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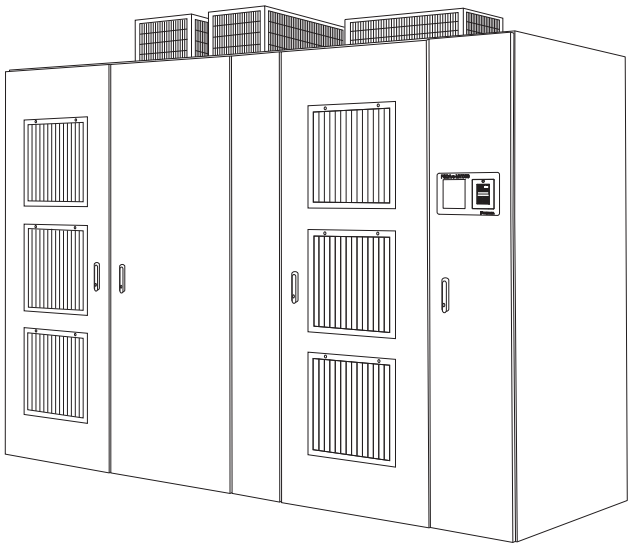
Super Energy-Saving Medium-Voltage AC Drive

FSDrive-MV1000

Instructions

Class: 2 kV, 3 kV, 4 kV, 6 kV, and 11 kV

To properly use the product, read this manual thoroughly and retain for easy reference, inspection, and maintenance. Ensure the end user receives this manual.



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MANUAL NO. TOEP C710687 02B

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Preface and General Safety

This section provides safety messages pertinent to this product that, if not heeded, may result in fatality, personal injury, or equipment damage. Yaskawa is not responsible for the consequences of ignoring these instructions.

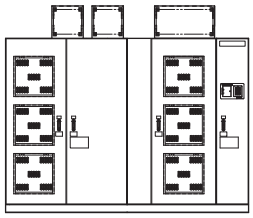
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i.1 Preface

This manual is designed to ensure correct and suitable application of MV1000-Series Drives. Read this manual before attempting to install, wire, operate, maintain, or inspect a drive and keep it in a safe, convenient location for future reference. Be sure that you understand all the precautions and safety information before attempting to use the product.

◆ Applicable Documentation

The following manuals are available for MV1000 series drives. Refer to the manual appropriate for your purpose.

	**Super Energy-Saving Medium-Voltage AC Drive FSDrive-MV1000 Instructions (this book)** **Manual No.: TOEP C710687 02**
	This manual contains basic information required to install and wire the drive, in addition to an overview of operating procedures, fault diagnostics, and maintenance and inspection. It covers the basic operation and trial running of this product.
	Super Energy-Saving Medium-Voltage AC Drive FSDrive-MV1000 Parameter Guide **Manual No.: TOEP C710687 03**
	This manual contains detailed information on parameter settings. Use this manual to expand drive functionality and to take advantage of higher performance features.

◆ Symbols

The symbols used in this manual are explained below.

Note: Indicates a supplement or precaution that does not cause drive damage.



Indicates a term or definition used in this manual.

◆ Terms and Abbreviations



- **Drive, MV1000:** Yaskawa FSDrive-MV1000 Series MV1000
- **V/f:** V/f Control
- **OLV:** Open Loop Vector Control
- **CLV:** Closed Loop Vector Control

◆ Trademarks

The companies and product names mentioned in this manual are trademarks or registered trademarks of those companies.

i.2 General Safety

◆ Supplemental Safety Information

- Illustrations, photographs, or examples used in this manual are provided as examples only and may not apply to all products to which this manual is applicable.
- The products and specifications described in this manual or the content and presentation of the manual may be changed without notice to improve the product and/or the manual.
- When ordering a new copy of the manual due to damage or loss, contact your Yaskawa representative or the nearest Yaskawa sales office and provide the manual number shown on the front cover.
- If the nameplate becomes worn or damaged, order a replacement from your Yaskawa representative or the nearest Yaskawa sales office.

General Precautions

- The diagrams in this manual may be indicated without covers or safety shields to show details. Restore covers or shields before operating the drive and run the drive according to the instructions described in this manual.
- Any illustrations, photographs, or examples used in this manual are provided as examples only and may not apply to all products to which this manual is applicable.
- The products and specifications described in this manual or the content and presentation of the manual may be changed without notice to improve the product and/or the manual.
- When ordering a new copy of the manual due to damage or loss, contact your Yaskawa representative or the nearest Yaskawa sales office and provide the manual number shown on the front cover.
- If nameplate becomes worn or damaged, order a replacement from your Yaskawa representative or the nearest Yaskawa sales office.
- Read and understand this manual before installing, operating or servicing this drive. The drive must be installed according to this manual and local codes.
  The following conventions are used to indicate safety messages in this manual. Failure to heed these messages could result in serious or possibly even fatal injury or damage to the products or to related equipment and systems.

⚠ DANGER

Indicates a hazardous situation, which, if not avoided, will result in serious injury or death.

⚠ **DANGER!** *will also be indicated by a bold key word embedded in the text followed by an italicized safety message.*

⚠ WARNING

Indicates a hazardous situation, which, if not avoided, could result in serious injury or death.

⚠ **WARNING!** *will also be indicated by a bold key word embedded in the text followed by an italicized safety message.*

⚠ CAUTION

Indicates a hazardous situation, which, if not avoided, could result in minor or moderate injury.

⚠ **CAUTION!** *will also be indicated by a bold key word embedded in the text followed by an italicized safety message.*

NOTICE

Indicates a property damage message.

NOTICE: *will also be indicated by a bold key word embedded in the text followed by an italicized safety message.*

◆ Safety Messages

⚠ DANGER

Heed all of the safety-related information in this manual.

Failure to comply could result in serious injury or death.

The operating company is responsible for any injuries or equipment damage resulting from failure to heed the warnings in this manual.

Electrical Shock Hazard

Do not connect or disconnect wiring while the power for the main circuit and controls is on.

Failure to comply could result in serious injury or death.

Even when the power supply of the medium-voltage main circuit to the drive is shut off, it takes some time for the internal capacitors to discharge. Wait until the CHARGE LED goes off before starting inspection. While an residual electric charge remains in the capacitor, the surface and inside of the Power Cell will carry a high voltage, so there will be a risk of serious injury or death. The heatsink of the Power Cell can become quite hot during operation, and proper precautions should be taken to prevent burns. When replacing the cooling fan, shut off the main circuit's power and then wait at least 15 minutes. Then, shut off the control circuit's power and make sure that the cooling fan has fully stopped before starting the work.

⚠ WARNING

Sudden Movement Hazard

Do not forget to include an emergency stop circuit in the application.

Failure to comply could result in serious injury or death. A communication error between the digital operator keypad and the drive’s internal control board may make it impossible to stop the drive with the digital operator.

After an emergency stop circuit has been wired, check to make sure it is operating properly.

Failure to comply could result in serious injury or death. The emergency stop circuit may fail to operate if left unchecked. The user is fully responsible for properly wiring the emergency circuit.

Some systems may start moving in response to the supply of power alone, resulting in serious injury or death.

Make sure that there are no personnel around the drive, motor and machine before turning the power on. Also check that couplings with motors, shaft keys and machinery are properly protected.

Electrical Shock Hazard

Never modify the drive.

Failure to comply could result in serious injury or death.

Yaskawa is not responsible for the consequences of any modification of the product by the user or any client of the user.

Do not allow unqualified personnel to perform work on the drive.

Failure to comply could result in serious injury or death.

The drive should be installed, wired, repaired, inspected, and have its parts replaced, by someone with a thorough knowledge of drive installation, adjustment and repair.

Fire Hazard

Verify that the rated voltage of the drive matches the voltage of the incoming power supply before applying power.

Failure to comply could result in serious injury or death by fire.

NOTICE

Equipment Hazard

Observe proper electrostatic discharge procedures (ESD) when handling the drive.

Failure to comply could result in ESD damage to the drive circuitry.

Do not operate damaged equipment.

Failure to comply could result in further damage to the equipment.

Do not connect or operate any equipment with visible damage or missing parts.

Also check the cable wiring and selection of peripheral devices to identify the cause. Contact your Yaskawa representative or the nearest Yaskawa sales office before restarting the drive or the peripheral devices if the cause cannot be identified.

Install adequate branch circuit short circuit protection in accordance with the standards in the country of use.

Failure to comply could result in damage to the drive.

This drive is suitable for circuits carrying a maximum current when shorted of 5 kVA, with a maximum voltage of 2640 Vac (class: 2 kV), 3630 Vac (class: 3 kV), 4576 Vac (class: 4 kV), 7260 Vac (class: 6 kV), or 12100 Vac (class: 11 kV).

If disinfectants or insecticides must be used to treat packing materials such as wooden frames, pallets, or plywood, the packing materials must be treated before the product is packaged, and methods other than fumigation must be used.

Example: Heat treatment, where materials are kiln-dried to a core temperature of 56°C for 30 minutes or more.

If the electronic products, which include stand-alone products and products installed in machines, are packed with fumigated wooden materials, the electrical components may be greatly damaged by the gases or fumes resulting from the fumigation process. In particular, disinfectants containing halogens, which includes chlorine, fluorine, bromine and iodine can contribute to the erosion of the capacitors, and DOP gas (phthalate esters) can cause cracking of resins.

◆ Drive Label Warning Example

Figure i.1 to *Figure i.5* below shows the locations of the warning labels on the drive. Always heed the warning and danger information listed in *Figure i.6* to *Figure i.8*.

■ Warning and Danger Information Locations

Class: 2 kV

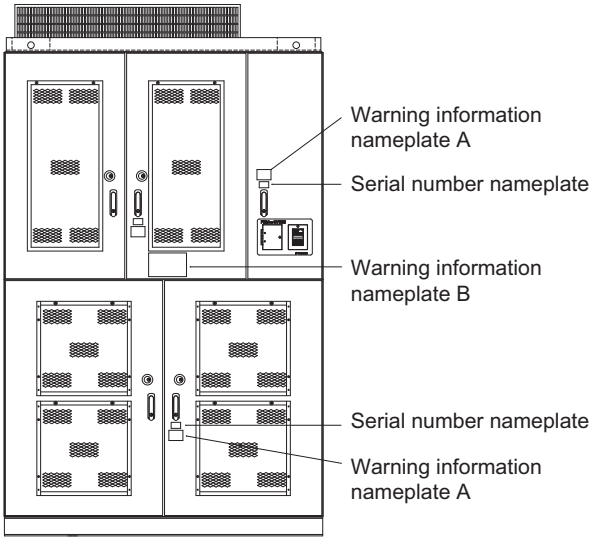


Figure i.1 Class: 2 kV

Class: 3 kV

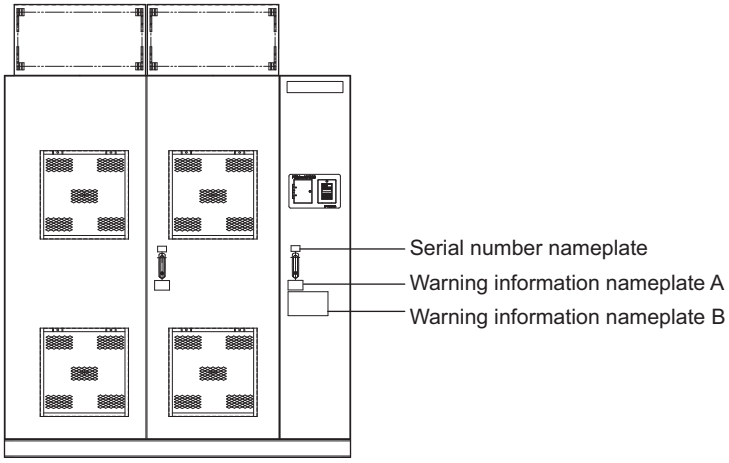


Figure i.2 Class: 3 kV

Class: 4 kV

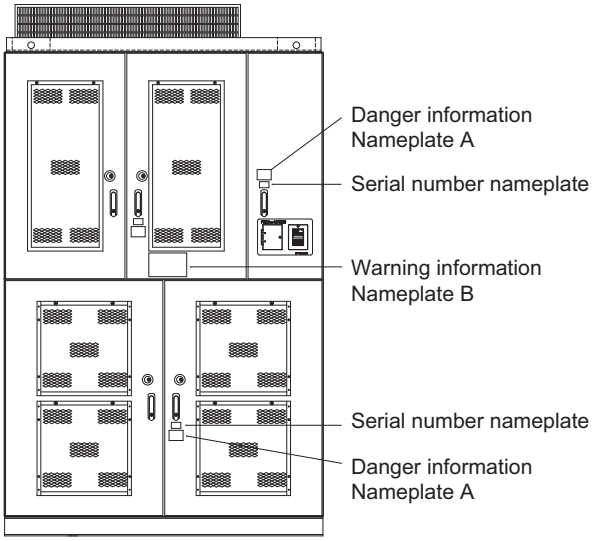


Figure i.3 Class: 4 kV

Class: 6 kV

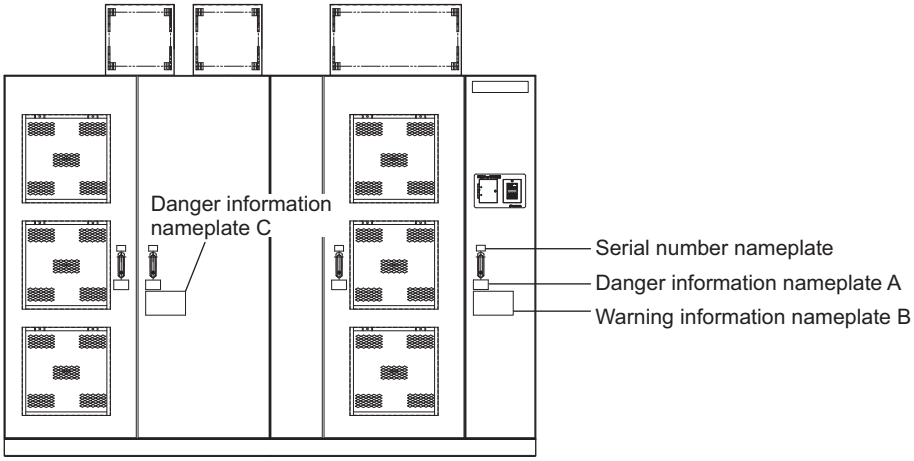


Figure i.4 Class: 6 kV

Class: 11 kV

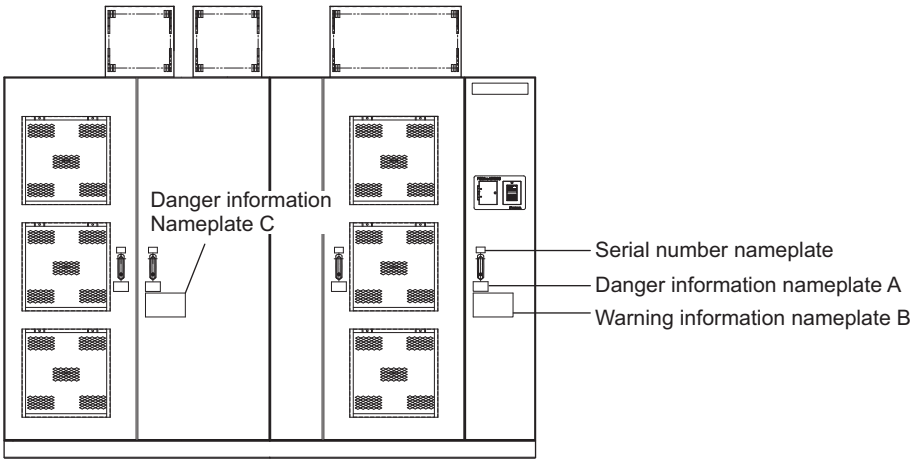


Figure i.5 Class: 11 kV

■ Warning and Danger Information

Nameplate A

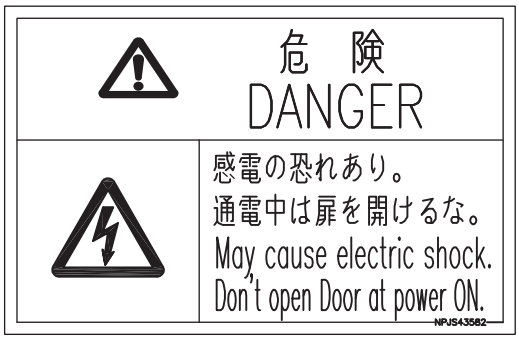


Figure i.6 Danger Information Example Nameplate A

Nameplate B

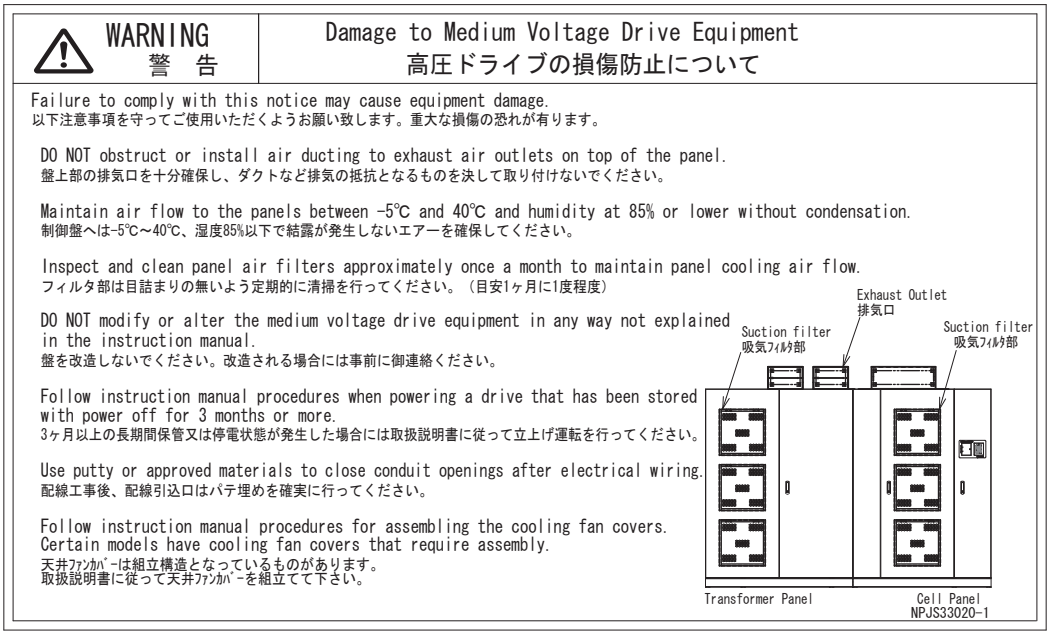


Figure i.7 Warning Information Example Nameplate B

Nameplate C

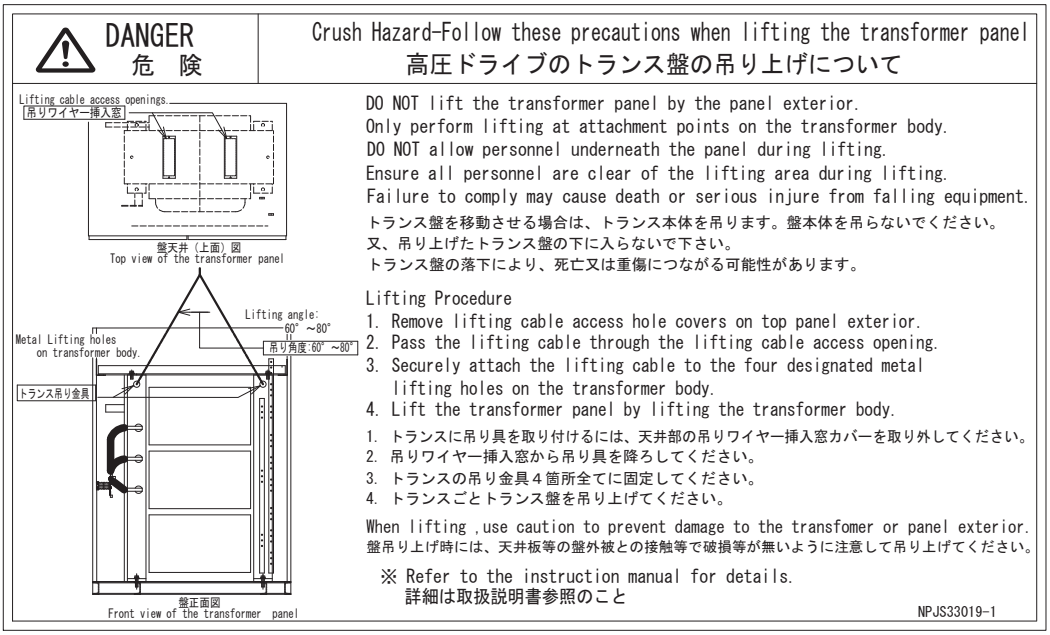


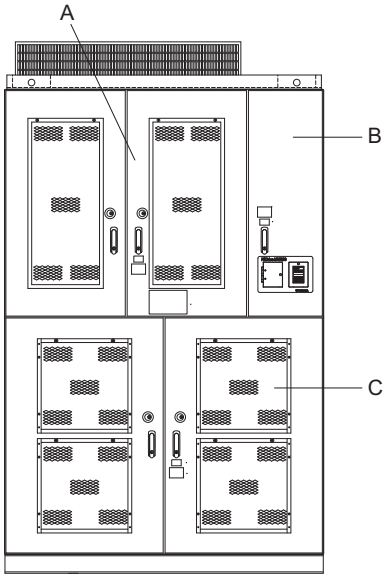
Figure i.8 Danger Information Example Nameplate C

Note: This danger information is not indicated on 2 kV and 4 kV class drives.

i.3 Mechanical Interlock

To use a mechanical interlock with 2 kV class and 4 kV class drives, install the same mechanical interlock on the incoming circuit breaker panel as is used with the drive.

1. Turn off the incoming circuit breaker and remove the mechanical interlock key.
2. Use the key to unlock the mechanical lock of the drive.



A – Medium voltage panel (Power Cells)
B – Low voltage panel (Controller)
C – Medium voltage panel (Transformer)

Figure i.9 Specification of Interlock Key (Kirk Key type F-Flat mounted)

i.4 Notes on Using Drives

◆ Selection

■ Power Supply Capacity

The main circuit power supply to be connected to the drive should have a capacity larger than the power required by the drive with the power factor and efficiency taken into account. When connecting multiple drives to a single supply, select a power source with a capacity larger than the sum of the power required by all the drives to be connected. Even when the power source has sufficient capacity, the supply voltage may drop when the power is turned on. This may cause malfunction of devices connected to the same power supply system if the power supply has a large power impedance.

■ Drive Capacity

When running more than one motor in parallel from a single drive, the capacity of the drive should be larger than [total motor rated current × 1.1].

■ Emergency Stop

During a drive fault condition, the output shuts off but the motor does not stop immediately. A mechanical brake may be required when it is necessary to stop the motor faster than the ability of the Fast Stop function of the drive.

◆ Installation

■ Ambient Environment

Install the drive in a clean environment free from airborne oil mist, corrosive gas, flammable gas, lint and dust. Install the fan cover at the top of the panel before starting operation. Any modification to the drive panel's cooling fan, such as connecting air exhaust duct, may reduce air flow for cooling and cause overheating and faults. Do not connect air exhaust duct.

■ Operating Environment

When power to the drive is reapplied after the drive has been stopped for an extended period, electrical components inside dry-type transformers and the Power Cell may be subject to condensation depending on the temperature and humidity of the switch room. Condensation reduces insulation and may cause short circuits. Yaskawa recommends installing a dehumidifier in the switch room.

■ Drive Storage

When storing an uninstalled drive in a warehouse or storing an installed drive without applying power, observe the following points to maintain its reliability:

Short-term storage of the drive
Short-term storage includes time periods up to one month after unpacking or up to three months after shipping. Store the drive in an environment that satisfies the conditions cited for environmental specifications. An ambient temperature of up to 60 °C is acceptable for short-term storage.

Long-term storage of the drive
Long-term storage includes time periods of more than one month after unpacking or more than three months after shipping. Contact Yaskawa if long-term storage is required. An ambient temperature of up to 50 °C is acceptable for long-term storage. Refer to *Long Term Storage of Drives on page 71* for details.

Store the spare parts without unpacking them. *Refer to Storing Spare Parts on page 208* for details.

■ Compliance with Local Laws

Please comply with the law of the relevant country where the drive panel is installed. For details, contact your Yaskawa representative.

■ Effects of Distortion in Power Supply

When the power supply voltage is originally distorted, or when multiple devices and the drive are connected to the same power supply, drive harmonics from the power supply system flow into the drive, and cause in high relative harmonic content.

◆ Settings

■ Driving Multiple Induction Motors

Use V/f control when running multiple induction motors using a single drive.

■ Upper Limits

The drive can be operated at speeds up to 120 Hz. Set an upper limit by using the upper limit frequency setting function. The default setting for the maximum output frequency is 60 Hz.

■ Acceleration/Deceleration Times

Acceleration and deceleration times are affected by the amount of torque generated by the motor, the load torque, and the inertia moment. Set a longer accel/decel time when Stall Prevention is enabled. The accel/decel times are lengthened for as long as the Stall Prevention function is in operation. Install one of the available braking options or increase the capacity of the drive for faster acceleration and deceleration.

◆ General Handling

■ Wiring Check

Never short the output terminals of the drive or apply voltage from the power supply to the output terminals (U, V, W). This will damage the drive.
Carry out wiring that conforms to the wire gauges and tightening torques described in this manual. Conduct a thorough check of wiring and sequences before turning the power on.

■ Circuit Breaker or Magnetic Contactor Selection and Installation

Select a breaker with sufficient capacity for the main circuit power supply side of the drive, taking the inrush current from the transformer into account.
Avoid using the breaker or magnetic contactor for frequent starting or stopping. This may damage the drive. Do not switch the breaker or magnetic contactor ON/OFF more than twice a day. If it is operated more frequently, install an optional inrush current suppression circuit between the main circuit power supply and the drive. Use a low-surge type Vacuum Circuit Breaker for drive primary side breaker.

■ Inspection and Maintenance

Even when the power supply of the medium-voltage main circuit to the drive is shut off, it takes some time for the internal capacitors to discharge. Wait until the CHARGE LED goes off before starting inspection. While an residual electric charge remains in the capacitor, the surface and inside of the Power Cell will carry a high voltage, so there will be a risk of serious injury or death. The heatsink of the Power Cell can become quite hot during operation, and proper precautions should be taken to prevent burns.
When replacing the cooling fan, shut off the main circuit's power and then wait at least 15 minutes. Then, shut off the control circuit's power and make sure that the cooling fan has fully stopped before starting the work.

■ Transportation and Installation

Never steam clean the drive. During transportation and installation, the drive must never be exposed to an atmosphere containing a halogen gas such as fluorine, chlorine, bromine, or iodine.

■ Hoisting

Some large capacity drives require that the transformer, not the transformer panel, be hoisted directly. Hoisting the drive panel may damage the drive. *Refer to Drive Transportation on page 44* for details.

■ Radio Frequency Interference

Inputs and outputs of the drive (main circuit) contain harmonic components that may adversely affect communication devices, such as AM radios, used in the vicinity. Use high-voltage cables and ground any shielded cables. Separate cables for control from high-current circuits (main circuit and relay sequence circuits) to avoid induction from peripheral devices. (It is advisable to separate them by a distance of 30 cm or more.)

■ Leakage Current

Harmonic leakage current passes through stray capacitance between the drive power lines, ground and the motor lines. Consider taking measures against this leakage current.

i.5 Notes on Motor Operation

◆ Existing Standard Motors

■ Insulation Voltage

Consider voltage tolerance levels and insulation in applications with high input voltage or particularly long wiring distances. Contact Yaskawa for consultation.

■ High Speed Operation

Running a motor beyond its rated speed may lead to problems imposed by vibration or the durability of motor bearings. Contact the manufacturer of the motor for details.

■ Torque Characteristics

Torque characteristics differ compared to operating the motor directly from line power. The user should have a full understanding of the load torque characteristics for the application.

■ Vibration and Shock

The FSDrive-MV1000 PWM control with multiple outputs reduces motor oscillation to the same level as in operation by commercial power supply. However, the motor oscillation is slightly larger due to the following factors:

- Resonance with the natural frequency of the mechanical system
  Take particular caution when adding a variable speed drive to an application running a motor from line power at a constant speed. If resonance occurs, install shock-absorbing rubber around the base of the motor and enable the Jump frequency selection to prevent continuous operation in the resonant frequency range.
- Residual unbalance of the rotating motor
  Particular care is required when running the motor beyond its rated speed.
- Subsynchronous Resonance
  Subsynchronous resonance can occur with long motor shafts and in applications such as turbines, blowers, and fans with high inertia loads. Use Closed Loop Vector Control when these applications experience mechanical resonance problems.

i.6 Warranty Information

◆ Warranty Period

This product is warranted for twelve months after being delivered to the end user or eighteen months from the date of shipment from Yaskawa's factory, whichever comes first.

◆ Scope of Warranty

■ Repairs

If a Yaskawa product is found to be defective due to Yaskawa workmanship or materials and the defect occurs during the warranty period, Yaskawa will bear the cost of repairing the unit. However, if the Yaskawa Authorized Service Center determines that the problem with a Yaskawa product is not due to defects in Yaskawa's workmanship or materials, then the end user will be responsible for the cost of any necessary repairs. Some problems that are outside the scope of this warranty are:

- Problems due to improper maintenance or handling, carelessness, or other reasons where the customer is determined to be responsible.
- Problems due to additions or modifications made to the Yaskawa product by the customer without Yaskawa's understanding.
- Problems due to the use of the Yaskawa product under conditions that do not meet the recommended specifications.
- Problems caused by unavoidable occurrences such as natural disaster or fire.
- Or other problems not due to defects in Yaskawa workmanship or materials.

Above after-sales service is applicable in Japan only. However, after-sales service is also available for customers outside of Japan on changeable basis. Contact sales representative of the country where the product was purchased.

■ Exceptions

Any inconvenience to the customers or damage to non-Yaskawa products due to Yaskawa's defective products whether within or outside the warranty period are NOT covered by this warranty.

◆ Restrictions

- This product is not designed or manufactured for use in devices or systems that may directly affect or threaten human lives or health.
- End users who intend to use this product for devices or systems relating to transportation, health care, space aviation, atomic or electric power, or underwater use must contact their Yaskawa representatives or the nearest Yaskawa sales office beforehand.
- This product has been manufactured under strict quality-control guidelines. However, if this product is to be installed in any location where failure of this product could involve or result in a life-and-death situation or loss of human life, or in a facility where failure may cause a serious accident or physical injury, safety devices must be installed to minimize the likelihood of any accident.

1

Receiving

This chapter explains how to inspect the drive upon receipt, and gives an overview of the different enclosure types and components.

1.1 SECTION SAFETY 24
1.2 GENERAL DESCRIPTION 25
1.3 MODEL NUMBER AND NAMEPLATE CHECK 29
1.4 COMPONENT NAMES AND CONFIGURATIONS 31

1.1 Section Safety

⚠ WARNING
Electrical Shock Hazard
If any parts in the drive are damaged or missing, stop the drive and contact your Yaskawa representative or the nearest Yaskawa sales office.
Electrical circuits could fail when current is applied, resulting in death, serious injury, or fire.

NOTICE
Observe proper electrostatic discharge procedures (ESD) when handling the drive.
Failure to comply may result in ESD damage to the drive circuitry.
A motor connected to a PWM drive may operate at a higher temperature than a motor being run with a commercial power supply and its operating speed range may be reduced due to the motor is cooling capacity.
Check in advance that the drive is suited to the load of the motor to be used.

1.2 General Description

◆ FSDrive-MV1000 Model Selection

Refer to tables in this section for drive selection depending on the nominal capacity.

■ Class: 2 kV

Table 1.1 MV1000 Models (Class: 2 kV)

Input Voltage (kV)	Power Supply Frequency (Hz)	Output Voltage (kV)	Model CIMR-MV2□	Motor Power <2> (HP)	Rated Output Current (A)	Nominal Capacity (kVA)
2.4	60	2.4	A□A□052 <1>	200	52	220
			A□A□068 <1>	300	68	290
			A□A□080 <1>	350	80	340
			A□A□093 <1>	400	93	390
			A□A□102 <1>	450	102	420
			A□A□115 <1>	500	115	480
			A□A□135 <1>	600	135	560
			A□A□160 <1>	700	160	670
			A□A□180 <1>	800	180	750
			A□A□205 <1>	900	205	850
			A□A□220 <1>	1000	220	920
			A□A□280 <1>	1250	280	1160
			A□A□330 <1>	1500	330	1370
			A□A□390 <1>	1750	390	1620
			A□A□440 <1>	2000	440	1830
			A□A□505 <1>	2250	505	2100
			A□A□550 <1>	2500	550	2300
			A□A□600 <1>	2750	600	2500

<1> Under development
<2> Indicates the power of Yaskawa's 4-pole motors.

■ Class: 3 kV

Table 1.2 MV1000 Models (Class: 3 kV)

Input Voltage (kV)	Power Supply Frequency (Hz)	Output Voltage (kV)	Model CIMR-MV2□	Nominal Capacity (kVA)	Rated Output Current (A)	Max. Applicable Motor Capacity <1> (kW)
3.3	50/60	3.3	C□C□035	200	35	132
			C□C□050	285	50	200
			C□C□070	400	70	315
			C□C□100	570	100	450
			C□C□140	800	140	630
			C□C□200	1150	200	900
			C□C□260	1500	260	1250
			C□C□330	1900	330	1500
			C□C□400	2300	400	1800
			C□C□520	3000	520	2500
			C□C□650	3700	650	3000

<1> Indicates the capacities of Yaskawa's 4-pole motors.

■ Class: 4 kV

Table 1.3 MV1000 Models (Class: 4 kV)

Input Voltage (kV)	Power Supply Frequency (Hz)	Output Voltage (kV)	Model CIMR-MV2□	Motor Power <2> (HP)	Rated Output Current (A)	Nominal Capacity (kVA)
4.16	60	4.16	D□D□039	300	39	280
			D□D□058	450	58	420
			D□D□064	500	64	460
			D□D□077	600	77	550
			D□D□093	700	93	670
			D□D□102	800	102	735
			D□D□115	900	115	830
			D□D□125	1000	125	900
			D□D□155	1250	155	1120
			D□D□190	1500	190	1370
			D□D□220 <1>	1750	220	1590
			D□D□250 <1>	2000	250	1800
			D□D□285 <1>	2250	285	2050
			D□D□315 <1>	2500	315	2270
			D□D□340 <1>	2750	340	2500
			D□D□375 <1>	3000	375	2700
			D□D□440 <1>	3500	440	3170
			D□D□505 <1>	4000	505	3640
			D□D□575 <1>	4500	575	4140
			D□D□625 <1>	5000	625	4500

<1> Under development
<2> Indicates the power of Yaskawa's 4-pole motors.

■ Class: 6 kV

Table 1.4 MV1000 Models (Class: 6 kV)

Input Voltage (kV)	Power Supply Frequency (Hz)	Output Voltage (kV)	Model CIMR-MV2□	Nominal Capacity (kVA)	Rated Output Current (A)	Max. Applicable Motor Capacity <1> (kW)
6.6	50/60	6.6	F□F□035	400	35	250
			F□F□050	570	50	400
			F□F□070	800	70	630
			F□F□100	1150	100	900
			F□F□140	1600	140	1250
			F□F□200	2300	200	1800
			F□F□260	3000	260	2500
			F□F□330	3800	330	3000
			F□F□400	4600	400	3600
			F□F□520	6000	520	5000
			F□F□650	7500	650	6000

<1> Indicates the capacities of Yaskawa's 4-pole motors.

■ Class: 11 kV

Table 1.5 MV1000 Models (Class: 11 kV)

Input Voltage (kV)	Power Supply Frequency (Hz)	Output Voltage (kV)	Model CIMR-MV2□	Nominal Capacity (kVA)	Rated Output Current (A)	Max. Applicable Motor Capacity <2> (kW)
11	50/60	11	H□H□035	660	35	530
			H□H□050	950	50	760
			H□H□070	1300	70	1070
			H□H□100	1900	100	1520
			H□H□140	2650	140	2130
			H□H□200	3800	200	3050
			H□H□260 <1>	5000	260	3960
			H□H□330 <1>	6200	330	5030
			H□H□400 <1>	7600	400	6100
			H□H□520 <1>	9900	520	7930
			H□H□650 <1>	12000	650	9910

<1> Under development
<2> Indicates the capacities of Yaskawa's 4-pole motors.

◆ Control Mode Selection

The control mode that is appropriate for your application can be selected from among the three available with the drive. Overviews of the control modes and their features are given below.

Table 1.6 Control Modes and their Features

Motor Type		Induction Motors			Remarks
Control Mode		V/f (Multimotor control)	OLV	CLV	–
Parameter Setting		A1-02 = 0	A1-02 = 2 (Factory setting)	A1-02 = 3	–
Basic Control		V/f control	Open Loop Vector control	Closed Loop Vector control	–
Main Applications		Multi-motor applications (where multiple motors are connected to a single drive)	• General variable speed control • Applications that require high performance and advanced functions without PG on the motor side.	Ultra-high-performance control with a PG at the motor side Examples: High-accuracy speed control Torque control Torque limit	–
PG Option Card		N/A	N/A	PG-B3 or PG-X3	–
Main Control Functions	Tuning	Line-to-line resistance (normally not needed)	Rotational, line-to-line resistance	Rotational, line-to-line resistance	Automatically adjusts the parameter settings that relate to the electrical characteristics of the motor.
	Torque Limit	N/A	YES	YES	Sets the maximum torque for the motor to protect the load and connected machinery.
	Torque Control	N/A	N/A	YES	Allows direct control of motor torque for tension control and other such applications. This drive has no regenerating capability.
	Droop Function	N/A (N/A when using a multi-motor)	N/A	YES	–
	Speed Estimate-type speed search	YES	YES	YES	Momentarily estimates (or detects) the motor speed during motor coasting, and actuates quickly without stopping the motor.

Note the following points when using the main control functions in *Table 1.6*.

- The V/f control mode (multimotor control) for drives is available with software versions PRG: 0108 and later.
- Perform Rotational Auto-Tuning when it is possible to separate the motor and the machine during test run. After performing Rotational Auto-Tuning, adjust the control system within the range where the machine does not vibrate. Rotational Auto-Tuning can only be performed when an induction motor is run in OLV or CLV.
- In vector control, combine only one motor with one drive. Multiple motors can be controlled by one drive in V/f control mode only. Select the drive capacity so the motor rated current is 50% to 100% of the drive rated current. When running multiple induction motors in parallel using a single drive, the capacity of the drive should be larger than 1.1 times the total motor rated current.
- When performing speed estimation type speed search, combine only one motor with one drive. The motor capacity must be the same as the drive or one frame lower.
- The torque restriction of the OLV control mode will give priority to accel/decel during accel/decel (during soft starter change). In addition, even if the motor speed drops during constant speed due to a torque restriction, it will not operate if the speed is less than the minimum frequency or in the reverse rotation direction. Set L7-07 = 1 (integral control) in cases where a torque limit has been enabled during accel/decel (for use in winding machines, etc.).

1.3 Model Number and Nameplate Check

Please perform the following tasks after receiving the drive:

- Inspect the drive for damage.
  If the drive appears damaged upon receipt, contact the shipper immediately.
- Verify receipt of the correct model by checking the information on the nameplate.
- If you have received the wrong model or the drive does not function properly, contact your supplier.
- Use a screwdriver or spanner to ensure that the screws and fastened parts are tightened. In particular, check the tightening torque of all terminal screws on the electrical connections.

⚠ **DANGER!** *If any parts in the drive are damaged or missing, stop the drive and contact your Yaskawa representative or the nearest Yaskawa sales office. Electrical circuits could fail when current is applied, resulting in death, serious injury, or fire.*

◆ Nameplate

The nameplate is affixed on the inside of the drive control panel door.
Example of the nameplate with standard specifications is shown in ***Figure 1.1***.

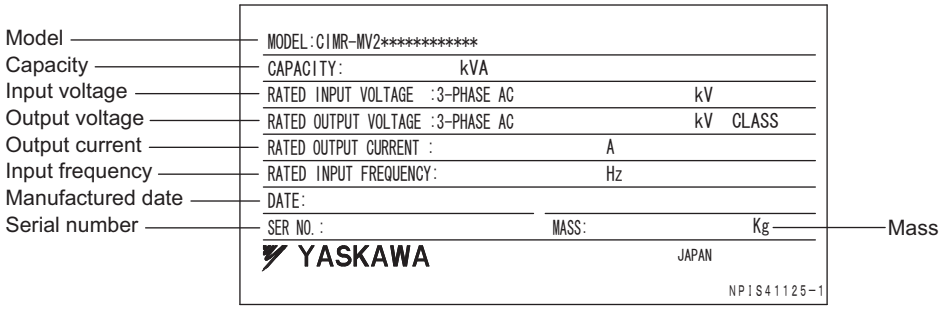


Figure 1.1 Example Drive Nameplate

◆ Drive Model Number Definition

CIMR- MV2 A A 5 A A 035 E1 A A

- CIMR-: Drive
- MV2: FSDrive-MV1000 series
- A (Region Code): No. A = Standard; No. C = Europe
- A (Input Voltage): No. A = 2.4 kV; No. C = 3.3 kV; No. D = 4.16 kV; No. F = 6.6 kV; No. H = 11 kV
- 5 (Input Frequency): No. 5 = 50 Hz; No. 6 = 60 Hz
- A (Output Voltage Class): No. A = 2 kV class; No. C = 3 kV class; No. D = 4 kV class; No. F = 6 kV class; No. H = 11 kV class
- A: Factory control number A,B,C...
- 035 (Output Current):

3/6/11 kV Class		2 kV Class		4 kV Class	
No.	Output Current	No.	Output Current	No.	Output Current
035	35 A	052	52 A	039	39 A
050	50 A	068	68 A	052	52 A
070	70 A	080	80 A	058	58 A
100	100 A	093	93 A	064	64 A
140	140 A	102	102 A	077	77 A
200	200 A	115	115 A	093	93 A
260	260 A	135	135 A	102	102 A
330	330 A	160	160 A	115	115 A
400	400 A	180	180 A	125	125 A
520	520 A	205	205 A	155	155 A
650	650 A	220	220 A	190	190 A
		280	280 A	220	220 A
		330	330 A	250	250 A
		390	390 A	285	285 A
		440	440 A	315	315 A
		505	505 A	340	340 A
		550	550 A	375	375 A
		600	600 A	440	440 A
				505	505 A
				575	575 A
				625	625 A

- E1 (Enclosure Type): No. E1 = IP40
- A (Environmental Specifications): No. A = Standard
- A: Design revision order A, B, C…

Figure 1.2 Drive Model Number Definition

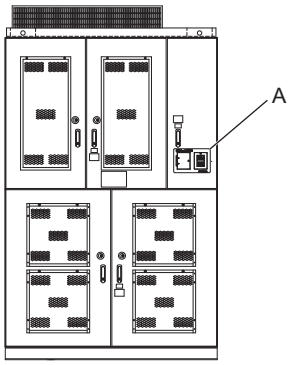
Note: All input voltages are not necessarily compatible with all output voltage classes.

1.4 Component Names and Configurations

This section gives an overview of the drive components described in this manual.

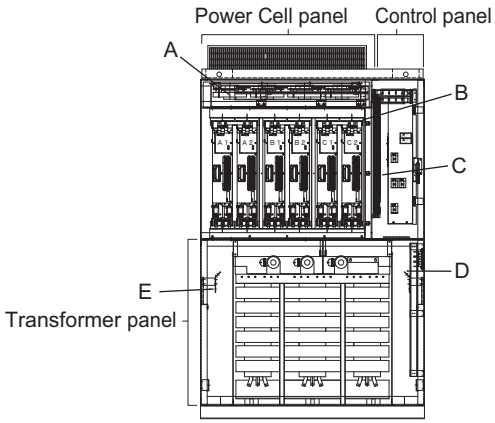
◆ External Appearance and Internal Layout

Drive external appearances and the layout of the internal devices are shown in *Figure 1.3* to *Figure 1.11*.



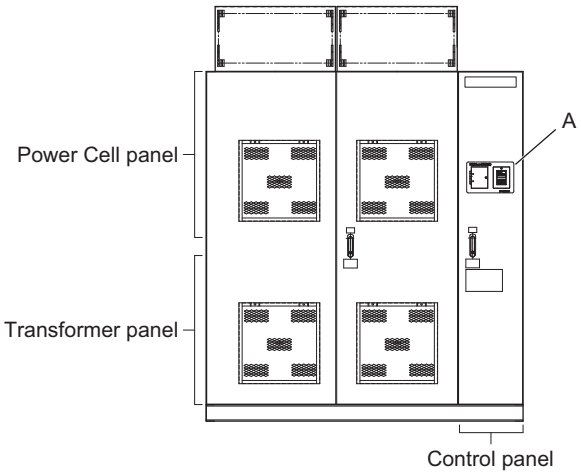
A – Digital Operator

Figure 1.3 External Appearance, Viewing Doors (Drive: 2 kV class, 600 HP)



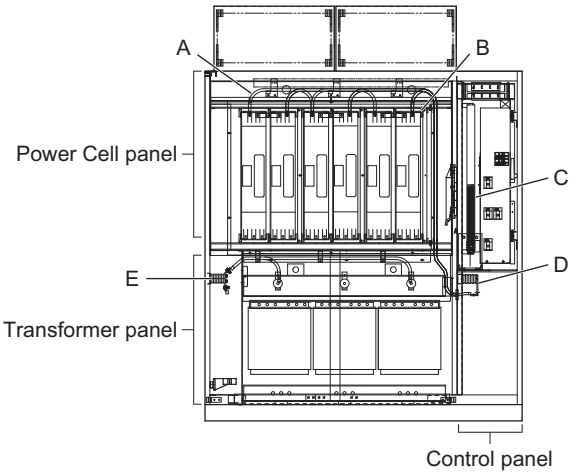
A – Cooling fans
B – Power Cells
C – Control circuit terminal
D – Main circuit output terminals
E – Main circuit input terminals

Figure 1.4 Internal Layout (Drive: 2 kV class, 600 HP)



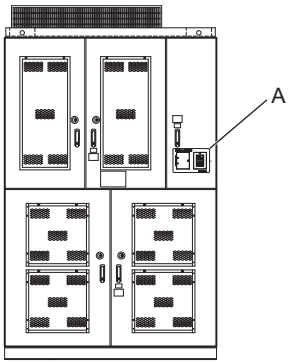
A – Digital Operator

Figure 1.5 External Appearance, Viewing Doors (Drive: 3 kV Class, 800 kVA)



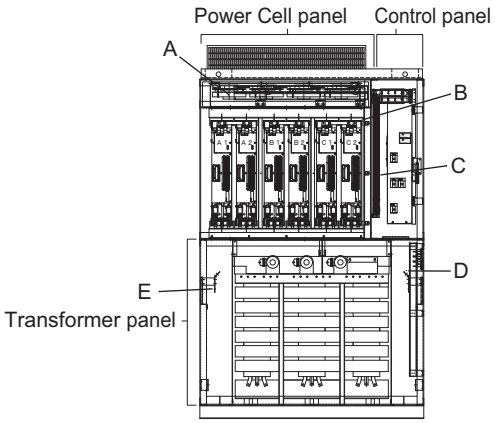
A – Cooling fans
B – Power Cells
C – Control circuit terminal
D – Main circuit output terminals
E – Main circuit input terminals

Figure 1.6 Internal Layout (Drive: 3 kV Class, 800 kVA)



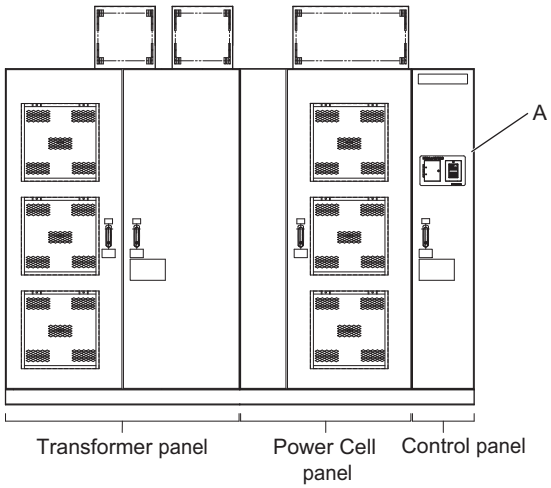
A – Digital Operator

Figure 1.7 External Appearance, Viewing Doors (Drive: 4 kV Class, 1000 HP)



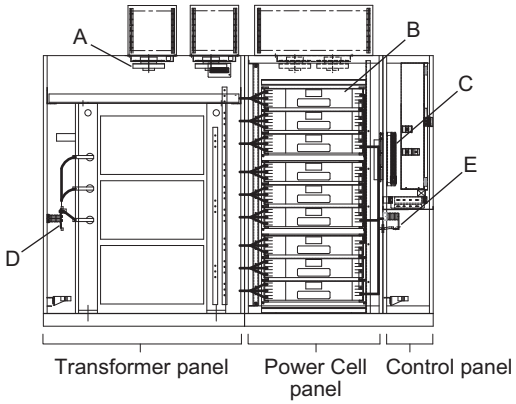
A – Cooling fans
B – Power Cells
C – Control circuit terminal
D – Main circuit output terminals
E – Main circuit input terminals

Figure 1.8 Internal Layout (Drive: 4 kV Class, 1000 HP)



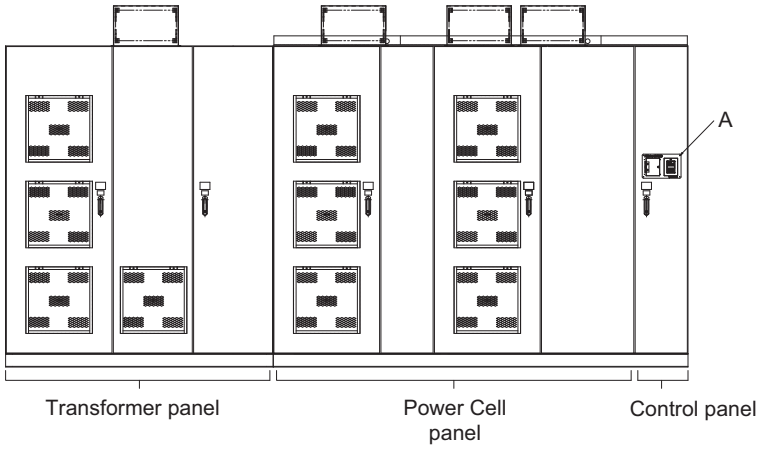
A – Digital Operator

Figure 1.9 External Appearance, Viewing Doors (Drive: 6 kV Class, 1600 kVA)



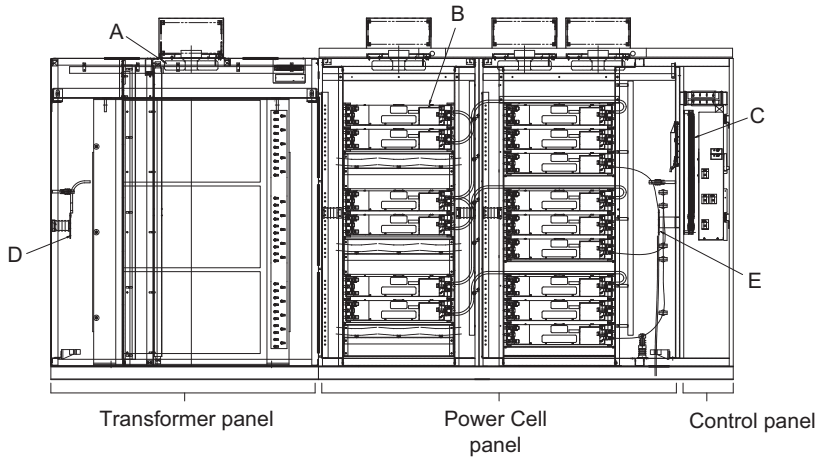
A – Cooling fans
B – Power Cells
C – Control circuit terminal
D – Main circuit input terminals
E – Main circuit output terminals

Figure 1.10 Internal Layout (Drive: 6 kV Class, 1600 kVA)



A – Digital Operator

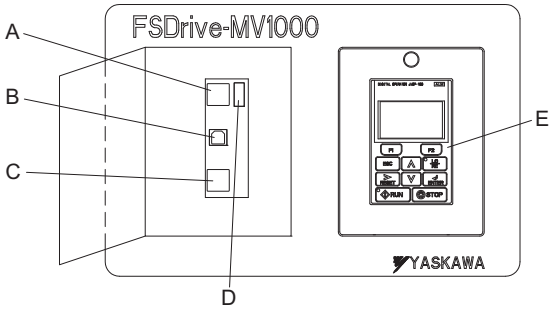
Figure 1.11 External Appearance, Viewing Doors (Drive: 11 kV Class, 2650 kVA)



A – Cooling fans
B – Power Cells
C – Control circuit terminal
D – Main circuit input terminals
E – Main circuit output terminals

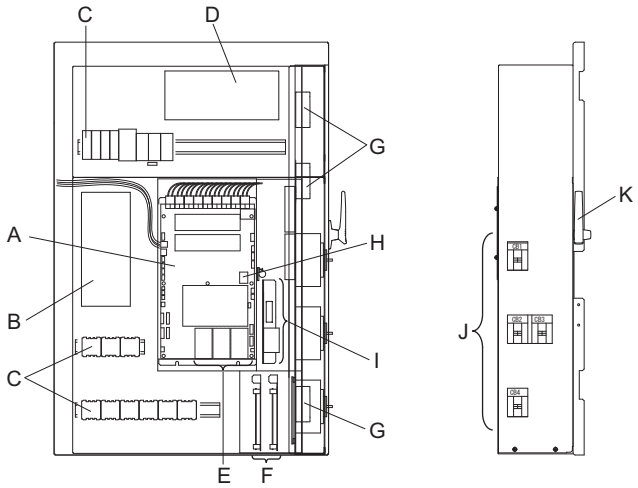
Figure 1.12 Internal Layout (Drive: 11 kV Class, 2650 kVA)

◆ Digital Operator, Communications Connector, and Internal Layout for Control Panel



A – Serial communications connector for drive
B – USB connector
C – Serial communications connector for PLC option
D – Selector switch
E – Digital operator

Figure 1.13 Digital Operator and Communications Connector for Control Panel



A – Control board
B – Relay board
C – Contactor and relay
D – Relay board (option)
E – Option board
F – Fan Fault Detection board
G – Noise filter
H – Current sensor board (option)
I – DC power supply
J – Circuit breaker
K – Pull-out handle

Figure 1.14 Internal Layout for Control Panel

The drive is composed of the following three elements:

- Transformer panel
- Power Cell panel
- Control panel

Note: A digital operator for reading and writing parameter settings and monitoring status and faults, and a USB connector for DriveWizard Plus MV communications are provided on the control panel door. Refer to *Using the Digital Operator on page 109* for details on the names and functions of the digital operator controls.

◆ Transformer Panel

The transformer panel houses a Three-phase transformer with multiple windings on the secondary side. The number of secondary winding on the transformer differs according to the output voltage class as shown below.

2 kV class: Six 3-phase windings

3 kV class: Six 3-phase windings

4 kV class: Six 3-phase windings

6 kV class: Nine 3-phase windings

11 kV class: Fifteen 3-phase windings

Each of the windings is connected to a three-phase input terminal of the Power Cell.

Multiple cooling fans for the transformer panel are mounted in the upper section of the drive panel. Cooled air taken in through the filters on the front of the transformer panel passes the transformer panel and is expelled into the upper section of the drive panel.

Note: Some models in which the cooled air from the fronts of both the transformer panel and Power Cell panel through the transformer panel and is expelled into the upper section of the drive panel.

◆ Power Cell Panel

The output side of the Power Cell Panel houses multiple Power Cells. The number of Power Cells will differ according to the voltage class:

2 kV class: Total of 6 Power Cells (Two for each phase)

3 kV class: Total of 6 Power Cells (Two for each phase)

4 kV class: Total of 6 Power Cells (Two for each phase)

6 kV class: Total of 9 Power Cells (Three for each phase)

11 kV class: Total of 15 Power Cells (Five for each phase)

Multiple cooling fans for the Power Cell panel are mounted in the upper section of the drive panel. Cooled air taken in through the filters on the front of the Power Cell panel passes the Power Cell fins in the cooling section, flows into the air duct at the rear of the drive, and is expelled into the upper section of the drive panel.

Each Power Cell consists of a power section and a control board. Each control board is connected to the controller in the control panel with a fiber optic cable. The control board controls PWM output of the Power Cell according to the references sent from the controller through the fiber optic cable. The control board has protection functions against overvoltage, undervoltage, IGBT overheat and other problems, and sends feedback to the controller through the fiber optic cable.

◆ Control Panel

The control panel houses the following devices.

All external cables except the input and output cables of the main circuit are connected to the control terminals.

- Controller and control power supply to control the drive
- MCCB (Molded Case Circuit Breaker)
- Contact I/O relay
- Peripheral circuits such as an isolation amplifier for analog I/O
- Control terminals

Note: A Single-phase, 200/220-Vac power supply is required as the power source for the cooling fan and control circuit.

■ Boards Comprising the Controller

The controller comprises the multiple boards listed below.

- Control board
- Isolation board
- Fan fault detection board
- Relay board
- Current detection resistance board (optional)
- Expansion board for optical link (only for 11 kV class drives)
- Built-in option board

■ Power Supply to the Controller

The following three types of power supplies are used with the controller.

Refer to *Spare Parts on page 207* for the power supply model.

- 5 V: Control circuit power supply
- ±15 V: Analog I/O power supply
- 24 V: Contact I/O power supply

2

Mechanical Installation

This chapter explains how to properly mount and install the drive.

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2.3 DIMENSIONS 66
2.4 STORING DRIVES 71

2.1 Section Safety

⚠ DANGER

Crush Hazard

When the drive is moved using a crane, it must be done by a qualified crane operator.

Improper use of the crane could result in the drive falling, causing death or injury.

When a lifter is used to load or remove Power Cells, the dedicated lifter must be used.

Failure to comply could result in a Power Cell falling, causing death or injury.

Do not remove bolts from the top of the transformer panel and fit hoisting tackle to lift it.

Failure to comply could result in deformation or falling of the transformer panel.

When lifting the transformer panel, take care to ensure that the housing is not damaged by contact with the ceiling plate or other parts.

Failure to comply could result in deformation of the transformer panel or damage to the ceiling plate.

NOTICE

Never install ducts in the air exhaust system.

Making modifications, such as connecting air exhaust ducts to the drive panel's cooling fan, could reduce the cooling airflow and result in an abnormal rise in temperature or drive failure. Do not connect air exhaust ducts.

Take measures to prevent salt-bearing atmospheric air, rain and dust getting into the switch room.

Insulation is impaired and metals are corroded by absorption of moisture and salt damage, and this can cause the drive to malfunction.
Also install an air conditioner or ventilation system with sufficient capacity to prevent all potential damage to the drive and the other devices in the switch room, and maintain an ambient temperature of no higher than 40°C and a humidity of no greater than 85% (Yaskawa recommends the installation of an air conditioner).

Observe the following precautions when installing the drive panel.

When installing the panel take care to prevent metal chips from drilling, oil, water, from and so on getting stuck to the drive or inside it. And when the installation work is completed, check thoroughly to ensure that no tools or unused parts have been left inside the panel, and that there are no foreign objects or obstructions on or around parts where power flows, at the air filters, or on the ventilation louver on the top of the drive. Failure to comply could result in damage to the panel.

When using rollers to move the drive panel, make sure that the following conditions are met.

Improper handling could result in damage to the panel.

Place the panel on the rollers while adjusting their positions so that they extend approximately 100 mm each side of the panel's frame.

Distribute the weight of the drive evenly on the rollers so stress is evenly distributed on the bottom of the drive.

Create a smooth, even surface for rolling by laying boards flat on the floor. Use boards with sufficient strength and durability, and make sure the boards do not have gaps between them.

When bolting frames between panels, make secure connections by using the tightening torque indicated in this manual.

Any space between two frames may cause a leakage of cooling air, resulting in the drive failure.

NOTICE

When storing the drive, be sure to observe the precautions explained in *Storing Drives on page 71*.
An incorrect storage method could result in damage to, or failure of, the drive.

Before turning on the power to the drive after a long period in storage, carefully check for moisture and dust.
Failure to comply could result in damage by fire or other damage.

2.2 Mechanical Installation

This section outlines specifications, procedures, and the environment for proper mechanical installation of the drive.

◆ Installation Environment

Install the drive in an environment matching the specifications in *Table 2.1* to help prolong the optimum performance life of the drive.

Table 2.1 Installation Environment

Environment	Conditions
Installation Area	Indoors
Enclosure Type	IP40 (simplified dustproof type)
Ambient Temperature	-5°C to +40°C If the ambient temperature changes greatly, condensation may occur. When installing the drive in such an environment, take measures to prevent condensation, such as installing a space heater inside the drive. If a space heater is required, contact your Yaskawa representative or the nearest Yaskawa sales office in advance.
Relative Humidity	85%RH max. (no condensing)
Storage Temperature	-20°C to +60°C (for very short term when handling) Refer to *Storing Drives on page 71* when storing the drive for extended periods without applying power.
Surrounding Area	Install the drive in an area free from: • oil mist and dust • radioactive materials • combustible materials • chlorides • direct sunlight • harmful gases and liquids metal shavings, oil, water, or other foreign materials
Altitude	0 to 2000 m
Pollution Degree	Level 2 or better

NOTICE: *Never install ducts in the air exhaust system. Making modifications, such as connecting air exhaust ducts to the drive panel's cooling fan, could reduce the cooling airflow and result in an abnormal rise in temperature or drive failure. Do not connect air exhaust ducts.*

NOTICE: *Take measures to prevent salt-bearing atmospheric air, rain, and dust getting into the switch room. Insulation is impaired and metals are corroded by absorption of moisture and salt damage, and this can cause the drive to malfunction. Also install an air conditioner or ventilation system with sufficient capacity to prevent all potential damage to the drive and the other devices in the switch room, and maintain an ambient temperature of no higher than 40°C and a humidity of no greater than 85% (Yaskawa recommends the installation of an air conditioner).*

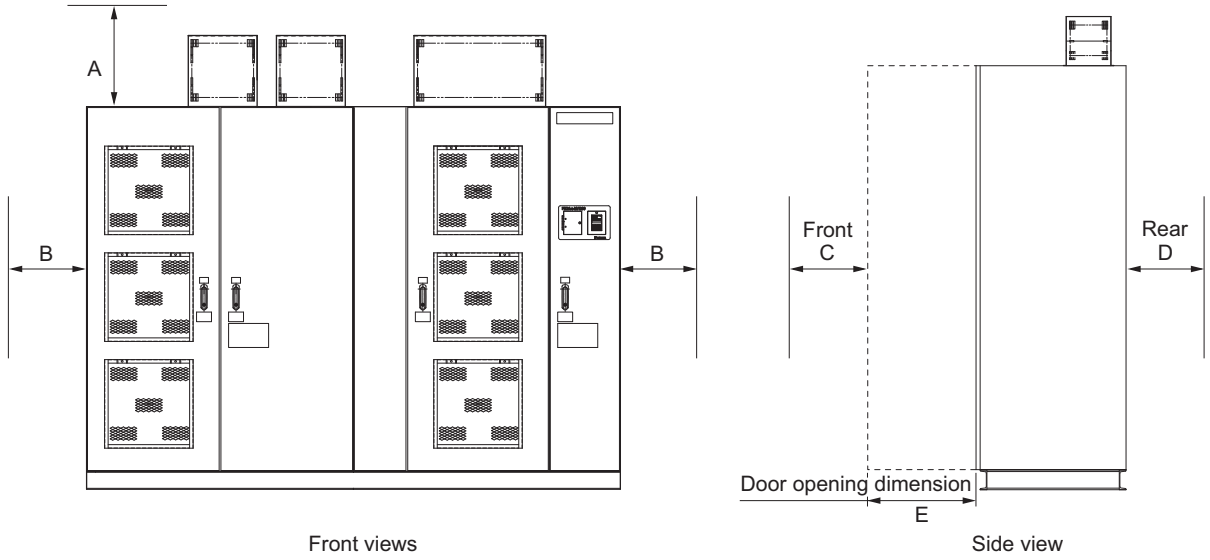
NOTICE: *Observe the following precautions when installing the drive.*
When installing the drive take care to prevent metal chips from drilling, oil, water, from and so on getting stuck to the drive or inside it. And when the installation work is completed, check thoroughly to ensure that no tools or unused parts have been left inside the panel, and that there are no foreign objects or obstructions on or around parts where power flows, at the air filters, or on the ventilation louver on the top of the drive. Failure to comply could result in damage to the panel.

Note:
1. Operate the drive with the fan cover attached on top of the panel. If the installation space is limited and the fan cover must be removed, contact your Yaskawa representative or the nearest Yaskawa office.
2. If the drive must be installed in a location subject to a high level of vibration caused by machines such as cranes, contact your Yaskawa representatives or the nearest Yaskawa sales office. The drive generates electrical interference, including radio interference. This should be considered when selecting the installation location.
3. Please comply with the law of the relevant country when installing the drive panel. For details, contact your Yaskawa representative.

◆ Installation Space

Figure 2.1 shows the installation distance required to maintain sufficient space for airflow and wiring.

Note: If the installation space for the drive is restricted and the space indicated in the figures below cannot be secured, contact your Yaskawa representatives or the nearest Yaskawa sales office.



A – Min. 1000 mm
B – Min. 30 mm
C – Min. 2000 mm
D – Min. 600 mm
E – Max. 800 mm

Figure 2.1 Drive Installation Space

Table 2.2 Precautions on Installation Space

Installation Space	Details
A (Top)	The drive requires sufficient space at the top for the replacement of the cooling fans and to cool the drive. Air is expelled through the cooling fans on top of the drive. If the cooling fans are too close to the ceiling, the air that has been expelled may be drawn back into the drive and reduce the cooling performance.
B (Sides)	Although side-by-side installation with other panels is possible, the factory recommends ensuring at least 30 mm spacing is available between panels.
C (Front)	Sufficient space is required to allow Power Cells to be drawn out and placed on the lifter to move them during replacement.
D (Rear)	Sufficient working space is required to route the cables and to install anchors on the back of the drive.
E (Front)	Sufficient working space is required to open the door.

◆ Drive Transportation

The method of transporting the drive differs depending on drive model. Transport the drive using the appropriate method indicated in *Table 2.3*.

Table 2.3 Models and Transportation Methods

Voltage Class (kV)	Nominal Capacity (kVA)	Motor Power (HP)	Transportation Method
2	220 to 560	200 to 600 <1>	Use the support hooks on the top of the drive to lift the drive. For details on the transportation procedure, refer to *Table 2.4*.
	670 to 1620	700 to 1750 <1>	Use the support hooks to lift the transformer panel. For details on the transportation procedure, refer to *Table 2.5*. Use the support hooks on the top of the drive to lift the Power Cell and control panels. For details on the transportation procedure, refer to *Table 2.4*.
	1830 to 2500	2000 to 2750 <1>	Use the support hooks to lift the transformer panel. For details on the transportation procedure, refer to *Table 2.5*. Use the support hooks on the top of the drive to lift the Power Cell and control panels. For details on the transportation procedure, refer to *Table 2.4*.
3	200 to 800	132 to 630	Use the support hooks on the top of the drive to lift the drive. For details on the transportation procedure, refer to *Table 2.6*.
	1150 to 2300	900 to 1800	Use the support hooks to lift the transformer panel. For details on the transportation procedure, refer to *Table 2.7*. Use the support hooks on the top of the drive to lift the Power Cell and control panels. For details on the transportation procedure, refer to *Table 2.6*.
	3000 to 3700	2500 to 3000	Use the support hooks to lift the transformer panel. For details on the transportation procedure, refer to *Table 2.8*. Use the support hooks on the top of the drive to lift the Power Cell and control panels. For details on the transportation procedure, refer to *Table 2.6*.
4	375 to 900	400 to 1000	Use the support hooks on the top of the drive to lift the drive. For details on the transportation procedure, refer to *Table 2.9*.
	1120 to 2700	1250 to 3000 <1>	Use the support hooks to lift the transformer panel. For details on the transportation procedure, refer to *Table 2.10*. Use the support hooks on the top of the drive to lift the Power Cell and control panels. For details on the transportation procedure, refer to *Table 2.9*.
	3170 to 4500	3500 to 5000 <1>	Use the support hooks to lift the transformer panel. For details on the transportation procedure, refer to *Table 2.10*. Use the support hooks on the top of the drive to lift the Power Cell and control panels. For details on the transportation procedure, refer to *Table 2.9*.
6	400 to 2300	250 to 1800	Use the support hooks to lift the transformer panel. For details on the transportation procedure, refer to *Table 2.12*. Use the support hooks on the top of the drive to lift the Power Cell and control panels. For details on the transportation procedure, refer to *Table 2.11*.
	3000 to 7500	2500 to 6000	Use the support hooks to lift the transformer panel. For details on the transportation procedure, refer to *Table 2.13*. Use the support hooks on the top of the drive to lift the Power Cell and control panels. For details on the transportation procedure, refer to *Table 2.11*.
11	660 to 3800	530 to 3050	Use the support hooks to lift the transformer panel. For details on the transportation procedure, refer to *Table 2.15*. Use the support hooks on the top of the drive to lift the Power Cell and control panels. For details on the transportation procedure, refer to *Table 2.14*.
	5000 to 12000 <1>	3960 to 9910	Use the support hooks to lift the transformer panel. For details on the transportation procedure, refer to *Table 2.15*. Use the support hooks on the top of the drive to lift the Power Cell and control panels. For details on the transportation procedure, refer to *Table 2.14*.

