Operation stop method (C00-1) =1: Free-run stop

$$\text{Average frequency} = \frac{S_0 + S_1 + \cdots + S_n}{T_0[sec] + T_1[sec] + \cdots + T_n[sec]} \times F_{MAX}[Hz]$$

2) Operation stop method (C00-1) =2: Deceleration stop

$$\text{Average frequency} = \frac{S_0 + S_1 + \cdots + S_n + S_D}{T_0[sec] + T_1[sec] + \cdots + T_n[sec] + T_D[sec]} \times F_{MAX}[Hz]$$

(Note 5) At the time of FRQ_SP operation, average frequency switches to FRQ_SP.



(7) Hank count display (D13-4)

The current Hank count displays at monitor D13-3. The Hank count is obtained using the following formula.

$$H_C = F_{AVG} \times T_{RUN} \times \frac{1}{840} \times \text{Gain}$$

F_{AVG} [Hz]: Average frequency T_{RUN} [sec]: Operation time
840: 1 Hank = 840 yard

It is necessary to set the gain (B60-7, B60-8) in order to display the Hank count correctly. The gain is obtained using the following formula.

$$\text{Gain} = 2p \times R_S \times \frac{2}{\text{Pole}} \times \frac{1}{G_R} \times K_C$$

R_S: Spindle radius [yard] Pole: Motor pole count

G_R: Gear ratio $= \frac{N_2}{N_1}$ (N_1: Motor gear count, N_2: Spindle gear count)

K_C: Compensation coefficient (Compensate slippage etc.)

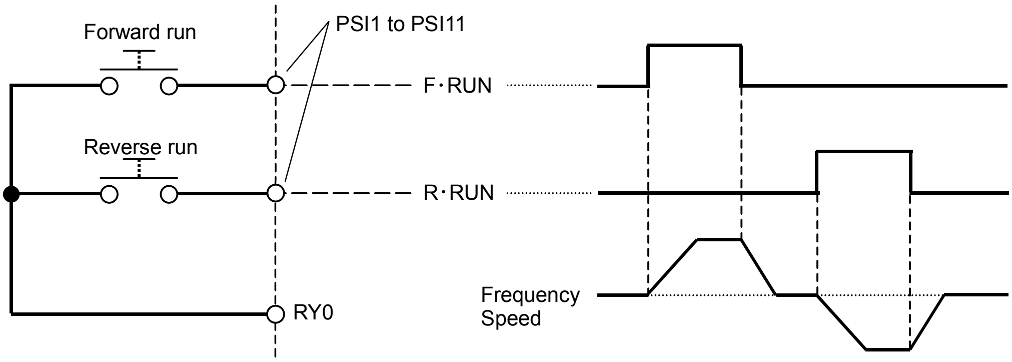
(Note 6) The Hank count calculation is continued during operation, however, is reset to zero when the power is turned OFF.

6-6-4 Explanation of Block-C parameter functions

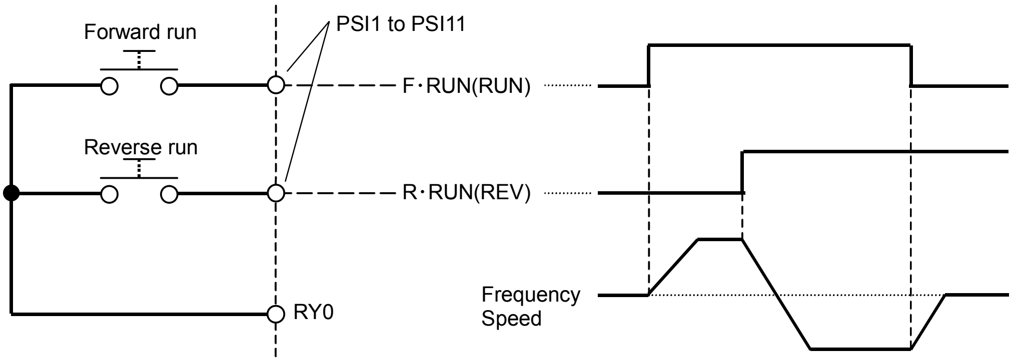
C00-0 Run command method

Set the run command method for the remote operation mode (when "LCL" LED on operation panel is OFF). Set the sequence command, F.RUN, R.RUN and HOLD with C03-0, C03-2 and C03-5.

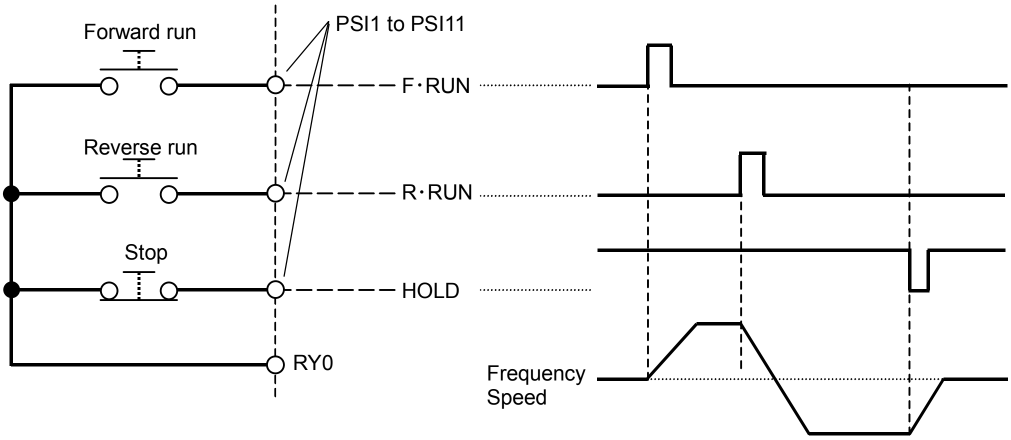
= 1: F·RUN, R·RUN



= 2: RUN, REV



= 3: Self hold



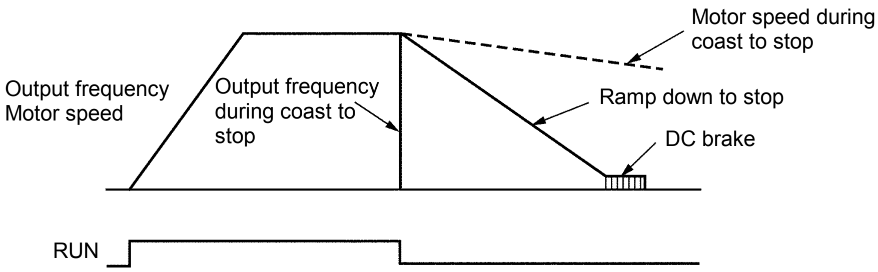
(Note) PSI8 to 11 can be used only when the relay interface option is mounted.

C00-1
C00-2

Run/stop methods
Jog stop method

= 1: Coast to stop
= 2: Deceleration stop

Coast to stop refers to stopping by turning the output OFF simultaneously with the stop command (F·RUN and R·RUN OFF).
Deceleration stop refers to stopping by decelerating to the stopping frequency with the ramp down after the stop command, and then applying the DC-brake to stop.



(Note) When not using the pick-up function to restart after coast to stop, confirm that the motor is stopped. When not using the pickup function, if the inverter is started while the motor is rotating, the inverter may trip.

C00-3

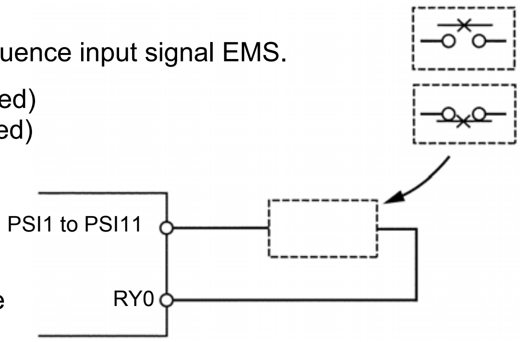
Emergency stop (EMS) input logic

Set the input logic of the emergency stop sequence input signal EMS.

= 1: Close to stop (when a contact is connected)
= 2: Open to stop (when b contact is connected)

Select the EMS signal input terminal from the control PCB terminal block PSI to 11, and set with C03-1.

(Note) PSI8 to 11 can be used only when the relay interface option is mounted.



C00-4

Emergency stop (EMS) mode

Set the method of stopping when the emergency stop sequence input EMS turns ON.

= 1: Coast to stop, without fault output
= 2: Coast to stop, with fault output (When the EMS signal turns ON, the output will be shut off, and FLT will be output.)
= 3: Ramp down to stop (without fault output)

C00-5 Control source switchover method (J1 setting)

J1 setting =1: OFF =2: ON
Select whether to use the sequence input signals from the control PCB terminal block in the local operation mode (when "LCL" LED on operation panel is ON).
Refer to section 5-5 for details.

C00-6 Control source switchover method (J2 setting)

J2 setting =1: OFF =2: ON
Select the auxiliary command input when the COP command is ON.
Refer to section 5-5 for details.

C00-7 Run contact output condition selection

The conditions for turning the sequence RUN output ON are set.
= 1: ON at pre-excitation (EXC)
= 2: OFF at pre-excitation (EXC)

C02-0~8 Various setting input selection

Refer to section 5-9 for details.

C03-0~F Sequence input terminal function – 1
C04-0~F Sequence input terminal function – 2
C05-0~7 Sequence input terminal function – 3
C06-0~A Sequence input terminal function – 4

Refer to section 5-3, 5-6 for details. Refer to the explanation for B06-0 to 6 (ratio interlock bias increase/decrease function) for details on C03-A and C04-9 to A.

C07-0~A Analog input terminal function

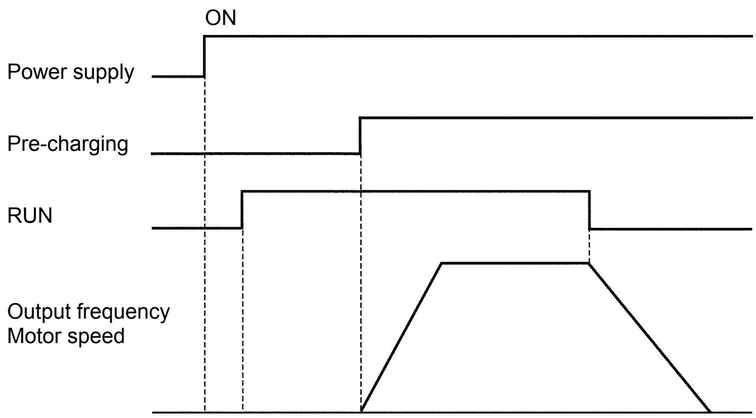
Refer to section 5-7 for details.

C08-0

Auto start (To F･RUN/R･RUN)

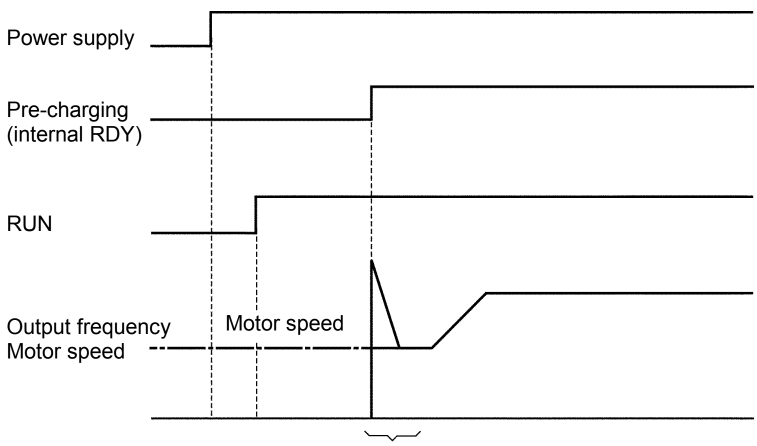
= 1: OFF (runs with the run command ON after pre-charging)
= 2: ON without pick-up
If the run command is ON when the power is turned on, run will start after the inverter is charged.

(Note 1) Pick-up is not executed with this setting, so if the motor is rotating when the power is turned ON, the inverter operation could trip.



= 3: ON with pick-up
If the run command turns ON when the power turns ON, pick-up will start when the inverter charging is completed, and then operation will start.
Set this when using momentary restart.

(Note 2) The speed can be detected with the IM vector control with sensor and PM motor control (C30-0 $\boxed{f0}$ = 3, 4). As pickup operation is not carried out, set C08-0 to 2.



Motor speed search
(For V/f control, IM speed sensor-less vector control C30-0 $\boxed{f0}$ =1,2)

(Note 3) If auto start (C08-0 = 2, 3) is used, undervoltage fault will not be detected.

C09-0

Parameter protection

Set this parameter to prevent unintentional operations from operation panel.
Changing of the data can be protected per function group with the setting value as shown below.

value	Block A	Block B, C			
		Basic	Extn.	S/W	H/W
1	○	○	○	○	○
2	×	×	×	×	×
3	○	×	×	×	×
4	○	×	○	×	×
5	○	×	○	○	×
6	○	○	○	○	○
7 ~ 8	×	×	×	×	×
9	○	○	○	○	○

○ : Unprotected (changeable)
× : Protected (unchangeable)

(Note 1) Set 2 to prohibit all changes.
(Note 2) Set 1 to allow all changes. The 9 setting is for maker maintenance, so do not set it.
(Note 3) When using the password number function (when C28-0 is set to 2), this parameter will also be locked. Set U00-1 to the value set with C28-1 to unlock the protection.

C09-1

Operation panel lock

This setting protects the operation panel FWD, REV and STOP key operations.
= 1: All operation possible
= 2: All operation prohibited (Note, the motor will stop when the STOP key is pressed for two seconds)
= 3: Only STOP key can be operated.

C09-2

LCL switchover protection

= 1: LCL mode switchover (LCL/SET + STOP keys) during running disabled
= 2: LCL mode switchover (LCL/SET + STOP keys) during running enabled

(Note) When switching from the local mode to the remote mode, if the terminal block RUN, R.RUN, F.JOG or R.JOG is ON, the mode will not switch even if operation is stopped.

C09-3
C09-4

Reveres run sequence (R·RUN) prohibit
Reverse run jogging sequence (R·JOG) prohibit

= 1: Enable = 2: Prohibit
Set this to prevent unintentional reverse run operation.
When set to "2", the sequence input "R RUN(R JOG)" operation command will be disabled.
Note that if the reverse run setting (negative value) is input into the speed setting during "F·RUN(F JOG)" operation, reverse run will start.

C09-5 Reverse run during ACR mode prohibit

= 1: Enable = 2: Prohibit
Set this to prevent unintentional reverse run operation.
When set to “2”, reverse run during ACR operation will be prohibited.
The reverse run speed will be limited to approx. 1% if reverse run is started.
This setting is ignored in the V/f mode.

C09-6 Fault history buffer clear

The fault history details can be cleared by setting the value to 1 and then pressing LCL/SET key.
This setting will not be registered in the internal memory. Thus, this parameter must be set each time.
Nothing will occur if set to a value other than 1.
Use this before handing the unit over to the final user.

(Note) The setting values exceeding 2000 are codes for maker maintenance, so do not set.

C09-7 Default value load

All values per function group are changed to the default values.

9: All default values load (Excluding the maker maintenance parameters)
10: Parameter A
11: Parameters B, C basic functions
12: Parameters B, C extended functions
13: Parameter B software option function
Parameter C hardware option function
14: Parameters B basic functions
15: Parameters B extended functions
16: Parameter B software option function
17: Parameters C basic functions
18: Parameters C extended functions
19: Parameter C hardware option function

Nothing will occur when values other than the above are set.
This parameter setting value will not be registered in the internal memory.

(Note) The setting values exceeding 2000 are codes for maker maintenance, so do not set.
If set, the following inverter operation may be abnormal.

C10-0~7 Custom parameter register

Refer to section 4-4 for details on operating these parameters.

C11-0

Default mode setting

Set which operation mode the operation panel starts up when the power is turned ON.
=1: Local operation mode (LCL)   =2: Remote operation mode (RMT)

C11-1

Operation command at auto start setting

=1: Stop   =2: Forward run   =3: Reverse run

Set the default operation mode at power ON when using the auto start function (C08-0=2, 3) in the local operation mode (operating with the operation panel).
For example, if C11-1 is set to 2 and operation is enabled after power ON (sequences RDY1, RDY2, MC are all ON), the forward run will take place.

C11-2

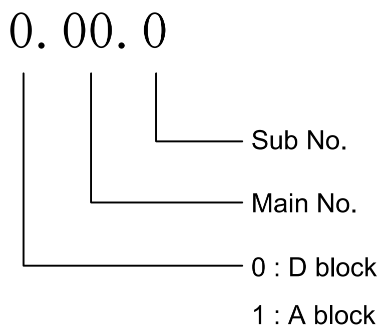
Operation panel frequency change operation

Set whether to change the frequency and speed setting values in real time.
=1: Change setting value in real time =2: Change setting value when set key is pressed

C11-3

Display parameter at power ON selection

Select the parameters displayed on the operation panel at power ON.
Refer to the following diagram.



C11-4

LCD panel: Language setting

Select the language displayed on the LCD panel.
=0: English
=1: French
=2: German
=3: Spanish
=4: Italian
(Note)   This is displayed only when the LCD panel is connected.

C11-5

LCD panel: Contrast adjustment

Adjust the contrast of the characters displayed on the LCD panel.
The character color will darken as a larger value is set.
(Note) This is displayed only when the LCD panel is connected.

C11-6

LCD panel: Backlight OFF timer setting

Set the time that the LCD panel backlight is ON.
Set the ON time with a second unit.
If the setting value is "0", the backlight will be ON at all times.
(Note) This is displayed only when the LCD panel is connected.

C11-7

Operation panel operation mode selection

The operation panel parameter operation method can be selected from two methods.
Refer to section 4-1-3 Selecting the operation method.

C12-0
C12-4

AI1 terminal input mode selection
AI2 terminal input mode selection

Select the input mode for the AI1 and AI2 terminals.

C12-0, 4 = 1 : Voltage input
= 2 : Current input

Refer to section 5-7 for details on using the analog input terminal.

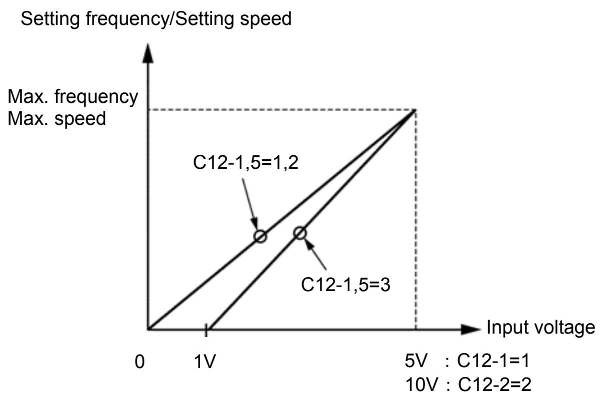
C12-1
C12-5

AI1 voltage input mode selection
AI2 voltage input mode selection

When the AI1 and AI2 terminal input mode is set to voltage input (C12-0, 4 = 1), set the full scale of these terminal input signals.

C12-1, 5 = 1 : 0 to 10V
= 2 : 0 to 5V
= 3 : 1 to 5V

As an example, the relation of the voltage input value and speed setting value when the AI1 and AI2 terminal input function is used for the speed setting is shown below. Refer to Table 5-7-1 for the relation of the analog input value and each setting value when using the input terminal for a function other than speed setting.



Voltage input mode

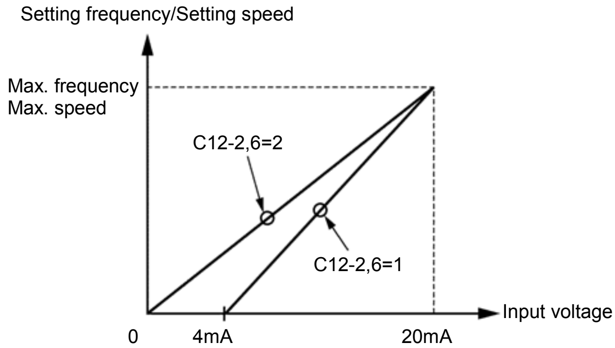
C12-2
C12-6

AI1 current input mode selection
AI2 current input mode selection

When the AI1 and AI2 terminal input mode is set to current input (C12-0, 4 = 2), set the full scale of these terminal input signals.

C12-2, 6 = 1 : 4 to 20mA
= 2 : 0 to 20mA

As an example, the relation of the current input value and speed setting value when the AI1 and AI2 terminal input function is used for the speed setting is shown below. Refer to Table 5-7-1 for the relation of the analog input value and each setting value when using the input terminal for a function other than speed setting.



Current input mode

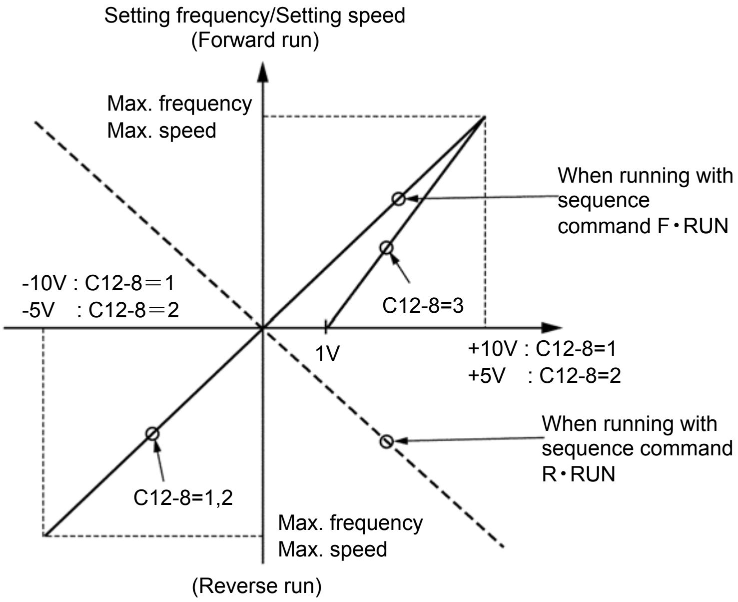
C12-8
C12-9

AI3 terminal input mode selection
AI3 input gain

Set the full scale of the AI3 terminal analog input signal with C12-8.

C12-8 = 1 : -10V to +10V
= 2 : -5V to +5V
= 3 : +1V to +5V

A multiplication gain can be applied on the AI3 terminal input value with C12-9.
As an example, the relation of the voltage input value and speed setting value when the AI3 terminal input function is used for the speed setting is shown below. Refer to Table 5-7-1 for the relation of the analog input value and each setting value when using the input terminal for a function other than speed setting.
Refer to section 5-7 for details on using the analog input terminals.



C12-3
C12-7
C12-A

Filter time constant for AI1 input
Filter time constant for AI2 input
Filter time constant for AI3 input

The filter time constant for the input value of the AI1, AI2 and AI3 terminals can be set.
Fluctuation of the setting value caused by input signal noise or chattering, etc., can be suppressed by increasing the time constant.

C12-B

Program setting filter

The program speed and ramp setting are set with the sequence commands S0 to SE, but chattering could occur when these input terminals are changed. In order to avoid this, batch filter processing is performed for S0 to SE.
The input signal is validated when the S0 to SE input terminals obtain the same value for longer than the set time, so the program settings will not change for the time set in C12-B after the input is changed.
Set C12-B to a time longer than that at which chattering could occur, and lower than the setting delay tolerance time.

C12-C Pulse train input : 0% setting frequency (F1)
C12-D Pulse train input : 100% setting frequency (F2)
C12-E Pulse train input frequency LPF time constant
C12-F Pulse train input judgment time

Refer to section 5-7-3 for details related to the pulse train input function.

C13-0 A01 terminal output
C13-1 A02 terminal output

The inverter's internal parameters can be output from the control PCB analog output terminals A01 and A02.

C13-7~A Built-in PLC input selection 1~4

The inverter output analog signals can be input to the built-in PLC. Select the details set in memory numbers 10h to 13h.

The parameters corresponding to the C13-0,1,7 to A setting values and the full scale of those output signals is shown below. The output voltage and current values are output as a percentage of the full scale. Refer to section 5-8 for details on using the analog output terminals. Refer to section 6-11 for details on using Built-in PLC.

The parameters corresponding to the C13-0, 1 setting values and the full scale of those output signals is shown below. The output voltage and current values are output as a percentage of the full scale. Refer to section 5-8 for details on using the analog output terminals.

Value	Parameter	Full scale
0	Output frequency	Max. frequency
1	Setting frequency Setting speed	Max. frequency Max. speed
2	Ramp output	Max. frequency Max. speed
3	Output current (Motor)	Motor rated current × 2
4	Output current (Drive)	Drive rated current × 2
5	Output voltage	Motor rated voltage
6	Motor output power	(Motor rated voltage × Motor rated current) × 2
7	DC voltage	200V Series : 300V 400V Series : 600V
8	OLT monitor (unit protection)	100%
9	Heat sink temperature	100°C
10	Motor speed	Max. speed

Value	Parameter	Full scale
11	Torque current	Motor rated current × 2
12	Excitation current	Motor rated current × 2
13	Actual motor rotation speed	Max. speed
14	Namp output	Rated torque × 2
15	OLT monitor (motor protection)	100%
16	Built-in PLC output 1	1000h
17	Built-in PLC output 2	1000h
18	Built-in PLC output 3	1000h
19	Built-in PLC output 4	1000h
20	DM1 for maker maintenance	1000h
21	DM2 for maker maintenance	1000h

(Note 1) DM1 and DM2 for maker maintenance are to be used only by the maker for maintenance.
The user must not set C13-0, 1 to 20 or 21.

C13-2 RA-RC output parameters
C13-3~5 PSO1, 2, 3 output parameters
C13-6 FA-FC output parameters

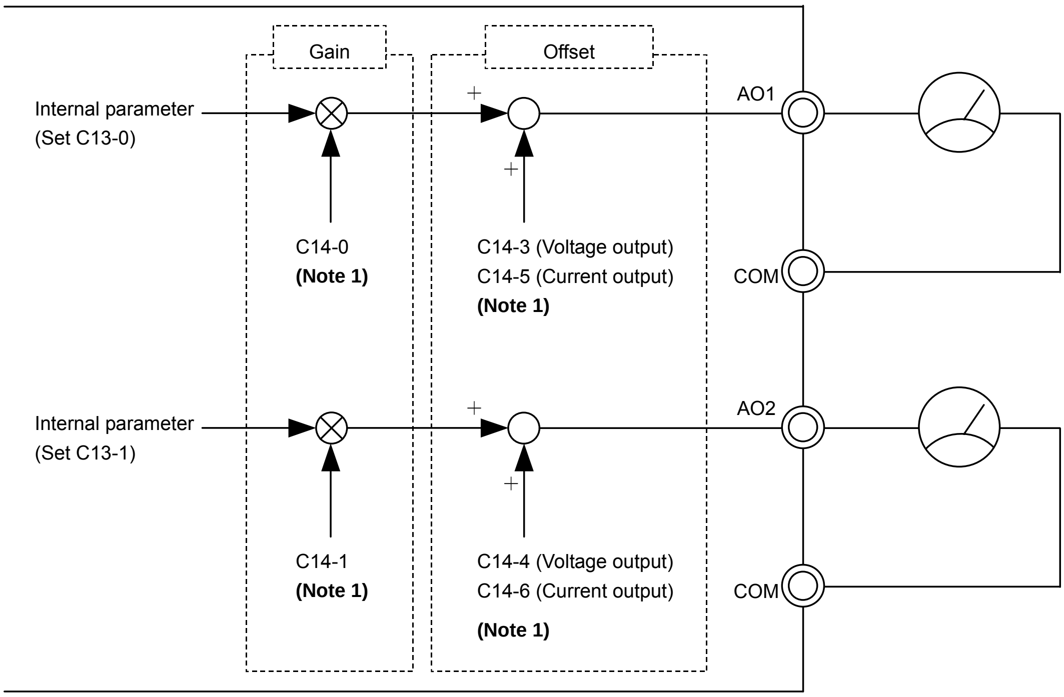
Refer to section 5-6-2 for details.

C13-B	**Pulse train output function**
C13-C	**Pulse frequency at 0%**
C13-D	**Pulse frequency at maximum frequency/speed**
C13-E	**Pulse train output parameter selection**
C13-F	**Output parameter absolute value calculation selection**

Refer to section 5-8-3 for details on the pulse train output function.

C14-7, 8	**A01, A02 output method selection**
C14-0, 1	**A01, A02 output gain**
C14-3, 4	**A01, A02 output offset (Voltage)**
C14-5, 6	**A01, A02 output offset (Current)**

The block diagram for the control PCB analog outputs A01 and A02 is shown below.



(Note 1) The maximum output voltage for the A01 and A02 output is approx. 11V. Thus, even if the gain or offset are set to a large value, a voltage higher than this maximum level will not be output.

Set the A01, A02 output method with C14-7, 8.
C14-7, 8 = 1: Voltage output 0V to 10V
= 2: Voltage output 0V to 10V (with 5V offset)
= 3: Current output 4mA to 20mA

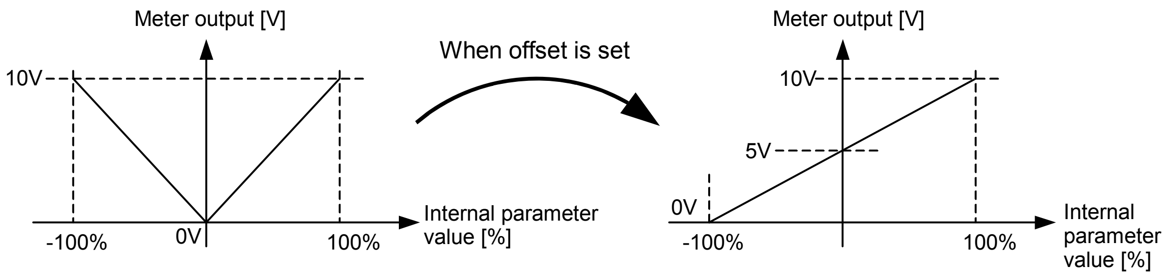
When using A01, A02 for the voltage output (C14-7, 8 = 1 or 2), connect the control PCB A01/A02 L bit (W3, W4) to the voltage mode side. When using for the current output (C14-7, 8 = 3), set the L bit to the current mode side. Refer to section 5-8 for details on this. When C14-7, 8 is set to 2, the parameter reference point is automatically set to 5V, and the output value gain is set to 0.5-fold.

A gain can be applied on the internal parameter value set with C13-0, 1.
Set this gain with C14-0, 1.
When C14-7, 8 is set to 2 and the output gain is set with C14-0, 1, the gain will be (0.5 × C14-0, 1).

Of the parameters selected with C13-0, 1, those shown below are coded with a plus/minus sign. When these parameters are selected, plus or minus can be added by offsetting the output value.
Set C14-3, 4 for the voltage output, and C14-5, 6 for the current output.

Setting value	Parameter	Full scale
0	Output frequency	Max. frequency
1	Setting frequency Setting speed	Max. frequency Max. speed
10	Motor speed	Max. speed
11	Torque current	Motor rated current × 2
12	Excitation current	Motor rated current × 2
13	Actual motor rotation speed	Max. speed
14	Namp output	Rated torque × 2

An example of setting a 5V offset for the voltage output is shown below.
If C14-7, 8 is set to 2, the offset amount when the offset is set with C14-3, 4 becomes (5V + C14-3, 4 setting value).



When offset is not set (Offset = 0V, gain = 1.00)

For offset 5V, gain 0.50

(Note 2) If plus or minus is set with offset, the signal is not output from A01, A02 when the power is shut off, so the output will be 0V (-100% in above example).

C14-2

Random scale display coefficient

Set the display value coefficient for the monitor parameter D00-4 (output frequency, speed random scale display) and D01-4 (set frequency, speed, ramp input random scale display.
The result of multiplying the output frequency or set frequency, etc., with this setting value is displayed at D00-4, D01-4).

C14-9~B

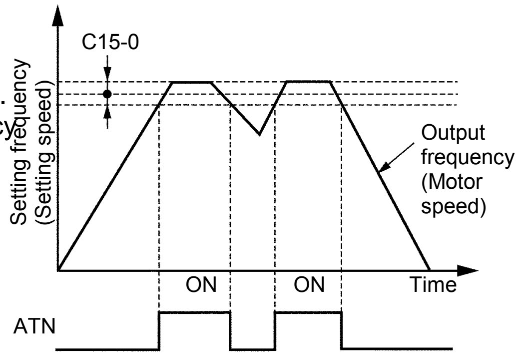
AI1, AI2, AI3 random scale coefficient

Set the random scale coefficient of the value displayed at monitor parameter D08-0 to 2 (analog input AI1, AI2, AI3 random scale display).

C15-0

Attainment (ATN) detection width

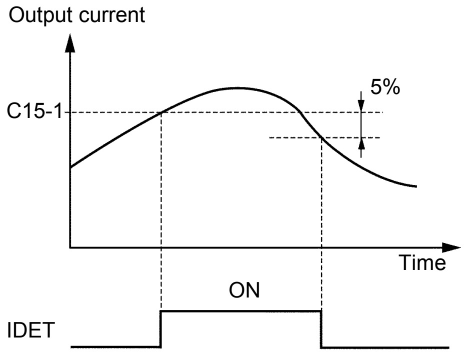
The attained output ATN operation width is set. Set with a percentage to the max. frequency (B00-4) or max. speed (B01-4).



C15-1

Current (IDET) detection level

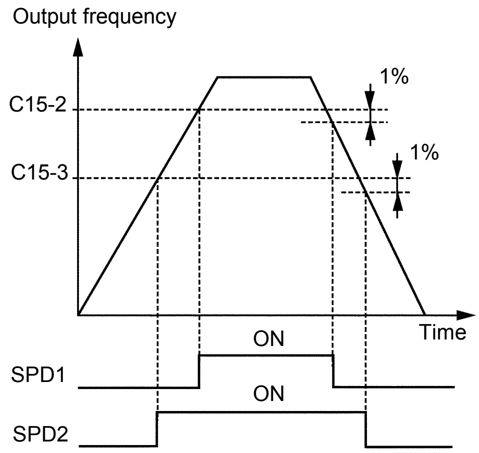
The current detection (IDET) operation level is set. Set with a percentage of the rated current (B00-6, B01-6).
A 5% hysteresis will occur with the IDET operation.



C15-2
C15-3

Speed detection (SPD 1) level - 1
Speed detection (SPD 2) level - 2

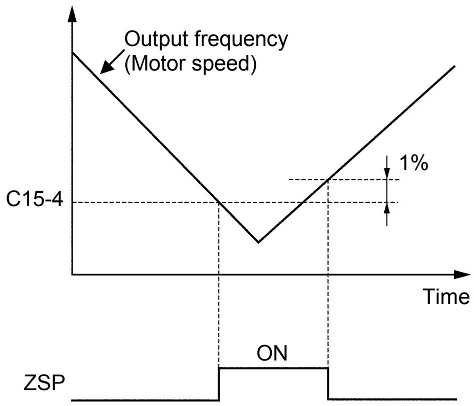
The speed detection SPD 1 and 2 operation level is set.
Set with a percentage to the max. frequency (B00-4) or max. speed (B01-4).
The output frequency or the motor speed will be the comparison target.
A 1% hysteresis will occur with SPD1 and 2 operation.



C15-4

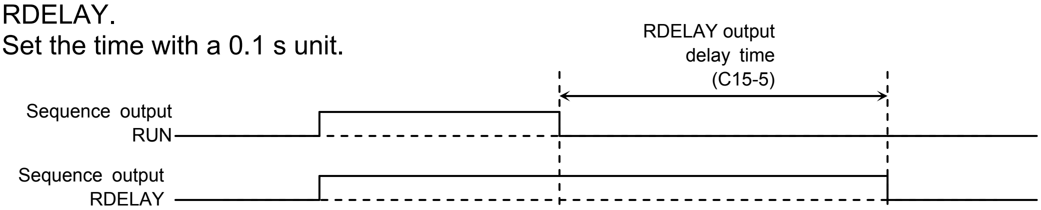
Zero speed detection (ZSP) level

The zero speed detection ZSP operation level is set.
Set with a percentage to the max. frequency (B00-4) or max. speed (B01-4).
The output frequency or the motor speed will be the comparison target.
A 1% hysteresis will occur with ZSP operation.



C15-5 RDELAY output delay time setting

Set the delay time from sequence output RUN OFF to RDELAY OFF in the sequence output RDELAY.
Set the time with a 0.1 s unit.



If the sequence output RUN turns ON again during the delay time, the ON state will continue. The conditions that cause DELAY to turn OFF at the subsequent RUN OFF will be applied after the delay time elapses again.

(Note) RDELAY is reset if the power is turned OFF.

C15-6~9 EC0 to 3 output fault selection

Set the details of the fault assigned to the sequence output EC0 to 3 with the following configuration.

0. 00. 0

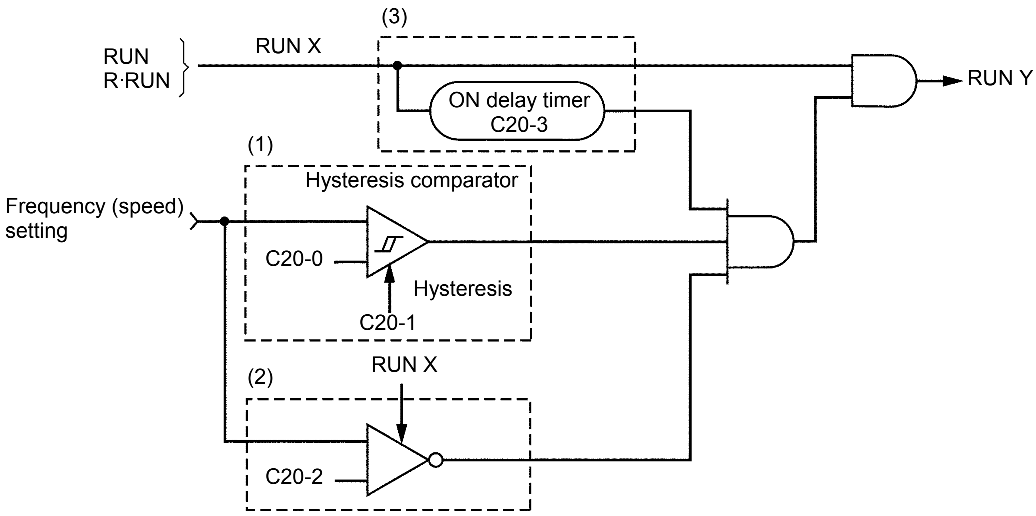
- Fault sub-code (0x0 to 0xF)
- Fault main code (0x00 to 0x13)
- 0: Major fault, 1: Minor fault

C15-A~E EC0 to 3, ALM OFF delay timer

Set the output hold time for the sequence output assigned to the minor fault output
Note that 0.0 is the setting value for holding the sequence output to the input of the fault reset signal (RST).

C20-0	**Start/stop frequencies (speeds)**
C20-1	**Start/stop frequency (speed) hysteresis**
C20-2	**Interlock frequency (speed)**
C20-3	**Run delay timer**

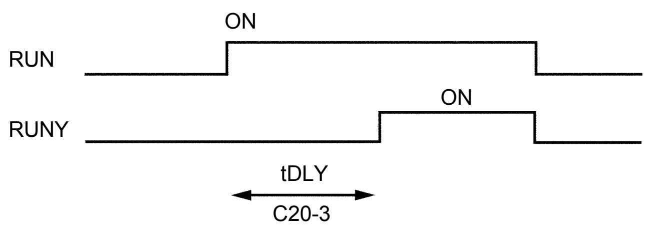
The following types of interlock can be obtained for the run RUN and R·RUN commands.



(1) Setting start/stop function
The motor will run when the frequency (speed) setting is higher than the C20-0 setting value, and will stop when lower.

(2) Start interlock
If the frequency (speed) setting value is larger than C20-2 when the run command (RUN X) is ON, the motor will not start.
Use this function when the frequency setting is to be lowered when starting for safety purposes.
Set C20-2 to 0 when not using this function.
(Note) When using the set operation start/stop and set interlock function together, set a higher interlock frequency value than that for the set operation start/stop frequency.

(3) Run delay timer
The motor will be delayed from the run command (RUN X) by the time set in C20-3.



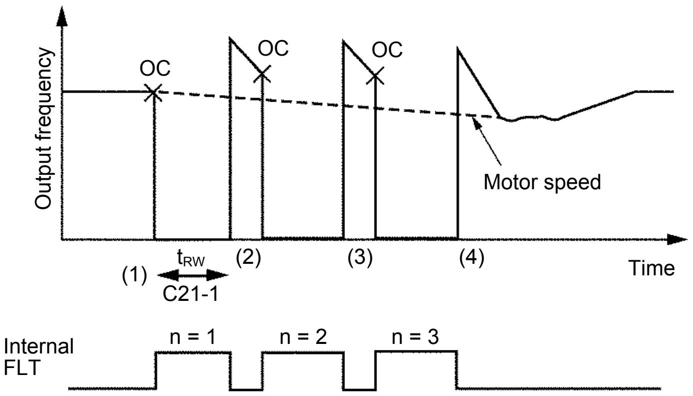
This is used for synchronization with peripheral machines such as mechanical brakes.
The run delay timer will not function in the jogging or local modes.

(Note 1) Set the parameter setting values to 0 when not using (1), (2) or (3).
(Note 2) The (1), (2) and (3) functions will not function during jogging run.
(Note 3) The (3) function will not function during the local mode.
(Note 4) When interlock is applied on (1), (2) or (3), the FWD and REV LED will flicker.

C21-0
Number of retries

C21-1
Retry wait time

Retry is a function that performs its own fault reset and restarts with pick-up. Set the number of retries, and the wait time (t_{RW}). If pick-up is not possible within the number of set times, an IO-4 fault will occur.
The errors that are targets of retry are power module (PM-n), overcurrent (OC-n), overvoltage (OU-n)(Note 3), overload (OL-n), overheat (UOH.), and ground fault (Gnd.).



(1) Waiting after trip due to OC-n.
(2) (3) Retry with pick-up.
(4) Successful pick-up, and completion of retry.

(Note 1) If C21-0=0, retry will not function.
(Note 2) During retry, FLT of the sequence output signals will not function.
(Note 3) OVT retry may not function correctly if the DC voltage drop is slow.
(Note 4) If the run command turns Off during retry, the retry will be cancelled and the FLT of the sequence output signals will turn ON.
(Note 5) The pick-up operation is not carried out during vector control with IM sensor and PM motor control (C30-0 $\boxed{f0}$ = 3,4).

⚠ CAUTION
When a fault occurs on an extremely rare case, this function automatically resets the fault and restarts the operation. If the fault occurs frequently, the inverter could be damaged, so first remove the cause of the fault.

C21-2
Pick-up wait time

The wait time t_{PW} after the output is cut off to when the pick-up operation is started is set.
Set the time to when the motor residual voltage is abated for this parameter. (The residual voltage is a voltage generated by the motor after the inverter output turns OFF, and will be abated in approx. 1 to 5 seconds. This abatement time will take longer if the motor capacity is large.)

C21-3

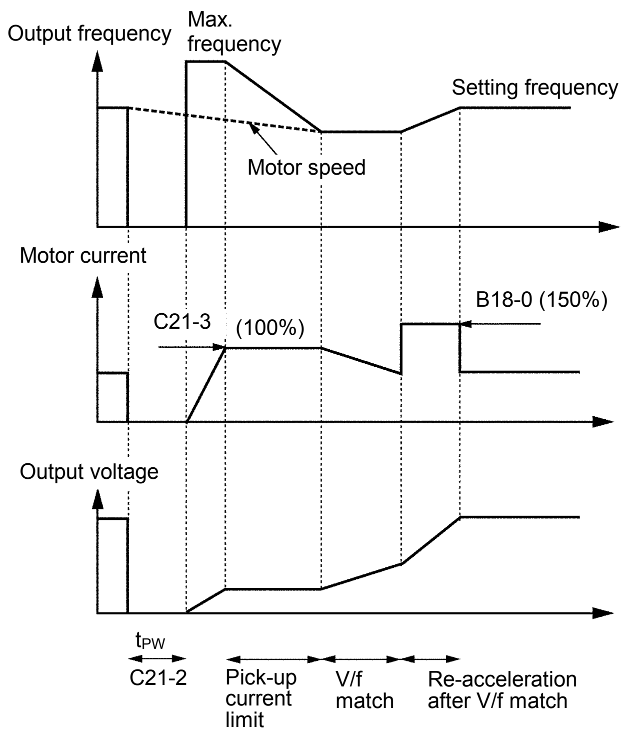
Pick-up current limit value

The current limit value during pick-up is set. This setting value is applied only during pick-up. Normally, set 100% and use.
Adjust within the following range only when the output torque at restart is to be limited.

C21-3 Setting value ≥ Applicable motor excitation current (%) +10%
(Normally 30 to 40%)

<Pick-up operation (When V/f control is selected)>

Pick-up starts when RUN or R.RUN is ON in the PICK ON state or when the power is turned on when auto start with pick-up is selected (C08-0=3).
The pick-up operation is carried out with the overcurrent limit function as shown below.



C21-4 V/f pick-up function selection

Select the pick-up function for when V/f control is selected (C30-0 $\boxed{f0}$ =1).

=1: No reverse run pick-up
Select this to restart the motor rotating in the same direction as the command when restarting after an instantaneous power failure. The motor will restart with the overcurrent limit from the maximum frequency in the same direction as the command.

=2: Reverse run pick-up enabled (FMAX)
Select this to restart the motor rotating in the same or reverse direction as the command when restarting after an instantaneous power failure. The motor rotation direction is detected first, and then is restarted with overcurrent limit from the maximum frequency in the detected direction.

=3: Reverse run pick-up enabled (estimated speed)
Select this to restart the motor rotating in the same or reverse direction as the command when restarting after an instantaneous power failure. First the motor rotation direction and frequency are detected, and then the motor restarts with the overcurrent limit from the frequency (detected value +10%) in the detected direction.

C21-5 Sensor-less pick-up function selection

Select the pick-up function for IM speed sensor-less vector control.

=1: Reverse run pick-up disabled, start search from NMAX
=2: Reverse run pick-up disabled, start search from setting value
=3: Reverse run pick-up enabled, start search from NMAX

C21-6 Speed estimation proportional gain for sensor-less pick-up

Set the speed estimation proportional gain used for pick-up during IM speed sensor-less vector control.

C21-7 Speed estimation integral gain for sensor-less pick-up

Set the speed estimation integral gain used for pick-up during IM speed sensor-less vector control.

C22-0
C22-1
C22-2
C22-3

Motor overload reference (L0)
0Hz overload (L2)
0.7 Fbase freq. overload (L1)
Motor overload breakdown reference

The operation reference for overload (OLT) is set.

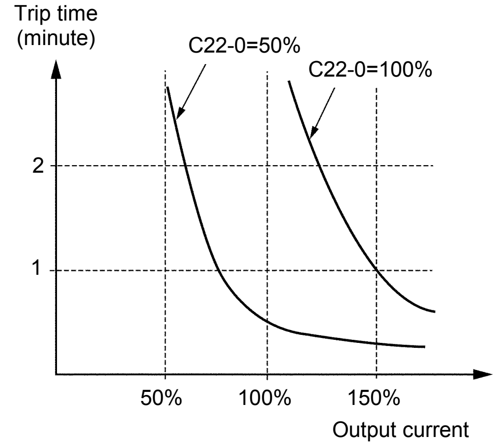
(1) Unit overload (OL-1)

Overload protection is performed under the following conditions based on the machine rated current reference.
The reference is judged as an overload when the C22-0 setting value is exceeded.

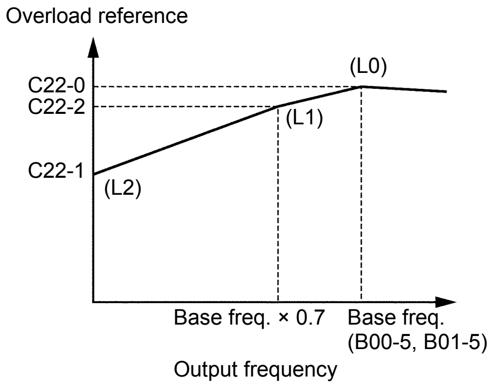
C30-0 $\boxed{f1}$ = 2 (Heavy-duty)
150% for one minute, 175% for 2.5 seconds

C30-0 $\boxed{f1}$ =1 (Normal-duty)
120% for one minute, 140% for 2.5 seconds

However, the overload reference is reduced by 50% at an output frequency of 1Hz.
The machine overload can be monitored at D02-2. Furthermore, analog output is possible if the setting value 8 is selected at C13-0, 1.



(2) Motor overload (OL-3)



Use the C22-3 setting to set the trip breakdown reference current for one minute in the case of a motor rated current (B00-6, B01-6) of 100%. When C22-3 is set to 120% for example, if C22-0 is 100%, and 120% of the motor rated current is output, a breakdown stop will occur due to a motor overload after one minute.
As shown in the diagram on the right, the counterclockwise limit characteristics change by setting C22-0. The diagram on the right is an example with C22-0 set to 100% and 50% when C22-3=150%.
For the self-cooling motor, when operating at low speed, set C22-1 and C22-2 to meet the motor characteristics. These characteristics are as shown in the diagram on the right.
The motor overload can be monitored at D02-3. Furthermore, select setting value 15 at C13-0, 1 to enable analog output.

