



Numerical Control (CNC)

Specifications and Instruction Manual

MDS-EX-CV/CVH Series

Introduction

Thank you for selecting the Mitsubishi numerical control unit. This instruction manual describes the handling and caution points for using this AC servo/spindle. Incorrect handling may lead to unforeseen accidents, so always read this instruction manual thoroughly to ensure correct usage.

Make sure that this instruction manual is delivered to the end user. Always store this manual in a safe place.

In order to confirm if all function specifications described in this manual are applicable, refer to the specifications for each CNC.

Notes on Reading This Manual

- (1) Since the description of this specification manual deals with NC in general, for the specifications of individual machine tools, refer to the manuals issued by the respective machine tool builders. The "restrictions" and "available functions" described in the manuals issued by the machine tool builders have precedence to those in this manual.
- (2) This manual describes as many special operations as possible, but it should be kept in mind that items not mentioned in this manual cannot be performed.
- (3) The characteristic values and numerical values without tolerances mentioned in this manual are representative values.

In this manual, the following abbreviations might be used.

MTB: Machine tool builder

Precautions for Safety

Please read this manual and auxiliary documents before starting installation, operation, maintenance or inspection to ensure correct usage. Thoroughly understand the device, safety information and precautions before starting operation.

The safety precautions in this instruction manual are ranked as "WARNING" and "CAUTION".

DANGER

When there is a potential risk of fatal or serious injuries if handling is mistaken.

WARNING

When a dangerous situation, or fatal or serious injuries may occur if handling is mistaken.

CAUTION

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

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

The signs indicating prohibited and mandatory matters are explained below.

	<p>Indicates a prohibited matter.</p> <p>For example, "Fire Prohibited" is indicated as  .</p>
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	<p>Indicates a mandatory matter.</p> <p>For example, grounding is indicated as  .</p>
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The meaning of each pictorial sign is as follows.

 CAUTION	 CAUTION rotated object	 CAUTION HOT	 Danger Electric shock risk	 Danger explosive
 Prohibited	 Disassembly is prohibited	 KEEP FIRE AWAY	 General instruction	 Earth ground

After reading this specifications and instructions manual, store it where the user can access it easily for reference.

The numeric control unit is configured of the control unit, operation board, servo drive unit, spindle drive unit, power supply, servo motor and spindle motor, etc.

In this section "Precautions for safety", the following items are generically called the "motor".

- ♦ Servo motor
- ♦ Linear servo motor
- ♦ Spindle motor
- ♦ Direct-drive motor

In this section "Precautions for safety", the following items are generically called the "unit".

- ♦ Servo drive unit
- ♦ Spindle drive unit
- ♦ Power supply unit
- ♦ Scale interface unit
- ♦ Magnetic pole detection unit

 <p>POINT</p> <p>Important matters that should be understood for operation of this machine are indicated as a POINT in this manual.</p>
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■ For Safe Use

Mitsubishi CNC is designed and manufactured solely for applications to machine tools to be used for industrial purposes. Do not use this product in any applications other than those specified above, especially those which are substantially influential on the public interest or which are expected to have significant influence on human lives or properties.

WARNING

■ Electric shock prevention

-  Make sure the power is shut OFF before connecting a unit and a motor to the power.
-  Do not open the front cover while the power is ON or during operation. Failure to observe this could lead to electric shocks.
-  Do not operate the unit with the front cover removed. The high voltage terminals and charged sections will be exposed, and can cause electric shocks.
-  Since the high voltage is supplied to the main circuit connector while the power is ON or during operation, do not touch the main circuit connector with an adjustment screwdriver or the pen tip. Failure to observe this could lead to electric shocks.
-  Do not remove the front cover and connector even when the power is OFF unless carrying out wiring work or periodic inspections. The inside of the units is charged, and can cause electric shocks.
-  Wait at least 20 minutes after turning the power OFF, confirm that the CHARGE lamp has gone out, and check the voltage between P and N terminals with a tester, etc., before starting wiring, maintenance or inspections. Failure to observe this could lead to electric shocks.
-  Ground the unit and motor. For the motor, ground it via the drive unit.
-  Wiring, maintenance and inspection work must be done by a qualified technician.
-  Wire the servo drive unit and servo motor after installation. Failure to observe this could lead to electric shocks.
-  Do not touch the switches with wet hands. Failure to observe this could lead to electric shocks.
-  Do not damage, apply forcible stress, place heavy items on the cables or get them caught. Failure to observe this could lead to electric shocks.
-  Always insulate the power terminal connection section. Failure to observe this could lead to electric shocks.
-  After assembling the built-in IPM/SPM spindle motor, if the rotor is rotated by hand etc., voltage occurs between the terminals of lead. Take care not to get electric shocks.

WARNING

■ Injury prevention

-  **When handling a motor, perform operations in safe clothing.**
-  **In the system where the optical communication with CNC is executed, do not see directly the light generated from CN1A/CN1B connector of drive unit or the end of cable. When the light gets into eye, you may feel something is wrong for eye.**
(The light source of optical communication corresponds to class1 defined in JISC6802 or IEC60825-1.)
-  **The linear servo motor, direct-drive motor and built-in IPM/SPM spindle motor uses permanent magnets in the rotor, so observe the following precautions.**

[Handling]

- The linear servo motor, direct-drive motor and built-in IPM/SPM spindle motor could adversely affect medical electronics such as pacemakers, etc., therefore, do not approach the rotor.
- Do not place magnetic materials as iron.
- When a magnetic material as iron is placed, take safety measure not to pinch fingers or hands due to the magnetic attraction force.
- Remove metal items such as watch, piercing jewelry, necklace, etc.
- Do not place portable items that could malfunction or fail due to the influence of the magnetic force.
- When the rotor is not securely fixed to the machine or device, do not leave it unattended but store it in the package properly.
- When installing the motor to the machine, take it out from the package one by one, and then install it.
- It is highly dangerous to lay out the motor or magnetic plates together on the table or pallet, therefore never do so.

[Transportation and storage]

- Correctly store the rotor in the package to transport and store.
- During transportation and storage, draw people's attention by applying a notice saying "Strong magnet-Handle with care" to the package or storage shelf.
- Do not use a damaged package.

[Installation]

- Take special care not to pinch fingers, etc., when installing (and unpacking) the linear servo motor.
-  **Incorrect wiring could lead to smoke or fire in the unit and the reactor, resulting in faults. Be careful when wiring.**

CAUTION

■ Fire prevention

-  Install the units, motors and regenerative resistor on non-combustible material. Direct installation on combustible material or near combustible materials could lead to fires.
-  Always install a circuit protector and contactor on the servo drive unit power input as explained in this manual. Refer to this manual and select the correct circuit protector and contactor. An incorrect selection could result in fire.
-  Shut off the power on the unit side if a fault occurs in the units. Fires could be caused if a large current continues to flow.
-  When using a regenerative resistor, provide a sequence that shuts off the power with the regenerative resistor's error signal. The regenerative resistor could abnormally overheat and cause a fire due to a fault in the regenerative transistor, etc.
-  The battery unit could heat up, ignite or rupture if submerged in water, or if the poles are incorrectly wired.
-  Cut off the main circuit power with the contactor when an alarm or emergency stop occurs.

■ Injury prevention

-  Do not apply a voltage other than that specified in this manual, on each terminal. Failure to observe this item could lead to ruptures or damage, etc.
-  Do not mistake the terminal connections. Failure to observe this item could lead to ruptures or damage, etc.
-  Do not mistake the polarity (+, -). Failure to observe this item could lead to ruptures or damage, etc.
-  Do not touch the radiation fin on unit back face, regenerative resistor or motor, etc., or place parts (cables, etc.) while the power is turned ON or immediately after turning the power OFF. These parts may reach high temperatures, and can cause burns or part damage.
-  Structure the cooling fan on the unit back face, etc., so that it cannot be touched after installation. Touching the cooling fan during operation could lead to injuries.
-  Take care not to suck hair, clothes, etc. into the cooling fan.

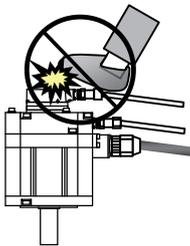
⚠ CAUTION

■ Various precautions

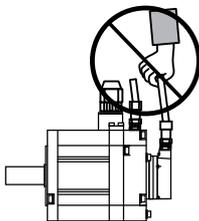
Observe the following precautions. Incorrect handling of the unit could lead to faults, injuries and electric shocks, etc.

(1) Transportation and installation

- ⚠ Correctly transport the product according to its weight.
- ❗ Use the motor's hanging bolts only when transporting the motor itself.
Do not use the motor's hanging bolts to transport a motor with other parts installed, or to transport a machine with a motor installed.
- ⚠ Do not stack the products above the tolerable number.
- ⚠ Follow this manual and install the unit or motor securely in a place where it can be borne and noncombustible. Insufficient fixing could lead to the unit or the motor slipping off during operation.
- ⚠ Do not get on top of or place heavy objects on the unit.



- ⚠ Do not hold the cables, axis or encoder when transporting the motor.



- ⚠ Do not hold the connected wires or cables when transporting the units.
- ⚠ Do not hold the front cover when transporting the unit. The unit could drop.
- ⚠ Always observe the installation directions of the units or motors.
- ⚠ Secure the specified distance between the units and control panel, or between the servo drive unit and other devices.
- ⚠ Do not install or run a unit or motor that is damaged or missing parts.
- ⚠ Do not block the intake or exhaust ports of the motor provided with a cooling fan.
- ⚠ Do not let foreign objects enter the units or motors. In particular, if conductive objects such as screws or metal chips, etc., or combustible materials such as oil enter, rupture or breakage could occur.
- ⚠ Provide adequate protection using a material such as connector for conduit to prevent screws, metallic detritus, water and other conductive matter or oil and other combustible matter from entering the motor through the power line lead-out port.
- ⚠ The units, motors and encoders are precision devices, so do not drop them or apply strong impacts to them.
- ⚠ Always operate the motor, which has a shaft with keyway, with the key attached.

⚠ CAUTION

⚠ Store and use the units under the following environment conditions.

Environment	Unit	Servo motor	Spindle motor
Ambient temperature	Operation: Operation 0 to +55°C (with no freezing), Storage / Transportation: -15°C to +70°C (with no freezing)	Operation: 0 to +40°C (with no freezing), Storage: -15°C to +70°C (with no freezing)	Operation: 0 to +40°C (with no freezing), Storage: -20°C to +65°C (with no freezing)
Ambient humidity	Storage: 90% RH or less (with no dew condensation), Storage / Transportation: 90% RH or less (with no dew condensation)	Operation: 80% RH or less (with no dew condensation), Storage: 90% RH or less (with no dew condensation)	Operation: 90% RH or less (with no dew condensation), Storage: 90% RH or less (with no dew condensation)
Atmosphere	Indoors (no direct sunlight) With no corrosive gas, inflammable gas, oil mist, dust or conductive fine particles		
Altitude	Operation/Storage: 1000 meters or less above sea level, Transportation: 13000 meters or less above sea level	Operation/Storage: 1000 meters or less above sea level, Transportation: 10000 meters or less above sea level	
Vibration / impact	According to each unit or motor specification		

(*) For details, confirm each unit or motor specifications in addition.

⚠ When disinfectants or insecticides must be used to treat wood packaging materials, always use methods other than fumigation (for example, apply heat treatment at the minimum wood core temperature of 56 °C for a minimum duration of 30 minutes (ISPM No. 15 (2009))).

If products such as units are directly fumigated or packed with fumigated wooden materials, halogen substances (including fluorine, chlorine, bromine and iodine) contained in fumes may contribute to the erosion of the capacitors.

When exporting the products, make sure to comply with the laws and regulations of each country.

⚠ Do not use the products in conjunction with any components that contain halogenated flame retardants (bromine, etc). Failure to observe this may cause the erosion of the capacitors.

⚠ Securely fix the servo motor to the machine. Insufficient fixing could lead to the servo motor slipping off during operation.

⚠ Always install the servo motor with reduction gear in the designated direction. Failure to do so could lead to oil leaks.

⚠ Structure the rotary sections of the motor so that it can never be touched during operation. Install a cover, etc., on the shaft.

⚠ When installing a coupling to a servo motor shaft end, do not apply an impact by hammering, etc. The encoder could be damaged.

⚠ Do not apply a load exceeding the tolerable load onto the servo motor shaft. The shaft could break.

⚠ Store the motor in the package box.

⚠ When inserting the shaft into the built-in IPM/SPM spindle motor, do not heat the rotor higher than 130°C. The magnet could be demagnetized, and the specifications characteristics will not be ensured.

⚠ Always use a nonmagnetic tool (explosion-proof beryllium copper alloy safety tool: NGK Insulators, etc.) when installing the built-in IPM/SPM spindle motor, direct-drive motor and linear servo motor.

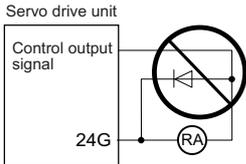
⚠ Always provide a mechanical stopper on the end of the linear servo motor's travel path.

❗ If the unit has been stored for a long time, always check the operation before starting actual operation. Please contact the Service Center, Sales Office or dealer.

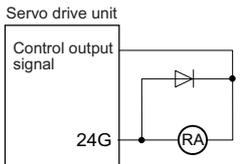
⚠ Install the heavy peripheral devices to the lower part in the panel and securely fix it not to be moved due to vibration.

⚠ CAUTION

(2) Wiring

- ⚠ Correctly and securely perform the wiring. Failure to do so could lead to abnormal operation of the motor.
 - ⚠ Do not install a condensing capacitor, surge absorber or radio noise filter on the output side of the drive unit.
 - ⚠ Correctly connect the output side of the drive unit (terminals U, V, W). Failure to do so could lead to abnormal operation of the motor.
 - ⚠ When using a power regenerative power supply unit, always install an AC reactor for each power supply unit.
 - ⚠ In the main circuit power supply side of the unit, always install an appropriate circuit protector or contactor for each unit. Circuit protector or contactor cannot be shared by several units.
 - ⚠ Always connect the motor to the drive unit's output terminals (U, V, W).
 - ⚠ Do not directly connect a commercial power supply to the servo motor. Failure to observe this could result in a fault.
 - ⚠ When using an inductive load such as a relay, always connect a diode as a noise measure parallel to the load.
 - ⚠ When using a capacitance load such as a lamp, always connect a protective resistor as a noise measure serial to the load.
 - ⚠ Do not reverse the direction of a diode which connect to a DC relay for the control output signals such as contractor and motor brake output, etc. to suppress a surge. Connecting it backwards could cause the drive unit to malfunction so that signals are not output, and emergency stop and other safety circuits are inoperable.
- 

Servo drive unit
Control output signal
24G
RA



Servo drive unit
Control output signal
24G
RA
- ⚠ Do not connect/disconnect the cables connected between the units while the power is ON.
 - ⚠ Securely tighten the cable connector fixing screw or fixing mechanism. An insecure fixing could cause the cable to fall off while the power is ON.
 - ⚠ When using a shielded cable instructed in the instruction manual, always ground the cable with a cable clamp, etc. (Refer to "EMC Installation Guidelines")
 - ⚠ Always separate the signals wires from the power line.
 - ⚠ Use wires and cables that have a wire diameter, heat resistance and flexibility that conforms to the system.

(3) Trial operation and adjustment

- ⚠ Check and adjust each program and parameter before starting operation. Failure to do so could lead to unforeseen operation of the machine.
- ⚠ Do not make remarkable adjustments and changes of parameter as the operation could become unstable.
- ⚠ The usable motor and unit combination is predetermined. Always check the combinations and parameters before starting trial operation.
- ⚠ The direct-drive motor and linear servo motor do not have a stopping device such as magnetic brakes. Install a stopping device on the machine side.
- ⚠ When using the linear servo motor for an unbalance axis, adjust the unbalance weight to 0 by installing an air cylinder, etc. on the machine side. The unbalance weight disables the initial magnetic pole adjustment.

CAUTION

(4) Usage methods

-  In abnormal state, install an external emergency stop circuit so that the operation can be stopped and power shut off immediately.
-  Turn the power OFF immediately if smoke, abnormal noise or odors are generated from the unit or motor.
-  Do not disassemble or repair this product.
-  Never make modifications.
-  When an alarm occurs, the machine will start suddenly if an alarm reset (RST) is carried out while an operation start signal (ST) is being input. Always confirm that the operation signal is OFF before carrying out an alarm reset. Failure to do so could lead to accidents or injuries.
-  Reduce magnetic damage by installing a noise filter. The electronic devices used near the unit could be affected by magnetic noise. Install a line noise filter, etc., if there is a risk of magnetic noise.
-  Use the unit, motor and regenerative resistor with the designated combination. Failure to do so could lead to fires or trouble.
-  The brake (magnetic brake) of the servo motor are for holding, and must not be used for normal braking.
-  There may be cases when holding is not possible due to the magnetic brake's life, the machine construction (when ball screw and servo motor are coupled via a timing belt, etc.) or the magnetic brake's failure. Install a stop device to ensure safety on the machine side.
-  After changing the programs/parameters or after maintenance and inspection, always test the operation before starting actual operation.
-  Do not enter the movable range of the machine during automatic operation. Never place body parts near or touch the spindle during rotation.
-  Follow the power supply specification conditions given in each specification for the power (input voltage, input frequency, etc.).
-  Set all bits to "0" if they are indicated as not used or empty in the explanation on the bits.
-  Do not use the dynamic brakes except during the emergency stop. Continued use of the dynamic brakes could result in brake damage.
-  If a circuit protector for the main circuit power supply is shared by several units, the circuit protector may not activate when a short-circuit fault occurs in a small capacity unit. This is dangerous, so never share the circuit protector.
-  Mitsubishi spindle motor is dedicated to machine tools. Do not use for other purposes.
-  This unit is not intended for use in low voltage public networks that supply power to households. Using this unit in such networks may cause radio frequency interference.
-  Do not use this unit in residential areas.
-  The NC drive unit have a motor overload protection (Set on the basis of 150% (full load current) stall current of the servo motor or 120% (full load current) motor short-time rated output current of the spindle motor). Electronic thermal memory retention and speed sensitive function are not provided by the drive.

(5) Troubleshooting

-  If a hazardous situation is predicted during power failure or product trouble, use a servo motor with magnetic brakes or install an external brake mechanism.
-  Always turn the main circuit power of the motor OFF when an alarm occurs.
-  If an alarm occurs, remove the cause, and secure the safety before resetting the alarm.

CAUTION

(6) Maintenance, inspection and part replacement

-  Always backup the programs and parameters before starting maintenance or inspections.
-  The capacity of the electrolytic capacitor will drop over time due to self-discharging, etc. To prevent secondary disasters due to failures, replacing this part every five years when used under a normal environment is recommended. Contact the Service Center, Service Station, Sales Office or dealer for repairs or part replacement.
-  Never perform a megger test (measure the insulation resistance) of the drive unit. Failure to observe this could lead to faults.
-  If the battery low warning is issued, immediately replace the battery. Replace the batteries while applying the drive unit's control power.
-  Do not short circuit, charge, overheat, incinerate or disassemble the battery.
-  For after-purchase servicing of the built-in motor, only the servicing parts for MITSUBISHI encoder can be supplied. For the motor body, prepare the spare parts at the machine tool builders.
-  For maintenance, part replacement, and services in case of failures in the built-in motor (including the encoder), take necessary actions at the machine tool builders. For drive unit, Mitsubishi can offer the after-purchase servicing as with the general drive unit.

(7) Disposal

-  Take the batteries and backlights for LCD, etc., off from the controller, drive unit and motor, and dispose of them as industrial wastes.
-  Do not disassemble the unit or motor.
-  Dispose of the battery according to local laws.
-  Dispose of the primary side of the linear servo motor as industrial waste. For the secondary side, dispose of it as industrial waste after demagnetizing it by heating it to 300°C or higher.
-  When incinerating optical communication cable, hydrogen fluoride gas or hydrogen chloride gas which is corrosive and harmful may be generated. For disposal of optical communication cable, request for specialized industrial waste disposal services that has incineration facility for disposing hydrogen fluoride gas or hydrogen chloride gas.

(8) Transportation

-  The unit and motor are precision parts and must be handled carefully.
-  According to a United Nations Advisory, the battery unit and battery must be transported according to the rules set forth by the International Civil Aviation Organization (ICAO), International Air Transportation Association (IATA), International Maritime Organization (IMO), and United States Department of Transportation (DOT), etc.

(9) General precautions

The drawings given in this manual show the covers and safety partitions, etc., removed to provide a clearer explanation. Always return the covers or partitions to their respective places before starting operation, and always follow the instructions given in this manual.

Treatment of waste

The following two laws will apply when disposing of this product. Considerations must be made to each law. The following laws are in effect in Japan. Thus, when using this product overseas, the local laws will have a priority. If necessary, indicate or notify these laws to the final user of the product.

- (1) Requirements for "Law for Promotion of Effective Utilization of Resources"
 - (a) Recycle as much of this product as possible when finished with use.
 - (b) When recycling, often parts are sorted into steel scraps and electric parts, etc., and sold to scrap contractors. Mitsubishi Electric recommends sorting the product and selling the members to appropriate contractors.

- (2) Requirements for "Law for Treatment of Waste and Cleaning"
 - (a) Mitsubishi Electric recommends recycling and selling the product when no longer needed according to item (1) above. The user should make an effort to reduce waste in this manner.
 - (b) When disposing a product that cannot be resold, it shall be treated as a waste product.
 - (c) The treatment of industrial waste must be commissioned to a licensed industrial waste treatment contractor, and appropriate measures, including a manifest control, must be taken.
 - (d) Batteries correspond to "primary batteries", and must be disposed of according to local disposal laws.

Disposal



(Note) This symbol mark is for EU countries only.
This symbol mark is according to the directive 2006/66/EC Article 20 Information for end-users and Annex II.

Your MITSUBISHI ELECTRIC product is designed and manufactured with high quality materials and components which can be recycled and/or reused.

This symbol means that batteries and accumulators, at their end-of-life, should be disposed of separately from your household waste.

If a chemical symbol is printed beneath the symbol shown above, this chemical symbol means that the battery or accumulator contains a heavy metal at a certain concentration. This will be indicated as follows:

Hg: mercury (0.0005%), Cd: cadmium (0.002%), Pb: lead (0.004%)

In the European Union there are separate collection systems for used batteries and accumulators.

Please, dispose of batteries and accumulators correctly at your local community waste collection/recycling centre.

Please, help us to conserve the environment we live in!

Trademarks

MELDAS, MELSEC, EZSocket, EZMotion, iQ Platform, MELSOFT, GOT, CC-Link, CC-Link/LT and CC-Link IE are either trademarks or registered trademarks of Mitsubishi Electric Corporation in Japan and/or other countries.

Other company and product names that appear in this manual are trademarks or registered trademarks of the respective companies.

本製品の取扱いについて

(日本語 /Japanese)

本製品は工業用 (クラス A) 電磁環境適合機器です。販売者あるいは使用者はこの点に注意し、住商業環境以外での使用をお願いいたします。

Handling of our product

(English)

This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

본 제품의 취급에 대해서

(한국어 /Korean)

이 기기는 업무용 (A 급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며 가정외의 지역에서 사용하는 것을 목적으로 합니다 .

WARRANTY

Please confirm the following product warranty details before using Mitsubishi Electric CNC.

1. Warranty Period and Coverage

Should any fault or defect (hereafter called "failure") for which we are liable occur in this product during the warranty period, repair services shall be provided at no cost through the distributor from which the product was purchased or through a Mitsubishi Electric service provider. Note, however, that this does not apply if the customer was informed prior to purchasing the product that the product is not covered under warranty. Also note that we are not responsible for any on-site readjustment and/or trial run that may be required after a defective unit is replaced.

[Warranty Term]

The term of warranty for this product shall be twenty-four (24) months from the date of delivery of the product to the end user, provided the product purchased from Mitsubishi Electric or a distributor in Japan is installed in Japan (but in no event longer than thirty (30) months, including distribution time after shipment from Mitsubishi Electric or a distributor).

Note that, in the case where the product purchased from Mitsubishi Electric or a distributor in or outside Japan is exported and installed in any country other than where it was purchased, please refer to "2. Service in Overseas Countries" below.

[Limitations]

- (1) The machine tool builder is requested to conduct an initial failure diagnosis, as a general rule. The diagnosis may also be carried out by Mitsubishi Electric or our service provider for a fee at the machine tool builder's request.
- (2) This warranty applies only when the conditions, method, environment, etc., of use are in compliance with the terms, conditions and instructions that are set forth in the instruction manual, user's manual, and the caution label affixed to the product, etc.
- (3) Even during the term of warranty, repair costs will be charged to the customer in the following cases:
 - (a) a failure caused by improper storage or handling, carelessness or negligence, etc., or a failure caused by a problem with the customer's hardware or software
 - (b) a failure caused by any alteration, etc., to the product made by the customer without Mitsubishi Electric's approval
 - (c) a failure which may be regarded as avoidable, if the customer's equipment in which this product is incorporated is equipped with a safety device required by applicable laws or has any function or structure considered to be indispensable in the light of common sense in the industry
 - (d) a failure which could have been avoided if consumable parts designated in the instruction manual, etc. had been duly maintained and replaced
 - (e) any replacement of consumable parts (including the battery, relay and fuse)
 - (f) a failure caused by external factors such as inevitable accidents, including without limitation fire and abnormal fluctuation of voltage, and acts of God, including without limitation earthquakes, lightning, and natural disasters
 - (g) a failure which could not have been foreseen under technologies available at the time of shipment of this product from Mitsubishi Electric
 - (h) any other failures which are not attributable to Mitsubishi Electric or which the customer acknowledges are not attributable to Mitsubishi Electric

2. Service in Overseas Countries

If the customer installs a product purchased from Mitsubishi Electric in a machine or equipment and exports it to any country other than where it was purchased, the customer may sign a paid warranty contract with our local FA center.

This applies in the case where the product purchased from us in or outside Japan is exported and installed in any country other than where it was purchased.

For details please contact the distributor from which the product was purchased.

3. Exclusion of Responsibility for Compensation against Loss of Opportunity, Secondary Loss, etc.

Regardless of the gratis warranty term, Mitsubishi Electric shall not be liable for compensation for:

- (1) Damage arising from any cause found not to be the responsibility of Mitsubishi Electric.
- (2) Lost opportunity or lost profit incurred by the user due to a failure of a Mitsubishi Electric product.
- (3) Special damage or secondary damage, whether foreseeable or not, compensation for accidents, and compensation for damages to products other than Mitsubishi Electric products.
- (4) Replacement by the user, maintenance of on-site equipment, start-up test run and other tasks.

4. Changes in Product Specifications

Specifications shown in our catalogs, manuals or technical documents are subject to change without notice.

5. Product Application

- (1) For use of this product, applications should be those that will not result in a serious damage even if a failure or malfunction occurs in the product, and a backup or failsafe function should operate on an external system when any failure or malfunction occurs to the product.
- (2) Mitsubishi Electric CNC is designed and manufactured solely for applications to machine tools for industrial purposes. Do not use this product in applications other than those specified above, especially those which have substantial influence on public interest or which are expected to have significant influence on human lives or properties.