<1> The following models are under development.
2 kV class: 200 to 600 HP, 700 to 1750 HP, and 2000 to 2750 HP
4 kV class: 1750 to 3000 HP, 3500 to 5000 HP
11 kV class: 5000 to 12000 kVA

When using rollers to move the drive panel, make sure that the following conditions are met. Improper handling could result in damage to the drive.

- Place the panel on the rollers while adjusting their positions so that they extend approximately 100 mm each side of the panel's frame.
- Distribute the weight of the drive evenly on the rollers so stress is evenly distributed on the bottom of the drive.
- Create a smooth, even surface for rolling by laying boards flat on the floor. Use boards with sufficient strength and durability, and make sure the boards do not have gaps between them.

Table 2.4 Transportation Procedure 1 (Class: 2 kV)

Transportation Procedure
1. Attach the wire ropes for lifting to the support hooks on the top of the panel to lift the drive.
2. Ensure that the hanging angle is 45°±15°.

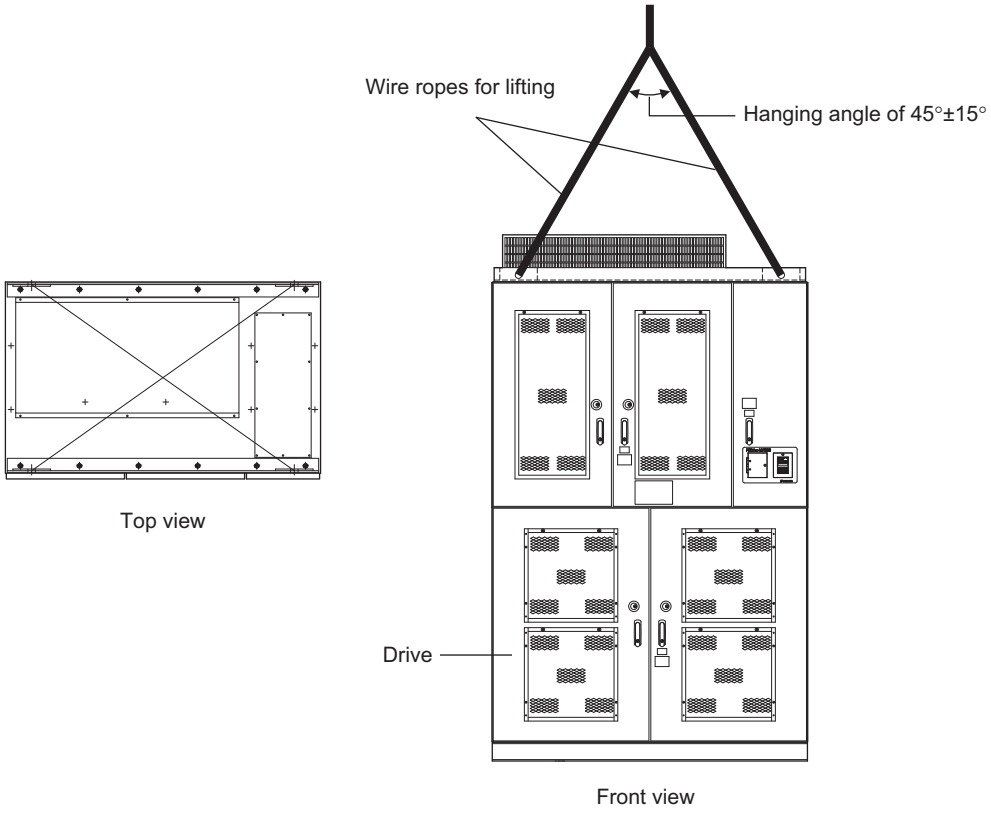


Figure 2.2 Inserting Wire Ropes for Lifting

Table 2.5 Transportation Procedure 2 (Class: 2 kV)

Transportation Procedure
1. Insert wire ropes for lifting through the support hook installation openings on the top of the drive. **Note:** Drives are shipped with the support hook installation openings fitted.

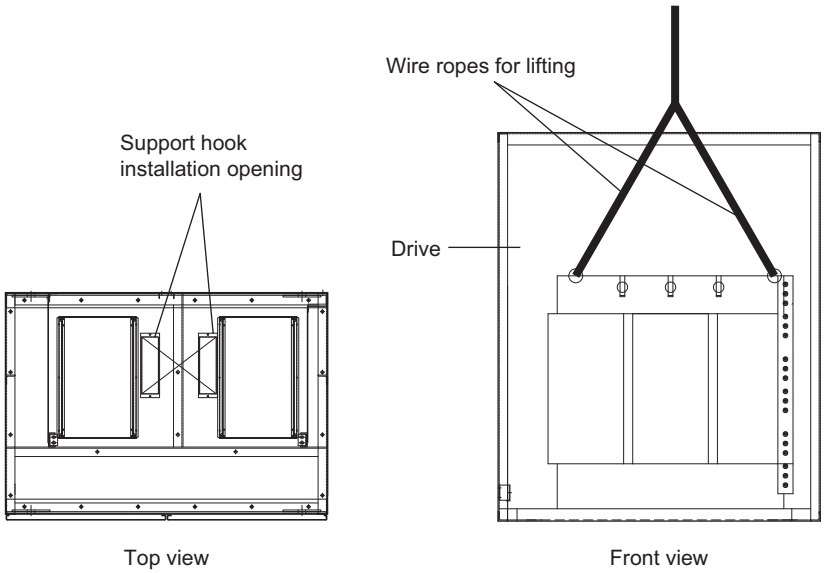


Figure 2.3 Inserting Wire Ropes for Lifting

2. Attach the wire ropes for lifting to the support hooks on the transformer to lift the transformer panel.

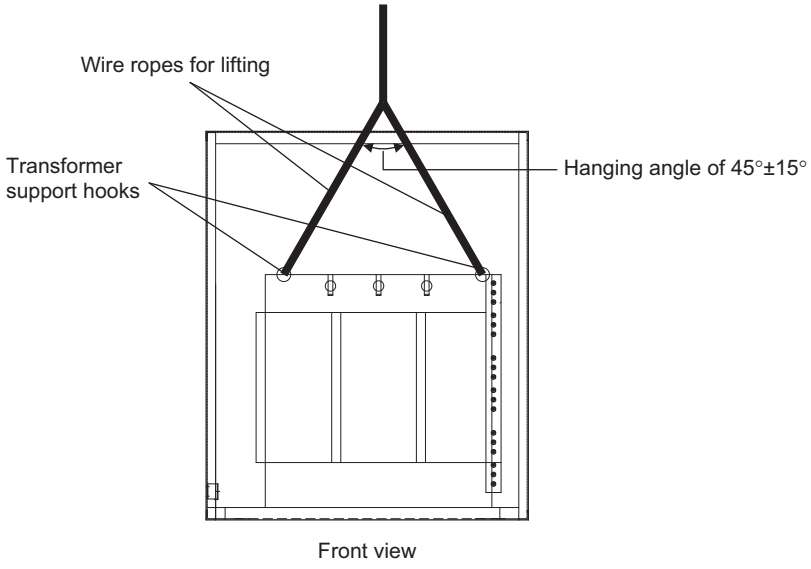


Figure 2.4 Suspension of Transformer Panel

3. Ensure that the hanging angle is 45°±15°.

⚠ **DANGER!** *Do not remove bolts from the top of the transformer panel and fit hoisting tackle to lift it. Failure to comply could result in deformation or falling of the transformer panel.*

⚠ **DANGER!** *When lifting the transformer panel, take care to ensure that the housing is not damaged by contact with the ceiling plate or other parts. Failure to comply could result in deformation of the transformer panel or damage to the ceiling plate.*

Table 2.6 Transportation Procedure 1 (Class: 3 kV)

Transportation Procedure
1. Attach the wire ropes for lifting to the support hooks on the top of the panel to lift the drive.
2. Ensure that the hanging angle is 45°±15°.

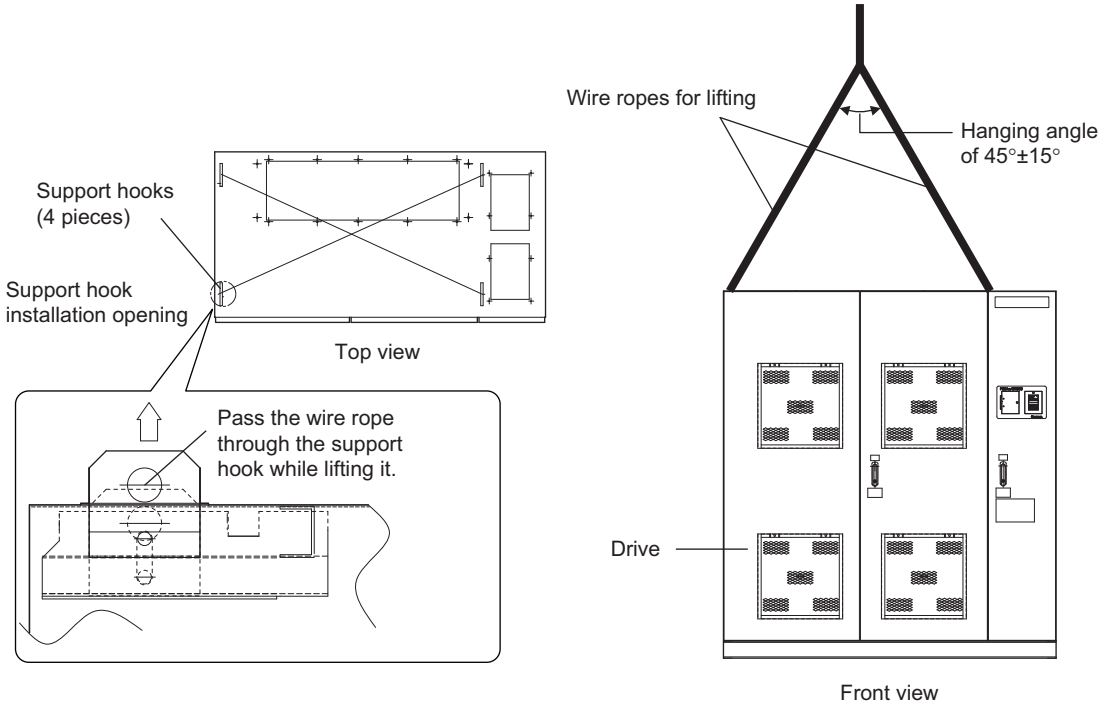


Figure 2.5 Inserting Wire Ropes for Lifting

Table 2.7 Transportation Procedure 2 (Class: 3 kV)

Transportation Procedure
1. Insert wire ropes for lifting through the support hook installation openings on the top of the drive.

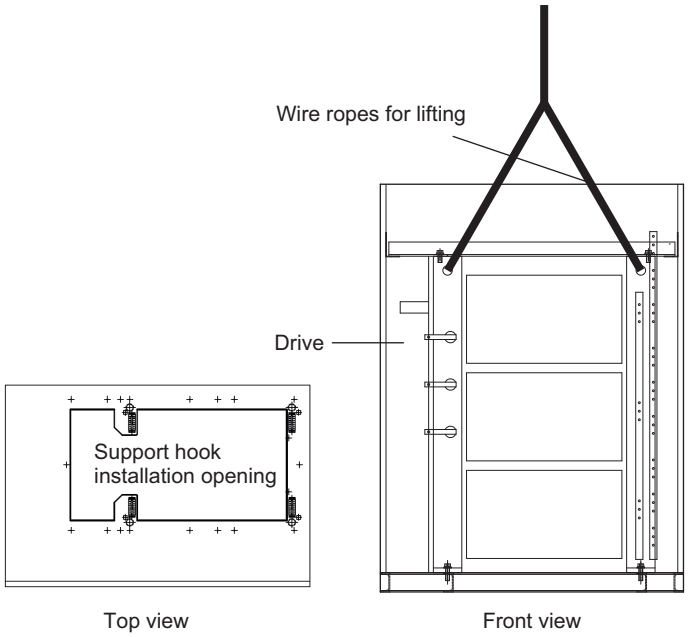


Figure 2.6 Inserting Wire Ropes for Lifting

2. Attach the wire ropes for lifting to the support hooks on the transformer to lift the transformer panel.

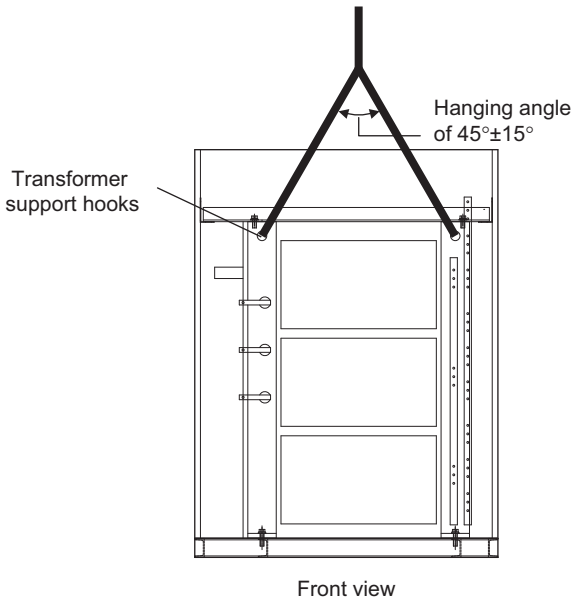


Figure 2.7 Suspension of Transformer Panel

3. Ensure that the hanging angle is no greater than 45°±15°.

⚠ **DANGER!** *Do not remove bolts from the top of the transformer panel and fit hoisting tackle to lift it. Failure to comply could result in deformation or falling of the transformer panel.*

⚠ **DANGER!** *When lifting the transformer panel, take care to ensure that the housing is not damaged by contact with the ceiling plate or other parts. Failure to comply could result in deformation of the transformer panel or damage to the ceiling plate.*

Table 2.8 Transportation Procedure 3 (Class: 3 kV)

Transportation Procedure
1. Insert wire ropes for lifting through the support hook installation openings on the top of the drive.

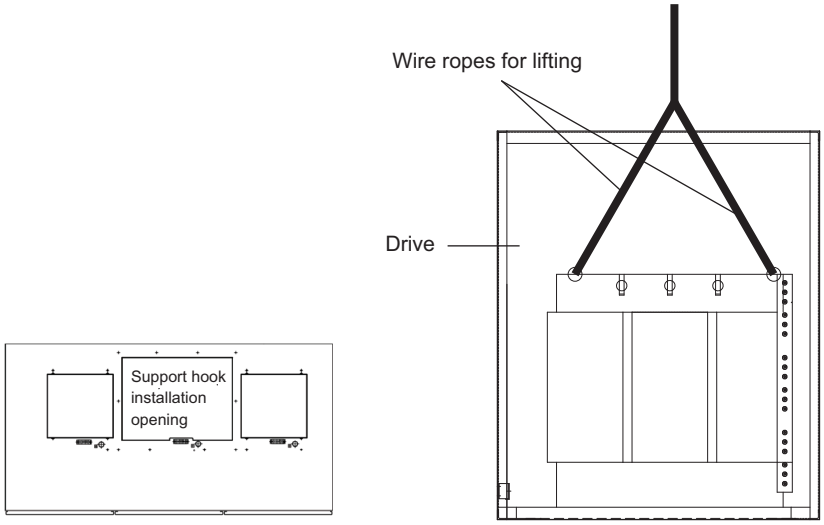


Figure 2.8 Inserting Wire Ropes for Lifting

2. Attach the wire ropes for lifting to the support hooks on the transformer to lift the transformer panel.

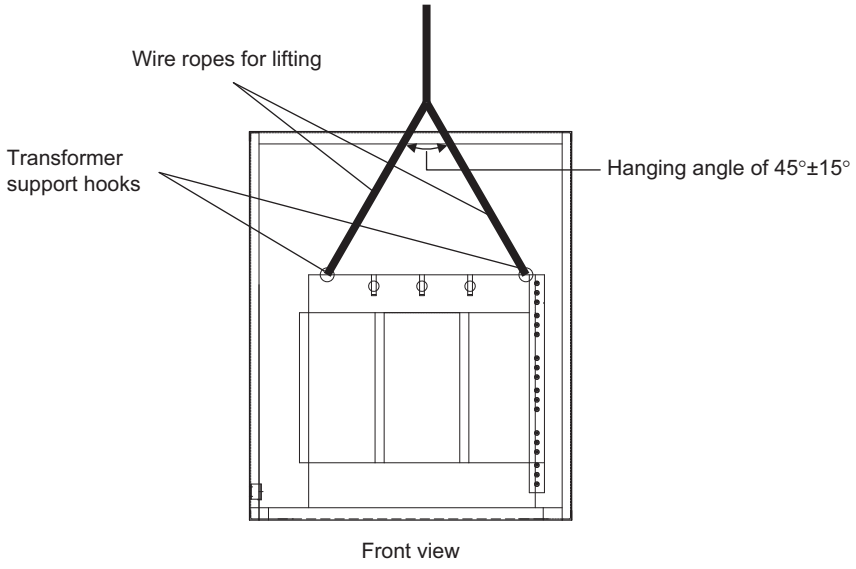


Figure 2.9 Suspension of Transformer Panel

3. Ensure that the hanging angle is 45°±15°.

⚠ **DANGER!** *Do not remove bolts from the top of the transformer panel and fit hoisting tackle to lift it. Failure to comply could result in deformation or falling of the transformer panel.*

⚠ **DANGER!** *When lifting the transformer panel, take care to ensure that the housing is not damaged by contact with the ceiling plate or other parts. Failure to comply could result in deformation of the transformer panel or damage to the ceiling plate.*

Table 2.9 Transportation Procedure 1 (Class: 4 kV)

Transportation Procedure
1. Attach the wire ropes for lifting to the support hooks on the top of the panel to lift the drive.

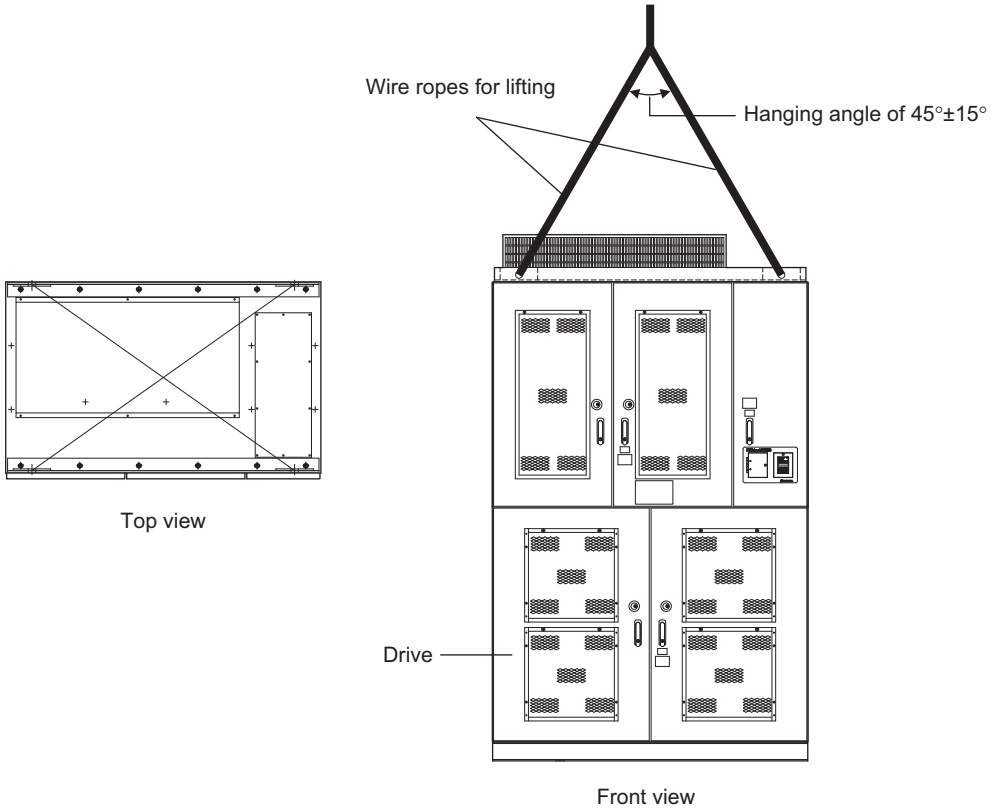
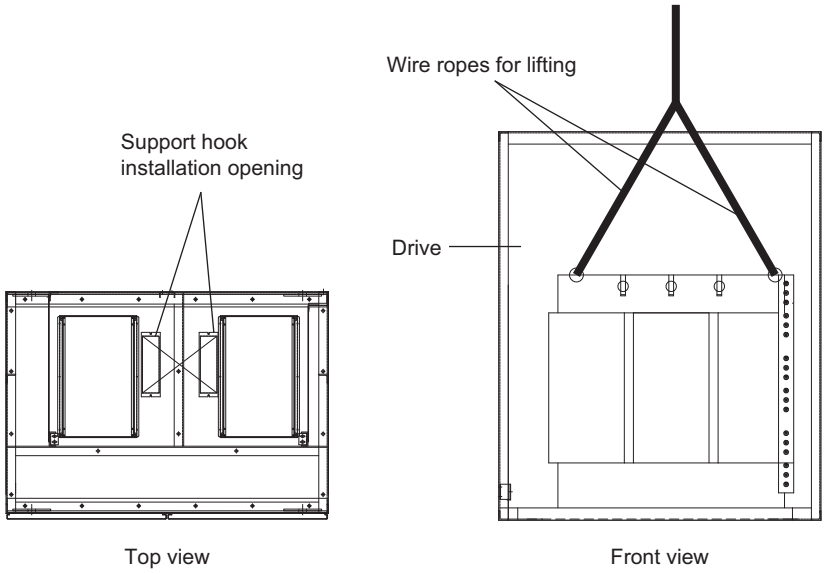
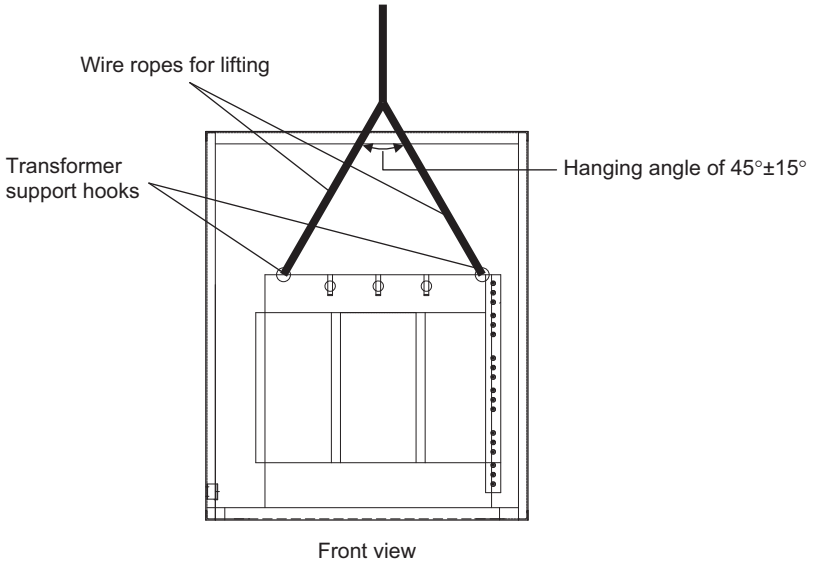


Figure 2.10 Inserting Wire Ropes for Lifting

2. Ensure that the hanging angle is 45°±15°.

Table 2.10 Transportation Procedure 2 (Class: 4 kV)

Transportation Procedure
1. Insert wire ropes for lifting through the support hook installation openings on the top of the drive. **Note:** Drives are shipped with the support hook installation openings fitted.    **Figure 2.11 Inserting Wire Ropes for Lifting**
2. Attach the wire ropes for lifting to the support hooks on the transformer to lift the transformer panel.    **Figure 2.12 Suspension of Transformer Panel**
3. Ensure that the hanging angle is 45°±15°.

⚠ **DANGER!** *Do not remove bolts from the top of the transformer panel and fit hoisting tackle to lift it. Failure to comply could result in deformation or falling of the transformer panel.*

⚠ **DANGER!** *When lifting the transformer panel, take care to ensure that the housing is not damaged by contact with the ceiling plate or other parts. Failure to comply could result in deformation of the transformer panel or damage to the ceiling plate.*

Table 2.11 Transportation Procedure 1 (Class: 6 kV)

Transportation Procedure
1. Insert wire ropes for lifting through the support hook installation openings on the top of the drive.

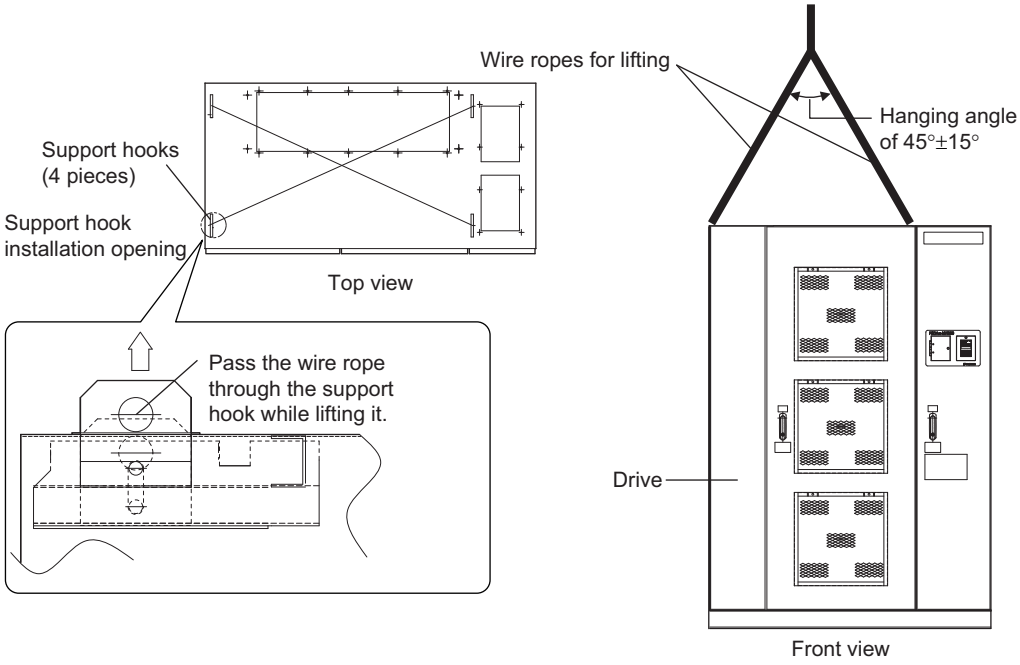


Figure 2.13 Inserting Wire Ropes for Lifting

2. Ensure that the hanging angle is 45°±15°.

Table 2.12 Transportation Procedure 2 (Class: 6 kV)

Transportation Procedure
1. Insert wire ropes for lifting through the support hook installation openings on the top of the drive.

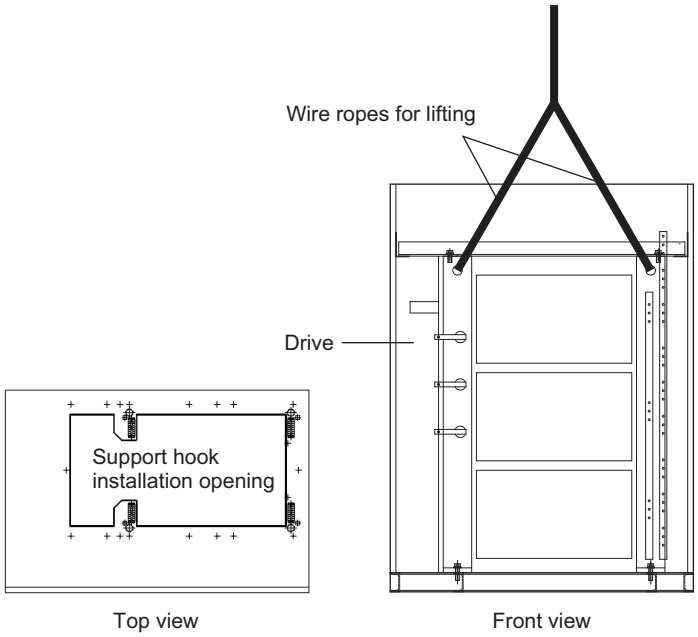


Figure 2.14 Inserting Wire Ropes for Lifting

2. Attach the wire ropes for lifting to the support hooks on the transformer to lift the transformer panel.

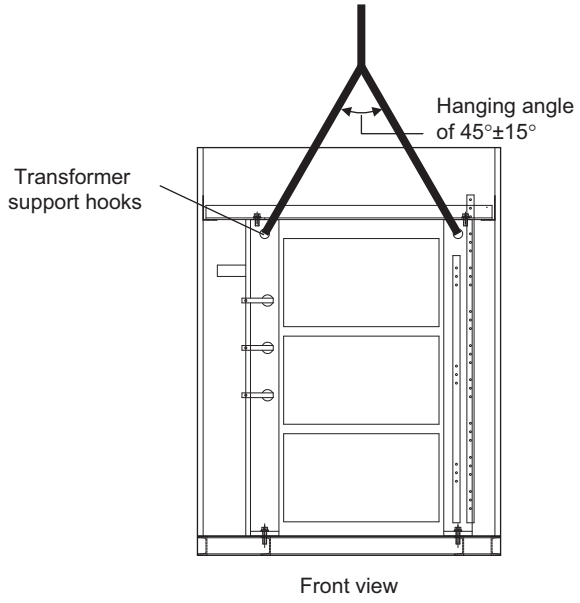


Figure 2.15 Suspension of Transformer Panel

3. Ensure that the hanging angle is 45°±15°.

⚠ **DANGER!** *Do not remove bolts from the top of the transformer panel and fit hoisting tackle to lift it. Failure to comply could result in deformation or falling of the transformer panel.*

⚠ **DANGER!** *When lifting the transformer panel, take care to ensure that the housing is not damaged by contact with the ceiling plate or other parts. Failure to comply could result in deformation of the transformer panel or damage to the ceiling plate.*

Table 2.13 Transportation Procedure 3 (Class: 6 kV)

Transportation Procedure
1. Insert wire ropes for lifting through the support hook installation openings on the top of the drive.

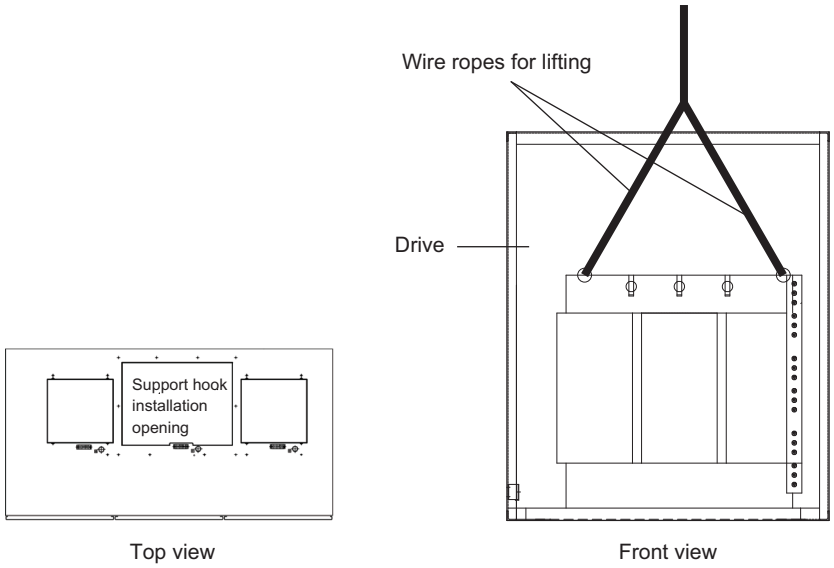


Figure 2.16 Inserting Wire Ropes for Lifting

2. Attach the wire ropes for lifting to the support hooks on the transformer to lift the transformer panel.

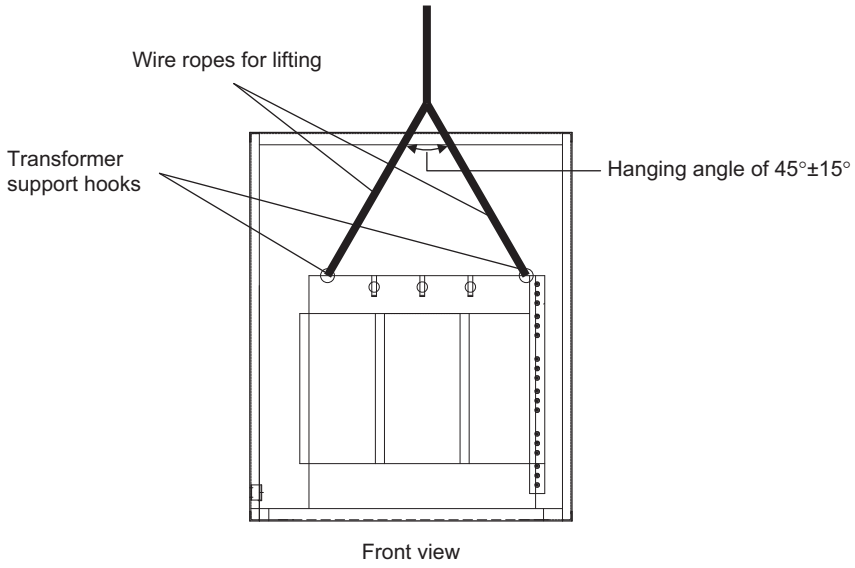


Figure 2.17 Suspension of Transformer Panel

3. Ensure that the hanging angle is 45°±15°.

⚠ **DANGER!** *Do not remove bolts from the top of the transformer panel and fit hoisting tackle to lift it. Failure to comply could result in deformation or falling of the transformer panel.*

⚠ **DANGER!** *When lifting the transformer panel, take care to ensure that the housing is not damaged by contact with the ceiling plate or other parts. Failure to comply could result in deformation of the transformer panel or damage to the ceiling plate.*

Table 2.14 Transportation Procedure 1 (Class: 11 kV)

Transportation Procedure
1. Attach the wire ropes for lifting to the support hooks on the top of the panel to lift the drive.

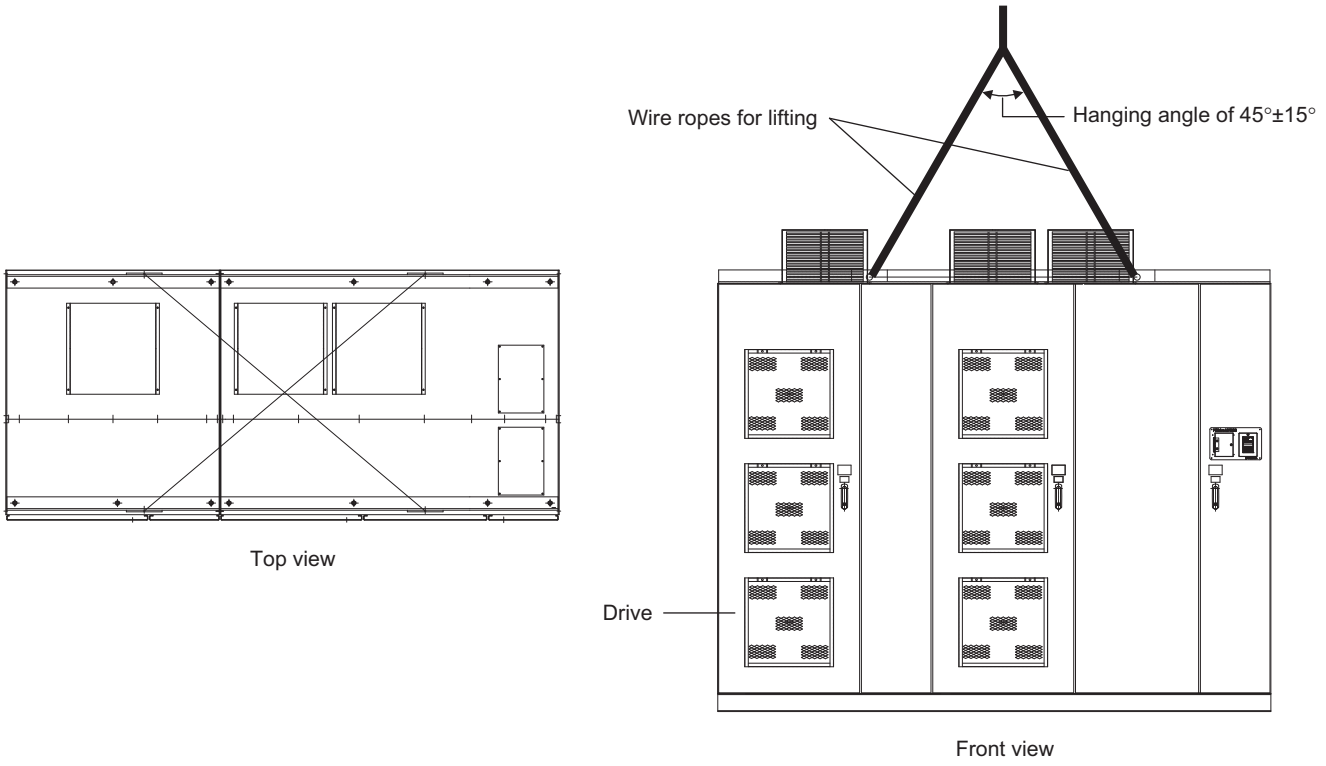


Figure 2.18 Inserting Wire Ropes for Lifting

2. Ensure that the hanging angle is 45°±15°.

Table 2.15 Transportation Procedure 2 (Class: 11 kV)

Transportation Procedure
1. Insert wire ropes for lifting through the support hook installation openings on the top of the drive.

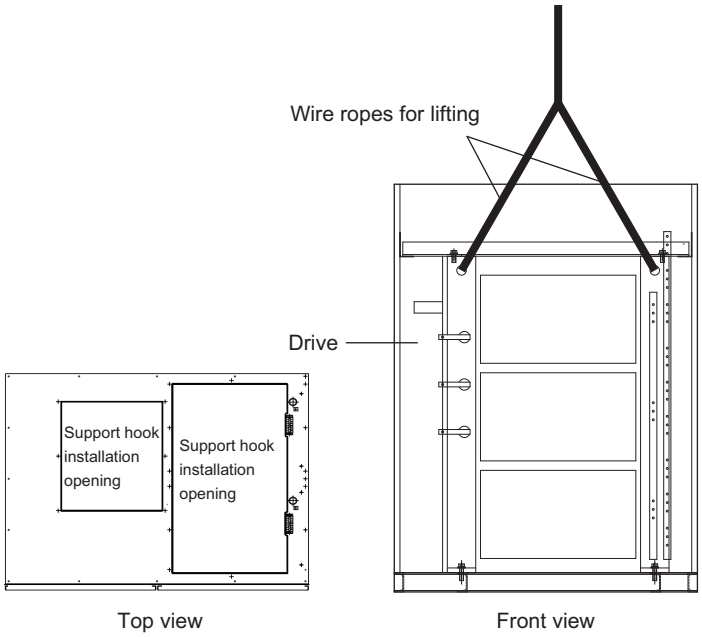


Figure 2.19 Inserting Wire Ropes for Lifting

2. Attach the wire ropes for lifting to the support hooks on the transformer to lift the transformer panel.

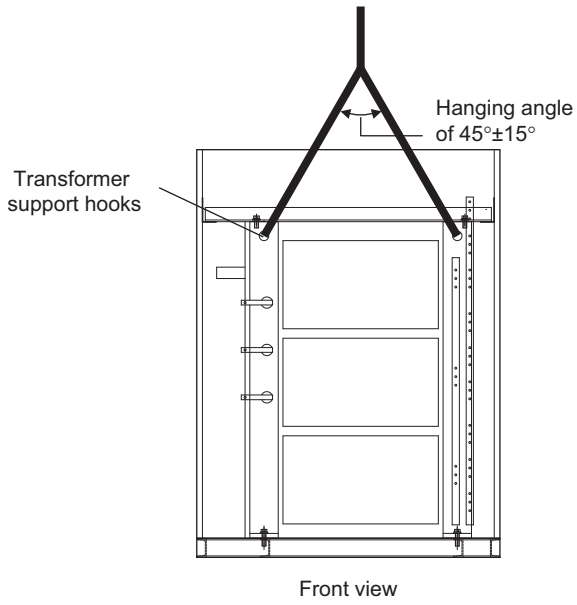


Figure 2.20 Suspension of Transformer Panel

3. Ensure that the hanging angle is 45°±15°.

⚠ **DANGER!** *Do not remove bolts from the top of the transformer panel and fit hoisting tackle to lift it. Failure to comply could result in deformation or falling of the transformer panel.*

⚠ **DANGER!** *When lifting the transformer panel, take care to ensure that the housing is not damaged by contact with the ceiling plate or other parts. Failure to comply could result in deformation of the transformer panel or damage to the ceiling plate.*

◆ Side-by-Side Installation

"Side-by-side" installation means a configuration in which a transformer panel, Power Cell panel and control panel separate when delivered are placed side-by-side, and are wired together.

The following models are installed side by side in a block construction (*Table 2.10*).

2 kV class: 700 to 2750 HP

3 kVclass: 1150 to 3700 kVA (200A to 650A)

4 kV class: 1250 to 5000 HP

6 kV class: All models

11 kV class: All models

Note: Models other than those indicated above are delivered with the transformer panel, Power Cell panel and control panel integrated within a single frame.

On these models, eight holes are provided each on the transformer panel frame and Power Cell panel frame (refer to the figure below).

Use M10 × 30L bolts, washers, S-washers, and nuts to join the sections.

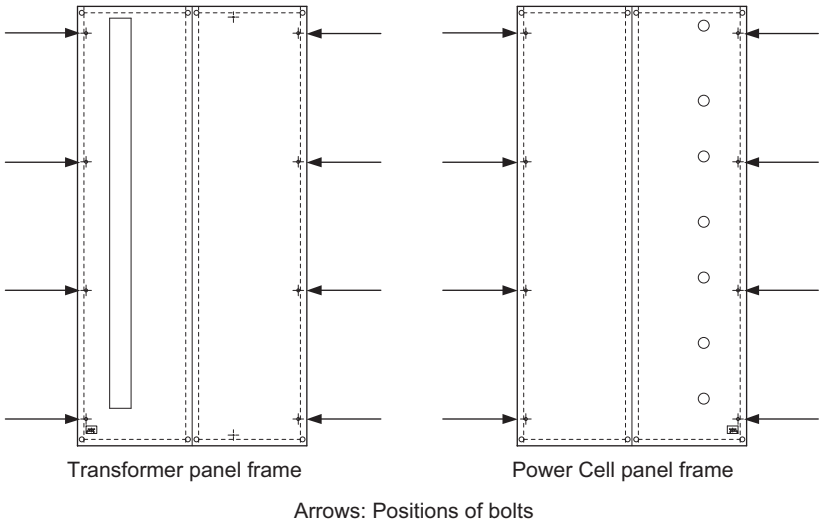


Figure 2.21 Mounting Holes for Side-by-Side Installation

When installing side by side a drive in a block construction, ensure that the specifications indicated in the table below are satisfied.

Table 2.16 Side-by-Side Configuration

Category	Specifications
Bolts between Panel	Tightening torque of M10 bolts provided as accessories: 18 to 23 N·m (lb.in.)
Wiring between Panel	Perform the following wiring between panels. • Main circuit wiring • Grounding bus bars • Cooling fan wiring • Resistance temperature detector: PT100 • Thermal switch • Fiber optic cable
Installation Accuracy of Drive Panels	Use a measuring instrument such as a theodolite to measure the levelness on the installation base at 1-meter intervals, and adjust to achieve a levelness error of within ±2 mm.

NOTICE: *When bolting frames between panel to each other, make secure connections by using the tightening torque indicated in this manual. Any space between two frames may cause a leakage of cooling air, resulting in drive failure.*

◆ Installing Cooling Exhaust Covers

- Cooling exhaust covers to be fitted at the top of the drive are delivered as accessories. Install the cooling exhaust covers provided as accessories after installing the drive.
- Bolts for securing the cooling exhaust covers are provisionally set in the drive where the covers are to be installed. Remove these bolts and install the cooling exhaust covers with them. Take proper precautions to avoid dropping fasteners into the panel.
- The number of locations where the cooling exhaust covers should be installed differs depending on the model of the drive.
- When transporting the drive or installing the cooling exhaust covers, be careful not to damage the cooling fans.

◆ Installing a Drive on a Floor

Table 2.17 shows the dimensions and the number of mounting holes for each voltage class when installing a drive on a floor.

Use mounting bolts, nuts, washers, S-washers, and taper washers of M12 diameter to secure the drive.

Secure the drive with bolts in all the designated holes. Secure the drive with bolts in all the designated holes even in normal installation environments where there is minimal or no vibration. Refer to *Dimensions on page 66* for details on the mass of the drives.

Table 2.17 Drive Installation and Mounting Hole Dimensions

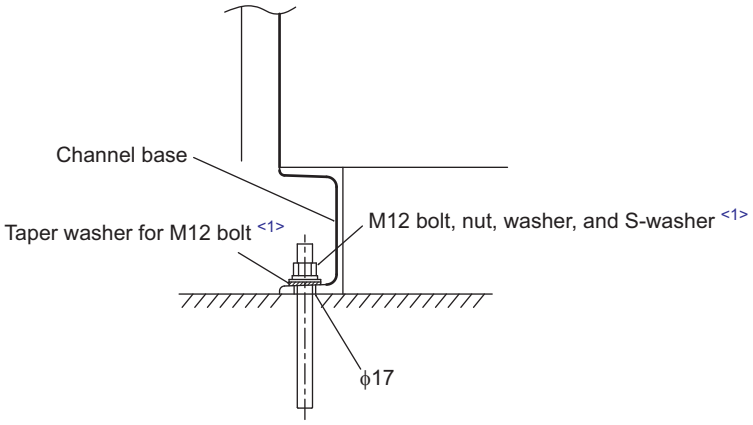
Voltage Class (kV)	Model CIMR-MV2□	Bottom Dimension Drawing	Installation Dimensions (mm)						Mounting Holes N - ϕ (mm)
			W1	W2	W3	W4	W5	d	
2	A□A□052 <1>	*Figure 2.23*	720	–	–	–	–	980	6 - ϕ17
	A□A□058 <1>		720	–	–	–	–	980	6 - ϕ17
	A□A□077 <1>		720	–	–	–	–	980	6 - ϕ17
	A□A□093 <1>		720	–	–	–	–	980	6 - ϕ17
	A□A□102 <1>		720	–	–	–	–	980	6 - ϕ17
	A□A□115 <1>		720	–	–	–	–	980	6 - ϕ17
	A□A□135 <1>		720	–	–	–	–	980	6 - ϕ17
	A□A□160 <1>	*Figure 2.24*	730	780	–	–	–	1230	12 - ϕ17
	A□A□180 <1>		730	780	–	–	–	1230	12 - ϕ17
	A□A□205 <1>	–	–	–	–	–	–	–	–
	A□A□220 <1>	–	–	–	–	–	–	–	–
	A□A□280 <1>	–	–	–	–	–	–	–	–
	A□A□330 <1>	–	–	–	–	–	–	–	–
	A□A□390 <1>	–	–	–	–	–	–	–	–
	A□A□440 <1>	–	–	–	–	–	–	–	–
	A□A□505 <1>	–	–	–	–	–	–	–	–
	A□A□550 <1>	–	–	–	–	–	–	–	–
	A□A□600 <1>	–	–	–	–	–	–	–	–
3	C□C□035	*Figure 2.25*	855	855	–	–	–	930	6-ϕ17
	C□C□050		855	855	–	–	–	930	6-ϕ17
	C□C□070		855	855	–	–	–	930	6-ϕ17
	C□C□100		855	855	–	–	–	930	6-ϕ17
	C□C□140		855	855	–	–	–	930	6-ϕ17
	C□C□200 <2>	*Figure 2.26*	1260	1260	–	–	–	1030	8-ϕ17
	C□C□260 <2>	*Figure 2.27*	680	830	–	–	–	1130	12-ϕ17
	C□C□330 <2>		680	1130	–	–	–	1530	12-ϕ17
	C□C□400 <2>		680	1130	–	–	–	1530	12-ϕ17
	C□C□520 <2>	*Figure 2.28*	490	950	960	–	–	1530	18-ϕ17
	C□C□650 <2>		565	950	960	–	–	1530	18-ϕ17

Voltage Class (kV)	Model CIMR-MV2□	Bottom Dimension Drawing	Installation Dimensions (mm)						Mounting Holes N - ϕ (mm)
			W1	W2	W3	W4	W5	d	
4	D□DA052	*Figure 2.29*	720	–	–	–	–	980	6 - ϕ17
	D□DA058		720	–	–	–	–	980	6 - ϕ17
	D□DA064		720	–	–	–	–	980	6 - ϕ17
	D□DA077		720	–	–	–	–	980	6 - ϕ17
	D□DA093		720	–	–	–	–	980	6 - ϕ17
	D□DA102		720	–	–	–	–	980	6 - ϕ17
	D□DA115		720	–	–	–	–	980	6 - ϕ17
	D□DA125		720	–	–	–	–	980	6 - ϕ17
	D□DA155 <2>	*Figure 2.30*	730	780	–	–	–	1230	12 - ϕ17
	D□DA190 <2>		730	780	–	–	–	1230	12 - ϕ17
	D□DA220 <1> <2>	–	–	–	–	–	–	–	–
	D□DA250 <1> <2>	–	–	–	–	–	–	–	–
	D□DA285 <1> <2>	–	–	–	–	–	–	–	–
	D□DA315 <1> <2>	–	–	–	–	–	–	–	–
	D□DA340 <1> <2>	–	–	–	–	–	–	–	–
	D□DA375 <1> <2>	–	–	–	–	–	–	–	–
	D□DA440 <1> <2>	–	–	–	–	–	–	–	–
	D□DA505 <1> <2>	–	–	–	–	–	–	–	–
	D□DA575 <1> <2>	–	–	–	–	–	–	–	–
	D□DA625 <1> <2>	–	–	–	–	–	–	–	–
6	F□F□035 <2>	*Figure 2.31*	1360	1260	–	–	–	1030	8-ϕ17
	F□F□050 <2>		1360	1260	–	–	–	1030	8-ϕ17
	F□F□070 <2>		1360	1260	–	–	–	1030	8-ϕ17
	F□F□100 <2>		1360	1260	–	–	–	1030	8-ϕ17
	F□F□140 <2>		1360	1260	–	–	–	1030	8-ϕ17
	F□F□200 <2>	*Figure 2.32*	830	1180	–	–	–	1230	12-ϕ17
	F□F□260 <2>	*Figure 2.33*	720	1430	–	–	–	1230	14-ϕ17
	F□F□330 <2>	*Figure 2.34*	590	880	1460	–	–	1530	20-ϕ17
	F□F□400 <2>		590	880	1460	–	–	1530	20-ϕ17
	F□F□520 <2>	*Figure 2.35*	640	1080	1660	–	–	1530	20-ϕ17
	F□F□650 <2>	*Figure 2.36*	552	1080	1660	–	–	1530	22-ϕ17
11	H□H□035 <2>	*Figure 2.37*	1760	1430	–	–	–	1330	10-ϕ17
	H□H□050 <2>		1760	1430	–	–	–	1330	10-ϕ17
	H□H□070 <2>		1760	1430	–	–	–	1330	10-ϕ17
	H□H□100 <2>		1760	1430	–	–	–	1330	10-ϕ17
	H□H□140 <2>		1760	1430	–	–	–	1330	10-ϕ17
	H□H□200 <2>	*Figure 2.38*	1180	2160	1660	–	–	1430	14-ϕ17
	H□H□260 <1> <2>	*Figure 2.39*	1230	1180	1760	–	–	1430	16-ϕ17
	H□H□330 <1> <2>	*Figure 2.40*	480	470	920	980	1000	1630	30-ϕ17
	H□H□400 <1> <2>	*Figure 2.40*	480	470	920	980	1000	1630	30-ϕ17
	H□H□520 <1> <2>	*Figure 2.41*	470	460	1120	–	–	1730	32-ϕ17
	H□H□650 <1> <2>	*Figure 2.42*	407.5	1120	–	–	–	1730	34-ϕ17

<1> Under development
<2> Side-by-side configurations comprising two or more drive panels

■ Example Drive Installation

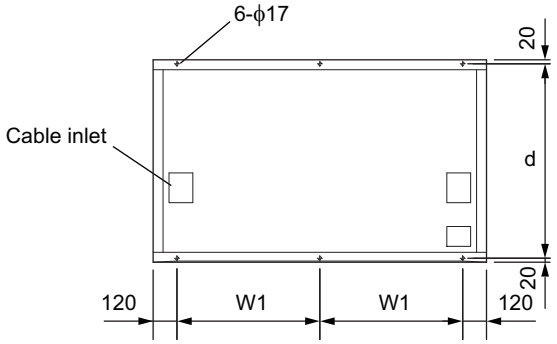
Use taper washers for the channel base contact surfaces.



<1> To be provided by the customer.

Unit: mm

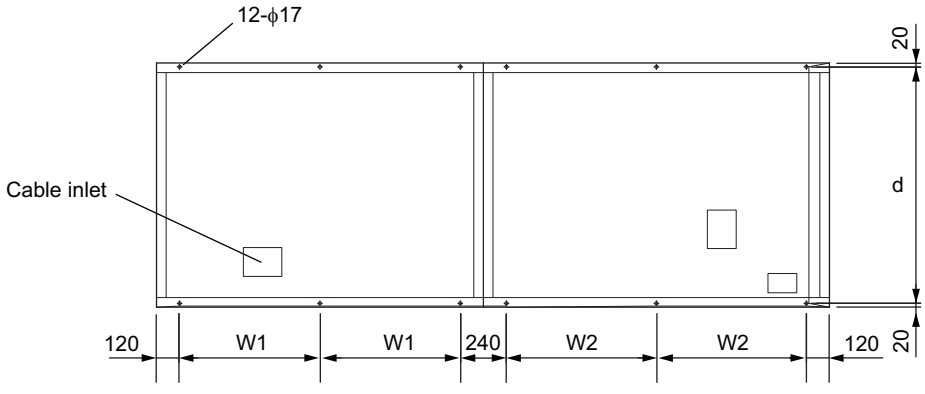
Figure 2.22 Channel Base Contact Face



Front: With the door removed

Unit: mm

Figure 2.23 Dimension Drawing 1 for Bottom (Class: 2 kV)



Front: With the door removed

Unit: mm

Figure 2.24 Dimension Drawing 2 for Bottom (Class: 2 kV)

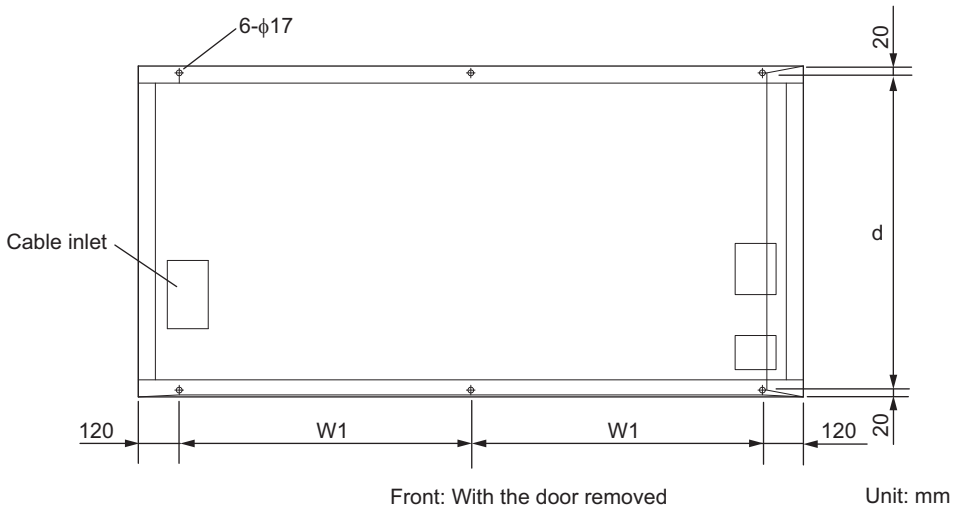


Figure 2.25 Dimension Drawing 1 for Bottom (Class: 3 kV)

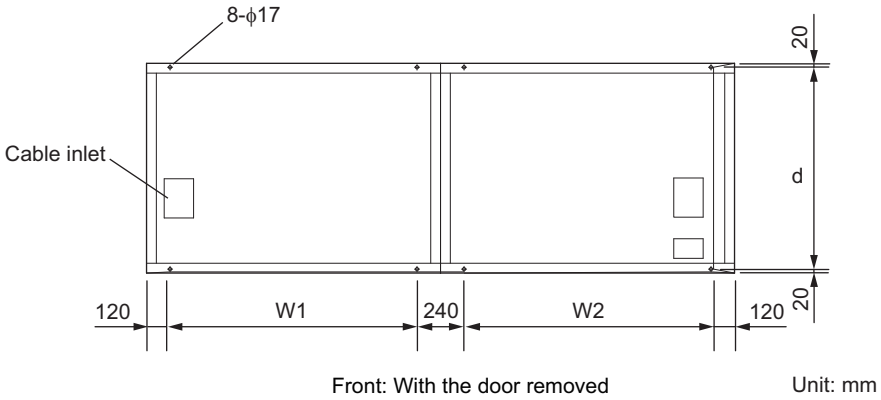


Figure 2.26 Dimension Drawing 2 for Bottom (Class: 3 kV)

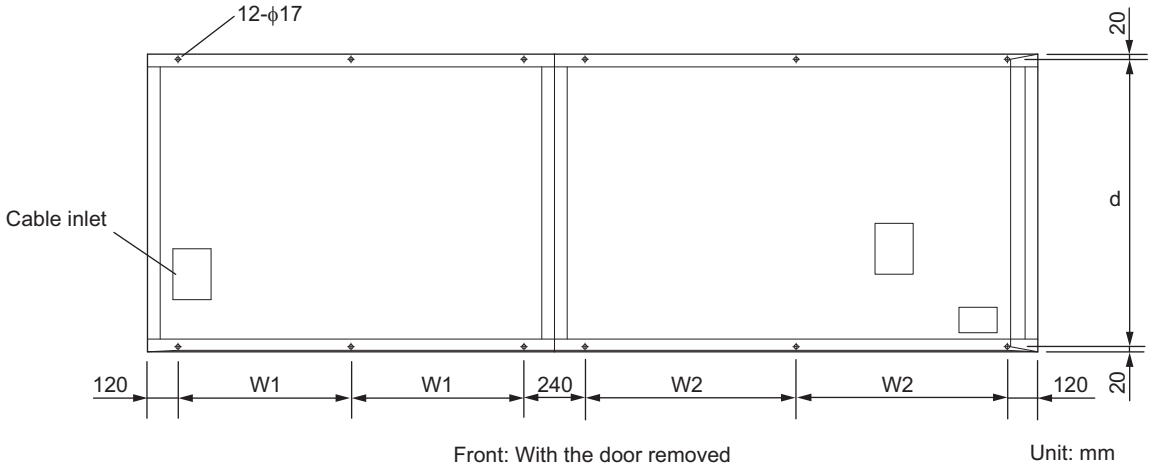


Figure 2.27 Dimension Drawing 3 for Bottom (Class: 3 kV)

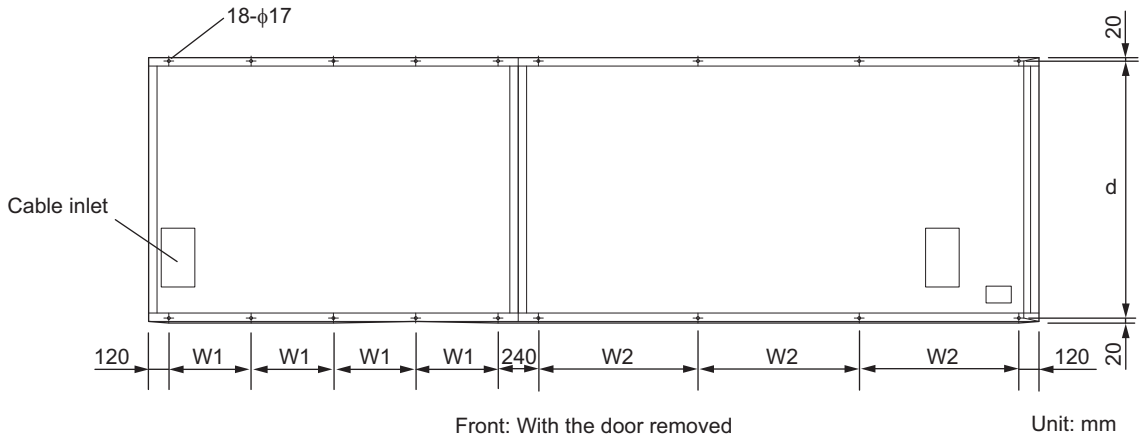


Figure 2.28 Dimension Drawing 4 for Bottom (Class: 3 kV)

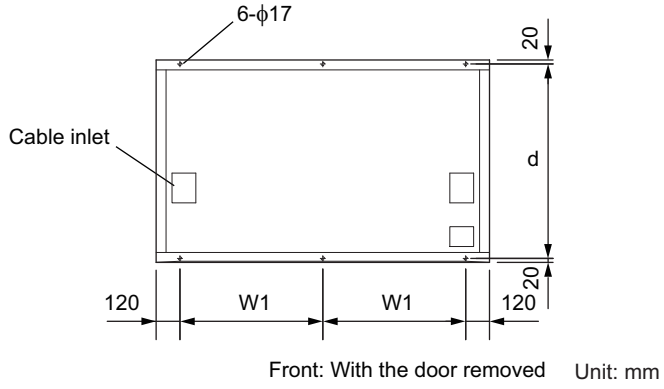


Figure 2.29 Dimension Drawing 1 for Bottom (Class: 4 kV)

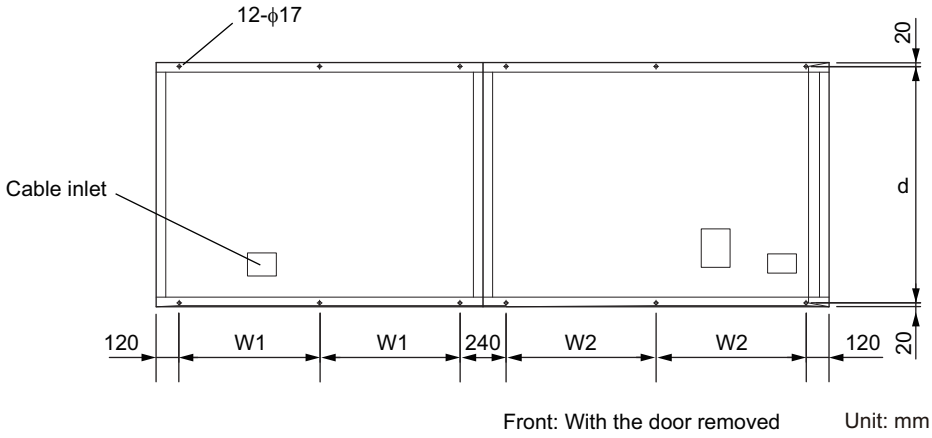


Figure 2.30 Dimension Drawing 2 for Bottom (Class: 4 kV)

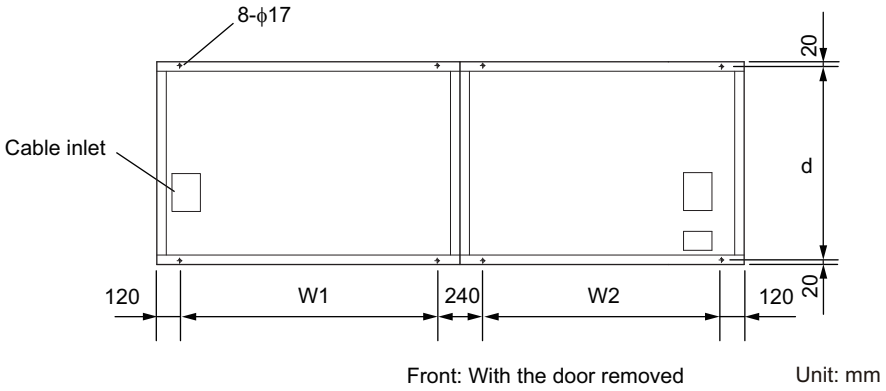


Figure 2.31 Dimension Drawing 1 for Bottom (Class: 6 kV)

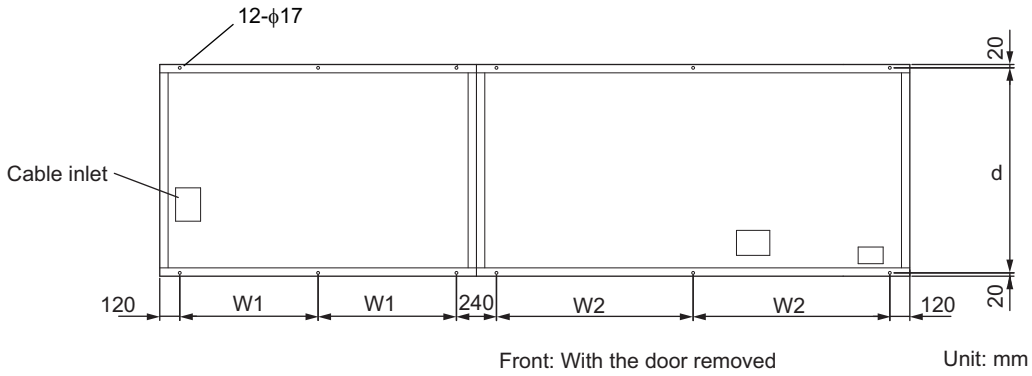


Figure 2.32 Dimension Drawing 2 for Bottom (Class: 6 kV)

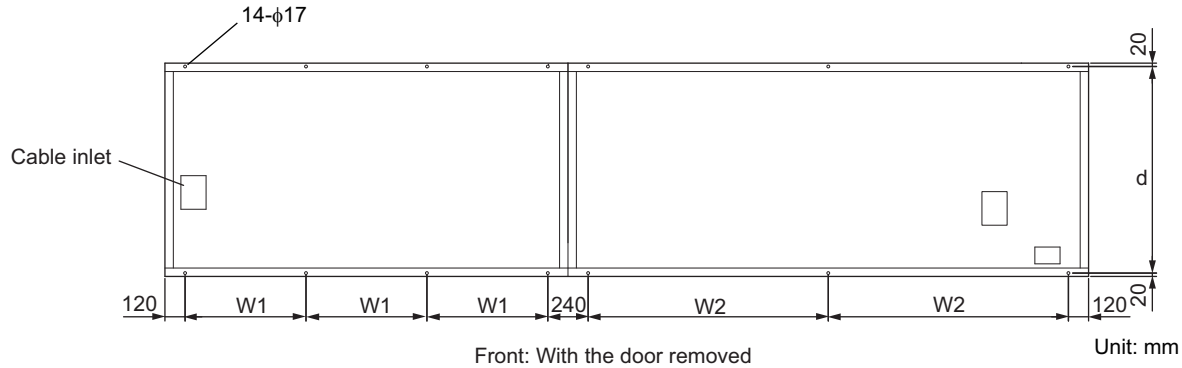


Figure 2.33 Dimension Drawing 3 for Bottom (Class: 6 kV)