C22-4

DBR overload

This parameter is for setting %ED of DB operation. When DB transistor or DBR built in the unit is used, set the parameter within the specification.
When 0.0 is set, the protection function is disabled. When the external DB unit is used, set to 0.0.

C22-5 Motor power loss braking setting

When the motor loss braking function is activated, set the voltage to increase with the base frequency as a percentage in respect to the rated output voltage (B00-3). Normally, 50% of the default value is set.
When the DC voltage attempts to rise due to deceleration operation or a regenerative load, the motor loss braking function raises the inverter output voltage and decreases the motor efficiency to prevent tripping by an overvoltage. This function is valid only when the motor loss braking is selected with the main circuit option selection (C31-0 $\boxed{f0}$ = 2) in the V/f control mode (C30-0 $\boxed{f0}$ = 1).

(Note 1) Take care to motor heating.
(Note 2) If the normal V/f setting is inappropriate, the motor efficiency will increase when the voltage is increased and thus tripping by the overvoltage could occur easily.

C22-6 Carrier frequency automatic reduction function selection

Select the validity of the function to automatically reduce the carried frequency to 2kHz when the inverter output current exceeds 110% of the unit's rated current and the cooling fin temperature exceeds the reference value 1, and for when the cooling fin temperature exceeds the reference value 2 regardless of the current.

C22-7 Phase failure detection function selection

Select the validity of the input/output phase failure detection function

f0: Input phase failure detection function selection
1: Function valid 2: Function invalid

f1: Output phase failure detection function selection
1: Function valid 2: Function invalid

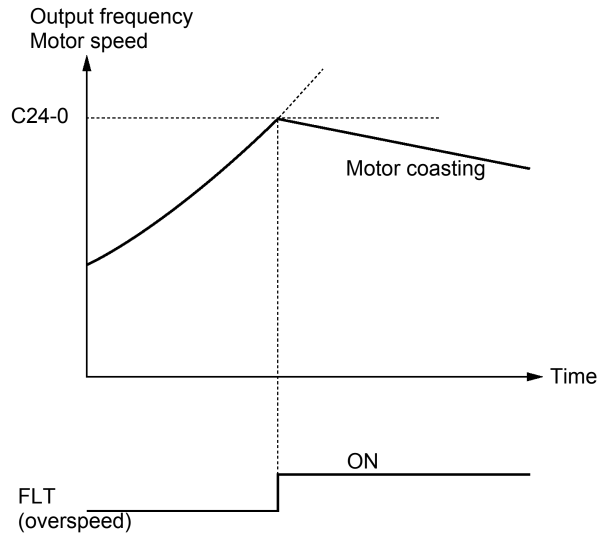
(1) Input phase failure detection
When this function is valid, a fault will be output if the inverter output current exceeds the level 55% or higher than the unit's rating and the DC voltage pulsation width exceeds 15% of the rated voltage (400V series: 600V, 200V series: 300V) for approx. 3 seconds.

(2) Output phase failure detection
When this function is valid, if the output current's 3-phase average value during normal operation exceeds 30% of the motor rated current and one of the phases has not reached 7.5% of the motor rated current, a fault will be output. A judgment time of 0.3 seconds is required when the operation frequency is 40Hz or more, and a time of the output cycle × 12-fold is required when the frequency is less than 40Hz.

(Example: When the output frequency is 5Hz, the judgment time is 0.2 seconds × 12 fold = 2.4 seconds)

C24-0 Overspeed protection level

Set the overspeed protection level. Set as a percentage in respect to the maximum frequency (B00-4) or maximum speed (B01-4). The output frequency or motor speed is the target for comparison.



C24-1 Control mode changeover during speed detection error

This is valid when vector control with IM sensor (C30-0 $\boxed{f0}$ = 3) or PM motor control (C30-0 $\boxed{f0}$ = 4) is selected.

= 1: The speed detection error is not monitored.

= 2: The speed detection error is monitored, and if an error occurs, a fault (FLT) is output. The motor then coasts to a stop.

= 3: The speed detection error is monitored, and if an error occurs, a minor fault (ALM) is output. The control changes from the vector control with IM speed sensor to the IM speed sensor-less vector control, and the operation is continued. When the speed detection returns to the normal state, the control changes again from the sensor-less vector control to the vector control with sensor, and the minor fault output is cleared. The presence of a minor fault due to a speed detection error can be confirmed with the minor fault monitor (D05-0). This is available only during vector control with IM sensor.

C24-2 Speed detection error level
C24-3 Speed detection error recovery level

This is valid when C24-1 = 3.
Set as a percentage in respect to the maximum speed (B01-4).
If the deflection of the speed detection value per 2ms increases above the value set with C24-2, it is judged as a speed detection error, and the control changes from the vector control with sensor to the sensor-less vector control. After changing, when the deflection of the speed estimated value for sensor-less vector control and the speed detection value drops to below the value set with C24-3, it will be judged that the speed detection has returned to the normal state. The control changes again from the sensor-less vector control to the vector control with sensor.

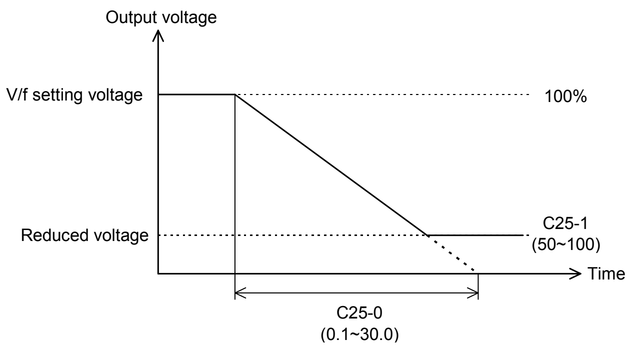
C24-4	**Control mode changeover during speed deviation error**
C24-5	**Speed deviation error level**
C24-6	**Speed deviation error judgment time**

A speed deviation error occurs when the speed command and speed detection difference is the same or higher than the speed deviation error level (C24-5), and this situation continues for longer than the speed deviation error judgment time (C24-6).

C24-7 Reverse error detection level

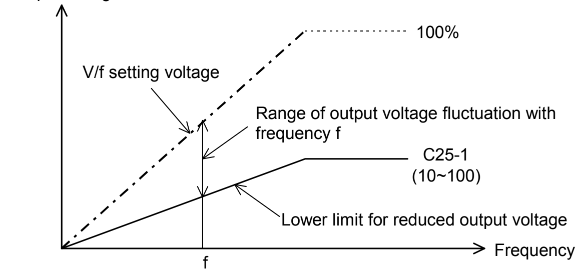
Set the error detection level for when the motor rotates in the reverse direction of the speed command.
Set using the base frequency as 100%.
The error is not detected when 0 is set.

C25-0 High-efficiency operation Voltage reduction time



This setting value is the time to reduce the output voltage from the V/f setting value to 0V after the output frequency reaches the set frequency.
Normally, the default value (10.0) is set. When using for loads with sudden torque fluctuations, and the output frequency drops remarkably with the overcurrent limit function, set an appropriately low value. If the rotation becomes unstable during the voltage reduction or recovery operations causing a trip, set an appropriately high value.
The high-efficiency operation function is valid when V/f control is selected (C30-0 $\boxed{f0}$ = 1) or auxiliary drive is selected.

C25-1 High-efficiency operation Voltage lower limit setting value



Set a value between 50 and 99 while the inverter is stopped to select the high-efficiency operation function.
When not using the high-efficiency operation function, set 100 while the inverter is stopped.
This setting value is the lower limit of the output voltage reduced when the high-efficiency operation function is selected, and uses the V/f setting voltage (output voltage when not using high-efficiency operation) as the reference.
Normally, the minimum value (50) is set. When using for loads with sudden torque fluctuations, and the output frequency drops remarkably with the overcurrent limit function, set an appropriately high value.

(Note) Slipping will increase during high-efficiency operation, so it is recommended to execute automatic tuning before operation and set the automatic torque boost selection to valid (A02-1 = 2).

<Operation of high-efficiency operation>

Normally for the V/f constant operation, the no-load loss is large with a light load, and the motor efficiency drops remarkably. Thus, according to the load, the output voltage is reduced using the C25-1 setting value as the lower limit in respect to the voltage set with V/f, and the motor efficiency is improved.

C25-2

Cooling fan ON/OFF control

=1: ON/OFF control is enabled
The cooling fan is working during the inerter operation, and it is stopped 5 minutes after the inverter stop. When the inverter is turned On, the cooling fan is working for 10 seconds.
=2: ON/OFF control is disabled
The cooling fan is working while the inverter power is On.

C26-0

Standard serial communication setting　Function selection

Select the serial communication method.
=1: Standard serial .. This is VAT2000 original protocol using ASCII codes.
=2: Modbus .... High-speed communication using binary codes is possible.

C26-1

Standard serial communication setting　Parameter protection function

The parameters shown with circles in the following table can be changed.

Setting value	Parameter A	Parameter B, C			
		Basic	Extend	S/W	H/W
1	○	○	○	○	○
2	×	×	×	×	×
3	○	×	×	×	×
4	○	×	○	×	×
5	○	×	○	○	×

○: Changeable　　× : Unchangeable

C26-2

Standard serial communication　Station No.

Set the local station No. for serial communication with the range from 1 to 247.

C26-3

Standard serial communication　Response timer

Set the minimum time for returning an answer after receiving a command during serial communication.
When Modbus communication is selected, the data frame reception complete judgment time (silent time) will be applied.

C26-4

Standard serial communication　Baud rate setting

Set the baud rate for serial communication.
=1: 4800bps　=2: 9600bps　=3: 14400bps　=4: 19200bps　=5: 38400bps
=6: 1200bps　=7: 2400bps

C26-5

Standard serial communication Stop bit setting

Set the number of stop bits for serial communication.
=1: 1bit =2: 2bit

When Modbus communication is selected, the parity setting (C26-2) has a priority. The value is fixed to 2 bits when parity is disabled, and 1 bit when parity is enabled.

C26-6

Standard serial communication Parity setting

Set the parity for serial communication.
=1: None =2: Even =2: Odd

C26-7

Base section serial communication frequency (speed) unit setting

Set the unit used as a reference for writing and reading the frequency command (speed setting command) value for the FW/FR command in the standard serial transmission function or one of the function03h, 10h settings in the Modbus communication function.

Example : C26-7=0 (for 0.01Hz or 0.1min^{-1} unit)
Standard serial command: (G01FW00000003000) :
For V/f setting : 30.00Hz is written
For vector or PM setting : 300.0min^{-1} is written
Modbus command: 0110000000020400000BB8F4ED :
For V/f setting : 30.00Hz is written
For vector or PM setting : 300.0min^{-1} is written

Example : C26-7=2 (for 0.01% unit)
Standard serial command: (G01FW00000003000) : 30.00% is written
Modbus command: 0110000000020400000BB8F4ED : 30.00% is written
% is a percentage of when 100% is the maximum frequency (B00-4) or maximum speed (B01-4).

When C26-7 is set between 3 and 5 unsigned, the - value is invalidated.

C28-0

Password No. function valid

Set the validity of the password No. when changing parameters.
=1: Function invalid =2: Function valid

When the password No. function is valid and the panel data protection function (C09-0) is set to a value other than 1, 6, or 9, C09-0 will be locked (changes disabled). To unlock the parameter, input the value recorded in Password No. Setting (C28-1) at Password NO. input (U00-1).

C28-1

Password No. setting

Set the password No. used when the password No. function is valid. Once set the display will return to 0, so make sure not to forget the set number. The default password No. is "0000", but once the password has been set, it cannot be reset to the default value even if default value load (C09-7) is executed.

C30-0 Control mode selection

Select the control mode. This parameter is set with the two digits $\boxed{f1}$ and $\boxed{f0}$.

f1: Select the unit overload mode.
- =1: Normal-duty (120%/1min)
- =2: Heavy-duty (150%/1min)

f0: Select the control mode.
- =1: V/f control
- =2: IM speed sensor-less vector control
- =3: Vector control with IM speed sensor
- =4: PM motor control with sensor
- =5: Sensor-less PM motor control (for future use)

(Note) When this parameter is changed, the motor overload breakdown reference (C22-3), overcurrent limit (B18-0), rating related parameter (B00, B01), manual torque boost voltage (A02-2), DC brake voltage (A03-0), as well as these settings in the auxiliary drive (B20 to 2F) will automatically be changed to the specified values when the parameter change is set by pressing the LCL/SET key on the operation panel. Always set this parameter first.

C31-0 Main circuit option selection

Select the usage of the motor loss braking and DB resistor (built-in or external).
Refer to the explanation on the motor loss braking setting (C22-5) for details on the motor loss braking function.
The motor loss braking function is valid when V/f control is selected (C30-0 $\boxed{f0}$ = 1) or auxiliary drive is selected.

C31-1 Ground fault detection function

Set the validity of the ground fault detection function.
When this function is valid, the output current's zero phase will be detected. If higher than the judgment value (approx. 50% of the unit rated current), a fault will be detected.

=1: Detection valid   =2: Detection invalid

C31-2 UVL proportional gain
C31-3 UVL integral time constant

Set the gain for lowering the frequency at the start of UVL operation.
The UVL function will be turned OFF if the UVL proportional gain is set to 0.
Normally, a value approx. half of the motor rated slip is set for the UVL proportional gain.
If the fault is UVT instead of UVL, reduce the UVL integral time constant.

C33-0 PS04 output parameters
C33-1 PS05 output parameters
C33-2 PS06 output parameters
C33-3 PS07 output parameters

In the same way as C13-2 to 6, select the number of the signal to be output from List of Parameters.
Refer to the Relay Option Manual for details on the output terminals.
This parameter does not appear when the relay option PCB is not mounted.

C34-6

Data range selection

Select the data range for the transmission input/output data.

Data Range Selection Table.

Setting value	Data size	Sign	Frequency setting		Speed setting	
			Data range	Unit	Data range	Unit
0	16bit	Unsigned	0d～44000d	0.01Hz	0d～65535d	$0.1min^{-1}$
1			0d～4400d	0.1Hz	0d～7200d	$1min^{-1}$
2			0d～10000d	0.01%	0d～10000d	0.01%
3		Signed	-32768d～32767d	0.01Hz	-32768d～32767d	$0.1min^{-1}$
4			-4400d～4400d	0.1Hz	-7200d～7200d	$1min^{-1}$
5			-10000d～10000d	0.01%	-10000d～10000d	0.01%
6	32bit	Unsigned	0d～44000d	0.01Hz	0d～72000d	$0.1min^{-1}$
7			0d～4400d	0.1Hz	0d～7200d	$1min^{-1}$
8			0d～10000d	0.01%	0d～10000d	0.01%
9		Signed	-44000d～44000d	0.01Hz	-72000d～72000d	$0.1min^{-1}$
10			-4400d～4400d	0.1Hz	-7200d～7200d	$1min^{-1}$
11			-10000d～10000d	0.01%	-10000d～10000d	0.01%

C50-0

Encoder pulse divided output setting

When using the speed detection option U30V24DN1, DN2, the signals input from the encoder can be divided by 1/N, and output as 2-phase pulses (A, B phases) with 90° phase difference from the PAOUT and PBOUT terminals.
Set the division ratio N with this parameter.
Adjust the setting value so that the output signal is up to 70kHz.

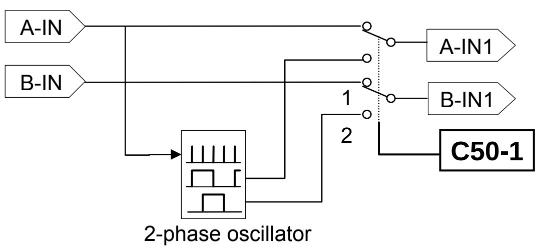
C50-1

2-phase, 1-phase encoder selection

Select the number of signals (2-phase, 1-phase) for the encoder being used.

C50-1 = 1: This is set when using an encoder that outputs a 2-phase pulse (A, B-phase) having a 90° phase difference.
The rotation direction can be judged, and the speed can be stably controlled even at low speeds.
Set the No. of pulses for one phase in the No. of encoder pulses (B01-8).

C50-2 = 2: This is set when using an encoder that outputs a 1-phase pulse.
Connect the input signal to the A or B phase input, and always leave one phase unconnected.
The 1-phase pulse signal for a proximity sensor, etc., is converted internally into a 2-phase signal.
With the 1-phase pulse mode, the rotation direction is recognized as the operating command direction. The forward run and reverse run directions are not judged.
A speed detection error could occur due to the effect of chattering in low speed areas, so use a 2-phase encoder when carrying out low-speed run or forward/reverse run.



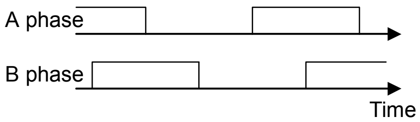
(Note 1) The 1-phase pulse mode cannot be used with the PM control mode.
(Note 2) The speed detection direction (symbol) when 1-phase input is selected is determined based on the movement direction.
(Note 3) In the case where ACR control is performed using vector control with an IM speed sensor when 1-phase input is selected, this is identified as the rotation direction outlined in Note 2. Exercise due caution with regards to the acceleration direction.

C50-2

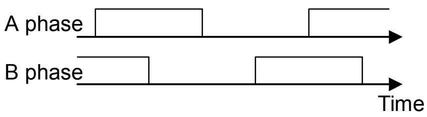
Encoder AB advance direction selection

The motor's rotation direction is judged by the advance and delay of the encoder's A and B phase pulse phase.
Refer to the following diagram and set this parameter according to the phase relation of the encoder's AB phase signal during forward run (CCW rotation).

(Note) If C50-2 is set to 2, set C50-3 to 0.



(a) When C50-2 is 1 (CCW rotation)



(b) When C50-2 is 2 (CCW rotation)

C50-3

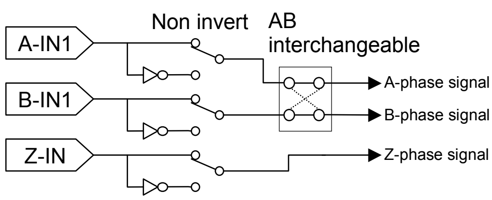
Encoder ABZ pulse type selection

When using an encoder with signal specifications which cannot be handled with the C50-2 and C51-2 settings, set C50-3 and invert or interchange the signals.

(Note) When C50-2 and C51-2 are set, set C50-3 to 0 (signal invert/interchange invalid).

The signal conversion circuit will operate with the combinations shown below according to the C50-3 setting No.

C50-3 setting value	A-IN Non invert / Invert	B-IN Non invert / Invert	Z-IN Non invert / Invert	AB inter-change
0	–	–	–	Inter-change invalid
1	Invert	–	–	
2	–	Invert	–	
3	Invert	Invert	–	
4	–	–	Invert	
5	Invert	–	Invert	
6	–	Invert	Invert	
7	Invert	Invert	Invert	
8	–	–	–	AB inter-change
9	Invert	–	–	
10	–	Invert	–	
11	Invert	Invert	–	
12	–	–	Invert	
13	Invert	–	Invert	
14	–	Invert	Invert	
15	Invert	Invert	Invert	



Pulse conversion circuit

C-51-0

Encoder selection

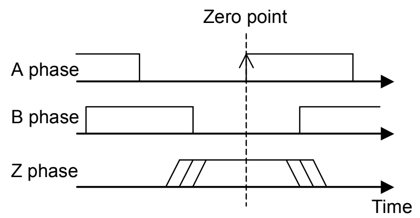
Select the type of encoder signals being used.

=1 : A, B, Z-phase + U, V, W-phase signal
=2: A, B, Z-phase + serial absolute signal
=3: A, B, Z-phase + U, V, W-phase signal (reduced wiring)
=4: SIN, COS signal

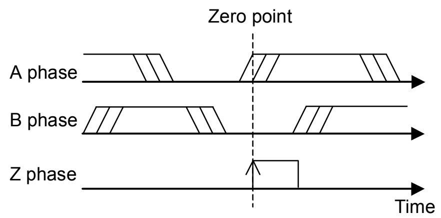
C-51-1 AB phase-Z phase type selection
C-51-2 Encoder Z signal reversal

With the VAT300, the A, B and Z phase pulse encoder signals are defined as waveforms which are generated as shown below during forward run (CCW rotation).
C51-1 is set according to the relation of the A phase signal's rising edge and Z phase signal phase. With this setting and at a time of reverse running, the A phase signal's down edge during the Z phase being high is the zero point.
Set C51-1 to 0 when the A phase signal's rising edge is generated while the Z phase signal is High (Fig. (a)). In this case, the A phase signal's rising edge is the zero point (magnetic pole position). In all other cases, set C51-1 to 1. In this case, the Z phase signal rising edge is the zero point. (Fig. (b)) In this case, the Z phase rising edge is the zero point even at a time of the reverse running.
If the Z phase signal needs to be inverted to match the signal definition shown below, set C51-2 to 1.

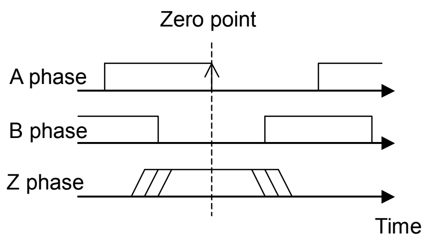
(Note) When C51-2 is set to 1, set C50-3 to 0.



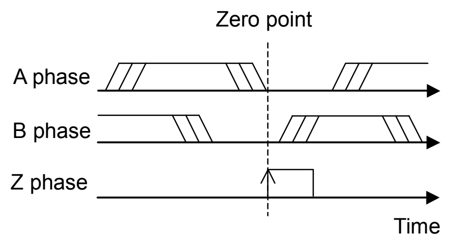
(a) When C51-1 is 0 (CCW rotation)



(b) When C51-1 is 1 (CCW rotation)



(c) When C51-1 is 0 (during CW rotation)

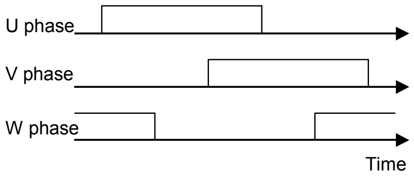


(d) When C51-1 is 1 (during CW rotation)

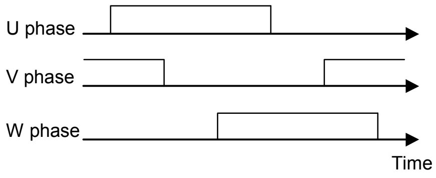
C-51-3 Encoder UVW advance direction selection
C-51-6 Encoder UVW pulse type selection

Set these parameters when using an A, B, Z phase + U, V, W phase signal encoder or reduced wiring type A, B, Z phase + U, V, W phase signal encoder.
When using the reduced wiring A, B, Z phase + U, V, W phase signal encoder, the VAT300 defines the initial signals input to the A, B, Z phases signal cables as the U, V and W phase signals respectively.

Refer to the following diagram and set C51-3 according to the encoder's U, V, W phase signal phase relation during forward run (CCW rotation).



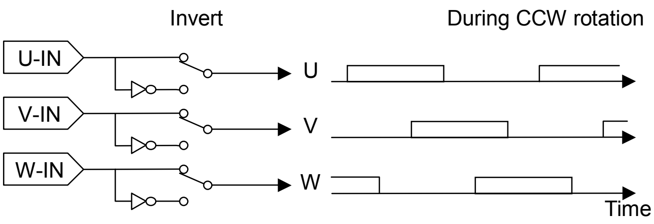
(a) When C51-3 is 1 (CCW rotation)



(b) When C51-3 is 2 (CCW rotation)

When using an encoder with signal specifications which cannot be handled with the C51-3 setting, refer to the following diagram and table and invert the signals by setting C51-6.
When C51-3 is set to 2, set C51-6 to 0 (signal invert invalid).

Setting No.	**U-IN Non invert / Invert**	**V-IN Non invert / Invert**	**W-IN Non invert / Invert**
0	–	–	–
1	Invert	–	–
2	–	Invert	–
3	Invert	Invert	–
4	–	–	Invert
5	Invert	–	Invert
6	–	Invert	Invert
7	Invert	Invert	Invert

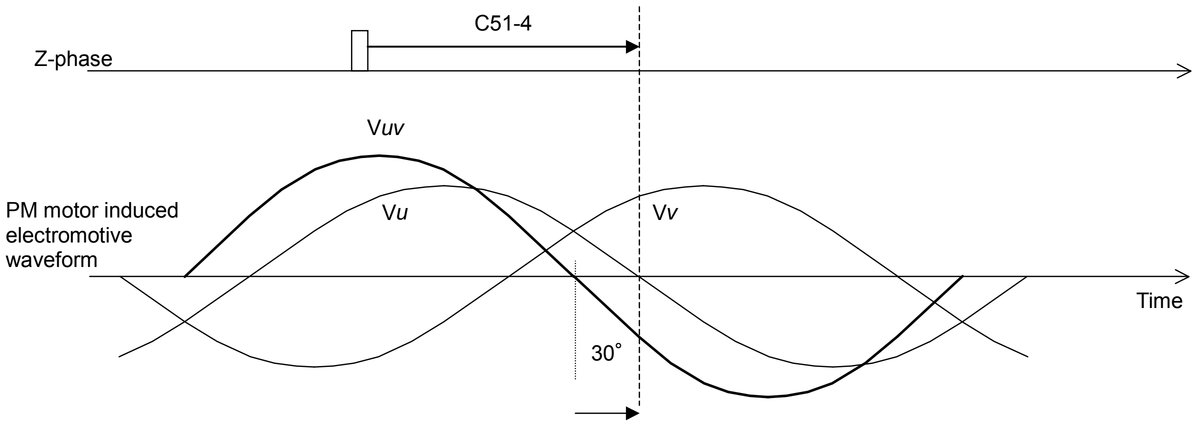


Pulse conversion circuit

C51-4

Z-IN → U phase winding phase angle

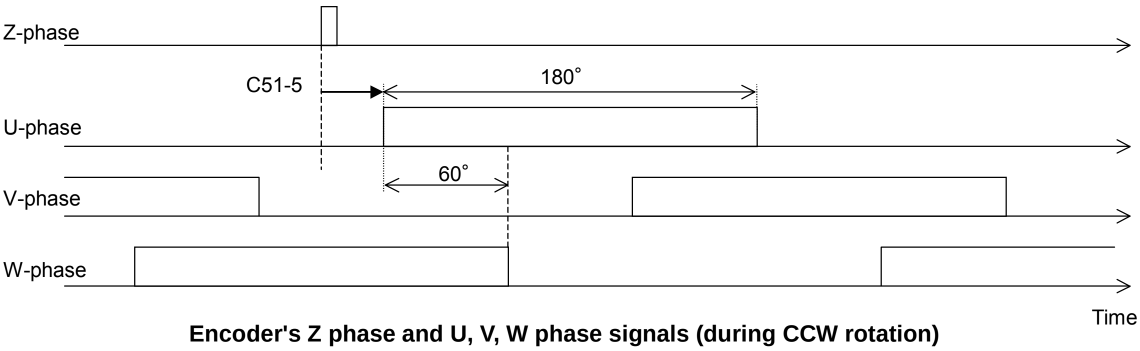
Observe the encoder's Z phase pulse and the inter-linear voltage waveform across the motor terminal UV phases during forward run (CCW rotation), and obtain the phase angle (electric angle) from the relation shown below using the Z phase pulse as a reference.
This parameter can be automatically adjusted with the automatic tuning function. Refer to section 3-5-3. Refer to section 3-5-4 for the adjustment method when using the magnetic pole estimation function.



Relation of encoder Z phase pulse and PM motor induced electromotive waveform phase (during CCW rotation)

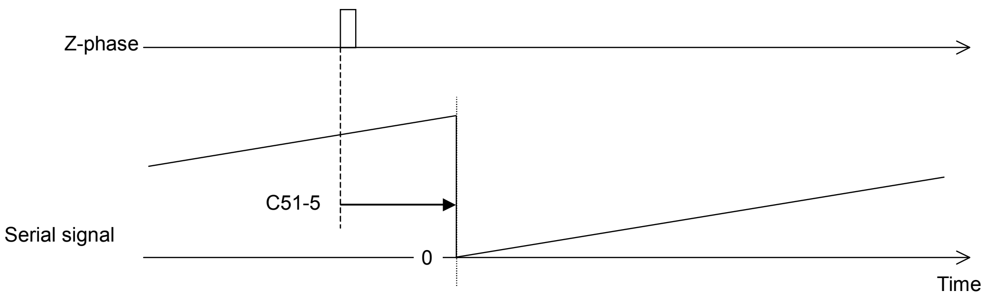
C51-5 Z-IN → U pulse angle

1) When using A, B, Z, phase + U, V, W phase signals or reduced wiring A, B, Z phase + U, V, W phase signals
   If there is a phase difference between the Z phase pulse and U phase pulse of the encoder in use, set the phase difference in C51-5.
   Set "0°" if there is no phase difference between the Z phase and U phase pulses.



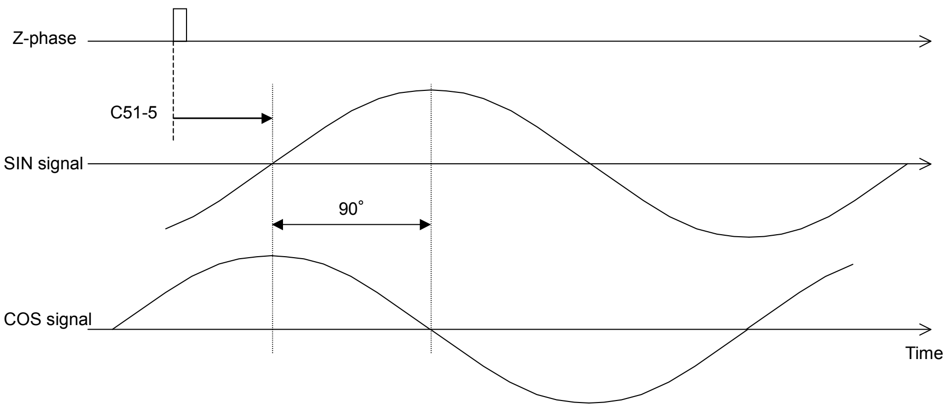
Encoder's Z phase and U, V, W phase signals (during CCW rotation)

2) When using A, B, Z phase + serial absolute signals
   If there is a phase difference between the Z phase pulse and serial absolute signal zero point, set that phase difference with an angle unit.



Encoder's Z phase and serial absolute signal (during CCW rotation)

3) When using sine wave signals
   Set the phase of the sine wave signal when the encoder's Z phase pulse is generated in C51-5.



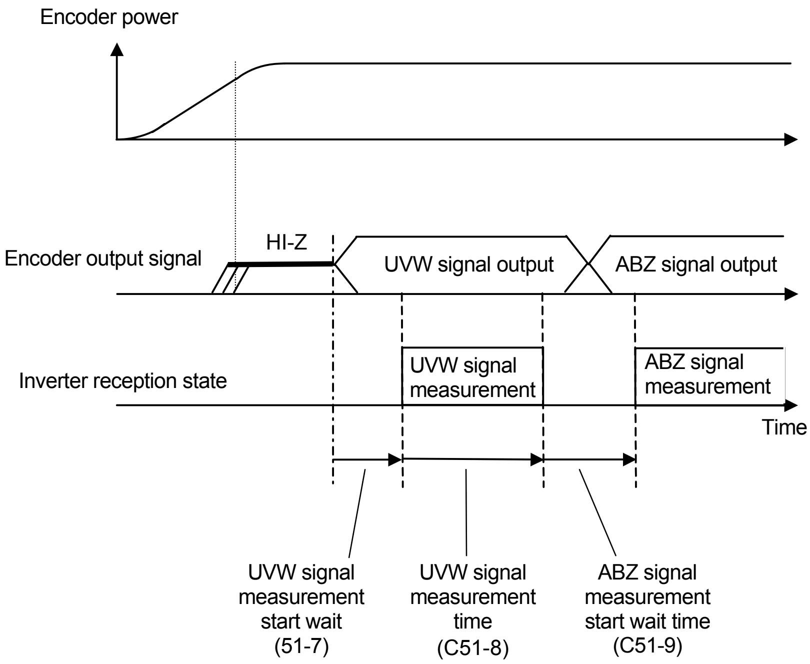
Encoder's Z phase and sine wave signal (during CCW rotation)

C51-7
C51-8
C51-9

UVW measurement start wait time [For reduced wiring ABZUVW]
UVW measurement end time [For reduced wiring ABZUVW]
ABZ measurement start wait time [For reduced wiring ABZUVW]

These parameters are set when using the reduced wiring type A, B, Z phase + U, V, W phase signal encoder. Set the parameters according to the specifications of the encoder in use.

When the power is turned ON to the encoder, the A, B and Z phase signal cables are at a high impedance (hereinafter, HI-Z). Set the UVW signal measurement start time in C51-7 using the time that the three signal cables are released from the high impedance state as a reference.
Set the UVW signal measurement end time in C51-8 using the UVW signal measurement start time (C51-7) as a reference.
(If the UVW signal cannot be measured within this time, the fault "SP-6" will be output.)
Set the time to start control with the ABZ signal in C51-9 using the UVW signal measurement end time (C51-8) as a reference.
(Note) The timer runs at a 2ms cycle, so all times set here must be as even umber.



6-6-5 Explanation of Block-U parameter functions

U00-0

Parameter copy function

The inverter parameters can be saved in the non-volatile memory in the operation panel. Conversely, the saved parameters can be read to the inverter's non-volatile memory. This function is handy for setting the same parameters in several inverters. Note that all operations in this function, including save, load, verify check and clear, must be executed while the inverter is stopped.

1001: Save
The inverter parameters are saved in the non-volatile memory in the operation panel.

2002: Load
The parameters saved in the operation panel's non-volatile memory are read out to the inverter.

Note) When parameter data exceeding the set range could be read out, such as when using inverters with different capacities, the parameters outside of the setting range may be loaded and the parameter settings may be unset. In this case, always turn the power OFF and ON once. If dEF. appears when the power is turned ON again, enter D20-2 and set the unset parameters.

3003: Verify check
The parameter data saved in the operation panel's non-volatile memory is compared against the parameter data saved in the inverter's non-volatile memory. EP. Err appears if the parameters are different.

4004: Clear
The operation panel's non-volatile memory is cleared.

U00-1

Password No. setting

If the panel data protection function (C09-0) is locked, input the four-digit value set with password No. setting (C28-1) into this parameter and unlock the function.
The default password No. is "0000".

U10-0

Built-in PLC No. of execution banks

Set the number of banks executed with the built-in PLC in the range of 0 to 20.
If 0 is set, the built-in PLC function will be invalid.
Refer to section 6-11 for details on the built-in PLC function.
* For the ROM version 9457.0+9458.4 and thereafter, the configuration is changed from 64-command * 5-bank to 16-command * 20-bank.

U10-1~8

Built-in PLC parameter

Set the user parameters usable with the built-in PLC.
Set with a hex value.

U20-0~7
U21-0~7

Built-in PLC command bank 1

Set the built-in PLC command. The commands are executed in order from the small numbers.
This is valid when U10-0 is set to 1 or higher.
Refer to section 6-11 for details on the built-in PLC function.

U22-0~7
U23-0~7

Built-in PLC command bank 2

This is valid when U10-0 is set to 2 or higher.

U24-0~7
U25-0~7

Built-in PLC command bank 3

This is valid when U10-0 is set to 3 or higher.

U26-0~7
U27-0~7

Built-in PLC command bank 4

This is valid when U10-0 is set to 4 or higher.

U30-0~7
U31-0~7

Built-in PLC command bank 5

This is valid when U10-0 is set to 5 or higher.

U32-0~7
U33-0~7

Built-in PLC command bank 6

This is valid when U10-0 is set to 6 or higher.

U34-0~7
U35-0~7

Built-in PLC command bank 7

This is valid when U10-0 is set to 7 or higher.

U36-0~7
U37-0~7

Built-in PLC command bank 8

This is valid when U10-0 is set to 8 or higher.

U40-0~7
U41-0~7

Built-in PLC command bank 9

This is valid when U10-0 is set to 9 or higher.

U42-0~7
U43-0~7

Built-in PLC command bank 10

This is valid when U10-0 is set to 10 or higher.

U44-0~7
U45-0~7

Built-in PLC command bank 11

This is valid when U10-0 is set to 11 or higher.

U46-0~7
U47-0~7

Built-in PLC command bank 12

This is valid when U10-0 is set to 12 or higher.

U50-0~7
U51-0~7

Built-in PLC command bank 13

This is valid when U10-0 is set to 13 or higher.

U52-0~7	
U53-0~7	

Built-in PLC command bank 14

This is valid when U10-0 is set to 14 or higher.

U54-0~7	
U55-0~7	

Built-in PLC command bank 15

This is valid when U10-0 is set to 15 or higher.

U56-0~7	
U57-0~7	

Built-in PLC command bank 16

This is valid when U10-0 is set to 16 or higher.

U60-0~7	
U61-0~7	

Built-in PLC command bank 17

This is valid when U10-0 is set to 17 or higher.

U62-0~7	
U63-0~7	

Built-in PLC command bank 18

This is valid when U10-0 is set to 18 or higher.

U64-0~7	
U65-0~7	

Built-in PLC command bank 19

This is valid when U10-0 is set to 19 or higher.

U66-0~7	
U67-0~7	

Built-in PLC command bank 20

This is valid when U10-0 is set to 20.

6-7 Setting the overload mode

6-7-1 Selecting the overload mode

Select one of the following modes according to the applicable load. If there is no difference in the load and unit capacity, the unit could be overloaded. Refer to the following table and select the mode which suits the load.

Unit overload mode	Explanation	C30-0 f1
1) Normal-duty setting (Normal-duty)	Select this when the ratio of the maximum load in respect to the rated load is low. The overload reference is 120% of the unit's rated current for one minute.	1
2) Heavy-duty setting (Heavy-duty)	Set this when the ratio of the maximum load in respect to the rated load is high. The overload reference is 150% of the unit's rated current for one minute.	2

(1) For the default setting, = 1: normal-duty setting (Normal-duty) is selected, so change the setting according to the application. When this parameter is selected, there are parameters with setting values and setting ranges that also fluctuate, so this parameter must be set before the other parameters.

(2) The parameters with setting values and setting ranges that fluctuate when this parameter is selected are shown below.

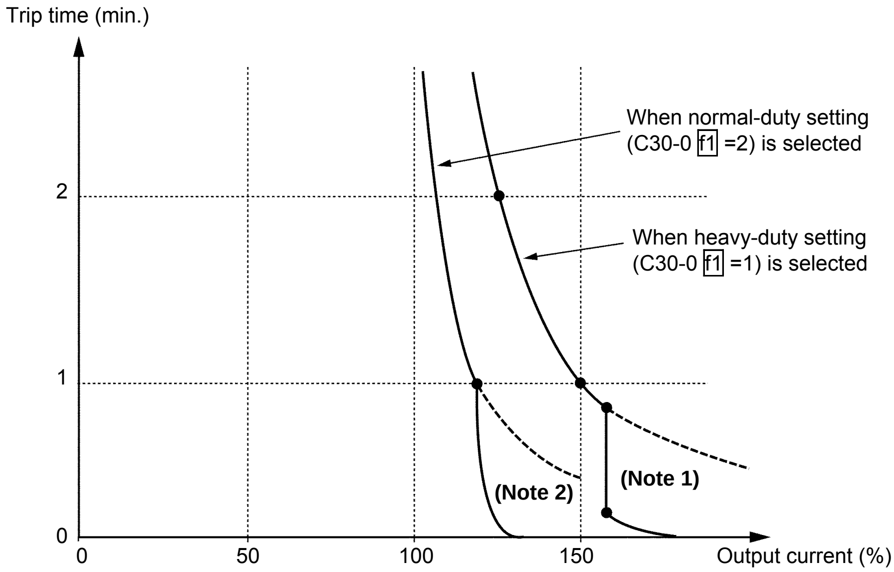
No.	Name		Min. value	Max. value	Default value	Unit	Function
A02 - Torque boost							
2	Manual torque boost setting		0.00	20.00	**(Note 1)**	%	Setting of torque boost at 0Hz. This is automatically adjusted by the automatic tuning.
A03 - DC brake							
0	DC braking voltage		0.01	20.00	**(Note 1)**	%	This is automatically adjusted by the automatic tuning. When setting manually, monitor the output voltage and change the setting in increments of 1% or less.
B00 - Output rating							
6	Motor rated current	Normal-duty	Heavy-duty rating Current × 0.3	Inverter rating **(Note 2)**	Inverter rating **(Note 2)**	A	Reference value for overcurrent limit, OLT, current % display, analog input and output.
		Heavy-duty					
B18 – Current limit							
0	Drive current limit	Normal-duty	50.	300.	125. **(Note 3)**	%	
		Heavy-duty			155.		
C22 – Overload							
3	Motor overload breakdown reference	Normal-duty	110.	300.	120.	%	A breakdown stoppage (OL-3) will occur after 1 minute with the motor rated reference current value at this value.
		Heavy-duty			150.		

(Note 1) The default value differs according to the inverter capacity and overload mode selection.
(Note 2) The normal-duty rated current value and heavy-duty rated current value shown in Table 1 are used for the unit's rating values.
(Note 3) When switching the overload mode selection from the heavy-duty setting to the normal-duty setting, 125 is forcibly set.

6-7-2 Overload characteristics

(1) Machine overload (OL-1)

The unit overload detection curve changes in sequence with the overload mode selection.
The machine overload characteristics are shown below.
Note that the unit rating current for the normal-duty setting and heavy-duty setting is the reference for the current value (%).



Overload characteristics (machine overload)

(Note 1) When the normal duty operation is selected, an overload inverse time characteristic of 120%, 60s is enabled.
Note that if 122% of the normal-duty rated current is exceeded, a trip will occur at the 140% for 2.5s inverse time characteristics. When the 1.0Hz or less, the trip will occur at inverse time characteristics which drop linearly to 60% for 60s of the normal-duty rated current.

(Note 2) When the heavy duty operation is selected, an overload inverse time characteristic of 150%, 60s is enabled.
Note that if 155% of the heavy-duty rated current is exceeded, a trip will occur at the 175% for 2.5s inverse time characteristics. When the 1.0Hz or less, the trip will occur at inverse time characteristics which drop linearly to 75% for 60s of the heavy-duty rated current.

(2) Motor overload (OL-3)

This overload protection is a time limit trip based on motor overload reference (C22-0) and motor overload breakdown reference (C22-3).
For example if C22-0=100% and C22-3 = 120%, the protection will trip if the motor reaches a current 120% for 60s.
Refer to C22-0 to 3 in item 6-6 for further details.

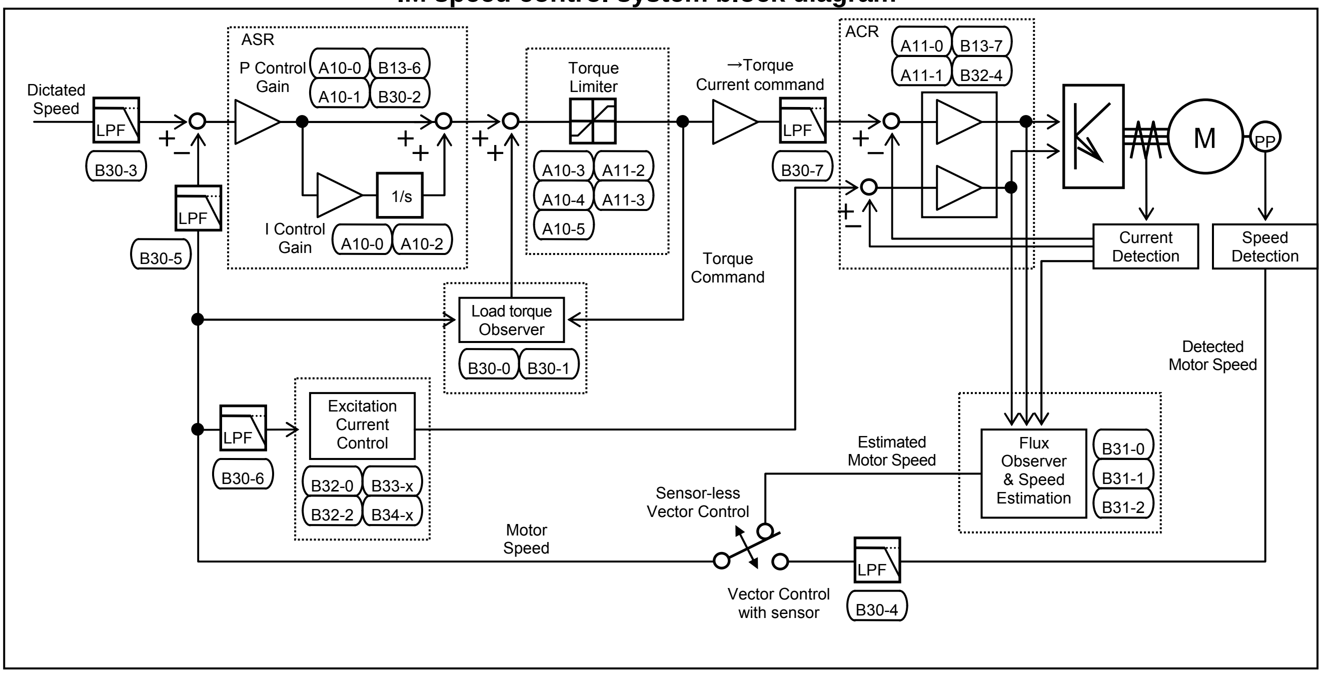
6-8 Adjusting the IM vector control speed control related parameters

When running the IM with the VAT300, ASR operation is possible by executing automatic tuning and setting simple speed control parameters. However, when carrying out high-response or high-accuracy control, the parameters must be adjusted in detail. In this section, the configuration of the speed control system is explained, and the adjustment parameters that need to be adjusted are indicated.

6-8-1 Speed control system of IM vector control

The speed control system of IM vector control is configured of blocks as shown below. Automatic tuning is used for adjusting the exciting current control, current regulator, flux observer and speed estimation mechanism, so these parameters often do not need to be adjusted. However, the parameters related to the speed regulator, torque limiter, load torque observer, various low path filters, etc., must be adjusted according to the user's system. Thus, these cannot be simply adjusted with automatic tuning. The final user of the system must adjust these parameters to match the system. Adjustments are carried out while referring to the block diagram below.

IM speed control system block diagram



(Note) The related parameter Nos. are indicated in the above function blocks.

6-8-2 IM speed regulator

The IM motor speed regulator (ASR) is configured of PI control, and has the following parameters.

Parameter No.	Parameter	Function
A10-0	ASR response	The required ASR response radian frequency is set.
A10-1	Machine time constant-1	The time (Tm) to accelerate the motor and load's torque inertia to the base speed at the rated torque is set. (Note)
A10-2	Integral time constant compensation coefficient	The compensation coefficient applied on the integral time constant of the speed regulator (ASR) is set. Increase the compensation coefficient when the overshooting is large during speed control.
B13-6	ASR gain compensation in constant power range	This sets the ASR P gain compensation value at the max. speed. By adjusting this parameter, the ASR P can be compensated in the constant power range. If ASR hunting occurs in the sensor-less control's constant output range, set a smaller value.
B30-2	ASR proportional item change rate limit	If the speed setting value or motor speed change suddenly, this will prevent the ASR's P item from suddenly changing.

(Note) The machine time constant Tm is expressed with the following expression.

$$Tm\ [ms] = 10.97 \times J\ [kg \cdot m^2] \times (Nbase\ [min^{-1}])^2\ /\ Power\ [W]$$

J : Total inertia $[kg \cdot m^2]$ (= 1/4 × GD^2 $[kgf \cdot m^2]$)
Nbase : Base speed $[min^{-1}]$
Power : Motor rated output [W]

6-8-3 Torque limiter for IM speed control

The output torque is limited. Set an appropriate value for protecting the load side.

Drive torque limiter: Set this to a large value to increase the torque during driving. Note that output torque control is performed even by the output current limiter (B18-0), so when set excessively, the set torque may not be attained.

Regenerative torque limiter: Set this to a large value to increase the torque during regeneration. Note that output torque control is performed even by the output current limiter (B18-0), so when set excessively, the set torque may not be attained. If the DBR or PWM converter, etc., are not provided and an excessively large setting is made, an overvoltage trip could occur during regeneration. In this case, lower the regeneration torque limiter setting.

Parameter No.	Parameter	Function
A10-3	ASR drive torque limiter	The limit value for the ASR drive side is set.
A10-4	ASR regenerative torque limiter	The limit value for the ASR regenerative side is set.
A10-5	Emergency stop regenerative torque limiter	The ASR regenerative side limit value applied during the emergency stop mode is set.
A11-2	ACR drive torque limiter	The ACR drive side limit value is set.
A11-3	ACR regenerative torque limiter	The ACR regenerative side limit value is set.

6-8-4 IM exciting current control

The exciting current is controlled to establish the secondary flux. A current reduction process in the constant output range or during voltage saturation, and high-speed magnetizing control to raise the secondary flux at a high speed are also carried out.

