**AC SPEED CONTROL EQUIPMENT**

# VAT20

1ph 200V-240V System, 0.2-0.75kW

# INSTRUCTION MANUAL

-------------------------------- **NOTICE** ----------------------------------------

1.   Read this manual thoroughly before using the VAT20, and store
     in a safe place for reference.

3.   When using this inverter in the EU, compliance with the EMC Directive (89/336/EEC) is
     required. Check carefully Chapter 2 -Wiring section in this manual.

4.   The contents of this manual can be changed without notice

# Table of Contents

# 1. Foreword

To fully employ all functions of the inverter, and to ensure the safety of users, please read through this operating manual in detail. Should you have any further query, please feel free to contact your local distributor or sales person of GE Power Controls. Our professional staves will be glad to serve whatever your need. Please continue your generous support and keep adapting products from GE Power Controls.

## Precaution

Inverter is a power electronic device, for safety reason, please take special care for paragraphs with "WARNING" or "CAUTION" symbol. They are important safety precautions to be aware of while transporting, installation, operating or examining the inverter. Please following these precaution to ensure your safety.

| ⚠ WARNING | Personnel injury may be resulted by improper operation. |

| ⚠ CAUTION | The inverter or mechanical system may be damaged by improper operation. |

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### ⚠ WARNING

- Do not touch the PCB or components on the PCB right after turning off the power before the charging indicator went off.
- Do not attempt to wire circuitry while power is on. Do not attempt to examine the components and signals on the PCB while the inverter operating.
- Do not attempt to disassemble or modify internal circuitry, wiring, or components of the inverter.
- The grounding terminal of the inverter must be grounded properly with 200V class type III standard.

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### ⚠ CAUTION

- Do not attempt to proceed dielectric strength test to internal components of the inverter. There are sensitive semiconductor-devices vulnerable to high voltage in the inverter.
- Do not connect the output terminals: T1(U), T2(V), and T3(W) to AC power outlet.
- The CMOS IC on the primary PCB of the inverter is vulnerable to static electrical charges. Do not contact the primary PCB of the inverter.

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# 2. Examination before installation

Every GE Power Controls inverter has been fully tested and examined before shipment. Please carry out following examination procedures after unpacking your inverter.

- Check to see the model number of the inverter. It should be the one that you ordered.
- Check to see if there is any damage during the transportation. Do not connect the inverter to the power supply if there is any sign of damage.

Report to regional sale representative if you find any abnormal condition as mentioned above.

# Chapter 1. Safety Precaution

## 1. Precautions of operation

### Before turning ON power

| ⚠ CAUTION |
|---|
| Choose appropriate power source with correct voltage setting as the input voltage specification of the inverter. |

| ⚠ WARNING |
|---|
| Special care must be taken while wiring the primary circuitry panel. The L1 and L2 terminal must be connected to input power source and must not be mistakenly connected to T1, T2 or T3 terminal. This may damage the inverter when the power is turned on. |

| ⚠ CAUTION |
|---|
| ● Do not attempt to transport the inverter by the front cover. Securely hold the inverter by the heat-sink mounting chassis to prevent the inverter from falling that may cause personnel injury or damage the inverter. |
| ● Install the inverter onto firm metal base or other inflammable material. Do not install the inverter onto or nearby any flammable material to avoid fire. |
| ● Additional cooling fan should be installed if several inverter are installed into one control panel to lower the temperature inside below 40 • to avoid overheating or fire alarm. |
| ● Turn off power supply before proceeding removal or installation of operating panel. Carry out installation procedure according to instructions given to avoid poor-contact situation resulting operating panel malfunction or no displaying information. |
| ● Suitable for use on a circuit capable of delivering not more than 5000RMS symmetrical amperes.240V maximum |
| ● Not proved with over speed Protection or equivalent |
| ● Only intended for use in a pollution degree 2 macro environment or equivalent |

### When power turned ON

| ⚠ WARNING |
|---|
| Do not attempt to install or remove connector of inverter when the power supply is turned on. Otherwise, the inverter may be damaged due to the surge peak caused by the insertion or removal. |

## Under Operation

| ⚠ WARNING |
| --- |
| Do not switch ON or OFF motor at the middle of operation. Otherwise, the inverter over-current break-down may be resulted. |

| ⚠ WARNING |
| --- |
| ● Do not remove the front cover of the inverter when the power is ON to avoid personnel injury caused by electrical shock.<br><br>● When the automatic restart function is enabled, the motor machinery will be restarted automatically after fully stop from operation. Do not get close to the machinery to avoid personnel injury. |

| ⚠ CAUTION |
| --- |
| ● Do not touch the heat-sink base.<br>● The inverter can be easily operated from low-speed to high-speed range. Please reconfirm the operating range of motor and machinery.<br>● Do not examining the signals on the PCB of the inverter when it is under operation.<br>● All inverter had been properly adjusted before delivery. Do not attempt to adjust it. |

| ⚠ CAUTION |
| --- |
| Do not proceed with disassemble or examination procedure before ensuring that the power is off and the Power LED extinguished. |

## When examination and maintenance

| ⚠ CAUTION |
| --- |
| Inverter environment should be within temp: $-10\,^{\circ}C \sim +40\,^{\circ}C$, humidity under 95% RH without condensing. |

| ⚠ CAUTION |
| --- |
| After the removal of shield sticker, the environment temperature should be within $-10\,^{\circ}C \sim +50\,^{\circ}C$ and humidity under 95% RH without condensing. Besides, the inverter should be free from water dripping or metal dust. |

## 2. Precautions of operation environment
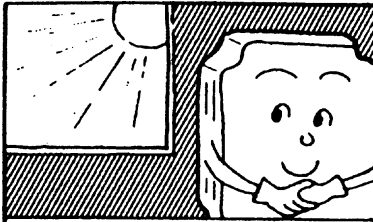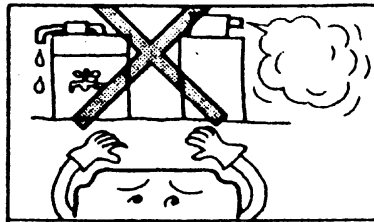
| | | |
|---|---|---|
| Avoid direct sunlight | Away from corrosive gas or liquid | Away from oil grease and gas |
| Away from salty environment | Avoid where rain or dripping water may get into the inverter | Avoid metal dust and dusty environment |
| Avoid massive vibration | Avoid heat | Avoid where environment temperature is too high |
| Away from high electrical-magnetic wave or ultra-high wave. (such as electro-soldering machine or other similar machinery.) | Away from radio-active matter | Away from flammable material |
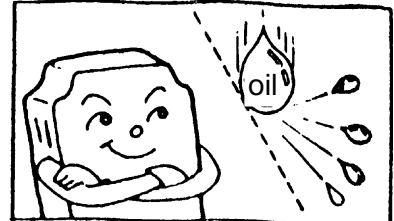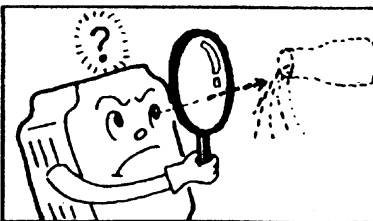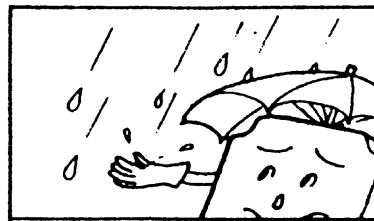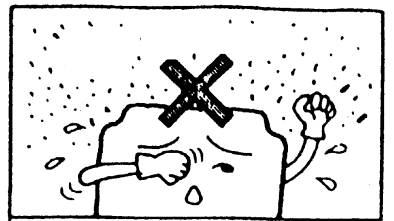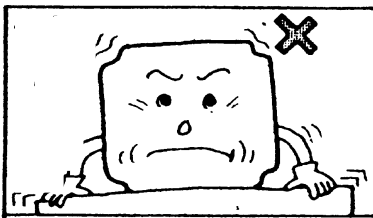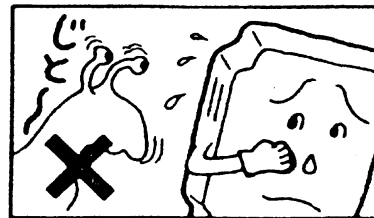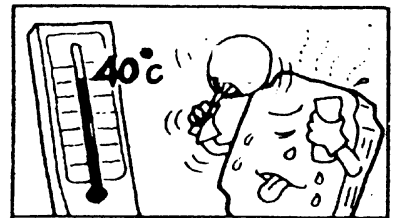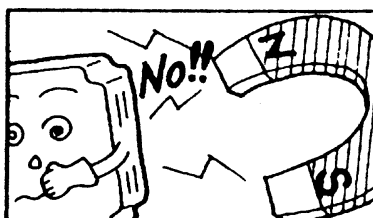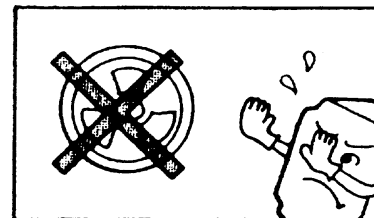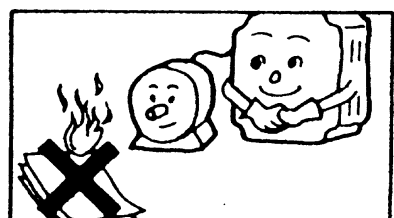
# Chapter 2. Hardware Instruction and Installation

## 1. Operation Environment

The installation site of the inverter pose direct impact to the fully functionality and the life-span of your inverter. Please carefully choose the installation site to meet following requirements:

- Mount the unit vertically
- Environment temperature: -10$^O$C ~ +40$^O$C
  without shield sticker : -10$^O$C ~ +50$^O$C
- Avoid placing close to any heating equipment
- Avoid water dripping or humid environment
- Avoid direct sunlight
- Avoid oil or salty corrosive gas
- Avoid contacting corrosive liquid or gas
- Prevent foreign dusts, flocks, or metal scraps from entering interior
- Away from radioactive matter or flammable material
- Avoid electric-magnetic interference (soldering or power machinery)
- Avoid vibration, if vibration can not be avoided, anti-rattler should be installed to reduce it.
- If inverter is installed in control panel, please tear off shield sticker of VAT20.Additional cooling fan should be installed to lower the environment below 50$^O$C
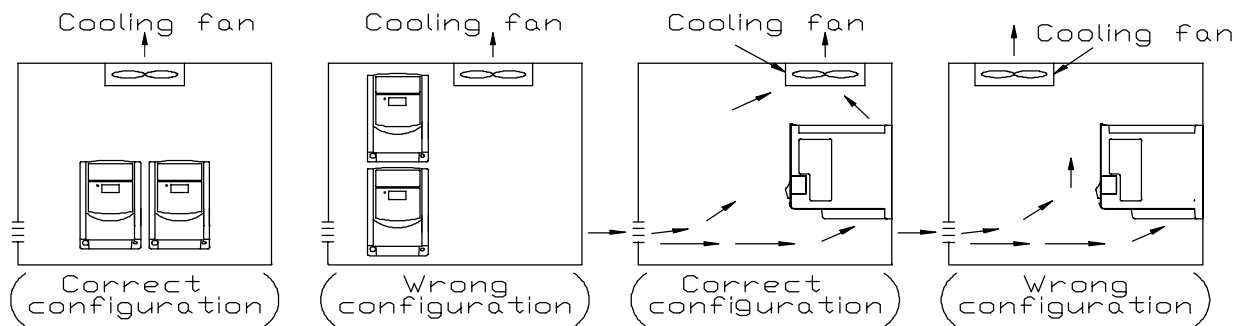


- Installation of the inverter must place the front side of inverter facing front and the top of inverter towards up direction for better heat dissipation.
- Installation rooming must be compliant to following requirement.
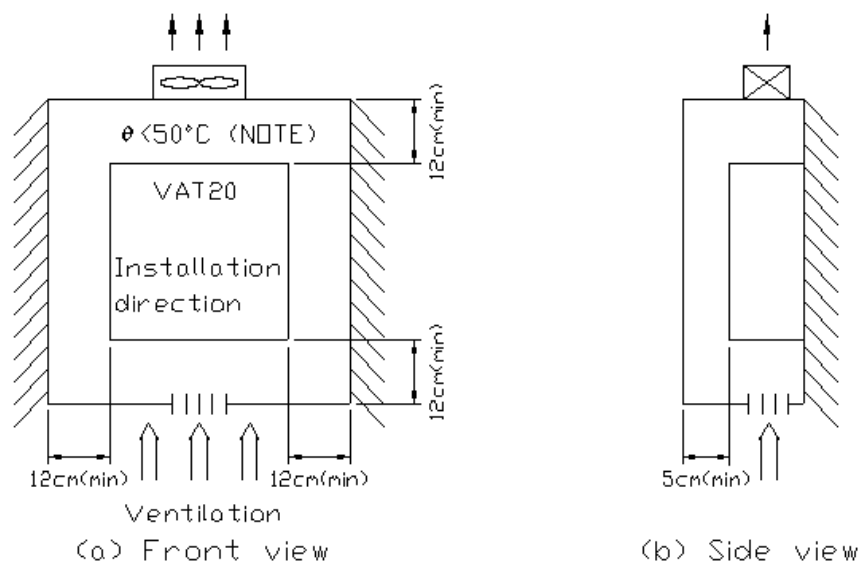


NOTE:    Please tear off shield sticker of VAT20 for max temperature iside the enclosure of 50ºC

# 2. Model No. Instructions

Inverter Model   ➡   MODEL: U20N0K7S (for example)

Input Power Rating ➡ I/P: AC 1PH 200 ~ 240V 50/60 Hz

Output Rating   ➡   O/P: AC 3PH 0 ~ 240V 1.6KVA 4.2A

| U20 | - | N | 0K7 | - | S |
|-----|---|---|-----|---|---|
| Series | | Power Voltage | KW Power Rated | | Option |