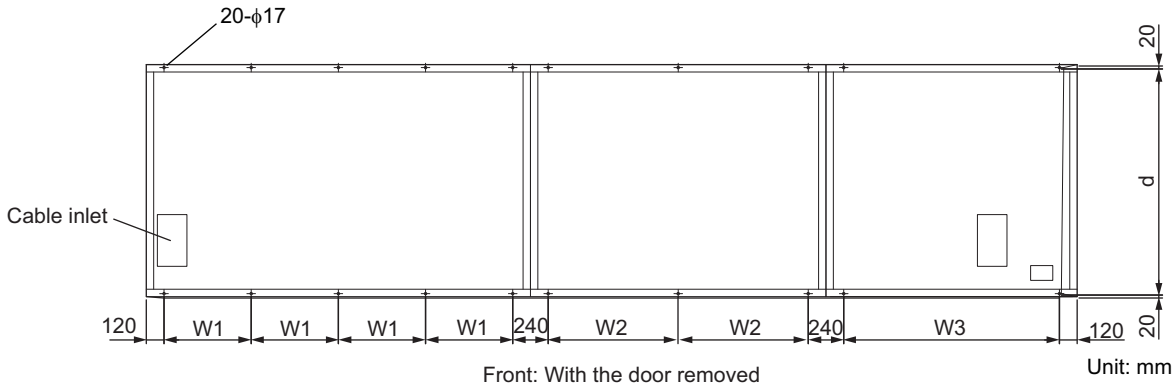


Figure 2.34 Dimension Drawing 4 for Bottom (Class: 6 kV)

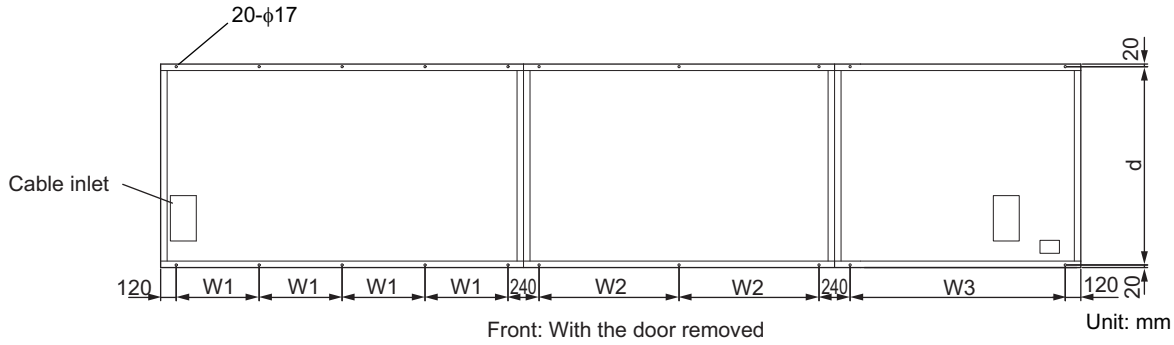


Figure 2.35 Dimension Drawing 5 for Bottom (Class: 6 kV)

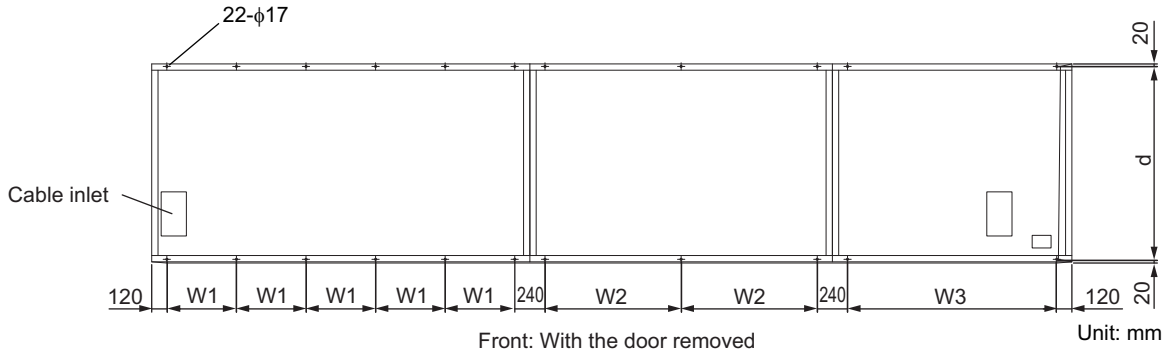


Figure 2.36 Dimension Drawing 6 for Bottom (Class: 6 kV)

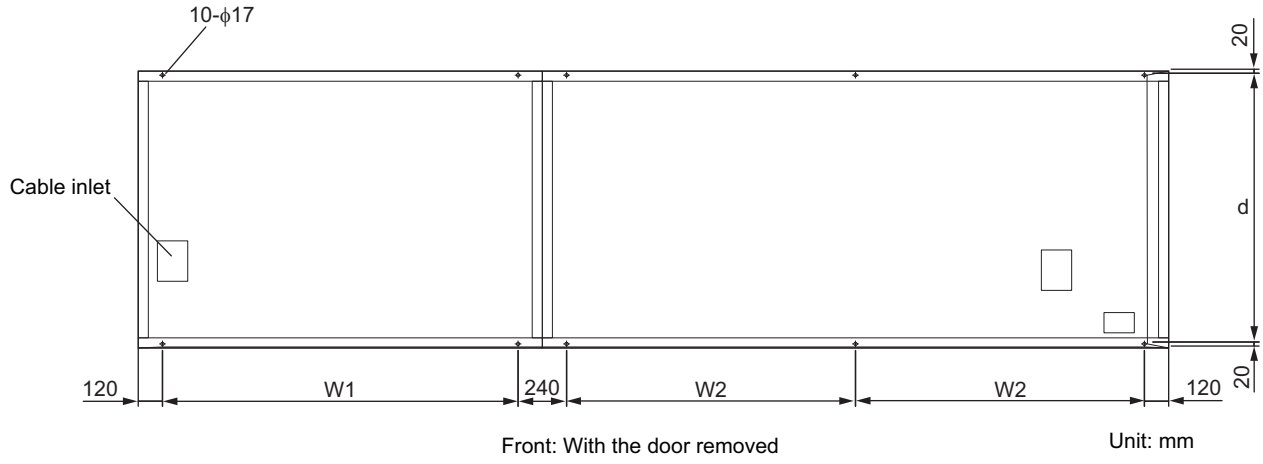


Figure 2.37 Dimension Drawing 1 for Bottom (Class: 11 kV)

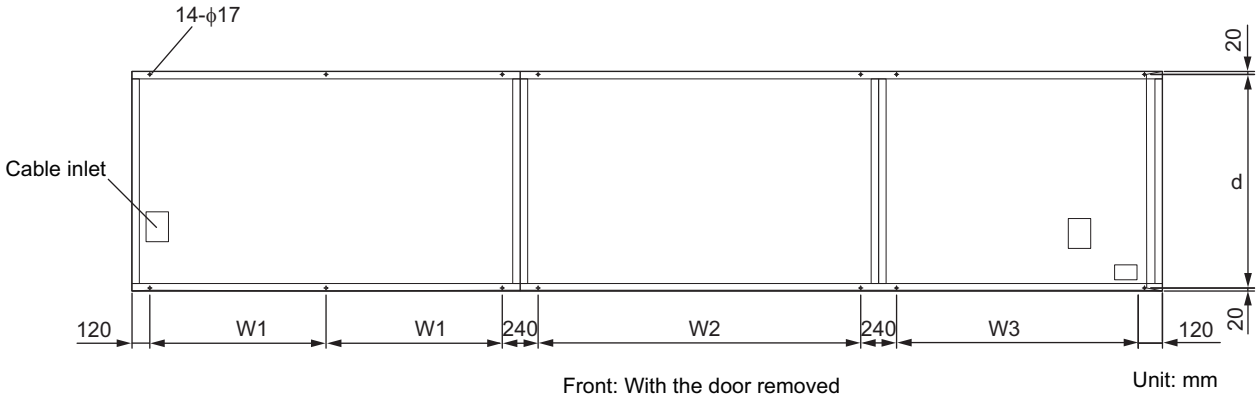


Figure 2.38 Dimension Drawing 2 for Bottom (Class: 11 kV)

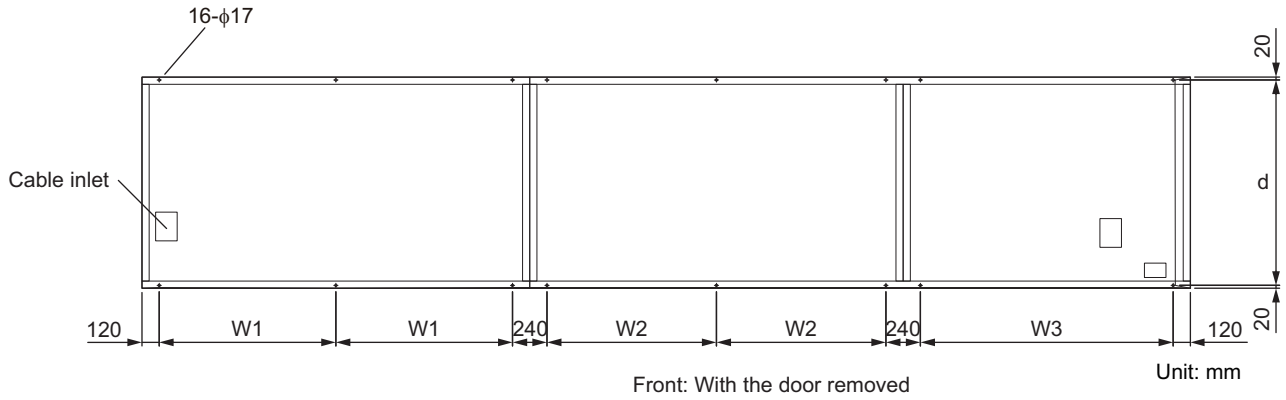


Figure 2.39 Dimension Drawing 3 for Bottom (Class: 11 kV)

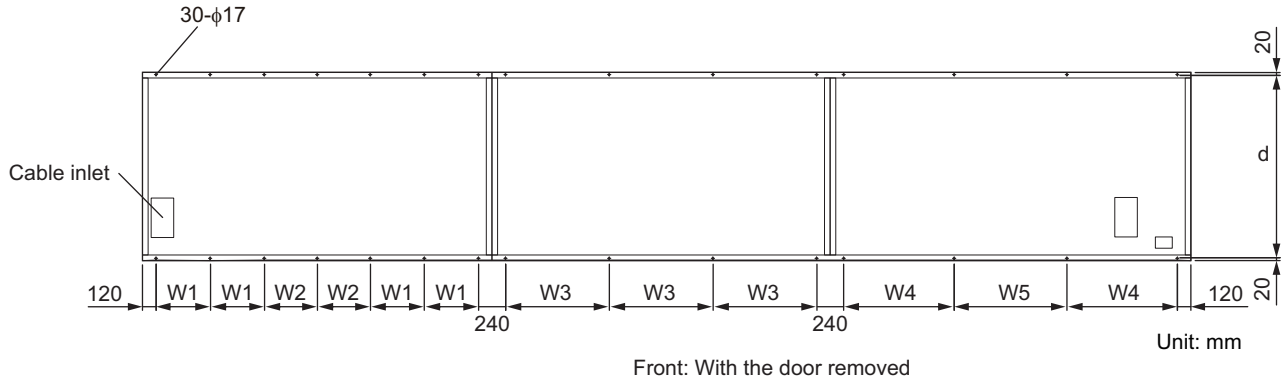


Figure 2.40 Dimension Drawing 4 for Bottom (Class: 11 kV)

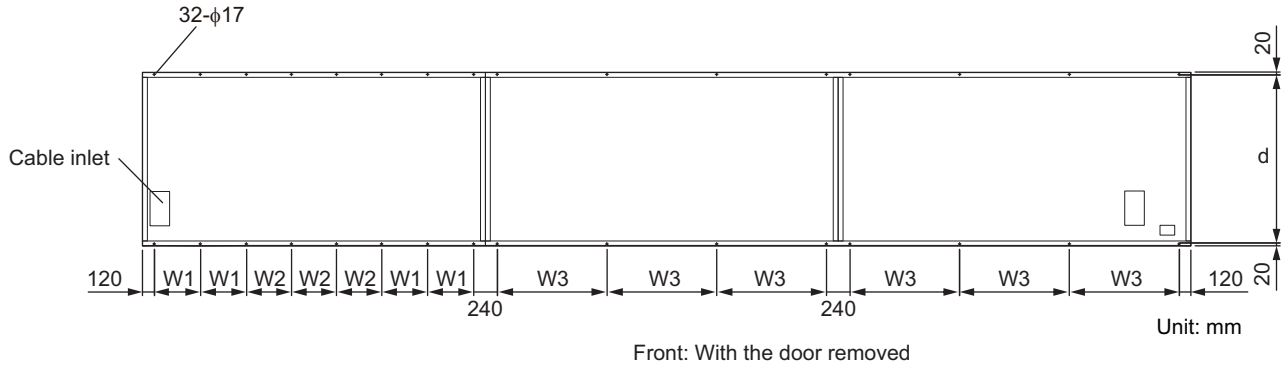


Figure 2.41 Dimension Drawing 5 for Bottom (Class: 11 kV)

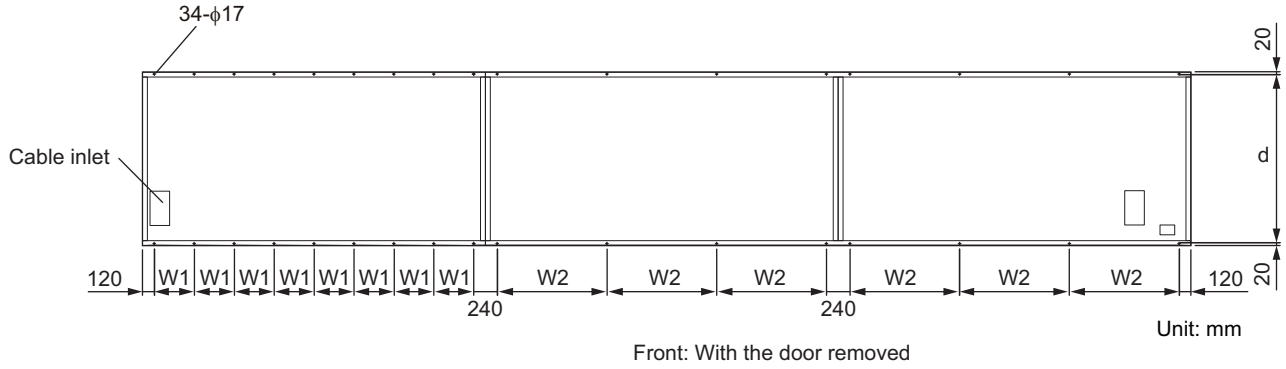


Figure 2.42 Dimension Drawing 6 for Bottom (Class: 11 kV)

2.3 Dimensions

The MV1000 drive dimensions and approximate mass are shown in *Table 2.18*.

Table 2.18 Drive Dimensions and Mass

Voltage Class (kV)	Model CIMR-MV2□	Dimensions (mm)						Approx. Mass (kg) <3>
		Dimension Drawing No.	Width	Depth	Height	Height	Height	
			W	D	H	H1	H2	
2	A□A□052 <1>	*Figure 2.43*	1680	1050	2800	2550	250	2400
	A□A□058 <1>		1680	1050	2800	2550	250	2400
	A□A□077 <1>		1680	1050	2800	2550	250	2600
	A□A□093 <1>		1680	1050	2800	2550	250	2600
	A□A□102 <1>		1680	1050	2800	2550	250	2600
	A□A□115 <1>		1680	1050	2800	2550	250	2800
	A□A□135 <1>		1680	1050	2800	2550	250	2800
	A□A□160 <1> <2>	*Figure 2.44*	3500	1270	2500	2100	400	4500
	A□A□180 <1> <2>		3500	1270	2500	2100	400	4500
	A□A□205 <1>		–	–	–	–	–	–
	A□A□220 <1>		–	–	–	–	–	–
	A□A□280 <1>		–	–	–	–	–	–
	A□A□330 <1>		–	–	–	–	–	–
	A□A□390 <1>		–	–	–	–	–	–
	A□A□440 <1>		–	–	–	–	–	–
	A□A□505 <1>		–	–	–	–	–	–
	A□A□550 <1>		–	–	–	–	–	–
	A□A□600 <1>		–	–	–	–	–	–
3	C□C□035	*Figure 2.45*	1950	1000	2550	2150	400	2100
	C□C□050		1950	1000	2550	2150	400	2200
	C□C□070		1950	1000	2550	2150	400	2400
	C□C□100		1950	1000	2550	2150	400	2600
	C□C□140		1950	1000	2550	2150	400	2800
	C□C□200 <2>	*Figure 2.46*	3000	1100	2550	2150	400	4100
	C□C□260 <2>		3500	1200	2550	2150	400	4500
	C□C□330 <2>		4100	1600	2550	2150	400	6900
	C□C□400 <2>		4100	1600	2550	2150	400	6900
	C□C□520 <2>		5300	1600	2800	2400	400	8100
	C□C□650 <2>		5600	1600	2800	2400	400	8200

Voltage Class (kV)	Model CIMR-MV2□	Dimensions (mm)						Approx. Mass (kg) <3>
		Dimension Drawing No.	Width	Depth	Height	Height	Height	
			W	D	H	H1	H2	
4	D□D□052	*Figure 2.47*	1680	1050	2800	2550	250	2400
	D□D□058		1680	1050	2800	2550	250	2400
	D□D□064		1680	1050	2800	2550	250	2400
	D□D□077		1680	1050	2800	2550	250	2600
	D□D□093		1680	1050	2800	2550	250	2600
	D□D□102		1680	1050	2800	2550	250	2600
	D□D□115		1680	1050	2800	2550	250	2800
	D□D□125		1680	1050	2800	2550	250	2800
	D□D□155 <2>	*Figure 2.48*	3500	1270	2500	2100	400	4500
	D□D□190 <2>		3500	1270	2500	2100	400	4500
	D□D□220 <1>		–	–	–	–	–	–
	D□D□250 <1>		–	–	–	–	–	–
	D□D□285 <1>		–	–	–	–	–	–
	D□D□315 <1>		–	–	–	–	–	–
	D□D□340 <1>		–	–	–	–	–	–
	D□D□375 <1>		–	–	–	–	–	–
	D□D□440 <1>		–	–	–	–	–	–
	D□D□505 <1>		–	–	–	–	–	–
	D□D□575 <1>		–	–	–	–	–	–
	D□D□625 <1>		–	–	–	–	–	–
6	F□F□035 <2>	*Figure 2.49*	3100	1100	2550	2150	400	3000
	F□F□050 <2>		3100	1100	2550	2150	400	3300
	F□F□070 <2>		3100	1100	2550	2150	400	3600
	F□F□100 <2>		3100	1100	2550	2150	400	3900
	F□F□140 <2>		3100	1100	2550	2150	400	4500
	F□F□200 <2>		4500	1300	2550	2150	400	6600
	F□F□260 <2>		5500	1300	2550	2150	400	7900
	F□F□330 <2>		6300	1600	2800	2400	400	10000
	F□F□400 <2>		6300	1600	2800	2400	400	11000
	F□F□520 <2>		7100	1600	2800	2400	400	14000
	F□F□650 <2>		7300	1600	2800	2400	400	15500
11	H□H□035 <2>	*Figure 2.50*	5100	1400	2700	2400	300	5600
	H□H□050 <2>		5100	1400	2700	2400	300	6100
	H□H□070 <2>		5100	1400	2700	2400	300	7000
	H□H□100 <2>		5100	1400	2700	2400	300	7700
	H□H□140 <2>		5100	1400	2700	2400	300	8200
	H□H□200 <2>		6900	1500	2700	2400	300	10100
	H□H□260 <1> <2>		7300	1500	2700	2400	300	12500
	H□H□330 <1> <2>		9300	1700	2800	2400	400	15550
	H□H□400 <1> <2>		9300	1700	2800	2400	400	17200
	H□H□520 <1> <2>		10700	1800	2800	2400	400	20800
	H□H□650 <1> <2>		10700	1800	2800	2400	400	23650

<1> Under development
<2> Side-by-side configurations comprising two or more drive panels
<3> The dimensions and masses are subject to change. For details on the CE-marking-conforming products, refer to *European Standards on page 220*.

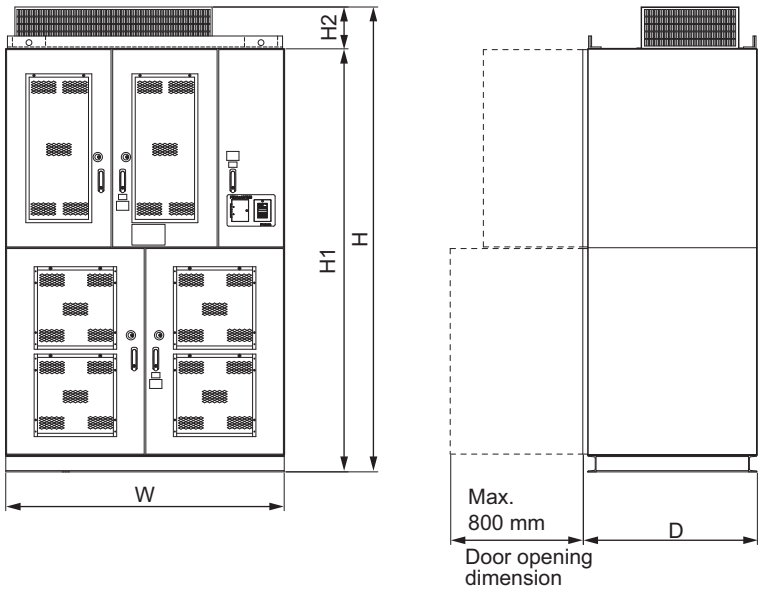


Figure 2.43 Dimension Drawing 1 (Class: 2 kV)

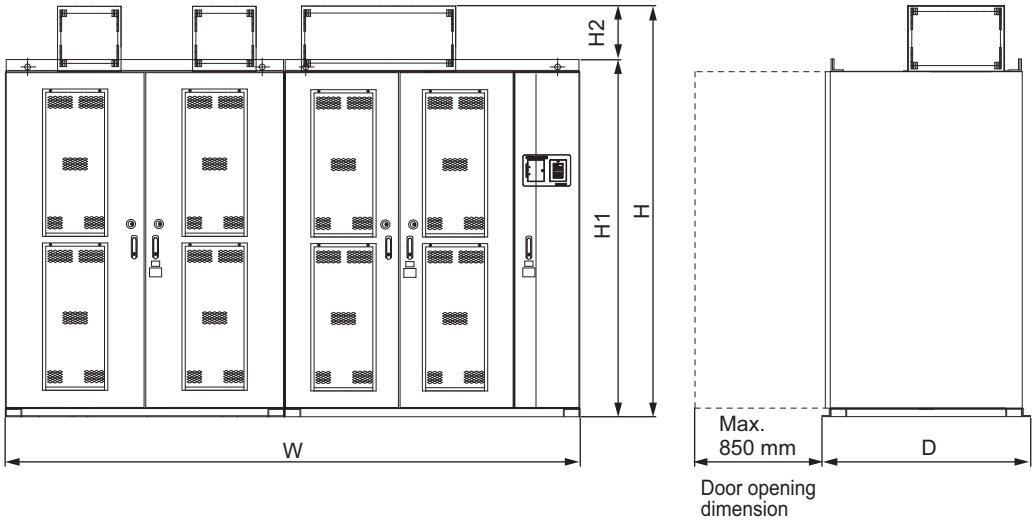


Figure 2.44 Dimension Drawing 2 (Class: 2 kV)

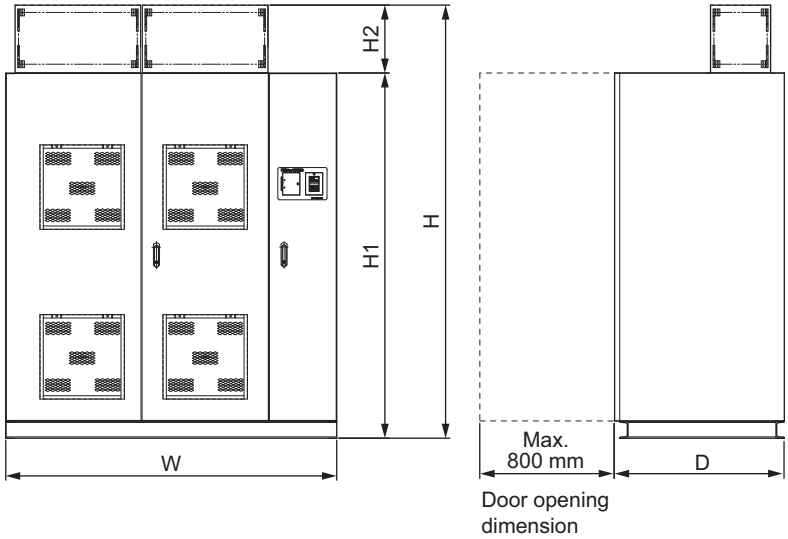


Figure 2.45 Dimension Drawing 1 (Class: 3 kV)

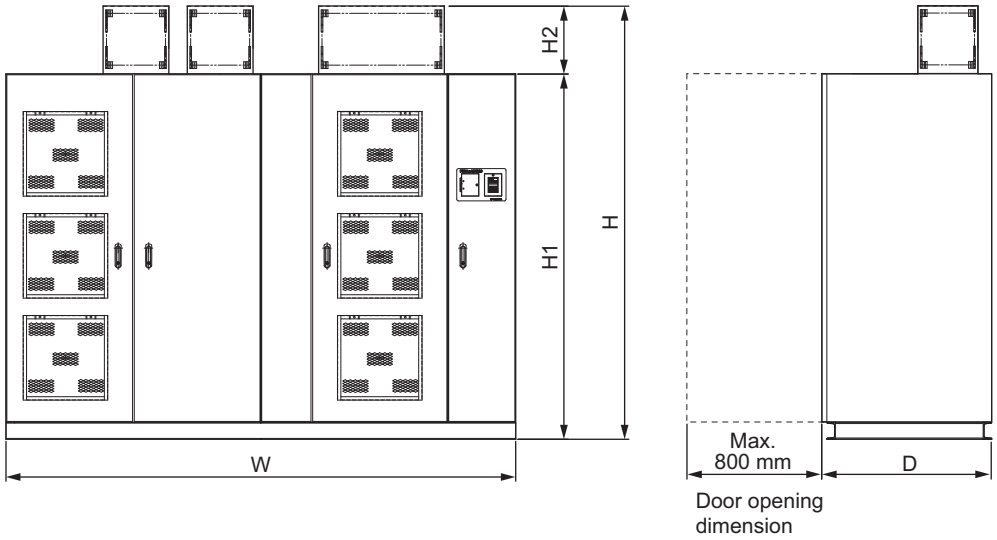


Figure 2.46 Dimension Drawing 2 (Class: 3 kV)

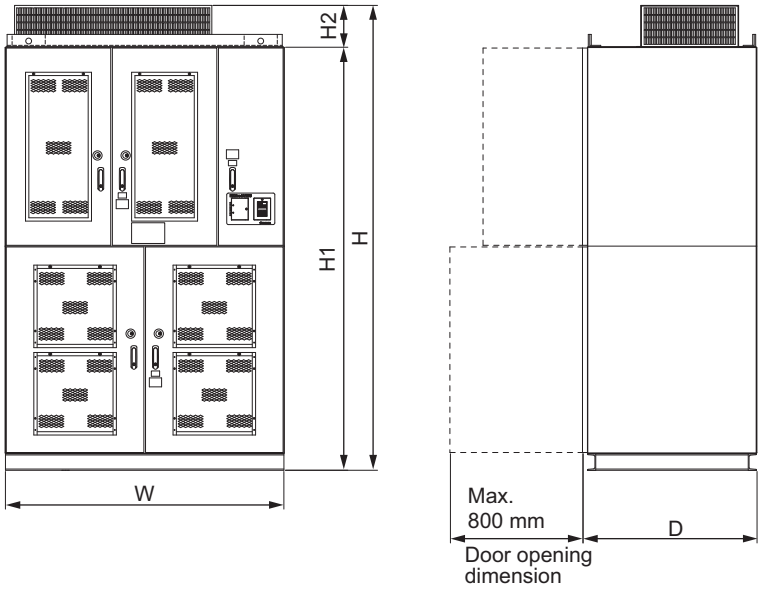


Figure 2.47 Dimension Drawing 1 (Class: 4 kV)

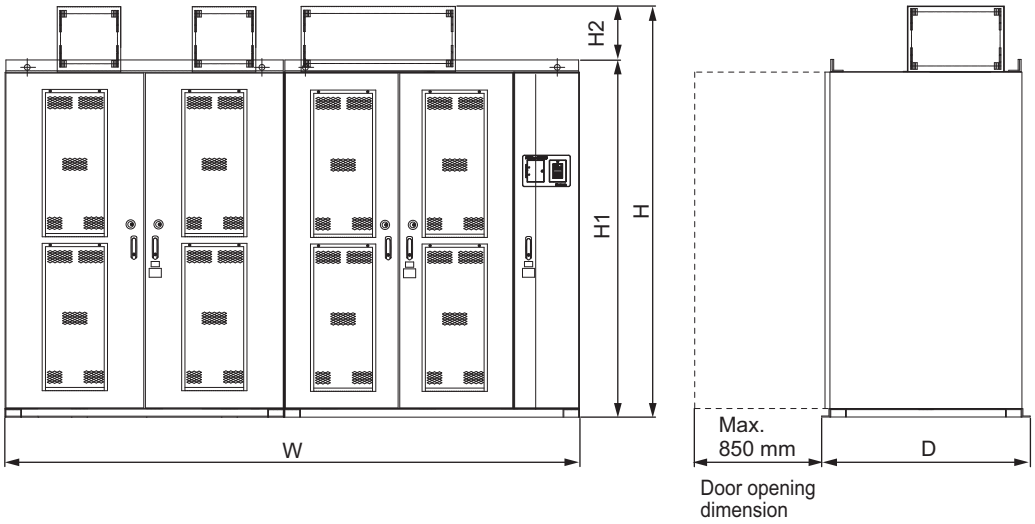


Figure 2.48 Dimension Drawing 2 (Class: 4 kV)

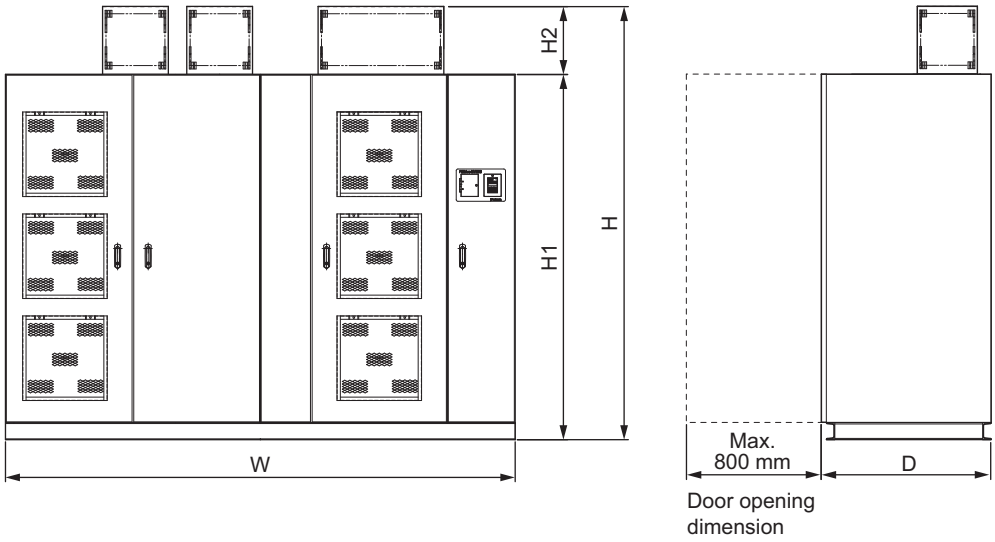


Figure 2.49 Dimension Drawing (Class: 6 kV)

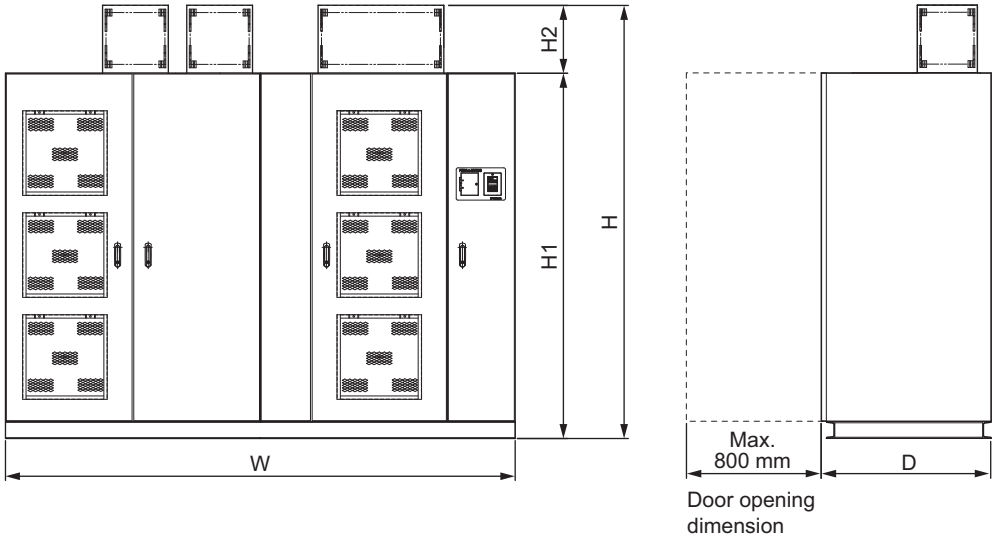


Figure 2.50 Dimension Drawing (Class: 11 kV)

2.4 Storing Drives

This section describes conditions and environments for short- and long-term storage of uninstalled drives and installed drives with no power applied.

NOTICE: *When storing the drive, be sure to observe the precautions explained in this section. An incorrect storage method could result in damage to, or failure of, the drive.*

◆ Short Term Storage of Drives

■ Time Frame

Storage of up to one month after unpacking or up to three months after shipping.

■ Surrounding Environment

Secure a storage environment that satisfies the conditions cited for the drive's installation environment. (refer to *Installation Environment on page 42*.)

◆ Long Term Storage of Drives

■ Time Frame

Storage of more than one month after unpacking or more than three months after shipping.

Note: Contact your Yaskawa representative or the nearest Yaskawa sales office in advance if long-term storage is required.

■ Surrounding Environment

Secure a storage environment that satisfies the conditions cited for the drive's installation environment. (refer to *Installation Environment on page 42*.)

Note that an ambient temperature of up to 50°C is acceptable for long-term storage of installed drives with no power applied.

Store the spare parts without unpacking them. Refer to *Storing Spare Parts on page 208* for details on the storage method.

■ Preparing a Drive for Storage

Storing an Installed Drive

- Cover the entire drive with two layers of sheeting at least 0.1 mm thick as protection from dust and water droplets.
- Completely seal the bottom of the drive with sealant to prevent moisture and dust from entering the drive.
- Protect every corner of the drive with shock-absorbing materials to prevent the sheet from tearing.

Storage in a Warehouse

Refer to *Figure 2.51* before storing the drive in a warehouse long-term, and take the following precautions:

- Cover the entire drive with two layers of sheeting at least 0.1 mm thick as protection from dust and water droplets.
- Protect every corner of the drive with shock-absorbing materials to prevent the sheet getting broken.
- Roll in the sheet under the bottom of the drive so that the drive will not absorb moisture from the floor.
- Do not place the drive directly on the floor. Place the drive on several 50 to 100 mm square wooden beams. Place the beams as shown in *Figure 2.51* so that the entire bottom of the drive is evenly loaded.
- Place the drive in the orientation indicated in the dimension drawings. Do not place it on its side or stack drives.
- Prevent the drive from scratches and other damage from external impacts.
- Insert color-changing silica gel into drive openings to absorb moisture. As a guide for appropriate quantity, use 1 kg per cubic meter. Replace the silica gel dessicant every three months. The time period for which the silica gel remains effective differs depending on the ambient humidity.
  Replace the silica gel every three months. Note, however, that the period the silica gel remains effective differs depending on the ambient humidity.
- Prevent the drive from falling by providing adequate support.
- The drive is not compatible with outdoor storage.

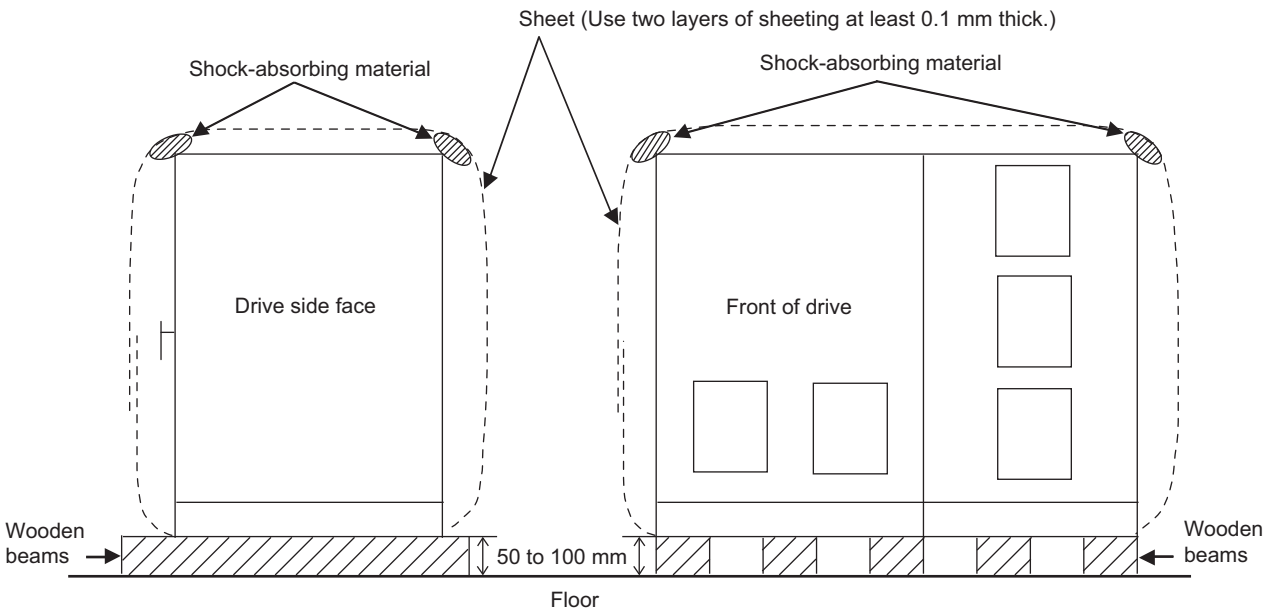


Figure 2.51 Preparing a Drive for Storage

■ Other Precautions

Devise measures to prevent the cables being damaged by rats or other possible causes.

■ Periodic Inspection

Inspect the following every month:

- The color of the silica gel. Changing colors indicate that moisture was absorbed. Check absorbency based on the degree of color change.
- Check the drive for water or condensation from humidity or roof leaks.
- Check the interior and exterior of the drive for rust and corrosion.

NOTICE: *Before turning on the power to the drive after a long period in storage, carefully check for moisture and dust. Failure to comply could result in damage by fire or other damage.*

3

Electrical Installation

This chapter describes the main circuit terminals, control circuit terminals, wiring specifications, and gives specifications on wiring and connections.

3.1 SECTION SAFETY 74
3.2 STANDARD CONNECTION DIAGRAM 77
3.3 TERMINALS 82
3.4 CABLE ROUTING 85
3.5 MAIN CIRCUIT WIRING 90
3.6 CONTROL CIRCUIT WIRING 99
3.7 CONNECTING TO A PC 103
3.8 EXTERNAL INTERLOCK 104
3.9 WIRING CHECK 105

3.1 Section Safety

⚠ DANGER

Electrical Shock Hazard

Do not connect or disconnect wiring while the power for the main circuit and controls is on.

Failure to comply could result in serious injury or death.

Do not touch the input and output terminals directly with your hands and do not bring the input and output wires into contact with the drive case or metal parts. In addition, do not short circuit the output wires.

Failure to comply could result in death, serious injury, or ground fault.

⚠ WARNING

Sudden Movement Hazard

After an emergency stop circuit has been wired, check to make sure that it is operating properly. Emergency stop circuits are needed to safely and quickly stop the operation of the drive.

Operating a drive with an emergency stop circuit whose operation has not been checked could result in serious injury or death.

Confirm the drive I/O signals and external sequence before starting the test run.

Failure to comply may result in serious injury or death.

Electrical Shock Hazard

Do not supply power to the main circuit while the panel doors are open.

Failure to comply could result in serious injury or death.
The diagrams in this manual may show the drive without covers or safety shields to show details. Be sure to reinstall covers or shields before operating the drive and run the drive according to the instructions described in this manual.

Always ground the motor-side ground terminal.

Improper equipment grounding could result in death, serious injury, or fire by contacting the motor case.

Do not perform work or operate the drive while wearing loose clothing, jewelry, or without eye protection.

Failure to comply could result in serious injury or death.
Remove all metal objects such as watches and rings, secure loose clothing and wear eye protection before beginning work on the drive.

Do not allow unqualified personnel to perform work on the drive.

Failure to comply could result in serious injury or death.

The drive should be installed, wired, repaired, inspected, and have its parts replaced, by someone with a thorough knowledge of drive installation, adjustment and repair.

Turn off the power for the main circuit and controls to all devices before connecting the drive's terminals.

Even when the power supply of the medium-voltage main circuit to the drive is shut off, it takes some time for the internal capacitors to discharge. Wait until the CHARGE LED goes off before starting inspection. While an electric charge remains in the capacitor, the surface and inside of the Power Cell will carry a high voltage, so there will be a risk of serious injury or death.

Use a ground wire of a gauge that complies with the technical standards for electrical equipment in the country where the drive is being used. Keep the wiring as short as possible.

Improper equipment grounding could cause leakage current to flow to the drive. If so, the potential of the drive's ground terminals becomes unstable at some distance from the grounding point, resulting in serious injury or death.

⚠ WARNING

Always ground the ground terminals. Also be sure to carry out the following grounding work.

Improper equipment grounding could result in serious injury or death by an electric shock through contact with ungrounded electrical equipment.

- Ground terminals (EA): grounding resistance of 10 W or less
- Ground terminals (ED): grounding resistance of 100 W or less

Do not touch circuit boards while the power is on.

Failure to comply could result in serious injury or death.

Fire Hazard

Tighten all terminal screws to the specified tightening torque.

Loose electrical connections could result in serious injury or death by fire due to overheating of electrical connections.

Do not use an improper voltage source.

Failure to comply could result in serious injury or death by fire.

Verify that the rated voltage of the drive matches the voltage of the incoming power supply before applying power.

NOTICE

Observe proper electrostatic discharge procedures (ESD) when handling the drive.

Failure to comply may result in ESD damage to the drive circuitry.

Use only shielded cable to wire analog input/output signals for the control circuit.

Failure to comply could result in drive malfunction.

Use shielded twisted-pair wires and ground the shield to the ground terminal of the drive.

Be careful not to create a short circuit between the analog output terminals.

Failure to comply could result in drive malfunction.

The length of the input/output cables for the control circuit should be 30 m or less.

Failure to comply could result in drive malfunction.

If the cables are longer than 30 m, measures, such as adding surge arrester or other devices, may need to be taken as protection against damage caused by lightning induction.

Do not ground to terminals other than the designated grounding terminals.

Failure to comply could cause the drive to malfunction.

To suppress the disturbance voltage of the control power, ground the ED (PE) ground terminal of the controller separately from the EA (PE) ground terminal.

Do not modify the drive circuitry.

Failure to comply could result in damage to the drive and will void warranty.

Do not attempt to modify or alter the drive.

Yaskawa is not responsible for any modification of the drive made by the user.

Check all the wiring and ensure that all connections are correct after installing the drive and connecting other devices.

Failure to comply could result in damage to the drive.

Consider voltage tolerance levels and insulation in applications with a high input voltage or particularly long wiring distances. Contact your Yaskawa representative or the nearest Yaskawa sales office.

The analog output terminals are for monitoring output frequency and current. These terminals are not used for controls such as feedback control. Be careful not to create a short circuit between analog output terminals.

Failure to comply could result in drive malfunction.

NOTICE

Keep the wiring for the main circuit separate from that for the control circuit.

Failure to comply could result in drive malfunction.

Select a power supply with a capacity larger than that of the drive to be connected.

When connecting multiple drives to a single power supply, select a power supply with a capacity larger than the sum of the power required by all the drives to be connected. Even when the power supply has sufficient capacity, the power supply voltage may drop when the power is turned on, causing malfunction of connected devices if the power supply has a large power impedance.

The area where the cables enter the bottom of the drive should be tightly sealed with fire-resistant putty so that no open space remains. Make sure the entire peripheral areas around the channel base and the pit cover are tightly sealed with the putty so that no opening remains.

A proper operating environment cannot be maintained if air or dust from the outside makes its way into the drive, and this can result in damage to the equipment.

Do not solder the ends of wire connections to the drive. Soldered wiring connections can loosen over time.

Improper wiring could result in drive malfunction due to loose terminal connections.

Do not short circuit the drive output terminals or connect the power supply lines to output terminals U, V and W of the drive.

Incorrect wiring can result in damage to the drive. Carry out wiring that conforms to the wire gauges and tightening torques described in this manual. Conduct a thorough check of wiring and sequences before turning the power on.

Select a breaker with sufficient capacity for the main circuit power supply side of the drive, taking the inrush current from the transformer into account.

Inputs and outputs of the drive (main circuit) contain harmonic components that may adversely affect communication devices, such as AM radios, used in the vicinity. Use high-voltage cables and ground any shielded cables. Separate cables for control from high-current circuits (main circuit and relay sequence circuits) to avoid induction from peripheral devices. (It is advisable to separate them by a distance of 30 cm or more.)

Connect input terminals U, V and W of the motor to output terminals U, V and W of the drive, pairing the terminal codes. The phase orders of the motor terminals and drive terminals should also match.

The motor may run in reverse if the phase orders do not match.

Do not connect the AC power line to the output terminals of the drive.

Failure to comply could result in serious injury or death by fire as a result of drive damage.

Do not share the ground wire with other devices such as welding machines or large-current electrical equipment.

Improper grounding could result in drive or equipment malfunction.

When using more than one drive, follow the instructions in this manual and ensure that the ground wires do not form a loop.

Improper grounding could result in drive or equipment malfunction.

When wiring the control circuit, separate it from the main circuit wiring (terminals R, S, T, U, V and W) and other power lines.

Improper grounding could result in drive malfunction.

Insulate the shielded wires of the drive, e.g. with tape, to prevent their contact with other signal lines or devices.

Failure to comply could result in drive or equipment malfunction due to short circuit.

3.2 Standard Connection Diagram

Connect the drive and peripheral devices as shown in the figures below. This section does not discuss drive operation; Refer to *Start-Up Programming & Operation on page 107* for instructions on operating the drive.

NOTICE: *Consider voltage tolerance levels and insulation in applications with a high input voltage or particularly long wiring distances. Contact your Yaskawa representative or the nearest Yaskawa sales office.*

◆ Class: 2 kV

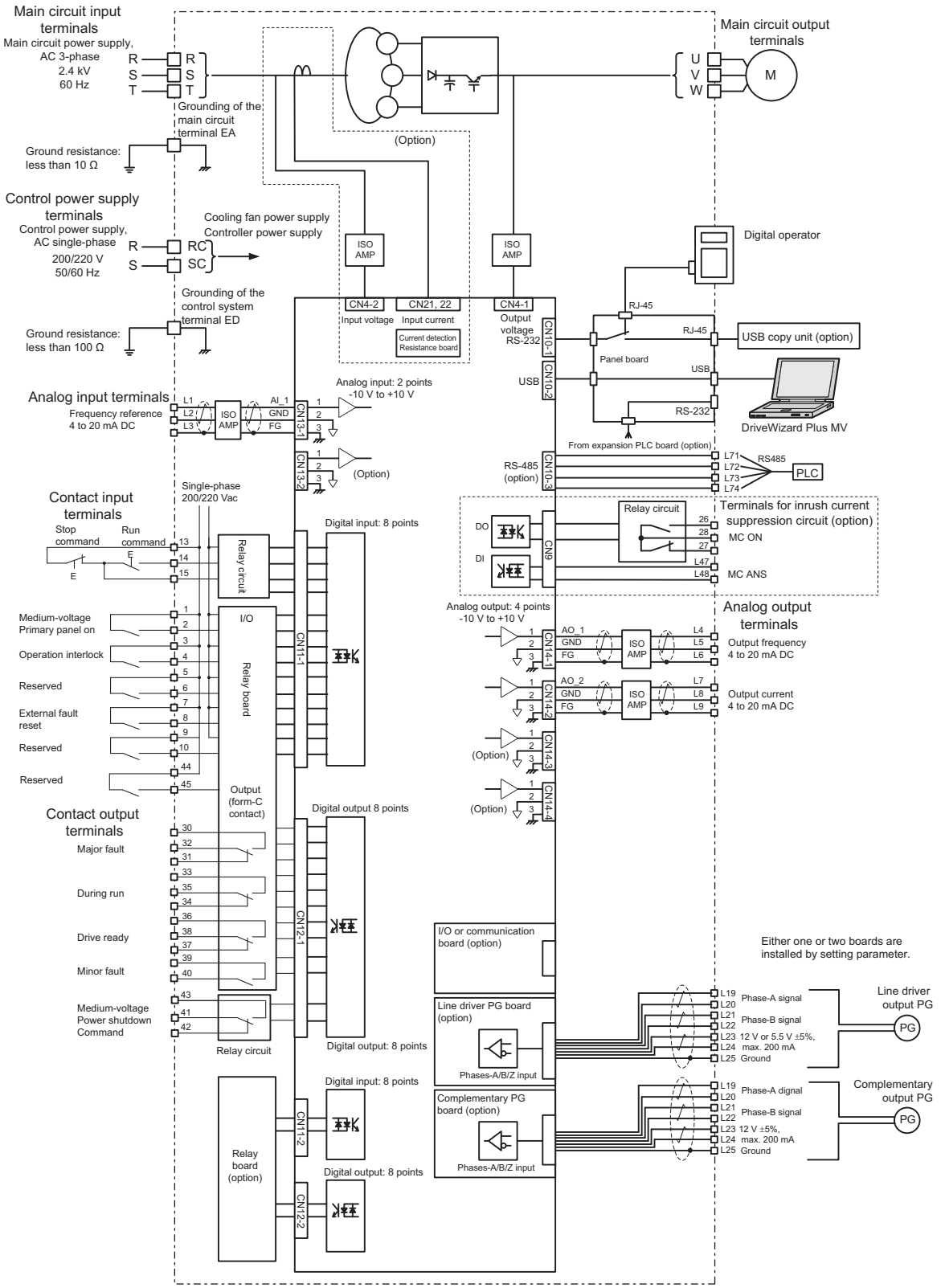


Figure 3.1 Drive Standard Connection Diagram (Example: CIMR-MV2□A□AA052)

◆ Class: 3 kV

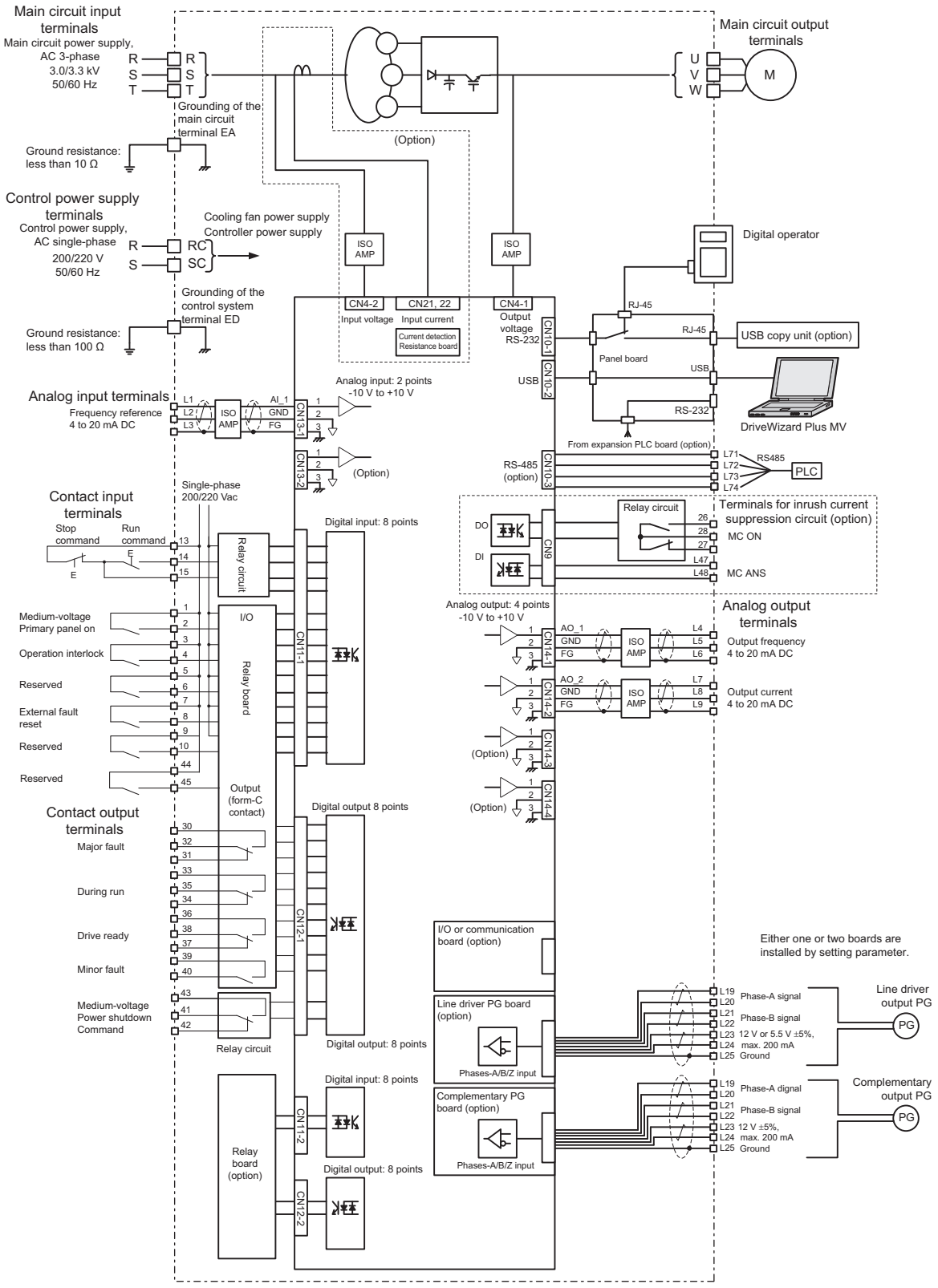


Figure 3.2 Drive Standard Connection Diagram (Example: CIMR-MV2□C□CA035)

◆ Class: 4 kV

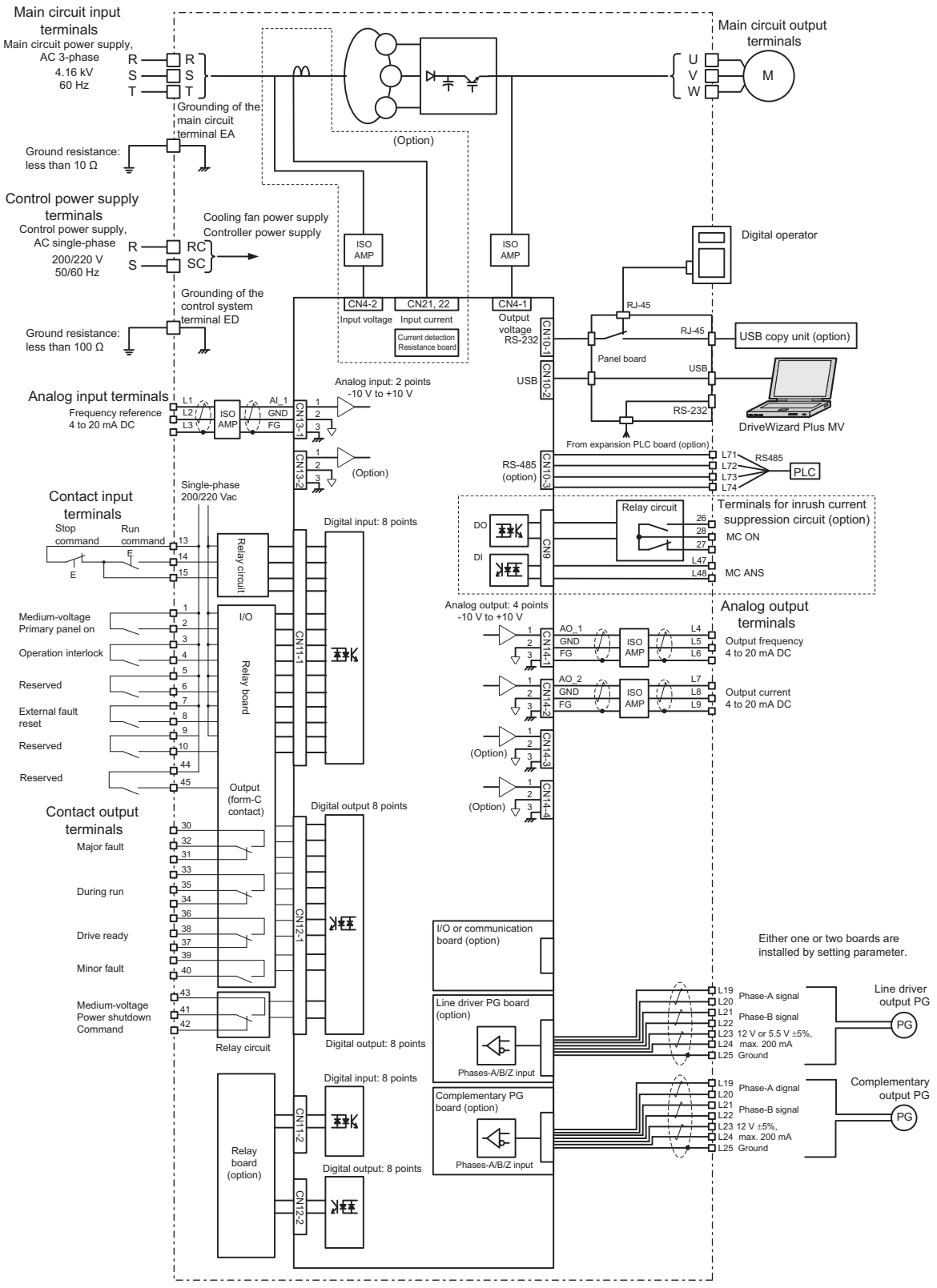


Figure 3.3 Drive Standard Connection Diagram (Example: CIMR-MV2□D□DA052)

◆ Class: 6 kV

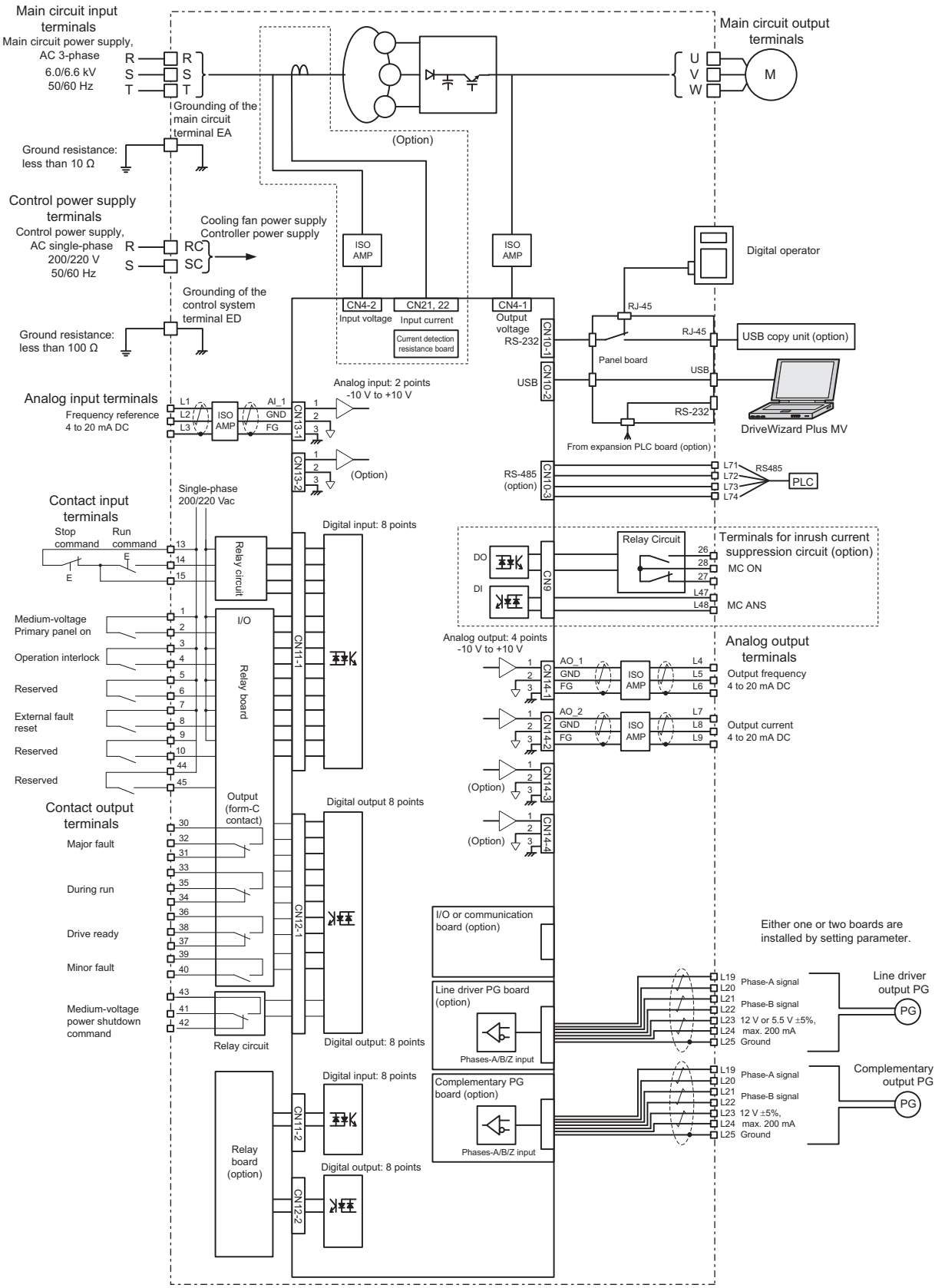


Figure 3.4 Drive Standard Connection Diagram (Example: CIMR-MV2□F□FA035)

◆ Class: 11 kV

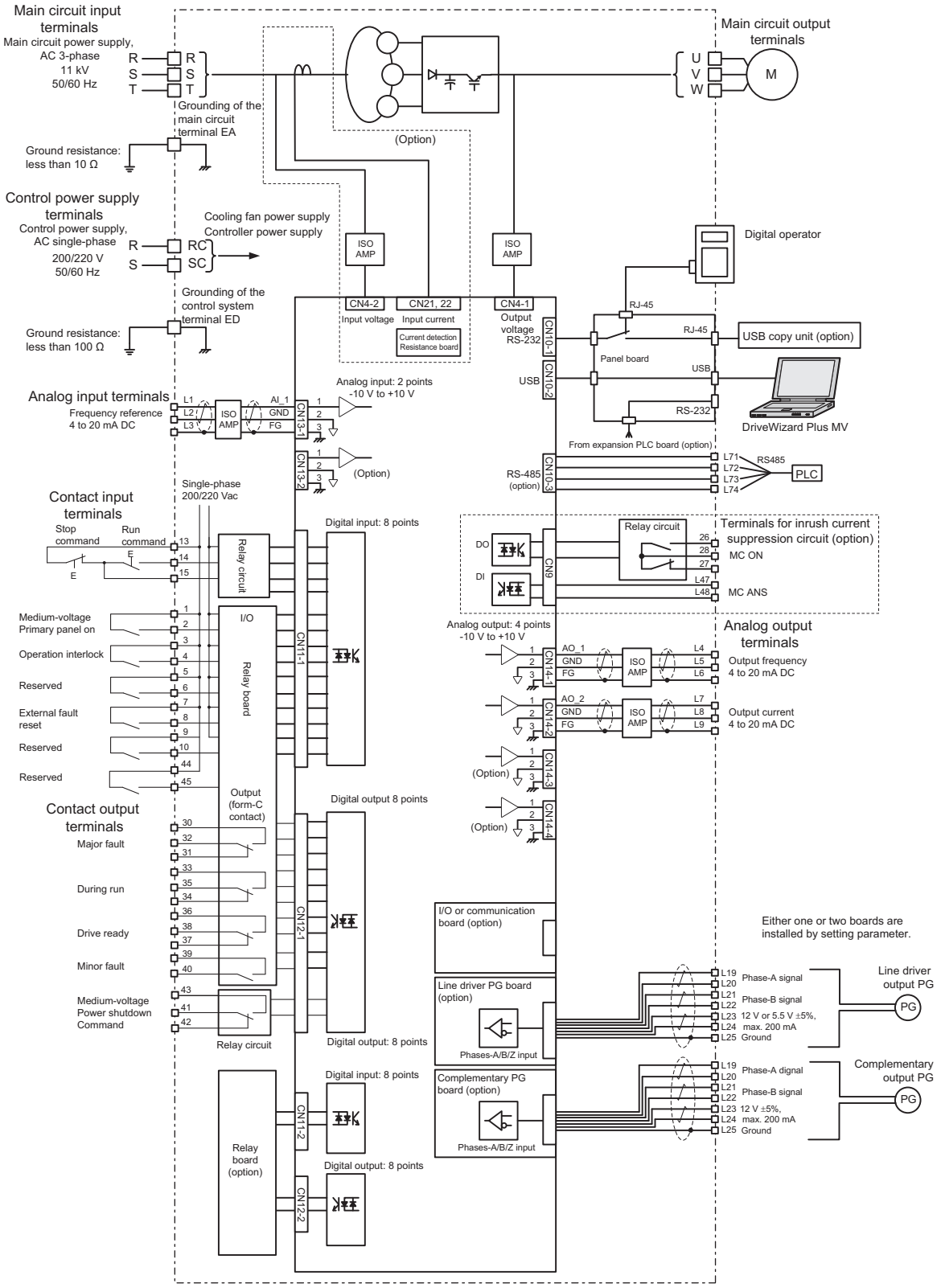
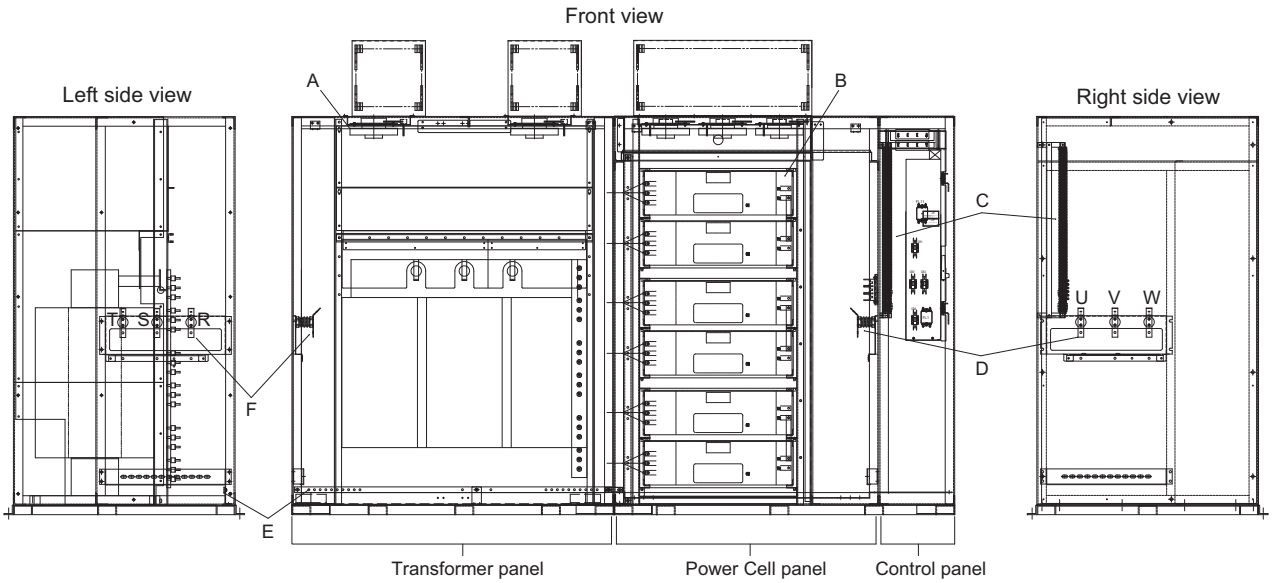


Figure 3.5 Drive Standard Connection Diagram (Example: CIMR-MV2□H□HA035)

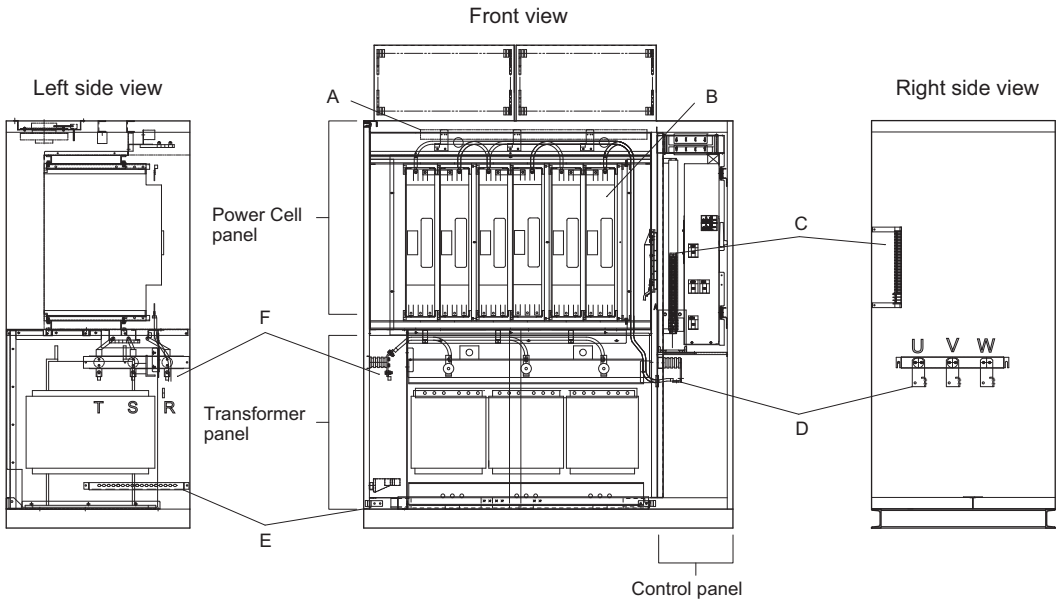
3.3 Terminals

Drive terminal locations are shown in *Figure 3.6* to *Figure 3.10*.