Parameter No.	Parameter	Function
B32-0	Speed flux control gain	This is the control gain used for high-speed control of the secondary flux when starting operation. Use this to control the secondary flux at a high speed at the start of operation or during operation in a constant output range. High speed control is possible by increasing the gain, but if increased too high, the magnetizing current may hunt.
B32-2	Voltage saturation compensation selection	If the output voltage in control is larger than the voltage that can be output by the inverter, select this control to limit the exciting current to prevent the current or torque from hunting. Select this when raising the output voltage to near the input voltage, or when the input voltage changes. Note that if voltage saturation occurs, some torque ripple will occur. In this case, lower the B01-9 no-load output voltage setting to avoid voltage saturation. Note that the output also decreases in proportion to the voltage.
B33-x	Table reference speed	This is the table reference speed used to perform excitation inductance variation compensation.
B34-x	M' fluctuation compensation	This compensates the exciting inductance fluctuation according to the B33 table reference speed. The compensation table is set in order to keep a constant output voltage, when operation is performed without load. * This is adjusted by the automatic tuning mode 4. (B19-0=4)

<Setting the table reference speed>

When all of B34 is set to the default value (=100%), B33 will be automatically set as shown below when adjusted with automatic tuning mode 4 (B19-0=4).
When set manually and the motor largely fluctuates immediately after M' enters the constant output range, the voltage error can be reduced by setting the base speed carefully.

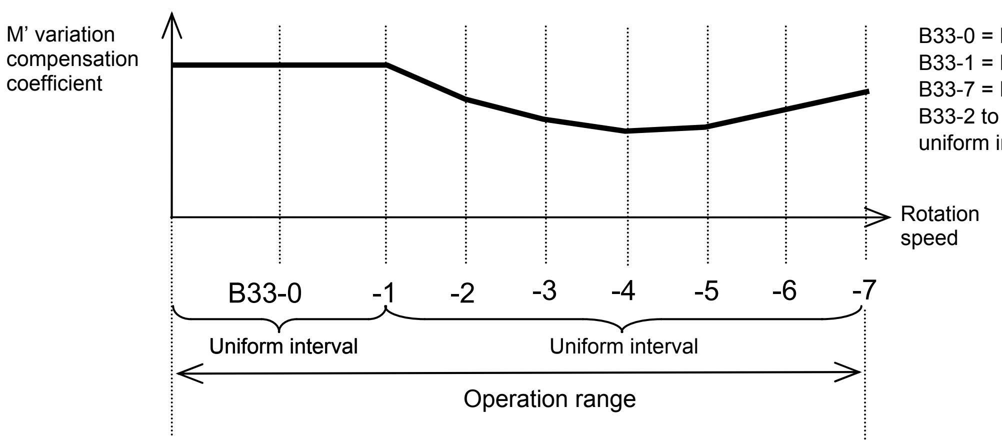


Table reference speed setting method

6-8-5 IM current regulator

The current regulator (ACR) is configured of PI control, and has the following parameters.

Parameter No.	Parameter	Function
A11-0	ACR response	The ACR response radian frequency is set. If the response is too low or too high, the current will become unstable, and the over current protection will function.
A11-1	ACR time constant	The ACR time constant is set. If the time constant is too long or too short, the current will become unstable, and the over current protection will function.
B13-7	ACR gain compensation in constant power range	This sets the ACR P gain compensation value at the max. speed.
B32-4	ACR voltage model FF selection	The voltage fluctuation caused by the leakage inductance is feed forward controlled. The current regulator (ACR) response speed will be increased. Select this if the current hunts in the high-speed operation range during sensor-less control.

6-8-6 IM flux observer and speed estimation mechanism

These are parameters used with speed sensor-less vector control.

Parameter No.	Parameter	Function
B31-0	Flux observer gain	This is the feedback gain for the flux observer. If hunting occurs at the estimated speed in the high-speed operation range, adjust within the range of 1.2 to 0.9.
B31-1	Speed estimated proportional gain	This is the proportional gain for the adaptive speed estimation mechanism. To increase the speed estimation response, set a large value. Note that if the value is too high, the speed estimation value will hunt.
B31-2	Speed estimated integral gain	This is the integral gain for the adaptive speed estimation mechanism. To increase the speed estimation response, set a large value. Note that if the value is too high, the speed estimation value will hunt.

6-8-7 IM load torque observer

The disturbance load applied on the motor is calculated and the torque command is compensated.
To increase the response toward disturbance, use the load torque observer.
By setting the speed regulator (ASR) to P and using the load torque observer, overshooting can be suppressed.

Parameter No.	Parameter	Function
B30-0	Load torque observer gain	Set the observer gain for the load torque observer. To increase the responsiveness of the external disturbance response characteristics, set a large gain. Note that if the gain is set too high, the output torque could hunt. When set to zero, the load torque observer will not function.
B30-1	Model machine time constant	Set the model machine time constant used by the load torque observer.

6-8-8 Various low path filters of IM vector control

The time constants of the low path filters used for speed detection, speed commands or torque current commands, etc., are set.
By adjusting these time constants, vibration caused by noise and overshooting can be suppressed.
Note that if an excessively high value is set, the control performance could drop.

Parameter No.	Parameter	Function
B30-3	Speed setting LPF time constant	Overshooting can be suppressed by setting this to the filter time constant equivalent to the speed response.
B30-4	Speed detection LPF time constant	The speed detection noise is cut.
B30-5	Speed detection LPF time constant for ASR	Set the low path filter time constant used for the speed detection value input into the speed regulator.
B30-6	Speed detection LPF time constant for compensation	Set the low path filter time constant used for the speed detection value for constant output range compensation or iron loss compensation, etc.
B30-7	Torque current command setting LPF time constant	Set the low path filter time constant used for the torque current command.
B30-8	LPF time constant for drooping	Set the low pass filter time constant applied on the dropping value input into the speed regulator.

6-9 Adjusting the PM motor control system parameters

A PM motor with sensor can be controlled with the VAT300. The position detection (speed detection) option dedicated for PM motor operation is required for this. The control of PM motor with sensor has basically the same torque control functions as the IM vector control with sensor, so either ASR operation or ACR operation is possible.
The differences with the IM vector control are listed below.

IM vector control with sensor	PM motor vector control
Only the speed detection is required.	Position detection (rotary encoder) and speed detection option are required.
By controlling the exciting current, the induced electromotive force can be controlled.	The permanent magnet's flux is constant so the terminal voltage is controlled by passing a weak field current. Thus, the constant output range is narrow compared to IM.
DC braking is possible. Even when rotating with the load external force, the machine will stop at the position after movement.	The DC excitation state is established during DC braking. Thus, a torsion angle is generated according to the load torque. The original position is returned to when the load is removed.
The 3-phase inductance is equivalent.	The d axis and q axis inductance differs for the IPM (interior magnet type) motor.
There is a excitation current flow even at no load.	The current is approx. zero during a no-load. (When the weak field current control is not functioning.)
There is a time lag between the generation of the exciting current and the generation of the secondary flux, so the torque generation at starting is delayed.	The torque can be output simultaneously with the current generation at starting.
Even during the motor is running, the terminal voltage stays at zero even when the gate is cut off.	While the motor is rotating, an induced electromotive force is generated at the motor terminal even if the gate is cut off. When an overspeed is reached, a regenerative current is generated to the inverter and can cause an overvoltage.

Precautions for using PM motor

(a) The current is approximately zero during the no-load. It cannot be determined that "the inverter is stopped because the ammeter reading is zero."

(b) Even if the inverter “CHARGE” LED is not illuminated, motor terminal induced electromotive force occurs while the motor is rotating. There is a possibility of electric shock, and therefore always connect cables after the motor has come to a complete stop. If the speed is significantly higher than the base speed when driving from the load side, the power will be regenerated from the motor, the inverter DC voltage will increase, a voltage overload will occur, and the motor could break down. A mechanical brake or other such protective device is required when external operational torque is applied.

6-9-1 Initializing the parameters

Refer to the PM motor data sheet and set the parameters required for the PM motor control from the panel. All other settings must comply with section 6-8 vector control with sensor. Refer to the test operation section for the encoder settings (C50, C51).

No.	Parameter	Unit
A20 – ACR control constant (PM)		
0	ACR response (PM)	rad/s
1	ACR time constant (PM)	ms
2	d axis current command cushion time (PM)	ms/I1
3	q axis current command cushion time (PM)	ms/I1
B01 – Output rating (Vector control)		
1	Motor rated output (Vector control)	kW
2	No. of motor poles (Vector control)	Pole
3	Motor rated voltage (Vector control)	V
4	Max. speed (Vector control)	min^{-1}
5	Motor rated frequency (Vector control)	min^{-1}
6	Motor rated current (Vector control)	A
7	Carrier frequency (Vector control)	
8	No. of encoder pulses (Vector control)	P/R
9	No-load output voltage (Vector control)	V
B03 – Motor circuit constant (PM)		
0	R1: PM motor primary resistance (Mantissa section)	mΩ
1	R1: PM motor primary resistance (Exponent section)	
2	Ld: PM motor d axis inductance (Mantissa section)	mH
3	Lq: PM motor q axis inductance (Mantissa section)	mH
4	Ld, Lq: PM motor inductance (Exponent section)	
5	Rated torque electric current	%/I1
B13 – Local setting		
6	ASR gain compensation in constant power range	%
7	ACR gain compensation in constant power range	%
8	Linear torque limit (NTL1) (at 100% torque)	%
9	Linear torque limit (NTL2) (at 0% torque)	%

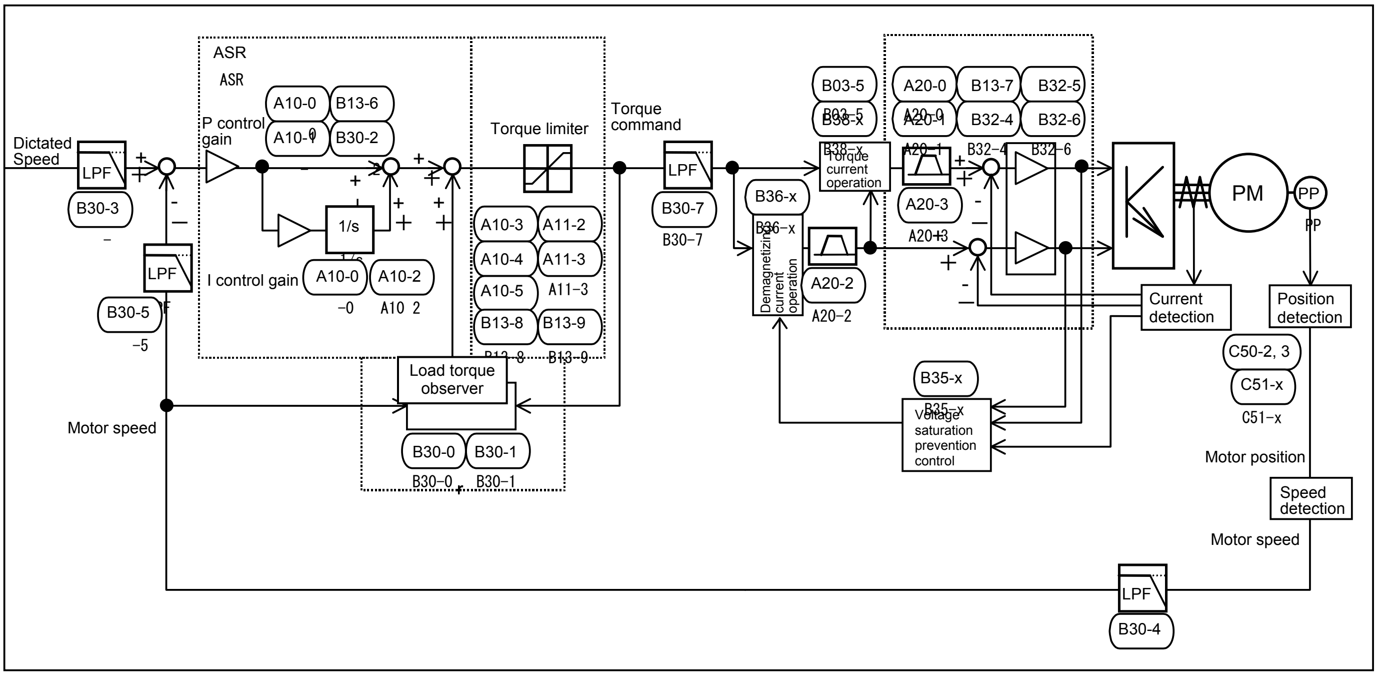
No.	Parameter	Unit
B35 – Voltage control constant (PM)		
0	Demagnetizing control operation voltage allowance (PM)	%/V1
1	Largest voltage setting (PM)	%/V1
2	Field weakening electric current limit value (PM)	%/V1
3	Demagnetizing current control proportional gain (PM)	
4	Demagnetizing current control integral time constant (PM)	ms
B36 – Field weakening electric current table (PM motor control)		
0	Field weakening electric current table 0 (PM) (at torque command 0%)	%/I1
1	Field weakening electric current table 1 (PM) (at torque command 25%)	
2	Field weakening electric current table 2 (PM) (at torque command 50%)	
3	Field weakening electric current table 3 (PM) (at torque command 75%)	
4	Field weakening electric current table 4 (PM) (at torque command 100%)	
5	Field weakening electric current table 5 (PM) (at torque command 125%)	
6	Field weakening electric current table 6 (PM) (at torque command 150%)	
C38 – Torque to Iq conversion adjustment coefficient table (PM)		
0	Torque to Iq conversion adjustment coefficient 0 (PM) (at Id command –100%)	%/I1
1	Torque to Iq conversion adjustment coefficient 1 (PM) (at Id command –75%)	
2	Torque to Iq conversion adjustment coefficient 2 (PM) (at Id command –50%)	
3	Torque to Iq conversion adjustment coefficient) 3 (PM) (at Id command –25%)	
4	Torque to Iq conversion adjustment coefficient 4 (PM) (at Id command 0%)	
5	Torque to Iq conversion adjustment coefficient 5 (PM) (at Id command 25%)	
6	Torque to Iq conversion adjustment coefficient 6 (PM) (at Id command 50%)	

(Note) Parameters with a "%I1" unit must be set with a rate that corresponds to the rated current, and the "%/V1" parameters must be set with a ratio corresponding to the rated voltage.

6-9-2 PM motor control speed control system

The PM motor control speed control system is configured of the following types of blocks. Of these blocks, the speed control system and load torque observer section operate as the same functions as the IM vector control. Refer to section 6-8 for details on adjusting these parameters. Refer to section 6-8-8 for details on setting the various low path filters (B30-3 to 8).
The sections unique to the PM motor control are the weak field current control and torque current operation section following the torque command. These are adjusted by setting the parameter sheet data enclosed with the motor from the panel.
Note that as with the IM, the parameters related to the speed regulator, torque limiter, load torque observer and various low path filters differ according to the user's system, and ultimately must be adjusted according to the system in use.

PM speed control system block



(Note) The numbers of the related parameters are indicated in the above function blocks.

6-9-3 Setting the PM motor circuit constants

The resistance and inductance elements are set as the PM motor circuit constants.

(1) Set the value of one phase converted into a 3-phase & Y connection.
(2) For the inductance element, set the value including the leakage inductance.
(3) If the wiring path is long, add the wiring path resistance and inductance elements to the motor constant.

In the following wiring example, the set constants are calculated with the following expressions.

(B03-0,1) = R_{LINE} + R1
(B03-2,4) = l_{LINE} + l_a + Md
(B03-3,4) = l_{LINE} + l_a + Mq

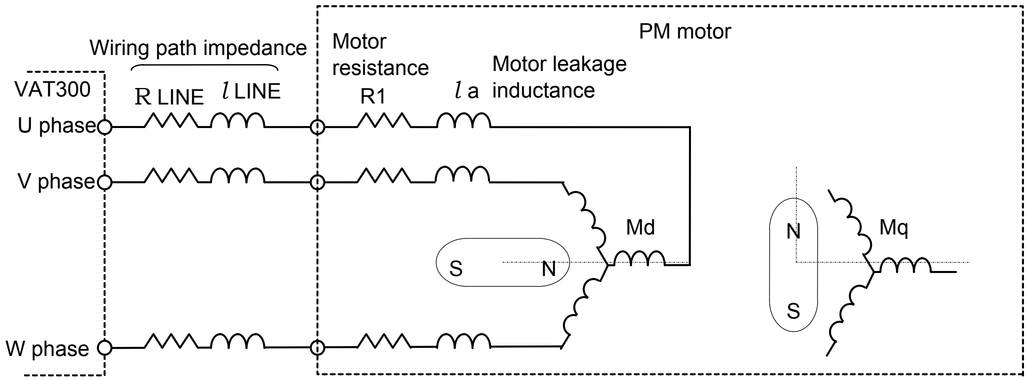


Fig. 6-9-3 PM motor and wiring path circuit constants

6-9-4 PM motor control current regulator

The PM motor control current regulator (ACR) is configured of the PI control, and has the following parameters.

Parameter No.	Parameter	Function
A20-0	ACR response (PM)	The ACR response radian frequency is set. Hunting at a several ms cycle will occur if the ACR response is too high. If the response is too low, the speed control system's gain cannot be set to a high value. Usually this should be set between 500 and 1500rad/s.
A20-1	ACR time constant (PM)	The ACR time constant is set. If the time constant is too long or too short, the current will become unstable, and the over current protection will function. Usually this should be set between 5 and 20ms.
B13-7	ACR gain compensation in constant power range	This sets the ACR P gain compensation value at the max. speed. Usually this should be set to 100% when using PM motor control.
B32-4	ACR voltage model FF selection	When using ACR feed forward compensation, set the setting value to 2, and set B32-5.
B32-5	ACR model voltage FF compensation	This is the compensation gain for the non-interference voltage element added to the ACR output. Use this when the operation frequency is high, or when the current control response is set to a high speed. Set a value of approx. 50 to 80%
B32-6	ACR proportional section dead time compensating factor	If the output frequency is 120Hz or more and an approx. 3ms cycle current vibration occurs, set a value between approx. 50 and 80%.

6-9-5 Torque limiter for PM motor

The output torque is limited. Refer to section 6-8-3 for details on the A10-3 to 5 and A11-2, 3 settings.

Parameter No.	Parameter
B13-8	Linear torque limit
B13-9	

With the PM motor, the weak field voltage range is narrow, and the voltage drop is large because of the armature's reaction. This causes the voltage to easily saturate when the speed increases or when the load is excessive. A linear torque limiter has been added to prevent this voltage saturation. As shown in Fig. 6-9-5-b, this functions simultaneously with the drive/regenerative torque limiter settings and variable torque function. The smaller value is used as the torque limiter value.
This linear torque limiter is set with the speed at 100% torque (B13-8) and speed at 0% torque (B13-9).
Do not change the default values (B13-8=400%, B13-9=450%) when not using this linear torque limiter function. This limiter is valid even during IM vector control.

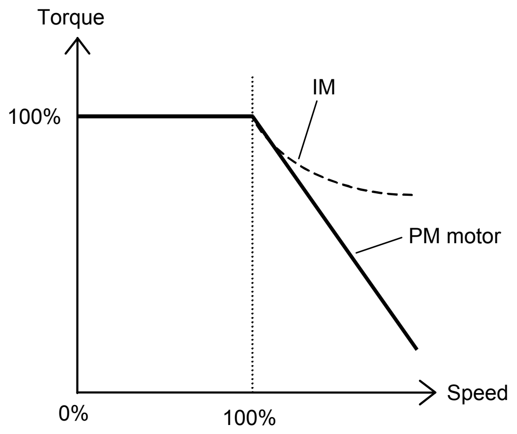


Fig. 6-9-5-a Torque characteristics of IPM motor

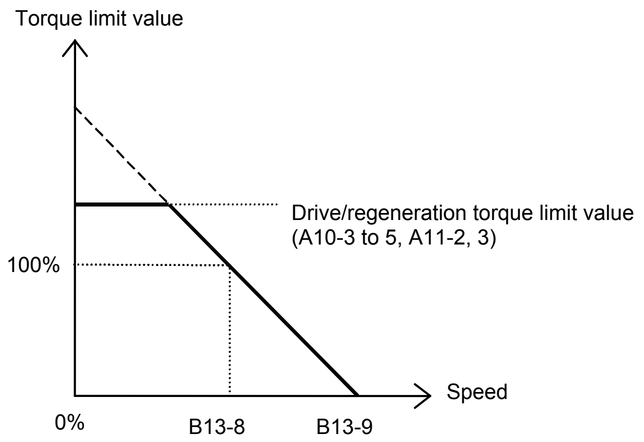


Fig. 6-9-5-b Linear torque limiter

6-9-6 Setting the weak field current pattern for the IPM motor

With the IPM (interior magnet type) PM motor with permanent magnet embedded in the iron core, the inductance has reverse salient-pole properties as indicated with $L_d<L_q$. With this type of motor, a large torque is generated with a small current by effectively using the reactance torque by passing a weak field current (negative direction current element for d axis).

The VAT300 has a function to generate a weak field current according to the torque command. These characteristics are set as the table data (B36-0 to 6).

This setting value differs according to the motor design, so set a value which is appropriate for the motor being used. Set zero if the motor or servomotor characteristics are unclear, or when using an SPM (surface permanent magnet) motor.

Set this weak field current table with a panel using positive values. Even if the setting is a positive value, it will be converted into a negative d axis current command internally. Set a negative value to set a current on the magnetizing side. This table setting is valid only when the voltage saturation prevention control is not functioning. When the voltage saturation prevention control explained in the following section is functioning, the weak field current will be automatically increased so a weak field current larger than the characteristics set here will be generated.

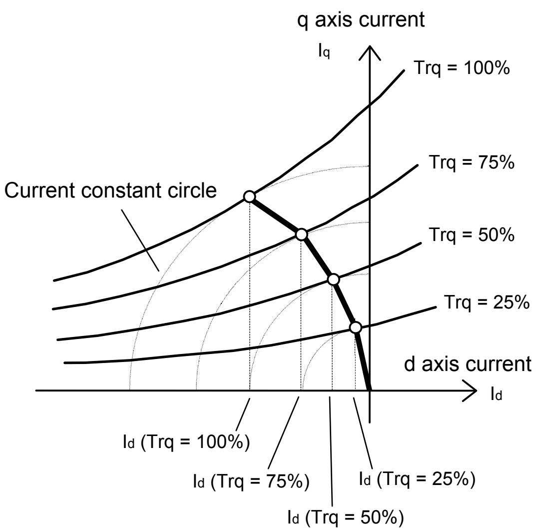


Fig. 6-9-6-a Relation of current vector and torque contour line

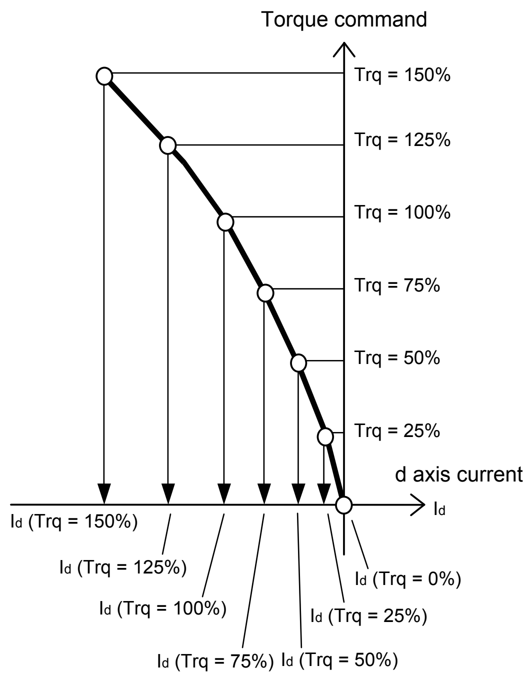


Fig. 6-9-6-b Weak field current table to be set

6-9-7 Setting the torque command and Iq current command conversion coefficient for the IPM motor

The relational expression of the torque (Trq) and d, q axis current (Id, Iq) which the IPM motor uses to generate the reactance torque from the weak field current is shown below.

$$I_q = \frac{Trq / (Pole/2)}{\phi_m - (L_q - L_d) I_d} = K_{T1} \cdot K_{T2}(I_d) \cdot Trq$$

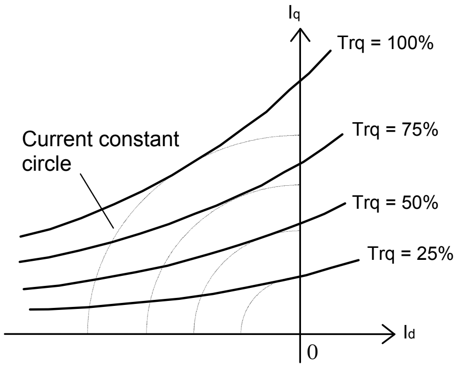


Fig. 6-9-7-a
Torque characteristics on IPM motor's Id-Iq axis

Fig. 6-9-7-a shows these torque characteristics expressed on the Id-Iq axis. Two types of conversion coefficients K_{T1} (B03-5) and K_{T2} (I_d)(B38-0 to 6) can be set with the VAT300 to handle the changes in the torque characteristics caused by this type of weak field current.
K_{T2} (I_d) is a compensation coefficient which relies on Id. The value is set at the Id's 25% pitch. This compensation coefficient is linearly interpolated as shown in Fig. 6-9-7-b. If Id is outside of this table's range, the table's end setting value (B38-0, 6) is applied.
K_{T1} (B03-5) is a coefficient used for fine adjustment by increasing and decreasing the entire compensation pattern.
Set these parameters to value appropriate for the motor being used. When driving a motor for which the characteristics are unclear, set all parameters to the default values (B38-0 to 6=100%).

For the IPM motor, set the K_{T_2} (I_d) compensation pattern with B38-0 to 6. Adjust B03-5 to finely adjust and increase or decrease this entire compensation pattern.

The SPM motor does not have a reactance torque, so set only B03-5. Leave B38-0 to 6 all at the default value (100%).

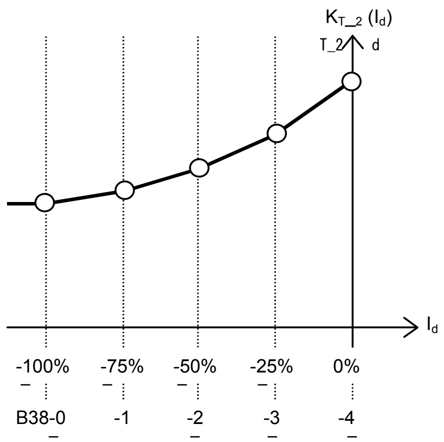


Fig. 6-9-7-b
Torque
→ Iq conversion coefficient table

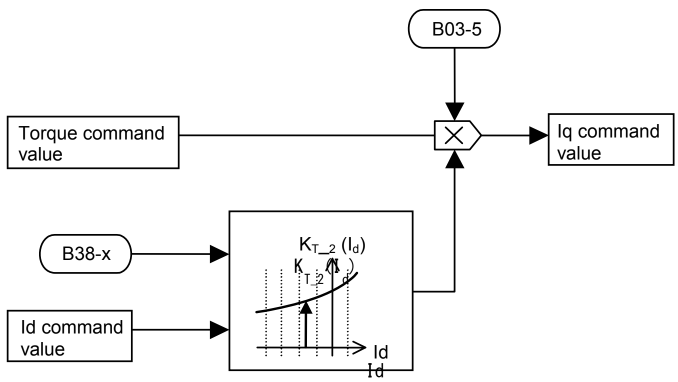


Fig. 6-9-7-c
Torque command
→ Iq command conversion block diagram

6-9-8 Operation of weak field in IPM motor constant output range

If the PM motor's speed increases, the terminal voltage increases, the inverter's maximum output voltage is reached, and the voltage is saturated. To prevent this voltage saturation, voltage saturation prevention control which automatically passes a weak field current (with reverse polarity of magnet's field flux) to suppress the terminal voltage is applied.
Set the following parameters to validate this function.

(B35-0) : This setting prevents the voltage saturation which occurs when the power voltage drops. The output voltage is limited to the value obtained by subtracting this setting value from the maximum output voltage corresponding to the power voltage.

(B35-1) : This setting prevents voltage saturation by suppressing the motor's terminal voltage to a set voltage or less.
Normally, the motor's continuous maximum rated voltage (100%: default value) is set.

B35-0 and 1 are set as a ratio of the rated voltage.

The relation of B35-0 and B35-1 is shown below. Normally, the B35-1 setting value is the maximum value of the terminal voltage. However, if the DC voltage drops, the terminal voltage's maximum value is limited to the voltage level attained by subtracting the B35-0 setting value from the output voltage limit value. The weak field current is passed automatically so that the terminal voltage does not exceed that maximum value. Thus, the current control system functions properly even if the motor speed increases or the DC voltage drops.

(B35-2) : Set the maximum limit value (limit value on Id negative side) for the weak field current generated to prevent voltage saturation as a ratio in respect to the rated current.
The magnet could be demagnetized (irreversible demagnetization) if an excessive weak field current is passed.
This setting prevents this demagnetization.

(B35-3, 4): Set the proportional gain and time constant for the voltage saturation prevention control.

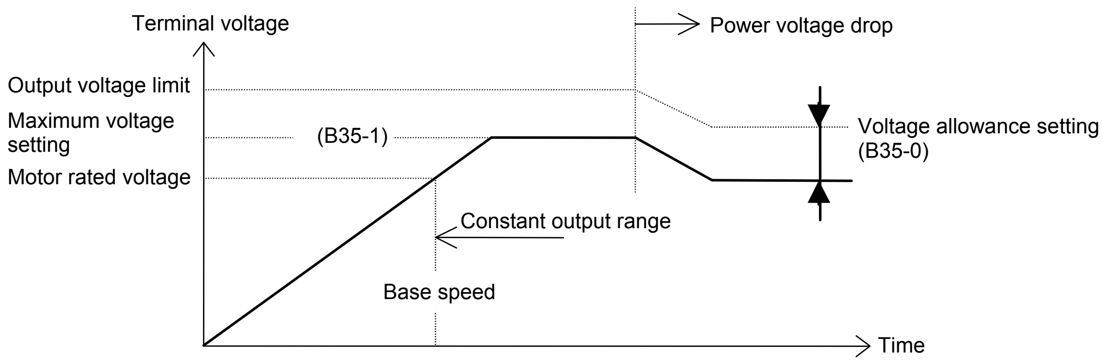


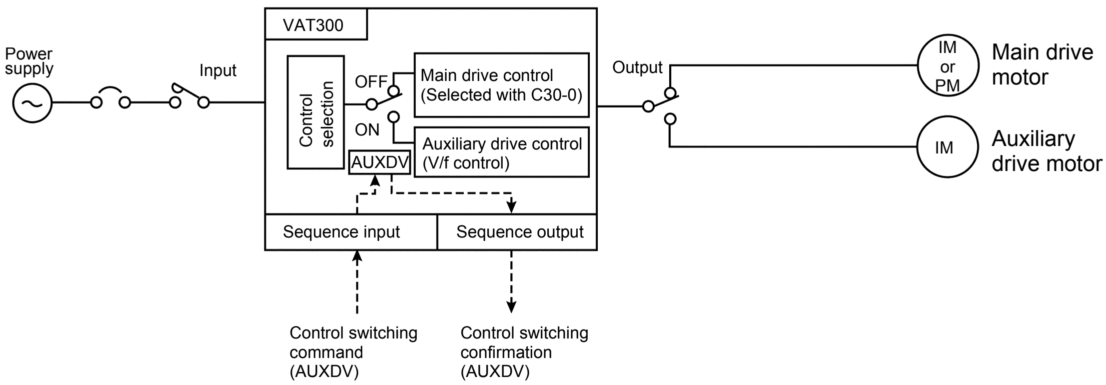
Fig. 6-9-8 Output voltage limit operation in constant output range

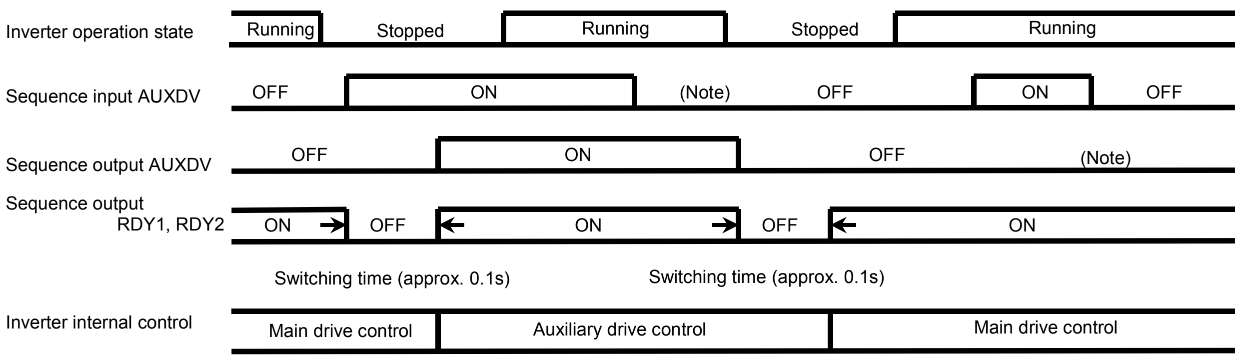
6-10 Operating the auxiliary drive motor

With the VAT300, a main drive motor operated with the C30-0:f0 control mode and an auxiliary drive motor operated with V/f control can be run by switching the internal control using the external sequence input AUXDV (auxiliary drive selection) and AUXSW0 and AUXSW1 (auxiliary drive No. selection).
The main drive motor and auxiliary drive are switched with the sequence input AUXDV. The auxiliary drive number is switched with AUXSW0 and AUXSW1.

6-10-1 Switching the main and auxiliary drive motor control

The inverter's internal main drive motor control and auxiliary drive motor control is switched with the external sequence input AUXDV. However, the control must be switched while the motor is stopped.
If the auxiliary drive selection signal is switched while the inverter is running, the switch will be invalid and instead will switch to the control corresponding to the signal status when the inverter stops.
When switching the control, the sequence output RDY1 and RDY2 (READY) turn OFF, and the inverter operation is prohibited. The state of the inverter internal control switching can be confirmed with the sequence output AUXDV (auxiliary drive selection).





(Note) The main and auxiliary drive motor control cannot be switched while the inverter is running. The drive switches to that corresponding to the sequence input AUXDV status when the motor stops.

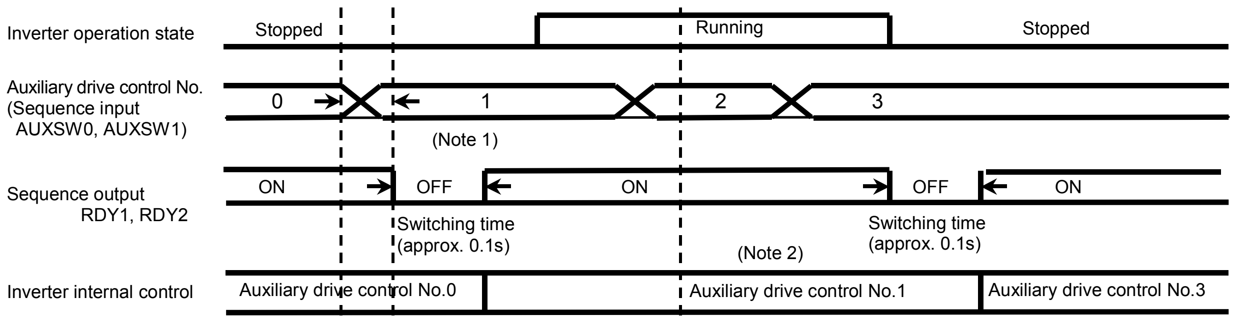
Switching of main drive motor control and auxiliary drive motor control

6-10-2 Switching control between auxiliary drive motors

The VAT300 has four auxiliary drive operation control parameters No. 0 to 3. No. 0 is valid in the default state. The auxiliary drive number is switched with the external sequence input AUXSW0 and AUXSW1. The inverter must be stopped when switching.
If AUXSW0 or AUXSW1 is changed while the inverter running, the switch will be invalid, and instead will switch to the No. corresponding to the signal status when the inverter stops.

AUX SW1	AUX SW0	Auxiliary drive No.	Corresponding parameters
L	L	0	B20-0 to B23-4
L	H	1	B24-0 to B27-4
H	L	2	B28-0 to B2B-4
H	H	3	B2C-0 to B2F-4

Relation of sequence input AUXSW0, AUXSW1 and auxiliary drive No., and applicable parameters



(Note 1) After switching to sequence input AUXSW0 or 1, a delay of 500ms will be applied before the drive No. is switched internally.
(Note 2) Auxiliary drive No. switching is invalid while the inverter is running.
The auxiliary drive will switch to the number corresponding to the status of AUXSW0 or AUXSW1 when the inverter stops.

Switching control between auxiliary drive motors

6-10-3 Auxiliary drive motor control related parameters

The dedicated parameters for auxiliary drive motor control are shown below.

Dedicated parameters for auxiliary drive motor
(When auxiliary drive No. is set to 0)

No.	Parameter
B20-0 to 5	Output rating (Auxiliary drive 0)
B20-6, 7	Start/Stop frequency (Auxiliary drive 0)
B20-8, 9	Upper/Lower limit (Auxiliary drive 0)
B21-0, 1	Frequency setting (Auxiliary drive 0)
B21-2 to 7	Acceleration/deceleration time (Auxiliary drive 0)
B22-0, 1	Torque boost (Auxiliary drive 0)
B22-2, 3	DC brake (Auxiliary drive 0)
B22-4 to 6	Over current limit (The parameters B18-3~6 are shared with the main drive motor control) (Auxiliary drive 0)
B22-7 to 9	Overload reference (Auxiliary drive 0)
B23-0 to 4	Braking on power deceleration ramp time (Auxiliary drive 0)

6-10-4 Functions and settings that cannot be used during auxiliary drive motor control

As opposed to V/f control (C30-0: f0-1) during main drive motor control, some functions cannot be used with auxiliary drive motor control.

Function and setting that cannot be used	Related parameter and sequence input
Automatic torque boost	A02-4 to 6
Frequency skip	B05-0 to 5
Ratio interlock	B06-0 to 3
V/F middle point	B17-0 to 3
Frequency increment/ decrement	C04-7, 8 (Sequence input FUP/FDW)
Interlock ratio bias increment/decrement	C04-9 to B (Sequence input BUP/BDW/IVLM)
Automatic tuning	B19-0
Primary resistance	B02-0 to 1 (Dedicated for main drive motor)
Control mode selection	C30-0 (Dedicated for main drive motor)

6-11 Built-in PLC Function

The VAT300 has a built-in PLC function. The sequence can be input/output and the analog signals can be input/output with this function. The built-in PLC function has the following features.

- A programmable sequence function is provided in the inverter.
- Commands are input with a command format based on the instruction codes.
- Commands can be input from the operation panel. This allows changes to be made easily at the site.
- Commands can be input with the standard serial. Command generation support software is also available.

6-11-1 Outline explanation of processing system

The built-in PLC function runs with the processing system shown in Fig. 6-11-1.
The interpreter section runs at a 2ms interval, so operations can be carried out at the same sample cycle as the regular inverter process. The commands are separated in units called "banks", and one bank is executed at a 2ms interval. The number of banks to be executed can be set with U10-0 (No. of executed banks), so if the process is heavy, it can be split into twenty banks and executed at a 40ms interval.
* For the ROM version 9457.0+9458.4 and thereafter, the configuration is changed from 64-command * 5-bank to 16-command * 20-bank.

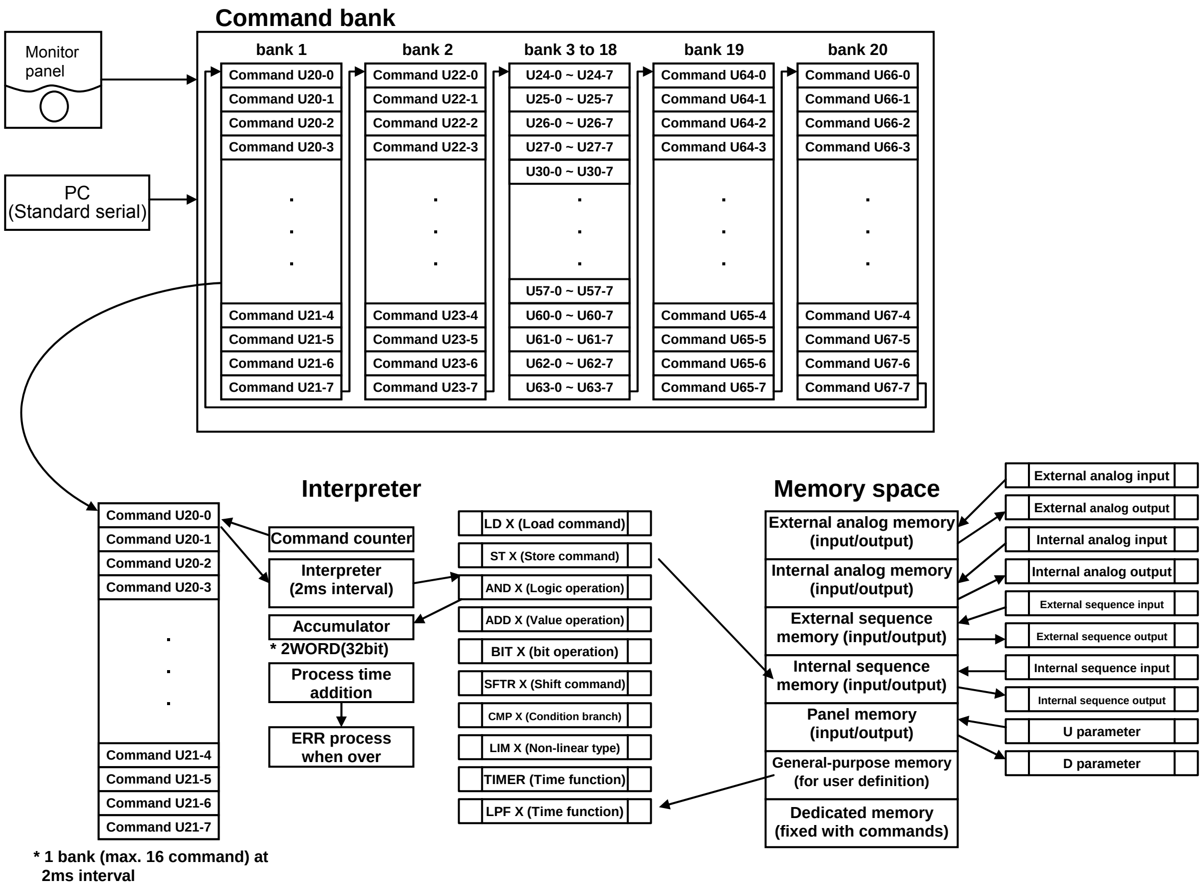


Fig. 6-11-1 Built-in PLC processing system

The built-in PLC reads the commands from the command bank. The command is then interpreted by the interpreter section, and then executed. Each command is operated using a 32-bit general-purpose accumulator and 16t-bit width memory space. Some commands are handled as 16 bits, and some are expanded to 32 bits and handled.
The built-in PLC function carries out the operation in the inverter, so some limits apply to the operation time. Each command is assigned a step count as the execution time. The interpreter increments the step count each time a command is executed. If the incremented step count value exceeds a set value (1280 steps) within a 2ms interval, the CPU-B will stop with a fault. In this case, review the command, and reset the number of steps executed with one bank so that it is smaller than the set value. If the CPU-B fails, the command bank execution number will be forcibly reset to 0. Reset the power to restart the built-in PLC function.

6-11-2 Related parameters

The parameters related to the built-in PLC are listed below. The memory numbers are explained later.

(1) Panel display (D10-0 to 3): Built-in PLC → Display
Four values can be displayed in parameters D10-0 to 3. To display, write the values in memory numbers 32h to 35h.

(2) Sequence input (C03 to C06): Built-in PLC → Inverter
The signals from the built-in PLC can be connected as sequence inputs.
The low-order 4 bits of memory No. 28h are PL1 to 4.

(3) Analog input (C07): Built-in PLC → Inverter
The signals from the built-in PLC can be connected as analog inputs.
The four words in memory No. 24h to 27h are output as the built-in PLC outputs 1 to 4 (set C07 between 8 and 11).

(4) Analog output (C13-0, 1): Built-in PLC → Analog output
Analog outputs are possible from the built-in PLC.
The four words in memory No. 24h to 27h are output as the built-in PLC outputs 1 to 4 (set C13-0,1 between 16 and 19).

(5) Sequence output (C13-2 to 6): Built-in PLC → Sequence output
Sequence output is possible from the built-in PLC.
The low-order 8 bits of memory No. 28h are PLC1 to 8.

(6) Analog input selection (C13-7 to A): Inverter → Built-in PLC
The inverter output analog signals can be input to the built-in PLC.
Select the details set in memory numbers 10h to 13h.

(7) No. of Built-in PLC execution banks (U10-0)
Set the number of banks to be executed with the built-in PLC.

(8) Built-in PLC parameter (U10-1 to 7): Parameter → Built-in PLC
Eight parameters can be input.
The details set with the parameters are set in memory numbers 2Ah to 31h.

(9) Built-in PLC command (U20 to U67)
Input the commands executed with the built-in PLC.

6-11-3 Memory space

The memory space used with the built-in PLC is shown below. The memory No. is indicated with a hexadecimal.

Memory No.	Name	Details	Unit	Read/ write
0	External analog input 1	Reads input value from AI1	1000h=100%	Read
1	External analog input 2	Reads input value from AI2	1000h=100%	Read
2	External analog input 3	Reads input value from AI3	1000h=100%	Read
5	External serial input 1	Reads serially set speed command	1000h=100%	Read
6	External serial input 2	Reads serially set torque command	1000h=100%	Read
7	External serial input 3	Reads serially set torque ratio 1	1000h=100%	Read
8	External serial input 4	Reads serially set torque bias	1000h=100%	Read
9	External serial input 5	Reads serially set torque ratio 2	1000h=100%	Read
A	External serial input 6	Reads serially set drive torque limiter	1000h=100%	Read
B	External serial input 7	Reads serially set regenerative torque limiter	1000h=100%	Read
C	External serial input 8	Reds serially set ASR response	0.1r/s/LSB	Read
D	External serial input 9	Reads serially set machine time constant	1ms/LSB	Read
10	Internal analog output 1	Reads output value selected with C13-7	1000h=100%	Read
11	Internal analog output 2	Reads output value selected with C13-8	1000h=100%	Read
12	Internal analog output 3	Reads output value selected with C13-9	1000h=100%	Read
13	Internal analog output 4	Reads output value selected with C13-A	1000h=100%	Read
14	External sequence input 1	Reads state set with terminal block	–	Read
18	External sequence input 5	Reads serially set status	–	Read
19	External sequence input 6	Reads serially set status	–	Read
1A	External sequence input 7	Reads serially set status	–	Read
1B	External sequence input 8	Reads serially set status	–	Read
1C	Internal sequence output 1	Reads inverter sequence output (D04-4)	–	Read
1D	Internal sequence output 2	Reads inverter sequence output (D04-5)	–	Read
1E	Internal sequence output 3	Reads inverter sequence output (D04-6)	–	Read
1F	Internal sequence output 4	Reads inverter sequence output (D04-7)	–	Read
20	Internal sequence output 5	Reads inverter alarm output (D05-0)	–	Read
24	Analog output 1	Writes value output with C13-0/1 = 16	1000h=10V	Write
25	Analog output 2	Writes value output with C13-0/1 = 17	1000h=10V	Write
26	Analog output 3	Writes value output with C13-0/1 = 18	1000h=10V	Write
27	Analog output 4	Writes value output with C13-0/1 = 19	1000h=10V	Write
28	Sequence output	Writes PLC1 to PLC8 output with C13	–	Write
2A	Panel parameter 1	Reads value set with U10-1	–	Read
2B	Panel parameter 2	Reads value set with U10-2	–	Read
2C	Panel parameter 3	Reads value set with U10-3	–	Read
2D	Panel parameter 4	Reads value set with U10-4	–	Read
2E	Panel parameter 5	Reads value set with U10-5	–	Read
2F	Panel parameter 6	Reads value set with U10-6	–	Read
30	Panel parameter 7	Reads value set with U10-7	–	Read
31	Panel parameter 8	Reads value set with U10-8	–	Read
32	Panel display 1	Writes value displayed with D10-0	–	Write
33	Panel display 2	Writes value displayed with D10-1	–	Write
34	Panel display 3	Writes value displayed with D10-2	–	Write
35	Panel display 4	Writes value displayed with D10-3	–	Write
40 to 5F	User memory	Memory which can be read/write freely	–	r/w
60 to 9F	Dedicated memory	Dedicated memory used by commands	–	r/w
A0 to BF	Constant memory	0 to 31d values are loaded at start up	–	Read

* The memory numbers other than those listed above are for future use.

* The external analog input is a full scale 100% when the gain is 1.0.

* The internal analog output unit differs according to the set parameter. However, it is 100% at the maximum or rated display value explained in C13. 10V = 100% conversion applies to the OLT monitor and heat sink temperature.
  (The output frequency is 100% at the maximum frequency, and the motor rated current is 100% at the rated current.)

* The following bit assignments apply to the external sequence input 1.

bit0 : Not used	bit4 : PSI4	bit8 : PSI8	bit12 : PSI12
bit1 : PSI1	bit5 : PSI5	bit9 : PSI9	bit13 : PSI13
bit2 : PSI2	bit6 : PSI6	bit10 : PSI10	bit14 : PSI14
bit3 : PSI3	bit7 : PSI7	bit11 : PSI11	bit15 : PSI15

* The following bit assignments apply to the external sequence inputs 5 to 8.