N:200V
Single
Phase

0K2: 0.2kW
0K4: 0.4kW
0K7: 0.7kW
I K5: 1.5kW
2K2: 2.2kW

S: Standard
   model

# 3. Specifications
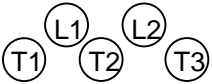
| Model No: VAT20- | | U20N0K2S | U20N0K4S | U20N0K7S | U20N1K5S | U20N2K2S |
|---|---|---|---|---|---|---|
| Suitable Motor Power Rating (KW) | | 0.2 | 0.4 | 0.75 | 1.5 | 2.2 |
| **Rated** | Motor HP | 1/4 | 1/2 | 1 | 2 | 3 |
| | Current A | 1.4 | 2.3 | 4.2 | 7.5 | 10.5 |
| | Capacity KVA | 0.53 | 0.88 | 1.6 | 2.9 | 4.0 |
| | Weight (Kg ) | 0.76 | 0.77 | 0.8 | 1.5 | 1.6 |
| Input Voltage Max. | | Single phase 200-240V (+10%-15%) , 50/60Hz (+/-5%) | | | | |
| Output Voltage Max. | | Three phase 200-240V +10%-15% (Input Voltage Max) | | | | |
| Input Signal Type | | PNP type (SOURCE) input | | | | |
| Control Method | | Sinusoidal wave PWM control | | | | |
| **Freq. Control** | Freq. Range | 0~120 Hz | | | | |
| | Resolution Setting | Digital : 0.1 Hz(0~99.9Hz); 1Hz(100~120Hz) Analog:0.06Hz/60Hz | | | | |
| | Keyboard Setting | Directly setup by ▼ ▲ buttons. | | | | |
| | External Signal Setting | 0~10V, 4~20mA , 0~20mA | | | | |
| | Other function | Frequency upper and lower limit | | | | |
| **General Control** | Accelerate/Decelerate time | 0.1~ 999 Sec | | | | |
| | V/F Pattern | 6 Patterns | | | | |
| | Torque control | Torque boost level adjustable (manual torque boost) | | | | |
| | Multi-Function input | 2 point, to be used as multi-speed 1(Sp1) / Jog / External emergency stop / External bb / Reset | | | | |
| | Multi-Function output | 1a Relay terminal, to be setup as Fault / Running / Frequency. | | | | |
| | Braking Torque | About 20%, additional breaking resistance not allowed | | | | |
| | Other function | Decelerate or free run stop, Auto reset, DC braking frequency / Voltage / Time can be setup by constants. | | | | |
| Indication function | | 7 segments*3 indicate frequency / inverter parameter / fault record / program version. | | | | |
| Operating temperature | | -10 ~ 40$^O$C | | | | |
| Humidity | | 0~95% RH non-condensing. | | | | |
| Vibration | | Under 1 G  ( 9.8 m/s$^2$ ) | | | | |
| EMC specification | | Class A ( Filter build in ) | | | | |
| Protection level | | IP20 | | | | |
| UL | | UL508C | | | | |
| **Protection function** | Overload protection | 150% for 1min. | | | | |
| | Over-voltage | DC voltage > 410V | | | | |
| | Under voltage | DC voltage < 200V | | | | |
| | Momentary power-loss | 0 ~ 2 sec : VAT20 can be restart by speed search | | | | |
| | Stall Prevention | Accelerate / Decelerate / Constant speed | | | | |
| **Protection function** | Output terminal short-circuit | Electronic circuitry protection | | | | |
| | Grounding fault | Electronic Circuitry protection | | | | |
| | Other function | Heat sink protection , Current limit | | | | |
| Dimension(W*H*D) mm | | 72*132*118 | | | 115*140*145 | |
| Installation | | Install by mounting screw or DIN rail (Option). | | | | |

# 3. Wiring

## Molded-Case Circuit Breaker / Magnetic Contact

● **GE Power Controls maintenance and service do not apply to damage caused by following situation:**

    (1) Damage to the inverter caused by the lack of appropriate molded-case circuit breaker or a circuit breaker with too-large capacity is installed in between the power supply and the inverter.

    (2) Damage to the inverter caused by the serial magnetic contactor, phase advancing capacitor, or surge-protector in between the inverter and the motor.

| Model No: U20N | 0K2S 0K4S 0K7S | 1K5S | 2K2S |
|---|---|---|---|
| Molded-case circuit breaker line Made by GE | 20A | 30A | 30A |
| Magnetic Contact (MC) | Made by GE CL00 | Made by GE CL00 | Made by GE CL00 |
| Primary Circuit Terminal (TM1) (T1) (L1) (T2) (L2) (T3) | Wire dimension 2.5mm$^2$ Terminal screw M3 | Wire dimension 2.5mm$^2$ Terminal screw M3 | Wire dimension 2.5mm$^2$ Terminal screw M3 |
| Signal Terminal (TM2) 1~11 | Wire dimension 0.75mm$^2$(#18 AWG), Terminal screw M3 | | |

● **Please utilize three-phase squirrel-cage induction motor with appropriate capacity.**

● **If a inverter is used to drive more than one motor, the total capacity must be smaller than the capacity of the inverter. Additional thermal relay must be installed in front of every motor. Use the Fn_18 at 1.0 times of the rated value specified on the motor nameplate at 50Hz, 1.1 times of the rated value specified on the motor nameplate at 60Hz.**

● **Do not install phase advancing capacitor, LC, or RC component between the inverter and the motor.**

# Application and precautions of Peripherals

Power supply

Molded-case
circuit breaker
or ground fault
interrupter

Electrical-
Mangnetic
contactor

AC reactor
for power
factor improve-
ment

VAT20
Inverter

Grounding

Motor

Grounding
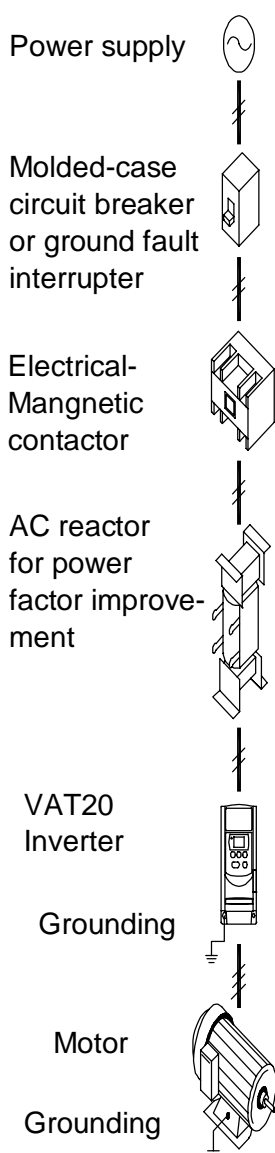
## Power Source
- Ensure to apply power source at correct rated voltage to prevent form damaging the inverter.
- Circuit breaker must be installed in between the AC power supply and the inverter.

## Molded-case circuit breaker:
- Utilize appropriate circuit breaker suitable for the rated voltage and current ratings of the inverter to switch ON/OFF the power supply to the inverter and as a protection for the inverter.
- Do not operate the circuit breaker to switch ON or OFF the inverter.

## Leakage circuit breaker:
- Leakage circuit breaker should be added to prevent false operation cause by leakage current and to ensure personnel safety.

## Magnetic Contact:
- The Magnetic Contact can be omitted at ordinary operation. To utilize external control, automatic restart, or breaking controller the magnetic contact must be added at the primary side.
- Do not operate the magnetic contact to switch ON or OFF the inverter.

## Power improvement AC Reactor:
- If large capacity power source is applied (over 600KVA), additional AC reactor may be added to improve power factor.

## Inverter:
- Power supply input terminals L1 and L2 is not differentiated on phase sequence, they can be arbitrarily connected. Their connection may be exchanged.
- Output terminal T1, T2, and T3 should be connected to the U, V, and W terminals of the motor respectively. If motor turns in opposite direction of the inverter, simply exchanging two of three wire connection may correct this problem.
- Output terminal T1, T2, and T3 must not be connected to power source to prevent from damaging inverter.
- Grounding terminal   Properly ground the grounding terminal in compliance to 200V class type three grounding

External wiring should be carried out in accordance with following requirement. Check and reassure the wiring is correct after the wiring is complete. (Do not utilize the control circuitry buzzer to check the wiring.)

**EMI** connecting:

It is very important that the connections between the frequency inverter with the screened motor cable and the EMI filter during the EMI tests are as following.

- Use a metal grounding plate and place the frequency inverter and the EMI filter on the plate.
- Use a screened motor cable with 4 connectors ( U,V,W,& Earth ), don't use the shielding as safety earth ( shield is high frequency earth )
- Remove painting around the two metal coupling nut holes. So that the metal coupling nuts ( and the shielding ) make contact with the frequency inverter and the motor.
- Don't solder a conductor to the shielding ( pig tail )
- Use a metal clamp to connect the shielding from the motor cable with the metal grounding plate. Now there is a perfect high frequency earth connection between frequency inverter . grounding plate and EMI filter.
- Keep the distance between frequency inverter and EMI filter as short as possible ( < 30cm ) otherwise  use screened cable with a metal coupling nut and a metal clamp addle to connect the shielded cable to the frequency inverter and metal grounding plate.
- The only earth connection between the LISN and the test plate should be via the EMI filter.
- Use a motor which belongs to the power rate of the frequency inverter . otherwise use a motor of less power.
- Install a noise filter for inverter onto the output side of the primary circuitry can suppress conducting noise. To reduce radio active noise, a metal pipe should be apply for wiring, and the wiring should be away from other controlling machine for more than 30 cm.

Class B (Residential Environment)
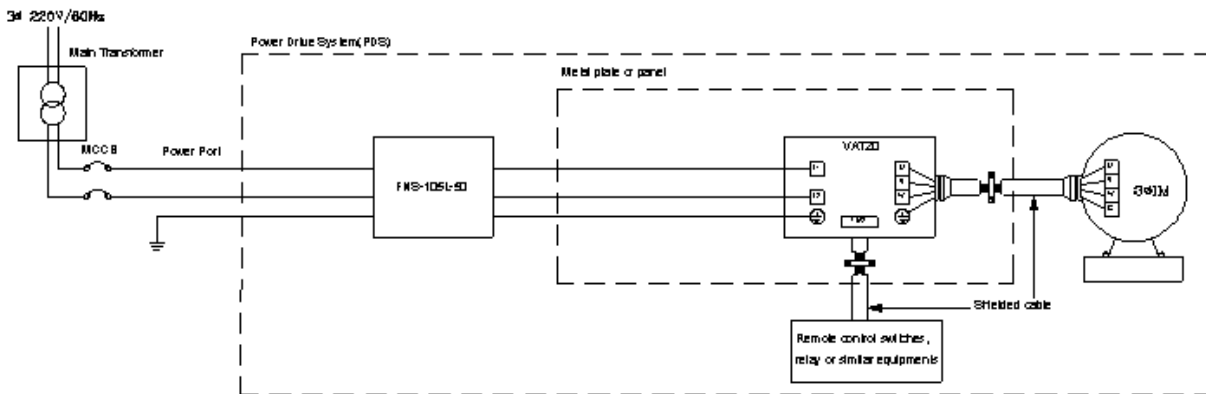
<u>Class A, Industrial Environment</u>
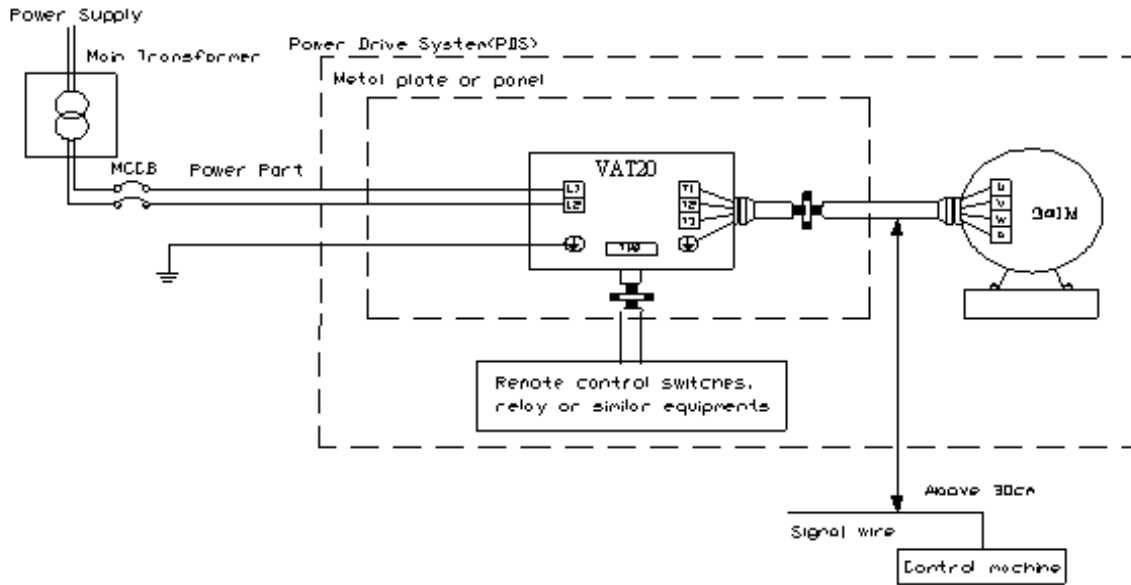


- When the distance between the inverter and motor is longer than 100m, connection wire should be carefully chosen to reduce the wiring resistance below 3% and the voltage drop (V) = $\sqrt{3}$ x Wire resistance ($\Omega$/km) x wire length (m) x current x $10^{-3}$

(B) Control circuitry wiring must be separated and away from the primary circuitry control line and other high-voltage or large-current power lines to avoid noise interference.