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Introduction

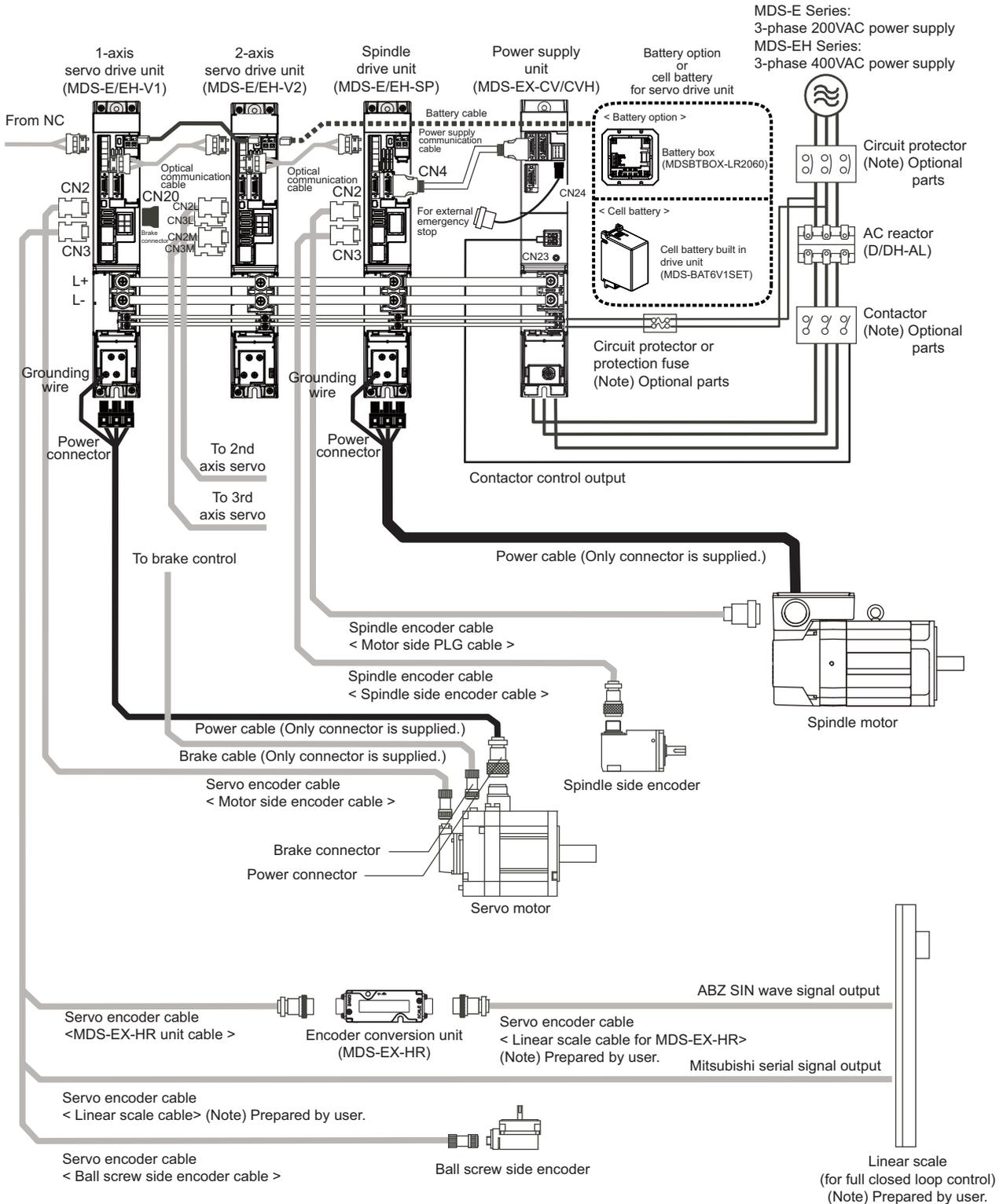
1 Introduction

1.1 System Configuration

This manual is a power supply unit "MDS-EX-CV/CVH Series" specifications and instruction manual. Before using the unit, read the following instruction manuals thoroughly to ensure correct usage.

- MDS-E/EH Series Specifications Manual (IB-1501226(ENG))
- MDS-E/EH Series Instruction Manual (IB-1501229(ENG))

1.1 System Configuration

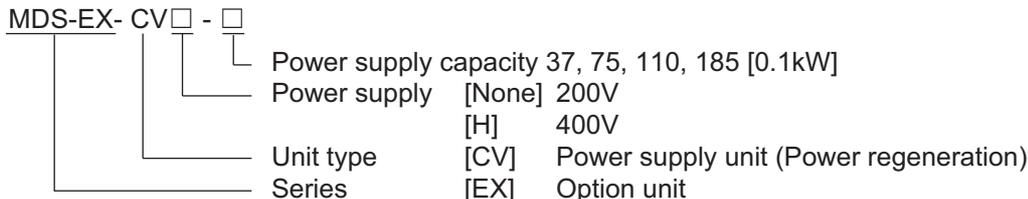


1 Introduction

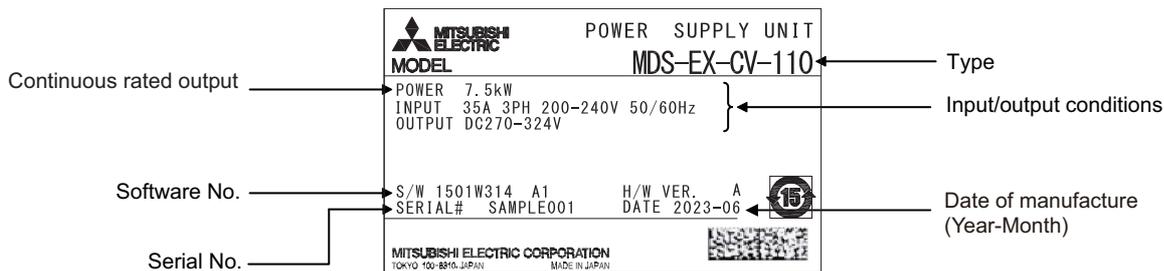
1.2 Explanation of Type

1.2 Explanation of Type

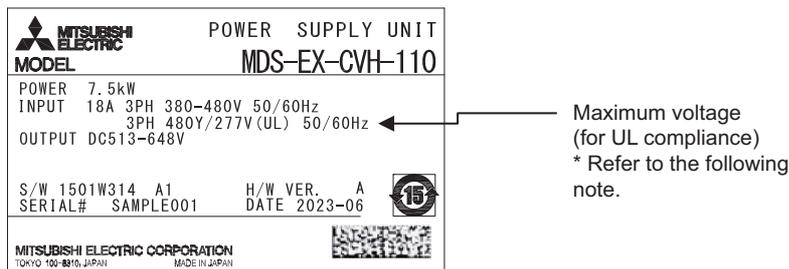
1.2.1 Unit Type



1.2.2 Rating Nameplate



Rating nameplate



Rating nameplate

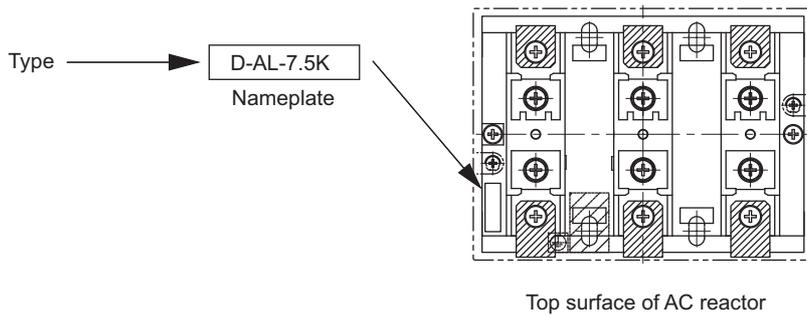
CAUTION

The description 480Y/277V indicates that the following conditions need to be satisfied for UL compliance (acquisition): Power wires are connected by the star connection, the maximum voltage across the wires is 480 V, and the maximum voltage between the phase and ground is 277 V.

1 Introduction

1.2 Explanation of Type

1.2.3 AC Reactor Model



■ 200V series

< MDS-EX-CV Series >

D-AL- (1)

AC reactor		Compatible power supply unit
(1) Type D-AL-	Capacity	
7.5K	7.5kW	MDS-EX-CV-37
		MDS-EX-CV-75
11K	11kW	MDS-EX-CV-110
18.5K	18.5kW	MDS-EX-CV-185

■ 400V series

< MDS-EX-CVH Series >

DH-AL- (1)

AC reactor		Compatible power supply unit
(1) Type DH-AL-	Capacity	
7.5K	7.5kW	MDS-EX-CVH-37
		MDS-EX-CVH-75
11K	11kW	MDS-EX-CVH-110
18.5K	18.5kW	MDS-EX-CVH-185

2

Specifications

2 Specifications

2.1 Power Supply Unit

■ 200V series

< MDS-EX-CV Series >

		Power supply unit MDS-EX-CV Series			
Power supply unit type MDS-EX-CV-		37	75	110	185
30-minute rated output [kW]		3.7	7.5	11.0	18.5
Continuous rated output [kW]		2.2	5.5	7.5	15
Power supply capacity [kVA]		5.3	11	16	27
Input	Rated voltage [V]	200 to 240 AC tolerable fluctuation: between +10 % and -15 %			
	Frequency [Hz]	50/60 tolerable fluctuation: between +5 % and -5 %			
	Rated current [A]	15	26	35	65
Output	Rated voltage [V]	270 to 324 DC			
Control power	Voltage [V]	200 to 240 AC tolerable fluctuation: between +10 % and -15 %			
	Frequency [Hz]	50/60 tolerable fluctuation: between +5 % and -5 %			
	Rated current [A]	0.2			
	Maximum rush current [A]	38			
	Maximum rush conductivity time [ms]	3			
Main circuit method		Converter with power regeneration circuit			
Structure		Open (degree of protection: IP20 excluding terminal block)			
Cooling method		Natural-cooling		Forced air cooling	
Mass [kg]		5	5	6	6
Heat radiated at rated output [W]		Inside panel: 17 Outside panel: 37	Inside panel: 25 Outside panel: 54	Inside panel: 18 Outside panel: 106	Inside panel: 29 Outside panel: 164
Unit outline dimension drawing		Refer to the following.			

■ 400V series

< MDS-EX-CVH Series >

		Power supply unit MDS-EX-CVH Series			
Power supply unit type MDS-EX-CVH-		37	75	110	185
30-minute rated output [kW]		3.7	7.5	11.0	18.5
Continuous rated output [kW]		2.2	5.5	7.5	15
Power supply capacity [kVA]		5.3	11	16	27
Input	Rated voltage [V]	380 to 480 AC tolerable fluctuation: between +10 % and -15 %			
	Frequency [Hz]	50/60 tolerable fluctuation: between +5 % and -5 %			
	Rated current [A]	5.2	13	18	35
Output	Rated voltage [V]	513 to 648 DC			
Control power	Voltage [V]	380 to 480 AC tolerable fluctuation: between +10 % and -15 %			
	Frequency [Hz]	50/60 tolerable fluctuation: between +5 % and -5 %			
	Rated current [A]	0.1			
	Maximum rush current [A]	19			
	Maximum rush conductivity time [ms]	12			
Main circuit method		Converter with power regeneration circuit			
Structure		Open (degree of protection: IP20 excluding terminal block)			
Cooling method		Natural-cooling		Forced air cooling	
Mass [kg]		5	5	6	6
Heat radiated at rated output [W]		Inside panel: 22 Outside panel: 32	Inside panel: 33 Outside panel: 46	Inside panel: 18 Outside panel: 106	Inside panel: 29 Outside panel: 164
Unit outline dimension drawing		Refer to the following.			

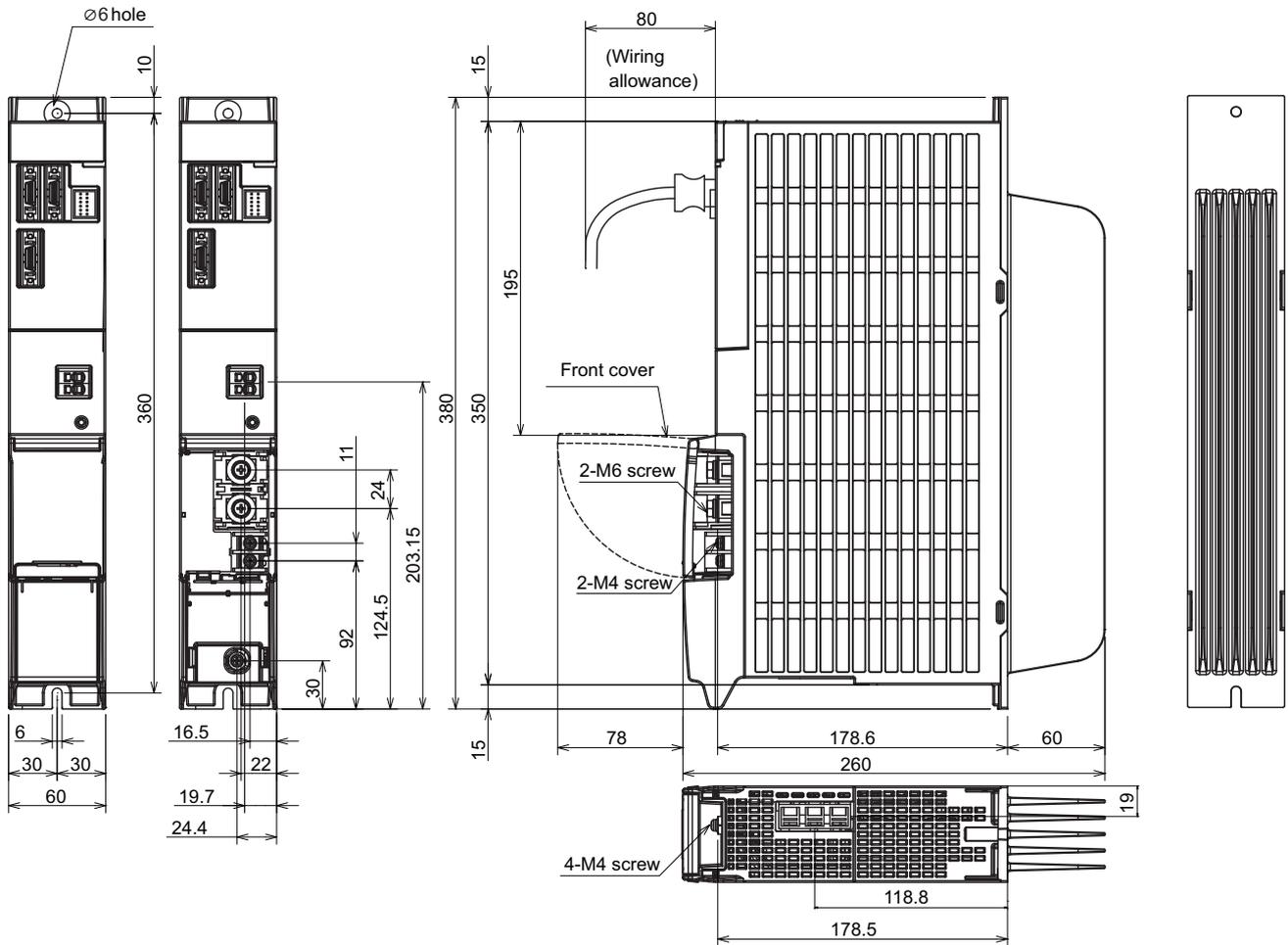
2 Specifications

2.1 Power Supply Unit

Outline dimension drawing

[Unit: mm]

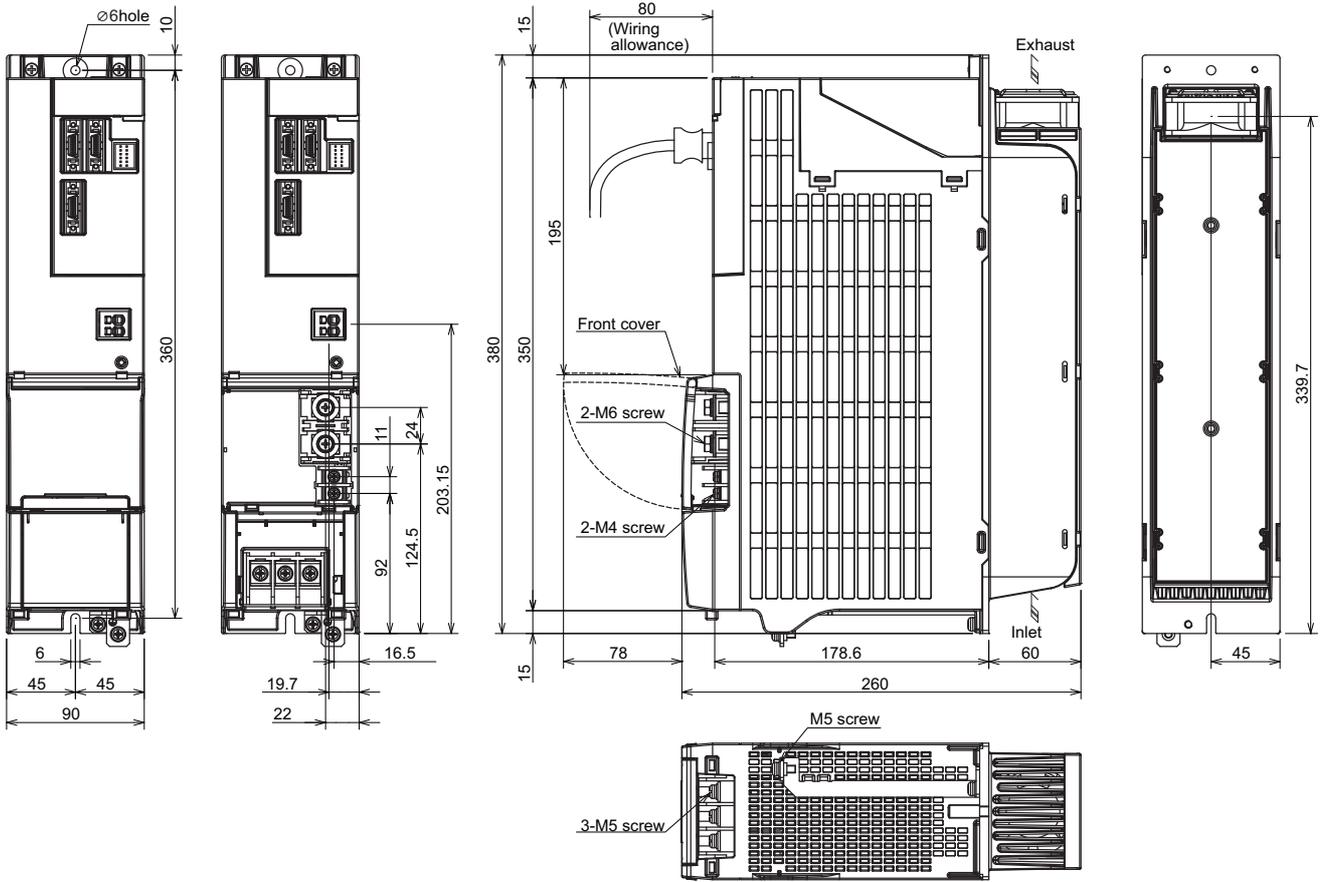
■ MDS-EX-CV/CVH-37/75



2 Specifications

2.1 Power Supply Unit

■ MDS-EX-CV/CVH-110/185



2.2 AC Reactor

An AC reactor must be installed for a power supply unit.

■ 200V series

< MDS-EX-CV Series >

		AC reactor		
AC reactor model D-AL-		7.5K	11K	18.5K
Compatible power supply unit type MDS-EX-CV-		37, 75	110	185
Rated capacity [kW]		7.5	11	18.5
Rated voltage [V]		200 to 240 AC tolerable fluctuation: between +10 % and -15 %		
Rated current [A]		27	40	66
Frequency [Hz]		50/60 tolerable fluctuation: between +5 % and -5 %		
Environment	Ambient temperature	Operation: -10°C to 60°C (with no freezing), Storage/Transportation: -10°C to 60°C (with no freezing)		
	Ambient humidity	Operation: 80%RH or less (with no dew condensation), Storage/Transportation: 80%RH or less (with no dew condensation)		
	Atmosphere	Indoors (no direct sunlight) With no corrosive gas, inflammable gas, oil mist, or dust		
	Altitude	Operation/Storage: 1000 meters or less above sea level, Transportation: 10000 meters or less above sea level		
	Vibration / impact	9.8m/s ² (1G) / 98m/s ² (10G)		
Mass [kg]		4.2	3.7	5.3

■ 400V series

< MDS-EX-CVH Series >

		AC reactor		
AC reactor model DH-AL-		7.5K	11K	18.5K
Compatible power supply unit type MDS-EX-CVH-		37, 75	110	185
Rated capacity [kW]		7.5	11	18.5
Rated voltage [V]		380 to 480 AC tolerable fluctuation: between +10 % and -15 %		
Rated current [A]		14	21	37
Frequency [Hz]		50/60 tolerable fluctuation: between +5 % and -5 %		
Environment	Ambient temperature	Operation: -10°C to 60°C (with no freezing), Storage/Transportation: -10°C to 60°C (with no freezing)		
	Ambient humidity	Operation: 80%RH or less (with no dew condensation), Storage/Transportation: 80%RH or less (with no dew condensation)		
	Atmosphere	Indoors (no direct sunlight) With no corrosive gas, inflammable gas, oil mist, or dust		
	Altitude	Operation/Storage: 1000 meters or less above sea level, Transportation: 10000 meters or less above sea level		
	Vibration / impact	9.8m/s ² (1G) / 98m/s ² (10G)		
Mass [kg]		4.0	3.7	5.3

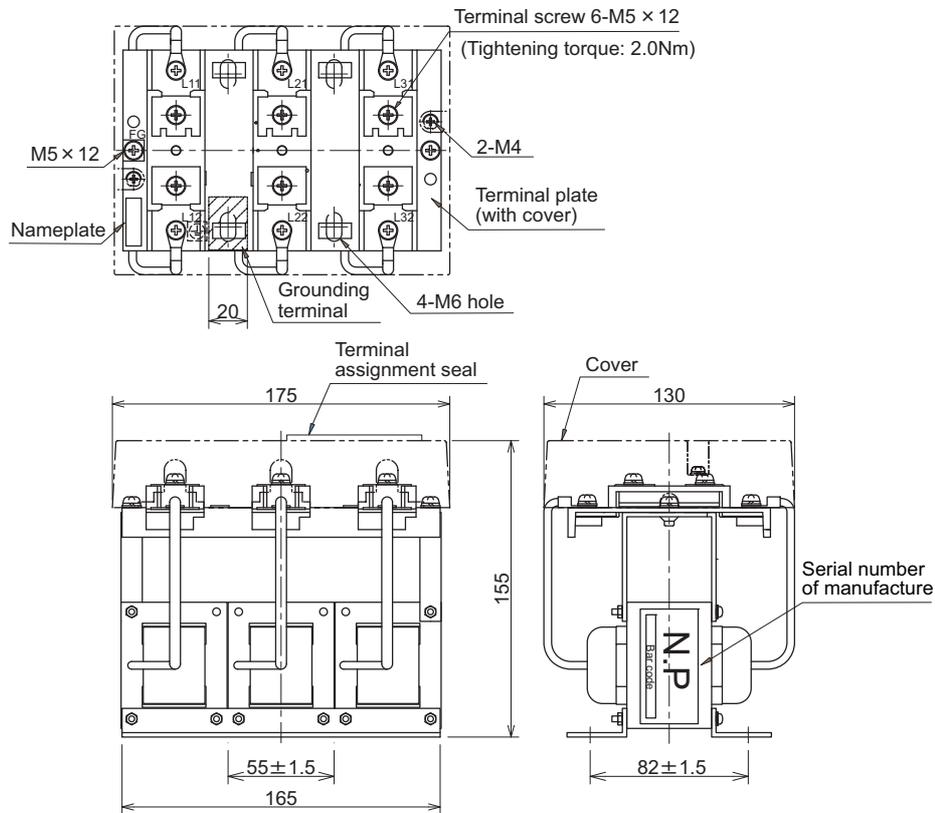
CAUTION

D/DH-AL is used for MDS-EX-CV/CVH.

Outline dimension drawing

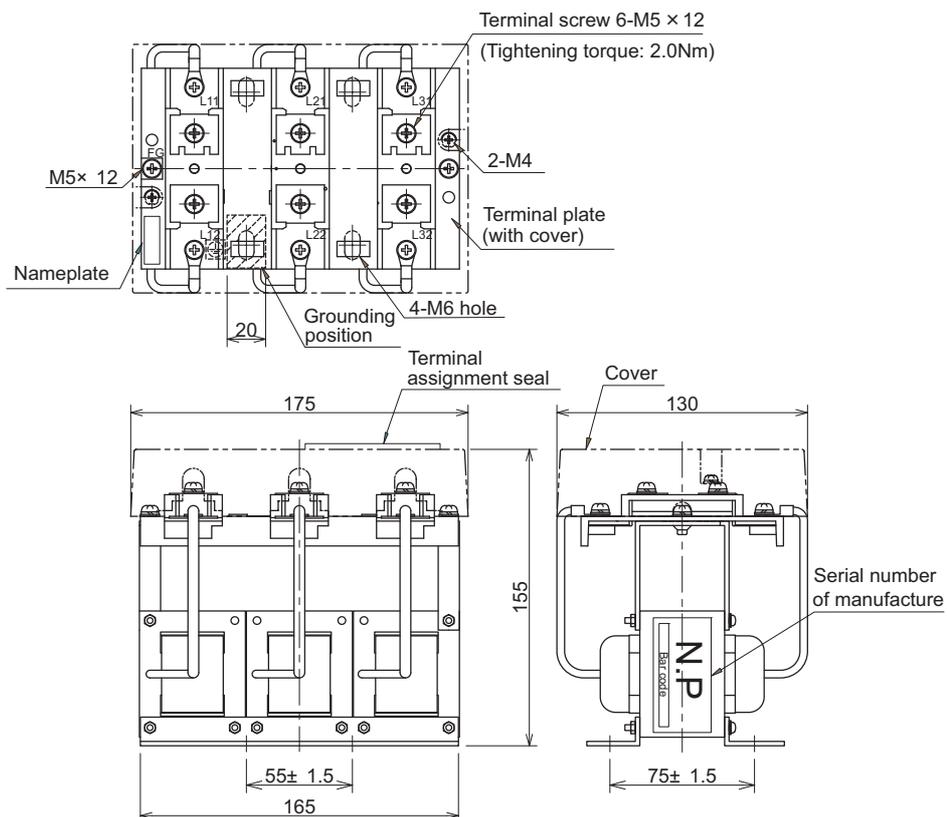
[Unit: mm]

■ D/DH-AL-7.5K



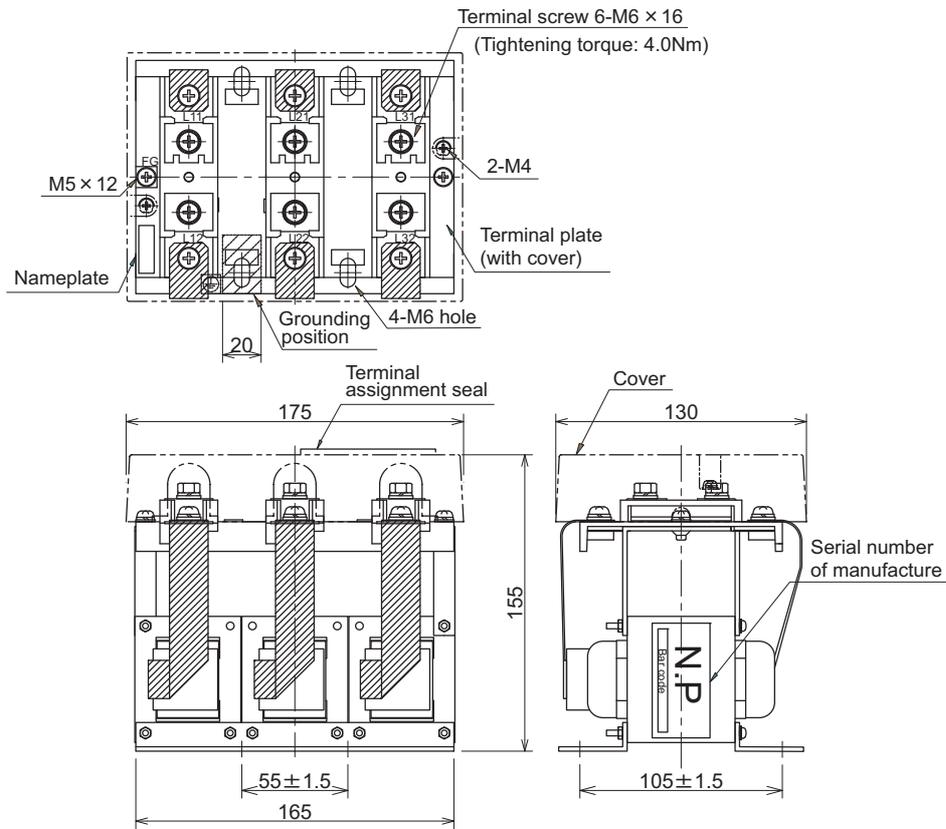
[Unit: mm]

■ D/DH-AL-11K



[Unit: mm]

■ D/DH-AL-18.5K

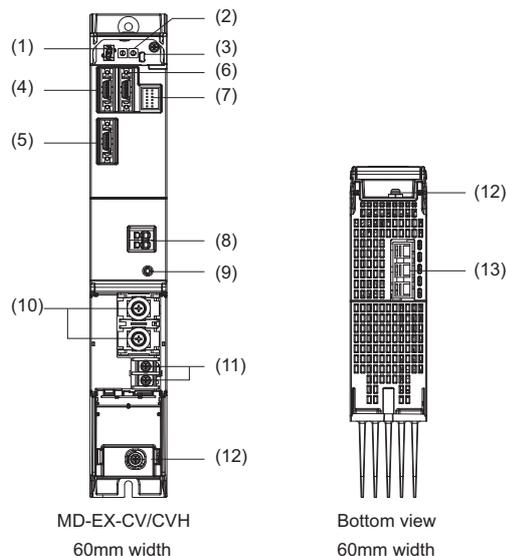


2 Specifications

2.3 Explanation of Each Part

2.3 Explanation of Each Part

■ Explanation of each MDS-EX-CV/CVH power supply unit part



The connector and terminal block layout may differ according to the unit being used. Refer to each unit outline drawing for details.

