MITSUBISHI

VARIABLE FREQUENCY DRIVES

HIGH POWER
HIGH PERFORMANCE
FULLY DIGITAL
AC INVERTERS

MELTRAC-A

PANEL ENCLOSURE BUILDING GUIDELINES

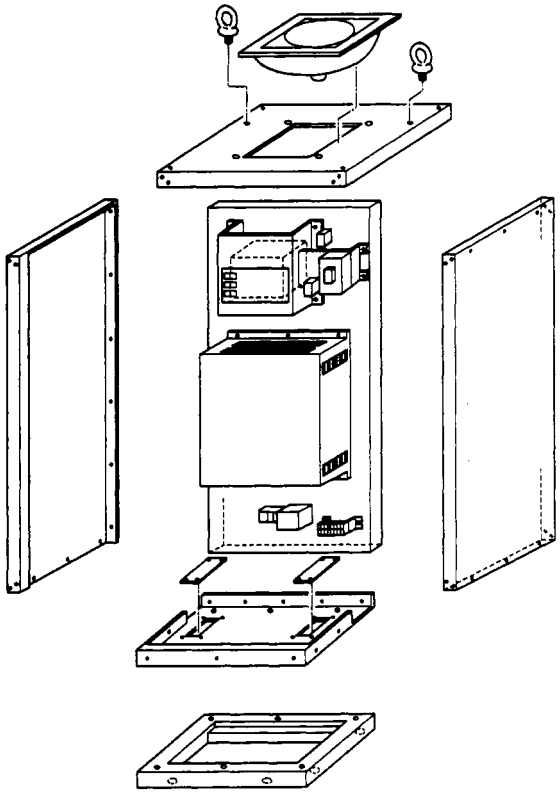


TABLE OF CONTENTS

1. INTRODUCTION

Your purchase of a Mitsubishi Transistor Inverter **MELTRAC-A** series is greatly appreciated. To use this inverter effectively and safely it should be installed in a stand-alone control panel. In addition, the inverter should be electrically and mechanically protected. Operation devices, monitor instruments, lamps and other components should be laid out to facilitate easy operation. Sequential logic needs to be programmed to perform the desired operations.
This manual describes the precautions and notes in preparing an inverter panel. Before using this manual, thoroughly read the operation manuals and catalogs for the **MELTRAC-A** series equipment.

2. CONSTRUCTION OF VARIABLE-SPEED DRIVE SYSTEMS USING INVERTER

2.1 ADVANTAGES OF INVERTER DRIVE SYSTEM

The inverter can easily control the speeds of a squirrel-cage motor which alone would otherwise operate at a fixed speed. Presently, the inverter is widely used as a most popular variable-speed drive system.
Some of the major advantages of the inverter are as follows.

(1) The inverter is simple in construction and capable of controlling squirrel-cage motors that are most generally used.
(2) The inverter steplessly controls motor speeds from low to high.
(3) The inverter circuit and control panel are simple. They are compatible with FA systems.
(4) The efficiency and power factor are high over the entire speed range.
(5) The inverter can be hooked up to existing motors.
(6) Given the inverter, a backup system (fixed speed) can be configured easily on commercial power source.
(7) The start-up current is small.

The following points should also be noted with the inverter from the hardware and system view points.

(1) The inverter is a high-tech electronic device consisting of a microcomputer and power semiconductors. General precautions for electronic devices should be exercised, such as installation in a proper environment and protection against electrical noise from the power circuit.
(2) The PWM output voltage is obtained by switching at a high speed the direct current power which is produced by rectifying the commercial power.
(3) Squirrel-cage motors are designed basically to be operated on the commercial power source.
(4) Some squirrel-cage motors of 45 kW or higher are made to special specifications and therefore the characteristics are different from one motor to another.
(5) The loss of power increases along with the capacity. Adequate heat radiation is an important considerations.
(6) Large-capacity motors are usually responsible for important operations and installations. The system reliability is therefore an important consideration.
(7) Slip is smaller (approximately 1 %) with a largecapacity motor than with a small one.
(8) The start-up torque tends to be slow to build with the operation through the inverter compared with the operation on the commercial power line.

2.2 PRECAUTIONS ON SYSTEM DESIGN

In order to design and build an optimal system that makes full use of the inverter drive, the following should be considered in advance.

(1) Only the parameter unit may be necessary for a single operation. However, operation devices and monitor instruments should be installed to provide the operator with better operation. When the operator panel is remote from the inverter panel, an effective anti-noise measure should be provided.

(2) For a simple interlocking or interacting operation or a simple applied control, the functions built-in the inverter may be used. A series operation panel or setting box may be installed as necessary.

(3) When using the inverter as part of the entire system, use the interface featuring the I/O device of the **MELSEC** Programmable Logic controller i. e. **MELSECNET/MINI-S3** (optical fiber cables). (T-OPT22 is necessary.)

(4) When building a complex operation system, a manual backup system should be installed.

(5) In an operation that does not tolerate even a momentarily power failure, install a back-up system operating on the commercial power line in preparation for inverter trip. In this case, measures should be taken for maintenance and repairing the inverter. Provide a sequence program that allows to reset to the inverter control. Check if the motor can be started up on the commercial power. When operating loads having large GD^2, consider the voltage drop during starting up on the commercial power in evaluating the power source capacity.

(6) When operating the most critical system, design a redundant (dual) system with a stand-by inverter and machine.

(7) Consider the consequence and resumption of operation in the event of a momentarily power failure or voltage drop that causes the inverter to run freely.

(8) If the power source is small, consider the effect of the harmonics generated by the inverter operating on the power system.

(9) Before selecting the inverter and motor capacities, properly evaluate the speed-torque characteristics of the machines to be operated, start-up torque, acceleration/deceleration profile, instantaneous peak torque and ther relevant operating characteristics.

(10) Check that the temperature stays within the allowable range when operating the motor at low speeds. This is especially critical in a so-called constant-torque operation which requires a large torque at low speeds.

(11) The inverter offers a variable speed operation. Check that the mechanical resonance point does not exist within the speed range of the inverter operation.

(12) Before hooking the inverter to an existing motor, check the motor for deterioration of insulation.

(13) The motor produces more noise than that produced in operations on the commercial power source. Check if special noise prevention measures are necessary.

(14) When applying the inverter to a load that requires regenerative torque, check the magnitude of regenerative energy and the frequency of regeneration.

(15) When controlling loads having a large GD^2 such as fans, check the practically optimal acceleration and deceleration times.

3. TYPES AND CONFIGURATIONS OF INVERTER PANEL ENCLOSURE

3.1 TYPES OF INVERTER PANELS

The inverter panel is of a cubicle construction that should be compatible with the environment in which it is used. The inverter panel should also be designed to be capable of radiating heat generated by the inverter, associated direct current reactor (DCL) and other components and devices. The inverter has built-in fans that forces out the heat generated within the inverter. The inverter panel must be provided with a ventilator and fresh air intake to remove heat generated within the inverter panel.

Consider the following notes in designing the inverter panel.

(1) Install the inverter vertically with bolts.
(2) Be sure to connect the associated direct current reactor across P and P1. Since the current flowing through the direct current reactor is fairly large, install it near the inverter while considering the suitable wire size and bending radius.
(3) The inverter has built-in forced ventilation fans. Lay out the inverter and other devices so that the air flow resistance into and out of the inverter is small.
(4) Installing a large capacity inverter requires large electrical cables to be connected to the input and output terminals of the inverter. Consider the cable routing, bending radius of the cable, location of the external terminals, size, direction and position of the external cables, and other installations in advance so that excessive forces will not be exerted on the inverter main circuit terminals. Do not install the inverter panel in a high temperature, high humidity environment. The ambient temperature must be 40°C or below and the humidity 90 % or below around the inverter panel.
(6) Do not use the inverter where corrosive gases, oil mist, vibration or salt exist.
(7) If used in a dusty condition, use an air filter at the air intake on the panel. When installing the air filter, thoroughly consider the air flow pressure drop, clogging and other factors in selecting a cooling fan to ensure adequate cooling.
(8) When water is around the inverter panel, design the inverter panel so that it does not allow water or water mist to enter. If used outdoor, design the inverter panel to allow correct forced ventilation while shutting out moisture. However, outdoor operation is not recommended.
(9) Design the inverter panel to avoid condensation especially in an humid environment. A space heater may be necessary that operates while the inverter is not operating.
(10) When a control circuit other than for the inverter is installed within the same inverter panel, check the mutual induction and electrical noise interference.

3.2 DEVICES INSTALLED IN INVERTER PANEL ENCLOSURE

In addition to the inverter itself and direct current reactor, the following devices should be provided for the inverter panel.

(1) Power circuit breaker

Install a circuit breaker that immediately isolates the inverter the power source to protect the circuit on the inverter power line in the event of a critical inverter accident.

(2) Control circuit breaker

To install the control circuit cables, branch them out from the primary terminals of the circuit breaker or of the magnetic contactor for the inverter power.

(3) Operation devices

(a) Inverter ON and OFF switches

* These are not necessary if operated with the parameter unit only.

(b) Frequency setting device (potentiometer)

* These are not necessary if operated with the parameter unit only.

Provide the following switches as necessary.

(a) Operation mode select switch (automatic-manual)

(b) Local Remote Control select switch (Local remote-panel)

(4) Monitor instruments

(a) Operation status lamps ("operation", "stop", "failure", etc.)

* The inverter control output terminals of SU, IPF, OL and FU are allocated for "frequency reached", "momentarily power failure", "overload warning" and "frequency detection", respectively. However, these terminals may be used to send out alarm codes.

(b) Monitor instruments ("output current", "output frequency", "output voltage", etc.)

* The inverter provides one analog and one pulse monitor output terminals (which, however, cannot be used simultaneously) that can be set through parameter setting. By selecting a desired parameter, any of the (a) output frequency, (b) output current, (c) output voltage, (d) frequency set value, or (e) operation speed can be analog or digital indicated.

(5) Sequence logic

Sequential control programs are necessary to operate the inverter safely while interlocking or interacting with the process. There may be several methods to prepare sequential control programs. Use control relays, programable logic controller **MELSEC-FX** or **MELSEC-A** or other devices commensurate with the sequence logic. When selecting control relays, check the minimum contact current in addition to the rated contact current.

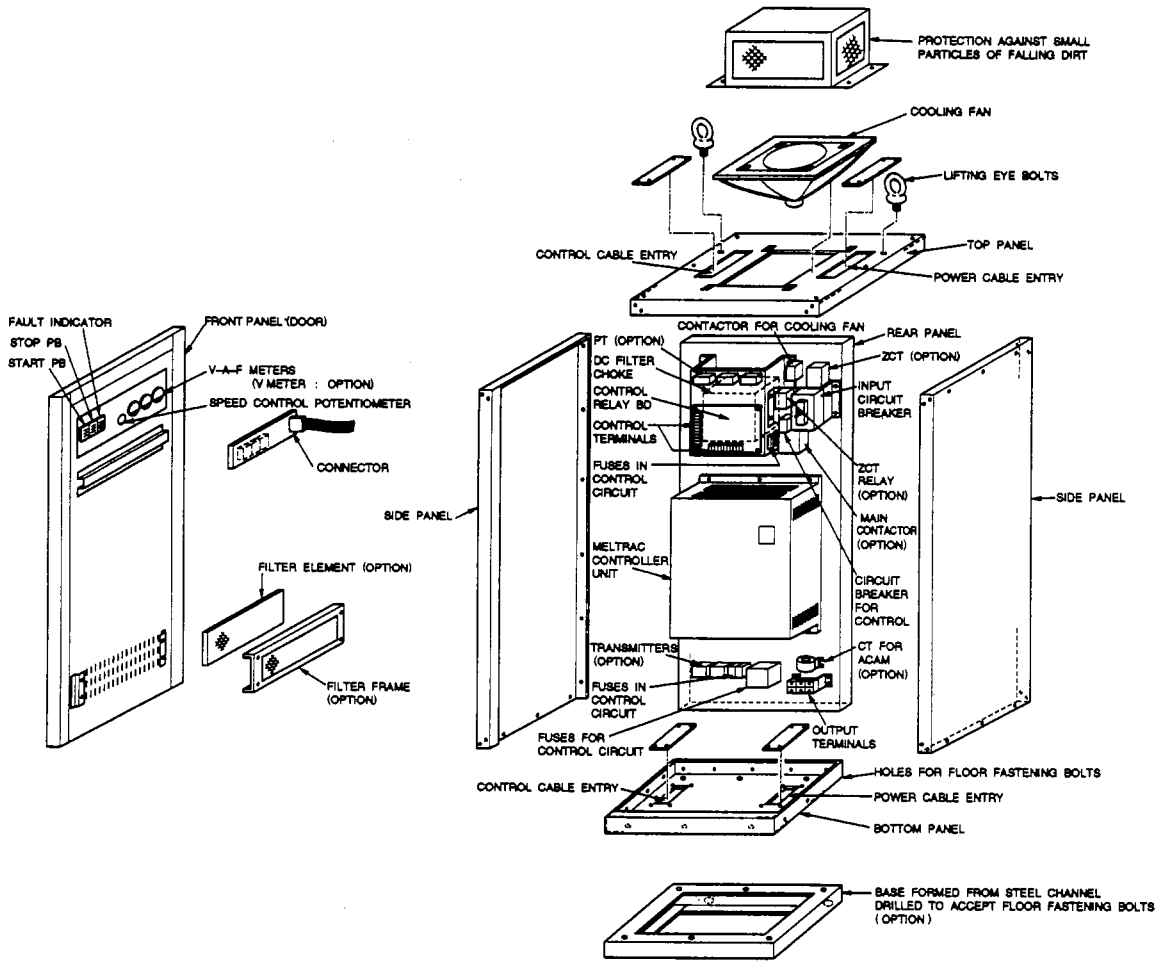
(6) Forced Ventilation required

Install an air intake with a filter at the bottom of the inverter panel door. Install an exhaust fan on the ceiling of the inverter panel for cooling panel inside. The fan capacity depends on the inverter capacity. Refer to Section 5.2 "LIST OF PERIPHERALS". The air intake opening should be 500 mm x 500 mm or larger. Design the air intake that avoid dust entrance as much as possible.