- To reduce the noise interference and avoid mistake operation, shielded twisted pair cable must be used to wire the control circuitry. Please refer to following diagram. Connect the shielding wire onto the grounding terminal.

**Wiring distance must be under 50m.**
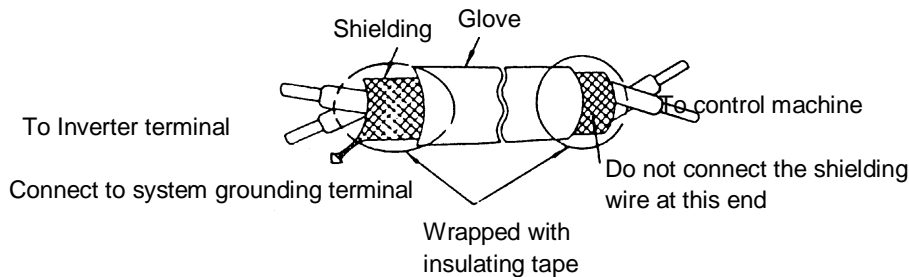


(C) The grounding terminal of the inverter must be correctly grounded in compliance with 200V class type three grounding.

- Grounding wire should be wired in accordance to electrical equipment (AWG) with the length of the grounding wire as short as possible.

- The grounding wire of the inverter must not be grounded together with other large current loading (such as soldering machine or large power motor). They should be grounded separately.

- Grounding circuitry must not be formed when grounding several inverters together.

11

(a)good     (b) good     (c) not good
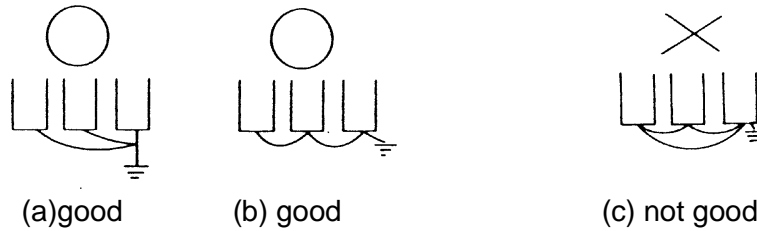
(D) Wire specification Choose appropriate wire with correct diameter for primary power circuitry and control circuitry in accordance with electricity regulations.

(E) Upon completion, check out to reassure the wiring correctness, broken wires, and secure terminal screws.

# VAT20 Wiring Diagram
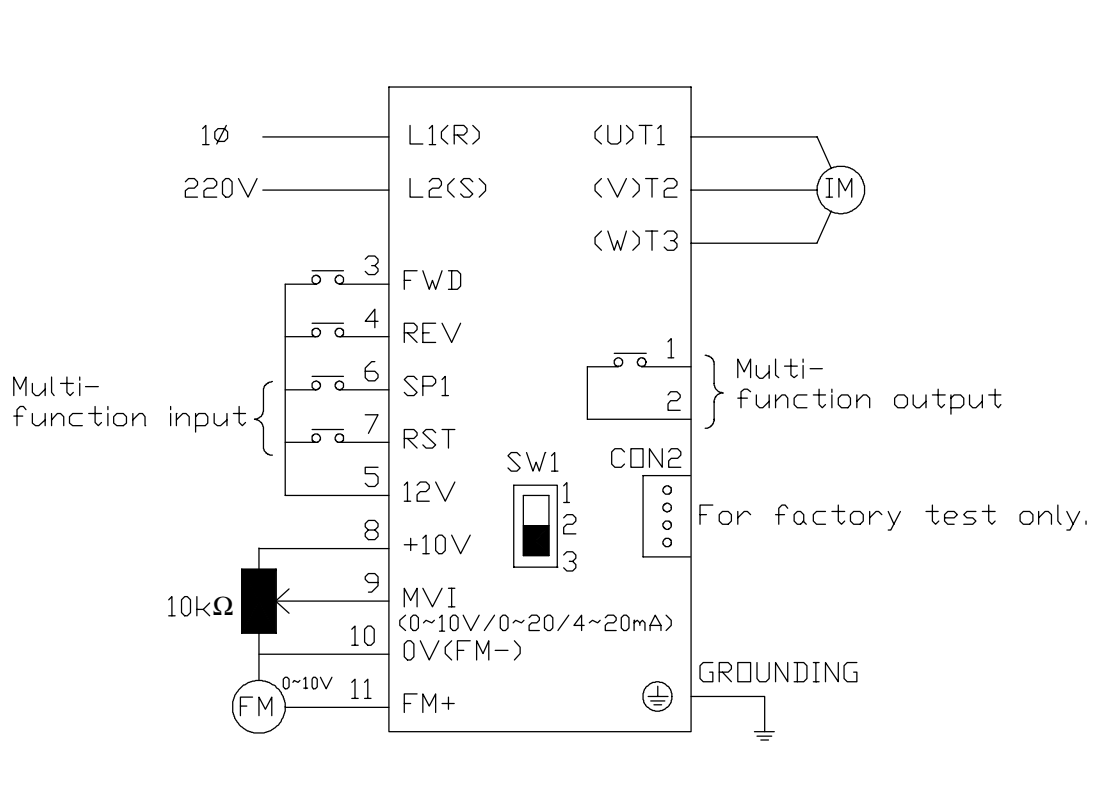


Terminations to Inverter must be made with either listed field wiring lug kits or listed crimp type ring terminals

## ● Other connections(external 24V supply)
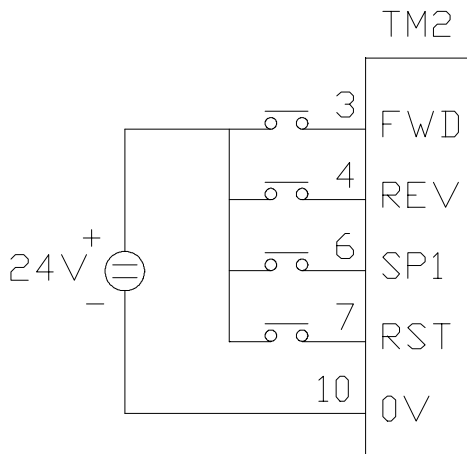
# VAT20 series inverter terminal descriptions

## Primary circuitry terminal black ( TM1 ) descriptions

| Terminal symbol | Function description |
|---|---|
| L1 (R) | Primary power source input |
| L2 (S) | |
| T1 (U) | Inverter output |
| T2 (V) | |
| T3 (W) | |
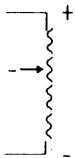
* Tightening torque for TM1 is 0.98 Nm.
* Use copper conductors only size field wiring based on 75 degrees C wire only.
* Wire voltage rating must be a minimum of 300V
* Electric ratings of the termination (TM1) as 300V 15A

## VAT20 control circuitry terminal block ( TM2 ) description

| | Terminal symbol | Terminal function description | |
|---|---|---|---|
| 1 | TRIP | Fault relay output terminal | |
| 2 | RELAY | Connection point rated capacity 250VAC/1A ( 30VDC / 1A ) | |
| 3 | FWD | Operation control terminals (refer to Fn_03) | |
| 4 | REV | | |
| 5 | + 12V | Common point of terminal 3 / 4 / 6 / 7 | |
| 6 | SP1 | Multifunction input terminals (refer to Fn_19) | |
| 7 | RESET | | |
| 8 | +10V | Power terminal of potentiometer ( Pin 3 ) | |
| 9 | Analog input point | Analog frequency signal input terminal ( Pin 2 of potentiometer or positive terminal of 0~10V / 4~20mA / 0~20mA) | |
| 10 | 0V (FM -) | Analog common point | Analog signal common point ( Pin 1 of potentiometer or negative terminal of 0~10V / 4~20mA / 0~20mA ) |
| 11 | FM+ | Analog output positive connection point | Analog frequency signal output terminal  Output terminal signal is 0 ~ 10VDC/Fn6 |

* Tightening torque for TM2 is 0.4 Nm.
* Use copper conductors only size field wiring based on 75 degrees C wire only.
* Wire voltage rating must be a minimum of 300V
* Control wiring should not run in the same conduit or race way with power or motor wiring
* Single Input and Output Terminals (TM2) Ratings are ALL Class 2
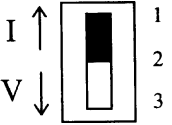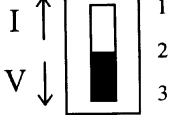
## SW1 function description

| SWITCH 1 | External signal type |
|---|---|
| I ↑ [switch: 1 up, 2 3 down] V ↓  1 2 3 | 0~20mA analog signal ( When Fn11 set to 1 )  4~20mA analog signal ( When Fn11 set to 2 ) |
| I ↑ [switch: 1 2 up, 3 down] V ↓  1 2 3 | 0~10 VDC analog signal ( When Fn11 set to 1 ) |

# 3. Dimensions and terminal block layout



Unit：mm

| LENGTH MODEL | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| OK2S/0K4S/0K7S | 132 | 116 | 130 | 8.2 | 118 | 61 | 72 |
|  |  |  |  |  |  |  |  |
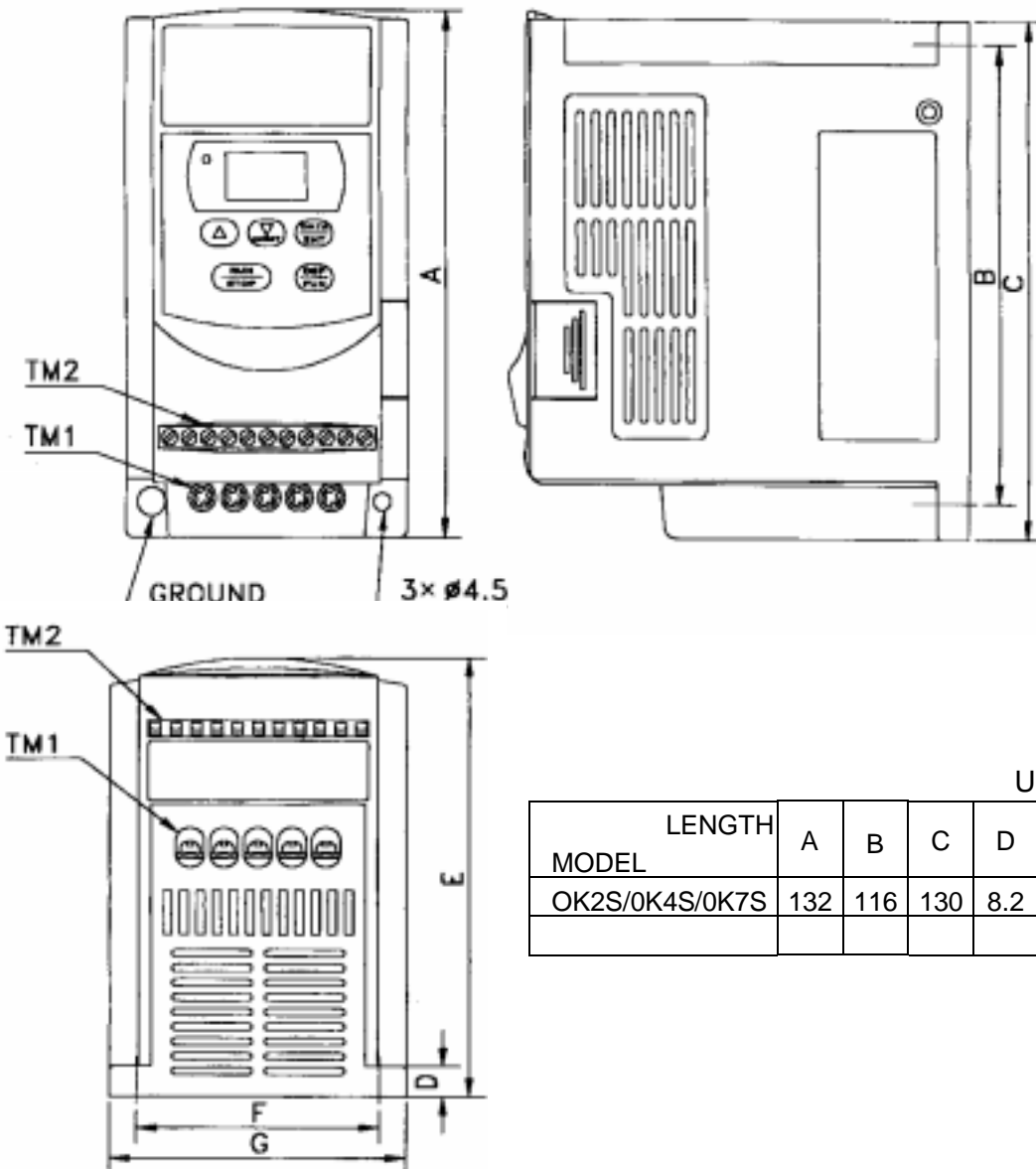
# Dimensions & Installation of class B Filter(U20AF0K7)