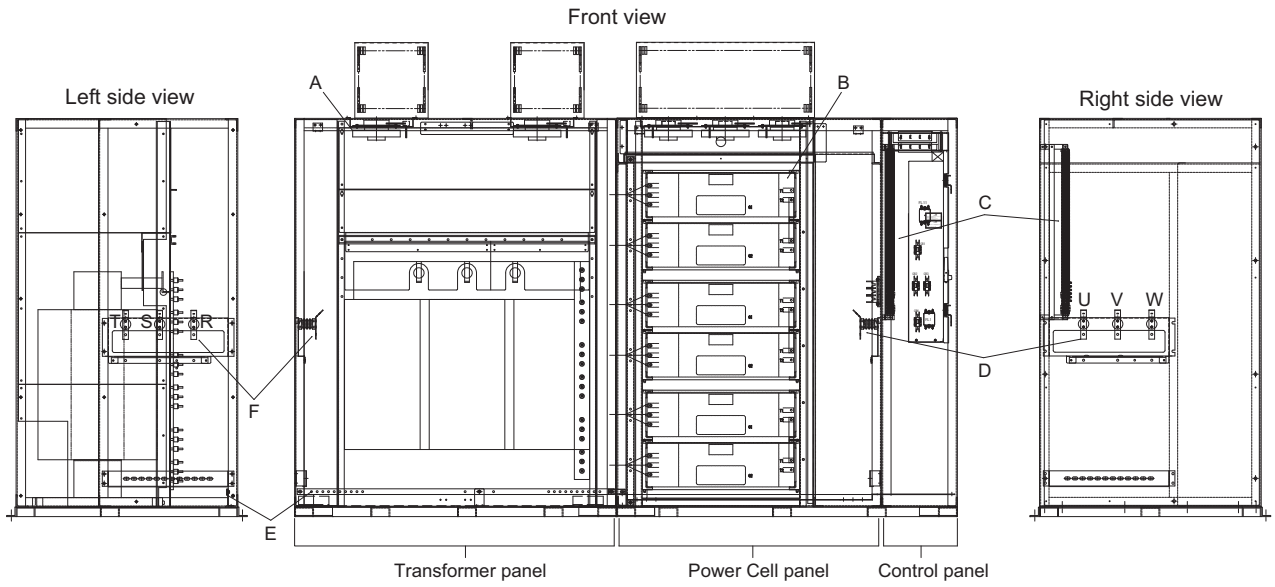
A – Cooling fan
B – Power Cell
C – Control circuit terminals
Grounding terminal ED
D – Main circuit output terminals U, V, and W
E – Grounding terminal EA
F – Main circuit input terminals R, S, and T

Figure 3.6 Terminal Locations (Drive: 2 kV Class, 700 HP)



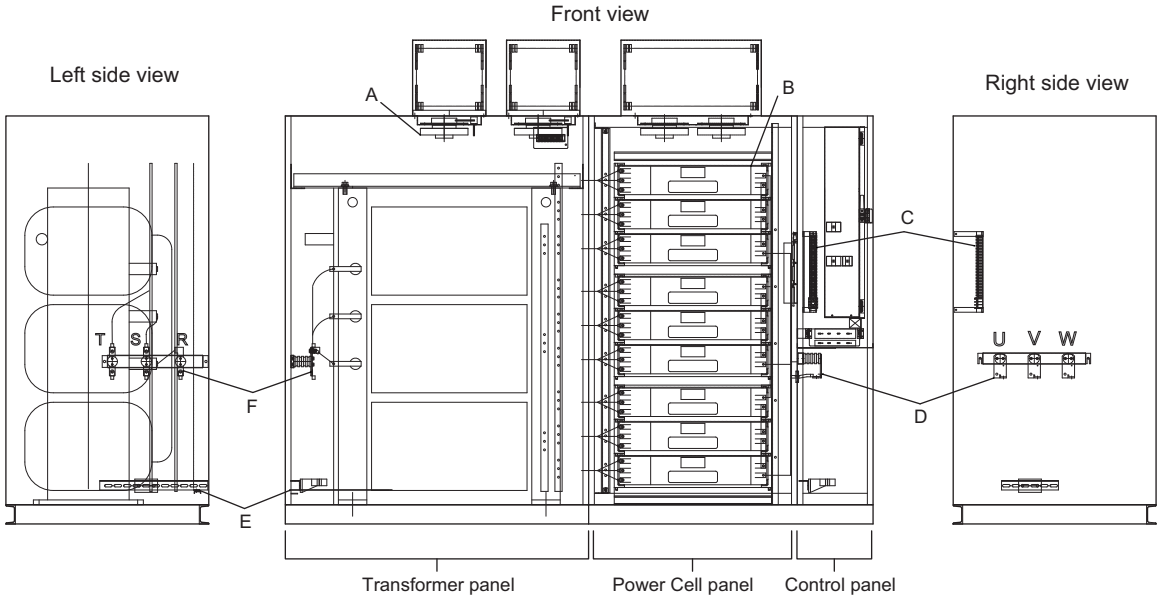
A – Cooling fan
B – Power Cell
C – Control circuit terminals
Grounding terminal ED
D – Main circuit output terminals U, V, and W
E – Grounding terminal EA
F – Main circuit input terminals R, S, and T

Figure 3.7 Terminal Locations (Drive: 3 kV Class, 800 kVA)



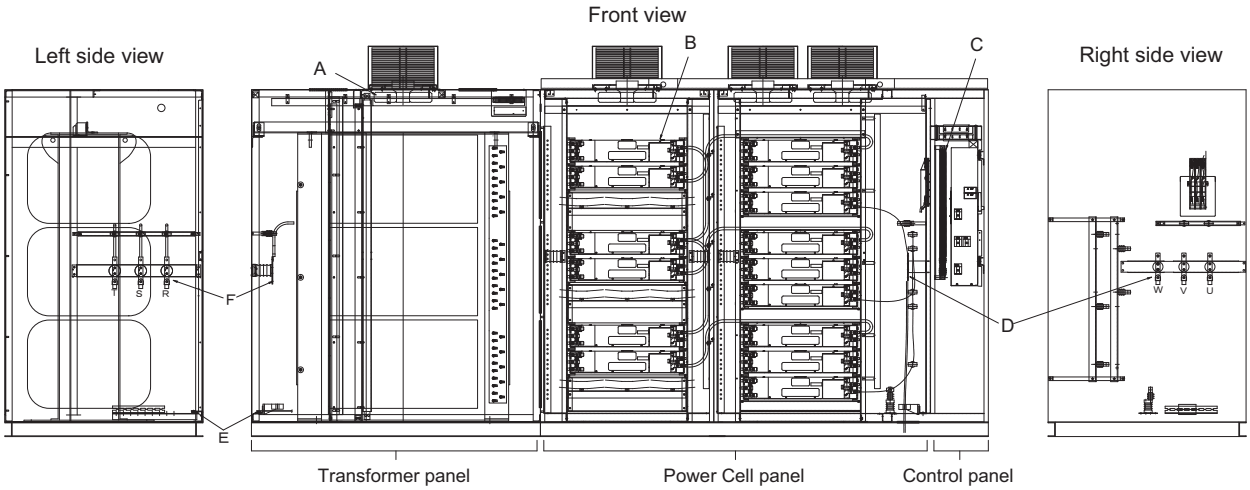
A – Cooling fan
B – Power Cell
C – Control circuit terminals
Grounding terminal ED
D – Main circuit output terminals U, V, and W
E – Grounding terminal EA
F – Main circuit input terminals R, S, and T

Figure 3.8 Terminal Locations (Drive: 4 kV Class, 1250 HP)



A – Cooling fan
B – Power Cell
C – Control circuit terminals
Grounding terminal ED
D – Main circuit output terminals U, V, and W
E – Grounding terminal EA
F – Main circuit input terminals R, S, and T

Figure 3.9 Terminal Locations (Drive: 6 kV Class, 1600 kVA)



A – Cooling fan
B – Power Cell
C – Control circuit terminals
Grounding terminal ED
D – Main circuit output terminals U, V, and W
E – Grounding terminal EA
F – Main circuit input terminals R, S, and T

Figure 3.10 Terminal Locations (Drive: 11 kV Class, 2650 kVA)

3.4 Cable Routing

The structure of the terminals conforms to JCS standards stipulated by the Japanese Electric Wire & Cable Makers' Association. Route the cables according to the JCS standards appropriate for the input voltage used.

Cable routing examples are shown below.

Note: Secure the cables with cable brackets. Do not secure them at an intermediate point between the cable bracket and control circuit terminals. Prepare cable brackets suitable for the size of the cables used.

◆ Main Circuit Cable Routing

■ Main Circuit Input-Side Cable

Route the input cable into the transformer panel through the drive cable inlet port at the bottom of the transformer panel.

Mount a cable bracket on the cable bracket clamp near the cable inlet port to secure the cables.

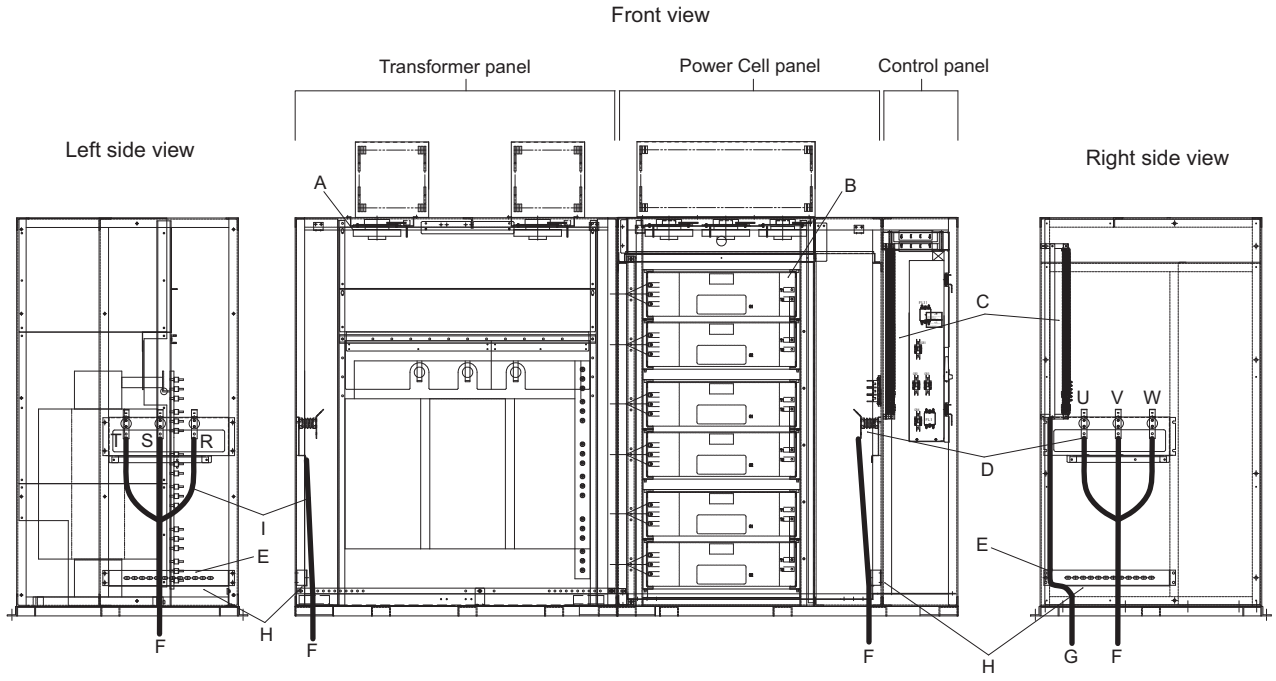
■ Main Circuit Output-Side Cable

Route the output cable into the Power Cell panel through the drive cable outlet port at the bottom of the transformer panel.

Mount a cable bracket on the cable bracket clamp near the cable inlet port to secure the cables.

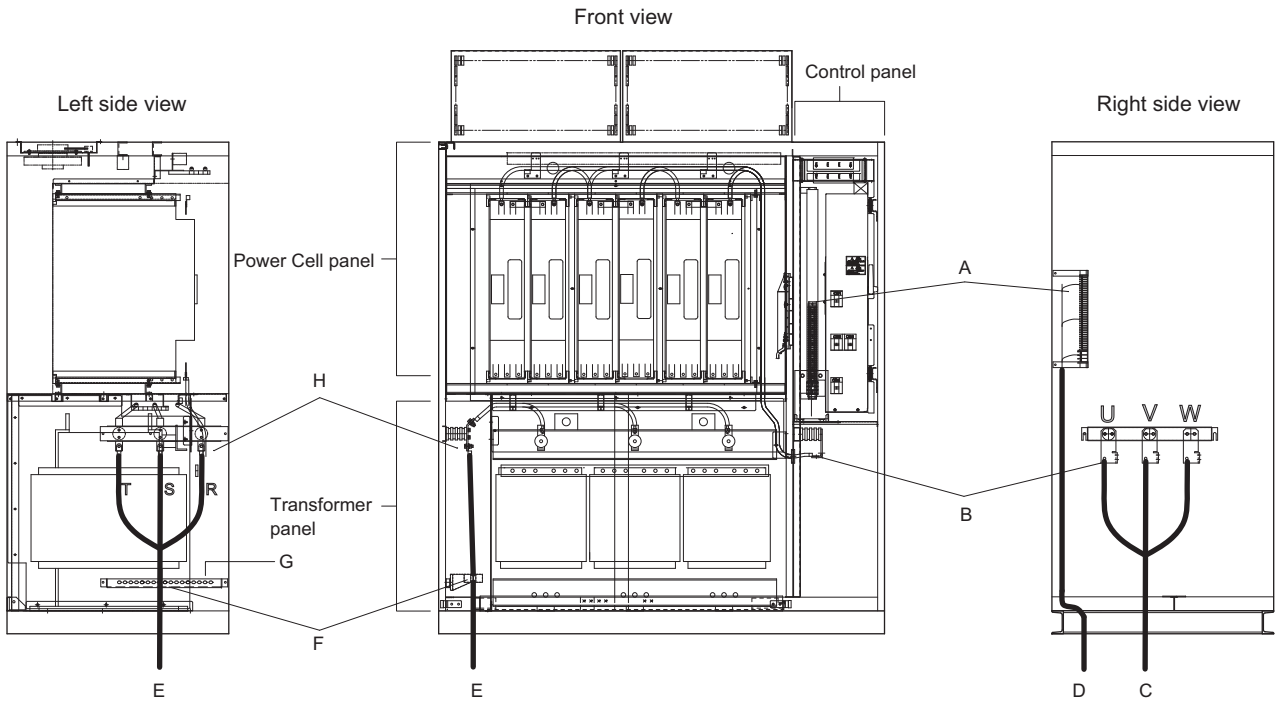
NOTICE: *Keep the wiring for the main circuit separate from that for the control circuit. Select a power supply with a capacity larger than that of the drive to be connected. When connecting multiple drives to a single power supply, select a power supply with a capacity larger than the sum of the power required by all the drives to be connected. Even when the power supply has sufficient capacity, the power supply voltage may drop when the power is turned on, causing malfunction of connected devices if the power supply has a large power impedance.*

NOTICE: *Equipment Hazard. Verify all control wiring and main circuit wiring is properly terminated and correctly connected to the proper terminals before applying power. Failure to comply may result in damage to the drive circuitry.*



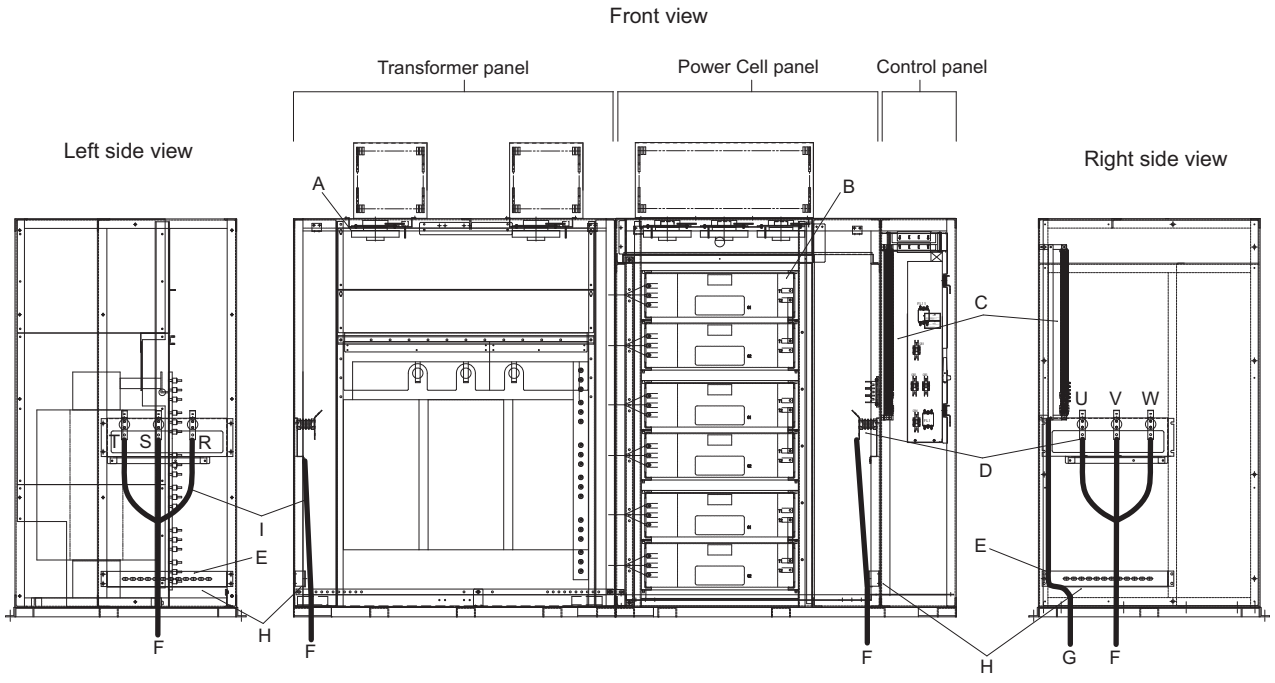
A – Cooling fan
B – Power Cell
C – Control circuit terminal
D – Main circuit output terminals U, V, and W
E – Cable bracket clamp
F – Main circuit cable
G – Control circuit cable
H – Cable bracket
I – Main circuit input terminals R, S, and T

Figure 3.11 Cable Routing (Drive: 2 kV Class, 700 HP)



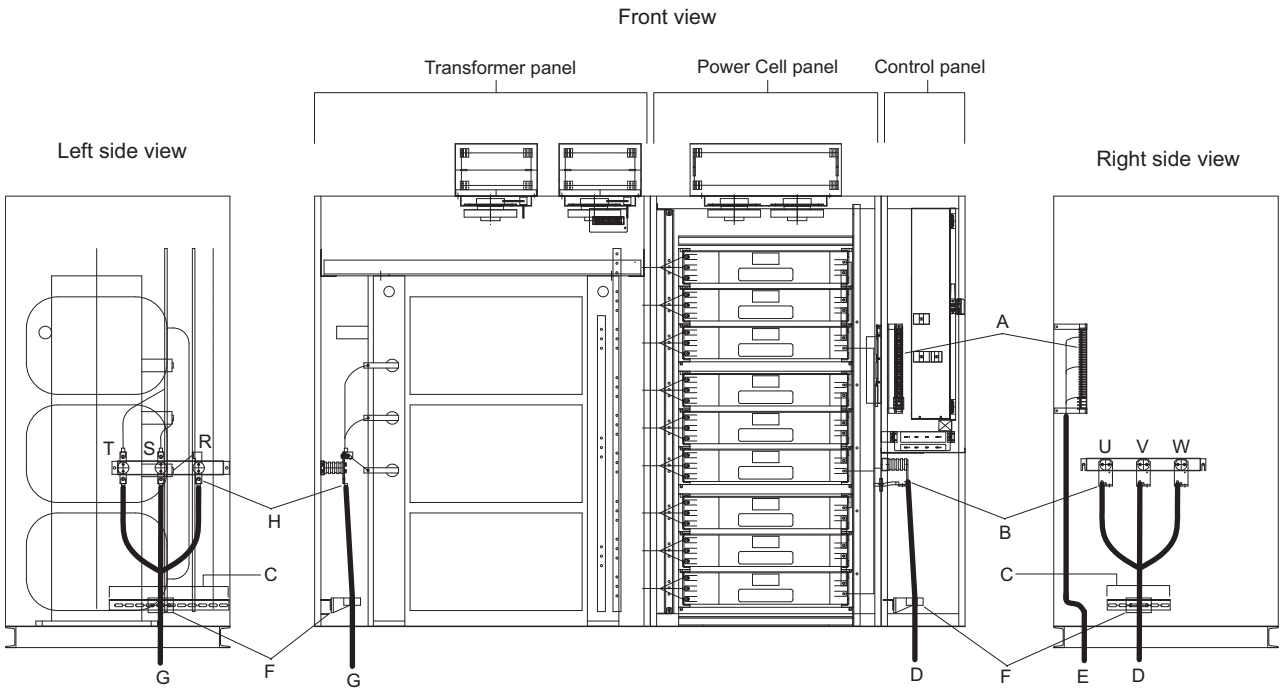
A – Control circuit terminal
B – Output side main circuit terminals U, V, and W
C – Output side main circuit cable
D – Control circuit cable
E – Input side main circuit cable
F – Cable bracket
G – Cable bracket clamp
H – Input side main circuit terminals R, S, and T

Figure 3.12 Cable Routing (Drive: 3 kV Class, 800 kVA)



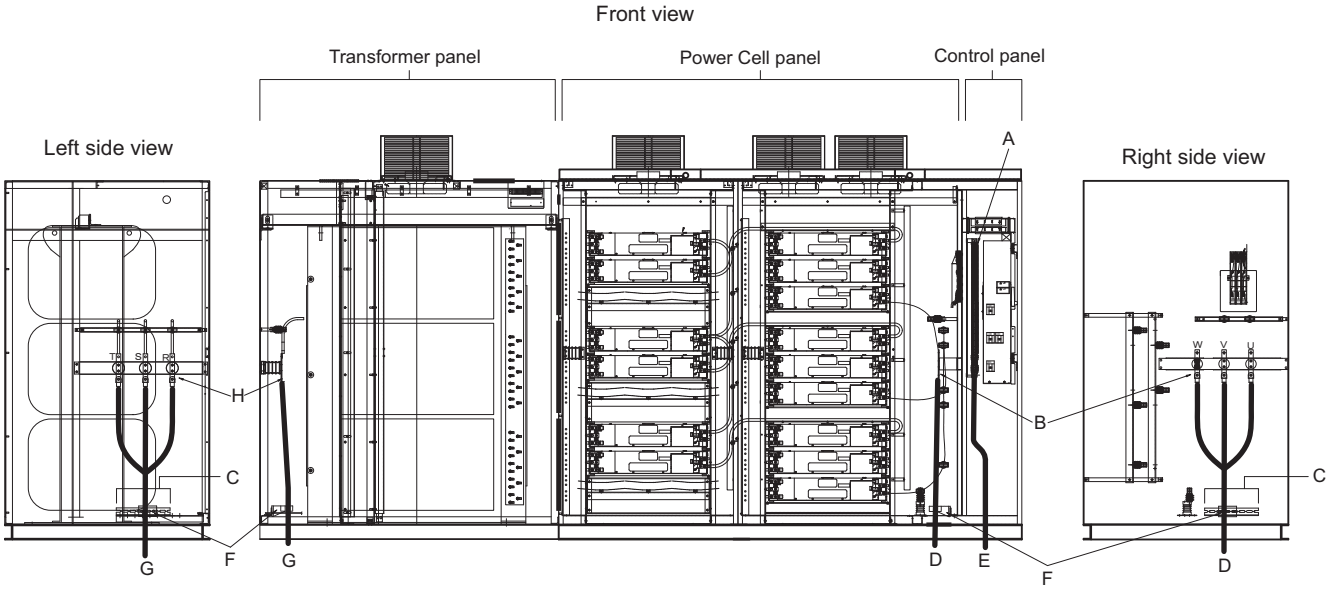
A – Cooling fan
B – Power Cell
C – Control circuit terminal
D – Main circuit output terminals U, V, and W
E – Cable bracket clamp
F – Main circuit cable
G – Control circuit cable
H – Cable bracket
I – Main circuit input terminals R, S, and T

Figure 3.13 Cable Routing (Drive: 4 kV Class, 1250 HP)



A – Control circuit terminal
B – Output side main circuit terminals U, V, and W
C – Cable bracket clamp
D – Output side main circuit cable
E – Control circuit cable
F – Cable bracket
G – Input side main circuit cable
H – Input side main circuit terminals R, S, and T

Figure 3.14 Cable Routing (Drive: 6 kV Class, 1600 kVA)

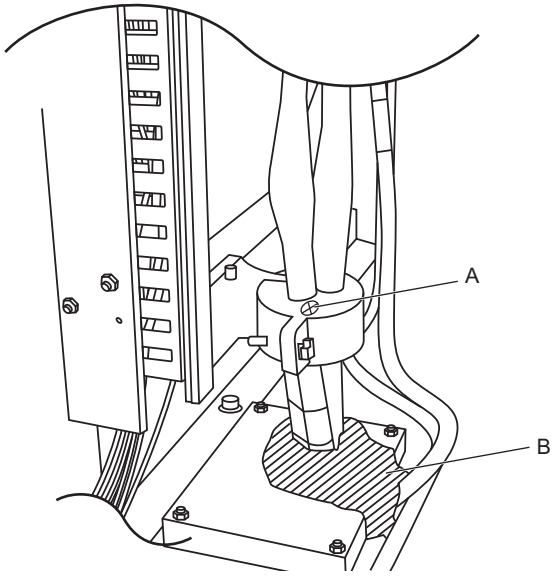


A – Control circuit terminal
B – Output side main circuit terminals U, V, and W
C – Cable bracket clamp
D – Output side main circuit cable
E – Control circuit cable
F – Cable bracket
G – Input side main circuit cable
H – Input side main circuit terminals R, S, and T

Figure 3.15 Cable Routing (Drive: 11 kV Class, 2650 kVA)

◆ Cable Routing Precautions

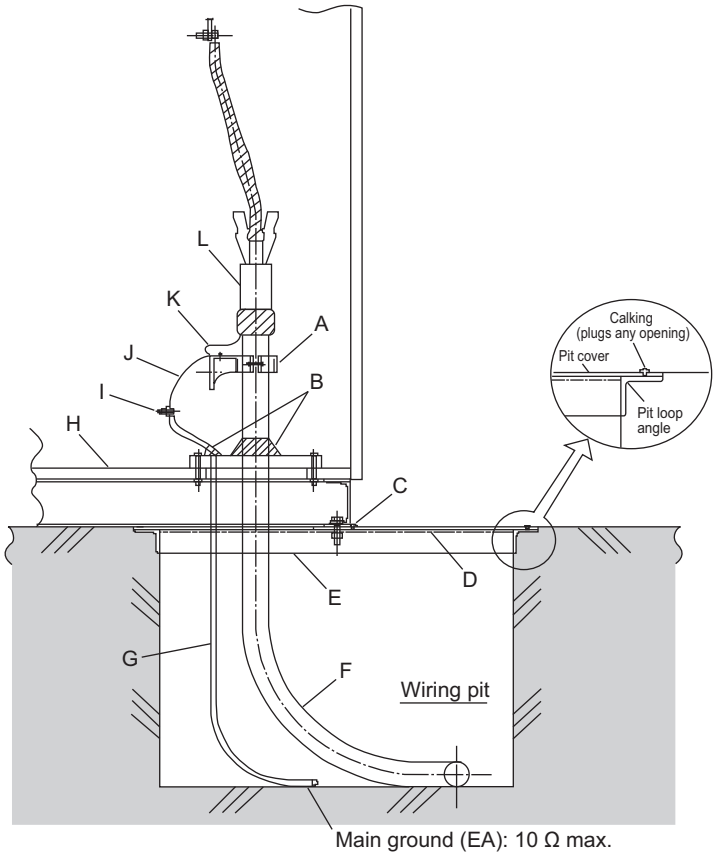
NOTICE: *The area where the cables enter the bottom of the drive should be tightly sealed with fire-resistant putty so that no open space remains. Make sure the entire peripheral areas around the channel base and the pit cover are tightly sealed with the putty so that no opening remains. A proper operating environment cannot be maintained if air or dust from the outside makes its way into the drive, and can result in damage to the equipment.*



A – Bracket grounding terminal

B – Completely seal the external cable inlet port with fire-resistant putty so no open space remains

Figure 3.16 External Cable Inlet Port



A – Bracket
B – Fire-resistant putty
C – Calking (plugs any opening)
D – Pit cover (plugs any opening)
E – Panel support base
F – Cable
G – Ground wire EA
H – Base of enclosure panel
I – Grounding bar
J – Bracket ground
K – Shield ground
L – Cable terminal control

Figure 3.17 Area Around the Drive Channel Base and Pit Cover

3.5 Main Circuit Wiring

This section describes the functions, specifications, and procedures required to safely and properly wire the main circuit in the drive.

NOTICE: *Equipment Hazard. Do not solder the ends of wire connections to the drive. Improper wiring practices could result in drive malfunction due to loose terminal connections.*

◆ Main Circuit Terminals (Common to All Capacities)

■ Input Terminals

Table 3.1 Main Circuit Input Terminals

Terminal Code	Terminal Name	Specifications
R	Main circuit phase-R input	Main circuit AC three-phase inputs 2.4 kVac 3.0/3.3 kVac 4.16 kVac 6.0/6.6 kVac 10.5/11 kVac 50 Hz/60 Hz
S	Main circuit phase-S input	
T	Main circuit phase-T input	

■ Output Terminals

Table 3.2 Main Circuit Output Terminals

Terminal Code	Terminal Name	Specifications
U	Main circuit phase-U output	Main circuit AC three-phase outputs (sinusoidal wave, proportional to input voltage) 2.4 kVac 3.0/3.3 kVac 4.16 kVac 6.0/6.6 kVac 10.5/11 kVac 50 Hz/60 Hz
V	Main circuit phase-V output	
W	Main circuit phase-W output	

NOTICE: *Do not short circuit the drive output terminals or connect the power supply lines to output terminals U, V and W of the drive. Incorrect wiring can result in damage to the drive. Carry out wiring that conforms to the wire gauges and tightening torques described in this manual. Conduct a thorough check of wiring and sequences before turning the power on.*

NOTICE: *Select a main circuit power supply with a capacity larger than that of the drive to be connected. Inputs and outputs of the drive (main circuit) contain harmonic components that may adversely affect communication devices, such as AM radios, used in the vicinity. Use high-voltage cables and ground any shielded cables. Separate cables for control from high-current circuits (main circuit and relay sequence circuits) to avoid induction from peripheral devices. (It is advisable to separate them by a distance of 30 cm or more.)*

◆ Wire Gauges and Tightening Torques

Use the tables in this section to select the appropriate wires and crimp terminals.

- Consider the voltage drop when selecting wire gauges. Increase the wire gauge when the voltage drop is greater than 2% of motor rated voltage. Ensure the wire gauge is suitable for the terminal block. Use the following formula to calculate the amount of voltage drop:

Line drop voltage (V) = $\sqrt{3}$ × wire resistance (Ω/km) × wire length (m) × motor rated current (A) × 10^{-3}

Note: The following conditions are assumed about the operating environment of the recommended wires for main circuit use: ambient temperature of 40°C maximum, wiring distance less than 100 m, and used at the rated current value.

■ Class: 2 kV

Table 3.3 Wire Gauge and Torque Specifications (Class: 2 kV)

Voltage Class (kV)	Model CIMR-MV2□A□A□	Rated Output Current (A)	Terminal		Terminal Screw Size	Tightening Toque (N•m)	Applicable Wire Size (mm^2)
			Function	Code			
2	052 <1>	52	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	22 to 100
		60	Ground	EA	M8	8.9 to 10.8	5.5 to 14
	058 <1>	58	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	22 to 100
		80	Ground	EA	M8	8.9 to 10.8	5.5 to 14
	077 <1>	77	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	38 to 100
		125	Ground	EA	M8	8.9 to 10.8	5.5 to 14
	093 <1>	93	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	38 to 100
		125	Ground	EA	M8	8.9 to 10.8	5.5 to 14
	102 <1>	102	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	38 to 100
		125	Ground	EA	M8	8.9 to 10.8	5.5 to 14
	115 <1>	115	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	38 to 100
		150	Ground	EA	M8	8.9 to 10.8	22 to 60
	135 <1>	135	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	38 to 100
		150	Ground	EA	M8	8.9 to 10.8	22 to 60
	160 <1>	160	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	38 to 100
		200	Ground	EA	M10	18.0 to 23.0	22 to 60
	180 <1>	180	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	38 to 100
		200	Ground	EA	M10	18.0 to 23.0	22 to 60
	205 <1>	205	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	60 to 100
		300	Ground	EA	M10	18.0 to 23.0	22 to 150
	220 <1>	220	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	60 to 100
		300	Ground	EA	M10	18.0 to 23.0	22 to 150
	280 <1>	280	I/O	R, S, T, U, V, W	M12	31.5 to 39.5	150 to 325
		400	Ground	EA	M12	31.5 to 39.5	60 to 200
	330 <1>	330	I/O	R, S, T, U, V, W	M12	31.5 to 39.5	150 to 325
		400	Ground	EA	M12	31.5 to 39.5	60 to 200
	390 <1>	390	I/O	R, S, T, U, V, W	M12	31.5 to 39.5	150 to 325
		400	Ground	EA	M12	31.5 to 39.5	60 to 200

Voltage Class (kV)	Model CIMR-MV2□A□A□	Rated Output Current (A)	Terminal		Terminal Screw Size	Tightening Toque (N•m)	Applicable Wire Size (mm^2)
			Function	Code			
2	440 <1>	440	I/O	R, S, T, U, V, W	M12	31.5 to 39.5	150 to 325
		600	Ground	EA	M16	78.5 to 98.0	150 to 325
	505 <1>	505	I/O	R, S, T, U, V, W	M12	31.5 to 39.5	150 to 325
		600	Ground	EA	M16	78.5 to 98.0	150 to 325
	550 <1>	550	I/O	R, S, T, U, V, W	M16	78.5 to 98.0	150 to 325
		800	Ground	EA	M16	78.5 to 98.0	150 to 325
	600 <1>	600	I/O	R, S, T, U, V, W	M16	78.5 to 98.0	150 to 325
		800	Ground	EA	M16	78.5 to 98.0	150 to 325

<1> Under development

■ Class: 3 kV

Table 3.4 Wire Gauge and Torque Specifications (Class: 3 kV)

Voltage Class (kV)	Model CIMR-MV2□C□C□	Rated Output Current (A)	Terminal		Terminal Screw Size	Tightening Toque (N•m)	Applicable Wire Size (mm^2)
			Function	Code			
3	035	35	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	22 to 100
			Ground	EA	M8	8.9 to 10.8	5.5 to 14
	050	50	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	22 to 100
			Ground	EA	M8	8.9 to 10.8	5.5 to 14
	070	70	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	22 to 100
			Ground	EA	M8	8.9 to 10.8	5.5 to 22
	100	100	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	38 to 100
			Ground	EA	M8	8.9 to 10.8	5.5 to 38
	140	140	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	38 to 100
			Ground	EA	M8	8.9 to 10.8	22 to 60
	200	200	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	38 to 100
			Ground	EA	M10	18.0 to 23.0	22 to 100
	260	260	I/O	R, S, T, U, V, W	M12	31.5 to 39.5	60 to 100
			Ground	EA	M10	18.0 to 23.0	22 to 150
	330	330	I/O	R, S, T, U, V, W	M12	31.5 to 39.5	150 to 325
			Ground	EA	M12	31.5 to 39.5	60 to 200
	400	400	I/O	R, S, T, U, V, W	M12	31.5 to 39.5	150 to 325
			Ground	EA	M12	31.5 to 39.5	60 to 200
	520	520	I/O	R, S, T, U, V, W	M16	78.5 to 98.0	150 to 325
			Ground	EA	M16	78.5 to 98.0	150 to 325
	650	650	I/O	R, S, T, U, V, W	M16	78.5 to 98.0	150 to 325
			Ground	EA	M16	78.5 to 98.0	150 to 325

■ Class: 4 kV

Table 3.5 Wire Gauge and Torque Specifications (Class: 4 kV)

Voltage Class (kV)	Model CIMR-MV2□D□D□	Rated Output Current (A)	Terminal		Terminal Screw Size	Tightening Torque (N•m)	Applicable Wire Size (mm^2)
			Function	Code			
4	052	52	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	22 to 100
		60	Ground	EA	M8	8.9 to 10.8	5.5 to 14
	058	58	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	22 to 100
		80	Ground	EA	M8	8.9 to 10.8	5.5 to 14
	064	64	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	22 to 100
		80	Ground	EA	M8	8.9 to 10.8	5.5 to 14
	077	77	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	38 to 100
		125	Ground	EA	M8	8.9 to 10.8	5.5 to 38
	093	93	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	38 to 100
		125	Ground	EA	M8	8.9 to 10.8	5.5 to 38
	102	102	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	38 to 100
		125	Ground	EA	M8	8.9 to 10.8	5.5 to 38
	115	115	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	38 to 100
		150	Ground	EA	M8	8.9 to 10.8	22 to 60
	125	125	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	38 to 100
		150	Ground	EA	M8	8.9 to 10.8	22 to 60
	155	155	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	38 to 100
		200	Ground	EA	M10	18.0 to 23.0	22 to 100
	190	190	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	38 to 100
		200	Ground	EA	M10	18.0 to 23.0	22 to 100
	220 <I>	220	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	60 to 100
		300	Ground	EA	M10	18.0 to 23.0	22 to 150
	250 <I>	250	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	60 to 100
		300	Ground	EA	M10	18.0 to 23.0	22 to 150
	285 <I>	285	I/O	R, S, T, U, V, W	M12	31.5 to 39.5	150 to 325
		400	Ground	EA	M12	31.5 to 39.5	60 to 200
	315 <I>	315	I/O	R, S, T, U, V, W	M12	31.5 to 39.5	150 to 325
		400	Ground	EA	M12	31.5 to 39.5	60 to 200
	340 <I>	340	I/O	R, S, T, U, V, W	M12	31.5 to 39.5	150 to 325
		400	Ground	EA	M12	31.5 to 39.5	60 to 200
	375 <I>	375	I/O	R, S, T, U, V, W	M12	31.5 to 39.5	150 to 325
		400	Ground	EA	M12	31.5 to 39.5	60 to 200

Voltage Class (kV)	Model CIMR-MV2□D□D□	Rated Output Current (A)	Terminal		Terminal Screw Size	Tightening Torque (N•m)	Applicable Wire Size (mm^2)
			Function	Code			
4	440 <1>	440	I/O	R, S, T, U, V, W	M12	31.5 to 39.5	150 to 325
		600	Ground	EA	M16	78.5 to 98.0	150 to 325
	505 <1>	505	I/O	R, S, T, U, V, W	M12	31.5 to 39.5	150 to 325
		600	Ground	EA	M16	78.5 to 98.0	150 to 325
	575 <1>	575	I/O	R, S, T, U, V, W	M16	78.5 to 98.0	150 to 325
		800	Ground	EA	M16	78.5 to 98.0	150 to 325
	625 <1>	650	I/O	R, S, T, U, V, W	M16	78.5 to 98.0	150 to 325
		800	Ground	EA	M16	78.5 to 98.0	150 to 325

<1> Under development

■ Class: 6 kV

Table 3.6 Wire Gauge and Torque Specifications (Class: 6 kV)

Voltage Class (kV)	Model CIMR-MV2□F□F□	Rated Output Current (A)	Terminal		Terminal Screw Size	Tightening Toque (N•m)	Applicable Wire Size (mm^2)
			Function	Code			
6	035	35	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	22 to 100
			Ground	EA	M8	8.9 to 10.8	5.5 to 14
	050	50	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	22 to 100
			Ground	EA	M8	8.9 to 10.8	5.5 to 14
	070	70	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	22 to 100
			Ground	EA	M8	8.9 to 10.8	5.5 to 22
	100	100	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	38 to 100
			Ground	EA	M8	8.9 to 10.8	5.5 to 38
	140	140	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	38 to 100
			Ground	EA	M8	8.9 to 10.8	22 to 60
	200	200	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	38 to 100
			Ground	EA	M10	18.0 to 23.0	22 to 100
	260	260	I/O	R, S, T, U, V, W	M12	31.5 to 39.5	60 to 100
			Ground	EA	M10	18.0 to 23.0	22 to 150
	330	330	I/O	R, S, T, U, V, W	M12	31.5 to 39.5	150 to 325
			Ground	EA	M12	31.5 to 39.5	60 to 200
	400	400	I/O	R, S, T, U, V, W	M12	31.5 to 39.5	150 to 325
			Ground	EA	M12	31.5 to 39.5	60 to 200
	520	520	I/O	R, S, T, U, V, W	M16	78.5 to 98.0	150 to 325
			Ground	EA	M16	78.5 to 98.0	150 to 325
	650	650	I/O	R, S, T, U, V, W	M16	78.5 to 98.0	150 to 325
			Ground	EA	M16	78.5 to 98.0	150 to 325

■ Class: 11 kV

Table 3.7 Wire Gauge and Torque Specifications (Class: 11 kV)

Voltage Class (kV)	Model CIMR-MV2□H□H□	Rated Output Current (A)	Terminal		Terminal Screw Size	Tightening Toque (N•m)	Applicable Wire Size (mm^2)
			Function	Code			
11	035	35	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	22 to 100
			Ground	EA	M8	8.9 to 10.8	5.5 to 14
	050	50	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	22 to 100
			Ground	EA	M8	8.9 to 10.8	5.5 to 14
	070	70	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	22 to 100
			Ground	EA	M8	8.9 to 10.8	5.5 to 22
	100	100	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	38 to 100
			Ground	EA	M8	8.9 to 10.8	5.5 to 38
	140	140	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	38 to 100
			Ground	EA	M8	8.9 to 10.8	22 to 60
	200	200	I/O	R, S, T, U, V, W	M10	18.0 to 23.0	38 to 100
			Ground	EA	M10	18.0 to 23.0	22 to 100
	260 <1>	260	I/O	R, S, T, U, V, W	M12	31.5 to 39.5	60 to 100
			Ground	EA	M10	18.0 to 23.0	22 to 150
	330 <1>	330	I/O	R, S, T, U, V, W	M12	31.5 to 39.5	150 to 325
			Ground	EA	M12	31.5 to 39.5	60 to 200
	400 <1>	400	I/O	R, S, T, U, V, W	M12	31.5 to 39.5	150 to 325
			Ground	EA	M12	31.5 to 39.5	60 to 200
	520 <1>	520	I/O	R, S, T, U, V, W	M16	78.5 to 98.0	150 to 325
			Ground	EA	M16	78.5 to 98.0	150 to 325
	650 <1>	650	I/O	R, S, T, U, V, W	M16	78.5 to 98.0	150 to 325
			Ground	EA	M16	78.5 to 98.0	150 to 325

<1> Under development

◆ Main Circuit Terminal and Motor Wiring

This section outlines the various steps, precautions, and checkpoints for wiring the main circuit terminals and motor terminals.

Make the input and output terminal connections correctly, according to applicable codes.

⚠ **DANGER!** *Do not touch the input and output terminals directly with your hands and do not bring the input and output wires into contact with the drive case or metal parts. In addition, do not short circuit the output wires. Incorrect wiring could lead to serious injury or death by an electric shock or grounding fault.*

NOTICE: *Connect input terminals U, V and W of the motor to output terminals U, V and W of the drive, pairing the terminal codes. The phase orders of the motor terminals and drive terminals should also match. The motor may run in reverse if the phase orders do not match.*

NOTICE: *Do not connect the AC power line to the output terminals of the drive. Failure to comply could result in serious injury or death by fire as a result of drive damage.*

■ Cable Length Between Drive and Motor

Voltage drop along the motor cable may cause reduced motor torque when the wiring between the drive and the motor is too, especially at low frequency output. This can also be a problem when motors are connected in parallel with a long total cable length. Drive output current will increase as the harmonic leakage current from the cable increases. An increase in leakage current may trip the drive due to an overcurrent and diminish the current detection accuracy.

■ Connections Between Drive and Motor

Match the codes and connect motor lead wires U, V, and W to the drive main circuit output terminals U, V, and W.

Confirm that the motor rotates in the forward direction on execution of the forward Run command. If the motor rotates in reverse, check the codes of the drive output terminals and the motor input terminals, then switch over any two of the motor output terminals U, V and W. When using a motor with a PG, also switch phases-A and -B output signals, using the cable wire specified by Yaskawa when connecting the drive and the PG circuit. Refer to ***Motor Rotates in the Opposite Direction from the Run Command on page 185*** for details.

■ Ground Wiring

Carefully follow the precautions below to correctly ground drives.

⚠ **WARNING!** *Electrical Shock Hazard. Use a ground wire of a gauge that complies with the technical standards for electrical equipment in the country where the drive is being used. Keep the wiring as short as possible. Improper equipment grounding could cause leakage current to flow to the drive. If so, the potential of the drive's ground terminals becomes unstable at some distance from the grounding point, resulting in serious injury or death.*

⚠ **WARNING!** *Electrical Shock Hazard. Always ground the ground terminals. Also be sure to carry out the following grounding work. Improper equipment grounding could result in serious injury or death by an electric shock through contact with ungrounded electrical equipment.*
- *Ground terminals (EA): Grounding resistance of 10 Ω or less*
- *Ground terminals (ED): Grounding resistance of 100 Ω or less*

NOTICE: *Do not share the ground wire with other devices such as welding machines or large-current electrical equipment. Improper grounding could result in drive or equipment malfunction.*

NOTICE: *When using more than one drive, follow the instructions in this manual and ensure that the ground wires do not form a loop. Improper grounding could result in drive or equipment malfunction.*

Refer to ***Figure 3.18*** when using multiple drives. Do not loop the ground wire.

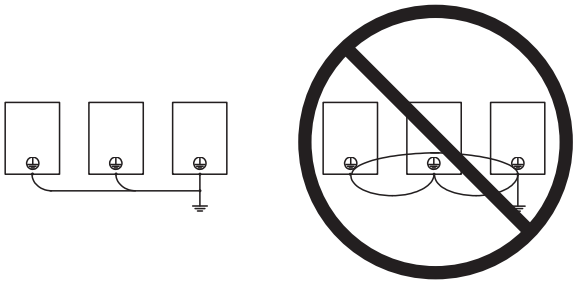


Figure 3.18 Multiple Drive Ground Wiring

3.6 Control Circuit Wiring

◆ Control Circuit Terminals

⚠**WARNING!** *Sudden Movement Hazard. After an emergency stop circuit has been wired, check to make sure that it is operating properly. Emergency stop circuits are needed to safely and quickly stop the operation of the drive. Operating a drive with an emergency stop circuit whose operation has not been checked could result in serious injury or death.*

⚠**WARNING!** *Confirm the drive I/O signals and external sequence before starting the test run. Failure to comply may result in or serious injury or death.*

■ Analog Input and Output Terminals

Table 3.8 Analog Input and Output Terminals

Type	Terminal	Signal Name	Signal Level	Terminal Function
Analog input terminals	L1	Speed (frequency) reference	4 to 20 mA DC, 0 to 60 Hz	Speed (frequency) reference input signal
	L2			Ground
	L3			Shield ground
Analog output terminals	L4	Output frequency	4 to 20 mA DC, 0 to 60 Hz	Output frequency reference output signal
	L5			Ground
	L6			Shield ground
	L7	Output current	4 to 20 mA DC, 0 to 100%	Output frequency reference output signal
	L8			Ground
	L9			Shield ground

■ Contact Input and Output Terminals

Table 3.9 Contact Input and Output Terminals

Type	Terminal	Signal Name	Signal Level	Terminal Function
Contact input terminals	1	Medium-voltage primary panel on	Contact input Single-phase, 220 Vac/8 mA	ON: Turning on (closed at default)
	2			
	3	Operation interlock	Contact input Single-phase, 220 Vac/8 mA	ON: Established (closed at default)
	4			
	5	Reserved	–	–
	6			
	7	External fault reset	Contact input Single-phase, 220 Vac/8 mA	ON: Reset
	8			
	9	Reserved	–	–
	10			
	13	Run command/Stop command	Contact input Single-phase, 220 Vac/8 mA	ON: Run
	14			
	15			OFF: Stop
	44	Reserved	–	–
	45			

Type	Terminal	Signal Name	Signal Level	Terminal Function
Contact output terminals	30	Major fault	Form-C contact relay Single-phase, 220 Vac/15 A, Single-phase, 110 Vac/15 A, 24 Vdc/15 A	Open: Major fault (32-31) Closed: Major fault (32-30)
	31			
	32			
	33	During run	Form-C contact relay Single-phase, 220 Vac/15 A, Single-phase, 110 Vac/15 A, 24 Vdc/15 A	Closed: During run (35-33) Open: During run (35-34)
	34			
	35			
	36	Drive ready	Form-C contact relay Single-phase, 220 Vac/15 A, Single-phase, 110 Vac/15 A, 24 Vdc/15 A	Closed: Drive ready (38-36) Open: Drive ready (38-37)
	37			
	38			
	39	Minor fault	N.O. contact relay Single-phase, 220 Vac/15 A, Single-phase, 110 Vac/15 A, 24 Vdc/15 A	Closed: Minor fault
	40			
	41	Medium-voltage power shutdown	Form-C contact relay 220Vac/55 A, 110 Vac/60 A 220 Vdc/1.5 A, 110 Vdc/5 A	Turning off (Contact state during power off time) Closed: Power turning OFF (41-42) Open: Power turning OFF (41-43)
	42			
	43			
	44	Reserved	–	–
	45			
	91	Door interlock	–	–
	92			
Terminals for inrush current suppression circuit	26	Inrush current suppression circuit (Option)	N.O. contact relay output Single-phase, 220 Vac/10 A, 24 Vdc/10 A	MC_ON signal (Output in response to Drive Ready)
	28			
	27		N.C. contact relay output Single-phase, 220 Vac/10 A, 24 Vdc/10 A	
	28			
	L47		Contact input Single-phase, 220 Vac/8 mA	MC_ANS signal (Closed by answer from inrush current suppression panel)
	L48			
Terminals for the PG <1>	L19	Line driver PG interface PG-X3 (Option)	A pulse signal input	Inputs the A and B signals Signal levels: Equivalent to RS-422
	L20		A inverse signal input	
	L21		B pulse signal input	
	L22		B inverse signal input	
	L23		PG power supply	Output voltage: 12 V ± 5% or 5.5 V ± 5% Max. output current: 200 mA
	L24		PG power supply common	
	L25		Ground	Grounds shielded lines
	L19	Complementary type PG interface PG-B3 (Option)	A+ pulse signal input	Inputs the A and B channel Signal levels: High level: 8 to 12 V Low level: 2.0 V or less
	L20		A- pulse signal input	
	L21		B+ pulse signal input	
	L22		B- pulse signal input	
	L23		PG power supply	Output voltage: 12 V ± 5% Max. output current: 200 mA
	L24		PG power supply common	
	L25		Ground	Grounds shielded lines
Terminals for the MEMOBUS/ Modbus communications	L71	MEMOBUS/Modbus communications (Option)	R+	RS-485
	L72		R-	
	L73		S+	
	L74		S-	

<1> When a PG interface options is installed, only one type, either a line driver PG interface or a complementary type PG interface may be chosen for use.

Note: Depending on parameter settings, either one or two boards can be inserted. In this table, it is assumed that one board is inserted.

■ Control Power Supply Input Terminals

Table 3.10 Control Power Supply Input Terminals

Type	Terminal	Terminal Function
Control power supply input terminal	RC	Single-phase 200/220 Vac 50/60 Hz
	SC	
Ground terminal	ED	Grounding of the control system

◆ Control Circuit Terminal Layout and Specifications

The control circuit terminals are arranged on a terminal block as shown in *Figure 3.19*.

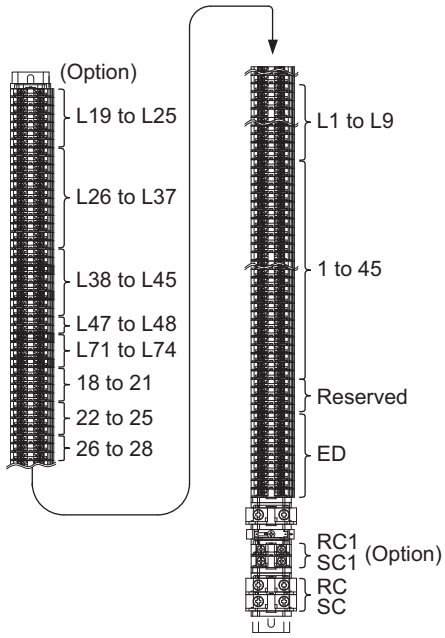


Figure 3.19 Terminal Configuration

■ Wire Gauges and Tightening Torque

Select appropriate wire type and gauges from *Table 3.11*.

Table 3.11 Wire Gauges and Torque Specifications

Terminal Type	Terminal	Screw Size	Tightening Torque (N•m)	Applicable Gauge (mm^2)	Recommended Gauge (mm^2)	Wire Type
Analog input and output terminals	L1 to L9	M3.5	0.8 to 1.0	0.5 to 2 <2>	1.25	Shielded twisted-pair wire <1>
Contact input and output terminals	1 to 45	M3.5	0.8 to 1.0	0.5 to 2 <2>	1.25	Insulated vinyl sheathed cable (CVV) for control circuit
Terminals for inrush current suppression circuit	26 to 28 L47 to L48	M3.5	0.8 to 1.0	0.5 to 2 <2>	1.25	Insulated vinyl sheathed cable (CVV) for control circuit
Control power supply input terminals	RC SC	M5	2 to 2.5	8 to 14 <2>	8	600-V insulated vinyl sheathed cable (VV)
Ground input terminals	ED	M5	2 to 2.5	8 to 14 <2>	8	600-V insulated vinyl sheathed cable (VV)
Terminals for the PG	L19 to L25	M3.5	0.8 to 1.0	0.5 to 2 <2>	1.25	Shielded twisted-pair wire <1>
Terminals for monitor of motor windings	18 to 21 L26 to L37	M3.5	0.8 to 1.0	0.5 to 2 <2>	1.25	Insulated vinyl sheathed cable (CVV) for control circuit

Terminal Type	Terminal	Screw Size	Tightening Torque (N•m)	Applicable Gauge (mm^2)	Recommended Gauge (mm^2)	Wire Type
Terminals for monitor of motor bearing	22 to 25 L38 to L45	M3.5	0.8 to 1.0	0.5 to 2 <2>	1.25	Insulated vinyl sheathed cable (CVV) for control circuit
Terminals for MEMOBUS/ Modbus communications	L71 to L74	M3.5	0.8 to 1.0	0.5 to 2 <2>	1.25	Shielded twisted-pair wire <1>

<1> Use shielded twisted-pair wires to input an external speed (frequency) reference.
<2> The size of the round crimp terminals must meet the standards in the country where the drive is being used.

◆ Wiring the Control Circuit Terminal

Observe the following precautions when wiring control circuits.

- Use shielded twisted-pair wires for analog I/O (terminals L1 to L9) wirings to prevent malfunctions caused by electrical noise.
- Tighten all terminal screws to the specified tightening torque. Refer to ***Table 3.11*** for details.
- Use round crimp terminals to connect signal wires to the terminal block.
- Use a Phillips screwdriver to tighten terminal screws.

⚠ **WARNING!** *Electrical Shock Hazard. Do not touch circuit boards while the power is on. Failure to comply could result in serious injury or death.*

NOTICE: *When wiring the control circuit, separate it from the main circuit wiring (terminals R, S, T, U, V and W) and other power lines. Improper grounding could result in drive malfunction.*

NOTICE: *Insulate the shielded wires of the drive, e.g. with tape, to prevent their contact with other signal lines or devices. Failure to comply could result in drive or equipment malfunction due to short circuit.*

3.7 Connecting to a PC

This drive is equipped with a USB port (Type-B).
The drive can connect to the USB port on a PC using a USB 2.0, AB type cable (sold separately). Use a USB repeater in order to suppress the effect of electrical interference.

USB Repeaters with Confirmed Functionality:

- USB2-EXA50 (ELECOM)
- KB-USB-R205 (Sanwa Supply)

After connecting the drive to a PC, Yaskawa DriveWizard Plus MV can be used to monitor drive performance and manage parameter settings. For details, refer to the instruction manual for DriveWizard Plus MV.

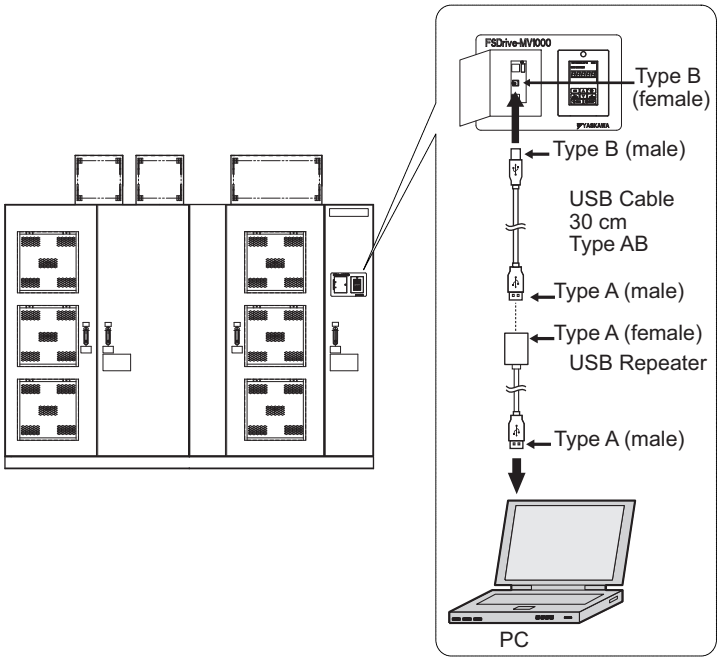


Figure 3.20 Connecting to a PC (USB)

3.8 External Interlock

Systems that may be affected during drive fault conditions should be interlocked with the drive fault output and ready signal.

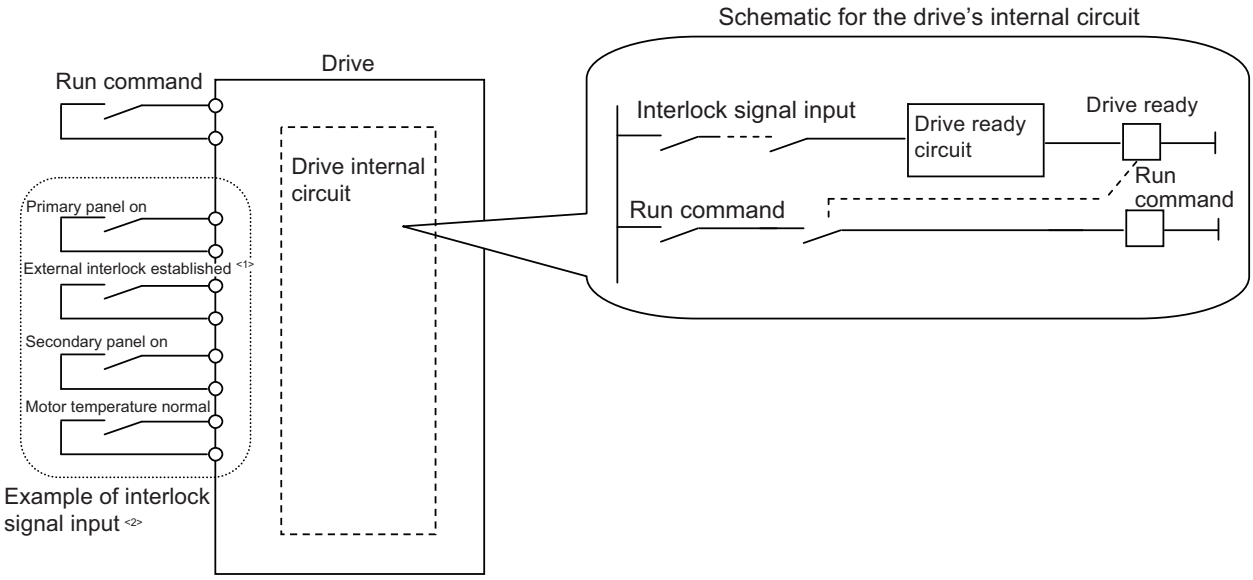
◆ Drive Ready

When the “Drive ready” signal has been set to one of the multi-function contact outputs, that output will close whenever the drive is ready to accept a Run command or is already running. Under the following conditions the Drive ready signal will switch off and remain off, even if a Run command is present:

- when the power supply is shut off
- during a fault
- when there is problem with the control power supply
- when a parameter setting error makes the drive unable to run even if a Run command has been entered
- when a fault such as overvoltage or undervoltage is triggered as soon as the Run command is entered
- when the drive is in the Programming mode and will not accept a Run command even when entered

■ Interlock Circuit Example

In some cases external signals other than the configuration signals of the drive are required as a condition for the drive to run.
In such cases, in addition to the ready conditions stated above, input these external interlock signals to the drive to use them as external interlock signals.
If any condition for these external interlock signals is not satisfied, the drive stops.
An example circuit configuration is shown in ***Figure 3.21***.



<1> “External interlock” signifies conditions where machinery or equipment could be damaged if the drive or motor is run outside the scope of its specifications.
<2> Always allocate necessary signals for protecting the system as external interlock signals.
Examples: Machine lubrication unit normal (N.O. contact) or emergency stop normal (N.O. contact).

Figure 3.21 Interlock Circuit Example

3.9 Wiring Check

◆ Checks

After wiring work, check that all wiring has been completed. Do not perform a buzzer check on control circuits. Confirm the following items.

- All wiring is correct.
- No foreign matter or unnecessary screws remain.
- There are no loose screws.
- No wire ends have contact with terminals to which they are not intended.
- The terminal numbers and cable lead names match.

4

Start-Up Programming & Operation

This chapter describes the functions of the digital operator and how to program the drive for initial operation.

4.1 SECTION SAFETY 108
4.2 USING THE DIGITAL OPERATOR 109
4.3 THE DRIVE AND PROGRAMMING MODES 113
4.4 START-UP FLOWCHARTS 120
4.5 POWERING UP THE DRIVE 123
4.6 AUTO-TUNING 124
4.7 NO-LOAD OPERATION TEST RUN 130
4.8 TEST RUN WITH LOAD CONNECTED 132
4.9 CHECKING AND SAVING PARAMETER DEFAULT VALUES. 133

4.1 Section Safety

⚠ DANGER

Electrical Shock Hazard

Do not connect or disconnect wiring while the power for the main circuit and controls is on.

Failure to comply could result in serious injury or death.

Do not open the drive panel doors while main circuit power is on.

Incorrect handling could result in an electric shock. Make sure that the drive panel doors are closed before turning on the main circuit power.

The diagrams in this manual may be indicated with the doors open to show details. Be sure to close the doors before operating the drive and run the drive it in accordance with the instructions in this manual.

⚠ WARNING

Safety Measures at the Machine

Do not forget to include an emergency stop circuit in the application.

Failure to comply could result in serious injury or death. A communication error between the digital operator keypad and the drive's internal control board may make it impossible to stop the drive with the digital operator.

After an emergency stop circuit has been wired, check to make sure it is operating properly.

Failure to comply could result in serious injury or death. The emergency stop circuit may fail to operate if left unchecked. The user is fully responsible for properly wiring the emergency circuit.

Some systems may start moving in response to the supply of main circuit power alone, resulting in serious injury or death.

Make sure that there are no personnel around the drive, motor and machine before turning the main circuit power on. Also check that couplings with motors, shaft keys and machinery are properly protected.

4.2 Using the Digital Operator

Use the digital operator to enter Run and Stop commands, edit parameters, and display data including fault and alarm information.