External sequence input 5

bit0 : EMS	bit4 : FJOG	bit8 : HOLD	bit12 : IPASS
bit1 : RST	bit5 : RJOG	bit9 : BRAKE	bit13 : CPASS
bit2 : FRUN	bit6 : EXC	bit10 : COP	bit14 : AFS1
bit3 : RRUN	bit7 : Not used	bit11 : CSEL	bit15 : AFS2

External sequence input 6

bit0 : AFS3	bit4 : S1	bit8 : FUP	bit12 : IVLM
bit1 : PROG	bit5 : S2	bit9 : FDW	bit13 : AUXDV
bit2 : CFS	bit6 : S3	bit10 : BUP	bit14 : PICK
bit3 : S0	bit7 : SE	bit11 : BDW	bit15 : Not used

External sequence input 7

bit0 : Not used	bit4 : LIM2	bit8 : DEDB	bit12 : Not used
bit1 : ACR	bit5 : MCH	bit9 : TRQB1	bit13 : Not used
bit2 : PCTL	bit6 : RF0	bit10 : TRQB2	bit14 : Not used
bit3 : LIM1	bit7 : DROOP	bit11 : FPOS	bit15 : Not used

External sequence input 8

bit0 : MBRK-ans	bit4 : S6	bit8 : PLS_IN	bit12 : E.FLT1
bit1 : PRST	bit5 : S7	bit9 : OCLLV1	bit13 : E.FLT2
bit2 : PIDEN	bit6 : AUXSW0	bit10 : OCLLV2	bit14 : E.FLT3
bit3 : S5	bit7 : AUXSW1	bit11 : Not used	bit15 : E.FLT4

* For the internal sequence output, the bottom of the display (D04-4 to 7) is the low-order bit, and the top is the high-order bit.

* The following bit assignments apply to the sequence output.

bit0 : PLC1	bit4 : PLC5	bit8 : Not used	bit12 : Not used
bit1 : PLC2	bit5 : PLC6	bit9 : Not used	bit13 : Not used
bit2 : PLC3	bit6 : PLC7	bit10 : Not used	bit14 : Not used
bit3 : PLC4	bit7 : PLC8	bit11 : Not used	bit15 : Not used

6-11-4 Commands

The commands used with the built-in PLC are a 4-digit value.
The commands can be input to the built-in PLC by inputting a 4-digit value in the U20 to U67 parameters.

0	1	C	8

$\underbrace{0\ 1}_{\text{Command No.}}\ \underbrace{C\ 8}_{\text{Memory No.}}$

The built-in PLC follows the command No. and executes the command using the memory No. X (16-bit) and accumulator A (32-bit). The accumulator is a 32-bit general-purpose register. Most of the commands are passed through the accumulator and operated.
The commands are listed below. Command No. 00 is the bank end command. The built-in PLC executes the commands in order from the head of the command bank. When the command reaches 00, execution of the current command bank is stopped. When the next 2ms interval is reached, the next command bank is executed from the head. If there is no X in the details of each command, the memory No. is random (not used).

List of built-in PLC commands

No.	Command	Details	Expression indication	No. of steps
00h	NOP	Nothing is executed. End of bank.	None	0
01	LD	X is loaded with sign extended to A.	A=X	85
02	LD_U	X is loaded without encoding A.	A=X	85
03	LD32	X (i) and X (i+1) are loaded as 32 bits.	A=X	100
04	ST_L	Low-order 16 bits of A are stored in X.	X=(short)A	84
05	ST_H	High-order 16 bits of A are stored in X.	X=(short)(A>>16)	85
06	ST32	A is stored in X (i) and X (i+1) as 32 bits.	X=A	101
07	BIT	A's X bit is obtained.	A=(A & bit X)>>X	115
08	SFT_R	A is shifted to the right by X bit. (With sign extension)	A=A>>X	Shift No.* 18+103
09	SFT_L	A is shifted to the left by X bit. (With sign extension)	A=A<<X	Shift No.* 18+103
0A	---	No action takes place. (For future use)		
0B	ADD	X is added to A.	A=A+X	89
0C	ADD32	X (i) and X (i+1) are added to A as 32 bits.	A=A+X	104
0D	SUB	X is subtracted from A.	A=A-X	89
0E	SUB32	X (i) and X (i+1) are subtracted from A as 32 bits.	A=A-X	104
0F	MUL_L	A is multiplied by X. (Low-order 32 bits are obtained)	A=A*X	117
10	MUL_H	A is multiplied by X. (High-order 32 bits are obtained)	A=(A*X)>>16	120
11	DIV	A is divided by X.	A=A/X	183
12 to 14	---	No action takes place. (For future use)		
15	AND	AND of A and X is obtained and saved in A.	A=A&X	92
16	OR	OR of A and X is obtained and saved in A.	A=A|X	92
17	XOR	XOR of A and X is obtained and saved in A.	A=A^X	92
18	NOT	NOT of A is saved in A	A=$\overline{A}$	77
19 to 1E	---	No action takes place. (For future use)		
1F	CMP_EQ	If A=X, A=1. In all other cases A=0.	A=(A==X)	97
20	CMP_NE	If A!=X, A=1. In all other cases A=0.	A=(A!=X)	97
21	CMP_GT	If A>X, A=1. In all other cases A=0.	A=(A>X)	97
22	CMP_LT	If A<X, A=1. In all other cases A=0.	A=(A<X)	97
23	CMP_GE	If A≥X, A=1. In all other cases A=0.	A=(A>=X)	97
24	CMP_LE	If A≤X, A=1. In all other cases A=0.	A=(A<=X)	97
25	JMP	X is added to command pointer unconditionally.	cp+=X	75
26	JMPC	If A!=0, X is added to command pointer.	if(A & bit0) cp+=X	96
27	JMPNC	If A=0, X is added to command pointer.	if(~A &bit0) cp+=X	96
28	NEG	A is inverted to –A.	A=-A	77
29	ABS	Absolute value of A is obtained.	A=ABS(A)	83
2A	LIM_G	If A is signed and A>X, then limit to X	If (A > X) A=X	107
2B	LIM_L	If A is signed and A<X, then limit to X	If (A < X) A=X	107
2C to 2D	---	No action takes place. (For future use)		

No.	Com-mand	Details	Expression indication	No. of steps
2E	TIMER1	Count up when input [64] is not 0. If counter [65] is higher than level [66], then output [67]=1 If input [64] is 0, and reset counter [65]	Input : 64 Counter : 65 Level : 66 Output : 67	105
2F	TIMER2	Same as TIMER1	Input : 68 Counter : 69 Level : 6A Output : 6B	105
30	TIMER3	Same as TIMER1	Input : 6C Counter : 6D Level : 6E Output : 6F	105
31	TIMER4	Same as TIMER1	Input : 70 Counter : 71 Level : 72 Output : 73	105
32	LPF1	Use accumulator as input, and execute LPF process with X gain. Output is accumulator.	Input : Acc Gain : X Buffer : [74, 75] Output : Acc	134
33	LPF2	Same as LPF1	Input : Acc Gain : X Buffer : [76, 77] Output : Acc	134
34	LPF3	Same as LPF1	Input : Acc Gain : X Buffer : [78, 79] Output : Acc	134
35	LPF4	Same as LPF1	Input : Acc Gain : X Buffer : [7A, 7B] Output : Acc	134

* A refers to the accumulator (32-bit) and X (16-bit) refers to the general memory or dedicated memory.
* If there is no X in the details of each command, the memory No. is random (not used).
* Unless indicated, the commands are handled as signed extensions.

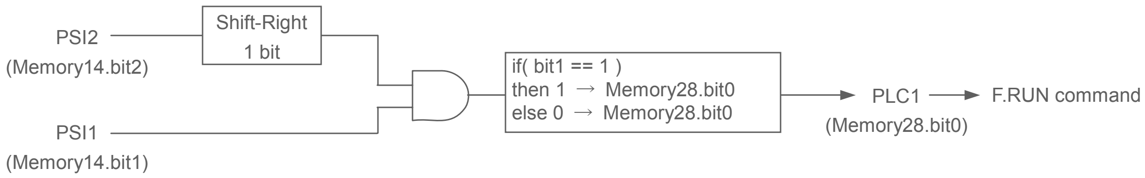
6-11-5 Usage examples

Examples of using the built-in PLC are shown below.

(1) Operation interlock

Specifications)

The forward run command (F.RUN) is interlocked with the external sequence input (PSI)



Block diagram

Parameters)

1) C03-0=12 (Disconnect PSI1 from F.RUN, and connect PLC1 and F.RUN commands.)
2) C03-7=0 (PSI2 is used for interlock signal, so disconnect from RESET)

Setting the commands)

(LD	Mem14)	U20-0=0114	: Load external sequence input 1 to accumulator.
(SFT_R	MemA1)	U20-1=08A1	: Shift accumulator one bit to the right. (Use fixed memory A1)
(AND	Mem14)	U20-2=1514	: Obtain AND of accumulator and external sequence input 1
(BIT	MemA1)	U20-3=07A1	: Detect bit 1 of accumulator (Use fixed memory A1)
(ST_L	Mem40)	U20-4=0440	: Retract accumulator value (use user memory 40)
(LD	MemA1)	U20-5=01A1	: Load "1" in accumulator
(NOT	)	U20-6=1800	: Reverse accumulator (0×FFFFFFFE)
(ST_L	Mem41)	U20-7=0441	: Retract accumulator value (use user memory 41)
(LD	Mem28)	U21-0=0128	: Load sequence output (PLC1 to 8) to accumulator
(AND	Mem41)	U21-1=1541	: Clear PLC1 bit on accumulator
(OR	Mem40)	U21-2=1640	: Update PLC1 bit on accumulator
(ST_L	Mem28)	U21-3=0428	: Write accumulative values to sequence output (PLC1 to 8)
(NOP	)	U21-4=0000	: End of bank

Setting the number of execution banks)

1) U10-0=1: Set the number of executed banks to 1 (bank 1 only)

Note) Set the number of execution banks after all settings have been completed. Failure to observe this could result in unexpected operations.

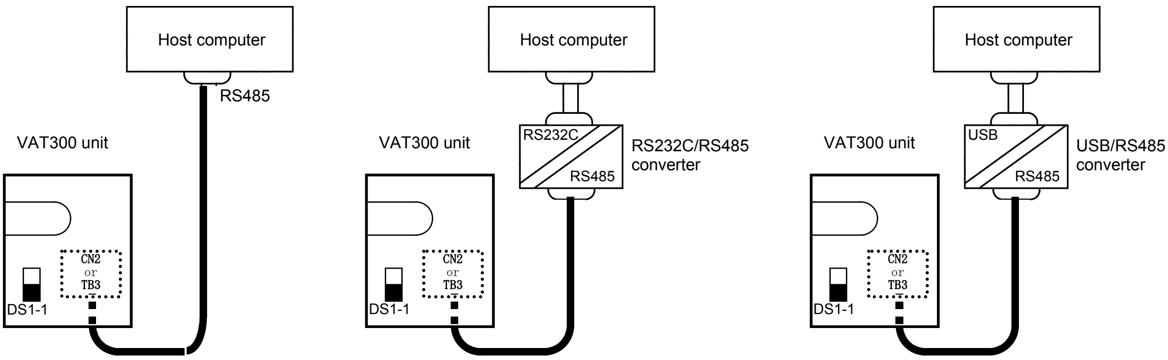
6-12 Explanation of standard serial and Modbus communication

The VAT300 is equipped with a serial transmission function using RS485 as a standard. The inverter can be controlled with a host computer using this function.
Either the Modbus network with Modbus protocol or the VAT300 series original communication protocol standard serial communication can be selected with the parameters.

6-12-1 Connection method

This network is configured of one host computer (master) and 1 to 32 VAT300 units (slaves).
CN2 on the basic section or TB3 is used for the connection.
Refer to section 2-4. Precautions for wiring the control signal for details on CN2 and TB3, and for the wiring methods.
The total length of the connected cable must be within 150 meters.
By using a commercially-available RS485-RS232C converter or USB converter unit as a relay, the inverter can be connected to a host computer equipped with a serial port or USB, such as a commercially-available personal computer.

- **Connecting the host computer and VAT300 (1-on-1)**

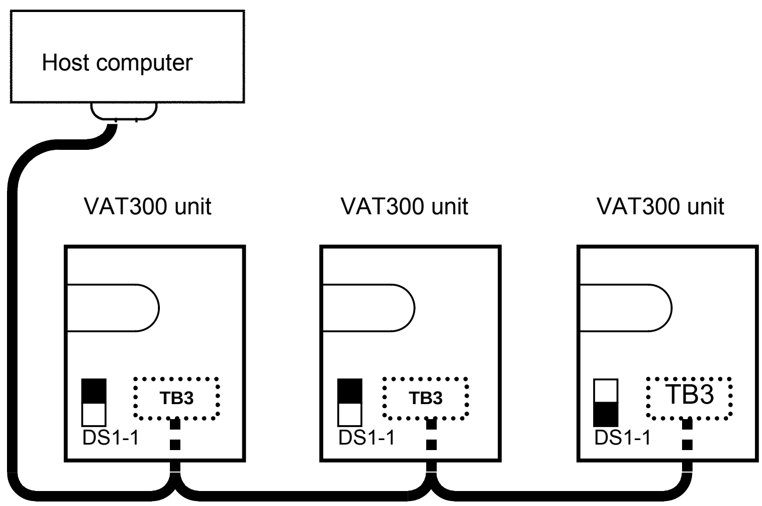


⚠ CAUTION

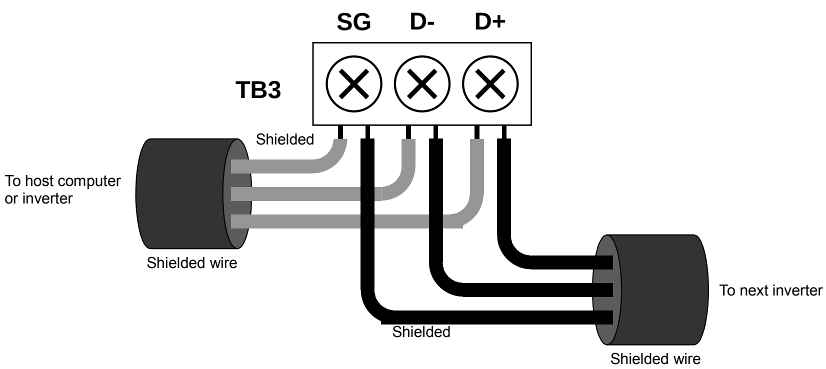
- Do not connect both CN2 and TB3 to the host computer.
- CN2 is a 4-pole 4-core modular connector. Pay attention to the number of poles, and prepare the cable and connector.
- Separates the communication cable from the main circuit cable and other power cables.
- A shielded twisted pair cable should be used for connecting TB3 and the host computer.
  Connect the shielded twisted pair cable's shield to the TB3 SG.
- When using a 1-on-1 connection, set the inverter's resistance (DS1 No. 1 switch on basic section) to the 120Ω side.
- When connecting the TB3 and shielded twisted pair cable, do not solder the wires which are exposed after the sheath is peeled off.
- If the communication is distorted and not carried out properly because of noise, etc., connect a ferrite core, etc., to the cable, and increase the noise resistance.

When connecting several VAT300 units, connect two wires to each TB3 terminal, and couple the VAT300 units.
An example of the connection is shown below.

- **Connecting the host computer and VAT300 (connecting several units)**



The details of the TB3 terminal section are shown below.



⚠ CAUTION

- Separates the communication cable from the main circuit cable and other power cables.
- A shielded twisted pair wire should be used for connecting TB3 and the host computer.
  Connect the twisted pair cable's shield to the TB3 SG.
- When using several slave units, set the resistance (DS1 No. 1 switch on basic section) of the last inverter to 120Ω.
- When connecting the TB3 and shielded twisted pair cable, do not solder the wires which are exposed after the sheath is peeled off.
- If the communication is distorted and not carried out properly because of noise, etc., connect a ferrite core, etc., to the cable, and increase the noise resistance.

6-12-2 Communication specifications

Item	Specification
Connection method	RS485, 2-wire type
Transmission distance	Total extension distance: 150m
Baud rate	Select from 1200, 2400, 4800, 9600, 14400, 19200, 38400bps
Transmission method	Start-stop synchronization, half-duplex communication
Frame configuration	Start : 1 bit Data : 8 bits Stop : Select from 1 bit or 2 bits Parity : Select from none, odd or even
Error detection	Sum check, parity, framing
Transmission code	8-bit binary or ASCII
Communication protocol	Select from Modbus-RTU communication or standard serial communication
Number of stations	Set between 1 and 32

The factory settings are shown below.

Communication protocol : Standard serial communication
Baud rate : 9600bps
Frame configuration : Start: 1bit, Data: 8bit, Stop: 2bit, Parity: odd, Station No.: 01

6-12-3 Procedures for enabling communication with host controller

The communication parameters must be set to enable communication with the host controller.
The procedure is given below.

(1) Select C26-0, and select the communication method.
Example: C26-0=0: Select standard serial communication.

(2) Select the station No.
Example: C26-2=18

(3) Set the baud rate.
Example: C26-4=5: 38400bps

(4) Set the number of stop bits.
Example: C26-5=1: Stop bit 1 bit

(5) Set the parity.
Example: C26-6=1: No parity

(6) After completing the settings, turn the power OFF once. When the control power has turned OFF, turn the power ON again.

Communication with the set communication method is now possible.
An excerpt of the parameter C26 setting details is given below.

<table>
<tr><th>No.</th><th>Parameter</th><th>Unit</th><th>Default</th><th>Min.</th><th>Max.</th><th>Function</th></tr>
<tr><td colspan="7">C26 – Standard serial transmission setting</td></tr>
<tr><td>0</td><td>Function selection</td><td></td><td>0.</td><td>0.</td><td>1.</td><td>0: Standard serial 1: Modbus</td></tr>
<tr><td>1</td><td>Parameter change protection</td><td></td><td>1.</td><td>1.</td><td>5.</td><td>The parameters with a ○ mark below can be changed.
<table>
<tr><th rowspan="2">Set-ting value</th><th rowspan="2">Block A Para-meter</th><th colspan="4">Block B, C Parameter</th></tr>
<tr><th>Basic</th><th>Extend</th><th>S/W</th><th>H/W</th></tr>
<tr><td>1</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>2</td><td>×</td><td>×</td><td>×</td><td>×</td><td>×</td></tr>
<tr><td>3</td><td>○</td><td>×</td><td>×</td><td>×</td><td>×</td></tr>
<tr><td>4</td><td>○</td><td>×</td><td>○</td><td>×</td><td>×</td></tr>
<tr><td>5</td><td>○</td><td>×</td><td>○</td><td>○</td><td>×</td></tr>
</table>
○: Changeable ×: Unchangeable</td></tr>
<tr><td>2</td><td>Station No.</td><td></td><td>1.</td><td>0.</td><td>247.</td><td>Set the local station No.</td></tr>
<tr><td>3</td><td>Response timer</td><td>sec.</td><td>0.00</td><td>0.00</td><td>2.00</td><td>Set the minimum time from receiving command to returning an answer.</td></tr>
<tr><td>4</td><td>CN2 standard serial communication baud rate setting</td><td>bps</td><td>2.</td><td>1.</td><td>7.</td><td>=1: 4800 =2: 9600 =3: 14400
=4: 19200 =5: 38400 =6: 1200bps
=7: 2400bps
=6, 7 can be set from D21-3=9458.2 and above.</td></tr>
<tr><td>5</td><td>CN2 standard serial communication stop bit setting</td><td></td><td>2.</td><td>1.</td><td>2.</td><td>=1: 1 bit =2: 2 bit</td></tr>
<tr><td>6</td><td>CN2 standard serial communication parity setting</td><td></td><td>3.</td><td>1.</td><td>3.</td><td>=1: None =2: Even =3: Odd</td></tr>
<tr><td>7</td><td>Base section serial communication frequency (speed) unit setting</td><td></td><td>0.</td><td>0.</td><td>5.</td><td>=0: 0.01Hz or 0.1min^{-1} unit: signed
=1: 0.1Hz or 1min^{-1} unit: signed
=2: 0.01% unit: signed
=3: 0.01Hz or 0.1min^{-1} unit: unsigned
=4: 0.1Hz or 1min^{-1} unit: unsigned
=5: 0.01% unit: unsigned</td></tr>
</table>

6-12-4 Using the VAT300 Series dedicated communication (standard serial communication)

The following exchanges can be carried out with the host computer by using the VAT300 series dedicated communication protocol (hereinafter, standard serial communication).

(1) Reading and writing of Block-A, B, C, U parameters
(2) Reading of Block-D monitor parameters
(3) Reading and writing of sequence commands
(4) Reading and writing of frequency commands and speed commands
(5) Reading and writing of torque commands, torque bias 1 settings, drive torque limiter reduction settings, regenerative torque limiter reduction settings
(6) Reading of fault history

6-12-4-a. Setting the standard serial transmission function

(1) When executing setting data write (FW) from the host computer and operating, make sure that the sequence command CFS is ON, and that the various setting input point selection C02 is fixed to serial.

Example) 1) Operation mode : Remote (RMT)
Speed setting input point selection: C02-0=4 (sequence)
CFS command : C04-1=4 (controlled with terminal block input PSI4), or

2) Speed setting input point selection: C02-0=2 (serial fixed)
The details of the setting data are determined by the control mode selection (C30-0: f0) and FW command data No. Refer to section 6-12-4-g Setting data write (FW) for details.

(2) When executing sequence command write (CW) from the host computer and operating, make sure that the sequence command COP is ON.

Example) Operation mode : Remote (RMT)
COP command : C03-8 = 16
(The inverter is always run with the sequence commands from the host computer.)

Refer to section 6-12-4-i Sequence command write (CW) for details on the CW command.
Refer to section 5-5 Sequence input logic Fig. 5-5 for details on the sequence input logic.

Note) When sending the auxiliary operation sequence command in Fig. 5-5, make sure that control switchover method (J2 setting) C00-6 is set to serial transmission input.
Control switchover method (J2 setting): C00-6 = 2 (serial transmission input)

(3) Set parameter change protection with C26-1.

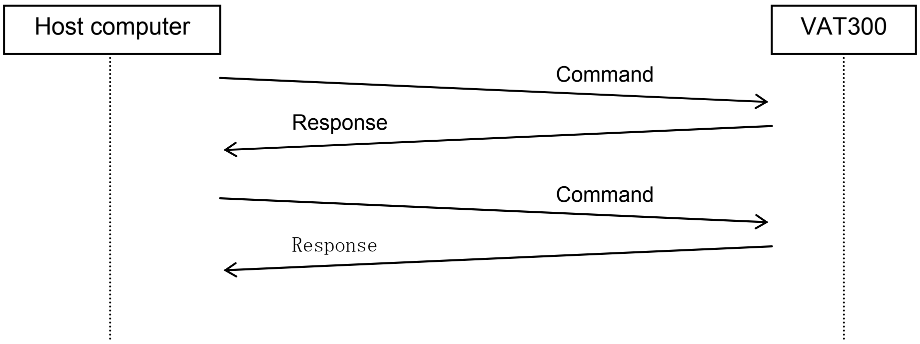
(4) Set the local station number with C26-2.

(5) Set the response timer value with C26-3.
The response timer is the timer which specifies the minimum time for the VAT300 to return the response packet after the host computer sends the command packet.

⚠ CAUTION
When setting the frequency/speed and controlling the sequence with serial transmission, the automatic start and restart after power failure functions may not operate correctly. This is caused by a difference in the power voltage operation and time for transmitting the command.

6-12-4-b. Transmission procedure

The VAT300 constantly waits for a command from the host computer.
When the VAT300 correctly receives a command from the host computer, it always returns a response as shown in Fig. 4.1.



6-12-4-c. Transmission format

1 packet
Maximum 128 Bytes

"("	"G"	STN	TEXT	"&"	SUM	")"	CR

(1) Data format: 8-bit ASCII
(2) Packet size: Maximum 128 Bytes
(3) Packet contents
"(" : Head code (1 Byte)
"G" : VAT300 designation code (1 Byte)
STN : Station No. (2 Bytes) Example) Station 1 → "01"
Input with a hexadecimal.
TEXT : Text area
"&" : Check sum judgment code (1 Byte)
When not using the check sum, delete the check sum judgment code and check sum.
SUM : Check sum (2 Bytes)
")" : Final code (1 Byte)
CR : Carriage return (1 Byte)

6-12-4-d. Transmission rules

(1) When there is a request from the host computer, the VAT300 checks the station No. given in the packet, and processes the request when it matches the local station No. If the station numbers do not match, the packet is ignored.
(2) Any space codes (20Hex) in the packet sent from the host computer are ignored. Note that the check sum is calculated including the space codes.

(Example)

(	G	0	1	F		R	0		0	0	0	&	8	E	)	CR

(The space code is ignored.)

(The check sum, including the space code, is calculated.)

(3) The check sum is always added to the response packet.
The check sum can be omitted from the packet sent from the host computer, but the check sum is always added to the packet sent from the VAT300.

(4) All transmission and reception data is 8-bit ASCII data.

(5) All data input before "(" is input in the reception data is ignored.

(6) Even if "(" is input while receiving the packet, the data received up to that point will be aborted.

(Example)

	(	G	––––––––––––––––––––	(	––––––––––––––––––––

(Ignored)

Even if "(" is input while receiving the packet, the data received up to that point will be aborted.

(7) The reception is interpreted as done only when ")" CR is received.

(8) Several commands can be arranged in one packet. (Up to nine commands.)
In this case, "," is used as the delimiter between commands.
If there are more than ten commands in one packet, error codes (illegal commands) equivalent to the number of excessive commands will be returned from the VAT300.
Up to nine commands will be executed normally. An example of the command and response is shown below.

(Example) Host computer transmission command packet

(G00FW00000001000 , FR0000 , CW0000000000040402) CR
(1st command) (2nd command) (3rd command)

(delimiter) (delimiter)

Response packet

(G00AK , FR00000001000 , AK & 0E)

(Response to 1st command) (Response to 2nd command) (Response to 3rd command)

Make sure that the command packet fits within 128 Bytes.
Also make sure that the response packet in respect to the command packet is within 128 Bytes.

(9) A broadcast packet can be sent.
By setting the station No. to "FF", all VAT300 units in the transmission path will process the packet.
The VAT300 will not send any response packet in respect to the broadcast packet. Thus, only write request commands are valid in the broadcast packet.

(Example)

(	G	F	F	F	W	0	0	0	0	0	0	0	0	4	0	4	)	CR

(By setting the station No. to "FF", the broadcast packet will be received by all stations.)

6-12-4-e. Creating a check sum

(Example)

(	G	0	0	F	R	0	0	0	0	&	4	D	)	CR
28H	47H	30H	30H	46H	52H	30H	30H	30H	30H	26H				

Add all

↓

24DHEX

↓

Convert low-order 1 Byte to ASCII

The ASCII codes of the characters between "(" and "&" are added with hexadecimal, and the low-order byte of the obtained value is converted into an ASCII code and used for the check sum.

6-12-4-f. Transmission commands

Basic command format

CMD (2 Byte)	Data No. (4 Byte)	DATA

Command list

Host computer to VAT300			
CMD	**Data No.**	**DATA**	**Function**
FW	000n	Nnnnnnn (7-digit decimal)	Setting data write
FR	000n	None	Setting data read
CW	000n	nn ······· nn (12-digit hexadecimal)	Sequence command write
CR	000n	None	Only sequence command read
DW	Annn Bnnn Cnnn Unnn	Nnnnnn (6-digit decimal)	Block-A, B, C, U parameter write
DR	Dnnn Annn Bnnn Cnnn Unnn	None	Block-D, A, B, C, U parameter read
ER	000n	None	Fault history read

Host computer from VAT300			
CMD	**Data No.**	**DATA**	**Function**
FR	000n	Nnnnnnn (7-digit decimal)	Setting data read (response)
CR	000n	nn ······· nn (12-digit hexadecimal)	Sequence command read (response)
DR	Dnnn Annn Bnnn Cnnn Unnn	Nnnnnn (6-digit decimal)	Block-D, A, B, C, U parameter read (response)
ER	000n	nn ······· nn (44-digit)	Fault history read (response)
AK	None	None	Successful completion response in respect to write request command
NK	Error code nn (2 byte)	None	Error response in respect to command

6-12-4-g. Setting data write (FW)

Function : The setting data is written to the selected setting register when the sequence command CFS is ON and the various setting input point selection: C02 is set to serial fixed. The contents of the setting data are determined by the control mode selection (C30-0: f0) and data No.
Refer to Setting data table for the data No.

Command

F	W	0	0	0	0	0	0	0	3	0	0	0

CMD — F W
DATA. No — 0 0 0 0
DATA — 0 0 0 3 0 0 0

(4-digit decimal data No. In this example, this is the "Frequency setting" write command.)

(7-digit decimal setting value. In this example, 30.00Hz is set.)

Response

A	K

(Successful completion)

N	K	Error code (2 Byte)

← (Error response:
Refer to Section 6. List of transmission error codes for details on the error codes.)

Setting data table

Control mode	DATA No.	Name	Unit	Min. value	Max. value
V/f control C30-0 : f0 = 1	0 0 0 0	Frequency command	Following C26-7 setting	B00-4:Max. frequency setting (-)	B00-4:Max. frequency setting
Vector, PM control C30-0 : f0 = 2, 3, 4	0 0 0 0	Speed command	Following C26-7 setting	B01-4:Max. speed setting (-)	B01-4:Max. speed setting
	0 0 0 0	Torque setting	0.1%	-300.0	300.0
	0 0 0 0	Torque bias 1 setting	0.1%	-300.0	300.0
	0 0 0 0	Drive torque limiter reduction setting	0.1%	0.0	100.0
	0 0 0 0	Regenerative torque limiter reduction setting	0.1%	0.0	100.0

Coded data

(Example)

DATA

–	0	0	0	1	2	3

(The data will be negative data when "-" is added.)

The data can be set as negative data by adding "-" to the highest order digit of the DATA area.
In the above example, the data is -123.

Frequency command/speed command unit

The unit for the frequency command/speed command can be changed with the C26-7: frequency (speed) unit setting. Refer to the 6-4: Parameter list or explanations.

The default setting is C26-7=0: 0.01Hz or 0.1min^{-1} (signed)

6-12-4-h. Setting data read (FR)

Function : The setting value set with the FW command is read and returned.

Command

F	R	0	0	0	1

CMD: F R
DATA. No: 0 0 0 1

(4-digit decimal data No.
In this example, this is the "Torque setting" read command.)

Refer to section 6-12-5-g. Setting data write (FW) Setting data table for details on DATA No.

Response

F	R	0	0	0	1	0	0	0	1	0	0	0

CMD: F R
DATA. No: 0 0 0 1
DATA: 0 0 0 1 0 0 0

(4-digit decimal data No.
The data No. from the host computer is returned.)

(7-digit decimal read data. In this example, the data is 100.0%.)

N	K	Error code (2 Byte)

(Error response:
Refer to Section 6. List of transmission error codes for details on the error codes.)

When the data to be read is coded
For negative read data, a "-" is added to the highest order digit of the data.

(Example)

DATA

–	0	0	0	1	2	3

(If a "-" is attached to the highest order digit, the data is a negative value.)

In the above example, the data is -123.

6-12-4-i. Sequence command write (CW)

Function : A sequence command is issued to the VAT300. The data sent at this time is held by the internal sequence command register until it is rewritten. To validate this sequence command, the sequence command: COP must be ON.
Refer to section 6-12-5-a Setting the standard serial transmission function for details on setting COP.

Command

C	W	0	0	0	0	0	0	0	A	0	0	0	5
CMD		DATA. No				DATA1				DATA2			

(4-digit decimal. Refer to section 6-12-5-o Sequence command bit assignment table for the numbers.)

(8-digit hexadecimal setting value. In this example 000A0005h is set.
* Refer to section 6-12-5-o Sequence command bit assignment table for details on the setting values.

Response

A	K

(Successful completion)

N	K	Error code (2 Byte)

(Error response:
Refer to Section 6. List of transmission error codes for details on the error codes.)

6-12-4-j. Sequence command read (CR)

Function : The sequence command set with the CW command is read and returned.

Command

C	R	0	0	0	1
CMD		DATA. No			

(4-digit decimal date No.
Refer to section 6-12-5-o Sequence command bit assignment table for the numbers.)

Response

C	R	0	0	0	1	0	0	4	B	6	0	0	2
CMD		DATA. No				DATA1				DATA2			

(4-digit decimal.
The data No. from the host computer is returned.)

(8-digit hexadecimal read data. In this example, 004B6002h is read.)
* Refer to section 6-12-5-o Sequence command bit assignment table for details on the setting values.

N	K	Error code (2 Byte)

(Error code)

(Error response:
Refer to Section 6. List of transmission error codes for details on the error codes.)

6-12-4-k. Block- A, B, C and U parameter write (DW)

Function : The Block-A, B, C and U parameter data in the VAT300 unit is changed.
Note that the parameter change protection may be set with C26-1.
Parameters which cannot be changed during operation, cannot be changed during operation.
Other parameters which cannot be changed during serial transmission are listed in the cautions.
The data is configured from the list of constants without the decimal point.

Example) A010 (Acceleration ramp time -1) 50.0 s → 000500

Command

<Example: Block-A parameter setting>

D	W	A	0	1	0	0	0	0	5	0	0
CMD		DATA. No				DATA					

DATA. No: (4-digit data No. In this example, this is A01-0: Acceleration ramp time -1.)

DATA: (6-digit decimal setting value. In this example, 50.0 seconds is set.)

Response

A	K

(Successful completion)

N	K	Error code (2 Byte)

← (Error response
Refer to Section 6. List of transmission error codes for details on the error codes.)

Setting data table

DATA No.	Name
A n n n	Block-A parameter
B n n n	Block-B parameter
C n n n	Block-C parameter
U n n n	Block-U parameter

Sub No.
Main No.

⚠ CAUTION

The parameters that cannot be changed with the write command are shown below. If the write command is executed for these parameters, an error will be returned (Parameter Read/Write Disable).

- A04-0 to 7 (Custom constants)
- C10-0 to 7 (Custom parameter selection)
- A05-0 to 2 (Block-B, C parameter display skip)
- C26-0 to 7 (Serial transmission setting)
- B19-0 (Automatic tuning function)
- Parameters not related to control mode selected with C30-0: f0.
  (Parameters that are not displayed on the operation panel.)

Coded data

The data can be set as negative data by adding "-" to the highest order digit of the DATA area.

DATA

–	0	0	1	2	3

6-12-4-l. Block-A, B, C, U and D parameter read (DR)

Function : The values of the block-A, B, C, U and D parameters in the VAT300 are read.

Command

<For monitor data read>

D	R	A	0	3	0

$\underbrace{\text{D R}}_{\text{CMD}}$ $\underbrace{\text{A 0 3 0}}_{\text{DATA. No}}$

↑

(4-digit decimal data No. Refer to the previous setting data table for details on the

Response

D	R	A	0	3	0	0	0	0	0	5	0

$\underbrace{\text{D R}}_{\text{CMD}}$ $\underbrace{\text{A 0 3 0}}_{\text{DATA. No}}$ $\underbrace{\text{0 0 0 0 5 0}}_{\text{DATA}}$

↑ 4-digit data No.
The data No. from the host computer is returned.)

↑ (6-digit decimal setting value.
In this example, 50 is set.)

N K	Error code (2 Byte)

← (Error response:
Refer to Section 6. List of transmission error codes for details on the error codes.)

Setting data table

DATA No.	Name
D n n n	Block-D parameter
A n n n	Block-A parameter
B n n n	Block-B parameter
C n n n	Block-C parameter
U n n n	Block-U parameter

Sub No.

Main No.

⚠ CAUTION

The parameters that cannot be read with the read command are shown below. If the read command is executed for these parameters, an error will be returned (Parameter Read/Write Disable).
Refer to 6-12-4-n. List of transmission error codes for details on the error codes.

- D20-0 (Fault history display)
- D20-1 (Minor fault history display)
- D20-2 (Parameter A, B, C change list)
- D30-0 (Inverter type)
- D30-1 (Option PCB)
- D22-0 (Automatic tuning progress state)
- A04-0 to 7 (Custom constants)
- A05-0 to 2 (Block-B, C parameter skip)
- C10-0 to 7 (Custom parameter selection)
- Parameters not related to control mode selected with C30-0: f0.
  (Parameters that are not displayed on the operation panel.)

If the data is coded data targeted for read, "-" will be attached to the highest-order digit of DATA.

DATA

–	0	0	1	2	3

6-12-4-m. Fault history read (ER)

Function : The fault history buffer of the VAT300 is read.

Command

E	R	0	0	0	0

CMD: E R; DATA. No: 0 0 0 0

(4-digit decimal data No. refer to the table on the right for details on the number.)

DATA No.				Explanation
0	0	0	0	Latest fault history
0	0	0	0	Previous fault history
0	0	0	0	2nd to last fault history
0	0	0	0	3rd to last fault history

Response

E	R	0	0	0	0	;	0	D	0	1	;	·	;	0	0	3	2

CMD: E R

DATA. No: 4-digit data No. The data No. from the host computer is returned.)

DATA: (Fault buffer corresponding to setting is displayed.)

N	K	Error code (2 Byte)

(Error response: Refer to Section 6. List of transmission error codes for details on the error codes.)

There are four fault history buffers from the latest to the 3rd to last fault histories. One group of these buffers is stored in the response.
In one buffer, two fault causes, and the output frequency, output current, DC voltage, hardware fault signal, cumulative power ON time, and cumulative run time at the time of fault occurrence are stored.
Refer to Appendix Table 4 for the fault cause display and details.

Details of group (DATA)

;	0 3 0 4	; 0 0 0 0	; 0/– 0 0 0 0 0	; 0 0 0 0
	Primary fault (4-digit hexadecimal)	Secondary fault (4-digit hexadecimal)	Output frequency (5-digit decimal + code)	Output current (4-digit decimal)

; 0 3 0 4	; 0 0 0 0	; 0 0 0 0 0	; 0 0 0 0 0
DC voltage (4-digit decimal)	Hardware fault signal (4-digit hexadecimal)	Cumulative power ON time (5-digit decimal)	Cumulative run time (5-digit decimal)

The above information is contained in the response data. A 43-byte data is sent.
";" is used to delimit each item in the group.
Refer to Appendix 3 List of fault codes for details on the primary fault and secondary fault.
The hardware fault signal displays the status of the D05-1: Hardware detection fault status bit as a 0 to FF hexadecimal.

6-12-4-n. List of transmission error codes

The error codes added to the NK response in respect to a command from the host computer are shown below.

Error code	Error name	Details
01	Transmission error	A transmission error, such as parity error or overrun error, was detected.
02	Check sum error	The check sum is illegal.
10	Illegal command	The command is not defined.
11	Illegal parameter	1) The parameter does not exist, or 2) The transmission format does not match.
12	Illegal data	1) The data limit is exceeded, or 2) The format does not match.
13	Parameter protect	The designated parameter is write-protected. (Write-protected with C26-1.)
14	Changing not possible during operation	The designated parameter cannot be changed during operation.
15	Transmission/reception buffer overflow	The transmission/reception data exceeds 128 Bytes.
16	Parameter read/write disable	A read or write-prohibited parameter was accessed.
20	EEPROM BUSY	The VAT300 is using the non-volatile memory.

6-12-4-o. Serial transmission sequence command Bit assignment table

DATA No : 0 0 0 0

DATA1

Bit	Signal	Bit	Signal
15	Always 0	0	AFS3
14	PICK	1	PROG
13	AUXDV	2	Always 0
12	IVLM	3	S0
11	IBDW	4	S1
10	BUP	5	S2
9	Always 0	6	S3
8	Always 0	7	SE

DATA2

Bit	Signal	Bit	Signal
15	AFS2	0	EMS
14	AFS1	1	RST
13	CPASS	2	FRUN
12	IPASS	3	RRUN
11	CSEL	4	FJOG
10	Always 0	5	RJOG
9	BRAKE	6	EXC
8	HOLD	7	Always 0

DATA No : 0 0 0 1

DATA1

Bit	Signal	Bit	Signal
15	Always 0	0	MBRK_ans
14	Always 0	1	PRST
13	Always 0	2	PIDEN
12	Always 0	3	S5
11	Always 0	4	S6
10	OCL LV2	5	S7
9	OCL LV1	6	AUXSW0
8	PLS_IN	7	AUXSW1

DATA2

Bit	Signal	Bit	Signal
15	Always 0	0	Always 0
14	Always 0	1	ACR
13	Always 0	2	PCTL
12	Always 0	3	LIM1
11	FPOS	4	LIM2
10	TRQB2	5	MCH
9	TRQB1	6	RF0
8	DEDB	7	DROOP

6-12-5 Using Modbus communication

The Modbus communication method is a single master/slave method. Only the master can start communication. The slave detects this communication, executes the designated function, and returns a response message. The master can communicate with the designated slave (station No.) and broadcast to all slaves. When using broadcast transmission, the slave only carries out the designated function and does not return a response message.
The following exchanges can be made with the host computer by using this communication function.

(1) Reading and writing of Block-A, B, C, U parameters
(2) Reading of Block-D monitor parameters
(3) Reading and writing of sequence commands
(4) Reading and writing of frequency commands and speed commands
(5) Reading and writing of torque commands, torque bias 1 settings, drive torque limiter reduction settings, regenerative torque limiter reduction settings
(6) Reading of fault history
(7) Reading of sequence status

6-12-5-a. Setting the Modbus communication function

(1) When executing setting data write from the host computer and operating, make sure that the sequence command CFS is ON, and that the various setting input point selection C02 is fixed to serial.

Example) 1) Operation mode : Remote (RMT)
Speed setting input point selection: C02-0=4 (sequence)
CFS command : C04-1=4 (controlled with terminal block input PSI4), or
2) Speed setting input point selection: C02-0=2 (serial fixed)

The details of the setting data are determined by the control mode selection (C30-0: f0). Refer to 6-12-5-f List of Modbus registers and setting examples for details. Refer to Fig. 5-9-1 to Fig. 5-9-8 for the sequence for selecting the determined setting data.

(2) When executing sequence command write from the host computer and operating, make sure that the sequence command COP is ON.

Example) Operation mode : Remote (RMT)
COP command : C03-8 = 16
(The inverter is always run with the sequence commands from the host computer.)

Refer to section 5-5 Sequence input logic Fig. 5-5 for details on the sequence input logic.

Note) When sending the auxiliary operation sequence command in Fig. 5-5, make sure that control switchover method (J2 setting) C00-6 is set to serial transmission input.
Control switchover method (J2 setting): C00-6 = 2 (serial transmission input)

(3) Set parameter change protection with C26-1.

(4) Set the local station number with C26-2.

⚠ CAUTION

When setting the frequency/speed and controlling the sequence with serial transmission, the automatic start and restart after power failure functions may not operate correctly. This is caused by a difference in the power voltage operation and time for transmitting the command.

6-12-5-b. Modbus protocol

The VAT300 is compatible only with the Modbus compliant RTU mode.
The communication protocol for the RTU mode is explained below.

End/start	Address	Function	Data	CRC	End/start
Silent interval of 3.5 characters or more	8bit	8bit	8bit × n	16bit	Silent interval of 3.5 characters or more
Changeable with C26-3	Slave: 1 to 99 Broadcast: 0	Correspondence: 0x01, 0x02, 0x03, 0x08, 0x0F, 0x10, 0x17 Exception response: BIT7: ON		Calculated for each command	Changeable with C26-3

In the RTU mode, a silent interval of 3.5 characters or more (varies according to baud rate) is inserted at the start and end of transmission. The silent interval is a state in which data is not sent. Note that if C26-3 is not equal to 0.00, the setting value will be followed.

The slave side station No. is designated as Address. If a request is made from the slave side, the local station No. is set. The station No. is set with C26-2.
The function executed by the slave is designated in Function and Data. Refer to the following explanations for details on the functions.
CRC is an error check. Each is automatically calculated and set based on the details of Address to Data.
The following calculation method is used.

1) CRC work = 0 × FFFF
2) CRC work low-order byte = CRC work low-order byte XOR send data (8-bit)
3) The following process is executed according to the state of the CRC work LSB.

CRC work LSB	Process
0	CRC work is shifted one bit to the right. MSB is set to 0 at this time.
1	CRC work is shifted one bit to the right. MSB is set to 0 at this time. The following operation is executed. CRC work = CRC work XOR 0xA001

4) The step 3) process is repeated for 8 bits (8 times).
5) The steps 2) to 4) are repeated for all send data (data from Address to before CRC).
6) The CRC work calculated with steps 1) to 5) is CRC.

Example of command:

01 03 0002 0002 65CB (Send command: Read torque setting)

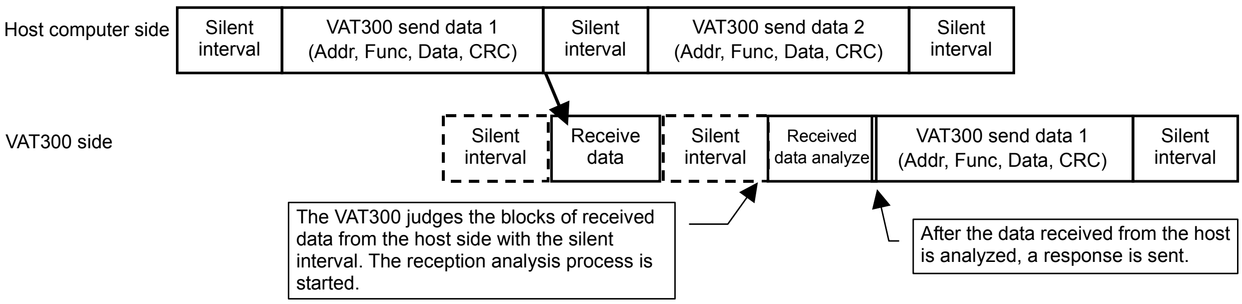
65CB: CRC (Each is automatically calculated and set.)
0002: DATA2 (number of registers)
0002: DATA1 (start register)
03: Function
01: Address
(designates the station No. of the send destination slave)

⚠ CAUTION

In the command example, a space is inserted to delimit each function. Do not insert the spaces when actually inputting the command.
In the above command, input [01030002000265CB], and send.

6-12-5-c. VAT300 Modbus communication time chart

The time chart for communication with the host computer is shown below.



The host computer waits for the silent interval time, and then sends one packet of data.
When sending data continuously, the host computer waits for the silent interval again.
The VAT300 recognizes the data sent after waiting the silent interval as the head of the packet, and starts the reception process. After the data is received, if a state in which no data is received for longer than the silent interval continues, the VAT300 determines that the reception is completed, judges and processes the contents of the command, and creates a request package.

6-12-5-d. Exceptional response code

The VAT300 judges and processes the data based on the packet received from the host computer. If the data is illegal or if data exceeding the range is received, an exception response is returned to indicate that the process cannot be completed.
The exceptional response is sent by setting bit7 of the sent function code to 1.
The exception response code sent after the function code are shown below.

List of exception response codes

Code	Name	Occurrence conditions
01h	Illegal function	A function code, which is not listed, was set.
02h	Illegal data address	An address which does not exist was set.
03h	Illegal data	An error was found in the data setting.
04h	IO data incorrect setting	In the MUX data instruction, the set and input data exceeds the maximum value or minimum value.
05h	MUX data corresponding No. not found	In the MUX data instruction, the set and input parameter block No. or data No. does not exist.
06h	MUX data incorrect setting	In the MUX data instruction, the write data set with the multiplex data is an illegal data.
07h	MUX data lock	In the MUX data instruction, write or read was not possible. (Refer to CC-Link Function Specifications.)
0Bh	Parameter function code incorrect	A parameter function code which does not exist was set.
0Ch	Outside input data range	The written data exceeds the inverter setting range.
10h	No corresponding parameter	The read/write destination parameter was not found, or is set to "hide".
14h	EEPROM busy	Non-volatile memory is used.

An example of the exception response sent from VAT300 is shown below.

01 83 02 C0F1 (Response: Replies that illegal data was accessed)

- C0F1 — CRC (Calculated on the INV side and automatically set.)
- 02 — Exception response code (illegal data access)
- 83 — Function (bit 7 turns ON)
- 01 — Addr (slave side station No.)

CAUTION

In the command example, a space is inserted to delimit each function. Do not insert the spaces when actually inputting the command. In the above example, the response is displayed as [018302C0F1].

6-12-5-e. List of standard serial communication code correspondence

The correspondence of the previous standard serial communication command and the Modbus functions is shown below.