156.0
145.0
134.0

M4x14L
Ø4.5 TYP

60.0
76.0

25.0
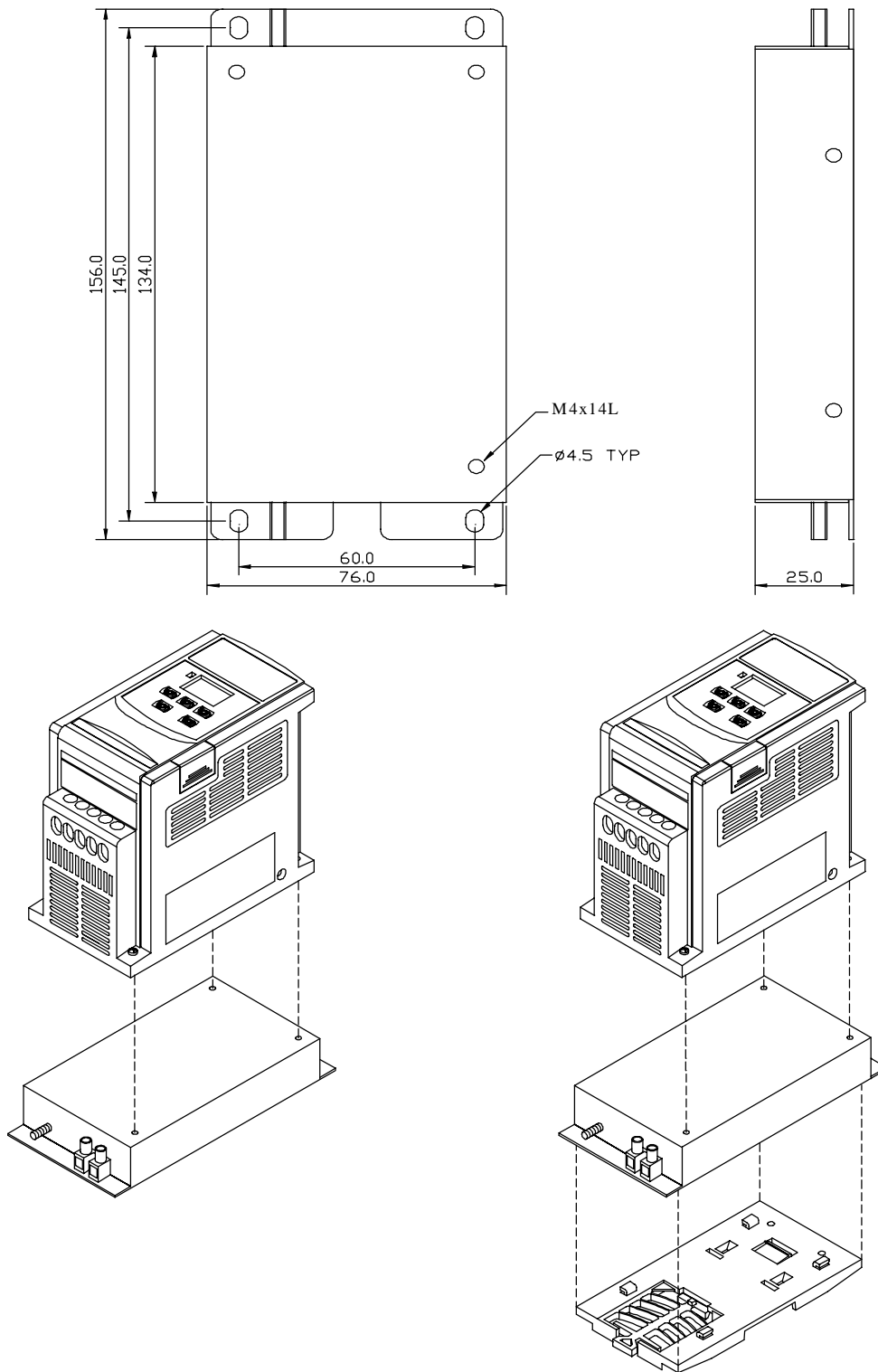
Inverter with class B filter (U20AF0K7) mounted.

Inverter with class B filter (U20AF0K7) & Din rail (U20AR0K7) mounted.

## Mounting screw operation diagram
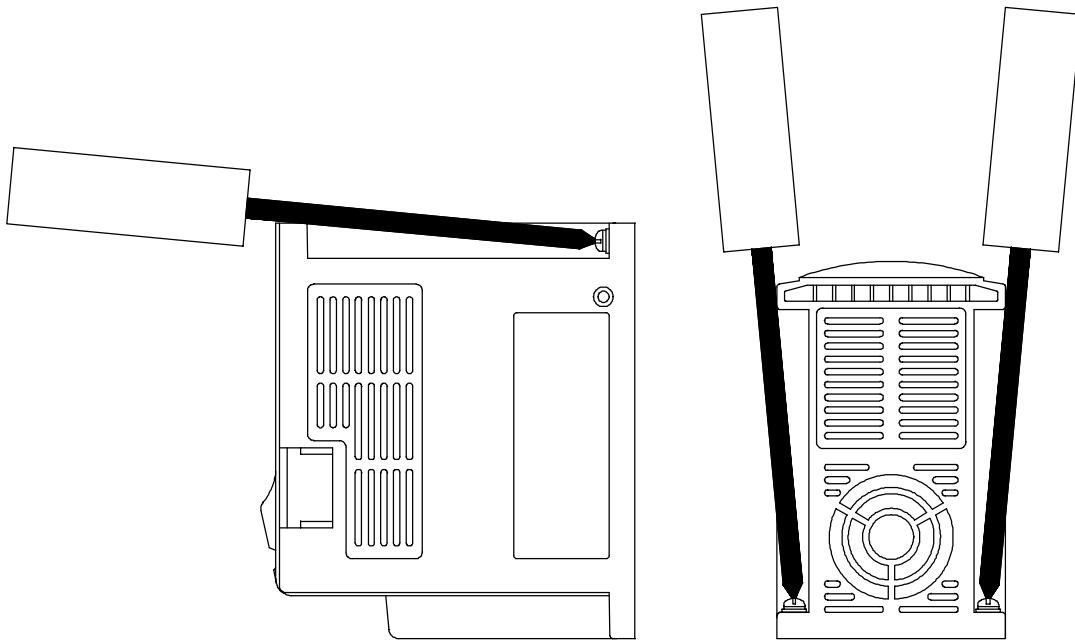


## Din rail (U20AR0K7) operation diagram

Step1-
Aim and insert the 4 retention ribs of U20AR0K7 at the 4 holes in rear panel of VAT20 .

Step2-
Push the U20AR0K7 forward until the middle rib grips firmly with real panel



Inserting hole

STEP 2

STEP 1

Retention rib

STEP 1

middle rib

STEP 2
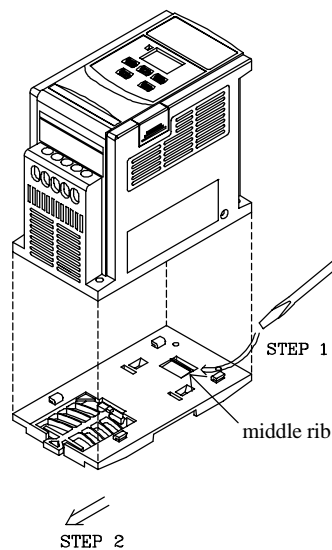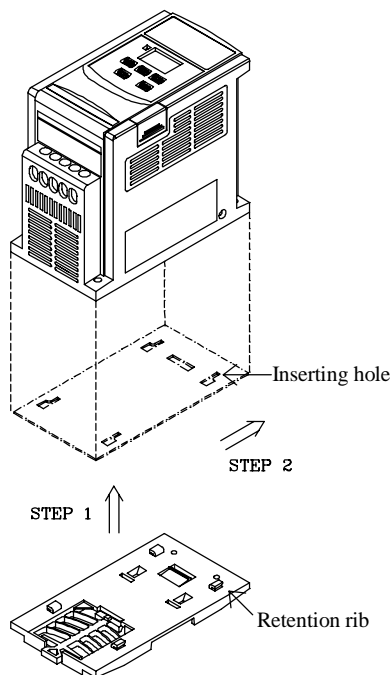
Step1-
Use small screw driver inserting the middle rib of U20AR0K7 and press the screw driver in order to strip U20AR0K7 from VAT20.

# DIN Rail Installation(rail)

Mounting clamp and 35mm width rail must be used to install VAT20 on the rail.

Install VAT20

Dismounting VAT20

Mounting plate

Pull mounting plate
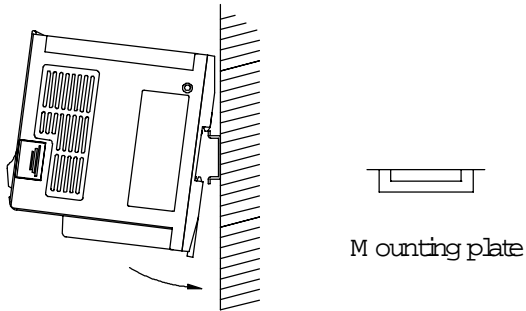
First place the groove on the back of module on the upper edge of din rail , and then push the module down to lock up position. Finally press the mounting plate upward into module.

Screw driver

① Pull the mounting plate downward.
② Rotate the T-verter module to dismount it.

Mount

DIN Rail
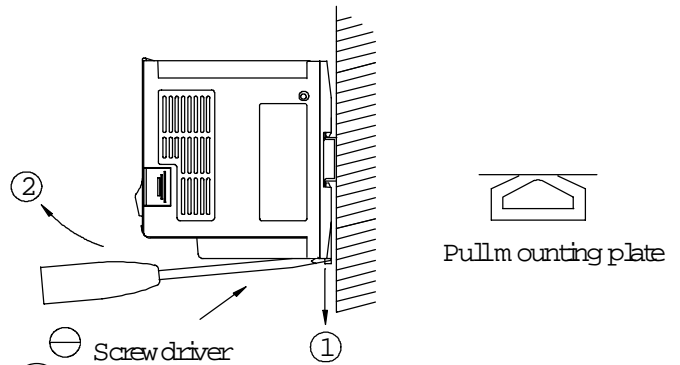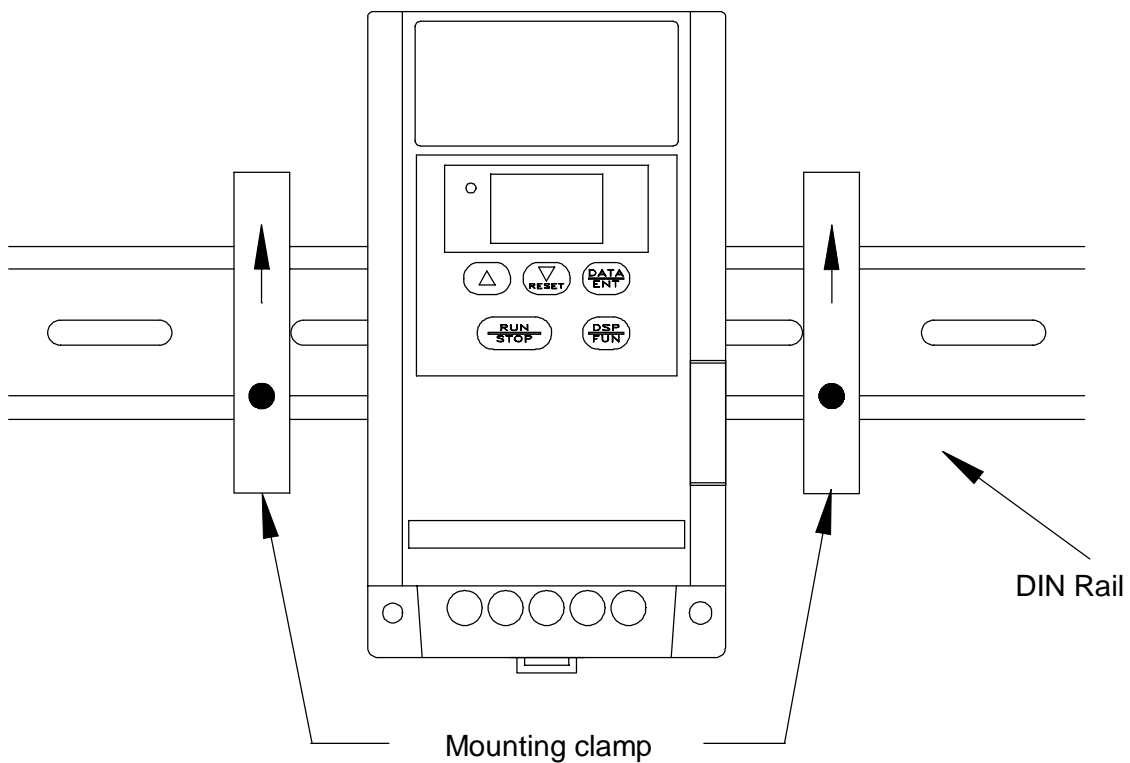
Mounting clamp

Mounting clamp must be used to fasten VAT20

# Chapter 3. Software Index

## 1.  Control Panel Instructions

POWER LED
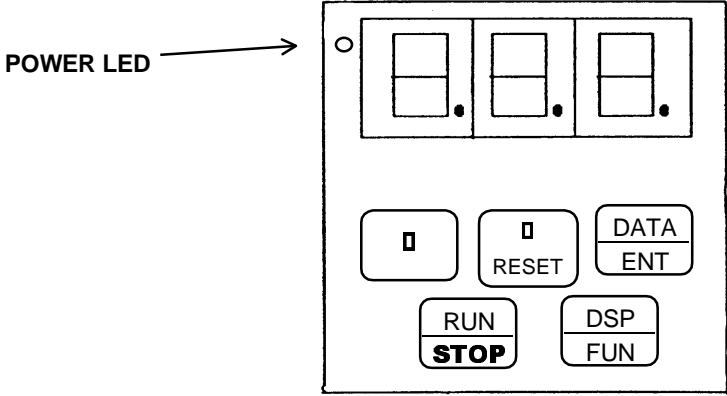


| ⚠ **CAUTION** |
|---|
| Do not operate keypad by screwdriver or other sharp-ended tool to avoid damaging keypad. |