◆ Keys and Displays

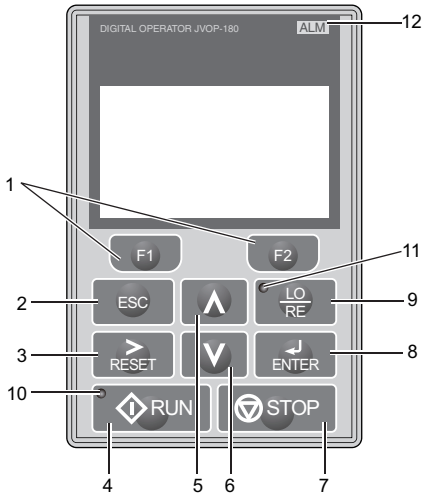


Figure 4.1 Keys and Displays on the Digital Operator

No.	Key	Name	Function
1	F1 F2	Function Key (F1, F2)	The functions assigned to F1 and F2 vary depending on the menu that is currently displayed. The name of each function appears in the lower half of the display window. Refer to *LCD Display on page 110* for the details of the functions assigned.
2	ESC	ESC Key	• Returns to the previous display. • Moves the cursor one space to the left. • Pressing and holding this button will return to the Frequency Reference display.
3	RESET	RESET Key	• Moves the cursor to the right. • Resets the drive to clear a fault situation.
4	RUN	RUN Key	Runs the drive in the LOCAL mode.
5		Up Arrow Key	• Scrolls up to display the next item. • Selects parameter numbers and increments setting values.
6		Down Arrow Key	• Scrolls down to display the next item. • Selects parameter numbers and decrements setting values.
7	STOP	STOP Key <1>	Stops drive operation.
8	ENTER	ENTER Key	• Enters parameter values and settings. • Selects a menu item to move between displays.
9	LO RE	LO/RE Selection Key <2>	Switches drive control between the digital operator (LOCAL) and the control circuit terminals (REMOTE).
10	RUN	RUN Light	Lit while the drive is operating the motor. Refer to *ALARM (ALM) LED Displays on page 111* for details.
11	LO RE	LO/RE Light	Lit while the digital operator is selected to run the drive (LOCAL mode).
12	ALM	ALM Light	Refer to *ALARM (ALM) LED Displays on page 111* for details.

<1> The STOP key has highest priority.
Pressing the STOP will always cause the drive to stop the motor, even if a Run command is active at any external Run command source. To disable the STOP key priority, set parameter o2-02 to 0.
<2> The LO/RE key can only switch between LOCAL and REMOTE when the drive is stopped.
To disable the LO RE key to prohibit switching between LOCAL and REMOTE, set parameter o2-01 to 0.

◆ LCD Display

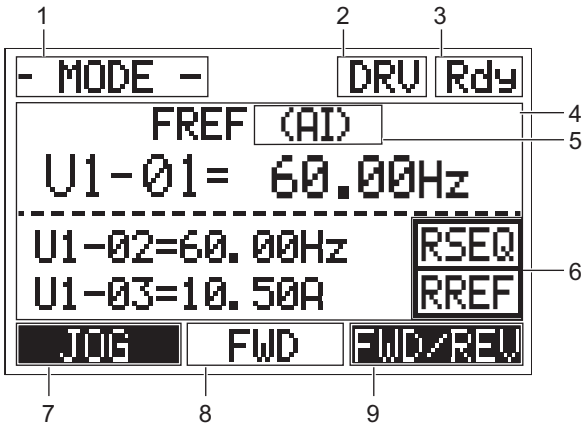


Figure 4.2 LCD Display

Table 4.1 Display and Contents

No.	Name	Display	Content
1	Operation Mode Menus	MODE	Displayed when in Mode Selection.
		MONITR	Displayed when in Monitor Mode.
		VERIFY	Indicates the Verify Menu.
		PRMSET	Displayed when in Parameter Setting Mode.
		A.TUNE	Displayed during Auto-Tuning.
		SETUP	Displayed when in Setup Mode.
2	Mode Display Area	DRV	Displayed when in Drive Mode.
		PRG	Displayed when in Programming Mode.
3	Ready	Rdy	Indicates the drive is ready to run.
4	Data Display	–	Displays specific data and operation data.
5	Frequency Reference Assignment <1>	OPR	Displayed when the frequency reference is assigned to the Digital Operator Option.
		AI	Displayed when the frequency reference is assigned to the drive's Analog Input of the drive.
		COM	Displayed when the frequency reference is assigned to the drive's MEMOBUS/Modbus Communication Inputs of the drive.
		OP	Displayed when the frequency reference is assigned to an drive Option Unit.
6	LO/RE Display <2>	RSEQ	Displayed when the run command is supplied from a remote source.
		LSEQ	Displayed when the run command is supplied from the digital operator keypad.
		RREF	Displayed when the frequency reference is supplied from a remote source.
		LREF	Displayed when the frequency reference is supplied from the digital operator keypad.
7	Function Key 1 (F1)	JOG	Pressing F1 executes the Jog function.
		HELP	Pressing F1 displays the Help menu.
		←	Pressing F1 scrolls the cursor to the left.
		HOME	Pressing F1 returns to the top menu (Frequency Reference).
		ESC	Pressing F1 returns to the previous display.
8	FWD/REV	FWD	Indicates forward motor operation.
		REV	Indicates reverse motor operation.
9	Function Key 2 (F2)	FWD/REV	Pressing F2 switches between forward and reverse.
		DATA	Pressing F2 scrolls to the next display.
		→	Pressing F2 scrolls the cursor to the right.
		RESET	Pressing F2 resets the existing drive fault or error.

<1> Displayed when in Frequency Reference Mode.
<2> Displayed when in Frequency Reference Mode and Monitor Mode.

◆ ALARM (ALM) LED Displays

Table 4.2 ALARM (ALM) LED Status and Contents

State	Content	Display
Illuminated	When the drive detects an error.	
Flashing	• When an alarm occurs. • When oPE is detected. • When a fault or error occurs during Auto-Tuning.	
Off	Normal operation (no fault or alarm).	

◆ LO/RE LED and RUN LED Indications

Table 4.3 LO/RE LED and RUN LED Indications

LED	Lit	Flashing	Flashing Quickly <1>	Off
	When the operator is selected for Run command and frequency reference control (LOCAL).	–	–	When a device other than the operator is selected for Run command and frequency reference control (REMOTE).
	During run	• During deceleration to stop • When a Run command is input and frequency reference is 0 Hz	• Decelerating for emergency stop • During stop by operation interlock • While the drive was set to LOCAL, a Run command was entered to the input terminals then the drive was switched to REMOTE. • A Run command was entered via the input terminals while the drive was not in Drive Mode. • During deceleration when a Fast Stop command was entered. • The STOP key was pressed while the drive was running in REMOTE. • The drive was powered up with b1-17 = 0 (default) while the Run command is active.	During stop
Examples				

<1> Refer to *Figure 4.3* for the difference between “flashing” and “flashing quickly”.

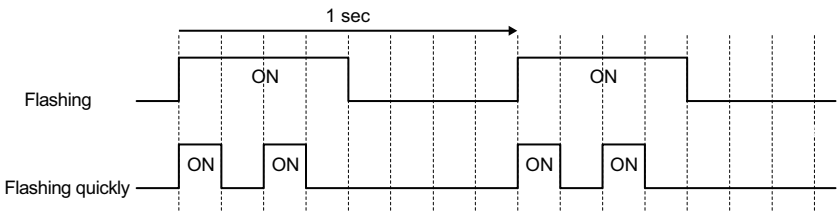


Figure 4.3 RUN LED Status and Meaning

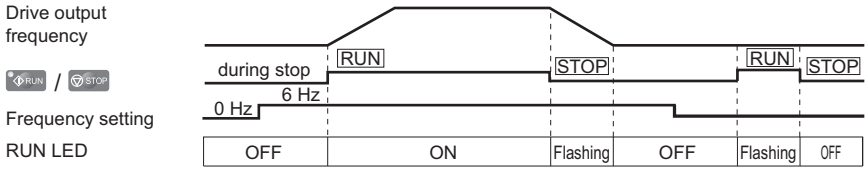
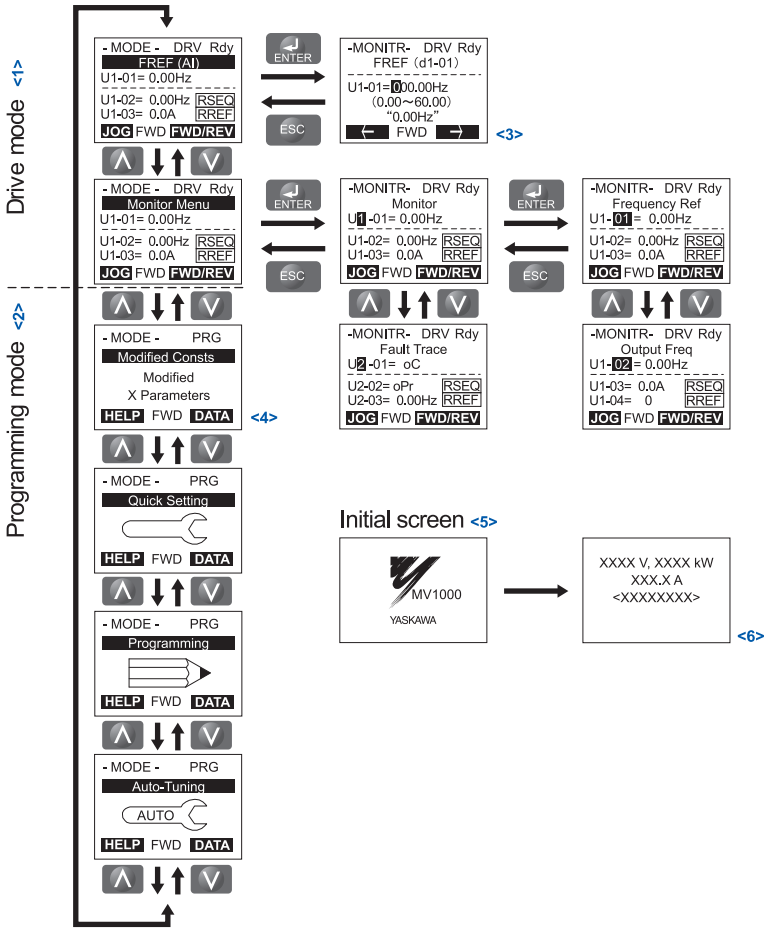


Figure 4.4 RUN LED and Drive Operation

◆ Menu Structure for Digital Operator



<1> Pressing RUN will start the motor.
<2> The drive cannot operate the motor.
<3> Flashing characters are shown as 0.
<4> "X" characters are used as examples in this manual. The digital operator will display the actual setting values.
<5> The frequency reference appears after the initial display which shows the product name.
<6> The information that appears on the display will vary depending on the drive.

Figure 4.5 Digital Operator Menu and Screen Structure

4.3 The Drive and Programming Modes

The drive has a Drive mode to operate the motor and a Programming Mode to edit parameter settings.

Drive Mode: In Drive Mode, the user can start the motor and observe operation status with the available monitors. Parameter settings cannot be edited or changed when in the Drive Mode.

Programming Mode: In Programming Mode the user can edit and verify parameter settings and perform Auto-Tuning. When the drive is in Programming Mode it will not accept a Run command unless b1-08 is set to 1.

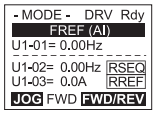
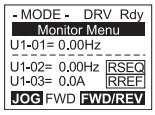
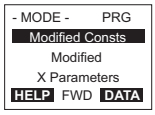
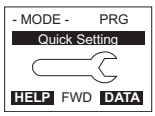
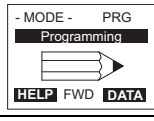
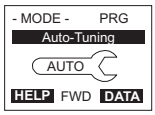
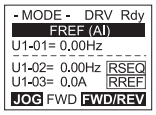
Table 4.4 describes the functions accessible by pressing the ∧ · ∨ keys of the digital operator.

Table 4.4 Modes

Mode	Contents	Key	LCD Display
Drive Mode (Operation/operation status monitor of the motor)	Frequency Reference	∧ · ∨	- MODE - DRV Rdy FREF (AI) U1-01= 0.00Hz U1-02= 0.00Hz RSEQ U1-03= 0.0A RREF JOG FWD FWD/REV
	Monitor Display	∧ · ∨	- MODE - DRV Rdy Monitor Menu U1-01= 0.00Hz U1-02= 0.00Hz RSEQ U1-03= 0.0A RREF JOG FWD FWD/REV
Programming Mode (Parameter setting)	Verify Menu	∧ · ∨	- MODE - PRG Modified Consts Modified X Parameters HELP FWD DATA
	Setup Group	∧ · ∨	- MODE - PRG Quick Setting HELP FWD DATA
	Parameter Setting Mode	∧ · ∨	- MODE - PRG Programming HELP FWD DATA
	Auto-Tuning Mode	∧ · ∨	- MODE - PRG Auto-Tuning AUTO HELP FWD DATA

◆ Navigating the Drive and Programming Modes

The drive is set to operate in Drive Mode when the control power supply is first powered up. Switch between display screens by using the ∧ and ∨ keys.

Control Power Supply Power-Up	**Frequency Reference**  **Default Setting**	This display screen allows the user to monitor and change the frequency reference while the drive is running. *Refer to The Drive and Programming Modes on page 113* for information on changing the frequency setting value. **Note:** The user can select the data displayed when the drive control power supply is first powered up with parameter o1-02.
Drive Mode		
	Monitor Display  	Lists the monitor parameters (U□-□□ parameters) available in the drive.
Programming Mode		
	Verify Menu  	Lists all parameters that have been edited or changed from default settings. ➡ Refer to *Verifying Parameter Changes: Verify Menu on page 117* for details.
		
	Setup Group  	Lists parameters necessary to get the drive operating quickly. ➡ Refer to *Simplified Setup Using the Setup Group on page 116* for details.
		
	Parameter Setting Mode  	Allows the user to access and edit all parameter settings. ➡ Refer to *Setup Group Parameters on page 119* for details.
		
	Auto-Tuning Mode  	Motor parameters are calculated and set automatically. ➡ Refer to *Auto-Tuning on page 124* for details.
		
Drive Mode	**Frequency Reference**  	Returns to the frequency reference display screen.

■ Drive Mode Details

The following actions are possible in the Drive Mode:

- Run and stop the drive
- Monitor the operation status of the drive (frequency reference, output frequency, output current, output voltage, etc.)
- View information on an alarm
- View a history of alarms that have occurred

Note: To run the drive, select the Drive Mode. Other modes are selectable while the drive is stopped, but the drive will only start operation when in Drive Mode.

Figure 4.6 illustrates how to change the frequency reference from 0.00 Hz to 6.00 Hz while in the Drive Mode.

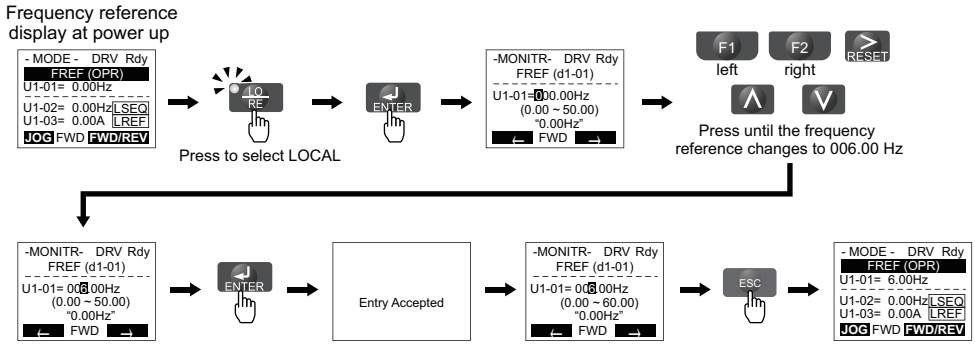


Figure 4.6 Setting the Frequency Reference while in the Drive Mode

Note: The drive will not accept a change to the frequency reference until the ENTER key is pressed after the frequency reference is entered. This feature prevents accidentally setting the frequency reference. To have the drive accept changes to the frequency reference as soon as changes are made without requiring the ENTER key, set o2-05 to 1.

■ Programming Mode Details

The following actions are possible in the Programming Mode:

- **Verify Menu**: Check a list of parameters that have been changed from their default values
- **Setup Group**: Access a list of commonly used parameters to simplify setup (Refer to *Simplified Setup Using the Setup Group on page 116* for details.)
- **Parameter Setting Mode**: Access and edit all parameter settings
- **Auto-Tuning Mode**: Automatically calculates and sets motor parameters to optimize drive performance

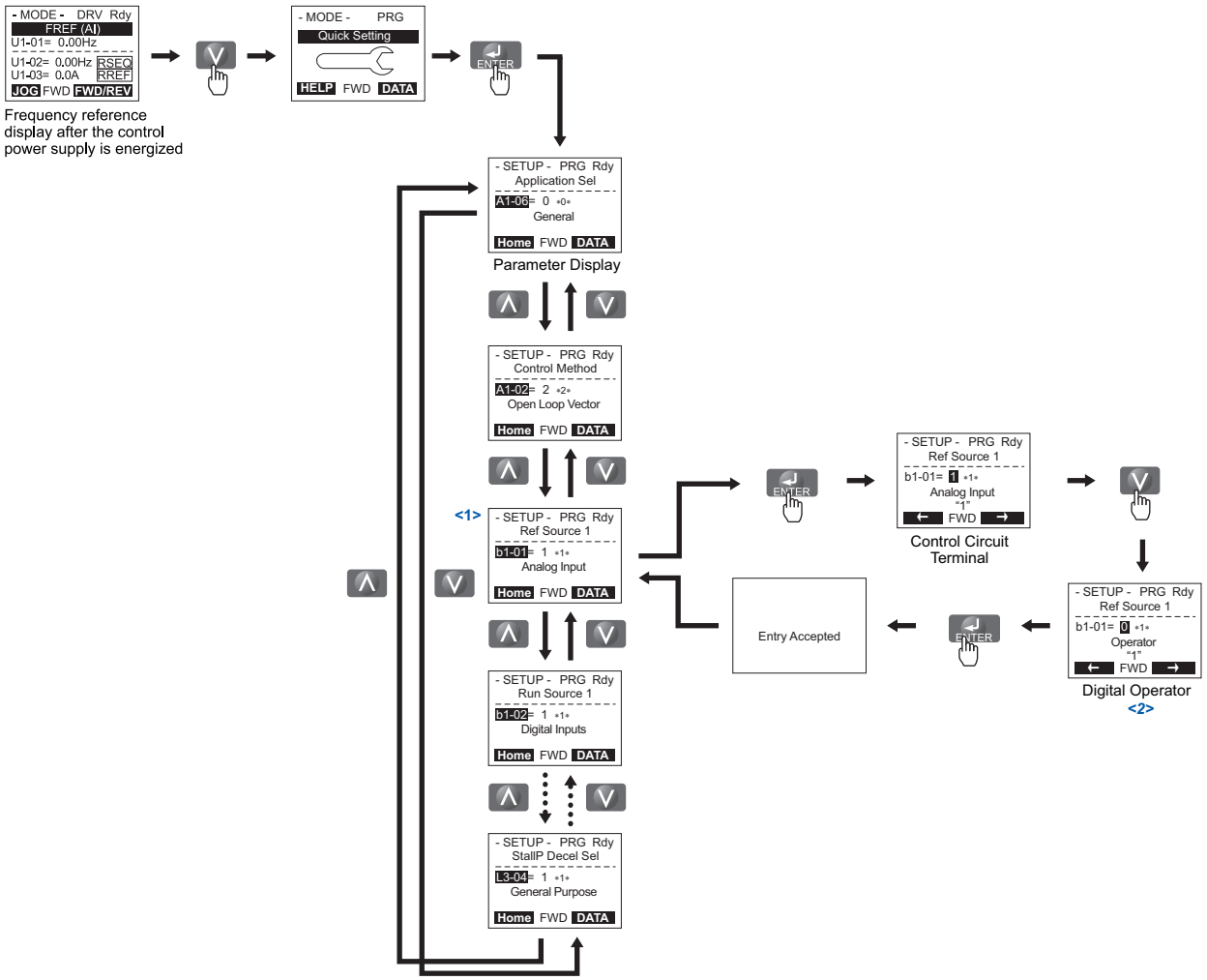
■ Simplified Setup Using the Setup Group

The Setup Group lists the 32 parameters registered as User Parameters. This group expedites the startup process for an application by showing only the most important parameters. Refer to *Figure 4.7* as an operation example.

Note: For details on the parameters of the setup mode, refer to Chapter 1 Parameter List of the FSDrive-MV1000 Parameter Guide (TOEP C710687 03).

Figure 4.7 illustrates how to enter and how to change parameters in the Setup Group.

In this example, the Setup Group is accessed to change b1-01 from 1 to 0. This changes the source of the frequency reference from the control circuit terminals to the digital operator.



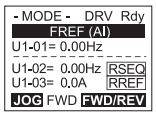
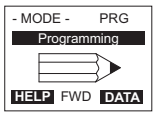
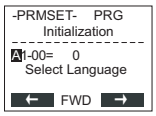
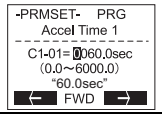
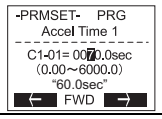
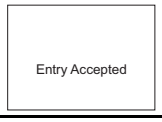
<1> To edit a parameter set value, go to the right steps.
To confirm the parameter list displayed in the Setup Group, go to the steps below.
<2> To go back to the initial screen, press ESC .
To edit another parameter in the Setup Group, press ∧ or ∨ .

Figure 4.7 Setup Group Example

◆ Changing Parameter Settings or Values

Key operations are shown in the following using the Acceleration Time 1 (C1-01) for an example.

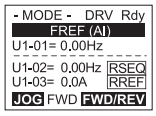
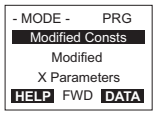
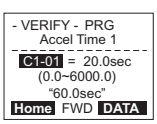
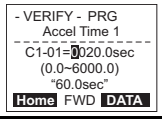
This example explains changing C1-01 (Acceleration Time 1) from 60.0 seconds (default) to 70.0 seconds.

	Operating Procedure		LCD Display
1	Press and hold ESC to display the frequency reference screen.	→	
2	Press ∧ or ∨ to display the Parameter Setting Mode screen.	→	
3	Press ENTER to enter the parameter menu tree.	→	
4	Select C1-01 by ∧, ∨, F1 or F2, and press ENTER.	→	
5	Press the ∧, ∨, F1 or F2 key and enter 0070.0.	→	
6	Press ENTER and the drive will confirm the change.	→	

◆ Verifying Parameter Changes: Verify Menu

The Verify Menu lists edited parameters from the Programming Mode or as a result of Auto-Tuning. The Verify Menu helps determine which settings have been changed and is particularly useful when replacing a drive. If no settings have been changed, the Verify Menu will read “nonE”. The Verify Menu also allows users to quickly access and re-edit any parameters settings that have been changed.

Note: The Verify Menu will not display parameters from the A1 group (except for A1-02) even if those parameters have been changed from their default settings.

	Operating Procedure		LCD Display
1	The control power supply is powered up. The initial display will appear.	→	
2	Press ∧ or ∨ until the display shows the top of the Verify Menu.	→	
3	Press ENTER to enter the list of parameters that have been edited from their original default settings. Press ∧ or ∨ displays the changed parameters. Press ∧ or ∨ until C1-01 is displayed.	→	
4	Press the ENTER key to access the setting value. Left digit flashes.	→	

◆ Switching between LOCAL and REMOTE

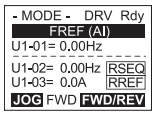
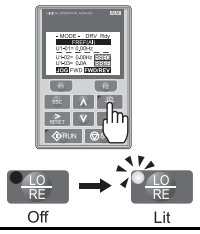
LOCAL mode is when the drive is set to accept the Run command from the digital operator RUN key. REMOTE mode is when the drive set to accept the Run command from an external device (i.e., input terminals, communication option, or other any devices) this is referred to as REMOTE mode.

⚠ **WARNING!** *Sudden Movement Hazard. The drive may start unexpectedly if the Run command is already applied when switching from LOCAL mode to REMOTE mode when b1-07 = 1, resulting in serious injury or death. Be sure all personnel are clear of rotating machinery.*

Switch the operation between LOCAL and REMOTE using the LO/RE key on the digital operator or via a digital input.

Note: **1.** After selecting LOCAL, the LO/RE light will remain lit.
2. The drive will not allow the user to switch between LOCAL and REMOTE during run.

■ Using the LO/RE Key on the Digital Operator

Operating Procedure			LCD Display
1	Energize the drive control power. The initial display will appear.	→	
2	Press LO/RE. The LO/RE light will light up. The drive is now in LOCAL. To set the drive for REMOTE operation, press the LO/RE key again. The LO/RE light will turn on.	→	

■ Using Contact Input Terminals 1 to 16 to Switch between LOCAL and REMOTE

It is possible to switch between LOCAL and REMOTE modes using one of the contact input terminals H1-01 to H1-16 (set the corresponding parameter H1-□□ to 1).

Note: Setting H1-□□ to 1 disables the LO/RE key on the digital operator.

◆ Setup Group Parameters

■ Setup Group (SETUP)

Only the frequently used parameters are selected into the setup mode to simplify drive setup. Take the following steps to modify parameters in the Setup Group:

1. Press ∧ or ∨ until the “Setup Group” screen is displayed.
2. Select a parameter, and change the setting. *Table 4.5* shows the parameters that can be used in the Setup Group. Use the “Parameter Setting Mode” screen to access parameters not found in the Setup Group.

Note: Changing parameter A1-02 will automatically change values of other parameters.

Table 4.5 Setup Group Parameters

No.	Name
A1-02	Control Method Selection
A1-06	Application Preset
b1-01	Frequency Reference Selection 1
b1-02	Run Command Selection 1
b1-03	Stopping Method Selection
C1-01	Acceleration Time 1
C1-02	Deceleration Time 1
d1-01	Frequency Reference 1
d1-02	Frequency Reference 2
d1-03	Frequency Reference 3
d1-04	Frequency Reference 4
d1-17	Jog Frequency Reference
E1-01	Input Voltage Setting
E1-04	Maximum Output Frequency

No.	Name
E1-05	Maximum Voltage
E1-06	Base Frequency
E1-09	Minimum Output Frequency
E1-13	Base Voltage
E2-01	Motor Rated Current
E2-04	Number of Motor Poles
E2-11	Motor Rated Power
H4-02	Analog Output 1 Gain
H4-12	Analog Output 2 Gain
H4-22	Analog Output 3 Gain
H4-32	Analog Output 4 Gain
L1-01	Motor Overload Protection Selection
L3-04	Stall Prevention Selection during Deceleration

Note: Parameter availability depends on the control mode set in A1-02; some parameters listed above may not be accessible in all control modes.

4.4 Start-Up Flowcharts

The flowcharts in this section summarize basic steps required to start the drive. Use the flowcharts to determine the most appropriate start-up method for a given application. The charts are quick references to help familiarize the user with startup procedures.

Flowchart	Subchart	Objective	Page
A	–	Basic start-up procedure and motor tuning	*120*
–	A-1	Parallel operation of multiple motors by V/f control	*121*
	A-2	High-performance operation using Open Loop Vector (OLV) or Closed Loop Vector (CLV) induction motor control	*122*

◆ Flowchart A: Basic Start-Up and Motor Tuning

Flowchart A describes a basic start-up sequence that varies slightly depending on the application. Use drive default parameter settings in simple applications that do not require high precision.

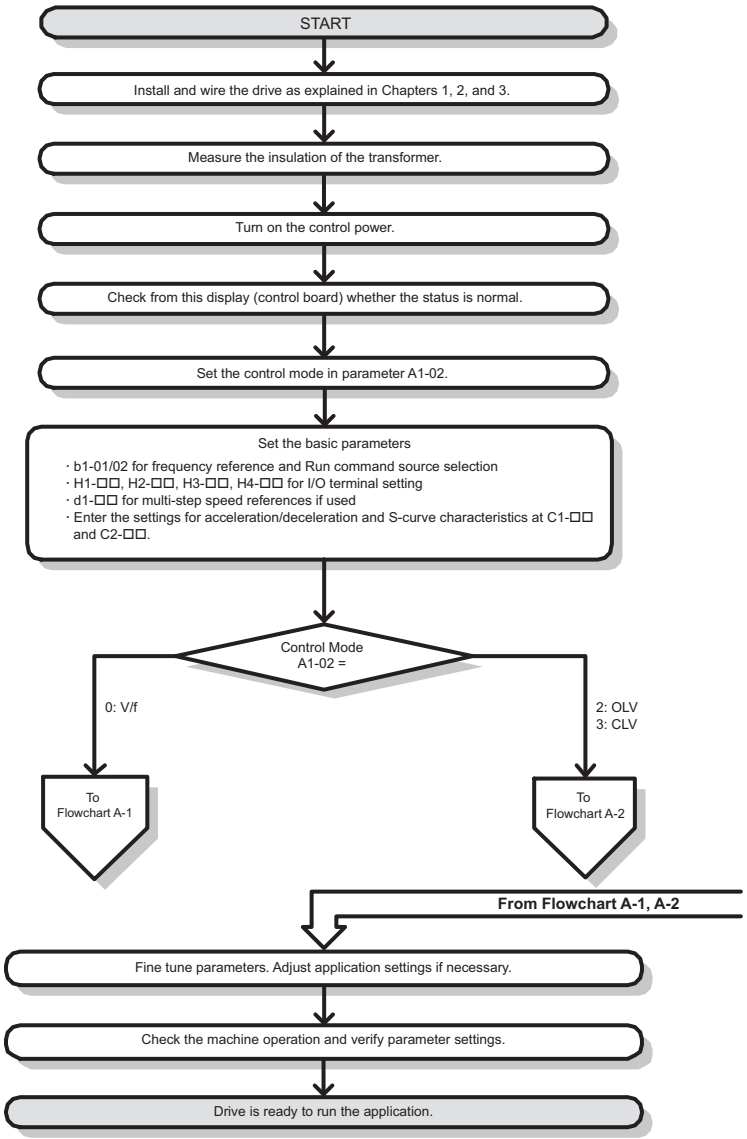


Figure 4.8 Basic Start-Up

◆ Subchart A-1: Parallel Operation of Multiple Motors by V/f Control

Subchart A-1 describes simple motor setup for V/f Control without PG feedback.

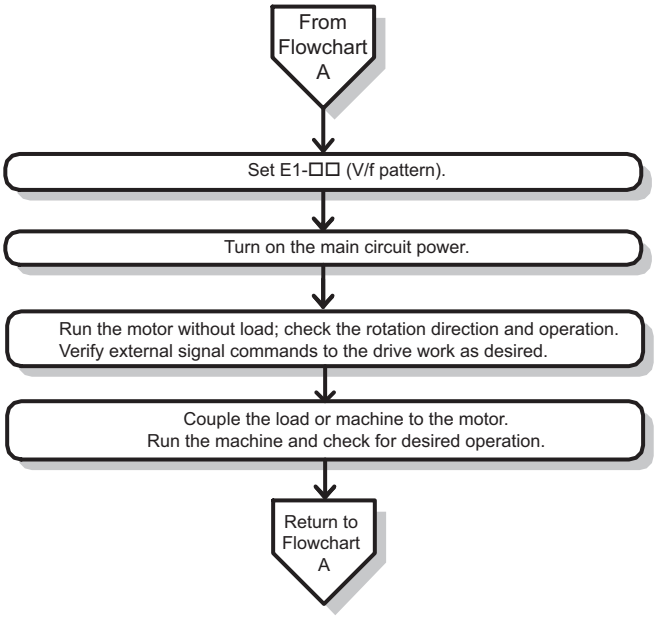
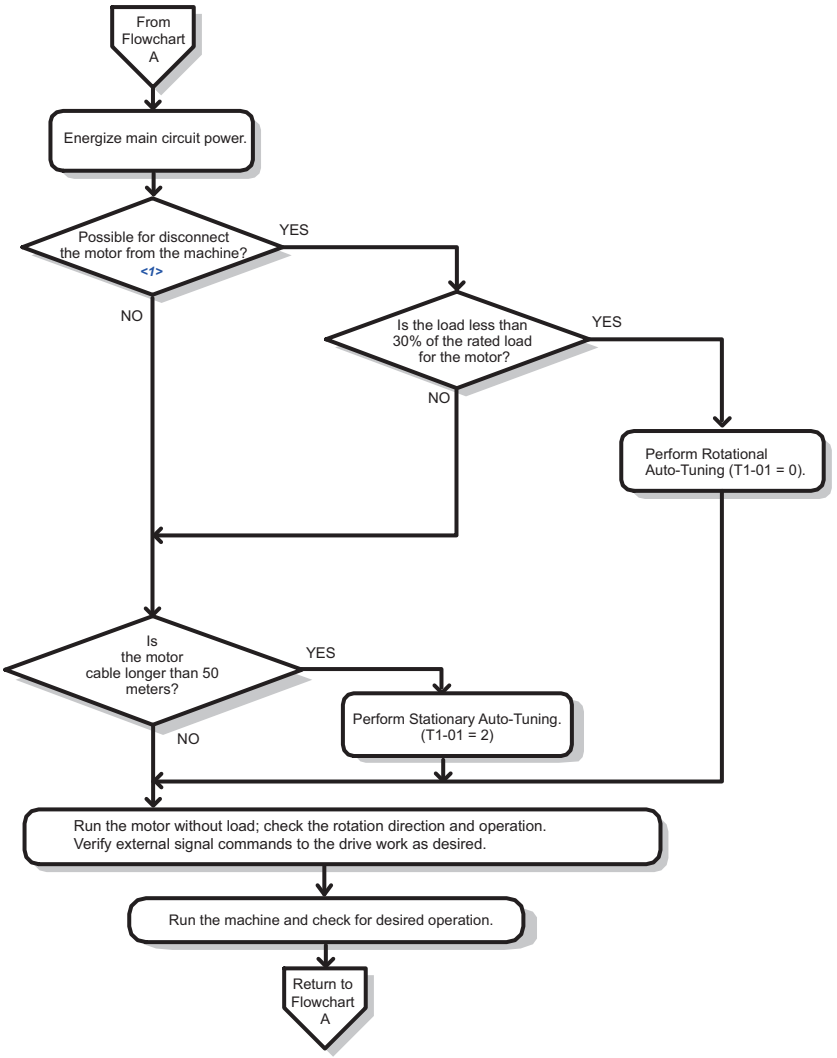


Figure 4.9 Parallel Operation of Multiple Motors by V/f Control

◆ Subchart A-2: High Performance Operation Using OLV or CLV

Subchart A-2 describes the setup procedure when using Open Loop Vector Control or Closed Loop Vector Control. Vector control is appropriate for applications requiring a high starting torque and torque limits.

Note: Although the drive sets parameters for the PG encoder during Auto-Tuning, sometimes the direction of the motor and direction of the PG get reversed. Use parameter F1-05 (PG1 Rotation Direction Setting) to switch the direction of the PG to match the motor direction.



<1> Ensure that the brake is released.

Figure 4.10 High Performance Operation Using OLV or CLV

4.5 Powering Up the Drive

◆ Powering Up the Drive and Status Display

■ Power Up

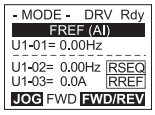
1. Turn the control power on, and check the digital operator to see if there are any faults.
2. Confirm the following before turning on the main circuit power supply.

Note: If a UPS is built-in, turn the power to the UPS on before turning on the control power. As a measure against overdischarge, also be sure to turn the UPS off after turning off the control power.

Item to Check	Description
Main Circuit Power Supply Voltage	Confirm that the power supply voltage of the main circuit is correct. 2 kV class: Three-phase, 2400 V (60 Hz ± 5%) 3 kV class: Three-phase, 3300 V (50 Hz ± 5% or 60 Hz ± 5%) 4 kV class: Three-phase, 4160 V (60 Hz ± 5%) 6 kV class: Three-phase, 6600 V (50 Hz ± 5% or 60 Hz ± 5%) 11 kV class: Three-phase, 11000 V (50 Hz ± 5% or 60 Hz ± 5%)
	Confirm that the input terminals R, S, and T of the main circuit's power supply are securely connected.
	Confirm that the drive and motor are properly grounded.
Connection between Drive Output Terminals and Motor Terminals	Confirm that the drive output terminals U, V, and W are surely connected to the motor terminals U, V, and W.
Connection of Drive Control Circuit Terminals	Confirm that the drive control circuit terminals are surely connected to the terminals of other controller.
Status of Drive Control Terminals	Confirm that all the drive control circuit terminals are turned OFF (drive is inactive).
Load Status	Confirm that the motor is in no-load state (not connected to the machine system).

■ Checking the Display Status

The digital operator lights will appear as follows when the control power supply and main circuit power are powered up normally.

No	Name	Description
Normal Operation		The data display area displays the frequency reference.
Fault	 (Example: Current detection fault)	ALM lights. The display content depends on the details of fault. *Refer to Troubleshooting on page 137* and take appropriate measures.

4.6 Auto-Tuning

◆ Types of Auto-Tuning

Select the optimal Auto-Tuning based on the conditions such as your application, control mode of the drive, and installation environment of the motor. When selecting the Auto-Tuning to run, refer to the flowcharts shown in *Start-Up Flowcharts on page 120*.

Note: Only the Auto-Tuning parameters valid for the control mode set in A1-02 are shown.

■ Auto-Tuning for Induction Motors

This feature automatically sets the following parameters for induction motors automatically:

- Motor parameters E1-☐☐ and E2-☐☐ (E3-☐☐, E4-☐☐ for motor 2)
- F1-☐☐ parameters for speed feedback detection (only when Closed Loop Vector Control is set)

Table 4.6 Types of Auto-Tuning for Induction Motors

Type	Parameter Setting	Application Condition and Benefit	Control Mode to Be Applied
Rotational Auto-Tuning	T1-01 = 0	• The motor can turn around during the Auto-Tuning: This allows the most precise control of the motor. • Running with constant output	Open Loop Vector Control Closed Loop Vector Control
Stationary Auto-Tuning for Line-to-Line Resistance	T1-01 = 2	• Tunes the drive after the cable between the drive and motor has been replaced with a cable over 50 m long. Assumes Auto-Tuning has already been performed. • Drive and motor capacities differ.	V/f Control Open Loop Vector Control Closed Loop Vector Control

Table 4.7 lists the data that must be entered for Auto-Tuning. The necessary information is usually listed on the motor nameplate or in the motor test report provided by the motor manufacturer. For details on the procedure for Auto-Tuning, refer to *Subchart A-1: Parallel Operation of Multiple Motors by V/f Control on page 121* or *Subchart A-2: High Performance Operation Using OLV or CLV on page 122* for details on Auto-Tuning processes and selections.

Table 4.7 Input Data for Auto-Tuning for Induction Motors

Input Data	Parameter	Units	Auto-Tuning Type (T1-01)	
			Rotational Auto-Tuning (0)	Auto-Tuning for Line-to-Line Resistance (2)
Motor Rated Capacity	T1-02	kW	Yes	Yes
Motor Rated Voltage	T1-03	V	Yes	No
Motor Rated Current	T1-04	A	Yes	Yes
Motor Base Frequency	T1-05	Hz	Yes	No
Number of Motor Pole	T1-06	–	Yes	No
Motor Base Speed	T1-07	r/min	Yes	No
PG Number of Pulses Per Revolution	T1-08	ppr	<1>	No

<1> Set when Closed Loop Vector control is selected.

◆ Before Auto-Tuning the Drive

Check the items below before Auto-Tuning the drive.

■ Basic Auto-Tuning Preparations

- Auto-Tuning requires the user to input data from the motor nameplate or motor test report. Make sure this data is available before Auto-Tuning the drive.
- For best performance, the drive input supply voltage must be greater than the motor rated voltage.
- To cancel Auto-Tuning, press STOP on the digital operator.

Table 4.8 describes contact input and output terminal operation while Auto-Tuning is being executed.

Table 4.8 Contact Input and Output Operation During Auto-Tuning

Tuning Mode	Contact Input Function	Contact Output Function
Rotational Auto-Tuning	Disabled	Functions the same as during normal operation
Stationary Auto-Tuning for Line-to-Line Resistance	Disabled	Maintains the status at the start of Auto-Tuning

⚠ **WARNING!** *Sudden Movement Hazard. Inadvertent holding brake release may cause damage to equipment or injury to personnel. If installed, do not release the mechanical brake during Stationary Auto-Tuning. Ensure that the mechanical brake release circuit is not controlled by the drive multi-function digital outputs during Stationary Auto-Tuning.*

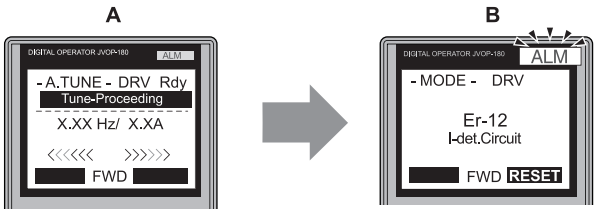
Note: To run the Rotational Auto-Tuning, be sure to disconnect the motor from the machine and check to see that there is nothing dangerous even if the motor starts to turn around. It could result in a failure of the drive. When the rotational Auto-Tuning is performed for load-connected motor, the motor parameter could not be calculated accurately and the motor could run unusually.

■ Notes on Rotational Auto-Tuning

- Decouple the load from the motor to achieve optimal performance from Rotational Auto-Tuning. Rotational Auto-Tuning is best suited for applications requiring high performance over a wide speed range.
- If it is not possible to decouple the motor and load, reduce the load so that it is less than 30% of the rated load. Performing Rotational Auto-Tuning with a higher load will set motor parameters incorrectly, and can cause irregular motor rotation.
- Ensure the motor-mounted brake is fully released if installed.
- Connected machinery should be allowed to rotate the motor.

◆ Auto-Tuning Interruption and Fault Codes

If tuning results are abnormal or STOP is pressed before completion, Auto-Tuning will be interrupted and a fault code will appear on the digital operator.



A – During the Auto-Tuning **B – Auto-Tuning Aborted**

Figure 4.11 Auto-Tuning Aborted Display

◆ Auto-Tuning Operation Example

The following example demonstrates Rotational Auto-Tuning when using Closed Loop Vector (A1-02 = 3).

■ Selecting the Type of Auto-Tuning

	Operating Procedure		LCD Display
1	The control power supply is powered up. The initial display will appear.	→	- MODE - DRV Rdy FREF (AI) U1-01= 0.00Hz U1-02= 0.00Hz RSEQ U1-03= 0.0A RREF JOG FWD FWD/REV
2	Press the ∧ or ∨ key until the Auto-Tuning display will appear.	→	- MODE - PRG Auto-Tuning AUTO HELP FWD DATA
3	Press ENTER to begin setting parameters.	→	- A.TUNE - PRG Tuning Mode Sel T1-01= 0 *0* Standard Tuning ESC FWD DATA
4	Press ENTER to select the value for T1-01. <1>	→	- A.TUNE - PRG Tuning Mode Sel T1-01= 0 *0* Standard Tuning "0" ← FWD →
5	Save the setting by pressing ENTER.	→	Entry Accepted
6	The display automatically returns to the display shown in Step 3.	→	- A.TUNE - PRG Tuning Mode Sel T1-01= 0 *0* Standard Tuning ESC FWD DATA

<1> T1-00 will appear on the display when one of the multi-function inputs has been set to switch between motor 1 and motor 2 (H1-□□ = 16).

■ Enter Data from the Motor Nameplate

After selecting the type of Auto-Tuning, enter the data required from the motor nameplate.

Note: These instructions continue from Step 6 in "Selecting the Type of Auto-Tuning".

	Operating Procedure		LCD Display
1	Press ∧ to access the motor output power parameter T1-02.	→	- A.TUNE - PRG Mtr Rated Power T1-02= 20000kW (0 ~ 65000) "20000kW" ESC FWD DATA
2	Pressing ENTER displays the value set in E2-11 (Motor rated capacity) when the control power is energized.	→	- A.TUNE - PRG Mtr Rated Power T1-02= 20000kW (0 ~ 65000) "20000kW" ← FWD →
3	Press F1, F2, RESET, ∧ and ∨ to enter the motor power nameplate data in kW.	→	- A.TUNE - PRG Mtr Rated Power T1-02= 25003kW (0 ~ 65000) "20000kW" ← FWD →
4	Press ENTER to save the setting.	→	Entry Accepted
5	The display automatically returns to the display in Step 1.	→	- A.TUNE - PRG Mtr Rated Power T1-02= 25000kW (0 ~ 65000) "20000kW" ESC FWD DATA

Operating Procedure			LCD Display
6	Repeat Steps 1 through 5 to set the following parameters: • T1-03, Motor Rated Voltage • T1-04, Motor Rated Current • T1-05, Motor Base Frequency • T1-06, Number of Motor Poles • T1-07, Motor Base Speed • T1-08 (PG Number of Pulses Per Revolution)	→	- A.TUNE - PRG Rated Voltage T1-03= 4000VAC (0 ~ 13000) "4000VAC" ESC FWD DATA ⋮ - A.TUNE - PRG Mtr Rated Slip T1-07= 1750RPM (0 ~ 24000) "1750RPM" ESC FWD DATA

Note: To execute Stationary Auto-Tuning for Line-to-Line Resistance only, set parameters T1-02 and T1-04.

■ Starting Auto-Tuning

⚠**WARNING!** *Sudden Movement Hazard. The drive and motor may start unexpectedly during Auto-Tuning, which could result in or serious injury or death. Ensure the area surrounding the drive motor and load are clear before proceeding with Auto-Tuning.*

⚠**WARNING!** *Electrical Shock Hazard. High voltage will be supplied to the motor when Stationary Auto-Tuning is performed even with the motor stopped, which could result in serious injury or death. Do not touch the motor until Auto-Tuning has been completed.*

NOTICE: *Equipment Hazard. Failure to comply could result in improper drive operation and the motor may exhibit abnormal operation. Adhere to these precautions prior to Rotational Auto-tuning:*

- *Disconnect or decouple the motor from the load.*
- *Never perform Rotational Auto-tuning with the motor connected to a load.*
- *Ensure all holding brakes connected to the motor or load are disengaged.*
- *Ensure the motor can spin freely with the load disconnected.*

Enter the required data from the motor nameplate. Press [ENTER] to proceed to the Auto-Tuning start display.

Note: These instructions continue from Step 6 in "Enter Data from the Motor Nameplate".

Operating Procedure			LCD Display
1	After entering the data listed on the motor nameplate, press [ENTER] to confirm.	→	- A.TUNE - DRV Auto-Tuning 0.00 Hz/ 0.0A Tuning Ready ? Press RUN key ESC FWD
2	Press [RUN] to activate Auto-Tuning. DRV flashes. The drive begins by injecting current into the motor for about 1 minute, and then starts to rotate the motor. **Note:** The tens digit of TUn 10 indicates the setting for T1-00 (Motor 1/2 Selection). The units digit indicates the setting for T1-01 (Auto-Tuning Mode Selection).	→	- A.TUNE - DRV Rdy Tune Proceeding X.XX Hz/ X.XA ‹‹‹‹‹‹ ›››››› FWD
3	Auto-Tuning finishes in approximately two to three minutes.	→	- MODE - DRV End Tune Successful FWD RESET

◆ Parameter Settings during Auto-Tuning for Induction Motors

The T1-☐☐ parameters set the Auto-Tuning input data for induction motor tuning.

Note: For motors operating in the field weakening range, first perform Auto-Tuning with the base data. After Auto-Tuning is complete, change E1-04, Maximum Frequency, to the desired value.

■ T1-00: Motor 1/Motor 2 Selection

Selects the motor to be tuned when motor 1/2 switching is enabled (i.e., a digital input is set for function H1-☐☐ = 16). This parameter is not displayed if motor 1/2 switching is disabled.

No.	Name	Setting Range	Default
T1-00	Motor 1/Motor 2 Selection	1 or 2	1

Setting 1: Motor 1

Auto-Tuning automatically sets parameters E1-☐☐ and E2-☐☐ for motor 1.

Setting 2: Motor 2

Auto-Tuning automatically sets parameters E3-☐☐ and E4-☐☐ for motor 2. Make sure that motor 2 is connected to the drive for Auto-Tuning.

■ T1-01: Auto-Tuning Mode Selection

Sets the type of Auto-Tuning to be used. Refer to *Types of Auto-Tuning on page 124* for details on the different types of Auto-Tuning.

Auto-Tuning is not possible when running multiple motors.

No.	Name	Setting Range	Default
T1-01	Auto-Tuning Mode Selection	2 (V/f) 0, 2 (OLV, CLV)	2 (V/f) 0 (OLV, CLV)

Setting 0: Rotational Auto-Tuning
Setting 2: Stationary Auto-Tuning for Line-to-Line Resistance

■ T1-02: Motor Rated Capacity

Sets the rated capacity of the motor according to the value on the motor nameplate.

No.	Name	Setting Range	Default
T1-02	Motor Rated Power	0 to 65000 kW	Determined by o2-04

■ T1-03: Motor Rated Voltage (T1-01 = 0)

Sets the motor rated voltage according to the motor nameplate value. Enter the voltage base speed here if the motor is operating above base speed.

For better control precision around rated speed when using a vector control mode, it can be helpful to enter the no-load voltage for the motor here. The motor's "no-load voltage" refers to the voltage needed to operate the motor under no-load conditions at rated speed. The no-load voltage can usually be found in the motor test report available from the manufacturer. If no data is available, enter approximately 95% of the rated voltage printed on the motor nameplate.

No.	Name	Setting Range	Default
T1-03	Motor Rated Voltage	0 to 13000 V	Determined by A1-02 and o2-04

■ T1-04: Motor Rated Current

Sets the motor rated current according to the motor nameplate value. Set the motor rated current between 50% and 100% of the drive rated current for optimal performance in OLV or CLV. Enter the current at the motor base speed.

No.	Name	Setting Range	Default
T1-04	Motor Rated Current	(n9-01) × 0.1 to (n9-01) × 2	Determined by o2-04

■ T1-05: Motor Base Frequency (T1-01 = 0)

Sets the motor rated frequency according to the motor nameplate value. If a motor with an extended speed range is used or the motor is used in the field weakening area, enter the maximum frequency to E1-04 (E3-04 for motor 2) after Auto-Tuning is complete.

No.	Name	Setting Range	Default
T1-05	Motor Base Frequency	0.0 to 120.0 Hz	60.0 Hz

■ T1-06: Number of Motor Poles (T1-01 = 0)

Sets the number of motor poles according to the motor nameplate value.

No.	Name	Setting Range	Default
T1-06	Number of Motor Poles	2 to 48	4

■ T1-07: Motor Base Speed (T1-01 = 0)

Used to set the motor rated speed according to the motor nameplate value.

No.	Name	Setting Range	Default
T1-07	Motor Base Speed	0 to 24000 r/min	1750 r/min

■ T1-08: PG Number of Pulses Per Revolution (T1-01 = 0)

Sets the number of pulses from the PG encoder. Set the actual number of pulses for one full motor rotation.

T1-08 will only be displayed in CLV.

No.	Name	Setting Range	Default
T1-08	PG Number of Pulses Per Revolution	0 to 60000 ppr	600 ppr

4.7 No-Load Operation Test Run

◆ No-Load Operation Test Run

This section explains how to operate the drive with the motor decoupled from the load during a test run.

■ Before Starting the Motor

Check the following items before operation:

- Ensure the area around the motor is safe.
- Ensure external emergency stop circuitry is working properly and other safety precautions have been taken.

■ During Operation

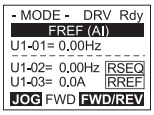
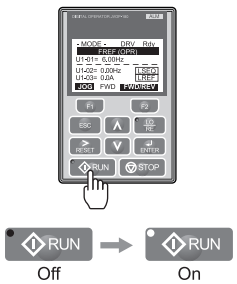
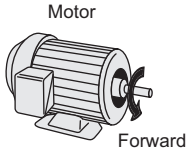
Check the following items during operation:

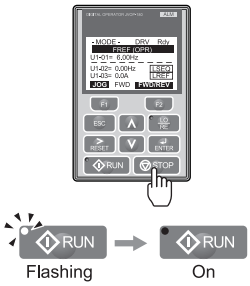
- The motor should rotate smoothly (i.e., no abnormal noise or oscillation).
- The motor should accelerate and decelerate smoothly.

■ No-Load Operation Instructions

The following example illustrates a test run procedure using the digital operator.

Note: Before starting the motor, set the frequency reference d1-01 to 6 Hz.

	Operating Procedure		LCD Display
1	The control power supply is powered up. The initial display will appear.	→	
2	Press the LO/RE key to select LOCAL. The LO/RE light will turn on.	→	
3	Press RUN to give the drive a Run command. RUN will light and the motor will rotate at 6 Hz.	→	
4	Ensure the motor is rotating in the correct direction and that no faults or alarms occur.	→	
5	If there is no error in step 4, press ∧ to increase the frequency reference. Increase the frequency in increments of 10 Hz, verifying smooth operation at all speeds. For each frequency, check the drive output current using monitor U1-03. The current should be well below the motor rated current. Example: 6 Hz → 60 Hz	–	
6	After checking drive output current, reduce the frequency reference to 0.0 Hz by pressing the ∨ button. The motor will decelerate.	–	

Operating Procedure			LCD Display
7	After the motor slows to a stop, press STOP to stop running. RUN flashes until the motor comes to a complete stop.	→	 Flashing On

4.8 Test Run with Load Connected

◆ Test Run with the Load Connected

After performing a no-load test run, connect the motor and proceed to run the motor and load together.

■ Precautions for Connected Machinery

⚠ **WARNING!** *Sudden Movement Hazard. System may start unexpectedly upon application of power, resulting in serious injury or death. Clear all personnel from the drive, motor, and machine area before applying power. Secure covers, couplings, shaft keys, and machine loads before applying power to the drive.*

⚠ **WARNING!** *Sudden Movement Hazard. Verify correct functionality of emergency stop circuits before equipment is placed into service. Failure to comply could result in serious injury or death. An untested emergency circuit may fail to operate properly when required.*

- Do not connect when the main circuit power and control power are ON.
- Check that the motor has come to a complete stop.
- Connect the load and machinery to the motor.
- Fasten all installation screws properly and check that the motor and connected machinery are secure.

■ Checklist Before Running Machinery

- Confirm that the Fast Stop circuit or mechanical safety measures operate correctly.
- Be ready to press STOP in case of emergency.

■ Checklist Before Operation

- Confirm that the Fast Stop circuit or mechanical safety measures operate correctly.
- Be ready to press STOP in case of emergency.

■ Operating the Motor under Loaded Conditions

Test run the application similarly to the no-load test procedure when connecting the machinery to the motor.

- Monitor U1-03 for overcurrent during operation.
- If the application permits running the load in the reverse direction, change the motor direction and the frequency reference while watching for abnormal motor oscillation or vibration.
- Correct any problems that occur with hunting, oscillation, or other control-related issues.

4.9 Checking and Saving Parameter Default Values

Use the Verify Menu to check all changes to parameter settings. Refer to *Verifying Parameter Changes: Verify Menu on page 117* for details.

Save the verified parameter settings. Change the parameter access level or set a password to the drive to prevent accidental modification of parameter settings.

◆ Saving User Default Values: o2-03

Setting o2-03 to 1 saves the current modified parameter settings as default values, then resets o2-03 to 0. The drive can now recall all the saved parameter values by performing a User Initialization (A1-03 = 1110). The saved settings can be initialized/restored as needed. Saving the User Parameter settings will cause selection 1110 (User Initialize) to appear as a selection for parameter A1-03 (Initialization). It is now possible to initialize/restore the saved settings. In addition, setting o2-03 to 2 (Clear All) clears the User default values, and "1110" is hidden from the selection for A1-03.

No.	Name	Description	Setting Range	Default
o2-03	Saving User Defaults	Saves/clears the default values used for A1-03 (Initialize Parameters). 0: Saved/Not Set 1: Set Defaults. Saves the current parameter settings as default values so a User Initialization can be performed to recall settings. 2: Clear All. Clears the current default values that have been saved. After default values are saved, it is possible to select setting 1110 (User initialize) in A1-03 (Initialize Parameters).	0 to 2	0
A1-03	Initialize Parameters	Selects a method to initialize the parameter. 0: No initializing 1110: User initialize (User parameter setting values must have been saved using o2-03.) 2220: Initialization with 2-wire sequence (Sets the parameters to default setting.)	0 to 5550	0

◆ Parameter Access Level: A1-01

Setting the Access Level for "Operation Only" (A1-01 = 0) allows the user to access parameters A1-□□ and U□-□□ only. Other parameters are not displayed.

Setting the Access Level for "User Parameters" (A1-01 = 1) allows the user to access only the parameters that have been previously saved as User Parameters. This is helpful when displaying only the relevant parameters for a specific application. The saved User Parameters can be displayed in the Set-up Mode.

No.	Name	Description	Setting Range	Default
A1-01	Access Level of Parameter	Selects the access level for parameters (for setting and monitoring). 0: Operation only (Sets and monitor A1-00 and A1-04. U□-□□ parameters can also be monitored.) 1: User parameters (Only the parameters A2-01 to A2-16 for each application and the recently changed parameters A2-17 to A2-32 can be set and monitored.) 2: Advanced Access (Can set and monitor all parameters)	0 to 2	2

No.	Name	Description	Setting Range	Default
A2-01 to A2-32	User Parameters 1 to 32	Function that automatically saves the parameters and settings and allows the user to select the parameters that are used frequently. When A2-33 is set to "1", the parameters and their values edited recently are automatically selected for A2-17 through A2-32 in sequence. (A2-01 through A2-16 must be set manually.) When A2-33 is "0", automatic selection of edited parameters is not performed. Users must register all parameters from A2-01 through A2-32.	b1-01 to o□-□□	–
A2-33	User Parameter Automatic Selection	0: Do not save list of recently viewed parameters. (Parameters A2-01 through A2-32 must be selected by the user.) 1: Save history of recently viewed parameters. (Recently edited parameters will be saved to A2-17 through A2-32. The most recently edited parameters are automatically selected for A2-17. Those edited after the most recently edited parameters are selected for A2-18 to a maximum of 16. When the number of edited parameter exceed 16, the oldest parameter will be deleted. This is utilized for the Set-up Mode.	0, 1	1

◆ Password Settings: A1-04, A1-05

The user can set a password in parameter A1-05 to restrict access to the drive. The password must be entered to A1-04 to unlock parameter access (i.e., parameter setting A1-04 must match the value programmed into A1-05). The following parameters cannot be viewed or edited until the value entered to A1-04 correctly matches the value set to A1-05: A1-01, A1-02, A1-03, A1-06, and A2-01 through A2-32.

Note: Parameter A1-05 is hidden from view. To display A1-05, access parameter A1-04 and press and simultaneously.

◆ Copy Function

Parameter settings can be copied to another drive to simplify parameter restoration or multiple drive setup. The drive supports the following copy options:

- **Digital Operator (supplied with this product)**
  The digital operator used to operate the drive supports copying, importing, and verifying parameter settings. For more information on the operation procedure, refer to *Operation Procedure of Copy Function (Digital Operator) on page 135* for details.
- **USB Copy Unit**
  The copy unit is an external option connected to the drive to copy parameter settings from one drive and save those settings to another drive. Refer to the manual supplied with the USB Copy Unit for instructions.
  Note: Connect the USB Copy Unit to the digital operator connector on the drive.
- **CopyUnitManager**
  The CopyUnitManager is a PC software tool. It allows the user to load parameter settings from the Copy Unit onto a PC, or from the PC onto a Copy Unit. This is useful when managing parameters for various drives or applications. Refer to the manual supplied with the CopyUnitManager for instructions.
- **DriveWizard Plus MV**
  DriveWizard Plus MV is a PC software tool for parameter management, monitoring, and diagnosis. DriveWizard Plus MV can load, store, and copy parameter settings. For more information on the operating procedure, refer to the operation manual supplied with the DriveWizard Plus MV software.

■ Operation Procedure of Copy Function (Digital Operator)

The digital operator will allow the following operations depending on the setting for parameter o3-01, Copy Function Selection:

INV → OP READ (o3-01 = 1)

Stores the parameter settings of one drive in the digital operator.

Note: The number of the read operations of the digital operator is limited. The maximum number of read operations available is about 100,000 times.

OP → INV WRITE (o3-01 = 2)

Copies parameters from the digital operator to the drive.

OP → INV VERIFY (o3-01 = 3)

Compares the parameters in the drive with the parameter settings saved on the digital operator for matches.

The read procedure is described below:

Note: Set o3-02, Copy Allowed Selection, to 1 (Allowed) when performing read functions. Setting o3-02 to 0 disables the Copy function and protects the parameters saved in the digital operator.

	Operating Procedure		LCD Display
1	Turn on the power supply.	→	- MODE - DRV Rdy FREF (AI) U1-01= 0.00Hz U1-02= 0.00Hz RSEQ U1-03= 0.0A RREF JOG FWD FWD/REV Initial setting screen
2	Press ∧ or ∨ to display the parameter setting mode screen, and then press ENTER.	→	- MODE - PRG Programming HELP FWD DATA
3	Select o3-01 (Copy Function Selection) by ∧, ∨ or RESET, and press ENTER.	→	-PRMSET- PRG Copy Function Sel o3-01= 0 "0" COPY SELECT ← FWD →
4	Press ∧ or ∨ to select an operation. Select "01" (INV → OP Read) in this example.	→	-PRMSET- PRG Copy Function Sel o3-01= 1 "0" INV→OP READ "0" ← FWD →
5	Press ENTER to starts the operation.	→	READ INV→OP READING
6	After the operation finishes, the screen automatically returns to the copy function selection screen.	→	End READ COMPLETE
7	Press ESC until the screen returns to the initial screen.	→	- MODE - DRV Rdy FREF (AI) U1-01= 0.00Hz U1-02= 0.00Hz RSEQ U1-03= 0,0A RREF JOG FWD FWD/REV Initial setting screen

5

Troubleshooting

This chapter provides descriptions of the drive faults, alarms, errors, related displays, and guidance for troubleshooting. This chapter can also serve as a reference guide for tuning the drive during a trial run.

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5.1 Section Safety

⚠ DANGER

Electrical Shock Hazard

Do not connect or disconnect wiring while the power for the main circuit and controls is on.

Failure to comply could result in serious injury or death.

Do not open the drive panel doors while main circuit power is on.

Incorrect handling could result in an electric shock. Make sure that the drive panel doors are closed before turning on the main circuit power.

The diagrams in this manual may be indicated with the doors open to show details. Be sure to close the doors before operating the drive and run the drive it in accordance with the instructions in this manual.

⚠ WARNING

Electrical Shock Hazard

Always ground the motor-side ground terminal.

Improper equipment grounding could result in death, serious injury or fire by contacting the motor case.

Do not carry out maintenance or inspection work while the power for the main circuit and controls is on.

Failure to comply could result in serious injury or death.

Even when the power supply of the medium-voltage main circuit to the drive is shut off, it takes some time for the internal capacitors to discharge. Wait until the CHARGE LED goes off before starting inspection. While residual electric charge remains in the capacitor, the surface and inside of the Power Cell will carry a high voltage, so there will be a risk of serious injury or death. The heatsink of the Power Cell can become quite hot during operation, and proper precautions should be taken to prevent burns.
When replacing the cooling fan, shut off the main circuit's power and then wait at least 15 minutes. Then, shut off the control circuit's power and make sure that the cooling fan has fully stopped before starting the work.

Do not allow unqualified personnel to perform work on the drive.

Failure to comply could result in serious injury or death.

The drive should be installed, wired, repaired, inspected, and have its parts replaced, by someone with a thorough knowledge of drive installation, adjustment and repair.

Do not perform work or operate the drive while wearing loose clothing, jewelry, or without eye protection.

Failure to comply could result in serious injury or death.
Remove all metal objects such as watches and rings, secure loose clothing and wear eye protection before beginning work on the drive.

Fire Hazard

Tighten all terminal screws to the specified tightening torque.

Loose electrical connections could result in serious injury or death by fire due to overheating of electrical connections.

Do not use an improper voltage source.

Failure to comply could result in serious injury or death by fire.

Verify that the rated voltage of the drive matches the voltage of the incoming drive input power before applying power.

Do not use improper combustible materials.

Failure to comply could result in serious injury or death by fire.

Attach the drive to metal or other noncombustible material.

NOTICE

Observe proper electrostatic discharge procedures (ESD) when handling the drive.
Failure to comply could result in ESD damage to the drive circuitry.

Do not disconnect the motor from the drive while the drive is outputting voltage.
Failure to comply could result in damage to the drive.

Use only shielded cable to wire analog input/output signals for the control circuit.
Failure to comply could result in drive malfunction.
Use shielded twisted-pair wires and ground the shield to the ground terminal of the drive.

Do not modify the drive circuitry.
Failure to comply could result in damage to the drive and will void warranty.

Do not attempt to modify or alter the drive.
Yaskawa is not responsible for any modification of the drive made by the user.

Check all the wiring and ensure that all connections are correct after installing the drive and connecting other devices.
Failure to comply could result in damage to the drive.

5.2 Motor Performance Fine-Tuning

This section offers helpful information for counteracting oscillation, hunting, or other problems that occur while performing a trial run. Refer to the section below that corresponds to the motor control method used.

Note: This section describes parameters that are commonly edited and may be set incorrectly. Consult Yaskawa for more information on detailed settings and fine-tuning the drive.

◆ Fine-Tuning V/f Control

Table 5.1 Parameters for Fine-Tuning Performance in V/f

Problem	Parameter No.	Corrective Action	Default	Suggested Setting
• Motor hunting and oscillation at speeds between 10 and 40 Hz	Hunting Prevention Gain Setting (n1-02)	• Reduce the setting if insufficient motor torque relative to the size of the load causes hunting, • Increase the setting when motor hunting and oscillation occur with a light load. • Reduce the setting if hunting occurs when using a motor with relatively low inductance, such as a high-frequency motor or a motor with a larger frame size.	1.00	0.10 to 2.00
• Poor torque or speed response • Motor hunting and oscillation	Torque Compensation Primary Delay Time (C4-02)	• Reduce the setting if motor torque and speed response are too slow. • Increase the setting if motor hunting and oscillation occur.	200 ms	100 to 1000 ms
• Poor motor torque at speeds below 10 Hz • Motor hunting and oscillation	Torque Compensation Gain (C4-01)	• Increase the setting if torque is insufficient at speeds below 10 Hz. • Reduce the setting if motor hunting and oscillation occur with a relatively light load.	1.00	0.50 to 1.50
• Poor motor torque at low speeds • Motor instability at motor start	Mid Output Frequency Voltage (E1-08) Minimum Output Frequency Voltage (E1-10)	• Increase the setting if torque is insufficient at speeds below 10 Hz. • Reduce the setting if the motor instability occurs at motor start.	E1-08: <1> E1-10: <1>	±3% of the motor rated voltage
Poor speed precision	Slip Compensation Gain (C3-01)	Set the motor rated current (E2-01), motor-rated slip (E2-02), and motor no-load current (E2-03), then adjust the slip compensation gain (C3-01).	1.0	0.5 to 1.5

<1> Determined by o2-04 (Drive Model Selection)

◆ Fine-Tuning Open Loop Vector Control

Table 5.2 Parameters for Fine-Tuning Performance in OLV

Problem	Parameter No.	Corrective Action	Default	Suggested Setting
• Poor motor torque and speed response • Motor hunting and oscillation at speeds between 10 and 40 Hz	**Speed Feedback Detection Control (AFR) Gain** (n2-01)	• Gradually reduce the setting in 0.05 increments if motor torque and speed response are too slow. • Gradually increase the setting in 0.05 increments if motor hunting and oscillation occur.	2.00	0.50 to 2.00
• Poor motor torque and speed response • Motor hunting and oscillation at speeds between 10 and 40Hz	**Speed Feedback Detection Control (AFR) Time Constant 1** (n2-02)	• Gradually reduce the setting in 10 ms increments to improve motor torque speed response. • Gradually increase the setting in 50 ms increments and check the performance if motor hunting and oscillation occur as a result of load inertia. **Note:** Ensure that n2-02 ≤ n2-03. When changing n2-02, set C4-02, Torque Compensation Primary Delay Time, accordingly.	250 ms	50 to 2000 ms

Problem	Parameter No.	Corrective Action	Default	Suggested Setting
• Overvoltage trips when accelerating, decelerating, or during sudden speed or load changes.	**Speed Feedback Detection Control (AFR) Time Constant 2** (n2-03)	• Gradually increase the setting in 50 ms increments if overvoltage trips occur. • Gradually reduce the setting in 10 ms increments if response is slow. **Note:** Ensure that n2-02 ≤ n2-03.When changing n2-03, increase the value of C4-06, Torque Compensation Primary Delay Time 2, proportionally.	750 ms	750 to 2000 ms
	Torque Compensation Primary Delay Time 2 (C4-06)	• Gradually increase the setting in 10 ms increments and check the performance if overvoltage trips occur. • Gradually reduce the setting in 2 ms increments and check the performance if response is slow. **Note:** Ensure that C4-02 ≤ C4-06. When changing C4-06, increase the value of n2-03 proportionally.	150 ms	150 to 750 ms
• Poor motor torque and speed response • Motor hunting and oscillation	**Torque Compensation Primary Delay Time** (C4-02)	• Gradually reduce the setting by 2 ms if motor torque and speed response are too slow. • Gradually increase the setting by 10 ms if motor hunting and oscillation occur. **Note:** Ensure that C4-02 ≤ C4-06. When changing C4-02, increase the value of n2-02, AFR Time Constant 1, proportionally.	50 ms	20 to 100 ms <1>
Poor speed response and stability	**Slip Compensation Primary Delay Time** (C3-02)	• Gradually reduce the setting in 10 ms increments if response is slow. • Gradually increase the setting in 10 ms increments if speed is unstable.	200 ms	100 to 500 ms
Poor speed precision	**Slip Compensation Gain** (C3-01)	• Gradually increase the setting in 0.1 ms increments if speed is too slow. • Gradually reduce the setting in 0.1 ms increments if speed is too fast.	1.0	0.5 to 1.5
• Poor motor torque at low speeds • Poor speed response • Motor instability at start	**Mid Output Frequency Voltage** (E1-08) Minimum Output Frequency Voltage (E1-10)	• Increase the setting if motor torque and speed response are too slow. • Reduce the setting if the motor exhibits excessive instability at motor start. **Note:** When working with a relatively light load, increasing this value too much can cause overtorque.	E1-08: <1> E1-10: <1>	±1% of the motor rated voltage

<1> Determined by o2-04 (Drive Model Selection)

When using Open Loop Vector Control, leave the torque compensation gain (C4-01) at its default setting of 1.00.
In the Open Loop Vector Control, when the speed precision is not improved for regenerative operation, enable slip compensation during regeneration by setting parameter C3-04 to 1.