		Name		Description
(1)	Control circuit	LED	---	Power supply status indication LED
(2)		SW1, SW2	---	Power supply setting switch
(3)		CN5	---	USB maintenance connector (usually not used)
(4)		CN4	---	Servo/spindle communication connector (primary)
(5)		CN9	---	Servo/spindle communication connector (secondary)
(6)		CN41	---	Power backup unit communication connector
(7)		CN24	---	External emergency stop input connector
(8)	Main circuit	CN23	---	External contactor control connector
(9)		---	CHARGE	TE2 output charging/discharging circuit indication LED
(10)		TE2	L+ L-	Converter voltage output terminal (DC output)
(11)		TE3	L11 L21	Control power input terminal (single-phase AC input)
(12)		PE	⊕	Grounding terminal
(13)		TE1	L1, L2, L3	Power input terminal (3-phase AC input)

[Screw size]

Type	Power supply unit MDS-EX-CV/CVH-	
	37, 75	110, 185
Unit width (mm)	60	90
(10) TE2	M6 × 18	
(11) TE3	M4 × 10	
(12) ⊕	M4 × 12	M5 × 12
(13) TE1	-	M5 × 12

Function Specifications

Function Specifications List

[Power supply specification]

Item		MDS-E/EH-CV	MDS-EX-CV/ CVH	MDS-EM/ EMH-SPV3 built-in converter	MDS-EJ/EJH- V1/V2/SP/SP2 built-in converter	MDS-EX-CVP Series
1 Base control functions	1.15 Power regeneration control	●	●	●	-	-
	1.16 Resistor regeneration control	-	-	-	●	-
	1.17 PWM control	-	-	-	-	●
4 Protection function	4.5 Fan stop detection	●	●	●	●	●
	4.6 Open-phase detection	●	●	●	-	●
	4.7 Contactor weld detection	●	●	●	●	●
	4.10 Deceleration and stop function at power failure (*1)	●	●	-	-	●
	4.11 Retraction function at power failure (*2)	●	●	-	-	●
5 Sequence function	5.1 Contactor control function	●	●	●	●	●
	5.3 External emergency stop function	●	●	●	●	●
	5.5 High-speed READY ON sequence	●	●	●	-	●
6 Diagnosis function	6.6 Power supply diagnosis display function	●	●	●	-	●
	6.7 Drive unit diagnosis display function	●	●	●	●	●

(*1) The power backup unit and resistor unit option are required.

(*2) The power backup unit and capacitor unit option are required.

(*3) Refer to "MDS-E/EH Series Specifications Manual" (IB-1501226(ENG)) for details of each function.

4

Characteristics

4 Characteristics

4.1 Environmental Conditions

4.1 Environmental Conditions

Environment	Conditions
Ambient temperature	0°C to +55°C (with no freezing)
Ambient humidity	90% RH or less (with no dew condensation)
Storage temperature	-15°C to +70°C (with no freezing)
Storage humidity	90% RH or less (with no dew condensation)
Atmosphere	Indoors (no direct sunlight); With no corrosive gas, inflammable gas, oil mist, dust or conductive fine particles
Altitude	Operation/storage: 1000 m or less above sea level Transportation: 13000 m or less above sea level
Vibration	Operation/storage: 4.9 m/s ² (0.5 G) or less, Transportation: 49 m/s ² (5 G) or less

(*) When installing the machine at 1,000m or more above sea level, the heat dissipation characteristics will drop as the altitude increases in proportion to the air density. The ambient temperature drops 1% with every 100m increase in altitude. When installing the machine at 1,800m altitude, the heating value of the drive unit must be reduced to 92% or less. The heating value is proportional to the square of the current, and required current decreasing rate follows the expression below.

$$\text{Required current decreasing rate} = \sqrt{0.92} = 0.95$$

Therefore, use the unit with the reduced effective load rate to 95% or less.

4.2 Heating Value

The values apply during the continuous rated output.

Type	Power supply unit	
	Heating value [W]	
	Inside panel	Outside panel
MDS-EX-CV-37	17	37
MDS-EX-CV-75	25	54
MDS-EX-CV-110	18	106
MDS-EX-CV-185	29	164
MDS-EX-CVH-37	22	32
MDS-EX-CVH-75	33	46
MDS-EX-CVH-110	18	106
MDS-EX-CVH-185	29	164

5

Installation

5 Installation

5.1 Installation Direction and Clearance

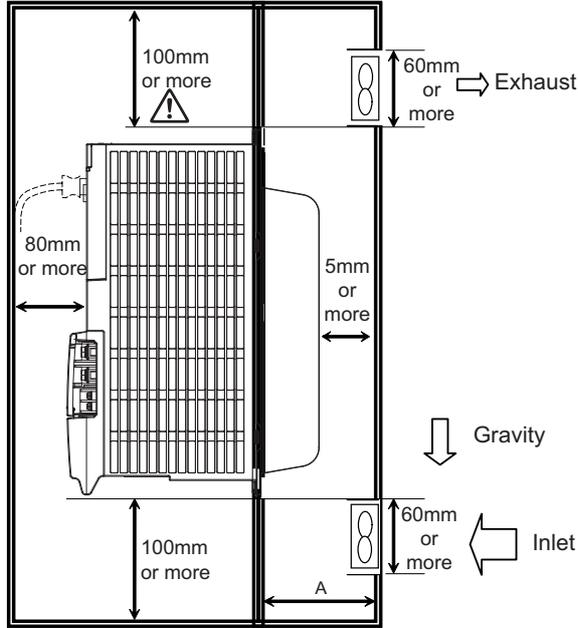
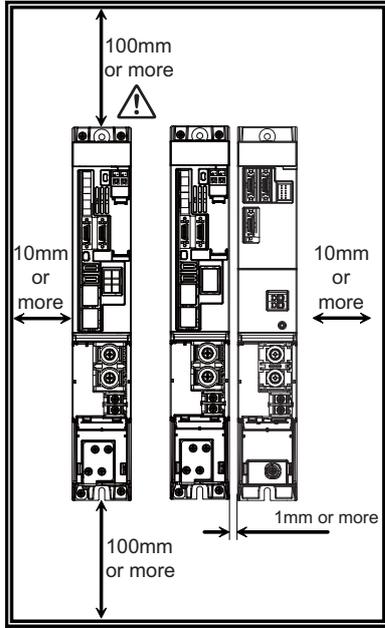
5.1 Installation Direction and Clearance

Wire each unit in consideration of the maintainability and the heat dissipation, as well as secure sufficient space for ventilation.

Also secure sufficient space to the top, bottom, left, and right as shown in the figure below to allow replacements of the fan unit.

■ Installation of MDS-EX-CV/CVH

The units must be installed in a control panel with IP54 degree of protection.



Radiation fin size	Installation clearance A
60mm/67mm	75mm or more
75mm	80mm or more
92mm	114mm or more

CAUTION

- (1) The ambient temperature condition for the power supply unit or the drive unit is 55°C or less.
- (2) Because heat can easily accumulate in the upper portion of the units, give sufficient consideration to heat dissipation when designing the panel. If required, install a fan in the panel to agitate the heat in the upper portion of the units.
- (3) Make sure to avoid wiring above the unit and provide an area for replacing fans. When wiring above the unit, cables that can be connected and disconnected easily are recommended. Refer to " Appx.1: Maintenance" for details.
- (4) Refer to "MDS-E/EH Series Specifications Manual (IB-1501226(ENG))" and "MDS-E/EH Series Instruction Manual (IB-1501229(ENG))" for heat radiation countermeasures in the control panel.

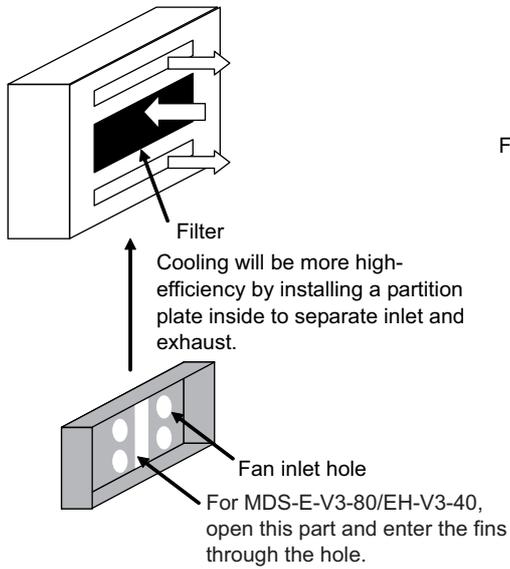
5 Installation

5.1 Installation Direction and Clearance

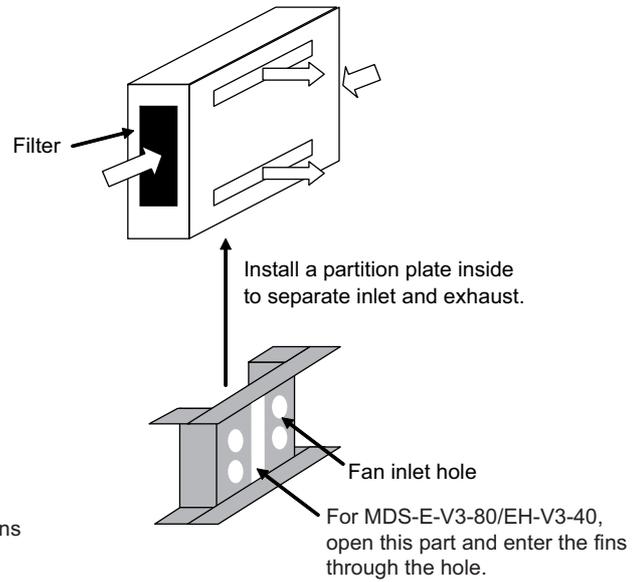
■ Panel structure of the unit back face

The type 'a' that has substantial cooling effect is recommended.

(a) Back face inlet type



(b) Side face inlet type



⚠ WARNING

Incorrect wiring could lead to smoke or fire in the unit and the reactor, resulting in faults. Be careful when wiring.

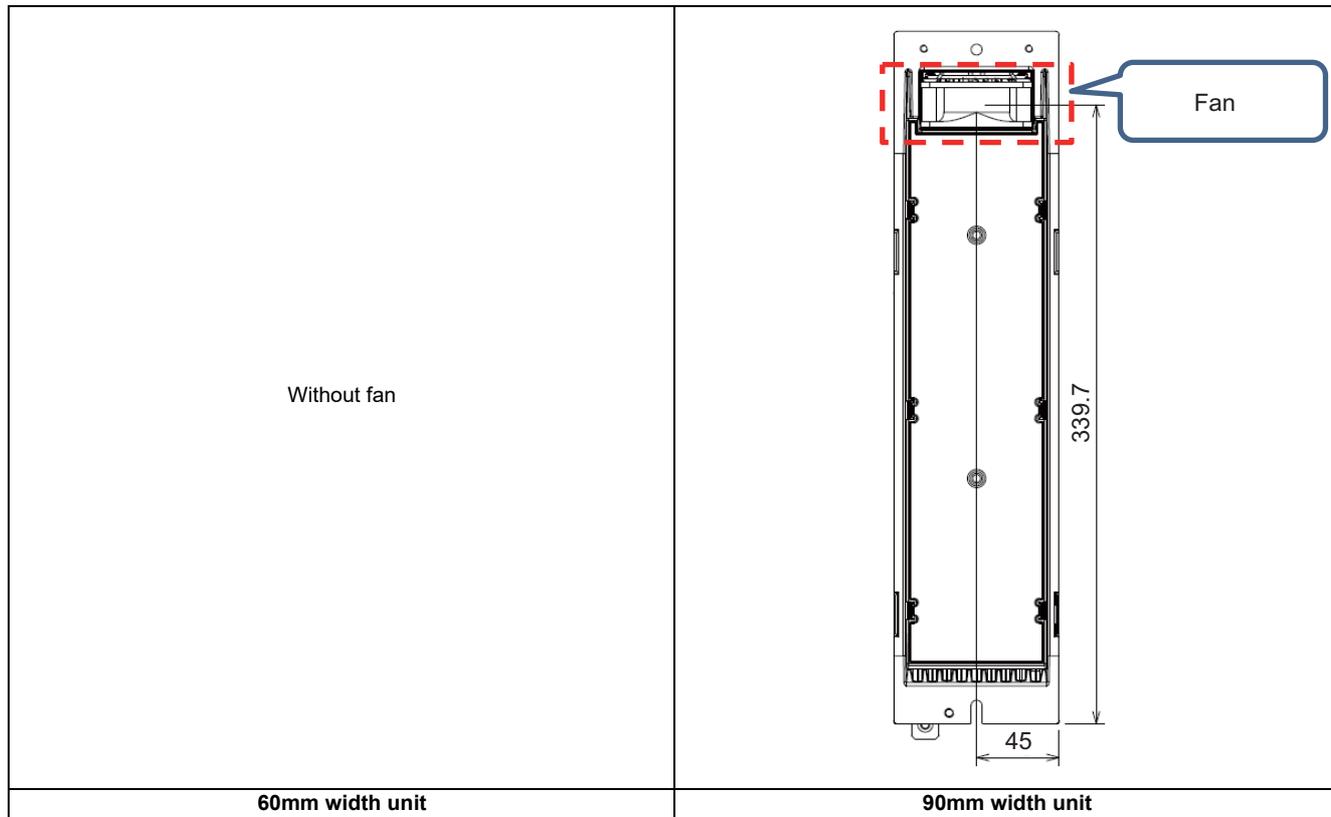
5 Installation

5.1 Installation Direction and Clearance

■ Cooling fan position

< MDS-EX-CV/CVH Series >

For MDS-EX-CV/CVH series, the inlet is below the unit fins, and the exhaust is above the unit fins.



⚠ CAUTION

Make the inlet and exhaust size more than the area that is a total of the cooling fan area.

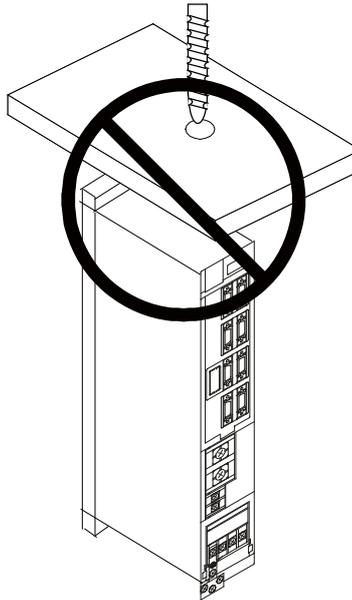
5 Installation

5.2 Preventing the Entry of Foreign Matter

5.2 Preventing the Entry of Foreign Matter

Conduct the following on the cabinet to prevent the entry of foreign matter.

- (1) Use packing, etc. in the cable inlet to prevent dust and oil from entering the cabinet.
- (2) Make sure that the external air does not enter inside by using head radiating holes, etc.
- (3) Close all gaps in the cabinet.
- (4) Properly install door packing.
- (5) If there is a rear cover, always apply packing.
- (6) As oil tends to accumulate on the top, take special measures such as oil-proof packing to prevent oil entering the cabinet from the screw holes.
- (7) After installing each unit, avoid machining in the periphery. Cutting debris, etc. adhering to electrical components may cause failures.
- (8) When using the unit in an area with toxic gases or high levels of dust, protect the unit with air purging (a system to flush the cabinet with clean air so that the panel's inner pressure is higher than the outer pressure).

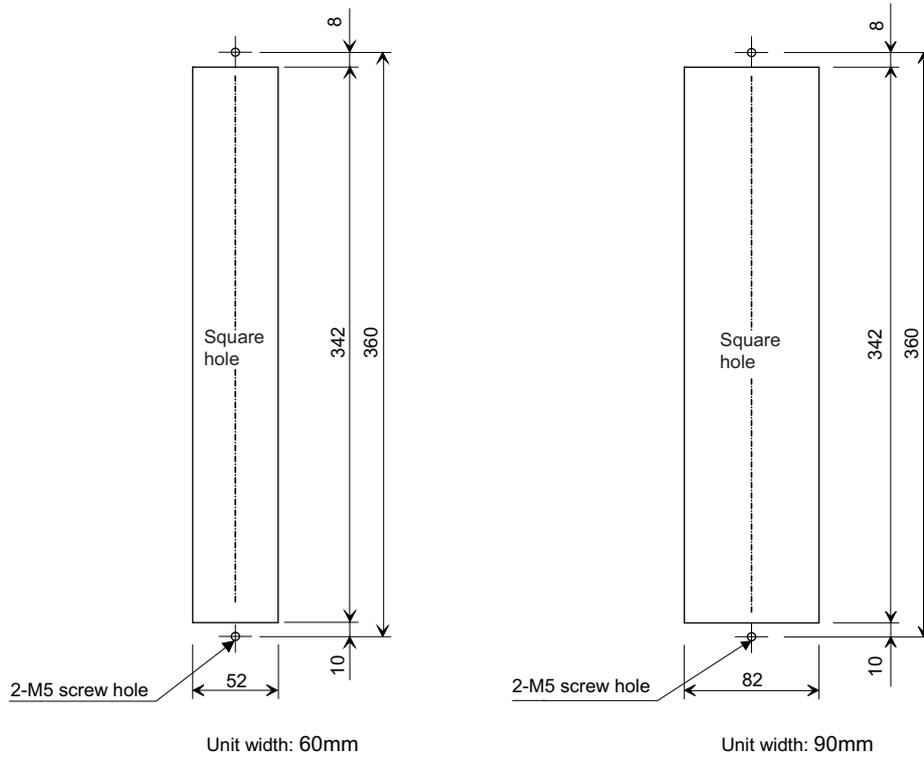


5 Installation

5.3 Panel Installation Hole Work Drawings (Panel Cut Drawings)

5.3 Panel Installation Hole Work Drawings (Panel Cut Drawings)

[Unit: mm]



POINT

Attach packing around the square hole to provide a seal.

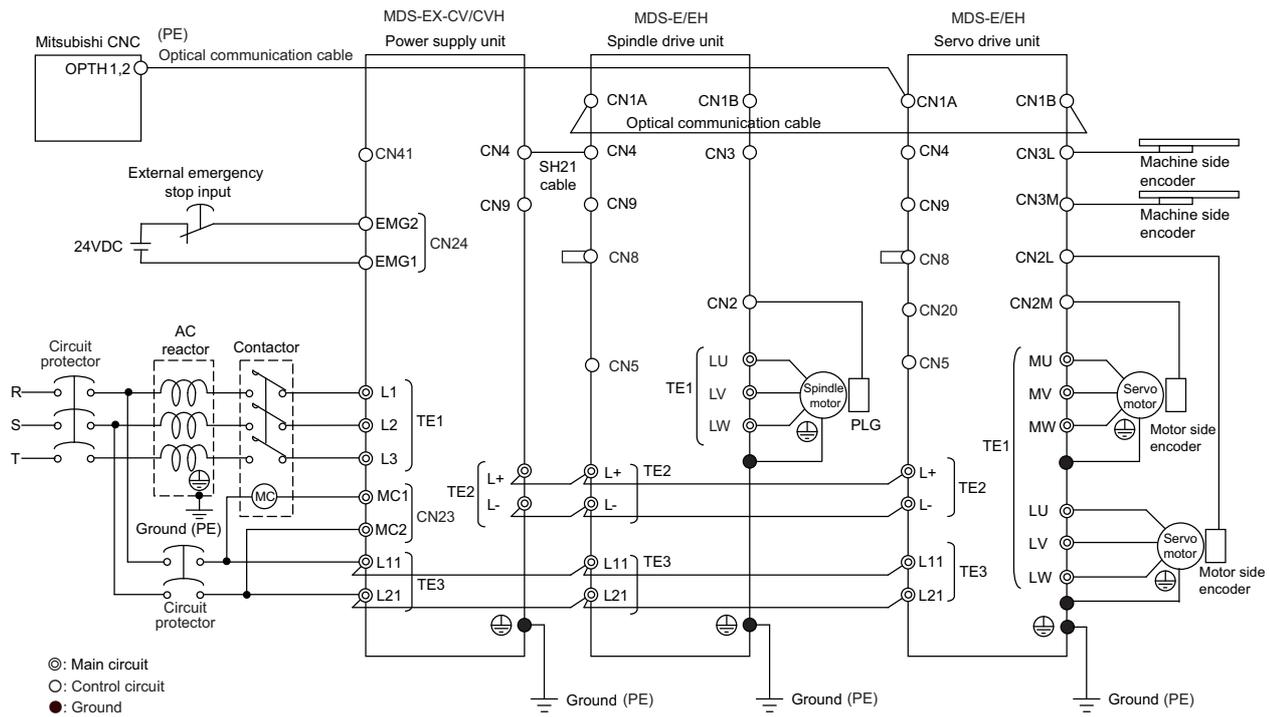
6

Wiring and Connection

6 Wiring and Connection

6.1 Part System Connection Diagram

6.1 Part System Connection Diagram



- (*1) The total length of the optical communication cable from the NC must be within 30m and within a minimum bending radius of 80mm.
- (*2) The connection method will differ according to the used motor.
- (*3) The main circuit (⊙) and control circuit (○) and ground (●) are safely separated.
- (*4) Connect the ground of the motor to the ground of the connected drive unit.

6 Wiring and Connection

6.2 Main Circuit Terminal Block/Control Circuit Connector

6.2 Main Circuit Terminal Block/Control Circuit Connector**6.2.1 Names and Applications of Main Circuit Terminal Block Signals**

The following table shows the details for each terminal block signal.

Name	Signal name	Description
L1, L2, L3	Main circuit power supply	Main circuit power supply input terminal <ul style="list-style-type: none"> • MDS-EX-CV: Connect a 3-phase 200 to 240 VAC (50/60 Hz) power supply. • MDS-EX-CVH: Connect a 3-phase 380 to 480 VAC (50/60 Hz) power supply.
L11, L21	Control circuit power supply	Control circuit power supply input terminal <ul style="list-style-type: none"> • MDS-EX-CV: Connect a single-phase 200 to 240 VAC (50/60 Hz) power supply. • MDS-EX-CVH: Connect a single-phase 380 to 480 VAC (50/60 Hz) power supply.
MC1, MC2	Contact control	Contact control terminal
	Protective grounding (PE)	Grounding terminal The power supply unit grounding terminal is connected and grounded.

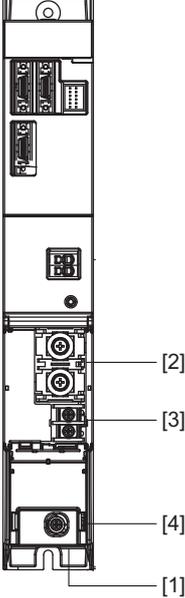
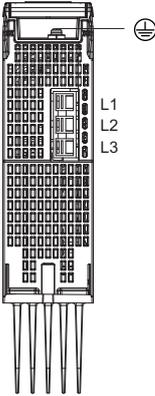
 CAUTION

- (1) Always use one AC reactor per power supply unit. Failure to observe this could lead to unit damage.
- (2) If a circuit protector is shared by several power supply units, the circuit protector may not activate when a short-circuit fault occurs in a small capacity unit. This is dangerous, so never share the circuit protector.
- (3) Be sure to use the circuit protector of the appropriate capacity for each power supply unit.

6.2.2 Connector Pin Assignment

■ Main circuit terminal block and connector

Power supply unit

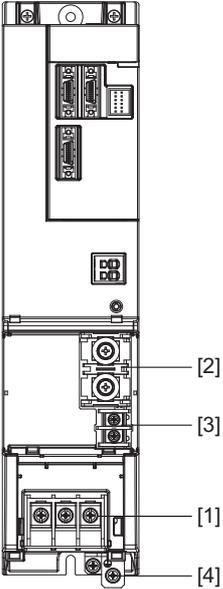
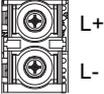
Terminal	Unit	MDS-EX-CV-37 to 75 MDS-EX-CVH-37 to 75					
Terminal position							
	Terminal specification/ Pin assignment	[1] TE1	 <p>(Note) This is a view from the bottom.</p>				
[2] TE2			<table border="1"> <tr> <td>Screw size</td> <td>M6 x 18</td> </tr> <tr> <td>Tightening torque</td> <td>4.0Nm</td> </tr> </table>	Screw size	M6 x 18	Tightening torque	4.0Nm
Screw size		M6 x 18					
Tightening torque		4.0Nm					
[3] TE3A, TE3B		<table border="1"> <tr> <td>Screw size</td> <td>M4 x 10</td> </tr> <tr> <td>Tightening torque</td> <td>1.2Nm</td> </tr> </table>	Screw size	M4 x 10	Tightening torque	1.2Nm	
Screw size	M4 x 10						
Tightening torque	1.2Nm						
[4] 	<p>Screw size M4 x 12 Tightening torque 1.2 Nm</p>						

(*) The illustrations of drive units are shown as an example.

6 Wiring and Connection

6.2 Main Circuit Terminal Block/Control Circuit Connector

Power supply unit

Terminal	Unit	MDS-EX-CV-110 to 185 MDS-EX-CVH-110 to 185				
Terminal position						
Terminal specification/ Pin assignment	[1] TE1	 <table border="1" data-bbox="842 1066 1233 1126"> <tr> <td>Screw size</td> <td>M5 x 12</td> </tr> <tr> <td>Tightening torque</td> <td>2.0Nm</td> </tr> </table>	Screw size	M5 x 12	Tightening torque	2.0Nm
	Screw size	M5 x 12				
	Tightening torque	2.0Nm				
	[2] TE2	 <table border="1" data-bbox="930 1200 1321 1261"> <tr> <td>Screw size</td> <td>M6 x 18</td> </tr> <tr> <td>Tightening torque</td> <td>4.0Nm</td> </tr> </table>	Screw size	M6 x 18	Tightening torque	4.0Nm
Screw size	M6 x 18					
Tightening torque	4.0Nm					
[3] TE3A, TE3B	 <table border="1" data-bbox="930 1328 1321 1388"> <tr> <td>Screw size</td> <td>M4 x 10</td> </tr> <tr> <td>Tightening torque</td> <td>1.2Nm</td> </tr> </table>	Screw size	M4 x 10	Tightening torque	1.2Nm	
Screw size	M4 x 10					
Tightening torque	1.2Nm					
[4] ⊕	<p>Screw size M5 x 12 Tightening torque 2.0 Nm</p>					

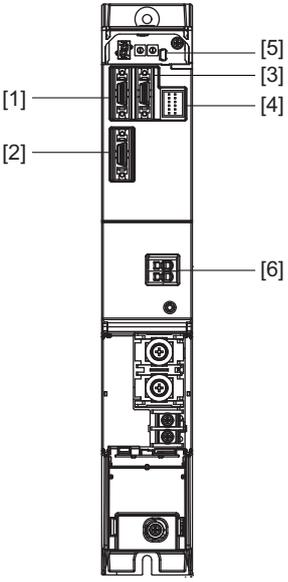
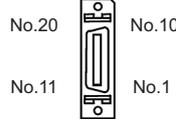
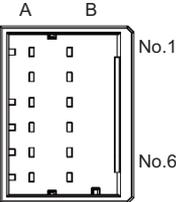
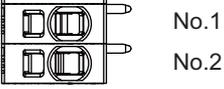
(*) The illustrations of drive units are shown as an example.