**Brief keypad operation flowchart**
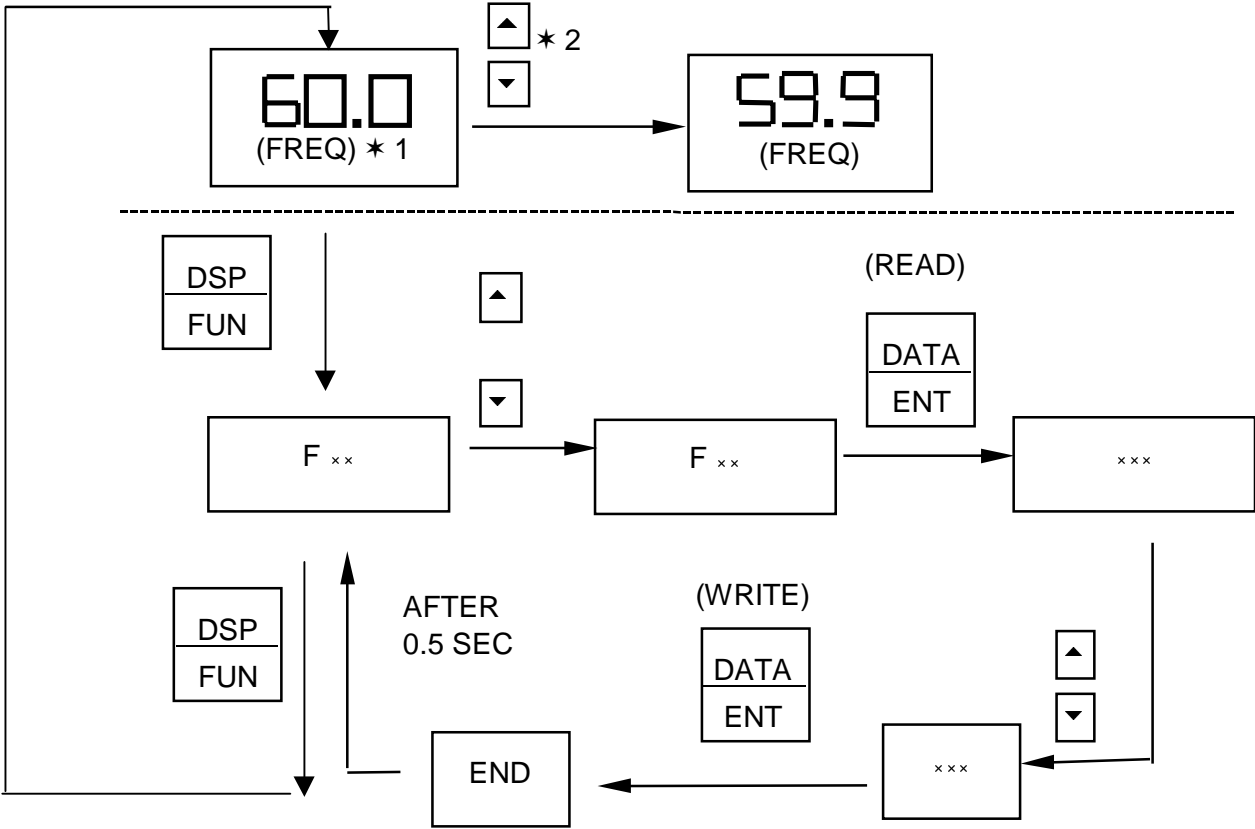


*1  Displayed setting frequency when stopped. Display output frequency when running.

*2  The setting frequency can be modified either when stopped or when running.

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# 2. List of Parameters

| Function | FN_ | Function Description | Unit | Range | Factory setting | Note |
|---|---|---|---|---|---|---|
| | 0 | Factory Adjustment | | | 0 | |
| Accelerate / Decelerate Time | 1 | Accelerate time | 0.1SEC | 0.1 ~ 999 S | 5.0 | *1*3 |
| | 2 | Decelerate time | 0.1SEC | 0.1 ~ 999 S | 5.0 | *1*3 |
| Operation mode | 3 | 0: Forward / Stop, Reverse / Stop 1:Run/Stop, Forward / Reverse | 1 | 0 ~ 1 | 0 | |
| Motor direction | 4 | 0: Forward    1: Reverse | 1 | 0 ~ 1 | 0 | *1 |
| V/F Pattern | 5 | V/F pattern setting | 1 | 1 ~ 6 | 1/4 | *2 |
| Frequency upper/lower limit | 6 | Frequency upper limit | 0.1Hz | 1.0 ~ 120Hz | 50/60Hz | *2*3 |
| | 7 | Frequency lower limit | 0.1Hz | 0.0 ~ 120Hz | 0.0Hz | *3 |
| SPI frequency | 8 | SP1 frequency | 0.1Hz | 1.0 ~ 120Hz | 10Hz | *3 |
| JOG frequency | 9 | JOG frequency | 0.1Hz | 1.0~ 10.0Hz | 6Hz | |
| Operation control | 10 | 0:keypad 1: external terminal | 1 | 0 ~ 1 | 0 | |
| Frequency Control | 11 | 0:keypad 1:external terminal(0~10v/0~20mA ) 2: external terminal ( 4~20mA ) | 1 | 0 ~ 2 | 0 | |
| Carrier frequency | 12 | Carrier Frequency setting | 1 | 1 ~ 5 | 5 | |
| Torque compensation | 13 | Torque compensation gain | 0.1% | 0.0 ~ 10.0% | 0.0% | *1 |
| Stop method | 14 | 0:decelerate stop,   1:free run stop | 1 | 0 ~ 1 | 0 | |
| DC braking setting | 15 | DC braking time | 0.1S | 0.0 ~ 25.5S | 0.5S | |
| | 16 | DC braking injection frequency | 0.1Hz | 1 ~ 10Hz | 1.5Hz | |
| | 17 | DC braking level | 0.1% | 0.0 ~ 20.0% | 8.0% | |
| Electronic thermal | 18 | Protection on motor rated current | 1% | 50 ~ 100% | 100% | |
| Multifunction input connection point | 19 | Multifunction input terminal 1 function | 1: Jog    2: Sp1 3: Emergency stop 4: External Base Block 5. Reset | | 2 | |
| | 20 | Multifunction input terminal 2 function | | | 5 | |
| Multi-function output | 21 | Multifunction output terminal | 1: Operating 2: Frequency reached 3: Fault | | 3 | |
| Reverse instruction | 22 | 0: REV run enabled 1: REV run disabled | 1 | 0 ~ 1 | 0 | |
| Momentary power loss | 23 | 0: enabled 1: disabled | 1 | 0 ~ 1 | 0 | |
| Auto restart | 24 | Number of Auto-restart times | 1 | 0 ~ 5 | 0 | |
| Factory setting | 25 | 010: Constants initialization to 50Hz system 020: Constants initialization to 60Hz system | | | | *2 |
| | 26 | Reserve | | | | |
| | 27 | Reserve | | | | |
| | 28 | Reserve | | | | |
| Software version | 29 | CPU program version | | | | |
| Fault  trace | 30 | Last 3 malfunction memory | | | | |

**NOTE:**

**\*1: Indicate this parameter can be adjusted during running mode**

**\*2: Please refer to Fn_25**

**\*3: If the setting range is above 100 , the setting unit becomes 1.**

# 3. Parameter function description

**Fn_00 Factory adjustment parameter. Do not change.**

---

**Fn_01 : Accelerate time = 0.1 ~ 999 sec**

**Fn_02 : Decelerate time = 0.1 ~ 999 sec**

---

1. **Accelerate/decelerate time calculation formula:**

$$\text{Accelerate time} = Fn\_01 \times \frac{\text{Setting Frequency}}{60 \text{ Hz}}$$

$$\text{Decelerate time} = Fn\_02 \times \frac{\text{Setting Frequency}}{60 \text{Hz}}$$

---

**Fn_03 : Operation mode selection =**

   **0 : Forward / Stop , Reverse / Stop**

   **1 : Run / Stop , Forward / Reverse**

---

*NOTE 1: Fn_03 take effect only when Fn_10 = 1 (external operation control)*

Fn_03 = 0
control method

Fn_03 = 1
control method

| 3 FWD /Stop | 3 Run / |
| 4 REV /Stop | 4 FWD/ REV |
| 5 | 5 COM |

TM2 PIN3

TM2 PIN4

Fn_03=0
Output

Forward

Reverse

(note)

Fn_03=1
Output

Forward
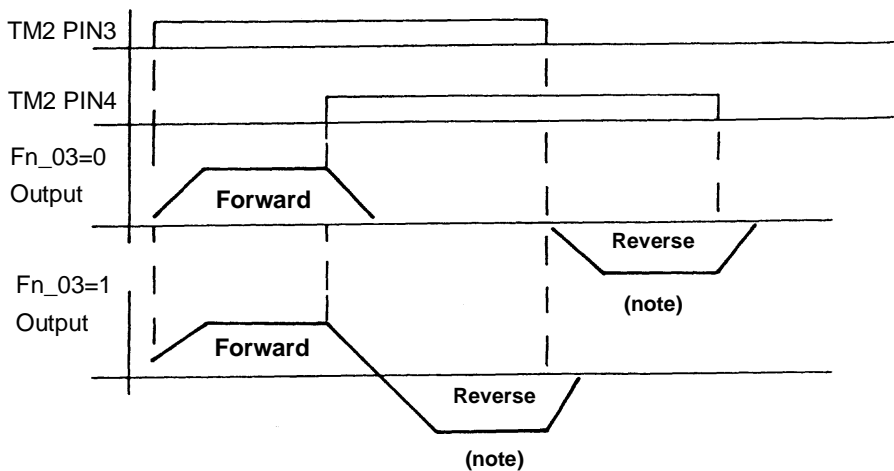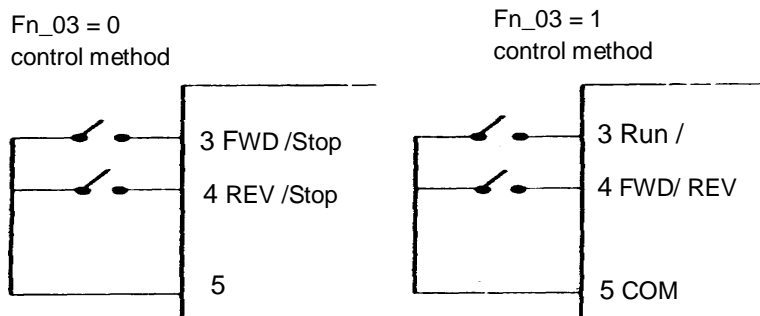
Reverse

(note)

*Note Reverse command is ignored when Fn_22 = 1*

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## Fn_04 : Motor rotation direction setting = 0 : forward
## 1 : reverse

Although there is no Forward/Reverse push button on the digital control panel, it is possible to adjust forward/reverse function by changing Fn_04 setting.

*NOTE:*
**When Fn_22 =1: Reverse disabled, the Fn_04 can not be set to 1. Then keypad indication would display "LOC".**

## Fn_05 : V/F pattern setting = 1 ~ 6

Adjust Fn_05 = 1-6 to select one of six fixed V/F pattern. (refer to following tables)

| Specification | 50 Hz System | | |
|---|---|---|---|
| Application | General Application | High starting torque | Decreasing torque |
| Fn_5 | 1 | 2 | 3 |
| V/F pattern |  |  |  |
| Specification | 60Hz System | | |
| Application | General Application | High starting torque | Decreasing torque |
| Fn_5 | 4 | 5 | 6 |
| V/F pattern |  |  |  |

| Fn_5 | B | C |
|---|---|---|
| 1/4 | 10% | 8% |
| 2/5 | 15% | 10.5% |
| 3/6 | 25% | 7.7% |

## Fn_06 : frequency upper limit = 1 ~ 120 Hz
## Fn_07 : frequency lower limit = 0 ~ 120 Hz



**Frequency setting signal**
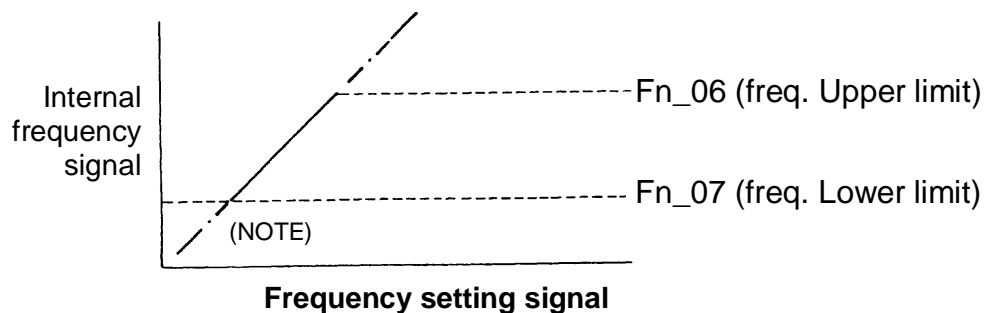
*NOTE:*

*If Fn_07 = 0 Hz,  and the frequency instruction is equal to 0Hz, the inverter will*
   *stop at 0 speed.*

*If Fn_07 > 0 Hz, and the frequency instruction ⧠ Fn_07, the inverter will*
   *output according to Fn_07 setting.*

## Fn_08 : sp1 frequency = 1 ~ 120 Hz
## Fn_09 : jog frequency = 1 ~ 10 Hz

*1.* When Fn_19 or Fn_20 = 2 and multifunction input terminal is ON, the inverter operate at sp1 frequency (Fn_08)

*2.* When Fn_19 or Fn_20 = 1 and multifunction input terminal is ON, the inverter operate at jog frequency (Fn_09)

*3.* The priority of reading frequency setting is Jog > Sp1 > Keypad setting or external frequency signal

## Fn_10 : Operation Control
### = 0 : Operation instruction is setup by Keypad
### = 1 : Operation instruction is setup by external terminal

*NOTE:*

*When Fn_10=1 (external operation control), emergency stop on the*
   *keypad is enabled.*

**Fn_11 : Frequency control**

**= 0 : Frequency instruction is setup by Keypad**

**= 1 : Frequency instruction is setup by VR or analog signal on**

**TM2 ( 0 ~ 10V / 0-20mA )**

**= 2 : Frequency instruction is setup by VR or analog signal on**

**TM2 ( 4-20mA )**

*NOTE 1:*
*When Jog frequency or Sp1 frequency is switched on, the frequency is setup by Sp1 speed, the  buttons on the keypad is disabled. Original setting will be restored after Sp1 connection is OFF.*

*NOTE2 :*
*During the acceleration after operating instruction and the acceleration/deceleration after Sp1 change the buttons on keypad is disabled.*
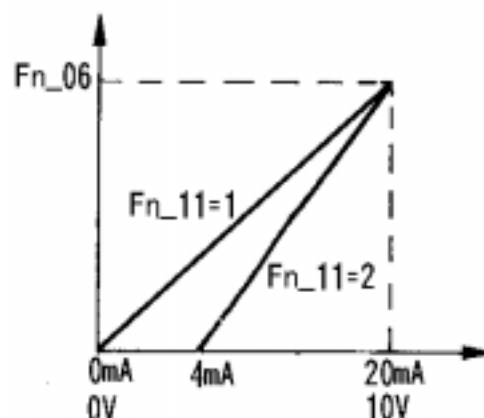


**Fn_12 : carrier frequency = 1 ~ 5**

| Fn_12 | carrier frequency | Fn_12 | carrier frequency |
|-------|-------------------|-------|-------------------|
| 1 | 4 kHz | 4 | 7.2 kHz |
| 2 | 5 kHz | 5 | 8 kHz |
| 3 | 6 kHz | | |

Although IGBT TYPE inverter can provide low noise environment under operation, it is possible that the slicing of high carrier frequency may interfere with external electronic components (or other controller) or even cause vibration driving motor. Adjusting carrier frequency can correct this situation.