◆ Fine-Tuning Closed Loop Vector Control

Table 5.3 Parameters for Fine-Tuning the Performance in CLV

Problem	Parameter No.	Corrective Action	Default	Suggested Setting
• Poor motor torque and speed response • Motor hunting and oscillation	<High speed side> ASR Proportional Gain 1 (C5-01) <Low speed side> ASR Proportional Gain 2 (C5-03) <1>	• Gradually increase the setting in increments of 5 if motor torque and speed response are too slow. • Reduce the setting if motor hunting and oscillation occur.	5.00	5.00 to 30.00
• Poor motor torque and speed response • Motor hunting and oscillation	**<High speed side> ASR Integral Time 1 (C5-02) <Low speed side> ASR Integral Time 2 (C5-04)** <1>	• Reduce the setting if motor torque and speed response are too slow. • Increase the setting if motor hunting and oscillation occur.	5.000 s	0.300 to 5.000 s
Difficulty maintaining the ASR proportional gain or the integral time at the low or high end of the speed range	ASR Gain Switching Frequency (C5-07) <1>	Switch the drive between two different ASR proportional gain and integral time settings based on the output frequency.	0.0 Hz	0.0 to max output frequency
Motor hunting and oscillation	ASR Primary Delay Time Constant (C5-06) <1>	• Gradually reduce the setting in 0.01 increments if motor torque and speed response are too slow. • Increase the setting if the load is less rigid and subject to oscillation.	0.012 s	0.004 to 0.060 s

<1> For more information about Speed Control (ASR), refer to the description of the Speed Control (C5-□□) parameters in the separate FSDrive-MV1000 Parameter Guide (TOEP C710687 03).

◆ Parameters to Minimize Motor Hunting and Oscillation

In addition to the parameters discussed on page *Table 5.4* and *Table 5.5*, the following parameters indirectly affect motor hunting and oscillation.

Table 5.4 Parameters that Affect Control Performance in Applications

Parameter No.	Application
Dwell Function (b6-01 through b6-04)	Prevents motor speed loss by maintaining the output frequency when working with heavy loads or when there is powerful backlash on the machine side.
Droop Function (b7-01, b7-03)	Moderates motor torque and balances the load level between two motors. (Enabled when Control Mode A1-02 = 3)
Accel/Decel Time (C1-01 through C1-11)	Adjusting accel and decel times will affect the torque presented to the motor during acceleration or deceleration.
S-Curve Characteristics (C2-01 to C2-04)	Prevents shock at the beginning and end of acceleration and deceleration.
Jump Frequency (d3-01 through d3-04)	Skips over the resonant frequencies of connected machinery.
Analog Input Filter Time Constant (H3-13)	Prevents fluctuation in analog input signals due to noise.
Stall Prevention (L3-01 through L3-06, L3-11, L3-23, L3-27)	• Prevents motor speed loss and overvoltage when the load is too heavy or during sudden acceleration/deceleration. • Adjustment is not normally necessary because Stall Prevention is enabled as a default.
Torque Limits (L7-01 through L7-04, L7-06, L7-07, L7-16)	• Set the maximum torque for Open Loop Vector Control. • Ensure that the drive capacity is greater than the motor capacity when increasing this setting. Be careful when reducing this value because motor speed loss may occur with heavy loads.

5.3 Types of Faults, Alarms, and Errors

◆ Types of Faults, Alarms, and Errors

Check the digital operator for information about possible faults if the drive or motor fails to operate. Refer to *Using the Digital Operator on page 109*.

If problems occur that are not covered in this manual, contact the nearest Yaskawa representative with the following information:

- Drive model
- Software version (U1-25, U1-26, U1-27, U1-28, U1-29, U9-09 <1>, U9-10 <1>).
- The serial number stated on the nameplate (SER NO.)
- Date of purchase
- Description of the problem
- Presence of data during a fault condition. (DriveWizard Plus MV maintenance tool is required)

<1> These parameters are the Power Cell number.

Table 5.5 contains descriptions of the various types of alarms, faults, and errors that may occur while operating the drive.

Table 5.5 Types of Alarms, Faults, and Errors

Type	Drive Response
Drive Faults	Drive faults are detected by the control panel. Power Cell faults are detected by the Power Cell control circuit and transmitted to the control panel. When the drive detects a fault: • The digital operator displays text indicating the specific fault and the ALM indicator LED remains lit until the fault is reset. • The fault interrupts drive output and the motor coasts to a stop. • Some faults allow the user to select the stopping method when the fault occurs. • Fault output terminals 32-30 will close, and 32-31 will open. Do not change the setting of parameter H2-02=E (Major Fault). The drive will remain inoperable until the fault is cleared. *Refer to Fault Reset Methods on page 182* for the reset operations.
Power Cell Faults	
Minor Faults and Alarms	When the drive detects an alarm or a minor fault: • The digital operator displays text indicting the specific alarm or minor fault, and the ALM indicator LED flashes. • The drive continues running the motor, although some alarms allow the user to select a stopping method when the alarm occurs. • A multi-function contact output set to be tripped by a minor fault (H2-□□ = 10) closes. The contact will not close if the output is set to be tripped by an alarm. To reset a minor fault or alarm, remove whatever is causing the problem.
Operator Programming Error	An operation error occurs when parameter settings conflict or do not match hardware settings (such as with an option card). When the drive detects an operation error: • The digital operator displays text indicating the specific error, and the ALM indicator LED flashes. • Contact outputs do not operate. The drive will not operate the motor until the error has been reset. Correct the settings that caused the Operator Programming Error to clear the error.
Auto-Tuning Errors	Tuning errors occur while performing Auto-Tuning. When the drive detects a tuning error: • The digital operator displays text indicating the specific error, and the ALM indicator LED flashes. • Contact outputs do not operate. • Motor coasts to stop. Remove the cause of the error and repeat the Auto-Tuning process.
Copy Function Errors	Copy Function Errors occur when using the digital operator or the USB Copy Unit to copy, read, or verify parameter settings. • The digital operator displays text indicating the specific error, and the ALM indicator LED flashes. • Contact outputs do not operate. Pressing any key on the digital operator will clear the fault. Determine the cause of the problem (such as model incompatibility) and try again.

◆ Fault, Alarm and Error Displays

■ Faults (Drive Faults and Power Cell Faults)

Table 5.6 gives an overview of possible fault codes. Conditions such as overvoltages can trip faults and alarms. It is important to distinguish between faults and alarms to determine the proper corrective actions.

When the drive detects a fault, the ALM indicator LED lights continuously and the fault code appears on the digital operator. An alarm is present if the ALM LED blinks and the fault code on the digital operator flashes. *Refer to Minor Faults and Alarms on page 145* for a list of alarm codes.

Table 5.6 Fault Displays (1)

Digital Operator Display	Name	Page
24V	Optional Power Supply Error	*148*
bUS	Option Communication Error	*148*
CE	MEMOBUS/Modbus Communication Error	*148*
CF	Control Fault	*149*
CFA nn COF <1>	Current Offset Fault	*149*
CFA nn CUV <1>	Undervoltage	*149*
CFA nn FU <1>	Fuse Blowout	*149*
CFA nn IGBT_FLT <1>	IGBT Fault	*149*
CFA nn OC <1>	Overcurrent	*150*
CFA nn OH <1>	IGBT Overheating	*150*
CFA nn OH1 <1>	IGBT Overheating 1	*150*
CFA nn OV <1>	Overvoltage 1	*150*
CFA nn OV2 <1>	Overvoltage 2	*150*
CFA nn VCF_OV <1>	Main Circuit Capacitor Neutral Point Potential Error	*151*
CPF00, CPF01 <2>	Control Circuit Error	*151*
CPF02	A/D Conversion Error	*151*
CPF06	EEPROM Memory Data Error	*151*
CPF20, CPF21 <2>	Control Circuit Error	*151*
CPF22	Hybrid IC Error	*151*
CPF23	Control Board Connection Error	*151*
CPF26 to CPF29	Control Circuit Error	*151*
CPF31 to CPF34		
CPF40 to CPF43		
dEv	Speed Deviation (for Control Mode with PG)	*152*
dO	Door Open	*152*

Digital Operator Display	Name	Page
EF0	Option Card External Fault	*152*
EF1 to EF16	External Fault (input terminal)	*152*
Err	EEPROM Write Error	*153*
FAn	Fan Fault	*153*
FbH	Excessive PID Feedback	*153*
FbL	PID Feedback Loss	*154*
GF	Ground Fault	*154*
IOV	Input Overvoltage	*154*
IUV	Power Supply Undervoltage	*154*
LF	Output Phase Loss	*154*
LIN nn LINK FAULT <1>	CCB-MB Communication Error (Link Fault)	*155*
oFA00	Option Card Connection Error at Option Port CN5-A	*155*
oFA01, oFA02	Option Card Fault at Option Port CN5-A	*155*
oFA03 to oFA06	Option Card Error Occurred at Option Port CN5-A	*155*
oFA10, oFA11	Option Card Error Occurred at Option Port CN5-A	*155*
oFA12 to oFA17	Option Card Fault at Option Port CN5-A	*155*
oFA30 to oFA43	Option Card Error Occurred at Option Port CN5-A	*155*
oFb00	Option Card Connection Error at Option Port CN5-B	*155*
oFb01, oFb02	Option Card Fault at Option Port CN5-B	*155*
oFb03 to oFb11	Option Card Error Occurred at Option Port CN5-B	*156*
oFb12 to oFb17	Option Card Fault at Option Port CN5-B	*156*
oFC00	Option Card Connection Error at Option Port CN5-C	*156*
oFC01, oFC02	Option Card Fault at Option Port CN5-C	*156*
oFC03 to oFC11	Option Card Error Occurred at Option Port CN5-C	*156*
oFC12 to oFC17	Option Card Fault at Option Port CN5-C	*156*

Table 5.7 Fault Displays (2)

Digital Operator Display	Name	Page
oL1	Motor Overload	*157*
oL2	Drive Overload	*157*
oL3	Overtorque Detection 1	*157*
oL4	Overtorque Detection 2	*158*
oL5	Mechanical Weakening Detection 1	*158*
oL7	High Slip Braking oL	*158*
OOV	Output Overvoltage	*158*
oPr	External Digital Operator Connection Fault	*158*
oS	Overspeed (for Control Mode with PG)	*158*
PGo	PG Disconnect (for Control Mode with PG)	*159*
PGoH	PG Hardware Fault (detected when using a PG-X3 option)	*159*

Digital Operator Display	Name	Page
SEr	Too Many Speed Search Restarts	*159*
SYNC	Commercial Synchronous Switching Error	*159*
TME	Transformer Temperature Fault	*159*
TME1	Transformer Temperature Fault 1	*159*
TME2	Transformer Temperature DI Fault	*160*
TME3	Transformer Temperature Sensor Disconnection	*160*
UL3	Undertorque Detection 1	*160*
UL4	Undertorque Detection 2	*160*
UL5	Mechanical Weakening Detection 2	*160*
Uv1	Undervoltage	*161*
Uv3	In-rush Prevention Circuit Error	*161*
VUB	Voltage Unbalance	*161*

<1> The number of the Power Cell at which the fault has occurred is indicated by “nn”.
<2> Displayed as CPF00 or CPF20 when occurring at drive power up. When one of the faults occurs after successfully starting the drive, the display will show CPF01 or CPF21.

■ Minor Faults and Alarms

Refer to *Table 5.8* for an overview of possible alarm codes. Conditions such as overvoltages can trip faults and alarms. It is important to distinguish between faults and alarms to determine the proper corrective actions.

When the drive detects an alarm, the ALM indicator LED blinks and the alarm code display flashes. Most alarms trigger a digital output programmed for alarm output (H2-□□ = 10). A fault (not an alarm) is present if the ALM LED lights without blinking. *Refer to Faults (Drive Faults and Power Cell Faults) on page 144* for information of fault codes.

Table 5.8 Minor Fault and Alarm Displays

Digital Operator Display	Name	Minor Fault Output (H2-□□ = 10)	Page
BAT	Battery Voltage Low	Yes	*162*
bb	Drive Baseblock (Voltage)	No	*162*
bUS	Option Communication Error	Yes	*162*
CALL	Serial Communication Transmission Error	Yes	*162*
CE	MEMOBUS/Modbus Communication Error	Yes	*163*
CrST	Cannot Reset	No	*163*
dEv	Speed Deviation (for Control Mode with PG)	Yes	*163*
dnE	Drive Disabled	Yes	*163*
EF	Forward/Reverse Run Command Input Error	Yes	*163*
EF0	Option Card External Fault	Yes	*164*
EF1 to EF16	External Fault (input terminal)	Yes	*164*
FAn	Fan Fault	Yes	*165*

Digital Operator Display	Name	Minor Fault Output (H2-□□ = 10)	Page
oL1	Motor Overload	Yes	*166*
oL3	Overtorque 1	Yes	*167*
oL4	Overtorque 2	Yes	*167*
oL5	Mechanical Weakening Detection 1	Yes	*167*
oS	Overspeed (for Control Mode with PG)	Yes	*167*
PASS	MEMOBUS/Modbus Comm. Test Mode Complete	No	*167*
PGo	PG Disconnect (for Control Mode with PG)	Yes	*167*
PGoH	PG Hardware Fault (detected when using a PG-X3 option)	Yes	*167*
rUn	Motor Switch during Run	Yes	*168*
SE	MEMOBUS/Modbus Communication Test Mode Error	Yes	*168*
TMA1	Transformer Temperature Fault	Yes	*168*

Digital Operator Display	Name	Minor Fault Output (H2-☐☐ = 10)	Page
FbH	Excessive PID Feedback	Yes	*165*
FbL	PID Feedback Loss	Yes	*165*
IOV	Input Overvoltage	Yes	*165*
oH	IGBT Overheating	No	*166*
oH2	Drive Overheat Warning	Yes	*166*

Digital Operator Display	Name	Minor Fault Output (H2-☐☐ = 10)	Page
UL3	Undertorque Detection 1	Yes	*168*
UL4	Undertorque Detection 2	Yes	*168*
UL5	Mechanical Weakening Detection 2	Yes	*168*
Uv	Undervoltage	Yes	*169*
VUB	Voltage Unbalance	Yes	*169*

<1> Output when H2-☐☐ =2F

■ Operator Programming Errors

Table 5.9 Operator Programming Error Displays

Digital Operator Display	Name	Page
oPE01	Drive Capacity Setting Fault	*170*
oPE02	Parameter Range Setting Error	*170*
oPE03	Contact Input Selection Error	*170*
oPE05	Run Command/Frequency Reference Source Selection Error	*171*
oPE06	Control Method Selection Error	*171*
oPE07	Multi-Function Analog Input Selection Error	*172*

Digital Operator Display	Name	Page
oPE08	Parameter Selection Error	*172*
oPE09	PID Control Selection Fault	*172*
oPE10	V/f Data Setting Error	*172*
oPE15	Torque Control Setting Error	*173*
oPE18	Online Tuning Parameter Setting Error	*173*
oPE20	Commercial Power Supply/Drive Synchronous Transfer Function	*173*

■ Auto-Tuning Errors

Table 5.10 Auto-Tuning Error Displays

Digital Operator Display	Name	Page
End1	Excessive V/f Setting	*174*
End2	Motor Iron Core Saturation Coefficient Error	*174*
End3	Rated Current Setting Alarm	*174*
End4	Adjusted Slip Calculation Error	*174*
End5	Resistance Tuning Error	*174*
End7	No-Load Current Alarm	*175*
Er-01	Motor Data Error	*175*
Er-02	Minor Fault	*175*

Digital Operator Display	Name	Page
Er-03	STOP Button Input	*175*
Er-04	Line-to-Line Resistance Error	*175*
Er-05	No-Load Current Error	*175*
Er-08	Rated Slip Error	*175*
Er-09	Acceleration Error	*175*
Er-10	Motor Direction Error	*176*
Er-11	Motor Speed Fault	*176*
Er-12	Current Detection Error	*176*

■ Errors and Displays When Using the Copy Function

Table 5.11 Copy Errors

Digital Operator Display	Name	Page
CoPy	Writing Parameter Settings (flashing)	*179*
CPEr	Control Mode Mismatch	*179*
CPyE	Error Writing Data	*179*
CSEr	Copy Unit Error	*179*
dFPS	Drive Model Mismatch	*179*
End	Task Complete	*179*
iFEr	Communication Error	*179*

Digital Operator Display	Name	Page
ndAT	Model, Voltage Class, Capacity Mismatch	*180*
rdEr	Error Reading Data	*180*
rEAd	Reading Parameter Settings (flashing)	*180*
vAEr	Voltage Class, Capacity Mismatch	*180*
vFyE	Parameter settings in the drive and those saved to the copy function are not the same	*180*
vrFy	Comparing Parameter Settings (flashing)	*180*

5.4 Fault Detection

◆ Fault Displays, Causes, and Possible Solutions

Faults are detected for drive protection, and cause the drive to stop. Remove the cause of the fault and manually clear the fault before attempting to run the drive again.

Table 5.12 Detailed Fault Displays, Causes, and Possible Solutions

Digital Operator Display	Fault Name
24V (Lit)	Option Power Supply Error
	• No input of 24V power detected • Message: Option power Flt
Cause	**Possible Solutions**
The 24V power (CN3) is not input to the controller in a state either the communication option, PG option, or DI option board is installed.	Input 24 V power (CN3) to the controller.
Digital Operator Display	**Fault Name**
bUS	Option Communication Error
	• The connection was lost after establishing initial communication. • Only detected when the Run command or frequency reference is assigned to an option card.
Cause	**Possible Solutions**
No signal was received from the PLC.	• Check for faulty wiring. • Correct the wiring. • Check for disconnected cables and short circuits and repair as needed.
Faulty communications wiring or an existing short circuit.	
Communications data error occurred due to electrical interference.	• Check the various options available to minimize the effects of electrical interference. • Counteract electrical interference in the control circuit, main circuit, and ground wiring. • If the magnetic contactor is identified as a source of electrical interference, install a surge protector to the MC coil. • Use only recommended cables or other shielded line. Ground the shield on the controller side or on the drive input power side. • Separate all communication wiring from drive power lines. Install an EMC noise filter to the drive input power supply.
The option card is damaged.	Replace the option card if there are no problems with the wiring and the error continues to occur.
The option card is not properly connected to the drive.	• The connector pins on the option card do not line up properly with the connector pins on the drive. • Reinstall the option card.
Digital Operator Display	**Fault Name**
CE	MEMOBUS/Modbus Communication Error
	Control data was not received for the CE detection time set to H5-09.
Cause	**Possible Solutions**
Faulty communications wiring or an existing short circuit.	• Check for faulty wiring. • Correct the wiring. • Check for disconnected cables and short circuits and repair as needed.
Communications data error occurred due to electrical interference.	• Check the various options available to minimize the effects of electrical interference. • Counteract electrical interference in the control circuit, main circuit, and ground wiring. • If the magnetic contactor is identified as a source of electrical interference, install a surge protector to the MC coil. • Use only recommended cables or other shielded line. Ground the shield on the controller side or on the drive input power side. • Separate all communication wiring from drive power lines. Install an EMC noise filter to the drive input power supply.

Digital Operator Display	Fault Name
CF	Control Fault
	The torque limit was reached continuously for three seconds or longer while ramping to stop in Open Loop Vector Control.
Cause	**Possible Solutions**
Motor parameters are set improperly.	Check the motor parameter settings and repeat Auto-Tuning.
Torque limit is set too low.	Set the torque limit to an appropriate value using parameters L7-01 to L7-04.
Load inertia is too big.	• Adjust the deceleration time (C1-02, C1-04, C1-06, C1-08). • Set the frequency to the minimum value and interrupt the Run command when the drive finishes decelerating.
The connection between motor and drive is improper.	• Check for faulty wiring. • Correct the wiring.
The line-to-line resistance has not been tuned.	Perform line-to-line resistance Auto-Tuning.
The stopping method setting is not appropriate.	The Run command fails to decelerate to a stop or is applied to unwanted machine.
A Run command was issued in the coast to stop state.	• The Stop command is issued after the motor stopped. • Enable Speed Search at start by setting b3-01 to 1.
Digital Operator Display	**Fault Name**
CFA nn COF	Current Offset Fault
	The current offset value at the current detection circuit exceeded the fault detection level.
Cause	**Possible Solutions**
Cell control board fault	Replace the cell control board.
Current detection circuit fault	Replace the current detection circuit.
Digital Operator Display	**Fault Name**
CFA nn CUV	Undervoltage
	The P side or N side voltage in the DC bus has fallen below the low voltage detection level.
Cause	**Possible Solutions**
The Power Cell input voltage is incorrect.	Correct the Power Cell input voltage.
The Power Cell input power fuse has blown.	Replace the Power Cell input power fuse.
Cell control board fault	Replace the cell control board.
Digital Operator Display	**Fault Name**
CFA nn FU	Fuse Blowout
	The P side or N side voltage in the DC bus has fallen below the low voltage detection level.
Cause	**Possible Solutions**
The Power Cell input power fuse has blown.	Replace the Power Cell input power fuse.
Phase loss for the input voltage of Power Cell (secondary transformer)	Replace the cell control board.
Phase loss for the power supply of the medium-voltage main circuit (primary transformer)	Check the wiring of the input terminal for the main circuit of the panel.
Cell control board fault or voltage detection board fault	Replace the cell control board or voltage detection board.
Digital Operator Display	**Fault Name**
CFA nn IGBT_FLT	IGBT Fault
	An IGBT fault has been detected.
Cause	**Possible Solutions**
Power Cell fault	Replace the Power Cell.
The motor has been damaged due to overheating or the motor insulation is damaged.	• Check the insulation resistance of the motor. • Replace the motor.
One of the motor cables has short circuited or there is a grounding problem.	• Check the motor cable. • Remove the short circuit.

Digital Operator Display	Fault Name
CFA nn OC	Overcurrent
	The output current has exceeded 132% of the rated current of the Power Cell.
Cause	**Possible Solutions**
Load is too heavy.	Reduce the load.
The motor or cable insulation is conducting electricity.	Replace the motor or cable.
The output side cable wiring is incorrect.	Correct the wiring.
The acceleration and deceleration times are too short.	Increase the acceleration and deceleration times.
The PG is not mounted correctly.	Mount the PG correctly.
PG cable is disconnected.	Reconnect the cable.
PG cable wiring is incorrect.	Correct the wiring.
The PG settings are incorrect.	Correct the PG settings.
The motor parameters are not set correctly.	Set the motor parameters correctly.
Digital Operator Display	**Fault Name**
CFA nn OH	IGBT Overheating
	A thermistor temperature met or exceeded the value set for L8-02.
Cause	**Possible Solutions**
Cooling fan fault possibly caused by inadequate airflow.	Replace the cooling fan.
The intake filter is soiled.	Clean or replace the intake filter.
The heatsink of the Power Cell is soiled.	Clean the heatsink of the Power Cell.
Fault of the cell control board (CCB), thermistor or Power Cell	Replace the CCB, thermistor, or Power Cell.
Parameter setting error	Check the parameter settings.
Digital Operator Display	**Fault Name**
CFA nn OH1	IGBT Overheating 1
	A thermistor temperature has exceeded the protection level.
Cause	**Possible Solutions**
Cooling fan fault possibly caused by inadequate airflow.	Replace the cooling fan.
The intake filter is soiled.	Clean or replace the intake filter.
The heatsink of the Power Cell is soiled.	Clean the heatsink of the Power Cell.
Fault of the cell control board (CCB), thermistor or Power Cell	Replace the CCB, thermistor, or Power Cell.
Parameter setting error	Check the parameter settings.
Digital Operator Display	**Fault Name**
CFA nn OV	Overvoltage 1
	The P side or N side voltage in the DC bus has exceeded the overvoltage detection level.
Cause	**Possible Solutions**
The deceleration time is too short.	Increase the deceleration time.
The Power Cell input voltage is incorrect.	Correct the Power Cell input voltage.
The Power Cell input power fuse has blown.	Replace the Power Cell input power fuse.
Cell control board fault	Replace the cell control board.
Digital Operator Display	**Fault Name**
CFA nn OV2	Overvoltage 2
	The P side or N side voltage in the DC bus has exceeded the overvoltage detection level.
Cause	**Possible Solutions**
The deceleration time is too short.	Increase the deceleration time.
The Power Cell input voltage is incorrect.	Correct the Power Cell input voltage.
The Power Cell input power fuse has blown.	Replace the Power Cell input power fuse.
Cell control board fault	Replace the cell control board.

Digital Operator Display	Fault Name
CFA nn VCF_OV	Main Circuit Capacitor Neutral Point Potential Error
	The P side or N side voltage in the DC bus has become unbalanced.
Cause	**Possible Solutions**
The bus capacitor circuit has deteriorated or there was a Power Cell fault.	• Replace the electrolytic capacitor. • Check the balance resistance. • Check the cable. • Replace the cell control board.
Digital Operator Display	**Fault Name**
CPF00, CPF01 <1>	Control Circuit Error
CPF20, CPF21 <1>	
Cause	**Possible Solutions**
There is a self-diagnostic error in control circuit.	• Cycle control power to the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.
Connector on the digital operator is damaged.	Replace the digital operator.
Digital Operator Display	**Fault Name**
CPF02	A/D Conversion Error
	An A/D conversion error or control circuit error occurred.
Cause	**Possible Solutions**
Control circuit is damaged.	• Cycle control power to the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.
Digital Operator Display	**Fault Name**
CPF06	EEPROM Memory Data Error
	There is an error in the data saved to EEPROM.
Cause	**Possible Solutions**
There is an error in EEPROM control circuit.	• Cycle control power to the drive. • If the problem continues, replace the control board. For instructions on replacing it, contact Yaskawa or your nearest sales representative.
The power supply was switched off while parameters were being saved to the drive and the communication option card was in use.	Reinitialize the drive (A1-03 = 2220).
Digital Operator Display	**Fault Name**
CPF22	Hybrid IC Error
Cause	**Possible Solutions**
Hybrid IC failure on the power board	• Cycle control power to the drive. • If the problem continues, replace the control board. For instructions on replacing it, contact Yaskawa or your nearest sales representative.
Digital Operator Display	**Fault Name**
CPF23	Control Board Connection Error
	Connection error between the control board and the Power Cell
Cause	**Possible Solutions**
Hardware is damaged.	• Turn off the power for the main circuit and controls and check the connection between the control board and the Power Cell. • If the problem continues, replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.
Digital Operator Display	**Fault Name**
CPF26 to CPF29	Control Circuit Error
CPF31 to CPF34	
CPF40 to CPF43	
Cause	**Possible Solutions**
Hardware is damaged.	If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

Digital Operator Display	Fault Name
dEv	Speed Deviation (for Control Mode with PG)
	The deviation between the speed reference and speed feedback is greater than the setting in F1-10 for longer than the time set to F1-11.
Cause	**Possible Solutions**
Load is too heavy.	• Check the size of the load. • Reduce the load.
Acceleration and deceleration times are set too short.	Increase the acceleration and deceleration times (C1-01 through C1-08).
The load is locked up.	Check the machine.
Parameters are not set appropriately.	Check the settings of parameters F1-10 and F1-11.
Motor brake is engaged.	Ensure the motor brake releases properly.
Digital Operator Display	**Fault Name**
dO	Door Open
	The contact input terminal from the door limit switch has detected that the panel door is open. (Fault detected when the terminal is open. No fault detected when the terminal assigned for H1-□□ = 73 is closed.)
Cause	**Possible Solutions**
The panel door is open.	Close the panel door.
The contact input terminal remains open.	• Check for disconnected cables and faulty wiring. • Correct the wiring.
	• Check that limit switch is operating normally. • Replace the limit switch.
Digital Operator Display	**Fault Name**
EF0	Option Card External Fault
	An external fault condition is present.
Cause	**Possible Solutions**
An external fault was received from the PLC and F6-03 was set to a value other than 3 “alarm only” (the drive continued to run after external fault).	• Remove the cause of the external fault. • Remove the external fault input from the PLC.
Problem with the PLC program	Check the PLC program and correct problems.
Digital Operator Display	**Fault Name**
EF1	External Fault (contact input 1)
	External fault input at contact input terminal 1
EF2	External Fault (contact input 2)
	External fault input at contact input terminal 2
EF3	External Fault (contact input 3)
	External fault input at contact input terminal 3
EF4	External Fault (contact input 4)
	External fault input at contact input terminal 4
EF5	External Fault (contact input 5)
	External fault input at contact input terminal 5
EF6	External Fault (contact input 6)
	External fault input at contact input terminal 6
EF7	External Fault (contact input 7)
	External fault input at contact input terminal 7
EF8	External Fault (contact input 8)
	External fault input at contact input terminal 8
EF9	External Fault (contact input 9)
	External fault input at contact input terminal 9
EF10	External Fault (contact input 10)
	External fault input at contact input terminal 10
EF11	External Fault (contact input 11)
	External fault input at contact input terminal 11
EF12	External Fault (contact input 12)
	External fault input at contact input terminal 12

EF13	External Fault (contact input 13)
	External fault input at contact input terminal 13
EF14	External Fault (contact input 14)
	External fault input at contact input terminal 14
EF15	External Fault (contact input 15)
	External fault input at contact input terminal 15
EF16	External Fault (contact input 16)
	External fault input at contact input terminal 16
Cause	**Possible Solutions**
An external device has tripped an alarm function.	Remove the cause of the external fault and reset the external fault digital input contact.
Wiring is incorrect.	• Properly connect the signal lines to the terminals assigned for eternal fault detection (H1-□□ = 20 to 2B). • Reconnect the signal line.
The contact inputs are set incorrectly.	• Check if the unused terminals have been set for H1-□□ = 20 to 2B (External Fault). • Change the terminal settings.
Digital Operator Display	**Fault Name**
Err	EEPROM Write Error
	Data cannot be written to the EEPROM.
Cause	**Possible Solutions**
Noise has corrupted data while writing to the EEPROM.	• Press "ENTER" on the digital operator. • Correct the parameter setting. • Cycle power to the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.
Hardware problem.	If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.
Digital Operator Display	**Fault Name**
FAn	Fan Fault
	A cooling fan error has been detected by a signal from the fan fault detection board (FFB).
Cause	**Possible Solutions**
Cooling fan fault	• Set the cooling fan ON/OFF control selection (L8-10) to 2, and confirm whether the error occurs again after the reset operation. • Confirm whether all cooling fans are operating. • Check U4-03 (Fan cumulative operation time) and U4-04 (fan maintenance timer). • Replace the cooling fan according to the user's manual if it has come to the end of its service life, or has failed. • Maintenance settings are performed in o4-07.
Fan fault detection board fault	• Check whether an error is displayed while all the cooling fans are in operation. • Replace the fan fault detection board. Contact Yaskawa or your nearest sales representative on replacing the board.
Cooling fan contactor fault	• Check the cooling fan contactor ON/OFF. • Replace the contactor.
Cooling fan wiring fault	• Check whether there are any broken connections or incorrect wiring. • Correct wiring connections.
Fan fault detection board setup error	• Check whether the fan fault detection board switch settings match with the connected fans. • Perform switch setting correctly.
Digital Operator Display	**Fault Name**
FbH	Excessive PID Feedback
	PID feedback loss detection is programmed to trigger a fault (b5-12 is set to 2 or 5), and the PID feedback input is greater than the level set b5-36 for longer than the time set to b5-37.
Cause	**Possible Solutions**
Parameters are not set appropriately.	Check the settings of parameters b5-36 and b5-37.
Incorrect PID feedback wiring	• Check for faulty wiring. • Correct the wiring.
There is a problem with the feedback sensor.	• Check the sensor on the controller side. • Replace the sensor if damaged.

Digital Operator Display	Fault Name
FbL	PID Feedback Loss
	PID feedback loss detection is programmed to trigger a fault (b5-12 = 2) and the PID feedback input is below the detection level set to b5-13 for longer than the time set to b5-14.
Cause	**Possible Solutions**
Parameters are set inappropriately.	Check the settings of parameters b5-13 and b5-14.
Incorrect PID feedback wiring	• Check for faulty wiring. • Correct the wiring.
There is a problem with the feedback sensor.	• Check the sensor on the controller side. • Replace the sensor if damaged.
Digital Operator Display	**Fault Name**
GF	Ground Fault
	A current short to ground exceeded 50% of rated current on the output side of the drive (Set L8-09 to 1 to enable ground fault detection.).
Cause	**Possible Solutions**
The motor has been damaged from overheating or the motor insulation is damaged.	• Check the insulation resistance of the motor. • Replace the motor.
A damaged motor cable is creating a short circuit or there is a grounding problem.	• Check the motor cable. • Remove the short circuit and reapply power to the drive.
	• Check the resistance between the motor cables and the ground terminal ⏚. Replace the cable.
Large stray capacitance of cable and ⏚ terminal	• Decrease the carrier frequency if the cable length exceeds 100 m. • Reduce the amount of stray capacitance.
Hardware problem	If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.
Digital Operator Display	**Fault Name**
IOV	Input Overvoltage
	The main circuit power supply voltage has exceeded the setting in L2-41 in longer than the time set to L2-42.
Cause	**Possible Solutions**
Excessive rise of the power supply voltage	• Check if the power supply is appropriate. • Adjust the power supply voltage of the main circuit (for example, changing the taps of the transformer). • Set L2-41 to the appropriate value. • If detection is faulty, replace the isolation board, which detects the power supply voltage of the main circuit, or the control board. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.
Digital Operator Display	**Fault Name**
IUV	Power Supply Undervoltage
	Power voltage has dropped for all Power Cell's during drive operation (voltage output).
Cause	**Possible Solutions**
There is a problem with the voltage from the drive power.	• Check the voltage. • Correct the voltage to be within the range listed in drive input power specifications.
The power has been interrupted.	Correct the drive input power.
Digital Operator Display	**Fault Name**
LF	Output Phase Loss
	Phase loss on the output side of the drive. Set L8-07 to 1 or 2 to enable Phase Loss Detection.
Cause	**Possible Solutions**
The output cable is disconnected.	• Check for wiring errors and ensure the output cable is connected properly. • Correct the wiring.
The motor winding is damaged.	• Check the resistance between motor lines. • Replace the motor if the winding is damaged.
The output terminal is loose.	• Apply the tightening torque specified in this manual to fasten the terminals. Retighten the terminals to the tightening torques specified in this manual. *Refer to Wire Gauges and Tightening Torques on page 91* for details.
The rated current of the motor being used is less than 5% of the drive rated current.	Check the drive and motor capacities.
An output transistor is damaged.	If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

Digital Operator Display	Fault Name
LIN nn LINK FAULT	CCB-MB Communication Error (Link Fault)
	No response has not been returned within 1 ms or longer in the communication cycle.
Cause	**Possible Solutions**
Fiber optic cable fault	Replace the fiber optic cable.
The cell control board (CCB) or control board has faulted	• Replace the CCB. • Replace the control board. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.
Digital Operator Display	**Fault Name**
oFA00	Option Card Connection Error at Option Port CN5-A
Cause	**Possible Solutions**
The option card installed into port CN5-A is incompatible with the drive.	Check if the drive supports the option card to be installed. Contact Yaskawa for assistance.
A PG option card is connected to option port CN5-A.	PG option cards are supported by option ports CN5-B and CN5-C only. Connect the PG option card to the correct option port.
Digital Operator Display	**Fault Name**
oFA01	Option Card Fault at Option Port CN5-A
Cause	**Possible Solutions**
The option card connection to port CN5-A is faulty.	• Turn off the power and reconnect the option card. • Check if the option card is properly plugged into the option port. • If the option is not a communication option card, try to use the card in a different option port. If the option card works properly in a different option port, CN5-A is damaged, and the drive requires replacement. If the error persists (oFb01 or oFC01 occur), replace the option card.
Digital Operator Display	**Fault Name**
oFA02	Option Card Fault at Option Port CN5-A
Cause	**Possible Solutions**
An option card of the same type is already installed in option port CN5-B or CN5-C.	Connect the option card properly. Except for PG options, only one of each option card type can only be installed simultaneously.
Digital Operator Display	**Fault Name**
oFA03 to oFA06	Option Card Error Occurred at Option Port CN5-A
oFA10, oFA11	
oFA12 to oFA17	Option Card Fault at Option Port CN5-A
oFA30 to oFA43	Option Card Error Occurred at Option Port CN5-A
Cause	**Possible Solutions**
Option card or hardware is damaged.	• Cycle control power to the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.
Digital Operator Display	**Fault Name**
oFb00	Option Card Connection Error at Option Port CN5-B
Cause	**Possible Solutions**
The option card installed in port CN5-B is incompatible with the drive.	Make sure the drive supports the option card to be installed. Contact Yaskawa for assistance.
A communication option card has been installed in option port CN5-B.	Communication option cards are only supported by option port CN5-A. It is not possible to install more than one communication option.
Digital Operator Display	**Fault Name**
oFb01	Option Card Fault at Option Port CN5-B
Cause	**Possible Solutions**
The option card installed in port CN5-B has been changed while operating.	Turn the control power off and reconnect the option card. Check if the option card is properly plugged into the option port.
The option card connection to port CN5-B is faulty.	Try to use the card in a different option port (in case of a PG option, use port CN5-C). If the option card works properly in a different option port, CN5-B is damaged, and the drive requires replacement. If the error persists (oFA01 or oFC01 occur), replace the option card.

Digital Operator Display	Fault Name
oFb02	Option Card Fault at Option Port CN5-B
Cause	**Possible Solutions**
An option card of the same type is already installed in option port CN5-A.	Except for PG options, only one of each option card type can only be installed simultaneously.
An input option card is already installed in option port CN5-A.	Install a communication option, a digital input option, or an analog input option. More than one of the same type of card cannot be installed simultaneously.
Digital Operator Display	**Fault Name**
oFb03 to oFb11	Option Card Error Occurred at Option Port CN5-B
oFb12 to oFb17	Option Card Fault at Option Port CN5-B
Cause	**Possible Solutions**
Option card or hardware is damaged.	• Cycle control power to the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.
Digital Operator Display	**Fault Name**
oFC00	Option Card Connection Error at Option Port CN5-C
Cause	**Possible Solutions**
The option card installed in port CN5-C is incompatible with the drive.	Confirm that the drive supports the option card to be installed. Contact Yaskawa for assistance.
A communication option card has been installed in option port CN5-C.	Communication option cards are only supported by option port CN5-A. It is not possible to install more than one communication option.
Digital Operator Display	**Fault Name**
oFC01	Option Card Fault at Option Port CN5-C
Cause	**Possible Solutions**
The option card installed in port CN5-C has been changed while operating.	Turn the control power off and reconnect the option card. Check if the option card is properly plugged into the option port.
The option card connection to port CN5-B is faulty.	Try to use the card in a different option port (in case of a PG option, use port CN5-B). If the option card works properly in a different option port, CN5-C is damaged, and the drive requires replacement. If the error persists (oFA01 or oFb01 occur), replace the option card.
Digital Operator Display	**Fault Name**
oFC02	Option Card Fault at Option Port CN5-C
Cause	**Possible Solutions**
An option card of the same type is already installed in option port CN5-A or CN5-B.	Except for PG options, only one of each option card type can only be installed simultaneously. Make sure only one type of option card is connected.
An input option card is already installed in option port CN5-A or CN5-B.	Install a communication option, a digital input option, or an analog input option. More than one of the same type of card cannot be installed simultaneously.
Three PG option boards are installed.	A maximum of two PG option boards can be used simultaneously. Remove the PG option board installed into option port CN5-A.
Digital Operator Display	**Fault Name**
oFC03 to oFC11	Option Card Error Occurred at Option Port CN5-C
oFC12 to oFC17	Option Card Fault at Option Port CN5-C
Cause	**Possible Solutions**
Option card or hardware is damaged.	• Cycle control power to the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

Digital Operator Display	Fault Name
oL1	Motor Overload
	The electronic motor overload protection tripped.
Cause	**Possible Solutions**
Load is too heavy.	Reduce the load.
Cycle times are too short during acceleration and deceleration.	Increase the acceleration and deceleration times (C1-01 through C1-08).
A general purpose motor is driven below the rated speed with too high load. When using a general-purpose motor, the operation with less than rated current could result in the overload at the time of low-speed operation.	• Reduce the load. • Increase the speed. • If the motor is supposed to operate at low speeds, either increase the motor capacity or use a motor specifically designed to operate in the desired speed range.
When using the drive dedicated motor, L1-01 (Motor Overload Protection Selection) was 1 (General-purpose motor).	Set L1-01 to 2.
The wrong motor rated current is set to E2-01.	• Check the motor-rated current. • Enter the value written on the motor nameplate to parameter E2-01.
The base frequency setting is too low.	• Check the rated frequency indicated on the motor nameplate. • Enter the rated frequency to E1-06 (Base Frequency).
Multiple motors are running off the same the drive.	Set L1-01 to 0 to disable the motor protection function and then install a thermal relay to each motor.
The electrical thermal protection characteristics and motor overload characteristics do not match.	• Check the motor characteristics. • Correct the type of motor protection that has been selected (L1-01). • Install an external thermal relay.
The electrical thermal relay is operating at the wrong level.	• Check the current rating listed on the motor nameplate. • Check the value set for the motor rated current (E2-01).
Speed Search related parameters are set incorrectly.	• Check values set to Speed Search related parameters. • Adjust the Speed Search current and Speed Search deceleration times (b3-02 and b3-03 respectively). • After Auto-Tuning, set b3-24 to 1 to enable the Speed Estimation Speed Search.
Output current fluctuation due to phase loss in the input power supply	Check whether input phase loss is present and improve the phase loss.
Digital Operator Display	**Fault Name**
oL2	Drive Overload
	The thermal sensor of the drive triggered overload protection.
Cause	**Possible Solutions**
Load is too heavy.	• Check the size of the load. • Reduce the load.
Cycle times are too short during acceleration and deceleration.	• Check the acceleration/deceleration time and cycle time. • Increase the acceleration and deceleration times (C1-01 through C1-08).
Overload occurred when operating at low speeds.	Reduce the load when operating at low speeds.
Excessive torque compensation	• Check the amount of torque compensation. • Reduce the torque compensation gain (C4-01) until there is no speed loss but less current.
Speed Search related parameters are set incorrectly.	• Check the settings for all Speed Search related parameters. • Adjust the current used during Speed Search (b3-03) and the Speed Search deceleration time (b3-02). • After Auto-Tuning the drive, set b3-24 to 1 to enable Speed Estimation Speed Search.
Output current fluctuation due to input phase loss	Check the power supply for phase loss.
Digital Operator Display	**Fault Name**
oL3	Overtorque Detection 1
	The current has exceeded the value set for torque detection (L6-02) for longer than the allowable time (L6-03).
Cause	**Possible Solutions**
Parameter settings are not appropriate for the load.	Check the settings of parameters L6-02 and L6-03.
Fault on the machine side (e.g., machine is locked up)	• Check the status of the machine. • Remove the cause of the fault.

Digital Operator Display	Fault Name
oL4	Overtorque Detection 2
	The current has exceeded the value set for Torque Detection Level 2 (L6-05) for longer than the allowable time (L6-06).
Cause	**Possible Solutions**
Parameter settings are not appropriate for the load.	Check the settings of parameters L6-05 and L6-06.
Fault on the machine side (e.g., machine is locked up)	• Check the status of the machine. • Remove the cause of the fault.
Digital Operator Display	**Fault Name**
oL5	Mechanical Weakening Detection 1
	Overtorque occurred, matching the conditions specified in L6-08.
Cause	**Possible Solutions**
Overtorque triggered mechanical weakening detection level set to L6-08.	Determine the cause of mechanical weakening.
Digital Operator Display	**Fault Name**
oL7	High Slip Braking oL
	The output frequency stayed constant for longer than the time set in n3-04 during High Slip Braking.
Cause	**Possible Solutions**
Excessive load inertia	• Reduce deceleration times in parameters C1-02, C1-04, C1-06, and C1-08 for applications that do not use High Slip Braking. • Use a braking resistor to shorten deceleration time.
Motor is driven by the load.	
Something on the load side is restricting deceleration.	
The overload time during High Slip Braking is too short.	• Increase parameter n3-04 (High-slip Braking Overload Time). • Install a thermal relay and increase the setting of n3-04 to the maximum value.
Digital Operator Display	**Fault Name**
OOV	Output Overvoltage
	The output voltage of the drive has exceeded the output overvoltage detection level in L8-63 for longer than the time set to L8-64.
Cause	**Possible Solutions**
Excessive rise of the output voltage	• Change the motor parameters to appropriate values. Parameters: E1-□□ and E2-□□. • Change the settings of L8-63 and L8-64 to appropriate values. • Check the cables on the output side for proper connections and correct if necessary.
Digital Operator Display	**Fault Name**
oPr	External Digital Operator Connection Fault
	The external digital operator has been disconnected from the drive. An oPr fault will occur when both of the following conditions are true: Output is interrupted when the digital operator is disconnected (o2-06 = 1). The Run command is assigned to the operator (b1-02 = 0 or LOCAL has been selected).
Cause	**Possible Solutions**
External digital operator is not properly connected to the drive.	• Check the connection between the digital operator and the drive. • Replace the cable if damaged. • Turn off the drive input power and disconnect the digital operator. Reconnect the digital operator and reapply drive input power.
Digital Operator Display	**Fault Name**
oS	Overspeed (for Control Mode with PG)
	The motor speed feedback exceeded the F1-08 setting (Overspeed Detection Level).
Cause	**Possible Solutions**
Overshoot is occurring.	Reduce the setting for C5-01 (ASR Proportional Gain 1) and increase the setting for C5-02 (ASR Integral Time 1).
Inappropriate parameter settings	Check the setting for the overspeed detection level and the overspeed detection time (F1-08 and F1-09).

Digital Operator Display	Fault Name
PGo	PG Disconnect (for Control Mode with PG)
	No PG pulses are received for longer than the time set to F1-14.
Cause	**Possible Solutions**
PG cable is disconnected.	Reconnect the cable.
PG cable wiring is incorrect.	Correct the wiring.
PG has no power.	Check the power line to the PG encoder.
PG encoder brake is clamped shut.	Ensure the motor brake releases properly.
Digital Operator Display	**Fault Name**
PGoH	PG Hardware Fault (detected when using a PG-X3 option card)
	PG cable is not connected properly.
Cause	**Possible Solutions**
PG cable is disconnected.	Reconnect the cable.
Digital Operator Display	**Fault Name**
SEr	Too Many Speed Search Restarts
	The number of Speed Search restarts exceeded the number set to b3-19.
Cause	**Possible Solutions**
Speed Search parameters are set to the wrong values.	• Reduce the detection compensation gain during Speed Search (b3-10). • Increase the current level when attempting Speed Search (b3-17). • Increase the detection time during Speed Search (b3-18). • Repeat Auto-Tuning.
Digital Operator Display	**Fault Name**
SYNC	Commercial Synchronous Switching Error
	An error was detected during commercial synchronous switching. (The synchronous switching signal is ON)
Cause	**Possible Solutions**
The drive input main circuit voltage (frequency) is not detected correctly.	• Check the main circuit wiring and input voltage detection circuit on the drive side. • Connect the drive-side main circuit wiring correctly (positive phase). Match the phase connected to the motor with a commercial power phase, with the drive input and output phases. • Replace the input voltage detection circuit.
Commercial synchronous switching is not completed within the time limit (n7-76).	• Check that the switching command and switching answers are operating correctly. • Review the command sequence to the switches. Check the power state and load state if voltage synchronization is not achieved. • Switch in a state with a small power fluctuation. • Revise the run state to that the load fluctuation is reduced. • Perform adjustment of the synchronization in the setting parameters (n7-□□).
The switch performs an operation different from the command (DO) from the drive.	• Check that the switching command and switching answers are operating correctly. • Review the command sequence to the switches.
Digital Operator Display	**Fault Name**
TME	Transformer Temperature Fault
	The temperature of the transformer has exceeded the protection level set to L8-87.
Cause	**Possible Solutions**
Cooling fan fault possibly due to inadequate cooling airflow	If the cooling airflow is inadequate, replace the cooling fan.
The intake filter is soiled.	Clean the intake filter.
Parameter setting error	Check the parameter settings.
Thermistor fault and disconnected signal line	If the problem occurs even at a low temperature, for example immediately after switching on the power, contact Yaskawa or your nearest sales representative.
Digital Operator Display	**Fault Name**
TME1	Transformer Temperature Fault 1
	The temperature of the transformer has exceeded the temperature fault level.
Cause	**Possible Solutions**
Cooling fan fault possibly due to inadequate cooling airflow.	If the cooling airflow is inadequate, replace the cooling fan.
The intake filter is soiled.	Clean the intake filter.
Parameter setting error	Check the parameter settings.
Thermistor fault and disconnected signal line	If the problem occurs at a low temperature, for example immediately after applying power, contact Yaskawa or your nearest sales representative.

Digital Operator Display	Fault Name
TME2	Transformer Temperature DI Fault
	A fault was detected from a contact input terminal (transformer overheat) on the control board.
Cause	**Possible Solutions**
Cooling fan fault possibly due to inadequate cooling airflow	If the cooling airflow is inadequate, replace the cooling fan.
The intake filter is soiled.	Clean the intake filter.
Overheated transformer and disconnected signal line	If the problem occurs at a low temperature, for example immediately after applying power, contact Yaskawa or your nearest sales representative.
Digital Operator Display	**Fault Name**
TME3	Transformer Temperature Sensor Disconnection
	Transformer temperature = -30°C or lower for 10 continuous seconds
Cause	**Possible Solutions**
Disconnection of the transformer temperature sensor cable detected.	• Check the transformer temperature sensor cable. • Fix the disconnection.
Digital Operator Display	**Fault Name**
UL3	Undertorque Detection 1
	The current has fallen below the minimum value set for torque detection (L6-02) for longer than the allowable time (L6-03).
Cause	**Possible Solutions**
Parameter settings are not appropriate for the load.	Check the settings of parameters L6-02 and L6-03.
Fault on the machine side Example: If there is undertorque, the pulley belt may be broken.	Check the status of the machine. Remove the cause of the fault.
Digital Operator Display	**Fault Name**
UL4	Undertorque Detection 2
	The current has fallen below the minimum value set for torque detection (L6-05) for longer than the allowable time (L6-06).
Cause	**Possible Solutions**
Parameter settings are not appropriate for the load.	Check the settings of parameters L6-05 and L6-06.
Fault on the machine side Example: If there is undertorque, the pulley belt may be broken.	Check the load for any problems. Remove the cause of the fault.
Digital Operator Display	**Fault Name**
UL5	Mechanical Weakening Detection 2
	The operation conditions matched the conditions set to L6-08.
Cause	**Possible Solutions**
Undertorque was detected and matched the conditions for mechanical loss detection set to L6-08.	Check the load side for any problems.

Digital Operator Display	Fault Name
Uv1	Undervoltage
	One of the following conditions occurred while the drive was operating (during voltage output): • Voltage in the DC bus fell below the undervoltage detection level (L2-05) • 2 kV class: Approx. 693 V • 3 kV class: Approx. 940 V • 4 kV class: Approx. 1188 V • 6 kV class: Approx. 1188 V • 11 kV class: Approx. 1188 V
Cause	**Possible Solutions**
Input power phase loss	• Check that the main circuit drive input power is wired incorrectly. • Correct the wiring.
One of the drive input power wiring terminals is loose.	• Ensure there are not loose terminals • Retighten the terminals to the tightening torques specified in this manual. *Refer to Wire Gauges and Tightening Torques on page 91* for details.
There is a problem with the voltage from the drive input power.	• Check the voltage. • Correct the voltage to be within the range listed in drive input power specifications. • If there is no problem with the power supply to the main circuit, check for problems with the main circuit breaker.
The power has been interrupted.	Correct the drive input power.
Digital Operator Display	**Fault Name**
Uv3	In-rush Prevention Circuit Error
	A malfunction has occurred in the in-rush prevention circuit.
Cause	**Possible Solutions**
There is an error in the in-rush prevention circuit breaker.	• Check the breaker maintenance period in U4-06 (in-rush prevention circuit breaker). • Replace the breaker if it has reached the end of its service life, or has failed. Maintenance settings are performed in o4-07.
There is an error in the in-rush prevention panel control power.	• Check that there are no wiring breaks or miswirings in the control power wiring. • Perform wiring correctly.
The breaker close command is not being input to the in-rush prevention panel.	• Check that there are no wiring breaks or miswirings between the drive and the in-rush prevention panel. • Check that there are no errors in the drive contact outputs. • Perform wiring correctly or replace the relay board.
Digital Operator Display	**Fault Name**
VUB	Voltage Unbalance
	The sum of the detected output voltages of the three phases exceeded the detection level for longer than the stipulated time.
Cause	**Possible Solutions**
The motor has been damaged due to overheating or the motor insulation is damaged.	Check the insulation resistance of the motor. Replace the motor.
One of the motor cables has short circuited or there is a grounding problem.	Check the motor cable. Remove the short circuit and reapply power.
	Check the resistance between the motor cables and the ground terminal ⏚. Replace the cable.
The output side cable wiring is incorrect.	Correct the wiring.

<1> When a fault occurred at the startup of the drive, CPF00 or CPF20 is displayed. When a fault occurred after the startup, CPF01 or CPF21 is displayed.

Table 5.13 Option Card Installation

Option Card	Available Port/Connector	Number of Option Cards Possible
SI-N3, SI-P3, AI-A3, DI-A3 <1>	CN5-A	1
PG-B3, PG-X3	CN5-B, C <2>	2
DO-A3, AO-A3	CN5-A, B, C	1

<1> When used for monitoring, AI-A3 and DI-A3 can be installed in any of CN5-A, B or C.
<2> Use port CN5-C when connecting one PG option card. Use ports CN5-B and CN5-C when connecting two PG option cards.

5.5 Alarm Detection

◆ Alarm Codes, Causes, and Possible Solutions

Alarms are drive protection functions that do not necessarily cause the drive to stop. After the cause of an alarm is removed, the drive will return to the same status as before the alarm occurred.

When an alarm has been triggered, the ALM light on the digital operator display blinks and the alarm code display flashes. If a contact output is set for an alarm (H2-□□ = 10), that output terminal will be triggered.

Table 5.14 Alarm Codes, Causes, and Possible Solutions

Digital Operator Display	Minor Fault Name	
BAT	Battery Voltage Low	
	Low battery voltage has been detected.	
Cause	**Possible Solutions**	**Minor Fault Output H2-□□=10**
The battery voltage has fallen to 2 V or lower.	Replace the battery.	Yes
Digital Operator Display	**Minor Fault Name**	
bb	Drive Baseblock (Voltage)	
	Drive output interrupted as indicated by an external baseblock signal.	
Cause	**Possible Solutions**	**Minor Fault Output H2-□□=10**
An external baseblock signal has been input at one of the contact input terminals 1 to 16.	Check the external circuit (contact inputs), and review the input timing of baseblock signals.	No
Digital Operator Display	**Minor Fault Name**	
bUS	Option Communication Error	
	After initial communication was established, the connection was lost. Assign a Run command or frequency reference to the option card.	
Cause	**Possible Solutions**	**Minor Fault Output H2-□□=10**
Communications wiring is faulty, there is a short circuit, or something is not connected properly.	Check for faulty wiring. Correct the wiring. Check for disconnected cables and short circuits. Repair as needed.	Yes
The communication option is damaged.	If there are no problems with the wiring and the fault continues to occur, replace the option.	
The communication option is not properly connected to the drive.	• The connector pins on the option are not properly lined up with the connector pins on the drive. • Reinstall the option card.	
Communications data error occurred due to electrical interference.	• Check the various options available to minimize the effects of electrical interference. • Counteract electrical interference in the control circuit, main circuit, and ground wiring. • If the magnetic contactor is identified as a source of electrical interference, install a surge protector to the MC coil. • Use only recommended cables or other shielded line. Ground the shield on the controller side or on the drive input power side. • Separate all communication wiring from drive power lines. Install an EMC noise filter to the drive input power supply.	
Digital Operator Display	**Minor Fault Name**	
CALL	Serial Communication Transmission Error	
	Communication has not yet been established.	
Cause	**Possible Solutions**	**Minor Fault Output H2-□□=10**
Communications wiring is faulty, there is a short circuit, or something is not connected properly.	• Check for wiring errors • Correct the wiring • Check for disconnected cables and short circuits. Repair as needed.	Yes
Programming error on the master side	Check communications at start-up and correct programming errors.	
Communications circuitry is damaged.	• Perform an self-diagnostics check. • If the problem continues, replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.	

Digital Operator Display	Minor Fault Name	
CE	MEMOBUS/Modbus Communication Error	
	Control data was not received correctly for two seconds.	
Cause	**Possible Solutions**	**Minor Fault Output H2-☐☐=10**
Communications data error occurred due to electrical interference.	• Check the various options available to minimize the effects of electrical interference. • Counteract electrical interference in the control circuit, main circuit, and ground wiring. • If the magnetic contactor is identified as a source of electrical interference, install a surge protector to the MC coil. • Use only recommended cables or other shielded line. Ground the shield on the controller side or on the drive input power side. • Separate all communication wiring from drive power lines. Install an EMC noise filter to the drive input power supply.	Yes
Communication protocol is incompatible.	Check the H5 parameter settings and the protocol setting in the controller and ensure settings are compatible.	
The CE detection time (H5-09) is set shorter than the time required for a communication cycle to take place.	• Check the PLC • Change the software settings in the PLC • Set a longer CE detection time (H5-09)	
Incompatible PLC software settings or there is a hardware problem.	Check the PLC and remove the cause of the error on the controller side.	
Communications cable is disconnected or damaged.	Check the connector to make sure the cable has a signal. Replace the communications cable.	
Digital Operator Display	**Minor Fault Name**	
CrST	Cannot Reset	
	A fault reset command was entered while the Run command was still present.	
Cause	**Possible Solutions**	**Minor Fault Output H2-☐☐=10**
Fault reset was being executed when a Run command was entered.	• Ensure that a Run command has cannot be entered from the external terminals or option during fault restart. • Turn off the Run command.	No
Digital Operator Display	**Minor Fault Name**	
dEv	Speed Deviation (for Control Mode with PG)	
	The deviation between the speed reference and speed feedback is greater than the setting in F1-10 for longer than the time in F1-11.	
Cause	**Possible Solutions**	**Minor Fault Output H2-☐☐=10**
Load is too heavy.	Reduce the load.	Yes
Acceleration and deceleration times are set too short.	Increase acceleration and deceleration times (C1-01 to C1-08).	
The load is locked up.	Check the machine.	
Parameter settings are inappropriate.	Check the settings of parameters F1-10 and F1-11.	
Brake is holding the PG.	Ensure the brake releases properly.	
Digital Operator Display	**Minor Fault Name**	
dnE	Drive Disabled	
Cause	**Possible Solutions**	**Minor Fault Output H2-☐☐=10**
The Run command was input while the signal was switched off when "Drive Enable" has been set for a contact input (H1-☐☐ = 6A or 70).	Check the operation sequence.	Yes
Digital Operator Display	**Minor Fault Name**	
EF	Forward/Reverse Run Command Input Error	
	Both forward run and reverse run closed simultaneously for over 0.5 s.	
Cause	**Possible Solutions**	**Minor Fault Output H2-☐☐=10**
Sequence error	Check the forward and reverse command sequence and correct the problem. **Note:** When minor fault EF is detected, the motor ramps to stop.	Yes

Digital Operator Display	Minor Fault Name	
EF0	Option Card External Fault	
	An external fault condition is present.	
Cause	**Possible Solutions**	**Minor Fault Output H2-☐☐=10**
An external fault was received from the PLC with F6-03 set to 3, which allows the drive to continue running after an external fault occurs.	• Remove the cause of the external fault. • Remove the external fault input from the PLC.	Yes
There is a problem with the PLC program.	Check the PLC program and correct problems.	
Digital Operator Display	**Minor Fault Name**	
EF1	External Fault (input terminal)	
	External fault contact input terminal 1	
EF2	External Fault (input terminal)	
	External fault contact input terminal 2	
EF3	External Fault (input terminal)	
	External fault contact input terminal 3	
EF4	External Fault (input terminal)	
	External fault contact input terminal 4	
EF5	External Fault (input terminal)	
	External fault contact input terminal 5	
EF6	External Fault (input terminal)	
	External fault contact input terminal 6	
EF7	External Fault (input terminal)	
	External fault contact input terminal 7	
EF8	External Fault (input terminal)	
	External fault contact input terminal 8	
EF9	External Fault (input terminal)	
	External fault contact input terminal 9	
EF10	External Fault (input terminal)	
	External fault contact input terminal 10	
EF11	External Fault (input terminal)	
	External fault contact input terminal 11	
EF12	External Fault (input terminal)	
	External fault contact input terminal 12	
EF13	External Fault (input terminal)	
	External fault contact input terminal 13	
EF14	External Fault (input terminal)	
	External fault contact input terminal 14	
EF15	External Fault (input terminal)	
	External fault contact input terminal 15	
EF16	External Fault (input terminal)	
	External fault contact input terminal 16	
Cause	**Possible Solutions**	**Minor Fault Output H2-☐☐=10**
An external device has tripped an alarm function.	Remove the cause of the external fault and reset the digital input contact.	Yes
Wiring is incorrect.	• Ensure the signal lines have been connected properly to the terminals assigned for external fault detection (H1-☐☐ = 2C to 2F). • Reconnect the signal line	
The contact inputs are set incorrectly.	• Check if the unused terminals have been set for H1-☐☐ = 2C to 2F (External Fault). • Change the terminal settings	

Digital Operator Display	Minor Fault Name	
FAn	Cooling Fan Error (during backup fan selection)	
	A cooling fan error has been detected from the fan fault detection board (FFB) signal.	
Cause	**Possible Solutions**	**Minor Fault Output H2-☐☐=10**
Cooling fan (backup fan) fault	• Set the cooling fan ON/OFF control selection (L8-10) to 2, and confirm whether the error occurs again after the reset operation. • Check whether the cooling fan is operating or not. • Replace the cooling fan according to the user's manual if it has come to the end of its service life, or has failed.	Yes
Fan fault detection board fault	• Check whether an error is displayed while all the cooling fans are in operation. • Replace the fan fault detection board. Contact Yaskawa or your nearest sales representative on replacing the board.	
Digital Operator Display	**Minor Fault Name**	
FbH	Excessive PID Feedback	
	The PID feedback input is higher than the level set in b5-36 for longer than the time set in b5-37, and b5-12 is set to 1 or 4.	
Cause	**Possible Solutions**	**Minor Fault Output H2-☐☐=10**
Parameter settings for b5-36 and b5-37 are incorrect.	Check parameters b5-36 and b5-37.	Yes
PID feedback wiring is faulty.	Correct the wiring.	
Feedback sensor has malfunctioned.	Check the sensor and replace it if damaged.	
Feedback input circuit is damaged.	Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.	
Digital Operator Display	**Minor Fault Name**	
FbL	PID Feedback Loss	
	The PID feedback input was lower than the level set in b5-13 (PID Feedback Loss Detection Level) for longer than the time set in b5-14 (PID Feedback Loss Detection Time).	
Cause	**Possible Solutions**	**Minor Fault Output H2-☐☐=10**
Parameters settings for b5-13 and b5-14 are incorrect.	Check parameters b5-13 and b5-14.	Yes
PID feedback wiring is faulty.	Correct the wiring.	
Feedback sensor has malfunctioned.	Check the sensor and replace it if damaged.	
Feedback input circuit is damaged.	Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.	
Digital Operator Display	**Minor Fault Name**	
IOV	Input Overvoltage	
	The main circuit power supply voltage has exceeded the setting in L2-41 for longer than the time set to L2-42.	
Cause	**Possible Solution**	**Minor Fault Output H2-☐☐=10**
Excessive rise of the power supply voltage	• Determine that an appropriate power supply is in use. • Adjust the power supply voltage of the main circuit (for example, changing the taps of the transformer). • Change the setting of L2-41 to appropriate value. • If detection is faulty, replace the isolation board, which detects the power supply voltage of the main circuit, or the control board. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.	Yes

Digital Operator Display	Minor Fault Name	
oH	IGBT Overheating	
	A thermistor temperature of the value set for L8-02 or higher has been detected.	
Cause	**Possible Solution**	**Minor Fault Output H2-☐☐=10**
Cooling fan fault possibly due to inadequate airflow	If the cooling airflow is inadequate, replace the cooling fan.	Yes
The intake filter is soiled.	Clean the intake filter.	
The heatsink of the Power Cell is soiled.	Clean the heatsink of the Power Cell.	
Fault of the cell control board (CCB), thermistor, or Power Cell	Replace the CCB, thermistor, or Power Cell.	
Parameter setting error	Check the parameter settings.	

Digital Operator Display	Minor Fault Name	
oH2	Drive Overheat Warning	
	"Drive Overheat Warning" was input to a contact input terminal, 1 through 16 (H1-☐☐ = B).	
Cause	**Possible Solutions**	**Minor Fault Output H2-☐☐=10**
An external device triggered an overheat warning in the drive.	• Search for the device that tripped the overheat warning. • Remove the cause of the problem.	Yes

Digital Operator Display	Minor Fault Name	
oL1	Motor Overload	
	The electronic motor overload protection tripped.	
Cause	**Possible Solutions**	**Minor Fault Output H2-☐☐=10**
Load is too heavy.	Reduce the load.	Yes
Cycle times are too short during acceleration and deceleration.	Increase the acceleration and deceleration times (C1-01 through C1-08).	
A general purpose motor is driven below the rated speed with too high load.	• Reduce the load. • Increase the speed. • If the motor is supposed to operate at low speeds, either increase the motor capacity or use a motor specifically designed to operate in the desired speed range.	
The output voltage is too high.	Adjust the user-set V/f patterns (E1-04 through E1-10) by reducing E1-08 and E1-10. Do not lower E1-08 and E1-10 too much, as this will reduce load tolerance at low speeds.	
The wrong motor rated current is set to E2-01.	• Check the motor rated current. • Enter the value written on the motor nameplate to parameter E2-01.	
The base frequency is set incorrectly.	• Check the rated frequency indicated on the motor nameplate. • Enter the rated frequency to E1-06 (Base Frequency).	
The electrical thermal protection characteristics and motor overload characteristics do not match.	• Check the motor characteristics. • Correct the type of motor protection that has been selected (L1-01). • Install an external thermal relay.	
The electrical thermal relay is operating at the wrong level.	• Check the current rating listed on the motor nameplate. • Check the value set for the motor rated current (E2-01).	
Speed Search related parameters are set incorrectly.	• Check values set to Speed Search related parameters. • Adjust the Speed Search current and Speed Search deceleration times (b3-02 and b3-03 respectively). • After Auto-Tuning, set b3-24 to 1 to enable Speed Estimation Speed Search.	
Output current fluctuation due to power supply loss	Check the power supply for phase loss.	