(7) Data Link

By addition of PLC Link or Computer Link (both are optional), the inverter panel controls and monitors the system operations as a terminal of the computer. Refer to the operation manuals for the corresponding options for detail.

The figure below shows an example stand-alone inverter panel and its component/device layout.



Surround the direct current reactor with ventilation duct fixed on the panel as shown in the figure to optimal cooling of the direct current reactor. The front face of the surrounding cover may be used to install a relay.

3.3 ENCLOSURE TYPES

NEMA TYPE 1 — GENERAL-PURPOSE — INDOOR enclosures are intended for use indoors, primarily to prevent accidental contact of personnel with the enclosed equipment, in areas where unusual service conditions do not exist.

NEMA TYPE 2 — DRIPPROOF — INDOOR enclosures are intended for use indoors to protect the enclosed equipment against falling noncorrosive liquids and falling dirt.

NEMA TYPE 3 — DUSTTIGHT, RAINTIGHT AND SLEET-RESISTANT (ICE-RESISTANT) — OUTDOOR enclosures are intended for use outdoors to protect the enclosed equipment against wind-blown dust and water.

NEMA TYPE 3R — RAINPROOF AND SLEET-RESISTANT (ICE-RESISTANT) — OUTDOOR enclosures are intended for use outdoors to protect the enclosed equipment against rain and are constructed so the accumulation and melting of sleet (ice) will not damage the enclosure and its external mechanisms.

NEMA TYPE 4 — WATERTIGHT AND DUSTTIGHT — INDOOR AND OUTDOOR enclosures are intended for use indoors or outdoors to protect the enclosed equipment against splashing water, seepage of water, falling or hose-directed water, and severe external condensation.

NEMA TYPE 4X — WATERTIGHT, DUSTTIGHT AND CORROSION-RESISTANT — INDOOR AND OUT-DOOR enclosures have the same provisions as Type 4 enclosures and, in addition, are corrosion-resistant.

NEMA TYPE 12 — INDUSTRIAL USE — DUSTTIGHT AND DRIPTIGHT — INDOOR enclosures are intended for use indoors to protect the enclosed equipment against fibers, flyings, lint, dust and dirt, and light splashing, seepage, dripping and external condensation of noncorrosive liquids.

NEMA TYPE 13 — OILTIGHT AND DUSTTIGHT — INDOOR enclosures are intended for use indoors primarily to house pilot devices such as limit switches, foot switches, pushbuttons, selector switches, pilot lights, etc., and to protect these devices against lint and dust, seepage, external condensation, and spraying of water, oil or coolant.

Conversion of NEMA Type Number to IEC Classification Designations	
NEMA Enclosure Type Number	IEC Enclosure Classification Designation
1	1P10
2	1P11
3	1P54
3R	1P14
3S	1P54
4 and 4X	1P56
5	1P52
6 and 6P	1P67
12 and 12K	1P52
13	1P54

NOTE: ① This comparison is based on tests specified in IEC Publication 529.
② Can not be used to convert IEC classification designations to NEMA Type numbers.

3.4 SELECTION OF THE CORRECT SIZE NEMA 1 (EQUIVALENT TO IP–10) ENCLOSURE FOR THE CORRESPONDING INVERTER CHASSIS UNIT

Question : How can I calculate enclosure size, if I want to mount an open MELTRAC-A Series inverter chassis unit in my own NEMA 1 enclosure?

Answer : It is – – – –

a) For selecting the correct size forced ventilation fan on the top of enclosure, calculate watts loss and required ventilation air volume in the controller.

$$\text{Required Ventilation Air Volume (CFM)} = \frac{\text{KW x 3413}}{1.085\ (\text{LAT-EAT})}$$

OR

$$\text{Required Ventilation Air Volume (m}^3\text{/min.)} = \frac{\text{KW x 860}}{17.28\ (t_2 - t_1)}$$

LAT : Leading Air Temperature (°F) or t_2 (°C)
EAT : Entrance Air Temperature (°F) or t_1 (°C)
KW : Heat losses (KW) of all equipment installed inside enclosure

b) DC filter choke prefers to be placed above inverter unit location where is the forced ventilation air path.
A wind velocity of 5 meters/sec (0.003 miles/sec) should be designed to pass through DC filter choke.
In this case, there should be the space of 8 inches between the DC filter choke and the top of the inverter chassis unit.

c) To meet NEMA code, the inverter panel must have
1. Fuse Disconnect (or circuit breaker)
2. Start/Stop pushbutton

Therefore in selecting proper enclosure, assume the customer use circuit breaker (or fuse + disconnect), start/stop pushbutton, contactor and etc.

I DON'T THINK THIS IS TRUE.

1) START/STOP CAN BE REMOTE
2 WIRE OR 3 WIRE

2) C BKR OR FUSED DISC. IS
REQ'D TO IN VIEW ≤ WITHIN 30'

IF ABOVE WAS TRUE, FR-A COULD
NOT QUALIFY AS NEMA 1

3.5 DUST-PROTECTED ENCLOSURE DESIGN GUIDELINES

When the inverter chassis unit and DC Reactor of MELTRAC A is stored in the closed, dust-preventive type panel, the heat-radiating area and approximate natural radiating surface dimensions required are shown in Table 1.

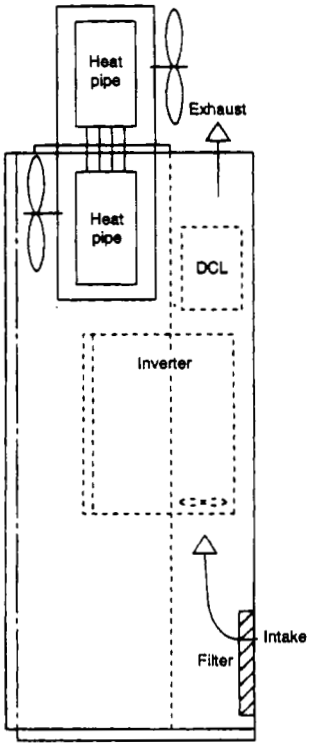
Table 1 Heat-radiating area of closed, dust-preventive type control panel

	Model of Inverter Chassis Unit/DCL	Closed, dust-preventive type (IP5X)			NOTE
		Loss radiated in the panel (W)	Area required for heat radiation (m^2)	Approx. natural radiating surface dimensions (mm)	
Inverter chassis unit	MT-A140- 75K	675	11.3	1200W X 1000D X 2300H	Heat sink radiation fins outside the panel
	MT-A140-110K	1013	16.9	2200W X 1000D X 2300H	
	MT-A140-150K	1350	22.5	3200W X 1000D X 2300H	
	MT-A140-220K	2025	33.8	5200W X 1000D X 2300H	
	MT-A140-280K	2577	42.3	7000W X 1000D X 2300H	
	MT-A140- 75K	2250	37.5	6000W X 1000D X 2300H	Inverter chassis unit wholly stored in the panel
	MT-A140-110K	3375	56.3	9300W X 1000D X 2300H	
	MT-A140-150K	4500	75.0	12600W X 1000D X 2300H	
	MT-A140-220K	6750	112.5	19300W X 1000D X 2300H	
	MT-A140-280K	8590	143.2	24800W X 1000D X 2300H	
DC Reactor	T75MH175A	210	3.6	850W X 850D X 850H	DC Reactor wholly stored in the panel
	T50MH270A	245	4.1	900W X 900D X 900H	
	T36MH350A	270	4.5	950W X 950D X 950H	
	T25MH530A	530	8.8	1350W X 1350D X 1350H	
	T16MH672A	580	9.6	1390W X 1390D X 1390H	

1. IP5X – – – IEC Publication 52G
2. The brake unit is not included.
3. The values in the table are different depending on the operational conditions and ambient temperature.
   (Heat generation at any other place except the inverter is not taken into consideration.)
4. The values in the table show the areas which are effective for heat radiation.
5. When the heat radiation fins are outside the panel, the loss shows the heat which is generated to inside the panel of the inverter unit.
6. Since the panel dimensions are the values gained when the surrounding of the whole (including the ceiling area) is free, it is necessary to separately investigate them if any side is blocked by the row panel, etc.
7. In addition to the size of the panel which stores DC Reactor is finally necessary to determine the panel dimensions with the heat radiating area taken into consideration.

3.5.1 Enclosure equipped with heat pipe type heat exchanger

By installing a heat pipe type heat exchanger for panels, dissipate the losses inside panel to the outside. Make sure structure allows room for maintenance on outside heat pipe as well as air filter, inner-inverter cooling fan, and cooling fan.



3.5.2 Enclosure equipped with air conditioning heat exchanger (cooler unit)

It is possible to apply a cooler unit for panel cooling in the place of heat pipe heat exchanger. There are such models that can exhaust up to 2000W with one unit.
Decide on structure according to reliability of cooler and maintainability of air filter.

3.6 HEAT LOSSES OF INVERTER CHASSIS UNIT AND DC REACTOR

Watt losses of inverter chassis unit and DC reactor are as follows:
Note:
(1) No consideration of other losses except for above both equipments is included.
(2) On designing the panel enclosure, other losses must be considered.

(1) In case of installing both inverter chassis unit and DC reactor in the panel enclosure.

Inverter Chassis Unit		DC Reactor		Total
Model	Watt loss (W)	Model	Watt loss (W)	Losses (W)
MT-A140-75K	2250	T75MH175A	210	2460
MT-A140-110K	3375	T50MH270A	245	3620
MT-A140-150K	4500	T36MH350A	270	4770
MT-A140-220K	6750	T25MH530A	530	7279
MT-A140-280K	8591	T16MH672A	580	9171

(2) In case of installing the cooling fin of heat sink of inverter chassis unit at outside of the panel enclosure.

A part of losses of inverter chassis unit is dissipated through the fin of it's heat sink to the outside. Heat losses inside the panel enclosure shall be as shown below:

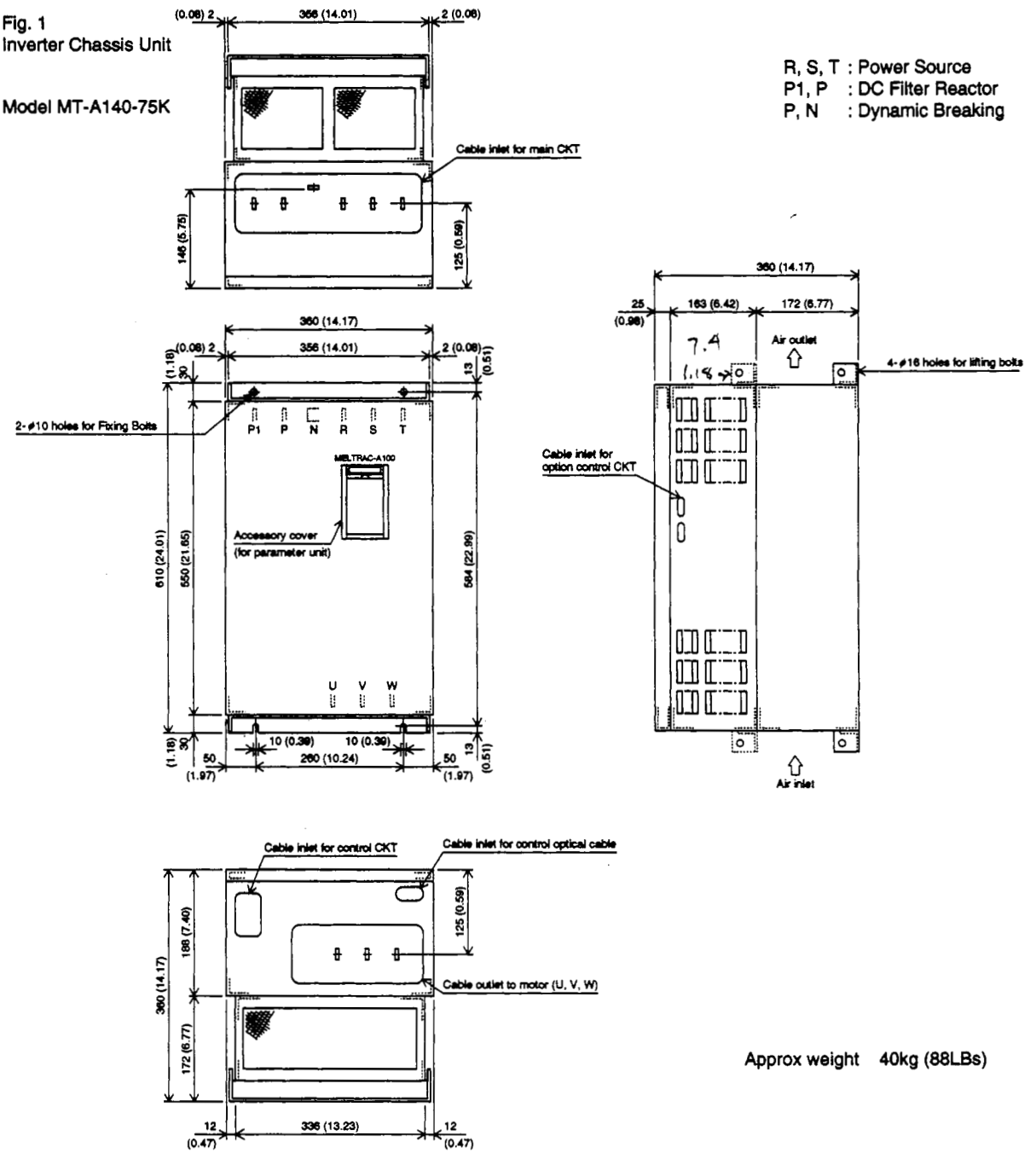
Inverter Chassis Unit		DC Reactor		Total
Model	Watt loss (W)	Model	Watt loss (W)	Losses (W)
MT-A140-75K	750	T75MH175A	210	960
MT-A140-110K	1125	T50MH270A	245	1370
MT-A140-150K	1500	T36MH350A	270	1770
MT-A140-220K	2250	T25MH530A	530	2780
MT-A140-280K	2860	T16MH672A	580	3157