**Fn_13: Torque compensation gain = 0 ~ 10 %**

Inverter output according to the B, C point voltage on the V/F pattern (refer to Fn_05 description) plus the Fn_13 settings to enhance the output torque

*NOTE : When Fn_13 = 0, the torque boost function is disabled.*

**Fn_14 Stopping method = 0 : decelerate stop**
**1 : free run stop**

**Fn_15 DC braking time = 0 ~ 25.5 sec**

**Fn_16 DC braking starting frequency = 1 ~ 10 Hz**

**Fn_17 DC braking level = 0 ~ 20 %**

**If Fn_14 = 0**

When the inverter receive the stop instruction, it decelerate to the frequency setup by Fn_16 and then output voltage level setup in the Fn_17; after the time duration setup in Fn_15, the inverter turn into complete stop.

**If Fn_14 = 1**

The inverter stop output immediately after receiving stop instruction. The motor get into free running state to completely stop.

**Fn_18: Motor rated current = 50 ~ 100 %**

1. **Function of the electronic thermal protecting motor is as follow:**

   (1)   Motor rated current = Inverter rated current x Fn_18
         Fn_18 = Motor rated current / inverter rated current

   (2)   When the load is within 100% of the motor rated current, the operation continues. When the load reaches 150% of the motor rated current the operation may continues for only 1 minute. (refer to curve (1) in figures 3)

   (3)   After protecting the electronic thermal activated, the inverter is cut off immediately. The OLI is flashing. To resume operation, push RESET button or activate external reset terminal.

   (4)   When the motor is operating at low speed, the heat dissipation efficiency is lower down. The electronic thermal activation level is reduced also. (change from curve (1) to curve (2) in figure 3). Choose appropriate Fn_05 setting according to applied motor to reach a better protection.

2. **Function of the electronic thermal protecting inverter is as follow:**

   (1)   When the load is within 103% of the inverter rated current, the operation continues. When the load reaches 150% of rated current of the inverter, operation may continues for only 1 minute. (refer to curve (1) of figure 3)

   (2)   After the activation of the electronic thermal protecting inverter, the inverter is cut off immediately. The OL2 is flashing. To resume the operation, push RESET button or activate external reset terminal.

Fn_05 = 1,2,3
50 Hz standard motor

Fn_05 = 4,5,6
60 Hz standard motor

(Figure 1)

(Figure 2)

(Figure 3)
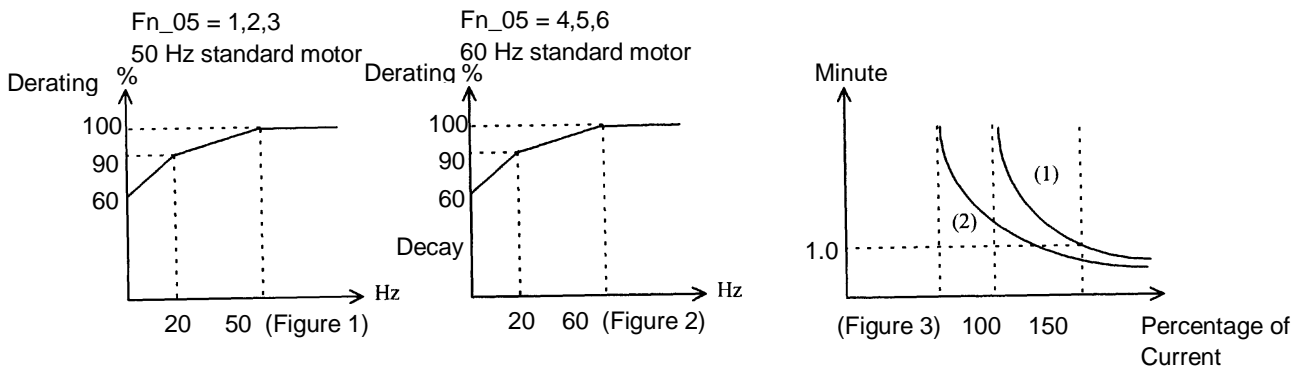
## Fn_19: Multifunction input terminal 1 function = 1~5
## Fn_20: Multifunction input terminal 2 function = 1~5

1. **Fn_19, Fn_20 =1 : JOG**

2. **Fn_19, Fn_20 =2: Sp1 terminal**

3. **Fn_19, Fn_20 =3: External emergency stop signal**

   When the external emergency stop signal is activated, the inverter proceed a decelerate stop (ignoring setting in Fn_14). Flash E.S. after stop. After the emergency stop signal is deactivated, turn the RUN switch OFF and then ON again.(Fn_10 =1) Or, push the RUN key (Fn_10=0). The inverter will then resume operation and restart. If the emergency stop signal is removed  before VAT20 stops, VAT20 will still execute emergency stop.

4. **Fn_19, Fn_20 =4: External Base Block ( immediate shut off )**

   When the external base block signal is activated, the inverter output will be immediately shut off (ignoring setting in Fn_14) and flash b.b. After the base block signal deactivated, turn the RUN switch OFF and then ON again (Fn_10 = 1) or push the RUN key (Fn_10=0), the inverter will restart from the starting frequency.

5. **Fn_19, Fn_20 = 5: Reset when inverter fault.**

## Fn_21: Multi-function output terminal = 1 ~ 3

1. Fn_21 = 1: Run mode signal

2. Fn_22 = 2: Frequency agreed signal

3. Fn_21 = 3: Fault signal

## Fn_22:Reverse instruction = 0 : REV command enabled
## = 1 : REV command disabled

*NOTE:*
*When Fn_04 is set to 1 (reverse), Fn_22 can not be set to 1, indication displays "LOC". Fn_04 must be change to 0 before setting Fn_22 to 1.*

## Fn_23: Restart after momentary power loss
## = 0 : restart enabled
## = 1 : restart disabled

1. When AC power supply is temporary lower down below low voltage protection level because of power company or encountering large loading current in the same power supply system, the inverter will stop output immediately. If the power source resumes within 2 seconds, the inverter can restart by speed search (start tracing from the breaking frequency), otherwise the inverter break away from "LV-C".

2. When Fn_23 =0, if the transient power off duration is less than 2 sec., the inverter resume operation via speed search at 0.5 sec after power up. The restart times is not limited by Fn_24. If the transient power off duration is longer than 2 sec., it is up to the setting on the Fn_24 to decide if the inverter can be automatically restarted.

3. When Fn_23 = 1, the inverter break from operation immediately after the transient power off and indicate LV-C. It can not be restarted. (Not controlled by Fn_24)

## Fn_24: Number of Auto-restart times = 0~5

1. When Fn_24 = 0, the inverter will not automatically rest after malfunction break from operation.

2. When Fn_24 > 0 , the inverter will resume operation via SPEED SEARCH at 0.5 second after malfunction break and turn output from inertial operation to the operating frequency before break-up. After that, the inverter will accelerate or decelerate to current frequency setting.

3. When the inverter is set to deceleration or DC breaking, the transient restart procedure is not performed.

4. When either of following situation happen, the transient restart count will be reset:

   (1)    No additional malfunction (in operation or stop) occurs within 10 minutes.
   (2)    Press RESET button or external terminal RESET is ON.

## Fn_25 : Factory settings function
### = 010 : Constants initialization to 50Hz system
### = 020 : Constants initialization to 60Hz system

1. When Fn_25 is set to 010, all parameters is restored to factory settings. The settings of Fn_05 =1 and Fn_06 = 50. Fn_25 is restored back to 000 after the reset process complete.

2. When Fn_25 is set to 020, all parameters is restored to factory settings. The settings of Fn_05 =4 and Fn_06 = 60. Fn_25 is restored back to 000 after the reset process complete.

## Fn_26: Reserve

## Fn_27: Reserve

## Fn_28: Reserve

## Fn_29: software (program) version

## Fn_30: Fault trace

1. Fault trace : indicate the sequence of the occurrence of malfunctions by the location of decimal point. **x.xx** indicate a recently happened malfunction. **xx.x** indicate the last malfunction that happened. **xxx.** indicated the earliest malfunction in the record.

2. After entering the Fn_30 function, the **x.xx** record will be displayed first. After that, press ▲ button can read out **xx.x→ xxx. → x.xx →**,,, consecutively.

3. After entering Fn_30 function, if the RESET button is pressed, all three malfunction record will be cleared. Indication display **-.--, --.-**, and **---.**

4. When the content of malfunction memory indicate O**.**CC, indicate the latest malfunction code is OC-C and so on.

# 4. Malfunction Indication and Countermeasure

## 4.1 Manual reset inoperative faults

| INDICATION | CONTENT | POSSIBLE CAUSE | COUNTERMEASURE |
|---|---|---|---|
| CPF | Program error | Outside noise interference | Place a RC surge absorber in parallel with the noise generating magnetic contact |
| EPR | EEPROM error | EEPROM defective | Replace EEPROM |
| OV | Voltage too high while not operating | 1.Power source voltage too high. <br> 2.Detection circuitry defective | 1.Examining the power supply <br><br> 2.Return the inverter for repair |
| LV | Voltage too low while not operating | 1.Power source voltage too low. <br> 2.Detection circuitry defective. | 1.Examining the power supply <br><br> 2.Return the inverter for repair |
| OH | Inverter over heat while not operating | 1.Detection circuit defective. <br><br> 2.Environment over-heat or poor ventilation | 1.Return the inverter for repair <br><br> 2.Improve ventilation |

## 4-2 Manual reset operative faults (Auto-Reset inoperative)

| INDICATION | CONTENT | POSSIBLE CAUSE | COUNTERMEASURE |
|---|---|---|---|
| OC | Over-current at stop condition | Detection circuit malfunction | Return the inverter for repair |
| OL1 | Motor over-load | 1. Loading too large <br><br> 2. Improper V/F model setting <br><br> 3. Improper Fn_18 setting | 1. Increase capacity of motor <br><br> 2. Adjust to use a proper V/F curve setting <br><br> 3. Adjust Fn_18 according to instruction |
| OL2 | Inverter over-load | 1. Loading too large <br><br> 2. Improper V/F model setting | 1. Increase capacity of inverter <br><br> 2. Adjust to use a proper V/F curve setting |

## 4-3 Manual Reset and Auto-Reset Operative faults

| INDICATION | CONTENT | POSSIBLE CAUSE | COUNTERMEASURE |
|---|---|---|---|
| **OCS** | Transient over-current starting machine | 1. Motor coil short-circuit with external casing<br>2. Motor connection wire short-circuit with grounding<br>3. Transistor module damaged | 1. Examining motor<br>2. Examining wiring<br>3. Replace transistor module |
| **OCA** | Over-current at acceleration | 1. Acceleration time setting too short<br>2. Improper V/F feature selection<br>3. Applied motor capacity exceeds inverter capacity | 1. Adjust acceleration time to longer setting<br>2. Adjust to a proper V/F curve<br>3. Replace and install another inverter with appropriate capacity |
| **OCC** | Over-current at steady speed | 1. Transient alteration of the loading<br>2. Transient alteration of the power supply | 1. Examining the loading configuration<br>2. Install inductor on the power supply input side |
| **OCd** | Over-current at deceleration | Deceleration setting too short | Adjust to use a longer acceleration time |
| **OCb** | Over-current at breaking | DC Breaking frequency, breaking voltage, or breaking time setting too long | Adjust to reduce settings of Fn_15, Fn_16, or Fn_17 |
| **OVC** | Over-voltage at operation/deceleration | 1. Deceleration time setting too short or inertial loading too large<br>2. Power supply voltage variation too large | 1. Adjust to use a longer deceleration time<br>2. Install a inductor on the power supply input side<br>3. Increase the capacity of inverter |
| **LVC** | Insufficient voltage level at operation | 1. Power supply voltage too low<br>2. Power supply voltage variation too large | 1. Improve power source quality<br>2. Adjust to use a longer acceleration time<br>3. Increase capacity of inverter<br>4. Install a reactor on the power supply input side |
| **OHC** | Heat-sink over heated at operation | 1. Loading too heavy<br>2. Ambient temperature too high or poor ventilation | 1. Examining the loading<br>2. Increase capacity of inverter<br>3. Improve ventilation |