6 Wiring and Connection

6.2 Main Circuit Terminal Block/Control Circuit Connector

■ Control circuit connector

Power supply unit

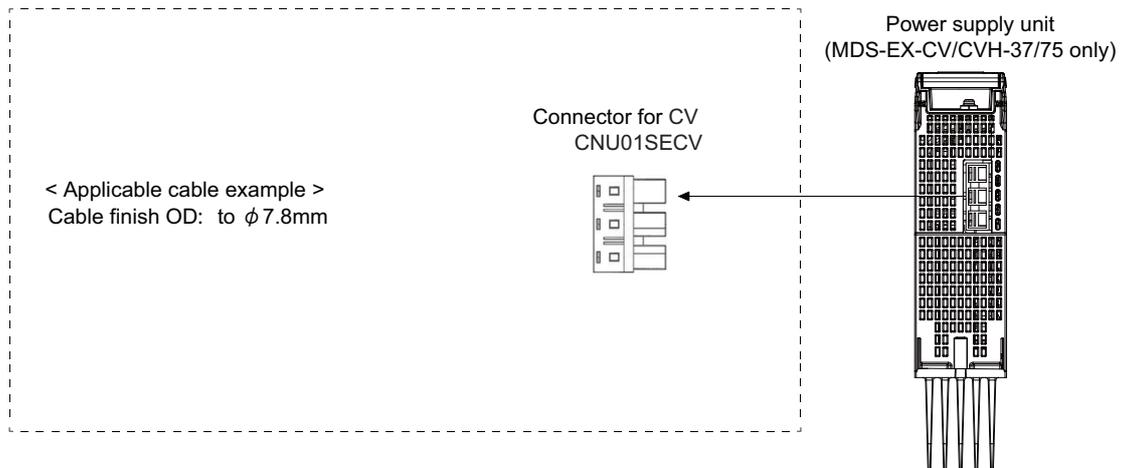
Terminal	Unit
<p>Connector position</p>	<p>MDS-EX-CV-37 to 185 MDS-EX-CVH-37 to 185</p> 
	<p>Pin No.</p> 
<p>Connector specification</p>	<p>[1] CN4 [2] CN41 [3] CN9</p>
	<p>[4] CN24</p> 
	<p>[5] CN5</p> 
	<p>[6] CN23</p> 

6 Wiring and Connection

6.2 Main Circuit Terminal Block/Control Circuit Connector

6.2.3 Connector Wiring Method

■ Power supply unit power supply connectors (only MDS-EX-CV/CVH-37/75)



Axis name	Connector model name	Applicable cable		Strip length [mm]	Connection lever	Manufacturer
		Size	Insulator outer dimension			
For CV	CNU01SECV (AWG14)	AWG16 to 8	7.8mm or less	12mm	J-FAT-OT-P	J.S.T

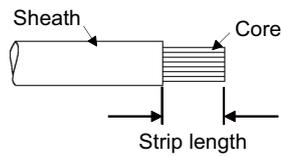
6 Wiring and Connection

6.2 Main Circuit Terminal Block/Control Circuit Connector

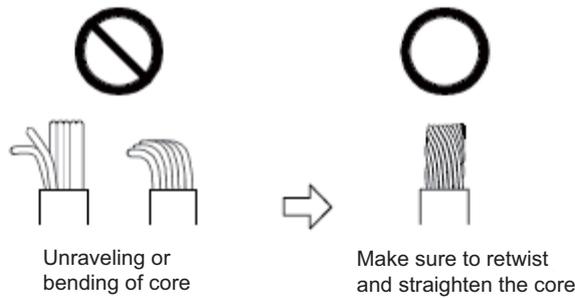
■ Cable connection procedure

- ◆ Processing of power insulator

Since the strip length of wire depends on the types of wire, etc., decide the optimum length according to the machining state.



Retwist and straighten the core as shown below.

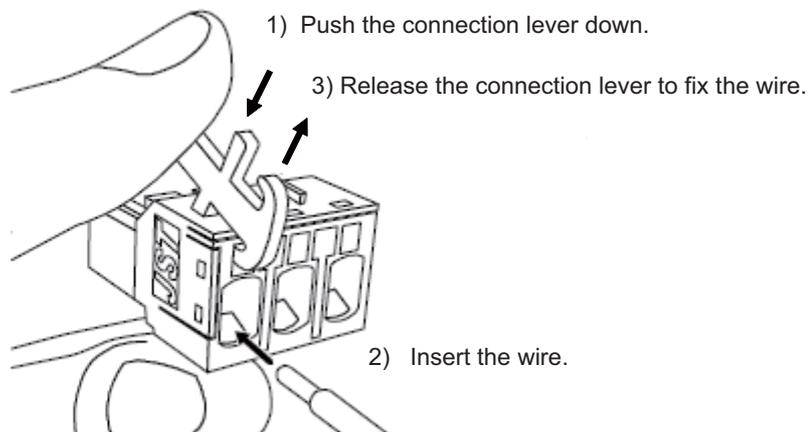


■ Insertion of the cable

Insert the connection lever as shown in the following illustration, and push it down to open the spring.

Keep the connection lever pushed down and insert the stripped wire to the insert hole. Confirm the insert depth so that the wire insulator is not caught.

Release the connection lever to fix the wire. Pulling the wire for confirming the secure connection.



6 Wiring and Connection

6.3 Connection of Power Supply

6.3 Connection of Power Supply

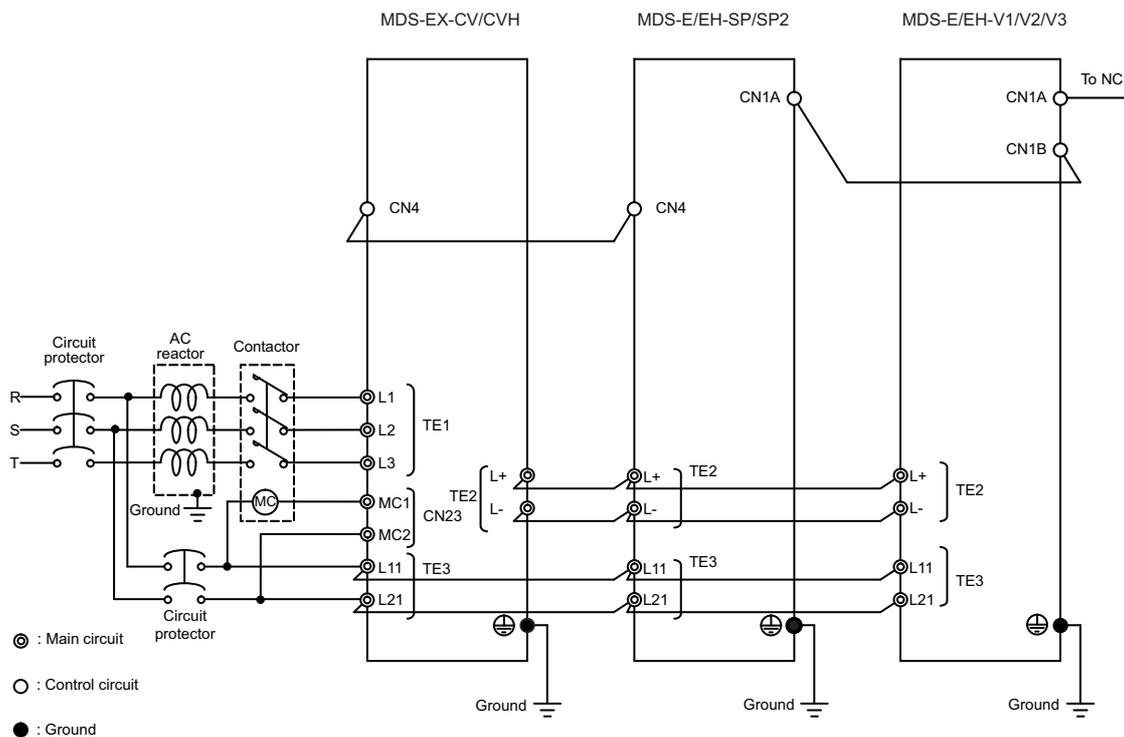
⚠ CAUTION

- (1) Make sure that the power supply voltage is within the specified range of each unit. Failure to observe this could lead to damage or faults.
- (2) For safety purposes, always install a circuit protector, and make sure that the circuit is cut off when an abnormality occurs or during inspections.
- (3) The wire size will differ according to each drive unit capacity.
- (4) For safety purposes, always install a magnetic contactor (contactor) on the main circuit power supply input. Large rush currents will flow when the power is turned ON.
- (5) A leakage current of approx. 15mA is passed in the power supply unit's magnetic contact drive circuit. Confirm that the excitation coil in the magnetic contact will not operate at 15mA or less.

6.3.1 Power Supply Input Connection

■ When using one power supply unit

Install the unit so that the total wiring length of the DC power supply terminals TE2 (L+, L-) is 1500 mm or less. Large capacity spindle drive units, in particular, should be installed adjacent to the power supply unit which they control.



⚠ CAUTION

- (1) The power supply unit is equipped with a power supply regenerative type converter. Always install an AC reactor in the power supply line.
- (2) When connecting to the TE3 terminal, connect to the power supply side (primary side) of the AC reactor.
- (3) Connect the power supply unit's CN4 connector with the spindle drive unit of the largest capacity. If there is no spindle drive unit, connect to the servo drive unit which is the unbalance axis.
- (4) Install the spindle drive unit adjacent to the power supply unit and keep the total TE2 wiring length of the other drive units to 1500mm or less.

6 Wiring and Connection

6.3 Connection of Power Supply

6.3.2 Wiring of the Grounding Cable

■ Connecting the protective grounding (PE) and frame ground (FG)

Each unit has a terminal or mounting hole to connect PE or FG.

Please connect a grounding cable to the main ground of a cabinet or a machine frame at one point.

Ground each device according to the grounding conditions set forth by each country. (Typically, a star connection neutral point ground is used in Europe.)

PE: Grounding to provide protection from electric shock, etc.

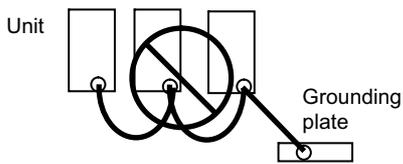
FG: Grounding to stabilize the operation of the devices, etc. (Suppress noise)

For UL compliance (acquisition), ground the neutral point of a star connection.



POINT

Do not connect the grounding cable from each unit to the grounding plate via other units. Noise from other units could result in malfunctions.



■ Grounding cable size

Use a grounding cable equal to or thicker than the wire connected to TE1 (L1/L2/L3) of MDS-EX-CV/CVH. (PE)

6.4 Peripheral Control Wiring

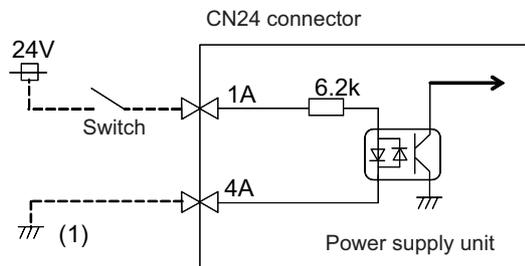
6.4.1 Input/Output Circuit Wiring

The CN9 connector is equipped with a 24 V input/output circuit for controlling external devices and control by external signals. Set the relevant parameters and use them with care for the wiring since some signals are changeover type, which can be switched over by parameters. Refer to the description of each function in the relevant sections for details on the function specifications and settings.

Connector	Input condition	
CN24	Switch ON	18 VDC to 25.2 VDC 2.9 mA or more
	Switch OFF	4 VDC or less 1 mA or less

Use switches or relays for wiring that satisfy the input/output (voltage, current) conditions.

Interface name	Selection example
For digital input signal (CN24)	Use a minute signal switch with a stable contact and operation even at low voltage or current. < Example > OMRON: G2A, G6B type, MY type, LY type



- If a ground of the external 24 V power is same as the ground of the 24 V power in the drive unit, a fault or abnormal operation could occur.
- The maximum rising / falling edge transmission delay time is 500 μ s.

Output

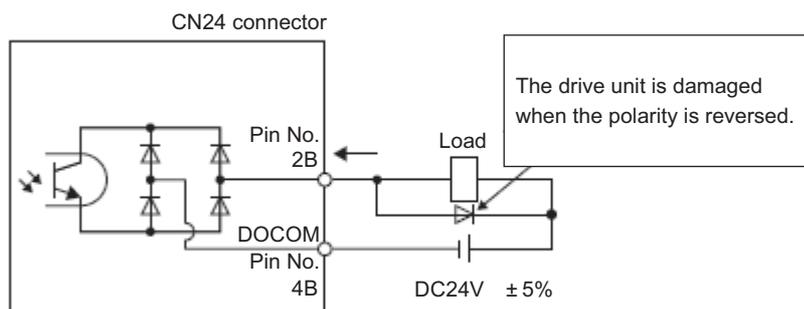
This circuit has an output transistor whose collector is the output terminal. Current flows into the collector terminal when the output transistor turns ON.

The lamp, relay, and photocoupler can be driven. Install a diode (D) for inductive loads and an inrush current suppression resistor (R) for lamp loads. Maximum 2.6 V of voltage drop occurs inside the unit.

Connector	Output condition	
CN24	Output voltage	24 VDC \pm 5%
	Tolerable output current	40 mA or less

Use switches or relays for wiring that satisfy the input/output (voltage, current) conditions.

Interface name	Selection example
For digital input signal (CN24)	Use a compact relay operated with rating of 24 VDC, 40 mA or less. < Example > OMRON: G6B type, MY type



7

Setup

7 Setup

7.1 Setting the Initial Parameters for the Drive Unit

7.1 Setting the Initial Parameters for the Drive Unit

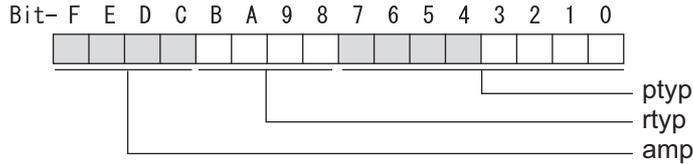
The servo and spindle related parameters must be set before the servo and spindle system can be started up. The servo and spindle related parameters are input from the NC. As the input method differs according to the NC being used, refer to each NC Instruction Manual.

7.1.1 Servo Parameter

(PR)	#2236	SV036	PTYP	Power supply type/ Regenerative resistor type
------	-------	-------	------	---

MDS-E/EH Series: Power supply type

When connecting a power supply unit, set a code for each power supply unit.



bit F-C : amp

Set the power backup function to be used.

- No function used : 0
- Deceleration and stop function at power failure : 8
- Retraction function at power failure : C

bit B-8 : rtp

Not used. Set to "0".

bit 7-0 : ptyp External emergency stop setting

When the emergency stop input signal of the power supply unit is "disabled"

- Power supply unit is not connected : 00h
- MDS-EX-CV-37 / MDS-EX-CVH-37 : 04h
- MDS-EX-CV-75 / MDS-EX-CVH-75 : 08h
- MDS-EX-CV-110 / MDS-EX-CVH-110 : 11h
- MDS-EX-CV-185 / MDS-EX-CVH-185 : 19h

When the emergency stop input signal of the power supply unit is "enabled"

(*) Set the power supply rotary switch to "4".

- Power supply unit is not connected : 00h
- MDS-EX-CV-37 / MDS-EX-CVH-37 : 44h
- MDS-EX-CV-75 / MDS-EX-CVH-75 : 48h
- MDS-EX-CV-110 / MDS-EX-CVH-110 : 51h
- MDS-EX-CV-185 / MDS-EX-CVH-185 : 59h

7 Setup

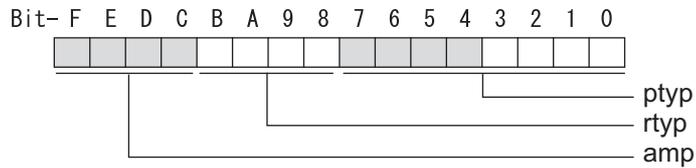
7.1 Setting the Initial Parameters for the Drive Unit

7.1.2 Spindle Parameter

(PR)	#13032	SP032	PTYP	Power supply type/ Regenerative resistor type
------	--------	-------	------	---

MDS-E/EH Series: Power supply type

When connecting a power supply unit, set a code for each power supply unit.



bit F-C : amp

Set the power backup function to be used.

- No function used : 0
- Deceleration and stop function at power failure : 8
- Retraction function at power failure : C

bit B-8 : rtyp

Not used. Set to "0".

bit 7-0 : ptyp External emergency stop setting

When the emergency stop input signal of the power supply unit is "disabled"

- Power supply unit is not connected : 00h
- MDS-EX-CV-37 / MDS-EX-CVH-37 : 04h
- MDS-EX-CV-75 / MDS-EX-CVH-75 : 08h
- MDS-EX-CV-110 / MDS-EX-CVH-110 : 11h
- MDS-EX-CV-185 / MDS-EX-CVH-185 : 19h

When the emergency stop input signal of the power supply unit is "enabled"

(*) Set the power supply rotary switch to "4".

- Power supply unit is not connected : 00h
- MDS-EX-CV-37 / MDS-EX-CVH-37 : 44h
- MDS-EX-CV-75 / MDS-EX-CVH-75 : 48h
- MDS-EX-CV-110 / MDS-EX-CVH-110 : 51h
- MDS-EX-CV-185 / MDS-EX-CVH-185 : 59h

Refer to the latest version of "MDS-E/EH Series Specifications Manual" (IB-1501226(ENG)) and "MDS-E/EH Series Instruction Manual" (IB-1501229(ENG)) for details about units other than those above.

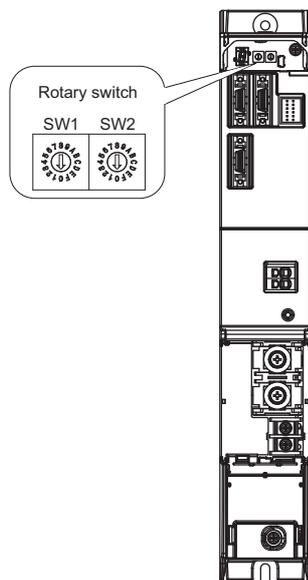
7 Setup

7.2 Initial Setup

7.2 Initial Setup

7.2.1 Setting the Rotary Switch

MDS-EX-CV/CVH

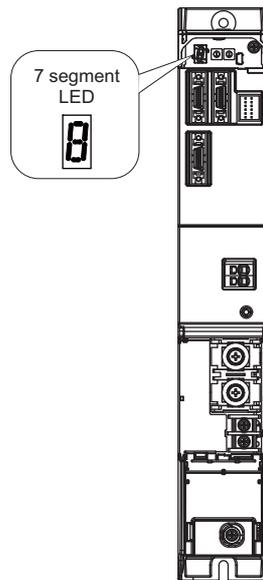


Rotary switch SW1 setting	Setting items
0	Normal setting
1 to 3	Setting prohibited
4	External emergency stop setting
5 to F	Setting prohibited

Rotary switch SW2 setting	Setting items
0	Normal setting
1 to F	Setting prohibited

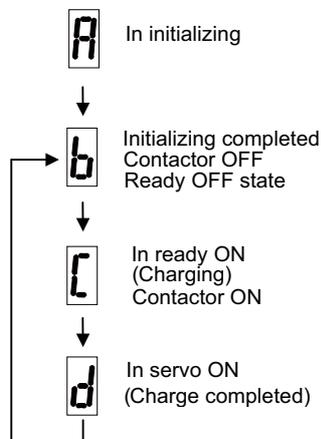
7.2.2 Transition of LED Display after Power Is Turned ON

Power supply unit



When the power of the NC and each drive unit/power supply unit is turned ON, each unit will automatically execute self diagnosis and initial settings for operation, etc. The LEDs on the front of the units will change as shown below according to the progression of these processes. If an alarm occurs, the alarm No. will appear on the LEDs. Refer to section "11.1.1 LED Display When Alarm or Warning Occurs" for details on the alarm displays.

Power supply unit LED display



CAUTION

- (1) Always input emergency stop when starting the servo system.
- (2) Do not insert or remove the external STO input connector (CN8) of the drive unit after starting the servo system. The motor power will be shut off and it may cause a machine collision.

7 Setup

7.2 Initial Setup



Selection

8 Selection

8.1 Selection of the Power Supply Unit

8.1 Selection of the Power Supply Unit

Select the power supply unit from the total sum of the rated output and the maximum momentary output. Refer to the latest version of "MDS-E/EH Series Specifications Manual" (IB-1501226(ENG)) and "MDS-E/EH Series Instruction Manual" (IB-1501229(ENG)) and select the unit correctly.

(1) Calculation of required continuous rated output

Power supply unit rated output > Σ (Spindle motor continuous rated output) + 0.3 Σ (Servo motor rated output)

Calculate the total sum of "the spindle motor continuous rated output" and "servo motor rated output" with the above expression.

(2) Calculation of required 30-minute rated output

Power supply unit 30-minute rated output > Σ (MAX(spindle motor short time rated output and output during acceleration/deceleration)) + 0.3 Σ (servo motor rated output)

Calculate the total sum of the maximum values of the "spindle motor short time rated output and output during acceleration/deceleration" and the "servo motor rated output" with the above expression.

(3) Calculation of required maximum momentary output

Maximum momentary rated capacity of power supply unit $\geq \Sigma$ (Spindle maximum momentary output) + Σ (Maximum momentary output of servo motor accelerating/decelerating simultaneously)

Calculate the total sum of the "spindle maximum momentary output" and "maximum output of servo motor accelerating/decelerating simultaneously" with the above expression.

(4) Selection of power supply unit

Select the power supply unit of which the rated capacity and maximum momentary rated capacity are larger than those selected in the item (1), (2), and (3). When the capacity is smaller than the item (1), (2), and (3), add the power supply unit.

Power supply unit rated capacity, maximum momentary rated capacity

< MDS-EX-CV Series >

Unit	MDS-EX-CV-	37	75	110	185
Rated capacity [kW]		4.2	8	11.5	19
Maximum momentary rated capacity [kW]		16	23	39	60

< MDS-EX-CVH Series >

Unit	MDS-EX-CVH-	37	75	110	185
Rated capacity [kW]		4.2	8	11.5	19
Maximum momentary rated capacity [kW]		16	23	39	60

⚠ CAUTION

- (1) When reducing the time constant replacing the conventional motor with the HG or HG-H Series motor, the power supply capacity may rise because the motor maximum momentary output increases more than the conventional motor. Make sure to check the selection with maximum momentary rated capacity.
- (2) When the large capacity drive unit (MDS-E-SP-400/640, MDS-EH-SP-200/320/480/600, MDS-EH-V1-200) is connected to the power supply unit, always install the drive unit immediately to the left of the power supply unit and connect the PN terminal with the dedicated DC connection bar.
- (3) When using two large capacity drive units or more, a power supply unit is required for each drive unit.

8 Selection

8.1 Selection of the Power Supply Unit



Refer to the latest version of "MDS-E/EH Series Specifications Manual" (IB-1501226(ENG)) for the calculation method of the spindle motor output and the servo motor output.

8 Selection

8.2 Selection of Power Supply

8.2 Selection of Power Supply

For the power supply capacity, calculate both the required spindle motor rated output and the servo motor rated output, and select the power supply capacity satisfying them.

(1) Calculation of rated output required for power supply

Rated output required for power supply = Σ (Spindle motor rated output required for power supply) + 0.3 Σ (servo motor rated output required for power supply)

Calculate the total sum of "Spindle motor rated output" and "servo motor rated output" required for the power supply with the above expression.

(2) Calculation of required power supply capacity

Power supply capacity (kVA) = Σ {(Required rated output calculated in the item (1) (kW) / Continuous rated output of power supply unit (kW)} \times Power supply capacity base value (kVA)}

Calculate "the required power supply capacity" with the above expression.

The power supply capacity base value corresponding to the capacity of the power supply unit "MDS-EX-CV/CVH" is shown in the following table.

< MDS-EX-CV Series >

Unit	MDS-EX-CV-	37	75	110	185
Power supply capacity base value [kW]		5.3	11.0	16.0	27.0

< MDS-EX-CVH Series >

Unit	MDS-EX-CVH-	37	75	110	185
Power supply capacity base value [kW]		5.3	11.0	16.0	27.0



Refer to the latest version of "MDS-E/EH Series Specifications Manual" (IB-1501226(ENG)) for the calculation method of the spindle motor rated output and the servo motor rated output required for power supply.

Specifications of Peripheral Devices

9.1 Selection of Wire

Selected wires must be able to tolerate each unit and motor terminal part to which the wire is connected. How to calculate tolerable current of an insulated wire or cable is shown in "Tolerable current of electric cable" (1) of Japanese Cable Makers' Association Standard (JCS)-168-E (1995), and the tolerable current, etc. are defined in the electrical equipment technical standards or the JEAC regulations. When exporting, select wires according to the related standards of the country or region of export. A wire's tolerable current is different depending on conditions such as its material, structure, ambient temperature, etc. Check the tolerable current described in the specifications of the wire used.

9.1.1 Wire Selection Standards for Each Product

Refer to the following table to select the wire which tolerates the selection-standard current of each product.

Product	Target	Standard
Power supply unit	Main circuit power cable (L1, L2, L3, earth)	Input rated current
	DC connection cable (L+,L-)	Output rated current
Common to each unit	Control power cable (L11, L21)	Control power maximum current

(*1) In the UL standards, using wires of 60°C and 75°C are the certification conditions. (UL61800-5-1)

9 Specifications of Peripheral Devices

9.1 Selection of Wire

< Power supply communication cable and connector >

Item		Model	Contents	
CN4/ CN41/ CN9	Power supply communication cable	SH21 Length: 0.35, 0.5, 1, 2, 3 m	Drive unit side connector (3M) Connector: 10120-6000EL Shell kit: 10320-3210-000	Power supply unit side connector (3M) Connector: 10120-6000EL Shell kit: 10320-3210-000
CN4/ CN41/ CN9	Power supply communication cable connector set	FCUA-CS000	Drive unit side connector (3M) Connector: 10120-3000VE Shell kit: 10320-52F0-008	Power supply unit side connector (3M) Connector: 10120-3000VE Shell kit: 10320-52F0-008
			Compatible part(*1) (J.S.T) Connector: MS-P20-L Shell kit: MS20-2B-28	Compatible part(*1) (J.S.T) Connector: MS-P20-L Shell kit: MS20-2B-28
For CN23	External contactor control connector	SPT 5/2-H-7, 5(-ZB)	Power supply unit side connector (Phoenix Contact) 	
For CN24	External emergency stop connector	CNU24X (AWG24)	Power supply unit side connector (J.S.T) Connector: J21DF-12V-KX-L Contact: BJ2F-21(*)-P1.0 (*2) 	
For TE1	Power connector for MDS-EX-CV/CVH-37/75 (L1/L2/L3)	CNU01SECV (AWG14)	Power supply unit side connector (J.S.T) Connector: 03JFAT-SAZGDS-P15 (dedicated for MDS-EX-CV/CVH-37/75) 	
			Connection lever J-FAT-OT-P (J.S.T) 	

(*1) The names of compatible parts may be changed at the manufacturer's discretion. Contact each manufacturer for more information.

(*2) Manual crimping tools: YRK-8852 (Contact each manufacturer for more information.)

9.1.2 Example of Wires by Unit

The following are examples of wire selections for each unit based on the certification standards. The relation between wire size and tolerable current conforms to the requirements specified in IEC/EN60204-1, UL61800-5-1, and JEAC8001. However, the tolerable current is different depending on the wire specifications of each manufacturer even among the wires of the same size.

■ 600 V vinyl insulated wire (IV wire) 60 °C product (Example according to IEC/EN60204-1 and UL61800-5-1)

< MDS-EX-CV Series >

Unit Type	Terminal name					
	TE1 (L1, L2, L3, ⊕)		TE3 (L11, L21)		TE2 (L+, L-)	
	mm ²	AWG	mm ²	AWG	mm ²	AWG
MDS-EX-CV-37	2	14	2	14	3.5	12
MDS-EX-CV-75	5.5	10	2	14	8	8
MDS-EX-CV-110	14	6	2	14	-	-
MDS-EX-CV-185	22	4	2	14	-	-

< MDS-EX-CVH Series >

Unit Type	Terminal name					
	TE1 (L1, L2, L3, ⊕)		TE3 (L11, L21)		TE2 (L+, L-)	
	mm ²	AWG	mm ²	AWG	mm ²	AWG
MDS-EX-CVH-37	2	14	2	14	2	14
MDS-EX-CVH-75	2	14	2	14	2	14
MDS-EX-CVH-110	3.5	12	2	14	-	-
MDS-EX-CVH-185	14	6	2	14	-	-

■ 600 V double (heat proof) vinyl insulated wire (HIV wire) 75 °C product (Example according to IEC/EN60204-1 and UL61800-5-1)

< MDS-EX-CV Series >

Unit Type	Terminal name					
	TE1 (L1, L2, L3, ⊕)		TE3 (L11, L21)		TE2 (L+, L-)	
	mm ²	AWG	mm ²	AWG	mm ²	AWG
MDS-EX-CV-37	2	14	2	14	3.5	12
MDS-EX-CV-75	5.5	10	2	14	5.5	10
MDS-EX-CV-110	8	8	2	14	14	6
MDS-EX-CV-185	14	6	2	14	22	4

< MDS-EX-CVH Series >

Unit Type	Terminal name					
	TE1 (L1, L2, L3, ⊕)		TE3 (L11, L21)		TE2 (L+, L-)	
	mm ²	AWG	mm ²	AWG	mm ²	AWG
MDS-EX-CVH-37	2	14	2	14	2	14
MDS-EX-CVH-75	2	14	2	14	2	14
MDS-EX-CVH-110	3.5	12	2	14	5.5	10
MDS-EX-CVH-185	8	8	2	14	8	8

■ 600 V bridge polyethylene insulated wire (IC) 105 °C product (Example according to JEAC8001)

< MDS-EX-CV Series >

Unit Type	Terminal name					
	TE1 (L1, L2, L3, ⊕)		TE3 (L11, L21)		TE2 (L+, L-)	
	mm ²	AWG	mm ²	AWG	mm ²	AWG
MDS-EX-CV-37	2	14	1.25 to 2	16 to 14	2	14
MDS-EX-CV-75	3.5	12			3.5	12
MDS-EX-CV-110	5.5	10			14	6
MDS-EX-CV-185	14	6			22	4

< MDS-EX-CVH Series >

Unit Type	Terminal name					
	TE1 (L1, L2, L3, ⊕)		TE3 (L11, L21)		TE2 (L+, L-)	
	mm ²	AWG	mm ²	AWG	mm ²	AWG
MDS-EX-CVH-37	2	14	1.25 to 2	16 to 14	2	14
MDS-EX-CVH-75	2	14			2	14
MDS-EX-CVH-110	2	14			3.5	12
MDS-EX-CVH-185	5.5	10			5.5	10

9.2 Selection of Circuit Protector and Contactor

Always select the circuit protector and contactor correctly, and install them to each power supply unit to prevent disasters.