3.7 OUTLINE DRAWINGS OF INVERTER CHASSIS UNIT AND DC REACTOR

Fig. 1
Inverter Chassis Unit

Model MT-A140-75K

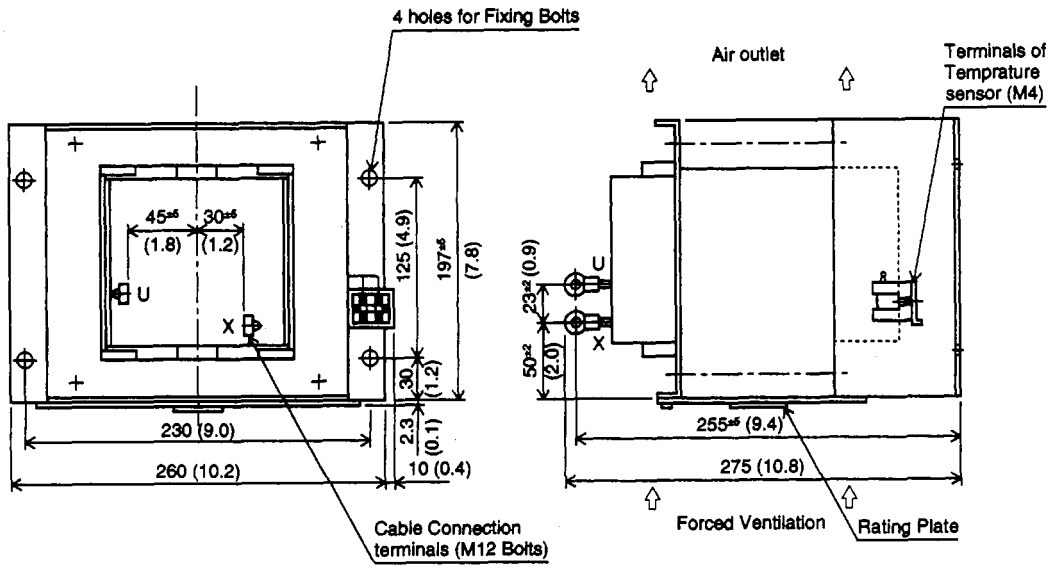
R, S, T : Power Source
P1, P : DC Filter Reactor
P, N : Dynamic Breaking

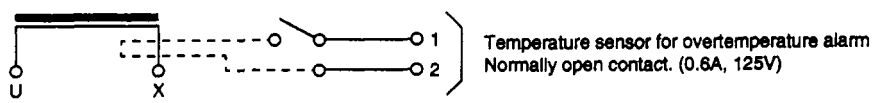


Approx weight 40kg (88LBs)

Unit : mm, kg
where Number in bracket is inches, Lbs.

Fig. 2 DC Reactor Model T75MH175A for Inverter chassis unit Model MT-A140-75K





NOTE 1) The accompanying DC Filter (Reactor) is manufactured with the condition that it must be air-cooled (air volume of 4 – 5m/sec. blown) from forced ventilation. Please consider the air-cooling structure based on this condition.

2) DC Filter is equipped with temperature sensor. Please connect it to the auxiliary signal input terminal with normally open (NO) contact 0.6A, 125V.

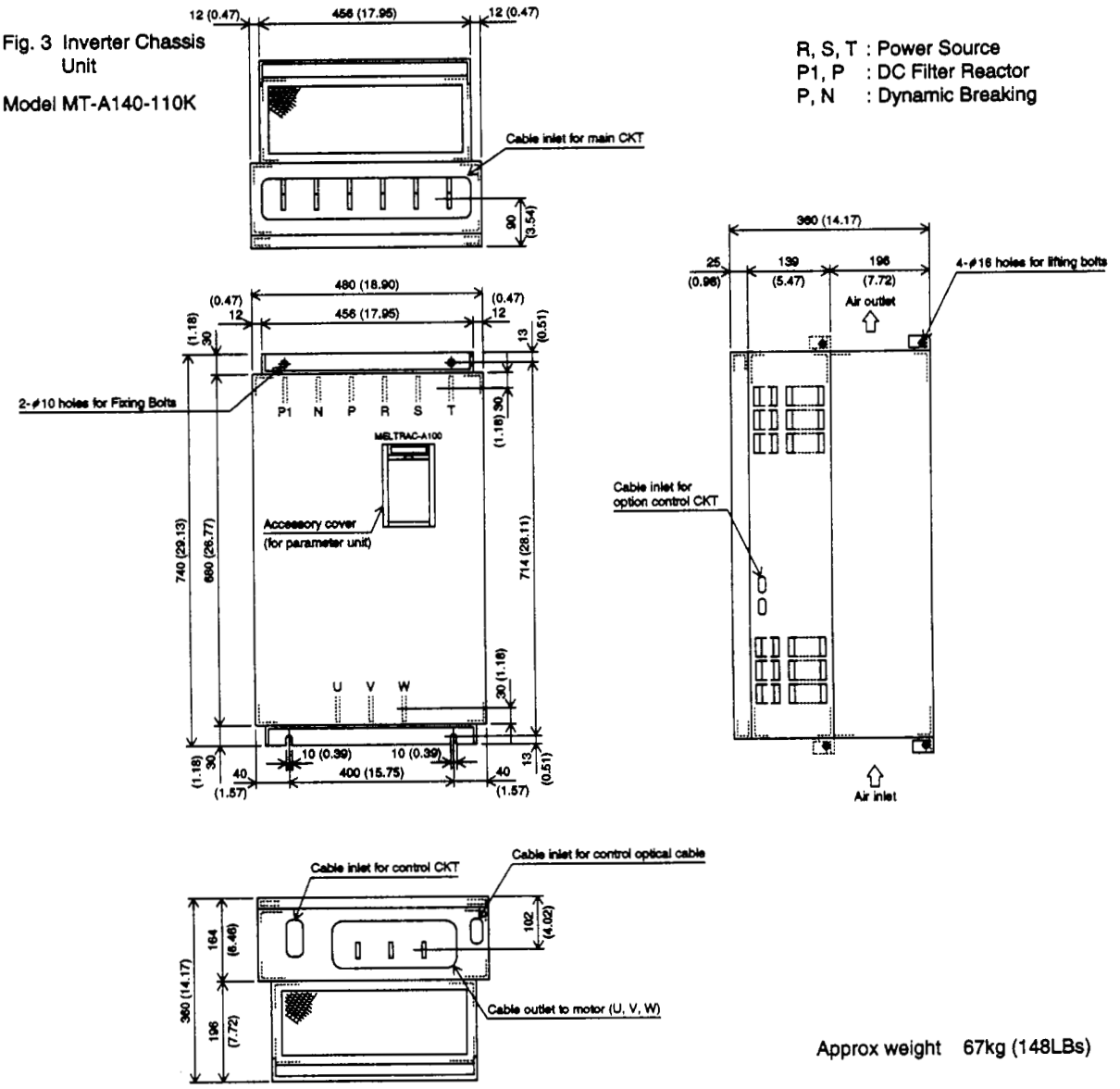
Unit : mm. kg
where Number in bracket is Inches, LBs.

Approx weight 22kg (49LBs)

Fig. 3 Inverter Chassis Unit

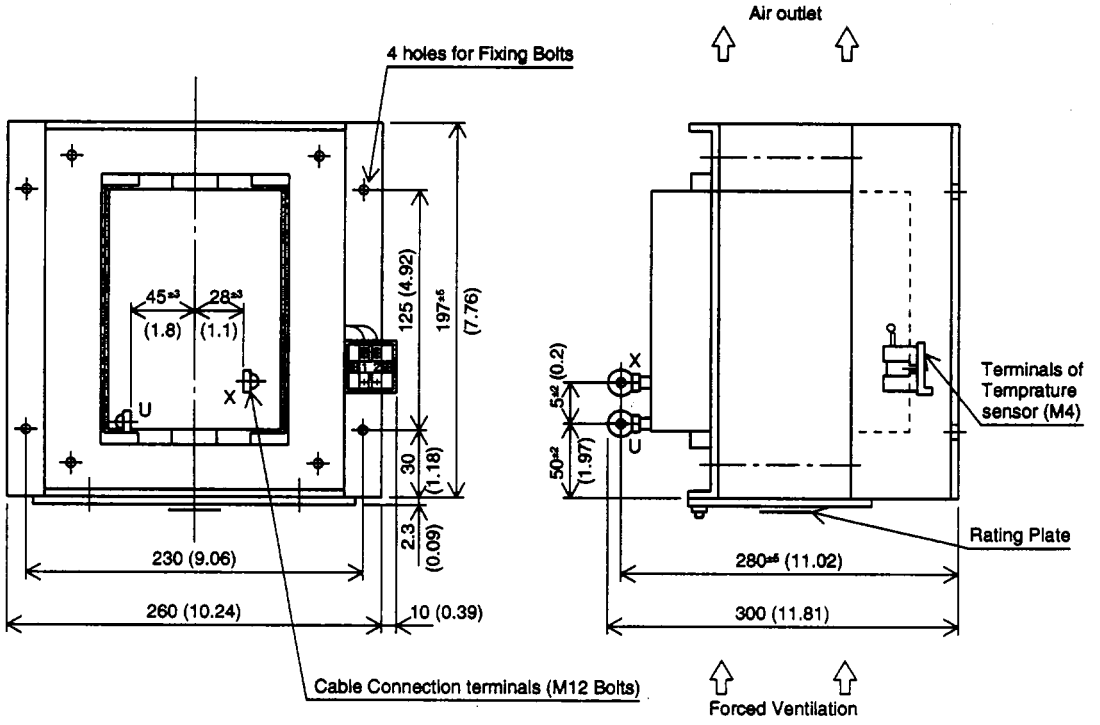
Model MT-A140-110K

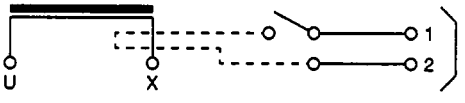
R, S, T : Power Source
P1, P : DC Filter Reactor
P, N : Dynamic Breaking



Approx weight 67kg (148LBs)

Fig. 4 DC Reactor Model T50MH270A for Inverter Chassis Unit Model MT-A140-110K





Temperature sensor for overtemperature alarm
Normally open contact. (0.6A, 125V)

NOTE 1) The accompanying DC Filter (Reactor) is manufactured with the condition that it must be air-cooled (air volume of 4 – 5m/sec. blown) from forced ventilation. Please consider the air-cooling structure based on this condition.

2) DC Filter is equipped with temperature sensor. Please connect it to the auxiliary signal input terminal with normally open (NO) contact 0.6A, 125V.

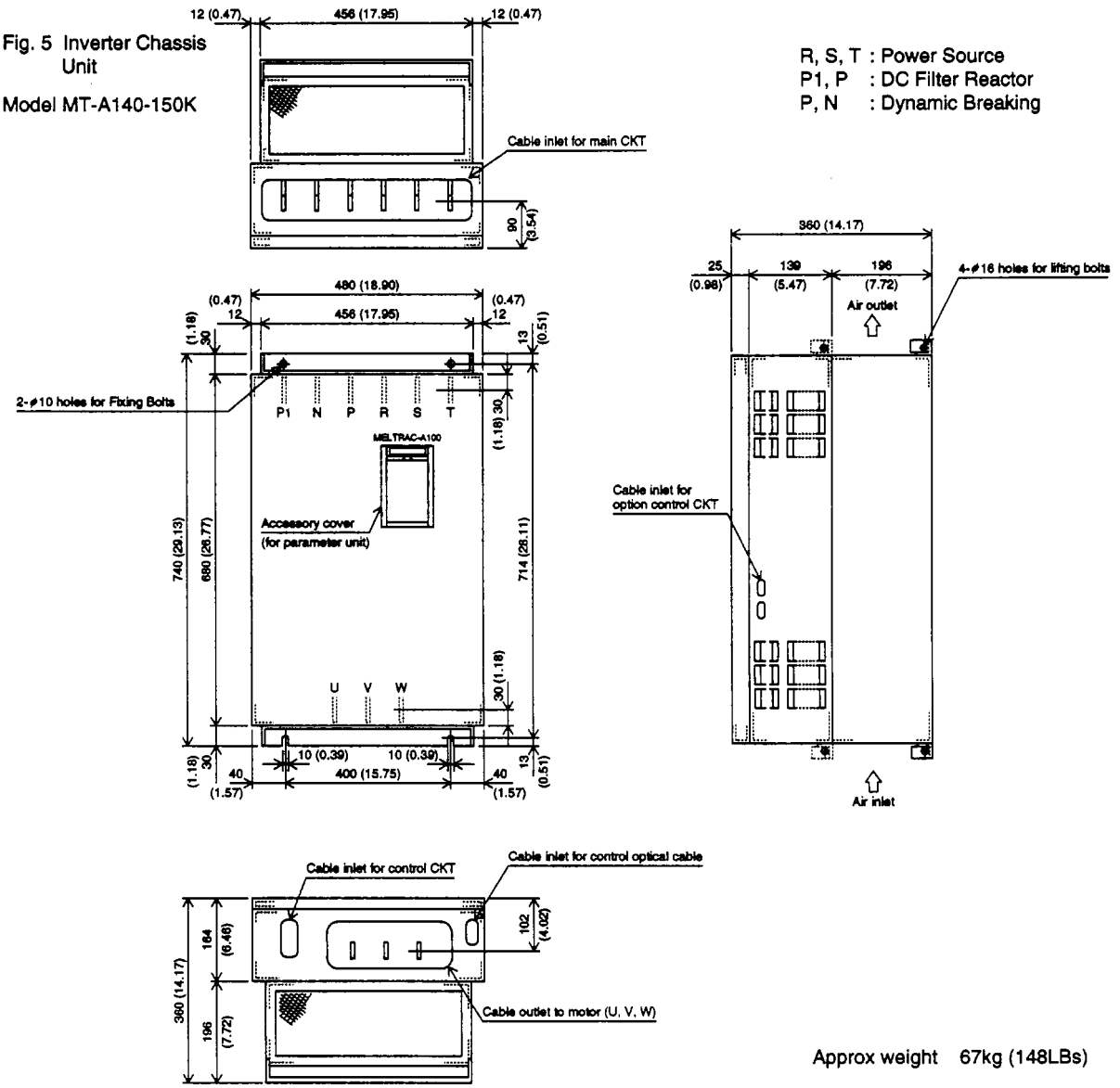
Unit : mm. kg
where Number in bracket is Inches, LBs.