Function	Start register: Function	Standard serial communication command
01h Read Coil Status	0000 : Sequence command (input) 1 read 0020 : Sequence command (input) 2 read	CR
02h Read Input Status	Sequence status (output) read	–
03h Read Holding Register	0000 : V/f Frequency setting read 0000 : VEC/PM Speed setting 0002 : VEC/PM Torque setting 0004 : VEC/PM Torque bias 1 setting 0006 : VEC/PM Drive torque limiter reduction setting 0008 : VEC/PM Regenerative torque limiter reduction setting	FR
	03E9 : Common Multiplexed data reading value	–
	Fault information read 0063 : Read latest fault information 0073 : Read previous fault information 0083 : Read 2nd to last fault information 0093 : Read 3rd to last fault information 00A3 : Read latest minor fault information 00B3 : Read previous minor fault information 00C3 : Read 2nd to last minor fault information 00D3 : Read 3rd to last minor fault information	ER
08h Diagnostic	Self-diagnosis mode	–
0Fh Force Multiple Coils	0000 : Sequence command (input) 1 write 0020 : Sequence command (input) 2 write	CW
10h Preset Multiple Registers	0000 : V/f Frequency setting 0000 : VEC/PM Speed setting 0002 : VEC/PM Torque setting 0004 : VEC/PM Torque bias 1 setting 0006 : VEC/PM Drive torque limiter reduction setting 0008 : VEC/PM Regenerative torque limiter reduction setting	FW
	Parameter write	DW
	03E7 : Common MUX command write for the multiplexed data reading value	–
17h Read Multiple Registers	Parameter read	DR

6-12-5-f. List of Modbus registers and setting examples

The details of each function and examples of setting the commands are given in the following section.

♦ Function 01h (Read Coil Status)

Details of function	Start register designation	Number of registers
Sequence command (Input) read	0000h : Sequence command 1 0020h : Sequence command 2	0020h (Sequence data 32 bit)

Function : The sequence command (input) is read.
This function carries out the same process as the CR command in the standard serial transmission function.
Refer to section 6-12-4-o. Serial transmission sequence command bit assignment table for the layout of bits in the read command.

Setting example:

Modbus command setting example

01 01 0000 0020 3DD2

- 3DD2: CRC code
- 0020: Number of registers
- 0000: Start register
- 01: Function
- 01: Station No.

Command contents : The contents of the sequence command 1 are read.

Response

01 01 04 00234167 7BA1 (Successful example)

- 7BA1: CRC code
- 00234167: Details of data
- 04: Size (4byte)
- 01: Function
- 01: Station No.

01 81 02 C191 (Example of failure)

- C191: CRC code
- 02: Exceptional response
- 81: Function
- 01: Station No.

The correspondence of the read data contents and serial transmission sequence command's bit assignment table is shown below.

Standard serial (DATA No.)		MODBUS (Start register)	Details of data
0000	→	0000	1003 5007 5007: DATA 1 1003: DATA 2
0001	→	0002	

♦ Function 02h (Read input Status)

Details of function	Start register designation	Number of registers
Sequence status read	000h : Fixed	0040h (Sequence data 64 bit)

Function : The sequence status is read.
Refer to the bit assignment table on the next page for the layout of bits in the read command.

Setting example:

Modbus command setting example

01 02 0000 0040 79FA

CRC code
Number of registers
Start register
Function
Station No.

Command contents : The contents of the sequence status are read.

Response

01 02 08 10035007 3827811F D37D (Successful example)

CRC code
Status data 2
Status data 1
Size (8 byte)
Function
Station No.

01 82 03 00A1 (Example of failure)

CRC code
Exceptional response
Function
Station No.

The contents of the read status data are as follow.

1003 5007 3827 811F

Sequence status 3
Sequence status 2
Sequence status 1
Sequence status 0

Refer to the following table for the bit assignment of each status.

Serial transmission sequence status bit assignment table

Sequence status 0

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Signal	IDET	REV	LCL	RDY2	RDY1	MC	FLT	RUN	EC3	EC2	EC1	EC0	COP	SPD2	SPD1	ATN

Sequence status 1

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Signal	LLMT	ZSP	ASW	FAN	ALM	AUXDV	DCC	ACC	Always 0	INT FAN	RDELAY	BPF	Doff-End	MBRK	DVER	ULMT

Sequence status 2

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Signal	PLC8	PLC7	PLC6	PLC5	PLC4	PLC3	PLC2	PLC1	Always 0	Always 0	Always 0	Always 0	Always 0	Always 0	Always 0	FPOS

Sequence status 3

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Signal	MPO8	MPO7	MPO6	MPO5	MPO4	MPO3	MPO2	MPO1	Always 0	Always 0	Always 0	Always 0	Always 0	Always 0	Always 0	Always 0

♦ Function 03h (Read Holding Register)

Control mode	Details of function	Start register	Number of registers	Unit	Min. value	Max. value
V/f control	Frequency setting	0000h	0002h (32-bit data)	Following C26-7 setting	B00-4:Max. frequency setting (-)	B00-4:Max. frequency setting
IM vector control PM motor control	Speed setting	0000h	0002h (32-bit data)	Following C26-7 setting	B01-4:Max. speed setting (-)	B01-4:Max. speed setting
	Torque setting	0002h	0002h (32-bit data)	0.1%/LSB	-300.0	300.0
	Torque bias 1 setting	0004h	0002h (32-bit data)	0.1%/LSB	-300.0	300.0
	Drive torque limiter reduction setting	0006h	0002h (32-bit data)	0.1%/LSB	0.0	100.0
	Regenerative torque limiter reduction setting	0008h	0002h (32-bit data)	0.1%/LSB	0.0	100.0
Common	Multiplexed data reading value	03E9h	0002h (32-bit data)			

Function :

Frequency setting to Regenerative torque limiter reduction setting

These functions carry out the same process as the FR command in the standard serial transmission function.

Multiplexed data reading value

This function reads the multiplexed data and is used when using a PLC without supporting Function17h. Refer to section 6-12-5-g.

Setting example:

Modbus command setting example

01 03 0002 0002 65CB

CRC code
No. of registers
Start register
Function
Station No.

Command contents : Torque setting value is read.

Response

01 03 04 000003E8 FA8D (Successful example)

CRC code
Data
Size (4 Byte)
Function
Station No.

01 83 02 C0F1 (Example of failure)

CRC code
Exceptional response
Function
Station No.

Frequency command/speed command unit

The unit for the frequency command/speed command can be changed with the C26-7: frequency (speed) unit setting. Refer to the 6-1: Parameter list or explanations.

The default setting is C26-7=0: 0.01Hz or 0.1min^{-1} (signed)

Details of function		Start register	Number of registers
Fault history buffer	Latest fault history	0063h	0010h
	Previous fault history	0073h	0010h
	2nd to last fault history	0083h	0010h
	3rd to last fault history	0093h	0010h
	Latest minor fault history	00A3h	0010h
	Previous minor fault history	00B3h	0010h
	2nd to last minor fault history	00C3h	0010h
	3rd to last minor fault history	00D3h	0010h

Function : One block of the fault history is read.
This function carries out the same process as the ER command in the standard serial transmission function. Refer to the following section for the contents read out.

Setting example:

Modbus command setting example

01 03 0063 0010 B418

CRC code
Number of registers
Start register
Function
Station No.

Command contents : Torque setting value is read.

Response

01 03 20 0000～0000 xxxx (Successful example)

CRC code
Data
Size (32byte)
Function
Station No.

01 83 02 C0F1 (Example of failure)

CRC code
Exceptional response
Function
Station No.

Refer to the following section for the data contents.

The data is configured of 32 bytes.
Each item is grouped in a 4-byte section. The details of the 4 bytes are shown below.
(The values in the following table are a setting example.)

00000203	0000040D	000003E8	00000005F	0000013A	00000001	00000000	00000000
Primary fault details	Secondary fault details	Frequency value at fault	Current value at fault	DC voltage at fault	Hardware fault signal	Cumulative power ON time	Cumulative run time
		0.01Hz/LSB	0.1A/LSB	1V/LSB		1 hour/LSB	1 hour/LSB

Refer to Appendix 3 Fault Codes for details on the primary fault and secondary fault.
The hardware fault signal displays the status of the D05-1: Hardware detection fault status bit as a 0 to FF hexadecimal.

♦ Function 0Fh (Force Multiple Coils)

Details of function	Start register command	Number of registers	No. of bytes
Sequence command (input) write	0000h : Sequence command 1 0020h : Sequence command 2	0020h (Sequence data 32 bit)	0004h

Function : The sequence command is written.
This function carries out the same process as the CW command in the standard serial transmission function.
A 4byte command can be written in one command.
Refer to section 6-12-4-o. Serial transmission sequence command bit assignment table for details on the bit assignment of the sequence command to be written in.

Setting example:

Modbus command setting example

01 0F 0000 0020 04 01234567 47C4

- 47C4 : CRC code
- 01234567 : Data (4byte)
- 04 : Size
- 0020 : Number of registers
- 0000 : Start register
- 0F : Function
- 01 : Station No.

Command contents : The data contents are written to sequence command 1.

Response

01 0F 20 3003 (Successful example)

- 3003 : CRC code
- 20 : Response Data
- 0F : Function
- 01 : Station No.

01 8F 02 C5F1 (Example of failure)

- C5F1 : CRC code
- 02 : Exceptional response
- 8F : Function
- 01 : Station No.

The correspondence of the written sequence command bit assignment is shown below.

Standard serial (DATA No.)		MODBUS (Start register)	Details of data
0 0 0 0	→	0 0 0 0	0123 4567
0 0 0 1	→	0 0 2 0	4567 : DATA 1 0123 : DATA 2

♦ Function 10h (Preset Multiple Registers)

Control mode	Details of function	Start register	Number of registers	Number of bytes	Unit	Max. value	Min. value
V/f control	Frequency setting	0000h	0002h (32-bit data)	04h	Following C26-7 setting	B00-4:Max. frequency setting (-)	B00-4:Max. frequency setting
IM vector control PM motor control	Speed setting	0000h	0002h (32-bit data)	04h		B01-4:Max. speed setting (-)	B01-4:Max. speed setting
	Torque setting	0002h	0002h (32-bit data)	04h	0.1%/LSB	-300.0	300.0
	Torque bias 1 setting	0004h	0002h (32-bit data)	04h	0.1%/LSB	-300.0	300.0
	Drive torque limiter reduction setting	0006h	0002h (32-bit data)	04h	0.1%/LSB	0.0	100.0
	Regenerative torque limiter reduction setting	0008h	0002h (32-bit data)	04h	0.1%/LSB	0.0	100.0

Function : A value is written into each setting.
This function carries out the same process as the FW command in the standard serial transmission function.

Setting example:

Modbus command setting example

01 10 0000 0002 04 00001770 FDBB

- FDBB: CRC code
- 00001770: Data (4byte)
- 04: Size
- 0002: Number of registers
- 0000: Start register
- 10: Function
- 01: Station No.

Command contents : The data value (60.00Hz) is written to the frequency setting.

Response

01 10 00000002 41C8 (Successful example)

- 41C8: CRC code
- 00000002: Response data
- 10: Function
- 01: Station No.

01 90 02 CDC1 (Example of failure)

- CDC1: CRC code
- 02: Exceptional response
- 90: Function
- 01: Station No.

Frequency command/speed command unit

The unit for the frequency command/speed command can be changed with the C26-7: frequency (speed) unit setting. Refer to the 6-1: Parameter list or explanations.

The default setting is C26-7=0: 0.01Hz or 0.1min^{-1} (signed)

Details of function	Start register designation	Number of registers	Number of bytes	
Parameter write	03EBh	0003h (48 bit-data)	06h	The parameter No. and parameter value are set in the data section.
MUX command write	03E7h	0001h (16 bit-data)	02h	The parameter No. value are set in the data section.

Function :

Parameter write

A value is written to the parameter. This function carries out the same process as the DW command in the standard serial transmission function.

MUX command write

This function is used when using a PLC without supporting Function17h. Refer to section 6-12-5-g..

Setting example:

Modbus command setting example

01 10 03EB 0003 06 A00000001388 8981

- 8981: CRC code
- A00000001388: Data (8byte)
- 06: Size
- 0003: Number of registers
- 03EB: Start registers
- 10: Function
- 01: Station No.

Command contents : The data value (50.00Hz) is written to parameter A00-0.

Response

01 10 03EB 0003 F078(Successful example)

- F078: CRC code
- 03EB 0003: Response Data
- 10: Function
- 01: Station No.

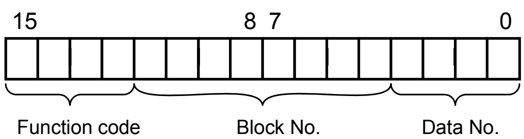
01 90 0B 0DC7 (Example of failure)

- 0DC7: CRC code
- 0B: Exceptional response
- 90: Function
- 01: Station No.

Data setting (Byte):

A000	00001388
Parameter designation section	Data designation section

Divide the parameter designation section as shown below and set the parameter No.



Function	Function code
Block-A parameter designation	A
Block-B parameter designation	B
Block-C parameter designation	C
Block-U parameter designation	E

♦ Function 17h (Read Multiple Registers)

Details of function	Start register	Number of registers	No. of bytes
Read parameter value	03E9h	0002h (32-bit data)	–
Read parameter No. setting	03E7h	0001h (16-bit data)	02h

Function : The parameter contents are read.
This process carries out the same process as the DR command in the standard serial transmission function.

Setting example:

Modbus command setting example

01 17 03E9 0002 03E7 0001 02 B004 9F52

- 9F52: CRC code
- B004: Parameter No.
- 02: Size
- 0001: Number of registers
- 03E7: Start register
- 0002: Number of registers
- 03E9: Start register
- 17: Function
- 01: Station No.

Command contents : Parameter B00-4 is read.

Response

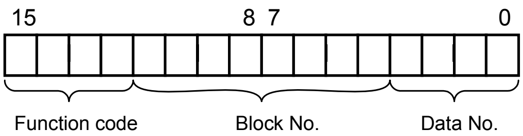
01 17 04 00001388 F471 (Successful example)

- F471: CRC code
- 00001388: Parameter data
- 04: Size(4byte)
- 17: Function
- 01: Station No.

01 97 10 4FFC (Example of failure)

- 4FFC: CRC code
- 10: Exceptional response
- 97: Function
- 01: Station No.

Divide the parameter designation section as shown below and set the parameter No.



Function	Function code
Monitor parameter designation	D
Block-A parameter designation	A
Block-B parameter designation	B
Block-C parameter designation	C
Block-U parameter designation	E

CAUTION

The following parameters cannot be changed using Function 10h "setting data write". If the write command is used to the following parameters, the error should be found.
A04-0 to 7 : Custom parameters
A05-0 to 2 : Parameter B and C indicatory skip
B19-0 : Automatic tuning selection
C10-0 to 7 : Custom parameter register
C26-0 to 7 : Standard serial transmission setting
Parameters having no relation to the control mode selected by C30-0:f0
Parameters not displayed on the operation panel by setting A05-0 to 2.

CAUTION

The The following parameters cannot be read using Function 17h and Function 03h + 10h.
D04-0 to 7 : Sequence status
D05-0 to 1 : Minor fault monitor
D07-0 : Pump operation status monitor
D08-B : Sequence input terminal status display
D08-C : Speed detection signal input status display
D20-0 : Fault history monitor
D20-1 : Minor failure past record indication
D20-2 : Parameter A, B and C modification list entry
D20-3 : Sequence input display (dedicated for LCD panel)
D20-4 : Sequence output display (dedicated for LCD panel)
D22-0 : Automatic tuning progression display
D30-0 : Inverter type
D30-1 : Option PCB
D30-2 to 5 : Field network option failure monitor
A04-0 to 7 : Custom parameters
C10-0 to 7 : Custom parameter register

However, the following parameters can be read by using other functions
D04-0 to 3 (Sequence status-Input 1 to 4) : can be read by Function 01h
D04-4 to 7 (Sequence status-Output 1 to 4): can be read by Function 02h
D20-0 (Fault history monitor) : can be read by Function 03h
D20-1 (Minor failure past record indication) : can be read by Function 03h

6-12-5-g. Additional function of Modbus

The multiplexed data read through Function 17h can also be read by using Function 10h and 03h at the same time.

Function	Details of function	Start register	Number of registers	No. of bytes
03h	Multiplexed data reading value	03E9h	0002h (32-bit data)	–
10h	MUX command write for the multiplexed data reading value	03E7h	0001h (16-bit data)	02h

In order to read parameters, follow the procedures below.
1) Set the parameter using Function 10h.
2) Set the parameter by using Function 03h, and the parameter setting can be read.

Setting example:

1) Set the parameter using Function 10h.

Modbus command setting example

01 10 03E7 0001 02 B015 3688

- 3688: CRC code
- B015: Parameter No.
- 02: Size
- 0001: Number of registers
- 03E7: Start register
- 10: Function
- 01: Station No.

Command contents : Set the parameter B01-5.

Response

01 10 03E70001 B1BA (Successful example)

- B1BA: CRC code
- 03E70001: Response data
- 10: Function
- 01: Station No.

01 90 03 0C01 (Example of failure)

- 0C01: CRC code
- 03: Exceptional response
- 90: Function
- 01: Station No.

The parameter setting method is the same as that of Function 10h and 17h (refer to the next page).

2) Set the parameter by using Function 03h, and the parameter setting can be read.

Modbus command setting example

01 03 03E9 0002 15BB

- 15BB — CRC code
- 0002 — Number of registers
- 03E9 — Start register
- 03 — Function
- 01 — Station No.

Command contents : Data read.

Response

01 03 04 00000708 F9C5 (Successful example)

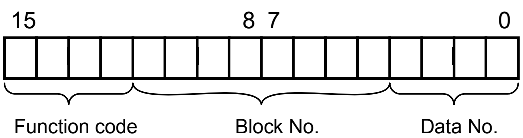
- F9C5 — CRC code
- 00000708 — Response data
- 04 — Size(4byte)
- 03 — Function
- 01 — Station No.

01 83 10 40FC (Example of failure)

- 40FC — CRC code
- 10 — Exceptional response
- 83 — Function
- 01 — Station No.

When the above procedure of 1) and 2) are correctly transferred, B01-5 will be shown in the response data column.
This time the response data should be 00000708h=1800d (default of B01-5)

Divide the parameter designation section as shown below and set the parameter No.



Function	Function code
Monitor parameter designation	D
Block-A parameter designation	A
Block-B parameter designation	B
Block-C parameter designation	C
Block-U parameter designation	E

6-13 ROM revisions

Functions changed / added by the revised ROMs

6-13-1 External failure function (available from the version 9457.0+9458.1)

(1) This function enables to cause a failure intentionally by a signal through the programmable sequence input terminal and to stop the inverter.
(2) The inverter will stop with free-running.
(3) The sequence inputs for the external failure function (C05-8~F) should be allocated to the input terminals.
(4) The sequence inputs and failure codes are as listed below.

Sequence inputs	Failure codes
C05-8	E.FLT1
C05-9	E.FLT2
C05-A	E.FLT3
C05-B	E.FLT4
C05-C	E.FLT5
C05-D	E.FLT6
C05-E	E.FLT7
C05-F	E.FLT8

(5) Return from the failure status after checking all the allocated input terminals are OFF (without failure) and also there is any other failure caused.

Notes for External failure function

・If a failure has already existed, the panel display will not be renewed even if the input terminals are turned ON.
・When plural input terminals are allocated for this function and are turned ON at the same time, the panel will display the failure code of the first terminal turned ON.
・This function is only available by the input through the terminal board. This function will not work by the signals input thorough Modbus, the standard serial interface, etc..

6-13-2 Field network option failure monitor (available from the version 9457.0+9458.3)

D30-2 **Field network option failure monitor 1 (status)**

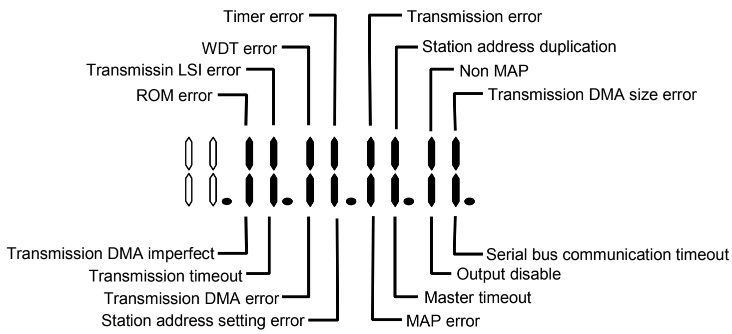
D30-3 **Field network option failure monitor 2 (status)**

These parameters will be displayed when the field network optional PCB is installed. The segment corresponding to the error on the PCB will be turned on, and will be turned off when the error is eliminated.

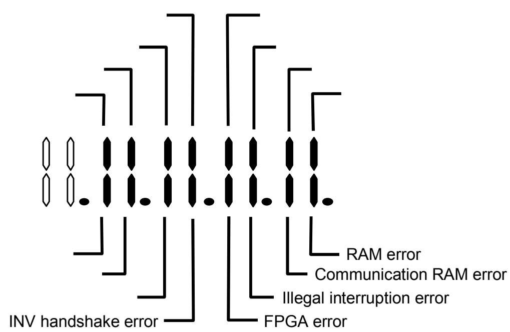
D30-4 **Field network option failure monitor 1 (latch)**

D30-5 **Filed network option failure monitor 2 (latch)**

These parameters will be displayed when the field network optional PCB is installed. If transmission error is detected as failure (C34-1=2), the segment corresponding to the error on the PCB will be turned on, and will not be turned off even when the error is eliminated. The segment will be turned off by the failure reset. If transmission error is not detected as failure or is detected as minor failure, each segment will not be turned on.



Field network option failure monitor 1(D30-2,4)



Field network option failure monitor 1(D30-3,5)

6-13-3 Analogue input display (available from the version 9457.0+9458.4)

D08-3 **AI1 Input voltage display**

D08-4 **AI2 Input voltage display**

D08-5 **AI3 Input voltage display**

The voltage on AI1, 2 and 3 terminals will be displayed in a unit of 0.01V. When the AI terminals are for current setting, “0” will be displayed.

D08-6 **AI1 Input current display**

D08-7 **AI2 Input current display**

The current on the AI1 and A2 terminals will be displayed in a unit of 0.01mA.

When the AI terminals are for voltage setting, “0” will be displayed.

D08-8	**AI1 Input display (in %)**
D08-9	**AI2 Input display (in %)**
D08-A	**AI3 Input display (in %)**

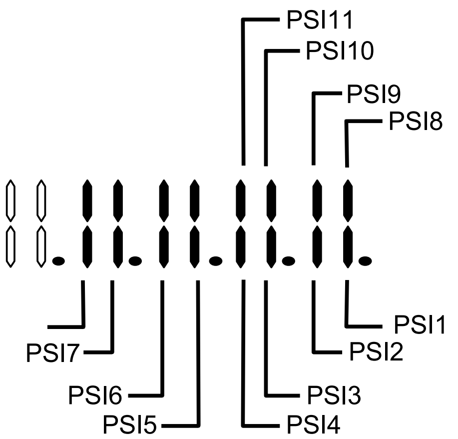
The current or voltage on the AI1, 2 and 3 terminals will be displayed in % against 10V and 20mA as 100%.

D08-B **Sequence input terminal status display**

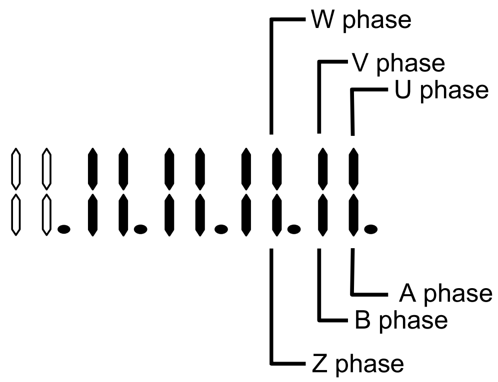
The input status of the sequence input terminals (PSI1~7) and the sequence input terminals on the relay PCB (PSI8~11) will be displayed.

D08-C **Speed detection signal input status display**

Encoder signal input status will be displayed.



Sequence input terminal status(D08-B)



Speed detection signal input status(D08-C)

Chapter 7 Options

7-1 Outline of options

The VAT300 Series options include those shown below. This chapter will focus on the stand-alone options and main circuit wiring devices.

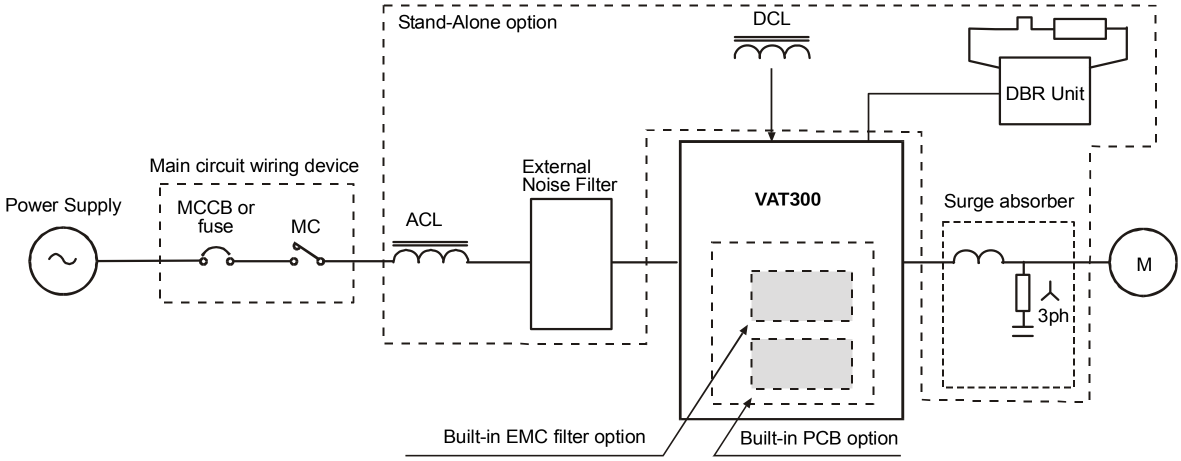


Fig. 7-1 Option configurations

Table 7-1-a

Item	Type	Function
Main circuit wiring devices		
Circuit Breaker (MCCB) or fuse	(Refer to Table 7-1-b.) Refer to Chapter 9 when using a UL/cUL compliant product.	Always install this device to protect the wiring of the inverter and peripheral devices.
Magnetic contactor (MC)	Select a device for the inverter rating. (Refer to Table 7-1-b.)	Install this device to provide an operation interlock. When using the DB unit, always install this device to protect the DBR. (Refer to Fig. 2-3-a.)
Stand-alone options		
ACL	ACR-□□□□ (Refer to Table 7-1-b.)	Always install the AC reactor (ACL) in the following cases. - For N045K0/X055K0 or lower capacities (heavy duty) When the capacity of the power supply transformer exceeds 500kVA - For X075K0 or higher capacities (heavy duty) When the capacity of the power supply transformer exceeds 10 times the inverter capacity. This is also effective in improving the power factor of the inverter input, in suppressing the current high harmonics and extending the life of the main circuit's electrolytic capacitor. The power factor will be approx. 0.9.
DCL	DCR-□□□□ (Refer to Table 7-1-b.)	Same as ACL, DC reactor (DCL) is effective in improving the power factor of the inverter input, in suppressing the current high harmonics and extending the life of the main circuit's electrolytic capacitor. The power factor will be approx. 0.9.
EMI filter	3SUP□-□□□□ (Refer to Table 7-1-b.)	This device suppresses the electromagnetic noise generated by the inverter. Mounting of this device is recommended for creating a balance with the peripheral devices of the inverter.
DB unit	U2KV23DBU-□□ (Refer to Table 7-1-b.)	This is used when the motor is to be stopped with dynamic braking.
Surge Absorber	ACFRxxx + RC filter	This suppress surge voltage at motor side, which may be generated, if length of output motor cable exceeds of 50mts

Table 7-1-a (continued)

Built-in PCB options (These are built-in type options mounted on the basic PCB of the inverter.)

Item	Type (Instruction manual)	Function	Class	Indication of rating nameplate (Note 1)
Speed detection 1 (complimentary type compatible)	U30V24DN1 N62P30609=1-01 (PCST-3480)	This is a speed detection PCB for the complimentary output type encoder. Response frequency: Change between 60±10kHz and 20kHz.	I	1
Speed detection 2 (line driver compatible)	U30V24DN2 N62P30610=1-01 (PCST-3481)	This is a speed detection PCB for the line driver output type encoder. Response frequency: 250kHz (signal: A, B, Z, S phase)	I	2
Speed detection 3 (PM compatible)	U30V24DN3 N62P30611=1-01 (PCST-3482)	This is a speed (pole position) detection PCB for the PM drive control, and is compatible with the line driver output type encoder. Response frequency: 250kHz (signal: A, B, Z, U, V, W phase)	I	3
Speed detection 4 **(Note 2)**	U30V24DN4 N62P30642=1-01 (PCST-3483)	Speed detection PCB compatible with Heidenhain ERN1387. 1Vp-p 2-phase, 2-set sine wave + Z-phase pulse	I	4
Speed detection 6	U30V24DN6 N62P30609=2-01 (PCST-3480)	This is a speed detection PCB for the single-phase complementary output type encoder circuit. The signal high level is set to 4V or more, and the low level is set to 1.0V or less.	I	6
Relay interface	U30V24RY0 N62P30612=1-01 (PCST-3477)	This is used to expand the contact input/output points. Relay input : 4 points (PSI8 to 11) 1c contact output : 4 points (PSO4 to 7)	III	N
Parallel interface	U30V24PI0 N62P30614=1-01 (PCST-3475)	This is used to receive parallel settings from the PLC. Parallel data input : 16 bits Data length : 16, 12, 8 bits selective Format : Binary or BCD selective Open collector output : 2 points (PSO4, 5)	III	M
Insulated AI/AO **(Note 2)**	U30V24AI0 N62P30622=1-01 (PCST-3479)	An insulated 4ch analog input, analog output is possible. Analog input : 16 bits (input range ±10V) Analog output : 12 bits (output range 10V)	II	S
Profibus-DP interface	U30V24SL0 N62P30616=1-01 (PCST-3466)	This is used to make a connection with the network on the Profibus-DP communication protocol. Transmission speed : 12Mbps No. of stations : 126 stations in one network	III	H
CC-Link interface	U30V24SL3 N62P30619=1-01 (PCST-3472)	This is used to make a connection with the CC-Link network. Transmission speed : 156kbps, 625kbps, 2.5Mbps, 5Mbps, 10Mbps (DIP switch settings can be made.) No. of stations : 64 stations in one network	III	K
DeviceNet interface	U30V24SL2 N62P30618=1-01 (PCST-3470)	This is used to make a connection with the DeviceNet network. Transmission speed : 125kbps, 250kbps, 500kbps (DIP switch settings can be made.) No. of stations : 64 stations in one network	III	J
CANopen interface	U30V24SL1 N62P30617=1-01 (PCST-3468)	This is used to make a connection with the CANopen network. Transmission speed : 125kbps, 250kbps, 500kbps, 1Mbps (DIP switch settings can be made.) No. of stations : 128 stations in one network	III	I

(Note 1) "0" indicates that the optional PCB is not installed.
(Note 2) The speed detection 4 (U30V24DN4) and insulated AI/AO (U30V24AIO) cannot be used simultaneously.

Table 7-1-b Main circuit wiring device ratings, and stand-alone option preparation drawing numbers and types (Normal-duty)

VAT300 Type	Motor KW(1)	MCCB (2) (A)	Line MC	EMC Filter (3)	Dynamic Braking Module	DBR (Note 4)	INPUT AC Reactor	DC Reactor	Surge Absorber (5) Reactor + RC
N000K7	0.75	15	CL00	Built in	Built in DB	TLR216P200	ACRP6A2H5	-	-
N001K5	1.5	15	CL00	Built in	Built in DB	TLR108P200	ACRP9A1H3	-	-
N002K2	2.2	15	CL00	Built in	Built in DB	TLR74P200	ACRP12A0H84	-	-
N004K0	4	20	CL01	Built in	Built in DB	TLR44P600	ACRP18A0H56	-	-
N005K5	5.5	30	CL02	Built in	Built in DB	TLR29P600	ACRP27A0H37	-	-
N007K5	7.5	40	CL04	U30F3075EB	Built in DB	TLR22P600	ACRP35A0H27	DCRP45A0H55	-
N011K0	11	60	CL04	U30F3075EB	Built in DB	TLR15P1000	ACRP55A0H18	DCRP60A0H4	-
N015K0	15	80	CL06	U30F3100EB	Built in DB	TLR11P1200	ACRP70A0H14	DCRP80A0H3	-
N018K5	18.5	100	CL07	U30F3100EB	Built in DB	TLR8,8P1500	ACRP80A0H14	DCRP100A0H24	-
N022K0	22	125	CL09	U30F3130EB	U2KV23DBUL2	TLR7,4P1800	ACRP97A0H11	DCRP120A0H2	-
N030K0	30	150	CL10	U30F3180EB	U2KV23DBUL3	TLR5P2500	ACRP140A0H072	DCRP150A0H17	-
N037K0	37	200	CK75	U30F3250ES	U2KV23DBUL3	TLR4P3000	ACRP180A0H056	DCRP180A0H14	-
N045K0	45	225	CK75	U30F3250ES	U2KV23DBUL4	-	ACRP200A0H051	DCRP220A0H11	-
X000K7	0.75	15	CL00	Built in	Built in DB	TLR864P200	ACRP3A8H1	-	ACFRP10A + RC
X001K5	1.5	15	CL00	Built in	Built in DB	TLR432P200	ACRP4A5H1	-	ACFRP10A + RC
X002K2	2.2	15	CL00	Built in	Built in DB	TLR295P200	ACRP6A3H4	-	ACFRP10A + RC
X004K0	4	15	CL00	Built in	Built in DB	TLR175P600	ACRP10A2H	-	ACFRP10A + RC
X005K5	5.5	20	CL00	Built in	Built in DB	TLR118P600	ACRP14A1H4	-	ACFRP14A + RC
X007K5	7.5	25	CL02	Built in	Built in DB	TLR86P600	ACRP18A1H1	DCRP25A2H1	ACFRP18A + RC
X011K0	11	30	CL04	Built in	Built in DB	TLR59P1000	ACRP27A0H75	DCRP32A1H6	ACFRP27A + RC
X015K0	15	40	CL04	Built in	Built in DB	TLR43P1000	ACRP35A0H58	DCRP40A1H2	ACFRP35A + RC
X018K5	18.5	50	CL04	Built in	Built in DB	TLR35P1500	ACRP38A0H58	DCRP50A0H96	ACFRP38A + RC
X022K0	22	60	CL06	Built in	Built in DB	TLR29P1800	ACRP45A0H45	DCRP60A0H82	ACFRP45A + RC
X030K0	30	80	CL06	Built in	U2KV23DBUH3	TLR22P2500	ACRP70A0H29	DCRP80A0H58	ACFRP62A + RC
X037K0	37	100	CL07	U30F3100EB	U2KV23DBUH3	TLR18P3000	ACRP90A0H22	DCRP100A0H49	ACFRP90A + RC
X045K0	45	125	CL09	U30F3130EB	U2KV23DBUH4	TLR15P3700	ACRP90A0H22	DCRP125A0H40	ACFRP90A + RC
X055K0	55	150	CL09	U30F3180EB	U2KV23DBUH4	-	ACRP115A0H18	DCRP140A0H32	ACFRP115A + RC
X075K0	75	200	CK75	U30F3250ES	U2KV23DBUH4	-	ACRP160A0H14	DCRP180A0H25	ACFRP160A + RC
X090K0	90	225	CK08	U30F3250ES	U2KV23DBUH4	-	ACRP185A0H11	DCRP210A0H25	ACFRP185A + RC
X110K0	110	300	CK85	U30F3320ES	U2KV23DBUH4	-	ACRP225A0H096	DCRP270A0H18	ACFRP300A + RC
X132K0	132	350	CK09	U30F3400ES	U2KV23DBUH4	-	ACRP300A0H067	DCRP310A0H14	ACFRP300A + RC
X160K0	160	400	CK09	U30F3600ES	U2KV23DBUH4	-	ACRP360A0H056	DCRP400A0H13	ACFRP360A + RC
X200K0	200	500	CK95	U30F3600ES	U2KV23DBUH4	-	ACRP460A0H056	DCRP540A0H08	ACFRP460A + RC
X250K0	250	600	CK10	U30F31000ES	2xU2KV23DBUH4	-	ACRP550A0H039	DCRP650A0H07	ACFRP550A + RC
X315K0	315	800	CK11	U30F31000ES	2xU2KV23DBUH4	-	ACRP700A0H035	DCRP740A0H06	ACFRP700A + RC
X400K0	400	1000	CK12	U30F31000ES	2xU2KV23DBUH4	-	ACRP850A0H023	DCRP950A0H05	ACFRP850A + RC
X475K0	475	1200		U30F31600ES	3xU2KV23DBUH4	-	ACRP950A0H016	DCRP1000A0H04	ACFRP950A + RC

(Note 1) Device selection conditions, for Normal Duty (Overload capacity 120%, 60s)

- The input current is calculated as follows: I = (IMkW)/ηIM/ηINV/COSø/voltage/$\sqrt{3}$
- The η_{IM} (motor efficiency) is 0.85 for 11kW or less, 0.9 for 15kW or more.
- The η_{INV} (inverter efficiency) is 0.95.
- COSø is 0.5 to 0.6 at the input power factor. When using ACL or DCL, recalculate as 0.9.
- The power supply voltage is 200V/380V. (If the power supply voltage differs, recalculate and select.)

(Note 2) Fuses or MCCB given are for IEC Ratings
When complying with UL/cUL, use a UL certified fuse as indicated in section 9-1.

(Note 3) Built-in EMC filters only in specified ratings and for drives U3SN_____F__ or U3SX_____F__

(Note 4) External Dynamic Braking Resistors for optimal performance. Note drives up to U3SN011K0 and U3SX11K0 include a built in DBR, which should be disconnected when using the external DBR
Check 7-3-1 section.

(Note 5) The Surge absorber -useful when length of motor cable is more than 50mts- is configured using the output reactor shown in above table plus RC filter, N11P34018=7 (use up to 1kHz carrier frequency)

Table 7-1-b Main circuit wiring device ratings, and stand-alone option preparation drawing numbers and types (Heavy-duty)

VAT300 Type	Motor KW (1)	MCCB (2) (A)	Line MC	EMC Filter (3)	Dynamic Braking Module	DBR (Note 4)	INPUT AC Reactor	DC Reactor	Surge Absorber (5) Reactor + RC
N000K7	0.4	15	CL00	Built in	Built in	TLR405P200	ACRP4A2H5	-	-
N001K5	0.75	15	CL00	Built in	Built in	TLR216P200	ACRP6A2H5	-	-
N002K2	1.5	15	CL00	Built in	Built in	TLR108P200	ACRP9A1H3	-	-
N004K0	2.2	20	CL00	Built in	Built in	TLR74P200	ACRP12A0H84	-	-
N005K5	4	30	CL01	Built in	Built in	TLR44P600	ACRP18A0H56	-	-
N007K5	5.5	35	CL02	U30F3075EB	Built in	TLR29P600	ACRP27A0H37	DCRP32A0H78	-
N011K0	7.5	50	CL04	U30F3075EB	Built in	TLR22P600	ACRP35A0H27	DCRP45A0H55	-
N015K0	11	70	CL04	U30F3100EB	Built in	TLR15P1000	ACRP55A0H18	DCRP60A0H4	-
N018K5	15	90	CL06	U30F3100EB	Built in	TLR11P1200	ACRP70A0H14	DCRP80A0H3	-
N022K0	18.5	125	CL07	U30F3130EB	U2KV23DBUL2	TLR8,8P1500	ACRP80A0H14	DCRP100A0H24	-
N030K0	22	125	CL09	U30F3180EB	U2KV23DBUL2	TLR7,4P1800	ACRP97A0H11	DCRP120A0H2	-
N037K0	30	150	CL10	U30F3250ES	U2KV23DBUL3	TLR5P2500	ACRP140A0H072	DCRP150A0H17	-
N045K0	37	200	CK75	U30F3250ES	U2KV23DBUL3	TLR4P3000	ACRP180A0H056	DCRP180A0H14	-
X000K7	0.4	15	CL00	Built in	Built in	TLR864P200	ACRP3A8H1	-	ACFRP10A + RC
X001K5	0.75	15	CL00	Built in	Built in	TLR864P200	ACRP3A8H1	-	ACFRP10A + RC
X002K2	1.5	15	CL00	Built in	Built in	TLR432P200	ACRP4A5H1	-	ACFRP10A + RC
X004K0	2.2	15	CL00	Built in	Built in	TLR295P200	ACRP6A3H4	-	ACFRP10A + RC
X005K5	4	15	CL00	Built in	Built in	TLR175P600	ACRP10A2H	-	ACFRP10A + RC
X007K5	5.5	20	CL00	Built in	Built in	TLR118P600	ACRP14A1H4	DCRP18A2H9	ACFRP14A + RC
X011K0	7.5	25	CL02	Built in	Built in	TLR86P600	ACRP18A1H1	DCRP25A2H1	ACFRP18A + RC
X015K0	11	35	CL04	Built in	Built in	TLR59P1000	ACRP27A0H75	DCRP32A1H6	ACFRP27A + RC
X018K5	15	50	CL04	Built in	Built in	TLR43P1000	ACRP35A0H58	DCRP40A1H2	ACFRP35A + RC
X022K0	18.5	60	CL04	Built in	Built in	TLR35P1500	ACRP38A0H58	DCRP50A0H96	ACFRP38A + RC
X030K0	22	70	CL06	Built in	U2KV23DBUH2	TLR29P1800	ACRP45A0H45	DCRP60A0H82	ACFRP45A + RC
X037K0	30	80	CL06	U30F3100EB	U2KV23DBUH3	TLR22P2500	ACRP70A0H29	DCRP80A0H58	ACFRP62A + RC
X045K0	37	100	CL07	U30F3130EB	U2KV23DBUH3	TLR18P3000	ACRP90A0H22	DCRP100A0H49	ACFRP90A + RC
X055K0	45	125	CL09	U30F3180EB	U2KV23DBUH4	TLR15P3700	ACRP115A0H18	DCRP125A0H40	ACFRP115A + RC
X075K0	55	150	CK75	U30F3180EB	U2KV23DBUH4	-	ACRP115A0H18	DCRP140A0H32	ACFRP115A + RC
X090K0	75	200	CK08	U30F3250ES	U2KV23DBUH4	-	ACRP160A0H14	DCRP180A0H25	ACFRP160A + RC
X110K0	90	225	CK85	U30F3250ES	U2KV23DBUH4	-	ACRP185A0H11	DCRP210A0H25	ACFRP185A + RC
X132K0	110	300	CK09	U30F3320ES	U2KV23DBUH4	-	ACRP225A0H096	DCRP270A0H18	ACFRP225A + RC
X160K0	132	350	CK09	U30F3400ES	U2KV23DBUH4	-	ACRP300A0H067	DCRP310A0H14	ACFRP300A + RC
X200K0	160	400	CK95	U30F3600ES	U2KV23DBUH4	-	ACRP360A0H056	DCRP400A0H13	ACFRP360A + RC
X250K0	200	500	CK10	U30F3600ES	U2KV23DBUH4	-	ACRP460A0H056	DCRP540A0H08	ACFRP460A + RC
X315K0	250	700	CK11	U30F31000ES	2xU2KV23DBUH4	-	ACRP550A0H039	DCRP650A0H07	ACFRP550A + RC
X400K0	315	800	CK12	U30F31000ES	2xU2KV23DBUH4	-	ACRP700A0H035	DCRP740A0H06	ACFRP700A + RC
X475K0	400	1000		U30F31000ES	2xU2KV23DBUH4		ACRP850A0H023	DCRP950A0H05	ACFRP850A + RC

(Note 1) Device selection conditions for Heavy Duty (Overload capacity 150%, 60s)
- The input current is calculated as follows: I = (IMkW)/ηIM/ηINV/COSø/voltage/√3
- The η_{IM} (motor efficiency) is 0.85 for 11kW or less, 0.9 for 15kW or more.
- The η_{INV} (inverter efficiency) is 0.95.
- COSø is 0.5 to 0.6 at the input power factor. When using ACL or DCL, recalculate as 0.9.
- The power supply voltage is 200V/380V. (If the power supply voltage differs, recalculate and select.)

(Note 2) Fuses or MCCB given are for IEC Ratings
When complying with UL/cUL, use a UL certified fuse as indicated in section 9-1.

(Note 3) Built-in EMC filters only in specified ratings and for drives U3SN_____F__ or U3SX_____F__

(Note 4) External Dynamic Braking Resistors for optimal performance. Note drives up to U3SN011K0 and U3SX015K0 include a built in DBR, which should be disconnected when using the external DBR
Check 7-3-1 section.

(Note 5) The Surge absorber -useful when length of motor cable is more than 50mts- is configured using the output reactor shown in above table plus RC filter, N11P34018=7 (use up to 1kHz carrier frequency)

7-2 Built-in PCB option

This is a built-in type option mounted on the VAT300 control PCB.
One type can be selected from option I, option II and option III. Up to three types of PCB options can be mounted at once.
These PCB options are connected to the connector on the VAT300 control PCB, and can be easily mounted even after purchasing the VAT300.

Refer to each instruction manual for details on the PCB options.
* A dedicated PCB mounting jig is required when mounting the PCB option II and III at the same time.

7-2-1 Option classes

(1) Option I

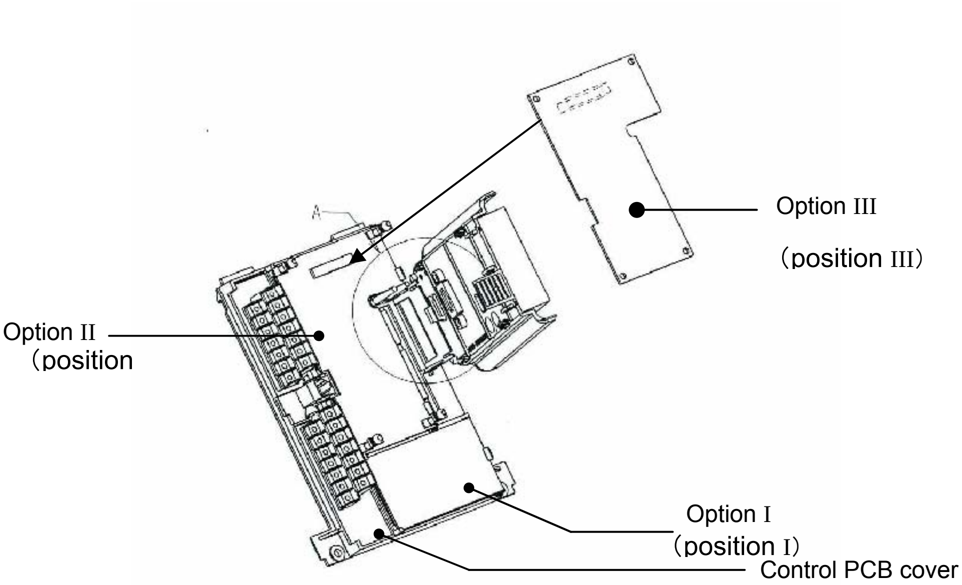
This is the PCB option for speed detection 1 to 4. The mounting position I is fixed.

(2) Option II

This is the PCB option for the Insulated AI/AO interface, etc. The mounting position is position II.

(3) Option III

This is the PCB option for the relay interface, serial communication etc. The mounting position is position III.
(Position III is PCB mounted on the PCB option at position II.)
Refer to Table 7-1-a for the detailed option classes.



Built-in PCB option mounting drawing

Notes for moving Operation panel folder

Do not raise the operation panel folder with an angle of larger than 90°, so that the folder should not be fallen off.

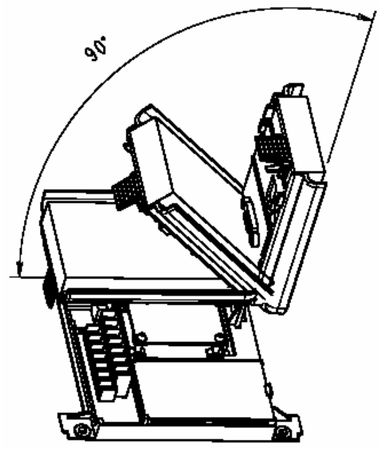


Fig. 7-2-1-b

If the operation panel folder should be taken off, push the hinges of the folder lightly and insert them into the original positions.

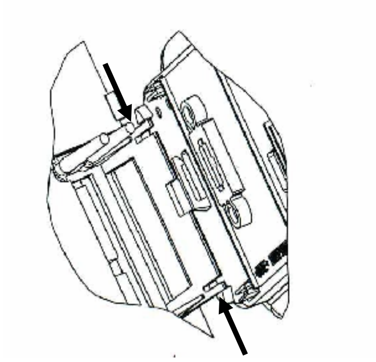


Fig. 7-2-1-c

7-3 Dynamic braking (DB) option

The VAT300 has a dynamic braking option.

Note) When Unit built-in DBR is used, set the DBR overload protection parameter (C22-4) to less than the actual used %ED (Max. 10.0). When the external DB unit is used, set C22-4 to 0.0.

7-3-1 Built-in DB circuit N018K0 / X022K0 and smaller

The DB transistor is built in as a standard for the N018K0 / X022K0 and smaller capacities.
For the N011K0/X015K0 and smaller capacities, the DB resistor (DBR) can be built in as an option.
When using the DB, use at 10%ED or less as shown in Fig. 7-3-1-a.
When using the dynamic braking option, set the Regenerative current limit (B18-1) and the DB option selection (C31-0 f0).