## 4-4 Other indications

| INDICATION | CONTENT | DESCRIPTION |
|---|---|---|
| SP0 | Zero Speed Stopping | When Fn_11 = 0, Fn_7= 0 and frequency setting < 1 Hz<br>When Fn_11 = 1, Fn_7<(Fn_6/100), and frequency setting <(Fn_6/100) |
| SP2 | Keypad emergency stop | The inverter setup to external operation (Fn_10=1). If the STOP key in the keypad is pressed at the middle of operation, the inverter stop according the setting in Fn_14 and flash SP2 after stop. The RUN switch must be turned OFF than ON to restart the machine. |
| E.S. | External emergency stop | When the external emergency stop signal is activated through the multi-function input terminal, the inverter decelerate and stop. Inverter flash E.S. after stop. (Refer to instruction for Fn_19 for detail). |
| b.b. | External BASE BLOCK | When the external BASE BLOCK signal is activated through the multifunction terminal, the inverter stop output immediately and flash b.b. for indication. (refer to instruction for Fn_19 for detail) |

## 4-5 Keypad Operation Error Indications

| INDICATION | CONTENT | POSSIBLE CAUSE | COUNTERMEASURE |
|---|---|---|---|
| LOC | Motor direction locked | 1. Attempt to reverse direction when Fn_22 = 1<br><br>2. Attempt to set Fn_22 to 1 when Fn_04 = 1 | 1. Adjust Fn_22 to 0<br><br>2. Adjust Fn_04 to 0 |
| Er1 | Keypad operation error | 1. Press ▲ or ▼ keys when Fn_11=1 or under sp1 operation<br><br>2. Attempt to modify Fn_29<br><br>3. Attempt to modify parameter that is not allowed to be modified during operation (refer to parameter list) | 1. Use ▲ or ▼ keys to adjust frequency setting only after Fn_11=0<br><br>2. Do not modify Fn_29<br><br>3. Modify in stop mode |
| Er2 | Parameter setting error | 1. Fn_6 ≤ Fn_7 | 1. Fn_6 > Fn_7 |

# 5. General Troubleshooting Method

| ABNORMALITY | CHECK POINT | COUNTERMEASURE |
|---|---|---|
| **Motor inoperative** | Is power source voltage delivered into L1, L2 terminal (is the charging indicator illuminated)? | • Check if the power source switched on.<br>• Turn power source OFF and then ON again.<br>• Reconfirm the power voltage level.<br>• Check to see if the mounting screw secured. |
| | Is there voltage output from output terminal T1, T2 and T3? | • Turn power source OFF and then ON again. |
| | If the loading too heavy to block motor? | • Reduce load to start motor. |
| | Is there any abnormal condition of the inverter? | • Refer to malfunction handling instructions to examine and correct wiring. |
| | Is the forward or reverse instruction loaded? | |
| | Is the analog frequency setting loaded? | • Check to see if wiring for analog frequency input signal is correct? |
| | If the operation mode setting correct? | • Check if the frequency input setting voltage is correct? |
| **Motor operate in opposite direction** | Is wiring on the output terminals T1, T2 and T3 correct? | • Operate by digital? |
| | Is the wiring for the forward and reverse signals correct? | • Wiring should be in accordance with the U, V, W terminals of motor. |
| **Motor operation speed fixed** | Is the wiring for analog frequency input correct? | • Examining the wiring and correct it. |
| | Is the operation mode setting correct? | • Examining the wiring and correct it. |
| | Is the loading too heavy? | • Operation panel operation mode setting check. |
| **Motor operation at speed too high or too low** | Is the specification of motor (poles, voltage) correct? | • Reduce loading |
| | Is the gear ratio correct? | • Reconfirm motor specification. |
| | Is the highest output frequency setting correct? | • Reconfirm gear ratio |
| | Is the voltage on motor side reduced extremely? | • Reconfirm highest output frequency |
| **Abnormal speed variation at operation** | Is the loading too heavy? | • Reduce loading variation |
| | Is the loading variation too large? | • Increase inverter and motor capacity |
| | Is the input power source steady and stable? | • Install AC reactor on the power supply input side |

# Simple VAT20 Troubleshooting Procedure

VAT20 INV Malfunction

Clearly defined malfunction — NO →

Sign of burn or breakage — NO →

Indication of abnormality — NO →

YES ↓ Proceed examination according to malfunction indication

Any sign of burnt of breakage? — YES → Examining component with sign of burnt or breakage

NO ↓

Is the primary circuitry DM normal? — ABNORMAL → Replace DM

NORMAL / ABNORMAL

Is the primary circuitry I.G.B.T. normal? — → Replace I.G.B.T.

NORMAL ↓

Control board, driver board, carry out visual inspection

Appearance abnormality — YES → Replace defective board

NO ↓

Switch power ON

Any illuminated indicator on the control panel — NO →

YES ↓

Any malfunction indication — NO →

Malfunction indication ←

The malfunction indication is? — Three malfunction record in Fn_30

Check to see the three malfunction record in Fn_30

Is LED2 illuminate? — NO → Replace current surge absorber

YES ↓

Is the DC input voltage of control power supply normal? — ABNORMAL → Examining terminals and wirings

NORMAL ↓

Is the control power source +5V normal? — ABNORMAL → Replace driver board

NORMAL ↓

Replace control board, digital controller.

Is replacing control board solve the problem? — NO → Inverter malfunction | Detail examination required.

YES

**(Continued)**

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# ( Continued )

```
┌─────────────────────┐
│ Examining Inverter  │
│    parameters       │
└─────────────────────┘
          │
┌─────────────────────┐
│ Carry out parameter │
│   initialization    │
└─────────────────────┘
          │
┌─────────────────────┐
│ Designate operation │
│   control method    │
└─────────────────────┘
          │
┌─────────────────────┐
│ Frequency instruction│
│      setting        │
└─────────────────────┘
          │
     ╱─────────╲         NO      ┌─────────────────────┐
    ╱ Does the   ╲ ───────────── │ Replace control board│
   ╱ controller displays╲        └─────────────────────┘
    ╲ frequency setting? ╱
     ╲─────────╱
          │
     ╱─────────╲         NO      ┌─────────────────────┐
    ╱ Is there   ╲ ───────────── │ Replace control board│
   ╱ voltage output on╲          └─────────────────────┘
    ╲ UVW terminals?  ╱
     ╲─────────╱
          │  YES
          ◄──────────────── YES
┌─────────────────────┐
│ Connect to motor and│
│  proceed operation  │
└─────────────────────┘
          │
     ╱─────────╲         YES
    ╱ Is there   ╲ ───────────────────────────────────
   ╱ any abnormality╲
    ╲   indication  ╱
     ╲─────────╱
          │  NO
     ╱─────────╲         NO
    ╱    Is      ╲ ───────────────────────────────────●
   ╱ output current of all╲
   ╲ phases in balance ╱
    ╲   condition.   ╱
     ╲─────────╱
          │  YES
┌─────────────────────┐
│ The inverter is     │
│    normal now.      │
└─────────────────────┘
```

```
     ╱─────────╲              No, The problem
    ╱ Is replacing╲           is not corrected
   ╱ control board correct╲ ──────────────
    ╲  the problem?  ╱
     ╲─────────╱
          │
     Yes, the problem
     has been corrected
```

```
┌─────────────────────┐
│ The inverter is out of order.│
├─────────────────────┤
│ Detail examination is required.│
└─────────────────────┘
```

# Error handling of malfunction indication of OC.OL

```
┌─────────────────────┐
│ When inverter display│
│ malfunction indication│
│ OC.OL.              │
└─────────────────────┘
          │
          ▼
    ╱─────────────╲
   ╱ Is the primary ╲  ABNORMAL   ┌──────────────────┐
  ╱  circuit I.G.B.T. ╲──────────▶│ Replace I.G.B.T. │
   ╲   normal?       ╱            └──────────────────┘
    ╲─────────────╱
      │ NORMAL
      ▼
    ╱─────────────╲
   ╱ Is the appearance╲           ┌──────────────────┐
  ╱    normal?        ╲──────────▶│ Replace defective PCB │
   ╲─────────────╱      YES       └──────────────────┘
      │
      ▼
┌─────────────────┐
│ Switch ON power │
│ supply          │
└─────────────────┘
      │
      ▼
    ╱─────────────╲
   ╱ Is there any   ╲   YES
  ╱ malfunction      ╲──────────────────────┐
   ╲ indication      ╱                       │
    ╲─────────────╱                          ▼
      │ NO                           ╱─────────────╲
      ▼                             ╱ Is the current ╲  ABNORMAL  ┌──────────────────┐
┌─────────────────┐                ╱  detector normal? ╲────────▶│ Replace detector.│
│ Input operation │                 ╲─────────────╱              └──────────────────┘
│ instruction     │                   │ NORMAL
└─────────────────┘                   ▼
      │ YES                   ┌──────────────────┐
      ▼                       │ Replace control board. │
┌─────────────────┐          └──────────────────┘
│ Input frequency setting │
└─────────────────┘
      │
      ▼
    ╱─────────────╲
   ╱ Is the output   ╲   NO       ┌──────────────────┐
  ╱ frequency         ╲─────────▶│ Replace control board │
   ╲ displayed?       ╱           └──────────────────┘
    ╲─────────────╱
      │ YES
      ▼
    ╱─────────────╲
   ╱ Is there output ╲   NO       ┌──────────────────┐
  ╱ voltage on UVW    ╲─────────▶│ Replace control board │
   ╲ terminals?       ╱           └──────────────────┘
    ╲─────────────╱                        │
      │ YES                                ▼
      ▼                          ╱─────────────╲
┌─────────────────┐             ╱ Is replacing   ╲   NO
│ Connect motor and│            ╱ control board correct this ╲───┐
│ proceed with operation. │      ╲ Problem?      ╱             │
└─────────────────┘              ╲─────────────╱              │
      │                            │ YES                       │
      ▼                            │                           │
    ╱─────────────╲                │                           │
   ╱ Is there any   ╲   YES        │                           │
  ╱ malfunction      ╲─────────────┴───────────────────────────┤
   ╲ indication      ╱                                          │
    ╲─────────────╱                                             │
      │ NO                                                      │
      ▼                                                         │
    ╱─────────────╲                                             │
   ╱ Is output       ╲   NO                                     │
  ╱ current of all phases ╲────────────────────●────────────────┤
   ╲ in balance condition. ╱                                    │
    ╲─────────────╱                                             │
      │ YES                        ┌──────────────────────┐     │
      ▼                            │ Inverter is out of order. │◀┘
┌─────────────────┐               │ Detail examination is required. │
│ The inverter is │               └──────────────────────┘
│ normal now.     │
└─────────────────┘
```

# Error handling of malfunction indication of OV.LV

```
┌─────────────────────┐
│ Inverter display OV.LV │
└─────────────────────┘
           │
           ▼
      ╱──────────╲
     ╱  Is there   ╲
    ╱ any abnormal   ╲──────────────────►┌──────────────────────┐
    ╲ breakage on     ╱                   │ Replace defective board │
     ╲ appearance    ╱                    └──────────────────────┘
      ╲──────────╱                                   │
           │                                         │
           ▼                                         │
   ┌──────────────┐                                  │
   │  Switch ON    │◄─────────────────────────────── │
   │ power supply  │
   └──────────────┘
           │
           ▼
      ╱──────────╲
     ╱ Is there any ╲         YES
    ╱ malfunction    ╲───────────────────►┌──────────────────────┐
    ╲ indication     ╱                     │  Replace control board │
     ╲──────────╱                          └──────────────────────┘
           │ NO                                       │
           ▼                                          │
   ┌──────────────┐                                   │
   │ Input operation│
   │  instruction  │
   └──────────────┘
           │
           ▼
   ┌──────────────┐
   │ Input frequency│
   │  instruction  │
   └──────────────┘
           │
           ▼
      ╱──────────╲
     ╱ Is the output ╲        NO
    ╱ frequency of    ╲──────────────────►┌──────────────────────┐
    ╲ controller      ╱                    │  Replace control board │
     ╲ displayed     ╱                     └──────────────────────┘
      ╲──────────╱
           │ YES
           ▼
      ╱──────────╲
     ╱  Is there    ╲         NO
    ╱ output voltage  ╲───────────────────►┌──────────────────────┐
    ╲ on T1, T2, and  ╱                    │  Replace control board │───┐
     ╲ T3 terminals? ╱                     └──────────────────────┘   │
      ╲──────────╱                                                     ▼
           │ YES                                              ╱──────────╲
           ▼                                                 ╱ Is the problem╲  NO
   ┌──────────────┐                                         ╱ corrected by     ╲───┐
   │ Connect motor.│◄──────────────────────────────────────╲ replacing control ╱   │
   │ Is the motor  │                                         ╲ board?          ╱    │
   │ operating?    │                                          ╲──────────╱          │
   └──────────────┘                                               │ YES             │
           │                                                      │                 │
           ▼                                                      │                 │
      ╱──────────╲         YES                                    │                 │
     ╱ Is there any ╲──────────────────────────────────────────┐ │                 │
    ╱ malfunction    ╲                                          │ │                 │
    ╲ indication?    ╱                                          │ │                 │
     ╲──────────╱                                               │ │                 │
           │ NO                                                 │ │                 │
           ▼                                                    │ │                 │
      ╱──────────╲                                              │ │                 │
     ╱ Is output    ╲        NO                                 ▼ ▼                 │
    ╱ current of all  ╲──────────────────────────────────────●─────               │
    ╲ phases in        ╱                                       │                    │
     ╲ balance condition╱                                      │                    │
      ╲──────────╱                                             ▼                    │
           │ YES                                    ┌──────────────────────┐        │
           ▼                                        │ The inverter is out   │        │
   ┌──────────────┐                                 │ of order.             │◄───────┘
   │ The inverter is│                                ├──────────────────────┤
   │  normal now.  │                                 │ Detail examination    │
   └──────────────┘                                  │ is required.          │
                                                     └──────────────────────┘
```