Digital Operator Display	Minor Fault Name	
oL3	Overtorque 1	
	Drive output current (or torque in OLV, CLV, AOLV/PM, CLV/PM) exceeded the value set to L6-02 for longer than the time set in L6-03.	
Cause	**Possible Solutions**	**Minor Fault Output H2-☐☐=10**
Parameter settings are not appropriate for the load.	Check parameters L6-02 and L6-03.	Yes
Fault on the machine side (e.g., machine is locked up)	Check the status of the machine. Remove the cause of the fault.	
Digital Operator Display	**Minor Fault Name**	
oL4	Overtorque 2	
	Drive output current (or torque in OLV, CLV, AOLV/PM, CLV/PM) exceeded the value set to L6-05 for longer than the time set in L6-06.	
Cause	**Possible Solutions**	**Minor Fault Output H2-☐☐=10**
Inappropriate parameter settings	Check parameters L6-05 and L6-06.	Yes
Fault on the machine side (e.g., machine is locked up)	Check the status of the machine. Remove the cause of the fault.	
Digital Operator Display	**Minor Fault Name**	
oL5	Mechanical Weakening Detection 1	
	Overtorque occurred, matching the conditions specified in L6-08.	
Cause	**Possible Solutions**	**Minor Fault Output H2-☐☐=10**
Overtorque triggered mechanical weakening detection level set to L6-08.	Determine the cause of mechanical weakening.	Yes
Digital Operator Display	**Minor Fault Name**	
oS	Overspeed (for Control Mode with PG)	
	The motor speed feedback exceeded the F1-08 setting.	
Cause	**Possible Solutions**	**Minor Fault Output H2-☐☐=10**
Overshoot is occurring.	Reduce the setting in C5-01 (ASR Proportional Gain 1) and increase the setting in C5-02 (ASR Integral Time 1).	Yes
Inappropriate parameter settings.	Check the setting for the overspeed detection level and the overspeed detection time (F1-08 and F1-09).	
Digital Operator Display	**Minor Fault Name**	
PASS	MEMOBUS/Modbus Comm. Test Mode Complete	
Cause	**Possible Solutions**	**Minor Fault Output H2-☐☐=10**
MEMOBUS/Modbus test has finished normally.	No measures (not an alarm.) This verifies that the test was successful.	No
Digital Operator Display	**Minor Fault Name**	
PGo	PG Disconnect (for Control Mode with PG)	
	Detected when no PG pulses are received for a time longer than setting in F1-14.	
Cause	**Possible Solutions**	**Minor Fault Output H2-☐☐=10**
PG cable is disconnected.	Reconnect the cable.	Yes
PG cable wiring is wrong.	Correct the wiring.	
PG encoder does not have enough power.	Make sure the correct power supply is properly connected to the PG encoder.	
PG encoder brake is clamped shut.	⇒Ensure the motor brake releases properly	
Digital Operator Display	**Minor Fault Name**	
PGoH	PG Hardware Fault (detected when using a PG-X3 option card)	
	PG cable disconnection was detected.	
Cause	**Possible Solutions**	**Minor Fault Output H2-☐☐=10**
PG cable is disconnected.	Reconnect the cable.	Yes

Digital Operator Display	Minor Fault Name	
rUn	Motor Switch during Run	
	A command to switch motors was entered during run.	
Cause	**Possible Solutions**	**Minor Fault Output H2-☐☐=10**
A motor switch command was entered during run.	Change the operation pattern so the motor switch command is entered while the drive is stopped.	Yes
Digital Operator Display	**Minor Fault Name**	
SE	MEMOBUS/Modbus Communication Test Mode Error	
	A digital input set to 67H (MEMOBUS/Modbus test) was closed while the drive was running.	
Cause	**Possible Solutions**	**Minor Fault Output H2-☐☐=10**
A digital input set to 67H (MEMOBUS/Modbus test) was closed while the drive was running.	Stop the drive and run the test again.	Yes
Digital Operator Display	**Minor Fault Name**	
TMA1	Transformer Temperature Fault	
	The temperature of the transformer has increased and has exceeded the protection level set to L8-87.	
Cause	**Possible Solution**	**Minor Fault Output H2-☐☐=10**
Cooling fan fault possibly caused by inadequate airflow.	If the cooling airflow is inadequate, replace the cooling fan.	Yes
The intake filter is soiled.	Clean the intake filter.	
Parameter setting error	Check the parameter settings.	
Thermistor fault and disconnected signal line	If the problem occurs at a low temperature, for example immediately after applying power, contact Yaskawa or your nearest sales representative.	
Digital Operator Display	**Minor Fault Name**	
UL3	Undertorque Detection 1	
	Drive output current (or torque in OLV, CLV, AOLV/PM, CLV/PM) has fallen below the value set to L6-02 for longer than the time set to L6-03.	
Cause	**Possible Solutions**	**Minor Fault Output H2-☐☐=10**
Inappropriate parameter settings	Check parameters L6-02 and L6-03.	Yes
Fault on the machine side Example: If there is undertorque, the pulley belt may be broken.	Check the status of the machine. Remove the cause of the fault.	
Digital Operator Display	**Minor Fault Name**	
UL4	Undertorque Detection 2	
	Drive output current (or torque in OLV, CLV, AOLV/PM, CLV/PM) has fallen below the value set to L6-05 for longer than the time set to L6-06.	
Cause	**Possible Solutions**	**Minor Fault Output H2-☐☐=10**
Inappropriate parameter settings	Check parameters L6-05 and L6-06.	Yes
Fault on the machine side Example: If there is undertorque, the pulley belt may be broken.	Check the status of the machine. Remove the cause of the fault.	
Digital Operator Display	**Minor Fault Name**	
UL5	Mechanical Weakening Detection 2	
	The operation conditions matched the conditions set to L6-08.	
Cause	**Possible Solutions**	**Minor Fault Output H2-☐☐=10**
Undertorque was detected and matched the conditions for mechanical loss detection set to L6-08.	Check the load side for any problems.	Yes

Digital Operator Display	Minor Fault Name	
Uv	Undervoltage	
	One of the following conditions occurred while the drive was stopped (a Run command was not entered): • DC bus voltage dropped below the level specified in L2-05. • Contactor to suppress inrush current in the drive was opened. • Low voltage in the control drive input power.	
Cause	**Possible Solutions**	**Minor Fault Output H2-☐☐=10**
Phase loss in the drive input power	Check for wiring errors in the main circuit drive input power. Correct the wiring.	Yes
Loose wiring in the drive input power terminals	Retighten the terminals to the tightening torques specified in this manual. *Refer to Wire Gauges and Tightening Torques on page 91* for details.	
There is a problem with the drive input power voltage.	Lower the voltage of the drive input power so it is within the limits listed in the specifications.	
The power has been interrupted.	Correct the drive input power.	
Digital Operator Display	**Minor Fault Name**	
VUB	Voltage Unbalance	
	The sum of the detected output voltages of the three phases exceeded the detection level for longer than the stipulated time.	
Cause	**Possible Solutions**	**Minor Fault Output H2-☐☐=10**
The motor has been damaged due to overheating or the motor insulation is damaged.	Check the insulation resistance of the motor. Replace the motor.	Yes
One of the motor cables has shorted out or there is a grounding problem.	Check the motor cable. Remove the short circuit and reapply power.	
	Check the resistance between the motor cables and ground terminal ⏚. Replace the cable.	
The output side cable wiring is wrong.	Correct the wiring.	

5.6 Operator Programming Error

◆ oPE Codes, Causes, and Possible Solutions

An Operator Programming Error (oPE) occurs when a contradictory parameter is set or an individual parameter is set to an inappropriate value.

The drive will not operate until the parameter or parameters causing the problem are set correctly. An oPE, however, does not trigger a contact terminal set for fault or alarm output. If an oPE occurs, investigate the cause and refer to *Table 5.15* for the appropriate action. When an oPE appears on the digital operator display, press the ENTER button to view U1-18 and see which parameter is causing the oPE error.

Table 5.15 oPE Codes, Causes, and Possible Solutions

Digital Operator Display	Error Name
oPE01	Drive Capacity Setting Fault
	Drive capacity and the value set to o2-04 do not match.
Cause	**Possible Solutions**
The drive model selection (o2-04) and the actual capacity of the drive are not the same.	Correct the value set to o2-04.
Digital Operator Display	**Error Name**
oPE02	Parameter Range Setting Error
	Parameters were set outside the possible setting range.
Cause	**Possible Solutions**
Parameters were set outside the possible setting range.	Use U1-18 to find parameters set outside the range. Set the parameters to the proper values.
Motor rated current and the motor no-load current setting in the drive are incorrect.	• There has been an attempt to set the motor rated current in E2-01 to a value lower than the no-load current set in E2-03. • Set the E2-01 value higher than the E2-03 value. • If E2-01 must be set to a value lower than the default setting of E2-03, first lower the value assigned to E2-03, then change the setting in E2-01 as necessary.
Note: When multiple errors occur simultaneously, other errors are given precedence over oPE02.	
Digital Operator Display	**Error Name**
oPE03	Contact Input Selection Error
	An incorrect function assignment is set for contact inputs H1-01 to H1-16.
Cause	**Possible Solutions**
The same function is assigned to more than one contact input. Excludes “Not used” and “External Fault.”	• Ensure all contact inputs are assigned to different functions. • Re-enter the contact settings to ensure there is no duplication.
The Up command was set but the Down command was not, or vice versa (settings 10 vs. 11).	Correctly set functions that need to be enabled in combination with other functions.
The Up 2 command was set but the Down 2 command was not, or vice versa (settings 75 vs. 76).	
Run/Stop command for a 2-wire sequence was set (H1-□□ = 42), but Forward/Reverse command (H1-□□ = 43) was not.	
Two of the following functions are set simultaneously: • Up/Down Command (10 vs. 11) • Up 2/Down 2 Command (75 vs. 76) • Hold Accel/Decel Stop (A) • Analog Frequency Reference Sample/Hold (1E) • Offset Frequency 1, 2, 3 Calculations (44, 45, 46)	• Check if contradictory settings have simultaneously been assigned to the contact input terminals. • Correct the contact input settings.
The Up/Down command (10, 11) and PID control (b5-01) are enabled simultaneously.	Set b5-01 to 0 to disable the Up/Down command.

Settings for N.C. and N.O. input for the following functions were selected simultaneously: • External Search Command 1 and External Search Command 2 (61 vs. 62) • Fast Stop N.O. and Fast Stop N.C. (15 vs. 17) • Motor Switch Command and Accel/Decel Time 2 (16 vs. 1A) • FWD Run Command (or REV) and FWD/REV Run Command (2-wire) (40, 41 vs. 42, 43) • Motor Switch Command and Up 2/Down 2 Command (16 vs. 75, 76)	• Check if contradictory settings have simultaneously been assigned to the contact input terminals. • Correct the contact input settings.
One of the following settings was entered while H1-☐☐ = 2 (External Reference 1/2): • b1-15 or b1-16 set to 3 but no option card is connected • b1-15 = 1 (Analog Input) and H3-02 (Analog Input Function Selection) is not set to 0 (Analog Frequency Reference).	
H2-☐☐ = 38 (Drive Enabled) but H1-☐☐ is not set to 6A (Drive Enable) and 70 (Drive Enable 2).	
A signed value (H3-01) is set for the analog input while allocating the UP2/DOWN2 commands (75 and 76).	Cancel either setting.
Digital Operator Display	**Error Name**
oPE05	Run Command/Frequency Reference Source Selection Error The setting for executing a Run command or frequency reference from communication option card input is not correct.
Cause	**Possible Solutions**
Frequency reference is assigned to an option card (b1-01 = 3) and an input option card is not connected to the drive.	Reconnect the input option card to the drive.
The Run command is assigned to an option card (b1-02 = 3) and an input option card is not connected to the drive.	
Although the digital card input is set for BCD special for a 5-digit input (F3-01 = 6), the data length is set for 8-bit or 12-bit (F3-03 = 0, 1).	Set the input data for 16 bit (F3-03 = 2)
The following values have been set while an AI-A3 option card is installed: • The source of frequency reference setting is assigned to an option card (b1-01 = 3). • The action for the analog card is set for separate terminal input (F2-01 = 0).	Make sure parameters are set properly.
The content below is set at the same time but AI-A3 option is not connected: • b1-16 (Run Command Selection 2) = 3 (Option card) • H1-☐☐ = 2 (External reference 1/2 selection)	Make sure parameters are set properly.
Digital Operator Display	**Error Name**
oPE06	Control Method Selection Error Correct the setting for the control method.
Cause	**Possible Solutions**
A control mode has been selected that requires a PG option card to be installed (A1-02 = 3), but no PG option card is installed.	• Connect a PG option card. • Correct the value set to A1-02.

Digital Operator Display	Error Name
oPE07	Multi-Function Analog Input Selection Error
	A contradictory setting is assigned to multi-function analog inputs H3-02 or H3-10 and PID functions conflict.
Cause	**Possible Solutions**
At least two analog input terminals are set to the same function (i.e., at least two of these parameters has the same setting: H3-02 and H3-10).	Change the settings to H3-02 and H3-10 so that functions no longer conflict. **Note:** Both 0 (frequency reference bias) and F (not used) or 1F (Through mode) can be set to H3-02 and H3-10 simultaneously.
The following simultaneous contradictory settings: H3-02 and H3-10 = C (PID Target Value) while b5-18 = 1 (enables b5-19 as the target PID value)	Disable one of the PID selections.
Digital Operator Display	**Error Name**
oPE08	Parameter Selection Error
	A function has been set that cannot be used in the motor control method selected.
Cause	**Possible Solutions**
Attempted to use a function that is not valid for the selected control mode.	Check the motor control method and the functions available.
In Open Loop Vector Control, n2-02 is greater than n2-03.	Correct parameter settings so that n2-02 is less than n2-03.
In Open Loop Vector Control, C4-02 is greater than C4-06.	Correct parameter settings so that C4-02 is less than C4-06.
Note: Use U1-18 to find which parameters are set outside the specified setting range. Other errors are given precedence over oPE08 when multiple errors occur simultaneously.	
Digital Operator Display	**Error Name**
oPE09	PID Control Selection Fault
	PID control function selection is incorrect. Requires that PID control is enabled (b5-01 = 1 to 4).
Cause	**Possible Solutions**
The following simultaneous contradictory settings have occurred: • b5-15 not 0.0 (PID Sleep Function Start Level) • The stopping method is set to either DC Injection Braking or coast to stop with a timer (b1-03 = 2 or 3).	Set b5-15 to another value other than 0. Set the stopping method to coast to stop or ramp to stop (b1-03 = 0 or 1).
When b5-01 = 1 or 2 (PID output 1/2), d2-02 (Frequency Reference Lower Limit) ≠ 0 was specified.	Correct the parameter settings.
When b5-01 = 1 or 2 (PID output 1/2), b5-11 (PID Output Reverse Selection) = 1 (Rotation direction reverses with negative PID output) was specified.	Correct the parameter settings.
PID control is set to b5-01 = 3 or 4, but the lower limit for the frequency reference (d2-01) is not 0.	Correct the parameter settings.
Digital Operator Display	**Error Name**
oPE10	V/f Data Setting Error
	One of the following setting errors have occurred: • E1-09 ≤ E1-07 < E1-06 ≤ E1-11 ≤ E1-04 • E3-09 ≤ E3-07 < E3-06 ≤ E3-11 ≤ E3-04
Cause	**Possible Solutions**
V/f Pattern Setting Error	Correct the settings for E1-04, E1-06, E1-07, E1-09, and E1-11. For motor 2, correct E3-04, E3-06, E3-07, E3-09, and E3-11.

Digital Operator Display	Error Name
oPE15	Torque Control Setting Error
	Parameters settings not allowed in combination with Torque Control have been set.
Cause	**Possible Solutions**
When A1-02 = 3 (Closed loop vector control), the following setting is specified: • The torque control selection is specified at the same time. d5-01=1 and H1-□□ = 71 • DROOP control and feed forward control are enabled when torque control is selected: d5-01 = 1 or H1-□□ = 71, and also b7-01 ≠ 0 or n5-01 = 1. • KEB command 2 (N.O. input, N.C. input) is enabled when torque control is selected: d5-01 = 1 or H1-□□ = 71 and also H1-□□ = 7A or H1-□□ = 7b. • The optimal deceleration and overexcitation deceleration 2 are enabled when torque control is selected (d5-01 = 1 or H1-□□ = 71) and (L3-04=2 or L3-04 = 5).	Correct the settings of b7-01, d5-01, H1-□□, L3-04 and n5-01.
Digital Operator Display	**Error Name**
oPE18	Online Tuning Parameter Setting Error
	Parameters that control Online Tuning are not set correctly.
Cause	**Possible Solutions**
One of the following settings has occurred while Online Tuning is enabled (n6-01 = 2) in Open Loop Vector control (A1-02 = 2): • E2-02 has been set below 30% of the original default value. • E2-06 has been set below 50% of the original default value. • E2-03 = 0	Set E2-02, E2-03, and E2-06 to the correct values.
Digital Operator Display	**Error Name**
oPE20	Commercial Power Supply/Drive Synchronous Transfer Function
	The multi-function contact I/O used in the commercial synchronous switching function has been selected incorrectly.
Cause	**Possible Solutions**
The necessary functions were not selected in the commercial synchronous switching function in the multi-function contact I/O.	• Set 82H and 83H in the multi-function contact input (H1-□□). • Set 40H and 41H in the multi-function contact input (H2-□□).

5.7 Auto-Tuning Fault Detection

◆ Auto-Tuning Codes, Causes, and Possible Solutions

The Auto-Tuning faults are shown below. When the following faults are detected, the fault is displayed on the digital operator and the motor coasts to a stop. Auto-Tuning faults do not trigger a contact terminal set for fault or alarm output.

An End□ error (where □ is a numeric character) indicates that although Auto-Tuning has been completed, there is some discrepancy in the calculations the drive made. If there is found to be no problem on checking the cause, use the tuning value as it stands. If there is judged to be a problem, implement countermeasures and then perform Auto-Tuning again, or set (input) the motor parameters manually.

Table 5.16 Auto-Tuning Codes, Causes, and Possible Solutions

Digital Operator Display	Error Name
End1	Excessive V/f Setting (detected only during Rotational Auto-Tuning, and displayed after Auto-Tuning is complete)
Cause	**Possible Solutions**
The torque reference exceeded 20% during Auto-Tuning.	• Before Auto-Tuning the drive, verify the information written on the motor nameplate and enter that data to T1-03 through T1-05. • Enter proper information to parameters T1-03 to T1-05 and repeat Auto-Tuning. • If possible, disconnect the motor from the load and perform Auto-Tuning. If the load cannot be uncoupled, use the current Auto-Tuning results.
The results from Auto-Tuning the no-load current exceeded 80%.	
Digital Operator Display	**Error Name**
End2	Motor Iron Core Saturation Coefficient Error (detected only during Rotational Auto-Tuning and displayed after Auto-Tuning is complete)
Cause	**Possible Solutions**
Motor data or data entered during Auto-Tuning was incorrect.	• Make sure the data entered to the T1 parameters match the information written on the motor nameplate. • Enter the correct information and restart Auto-Tuning.
Results from Auto-Tuning are outside the parameter setting range, assigning the iron-core saturation coefficients (E2-07 and E2-08) a temporary value.	• Check and correct faulty motor wiring. • Disconnect the motor from machine and perform Rotational Auto-Tuning.
Digital Operator Display	**Error Name**
End3	Rated Current Setting Alarm (displayed after Auto-Tuning is complete)
Cause	**Possible Solutions**
The correct current rating printed on the nameplate was not entered into T1-04.	• Check the setting of parameter T1-04. • Check the motor data and repeat Auto-Tuning.
Digital Operator Display	**Error Name**
End4	Adjusted Slip Calculation Error
Cause	**Possible Solutions**
In Stationary Auto-Tuning, the slip value resulted in 0.2 Hz or less.	• Check the value input for T1-□□. • Execute Rotational Auto-Tuning.
The slip that was calculated is outside the allowable range.	
The value after the compensation in E2-08 (Motor Iron-Core Saturation Coefficient 2) exceeds the upper and lower limits.	
The measured value of secondary resistance is negative.	
Digital Operator Display	**Error Name**
End5	Resistance Tuning Error
Cause	**Possible Solutions**
The calculated resistance value is outside the allowable range.	Double-check the data entered for the Auto-Tuning process.

Digital Operator Display	Error Name
End7	No-Load Current Alarm
Cause	**Possible Solutions**
The entered no-load current value was outside the allowable range.	Check and correct faulty motor wiring.
Auto-Tuning results were less than 5% of the motor rated current.	Double-heck the data entered for the Auto-Tuning process.
Digital Operator Display	**Error Name**
Er-01	Motor Data Error
Cause	**Possible Solutions**
Motor data or data entered during Auto-Tuning was incorrect.	• Check that the motor data entered to T1 parameters matches motor nameplate input before Auto-Tuning. • Enter the correct information and start Auto-Tuning over again.
Motor output power and motor-rated current settings (T1-02 and T1-04) do not match.	• Check the drive and motor capacities. • Correct the settings of parameters T1-02 and T1-04.
Motor rated current and detected no-load current are not consistent with another.	• Check the motor rated current and no-load current. • Correct the settings of parameters T1-04 and E2-03.
Base frequency and motor rated speed (T1-05 and T1-07) do not match.	Set T1-05 and T1-07 to the correct values.
Digital Operator Display	**Error Name**
Er-02	Minor Fault
Cause	**Possible Solutions**
Motor data or data entered during Auto-Tuning was incorrect.	• Check that the motor data entered to T1 parameters matches motor nameplate input before Auto-Tuning. • Enter the correct information and restart Auto-Tuning.
Wiring is incorrect.	Check and modify the wiring.
Load is too heavy.	• Check the circumference of the machine. • Check the load.
Digital Operator Display	**Error Name**
Er-03	STOP Button Input
Cause	**Possible Solutions**
Auto-Tuning canceled by pressing STOP button.	Auto-Tuning did not complete properly. Restart Auto-Tuning.
Digital Operator Display	**Error Name**
Er-04	Line-to-Line Resistance Error
Er-05	No-Load Current Error
Er-08	Rated Slip Error
Cause	**Possible Solutions**
Motor data or data entered during Auto-Tuning was incorrect.	• Check that the motor data entered to T1 parameters matches motor nameplate input before Auto-Tuning. • Restart Auto-Tuning and enter the correct information.
The tuning process took too long.	• Check and correct faulty motor wiring. • Disconnect the motor from machine and perform Rotational Auto-Tuning.
Results from Auto-Tuning are outside the parameter setting range.	
Digital Operator Display	**Error Name**
Er-09	Acceleration Error (detected only during Rotational Auto-Tuning)
Cause	**Possible Solutions**
The motor did not accelerate for the specified acceleration time.	• Increase the acceleration time (C1-01). • Disconnect the machine from the motor, if possible.
Torque limit when motoring is too low (L7-01 and L7-02).	• Check the settings of parameters L7-01 and L7-02. • Increase the setting.

Digital Operator Display	Error Name
Er-10	Motor Direction Error (detected only during Rotational Auto-Tuning)
Cause	**Possible Solutions**
The connection of drive and PG encoder (pulses A, B) or the connection of drive and motor (phases -U, -V, and-W) is wrong.	• Check and correct wiring to the PG encoder. • Check the wiring of motor.
Motor and PG direction are opposite.	• Check the motor speed monitor U1-05 while turning the motor manually in forward direction. If the sign displayed is negative, change the setting of parameter F1-05.
The load pulled the motor in the opposite direction of the speed reference and the torque exceeded 100% in Closed Loop Vector Control.	• The motor is turning around pulled by the machine. Uncouple the motor from the machine. • There is a problem with the PG wiring, PG rotation direction, and the setting of F1-05. Check the PG wiring and the setting of F1-05.
Digital Operator Display	**Error Name**
Er-11	Motor Speed Fault (detected only during Rotational Auto-Tuning)
Cause	**Possible Solutions**
Torque reference is too high during the acceleration (only for the Open Loop Vector Control).	• Increase the acceleration time (C1-01). • Disconnect the machine from the motor, if possible.
Digital Operator Display	**Error Name**
Er-12	Current Detection Error
Cause	**Possible Solutions**
One of the motor phases is missing: (U, V, W).	Check all wiring and correct any mistakes.
The current exceeded the current rating of the motor.	• Check the motor wiring for a short between motor lines. • If a magnetic contactor is used between motors, make sure it is closed. • Replace the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.
The current is too low.	
Attempted Auto-Tuning without motor connected to the drive.	Connect the motor and perform Auto-Tuning.
Current detection signal error.	Replace the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.

5.8 LED Indicators on the Controller and Cell Control Board

The following section describes the LED indicators on the controller in the control panel and on the Cell Control Board (CCB) in the Power Cell panel. These indicators display operation statuses and faults.

◆ LED Indicators on the Controller

The controller has two types of LED indicators: An LED indicator that displays the controller status, and an LED indicator that displays the Power Cell status detected by the controller.

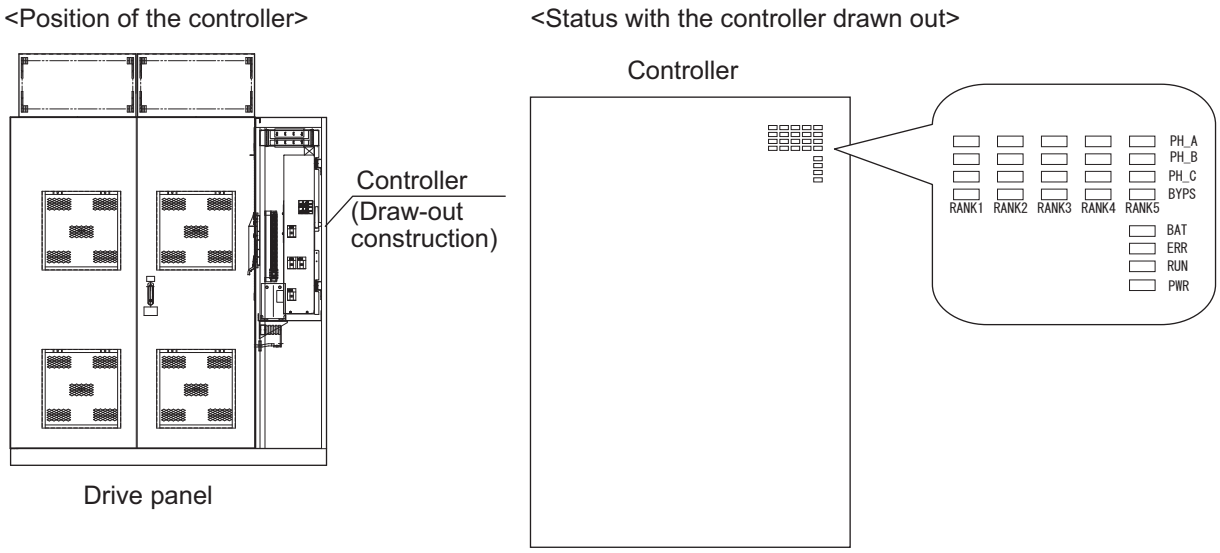


Figure 5.1 LED on Controller

Power Cell Status LEDs:
PH_A RANK1 to 5 (Red): Lit when a phase-U rank 1 to 5 Power Cell fault occurs.
PH_B RANK1 to 5 (Red): Lit when a phase-V rank 1 to 5 Power Cell fault occurs.
PH_C RANK1 to 5 (Red): Lit when a phase-W rank 1 to 5 Power Cell fault occurs.
BYPS RANK1 to 5 (Red): Lit when a fault occurs in a rank 1 to 5 Power Cell for bypass.

- Controller Status LEDs
  BAT (Red): Lit when the voltage of the battery housed in the controller drops.
  ERR (Red): Lit when a fault occurs in the controller.
  RUN (Green): Lit during operation of the controller.
  PWR (Green): Lit when the controller is powered on.

◆ LED Indications on the Cell Control Board

The LEDs on the CCB mounted in a Power Cell indicate the power supply status of the CCB and the operation status/ fault status of the Power Cell.

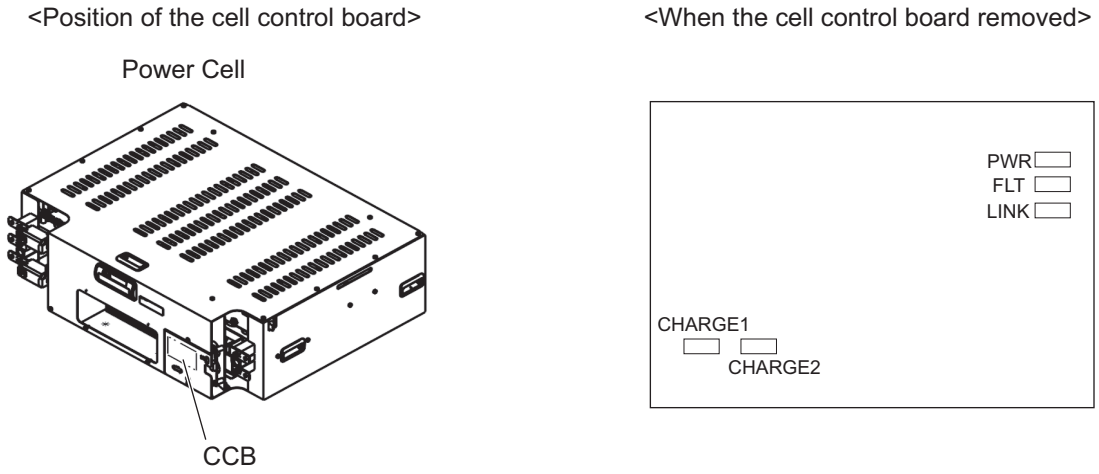


Figure 5.2 LEDs on the CCB

PWR (Green): Lit when the control power is on.

FLT (Red): Lit when a Power Cell fault occurs.

LINK (Green): Lit when transmissions to/from the controller are normal.

CHARGE1 (Red): Lit when the DC bus bar voltage Vpc is 50 V or higher.

CHARGE2 (Red): Lit when the DC bus bar voltage Vcn is 50 V or higher.

Never touch the Power Cell while any of these LED indicators are lit.

The LED indications for the Power Cell ready status, normal operation status, and fault status are shown in *Table 5.17*.

Table 5.17 LED Indications on the Cell Control Board

LED	Power Cell Ready Status	Normal Operation	Fault
PWR (Green)	On	On	On
FLT (Red)	Off	Off	On
LINK (Green)	On	On	–<1>
CHARGE1 (Red)	On	On	On
CHARGE2 (Red)	On	On	On

<1> The "–" character signifies on, and – signifies an unstable state with the LED going on and off.

5.9 Copy Function Related Displays

◆ Tasks, Errors, and Troubleshooting

When executing the tasks offered by the copy function, the digital operator indicates the task being performed. When an error occurs, a code appears on the digital operator to indicate the error. Note that errors related to the Copy function do not trigger a contact terminal set for fault or alarm output. Press any key on the digital operator to clear an error.
Table 5.18 lists the corrective action that can be taken when an error occurs.

Note: **1.** The drive should be fully stopped when using the copy function.
2. The drive will not accept a Run command while the copy function is being executed.
3. Parameters can only be saved to an drive when the voltage class, capacity, control mode, and software version match.

Table 5.18 Copy Function Task and Error Displays

Digital Operator Display	Error Name
CoPy	Writing Parameter Settings (flashing)
Cause	**Possible Solutions**
Parameters are being written to the drive.	This is not an error.
Digital Operator Display	**Error Name**
CPEr	Control Mode Mismatch
Cause	**Possible Solutions**
Control mode of the parameters to be loaded onto the drive and the control mode already set to the drive do not match.	• Check the control mode for the parameters that are to be loaded onto the drive and the control mode set to the drive to which those parameters will be written. • Set the same control mode using parameter A1-02 and retry.
Digital Operator Display	**Error Name**
CPyE	Error Writing Data
Cause	**Possible Solutions**
Failed writing parameters.	Attempt to write parameters again.
Digital Operator Display	**Error Name**
CSEr	Copy Unit Error
Cause	**Possible Solutions**
Hardware fault	Replace the digital operator or the USB Copy Unit.
Digital Operator Display	**Error Name**
dFPS	Drive Model Mismatch
Cause	**Possible Solutions**
The drives used in the copy and write process are not the same model.	• Check the model number of the drive from which the parameters were copied and the model of the drive to which those parameters will be written. Make sure the two drives are the same model and have the same software version.
Digital Operator Display	**Error Name**
End	Task Complete
Cause	**Possible Solutions**
Finished reading, writing, or verifying parameters	This is not an error.
Digital Operator Display	**Error Name**
iFEr	Communication Error
Cause	**Possible Solutions**
A communication error occurred between the drive and the digital operator or the USB Copy Unit.	⇒Check the cable connection.
A non-compatible cable is being used to connect the USB Copy Unit and the drive.	⇒Use the cable originally packaged with the USB Copy Unit.

Digital Operator Display	Error Name
ndAT	Model, Voltage Class, Capacity Mismatch
Cause	**Possible Solutions**
The drive from which the parameters were copied and the drive to which the parameters will be written have different electrical specifications, capacities, are set to different control modes, or are different models.	Make sure model numbers and specifications are the same for both drives.
The drive or USB Copy Unit being used to write the parameters is blank and does not have any parameters saved on it.	Make sure all connections are correct, and copy the parameter settings onto the USB Copy Unit or the digital operator.
Digital Operator Display	**Error Name**
rdEr	Error Reading Data
Cause	**Possible Solutions**
Failed while attempting to read parameter settings from the drive.	⇒Press and hold the READ key on the USB Copy Unit for at least one second to have the unit read parameters from the drive.
Digital Operator Display	**Error Name**
rEAd	Reading Parameter Settings (flashing)
Cause	**Possible Solutions**
Displayed while the parameter settings are being read onto the USB Copy Unit.	This is not an error.
Digital Operator Display	**Error Name**
vAEr	Voltage Class, Capacity Mismatch
Cause	**Possible Solutions**
The drive from which the parameters were copied and the drive on which the Verify mode is being performed have different electrical specifications or are different capacities.	Make sure electrical specifications and capacities are the same for both drives.
Digital Operator Display	**Error Name**
vFyE	Parameter settings in the drive and those saved to the copy function are not the same
Cause	**Possible Solutions**
Indicates that parameter settings that have been Read and loaded onto the Copy Unit or digital operator are different.	To synchronize parameters, either copy the parameter settings on the USB Copy Unit or the digital operator and save them in the drive, or copy the parameter settings on the drive and save them in the USB Copy Unit or the digital operator.
Digital Operator Display	**Error Name**
vrFy	Comparing Parameter Settings (flashing)
Cause	**Possible Solutions**
The Verify mode has confirmed that parameter settings on the drive and parameters read to the copy device are identical.	This is not an error.

5.10 Diagnosing and Resetting Faults

When a fault occurs and the drive stops, follow the instructions below to remove whatever conditions triggered the fault, then restart the drive.

◆ Fault Occurs Simultaneously with Power Loss

⚠**WARNING!** *Sudden Movement Hazard. Ensure there are no short circuits between the main circuit terminals (U, V, W) or between the ground and main circuit terminals before restarting the drive. Failure to comply may result in serious injury or death and will cause damage to equipment.*

1. Turn on the drive input power.
2. Use monitor parameters U2-☐☐ to display data on the operating status of the drive just before the fault occurred.
3. Remove the cause of the fault and reset.

Note: 1. To determine out what faults were triggered, check the fault history in U2-02 (Previous Fault). Information on drive status when the fault occurred, such as the frequency, current, and voltage, can be found in U2-03 through U2-31.
Refer to *Viewing Fault Trace Data After Fault on page 181* for information on how to view fault data.
2. When the fault continues to be displayed after cycling power, remove the cause of the fault and reset.

◆ If the Drive Still has Power After a Fault Occurs

1. Turn the main circuit power supply off.
2. Look at the digital operator for information on the fault that occurred.
3. Refer to *Fault Displays, Causes, and Possible Solutions on page 148*.
4. Remove the cause of the fault and reset.
Refer to *Fault Reset Methods on page 182*.

◆ Viewing Fault Trace Data After Fault

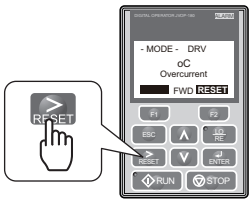
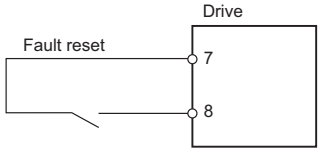
The checking method shown here uses an example in which the drive detects oL2 (Drive Overheat).

	Step		Display/Result
1	Turn on the drive input power. The first screen displays.	→	- MODE - DRV Rdy FREF (AI) U1-01= 0.00Hz U1-02= 0.00Hz RSEQ U1-03= 0.0A RREF JOG FWD FWD/REV
2	Press ∧ until the monitor screen is displayed.	→	- MODE - DRV Rdy Monitor Menu U1-01= 0.00Hz U1-02= 0.00Hz RSEQ U1-03= 0.0A RREF JOG FWD FWD/REV
3	Press ENTER to display the parameter setting screen.	→	-MONITR- DRV Rdy Monitor U1-01= 0.00Hz U1-02= 0.00Hz RSEQ U1-03= 0.0A RREF JOG FWD FWD/REV
4	Press ∧ and RESET to scroll to monitor U2-01 (Previous Fault).	→	-MONITR- DRV Rdy Current Fault U2-01= – U2-02= oL2 RSEQ U2-03= 0.00Hz RREF JOG FWD FWD/REV
5	Press ∧ to view previous fault (oL2 in this example).	→	- MONITR - DRV Rdy Last Fault U2-02= oL2 U2-03= 0.00Hz RSEQ U2-04= 0.00Hz RREF JOG FWD FWD/REV

	Step		Display/Result
6	Continue to press ∧ to view drive status information when the fault occurred. Parameters U2-03 through U2-31 help determine the cause of a fault. Parameters to be monitored differ depending on the control mode.	→	- MONITR - DRV Rdy Frequency Ref U2-03= 0.00Hz U2-04= 0.00Hz RSEQ U2-05= 0.00A RREF JOG FWD FWD/REV ⋮ ↑ - MONITR - DRV Rdy Input Voltage U2-31= 00000001 U2-01= ----- RSEQ U2-02= oL2 RREF JOG FWD FWD/REV

◆ Fault Reset Methods

When a fault occurs, the cause of the fault must be removed and the drive must be restarted. The table below lists the different methods of restarting the drive.

No.	After the Fault Occurs	Procedure	
Method 1	After remove the cause of the fault, restart the drive, and reset the fault.	Press the RESET key on the digital operator while the error code is displayed.	
Method 2	Resetting via Fault Reset Contact Input 7	Close then open the fault reset signal. (14 (fault reset signal) must be assigned to contact input H1-☐☐.) Contact input 4 is set for “fault reset” as default (H1-04 = 14).	
Method 3	Turn off the drive main power supply and control power supply. Reapply power after the LEDs on the digital operator have turned off: first the control power supply and then the drive main power supply.		–

Note: If the Run command is present, the drive will disregard any attempts to reset the fault. Remove the Run command before attempting to clear a fault situation.

5.11 Troubleshooting without Fault Display

This section describes troubleshooting problems that do not trip an alarm or fault.
The following symptoms indicate that the drive is not set correctly for proper performance with the motor. *Refer to Motor Performance Fine-Tuning on page 140* in this manual or to the FSDrive-MV1000 Parameter Guide (TOEP C710687 03) for guidance on troubleshooting.

- Motor hunting and oscillation
- Poor motor torque
- Poor speed precision
- Poor motor torque and speed response
- Electrical interference from the motor

◆ Common Problems

Common Problems		Reference Page
Cannot Change Parameter Settings		*183*
Motor Does Not Rotate Properly after Pressing RUN Button or after Entering External Run Command	Motor Does Not Rotate	*184*
	Motor Rotates in the Opposite Direction from the Run Command	*185*
	Motor Rotates in One Direction Only	*185*
Motor is Too Hot		*185*
Drive Does Not Allow Selection of Rotational Auto-Tuning		*185*
Motor Stalls During Acceleration or With Large Loads/Acceleration Time is Too Long		*186*
Drive Frequency Reference Differs from the Controller Frequency Reference Command		*186*
Excessive Motor Oscillation and Erratic Rotation		*187*
Load Falls When Brake is Applied (Hoist-Type Applications)		*187*
Electrical Interference from Drive or Motor Cables When the Drive is Powered On		*187*
Connected Machinery Vibrates When Motor Rotates	Unexpected Interference from Connected Machinery	*187*
	Oscillation or Hunting	*187*
PID Output Fault		*187*
Insufficient Starting Torque		*188*
Motor Rotates After the Drive Output is Shut Off (Motor Rotates During DC Injection Braking)		*188*
Output Frequency is not as High as Frequency Reference		*188*
Motor Does Not Restart after Power Loss		*188*

◆ Cannot Change Parameter Settings

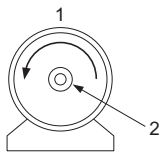
Cause	Possible Solutions
The drive is running the motor (i.e., the Run command is present).	• Stop the drive and switch over to the Programming Mode. • Most parameters cannot be edited during run.
The Access Level is set to restrict access to parameter settings.	Set the Access Level to allow parameters to be edited (A1-01 = 2).
The digital operator is not in the Parameter Setup Mode (the screen should display “PAr”).	Determine the mode in which the digital operator is currently set. Parameters cannot be edited when in the Setup Mode (“STUP”). Switch modes so that “PAr” appears on the screen. Refer to *The Drive and Programming Modes on page 113* for details.
A contact input terminal is set to allow parameter editing (H1-02 through H1-16 = 1B).	When the terminal is open, parameters cannot be edited. Turn on the contact input terminal set to 1B and then set the parameter.
The wrong password was entered.	If the password entered to A1-04 does not match the password saved to A1-05, then drive settings cannot be changed. Reset the password. • If you cannot remember the password: • Scroll to A1-04. Press STOP and ∧ simultaneously. Parameter A1-05 will appear. • Set a new password to parameter A1-05.

◆ Motor Does Not Rotate Properly after Pressing RUN Button or after Entering External Run Command

■ Motor Does Not Rotate

Cause	Possible Solutions
The drive is not in the Drive Mode.	• Check if the DRV light on the digital operator is lit. Enter the Drive Mode to begin operating the motor. *Refer to The Drive and Programming Modes on page 113* for details.
The LO/RE function selection key was pressed as a command was entered from the control circuit terminal.	To change the run authority to the digital operator, press the LO/RE function selection key while the drive is stopped. Then disable the Run commands from the control circuit terminal. Take the following steps to solve the problem: • Press the LO/RE function selection key. • Restart the control power. If o2-01 is set to 0, then the LO/RE button will be disabled.
Auto-Tuning has just completed.	• When Auto-Tuning completes, the drive is switched back to the Programming Mode. The Run command will not be accepted unless the drive is in the Drive Mode. Use the digital operator to enter the Drive Mode. *Refer to The Drive and Programming Modes on page 113* for details.
A Fast Stop was executed and has not yet been reset.	Reset the Fast Stop command.
Settings are incorrect for the source that provides the Run command.	Check parameter b1-02 (Run Command Selection 1). Set b1-02 so that it corresponds with the correct Run command source. 0: Digital operator 1: Control circuit terminal (default setting) 2: MEMOBUS/Modbus communications 3: Option card
There is faulty wiring in the control circuit terminals.	• Check the wiring for the control terminal. • Correct wiring mistakes. • Check the input terminal status monitor (U1-10).
The drive has been set to accept the frequency reference from the incorrect source.	Check parameter b1-01 (Frequency Reference Selection 1). Set b1-01 to the correct source of the frequency reference. 0: Digital operator keypad 1: Control circuit terminal (default setting) 2: MEMOBUS/Modbus communications 3: Option card
Frequency reference is too low.	• Check the frequency reference monitor (U1-01). • Increase the frequency by changing the maximum output frequency (E1-09).
The analog input setting is not appropriate.	• Check the analog input terminal settings. If 1 (frequency reference gain) has been set for H3-02 (function selection for analog input terminal L1) and no voltage (current) has been input, the frequency reference will be zero. • Check if H3-02 has been set to the proper values. • Check if the analog input value has been set properly (U1-13).
The STOP key was pressed.	• Pressing the STOP key will decelerate the drive to stop. • Switch off the Run command and then re-enter a new Run command. • Set o2-02 to 0 to disable the STOP key.
Motor starting torque is too low.	*Refer to Motor Performance Fine-Tuning on page 140* for details.
Frequency reference value is too low or the drive does not accept the value entered.	Enter a value that is above the minimum output frequency determined by E1-09.

■ Motor Rotates in the Opposite Direction from the Run Command

Cause	Possible Solutions
Phase wiring between the drive and motor is incorrect.	• Check the motor wiring. • Switch two motor cables (U, V, and W) to reverse motor direction. • Connect drive output terminals U, V, and W in the right order to match motor terminals U, V, and W.
The connection is incorrect between the drive control circuit terminals (forward/reverse) and forward/reverse signals of control panel.	• Check to see the wiring of control circuit. • Correct the wiring.
The forward direction for the motor is setup incorrectly.	Connect the drive's output terminals (U, V, and W) and motor terminals (U, V, and W) properly. When the wiring is correct, exchange two of cables U, V, and W connected to the motor.  1 Typically, forward is designated as being counterclockwise when looking from the motor shaft. 2 Motor Shaft

Note: Check the motor specifications for the forward and reverse directions. The motor specifications will vary depending on the manufacturer of the motor.

■ Motor Rotates in One Direction Only

Cause	Possible Solutions
The drive prohibits reverse rotation.	Set b1-04 to allow the motor to rotate in reverse.

◆ Motor is Too Hot

Cause	Possible Solutions
The load is too heavy.	If the load is too heavy for the motor, the motor will overheat as it exceeds its rated torque value for an extended period of time. Keep in mind that the motor also has a short-term overload rating in addition to the possible solutions provided below: • Reduce the load. • Increase the acceleration and deceleration times. • Check the values set for the motor protection (L1-01, L1-02) as well as the motor rated current (E2-01). • Increase motor capacity.
The air around the motor is too hot.	• Check the ambient temperature. • Cool the area until it is within the specified temperature range.
The drive is operating in a vector control mode but Auto-Tuning has not yet been performed.	• Perform Auto-Tuning. • Calculate the motor value and reset the motor parameters. • Change the motor control method to V/f Control (A1-02 = 0).
Insufficient voltage insulation between motor phases.	When a motor is connected to the drive output terminals (U, V, W), a surge voltage is generated between the motor coils and drive switching. Generally, the maximum surge voltage is about 1.5 times the Power Cell input power supply voltage (1500 V with a 1200 V input). Use a motor with a voltage tolerance higher than the max voltage surge.
The motor fan has stopped or is clogged.	Check the motor fan.

◆ Drive Does Not Allow Selection of Rotational Auto-Tuning

Cause	Possible Solutions
The desired Auto-Tuning mode is not available for the selected control mode.	Check to see that A1-02 (Control Method Selection) is set to 0 (V/f control). Select the correct control mode at A1-02.

◆ Motor Stalls During Acceleration or With Large Loads or Acceleration Time is Too Long

Cause	Possible Solutions
Torque limit has been reached or current suppression keeps the drive from accelerating.	Take the following steps to resolve the problem: • Reduce the load. • Increase motor capacity. Although the drive has a Stall Prevention function and a Torque Compensation Limit function, accelerating too quickly or trying to drive an excessively large load can exceed the capabilities of the motor.
Load is too heavy.	
Torque limit is not set properly.	Check the torque limit setting.
Frequency reference is too low.	Check the maximum output frequency (E1-04). • Increase E1-04 if it is set too low. • Check U1-01 for proper frequency reference. • Check if a frequency reference switch signal has been set to one of the contact input terminals. • If analog input is used, check for a low gain level set for terminal L1 (H3-03).
Load is too heavy.	• Reduce the load so that the output current remains within the motor rated current. • In extruder and mixer applications, the load will sometimes increase as the temperature drops. • Increase the acceleration time. • Check if the mechanical brake is fully releasing properly.
Acceleration time has been set too long.	Check if the acceleration time parameters have been set too long (C1-01, C1-03, C1-05, C1-07).
Although the drive is operating in vector motor control method, Auto-Tuning has not been performed.	• Perform Auto-Tuning. • Calculate motor data and reset motor parameters.
Incorrect frequency reference setting.	• Check the analog input terminal settings. Analog input terminal L1 is set for frequency gain (H3-02 is set to 1), but there is no voltage or current input provided. • Make sure H3-02 is set to the proper value. • Make sure the analog input value is set to the proper value (U1-13).
The Stall Prevention level during acceleration set too low.	• Check the Stall Prevention level during acceleration (L3-02). • If L3-02 is set too low, acceleration may be taking too long. • Increase L3-02.
The Stall Prevention level during run has been set too low.	• Check the Stall Prevention level during run (L3-06). • If L3-06 is set too low, speed will drop as the drive outputs torque. • Increase the setting value.
Drive reached the limitations of the V/f motor control method.	• If the motor cable is long (50 m or more), run Auto-Tuning only for Line-to-Line Resistance. • Consider switching to vector control mode.

◆ Drive Frequency Reference Differs from the Controller Frequency Reference Command

Cause	Possible Solutions
The analog input gain and bias for the frequency reference input are set to incorrect values.	Check the gain and bias settings for the analog inputs that are used to set the frequency reference. Check parameters H3-03 and H3-04 for input L1. Set these parameters to the appropriate values.
A frequency bias signal is being entered via analog input terminal L1.	• The analog input setting (H3-02) is the sum of the individual input values. • Make sure that H3-02 is set appropriately. • Make sure that the analog input level is appropriate (U1-13).
PID control is enabled.	If PID control is not necessary for the application, disable it by setting b5-01 to 0. When PID control is enabled, the drive adjusts the output frequency to match the PID setpoint. The drive will only accelerate to the maximum output frequency set in E1-04 while PID control is enabled.

◆ Excessive Motor Oscillation and Erratic Rotation

Cause	Possible Solutions
Poor balance between motor phases.	Check drive input power voltage to ensure that it provides stable power, or disable input phase loss detection.
Hunting prevention function is disabled.	• Enable Hunting Prevention (n1-01 = 1). • Increase the AFR gain (n2-01) or the AFR time constant (n2-02).

◆ Electrical Interference from Drive or Output Lines When the Drive is Powered On

Cause	Possible Solutions
Relay switching in the drive generates excessive electrical interference.	• Ground the drive (EA) and motor (EA).
	• Separate the main circuit wiring and the control lines.
	• Make sure wires and the motor have been properly grounded.

◆ Connected Machinery Vibrates When Motor Rotates

■ Unexpected Interference from Connected Machinery

Cause	Possible Solutions
The drive output frequency is the same as the resonant frequency of the connected machinery.	• Adjust the parameters used for the Jump frequency function (d3-01 through d3-04) to skip the problem-causing bandwidth. • Place the motor on a rubber pad to reduce vibration.

■ Oscillation or Hunting

Cause	Possible Solutions
Insufficient tuning.	Perform Auto-Tuning. Refer to *Motor Performance Fine-Tuning on page 140* for details.
Gain is too low when using PID control.	Make the adjustments by referring to the information on the PID control parameters (b5-☐☐) in the separate FSDrive-MV1000 Parameter Guide (TOEP C710687 03).
The frequency reference is assigned to an external source and the signal is noisy.	Ensure that electrical interference is not affecting the signal lines. • Separate main circuit wiring and control circuit wiring. • Use twisted-pair cables or shielded wiring for the control circuit. • Increase the analog input time filter constant (H3-13).
The cable between the drive and motor is too long.	• Perform Auto-Tuning. • Reduce the length of the cable.

◆ PID Output Fault

Cause	Possible Solutions
No PID feedback input.	• Check the analog input terminal settings. Check that B (PID feedback) has been set for H3-02 (function selection for analog input terminal L1). Check that assignment to the analog input terminal and the actual signal input match. • Check the connection of the feedback signal. • Check the various PID-related parameter settings. • No PID feedback input to the terminal causes the value detected to be 0, causing a PID fault and the drive to operate at max frequency.
The level of detection and the target value do not correspond with each other.	• PID control keeps the difference between target and detection values at 0. Set the input level for the values relative to one another. • Use analog input gain H3-11 to adjust PID target and feedback signal scaling.
Reverse drive output frequency and speed detection. When output frequency rises, the sensor detects a speed decrease.	Set PID output for reverse characteristics (b5-09 = 1).
Adjustment made to PID parameter settings are insufficient.	Make the adjustments by referring to the information on the PID control parameters (b5-☐☐) in the separate FSDrive-MV1000 Parameter Guide (TOEP C710687 03).

◆ Insufficient Starting Torque

Cause	Possible Solutions
Auto-Tuning has not yet been performed (required for vector control modes).	Perform Auto-Tuning. Refer to *Motor Performance Fine-Tuning on page 140* for details.
The control mode was changed after performing Auto-Tuning.	Perform Auto-Tuning again.
Only Stationary Auto-Tuning was performed.	Perform Rotational Auto-Tuning.

◆ Motor Rotates After the Drive Output is Shut Off (Motor Rotates During DC Injection Braking)

Cause	Possible Solutions
DC Injection Braking is set too low and the drive cannot decelerate properly.	• Adjust the DC Injection braking settings. • Increase the current level for DC Injection Braking (b2-02). • Increase the DC Injection Braking time at stop (b2-04).
The stopping method is set so that the drive coasts to stop.	Set b1-03 (Stopping Method Selection) to 0 or 2.

◆ Output Frequency is not as High as Frequency Reference

Cause	Possible Solutions
Frequency reference is set within the range of the Jump frequency.	• Adjust the parameters used for the Jump frequency function (d3-01, d3-02, d3-03, d3-04). • Enabling the Jump frequency prevents the drive from outputting the frequencies specified in the Jump range.
Upper limit for the frequency reference has been exceeded.	• Set the maximum output frequency and the upper limit for the frequency reference to more appropriate values (E1-04, d2-01). • The following calculation yields the upper value for the output frequency: E1-04 × d2-01 / 100
Large load triggered Stall Prevention function during acceleration.	• Reduce the load. • Adjust the Stall Prevention level during acceleration (L3-02).

◆ Motor Does Not Restart after Power Loss

Cause	Possible Solutions
The Run command was not reissued again when power was restored.	Check the sequence and wiring that has been set up to enter the Run command. Set up a relay should to ensure the Run command remains enabled throughout any power loss.

6

Periodic Inspection & Maintenance

This chapter describes the periodic inspection and maintenance of the drive to ensure that it receives the proper care to maintain overall performance.

6.1 SECTION SAFETY 190
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6.3 PERIODIC MAINTENANCE 196
6.4 REPLACING THE BATTERY 198
6.5 REPLACING THE COOLING FAN 200
6.6 REPLACING POWER CELLS 204
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6.1 Section Safety

⚠ DANGER

Electrical Shock Hazard

Do not connect or disconnect wiring while the power for the main circuit and controls is on.

Failure to comply could result in serious injury or death.

Even when the power supply of the medium-voltage main circuit to the drive is shut off, it takes some time for the internal capacitors to discharge. Wait until the CHARGE LED goes off before starting inspection. While an residual electric charge remains in the capacitor, the surface and inside of the Power Cell will carry a high voltage, so there will be a risk of serious injury or death. The heatsink of the Power Cell can become quite hot during operation, and proper precautions should be taken to prevent burns. When replacing the cooling fan, shut off the main circuit's power and then wait at least 15 minutes. Then, shut off the control circuit's power and make sure that the cooling fan has fully stopped before starting the work.

Never connect or disconnect wiring, remove connectors or option cards, or replace the cooling fan, while the power is on.

Failure to comply could result in serious injury or death.

Disconnect the power to the drive and check that there is no residual charge in it before starting servicing.

Do not supply power to the main circuit while drive covers are removed.

Failure to comply could result in serious injury or death.

The diagrams in this manual may show the drive without covers or safety shields to show details. Be sure to reinstall covers or shields before operating the drive and run the drive according to the instructions described in this manual.

⚠ WARNING

Electrical Shock Hazard

Always ground the motor-side ground terminal.

Improper equipment grounding could result in death, serious injury, or fire by contacting the motor case.

Do not remove covers or touch circuit boards while the power is on.

Failure to comply could result in serious injury or death.

Do not touch the input and output terminals directly with your hands and do not bring the input and output wires into contact with the drive case.

Do not allow unqualified personnel to perform work on the drive.

Failure to comply could result in serious injury or death.

The drive should be installed, wired, repaired, inspected, and have its parts replaced, by someone with a thorough knowledge of drive installation, adjustment and repair.

Do not perform work or operate the drive while wearing loose clothing, jewelry, or without eye protection.

Failure to comply could result in serious injury or death.

Remove all metal objects such as watches and rings, secure loose clothing and wear eye protection before beginning work on the drive.

Fire Hazard

Tighten all terminal screws to the specified tightening torque.

Loose electrical connections could result in serious injury or death by fire due to overheating of electrical connections.

Do not use an improper voltage source.

Failure to comply could result in serious injury or death by fire.

Verify that the rated voltage of the drive matches the voltage of the incoming power supply before applying power.

NOTICE

Observe proper electrostatic discharge procedures (ESD) when handling the drive and circuit boards.

Incorrect handling could result in ESD damage to the drive circuitry.

Use only shielded cable to wire analog input/output signals for the control circuit.

Failure to comply could result in drive malfunction.
Use shielded twisted-pair wires and ground the shield to the ground terminal of the drive.

Do not allow unqualified personnel to perform work on the drive.

Failure to comply could result in serious injury or death.

The drive should be installed, wired, repaired, inspected, and have its parts replaced, by someone with a thorough knowledge of drive installation, adjustment and repair.

Do not modify the drive circuitry.

Failure to comply could result in damage to the drive and will void warranty.

Yaskawa is not responsible for any modification of the drive made by the user.

Check all the wiring and ensure that all connections are correct after installing the drive and connecting other devices.

Failure to comply could result in damage to the drive.

Connect the wires with the correct phase order.

The motor will run in reverse if the phase orders are not matched.

Connect input terminals U, V and W of the motor to output terminals U, V and W of the drive, pairing the terminal codes. The phase orders of the motor terminals and drive terminals should also match.

Do not operate damaged equipment.

Failure to comply could result in further damage to the equipment.

Do not connect or operate any equipment with visible damage or missing parts.

6.2 Inspection

Power electronics have a limited life and may exhibit changes in characteristics or performance deterioration after years of use under normal conditions. To help avoid such problems, it is important to perform preventive maintenance and periodic inspection on the drive.

Drives contain a variety of power electronics such as power transistors, semiconductors, capacitors, resistors, fans, and relays. The electronics in the drive serve a critical role in maintaining proper motor control. The proper functioning of drives is dependent on the correct operation of all these parts.

Follow the inspection checklists provided in this section as a part of a regular maintenance program. Perform equipment inspections at intervals of one year after installation.

Note: The drive will require more frequent inspection if it is used under harsh conditions, such as:

- High ambient temperatures
- Frequent starting and stopping
- Fluctuations in the AC supply or load
- Excessive vibration or shock loading
- Atmospheres containing dust, metal dust, salt, sulfuric acid, or chlorine
- Poor storage conditions

Perform the first equipment inspection one year after installation.

◆ Recommended Daily Inspection

Table 6.1 outlines the recommended daily inspection for Yaskawa drives. Check the following items on a daily basis to avoid premature deterioration in performance or product failure. Copy this checklist and mark the “Checked” column after each inspection.

Table 6.1 General Recommended Daily Inspection Checklist

Inspection Category	Details of Inspection	Checked
Ambient Environment	Check the ambient temperature.	
	Check the humidity.	
	Check for toxic gas.	
	Check for adhesion of dust, oil mist, etc.	
Equipment in General	Check for abnormal vibration and noise.	
Power Supply Voltage	Check the power supply voltage for the main circuit and controls. (Check the indication on the gage of the power supply unit.)	
Transformer	Check for odor and abnormal noise.	
Cooling System	Check the cooling fan for abnormal vibration or noise.	
	Check the air filter for soiling.	
Lamp (Option)	Check if any lamp is blown.	
Meters (Option)	Check if the meter indication is normal.	

◆ Recommended Periodic Inspection

Table 6.2 outlines the recommended periodic inspections for Yaskawa drive installations. Although periodic inspections should generally be performed once a year, the drive may require more frequent inspection in harsh environments or with rigorous use. Periodic inspection will help to avoid premature deterioration in performance or product failure. Copy this checklist and mark the "Checked" column after each inspection.

■ Periodic Inspection

⚠ **DANGER!** *Electrical Shock Hazard. Do not connect or disconnect wiring or service equipment while the power is on. Failure to comply will result in serious injury or death. Before servicing, disconnect all power to the equipment. There may be multiple sources of power and control power may be present although the CHARGE indicator LED is extinguished. Verify that control power is removed. The internal capacitor and the Power Cell exterior surface and interior remain charged even after the medium-voltage power supply is turned off. Verify the CHARGE indicator LED is extinguished before servicing and remove control power. To prevent electric shock, wait for at least the time specified on the warning label after all indicators are OFF, and then measure for unsafe voltages to confirm the drive has reached a safe level before servicing.*

Table 6.2 Periodic Inspection Checklist

Inspection Area	Inspection Category	Details of Inspection	Page	Checked
Transformer Panel Power Cell Panel	Entire transformer and Power Cell panel	Megger check between the main circuit terminals and ground terminal	*194*	
		Check for loose screws, bolts, or connectors.	*194*	
		Check for damage to parts or deformation or discoloration of parts due to overheating or deterioration.	–	
		Check for soiling or adhesion of dust, etc.	–	
	Wires	Check for damage or deterioration of the cable sheath.	–	
	Transformer	Check the windings for damage, and check for breakage in the insulation sheets.	*194*	
		Check the windings for accumulation of dust, and for adhesion of foreign matter.		
	Power Cells	Check for leakage from the smoothing capacitor.	*195*	
		Confirm that the safety valve of the smoothing capacitor is not protruding.		
		Confirm that the smoothing capacitor has not expanded.		
		Measure the capacitance of the smoothing capacitor. (Check the indication on the gauge.)		
		Check for loose screws or bolts.		
		Check that the main circuit fuse and the control fuses on the boards are normal.		
		Check for accumulated dust and dirt on the heatsink.		
	Surge absorber	Make sure the appearance is clean, the terminals are tightened properly, and the installation bolts are securely fastened.	–	
Control Panel	Circuits	Confirm no abnormalities in protective and indication circuits.	–	
	Relays	Confirm that there is no chattering noise during operation.	–	
		Confirm timer operation.		
		Check for damaged contacts.		
	Board	Check for abnormal smells and discoloration.	*195*	
		Confirm the power supply voltage.		
		Check for loose screws, bolts, or connections.		
	Digital Operator	Make sure data appears on the digital operator properly.	–	
		Check for soiling of the digital operator.	–	
Cooling System	Air filter	Check for dirty or clogged filter.	*195*	
	Cooling fan	Check for abnormal vibration and noise.	*195*	
		Confirm the bearing operation.		

Perform out periodic inspections in the manner described below.

■ Megger Check (Measurement of Insulation Resistance)

Measure Insulation Resistance of the Drive Primary Circuit

Use a 1000 V Megger insulation resistance tester.

The measured insulation resistance must be 30 MΩ or more.

If the input voltage detection circuit (option) is installed, disconnect the wiring to the voltage detection sensor before measuring insulation resistance as the primary circuit is grounded at high-resistance for input voltage detection.

Measure Insulation Resistance of the Drive Secondary Circuit (Motor Side)

Use a 1000 V Megger insulation resistance tester.

The measured insulation resistance must be 2 MΩ or more.

The secondary circuit is grounded at high-resistance for output voltage detection. Disconnect the high-resistance resistor for voltage detection and Power Cell output cables connected to the output terminals before measuring insulation resistance.

Measure Insulation Resistance of the Surge Absorber

Use a 1000 V Megger insulation resistance tester.

The measured insulation resistance must be 1000 MΩ or more.

Note: Make sure that the surge absorber has been removed from the circuit.

■ Screws, Bolts, and Connectors

⚠ **WARNING!** *Fire Hazard. Tighten all terminal screws to the specified tightening torque. Loose electrical connections could result in serious injury or death by fire due to overheating of electrical connections.*

Loose wiring connections of the main circuit cable could cause the connections to overheat and start a fire. During periodic inspections, be sure to retighten the screws and bolts, and to reinsert the connector securely. For the tightening torque of the screws and bolts, refer to the following recommendations.

- M8 bolts: 8.9 N·m to 10.8 N·m
- M10 bolts: 18 N·m to 23 N·m
- M12 bolts: 31.5 N·m to 39.5 N·m
- M16 bolts: 78.5 N·m to 98 N·m

Check the following items:

- High-voltage input terminals, high-voltage output terminals
- Input voltage detection circuit (option), output voltage detection circuit
- Transformer primary terminals/primary voltage tap terminals
- Transformer secondary terminals
- Power Cell I/O terminals and fiber optic cable connector
- Power Cell screws, bolts, and connectors
- Control power supply input terminals
- Control transformer I/O terminals (option)
- Power relay I/O terminals for cooling fans
- Screws, bolts, and connectors of each control board
- Control I/O terminals

■ Transformer

Check the following items:

- Check for anything abnormal in the external appearance.
- Check for discoloration indicating burn marks.
- Check for accumulated dirt and dust then remove.
  If you find any, clean it away.
- Check for loose bolts in the I/O terminals and tap terminals. Retighten bolts to the recommended tightening torque.

■ Power Cell

Check the following items:

- Check for discoloration indicating burn marks.
- Check for leakage from the smoothing capacitor.
- Check for loose bolts in the input terminals (L1, L2, L3) and the output terminals (T1, T2). Retighten bolts to the recommended tightening torque.
- Check for a loose fiber optic cable connector and re-insert.
- Check for loose screws and bolts inside Power Cells. Retighten screws and bolts to the recommended tightening torque.
  If there are any, retighten them.
- Check the main circuit fuse and control fuse on the board for discoloration and partial looseness.
- Check for accumulation of dirt and dust on the heatsink.
  Remove debris with dried compressed air at: 39.2×10^4 to 58.8×10^4 Pa (4 to 6 kg·cm^2).

■ Air Filter

If the air filter is soiled or clogged with dirt and dust, the cooling capacity of the drive will be compromised, and the temperature of the drive will rise abnormally. Check the air filter for dirt and dust at each periodic inspection, and clean it with neutral detergent every six months.

■ Board

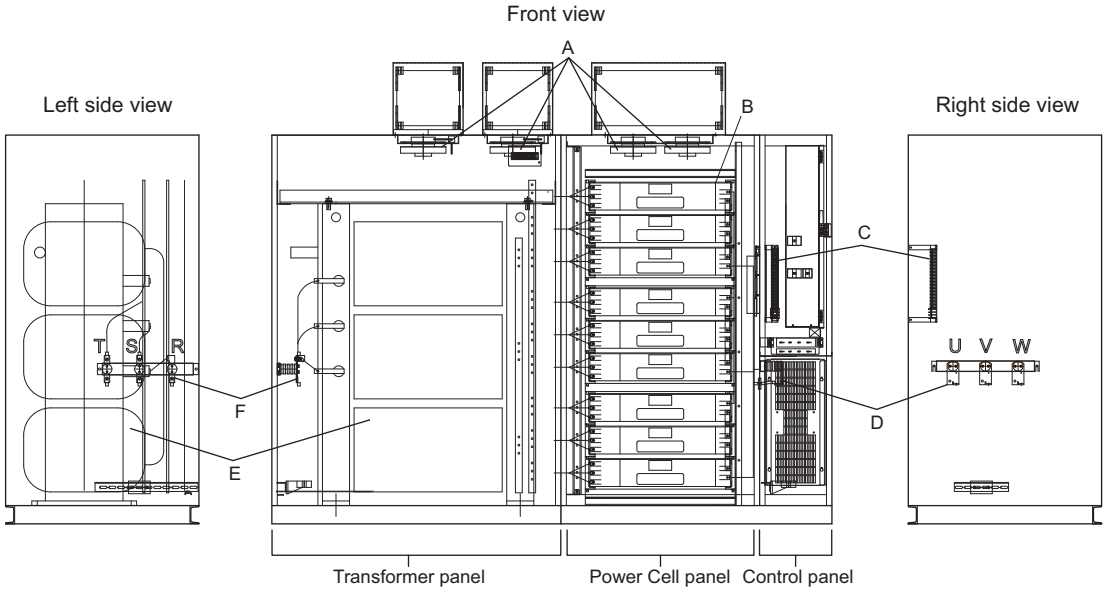
Check the following items:

- Check the board for abnormal odors or discoloration.
- Check for loose screws or connectors. Retighten screws and connectors to the recommended tightening torque.