CAUTION

Always use the circuit protector specified in "9.2.1 Selection of Circuit Protector" for UL compliance (acquisition). When using a circuit protector that is not specified in "9.2.1 Selection of Circuit Protector", UL certification is not acquired.

9.2.1 Selection of Circuit Protector

Calculate the circuit protector selection current from the nominal input voltage (voltage supplied to the power supply unit) as shown in the expression below. Then select the minimum capacity circuit protector whose rated current meets the circuit protector selection current.

< MDS-EX-CV Series >

Circuit protector selection current [A] =

(Circuit protector selection current for 200 V input [A] / Nominal input voltage [V]) × 200 [V]

Selection of circuit protector for 200 V input

Unit Type MDS-EX-CV-	37	75	110	185
Circuit protector selection current for 200 V input	15A	31A	45A	76A
Selection example of circuit protector (Mitsubishi Electric Corp.)	NF125-HVU 20A	NF125-HVU 40A	NF125-HVU 60A	NF125-HVU 100A
Rated current of the selection example of circuit protector	20A	40A	60A	100A

CAUTION

The UL standard of the unit type above is valid only when the unit is combined with the circuit protector above. Always use the above circuit protector for UL compliance (acquisition). When using a circuit protector other than the circuit protector specified above, UL certification is not acquired.

Optional part: The NC unit does not come with a protector. Purchase the part from your dealer, etc.

(Example) Select a circuit protector for using the MDS-EX-CV-37 with a 220V normal input voltage.

Circuit protector selection current = $15/220 \times 200 = 13.7[A]$

9 Specifications of Peripheral Devices

9.2 Selection of Circuit Protector and Contactor

< MDS-EX-CVH Series >

Circuit protector selection current [A] =

(Circuit protector selection current for 380 V input [A] / Nominal input voltage [V]) × 380 [V]

Selection of circuit protector for 380 V input

Unit Type MDS-EX-CVH-	37	75	110	185
Circuit protector selection current for 380 V input	8A	16A	24A	40A
Selection example of circuit protector (Mitsubishi Electric Corp.)	NF125-HVU 10A	NF125-HVU 20A	NF125-HVU 30A	NF125-HVU 50A
Rated current of the selection example of circuit protector	10A	20A	30A	50A

 CAUTION

The UL standard of the unit type above is valid only when the unit is combined with the circuit protector above. Always use the above circuit protector for UL compliance (acquisition). When using a circuit protector other than the circuit protector specified above, UL certification is not acquired.

Optional part: The NC unit does not come with a protector. Purchase the part from your dealer, etc.

(Example) Select a circuit protector for using the MDS-EX-CVH-37 with a 480V normal input voltage.

$$\text{Circuit protector selection current} = 8/480 \times 380 = 6.3[\text{A}]$$

 CAUTION

- (1) Do not share a circuit protector for multiple power supply units as it is dangerous. Always install a circuit protector for each power supply unit.
- (2) If the control power (L11, L21) must be protected, select according to the section "Circuit protector".

9 Specifications of Peripheral Devices

9.2 Selection of Circuit Protector and Contactor

9.2.2 Selection of Contactor

Calculate the contactor selection current from the nominal input voltage (power supply unit) as shown in the expression below. Then select the contactor whose conventional free-air thermal current meets the contactor selection current.

< MDS-EX-CV Series >

Contactor selection current [A] =

$$(\text{Contactor selection current for 200 V input [A]} / \text{Nominal input voltage [V]}) \times 200 \text{ [V]}$$

Selection of contactor for 200 V input

Unit Type MDS-EX-CV-	37	75	110	185
Contactor selection current for 200 V input	15A	31A	45A	76A
Conventional freeair thermal current of the selection example of contactor	20A	50A	50A	100A

Optional part: The NC unit does not come with a contactor. Purchase the part from your dealer, etc.

(Example) Select a contactor for using the MDS-EX-CV-37 with a 220V normal input voltage.

$$\text{Contactor selection current} = 15/220 \times 200 = 13.7\text{[A]}$$

< MDS-EX-CVH Series >

Contactor selection current [A] =

$$(\text{Contactor selection current for 380 V input [A]} / \text{Nominal input voltage [V]}) \times 380 \text{ [V]}$$

Selection of contactor for 380 V input

Unit Type MDS-EX-CVH-	37	75	110	185
Contactor selection current for 380 V input	8A	16A	24A	40A
Conventional freeair thermal current of the selection example of contactor	20A	20A	32A	50A

Optional part: The NC unit does not come with a contactor. Purchase the part from your dealer, etc.

(Example) Select a contactor for using the MDS-EX-CVH-37 with a 480V normal input voltage.

$$\text{Contactor selection current} = 8/480 \times 380 = 6.3\text{[A]}$$



POINT

- (1) Use an alternating contactor.
- (2) If the contactor selection current is 20 A or less, select a contactor whose conventional free-air thermal current is 20 A or more.
- (3) Select a contactor whose excitation coil does not operate at 15 mA or less.

9.3 Dedicated Options

9.3.1 Optional Cover

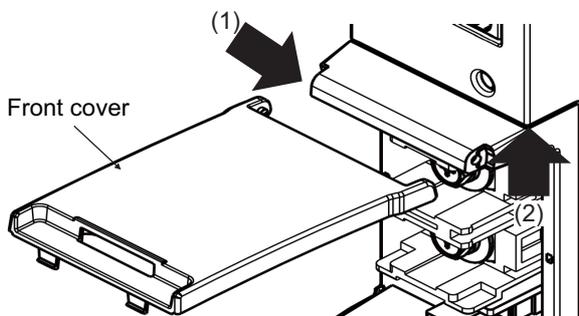
The table below shows the lineup of optional covers. Replace and install the optional cover according to the replacing and installing method.

■ Optional cover type

Unit type	Optional cover type
MDS-EX-CV-37/75	EX-COVER-1
MDS-EX-CVH-37/75	EX-COVER-1
MDS-EX-CV-110/185	EX-COVER-2
MDS-EX-CVH-110/185	EX-COVER-2

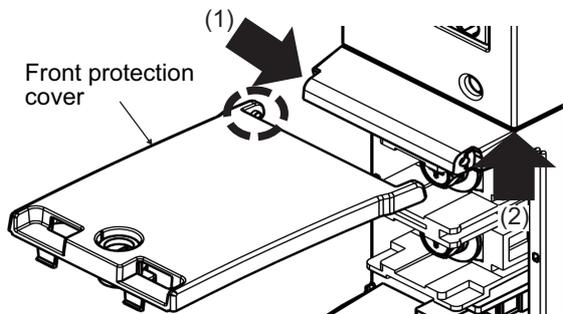
■ Replacing the optional cover EX-COVER-1

Follow the procedures below to replace the front cover.



Removing the front cover

- (1) Open the front cover and push it towards either the right or left side of the unit.
- (2) While pushing the front cover from one side, tilt upwards the opposite side of the front cover that protrudes outwards.
- (3) The front cover becomes unhinged and can be removed.



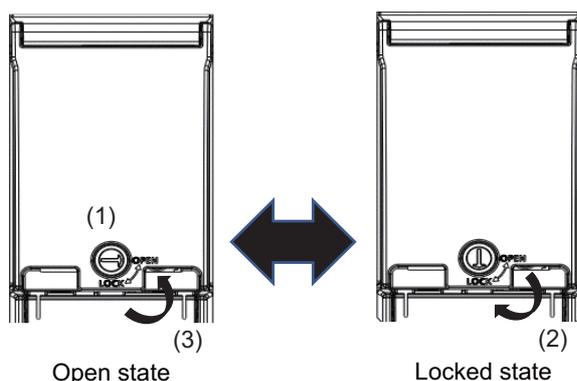
Installing the front protection cover

- (1) Insert either the right or left hinge of the front protection cover (EX-COVER-1).
- (2) Fit the hinge on the other side by bringing it toward the hinging point.
- (3) Once both sides of the hinge have been fitted, the front protection cover is installed.

(*) As the front cover and front protection cover are easily broken, handle them with care during installation or removal.

■ Operation method for the optional cover

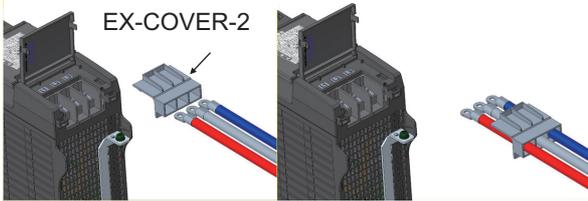
Follow the procedures below to lock or open the front protection cover.



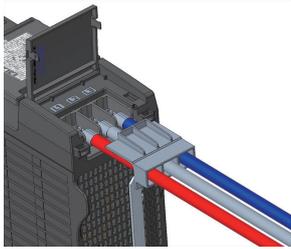
- (1) Insert a flat blade screwdriver in the arrow part on the front protection cover.
- (2) Turn the screwdriver 90 degrees clockwise to lock.
- (3) Turn the screwdriver 90 degrees counterclockwise to open.

■ Installing the optional cover EX-COVER-2

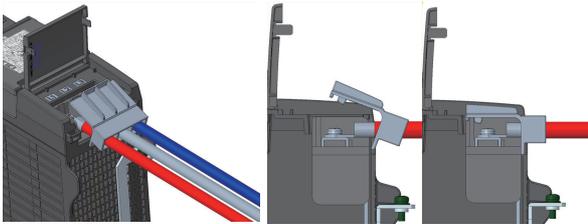
Follow the procedures below to install the optional cover (EX-COVER-2).



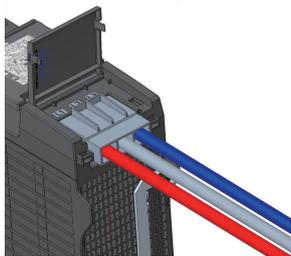
(1) Feed the main circuit power supply cables through the optional cover (EX-COVER-2).



(2) Fasten the cables to the terminal block (L1, L2, L3) with screws.



(3) Tilt the optional cover (EX-COVER-2) to fit it in the groove of the case.



(4) Close the front cover.

9.3.2 Optional Bumper

Optional bumper can be installed on the front cover.

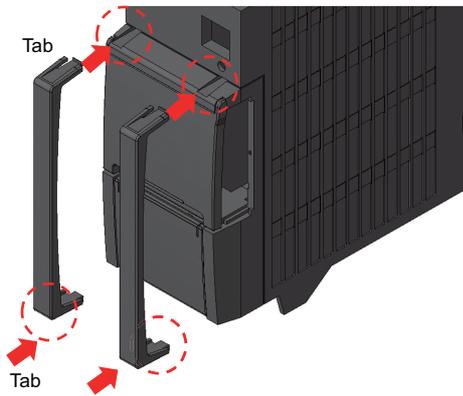
When installing and uninstalling the optional bumpers, make sure to turn off the power supply of the unit and confirm that the CHARGE lamp is turned off completely.

■ Optional bumper type

Unit type	Optional bumper type
MDS-EX-CV-110/185	EX-BUMPER-1
MDS-EX-CVH-110/185	EX-BUMPER-1

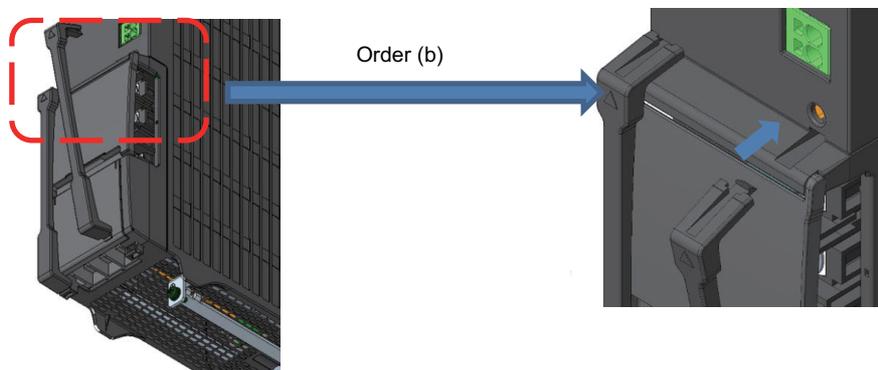
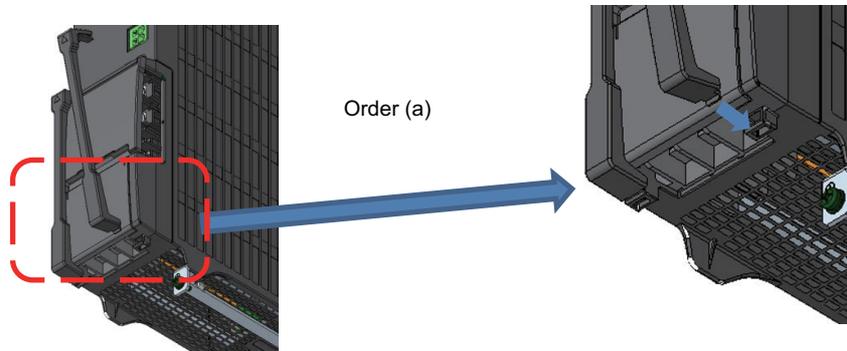
■ Installing the optional bumper

Follow the procedures below to install the optional bumpers.



Installing the optional bumpers

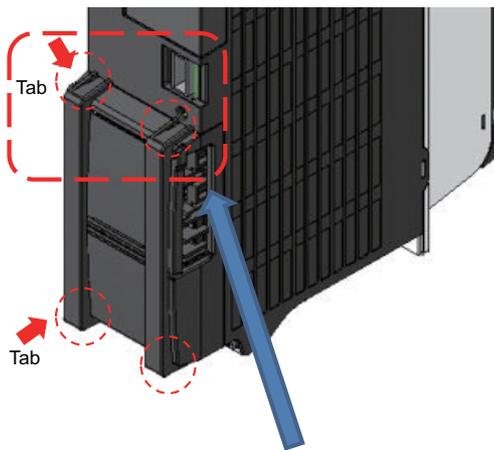
- (1) Install the optional bumpers one after the other.
- (2) While pressing the tabs, insert the optional bumpers to the grooves on the top and the bottom of the unit cover.
(There are grooves on the bottom part as well.)
Insert the optional bumpers in the following order:
 - (a) Tabs on the bottom of the unit cover
 - (b) Tabs on the top of the unit cover
- (3) Confirm that the tabs are locked to the grooves.



Magnified figure (bottom view)

■ Uninstalling the optional bumper

Follow the procedures below to uninstall the optional bumpers.



Uninstalling the optional bumpers

(1) Press the tabs of the optional bumpers to unlock them in the following order:

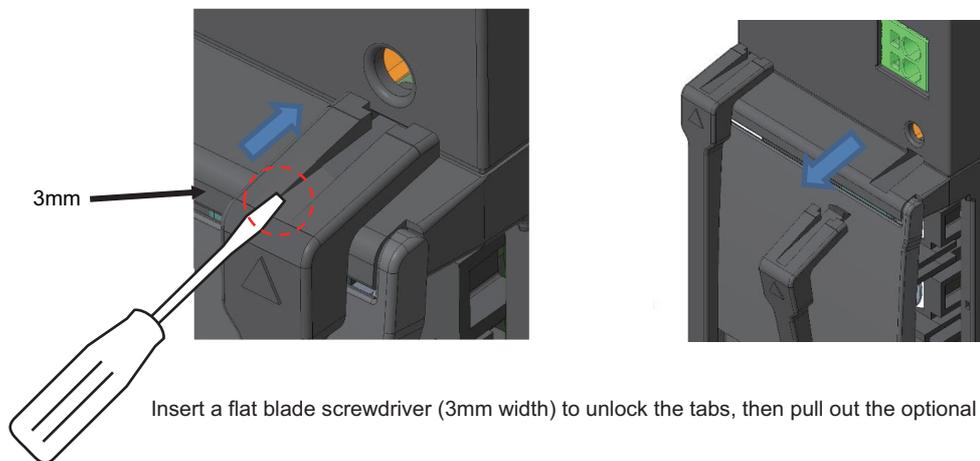
(a) Insert a flat blade screwdriver (3mm width) to the top tabs to unlock them.

(b) After unlocking the top tabs, unlock the bottom tabs.

(2) With the tabs unlocked, pull out the optional bumpers.

(There are grooves on the bottom part as well.)

(3) The optional bumpers are uninstalled.



Insert a flat blade screwdriver (3mm width) to unlock the tabs, then pull out the optional bumpers.

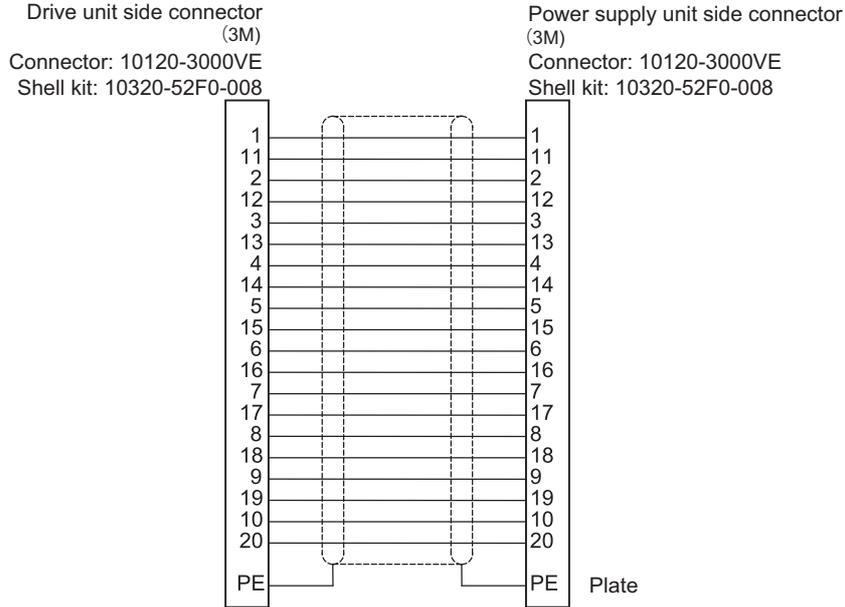
Cable and Connector Specifications

10 Cable and Connector Specifications

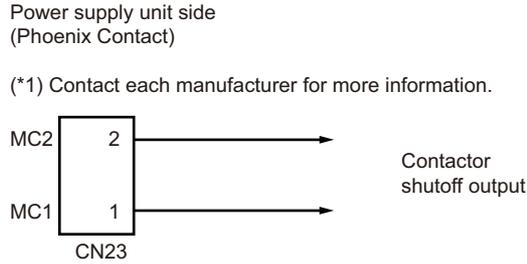
10.1 Cable Connection Diagram

10.1 Cable Connection Diagram

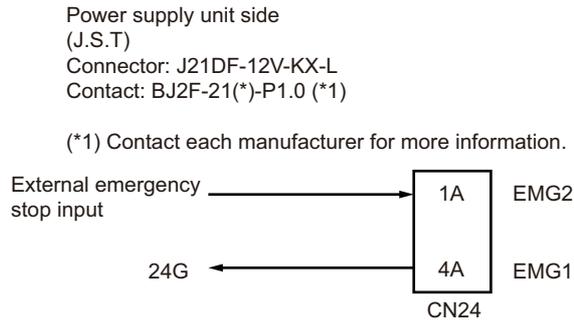
[SH21 cable connection diagram]



[CN23 external contactor control output connector connection diagram]

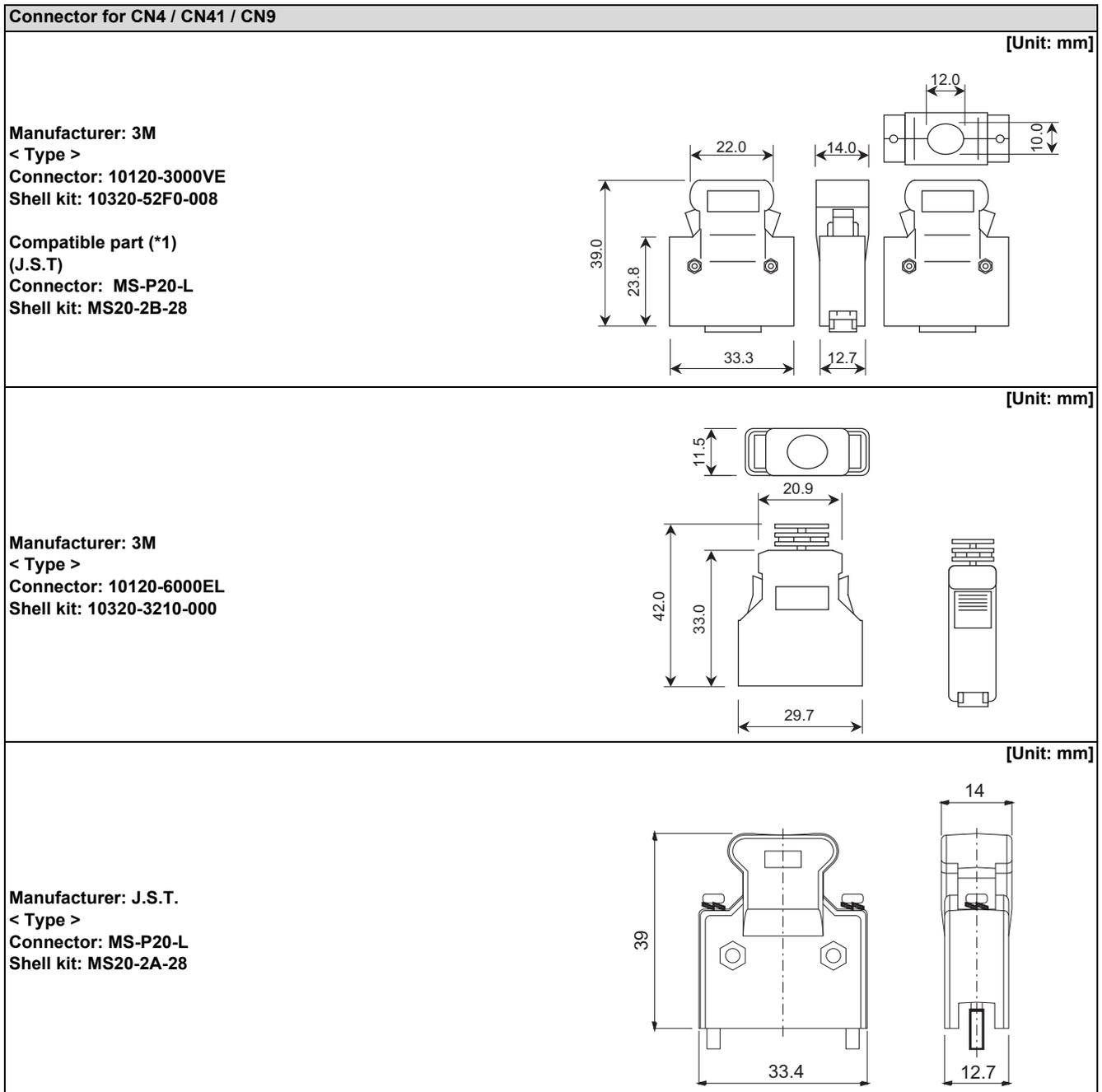


[CN24 external emergency stop connector connection diagram]



10.2 Connector Outline Dimension Drawings

Connector for CN4 / CN41 / CN9



(*1) The names of compatible parts may be changed at the manufacturer's discretion. Contact each manufacturer for more information.

10 Cable and Connector Specifications

10.2 Connector Outline Dimension Drawings

Connector for CN23 (External contactor control connector)

Power supply unit connector for CN23 (External contactor control connector) [Unit: mm]

Manufacturer: Phoenix Contact
 (*1) Contact each manufacturer for more information.

Connector for CN24 (Connector for external emergency stop)

Power supply unit connector for CN24 (Connector for external emergency stop) [Unit: mm]

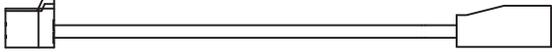
Manufacturer: J.S.T.
 < Type >
 Connector: J21DF-12V-KX-L
 Contact: BJ2F-21(*)-P1.0 (*1)
 (*1) Contact each manufacturer for more information.

10 Cable and Connector Specifications

10.3 External emergency stop conversion cable

10.3 External emergency stop conversion cable

External emergency stop conversion cable

Item	Model	Contents
Conversion for CN24	External emergency stop conversion cable	EX-EMGICABL MDS-EX-CV side (JST) Connector: J21DF-12V-KX-L Contact: SJ2F-002GF-P1.0 Cable for MDS-E/EH-CV side (DDK) Connector: DK-2100D-08F Contact: DK-2TABSLP1-100 

10 Cable and Connector Specifications

10.3 External emergency stop conversion cable

Troubleshooting

11 Troubleshooting

11.1 Points of Caution and Confirmation

11.1 Points of Caution and Confirmation

If an error occurs in the power supply unit, a warning or alarm will occur. When a warning or alarm occurs, check the state while observing the following points, and inspect or remedy the unit according to the details given in this section.

[Points of confirmation]

- (1) What is the alarm code display?
- (2) Can the error or trouble be repeated? (Check alarm history)
- (3) Is the motor and servo drive unit temperature and ambient temperature normal?
- (4) Are the servo drive unit, control unit and motor grounded?
- (5) Was the unit accelerating, decelerating or running at a set speed? What was the speed?
- (6) Is there any difference during forward and backward run?
- (7) Was there a momentary power failure?
- (8) Did the trouble occur during a specific operation or command?
- (9) At what frequency does the trouble occur?
- (10) Is a load applied or removed?
- (11) Has the drive unit been replaced, parts replaced or emergency measures taken?
- (12) How many years has the unit been operating?
- (13) Is the power supply voltage normal? Does the state change greatly according to the time band?

CAUTION

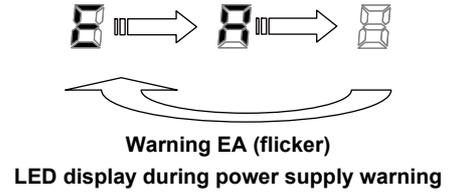
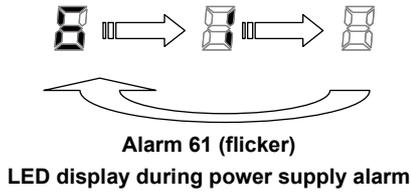
- (1) **This power supply unit uses a large capacity electrolytic capacitor. When the CHARGE lamp on the front of the power supply unit is lit, voltage is still present at the PN terminal (TE2). Do not touch the terminal block in this state.**
- (2) **Before replacing the unit, etc., always confirm that there is no voltage at the PN terminal (TE2) with a tester or wait at least 20 minutes after turning the main power OFF.**
- (3) **Never check the conductivity inside the unit**
- (4) **Never carry out a megger test on the drive unit or power supply unit as the unit could be damaged.**
- (5) **Do not touch the radiation fin on unit back face, regenerative resistor or motor, etc., or place parts (cables, etc.) nearby while the power is turned ON or immediately after turning the power OFF. These parts may reach high temperatures, and can cause burns or part damage.**

11 Troubleshooting

11.1 Points of Caution and Confirmation

11.1.1 LED Display When Alarm or Warning Occurs

For the power supply unit, the alarm/warning No. is displayed one digit at a time in sequence. The display flickers when an alarm or a warning occurs.



11 Troubleshooting

11.2 List of Unit Protective Functions

11.2 List of Unit Protective Functions

11.2.1 List of Alarms

When an alarm occurs, the servo drive unit will make the motor stop by the deceleration control or dynamic brake. The spindle drive unit will coast to a stop or will decelerate to a stop. At the same time, the alarm No. will appear on the NC monitor screen and on the LEDs on the front of each drive unit. Check the alarm No., and remove the cause of the alarm by following this list.