# (1).  Motor inoperative

```
                    ┌─────────────────┐
         YES        │ Is the circui   │
    ┌───────────────│ t breaker (MCCB)│
    │               │ switched ON?    │
    │               └─────────────────┘
    │                       │ NO
    │                       │
    │               ┌─────────────────┐        Can not    ┌──────────────────────┐
    │               │ Can you switch  │─────────────────→ │ Wiring short-circuit │
    │               │ ON the MCCB?    │                   └──────────────────────┘
    │               └─────────────────┘
    └───────────────────────┤
                            │
                    ┌─────────────────┐
                    │ Is the          │       ABNORMAL    ┌──────────────────────┐
                    │ voltage between │─────────────────→ │ • Power source       │
                    │ L1-L2 power     │                   │   abnormality        │
                    │ input terminals │                   │ • Poor wiring        │
                    │ normal?         │                   └──────────────────────┘
                    └─────────────────┘
                            │ Normal
                            │ (within +/- 10% of nominal value)
                    ┌─────────────────┐          NO       ┌──────────────────────┐
                    │ Is Power LED    │─────────────────→ │ VAT20 malfunction    │
                    │ off ?           │                   └──────────────────────┘
                    └─────────────────┘
                            │
                    ┌─────────────────┐          NO       ┌──────────────────────┐
                    │ Is the operation│─────────────────→ │ Place the operation  │
                    │ switch on the   │                   │ switch to RUN        │
                    │ RUN position?   │                   │ position.            │
                    └─────────────────┘                   └──────────────────────┘
                            │ YES
                    ┌─────────────────┐          NO       ┌──────────────────────┐
                    │ Is there any    │─────────────────→ │ VAT20 malfunction    │
                    │ output voltage  │                   └──────────────────────┘
                    │ on motor        │
                    │ T1-T2-T3?       │
                    └─────────────────┘
                            │
                    ┌─────────────────┐          NO       ┌──────────────────────┐
                    │ Is the          │─────────────────→ │ VAT20 malfunction    │
                    │ T1-T2,T2-T3,    │                   └──────────────────────┘
                    │ T3-T1 output    │
                    │ voltage in      │
                    │ balance         │
                    │ condition?      │
                    └─────────────────┘
                            │ YES (When the motor is not connected, and the voltage differences between
                            │      wires are within +/- 3% can be treated as in balance condition.)
                    ┌─────────────────┐
                    │ Motor over-load │
                    │ Defective motor │
                    │ Poor wiring     │
                    └─────────────────┘
```

## (2). Motor over-heat

**Is there over-loading condition or the load current exceeds rated current?**
— YES → Reduce loading Enlarge VAT20 and Motor capacity
— NO ↓

**Operate at low speed for a long time?**
— YES → Select another motor
— NO ↓

**Is the voltage level between T1-T2, T2-T3, and T3-T1 normal?**
— NO → VAT20 malfunction
— YES ↓

**Is there anything that might affect motor cooling?**
— YES → Remove obstacle affecting motor cooling
— NO ↓

**Poor connection between VAT20 and motor**
— YES → Correct the connection

## (3). Disturbing motor operation

**During acceleration or deceleration ?**
— YES → **Is the acceleration/deceleration time setting appropriate?**
  — Not appropriate → Increase or decrease acceleration / deceleration time
  — Appropriate → Reduce load Increase VAT20 and motor capacity
— NO ↓

**Is the voltage level between T1-T2, T2-T3, and T3-T1 normal?**
— NO → VAT20 malfunction
— YES (The differences between different wires are within ¡Ó5%) ↓

**Is there any loading variation condition?**
— YES → Reduce loading variation or install fly wheel
— NO ↓

**Is there any excess vibration at transmission parts like gears?**
— YES → Improve mechanical system
— NO → VAT20 malfunction

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# Routine examination and periodical examination

Inverter requires routine and periodical examination and maintenance for a more stable and safer operation.
Refer to following table for required examination item for a more stable and safer operation.
Carry out examination after the " Power LED " indicator goes off for 5 minutes to prevent the maintenance personnel injury caused by the remaining charges in the capacitor of inverter.

| Maintenance item | Maintenance description | Examination period | | Examination method | Criterion | Countermeasure |
|---|---|---|---|---|---|---|
| | | Routine | 1 Year | | | |
| Installation site environment | Reconfirm environment temperature and humidity | ○ | | Refer to installation instructions and measure with thermometer and hygrometer | Temperature: -10~40 OC Humidity: under 95% without condensing | Improve installation site environment |
| | Check and remove any flammable material nearby | ○ | | Visual inspection | No foreign object | |
| Inverter Installation anf grounding | Is there any abnormal vibration on the installation site? | ○ | | Visual and audio inspection | No foreign object | Tighten loose screw |
| | Is the grounding resistance within acceptable range? | | ○ | Measure resistance by multi-meter | 200V class under 100 ohm | Improve grounding |
| Input power source voltage | Is the voltage of the primary circuitry normal? | ○ | | Measure voltage by multi-meter | Voltage level conforming specification | Improve input power source |
| Inverter external terminal mounting screw | Is the tighten parts secured? | | ○ | Visual inspection. Use screwdriver to verify screw tightness | No abnormality | Tighten loose screw or return for repair |
| | Is there any sign of breakage on the terminal panel? | | ○ | | | |
| | Is there any obvious rusty condition? | | ○ | | | |
| Internal wiring of inverter | Is it deformed or skewed? | | ○ | Visual inspection | No abnormality | Replace or return for repair |
| | Is the insulation of wire broken? | | ○ | | | |
| Heat-sink | Is it accumulating dust or dirt? | ○ | | Visual inspection | No abnormality | Clean up dust or dirt |
| PCB | Is it accumulating conductive metal or oil stain? | | ○ | Visual inspection | No abnormality | Clean up or replace PCB |
| | Is there any over-heated or burnt component? | | ○ | | | |
| Cooling fan | Is there any abnormal vibration or noise? | | ○ | Visual and audio inspection | No abnormality | Replace cooling fan |
| | Is it accumulating dust or dirt? | ○ | | Visual inspection | | Clean up |
| Power component | Is it accumulating dust or dirt? | | ○ | Visual inspection | No abnormality | Clean up |
| | Examine resistance between each terminal | | ○ | Measure by multi-meter | No short-circuit or open-circuit on the three-phase output | Replace power component or inverter |
| Capacitor | Is there any sign of strange odor or leakage? | ○ | | Visual inspection | No abnormality | Replace capacitor or inverter |
| | Is there any sign of swelling or bulging? | ○ | | | | |

# Chapter 4. Maintenance and Peripherals

## Maintenance and Examination

Frequent examination and maintenance is not required for VAT20.
To maintain appropriate reliability for a long term of time, please proceed with following periodical examination. Remember to turn off power supply and wait till the Power LED went off before proceed. (Due to the large amount of remaining charges in the internal capacitors.)

(1)   Clean out internal dust and dirt.
(2)   Check out mounting screws on every terminal and parts. Tighten loose screws.
(3)   Dielectric strength test

    (a)   Remove all conducting wires between VAT20 and outside world. Power must be turned OFF.
    (b)   The dielectric strength test inside VAT20 should be carried out only for VAT20 major circuitry. Use DC 500V: high resistance meter. Measured resistance should be higher than 100M ohm.

*CAUTION: Do not perform dielectric strength test to the control circuit.*
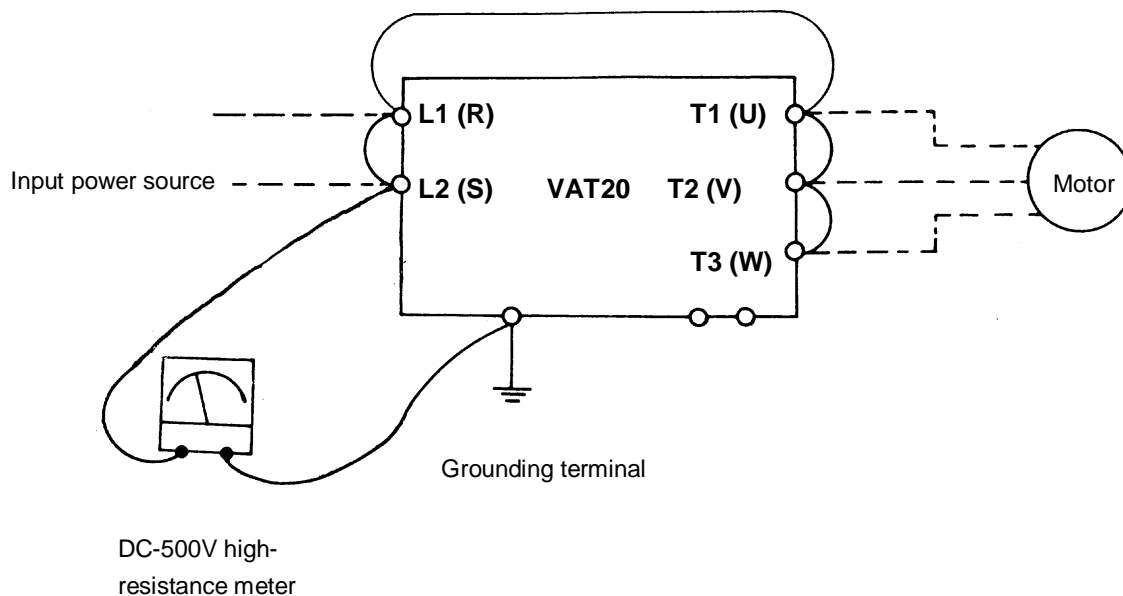


**Connection for dielectric strength test**

# Voltage Current Measurement

The voltage and current measurement on the primary and secondary side may be different for the reason of the instrumentation and the high frequency wave. Refer to following diagram for measurement:



Different kinds of instrument
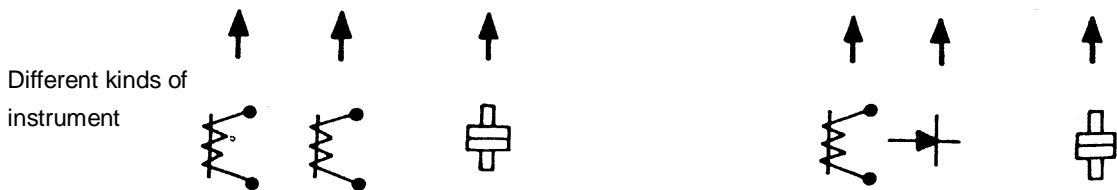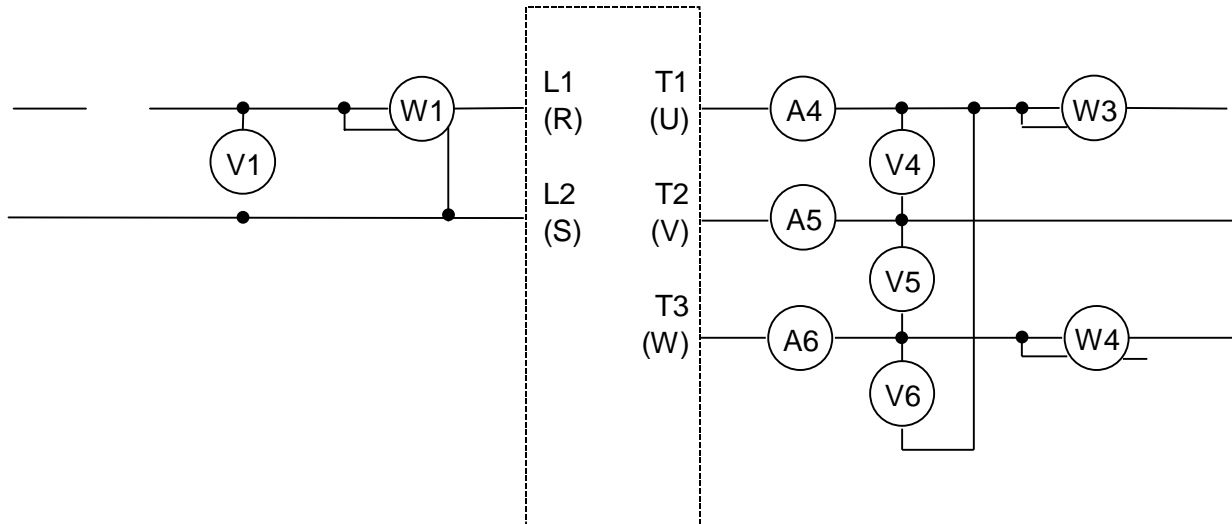
| Measurement | Measuring point | Instrument | NOTE (Measurement criterion) |
|---|---|---|---|
| Input voltage VI | V1 | Moving-iron | |
| Input current Ii | A1 | Moving-iron | |
| Input power Pi | W1 | Power-meter | P=W1 |
| Input power factor PFi | Calculate power factor by the input voltage, input current and input power $$PFi = \frac{Pi}{\sqrt{3}Vi \cdot Ii} \times 100\%$$ | | |
| Output voltage Vo | V4  V5  V6 | Rectifier (Moving-iron not allowed) | Maximum voltage difference between wires under 3% |
| Output Current Io | A4  A5  A6 | Moving-iron | Under VAT20 rated current |
| Measurement | Measuring point | Instrument | NOTE (Measurement criterion) |
| Output power Po | W3  W4 | Power-meter | Po=W3+W4 |
| Output power factor PFo | $$PFo = \frac{Po}{\sqrt{3}V0 \cdot Io} \times 100\%$$ | | |

# Input AC Reactor Specification

| Model | Input AC Reactor | |
|---|---|---|
| | Current value ( A ) | Inductance ( m H ) |
| U20N0K2S | 3 | 7.0 |
| U20N0K4S | 5.2 | 4.2 |
| U20N0K7S | 9.4 | 2.1 |
| U20N1K7S | | |
| U20N2K2S | | |

# EMI Filter (class B) Specification

| Model | Dimension(mm) | Current(A) | Inverter model |
|---|---|---|---|
| U20AF0K7 | 156X76X25 | 10A | U20N0K2S<br>U20N0K4S<br>U20N0K7S |

# DIN RAIL Specification

| Model | Dimension | Inverter model |
|---|---|---|
| U20AR0K7 | 130x72x7.5 | U20N0K2S<br>U20N0K4S<br>U20N0K7S |