Approx weight 30kg (66LBs)

Fig. 5 Inverter Chassis Unit

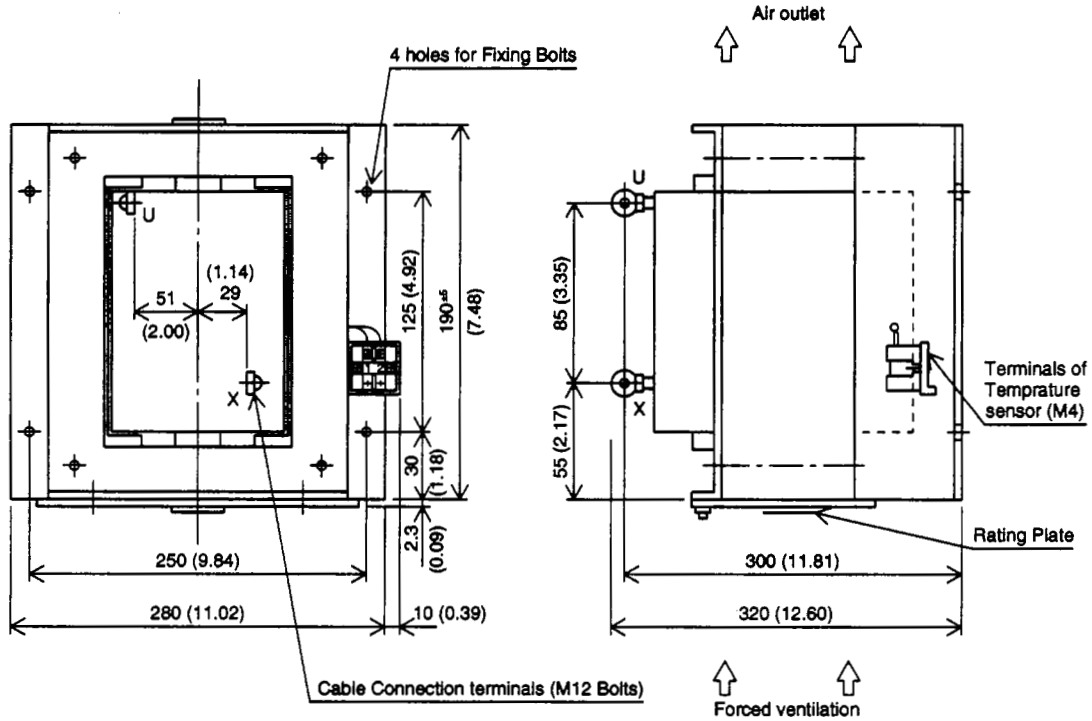
Model MT-A140-150K

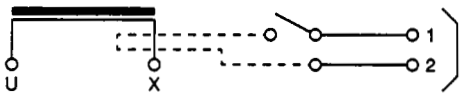
R, S, T : Power Source
P1, P : DC Filter Reactor
P, N : Dynamic Breaking



Approx weight 67kg (148LBs)

Fig. 6 DC Reactor Model T36MH350A for Inverter Chassis Unit Model MT-A140-150K





Temperature sensor for overtemperature alarm
Normally open contact. (0.6A, 125V)

NOTE 1) The accompanying DC Filter (Reactor) is manufactured with the condition that it must be air-cooled (air volume of 4 – 5m/sec. blown) from forced ventilation. Please consider the air-cooling structure based on this condition.

2) DC Filter is equipped with temperature sensor. Please connect it to the auxiliary signal input terminal with normally open (NO) contact 0.6A, 125V.

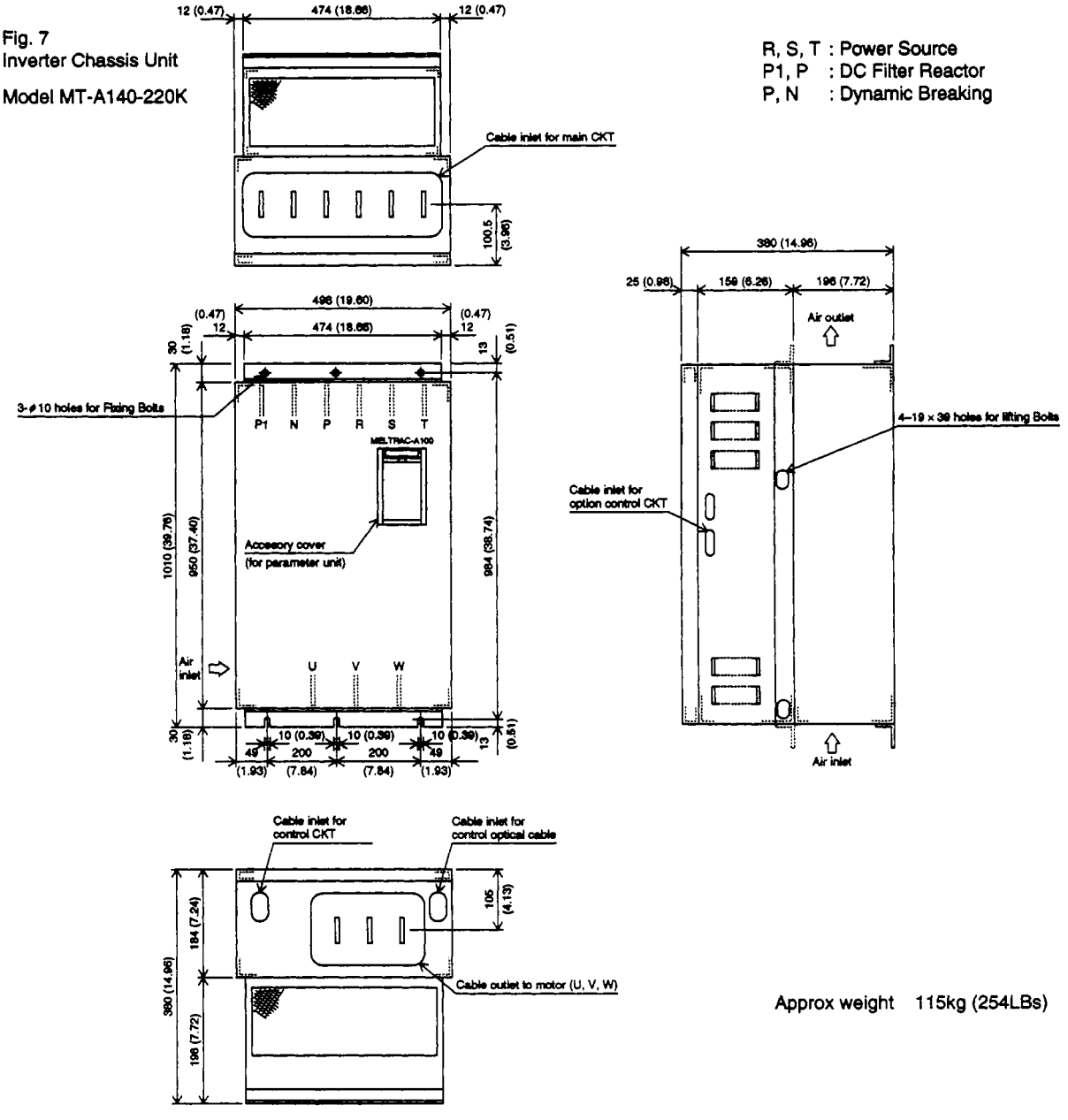
Unit : mm. kg
where Number in bracket is Inches, LBs.

Approx weight 36kg (79LBs)

Fig. 7
Inverter Chassis Unit

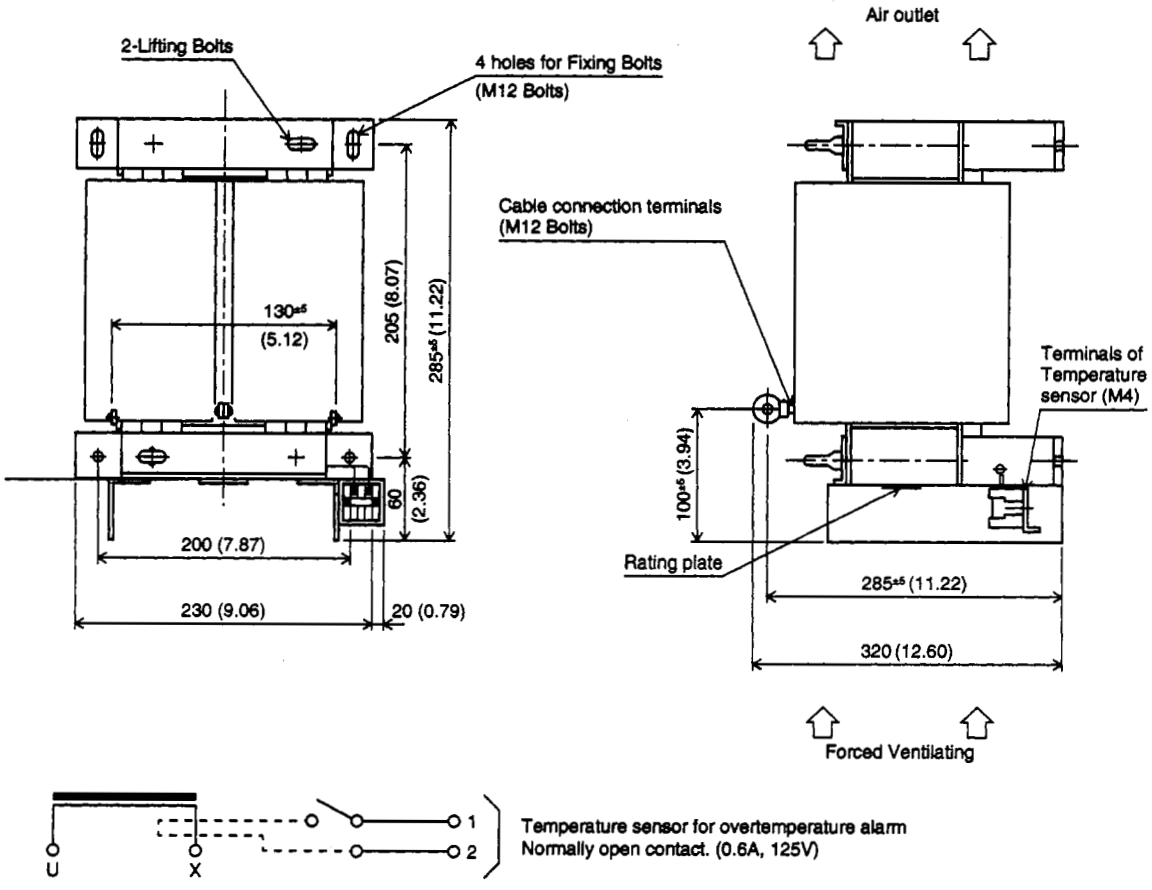
Model MT-A140-220K

R, S, T : Power Source
P1, P : DC Filter Reactor
P, N : Dynamic Breaking



Approx weight 115kg (254LBs)

Fig. 8 DC Reactor Model T25MH530A for Inverter Chassis Unit Model MT-A140-220K



NOTE 1) The accompanying DC Filter (Reactor) is manufactured with the condition that it must be air-cooled (air volume of 4 – 5m/sec. blown) from forced ventilation. Please consider the air-cooling structure based on this condition.