List of alarms

No.	Name	Details	Reset method
61	Power supply: Power module overcurrent	Overcurrent protection function in the power module has started its operation.	PR
62	Power supply: Frequency error	The input power supply frequency increased above the specification range. Or, incorrect wiring of the power supply wire was detected.	PR
64	Power supply: Overload	Overload detection level exceeded 100 %. The power supply is overloaded.	NR
66	Power supply: Process error	An error occurred in the process cycle.	PR
67	Power supply: Phase interruption	An open-phase condition was detected in input power supply circuit.	PR
68	Power supply: Watchdog	The system does not operate correctly. LED display is fixed as "8".	AR
69	Power supply: Grounding	The motor power cable is in contact with FG (Frame Ground).	PR
6A	Power supply: External contactor welding	A contact of the external contactor is welding.	PR
6B	Power supply: Rush circuit error	An error was detected in the rush circuit.	PR
6C	Power supply: Main circuit error	An error was detected in charging operation of the main circuit capacitor.	PR
6D	Parameter setting error	An error was detected in the parameter sent from the drive unit.	PR
6E	Power supply: H/W error	An error was detected in the internal memory.	AR
	A/D error	An error was detected in the A/D converter.	
	Unit ID error	An error was detected in the unit identification.	
6F	Power supply error	No power supply is connected to the drive unit, or a communication error was detected.	AR
70	Power supply: External emergency stop error	A mismatch of the external emergency stop input and NC emergency stop input continued for 30 seconds.	PR
71	Power supply: Instantaneous power interruption	The power was momentarily interrupted.	NR
72	Power supply: Fan stop	A cooling fan built in the power supply unit stopped, and overheat occurred in the power module.	PR
73	Power supply: Over regeneration	Over-regeneration detection level became over 100%. The regenerative resistor is overloaded. This alarm cannot be reset for 15 min from the occurrence to protect the regeneration resistor. Leave the drive system energized for more than 15 min, then turn the power ON to reset the alarm.	NR
74	Power supply: Option unit error	An alarm was detected in the power backup unit (power supply option unit).	NR
75	Power supply: Overvoltage	L+ and L- bus voltage in main circuit or the input voltage exceeded the allowable value. As the voltage between L+ and L- may be high immediately after this alarm, another alarm may occur if this alarm is reset in a short time. Wait more than 5 min before resetting so that the voltage drops.	NR
76	Power supply: Function setting error	A wrong external emergency stop signal is input.	AR
	Power supply: Function selection error	"Setting prohibited" for the rotary switch 1 and 2 is selected.	
77	Power supply: Power module overheat	Thermal protection function in the power module has started its operation.	PR

AR: Drive unit power ON/OFF, PR: NC power ON/OFF, NR: Reset with the NC RESET button. This alarm can also be reset with the PR and AR resetting conditions.

11 Troubleshooting

11.3 Troubleshooting

11.2.2 List of Warnings

When a warning occurs, a warning No. will appear on the NC monitor screen and on the LEDs on the front of each unit. Check the warning No., and remove the cause of the warning by following this list.

List of Warnings

No.	Name	Details	Reset method
E9	Instantaneous power interruption warning	The power was momentarily interrupted.	NR
EA	In external emergency stop state	External emergency stop signal was input.	*
EB	Power supply: Over regeneration warning	Over-regeneration detection level exceeded 80%.	*
EC	Power supply: Overload warning	Overload detection level exceeded 80 %.	*
ED	Unit replacement warning	The waveforms measured by the power supply recorder have not been recorded in the memory. When the warning continues after turning ON the power supply again, it cannot be reset.	AR
EE	Power supply: Fan stop warning	A cooling fan built in the power supply unit stopped.	*
EF	Power supply: Option unit warning	A warning was detected in the power backup unit (power supply option unit).	*

11.3 Troubleshooting

If the NC system does not start up correctly and a system error occurs when the NC power is turned ON, the drive unit may not have been started up properly. Check the LED display on the power supply unit, and take measures according to this section.

Power supply unit alarm

Alarm No. 61		Power supply: Power module overcurrent	
		Overcurrent protection function in the power module of power supply has started its operation.	
	Investigation details	Investigation results	Remedies
1	Check the state of the operation when the alarm occurs, and if the alarm repeats.	The alarm occurs immediately after 400 VAC is supplied or after READY is turned ON.	Replace the unit.
		The alarm occurs occasionally during READY ON.	Check the investigation item No. 3.
		The alarm occurs after continuous operation for a long time. The unit is hot.	Check the investigation item No. 2.
2	Check the load state of all motors (during stopped).	The total load of all motors exceeds the rated capacity of the power supply unit.	Lower the motor load and operation frequency.
		The total does not exceed the capacity.	Check the investigation item No. 3.
3	Check the power capacity of the facility. Check the capacity of the step-down transformer (KVA).	The power capacity of the facility is insufficient.	Increase the power capacity of the facility.
		The specified power capacity is sufficient.	Check the investigation item No. 4.
4	Measure the voltage across wires. Is the voltage 380 V or more even when the motor is accelerating?	The voltage drops to less than 380 V occasionally.	Increase the power capacity of the facility.
		The difference of the voltage across wires is 10 V or more.	Improve the power phase balance.
		The difference of the voltage across wires is less than 10 V.	Check the investigation item No. 5.
5	Check whether there is any device (machine) causing the power distortion.	The power supply waveform is distorted when measuring the input voltage waveform during servo OFF.	Improve the source of the distortion. For example, when the power supply waveform is distorted when another machine is in operation, move the wiring to the power which is far from the machine's power supply.
		The power supply waveform is not distorted.	Check the investigation item No. 6.
6	Check if there is any abnormality in the unit's ambient environment. (Ex. Noise, grounding, etc.)	Take remedies according to the causes of the abnormality in the ambient environment.	

11 Troubleshooting

11.3 Troubleshooting

Alarm No. 62		Power supply: Frequency error	
		The input power supply frequency increased above the specification range. Or, incorrect wiring of the power supply wire was detected.	
	Investigation details	Investigation results	Remedies
1	Check the state of the operation when the alarm occurs, and if the alarm repeats.	The alarm occurs each time immediately after the power is turned ON. Or, the alarm occurs occasionally regardless of the operation state.	Check the investigation item No. 2, 3.
		The alarm occurs only while the motor is accelerating/decelerating.	Check the investigation item No. 4.
2	Check the power cable connection (phase sequence).	The connection is incorrect.	Correct the power cable connection.
3	Measure the power voltage waveform during normal operation.	The frequency is deviated from 50 Hz ± 3% or 60 Hz ± 3%.	Review the power facilities.
		The voltage waveform dips at some sections.	Improve the source of the distortion. Install an EMC filter.
		There is no problem.	Check the investigation item No. 5.
4	Measure the power voltage when the motor is accelerating/decelerating.	The frequency greatly fluctuates during acceleration/deceleration.	Review the power facilities.
		The voltage waveform during deceleration dips in some sections.	Improve the source of the distortion. Install an EMC filter.
		There is no problem.	Check the investigation item No. 5.
5	Check if there is any abnormality in the unit's ambient environment. (Ex. Noise, grounding, etc.)	Take remedies according to the causes of the abnormality in the ambient environment.	

Alarm No. 64		Power supply: Overload	
		Overload detection level exceeded 100 %. The power supply is overloaded.	
	Investigation details	Investigation results	Remedies
1	Check the state of the operation when the alarm occurs, and if the alarm repeats.	The alarm occurs occasionally after ready ON regardless of the operation state.	Replace the unit.
		The alarm occurs after continuous operation for a long time.	Check the investigation item No. 2.
2	Check the load state of all motors.	The total load of all motors exceeds the rated capacity of the power supply unit.	Lower the motor load and operation frequency.
		The total does not exceed the capacity.	Check the investigation item No. 3.
3	Check the investigation item 3 of Alarm No. 61.		

(*) NR and PR resetting are not possible when the overload level is 50% or more. Do not forcibly reset (AR) by turning the unit power OFF. If AR resetting is used at 50% or higher, the level is set to 80% when the power is turned ON next.

Alarm No. 66		Power supply: Process error	
		An error occurred in the process cycle.	
	Investigation details	Investigation results	Remedies
1	Check if the alarm repeats.	The alarm occurs each time after the power is turned ON.	Replace the unit.
		The alarm occurs occasionally.	Check the investigation item No. 2.
2	Check if there is any abnormality in the unit's ambient environment. (Ex. Noise, grounding, etc.)	Take remedies according to the causes of the abnormality in the ambient environment.	

Alarm No. 67		Power supply: Phase interruption	
		An open-phase condition was detected in input power supply circuit.	
	Investigation details	Investigation results	Remedies
1	Check the voltage for each input phase.	There are phases with no voltage.	Correct the power supply.
		There is no problem.	Check the investigation item No. 2.
2	Check the alarm No. "71" items.		

11 Troubleshooting

11.3 Troubleshooting

Alarm No. 68		Power supply: Watchdog	
		The system does not operate correctly. LED display is fixed as "8".	
	Investigation details	Investigation results	Remedies
1	Check if the alarm repeats.	The alarm occurs each time READY is turned ON.	Replace the unit.
		The alarm occurs occasionally.	Check the investigation item No. 2.
2	Check if there is any abnormality in the unit's ambient environment. (Ex. Noise, grounding, etc.)	Take remedies according to the causes of the abnormality in the ambient environment.	

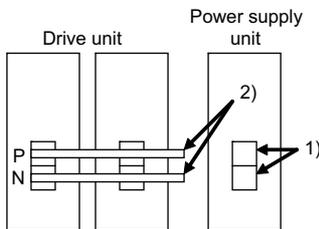
Alarm No. 69		Power supply: Grounding	
		The motor power cable is in contact with FG (Frame Ground).	
	Investigation details	Investigation results	Remedies
1	Measure the insulation across the power cables (U,V,W) for all motors and the ground. (Carry out a megger test.)	Less than 1 MΩ. (Grounding)	The motor or power cable may be ground faulted.
		1 MΩ or more. (Normal)	Check the investigation item No. 2.
2	Is there oil on the motor or power cable?	Oil is on the motor or power cable.	Take measures so that oil does not get on the motor or power cable. Check the motor's cannon connector and the inside of the terminal box, and clean as necessary.
		There is no oil on the motor or power cable.	Check the investigation item No. 3.
3	Measure the insulation again.	Less than 1 MΩ. (Grounding)	Replace the motor or cable.
		1 MΩ or more. (Normal)	Check the investigation item No. 2.
4	Measure the resistance across the U, V, W phase terminals of the servo/spindle drive unit and the ground. (Note) Do not measure the insulation as the unit is damaged. The unit is hot.	Less than 100 kΩ.	Replace the drive unit.
		100 kΩ or more.	Replace the power supply unit.
5	Check whether there is any axis in which alarm 24 has occurred.	There is an axis in which alarm 24 has occurred.	Check the alarm No. "24" items.
		There is no axis in which alarm 24 has occurred.	Check the investigation item No. 2.

Alarm No. 6A		Power supply: External contactor welding	
		A contact of the external contactor is welding.	
	Investigation details	Investigation results	Remedies
1	Check whether any alarm has occurred on the drive unit side.	An alarm has occurred.	Remove the cause of the alarm on the drive side, and check the investigation item No. 2.
		An alarm has not occurred.	Check the investigation item No. 2.
2	Check whether the contactor's contact has welded.	The contactor has welded.	Replace the contactor.
		The contactor has not welded.	Check the investigation item No. 3.
3	Check that the contactor excitation wiring is correctly connected from the power supply unit's MC1 terminal.	The connection is correct.	Correctly connect.
		The connection is incorrect.	Replace the power supply unit.

11 Troubleshooting

11.3 Troubleshooting

Alarm No. 6B		Power supply: Rush circuit error	
		A thyristor for rush short circuit is ON when rushing.	
	Investigation details	Investigation results	Remedies
1	Check whether any alarm has occurred on the drive unit side.	An alarm has occurred.	Remove the cause of the alarm on the drive side, and check the investigation item No. 2.
		An alarm has not occurred.	Check the investigation item No. 2.
2	Check if the alarm repeats.	The alarm occurs each time READY is turned ON.	Replace the unit.
		The alarm occurs occasionally.	Check the investigation item No. 3.
3	Check if there is any ground fault in the motor.	Check the investigation item of Alarm No. 69.	Take remedies of Alarm No. 69.
		No ground fault.	Check the investigation item No. 4.
4	Check if there is any abnormality in the unit's ambient environment. (Ex. Noise, grounding, etc.)	Take remedies according to the causes of the abnormality in the ambient environment.	

Alarm No. 6C		Power supply: Main circuit error																								
		An error was detected in charging operation of the main circuit capacitor.																								
	Investigation details	Investigation results	Remedies																							
1	Check the CHARGE lamp state when the alarm occurs.	[1] The light of the lamp becomes faint. [2] An alarm occurs when ready is turned ON again.	Replace the power supply unit.																							
		The lamp turns ON instantly, but when the alarm occurs and the contactor turns OFF, the lamp turns OFF immediately.	Check the investigation item No. 2.																							
		The lamp never turns ON.	Check the investigation item No. 2. Then replace the unit.																							
2	Disconnect the power supply unit's PN terminal block wiring, and measure the resistance value at 1) and 2) shown below.  <p>(Note) When disconnecting the PN wiring, turn OFF the power, make sure the CHARGE lamp has turned OFF at contactor OFF and then wait at least twenty minutes before disconnecting. Do not disconnect immediately after the power OFF.</p>	1) The power supply unit side is abnormal. 2) The drive unit side is abnormal.	Replace the power supply unit.																							
		1) and 2) are both normal.	Disconnect the PN wiring, and then check the drive unit side.																							
		<table border="1"> <thead> <tr> <th rowspan="2">Tester measurement point</th> <th colspan="2">Polarity</th> <th rowspan="2">Normal</th> <th rowspan="2">Abnormal</th> </tr> <tr> <th>+</th> <th>-</th> </tr> </thead> <tbody> <tr> <td rowspan="2">1)</td> <td>P</td> <td>N</td> <td>Several 100Ω</td> <td>Short-circuit/∞Ω</td> </tr> <tr> <td>N</td> <td>P</td> <td>∞Ω</td> <td>Several 100Ω</td> </tr> <tr> <td rowspan="2">2)</td> <td>P</td> <td>N</td> <td>Several 100Ω</td> <td>Short-circuit/∞Ω</td> </tr> <tr> <td>N</td> <td>P</td> <td>∞Ω</td> <td>Several 100Ω</td> </tr> </tbody> </table>	Tester measurement point	Polarity		Normal	Abnormal	+	-	1)	P	N	Several 100Ω	Short-circuit/∞Ω	N	P	∞Ω	Several 100Ω	2)	P	N	Several 100Ω	Short-circuit/∞Ω	N	P	∞Ω
Tester measurement point	Polarity			Normal	Abnormal																					
	+	-																								
1)	P	N	Several 100Ω	Short-circuit/∞Ω																						
	N	P	∞Ω	Several 100Ω																						
2)	P	N	Several 100Ω	Short-circuit/∞Ω																						
	N	P	∞Ω	Several 100Ω																						
3	Measure the voltage across wires. Is the voltage 380 V or more even when the motor is accelerating?	The voltage drops to less than 380 V occasionally.	Increase the power capacity.																							

Alarm No. 6D		Parameter setting error:	
		An error was detected in the parameter sent from the drive unit.	
	Investigation details	Investigation results	Remedies
1	Check if the alarm repeats.	The alarm occurs each time after the power is turned ON.	Replace the unit.
		The alarm occurs occasionally.	Check the investigation item No. 2.
2	Check if there is any abnormality in the unit's ambient environment. (Ex. Noise, grounding, etc.)	Take remedies according to the causes of the abnormality in the ambient environment.	

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11.3 Troubleshooting

Alarm No. 6E		Power supply: H/W error/AD error	
		An error was detected in the internal memory or A/D converter.	
	Investigation details	Investigation results	Remedies
1	Check if the alarm repeats.	The alarm occurs each time READY is turned ON.	Replace the unit.
		The alarm occurs occasionally.	Check the investigation item No. 2.
2	Check if there is any abnormality in the unit's ambient environment. (Ex. Noise, grounding, etc.)	Take remedies according to the causes of the abnormality in the ambient environment.	

Alarm No. 6F		Power supply error:	
		No power supply is connected to the drive unit, or a communication error was detected. Or, incorrect wiring of the power supply wire was detected.	
	Investigation details	Investigation results	Remedies
1	Check the time it takes for the unit power to change from OFF to ON.	Within 3 seconds	Ensure that there are 3 seconds or more for the power to change from OFF to ON.
		More than 3 seconds	Check the investigation item No. 2.
2	Check the LED display on the power supply unit.	"F" is flickering.	An A/D converter error has occurred. Check the alarm No. "6E" items.
		Another alarm code is flickering.	Check items of each alarm No.
		"0" is displayed.	Check the investigation item No. 3.
		"F" is displayed.	Check the investigation item No. 3.
		"8" is displayed.	Check the alarm No. "68" items.
		"b", "C", "d" is displayed.	Check the investigation item No. 4.
3	Check the rotary switch setting.	0 or 4 is set.	Check the investigation item No. 4.
		A value other than the above is set.	Correctly set the rotary switch.
4	Check the communication cable (CN4) connected with the drive unit.	There is a problem with the wiring or shield.	Replace the cable.
		There is no problem.	Replace the unit.

(*) Alarm 6F is detected at the same time other power supply alarms occur.

Alarm No. 70		Power supply: External emergency stop error	
		A mismatch of the external emergency stop input and NC emergency stop input continued for 30 seconds.	
	Investigation details	Investigation results	Remedies
1	Check the connection between external emergency stop and NC emergency stop.	Not wired correctly.	Correctly wire the external emergency stop and NC emergency stop.
2	Check if there is any abnormality in the unit's ambient environment.	No abnormality is found in particular.	Replace the drive unit.
		The grounding is incomplete.	Take remedies according to the causes of the abnormality. Additionally ground and review.

11 Troubleshooting

11.3 Troubleshooting

Alarm No. 71		Power supply: Instantaneous power interruption	
		The power was momentarily interrupted.	
	Investigation details	Investigation results	Remedies
1	Investigate the sequence to check whether the contactor has been turned OFF with an emergency stop button, etc.	The contactor has been turned OFF externally.	Review the machine sequence. When turning the contactor OFF with external means, such as an emergency stop button, this alarm can be avoided by inputting NC emergency stop at the same time.
		The contactor has not been turned OFF.	Check the investigation item No. 2.
2	Check if the alarm repeats.	The alarm occurs each time READY is turned ON.	Check the investigation item No. 3.
		The alarm occurs at a certain operation.	Check the investigation item No. 1. If there is no problem, check the investigation item No. 3.
		The alarm occurs occasionally during operation.	Check the investigation item No. 4.
3	Check whether the power input wire and contactor are correctly wired.	The wiring is incorrect.	Correctly connect.
		There is no problem.	Check the investigation item No. 4.
4	Check the power voltage waveform with a synchroscope.	An instantaneous power failure or voltage drop occurs frequently.	Correct the power facility.
		There is no problem.	Replace the unit.

Alarm No. 72		Power supply: Fan stop	
		A cooling fan built in the power supply unit stopped, and overheat occurred in the power module.	
	Investigation details	Investigation results	Remedies
1	Turn the NC power ON again, and confirm the rotation of the fan. Note) Ensure that there are 13 seconds or more for the power to change from OFF to ON. For a fan used for the power supply unit, ensuring 13 seconds or more or the power to change from OFF to ON is required.	The fan is rotating, and an alarm did not occur again.	Continue to use. The unit may have been turned ON without ensuring that there are 13 seconds or more for the power to change from OFF to ON. Wait for more than 13 seconds, and turn the power ON again.
		The fan did not rotate. Or, an alarm occurred again.	Check the investigation item No. 2.
2	Check if the connector connected to a fan is disconnected.	The connector is disconnected.	Correctly connect the connector.
		The connector is not disconnected.	Check the investigation item No. 3.
3	Check if oil or cutting chips are adhered to the fan.	Oil or cutting chips are adhered.	Improve the use environment and replace the power supply unit.
		Oil or cutting chips are not adhered. The cable may be broken.	Replace the power supply unit.

Alarm No. 73		Power supply: Over regeneration	
		Over-regeneration detection level became over 100 %. The regenerative resistor is overloaded. This alarm cannot be reset for 15 min from the occurrence to protect the regeneration resistor. Leave the drive system energized for more than 15 min, then turn the power ON to reset the alarm.	
	Investigation details	Investigation results	Remedies
1	Check the alarm occurrence state and regenerative load displayed on the NC Monitor screen while changing the operation mode.	The regenerative load value increases when the power is turned ON and the motor is not rotated.	Check whether the state is affected by power fluctuation, grounding or noise. If there is no problem, replace the unit.
		The regenerative load value increases each time the motor decelerates, and the alarm occurs.	A-CR: Check the investigation item No. 2. C1-CV: Check the investigation item No. 4.
		The regenerative load value increases each time the motor decelerates, but the alarm does not occur when the operation mode is eased.	A-CR: Check the investigation item No. 2. C1-CV: Ease the operation mode.
2	Check whether the parameter (regenerative resistor type) of the drive unit controlling the power supply unit is correct.	The setting is incorrect.	Correctly set. (Check the alarm No. "6D" items.)
		The setting is correct.	Check the investigation item No. 3.
3	Check the regenerative resistor's state. [1] Is oil adhered? [2] Measure the resistance value.	The regenerative resistor is abnormal.	Replace the regenerative resistor.
		There is no problem.	Check the investigation item No. 4.
4	Check the alarm No. "75" items.		

11 Troubleshooting

11.3 Troubleshooting

Alarm No. 74		Power supply option unit error	
		An alarm was detected in the power backup unit (an option unit for the power supply).	
	Investigation details	Investigation results	Remedies
1	Check the LED display on the power backup unit.	Check the LED display on the power backup unit to identify what alarm is occurring to the unit.	Fix the error occurring to the power backup unit and remove the alarm. Refer to MDS-E/EH Series Instruction Manual (IB-1501229(ENG)) "List of power backup function alarms".

Alarm No. 75		Power supply: Overvoltage	
		L+ and L- bus voltage or the input voltage in main circuit exceeded the allowable value. As the voltage between L+ and L- is high immediately after this alarm, another alarm may occur if this alarm is reset in a short time. Wait more than 5 min before resetting so that the voltage drops.	
	Investigation details	Investigation results	Remedies
1	Check if the alarm repeats.	The alarm occurs each time the motor decelerates.	Check the investigation item No. 3.
		The alarm occurs occasionally.	Check the investigation item No. 2.
2	Check the power supply's alarm history.	Auxiliary regeneration frequency over (E8) occurs just before the over-voltage occurs.	Limit the occurrence of the excessive instantaneous regeneration by not decelerating multiple axes at the same time.
		Others.	Check the investigation item No. 3.
3	Check the power capacity.	The power capacity is insufficient.	Increase the power capacity.
		The specified power capacity is secured.	Check the investigation item No. 4.
4	Measure the voltage across wires. [1] Is the voltage 380 V or more even when the motor is accelerating?	The voltage drops to less than 380 V occasionally.	Increase the power capacity.
		The voltage exceeds to 480 V occasionally.	Lower the input voltage.
		The difference of the voltage across wires is 10 V or more.	Improve the power phase balance.
		The difference of the voltage across wires is less than 10 V.	Check the investigation item No. 5.
5	Measure the power voltage with a synchroscope, and check whether there is any distortion. [1] Are there any other devices causing the power distortion?	The power voltage is distorted.	Improve the source of the distortion. Install an AC reactor.
		The power voltage waveform is not abnormal.	Check the investigation item No. 6.
6	Check if there is any abnormality in the unit's ambient environment. (Ex. Noise, grounding, etc.)	Take remedies according to the causes of the abnormality in the ambient environment.	

Alarm No. 76		Power supply: Function setting error	
		The rotary switch setting of external emergency stop is not correct, or a wrong external emergency stop signal is input.	
	Investigation details	Investigation results	Remedies
1	Check the rotary switch 1 setting.	When using external emergency stop, the rotary switch is not set to "4".	Set the rotary switch 1 to "4".
2	Check the rotary switch 2 setting.	Rotary switch is set to other than "0" to "3".	Set rotary switch 2 to "0" to "3".
3	Check if there is any abnormality in the unit's ambient environment.	No abnormality is found in particular.	Replace the drive unit.
		The grounding is incomplete.	Take remedies according to the causes of the abnormality. Additionally ground and review.

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11.3 Troubleshooting

Alarm No. 77		Power supply: Power module overheat	
		Thermal protection function in the power module has started its operation.	
	Investigation details	Investigation results	Remedies
1	Confirm that the fan is properly rotating.	Large amounts of cutting oil or cutting debris, etc., are on the fan, or the rotation is slow.	Clean or replace the fan.
		The fan is properly rotating.	Check the investigation item No. 2.
2	Check whether the heat dissipating fins are dirty.	Cutting oil or cutting debris, etc., are on the fins, and the fins are clogged.	Clean the fins.
		The fins are normal.	Check the investigation item No. 3.
3	Measure the power supply unit's ambient temperature.	55°C or more	Improve the ventilation and cooling for the power distribution panel.
		Less than 55°C.	Check the investigation item No. 4.
4	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	Take remedies according to the causes of the abnormality in the ambient environment.	

11 Troubleshooting

11.3 Troubleshooting

Power supply unit warning

Warning No. E9		Instantaneous power interruption warning		
		The power was momentarily interrupted.		
Investigation details		Investigation results		Remedies
1	Check the alarm No. "4F" or "71" items.			

Warning No. EA		In external emergency stop state		
		External emergency stop signal was input.		
Investigation details		Investigation results		Remedies
1	Check whether the specifications allow use of the external emergency stop.	Use is not allowed.		Invalidate the external emergency stop.
		Use is allowed.		Check the investigation item No. 2.
2	Measure the input voltage of the external emergency stop connector of each unit.	24V is input.		Replace the power supply unit.
		24V is not input.		Check whether the external emergency stop cable is broken, or check the external contact operation.

Warning No. EB		Power supply: Over regeneration warning		
		Over-regeneration detection level exceeded 80 %.		
Investigation details		Investigation results		Remedies
1	Check the alarm No. "73" items.			

Warning No. EC		Power supply: Overload warning:		
		Overload detection level exceeded 80 %.		
Investigation details		Investigation results		Remedies
1	Check the alarm No. "64" items.			

Warning No. ED		Unit replacement warning:		
		The waveforms measured by the power supply recorder have not been recorded in the memory. When the warning continues after turning ON the power supply again, it cannot be reset.		
Investigation details		Investigation results		Remedies
1	Turn the unit power ON again, and confirm the warning.	Warning is not displayed.		Continue to use.
		Warning is displayed.		Check the investigation item No. 2.
2	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.		Replace the unit.

Warning No. EE		Power supply: Fan stop warning:		
		A cooling fan built in the power supply unit stopped.		
Investigation details		Investigation results		Remedies
1	Check the alarm No. "72" items.			

Warning No. EF		Power supply option unit warning:		
		A warning was detected in the power backup unit (an option unit for the power supply).		
Investigation details		Investigation results		Remedies
1	Check the LED display on the power backup unit.	Check the LED display on the power backup unit to identify what warning is occurring to the unit.	Fix the error occurring to the power backup unit and remove the warning. Refer to "List of power backup function warnings" in MDS-E/EH Series Instruction Manual (IB-1501229(ENG)).	

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11.3 Troubleshooting

Appx.1: Maintenance

12.1 Periodic Inspections

Periodic inspection of the following items is recommended.

- ♦ Are any of the screws on the terminal block loose? If loose, tighten them.
- ♦ Are any of the cables damaged or cracked? If the cables move with the machine, periodically inspect the cables according to the working conditions.

12.2 Service Parts

A guide to the part replacement cycle is shown below. Note that these will differ according to the working conditions or environmental conditions, so replace the parts if any abnormality is found. Contact Mitsubishi branch or your dealer for repairs or part replacements.

Part name		Standard replacement time	Remarks
MDS-EX-CV/CVH	Smoothing capacitor	10 years	The standard replacement time is a reference. Even if the standard replacement time is not reached, the part must be replaced if any abnormality is found.
	Cooling fan	10,000 to 30,000 hours (2 to 3 years)	

- ♦ Power smoothing capacitor:
The characteristics of the power smoothing capacitor will deteriorate due to the effect of ripple currents, etc. The capacitor life is greatly affected by the ambient temperature and working conditions. However, when used continuously in a normal air-conditioned environment (ambient temperature is an average of 40 °C or less), the service life will be ten years.
- ♦ Relays:
Contact faults will occur due to contact wear caused by the switching current. The service life will be reached after 100,000 cumulative switches (switching life) although this will differ according to the power capacity.