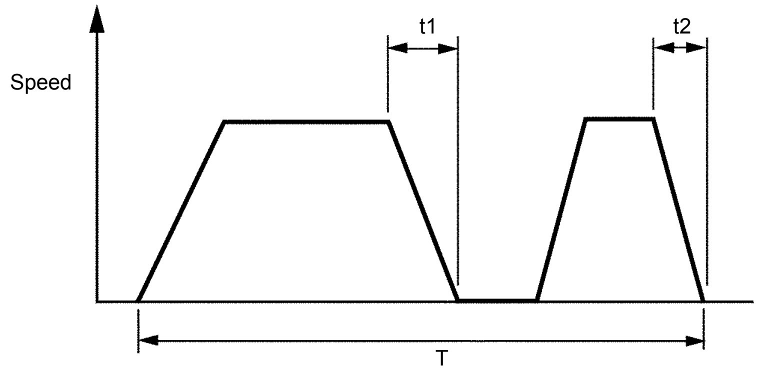


Fig. 7-3-1-a

(1) Unit built-in DBR

The specification of DBR built into the unit is shown in Table 7-3-1-a. If these resistors are applied, use within t(sec) shown in Table 7-3-1-a.

Table 7-3-1-a Unit built-in DBR

Inverter type VAT300 U3S_	Resistance capacity (W)	Built-in DBR (Ω)	Heavy-duty		Normal-duty		t (sec) (Note 1)
			Motor capacity (kW)	Braking torque (%)	Motor capacity (kW)	Braking torque (%)	
N000K7	120	220	0.4	200	0.75	110	30
N001K5	120	220	0.75	110	1.5	55	30
N002K2	120	220	1.5	55	2.2	35	30
N004K0	120	180	2.2	45	4.0	25	20
N005K5	120	110	4.0	40	5.5	30	10
N007K5	120	91	5.5	35	7.5	25	10
N011K0	120	91	7.5	25	11	15	10
X000K7	120	430	0.4	340	0.75	220	10
X001K5	120	430	0.75	220	1.5	130	10
X002K2	120	430	1.5	130	2.2	75	10
X004K0	120	430	2.2	75	4.0	40	10
X005K5	120	430	4.0	40	5.5	30	10
X007K5	120	430	5.5	30	7.5	20	10
X011K0	120	430	7.5	20	11	15	10
X015K0	120	430	11	15	15	10	10

(Note 1) Set C22-4 to [t / 600sec] × 100%.

(2) External DB resistor

If the braking torque is insufficient with the above built-in resistor, provide an external DB resistor with a circuit as shown in Fig. 7-3-1-b. When using an external DB resistor, remove the built-in DB resistor. The resistance value and usable minimum resistance value to obtain a 100% braking torque is shown in Table 7-3-1-b.
When using the external DB resistor, use of a burning prevention circuit, including the thermal relay (76D) shown in Fig. 7-3-1-b. is recommended.

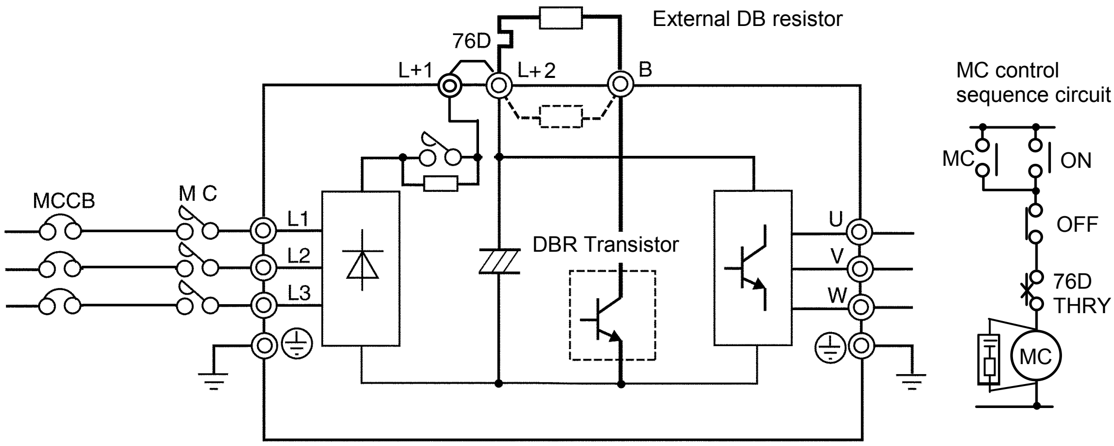


Fig. 7-3-1-b DBR circuit

Table 7-3-1-b External DBR

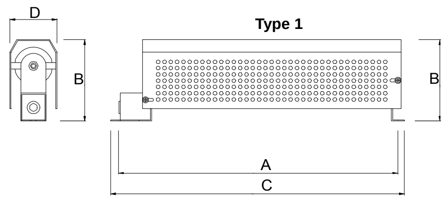
Inverter type VAT300 U3S_	Heavy-duty		Normal-duty	
	Motor capacity (kW)	100% braking resistance type	Motor capacity (kW)	100% braking resistance type
N000K7	0.4	TLR405P200	0.75	TLR216P200
N001K5	0.75	TLR216P200	1.5	TLR108P200
N002K2	1.5	TLR108P200	2.2	TLR74P200
N004K0	2.2	TLR74P200	3.7	TLR44P600
N005K5	4.0	TLR44P600	5.5	TLR29P600
N007K5	5.5	TLR29P600	7.5	TLR22P600
N011K0	7.5	TLR22P600	11	TLR15P1000
N015K0	11	TLR15P1000	15	TLR11P1200
N018K5	15	TLR11P1200	18	TLR8,8P1500
X000K7	0.4	TLR864P200	0.75	TLR864P200
X001K5	0.75	TLR864P200	1.5	TLR432P200
X002K2	1.5	TLR432P200	2.2	TLR295P200
X004K0	2.2	TLR295P200	3.7	TLR175P600
X005K5	4.0	TLR175P600	5.5	TLR118P600
X007K5	5.5	TLR118P600	7.5	TLR86P600
X011K0	7.5	TLR86P600	11	TLR59P1000
X015K0	11	TLR59P1000	15	TLR43P1000
X018K5	15	TLR43P1000	18	TLR35P1500
X022K0	18	TLR35P1500	22	TLR29P1800

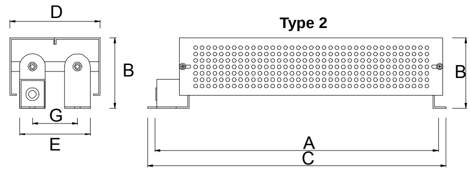
Table 7-3-1-c External DBR Dimensions

Resistance	Wire	Dimensions						
(Note1)	(mm^2)	A	B	C	D	E	G	Type
TLR405P200	2.5	215	80	235	40 ∅	-	-	1(*)
TLR216P200	2.5	215	80	235	40 ∅	-	-	1(*)
TLR108P200	2.5	215	80	235	40 ∅	-	-	1(*)
TLR74P200	2.5	215	80	235	40 ∅	-	-	1(*)
TLR44P600	2.5	430	95	460	57	-	-	1
TLR29P600	2.5	430	95	460	57	-	-	1
TLR22P600	2.5	430	95	460	57	-	-	1
TLR15P1000	2.5	430	105	460	66	-	-	1
TLR11P1200	4	430	125	460	80	-	-	1
TLR864P200	2.5	215	80	235	40 ∅	-	-	1(*)
TLR432P200	2.5	215	80	235	40 ∅	-	-	1(*)
TLR295P200	2.5	215	80	235	40 ∅	-	-	1(*)
TLR175P600	2.5	430	95	460	57	-	-	1
TLR118P600	2.5	430	95	460	57	-	-	1
TLR86P600	2.5	430	95	460	57	-	-	1
TLR59P1000	2.5	430	105	460	66	-	-	1
TLR43P1000	2.5	430	105	460	66	-	-	1
TLR35P1500	2.5	430	105	460	139	105	65	2

Note 1 Recommended resistor is rated for a ED of 10%, with maximum braking time of 20 sec. For braking large inertia loads, ask your supplier for an appropriate resistor. Note that VAT300 up to N011K5 and up to X015K5, include DB resistor as shown in table 7-3-1a. This should be disconnected when using external resistors

Type 1(*) As type 1, but provided with 210mm output cable (No terminals)





7-3-2 External DB unit N022K0 / X030K0 and higher

Use an external DB unit when carrying out dynamic braking with the N022K0/X030K0 and larger unit. Applicable DB unit, the resistance value and usable minimum resistance value to obtain a 100% braking torque, is shown in Table 7-3-2.
Connect the DB unit as shown in Fig. 7-3-2. When carrying out dynamic braking with one DB unit, use at 10%ED or less as shown in Fig. 7-3-1-a. If the braking torque is insufficient with one unit, connect a DB unit in parallel.

Set in module U2KV23DBU the parameters A0.x and A1.x at least. Check manual of U2KV23DBU.

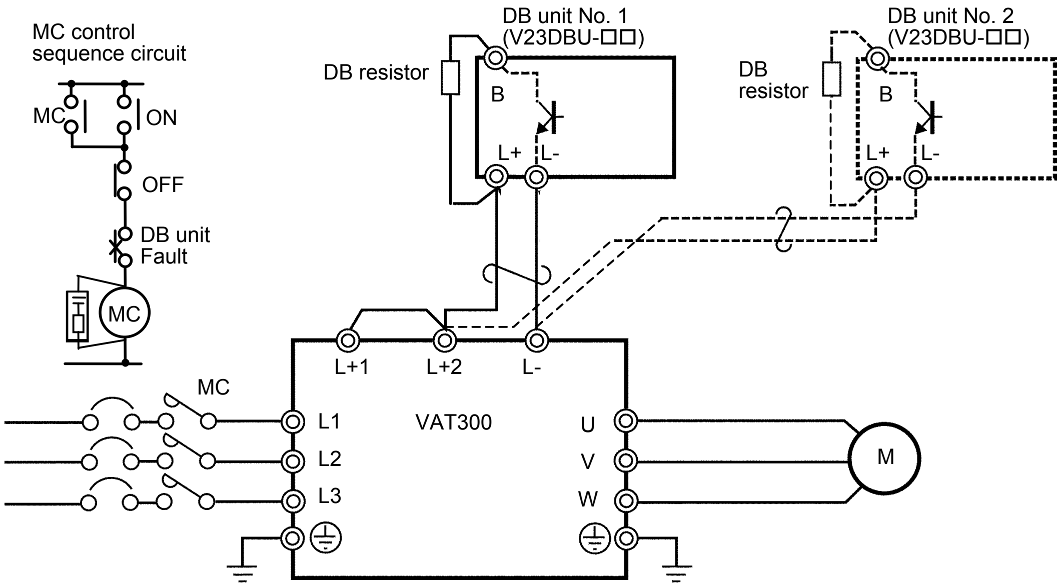


Fig. 7-3-2 DB unit connection

Table 7-3-2 External DB unit

Inverter type VAT300 U3S_	Heavy-duty			Normal-duty		
	Motor (kW)	DB unit type U2KV23_	100% braking resistance (3)	Motor (kW)	DB unit type U2KV23_	100% braking resistance (3)
N022K0	18	DBUL2	TLR8,8P1500	22	DBUL2	TLR7,4P1800
N030K0	22		TLR7,4P1800	30	DBUL3	TLR5P2500
N037K0	30	DBUL3	TLR5P2500	37		TLR4P3000
N045K0	37		TLR4P3000	45	DBUL4	(4) 3.8Ω
X030K0	22	DBUH2	TLR29P1800	30	DBUH3	TLR22P2500
X037K0	30	DBUH3	TLR22P2500	37		TLR18P3000
X045K0	37		TLR18P3000	45	DBUH4	TLR15P3700
X055K0	45	DBUH4	TLR15P3700	55		(4) 12.5Ω
X075K0	55		(4) 12.5Ω	75		(4) 9.2Ω
X090K0	75		(4) 9.2Ω	90		(4) 7.7Ω
X110K0	90		(4) 7.7Ω	110		(4) 6.3Ω
X132K0	110		(4) 6.3Ω	132		(4) 5.2Ω
X160K0	132		(4) 5.2Ω	160		(4) 4.3Ω
X200K0	160		(4) 4.3Ω	200		(4) 3.4Ω
X250K0	200		(4) 3.4Ω	250	DBUH4 × 2 units	(4) 5.6Ω × 2 sets
X315K0	250	DBUH4 × 2 units	(4) 5.6Ω × 2 sets	315		(4) 4.4Ω × 2 sets
X400K0	315		(4) 4.4Ω × 2 sets	400		(4) 3.4Ω × 2 sets
X475K0	400		(4) 3.4Ω × 2 sets	475	DBUH4 × 3 units	(4) 4.5Ω × 3 sets

(1) Set the following parameters when using external DB unit.

C31-0 $\boxed{f1}$ = 2 : With DB
B18-1 = 100% : Regenerative current limit
B22-5 = 100% : Regenerative current limit (Auxiliary drive0)
B26-5 = 100% : Regenerative current limit (Auxiliary drive1)
B2A-5 = 100% : Regenerative current limit (Auxiliary drive2)
B2E-5 = 100% : Regenerative current limit (Auxiliary drive3)

(2) Obtain the power generation capacity and DBR resistance value with the following expressions.

$$\text{Power generation capacity (kW)} = \frac{\text{Regenerative torque}}{\text{Motor rated torque}} \times 0.85 \times \text{Motor capacity (kW)}$$

$$\text{DBR resistance value} = \frac{K}{\text{Power generation capacity}}$$

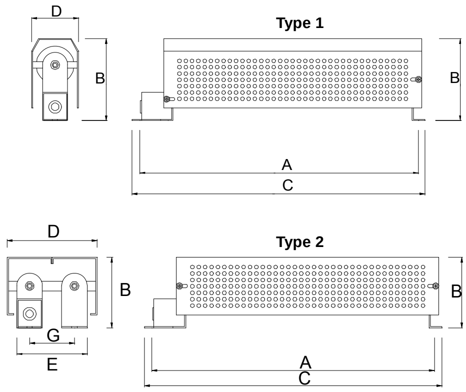
Note that for the 200V Series, K = 148.2
For the 400V Series, K = 593

(3) GE standard resistors TLRxxx are given for drives up to X055K0, and 5%ED. Ask your dealer for bigger ratings or heavier duty usage

(4) Braking resistors for ratings above X055K0 are are only available by special request to GE. Resistance value is shown in ohms. Ask your dealer for details

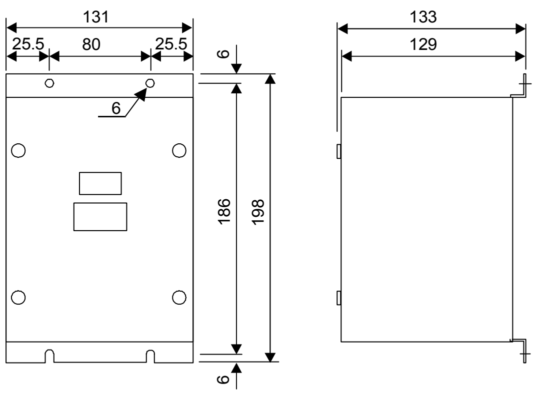
7-3-3 Dimensions of external Dynamic Braking Resistors and Braking Units

(1) External Resistors

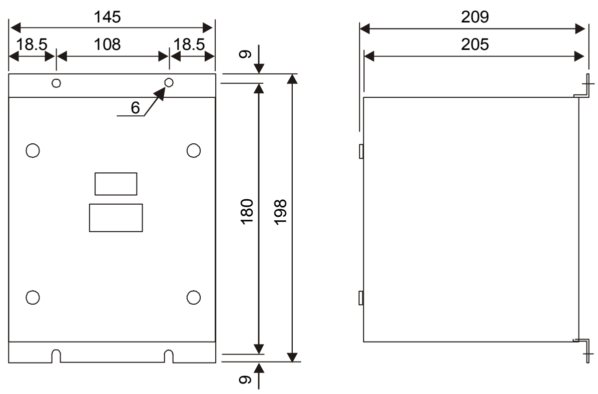


Resistance (Note1)	Wire (mm^2)	Dimensions						
		A	B	C	D	E	G	Type
TLR8,8P1500	4	430	105	460	139	105	65	2
TLR7,4P1800	6	430	105	460	139	105	65	2
TLR5P2500	16	430	105	460	207	185	136	2
TLR4P3000	16	410	180	430	139	119	68	2
TLR29P1800	4	430	105	460	139	105	65	2
TLR22P2500	6	430	105	460	207	185	136	2
TLR18P3000	16	410	180	430	139	119	68	2
TLR15P3700	16	410	180	430	139	119	68	2

(2) External Braking Units



U2KV23DBUL1, L2, L3
U2KV23DBUH1, H2, H3



U2KV23DBUH4

7-4 AC Reactors, DC Reactors and Surge absorbers

Select the ACL and DCL according to the Table 7-1-b inverter type. Refer to Table 7-4-a, Table 7-4-b and Table 7-4-c for the outline dimension. The ACL is equivalent to a 3% impedance of the inverter capacity.

Table 7-4-a Outline dimensions of ACL

Catalolg #	Drawing	DIMENSIONS (mm)						Weight (kg)	Losses W
		A	B	C	D	E	Ø		
ACRP4A2H5	1	120	80	152	41	100	6	1,3	16
ACRP6A2H5	1	120	80	152	41	100	6	1,5	18
ACRP9A1H3	1	120	80	152	41	100	6	1,6	17
ACRP12A0H84	1	120	80	152	41	100	6	1,7	18
ACRP18A0H56	1	120	90	152	51	100	6	2,4	21
ACRP27A0H37	1	150	95	183	46	125	6	3,3	32
ACRP35A0H27	1	150	95	183	46	125	6	3,7	35
ACRP55A0H18	1	150	110	183	61	125	6	5,5	42
ACRP70A0H14	1	150	111	250	77	100	9	5,6	100
ACRP80A0H14	1	150	121	250	87	100	9	7,1	108
ACRP97A0H11	1	150	126	250	92	100	9	7,8	124
ACRP140A0H072	3	180	166	216	92	120	9	11,9	155
ACRP180A0H056	3	180	176	216	102	120	9	14,2	175
ACRP200A0H051	3	180	186	216	112	120	9	15,9	210
ACRP3A8H1	1	120	80	152	41	100	6	1,4	17
ACRP4A5H1	1	120	80	152	41	100	6	1,5	16
ACRP6A3H4	1	120	80	152	41	100	6	1,7	19
ACRP10A2H	1	120	90	152	51	100	6	2,5	23
ACRP14A1H4	1	150	95	178	46	125	6	3,2	29
ACRP18A1H1	1	150	95	178	46	125	6	4	35
ACRP27A0H75	1	150	106	233	72	100	9	4,8	77
ACRP35A0H58	1	150	111	233	77	100	9	5,5	98
ACRP38A0H58	1	150	116	233	82	100	9	6,4	96
ACRP45A0H45	1	150	121	233	87	100	9	7,1	102
ACRP70A0H29	1	150	151	250	117	100	9	11	147
ACRP90A0H22	1	180	136	286	102	120	9	13,1	158
ACRP115A0H18	1	180	156	301	122	120	9	16,9	186
ACRP160A0H14	3	240	181	288	107	160	9	25,7	268
ACRP185A0H11	3	240	181	288	107	160	9	26,3	255
ACRP225A0H096	3	240	191	288	117	160	9	30,7	305
ACRP300A0H067	3	240	226	288	142	160	9	40,4	356
ACRP360A0H056	3	240	226	288	142	160	9	42,2	425
ACRP460A0H056	3	300	258	400	142	200	9	64,1	595
ACRP550A0H039	3	300	258	400	142	200	9	64,9	636
ACRP700A0H035	3	360	316	472	202	300	11	116,2	991
ACRP850A0H023	3	420	296	544	178	350	11	115	856
ACRP950A0H016	3	420	306	544	188	350	11	123,6	934

Fig. 1

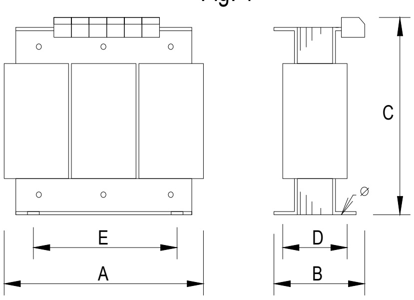


Fig. 3

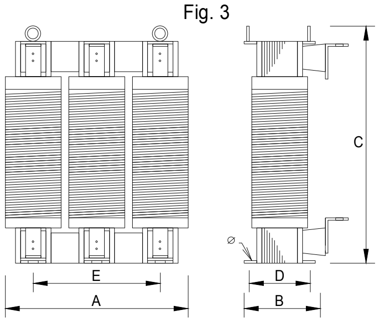


Table 7-4-b Outline dimensions of DCL

Catalolg #	Drawing	DIMENSIONS (mm)						Weight	Losses
		A	B	C	D	E	Ø	(kg)	W
DCRP32A0H78	5	100	110	173	91	75	6	3,9	37
DCRP45A0H55	5	120	110	203	86	90	6	6,1	33
DCRP60A0H4	5	120	120	220	96	90	6	6,4	41
DCRP80A0H3	5	120	135	220	111	90	6	7,1	45
DCRP100A0H24	5	120	135	235	111	90	6	7,1	51
DCRP120A0H2	5	160	150	285	130	120	9	13,4	43
DCRP150A0H17	5	160	160	285	140	120	9	15	50
DCRP180A0H14	6	160	156	288	82	120	9	11,6	71
DCRP220A0H11	6	160	161	288	87	120	9	12,9	77
DCRP18A2H9	5	100	95	178	76	75	6	3,5	42
DCRP25A2H1	5	100	95	183	76	75	6	3,5	54
DCRP32A1H6	5	100	110	183	91	75	6	3,9	59
DCRP40A1H2	5	100	110	183	91	75	6	3,9	56
DCRP50A0H96	5	120	110	209	86	90	6	6,1	60
DCRP60A0H82	5	120	120	226	96	90	6	6,4	65
DCRP80A0H58	5	120	135	226	111	90	6	7,1	58
DCRP100A0H49	5	120	135	241	111	90	6	7,1	91
DCRP125A0H40	5	160	150	293	130	120	9	13,4	79
DCRP140A0H32	5	160	150	293	130	120	9	3,9	74
DCRP180A0H25	6	160	186	288	112	120	9	18,3	92
DCRP210A0H25	6	160	216	288	142	120	9	24,2	132
DCRP270A0H18	6	160	226	288	152	120	9	27,7	127
DCRP310A0H14	6	160	246	288	162	120	9	29,8	151
DCRP400A0H13	6	200	231	400	147	150	9	40,9	190
DCRP540A0H08	6	200	251	400	157	150	9	45,7	212
DCRP650A0H07	6	200	281	400	177	150	9	56,2	237
DCRP740A0H06	6	200	296	400	192	150	9	61,6	265
DCRP950A0H05	6	240	356	472	252	180	11	99,3	256
DCRP1000A0H04	6	240	366	472	262	180	11	103,1	257

Fig. 5

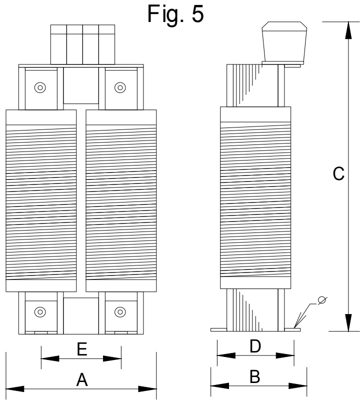
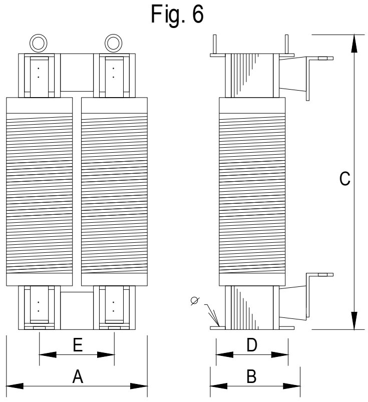


Fig. 6



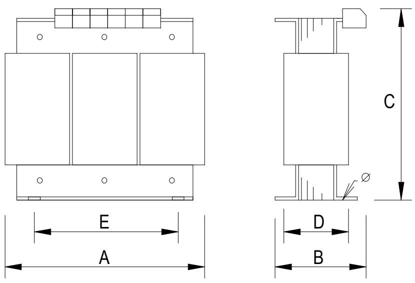
7-4-1 Surge Absorbers

Surge absorber usage is shown on Table 7-1b, for both Normal Duty and Heavy duty ratings. Other details are given below. Surge absorber is composed by two items, ACFR reactor and RC filters

Catalolg #	Drawing	DIMENSIONS (mm)						Weight (kg)	Losses W
		A	B	C	D	E	Ø		
ACFRP10A	1	120	80	152	41	100	6	1,2	16
ACFRP14A	1	120	80	152	41	100	6	1,2	15
ACFRP18A	1	120	80	152	41	100	6	1,2	17
ACFRP27A	1	120	80	157	41	100	6	1,4	18
ACFRP35A	1	120	90	157	51	100	6	2,2	21
ACFRP38A	1	120	90	157	51	100	6	2,2	21
ACFRP45A	1	150	110	183	67	125	6	4,1	33
ACFRP62A	1	150	101	250	67	100	9	4,2	66
ACFRP90A	1	150	121	250	87	100	9	7,5	84
ACFRP115A	1	180	131	299	97	120	9	12,1	112
ACFRP160A	3	180	211	216	137	120	9	21,1	183
ACFRP185A	3	240	181	288	107	160	9	25,5	218
ACFRP225A	3	240	216	288	142	160	9	36,6	304
ACFRP300A	3	300	231	400	147	200	9	59,3	477
ACFRP360A	3	300	266	400	182	200	9	78,3	593
ACFRP460A	3	360	308	472	212	300	11	122,4	728
ACFRP550A	3	360	338	472	242	300	11	145,8	863
ACFRP700A	3	420	371	544	273	350	11	209,7	1486
ACFRP850A	3	480	446	616	328	400	11	336,3	1104
ACFRP950A	3	480	476	616	358	400	11	377	1267

Catalolg # RC	Drawing	VAT300 setting for CF	Weight (kg)	Losses W
N11P34018=7	Fig. 06	Maximum Carrier frequency 1kHz		297

Fig. 1



D= 135mm for N11P34018=7

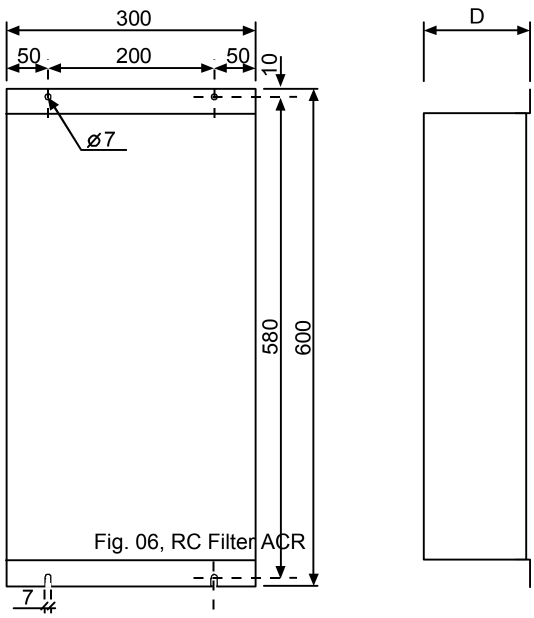
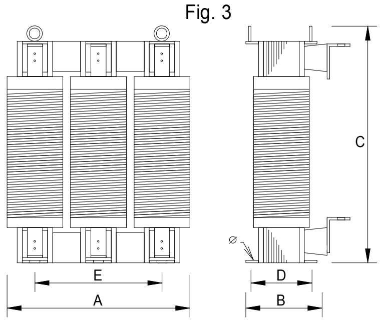


Fig. 06, RC Filter ACR

Fig. 3



7-5 EMI filter

EMC compliance for VAT300 is achieved either by either built-in filters in the drive or by external filters. Built in filters are available for drives up to 30KW/400V (U30SX030K0_) only. For larger drives, an external EMI filter should be used when complience with EMC is required.
Check table 7-1-b or the tables below to select the filter according to inverter type

Table 7.5.1 VAT300 Drives with Built-in Filter

VAT300 Series	VAT300 Model	Second Environment EN61800-3 Category C3	First Environment EN61800-3 Category C2
		Filter type	Add ferrite cores
200V Series with built in filter	U30N000K7F__	Built-in the drive	P：ZCAT3035-1330×3 C：ZCAT3035-1330×1 M：ZCAT3035-1330×1
	U30N001K5F__		
	U30N002K2F__		
	U30N004K0F__		NA
	U30N005K5F__		
400V Series with built in filter	U30X000K7F__	Built-in the drive	P：ZCAT3035-1330×3 C：ZCAT3035-1330×1 M：ZCAT3035-1330×1
	U30X001K5F__		
	U30X002K2F__		
	U30X004K0F__		
	U30X005K5F__		
	U30X007K5F__	Built-in the drive	NA
	U30X011K0F__		
	U30X015K0F__		
	U30X018K5F__		
	U30X022K0F__		
	U30X030K0F__		

*2) P: Ferrite cores for power cable; C: Ferrite cores for control cable;
M: Ferrite cores for motor cable

Table 7.5.2 External filters for VAT300 drives without Built-in Filter (200V series)

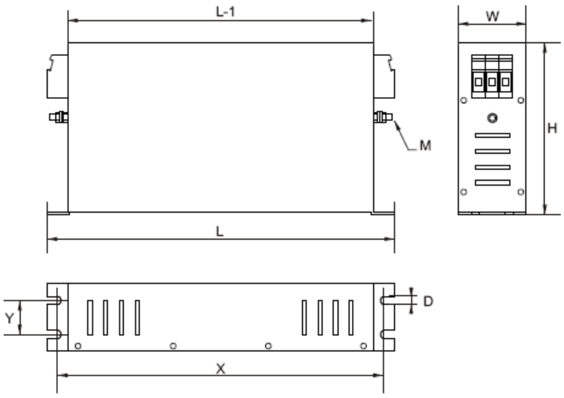
VAT300 Series	VAT300 Model	Second Environment (EN61800-3 Category C3) External filter selection	
		Use with VAT300 in ND	Use with VAT300 in HD
200V Series	U30N000K7S__	U30F3016EB	U30F3016EB
	U30N001K5S__	U30F3016EB	U30F3016EB
	U30N002K2S__	U30F3016EB	U30F3016EB
	U30N004K0S__	U30F3030EB	U30F3030EB
	U30N005K5S__	U30F3030EB	U30F3030EB
	U30N007K5S__	U30F3075EB	U30F3075EB
	U30N011K0S__	U30F3075EB	U30F3075EB
	U30N015K0S__	U30F3100EB	U30F3100EB
	U30N018K5S__	U30F3100EB	U30F3100EB
	U30N022K0S__	U30F3130EB	U30F3130EB
	U30N030K0S__	U30F3180EB	U30F3180EB
	U30N037K0S__	U30F3250ES	U30F3250ES
	U30N045K0S__	U30F3250ES	U30F3250ES

Table 7.5.3 External filters for VAT300 drives without Built-in Filter (400V series)

VAT300 Series	VAT300 Model	Second Environment (EN61800-3 Category C3) External filter selection	
		Use with VAT300 (ND)	Use with VAT300 (HD)
400V Series	U30X000K7S__	U30F3016EB	U30F3016EB
	U30X001K5S__	U30F3016EB	U30F3016EB
	U30X002K2S__	U30F3016EB	U30F3016EB
	U30X004K0S__	U30F3016EB	U30F3016EB
	U30X005K5S__	U30F3030EB	U30F3030EB
	U30X007K5S__	U30F3030EB	U30F3030EB
	U30X011K0S__	U30F3030EB	U30F3030EB
	U30X015K0S__	U30F3055EB	U30F3055EB
	U30X018K5S__	U30F3055EB	U30F3055EB
	U30X022K0S__	U30F3075EB	U30F3075EB
	U30X030K0S__	U30F3100EB	U30F3100EB
	U30X037K0S__	U30F3100EB	U30F3100EB
	U30X045K0S__	U30F3130EB	U30F3130EB
	U30X055K0S__	U30F3180EB	U30F3180EB
	U30X075K0S__	U30F3250ES	U30F3180EB
	U30X090K0S__	U30F3250ES	U30F3250ES
	U30X110K0S__	U30F3320ES	U30F3320ES
	U30X132K0S__	U30F3400ES	U30F3320ES
	U30X160K0S__	U30F3600ES	U30F3400ES
	U30X200K0S__	U30F3600ES	U30F3600ES
	U30X250K0S__	U30F31000ES	U30F3600ES
	U30X315K0S__	U30F31000ES	U30F31000ES
	U30X400K0S__	U30F31000ES	U30F31000ES
	U30X475K0S__	U30F31600ES	U30F31000ES

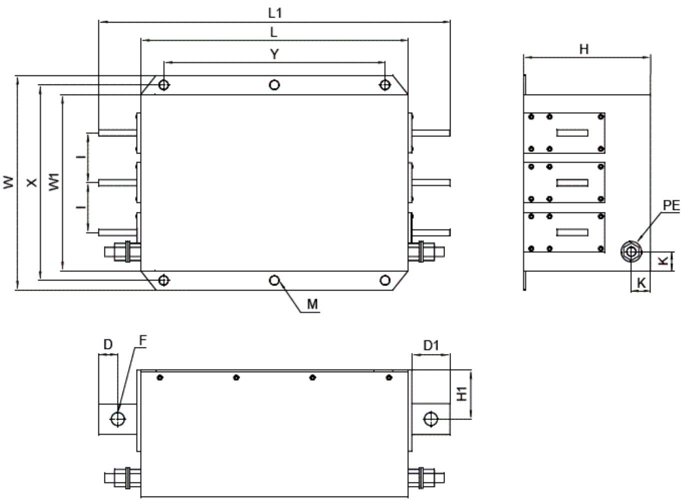
7.5.1 External filter dimensions, Book case type

EMI Filter	Dimensions								Weight
	L	L-1	H	W	X	Y	M	D	Kg
U30F3016EB	250	220	70	45	235	25	M5	M5	1.7
U30F3030EB	270	240	85	50	255	30	M5	M5	1.8
U30F3055EB	250	220	90	85	235	60	M6	M5	3.1
U30F3075EB	270	240	135	80	255	60	M6	M6	4
U30F3100EB	270	240	150	90	255	65	M10	M6	5.5
U30F3130EB	270	240	150	90	255	65	M10	M6	7.5
U30F3180EB	380	350	170	120	365	102	M10	M6	11



7.5.1 External filter dimensions, Standard brick case type

EMI Filter	Dimensions														Weight
	W	W1	X	L	L1	Y	H	H1	K	M	D	D1	F	I	PE	Kg
U30F3250ES	190	140	165	300	392	240	116	41	20	Ø12	15	42	Ø11	40	M10	7
U30F3320ES	260	210	235	300	392	240	116	41	20	Ø12	15	42	Ø11	60	M10	10.3
U30F3400ES	260	210	235	300	392	240	116	41	20	Ø12	15	42	Ø11	60	M10	10.3
U30F3600ES	260	210	235	300	392	240	116	48,5	20	Ø12	15	42	Ø11	60	M10	11
U30F31000ES	280	230	255	350	460	290	166	64	25	Ø12	25	50	Ø17	65	M12	18
U30F31600ES	300	250	275	400	592	340	166	61	25	Ø12	25	52	Ø17	80	M12	27



Chapter 8 Maintenance and Inspection

⚠ DANGER

- Always wait at least 10 minutes after turning the input power OFF before starting inspections.
  Wait at least 10 minutes after turning the input power OFF before starting work. Make sure that the displays on the operation panel have gone out before removing the front cover.
  Remove the front cover, and confirm that the "CHARGE" LED in the unit has gone out. Also check that the voltage between L+1 or L+2 and L- is 15V or less before starting the inspections.
  Failure to observe this could lead to electric shocks.
- Maintenance, inspections and part replacement must be done by a designated person.
  (Remove all metal accessories such as watches, bracelets, etc., before starting the work.)
  (Always use an insulation measure tool.)
  Failure to observe this could lead to electric shocks and injuries.
- Always turn the power OFF before inspecting the motor or machine. A potential is applied on the motor terminal even when the motor is stopped.
  Failure to do so could lead to electric shocks and injuries.
- Do not use parts other than those designated for the replacement parts.
  Contact your inverter dealer for replacement parts.
  Failure to observe this could lead to fires.

⚠ CAUTION

- Vacuum the inverter with a vacuum cleaner to clean it. Do not use water or organic solvents.
  Failure to observe this could lead to fires or damage.

8-1 Inspection items

The inspection must be carried out periodically. Determine the cycle according to the installation environment and working frequency of the VAT300. If there are any abnormalities, the cause must be inspected immediately and countermeasures taken.

(1) Daily inspections

Table 8-1-a

Inspection item	Inspection details and work
Temperature/humidity	Confirm that the ambient temperature is –10 to 50°C, and that the humidity is 95% or less with no dew condensation.
Oil mist, dust and corrosive gas	Confirm that there is no oil mist, dust or corrosive gas, etc., in the VAT300.
Abnormal noise and vibration	Confirm that there is no abnormal noise or vibration from the installation site or VAT300.
Input power source	Confirm that the input voltage and frequency are within the specifications range.
Cooling fan	Confirm that the cooling fan rotates normally and that no lint, etc. is stuck on it.
Indicator	Confirm that all lamps on the operation panel light properly.

(2) Periodic inspections

Table 8-1-b

Inspection item	Inspection details and work
VAT300 appearance	Check the state of dirt and dust on the vent or heatsink, and clean if necessary.
VAT300 interior	Check the state of dirt and dust on the PCB and inside the equipment, and clean if necessary.
Terminal block	Tighten the terminal block screws if loose.
Cooling fan	Replace the fan every three years.
Electrolytic capacitor	Confirm that there is no liquid leaking or sheath discoloration. Please exchange electrolytic capacitors of a main circuit for about five years. (When the average annual temperature of the panel in which the VAT300 is stored is 25°C or less. Please consult our company when it is used in the environment for the average temperature to exceed 25°C during year.)
Insulation test	An insulation test has been completed at the factory, so avoid performing a megger test on the VAT300 when possible. If unavoidable, follow **(Note 1)**.
Encoder	Confirm that there is no looseness or play in the bearings or couplings. The bearings are durable parts. This is approx. 10,000 hours at 6000rpm, and approx. 30,000 hours at 3000rpm.They must be replaced periodically.

(Note 1) Use the following procedures when an insulation test must be carried out. Pay special care as an incorrect test could damage the product.

• Megger test of main circuit

1) Turn OFF the power to all circuits connected to the VAT300, and confirm that the operation panel display has turned OFF. Then, remove the front cover.
   Confirm that the "CHARGE" LED on the PCB has gone out, and that the voltage between L+1, L+2 and L- (if unit capacity does not have L-, negative pole of main circuit electrolytic capacitor) is completely discharged.
2) Short-circuit the main circuit terminals in a batch as shown in Fig. 8-1. If the unit capacity does not have an L- terminal, add the main circuit electrolytic capacitor negative pole to the batch short-circuit.
   If the test voltage could be applied on the control circuit, disconnect the control terminal block wiring.
3) Carry out the megger test at 500VDC. Connect the + pole of the megger tester to where the main circuit is short-circuited in a batch, and connect the - pole to the ground (grounding terminal), so that the test voltage is not applied on the other circuits.
4) When the VAT300 isolated, the state is normally if the megger measurement results are 1MΩ or more.

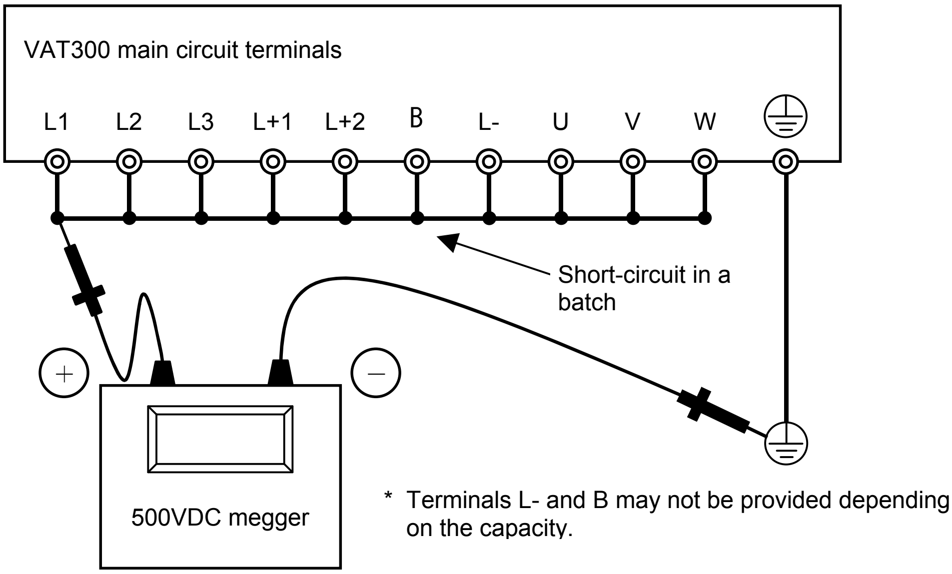


Fig. 8-1 Main circuit megger test

• Testing the control circuit's insulation

Test the control circuit's insulation with the tester's high-resistance range. Never perform a megger test or pressure test.

1) Turn OFF the power to all circuits connected to the VAT300, and confirm that the operation panel display has turned OFF. Then, remove the front cover. Confirm that the "CHARGE" LED on the PCB has gone out, and that the voltage between L+1, L+2 and L- is completely discharged.
2) Disconnect all wires connected to the control circuit terminal.
3) Measure the resistance between the control circuit terminal and ground. The insulation is normal if the resistance is 1MΩ or more.

(3) Inspection of spare parts, etc.

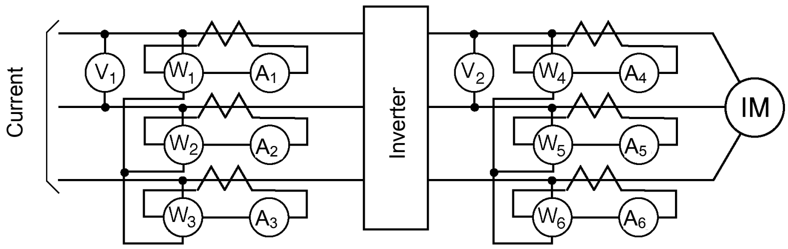
The inspections shown in Table 8-1-b must be performed even for parts which are not powered for a long time, such as spare parts. The characteristics of the large capacity electrolytic capacitor, used in the main circuit, will drop if the capacitor is not energized for a long time. Turn the power ON for approx. five hours once every six months. Also check the operation of the VAT300 at this time. If the inverter has not been energized for a long time, do not connect it directly to a commercial power supply. Instead, energize it by using a Slidac, etc., to gradually increase the input voltage and confirm that there is no abnormality.

(4) Storage conditions

Temperature	+5°C(winter) ~ +35°C(summer)
Change in temperature	±10°C/day
Humidity	Below 75% RH(without condensation)
Atmosphere	Without oil mist, dust, corrosive gas
Vibration	Not allowed
Altitude	1000 m or below
Condition	Without direct light / ultraviolet rays

8-2 Measuring devices

As the voltage and current on the input and output sides include high harmonics, the measured value will differ according to the measuring device. When measuring with a device for commercial frequencies, measure with the following circuits and noted measuring devices.
Use of a digital power meter is recommended for performing a highly accurate measurement.



V_1 : Moving iron type voltmeter

V_2 : Rectifying voltmeter

W_1 ~ W_6 : Electrodynamometer type power meter

A_1 ~ A_6 : Moving iron type ammeter

Fig. 8-2 Measurement circuit example

8-3 Protective functions

The VAT300 has the protective functions shown in Table 8-3.

Table 8-3 Protective function

Name	Function
Overcurrent trip (OC)	The output is cut off and the inverter stops if the instantaneous value of the output current exceeds the preset value.
Overvoltage trip (OV)	The output is cut off and the inverter stops if the instantaneous value of the DC voltage in the main circuit exceeds the preset value.
Undervoltage trip (UV)	The output is cut off and the inverter stops if the DC voltage drops to approx. 65% or less due to a power failure or voltage drop during operation.
Overcurrent limit	If an overload occurs, the output frequency is automatically adjusted so that the output current is less than the overcurrent limit (125% as a standard) set with B18-0.
Overvoltage limit	If the output frequency is reduced suddenly, the DC voltage will rise in the main circuit due to the regenerative power. The output frequency will be automatically adjusted to prevent the DC voltage in the main circuit from exceeding the preset value.
Overload trip (OL)	The output will be cut off and the inverter will stop if the overload characteristics set with C22-0, 1, 2 and 3 are exceeded. The setting (120% for 1 min. as a standard) can be changed according to the characteristics of the motor. In addition to the above setting, 120% for one minute (standard) or 150% for one minute can be selected with the unit overload mode selection (C30-0).
Overheat (UOH)	An increase in the heat sink temperature is detected with the thermistor and thermostat. When the temperature exceeds the preset value, the output is cut off and the inverter is stopped.
Self-diagnosis (IO, dER, CPU)	The built-in CPU, peripheral circuits and data are tested and monitored for abnormalities.
Grounding trip (GRD)	The output will be cut off and the inverter will stop if a ground fault is detected.
Power module fault (PM)	The operation of the main circuit power module protection function is detected, and the inverter will stop if a fault is detected.
Phase failure (PHL)	A phase failure in the main circuit input/output is detected, the output is shut off, and the operation is stopped.

8-4 Troubleshooting with fault display

The countermeasures for when the inverter stops with a fault displayed are shown in Table 8-4.

Table 8-4 Troubleshooting

Display symbol	Name	Causes and countermeasures
 EMS.	Emergency stop	1. The sequence input EMS has been activated. Check the signal wiring. 2. This fault occurs when C00-4 is set to 2.
 PM-n	Power module	1. Indicates that the short circuit protection circuit activated. 2. The power module in the main circuit may be broken. Replace if there is any abnormality. 3. A short circuit in the load may have occurred. 4. A ground fault may have occurred in the power cable or motor. Restore the grounded point. 5. The power module may have malfunctioned due to noise. Improve the installation environment in respect to noise, such as the grounding method or wiring distance. 6. Refer to the following for sub-code n. Sub-code: n 1: Stopped 2: In constant speed operation 3: Accelerating 4: Decelerating 5: Braking 6: In ACR 7: In excitation 9: In automatic tuning.
 OC-1	Overcurrent during stop	1. The power module in the main circuit may be broken. Replace if there is any abnormality. 2. A ground fault may have occurred in the power cable or motor. Restore the grounded point. 3. The power module may have malfunctioned due to noise. Improve the installation environment in respect to noise, such as the grounding method or wiring distance.
 OC-2	Overcurrent during constant speed operation	1. A sudden change in the load or short circuit may have occurred. Reduce the load fluctuation. 2. The power voltage may have dropped. 3. The inverter may be running in an unstable range. Set the frequency jump (B05-0 to 5), or adjust the torque stabilizing gain (B18-2). The state may also be improved by changing the carrier frequency (B01-7). **(Note 1)** 4. The speed loss prevention control may not match the load. Halve the speed loss prevention gain B18-5, and double the time constant B18-6. If the state is improved, finely adjust. 5. A ground fault may have occurred in the power cable or motor. Restore the grounded point. 6. The power module may have malfunctioned due to noise. Improve the installation environment in respect to noise, such as the grounding method or wiring distance.

(Note 1) Refer to the Appendix Table output Current Derating when changing the carrier frequency.
Pay special attention to the state such as motor heating.