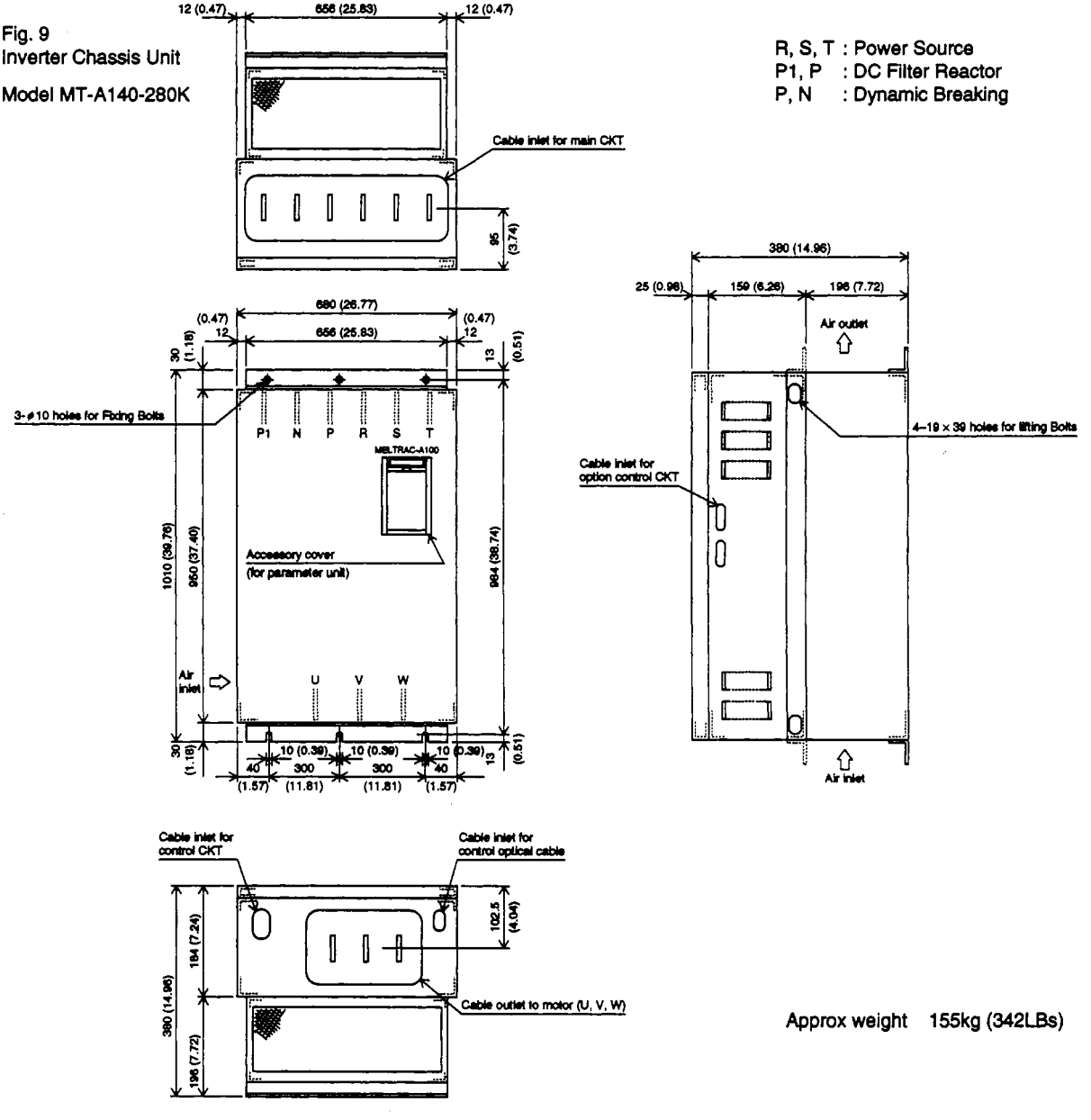
2) DC Filter is equipped with temperature sensor. Please connect it to the auxiliary signal input terminal with normally open (NO) contact 0.6A, 125V.

Unit : mm. kg
where Number in bracket is Inches, LBs.

Approx weight 42kg (93LBs)

Fig. 9
Inverter Chassis Unit

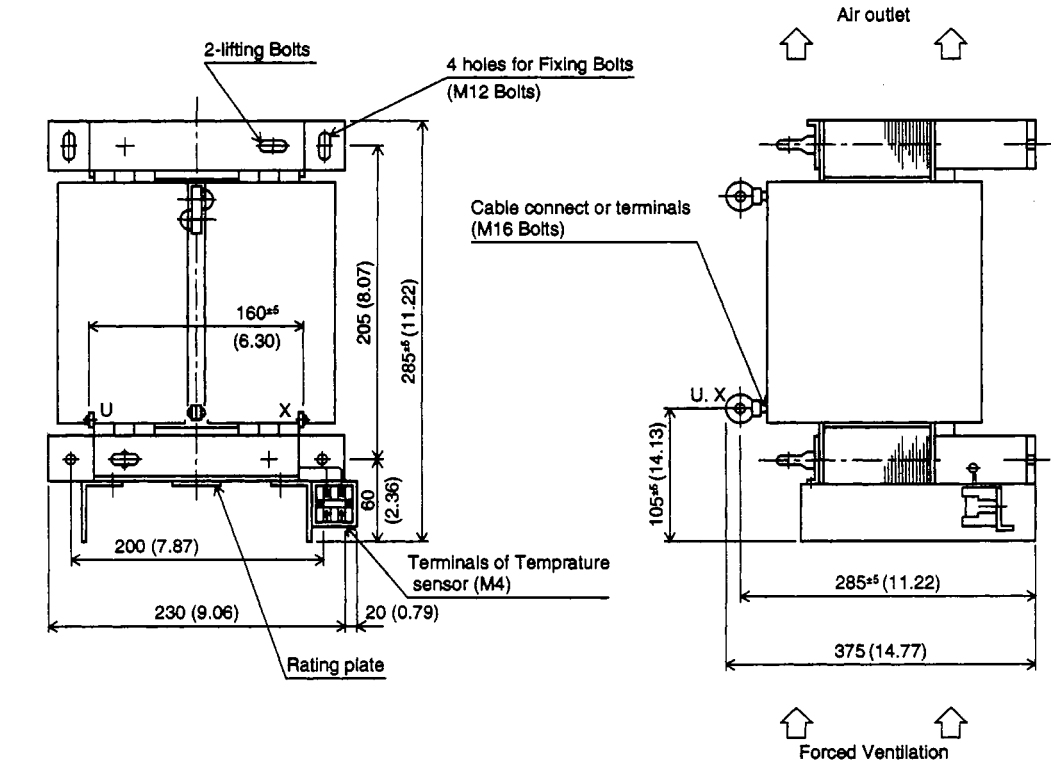
Model MT-A140-280K



R, S, T : Power Source
P1, P : DC Filter Reactor
P, N : Dynamic Breaking

Approx weight 155kg (342LBs)

Fig. 10 DC Reactor Model T16MH672A for Inverter Chassis Unit Model MT-A140-280K



NOTE 1) The accompanying DC Filter (Reactor) is manufactured with the condition that it must be air-cooled (air volume of 4 – 5m/sec. blown) from forced ventilation. Please consider the air-cooling structure based on this condition.

2) DC Filter is equipped with temperature sensor. Please connect it to the auxiliary signal input terminal with normally open (NO) contact 0.6A, 125V.

Unit : mm. kg
where Number in bracket is Inches, LBs.

Approx weight 50kg (110LBs)

4. PRECAUTIONS ON DESIGNING INVERTER PANELS

4.1 PRECAUTIONS ON DESIGNING CIRCUITS

(1) The circuit breaker installed on the input side of the inverter should be provided with a shunt trip device (SHT). To ensure safety, turn off this circuit breaker if the inverter stops operation to protect the devices.
If a magnetic contactor is provided on the input side of the inverter, also turn off the magnetic contactor for the same situation and reason as for the circuit breaker.

(2) A magnetic contactor is not necessarily provided on the input side of the inverter. However, if providing one so as not to apply power to the main circuit for safety reasons during inverter stop, the operating sequence with respect to the inverter should be as follows.
  (a) Time t1 from picking up of input contactor (88) to starting inverter operation is the time for checking that the DC voltage (the capacitor charge voltage) has reached the specified level. (t1 = approximately 1 second)
  (b) Make sure that the input magnetic contactor turns off in 0.5 second after the inverter stops. It is not preferable that the input magnetic contactor has turned off before the inverter stops.

(3) Contactors 88L1, 88L2 and 88H are necessary to install a backup circuit operating on the commercial power line.
  (a) Be sure to mechanically and electrically interlock commercial line contactor (88H) and inverter output contactor (88L2) so that these two contactors will not turn on simultaneously. If the commercial line power is applied to the input terminals of the inverter from 88H through 88L2, the inverter will be damaged.
  (b) When switching from the operation on the commercial power line to the operation on the inverter power line, first turn on 88L1 to apply power to the inverter input terminals. When the DC voltage is established (takes approximately one second), turn off 88H. Then turn on inverter output contactor (88L2). This sequence is to avoid a rush charge current from flowing into the inverter.

(c) When changing from the operation on the inverter power line to the operation on the commercial power line, the inverter then 88L2 are to be turned off. Then, wait until the residual motor voltage disappear (approximately three seconds) before turning on **88H**. At this stage, voltage drop in the power source due to the start-up current and false operation of the thermal relays (fans) should be checked.

(4) If a protective function is activated, do not reset the system from the remote panel. Otherwise, the cause of the failure will not be known. If the accident is critical but the cause is not known, it may worsen.

(5) When stopping the motor then restarting it while the motor is still running freely, the restart function on the commercial power line of the inverter is activated to subsidize the free run first. The inverter then accelerates the motor.

(6) The input and output signals in the inverter control circuit are designed to operate under direct current 24 volts. Refer page 12 for the specifications of the control devices. Check the coil current and the minimum contact current of the relays to be used for selection.

(7) Install the exhaust fan circuit. Refer to "LIST OF PERIPHERALS" for the leading particulars of the exhaust fan.

(8) It is recommended that the control power should remain on even when the main circuit power is off. Otherwise, when a protective function is activated the control circuit power is turned off at the same time as the main ircuit power is turned off. This makes investigation on the cause of failure difficult. Or, it is difficult to check the control circuit operation without turning on the main circuit.

(9) The frequency setting signal circuit uses micro current. Install micro signal contacts in this circuit to ensure sound contact.

(10) Install a ground fault relay, if used, on the inverter power line. The ground fault relay should be capable of handling high harmonics and surge created by the inverter.

(11) If thyristors are installed in the same power line or if the line voltage fluctuates 3 % or more, install an AC reactor (optional).

(12) If a fluorescence lamp is installed in the inverter panel, install a Spark Suppressor (CR50500, made by Okaya) at the terminals of the fluorescence lamp.

4.2 PRECAUTIONS ON DESIGNING CONSTRUCTION

(1) Install the inverter at the lower section of the inverter panel. Install the direct current reactor above the inverter. This is to ensure that fresh air coming in through the bottom of the inverter panel cools the inverter first.

(2) Forced-cool the direct current reactor at an air velocity of approximately 5 m/sec.

(3) Do not install the inverter panel in a dusty environment. Otherwise, dust causes poor contact, short circuit, deterioration in insulation when dust contains moisture and reduction in cooling air flow and subsequent insufficient cooling by clogged filter.

(4) If the inverter panel should be installed in a dusty environment, install the inverter heat radiation fins and direct current reactor outside the panel. Make the panel fully-closed. Use a heat pipe cooling device to remove heat. Make sure that the inverter heat radiation fins are accessible and removable to facilitate maintenance and repair.

(5) If the inverter panel is installed in an environment where corrosive gases or salt exist, provide the same precautions described in (4) above. Otherwise, the printed circuit boards and components are corroded and relays, switches and connectors produce poor electrical contact.

(6) Lay out the parts and external terminals so that the main circuit and the control circuit are completely isolated from the other.

(7) Use shielded cables for the analog, pulse and PLG signals so that they will not be affected by induction from other signals.

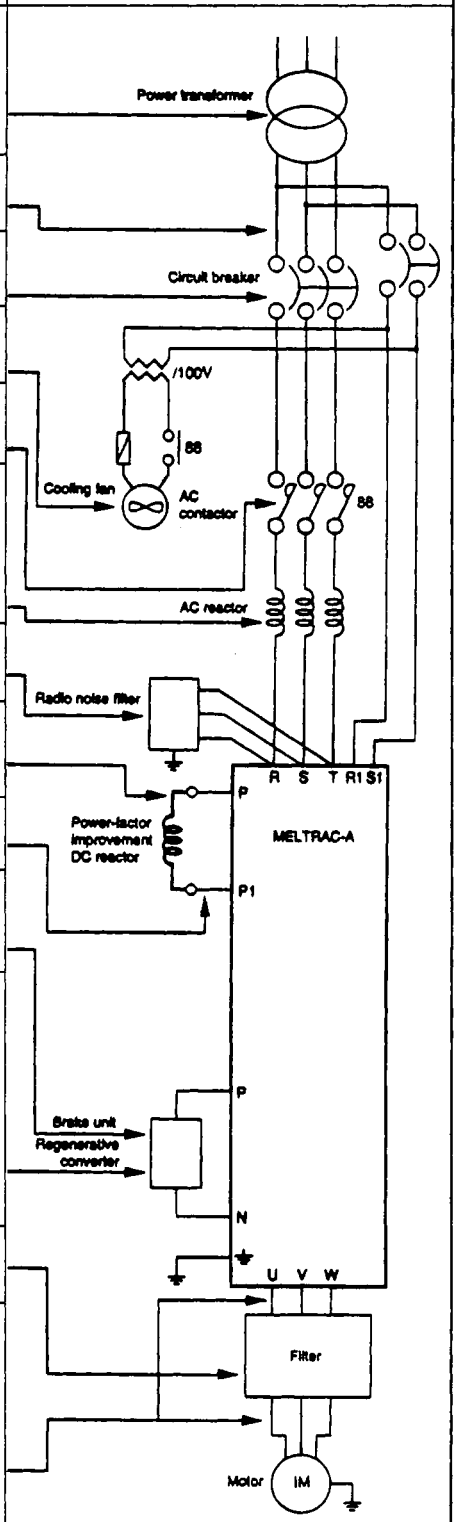
(8) When installing the parameter unit on the door of the inverter panel, use the exclusive cables (optional). Install the cables so that excessive forces will not exerted on the cables to avoid them from being disconnected from the parameter unit.

(9) Grounding is one of the most important wirings for the inverter panel. Provide a grounding bus line that can be connected to grounding cable of 38mm^2.

(10) The cable for the main circuit will be fairly large in diameter. Determine the device considering the cable routing between the devices and between the devices and external terminals.