12.3 Wire Connection Method of Power Supply Unit Connector for CN23 (External Contactor Control Connector)

(1) Strip the wire sheath.

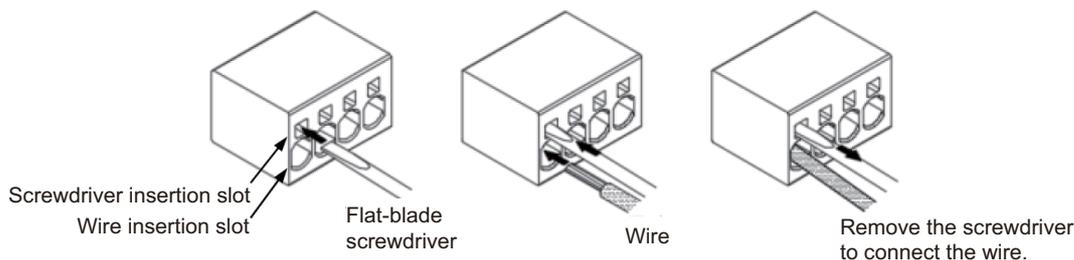
Applicable wire	Solid wire	0.2 to 10 mm ²
	Twisted wire	0.2 to 6 mm ²
	AWG	24 to 8
	Twisted wire with a ferrule (without plastic sleeve)	0.25 to 6 mm ²
	Twisted wire with a ferrule (with plastic sleeve)	0.25 to 6 mm ²
	TWIN two wires with a ferrule (with plastic sleeve)	0.25 to 1.5 mm ²
Length of ferrule	Without plastic sleeve	10 to 15 mm
	With plastic sleeve	12 to 15 mm
	Crimping tools CRIMPFOX6 (1212034)	
Cable length after stripping	15 mm for a bare wire Refer to the specifications for a ferrule when using it.	
Recommended screwdriver	SZF 1-0,6x3,5 (1204517)	

(2) Connect a ferrule to the end of the wire as required.

(3) Insert a flat-blade screwdriver with an edge width of 3.5 mm or less and an edge thickness of 0.6 mm or less completely into the screwdriver insertion slot (*2). With the screwdriver inserted, insert the wire completely to the end of a wire insertion slot. Remove the screwdriver.

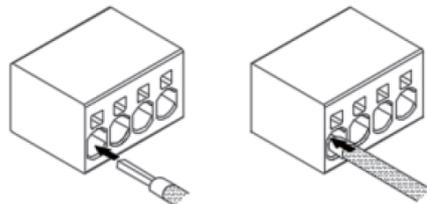
(*1) The actual connector has 2 pins.

(*2) Insert the flat blade screwdriver at an angle to the wire insertion slot to prevent damaging the connector.



* When using Push-In function

Insert a wire^{*1} or a twisted wire with a ferrule completely to the end of a wire insertion slot.



^{*1} Depending on wire thickness and hardness, some wires cannot be used.

12.4 Replacing the Power Supply Unit Fan

Turn the power supply of the unit OFF. Make sure the CHARGE lamp is turned OFF.

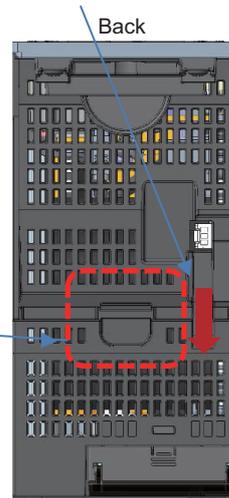
■ Uninstalling the fan

(1) Before the fan is uninstalled.



POINT

Unlock the upper cover then pull it out to remove it.



(2) Remove the upper cover of the case.



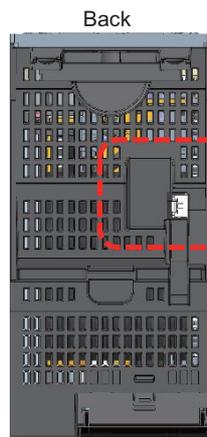
Top surface of unit

(3) Unlock the fan connector.



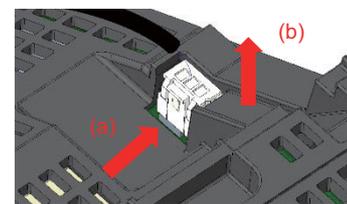
POINT

(4) Remove the fan connector.



Top surface of unit

- (a) Press the connector lock to unlock it.
- (b) Pull out the connector while pressed (unlocked).



Magnified figure

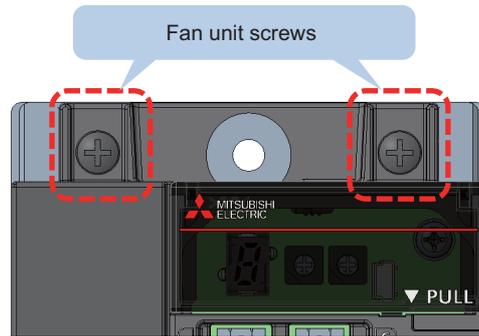
12 Appx.1: Maintenance

12.4 Replacing the Power Supply Unit Fan

(5) Remove the two screws of the fan unit.



 **POINT**



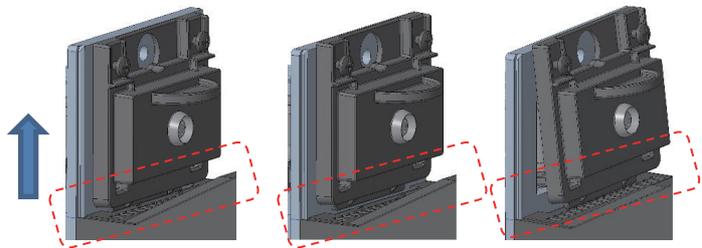
Top surface of unit

(6) Lift the fan unit.



 **POINT**

Lift the fan unit slightly to unlock the fixing part on the bottom of the fan unit, then pull out the fan.

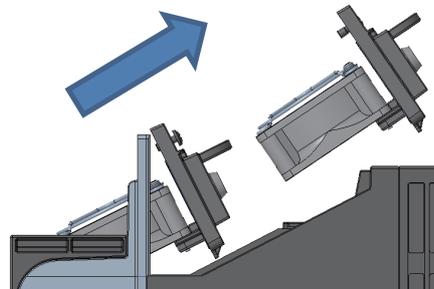


(7) Remove the fan unit.



 **POINT**

Pull up the fan unit diagonally.



(8) After the fan is uninstalled.



12 Appx.1: Maintenance

12.4 Replacing the Power Supply Unit Fan

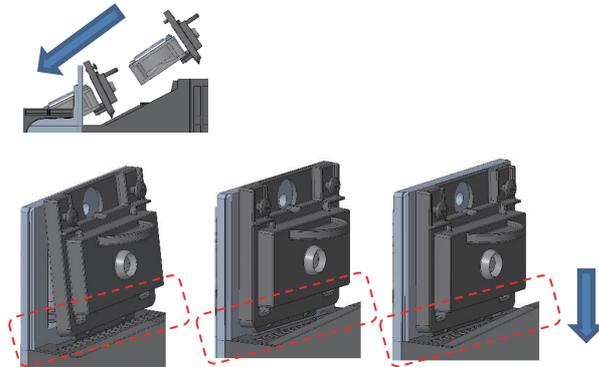
■ Installing the fan

(1) Before the fan is installed.

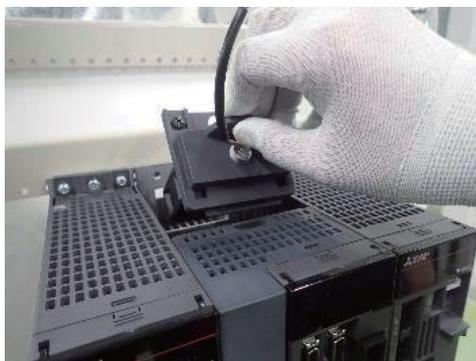


POINT

Insert the fan unit diagonally until the fan faces the fins, then push down the fan unit to insert it in the fixing groove below the fan unit.



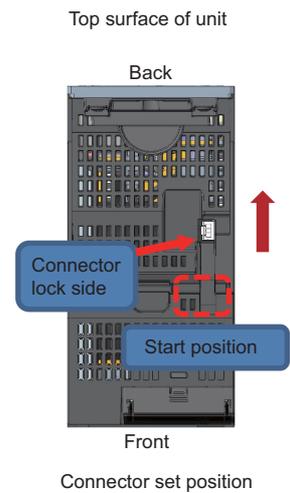
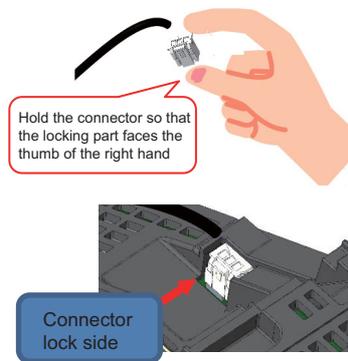
(2) Insert the fan unit.



POINT

As the unit has a lock structure on the inner side of the unit, hold the connector so that the locking part faces the inner side of the unit.

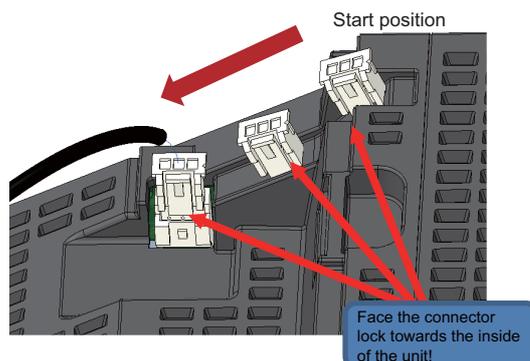
(3) Hold the connector on the end of the fan cable.



(4) Slide the fan connector down the slide and fix it.



Set the connector to the start position. Slide the connector down the slide and insert it. Pay attention to which side the locking part of the connector is facing (the locking part should face the inner side of the unit).



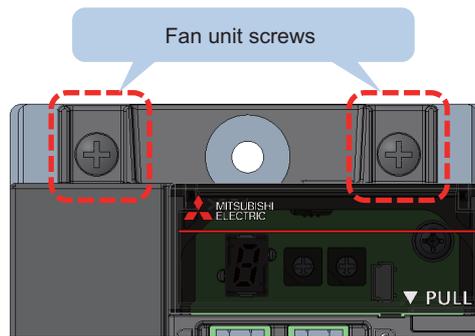
12 Appx.1: Maintenance

12.4 Replacing the Power Supply Unit Fan

(5) Fasten the two screws of the fan unit.



 **POINT**



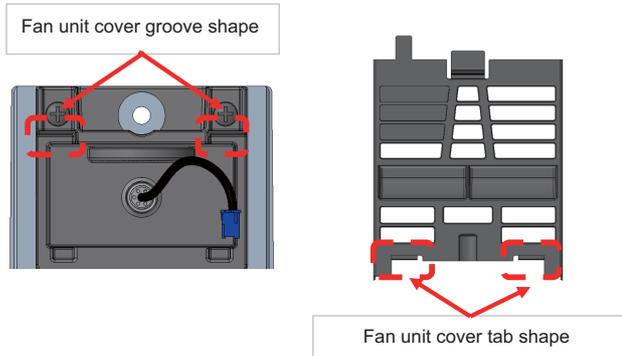
Top surface of unit

(6) Insert the upper cover of the case.

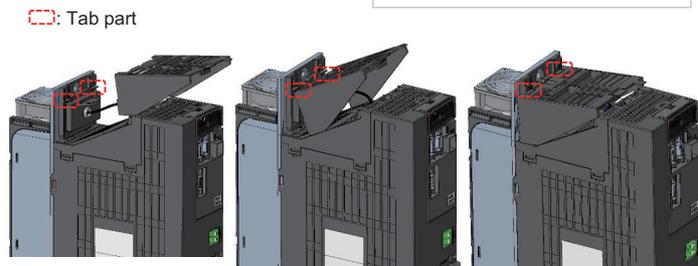


 **POINT**

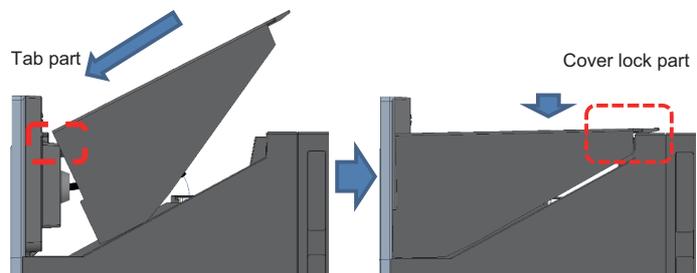
Insert the upper cover diagonally so that the upper cover tabs hook on the upper cover. Press the cover lock to fix it.



(7) Press the cover lock.



(8) After the fan is installed.



12 Appx.1: Maintenance

12.4 Replacing the Power Supply Unit Fan

Appx.2: Compliance to EC Directives

13 Appx.2: Compliance to EC Directives

13.1 Compliance to EC Directives

■ European EC Directives

In the EU Community and UK, the attachment of a CE mark and a UKCA mark (European CE marking/UK UKCA Regulations) is mandatory to indicate that the basic safety conditions of the Machine Directives (issued Jan. 1995), EMC Directives (issued Jan. 1996), Electromagnetic Compatibility Regulations (issued Jan.2021), the Low-voltage Directives (issued Jan. 1997), and the Electrical Equipment (Safety) Regulations (issued Jan. 2021) are satisfied. The machines and devices in which the servo and spindle drive are assembled are the targets for European CE marking and UK UKCA Regulations.

■ Compliance to EMC Directives/Electromagnetic Compatibility Regulations

The servo and spindle drive are components designed to be used in combination with a machine or device. These are not directly targeted by the Directives, but a CE mark and a UKCA mark must be attached to machines and devices in which these components are assembled. The next section "Appx.3: EMC Installation Guidelines", which explains the unit installation and control panel manufacturing method, etc., has been prepared to make compliance to the EMC Directives/ Electromagnetic Compatibility Regulations easier.

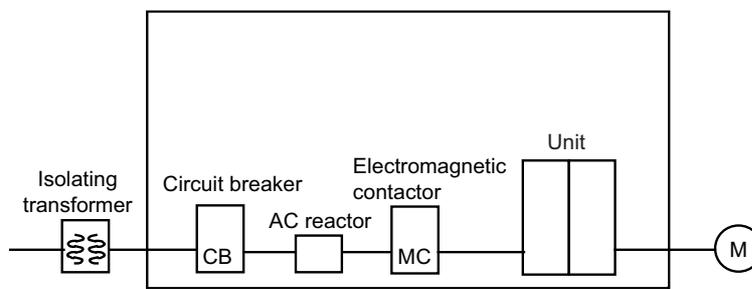
■ Compliance to Low-voltage Directives/Electrical Equipment (Safety) Regulations

Each unit is targeted for the Low-voltage Directives/Electrical Equipment (Safety) Regulations. An excerpt of the precautions given in this specification is given below. Please read this section thoroughly before starting use. For the EMC Directives/Electromagnetic Compatibility Regulations and Low-voltage Directives/Electrical Equipment (Safety) Regulations, Self-Declaration Documents have been prepared. Contact Mitsubishi or your dealer when required.

13.2 Cautions for EC Directive Compliance

Use the Low-voltage Directive/Electrical Equipment (Safety) Regulations compatible parts for the servo/spindle drive and servo/spindle motor. In addition to the items described in this instruction manual, observe the items described below.

■ Configuration



Insert a type B circuit breaker (RCD) in the power supply side of the unit.

13 Appx.2: Compliance to EC Directives

13.2 Cautions for EC Directive Compliance

■ Environment

Use the units under an Overvoltage Category III and Pollution Class of 2 or less environment as stipulated in IEC60664.

- ♦ To adjust the units to the Overvoltage Category II, insert an isolating transformer of the star connection complying with EN or IEC standard in the input of the power supply unit.
- ♦ To adjust the units to the Pollution Class of 2, install the units in a control panel having a structure (IP54 or higher) in which water, oil, carbon or dust cannot enter.
- ♦ To comply the Low-Voltage Directive, install the units in a control panel of IP54 or higher for protection against electric shock and fire.

Environment	Unit	Servo motor	Spindle motor
Ambient temperature	Operation: Operation 0 to +55°C (with no freezing), Storage / Transportation: -15°C to +70°C (with no freezing)	Operation: 0 to +40°C (with no freezing),: Storage: -15°C to +70°C (with no freezing)	Operation: 0 to +40°C (with no freezing),: Storage: -20°C to +65°C (with no freezing)
Ambient humidity	Operation: 90% RH or less (with no dew condensation), Storage / Transportation: 90% RH or less (with no dew condensation)	Operation: 80% RH or less (with no dew condensation), HK(-H) Series: 10 to 90% RH or less (with no dew condensation) Storage: 90% RH or less (with no dew condensation), HK(-H) Series: 10 to 90% RH or less (with no dew condensation)	Operation: 90% RH or less (with no dew condensation), Storage: 90% RH or less (with no dew condensation)
Atmosphere	Indoors (no direct sunlight) With no corrosive gas, inflammable gas, oil mist, dust or conductive fine particles No object generating a strong magnetic field External magnetic field: 10 mT or less		
Altitude	Operation/Storage: 1000 meters or less above sea level, Transportation: 13000 meters or less above sea level	Operation/Storage: 1000 meters or less above sea level, Transportation: 10000 meters or less above sea level	
Vibration / impact	According to each unit or motor specification		

(*) For details, confirm each unit or motor specifications in addition.

■ Power supply

- ♦ Use the power supply and servo/spindle drive unit under an Overvoltage Category III or less environment as stipulated in IEC60664.
- ♦ Earth the PE terminal of the units to the neutral point of the star connection.
- ♦ Do not omit the circuit breaker and electromagnetic contactor.

■ Earthing

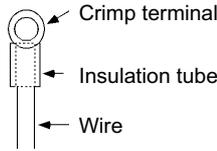
- ♦ To prevent electric shocks, always connect the servo/spindle drive unit protective earth (PE) terminal (terminal with mark) to the protective earth (PE) on the control panel.
- ♦ When connecting the earthing wire to the protective earth (PE) terminal, do not tighten the wire terminals together. Always connect one wire to one terminal.



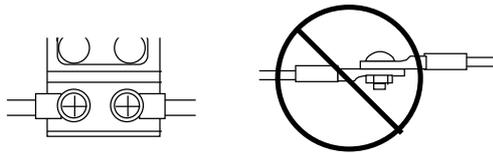
13 Appx.2: Compliance to EC Directives
 13.2 Cautions for EC Directive Compliance

■ Wiring

- Always use crimp terminals with insulation tubes so that the connected wire does not contact the neighboring terminals.



- Do not connect the wires directly.



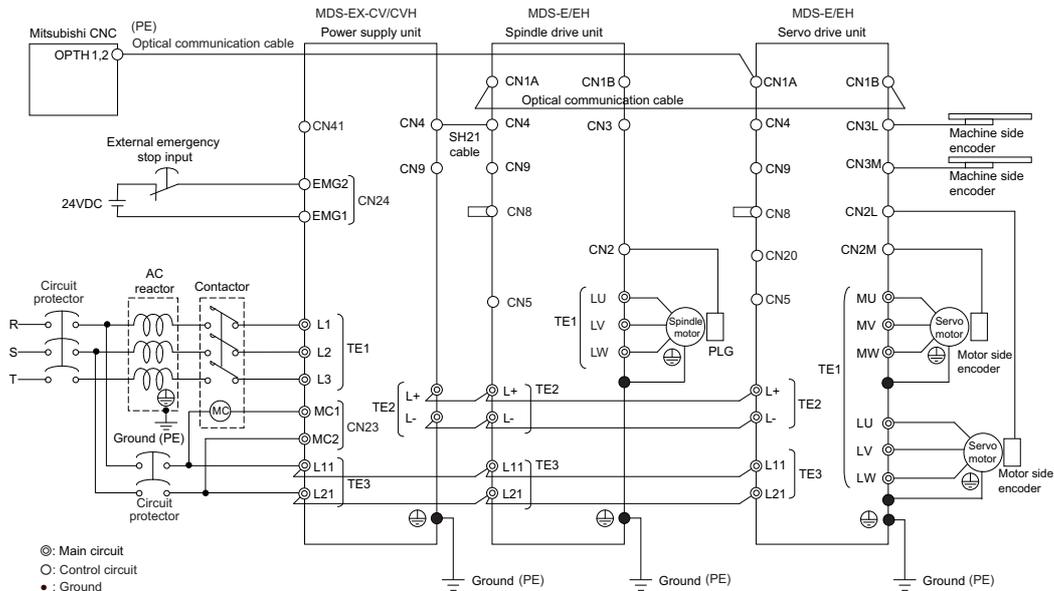
- Always install the power supply unit and servo/spindle drive unit on the metal panel.

■ Peripheral devices

- Use EN/IEC Standards compliant parts for the circuit protector and contactor.
- Select type B circuit protector manufactured by RCD.
 Apply Annex C of EN60204-1 for sizing of the circuit protector.

■ Miscellaneous

- Refer to the next section "Appx.3: EMC Installation Guidelines" for methods on complying with the EMC Directives/EMC Regulations.
- Ground the facility according to each country's requirements.
- The control circuit connector (○) is safely separated from the main circuit (⊙) and ground (●).
- Inspect the appearance before installing the unit. Carry out a performance inspection of the final unit, and save the inspection records.



Appx.3: EMC Installation Guidelines

14.1 Introduction

As the NC unit is a component designed to control machine tools, it is believed to be out of the direct EMC Directives/ Electromagnetic Compatibility Regulations subject. However, we would like to introduce the following measure plans to backup EMC Directives/Electromagnetic Compatibility Regulations compliance of the machine tool as the NC unit is a major component of the machine tools.

- ♦ Methods for installation in control/operation panel
- ♦ Methods of wiring cable outside of panel
- ♦ Introduction of countermeasure parts

Mitsubishi is carrying out tests to confirm the compliance to the EMC Directives/Electromagnetic Compatibility Regulations under the environment described in this manual. However, the level of the noise will differ according to the equipment type and layout, control panel structure and wiring lead-in, etc. Thus, we ask that the final noise level be confirmed by the machine tool builder. For measures for CNC, refer to "EMC INSTALLATION GUIDELINES" of each NC Connection Manual.

14.2 EMC Directives/Electromagnetic Compatibility Regulations

The EMC Directives/Electromagnetic Compatibility Regulations regulate mainly the following two withstand levels.

- ♦ Emission Capacity to prevent output of obstructive noise that adversely affects external sources.
- ♦ Immunity Capacity not to malfunction due to obstructive noise from external sources.

The details of each level are classified in the table below. It is assumed that the Standards and test details required for a machine tool are about the same as these.

Class	Name	Details	Generic Standard	Standards for determining test and measurement
Emission	Radiated noise	Electromagnetic noise radiated through the air	EN61000-6-4 (General industrial machine)	-----
	Conductive noise	Electromagnetic noise discharged from power line	EN61800-3 (Motor control unit)	
Immunity	Static electricity electrical discharge immunity test	(Example) Withstand level of discharge of electricity charged in a human body.	EN61000-6-2 (General industrial machine) EN61800-3 (Motor control unit)	EN61000-4-2
	Radiated radio-frequency magnetic field immunity test	(Example) Simulation of immunity from digital wireless transmitters		EN61000-4-3
	Electrical fast transient/burst immunity test	(Example) Withstand level of noise from relays or connecting/disconnecting live wires		EN61000-4-4
	Immunity to conducted disturbance induced by radio frequency magnetic field	(Example) Withstand level of noise entering through power line, etc.		EN61000-4-6
	Power supply frequency field immunity test	(Example) 50/60Hz power frequency noise		EN61000-4-8
	Immunity test for voltage dip, short-time power failure and voltage fluctuation	(Example) Power voltage drop withstand level		EN61000-4-11
	Surge immunity test	(Example) Withstand level of noise caused by lightning		EN61000-4-5

14.3 EMC Measures

The main items relating to EMC measures include the following.

- Store the device in an electrically sealed metal panel.
- Earth all conductors that are floating electrically. (Lower the impedance.)
- Wire the power line separated from the signal wire as far as possible.
- Use shielded wires for the cables wired outside of the panel.
- Install a noise filter.

Ensure the following items to suppress noise radiated outside of the panel.

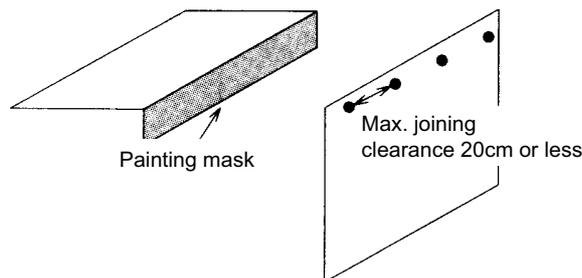
- Accurately ground the devices.
- Clamp shielded wires in the control panel.
- Increase the panel's electrical seal. Reduce the gap and hole size. Note that the electromagnetic noise radiated in the air is greatly affected by the clearance of the panel and the quality of the cable shield.

14.4 Measures for Panel Structure

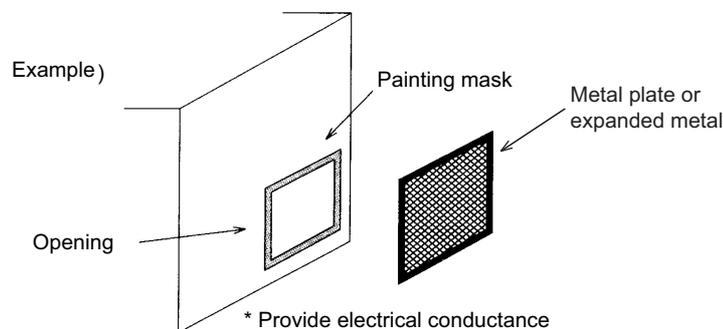
The design of the panel is a very important factor for the EMC measures, so take the following measures into consideration.

14.4.1 Measures for Control Panel Unit

- Use metal for all materials configuring the panel.
- For the joining of the top plate and side plates, etc., mask the contact surface with paint, and fix with welding or screws so that the impedance is reduced. In either case, keep the joining clearance to a max. of 20cm for a better effect. Note that if the plate warps due to the screw fixing, etc., creating a clearance, noise could leak from that place.



- Plate the earth plate (with nickel, tin), and connect the connections with a low impedance.
- If there is an opening on the panel surface, such as the ventilation holes, cover it with a metal plate or expanded metal. Make sure not to connect using metal or a conductor without peeling off the surface, which results in an insufficient electrical connection. (ex. connection by putting painted surfaces together)

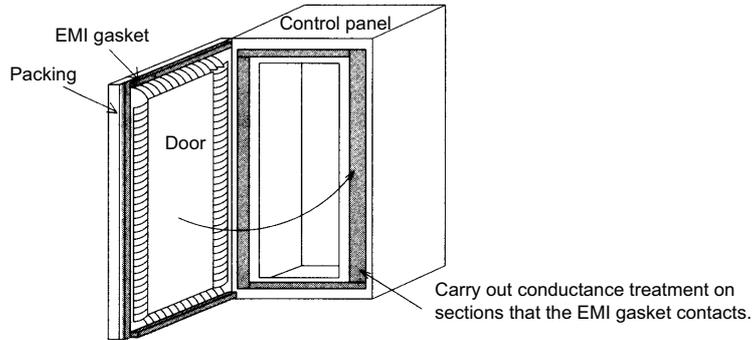


14 Appx.3: EMC Installation Guidelines

14.4 Measures for Panel Structure

14.4.2 Measures for Door

- Use metal for all materials configuring the door.
 - Use an EMI gasket or conductive packing for the contact between the door and control panel unit.
 - The EMI gasket or conductive packing must contact at a uniform and correct position of the metal surface of the control panel unit.
 - The surface of the control panel unit contacted with the EMI gasket or conductive packing must have conductance treatment.
- (Example) Weld (or screw) a plate that is plated (with nickel, tin).



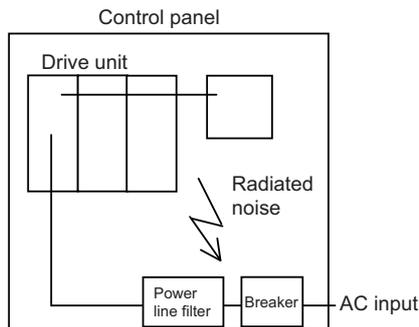
- As a method other than the above, the control panel unit and door can be connected with a plain braided wire. In this case, the panel and door should be contacted at as many points as possible.