Display symbol	Name	Causes and countermeasures
 OC-3	Overcurrent during acceleration	1. Increase the acceleration time setting (A01-0). 2. The speed or frequency setting may have increased suddenly before the flux was established. Adjust (A01-0). When using V/F control, this state may be avoided by using the external brake control (B46). When using vector control, executing pre-excitation may be effective. However, sufficient timing with the mechanical brakes must be provided if the load could drop, etc. 3. Reduce the torque boost voltage (A02-2). 4. An excess GD^2, short circuit or rapid fluctuation of the load may have occurred. 5. An overcurrent may have been detected when passing through an unstable area. Set the frequency jump (B05-0 to 5), or adjust the torque stabilizing gain (B18-2). The state may also be improved by changing the carrier frequency (B01-7). **(Note 1)** 6. The speed loss prevention control may not match the load. Halve the speed loss prevention gain B18-5, and double the time constant B18-6. If the state is improved, finely adjust. 7. A ground fault may have occurred in the power cable or motor. Restore the grounded point.
 OC-4	Overcurrent during deceleration	1. Increase the deceleration time setting (A01-1). 2. A short circuit or rapid fluctuation of the load may have occurred. 3. An overcurrent may have been detected when passing through an unstable area. Set the frequency jump (B05-0 to 5), or adjust the torque stabilizing gain (B18-2). The state may also be improved by changing the carrier frequency (B01-7). **(Note 1)** 4. The speed loss prevention control may not match the load. Halve the speed loss prevention gain B18-5, and double the time constant B18-6. If the state is improved, finely adjust. 5. A ground fault may have occurred in the power cable or motor. Restore the grounded point.
 OC-5	Overcurrent during braking	1. Reduce the brake voltage setting (A03-0). 2. A short circuit or rapid fluctuation of the load may have occurred. 3. A ground fault may have occurred in the power cable or motor. Restore the grounded point.
 OC-6	Overcurrent during ACR	1. A short circuit or rapid fluctuation of the load may have occurred. 2. A ground fault may have occurred in the power cable or motor. Restore the grounded point.
 OC-7	Overcurrent during pre-excitation	

Display symbol	Name	Causes and countermeasures
 OC-9	Overcurrent during automatic tuning	1. Increase the acceleration time setting (A01-0). 2. Increase the deceleration time setting (A01-1). 3. A short circuit or rapid fluctuation of the load may have occurred. 4. Adjust the torque stabilizing gain (B18-2). 5. A ground fault may have occurred in the power cable or motor. Restore the grounded point.
 OV-1	Overvoltage during stop	1. The power supply voltage may have risen. Reduce the voltage to within the specified range. 2. A surge voltage may be superimposed on the power supply. Check the power system.
 OV-2	Overvoltage during constant speed operation	1. The power supply voltage may have risen. Reduce the voltage to within the specified range. 2. The rotation speed or load may have fluctuated. 3. The overcurrent limit may have functioned because of a sudden change in the load, etc. Refer to OC-2 and 3 above.
 OV-3	Overvoltage during acceleration	
 OV-4	Overvoltage during deceleration	1. The load GD^2 may be too large. Set the deceleration time (A01-1) according to the load GD^2. 2. The power supply voltage may have risen. Reduce the voltage to within the specified range. The overcurrent limit may have functioned because of a sudden change in the load, etc. Refer to OC-4.
 OV-5	Overvoltage during braking	1. The power supply voltage may have risen. Reduce the voltage to within the specified range.
 OV-6	Overvoltage during ACR	
 OV-7	Overvoltage during pre-excitation	
 OV-9	Overvoltage during automatic tuning	

Display symbol	Name	Causes and countermeasures
 UV-n	Undervoltage	1. The power voltage may have dropped, and input phase failure may have occurred, or an instantaneous power failure may have occurred. Check the power supply system and correct if necessary. 2. Refer to the following for sub-code n. Sub-code: n 1: Stopped 2: In constant speed operation 3: Accelerating 4: Decelerating 5: Braking 6: In ACR 7: In excitation 9: In automatic tuning.
 UOH.n	Overheat	1. A trouble may have occurred in the cooling fan. Replace if necessary. 2. The ambient temperature may have risen. Lower the ambient temperature. (50°C or less) 3. The vent or heatsink may be clogged. Clean the dirt and dust accumulated in the vent, etc. 4. The carrier frequency may be set too high. Confirm that the setting is within the range given in Appendix Table 1 (Note 5). 5. Refer to the following for sub-code n. Sub-code: n 1: Detect with thermistor 2: Detect with thermostat
 SP-1	Overspeed	1. Displays indicating that the motor rotation count exceeded the overspeed setting value (C24-0). Adjust the ASR response (A10-0, 1), and suppress the overshooting. Increase the acceleration time setting (A01-0), or change the speed setting so that it is gradual.
 SP-2	Speed detection error	1. Indicates that the motor rotation speed fluctuation ratio exceeded the error level setting value (C24-2). Check the encoder wiring.
 SP-3	Speed deviation error	1. Indicates that the difference between the motor rotation speed command value and detected value exceeds the error detection setting value (C24-5, 6). Check the encoder wiring. 2. The speed command may be set incorrectly, or the S-pattern characteristics setting may be too high. Set the speed command and B10-4 properly.
 SP-4	Reverse run detection error	1. The motor rotated in the reverse direction of the speed command and exceeded the error detection setting value (C24-7). Check whether the motor ran in reverse because of the load, and check the ASR torque limiter (A10-3, 4) setting values.

Display symbol	Name	Causes and countermeasures
 SP-5	Encoder initialization error 1	1. Indicates that an encoder initialization error occurred during PM motor control. 1) A, B, Z phase + U, V, W phase signals Indicates that the UVW signal is abnormal. Check the encoder selection (C51-0) and encoder wiring. 2) A, B, Z phase + serial absolute signals Indicates that the serial signal is not being received correctly. Check the encoder selection (C51-0) and encoder wiring. 3) A, B, Z phase + U, V, W phase signals (Reduced wiring) Indicates that the signal is abnormal. Check the encoder selection (C51-0) and encoder wiring. 4) SIN, COS signal Indicates that the signal is abnormal. Check the encoder selection (C51-0) and encoder wiring.
 SP-6	Encoder initialization error 2	1. Indicates that an encoder initialization error occurred during PM motor control. 1) A, B, Z phase + serial absolute signals Indicates that the received serial signal is abnormal. Check the encoder wiring. Improve the installation environment in respect to noise. 2) A, B, Z phase + U, V, W phase signals (Reduced wiring) Indicates that the UVW signal is abnormal. Check the encoder selection (C51-0), time setting (C51-7 to 9) and encoder wiring. 3) SIN, COS signal Indicates that the SIN or COS signal is disconnected. Check the encoder wiring.
 FUSE	Fuse blown	1. Indicates that the main circuit fuse in the use is disconnected. (Limited to capacities having a fuse warning contact.) Check that the main circuit input/output wiring is correct. Check whether any foreign debris has entered the unit, or whether there is any short-circuit or ground fault. If the fuse is blown, it must be replaced.
 BPFLT	Parallel unit signal cutoff	1. Indicates that the connection signal was disconnected when using a parallel machine. Check the wiring and connector.

Display symbol	Name	Causes and countermeasures
 ATT-n	Automatic tuning abnormal completion n: Step No.	1. n = 1 The motor may not be connected correctly. Check the connection. The B00 and B01 parameters may not be set correctly. Check the parameter settings. 2. n = 2 The B00 and B01 parameters may not be set correctly. Check the parameter settings. 3. n = 3 The load and machine may not be separated. Separate the load and machine. Increase the acceleration time (A01-0). Increase the deceleration time (A01-1). If the motor vibrates, increase the torque stabilizing gain (B18-2). 4. n = 4 The load and machine may not be separated. Separate the load and machine. If the motor vibrates, increase the torque stabilizing gain (B18-2). 5. n = 5 If the motor does not stop. Increase the acceleration/deceleration time (A01-0, A01-1). If the motor is stopped. The B00 and B01 parameters may not be set correctly. Check the parameter settings. 6. n = 6 The B00 and B01 parameters may not be set correctly. Check the parameter settings. 7. n = 8 The voltage did not stabilize for one second or longer during pulse measurement. Adjust the pulse voltage for magnetic pole estimation (B39-1) and pulse width for magnetic pole estimation (B39-2). 8. n = 9 Automatic tuning did not end correctly even after retrying three times. Adjust the pulse voltage for magnetic pole estimation (B39-1) and pulse width for magnetic pole estimation (B39-2).
 OL-1	Equipment load	1. VAT300 may have overloaded. Reduce the load or increase the inverter capacity. 2. If this occurs at a low speed, avoid continuous operation at a low speed, or decrease boost (A02-2) and brake voltage (A03-0).
 OL-2	DBR overload	1. The regenerative power may be excessive. Increase the deceleration time, and reduce the regenerative power. 2. C22-4: DBR overload may not be set correctly. Set a value appropriate for DBR and the unit.

Display symbol	Name	Causes and countermeasures
 OL-3	Motor overload	1. The motor may have overloaded. Reduce the load or increase the motor and inverter capacity. 2. If this occurs at a low speed, avoid continuous operation at a low speed, or decrease boost (A02-2) and brake voltage (A03-0). When using vector control, the problem may be improved by lowering the no-load voltage (B01-9).
 GRD.n	Grounding	1. A ground fault may have occurred in the power cable or motor. Restore the grounded point. 2. The power module may have malfunctioned due to noise. Improve the installation environment in respect to noise, such as the grounding method or wiring distance. 3. Refer to the following for sub-code n. Sub-code: n 1: Stopped 2: In constant speed operation 3: Accelerating 4: Decelerating 5: Braking 6: In ACR 7: In excitation 9: In automatic tuning.
 IO-1	I/O error (gate turn-off circuit error)	1. The VAT300 may be malfunctioning due to external noise, etc. Look for the noise source and remove the cause. The control circuit may be faulty. 2. The OC, OV, GRD or PM fault may have occurred immediately after the run command was input (within 6ms). Check the faulty history, and investigate the cause.
 IO-2	I/O error (A/D converter error)	1. The VAT300 may be malfunctioning due to external noise, etc. Look for the noise source and remove the cause. The control circuit may be faulty.
 IO-3	I/O error (current detection error)	1. The current detector connectors may be connected improperly. Properly connect these. 2. The current detection may be faulty.
 IO-4	I/O error (retry time-out)	1. Retry has failed. There are no countermeasures for this code, so reset the VAT300.
 IO-B	PID error	1. The PID settings or detected input may be incorrect. Check the settings or detection value.

Display symbol	Name	Causes and countermeasures
 IO-C	External brake IDET error	1. The output current did not reached the current detection value (C15-1) when releasing the external brake. Check that the settings are correct, or that the motor wiring connections are correct.
 IO-D	External brake RUN error	1. RUN did not turn OFF after engaging the external brake. Check that the settings are correct, or that the RUN command is OFF within B46-4.
 IO-E	External brake answer error	1. The brake command and answer signal from the brake do not match. Check the answer signal from the brake.
 CPU-n	CPU error	1. The unit may be malfunctioning due to external noise, etc. Look for the noise source and remove the cause. 2. The control circuit may be faulty. 3. For all sub-codes other than 8, turn the power off and on once. 4. Refer to the following for sub-code n. Sub-code: n 1: Watch dog error (CPU operation is delayed. This is detected during normal operation. 2: CPU operation error 3: CPU internal RAM error 4: External RAM error 6: EEPROM check sum error 7: EEPROM read error 8: EEPROM write error (This is only displayed. The gate is not cut off, and FLT is not output.) A: Stack overflow B: Built-in PLC overload
 DER	E^2PROM data error	1. The parameter setting value is incorrect. Correct the parameter setting value with the following procedure. (1) Select D20-2 with the monitor mode, and press the set key. The parameter for which an error occurred will display. (2) Set the correct parameter in this state. (3) Press the ▲ and ▼ keys to sequentially display the erroneous parameters.
 EP.ERR.	Verify check data error	1. An error may have occurred when using verify check in the parameter copy function using the operation panel. Execute the parameter copy function again.

Display symbol	Name	Causes and countermeasures
 PHL1	Input phase failure	1. There may be a phase failure in the AC input power supply. Investigate the AC input power supply, and eliminate the phase failure. 2. The AC input wiring may be disconnected. Check the tightening, etc., of the AC input wire. 3. The load pulsation may be too high, or the motor control may be hunting. Suppress the load pulsation, or lower the ASR response. 4. When using an electrical circuit configuration which includes the external circuit, it may be resonating. Contact GE.
 PHL2	Output phase failure	1. The motor's primary coil may not be correct. Check the motor. 2. The motor wiring may be disconnected. Check the wire tightening state, etc.
 E.FLT1 to 8 (Symbol example shows E.FLT8)	External fault	1. The programmable sequence input terminal set for the external fault has turned ON. Turn the input OFF. 2. Check the terminal block wiring.
 MC-1	MC error	1. At least one of the pre-charge magnetic contactors installed in 200H or larger units may not be working properly. Turn the power off and check the magnetic contactors. 2. There may be a failure in the auxiliary contacts of the pre-charge magnetic contactors installed in 200H or larger units. Check the auxiliary contacts.

8-5 Troubleshooting with no fault display

The causes and countermeasures for errors with no fault display are shown in Table 8-5.

Table 8-5 Troubleshooting

Phenomenon	Causes and countermeasures
Motor does not run	1. The input/output cable may be incorrectly wired, the motor may be incorrectly connected, a phase failure may have occurred or the power voltage may have dropped. Check and correct the wiring. Confirm that READY is completed with D04-4, that the run command related bits (RDY1, RDY2, MC, RUN) are lit, and that the fault bit (FLT) is not lit. 2. The motor may be locked or the load excessively heavy. Reduce the load. If the starting torque is insufficient during V/f control, adjust the torque boost (A02). A large starting torque can be attained by selecting automatic torque boost (A02-1;2), and finely adjusting the slip compensation gain (A002-5) and maximum torque boost gain (A02-6) attained with automatic tuning. 3. The reverse run interlock function (C09-3) may be set or the other parameters may be incorrect. Check the RUN, REV and EMS signals with D04-0. If the signal is input, cancel it once before starting. 4. The voltage may not be output to the VAT300 output terminal. Measure the output voltage, and confirm that the three phases are balanced. 5. The local/remote setting may be incorrect. Set according to the required mode. 6. The frequency (speed) command may not be input. When using V/F control, refer to D01-0 (D01-4 for vector control), and check the currently set value. Refer to section 5-9 for details. 7. When using vector control, the encoder signal may not be input correctly. Check the encoder signal. Check that the D00-2 rotation detection is correct when the motor is manually turned forward and reverse. If abnormal, check the wiring, etc. Change the encoder phase order (C50-2, C51-3).
Motor runs in opposite direction	1. The output terminals U, V, and W sequence may be incorrect. Interchange the phase sequence. When using vector control, also change the encoder phase order (C50-2, C51-3) according to the changes in the main circuit phase order. 2. The sequence input wires for forward/reverse run may not be connected to the specified terminals. Connect the wires as follows: Forward run: Short-circuit terminals PSI1 - RY0 (When input terminal function setting is C03-0=1 (default value)) Reverse run: Short-circuit terminals PSI4 - RY0 (When input terminal function setting is C03-2=4 (default value))
Motor runs but the speed does not vary	1. The load may be too heavy. Reduce the load. 2. The frequency setting signal level may be too low. Check the signal level and circuit. When using V/F control, refer to D01-0 (D01-4 for vector control), and check the currently set value. Refer to section 5-9 for details.

Phenomenon	Causes and countermeasures
Motor acceleration/ deceleration is not smooth	1. The motor acceleration/deceleration time setting (A01-0, 1) may be too low. Increase the acceleration/deceleration time. 2. Reduce the manual torque boost voltage (A02-2). If automatic torque boost (A02-1) is selected, adjust A02-5 and A02-6. 3. The speed or frequency setting may have increased suddenly before the flux was established. Adjust (A01-0). When using V/F control, this state may be avoided by using the external brake control (B46). When using vector control, executing pre-excitation may be effective. However, sufficient timing with the mechanical brakes must be provided if the load could drop, etc. 4. An unstable area may have been passed through. Set the frequency jump (B05-0 to 5), or adjust the torque stabilizing gain (B18-2). 5. When using IM speed sensor-less vector control, carry out the adjustment in item 3-5-2.
Motor speed varies during constant speed operation	1. The load may be fluctuating excessively or the load is too heavy. Reduce the load or fluctuation. 2. When using vector control, adjust ASR response (A10-0, 1). To increase the speed control response in respect to sudden load fluctuations (impact drop load, etc.), adjust B30-0, 1. Hunting could occur if this is set too high. 3. The speed detection may be affected by noise. Improve the installation environment in respect to noise, such as the grounding method or wiring distance. 4. If the speed fluctuates during IM speed sensor-less vector control, adjust the speed estimation related parameters (B31-0, 1, 2). 5. The inverter-motor ratings may not match the load. Select an inverter-motor set that matches the load.
Motor speed is too high or low	1. The number of poles or voltage may be incorrect. Check the motor specifications. 2. The maximum frequency (speed) or base frequency [B00-4, 5 (B01-4, 5)] may be incorrect. 3. The motor terminal voltage may be low. Use a thicker output cable.
Operation panel display cannot be changed, or the display is frozen. Cannot display target operation mode.	1. The operation panel connector may be disconnected, or the cable may be broken. Check the connector and wiring. 2. Communication with the operation panel may be disconnected because of noise. Turn the VAT300 power OFF once, wait for the operation panel display to go out, and then turn the power ON again.
Cannot pick up	1. The parameter settings or external setting may be incorrect. PICK (C04-D), automatic start (C08-0) and the control signals from the external source (run command, pick-up command, emergency stop input, etc.) may not be input correctly. Correctly set the related parameters. 2. The pick-up related parameters may not be adjusted properly. Adjust the pick-up related parameters (C21). 3. The overcurrent limit related parameters may not be adjusted properly. If an overcurrent fault (OC) or overvoltage fault (OV) occurs, adjust the overcurrent speed loss prevention gain and time constant (B18-5, 6). Try setting B18-5 to half of the preset value (0.50) and B18-6 to double the value (200). If an effect is observed, finely adjust the settings. Note that the effect may differ according to the motor and load.

Chapter 9 Compatible Standards

9-1 UL/cUL Standards

The VAT300 complies with UL508C and CSA C22.2 No.14.
Observe the following matters when using the inverter as a UL/cUL Standard compatible product.

1) Use the inverter in an installation environment which does not exceed the set maximum ambient temperature.
2) For the main circuit connected to the inverter, use a "75°C CU" "voltage rating 600V or higher" copper wire.
3) Use the wire sizes given in Table 9-1-a and Table 9-1-b for the main circuit wiring. Use a UL/CSA Certified round crimp terminal which matches the wire diameter for the terminal connection. Crimp the crimp terminal with a crimping tool recommended by the maker.
4) When wiring the circuit, tighten with the torque given in Table 9-1-a and Table 9-1-b.
5) Integral solid state short circuit protection does not provide branch circuit protection, Branch circuit protection must be provided in accordance with the National Electric Code and any additional local codes.
6) Always provide a UL Certified fuse or UL Certified Molded Case Circuit Breaker (MCCB) protection circuit shown in Table 9-1-c on the input side of the inverter. Use a fuse for the 011L/015H and smaller capacities.
7) Use a power that complies with the following conditions for the inverter's input power.
   N000K7 to N045K0, 240VAC or less, Short-circuit current 10,000A or less
   X000K7 to X055K0, 480VAC or less, Short-circuit current 10,000A or less
   X075K0 to X475K0, 480VAC or less, Short-circuit current 42,000A or less
8) Install the inverter as "open type equipment".
9) The installation environment must satisfy "pollution degree 2".
10) The inverter has a motor overload protection function. Refer to Chapter 6, and set parameters C22-0 to 3 correctly.

Motor overload (OL-3)

Use the C22-3 setting to set the trip breakdown reference current for one minute in the case of a motor rated current (B00-6, B01-6) of 100%. When C22-3 is set to 120% for example, if C22-0 is 100%, and 120% of the motor rated current is output, a breakdown stop will occur due to a motor overload after one minute.

As shown in Fig.9-1-a, the counterclockwise limit characteristics change by setting C22-0. The diagram on the right is an example with C22-0 set to 100% and 50% when C22-3=150%.

For the self-cooling motor, when operating at low speed, set C22-1 and C22-2 to meet the motor characteristics. These characteristics are as shown in Fig.9-1-b.

The motor overload can be monitored at D02-6. Furthermore, select setting value 15 at C13-0, 1 to enable analog output.

11) Use the control terminals RA/RC, FA/FB/FC at 30VAC/DC or less.

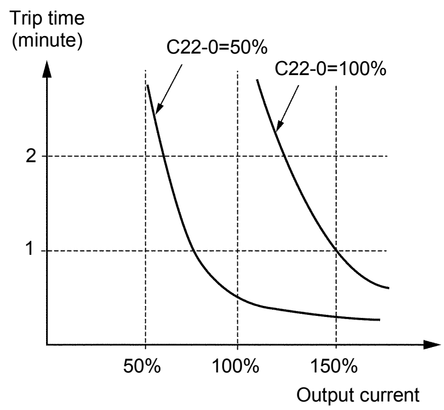


Fig.9-1-a Overload characterristics

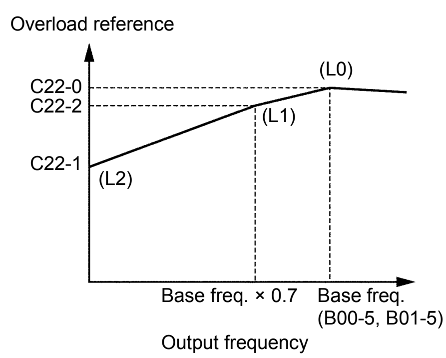


Fig.9-1-b Reduction of the Overload reference by frequency.

Table 9-1-a Terminals, Applicable Wire Sizes and Tightening Torque (For Normal-duty)

Inverter type VAT300 U3S_		Terminal screw size	Tightening torque		L1, L2, L3, U, V, W			Ground		
			N·m	lb-in	Terminal connector Part No.	AWG	mm^2	Terminal connector Part No.	AWG	mm^2
N000K7		M4	1.8	15.9	R2-4	14	2.1	R2-4	14	2.1
N001K5		M4	1.8	15.9	R2-4	14	2.1	R2-4	14	2.1
N002K2		M4	1.8	15.9	R2-4	14	2.1	R2-4	14	2.1
N004K0		M4	1.8	15.9	R5.5-4	10	5.3	R5.5-4	12	3.3
N005K5		M4	1.8	15.9	8-4	8	8.4	R5.5-4	10	5.3
N007K5		M5	3.0	26.5	R8-5	8	8.4	R5.5-5	10	5.3
N011K0		M5	3.0	26.5	R14-5	6	13.3	R5.5-5	10	5.3
N015K0		M6	4.5	39.8	38-6	3	26.7	R8-6	8	8.4
N018K5		M8	9.0	79.7	R38-8	2	33.6	R8-8	8	8.4
N022K0		M8	9.0	79.7	R60-8	1	42.4	R14-8	6	13.3
N030K0		M8	9.0	79.7	R60-8×2P	1/0×2P	53.5×2P	R14-8	6	13.3
N037K0		M10	10.0	88.5	R60-10×2P	1/0×2P	53.5×2P	R14-10	6	13.3
N045K0		M10	10.0	88.5	R60-10×2P	1/0×2P	53.5×2P	R22-10	4	21.2
X000K7		M4	1.8	15.9	R2-4	14	2.1	R2-4	14	2.1
X001K5		M4	1.8	15.9	R2-4	14	2.1	R2-4	14	2.1
X002K2		M4	1.8	15.9	R2-4	14	2.1	R2-4	14	2.1
X004K0		M4	1.8	15.9	R2-4	14	2.1	R2-4	14	2.1
X005K5		M4	1.8	15.9	R5.5-4	12	3.3	R5.5-4	12	3.3
X007K5		M4	1.8	15.9	R5.5-4	10	5.3	R5.5-4	10	5.3
X011K0		M4	1.8	15.9	8-4	8	8.4	R5.5-4	10	5.3
X015K0		M5	3.0	26.5	R8-5	8	8.4	R5.5-5	10	5.3
X018K5		M5	2.0	17.4	R14-5	6	13.3	R5.5-5	10	5.3
X022K0		M5	2.0	17.4	R14-5	6	13.3	R5.5-5	10	5.3
X030K0		M6	4.5	39.8	R22-6	4	21.2	R8-6	8	8.4
X037K0		M8	9.0	79.7	R38-8	2	33.6	R8-8	8	8.4
X045K0		M8	9.0	79.7	R60-8	1	42.4	R14-8	6	13.3
X055K0		M8	9.0	79.7	R60-8	1/0	53.5	R14-8	6	13.3
X075K0		M10	28.9	255.7	R60-10×2P	1/0×2P	53.5×2P	R14-10	6	13.3
X090K0		M10	28.9	255.7	R60-10×2P	1/0×2P	53.5×2P	R14-10	6	13.3
X110K0		M10	28.9	255.7	R60-10×2P	1/0×2P	53.5×2P	R22-10	4	21.2
X132 K0	L1,L2,L3	M10	28.9	255.7	R80-10×2P	3/0×2P	85.0×2P	R22-10	4	21.2
	U, V, W				R80-10×2P	2/0×2P	67.4×2P			
X160K0		M10	28.9	255.7	R100-10×2P	4/0×2P	107.2×2P	R38-10	3	26.7
X200K0		M10	28.9	255.7	R150-10×2P	300×2P	152×2P	R38-10	2	33.6
X250K0		M16	125	1106	R200-16×2P	400×2P	203×2P	R60-16	1	42.4
X315 K0	L1,L2,L3	M16	125	1106	R150-16×4P	300×4P	152×4P	R60-16	1/0	53.5
	U, V, W				R100-16×4P	4/0×4P	107.2×4P			
X400 K0	L1,L2,L3	M16	125	1106	R200-16×4P	400×4P	203×4P	R80-16	2/0	67.4
	U, V, W				R200-16×4P	350×4P	177×4P			
X475K0		M16	125	1106	R200-16×4P	400×4P	203×4P	R80-16	3/0	85.0

Table 9-1-b Terminals, Applicable Wire Sizes and Tightening Torque (For Heavy-duty)

Inverter type VAT300 U3S_	Terminal screw size	Tightening torque		L1, L2, L3, U, V, W			Ground		
		N·m	lb-in	Terminal connector Patt No.	AWG	mm^2	Terminal connector Part No.	AWG	mm^2
N000K7	M4	1.8	15.9	R2-4	14	2.1	R2-4	14	2.1
N001K5	M4	1.8	15.9	R2-4	14	2.1	R2-4	14	2.1
N002K2	M4	1.8	15.9	R2-4	14	2.1	R2-4	14	2.1
N004K0	M4	1.8	15.9	R2-4	14	2.1	R2-4	14	2.1
N005K5	M4	1.8	15.9	R5.5-4	10	5.3	R2-4	14	2.1
N007K5	M5	3.0	26.5	R8-5	8	8.4	R2-5	14	2.1
N011K0	M5	3.0	26.5	R14-5	8	8.4	R2-5	14	2.1
N015K0	M6	4.5	39.8	R22-6	6	13.3	R2-6	14	2.1
N018K5	M8	9.0	79.7	R38-8	3	26.7	R2-8	14	2.1
N022K0	M8	9.0	79.7	R60-8	2	33.6	R5.5-8	12	3.3
N030K0	M8	9.0	79.7	R60-8	1	42.4	R5.5-8	10	5.3
N037K0	M10	10.0	88.5	R60-10×2P	1/0×2P	53.5×2P	R5.5-10	10	5.3
N045K0	M10	10.0	88.5	R60-10×2P	1/0×2P	53.5×2P	R14-10	6	13.3
X000K7	M4	1.8	15.9	R2-4	14	2.1	R2-4	14	2.1
X001K5	M4	1.8	15.9	R2-4	14	2.1	R2-4	14	2.1
X002K2	M4	1.8	15.9	R2-4	14	2.1	R2-4	14	2.1
X004K0	M4	1.8	15.9	R2-4	14	2.1	R2-4	14	2.1
X005K5	M4	1.8	15.9	R2-4	14	2.1	R2-4	14	2.1
X007K5	M4	1.8	15.9	R5.5-4	12	3.3	R2-4	14	2.1
X011K0	M4	1.8	15.9	R5.5-4	10	5.3	R2-4	14	2.1
X015K0	M5	3.0	26.5	R5.5-5	8	8.4	R2-5	14	2.1
X018K5	M5	2.0	17.4	R8-5	8	8.4	R2-5	14	2.1
X022K0	M5	2.0	17.4	R14-5	6	13.3	R2-5	14	2.1
X030K0	M6	4.5	39.8	R22-6	6	13.3	R2-6	14	2.1
X037K0	M8	9.0	79.7	R38-8	4	21.2	R5.5-8	12	3.3
X045K0	M8	9.0	79.7	R38-8	2	33.6	R5.5-8	10	5.3
X055K0	M8	9.0	79.7	R60-8	1	42.4	R14-8	6	13.3
X075K0	M10	28.9	255.7	R60-10	1/0	53.5	R14-10	6	13.3
X090K0	M10	28.9	255.7	R60-10×2P	1/0×2P	53.5×2P	R14-10	6	13.3
X110K0	M10	28.9	255.7	R60-10×2P	1/0×2P	53.5×2P	R14-10	6	13.3
X132K0	M10	28.9	255.7	R60-10×2P	1/0×2P	53.5×2P	R14-10	6	13.3
X160K0 L1,L2,L3	M10	28.9	255.7	R80-10×2P	3/0×2P	85.0×2P	R14-10	6	13.3
X160K0 U, V, W				R80-10×2P	2/0×2P	67.4×2P			
X200K0	M10	28.9	255.7	R100-10×2P	4/0×2P	107.2×2P	R14-10	6	13.3
X250K0	M16	125	1106	R150-16×2P	300×2P	152×2P	14-16	6	13.3
X315K0	M16	125	1106	R200-16×2P	400×2P	203×2P	22-16	4	21.2
X400K0 L1,L2,L3	M16	125	1106	R150-16×4P	300×4P	152×4P	22-16	4	21.2
X400K0 U, V, W				R100-16×4P	4/0×4P	107.2×4P			
X475K0 L1,L2,L3	M16	125	1106	R200-16×4P	400×4P	203×4P	22-16	4	21.2
X475K0 U, V, W				R200-16×4P	350×4P	177×4P			

(Note1) "x2p" refers to two parallel connections.
(Note2) Terminal and crimping tools maker : JST Mfg. Co., Ltd.
Crimping tools :
Ratchet Hand Tool, Model No. YHT-2210 (up to 10AWG)
Pneumatic Hand Tool, Model No. YA-5 (from 8AWG up to 1/0AWG)

Table 9-1-c Input protection fuse, MCCB rated current

Inverter type VAT300-U3S_	Applicable protection circuit	Fuse/MCCB rated current (A)	
		Normal-duty	Heavy-duty
N000K7	UL Certified fuse (Voltage rating 300V Class T Fast Acting)	15	15
N001K5		15	15
N002K2		15	15
N004K0		20	15
N005K5		30	20
N007K5		40	30
N011K0		60	40
N015K0	UL Certified fuse (Voltage rating 300V Class T Fast Acting) or UL Certified Molded Case Circuit Breaker (MCCB)	80	60
N018K5		100	80
N022K0		125	100
N030K0		150	125
N037K0		200	150
N045K0		225	200
X000K7	UL Certified fuse (Voltage rating 600V Class J Fast Acting)	15	15
X001K5		15	15
X002K2		15	15
X004K0		15	15
X005K5		20	15
X007K5		25	20
X011K0		30	25
X015K0		40	30
X018K5	UL Certified fuse (Voltage rating 600V Class J Fast Acting) or UL Certified Molded Case Circuit Breaker (MCCB)	50	40
X022K0		60	50
X030K0		80	60
X037K0		100	80
X045K0		125	100
X055K0		150	125
X075K0	UL Certified fuse (Voltage rating 600V Class J Fast Acting)	200	150
X090K0		225	200
X110K0		300	225
X132K0		350	300
X160K0		400	350
X200K0		500	400
X250K0		600	500
X315K0		800	600
X400K0		1000	800
X475K0		1200	1000

9-2 CE Marking

The VAT300 from N000K7 to N045K0 and X000K7 to X475K0 ratings, comply with the EMC Directives and Low Voltage Directives. Observe the following matters when using the inverter as an EMC Directive compliant product.

9-2-1 EMC Instruction of preface

This Instruction details how to meet the EMC directives (89/336/EEC) with VAT300. It is important to understand and before installation and operation of drive. The VAT300 designed to meet the EMC directives and are suitable for use in the Industrial, Residential, Commercial and Light Industrial Environments. These drives have been tested with the power cables and control leads connected as shown in Fig. 9-2-a. If these drives are connected with fewer control leads than these examples, it may be possible to reduce installation costs by using ordinary cables rather than screened cables which are recommend in this manual. It is strongly advised however that a compliance test should be performed under the actual operating conditions to certify that the system complies with the relevant EMC requirements.

This instruction also details how to use filters for installation: the installation where the drives are installed as stand-alone equipment without being fitted into any enclosure, and the installation where the drives are installed inside a metal enclosure.

WARNING

1. This manual represents GE's recommendations based on its understanding of the EMC regulations only and GE cannot accept responsibility for any legal problems arising from or in connection with the use of its products.
2. GE have made every effort to ensure that their products comply with the directives laid out in the certificate of conformity which is supplied with each drive. In the case of EMC, the testing has been carried out using the filters which are recommended for each product. As VAT300 in size up to 30kW are designed to be built into metal cabinets, they are considered to be components. Therefore, the final responsibility for compliance rests with the system builder.

9-2-2 Installation environment

Table 9-2-a shows the EMC standard conformity table of VAT300. Basically, the VAT300 conforms with the EN61800-3 Category C3. First environment Category C2 however, is achieved for drives up to to N002K2 and up to X005K5, by installing ferrite cores in I/O power cables. (Detalis in Table 9-2-c.).

In Residential, Commercial, or Light Industrial Environment, install VAT300 drives up to 55KW inside a metal structure cabinet, and and ensure that the drive is not installed adjacent to devices or equipment, like measuring devices, that are not CE marked.
For VAT300 in size X075K0 and larger that are not designed for use in the Residential, Commercial and Light Industrial Environments, ensure that no device or equipment is installed adjacent to the drive that is intended for the Residential, Commercial and Light Industrial Environments only, as interference with such equipment may occur.

Table 9-2-a EMC standard conformity table of VAT300

Conformity standard	First environment (EN61800-3:Category C2)	Second environment (EN61800-3:Category C3)
The view of VAT300	from N000K7 to N002K2 from X000K7 to X005K5	from N004K0 to N045K0 from X007K5 to X475K0

9-2-3 Input filters and their connections

WARNING

1. Electrical shock hazards. The input filter terminals must be fully covered with appropriate insulation material to avoid electrical shocks.
2. Electrical shock hazards. The input filters must be fully earthed. Otherwise, there may be a risk of electrical shocks and the effectiveness of filters will be impaired.

In most cases, the input filter should be installed as closely to the drive as possible to ensure its effectiveness. The following table shows the maximum distance between the filter and the drive. This may be changed, if, for instance, a complete system is filtered in its entirety. In this case, the whole system would require testing to ensure EMC compliance.

Table 9-2-b Max. distance between drive and filter

Sizes	Max. distance
N000K7~N005K5, X000K7~X030K0	0.3 meter
N007K5 ~N045K0 , X037K0~X475K0	0.5 meter

Ensure that the input filter is securely and effectively earthed. If the drive is installed on a metal plate, install the filter on the same plate and then earth the plate. This is effective to reduce EMI.

9-2-4 Choosing and installing power cables

9-2-4-a Choosing power cables

The input cables to the drive via the filter must be selected from those specified in the drive's manual. The output cables from the drive must be screened or armoured cables (see Fig. 9-2-a) and should be selected from Table 9-1-a or Table 9-1-b.

9-2-4-b Installing power cables

The power cables comprises three sections: one on the primary side of the filter, one between the filter and the drive and one on the output of the drive. Ensure that these are not installed in parallel to each other and that these are laid down apart from each other by at least 0.5m. Please also ensure that the screen of the output cable is earthed at both ends with one end connected to the drive's earth terminal and the other end to that of the motor. Please arrange the termination at the drive's end inside the drive enclosure, and if this is not possible and the cable is terminated outside the drive enclosure, terminate the cables as closely to the drive's conduit hole as possible, i.e., within 0.1 m from it.

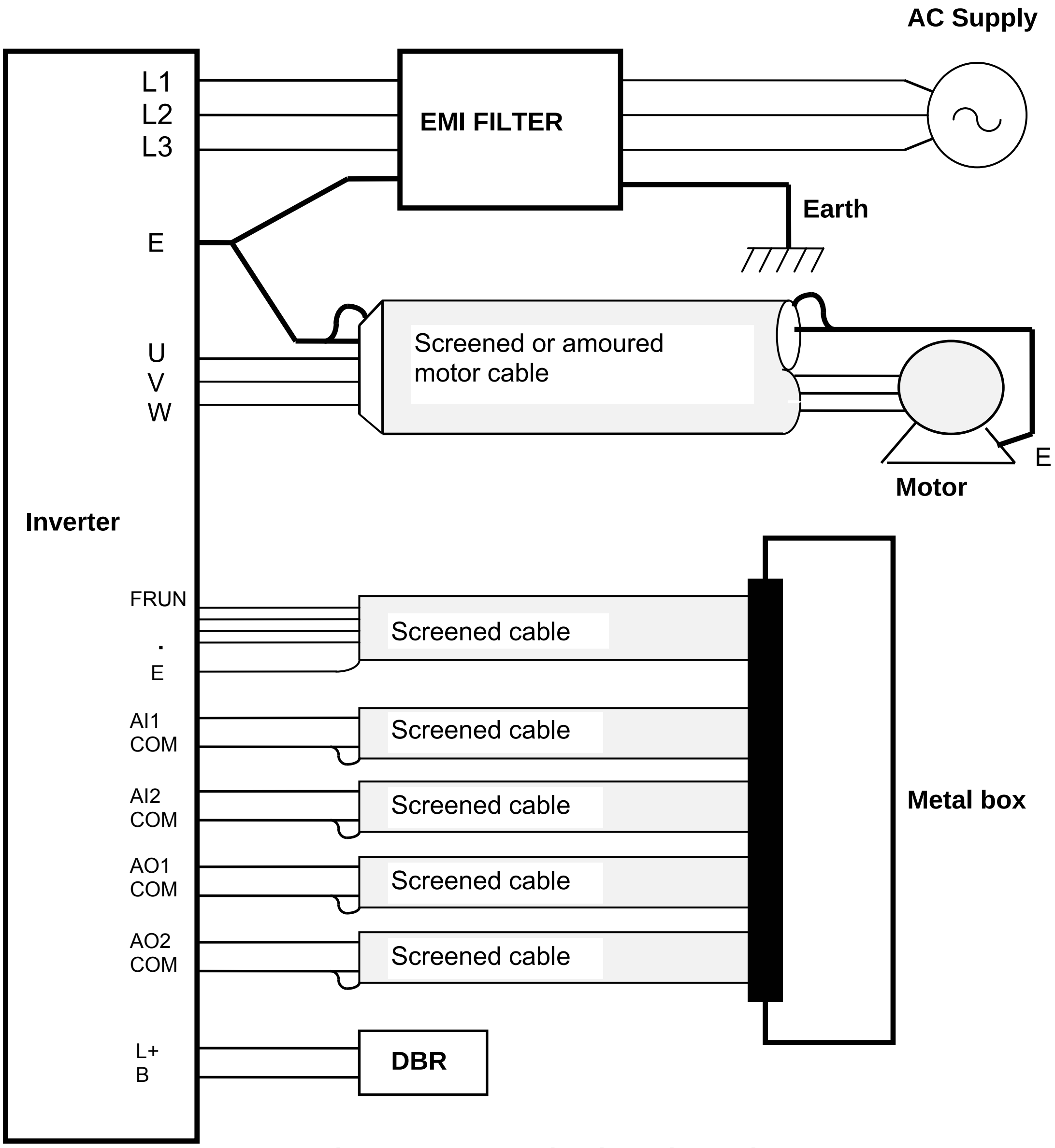


Fig.9-2-a Installation (Stand-alone)

9-2-5 Choosing and connecting control leads

Control leads should be selected in accordance with the instructions in the drive's manual and should be screened if they are used for a speed setting circuitry, analogue signal circuitry for metering, or relay signal circuitry. The screen should be connected to the drive's earth or COM terminal only (refer to Fig.9-2-a) The control leads should be wired away from the power cables. If the control leads must run across the power cables, cross them at the right angle, and if they are laid down alongside each other, ensure to separate them by at least 0.5 m. When the section which runs along the power cables exceeds 10 m, separate them further more. The control leads should not share the same conduit hole of the drive with the power cables. Separate analogue control leads from relay control leads.

To reduce emission and to increase immunity, ensure that no control leads are connected that are not used. Also, ensure that control leads are wired in such manner that they are as short as possible.

The relay signal controller and analogue speed setting controller, analog signal meters should be put in a metal box together.

9-2-6 Earthing method

Earth the drive, motor and filter in such manner that the earthing cables are as short as possible. Select and install earthing cables in accordance with local requirements. It is recommendable to use low impedance earthing cables, i.e. those that can carry as much current as possible. If the motor does not share the same earth post with the drive and filter, do not connect the screen and earth lead of the drive's output cable to the motor.

9-2-7 EMI and EMC

The EMC directives set out immunity requirements for the electrical drive (ability to work properly without being affected by external electromagnetic disturbance), in addition to the previously enforced emission requirements (electromagnetic disturbance generated by the electrical drive).

In addition to the radiated noise directly generated from the drive and its connected cables, the emission requirement includes the conducted noise which is conducted outside the drive through the input cables.

Immunity is the ability of a drive to operate properly without being affected by an external disturbance.

The EMC compliance is only achieved when the drive's immunity level exceeds its emission level under its operating environment.

In addition to the immunity against a radiated and conducted disturbance, the EMC directives also requires of the drive the immunity against static electricity discharges and fast transients.

A human body can easily be charged with static electricity by merely walking on carpet and with a mere touch on the drive, this static electricity will be discharged through it. A discharging spark can be at such a magnitude that it can damage the drive.

A drive which is installed near cables connected to a switchable inductive load can often operate incorrectly due to a fast transient induced on its control leads at a switching of the inductive load.

These are just a few examples of disturbance to which the drive is exposed, and the drive is now required to operate correctly without being affected by such disturbance.

9-2-8 Considerations to measuring devices

All the cables and leads connected to the drive or filter should be regarded as active sources of electrical noise. For inspection or service, use measuring devices or equipment that are CE marked. If they require an external power supply, use one which is separate or well insulated from that of the drive system.

Even for a system that comprises CE marked equipment and devices only, an EMC compliance test may be required if the whole system is exported from one country to another. Ask the local government for details.

9-2-9 Installation into a metal cabinet

To clear the levels of the Residential, Commercial, Light Industrial Environments and the Industrial Environment for the drives up to 475kW, the following method of installation is required.

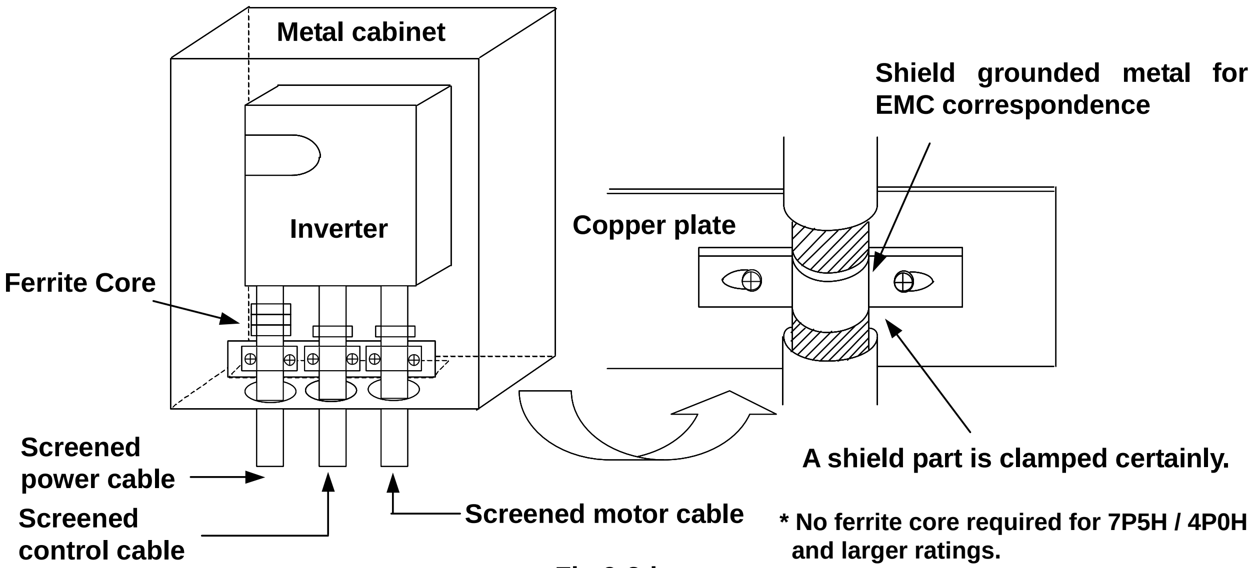
9-2-9-a When using drives with built-in EMI filters (N000K7 to N005K5, X000K7 to X030K0))

(1) Install the drive with built-in filters in a metal cabinet. This ensure to meet Second Environment Category C3.
Note that drives from N000K7 to N002K2 and from X000K7 to X005K5, can meet First environment Category C2, by installing 3 pieces of the ferrite cores on the power source cable, one on the motor cable and other on the control cable as shown in Fig. 9-2-b.
All these 5 ferrites are delivered into the drive package, when order VAT300 with built-in filter.

(2) The power source cable and motor cable outside the metal cabinet should be shielded and made to be as short as possible. Electrically connect the shield to the earth terminal of the motor.
(3) In order to suppress the noise emission from the cables, earth the shield of the power source cable and motor cable to the metal cabinet with metal clamps.
(4) Use the shielded cables for the drive control wiring and earth the shield to the metal cabinet with a metal clamp.

9-2-9-b When using the external EMI filters (VAT300- up N045K0 and up to X475K0)

(1) Install the drive unit in a metal cabinet and put the EMI filter on the power source cable as shown in Fig. 9-2-c.
(2) The power source cable and motor cable outside the metal cabinet should be shielded and as shortest as possible. Electrically connect the shield to the earth terminal of the motor.
(3) It is not necessary to use shielded cables for the control circuit wiring inside the metal cabinet. However, make the EMI filter power source cable and the motor cable as short as possible, and separate them as far from each other as possible.
(4) In order to suppress the noise emission from the cables, earth the shield of the power source cable and motor cable to the metal cabinet with metal clamps.
(5) Use the shielded cables for the drive control wiring and earth the shield to the metal cabinet with a metal clamp.



* No ferrite core required for 7P5H / 4P0H and larger ratings.