5. SELECTING PERIPHERALS AND OPTIONS
5.1 GUIDELINE FOR SELECTING PERIPHERALS AND OPTIONAL DEVICES

■ Selection Guide

Name (model)	Description	Installation
Power source capacity	Capacity must exceed kVA described in "Power supply Capacity" standard specifications (p. 26). With the DC reactor installed, the power factor of power source will be approximately 95%. This value is less than or equal to the power factor when the motor is operated using commercial power.	
Line-side main circuit cable	Select proper cable size.	
Circuit Breaker	Select proper input circuit breaker.	
Cooling Fan	Install cooling fan to discharge heat (generated by inverter and DC reactor) outside of enclosure.	
AC contactor	Select appropriate size AC contactor.	
AC reactor for power coordination	Install to prevent inverter malfunction if surge voltage is generated on power line from a thyristor converter or vacuum contactor on the same power system. Also install when the supply voltage imbalance is greater than 3%.	
Radio noise filter (FR-BIF)	Use to reduce noise in the AM radio frequency band which may be generated by the inverter. For use on inverter input side only.	
DC reactor for power factor improvement	Install the DC reactor specially designed for the MELTRAC-A. Power factor will be approximately 95%.	
Reactor connecting cable	Select proper cable size.	
Brake unit (MT-BU) and discharge resistor (MT-BR)	This brake unit improves inverter braking capability. Use the brake unit in combination with a discharge resistor.	
Power regenerative converter (available soon)	Use when continuous or high braking capacity is required and when operating and stopping high inertial loads (GD^2) frequently. This unit is a high-performance brake unit that saves energy by regenerating power back to the power source. Unit advantages include no need for discharge resistors and significantly cooler operation.	
Sine-wave filter	This filter reduces motor noise. The next largest inverter for the motor rating should be selected.	
Load-side main circuit cable	Select proper cable size.	

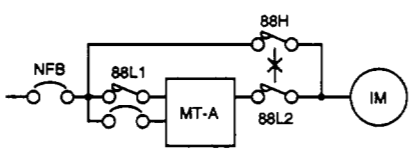
5.2 LIST OF PERIPHERALS

This selection table is based on the standard design motors manufactured by Mitsubishi Electric Corporation (Note 1).

Voltage	Variable torque motor rating (Note 6)	Applicable inverter type	DC reactor (accessory)	Fuseless breaker (Note 2)	Electromagnetic contactor (Note 3)	Wire (mm²) (Note 4)			Exhaust fan (reference) (Note 5)
						R, S, T	U, V, W	P, P1	
400V to 460V	75kW (100HP)	MT-A140-75K	T75MH 175A	NF225 225A (NF225 225A)	S-K100 (S-K150)	(130A) 60	(140A) 60	(160A) 60	PF-25ASD 1φ 100/110V 50/60Hz 12m³/min 3mmAg Suction port, 500 X 500mm or more
	90kW (125HP)	MT-A140-110K	T50MH 270A	NF225 225A (NF400 300A)	S-K150 (S-K180)	(157A) 60	(174A) 60	(192A) 80	
	110kW (150HP)	MT-A140-110K	T50MH 270A	NF225 225A (NF400 350A)	S-K180 (S-K220)	(190A) 80	(205A) 80	(233A) 100	
	132kW	MT-A140-150K	T36MH 350A	NF400 400A (NF400 400A)	S-K180 (S-K220)	(230A) 100	(235A) 100	(282A) 100	
	150kW (200HP)	MT-A140-150K	T36MH 350A	NF400 400A (NF400 400A)	S-K300 (S-K300)	(260A) 125	(285A) 125	(318A) 150	PF-30BSD 1φ 100/110V 50/60Hz 20m³/min 4mmAg Suction port, 500 X 500mm or more
	160kW	MT-A140-220K	T25MH 530A	NF400 400A (NF600 500A)	S-K300 (S-K400)	(278A) 125	(305A) 150	(340A) 2X100	
	185kW (250HP)	MT-A140-220K	T25MH 530A	NF400 400A (NF600 500A)	S-K300 (S-K400)	(322A) 150	(350A) 150	(395A) 2X100	
	200kW	MT-A140-220K	T25MH 530A	NF400 400A (NF600 600A)	S-K400 (S-K400)	(348A) 2X100	(375A) 2X100	(426A) 2X100	
	220kW (300HP)	MT-A140-220K	T25MH 530A	NF600 500A (NF600 600A)	S-K400 (S-K600)	(383A) 2X100	(410A) 2X100	(470A) 2X100	
	250kW (350HP)	MT-A140-280K	T16MH 672A	NF-600 600A (NF600 600A)	S-K600 (S-K600)	(435A) 2X100	(460A) 2X100	(533A) 2X125	
	280kW (400HP)	MT-A140-280K	T16MH 672A	NF-600 600A (NF800 800A)	S-K600 (S-K600)	(487A) 2X125	(515A) 2X125	(596A) 2X150	

Notes 1. Motors of 75kW or more are basically custom-made. Their characteristics depend on the number of poles, the protection form, and the manufacturer.
Check the specifications of the motor actually used.

2. Types in parentheses are applied when devices are run on commercial power. Select an interruption capacity that is suitable for the short-circuit capacity of the power source. To use a leakage breaker, select one that accommodates harmonic surges and has a sensitivity current of 100 to 500 mA.



3. The model in parentheses is the contactor to be used on the motor side when run on commercial power.
4. For cables outside the panel (R, S, T, U, V, and W), a larger size may be selected than listed in this table depending on the cabling conditions and the cabling distance.
5. An exhaust fan is needed to discharge heat generated in the panel. Select a fan that can provide an adequate exhaust air flow taking into account the pressure loss caused by the filter at the inlet port.
6. HP rating is only at 460V.

5.3 No-Fuse Breakers (NFBs) and Input Circuit Fuses

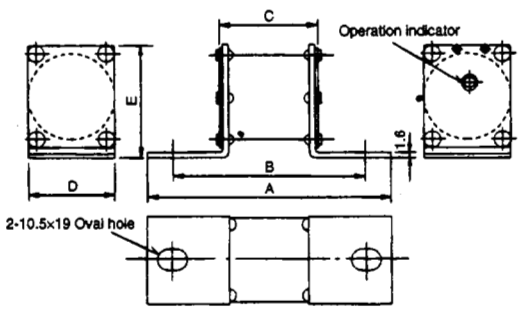
(1) Protective coordination

The NFB is used to protect the wiring from damage caused by overload and short-circuit currents. Install the NFB to shut off any accidental current passing the inverter input circuit, such as overload and short-circuit, and minimize the influence of the accident.
Select the NFB of which interrupting capacity is appropriate for the estimated short-circuit current in the circuit according to the overall impedance of the power supply. (For full information, refer to the Mitsubishi no-fuse breaker technical information.)
The master NFB and inverter NFB must be fully coordinated for protection. Should a low-impedance short circuit occur, for example, if the transistors in the inverter circuit of the inverter are damaged or the diodes in the converter circuit are broken, the master NFB may be tripped. Hence, it is necessary to make precheck using the operational characteristic curve. Use of a fast acting fuse for semiconductor element protection allows the coordination range to be expanded by a current limiting effect. (For more information on the fuse, see Table 5.3.1.) When the overall impedance of the power supply line is small, the peak value of the inverter input power supply increases. Therefore, the current peak value must be reduced by the current limiting action of the power-factor correcting reactor.
Therefore, the MT-A series is designed to attach a power factor improving direct current reactor to the direct current circuit as standardized attachment.

Table. 5.3.1 Fast Acting Fuse Selection Table

Inverter Model	Fuse Rating		Fuse type
	Rated current	Interrupting capacity	
MT-A140-75K	200	500V 100kA	FLG-500 x 200
MT-A140-110K	300		FLG-500 x 300
MT-A140-150K	400		FLG-500 x 400
MT-A140-220K	500		FLG-500 x 500
MT-A140-280K	600		FLG-500 x 600

* **for details on characteristics of fast acting fuse, refer to "Mitsubishi Semi-Conductor Protection Fast Acting Fuse" catalog**



Style	A	B	C	D	E
FLG-250 x 300	100	68	34	40	45.5
FLG-250 x 400/500	100	68	34	45	53
FLG-500 x 200	110	78	44	40	45.5
FLG-500 x 300/400/500/600	120	88	54	45	53

(2) Setting the rated current and the interrupting capacity of inverter primary NFB

The NFB in the inverter primary circuit is used to protect the inverter primary wiring form overload and short circuit. A large in rush current will not occur on inverter operation. However, on a system designed so that commercial operation for back up is possible, an NFB with large enough rated current must be selected so that it will not trip at activation current on commercial operation. Especially when load GD is large (as in a fan), be sure to select an NFB with large rated current.
Interrupting capacity should be determined by calculating short-circuit current from system impedance and capacity of NFB should be larger than the calculated value.

5.4 Magnetic Contactor

(1) Inverter primary magnetic contactor (MC)

The inverter primary circuit can be directly connected with the NFB, in some cases, the MC may be provided for any of the following purposes.

(a) To prevent an accident caused by automatic restart when the power is restored after the inverter has been stopped by a power failure. (When an instantaneous power failure of 15msec or longer occurs, instantaneous power failure protection is activated to prevent the inverter from automatically restarting when the power is restored. When a power failure is longer than about 50 to 100msec, the inverter is automatically reset when the power is restored and is therefore restarted automatically if the run signal is on.)

(b) To disconnect the inverter from the power supply when the inverter protective function is activated or when a fault occurs in the drive unit (e.g. emergency stop operation).

(c) To keep the inverter stopped for a long time
The inverter control power supply and cooling fan are always running, consuming a little power. When the inverter is kept stopped for a long time, power can be economized slightly by switching the inverter power supply off.

(d) To separate the inverter from the power supply to ensure safety during maintenance and inspection. Since the inverter primary MC is used for the above purposes, the number of on/off times is extremely small. Select the MC which conforms to Standard Code JEM1038-AC Class 3 in relation to the inverter input current.

Note: The inverter may be run and stopped by switching the MC on and off. However, frequent start and stop using the MC must be avoided because an inrush current repeated at power-on reduces the life of the converter circuit (switching life is about 200,000 times). Run and stop the inverter by switching on and off the inverter start control terminal (STF, STR).

(2) Inverter secondary magnetic contactor

When a magnetic contactor is provided between the inverter and motor, do not switch on the MC during operation in principle. When the MC is provided for either of the following purposes, switch on the MC when both the inverter and motor are at a stop.

(a) To run the motor by switching between the commercial power supply and inverter In this case, the commercial power supply MC and inverter output circuit MC must be magnetic contactors with electrical and mechanical interlocks and the two MCs must be designed not to turn on at the same time. The transistors are damaged if the commercial power is applied to the inverter output terminals. Select the MC which has a sufficient capacity for the inverter output current. (JEM1038-AC Class 3 or higher) Take special care so that the inverter is not connected with the commercial power supply by an arc generated when the current is shut off.

(b) To use one inverter with several motors by switching the inverter-driven motors from one to another. The MC must be switched on when both the inverter and motor are at a stop. The MC may be switched off during operation. Select the MC which meets JEM-1038-AC Class 3 or higher in consideration of the switching life.

5.5 Thermal Relay

A thermal relay is generally used to protect a general-purpose motor. The current flowing in the general-purpose motor driven from the inverter is about 10% larger than that flowing in the motor driven with the commercial power supply.
For this reason, set the thermal relay to 1.1 times greater than the current value for use with the commercial power supply. Note that the temperature rise of the motor may exceed the permissible value even at the load current of within the rated value when the motor is continuously run at the rated torque at low speed. Therefore, select the motor capacity so that the load torque is less than the permissible motor torque. The MT-A inverters are incorporated with an electronic thermal relay to protect the motor from overload in the low speed range.
When several motors are operated by one inverter or when a special motor is operated, the operational characteristic of the electronic thermal relay cannot be coordinated with the overload thermal characteristic of the motor. Therefore, provide a thermal relay in this case.

5.6 Cable Size and Wiring Distance

(1) Main circuit cables

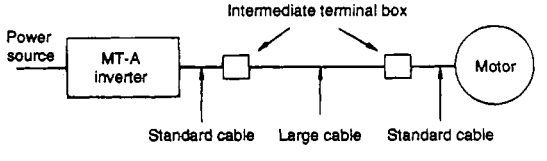
Like that of a general power cable, determine the size of the main circuit cable after examining its current capacity, short circuit protection and cable voltage drop. The effective value of the inverter primary current must be noted because a current larger than the motor overload current may flow depending on the inverter input power factor. If the wiring distance of the cable between the inverter and motor is long, a voltage drop increases, causing the motor torque to be insufficient and the current to increase. In an extreme case, the motor may be overheated. Note that especially when the output frequency is low, the output voltage of the inverter is low accordingly and the rate of voltage drop increases.
Select the cable size so that the voltage drop between the inverter and motor is 3% of the rated voltage.

The line voltage drop can be calculated by the following expression:

$$\text{Line voltage drop [V]} = \frac{\sqrt{3} \times \text{cable resistance [m}\Omega\text{/m]} \times \text{wiring distance [m]} \times \text{current [A]}}{1{,}000}$$

Use a larger cable diameter when the wiring distance is long or it is desired to decrease the voltage drop in the low speed range (torque reduction).

Note: When it is desired to use a larger-diameter cable but it cannot be connected directly with the motor and inverter terminals, provide relay terminal boxes as shown below:



- Wiring length to the motor
  When the wiring distance between the inverter and motor is long, overcurrent protection may be activated by the influence of the charging current (leakage current) due to the stray capacity of the wiring in addition to the aforementioned voltage drop. Hence, the wiring length should be 500m maximum. (When several motors are connected, the overall length should be within 1000m)
  When primary magnetic flux control has been selected, the cable length should be within 30m. A longer cable length may cause instable rotation at low speed, in addition to reduced torque.

(2)Control circuit cables

The cable size of 0.75mm² or larger is enough for use with other than the main circuit, e.g. operation and signal circuits.

A brake wire of 0.75m is recommended for in-panel wiring when directly connected to brake circuit terminal base. (screw for terminal base is M3.)

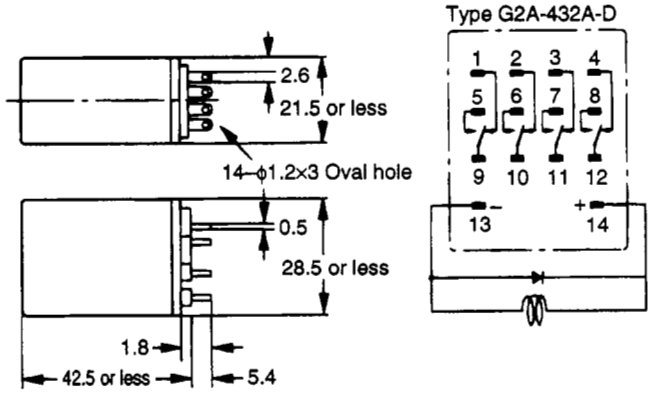
5.7 Earth-Leakage Circuit Breakers (ELCBs)

Since harmonic components are included in the output voltage of the inverter which drives the motor, an earth leakage current occurs continuously due to the electrostatic capacitance to the earth in the electrical path from the inverter to the motor and the stray capacitance between the motor winding and iron core. For this reason, the rated sensitivity current of the ground fault interrupter installed in the power supply side of the inverter should be selected as described below:

Select unit with rated response current at 100 to 500mA.