14.4.3 Measures for Operation Board Panel

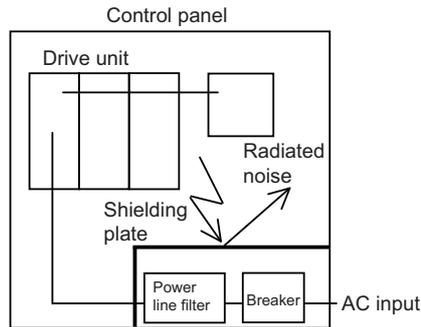
- Always connect the operation board and indicator with an earthing wire.
- If the operation board panel has a door, use an EMI gasket or conductive packing between the door and panel to provide electrical conductance in the same manner as the control panel.
- Connect the operation board panel and control panel with a sufficiently thick and short earthing wire.

14.4.4 Shielding of the Power Supply Input Section

- Separate the input power supply section from other parts in the control panel so that the input power supply cable will not be contaminated by radiated noise.
- Do not lead the power line through the panel without passing it through a filter.



The power supply line noise is eliminated by the filter, but cable contains noise again because of the noise radiated in the control panel.



Use a metal plate, etc., for the shielding partition. Make sure not to create a clearance.

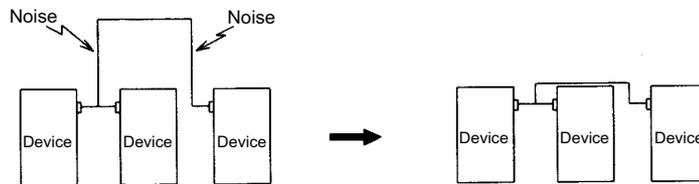
14.5 Measures for Various Cables

The various cables act as antennas for the noise and discharge the noise externally. Thus appropriate treatment is required to avoid the noise.

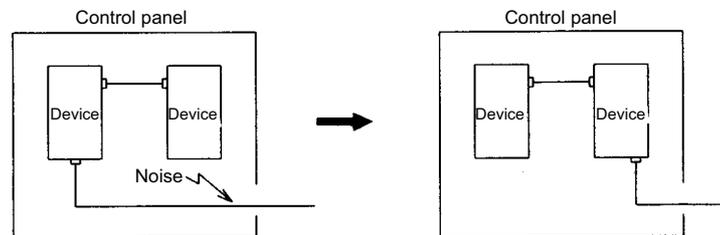
The wiring between the drive unit and motor act as an extremely powerful noise source, so apply the following measures.

14.5.1 Measures for Wiring in Panel

- If the cables are led unnecessarily in the panel, they will easily pick up the radiated noise. Thus, keep the wiring length as short as possible.



- The noise from other devices will enter the cable and be discharged externally, so avoid internal wiring near the openings.



- Connect the control device earthing terminal and earthing plate with a thick wire. Take care to the leading of the wire.

14.5.2 Measures for Shield Treatment

Common items

Use of shield clamp fittings is recommended for treating the shields. The fittings are available as options, so order as required. (Refer to the section "Shield Clamp Fitting" in this chapter.)

Clamp the shield at a position within 10cm from the panel lead out port.



POINT

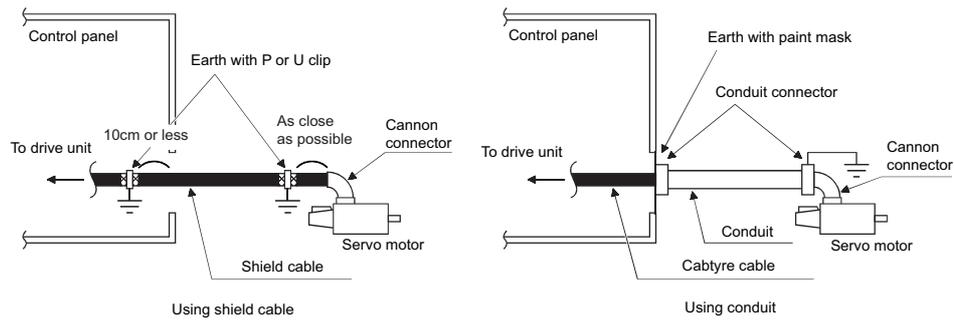
- (1) When leading the cables, including the grounding wire (FG), outside of the panel, clamp the cables near the panel outlet (recommendation: within 10cm).
- (2) When using a metal duct or conduit, the cables do not need to be clamped near the panel outlet.
- (3) When leading cables not having shields outside the panel, follow the instructions given for each cable. (Installation of a ferrite core, etc., may be required.)

14 Appx.3: EMC Installation Guidelines

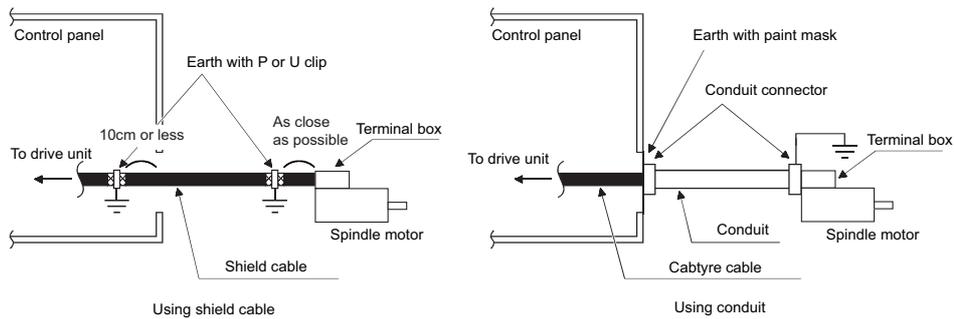
14.5 Measures for Various Cables

14.5.3 Servo/Spindle Motor Power Cable

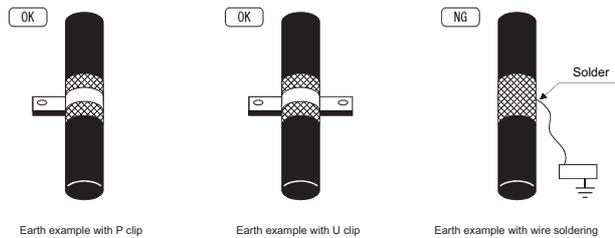
Power cable for servo motor



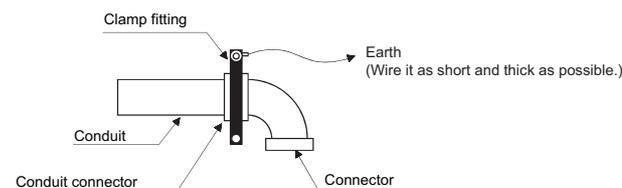
Power cable for spindle motor



- Use four wires (3-phase + earthing) for the power cable that are completely shielded and free from breaks.
- Earth the shield on both the control panel side and motor chassis side. The shield earth position on the drive unit side must be 10cm or less from the control panel.
- Earth the shield with a metal P clip or U clip.
(A cable clamp fitting can be used depending on the wire size.)
- Directly earth the shield. Do not solder the braided shield onto a wire and earth the end of the wire.



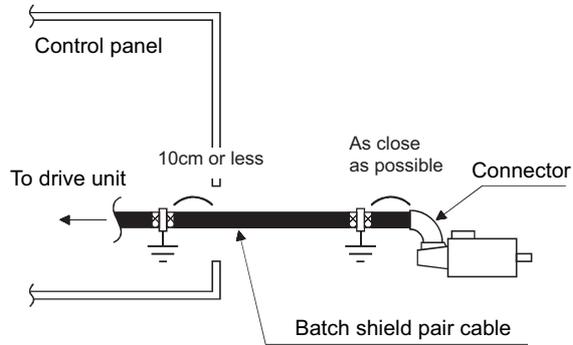
- When not using a shield cable for the power cable, use a conventional cabtyre cable. Use a metal conduit outside the cable.
- Earth the power cable on the control panel side at the contact surface of the conduit connector and control panel.
(Mask the side wall of the control panel with paint.)
- Follow the treatment shown in the example for the conduit connector to earth the power cable on the motor side.
(Example: Use a clamp fitting, etc.)



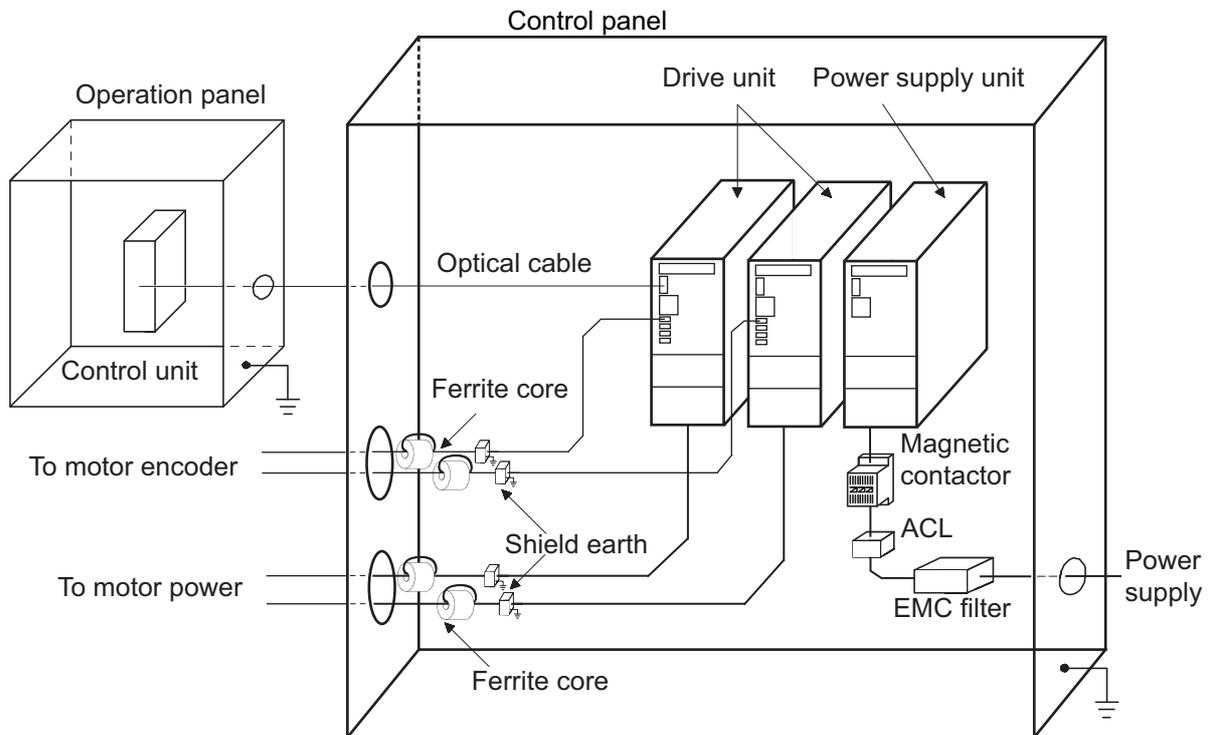
14.5.4 Servo/Spindle Motor Encoder Cable

Use a shield pair cable for encoder cable of the servo motor to earth on NC side (inside the control panel.) Mounting a ferrite core directly behind the unit connector is also effective in suppressing noise.

Encoder cable for servo motor



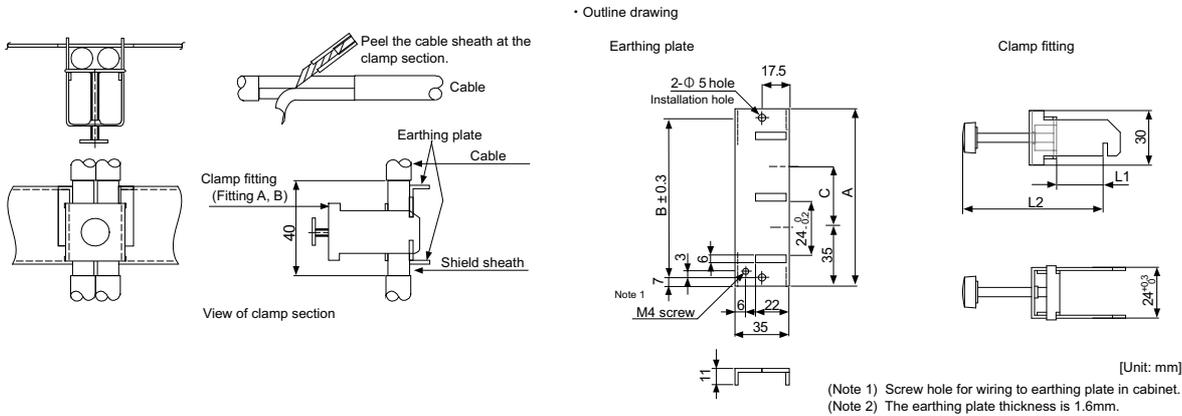
■ Installation example



14.6 EMC Countermeasure Parts

14.6.1 Shield Clamp Fitting

The effect can be enhanced by connecting the cable directly to the earthing plate. Install an earthing plate near each panel's outlet (within 10 cm), and press the cable against the earthing plate with the clamp fitting. If the cables are thin, several can be bundled and clamped together. Securely earth the earthing plate with the frame ground. Install directly on the cabinet or connect with an earthing wire.



	A	B	C	Enclosed fittings
Ground Plate #D	100	86	30	Clamp fitting A x 2
Ground Plate #E	70	56	-	Clamp fitting B x 1

	L1 (maximum dimension when it is open)	L2 (reference dimension)
Clamp fitting A	25	(77)
Clamp fitting B	12	(54)

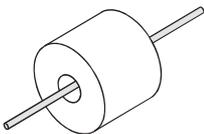
14.6.2 Ferrite Core

Noise can be suppressed by installing a ferrite core to the cable if the power cable and encoder cable, which are led from outside of the control panel, are the noise sources.

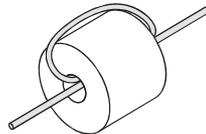
Specify the frequency of radiated noise and select the ferrite with high impedance corresponding to the frequency.

By wrapping the cable around the ferrite core according to the cable diameter as shown in the example, the impedance rises, obtaining a better effect.

< Example of use >



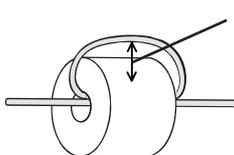
Lead through one time (one turn)



Lead through two times (two turns)



Lead through three times (three turns)



The clearance between the ferrite core and cable must be as narrow as possible when winding a cable.

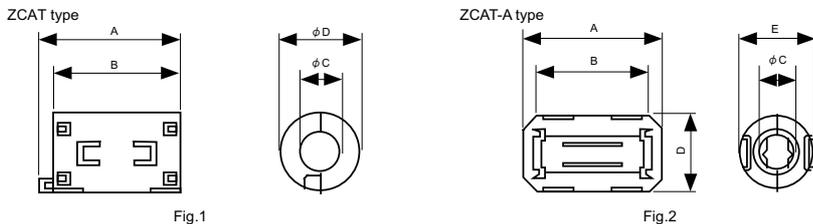
14 Appx.3: EMC Installation Guidelines

14.6 EMC Countermeasure Parts

< Recommended ferrite core >

A ferrite core is integrated and mounted on the plastic case. Quick installation is possible without cutting the interface cable or power cable. This ferrite core is effective against common mode noise, allowing measures against noise to be taken without affecting the signal quality.

TDK ZCAT Series



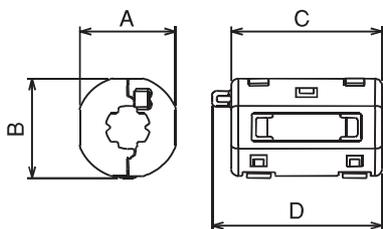
[Unit: mm]

Item	Fig	A	B	C	D	E	Applicable cable outline	Mass
ZCAT3035-1330(-BK) ^{*1}	1	39±1	34±1	13	30	-	13max.	63
ZCAT2035-0930-M(-BK)	2	35±1	28±1	9±1	19.5±1	17.4±1	6 to 9	22

(*1) A fixing band is enclosed when shipped.

Contact:
 TDK Corporation
<http://www.global.tdk.com/>

Kitagawa Industries GRFC Series



[Unit: mm]

Part number	A	B	C	D	Applicable bundle diameter	Impedance *Ω/100 MHz (1 turn)
RFC-H13	31.7	29.4	41.0	-	Φ12.5 to 13.5	≥ 170
RFC-20	40.0	40.0	47.0	-	Max.Φ20	≥ 180

Contact:
 KITAGAWA INDUSTRIES CO.,LTD.
<http://www.kitagawa-ind.com/eng/>

14.6.3 Power Line Filter

HF3000C-SZA Series for 200V/400V

■ Features

- ♦ 3-phase 3-wire type (500V series)
- ♦ Compatible with 200V/400V
- ♦ Compliant with EU Standards EN55011 (Group 1 Class A)
- ♦ Downsized for the space-saving book type

■ Application

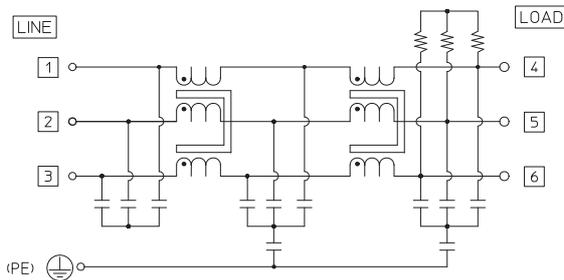
- ♦ Applications such as large machine tool, inverter, servo, etc.

■ Specifications

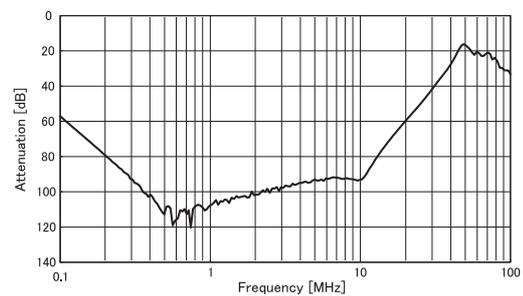
Item	HF3000C-SZA											
	HF3010 C-SZA	HF3020 C-SZA	HF3030 C-SZA	HF3040 C-SZA	HF3050 C-SZA	HF3060 C-SZA	HF3080 C-SZA	HF3100 C-SZA	HF3150 C-SZA	HF3200 C-SZA	HF3250 C-SZA	HF3300 C-SZA
Rated voltage	3-phase 3-wire type 500VAC (530VAC max 50/60Hz)											
Rated current	10A	20A	30A	40A	50A	60A	80A	100A	150A	200A	250A	300A
Leakage current	7mA max 400VAC 50Hz(by UL1283)											
Ambient temp	-20 to 50°C											
Safety standards	CSA, UL1283/EN60939-2											
Vibration Resistance	Frequency: 10Hz to 55Hz Acceleration rate: 9.8m/s ²											



< Circuit diagram >

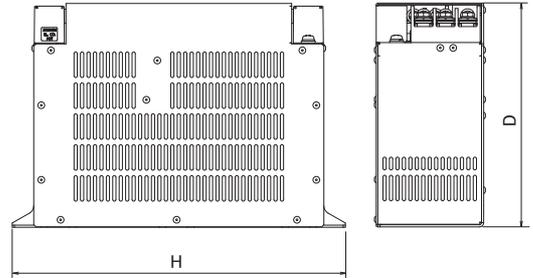
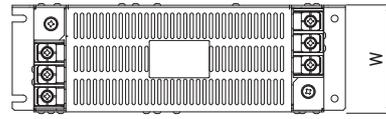


< Attenuation > Typical example: HF3150C-SZA



■ Outline dimension drawing

Model	Rated current	Mass (typ.)	Dimension [Unit:mm]		
			W	D	H
HF3010C-SZA	10A	0.9kg	220	66	78
HF3020C-SZA	20A	1.3kg			
HF3030C-SZA	30A	1.3kg			
HF3040C-SZA	40A	2.0kg	270	80	84
HF3050C-SZA	50A	2.0kg			
HF3060C-SZA	60A	2.1kg			
HF3080C-SZA	80A	5.4kg	310	100	210
HF3100C-SZA	100A	5.8kg			
HF3150C-SZA	150A	9.0kg			
HF3200C-SZA	200A	11kg	400	120	260
HF3250C-SZA	250A	12kg			
HF3300C-SZA	300A	13kg			



14 Appx.3: EMC Installation Guidelines

14.6 EMC Countermeasure Parts

14.6.4 Surge Absorber

Insert a surge absorber in outside the AC reactor when viewed from the power supply unit and drive unit to prevent damage to the control panel or power supply unit, etc. caused by the surge (lightning or sparks, etc.) applied on the AC power line. Do not insert the surge absorber between the AC reactor, and the power supply unit and drive unit. Harmonic components occur due to the power regeneration control.

Use a surge absorber that satisfies the following electrical specifications.

< Surge absorber for 200V >

RSPD Series for 200V (for both between phases and between phase and earth)

Part name	Rated voltage 50/60Hz	Voltage protection level	Surge withstand level 8/20 μs	Service temperature
RSPD-250-U4	3AC 250V	1300V	2500A	-40 to 70°C

< Surge absorber for 400V >

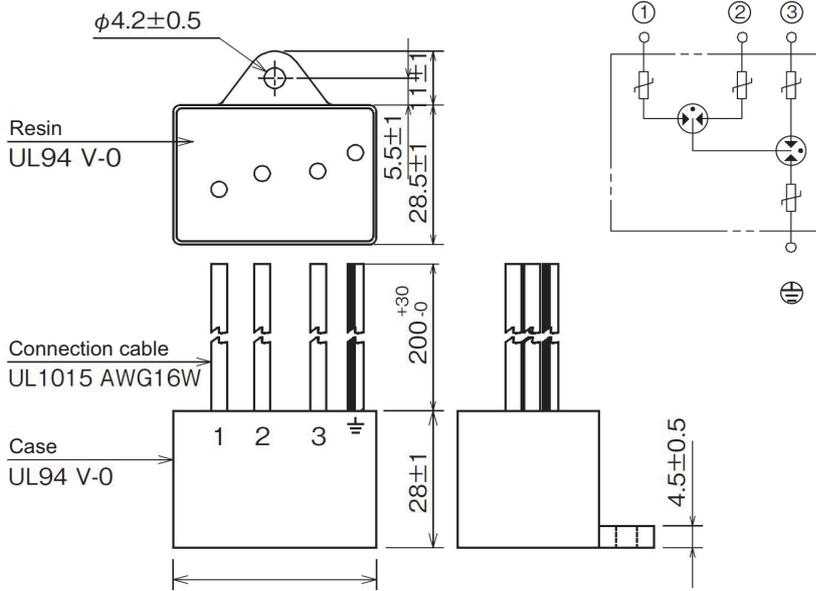
RSPD Series for 400V (for both between phases and between phase and earth)

Part name	Rated voltage 50/60Hz	Voltage protection level	Surge withstand level 8/20 μs	Service temperature
RSPD-500-U4	3AC 500V	2000V	2500A	-40 to 70°C

[Unit: mm]

Outline dimension drawings

Circuit diagram

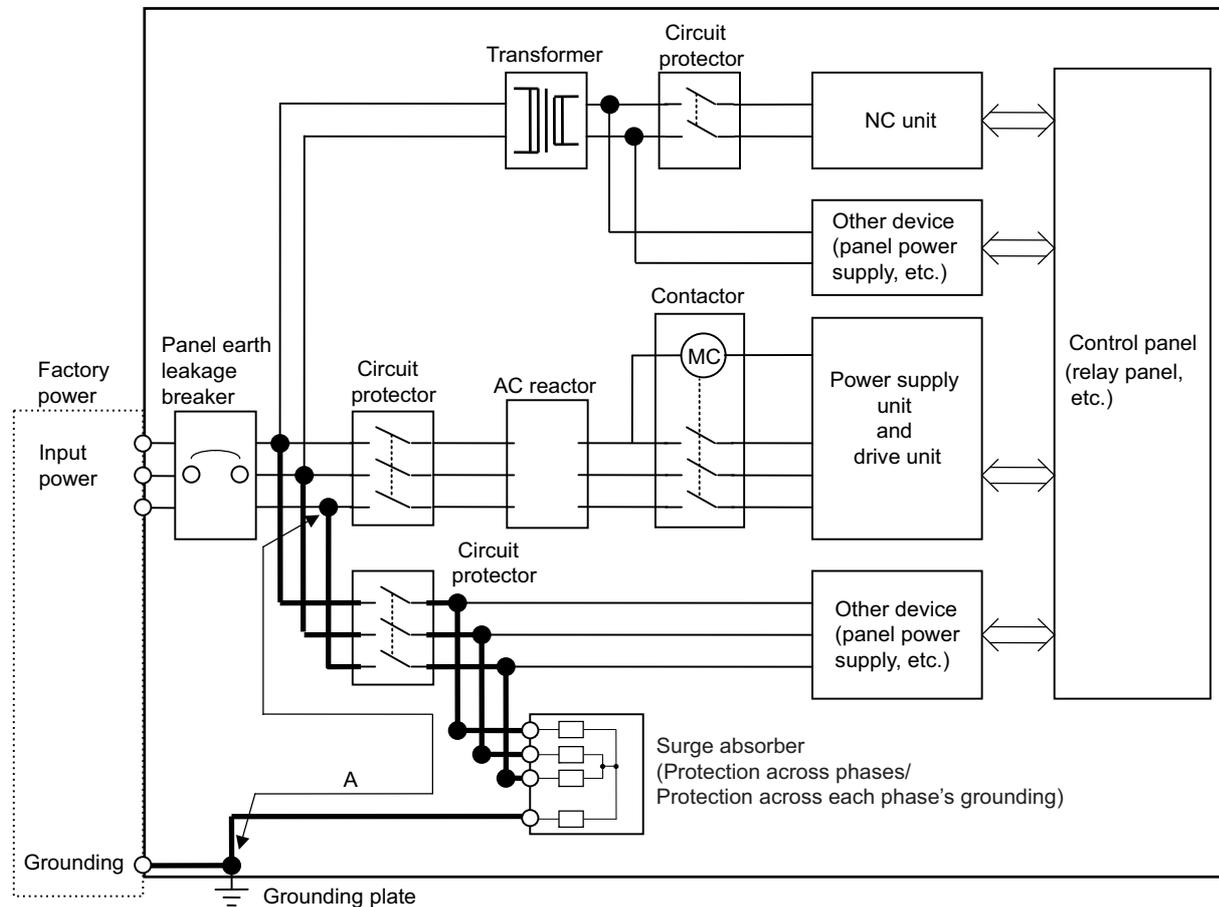


Contact: Okaya Electric Industries Co., Ltd. <http://www.okayaelec.co.jp/english/index.html>

< Example of surge absorber installation >

An example of installing the surge absorber in the machine control panel is shown below.

A short-circuit fault will occur in the surge absorber if a surge exceeding the tolerance is applied. Thus, install a circuit protector in the stage before the surge absorber. Note that almost no current flows to the surge absorber during normal use, so a circuit protector installed as the circuit protection for another device can be used for the surge absorber.

Installing the surge absorber**⚠ CAUTION**

- (1) The wires from the surge absorber should be connected without extensions.
- (2) If the surge absorber cannot be installed just with the enclosed wires, keep the wiring length of A to 2m or less. If the wires are long, the surge absorber's performance may drop and inhibit protection of the devices in the panel.
- (3) Surge absorber to be selected varies depending on input power voltage.
- (4) Do not insert the surge absorber in the place with a lot of harmonic components.

14 Appx.3: EMC Installation Guidelines

14.6 EMC Countermeasure Parts

Revision History

Date of revision	Manual No.	Revision details
Sep. 2022	IB(NA)1501700-A	First edition created.
Nov. 2023	IB(NA)1501700-B	<ul style="list-style-type: none"> - "Introduction" was revised. - "Specifications" was revised. - Function Specifications List was revised. - "Heating Value" was revised. - "Installation Direction and Clearance" was revised. - "Panel Installation Hole Work Drawings (Panel Cut Drawings)" was revised. - "Connector Pin Assignment" was revised. - "Connector Wiring Method" was revised. - "Wiring of the Grounding Cable" was revised. - "Input/Output Circuit Wiring" was revised. - "Setup" was revised. - "Selection" was revised. - "Example of Wires by Unit" was revised. - "Selection of Circuit Protector and Contactor" was revised. - "Optional Cover" was revised. - "Optional Bumper" was added. - "Troubleshooting" was revised. - "Wire Connection Method of Power Supply Unit Connector for CN23 (External Contactor Control Connector)" was revised. - "Replacing the Power Supply Unit Fan" was added. - "Compliance to EC Directives" was revised. - "EMC Installation Guidelines" was revised.

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Every effort has been made to keep up with software and hardware revisions in the contents described in this manual.

However, please understand that in some unavoidable cases simultaneous revision is not possible.

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