Fig.9-2-b

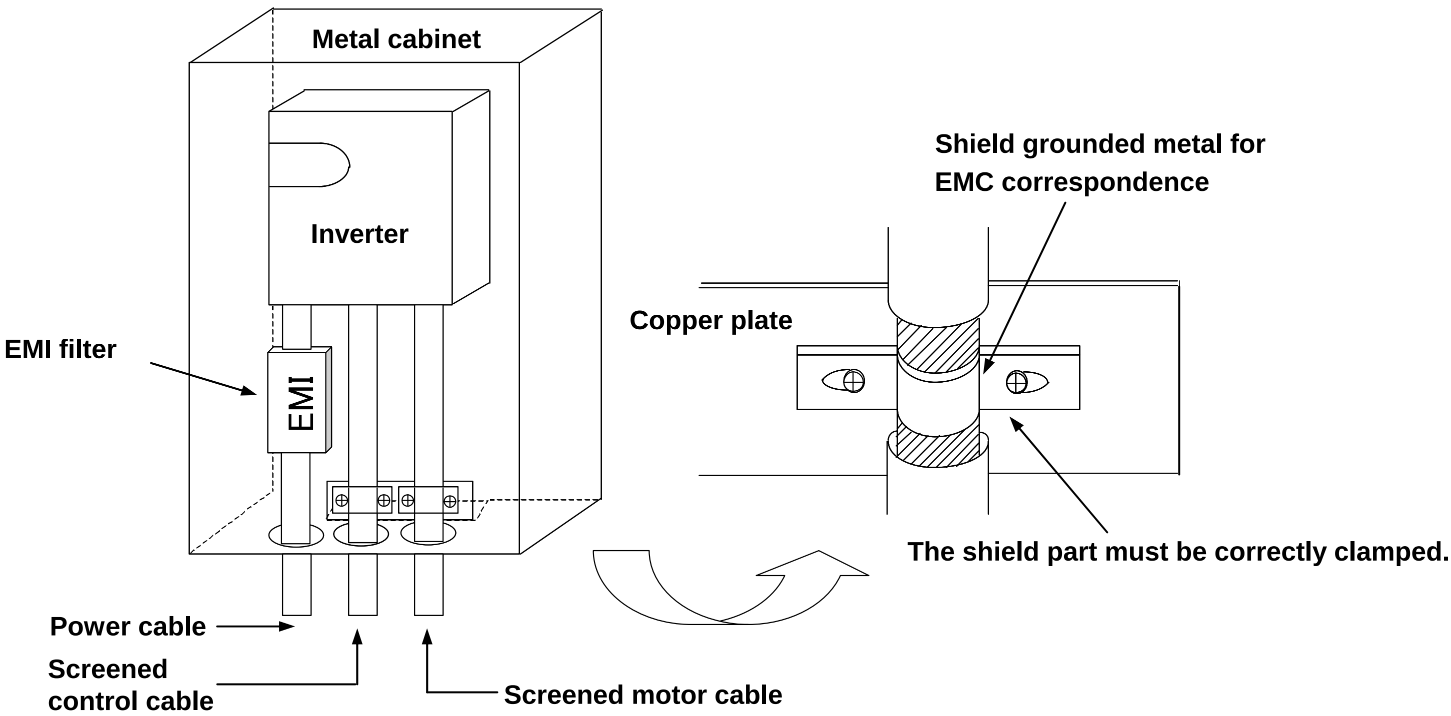


Fig.9-2-c

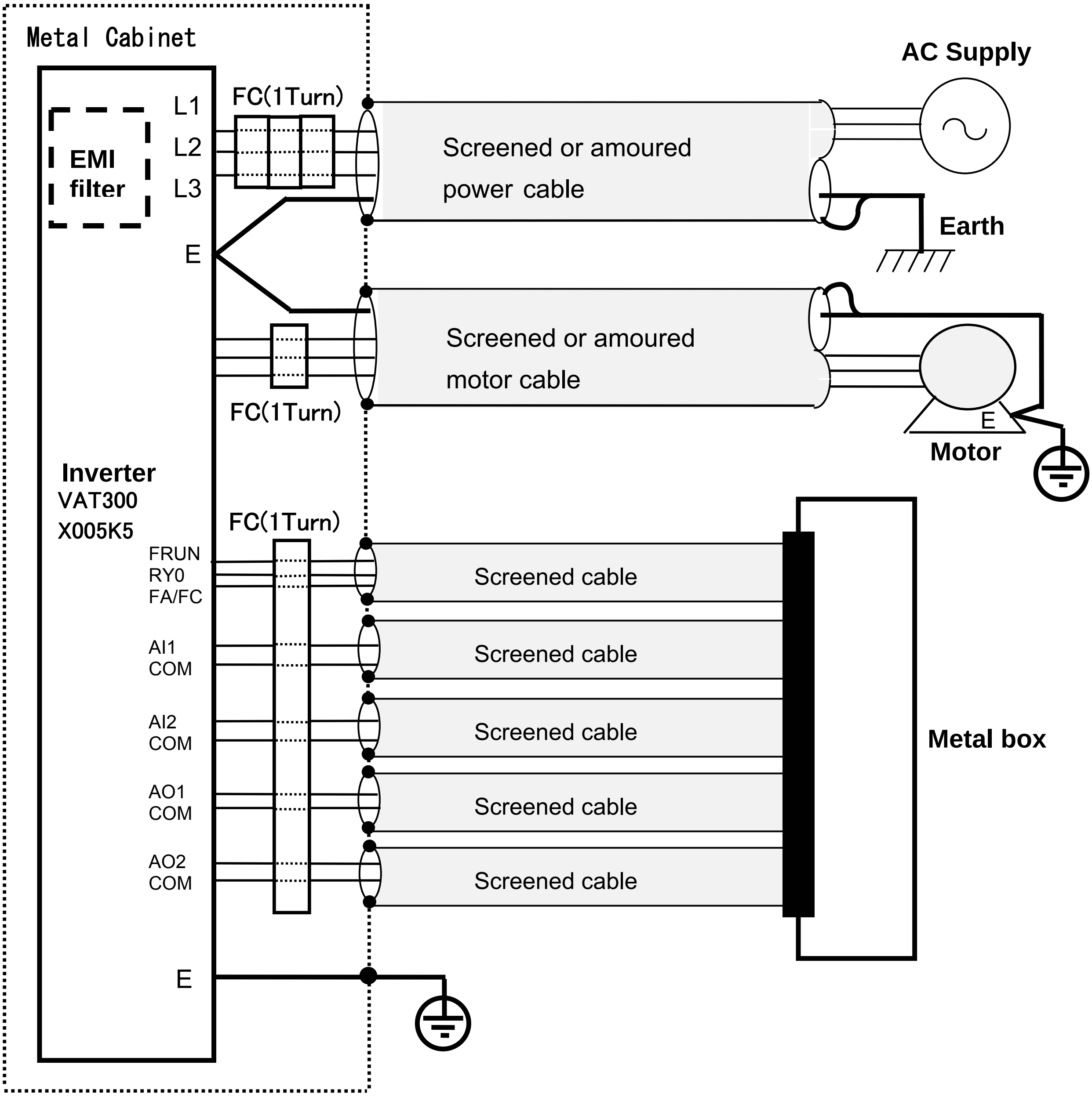


Fig. 9-2-d

Example to meet EN61800-3, Category C2 for built-in filter drives, up to N002K2 or up to X005K5

Ferrite Core	Type	Manufacturer
FC	ZCAT3035-1330	TDK

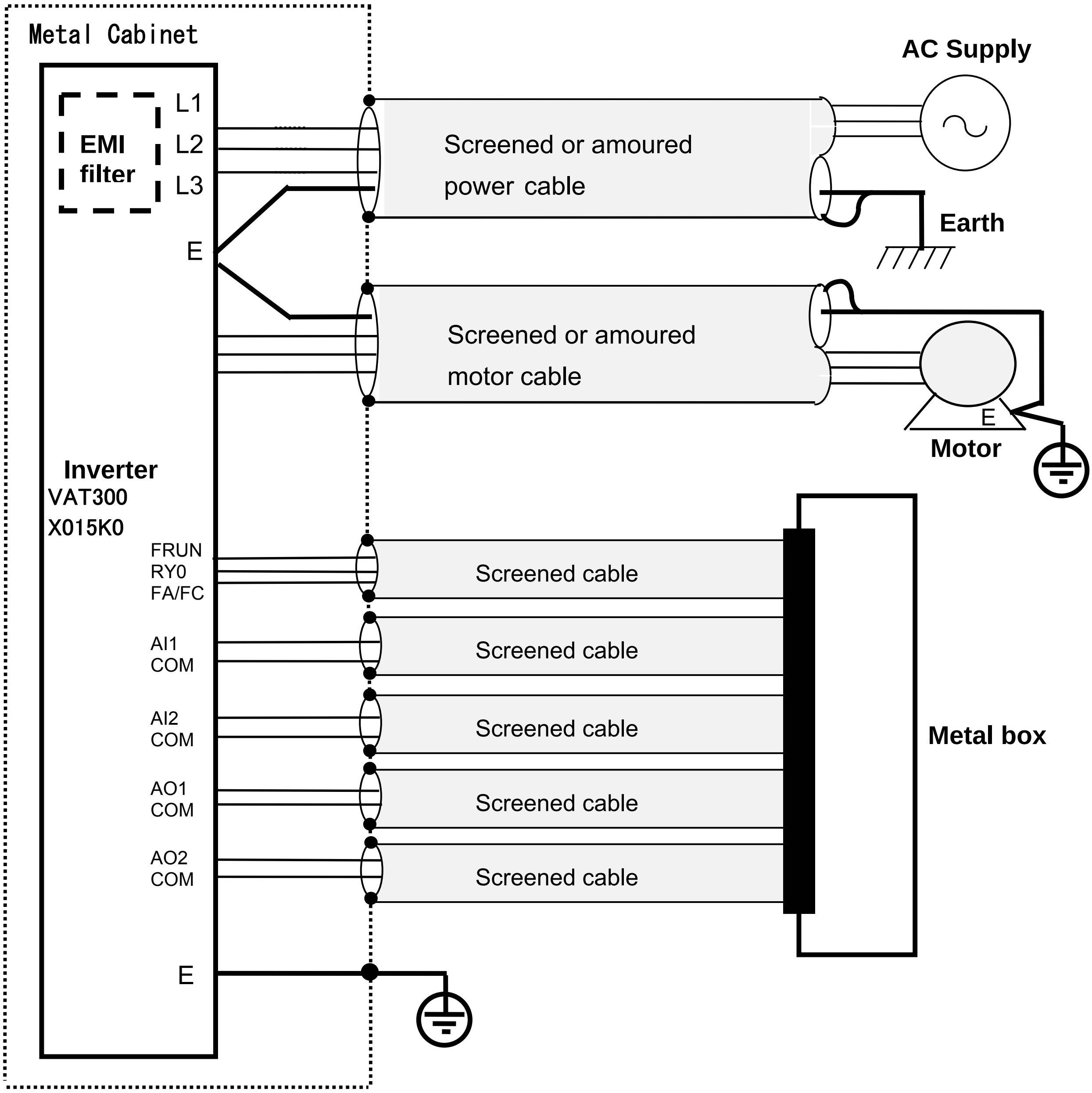


Fig. 9-2-d

Example to meet EN61800-3, Category C3 for built-in filter drives, up to N005K5 or up to X030K0

9-2-10 Selecting and fitting of filters

Table 9-2-c VAT300 Drives with Built-in Filter

VAT300 Series	VAT300 Model	Second Environment EN61800-3 Category C3	First Environment EN61800-3 Category C2
		Filter type	Add ferrite cores
200V Series with built in filter	U30N000K7F__	Built-in the drive	P：ZCAT3035-1330×3 C：ZCAT3035-1330×1 M：ZCAT3035-1330×1
	U30N001K5F__		
	U30N002K2F__		
	U30N004K0F__		NA
	U30N005K5F__		
400V Series with built in filter	U30X000K7F__	Built-in the drive	P：ZCAT3035-1330×3 C：ZCAT3035-1330×1 M：ZCAT3035-1330×1
	U30X001K5F__		
	U30X002K2F__		
	U30X004K0F__		
	U30X005K5F__		
	U30X007K5F__	Built-in the drive	NA
	U30X011K0F__		
	U30X015K0F__		
	U30X018K5F__		
	U30X022K0F__		
	U30X030K0F__		

*2) P: Ferrite cores for power cable; C: Ferrite cores for control cable;
M: Ferrite cores for motor cable

Table 9-2-d External filters for Drives without Built-in Filter (200V series)

VAT300 Series	VAT300 Model	Second Environment (EN61800-3 Category C3) External filter selection	
		Use with VAT300 in ND	Use with VAT300 in HD
200V Series	U30N000K7S__	U30F3016EB	U30F3016EB
	U30N001K5S__	U30F3016EB	U30F3016EB
	U30N002K2S__	U30F3016EB	U30F3016EB
	U30N004K0S__	U30F3030EB	U30F3030EB
	U30N005K5S__	U30F3030EB	U30F3030EB
	U30N007K5S__	U30F3075EB	U30F3075EB
	U30N011K0S__	U30F3075EB	U30F3075EB
	U30N015K0S__	U30F3100EB	U30F3100EB
	U30N018K5S__	U30F3100EB	U30F3100EB
	U30N022K0S__	U30F3130EB	U30F3130EB
	U30N030K0S__	U30F3180EB	U30F3180EB
	U30N037K0S__	U30F3250ES	U30F3250ES
	U30N045K0S__	U30F3250ES	U30F3250ES

Table 9-2-e External filters for Drives without Built-in Filter (400V series)

VAT300 Series	VAT300 Model	Second Environment (EN61800-3 Category C3) External filter selection	
		Use with VAT300 (ND)	Use with VAT300 (HD)
400V Series	U30X000K7S__	U30F3016EB	U30F3016EB
	U30X001K5S__	U30F3016EB	U30F3016EB
	U30X002K2S__	U30F3016EB	U30F3016EB
	U30X004K0S__	U30F3016EB	U30F3016EB
	U30X005K5S__	U30F3030EB	U30F3030EB
	U30X007K5S__	U30F3030EB	U30F3030EB
	U30X011K0S__	U30F3030EB	U30F3030EB
	U30X015K0S__	U30F3055EB	U30F3055EB
	U30X018K5S__	U30F3055EB	U30F3055EB
	U30X022K0S__	U30F3075EB	U30F3075EB
	U30X030K0S__	U30F3100EB	U30F3100EB
	U30X037K0S__	U30F3100EB	U30F3100EB
	U30X045K0S__	U30F3130EB	U30F3130EB
	U30X055K0S__	U30F3180EB	U30F3180EB
	U30X075K0S__	U30F3250ES	U30F3180EB
	U30X090K0S__	U30F3250ES	U30F3250ES
	U30X110K0S__	U30F3320ES	U30F3320ES
	U30X132K0S__	U30F3400ES	U30F3320ES
	U30X160K0S__	U30F3600ES	U30F3400ES
	U30X200K0S__	U30F3600ES	U30F3600ES
	U30X250K0S__	U30F31000ES	U30F3600ES
	U30X315K0S__	U30F31000ES	U30F31000ES
	U30X400K0S__	U30F31000ES	U30F31000ES
	U30X475K0S__	U30F31600ES	U30F31000ES

9-2-10-c Insulation test

⚠ CAUTION

If an insulation test is performed on a system incorporating VAT300 and filters, do one of the following.

- Remove the input filters from the system during the test. (For precautions for the drive, see Chapter 2.)
- Perform the test at the maximum voltage of 1500VAC.

Appendix 1 Type Description System

■ Standard specifications

■ 200V Series VAT300- U3SN000K7 to U3SN045K0

Item			Specifications												
System			200V Series												
Type (VAT300-U3SN0_)			00K7	01K5	02K2	04K0	05K5	07K5	11K0	15K0	18K0	22K0	30K0	37K0	45K0
Inverter rating	Normal-duty	Rated capacity [kVA] **(Note 1)**	1.7	2.8	3.8	5.5	8.3	11	16	21	26	30	41	51	60
		Max. continuous rated current [A] **(Note 2)**	5.0	8.0	11	16	24	33	46	61	76	88	118	146	174
		Max. applicable motor [kW] **(Note 3)**	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45
		Carrier frequency **(Note 4)**	1 to 15kHz (Default : Soft sound 4kHz)												
		Overload current rating	120% for 1 min., 140% for 2.5 seconds												
	Heavy-duty	Rated capacity [kVA] **(Note 1)**	1.0	1.7	2.8	3.8	5.5	8.3	11	16	21	26	30	41	51
		Max. continuous rated current [A] **(Note 2)**	3.0	5.0	8.0	11	16	24	33	46	61	76	88	118	146
		Max. applicable motor [kW] **(Note 3)**	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37
		Carrier frequency **(Note 4)**	1 to 15kHz (Default : Soft sound 4kHz)												
		Overload current rating	150% for 1 min., 175% for 2.5 seconds												
Power supply		Rated input voltage: rated input frequency	200 to 240V ±10% 50 or 60Hz ±5%							200 to 230V ±10% 50 or 60Hz ±5%					
Output		Rated output voltage **(Note 5) (Note 6)**	200 to 240V (Max.)												
		Output frequency	0.1 to 440Hz												
Main circuit devices		EMI filter	Built-in (option)					Standalone (option)							
		DC reactor	Standalone (option)												
		Dynamic braking circuit	Built-in (standard)									Standalone (option)			
		Dynamic braking resistor	Built-in (option)							Standalone (option)					
Construction		Structure	Wall-mounted									Wall-mounted (standard) Free-standing type (option)			
		Enclosure	IP20									IP00			
		Cooling method	Self-cooling	Forced air cooling											
		Approx. weight (kg)	3					5		12		23		30	
		Paint color	Munsell N4.0												
Working environment			Indoors, Working ambient temperature: -10 to 50°C **(Note 7)** Relative humidity: 95%RH or below (no dew condensation), Altitude: 1000m or less, Vibration: 4.9m/s^2 or less Freedom from corrosive or explosive gases, steam, dust, oil mist or cotton lint.												

■ 400V Series VAT300- U3SX000K7 to U3SX055K0

Item			00K7	01K5	02K2	04K0	05K5	07K5	11K0	15K0	18K0	22K0	3K0	37K0	45K0	55K0
Specifications																
System			400V Series													
Type (VT300 U3SX0_)			00K7	01K5	02K2	04K0	05K5	07K5	11K0	15K0	18K0	22K0	3K0	37K0	45K0	55K0
Inverter rating	Normal-duty	Rated capacity [kVA] **(Note 1)**	1.7	2.5	3.8	6.0	9.0	12	16	21	26	30	42	51	60	75
Inverter rating	Normal-duty	Max. continuous rated current [A] **(Note 2)**	2.5	3.6	5.5	8.6	13	17	23	31	37	44	60	73	87	108
Inverter rating	Normal-duty	Max. applicable motor [kW] **(Note 3)**	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
Inverter rating	Normal-duty	Carrier frequency **(Note 4)**	1 to 15kHz (Default : Soft sound 4kHz)													
Inverter rating	Normal-duty	Overload current rating	120% for 1 min., 140% for 2.5 seconds													
Inverter rating	Heavy-duty	Rated capacity [kVA] **(Note 1)**	1.0	1.7	2.5	3.8	6.0	9.0	12	16	21	26	30	42	51	60
Inverter rating	Heavy-duty	Max. continuous rated current [A] **(Note 2)**	1.5	2.5	3.6	5.5	8.6	13	17	23	31	37	44	60	73	87
Inverter rating	Heavy-duty	Max. applicable motor [kW] **(Note 3)**	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45
Inverter rating	Heavy-duty	Carrier frequency **(Note 4)**	1 to 15kHz (Default : Soft sound 4kHz)													
Inverter rating	Heavy-duty	Overload current rating	150% for 1 min., 175% for 2.5 seconds													
Power supply		Rated input voltage: rated input frequency	380 to 480V ±10% 50 or 60Hz ±5%													
Output		Rated output voltage **(Note 5) (Note 6)**	380 to 480V (Max.)													
Output		Output frequency	0.1 to 440Hz													
Main circuit devices		EMI filter	Built-in (option)											Standalone (option)		
Main circuit devices		DC reactor	Standalone (option)													
Main circuit devices		Dynamic braking circuit	Built-in (standard)										Standalone (option)			
Main circuit devices		Dynamic braking resistor	Built-in (option)								Standalone (option)					
Construction		Structure	Wall-mounted											Wall-mounted (standard) Free-standing type (option)		
Construction		Enclosure	IP20											IP00		
Construction		Cooling method	Self-cooling		Forced air cooling											
Construction		Approx. weight (kg)	3					5			12			23		27
Construction		Paint color	Munsell N4.0													
Working environment			Indoors, Working ambient temperature : -10 to 50°C **(Note 7)** Relative humidity: 95%RH or below (no dew condensation), Altitude: 1000m or less, Vibration: 4.9m/s^2 or less Freedom from corrosive or explosive gases, steam, dust, oil mist or cotton lint.													

■ 400V Series VAT300, U3SX075K0 to U3SX475K0

Item			Specifications												
System						400V Series									
Type (VAT300-U3SX_)						075K	090K	110K	132K	160K	200K	250K	315K	400K	475K
Inverter rating	Normal-duty	Rated capacity [kVA] **(Note 1)**				102	124	148	173	222	297	360	409	513	603
		Max. continuous rated current [A] **(Note 2)**				147	179	214	249	321	428	519	590	740	870
		Max. applicable motor [kW] **(Note 3)**				75	90	110	132	160	200	250	315	400	475
		Carrier frequency **(Note 4)**	1 to 8kHz (Default : Soft sound 4kHz)												
		Overload current rating	120% for 1 min., 140% for 2.5 seconds												
	Heavy-duty	Rated capacity [kVA] **(Note 1)**				75	102	124	148	173	222	297	360	409	513
		Max. continuous rated current [A] **(Note 2)**				108	147	179	214	249	321	428	519	590	740
		Max. applicable motor [kW] **(Note 3)**				55	75	90	110	132	160	200	250	315	400
		Carrier frequency **(Note 4)**	1 to 8kHz (Default : Soft sound 4kHz)												
		Overload current rating	150% for 1 min., 175% for 2.5 seconds												
Power supply		Rated input voltage: rated input frequency				380 to 480V ±5% 50 or 60Hz ±5%									
Output		Rated output voltage **(Note 5) (Note 6)**				380 to 480V (Max.)									
		Output frequency	0.1 to 440Hz												
Main circuit devices		EMI filter	Standalone (option)												
		DC reactor				Stand-Alone (option)									
		Dynamic braking circuit	Standalone (option)												
		Dynamic braking resistor	Standalone (option)												
Construction		Structure	Wall-mounted (standard), Free-standing type (option)												
		Enclosure	IP00 (standard), IP20 (option)												
		Cooling method	Forced air cooling												
		Approx. weight (kg)				42	45	60	65	90	100	200	285	290	295
		Paint color	Munsell N4.0												
Working environment			Indoors, Working ambient temperature : -10 to 50°C **(Note 7)** Relative humidity: 95%RH or below (no dew condensation), Altitude: 1000m or less, Vibration: 4.9m/s^2 or less Freedom from corrosive or explosive gases, steam, dust, oil mist or cotton lint.												

(Note 1) The output voltage indicates the output capacity [kVA] at 200V for the 200V series, and 400V for the 400V series.
(Note 2) Indicates the total effective value including the higher harmonics.
(Note 3) Indicates the case for the standard 4-pole squirrel cage motor.
(Note 4) If 4kHz is exceeded when using the normal-duty setting, and if 4, 6, 8 or 10kHz is exceeded when using the heavy-duty setting, the maximum continuous rated current must be lowered.

- **For 200V series, normal-duty setting**

Capacity	4kH	6kHz	8kHz	10kHz	12kHz	15kHz	Derating
N000K7	5.0	4.7	4.4	4.1	3.9	3.6	4k to 10kHz: 3%/1kHz 10k to 15kHz: 2%/1kHz
N001K5	8.0	7.5	7.0	6.6	6.2	5.8	
N002K2	11.0	10.3	9.7	9.0	8.6	7.9	
N004K0	16.0	15.0	14.1	13.1	12.5	11.5	
N005K5	24.0	22.6	21.1	19.7	18.7	17.3	
N007K5	33.0	31.0	29.0	27.1	25.7	23.8	
N011K0	46.0	43.2	40.5	37.7	35.9	33.1	
N015K0	61.0	57.3	53.7	50.0	47.6	43.9	
N018K5	76.0	71.4	66.9	62.3	59.3	54.7	
N022K0	88.0	82.7	77.4	72.2	66.9	59.0	3%/1kHz
N030K0	118.0	110.9	103.8	96.8	89.7	79.1	
N037K0	146.0	137.2	128.5	119.7	111.0	97.8	
N045K0	174.0	163.6	153.1	142.7	132.2	116.6	

- **For 400V series, normal-duty setting**

Capacity	4kH	6kHz	8kHz	10kHz	12kHz	15kHz	Derating
X000K7	2.5	2.3	2.0	1.8	1.6	1.4	4k to 10kHz: 5%/1kHz 10k to 15kHz: 3%/1kHz
X001K5	3.6	3.2	2.9	2.5	2.3	2.0	
X002K2	5.5	5.0	4.4	3.9	3.5	3.0	
X004K0	8.6	7.7	6.9	6.0	5.5	4.7	
X005K5	13.0	11.7	10.4	9.1	8.3	7.2	
X007K5	17.0	15.3	13.6	11.9	10.9	9.4	
X011K0	23.0	20.7	18.4	16.1	14.7	12.7	
X015K0	31.0	27.9	24.8	21.7	19.8	17.1	
X018K5	37.0	33.3	29.6	25.9	23.7	20.4	
X022K0	44.0	39.6	35.2	30.8	28.2	24.2	
X030K0	60.0	54.0	48.0	42.0	36.0	27.0	5%/1kHz
X037K0	73.0	65.7	58.4	51.1	43.8	32.9	
X045K0	87.0	78.3	69.6	60.9	52.2	39.2	
X055K0	108.0	97.2	86.4	75.6	64.8	48.6	
X075K0	147.0	132.3	117.6				5%/1kHz
X090K0	179.0	161.1	143.2				
X110K0	214.0	192.6	171.2				
X132K0	249.0	224.1	199.2				
X160K0	321.0	288.9	256.8				
X200K0	428.0	385.2	342.4				
X250K0	519.0	467.1	415.2				
X315K0	590.0	531.0	472.0				
X400K0	740.0	666.0	592.0				
X475K0	870.0	783.0	696.0				

- **For 200V series, heavy-duty setting**

Capacity	4kH	6kHz	8kHz	10kHz	12kHz	15kHz	Derating
N000K7	→	→	→	3.0	2.8	2.6	10k to 15kHz: 2%/1kHz
N001K5	→	→	→	5.0	4.7	4.3	
N002K2	→	→	→	8.0	7.5	6.8	
N004K0	→	→	→	11.0	10.3	9.4	
N005K5	→	→	→	16.0	15.0	13.6	
N007K5	→	→	→	24.0	22.6	20.4	
N011K0	→	→	→	33.0	31.0	28.1	
N015K0	→	→	46.0	43.2	41.4	38.6	8k to 10kHz: 3%/1kHz 10k to 15kHz: 2%/1kHz
N018K5	→	→	61.0	57.3	54.9	51.2	
N022K0	→	76.0	71.4	66.9	62.3	55.5	6k to 15kHz: 3%/1kHz
N030K0	→	88.0	82.7	77.4	72.2	64.2	
N037K0	118.0	110.9	103.8	96.8	89.7	79.1	3%/1kHz
N045K0	146.0	137.2	128.5	119.7	111.0	97.8	

- **For 400V series, heavy-duty setting**

Capacity	4kH	6kHz	8kHz	10kHz	12kHz	15kHz	Derating
X000K7	→	→	→	1.5	1.4	1.3	10k to 15kHz: 3%/1kHz
X001K5	→	→	→	2.5	2.4	2.1	
X002K2	→	→	→	3.6	3.4	3.1	
X004K0	→	→	→	5.5	5.2	4.7	
X005K5	→	→	→	8.6	8.1	7.3	
X007K5	→	→	→	13.0	12.2	11.1	
X011K0	→	→	→	17.0	16.0	14.5	
X015K0	→	→	23.0	20.7	19.3	17.3	8k to 10kHz: 5%/1kHz 10k to 15kHz: 3%/1kHz
X018K5	→	→	31.0	27.9	26.0	23.3	
X022K0	→	→	37.0	33.3	31.1	27.8	
X030K0	→	→	44.0	39.6	35.2	28.6	8k to 15kHz: 3%/1kHz
X037K0	→	60.0	54.0	48.0	42.0	33.0	6k to 15kHz: 5%/1kHz
X045K0	→	73.0	65.7	58.4	51.1	40.2	
X055K0	87.0	78.3	69.6	60.9	52.2	39.2	5%/1kHz
X075K0	108.0	97.2	86.4				5%/1kHz
X090K0	147.0	132.3	117.6				
X110K0	179.0	161.1	143.2				
X132K0	214.0	192.6	171.2				
X160K0	249.0	224.1	199.2				
X200K0	321.0	288.9	256.8				
X250K0	428.0	385.2	342.4				
X315K0	519.0	467.1	415.2				
X400K0	590.0	531.0	472.0				
X475K0	740.0	666.0	592.0				

The carrier frequency automatic reduction function may automatically reduce the carrier frequency to 2.0kHz depending on the output current or inverter temperature. This function is valid only when C22-6 is set to 1. The reduction function is enabled as the factory setting. The setting value and actual carrier frequency may differ, so check the actual carrier frequency with D03-3. The reduction conditions for each capacity are shown below.

- For For X000K7 to X005K5, N000K7 to N005K5
  If the power module temperature exceeds 110°C, the carrier frequency is automatically reduced to 2.0kHz.

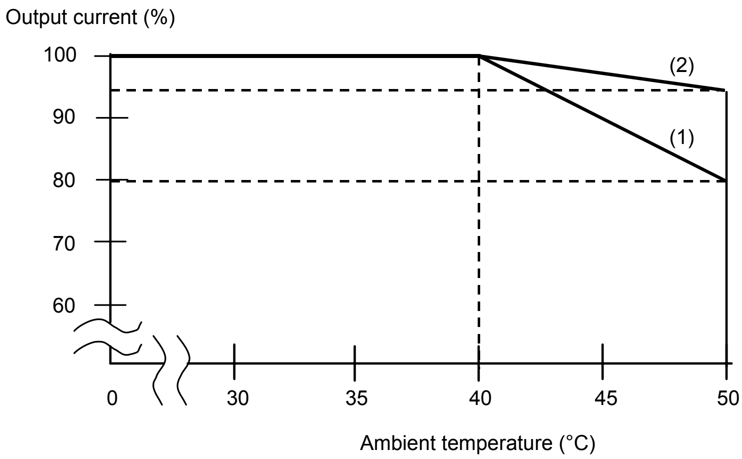
- For X007K5 to X022K0, N007K5, N011K0
  If the power module temperature exceeds 85°C, the carrier frequency is automatically reduced to 2.0kHz.
- For 030H or more, 015L or more
  If the heat sink temperature 75°C is exceeded and the output current exceeds 110% or if the heat sink temperature 95°C is exceeded, the carrier frequency will automatically change to 2.0kHz.

* Check the power module and heat sink temperature with D02-4.

(Note 5) An output voltage exceeding the input voltage cannot be attained.
(The upper limit of the output voltage effective value is the DC voltage/1.37.)

(Note 6) The rated output voltage for the sensor-less vector control mode, vector control with sensor mode, PM control with sensor mode and the sensor-less PM control mode is as follows.
200V series : 160V/180V/190V respectively in respect to input voltage 200V/220V/240V
400V series : 300V/320V/360V/380V respectively in respect to input voltage 380V/400V/440V/480V

(Note 7) The following conditions apply to the upper limit of the working ambient temperature when using the normal-duty setting.



(1) N005K5
If the ambient temperature exceeds 40°C, reduce the output current by 2% per 1°C.
(2) N011K0 / X005K50 (NF)/ X015K0
If the ambient temperature exceeds 40°C, reduce the output current by 0.5% per 1°C.

■ Control specifications table

		V/f control	Speed sensor-less vector control	Vector control with speed sensor (Note 1)	PM motor control with sensor (Note 2)	Sensor-less PM motor control (Note 4)
Frequency control	Control method	All digital control Sine wave approximation PWM				
	Transfer frequency	Mono-sound mode : 1 to 15kHz (0.1kHz increments) Soft sound mode : Average frequency 2.1 to 5kHz Frequency modulation method (3 tone modulation, 4 tone modulation)				Mono-sound mode: 4kHz or 6kHz
	Output frequency resolution	0.01Hz				
	Frequency setting resolution	0.01Hz (digital) 0.03% (analog) In respect to maximum frequency				
	Frequency accuracy	±0.01% (digital) at 25±10°C ±0.0% (analog) at 25±10°C				
Control specifications	Voltage/frequency characteristics	Middle V/f point of five points randomly set between 3 and 440Hz can be set	Randomly set between 150 and 9999min^{-1} (max. 180Hz)		Randomly set between 150 and 9999min^{-1} (max. 210Hz)	Randomly set between 150 and 9999min^{-1} (max. 240Hz)
	Torque boost	Manual/automatic selective	–			
	Max. torque boost	Max. torque for applicable motor is output when used with automatic tuning.	–			
	Automatic tuning	Automatic measurement of motor constants Automatic measurement of various parameters Basic method which does not rotate motor, and extended method which rotates motor are available			Encode phase adjustment Magnetic pole position estimation	Automatic measurement of motor constants (Rotates motor)
	Starting frequency	Set between 0.1 and 60.0Hz	–			
	Starting torque	200% or more **(Note 3)** • Using motor • At 150% of rated current • Attainment time approx. 3 sec.	–			Approx. 50% • Using standard sensor-less control motor • At 150% of rated current
	Acceleration/ deceleration time	0.01 to 60000sec Acceleration/deceleration time × 2, jogging dedicated × 1, program cushion × 8				
	Acceleration/ deceleration mode	Linear/S-character selective				
	Operation method	3 modes selective • Forward run/reverse run • Run stop/forward run reverse run • Forward run pulse/reverse run pulse/stop				

(Note 1) The IM speed detection option PCB is required.

(Note 2) This is for the PM motor (may differ depending the manufacturer). The PM speed detection option PCB is required.

(Note 3) Differs according to the motor capacity, rated voltage and rated frequency. If 45kW is exceeded, starting torque is approx. 150%.

(Note 4) Sensor-less PM motor control is under development for energy-saving operation of fan/pump

■ Control specifications table (continued)

			V/f control	Speed sensor-less vector control	Vector control with speed sensor (Note 1)	PM motor control with sensor (Note 2)	Sensor-less PM motor control (Note 4)
Control specifications	Stop method		Deceleration stop in respect to run, emergency stop and inching, coast to stop selective				
	DC braking		Braking start frequency, randomly set between 0.1 and 60.0Hz Braking voltage, randomly set between 0.1 and 20.0%	Braking start speed, randomly set between 0.00 and 50.00% Braking current ,randomly set between 50 and 150%.			
		Braking time	Randomly set between 0.0 and 20.0 seconds				
	Output frequency		0 to 440Hz	0 to 180Hz		0 to 210Hz	0 to 240Hz
	Speed control	Control range	Simple ASR function is not specified	1 : 100	1 : 1000	1 : 100	1 : 5
		Constant output range	Up to 1 : 7	Up to 1 : 2	Up to 1 : 4	Up to 1 : 1.5	
		Control accuracy (At Fmax ≥ 50Hz)	±0.01%	±0.5%	±0.01%	±0.01%	
		Control response	Simple ASR function is not specified	5Hz	30Hz	–	
Setting	Multi-step frequency setting		8 steps Acceleration/deceleration time as changeable 5-bit non-encode mode				
	Ratio interlock setting		During remote setting mode y = Ax + B + C y: Operation results x: Operation input A: 0.000 to ±10.000 B: 0.00 to ±440.00Hz C: Auxiliary input With output upper/lower limit	During remote setting mode y = Ax + B + C y: Operation results x: Operation input A: 0.000 to ±10.000 B: 0 to ±9999min^{-1} C: Auxiliary input With output upper/lower limit			
	Frequency jump		Three places can be set Width can be varied between 0.0 and 10Hz	–			
	Slip compensation		Operation/non selective Slip compensation gain: 0.0 to 20.0	–			
	Automatic run function		10-step automatic run function Synchronous/asynchronous selective				
	Built-in PLC function		Arithmetic operations, logical operations, size comparison and LPF operations, etc., in respect to the sequence input/output and analog input/output are possible. Program capacity: max. 16 commands * 20 banks, operation cycle: 1 bank in 2ms				
	Others		PID control Pick-up Automatic start Restart after instantaneous power failure Reverse run prevention Traverse pattern		Deceleration control at power failure Multi-pump Spinning frame		Pick-up (auto-start, re-start after momentary stop) : impossible
Control input/output	Operation panel		Local/remote changeover operation, forward run/reverse run direct operation, reference, change and copy of all parameters Mountable outside unit (extension cable max. 3m)				
		LCD type	Display : 16 characters * 2 lines Status display LED: 4 points Operation : Operate with knob and set key				
		LED type	Display : 7-segment LED × 5 digits + sign Status/unit display LED: 7 points Operation : Operate with ▲▼ keys + set key				
	Sequence input		Programmable : 7 points sink/source changeable, PSI7 is used as pulse train input				

■ Control specifications table (continued)

		V/f control	Speed sensor-less vector control	Vector control with speed sensor (Note 1)	PM motor control with sensor (Note 2)	Sensor-less PM motor control (Note 4)
Control input/output	Sequence output	Relay 1c contact: 1 point (programmable), relay 1a contact: 1 point (programmable), open collector: 3 points (programmable), PS03 is used as pulse train output The programmable details can be changed between speed detection, pre-charging complete, reverse run, direction operation, current reached, speed reached, acceleration, deceleration and fault code				
	Frequency setting	Voltage input (0 to 10V, 0 to 5V, 1 to 5V) or current input (4 to 20mA, 0 to 20mA): 2 points Voltage input (0 to ±10V, 0 to ±5C, 1 to 5V): 1 point (used with sequential ratio operation or PID feedback, etc.) Pulse train input (max. 10kHz): 1 point				
Control	Meter output	Voltage output (0 to 10V) or current output (4 to 20mA): 2 points (programmable) Change between output frequency, output voltage, output current, DC voltage, etc.				
Communication	Serial interface	Communication protocol: Modbus-RTU or VAT300 series dedicated communication (standard serial) Connection method: RS485, 2-wire type, Transmission distance: total extension distance 150m or less, Transmission method: Start-stop synchronization, half-duplex communication, Baud rate: select from 1200/2400/4800/9600/14400/19200/38400bps, No. of stations: max. 32 units, Error detection: Sum check, parity, framing				
Protection	Preventive	Overcurrent limit (primary current limit level changeable in three stages), overcurrent limit, undervoltage limit, overload warning, carrier frequency automatic reduction at overload (cooling fin overheat) (selective)				
	Shut-off	Overcurrent, overvoltage, undervoltage, IGBT fault, phase failure (input/output), overload, cooling fin temperature rise, ground fault, other self-diagnosis				
	Fault history	Past four faults recorded. Recorded details: primary cause, secondary cause, output frequency/current/DC voltage before shutoff, hardware latch, cumulative ON time, cumulative operation time				
	Overload withstand level	Normal-duty setting 120% for 1 minute, 140% for 2.5 seconds (reduced to 60% for 1 minute from 1Hz to 0.1Hz), inverse time characteristics Heavy-duty setting 150% for 1 minute, 175% for 2.5 seconds (reduced to 75% for 1minute from 1Hz to 0.1Hz), inverse time characteristics				
	Retry	Randomly set between 0 and 10 times				

Appendix 2 Outline Dimension Drawings

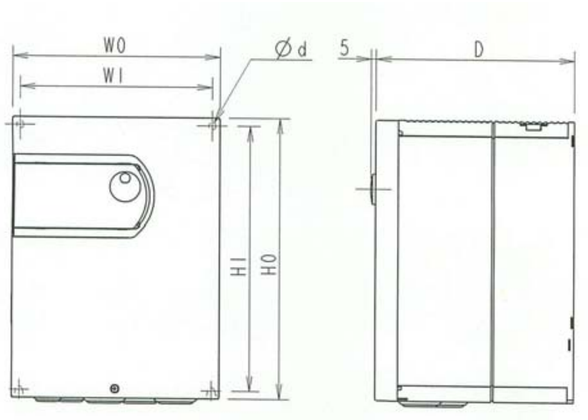


Fig. 1

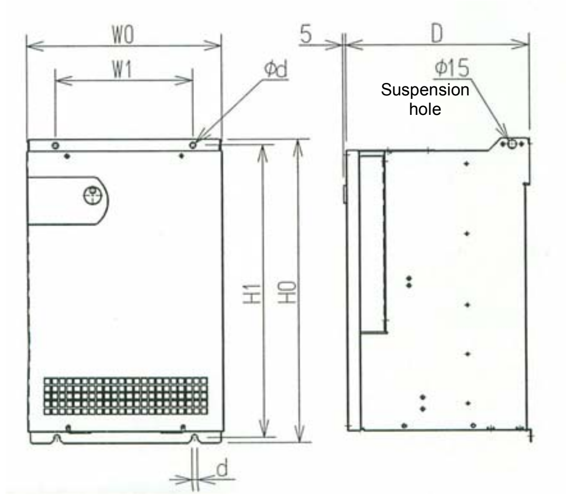


Fig. 2

■ **200V Series VAT300 N000K7 to N045K0. 400V Series VAT300 X000K7 to X055K0**

<table>
<tr><th colspan="2">Type</th><th colspan="6">Dimensions (mm)</th><th rowspan="2">Main circuit terminal</th><th rowspan="2">Weight (kg)</th><th rowspan="2">Fig.</th></tr>
<tr><th>200V Series</th><th>400V Series</th><th>W0</th><th>W1</th><th>H0</th><th>H1</th><th>D</th><th>ød</th></tr>
<tr><td>N000K7
N001K5
N002K2
N004K0
N005K5</td><td>X000K7
X001K5
X002K2
X004K0
X005K5</td><td>155</td><td>140</td><td>250</td><td>235</td><td>180</td><td>6</td><td rowspan="2">M4</td><td>3</td><td rowspan="6">1</td></tr>
<tr><td></td><td>X007K5
X011k0</td><td rowspan="2">205</td><td rowspan="2">190</td><td rowspan="2">275</td><td rowspan="2">260</td><td rowspan="2">196</td><td rowspan="5">7</td><td rowspan="2">5</td></tr>
<tr><td>N007K5
N011k0</td><td>X015k0</td><td rowspan="2">M5</td></tr>
<tr><td></td><td>X018k0
X022k0</td><td rowspan="3">260</td><td rowspan="3">240</td><td rowspan="3">350</td><td rowspan="3">330</td><td rowspan="3">298</td><td rowspan="3">12</td></tr>
<tr><td>N015K0</td><td>X030k0</td><td>M6</td></tr>
<tr><td>N018K5</td><td></td><td rowspan="3">M8</td></tr>
<tr><td>N022K0
N030K0</td><td>X037k0
X045k0</td><td rowspan="2">300</td><td rowspan="2">200</td><td>470</td><td>450</td><td rowspan="3">317</td><td rowspan="3">10</td><td>23</td><td rowspan="3">2</td></tr>
<tr><td></td><td>X055k0</td><td rowspan="2">520</td><td rowspan="2">500</td><td>27</td></tr>
<tr><td>N037K0
N045K0</td><td></td><td>340</td><td>240</td><td>M10</td><td>30</td></tr>
</table>

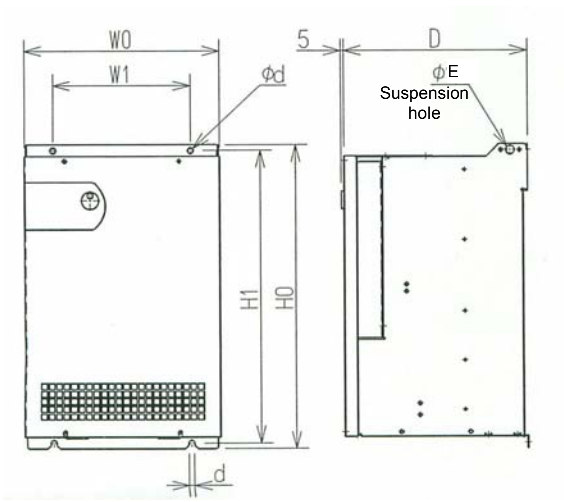


Fig. 3

■ **400V Series VAT300- X075K0 to X475K0**

Type		Dimensions (mm)							Main circuit terminal	Weight (kg)	Fig.
	400V Series	W0	W1	H0	H1	D	ød	øE			
	X075K0	435	300	615	595	350	10	20	M10	42	3
	X090K0									45	
	X110K0	500	400	710	684					60	
	X132K0									65	
	X160K0	580	400	1020	990	470	13	23		90	
	X200K0									100	
	X250K0	580	400	1260	1230		15	23	M16	200	
	X315K0	870	600	1260	1230					285	
	X400K0									290	
	X475K0									295	

Appendix 3. Fault Codes

Code	Display	Fault	Description	Retry
00	- - -	No fault	No fault recorded.	×
01	(EMS)	Emergency stop	Indicates that sequence signal EMS has been input in C00-4 = 2 (fault output at emergency stop) mode.	×
02	(PM-n)	Power module error	Power module fault n: sub-code 1: during stop 2: during operation at the set speed 3: during acceleration 4: during deceleration 5: during braking 6: during ACR 7: during excitation 9: during automatic tuning	○
03	(OC-n)	Over current	The output has risen to or beyond 300%. n: sub-code 1: during stop 2: during operation at the set speed 3: during acceleration 4: during deceleration 5: during braking 6: during ACR 7: during excitation 9: during automatic tuning	○
04	(OV-n)	Over voltage	The DC voltage has risen to or beyond the preset level. (Vdc ≥ 800 or 400V) n: sub-code 1: during stop 2: during operation at the set speed 3: during acceleration 4: during deceleration 5: during braking 6: during ACR 7: during excitation 9: during automatic tuning	○
05	(UV-n)	Under voltage	While the drive is running, the DC voltage has lowered to or beyond the preset level (65% of the rating). n: sub-code 1: during stop 2: during operation at the set speed 3: during acceleration 4: during deceleration 5: during braking 6: during ACR 7: during excitation 9: during automatic tuning When C08-0=2, 3 (automatic start), only the symbol is displayed, and the FLT LED does not operate.	×
06	(PHL.n)	Phase failure	This indicates that there is a phase failure in the AC input power supply. n: sub-code 1: Input phase failure 2: Output phase failure	×
07	(UOHn.)	Overheat	The heatsink temperature has risen. n: sub-code 1: Detected with thermistor 2: Detected with thermostat	○
08	(SP-n)	Speed error	This indicates that the motor rotation speed is abnormal. n: sub-code 1: Overspeed (C24-0 over) 2: Speed (magnetic pole position) detection error (C24-2) 3: Speed deviation error (C24-5) 4: Reverse run detection error 5: Encoder initialization error 1 6: Encoder initialization error 2	×
09	(CONV.)	Converter fan fault	This indicates that trouble has occurred in the converter cooling fan. (Only on parallel machines mounted with a converter fan.)	○
0A	(ATT-n.)	Automatic tuning abnormal completion	This indicates that the automatic tuning did not complete normally. n: sub-code (Automatic tuning step) 1: Setting error 2: Calculation operation error 3: Operation error 4: Load error 5: End process error 6: Convergence operation error 7: Magnetic pole position estimation motor rotation error 8: Magnetic pole position estimation voltage stability error 9: Magnetic pole position estimation retry error	×
0B	(OL-n.)	Overload	Indicate that the output current exceeded the thermal operation time having inverse time characteristics. When Normal-duty is set, the standard characteristics are 120% for one minute in respect to the motor rated current value. At 122% or more in respect to the inverter rated current, this will be 140% for 2.5 seconds. When Heavy-duty is set, the standard is 150% for one minute in respect to the motor rated current value. At 155% or more in respect to the inverter rated current, this will be 175% for 2.5 seconds. n: sub-code 1: Equipment overload 2: DBR overload 3: Motor overload	○

Code	Display	Fault	Description	Retry
0C	(GRD. n)	Ground	The Drive has sensed grounded conditions on the output. n: sub-code 1: during stop 2: during operation at the set speed 3: during acceleration 4: during deceleration 5: during braking 6: during ACR 7: during excitation 9: during automatic tuning	○
0D	(IO-n.)	I/O error	There has been an error in communications through the I/O port. n: sub-code 1: Gate shutdown circuit error. A feedback signal has disagreed to a gate shutdown command. 2: A/D convertor error. The A/D convertor has been jammed. 3: Current detector offset. The offset of the current detector has increased to or beyond 0.5V. 4: Retry time out. Indicates that the operation was not successful within the No. of retries set in C21-0. 7: This indicates that the field network interface option cannot be started up. 8: Watch-dog error in the transmission between the field network interface and the basic PCB. (transmission jam / stop) 9: Field network interface error. The details can be shown in D30-2~5. B: PID error C: External brake IDET error D: External brake RUN error E: External brake answer error F: Thermistor fault	×
0E	(CPU. n)	CPU error	There has been an error while the CPU, RAM or ROM is in the self-diagnosis mode at power-up. n: sub-code 1: Watch-dog error, indicating that the CPU has been jammed. This fault may appear during at-speed operation. 2: CPU calculation error. 3: CPU RAM error. 4: External RAM error. 6: E^2PROM check-sum error. 7: E^2PROM read error. 8: E^2PROM write error. This error is only displayed, and the gate will not shut down and FLT will not be output. A: Stack overflow B: Built-in PLC overload * CPU1 to 6, 7 and 8 are specific fault output functions and cannot be output.	×
0F	(FUSE)	Fuse blown	Indicate that the main circuit's fuse has blown.	○
10	(BPFLT)	Parallel unit signal cutoff	Indicates that the connection signal with the parallel unit has been cut off.	○
11	(E.FLTn)	External fault	Indicates that an external fault was input from the programmable sequence input terminal. n: sub-code 1: Terminal set with C05-8 turned ON 2: Terminal set with C05-9 turned ON 3: Terminal set with C05-A turned ON 4: Terminal set with C05-B turned ON 5: Terminal set with C05-C turned ON 6: Terminal set with C05-D turned ON 7: Terminal set with C05-E turned ON 8: Terminal set with C05-F turned ON	×
13	(MC-n.)	MC error	At least one of the pre-charge magnetic contactors in 200H or larger units may not be working properly. n : sub-code 1 : Magnetic contactor nor working well when the power on.	×
-	(dEr)	E^2PROM data error	Indicates that there is an error in the various data stored in the E^2PROM. For details, enter the monitor mode: D20-2, and correct the data. **Caution)** If this appears when starting up, the details will not be stored internally. Thus, after starting up normally, these details cannot be read with the fault history (D20-0).	×

Appendix 4. Display Messages

Display	Name	Explanation
oFF	OFF	• Indicates that the motor is stopped.
rUn	RUN	• Indicates that the motor is running. • Occurs when a parameter, which cannot be changed during operation, was changed during operation.
LoC	LOCK	• Indicates that the parameters are locked. • Occurs when a parameter locked with C09-0 was operated. • Also occurs when a key other than the STOP key was pressed while key operations were prohibited with C09-1.
rtY	RETRY	• Indicates that the operation is being retried. • The value displayed at the same time is the number of retries.
br.	BRAKE	• Indicates that the brakes are being applied.
PU.	Pick Up	• Indicates that pick-up is being applied.
ouEr.	Over	• Indicates that the scale display has exceeded the upper limit 99999.
EP.Err	EEPROM Error	• Indicates that an error occurred during the parameter copy function's verify check using the operation panel.
Err	ERROR	• Indicates that the fault display mode is active.
n.Er	Minor Error	• Indicates that the minor fault display mode is active.
LSt	LIST	• Indicates that the list display mode is active.
At.Str	Auto Tuning Start	• Indicates that automatic tuning will be started.
At.End	Auto Tuning End	• Indicates that automatic tuning has ended.
d.CHG	Data CHANGE	• Indicates the head of the list display.
d.End	Data END	• Indicates the end of the list display.

Appendix 5. Segment LED Display

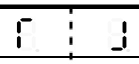
(1) Numeric

Display										
Numerics	0	1	2	3	4	5	6	7	8	9

(2) Alphabet

Display										
Alphabet	A	B (b)	C	D (d)	E	F	G	H	I	J

Display										
Alphabet	L	M (m)	N (n)	O	P	Q (q)	R (r)	S	T (t)	U

Display				
Alphabet	V (v)	Y	–	「 」 **(Brackets)**

Revision history				
Revision	Issued on	Revision details	CPU version	ROM version
A	July 2007		9457.0	9458.4
B	Aug. 2007		9457.0	9458.4

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