5.8 Selecting Relay

Relay used for input STF and STR, brake circuits 10, 2, and 5.	Use small signal type (twin contacts) to prevent defective contact. Tateishi: model G2A, Fuji: model 473, 474, etc.
Relay used for output RUN and SU.	Use small relay of under 100mA of DC12V or DC24V. Be sure to attach by diode. Omrom: G2A-432A-D, G2R-1-SD, etc.

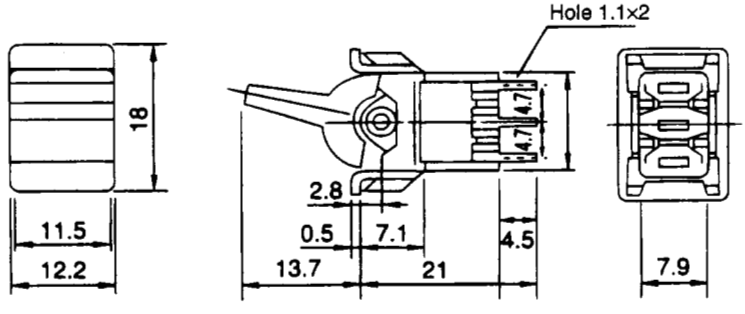


- Take care not to mistake polarity when wiring.

5.9 Selecting Braking Circuit Input Switch

Use switch for infinitesimal current to prevent contact defects.

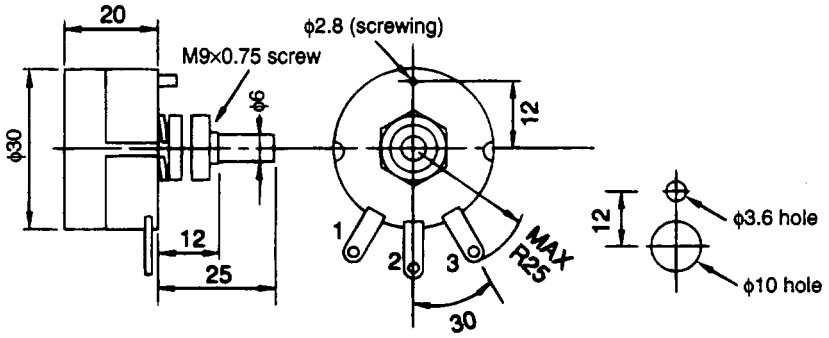
Example of switch (Nippon Kaiheiki)
Paddle Locker Switch (M-2012J-G-W1W)



5.10 Selecting the Frequency Setting Potentiometer

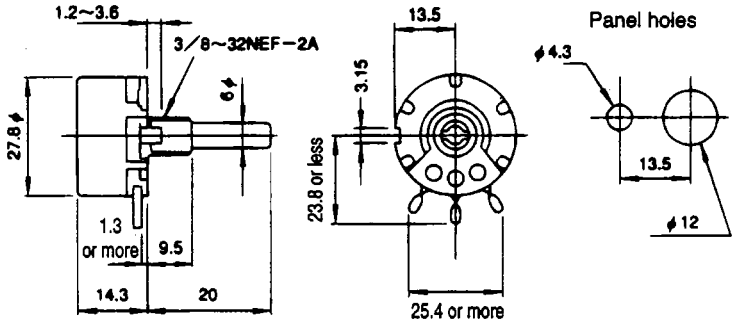
(1) Type: WA2WYA2SEBK1kΩ (Japan Resistor)
Wound variable resistor 2W1kBΩ characteristic

(2) Type: RVJ4MAT1WKLB specially made (Tokyo Kosumosu)



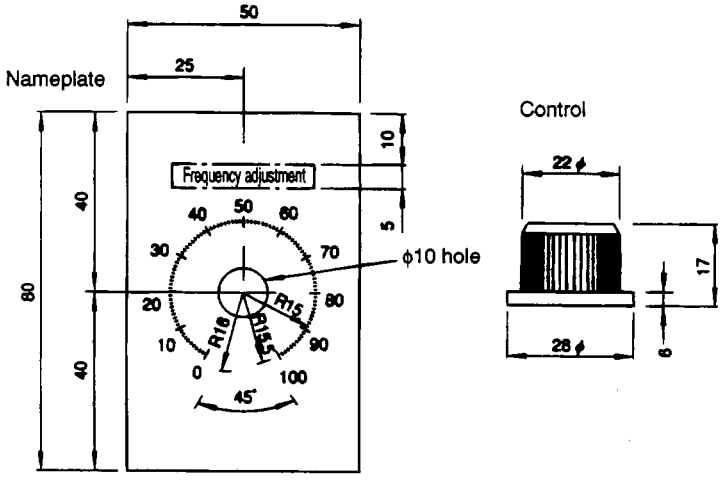
WA2WYA

(Unit : mm)



RVJ4NAT

5.11 Frequency Setting Device Name Plate and Dial



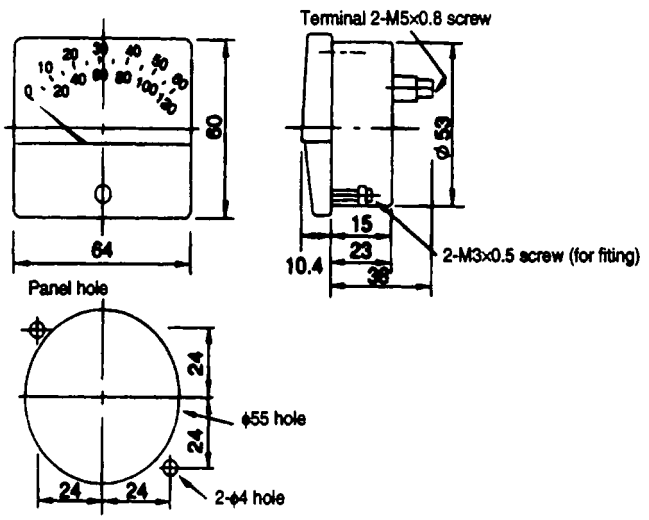
5.12 Selecting the Frequency Meter and Calibration Resistor

The manual controller with frequency meter (such as the FR-AX) is available. When only a frequency meter is installed separately, use the instrument of the following specifications:

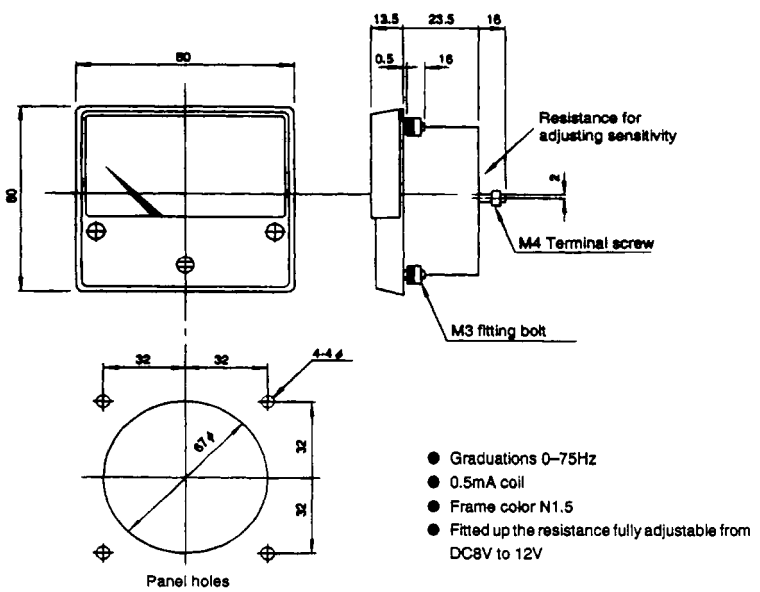
Moving-coil DC ammeter
Full scale 1mA (internal resistance 300Ω max.)
Graduations: 60, 120, 240Hz in full scale.
Alternatively, graduate in rpm according to the number of poles of the motor used.

- Frequency meter

[Example] (1)Connecting between FM and SD
Type: YM206G, 1mA, BKO-C1529H74
Graduations: 0 to 65, 130Hz, double graduations



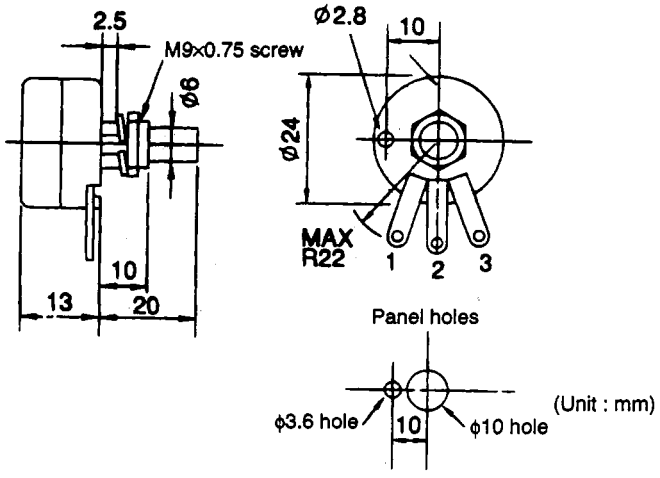
[Example] (2)Connecting between AM and 5
Type: YM-8



- Scale calibration resistor
  Frequency scale terminal FM of inverter generates maximum approximately 5VDC. Thus, calibrate scale by using the below specified variable resistor. This is not necessary when calibration is conducted by applying parameter unit.
  Scale calibration resistor over 1/3W 10kΩ

(Example)

Type: RV24YN, 20SB10kΩ-K (Tokyo Kosumosu)
Carbon film type variable resistor, 1/3W 10kΩB characteristic



5.13 Selection of Twist wire and Shield wire

(Example) Twist wire
Type: KV-2C × 0.35Q (Daiichi Denko)

Number of poles, size (mm²)	Finished exterior perimeter (mm)	Characteristics of one electric wire				Color
		Structure (poles/mm)	Conductor resistance (Ω/km)	Rated voltage (V)	Allowable temperature (°C)	
2×0.3	2×0.3	12/0.18	Under 64.4	300	60	Red/White

(Example) Multicore shield wire
Type: VCT-S3C × 0.55Q (Jyoban Densen)

Number of poles, size (mm²)	Finished exterior perimeter (mm)	Characteristics of one electric wire				Color
		Structure (poles/mm)	—	Rated voltage (V)	—	
3×0.3	8.3	20/0.18	—	600	—	Grey

6. Notes on Installation of the Inverter in the Panel

6.1 Position of Inverter Installation

(1)Clearances around the inverter

To ensure proper heat dissipation and easy access, leave at least the following dimensions between the inverter and other devices or panel walls. The following minimum dimensions must be left under the inverter as wining space and above the inverter as dissipation space.

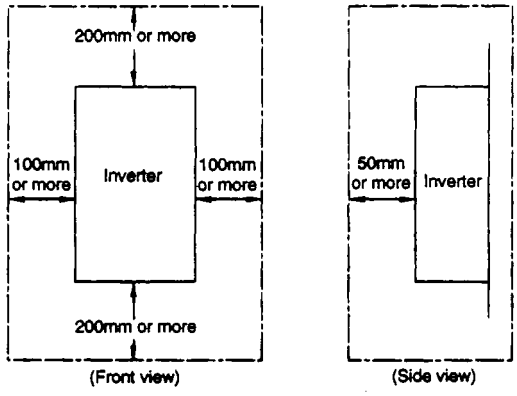


Fig.6.1.1 Clearances around the Inverter

(2)Installation direction of the inverter

Install inverter so that it is situated horizontally in the normal fashion. Do not install it horizontally or in any other manner.

(3)Layout Inside Panel

Inside panel layout of inverter and direct current reactor should have the inverter situated below the direct current reactor, so that sucked in air from bottom of panel can cool the inverter. (This also makes wiring between the inverter and direct current reactor easier.)

(4)Upper Part of Inverter

The inverter unit is installed with a cooling fan inside, making heat in the inverter to rise from the lower part of the unit to the top.

Therefore, if another unit or device is to be situated above the inverter, such should be a unit or device that is immune from defects caused by heat.

Set surrounding temperature so that temperature at fan suction at the bottom of the inverter is below 50°C.

(5)Separation Wiring

Layout of parts and external terminals should be planned so that wiring for the main circuit and braking circuit is completely separated.

(6)Lead of Main Circuit

The wiring of the main circuit will become quite thick. Be sure to check the bending radius of wires and the wiring layout between devices and external terminals prior to actual wiring to prevent excessive force to buld on the main circuit terminal of inverter.

(7)Layout of Exhaust Fan and Inverter

The cooling fan causes the heat generated in the inverter to flow from the bottom to top of the unit as warm wind. When a fan is installed to ventilate the heat, determine the installation place of the ventilating fan after full consideration of the wind flow. (The wind flows in a path where resistance is small. Lay parts out so that cooling air blows on the inverter.)

*Direct current reactor needs to be cooled at wind speed of approximately 5m/sec. Direct current can be cooled by exhaust fan if placed wind duct of exhaust fan.

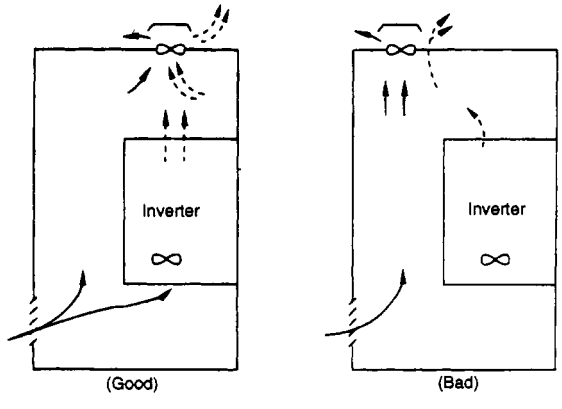


Fig.6.1.2 Positions of Ventilation Fan and Inverter

6.2 Noise filter

(1) Installation position

Since the noise filter produces a greater effect when it is located closer to the source of noise, determine its installation position in consideration of the following:

(a) When used in the inverter power supply circuit, install the noise filter in a position where the wiring distance from the inverter input terminals is short.

(b) There should be over 4 line-noise filters serialized as shown in diagram.

(c) Radio noise filter FR-BIF cannot be applied to output side.

(2) Wiring

The noise filter cannot produce its effect unless it is properly wired as shown in Fig.s 6.2.1 and 6.2.2.

The noise filter must be installed as close as possible to the inverter and its wiring distance minimized. In addition, the primary and secondary wirings of the noise filter must not be close to each other or cross each other.

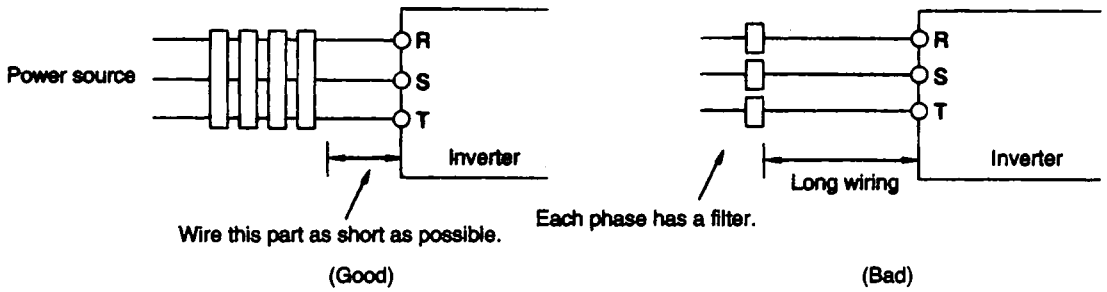


Fig.6.2.1 Wiring the Noise Filter

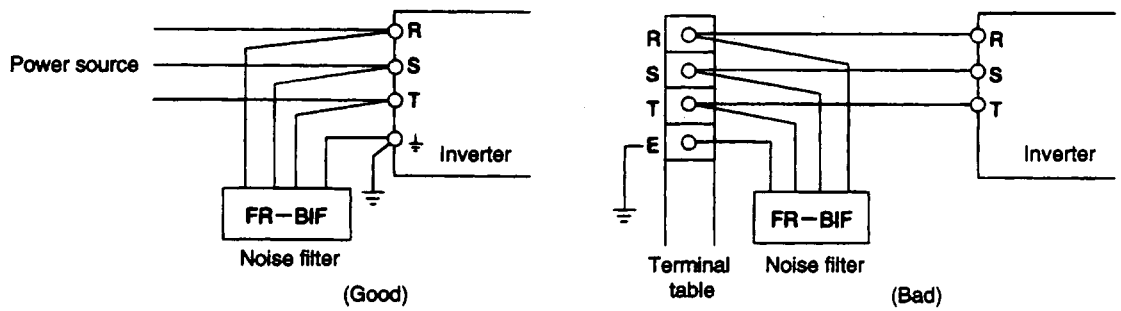


Fig.6.2.2 Wiring the FR-BIF

6.3 Wiring the control circuit

(1) Use twisted or shielded cables for connection with the control circuit terminals (10, 2, 5, 4, AM). Do not ground the shield but connect it as shown in Fig.6.3.1 or 6.3.2. (Keep the other end of the shield open.)

(2) Use twisted or shielded cables for connection with the display (frequency) meter terminals (FM, SD) over a wiring distance of 200m maximum. If the distance exceeds 200m, the display (frequency) meter reading may result in a larger error.

(3) Run the control circuit cables away from the power line over the shortest distance.

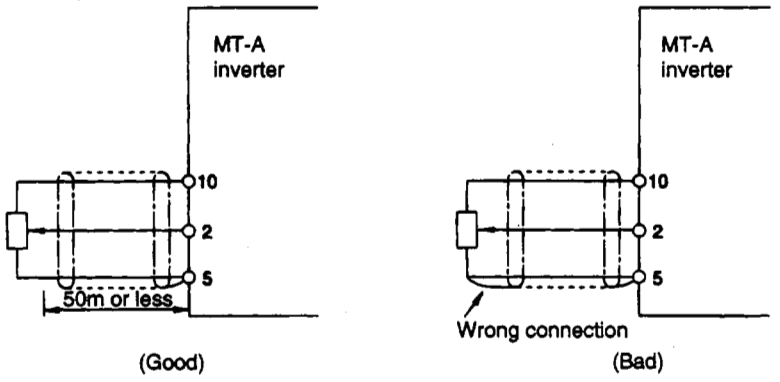


Fig.6.3.1 Connecting the Shielded Cables

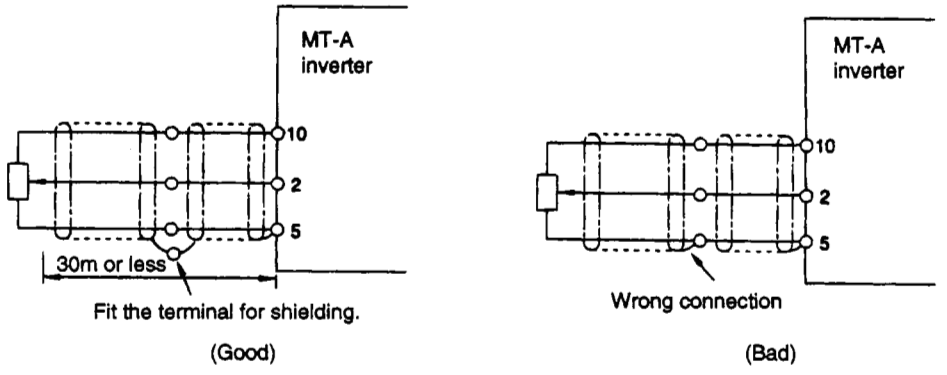


Fig.6.3.2 Connecting the Shielded Cables

6.4 Measures against external noise

(1) Strengthening the measures against noise

The MELTRAC series inverters are sufficiently protected from noise. However, extremely large external noise may cause the inverter to malfunction. When there is such external noise that cannot be eliminated, wire the inverter in accordance with Fig.6.4.1.

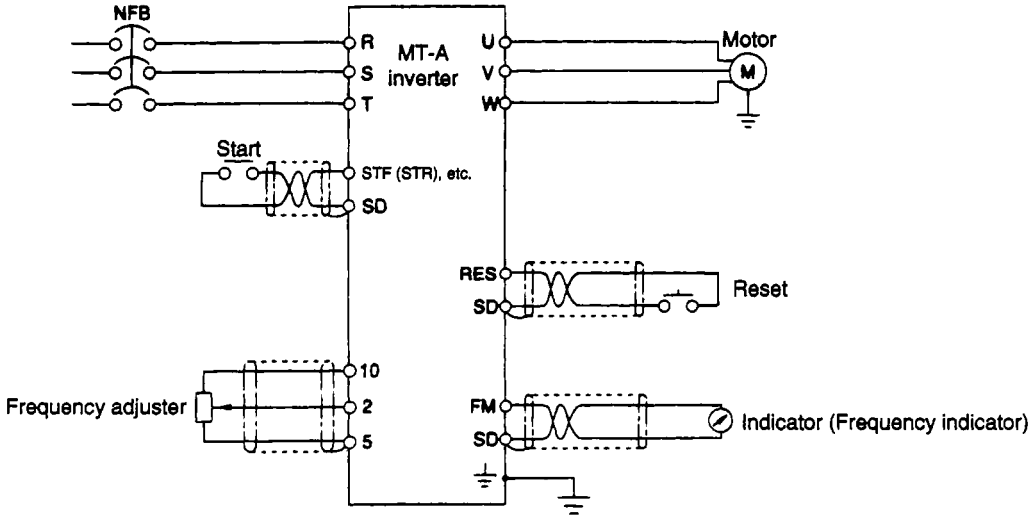


Fig.6.4.1 Measures against Noise

(2) Remote control, etc.

Acting as an antenna, the signal lines are susceptible to external noise. Therefore, run the signal lines as far away as possible from the power line. If the inverter is controlled 30m or further away from its installation position, it is recommended to use any of the following:

(a) Speed setting device

Use the FR-FK motorized speed setter. (For the using method, see the corresponding information.)

(b) External start/stop signal

Add a relay in the vicinity of the inverter.

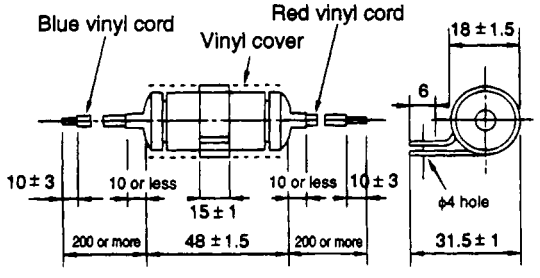
(c) Cables

Use twisted or twisted shield cables.

(d) Surge suppressors

Install surge suppressors to the coils of the relays, valves, etc. around the inverter.

[Example] DCR2-12003-5041 (manufactured by Matsuo)



(Unit : mm)

7. TESTING

7.1 CHECKING WIRING

(1) Check the wiring thoroughly for incorrect connections in the main and control circuits.

(2) Check the connectors for poor contact or insufficient insertion. Check that the main and control circuits do not touch each other.

(3) Check that the grounding has been done correctly. Be sure to correctly ground the inverter also before testing in the workshop.

7.2 DIELECTRIC WITHSTAND VOLTAGE TEST

Perform dielectric withstand voltage test on the circuits except for the inverter control circuit.
Install jumper straps across terminals R, S, T, U, V and W to comprehensively perform dielectric strength test on the main circuit.

7.3 INSULATION RESISTANCE MEASUREMENT

First, make sure that the inverter has been grounded. Use a 500 volt insulation tester to test the main circuit only. A 1000 Volt insulation tester is not recommended.

7.4 OPERATION TEST

First, perform a sequence test on the control circuit. Check that the inverter parameters are correct. Turn on the main circuit. Check the motor and other machines for safety. Start the operation.

8. PRECAUTIONS ON INVERTER INSTALLATION AND OPERATION

8.1 INSTALLING INVERTER PANEL

(1) Make the cable between the inverter panel and the motor shortest possible minimize the impedance between the inverter and the motor.

(2) In principle, install the inverter in the electric room.

(3) Check that the environmental conditions comply with the requirements defined in the inverter specification.

(4) Be sure to ground the inverter securely.

8.2 EXTERNAL WIRING

(1) Separate the main circuit wiring 30 m or more away from the control circuit wiring. Minimize the distance over which the two circuits run in parallel to each other.

(2) Ground the shield of the shielded cables carrying frequency signals at one point on the inverter side. If grounded at two points for incoming and outgoing signals, circulating currents flows to generate noise. Install the shielded cables in an independent duct from other control or power lines or in a steel conduit.

8.3 GROUNDING INVERTER PANEL

Ground the inverter panel directly to the grounding electrode or grounding bus line without routing other panels or devices. (Special Class 3 10 ohm or better). Use the grounding wire of 38 mm2 or larger.

8.4 MEASURES AGAINST NOISE

Source the inverter operation power from the exclusive transformer. To reduce noise, provide a noise suppressor for the relays connected to the operation power source.
(Example of noise suppressor) (circuit of 220V or less) ... CR50500BI Made by Okaya Denki)
If a thyristor control unit without ACL is connected to the same bus line, add the power coordination AC reactor (optional).

8.5 CHECKING LINE VOLTAGE

Check that the line voltage is within the allowable voltage for the inverter. Also check that the transient voltage drop immediately after starting other machine or a voltage drop due to start-up current complies with the above requirement. For a 400 Volt system, check that the grounding installation is of neutral grounding or isolated neutral system. Note that one-line grounding is prohibited by the Electrical Installation Standard.

9. PRECAUTIONS ON OPERATION AND MAINTENANCE OF INVERTERS

(1) Due to electrical charge in the capacitor, the system cannot be started up within one second after turning on the main power.

(2) Perform dielectric strength test only on the main circuit. Do not perform dielectric strength test on the control circuit.

(3) Do not perform dielectric test on the inverter. Be sure to disconnect the cables from the inverter before performing dielectric strength test on the cables.

(4) Use a tester to test the control circuit for continuity. Do not use the dielectric strength tester or buzzer instead.

(5) For some time after turning off the inverter power, the capacitor has been charged to high potential. Before accessing the main circuit, check that the charge lamp is off indicating that the capacitor has been discharged, and also check that the voltage across P and N in the main circuit is no greater than DC 30 V.

(6) Set the acceleration and deceleration times to be longer than commercial acceleration or natural deceleration times, respectively.

(7) Even in handling a small load, do not connect the motor the rated capacity of which exceeds that of the inverter.

(8) When using a radio communications equipment, close the inverter cover or the door on the panel.

(9) Do not connect a phase advancing capacitor in the load circuit of the inverter.

(10) Check that the connectors, screws and nuts are securely fastened.

MITSUBISHI ELECTRIC CORPORATION

HEAD OFFICE : MITSUBISHI DENKI BLDG., MARUNOUCHI, TOKYO 100. TELEX : J24532 CABLE : MELCO TOKYO
NAGASAKI WORKS : 6-14 MARUO-MACHI, NAGASAKI, JAPAN TEL (0958) 64-2580 TELEX : 7523-97 MELCO J

BUS ROD(9401)