■ Cooling Fan

Check the following items:

- Check for abnormal vibration and noise.
- Check for loose installation bolts. Retighten bolts to the recommended tightening torque.
- Insulation resistance of the cooling fan's motor
  Check the insulation resistance of the cooling fan motor using a 500 V Megger insulation resistance tester. The measured insulation resistance must be 10 MΩ or more.
- Check the cooling fan motor bearing. The service life of the bearing is approximately 40,000 hours.



A – Cooling fan
B – Power Cells
C – Control circuit terminals
D – Main circuit output terminals
E – Transformer
F – Main circuit input terminals

Figure 6.1 Internal Layout Diagram (Drive: 6 kV Class, 1600 kVA)

6.3 Periodic Maintenance

To maintain drive operating reliably over a long period of time. Yaskawa recommends performing periodic inspections and replacing consumable parts in accordance with their service lives. Periodic inspection standards vary depending on the drive installation environment and usage conditions.

- Cooling fans
- Power cell smoothing capacitors

For the replacement of other parts, contact a Yaskawa representative or the nearest Yaskawa sales office. Replacement of other drive components must be performed by trained professionals.

◆ Part Replacement Guidelines

Table 6.3 shows the estimated performance life of components that require replacement during the life of the drive. Only use Yaskawa replacement parts for the appropriate drive model and version.

Table 6.3 Standard Replacement Period

Part Name	Standard Replacement Period	Replacement Method and Remarks
Cooling fan	3 to 4 years (40,000 service hours)	Replace with a new fan. (Determine replacement need after inspection.)
Power Cell smoothing capacitor	5 years	Replace with a new capacitor. (Determine replacement need after inspection.)
Fuses	10 years	Replace with new fuses.
Aluminum capacitor on the printed circuit board	5 years	Replace with a new board. (Determine replacement need after inspection.)
Battery (lithium battery)	5 years	Replace with a new battery (connect the battery to the control board with the connector). Product name: CR6L-CN014S manufactured by FDK Corporation Specifications: 3 V/2000 mAh
DC power supply	10 years	Replace with a new DC power supply.

NOTICE: *The standard replacement period is based on the conditions listed below. The times stated are for guidance, and the lives of the parts are not guaranteed for these times. Some parts may require more frequent replacement due to poor environments or rigorous use.*
Usage conditions for standard replacement period:
• Ambient temperature: Yearly average of 30 °C
• Load factor: 80% maximum
• Operation time: 12 hours or fewer a day

◆ Performance Life Monitors/Maintenance Monitors

The drive has Maintenance Monitors that keep track of component wear. This feature provides advance maintenance warning and eliminates the need to shut down the entire system for unexpected problems. The drive allows the user to check predicted maintenance periods for the components listed below.

- Cooling Fan
- Power Cell smoothing capacitors
- Inrush prevention circuit breaker (option)
- IGBTs

The drive calculates the maintenance period for components that may require replacement during the life of the drive. A percentage of the maintenance period is displayed on the digital operator by viewing the appropriate monitor parameter.

When the maintenance period reaches 100%, there is increased risk that the drive may malfunction. Yaskawa recommends checking the maintenance period regularly to ensure maximum performance life.

Refer to Recommended Periodic Inspection on page 193 for more details.

Table 6.4 Performance Life Monitors Used for Component Replacement

Parameter	Component	Contents
U4-03	Cooling Fan	Displays the accumulated operation time of the fan from 0 to 99999 hours. This value is automatically reset to 0 after it reaches 99999.
U4-04		Displays the accumulated fan operation time as a percentage of the specified maintenance period.
U4-05	DC Bus Capacitors	Displays the accumulated time the capacitors are used as a percentage of the specified maintenance period.
U4-06	In-rush Prevention Circuit Breaker	Counts the number of ON/OFF operations for the in-rush prevention circuit breaker, and displays the maintenance period as a percentage [%].
U4-07	IGBT	Displays the percentage of the maintenance period reached by the IGBTs.

■ Related Drive Parameters

Use parameters o4-03, o4-05, o4-07, and o4-09 to reset a Maintenance Monitor to zero after replacing a specific component.

NOTICE: *If these parameters are not reset after the corresponding parts have been replaced, the Maintenance Monitor function will continue to count down the performance life from the value that was reached with the old part. If the Maintenance Monitor is not reset, the drive will not have the correct value of the performance life for the new component.*

6.4 Replacing the Battery

A battery for memory backup is provided in the controller.

When the battery voltage drops below 2 V, “BAT” will be displayed on the digital operator and the LED indicator “BAT” on the control board will light up, both indicating low battery voltage. Replace the battery when these alarms have been tripped.

Yaskawa recommends replacing the battery every 5 years regardless of whether an alarm has been tripped. The battery replacement interval is indicated on a dedicated nameplate on the controller.

Use battery model CR6L-CN014S.

Note: Do not turn off the control power with an alarm detected.
Failure to comply may result in loss of the data and the calendar settings stored in the backup memory.
If the control power is turned on when the battery voltage is less than 2 V, the backup data will be automatically cleared.

◆ Battery Replacement Procedure

⚠ **WARNING!** *Electrical Shock Hazard. Do not allow unqualified personnel to perform work on the drive. Failure to comply could result in serious injury or death. The drive should be installed, wired, repaired, inspected, or serviced, by personnel with a thorough knowledge of medium-voltage drive installation, adjustment and repair.*

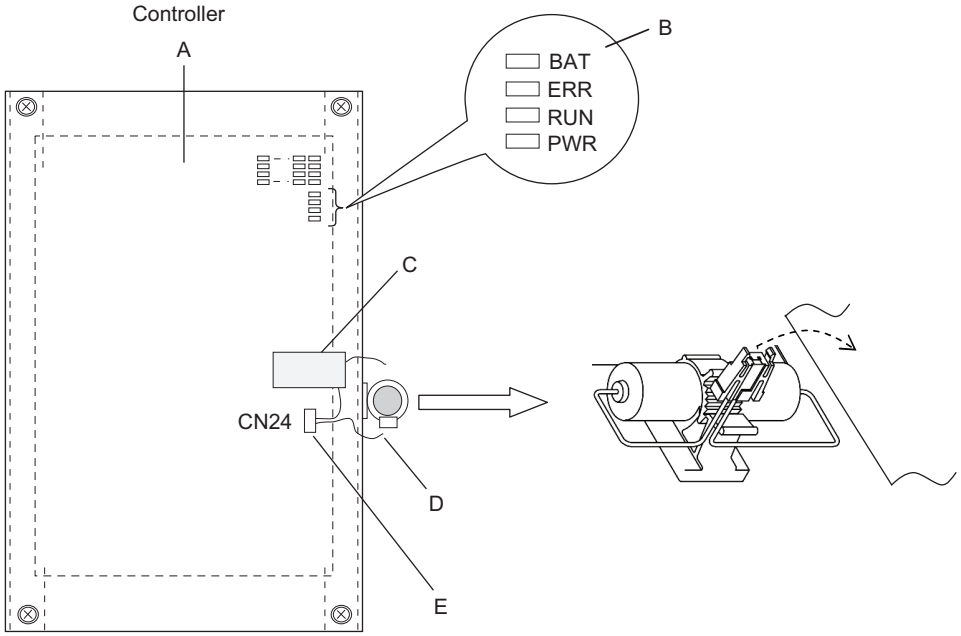
NOTICE: *Damage to Equipment. Observe electrostatic discharge procedures (ESD) when handling the drive or circuit boards. Failure to comply could result in ESD damage to the drive circuitry.*

NOTICE: *Damage to Equipment. Do not short-circuit the battery connector when removing or mounting the battery or cleaning the connector. Failure to comply will result in loss of backup data.*

Note: Replace the battery while the control power is being supplied.
If the control power has been shut off, replace the battery within one hour. The data is backed up by the built-in capacitor for this time even if there is no battery.
If the control power is off for more than an hour, the backup data may be corrupted. In this case, turn on the control power with the battery removed to clear the backup data and then set the battery.

Replace the battery by using the following procedure:

1. Shut off the main circuit power and wait at least 15 minutes.
2. Remove the cover from the controller.
3. Remove the battery connector (CN24). The battery alarm LED will light.
   Note: Clean the battery connector with alcohol or equivalent if there is dust or oil on the connector.
4. Remove the battery from the battery holder.
5. Mount a new battery in the battery holder. Take care to ensure that the cable is not trapped.
6. Confirm the polarities and connect the battery to the connector (CN24).
7. Check that the battery alarm LED indicator has turned off.
8. Add the next battery replacement date next to the battery label.



A – Control board
B – Battery alarm LED indicator
C – Battery label
D – Battery
E – Battery connector (CN24)

Figure 6.2 Replacing the Battery

6.5 Replacing the Cooling Fan

NOTICE: *Equipment Hazard. Replace the cooling fan with a fan that is specified for use in combination with the drive. Incorrect cooling fan installation may cause overheating of the drive or degraded performance.*

Contact your Yaskawa representative or the nearest Yaskawa sales office to get a cooling fan replaced.

For drives with multiple cooling fans, replace all of the fans when performing maintenance to ensure maximum product performance life.

◆ Models and Number of Cooling Fans Used

Table 6.5 Models and Number of Cooling Fans Used

Voltage Class (kV)	Control Power Supply Voltage (V)	Power Supply Frequency (Hz)	Model CIMR-MV2□	Transformer Panel		Power Cell Panel	
				Model/Specifications	Qty	Model/Specifications	Qty
2	200/220	60	A□A□052 <1>	S3G250-BC54-01, 169W	3	–	–
			A□A□068 <1>				
			A□A□080 <1>		4		
			A□A□093 <1>				
			A□A□102 <1>				
			A□A□115 <1>				
			A□A□135 <1>				
			A□A□160 <1>			S3G250-BC54-01, 169W	3
			A□A□180 <1>				
			A□A□205 <1>				
			A□A□220 <1>				
			A□A□280 <1>		3	S3G400-KC22-51, 375W	3
			A□A□330 <1>				
			A□A□390 <1>				
			A□A□440 <1>	–	–	–	–
			A□A□505 <1>				
			A□A□550 <1>				
			A□A□600 <1>				

Voltage Class (kV)	Control Power Supply Voltage (V)	Power Supply Frequency (Hz)	Model CIMR-MV2□	Transformer Panel		Power Cell Panel	
				Model/Specifications	Qty	Model/Specifications	Qty
3	200/220	50/60	C□CA035	S3G250-BC54-01, 169W	2	–	–
			C□CA050				
			C□CA070				
			C□CA100		3		
			C□CA140		4		
			C□CA200		3	S3G250-BC54-01, 169W	3
			C□CA260	S3G400-KC22-51, 375W	2	S3G400-KC22-51, 375W	2
			C□CA330		3		3
			C□CA400				
			C□CA520	S3G500-AM56-21, 750W	3	S3G500-AM56-21, 750W	2
			C□CA650				3
			C□CB035	S3G250-BC54-01, 169W	2	–	–
			C□CB050				
			C□CB070				
			C□CB100		4		
			C□CB140	S3G500-AM56-21, 750W	2		
			C□CB200	S3G250-BC54-01, 169W	4	S3G250-BC54-01, 169W	3
			C□CB260	S3G400-KC22-51, 375W	2	S3G400-KC22-51, 375W	2
			C□CB330	S3G500-AM56-21, 750W	3		3
			C□CB400				
			C□CB520			S3G500-AM56-21, 750W	2
			C□CB650		4		3
4	200/220	60	D□D□039	S3G250-BC54-01, 169W	3	–	–
			D□D□052				
			D□D□058				
			D□D□064				
			D□D□077		4		
			D□D□093				
			D□D□102				
			D□D□115				
			D□D□125				
			D□D□155			S3G250-BC54-01, 169W	3
			D□D□190				
			D□D□220 <1>				
			D□D□250 <1>				
			D□D□285 <1>	S3G400-KC22-51, 375W	3	S3G400-KC22-51, 375W	3
			D□D□315 <1>				
			D□D□340 <1>				
			D□D□375 <1>				
			D□D□440 <1>	–	–	–	–
			D□D□505 <1>				
			D□D□575 <1>				
			D□D□625 <1>				

Voltage Class (kV)	Control Power Supply Voltage (V)	Power Supply Frequency (Hz)	Model CIMR-MV2☐	Transformer Panel		Power Cell Panel	
				Model/Specifications	Qty	Model/Specifications	Qty
6	200/220	50/60	F☐FA035	S3G250-BC54-01, 169W	2	S3G250-BC54-01, 169W	2
			F☐FA050				
			F☐FA070		3		
			F☐FA100				
			F☐FA140		4		3
			F☐FA200	S3G500-AM56-21, 750W	2	S3G400-KC22-51, 375W	2
			F☐FA260	S3G400-KC22-51, 375W	3		3
			F☐FA330			S3G500-AM56-21, 750W	3
			F☐FA400	S3G500-AM56-21, 750W	3		
			F☐FA520				
			F☐FA650		5		5
			F☐FB035	S3G250-BC54-01, 169W	2	S3G250-BC54-01, 169W	2
			F☐FB050				
			F☐FB070		3		
			F☐FB100	S3G500-AM56-21, 750W	2		
			F☐FB140				3
			F☐FB200			S3G400-KC22-51, 375W	2
			F☐FB260		3		3
			F☐FB330		4	S3G500-AM56-21, 750W	3
			F☐FB400				
			F☐FB520				
			F☐FB650		5		5
11	200/220	50/60	H☐H☐035	S3G400-KC22-51, 375W	2	S3G400-KC22-51, 375W	2
			H☐H☐050				
			H☐H☐070		3		
			H☐H☐100		4		3
			H☐H☐140				
			H☐H☐200				4
			H☐H☐260 <1>		6		5
			H☐H☐330 <1>	S3G500-AM56-21, 750W	4	S3G500-AM56-21, 750W	5
			H☐H☐400 <1>		5		
			H☐H☐520 <1>		6		6
			H☐H☐650 <1>		8		8

<1> Under development

◆ Cooling Fan Replacement Procedure

Replace cooling fans by using the following procedure. The general steps are given here. For details, contact your Yaskawa representative or the nearest Yaskawa sales office.

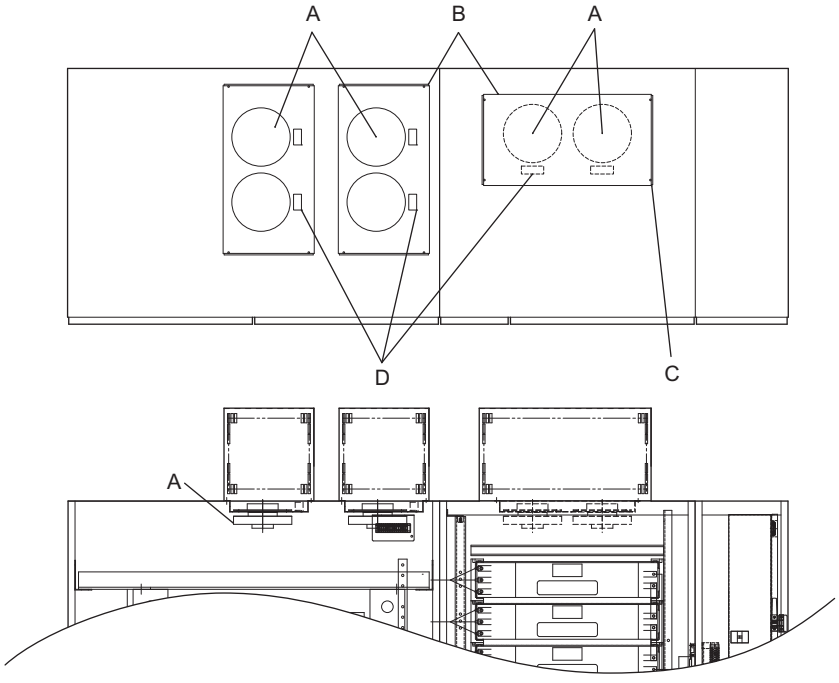
⚠ **DANGER!** *Electrical Shock Hazard. Do not connect or disconnect wiring or service equipment while the power is on. Failure to comply will result in serious injury or death. Before servicing, disconnect all power to the equipment. There may be multiple sources of power and control power may be present although the CHARGE indicator LED is extinguished. Verify that control power is removed. The internal capacitor and the Power Cell exterior surface and interior remain charged even after the medium-voltage power supply is turned off. Verify the CHARGE indicator LED is extinguished before servicing and remove control power. To prevent electric shock, wait for at least the time specified on the warning label after all indicators are OFF, and then measure for unsafe voltages to confirm the drive has reached a safe level before servicing.*

■ Removal

1. Remove the mounting screws from the drive ventilation cover, then remove the ventilation cover at the top of the drive.

⚠ **CAUTION!** *Take due care not to drop any of the mounting screws inside the drive.*

2. Disconnect the cooling fan cables from the relay terminals.
3. Remove the cooling fan mounting screws.
4. Pull upward on the cooling fan to remove.



A – Cooling fan
B – Ventilation cover
C – Relay terminal
D – Ventilation cover mounting screws (M6)

Figure 6.3 Cooling Fan Replacement (Drive: 6 kV Class, 1600 kVA)

■ Mounting

Arrange the cooling fan cables so that they will not make contact with, or be caught in, the fan blades.

1. Set the new cooling fan in place and tighten the mounting screws.
2. Reinstall the components in the reverse order of removal.

6.6 Replacing Power Cells

◆ Power Cell Replacement Procedure

The general steps are given here. For details, contact your Yaskawa representative or the nearest Yaskawa sales office.

⚠ **DANGER!** *Electrical Shock Hazard. Do not connect or disconnect wiring or service equipment while the power is on. Failure to comply will result in serious injury or death. Before servicing, disconnect all power to the equipment. The internal capacitor and the Power Cell exterior surface and interior remain charged even after the medium-voltage power supply is turned off. Verify the CHARGE indicator LED is extinguished before servicing and remove control power. There may be multiple sources of power and control power may be present although the CHARGE indicator LED is extinguished. To prevent electric shock, wait for at least the time specified on the warning label after all indicators are OFF, and then measure for unsafe voltages to confirm the drive has reached a safe level before servicing.*

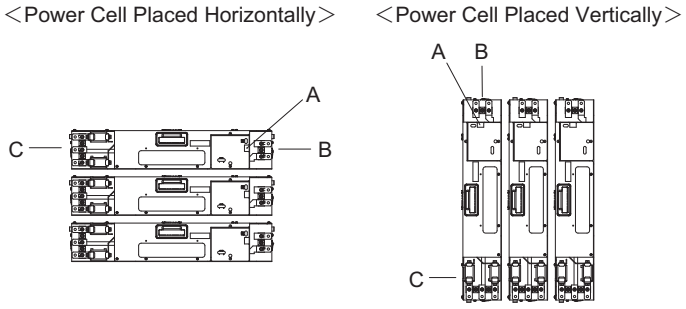
⚠ **WARNING!** *Electrical Shock Hazard. Do not allow unqualified personnel to perform work on the drive. Failure to comply could result in serious injury or death. The drive should be installed, wired, repaired, inspected, or serviced, by personnel with a thorough knowledge of medium-voltage drive installation, adjustment and repair.*

NOTICE: *Equipment Hazard. Observe proper electrostatic discharge procedures (ESD) when handling the drive or circuit boards. Failure to comply could result in ESD damage to the drive circuitry.*

■ Removal

Replace Power Cells using the following the procedure:

1. Disconnect the fiber optic cable from the cell control board (CCB). Take care not to damage the cable when pulling out the Power Cell.

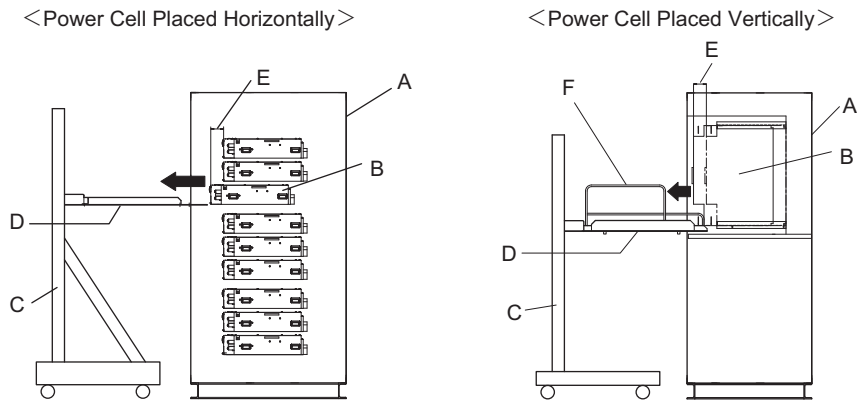


A – Fiber optic cable
B – Output terminals (T1, T2)
C – Input terminals (L1, L2, L3)

Figure 6.4 Disconnecting the Power Cell Wiring

2. Disconnect the three phase wiring from the input terminals (L1, L2, L3), and the wiring (copper bars or wires) from the output terminals (T1, T2).
3. Pull the Power Cell out about 100 mm toward front.
4. Fit the lifter platform at that position to place it under the Power Cell.
5. Slowly pull the handle on the front face of the Power Cell and to remove it from the drive.
6. Shift the entire Power Cell onto the platform of the dedicated lifter.

⚠ **CAUTION!** *Pinching Hazard. Carefully and slowly pull out the Power cell when servicing. Failure to comply may result in injury to hands or fingers.*



A – Drive

B – Power Cells

C – Lifter

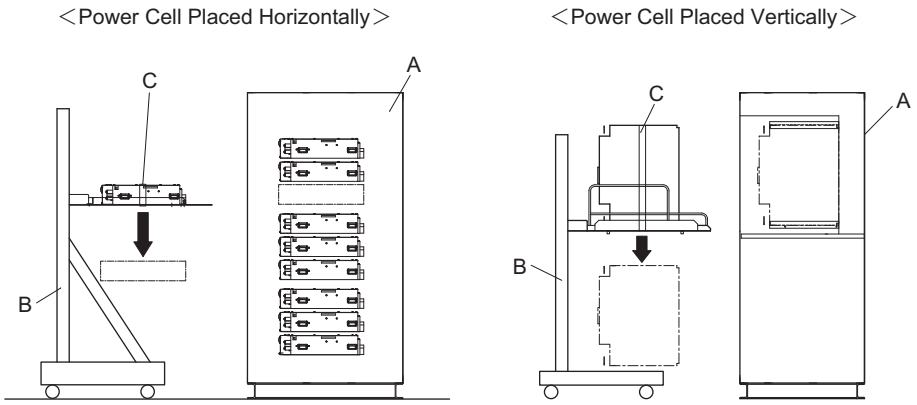
D – Fix the lifter at the appropriate height for the Power Cell.

E – Pull the Power Cell out about 100 mm toward front.

F – Safety rail to prevent the Power Cell from falling (provided with lifter)

Figure 6.5 Drawing Out a Power Cell

7. Secure the Power Cell on the platform with a belt or other means to prevent falling and move the Power Cell to a stable position.

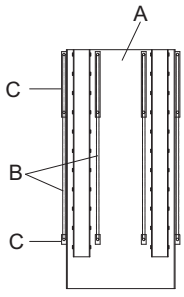


A – Drive

B – Lifter

C – Belt to prevent the Power Cell from falling

Figure 6.6 Moving A Power Cell



A – Lifter (bucket)

B – Two safety rails to prevent the Power Cell from falling (provided with lifter)

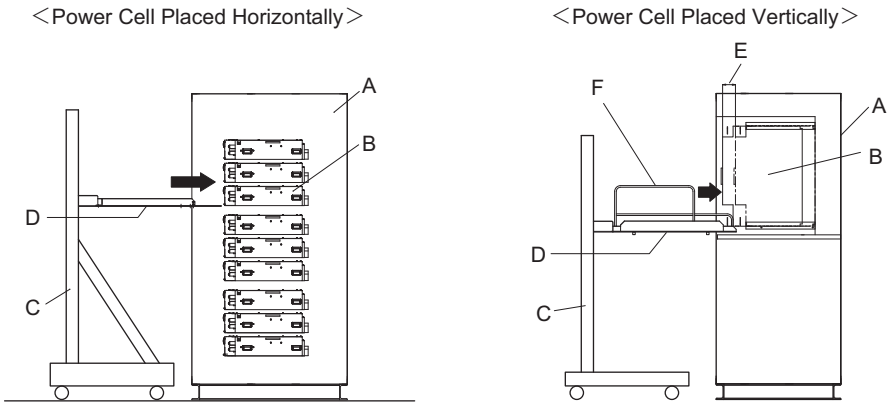
C – Position to insert safety rails

Figure 6.7 Safety Rails to Prevent the Power Cell from Falling

Note: Safety rails to prevent the Power Cell from falling are removable. Insert the rails according to the position of the Power Cell.

■ Mounting

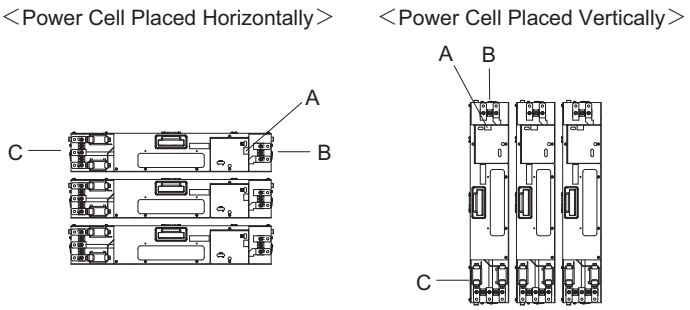
1. Mount a Power Cell by following the procedure for removal in reverse.
2. Move the Power Cell that is loaded on a lifter to the front of the drive panel in which the Power Cell is to be inserted.
3. Push the Power Cell in from the front and mount it.



A – Drive
B – Power Cells
C – Lifter
D – Fix the lifter at the appropriate height for the Power Cell.

Figure 6.8 Inserting a Power Cell

4. Connect the three-phase input wiring to the input terminals (L1, L2, L3), and connect the wiring to the output terminals (T1, T2).
5. Connect the fiber optic cable to the cell control board (CCB).



A – Fiber optic cable
B – Output terminals (T1, T2)
C – Input terminals (L1, L2, L3)

Figure 6.9 Wiring of Power Cells

6.7 Spare Parts

◆ Spare Parts

Considering the importance of the system in which the drive is used, it is recommended that spare parts be prepared in advance to cover all eventualities for maintenance management. Check the following points before ordering spare parts from your nearest Yaskawa representative or Yaskawa sales office:

Drive: Model, capacity, and Yaskawa order number

Spare parts: Part name, model, and quantity

■ Circuit Board and DC Power Supplies

Table 6.6 Spare Parts for Circuit Board and DC Power Supplies

Category		Part Name	Model	Remarks
Power Cell related		Cell control board (CCB)	JEBC-61406-0	Common to all capacities
		Gate drive board (GDB)	JEBC-61511-0	For Power Cells: 35 A
			JEBC-61511-1	For Power Cells: 50 A
			JEBC-61511-2	For Power Cells: 70 A
			JEBC-61511-3	For Power Cells: 100 A
			JEBC-61511-4	For Power Cells: 140 A
			JEBC-61511-5	For Power Cells: 200 A
			JEBC-61511-6	For Power Cells: 260 A
			JEBC-61511-7	For Power Cells: 330 A
			JEBC-61511-8	For Power Cells: 400 A
			JEBC-61511-9	For Power Cells: 520 A
			JEBC-61511-A	For Power Cells: 650 A
		Voltage detection board (VDB)	JEBC-61912	Common to all capacities
Panel related	Controller	Control board (CNT)	JEBC-61304-INV	The board that controls the drive
		Expansion board for optical link (EO-EXT)	JEBC-61610	Applicable for the 11 kV output voltage class
		DC power supply 1 (PS1)	PMC30E-2C	5 V, ±15 V: Control circuit power supply and analog I/O power supply
		DC power supply 2 (PS2)	PBA50F-24-C	24 V: Control circuit power supply and contact I/O power supply
		Isolation board (ISO)	JEBC-61701	For I/O voltage detection
		Relay board (RLB)	JEBC-61913	For I/O interface 200/220 Vac
			JEBC-61913-1	For I/O interface 220/240 Vac
			JEBC-61913-2	For I/O interface 110/120 Vac
		Fan fault detection board (FFB)	JEBC-61703-0	For fan drive and fault detection (S3G250)
			JEBC-61703-1	For fan drive and fault detection (S3G400 and S3G500)
		Current detection resistor board (IDB) (option)	JEBC-61902-1	47 Ω (varies depending on the drive)
			JEBC-61902-2	30 Ω (varies depending on the drive)
			JEBC-61902-4	22 Ω (varies depending on the drive)
			JEBC-61902-5	15 Ω (varies depending on the drive)
			JEBC-61902-7	68 Ω (varies depending on the drive)
			JEBC-61902-8	10 Ω (varies depending on the drive)

Note: Depending on the Power Cell rating, the CCB and CNT for earlier software versions may not be able to be used. Use the CCB and CNT for the version shown in the following table. The software version is listed on each board.

Table 6.7 Power Cell and Software Version for Cell Control Board and Control Board

Power Cell Rating	Software Version	
	Cell Control Board	Control Board
35 to 200 A <1>	S0100 or later	S0100 or later
260 to 400 A	S0101 or later	S0102 or later
520 to 650 A	S0102 or later	S0107 or later

<1> Use CNT S0102 or later when the CCB software version is S0101.

■ Power Cell Related

Table 6.8 Power Cell Spare Parts

Power Cell Rating	Procurement Code	Model	Specifications
35 A	7910251-1010□	JESD-MV2S12035	1200 Vac, 35 A rating
50 A	7910251-1020□	JESD-MV2S12050	1200 Vac, 50 A rating
70 A	7910251-1030□	JESD-MV2S12070	1200 Vac, 70 A rating
100 A	7910251-1040□	JESD-MV2S12100	1200 Vac, 100 A rating
140 A	7910251-1050□	JESD-MV2S12140	1200 Vac, 140 A rating
200 A	7910251-1060□	JESD-MV2S12200	1200 Vac, 200 A rating
260 A	7910251-1070□	JESD-MV2S12260	1200 Vac, 260 A rating
330 A	7910251-1080□	JESD-MV2S12330	1200 Vac, 330 A rating
400 A	7910251-1090□	JESD-MV2S12400	1200 Vac, 400 A rating
520 A	7910251-1100□	JESD-MV2S12520	1200 Vac, 520 A rating
650 A	7910251-1110□	JESD-MV2S12650	1200 Vac, 650 A rating

■ Panel Related

Table 6.9 Panel Spare Parts

Part Name	Model	Remarks
Digital operator	JVOP-180	–
Cooling fan	S3G250-BC54-01	Varies depending on the drive capacity. Refer to *Models and Number of Cooling Fans Used on page 200*.
	S3G400-KC22-71	
	S3G500-AM56-21	

◆ Storing Spare Parts

Observe the following precautions to maintain the life and reliability of Power Cells, boards, cooling fans, or other spare parts when stored:

- Do not unpack the product.
- If the product has been unpacked, enclose the board in a conductive, sealed bag.
- Protect the product not to be directly loaded during storage.

■ Storage Location

Store products held in reserve in a location, such as a warehouse, office, or similar location, with an ambient temperature of -5 °C to +40 °C, a relative humidity no greater than 85%, and without condensation or freezing. For storage over short periods (approximately one month), for example during transportation, a temperature range of -20 to +60 °C is permissible.

Avoid storing the products in the areas with the following characteristics:

- Exposure to direct sunlight.
- Subject to shock and vibration during transportation.
- Dust and oil mist, such as a cement factory or spinning mill.
- Corrosive gas, such as a chemical factory, refinery, or sewage plant.
- A risk of salt damage, such as a location near the sea, or in salt damaged areas.

■ Preventing Power Cell Deterioration

Apply voltage to a reserve Power Cell smoothing capacitor every six months to avoid deterioration.

Use a customer-supplied variable power supply and step-up transformer to apply voltage. Increase the voltage gradually over two to three minutes and continue to apply the voltage for at least one hour with no load. *Refer to When Using an AC Variable Power Supply (Single-phase/Three-phase) on page 209* and *When Using a DC Variable Power Supply on page 209* for details.

After installing a spare Power Cell into the drive panel and using it for the first time, leave the main circuit power supply on continuously for 20 minutes after voltage was first applied to the Power Cell to stabilize the Power Cell capacitors.

Note: **1.** Use a variable power supply with a step-up transformer.
2. A variable power supply and step-up transformer is to be provided by the customer.

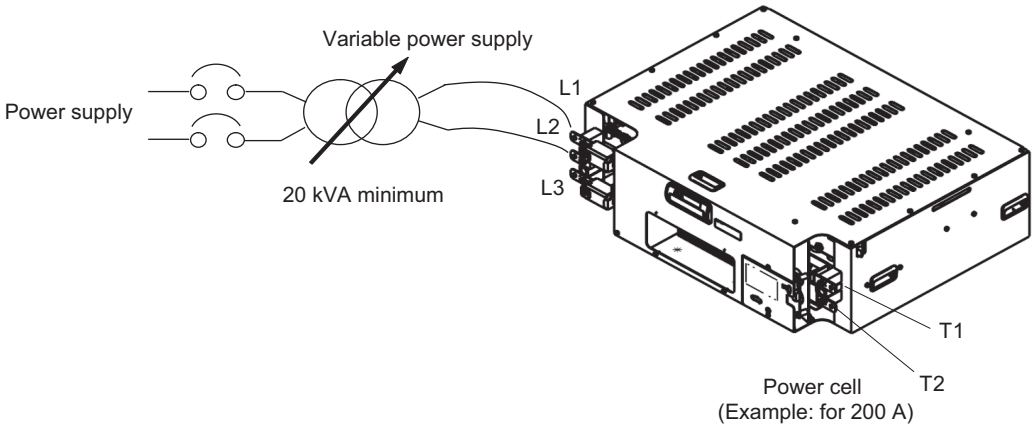


Figure 6.10 Applying Voltage to the Power Cell

When Using an AC Variable Power Supply (Single-phase/Three-phase)

1. Connect a single-phase variable power supply to terminals L1 and L2 (or L3).
   Connect a three-phase variable power supply to terminals L1, L2 and L3.
2. Gradually increase the voltage from 0 to 440 Vac.

Note: If there has been no voltage application for two years or longer, gradually increase the voltage over 2 to 3 minutes.

When Using a DC Variable Power Supply

1. Connect the power supply to the terminals L1 and L2 (or L3).
2. Gradually increase the voltage from 0 to 600 Vdc.

Note: If there has been no voltage application for two years or longer, gradually increase the voltage over 2 to 3 minutes.

7

Options

This chapter describes the options that can be used with this drive.

7.1 SECTION SAFETY 212
7.2 OPTIONS 213

7.1 Section Safety

⚠ DANGER

Electrical Shock Hazard

Do not connect or disconnect wiring while the power for the main circuit and controls is on.

Failure to comply could result in serious injury or death.

The internal capacitor remains charged even after the drive input power is turned off. After shutting off the power, wait for at least the amount of time specified on the drive before touching any components.

Do not supply power to the main circuit while drive covers are removed.

Failure to comply could result in serious injury or death.

The diagrams in this manual may be indicated without covers or safety shields to show details. Restore covers or shields before operating the drive and run the drive according to the instructions described in this manual.

⚠ WARNING

Electrical Shock Hazard

Do not remove covers of the drive or touch circuit boards while the main circuit power is on.

Failure to comply could result in serious injury or death.

Do not allow unqualified personnel to perform work on the drive.

Failure to comply could result in serious injury or death.

The drive should be installed, wired, repaired, inspected, and have its parts replaced, by someone with a thorough knowledge of drive installation, adjustment and repair.

Do not perform work or operate the drive while wearing loose clothing, jewelry, or without eye protection.

Failure to comply could result in serious injury or death.

Remove all metal objects such as watches and rings, secure loose clothing and wear eye protection before beginning work on the drive.

Always ground the motor-side ground terminal.

Improper equipment grounding could result in serious injury or death by contacting the motor case.

Fire Hazard

Tighten all terminal screws to the specified tightening torque.

Loose electrical connections could result in serious injury or death by fire due to overheating of electrical connections.

NOTICE

Observe proper electrostatic discharge procedures (ESD) when handling the drive.

Failure to comply may result in ESD damage to the drive circuitry.

Do not disconnect the motor from the drive while the drive is outputting voltage.

Failure to comply could result in damage to the drive.

7.2 Options

Table 7.1 lists the names of the various options available for the drive. Contact your Yaskawa representatives or the nearest Yaskawa sales office.

- Option Selection: Refer to the Yaskawa catalog for selection and part numbers.
- Option Installation: Refer to the corresponding option manual for installation and wiring instructions.

◆ Built-in Type

All built-in type options mount to the connectors on the controller board.

Table 7.1 Built-in Type Options

Type	Name	Function	Reference Manual
Speed (Frequency) Reference Card	Analog Input AI-A3	Enables high-precision and high-resolution analog speed reference setting. • Input signal level: -10 to +10 Vdc (20 kΩ), 4 to 20 mA (500 Ω) • Input channels: 3 channels (DIP switch for input voltage/input current selection) • Input resolution: Input voltage 13-bit signed (1/8192) Input current 1/6554	This manual or FSDrive-MV1000 Parameter Guide (TOEP C710687 03)
	Digital Input DI-A3	Enables 16-bit digital speed reference setting. • Input signal: 16 bit binary, 4-digit BCD + sign signal + set signal • Input voltage: +24 V (isolated) • Input current: 8 mA User-set: 8-bit, 12-bit, 16-bit	This manual or FSDrive-MV1000 Parameter Guide (TOEP C710687 03)
Communications Card <1>	DeviceNet Interface SI-N3	Connects to a DeviceNet network. Using this communications protocol, it is possible to run and stop the drive, set and reference parameters, and monitor output frequency, output current, or similar items.	FSDrive-MV1000 Option DeviceNet Technical Manual (SIEP C710687 04)
	PROFIBUS-DP Interface SI-P3	Connects to a PROFIBUS-DP network. Using this communications protocol, it is possible to run and stop the drive, set and reference parameters, and monitor output frequency, output current, or similar items.	FSDrive-MV1000 Option PROFIBUS-DP Technical Manual (SIEP C710687 05)
Monitor Card	Analog Monitor AO-A3	Outputs analog signal for monitoring drive output state (output freq., output current etc.). • Output resolution: 11-bit signed (1/2048) • Output voltage: -10 to +10 Vdc (non-isolated) • Terminals: 2 analog outputs	This manual or FSDrive-MV1000 Parameter Guide (TOEP C710687 03)
	Digital Output DO-A3	Outputs isolated type digital signal for monitoring drive run state (alarm signal, zero speed detection, etc.) • Terminals: 6 photocoupler outputs (48 V, 50 mA or less) 2 relay contact outputs (250 Vac 1 A or less, 30 Vdc 1 A or less)	This manual or FSDrive-MV1000 Parameter Guide (TOEP C710687 03)
PG Speed Controller Card <2>	Complementary Type PG Interface PG-B3	For control modes requiring a PG encoder for motor feedback. • Phase -A, -B, and -Z pulse (3-phase) inputs (complementary type) • Max. input frequency: 50 kHz • Pulse monitor output: Open collector, +24 V, max. current 30 mA • Power supply output for PG: +12 V, max. current 200 mA	This manual or FSDrive-MV1000 Parameter Guide (TOEP C710687 03)
	Line Driver PG Interface PG-X3	For control modes requiring a PG encoder for motor feedback. • Phase -A, -B, and -Z pulse (differential pulse) inputs (RS-422) • Max. input frequency: 300 kHz • Pulse monitor output: RS-422 • Power supply output for PG: +5 V or +12 V, max. current 200 mA	This manual or FSDrive-MV1000 Parameter Guide (TOEP C710687 03)
PLC Function	Expansion PLC Board BC-620	Supplements PLC functions required to customize the drive. • Program memory capacity: Equivalent to 8,000 steps • Execution speed: 1,000 steps/1 ms • Language: Ladder language, textual language	<3>

<1> Only one communication card can be selected at a time.
<2> To apply PG control, the PG speed control card must be selected.
<3> Contact Yaskawa for documentation.

◆ Panel Housed Type

Table 7.2 Panel Housed Type Options

Type	Name	Function	Reference Manual
Momentary Power Loss Compensation	Uninterruptible Power Supply (UPS) Unit	UPS is installed inside the panel and backs up a control power supply when momentary power losses occur. This option is required to implement measures against momentary power loss (for the speed search function or KEB function)	–
Continuation of Operation	Backup Cooling Fan <1>	Automatically enables continued operation of the drive in the event of cooling fan failure. (N + 1 backup system)	<2>
Measures for Cold Regions	Space Heater	Adds a space heater circuit to suppress condensation inside the panel. This option does not always prevent condensation. Use the drive in an environment with no condensation.	–
Panel Door Open Interlock		Detects opening of the panel door by adding a limit switch. Medium-voltage power shutdown command is output on detecting opening.	–

<1> Contact Yaskawa for details on availability.
<2> Contact Yaskawa for documentation.

◆ Separate Installation Type

Table 7.3 Separate Installation Type Options

Type	Name	Function	Reference Manual
Maintenance	DriveWizard Plus MV	DriveWizard Plus MV is an engineering tool for performing everything from setup, to test run and maintenance for Yaskawa drives. It provides a single functional format that can be easily operated out of the box by everyone from beginners to experts in drive tuning to support connection, test run, to maintenance.	DriveWizard Plus MV User's Manual (EZZ010941)
	USB Copy Unit JVOP-181	Enables the copying and transfer of parameters between drives using (one-touch) simple operations. This unit can also be used as a conversion connector between the communication port (RJ-45) of a drive and a USB port of a PC running DriveWizard Plus MV. This option includes a copy unit with USB interface, an RJ-45 cable, and a USB cable.	<2>
Power Cell Replacement	Lifter for Replacing Power Cells	Facilitates power cell replacement. A maintenance space of at least 2000 mm must be secured in front of the panel in order to replace Power Cells with a lifter.	–
Installation	Inrush Current Suppression Circuit <1>	Suppresses the inrush current at the drive power on by adding a circuit (inrush suppression circuit panel)	This manual or FSDrive-MV1000 Parameter Guide (TOEP C710687 03)

<1> Contact Yaskawa for details on availability.
<2> Contact Yaskawa for documentation.

Appendix: A

Specifications

This chapter describes the specifications and derating method for the drive.

A.1 MODEL-SPECIFIC SPECIFICATIONS. 216
A.2 DRIVE SPECIFICATIONS 218

A.1 Model-Specific Specifications

◆ Class: 2 kV

Table A.1 Model-Specific Specifications (Class: 2 kV)

Item		Specifications																	
Model: CIMR-MV2□A□A□		052 <1>	068 <1>	080 <1>	093 <1>	102 <1>	115 <1>	135 <1>	160 <1>	180 <1>	205 <1>	220 <1>	280 <1>	330 <1>	390 <1>	440 <1>	505 <1>	550 <1>	600 <1>
Nominal Capacity (kVA)	2.4 kV Output	220	290	340	390	420	480	560	670	750	850	920	1160	1370	1620	1830	2100	2300	2500
	Max. Applicable Motor Capacity (kW)	170	230	270	310	340	380	450	530	600	680	730	930	1100	1300	1460	1680	1830	2000
Motor Power (HP)		200	300	350	400	450	500	600	700	800	900	1000	1250	1500	1750	2000	2250	2500	2750
Output Rating	Rated Output Current (A)	52	68	80	93	102	115	135	160	180	205	220	280	330	390	440	505	550	600
	Rated Output Voltage (V)	Three-phase, 2400 V (sine wave, proportional to input voltage)																	
Power Supply	Main Circuit	Three-phase, 2400 V -20% to +10%, 60 Hz																	
	Control Circuit	Single-phase, 200/220 V 50/60 Hz ± 5%, 15 kVA <2>																	

<1> Under development
<2> CE-marking-conforming products are 230 V specifications.

◆ Class: 3 kV

Table A.2 Model-Specific Specifications (Class: 3 kV)

Item		Specifications									
Model: CIMR-MV2□C□C□		035	050	070	100	140	200	260	330	400	520	650
Nominal Capacity (kVA)	3.3 kV Output	200	285	400	570	800	1150	1500	1900	2300	3000	3700
	Max. Applicable Motor Capacity (kW)	132	200	315	450	630	900	1250	1500	1800	2500	3000
Output Rating	Rated Output Current (A)	35	50	70	100	140	200	260	330	400	520	650
	Rated Output Voltage (V)	Three-phase, 3000 V or 3300 V (sine wave, proportional to input voltage)										
Power Supply	Main Circuit	Three-phase, 3000 V (50 Hz ± 5%) or 3300 V (50/60 Hz ± 5%) -20% to +10% <1>										
	Control Circuit	Single-phase, 200/220 V -10% to +10% 50/60 Hz ± 5%, 15 kVA <2>										

<1> Output not guaranteed at −10% and lower
<2> CE-marking-conforming products are 230 V specifications.

◆ Class: 4 kV

Table A.3 Model-Specific Specifications (Class: 4 kV)

Item		Specifications																			
Model: CIMR-MV2□D□D□		039	058	064	077	093	102	115	125	155	190	220 <1>	250 <1>	285 <1>	315 <1>	340 <1>	375 <1>	440 <1>	505 <1>	575 <1>	625 <1>
Nominal Capacity (kVA)	4.16 kV Output	280	420	460	550	670	735	830	900	1120	1370	1590	1800	2050	2270	2500	2700	3170	3640	4140	4500
	Max. Applicable Motor Capacity (kW)	220	330	370	440	540	590	660	720	890	1100	1270	1440	1640	1820	1960	2160	2540	2910	3310	3600
Motor Power (HP)		300	450	500	600	700	800	900	1000	1250	1500	1750	2000	2250	2500	2750	3000	3500	4000	4500	5000
Output Rating	Rated Output Current (A)	39	58	64	77	93	102	115	125	155	190	220	250	285	315	340	375	440	505	575	625
	Rated Output Voltage (V)	Three-phase, 4160 V (sine wave, proportional to input voltage)																			
Power Supply	Main Circuit	Three-phase, 4160 V -20% to +10%, 60 Hz																			
	Control Circuit	Single-phase, 200/220 V 50/60 Hz ± 5%, 15 kVA <2>																			

<1> Under development
<2> CE-marking-conforming products are 230 V specifications.

◆ Class: 6 kV

Table A.4 Model-Specific Specifications (Class: 6 kV)

Item		Specifications										
Model: CIMR-MV2□F□F□		035	050	070	100	140	200	260	330	400	520	650
Nominal Capacity (kVA)	6.6 kV Output	400	570	800	1150	1600	2300	3000	3800	4600	6000	7500
	Max. Applicable Motor Capacity (kW)	250	400	630	900	1250	1800	2500	3000	3600	5000	6000
Output Rating	Rated Output Current (A)	35	50	70	100	140	200	260	330	400	520	650
	Rated Output Voltage (V)	Three-phase, 6000 V or 6600 V (sine wave, proportional to input voltage)										
Power Supply	Main Circuit	Three-phase, 6000 V (50 Hz ± 5%) or 6600 V (50/60 Hz ± 5%) -20% to +10% <1>										
	Control Circuit	Single-phase, 200/220 V -10% to +10% 50/60 Hz ± 5%, 15 kVA <2>										

<1> Output not guaranteed at -10% and lower
<2> CE-marking-conforming products are 230 V specifications.

◆ Class: 11 kV

Table A.5 Model-Specific Specifications (Class: 11 kV)

Item		Specifications										
Model: CIMR-MV2□H□H□		035	050	070	100	140	200	260 <1>	330 <1>	400 <1>	520 <1>	650 <1>
Nominal Capacity (kVA)	11 kV Output	660	950	1300	1900	2650	3800	5000	6200	7600	9900	12000
	Max. Applicable Motor Capacity (kW)	530	760	1070	1520	2130	3050	3960	5030	6100	7930	9910
Output Rating	Rated Output Current (A)	35	50	70	100	140	200	260	330	400	520	650
	Rated Output Voltage (V)	Three-phase, 10000 V, 10500 V, or 11000 V (sine wave, proportional to input voltage)										
Power Supply	Main Circuit	Three-phase, 10000 V, 10500 V or 11000 V (50/60 Hz ± 5%) -20% to +10% <2>										
	Control Circuit	Single-phase, 200/220 V -10% to +10% 50/60 Hz ± 5%, 15 kVA <3>										

<1> Under development
<2> Output not guaranteed at -10% and lower
<3> CE-marking-conforming products are 230 V specifications.

A.2 Drive Specifications

Table A.6 Drive Specifications

Item		Specifications
Efficiency		Approx. 97% (At rated motor speed, 100% load)
Power Factor		Min. 0.95 (At motor rated speed, 100% load)
Cooling Method		Forced air-cooling by fan (with failure detection)
Control	Control Method	Open Loop Vector Control (OLV), Closed Loop Vector Control (CLV), V/f control (for multiple motor operation), Closed Loop Control for SM (optional)
	Main Circuit	Voltage-type PWM control with multiple outputs connected in series (Power Cell: 3-level output)
	Frequency Control Range	0.01 to 120 Hz
	Frequency Control Accuracy	±0.5%
	Analog Input Resolution	0.03 Hz
	Accel/Decel Time	0.1 to 6000 s
	Torque Accuracy <1>	±5% (OLV), ±3% (CLV)
	Overload Tolerance	Continuous rated current 100%, overload tolerance 110% for 1 minute and 120% for 15 seconds
	Momentary Power Loss Compensation Time <2>	Max. 2 seconds
	Main Control Functions	Torque control, Droop control, Speed/torque control switch, Momentary power loss compensation, Speed search, Overtorque detection, Torque limit, 17-step speed (max.), Accel/decel time switch, S-curve accel/decel, Auto-tuning (rotational, stationary), Dwell, Cooling fan on/ off, Slip compensation, Torque compensation, Frequency jump, Upper/lower limits for frequency reference, DC injection braking at start and stop, PID control (with sleep function), MEMOBUS communication (RS-485, max. 115.2 kbps), Fault retry
Protective Functions		Overcurrent, Overvoltage, Undervoltage, Output ground fault, Output open-phase, Overload, Cooling-fan error, Transformer overheat, Motor overheat, etc.
PLC Functions (Optional)		Expansion PLC board
Maintenance Tools		USB: DriveWizard Plus MV
Communications (Optional) <3>		• RS-485: MEMOBUS (Modbus) • One of the following hardware; PROFIBUS-DP, DeviceNet, Ethernet, or CP-215 can be installed.
Input Transformer		Class H dry type, -5%/N/+5% tap, secondary multi-phase winding
Temperature Protection		Power Cells: protected by thermistor for temperature Transformer: protected by temperature monitor (PT100 Ω) and thermo switches
Maintainability/ Environmental	Control Panel	Status display, Fault display, Parameter setting, Parameter reference
	Main Circuit	Power Cell construction
	Protection Design	IP40 (simplified dustproof type)
	Ambient Temperature, Relative Humidity	-5°C to +40°C with derating, 85% RH maximum (no condensation)
	Storage Temperature	-20°C to +60°C (for very short term when handling) <4>
	Atmosphere	General environmental conditions, free from dust and corrosive gases Altitude: 0 to 2000 m
Panel Specifications	Painting	Munsel 5Y7/1 semi gloss for inner and outer faces
	Form	Made of enclosing steel sheets, vertical standalone type, front maintenance type
Applicable Standards		JIS, JEM, JEC <5>

<1> Adjustments (e.g., to parameters) are required after auto-tuning.
<2> When using the momentary power loss compensation function, an uninterruptible power supply unit option is required for the control power supply.
<3> An option card and additional wiring are required to use the communications function. For CP-215 communication, an optional expansion PLC board is required.
<4> Refer to *Long Term Storage of Drives on page 71* for details on the long term storage of the drives.
<5> Refer to *European Standards on page 220* for details on compliance with CE standards.

Appendix: B

Standards Compliance

This appendix explains the guidelines and criteria for maintaining CE standards.

B.1 EUROPEAN STANDARDS. 220

B.1 European Standards



Figure B.1 CE Mark

The CE mark indicates compliance with European safety and environmental regulations. It is required for engaging in business and commerce in Europe.
European standards include the EMC guidelines for controlling noise.

This drive displays the CE mark based on the EMC guidelines.

- **EMC Requirements**: IEC/EN 61800-3:2004
- **General Requirements**: IEC/EN 61800-4:2003
- **Safety Requirements**: IEC/EN 61800-5-1:2003

Devices used in combination with this drive must also be CE certified and display the CE mark. When using drives displaying the CE mark in combination with other devices, it is ultimately the responsibility of the user to ensure compliance with CE standards. After setting up the device, verify that conditions meet European standards.

◆ European Standards Compliance

This drive has been tested according to European standards: IEC/EN 61800-3, IEC/EN 61800-4, and IEC/EN 61800-5-1.

To comply with the European standards, be sure to meet the following conditions when combining this drive with other devices:

■ Area of Use

Do not use drives in areas with pollution higher than severity 2 and overvoltage category 3 in accordance with IEC/EN 664.

The parts used in the drive's cooling fan have an IP20AH protection level (Other parts of the drive have an IP40 protection level.). Install the panel in a closed electrical room. Handling of this drive must be done by authorized personnel only.

The drive's noise level is more than 70 dB, so measures must be taken to prevent problems resulting from noise.
This drive is intended for use to following area.

Second Environment

Environment that includes all establishments other than those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.

Note: Industrial areas, technical areas of any building fed from a dedicated transformer are examples of second environment locations.

PDS of Category C4

PDS of rated voltage equal to or above 1000 V, or rated current equal to or above 400 A, or intended for use in complex systems in the second environment

■ Installation of Medium-Voltage Circuit Breakers

A medium-voltage circuit breaker should be installed on the primary side of the drive to protect the drive's wiring and prevent other secondary damage. The maximum inrush current of the drive's transformer is approximately 15 times larger than the current rating. Select a suitable circuit breaker. For details about the inrush current's characteristics, contact your Yaskawa representative or the nearest Yaskawa sales office.

■ Short-Circuit Current

When a short circuit occurs on the output side of the drive, a current will flow that can be a maximum of 20 times greater than the current rating. To prevent cable damage, select cables for the main circuit that meet this specification. For details, refer to *Main Circuit Wiring on page 90*.

■ Grounding

Grounding terminals that are indicated as EA and ED in this manual are equivalent to those indicated as PE and PE (ED) in European standards. When connecting the grounding terminals, observe the precautions and follow the procedures outlined in this manual to ensure safety.

To comply with EMC guidelines, be sure that the PE and PE (ED) grounding terminals are separately connected.

■ Connection of the Limit Switch

To ensure safety, door limit switches are provided in the panel. Door limit switches that detect opening of the panel door are provided in the drive as a measure to ensure safety. Be sure to correctly connect cables for this circuit. After connecting the cables, confirm that primary switch gear will be tripped when the doors are open.

■ Dimensions

Dimensions and approximate masses of CE-marking-conforming products are shown below.

Table B.1 Drive Dimensions and Approximate Masses

Voltage Class (kV)	Model CIMR-MV2C	Dimensions (mm)						Approx. Mass (kg) <3>
		Dimension Drawing No.	Width	Depth	Height	Height	Height	
			W	D	H	H1	H2	
6	F5FA035 <1> <2>	*Figure B.2*	3100	1100	2550	2150	400	3600
	F5FA050 <1> <2>		3100	1100	2550	2150	400	4000
	F5FA070 <1> <2>		3100	1100	2550	2150	400	4300
	F5FA100 <1> <2>		3100	1100	2550	2150	400	4700
	F5FA140 <1> <2>		3100	1100	2550	2150	400	5000
	F5FA200 <1> <2>		4500	1300	2550	2150	400	7400
	F5FA260 <1> <2>		5500	1300	2550	2150	400	8800
	F5FA330 <1> <2>		6300	1600	2800	2400	400	10500
	F5FA400 <1> <2>		6300	1600	2800	2400	400	11300
	F5FA520 <1> <2>		7100	1600	2800	2400	400	13500
	F5FA650 <1> <2>		7300	1600	2800	2400	400	15200

<1> Side-by-side configurations comprising two or more drive panels
<2> Under development
<3> The dimensions and masses are subject to change.

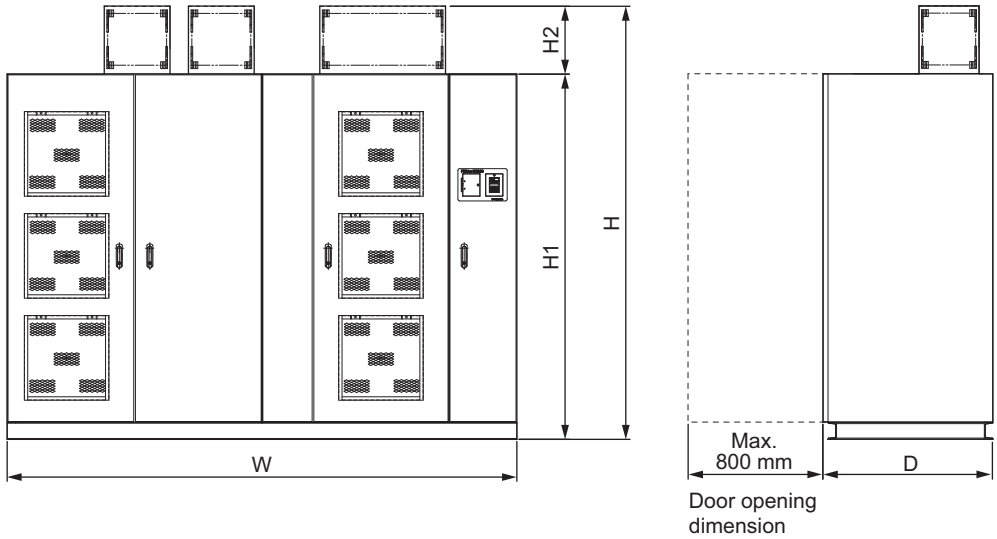


Figure B.2 Dimension Drawing (Class: 6 kV)

Appendix: C

MEMOBUS/Modbus Communications

C.1 MEMOBUS/MODBUS CONFIGURATION 224
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C.1 MEMOBUS/Modbus Configuration

Drives can be controlled from a PLC or other master device via serial communications using the MEMOBUS/Modbus protocol.

MEMOBUS/Modbus communications can be configured using one master and a maximum of 255 slaves. The drive has slave functionality only, meaning that serial communication is normally initiated from the master and responded to by the slaves.

The address or node for each slave must be set beforehand so that the master can communicate with the slave at that address. A slave that receives a command from the master will perform the specified function and then send a response back to the master.

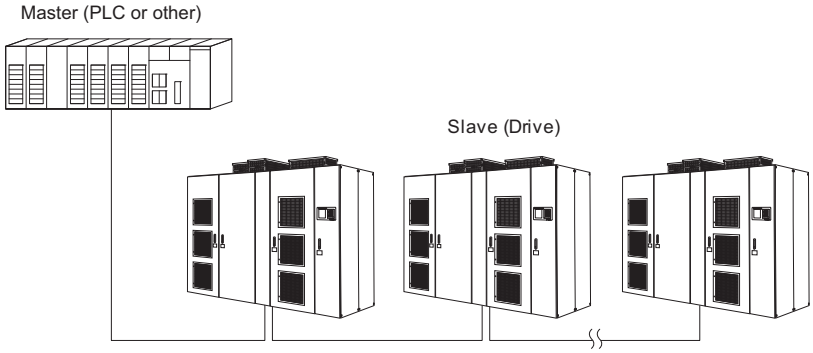


Figure C.1 Connecting Multiple Drives to a Master

C.2 Communication Specifications

MEMOBUS/Modbus specifications appear in *Table C.1*.

Table C.1 MEMOBUS/Modbus communications Specifications

Item	Specifications	
Interface	RS-485	
Communications Cycle	Asynchronous (Start-stop synchronization)	
Communication Parameters	Communication Speeds Available	1.2; 2.4; 4.8; 9.6; 19.2; 38.4; 57.6; 76.8; 115.2 kbps
	Data length	8 bit (fixed)
	Parity	Select even, odd, or none
	Stop bit	1 bit (fixed)
Protocol	MEMOBUS/Modbus (using RTU mode only)	
Max Number of Slaves	31 drives (RS-485)	

C.3 Connecting to a Network

This section explains how to connect the drive to a MEMOBUS/Modbus network and the network termination required.

◆ Network Cable Connection

Follow the instructions below to connect the drive to a master.

1. With the power shut off, connect the communications cable to the drive and the master. The MEMOBUS/Modbus cable requires an external terminal not provided.

Note: 1. Separate the communications cables from the main circuit cables and other wiring and power cables. Use shielded cables for the communications cables, and properly shielded clamps to prevent problems with noise. When using RS-485 communications, connect S+ to R+, and S- to R- as shown in the diagram below.
2. Refer to *Table 3.7* for detailed connection terminals.
3. Refer to *Table 3.5* for detailed wires.

2. Check or set the termination resistor selection at all slaves. Use the description in ***Network Termination on page 227*** for slaves that are drives.
3. Switch the power on.
4. Set the parameters needed for serial communications (H5-01 through H5-12) using the digital operator. Refer to the FSDrive-MV1000 Parameter Guide (TOEP C710687 03) for details.
5. Shut the power off and wait until the display on the digital operator goes out completely.
6. Turn the power back on.
7. The drive is now ready to begin communicating with the master.

◆ Wiring Diagram for Multiple Connection

Figure C.2 explains the wiring diagrams for multiple connections using the MEMOBUS/Modbus communications.

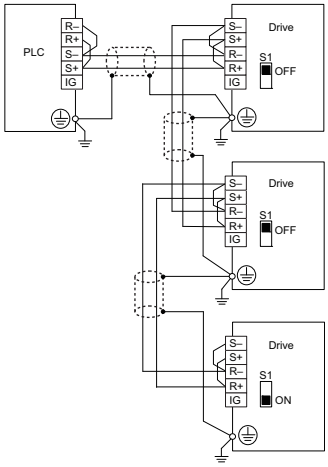


Figure C.2 RS-485 Interface

Note: 1. Turn on the DIP switch on the drive that is located at the end of the network. All other slave devices must have this DIP switch set to the OFF position.
2. Set H5-07 to “1” when using the RS-485 interface.

◆ Network Termination

The two ends of the MEMOBUS/Modbus network line have to be terminated. The drive has a built in termination resistor that can be enabled or disabled using DIP switch S1. If a drive is located at the end of a network line, enable the termination resistor by setting DIP switch S1 to the ON position. Disable the termination resistor on all slaves that are not located at the network line end.

Figure C.3 illustrates the setting of DIP switch S1.

To set the DIP switch on the terminal board, use an appropriate sized tool with a tip of approximately 8 mm in width.

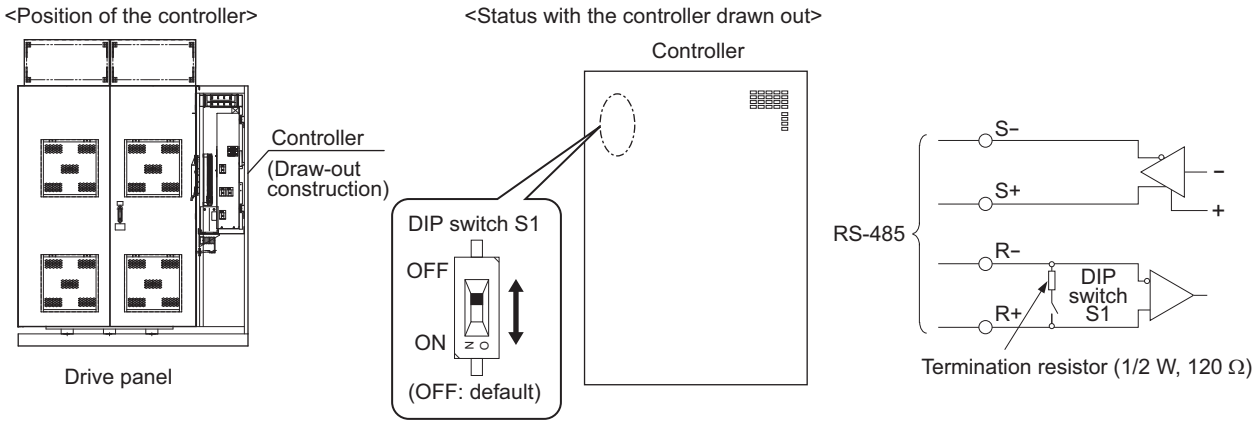


Figure C.3 Serial Communications Terminal and DIP Switch S1

C.4 MEMOBUS/Modbus Setup Parameters

◆ MEMOBUS/Modbus Serial Communication

This section describes parameters necessary to set up MEMOBUS/Modbus communications.

■ H5-01: Drive Node Address

Sets the drive node address used for MEMOBUS/Modbus communications.

Note: After changing this parameter, the control power must be cycled to enable the new setting.

No.	Name	Setting Range	Default
H5-01	Drive Node Address	0 to FF <1>	1F

<1> If the address is set to 0, no response will be provided during communications.

For serial communications to work, each individual slave drive must be assigned a unique slave address. Setting H5-01 to any value besides 0 assigns the drive its address in the network. Slave address don't need to be assigned in sequential order, but each address needs to be unique so that no two drives have the same address.

■ H5-02: Communication Speed Selection

Sets the MEMOBUS/Modbus communications speed.

Note: After changing this parameter, the control power must be cycled to enable the new setting.

No.	Name	Setting Range	Default
H5-02	Communication Speed Selection	0 to 5	3

H5-02	Communication Speed	H5-02	Communication Speed
0	1200 bps	5	38400 bps
1	2400 bps	6	57600 bps
2	4800 bps	7	76800 bps
3	9600 bps	8	115200 bps
4	19200 bps	–	–

■ H5-03: Communication Parity Selection

Sets the parity used for MEMOBUS/Modbus communications.

Note: After changing this parameter, the control power must be cycled to enable the new setting.

No.	Name	Setting Range	Default
H5-03	Communication Parity Selection	0 to 2	0

Setting 0: No parity
Setting 1: Even parity
Setting 2: Odd parity

■ H5-04: Stopping Method after Communication Error (CE)

Selects the stopping method after a communications error (CE) has occurred.

No.	Name	Setting Range	Default
H5-04	Stopping Method after Communication Error (CE)	0 to 3	3

Setting 0: Ramp to stop (uses the deceleration time currently enabled)
Setting 1: Coast to stop
Setting 2: Fast Stop
Setting 3: Alarm only (continue operation)

■ H5-05: Communication Fault Detection Selection

Enables or disabled the communication error (CE) detection for MEMOBUS/Modbus communications.

No.	Name	Setting Range	Default
H5-05	Communication Fault Detection Selection	0 or 1	1

Setting 0: Disabled

No communication error detection. The drive continues operation.

Setting 1: Enabled

If communication is lost for more than the time set in H5-09, then a CE fault will be triggered and the drive will operate as determined by parameter H5-04.

■ H5-06: Drive Transmit Wait Time

Sets the time the drive waits after receiving data from a master until responding data.

No.	Name	Setting Range	Default
H5-06	Drive Transmit Wait Time	5 to 65 ms	5 ms

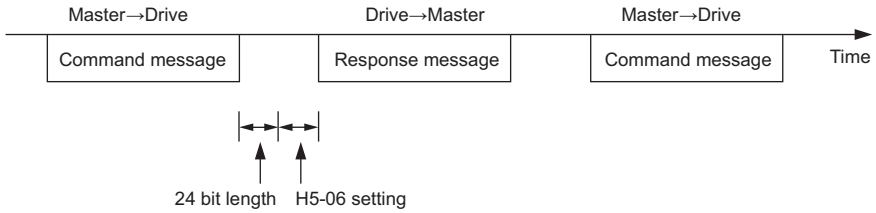


Figure C.4 Drive Transmit Wait Time Setting

■ H5-07: RTS Control Selection

Enables or disables RTS control.

No.	Name	Setting Range	Default
H5-07	RTS Control Selection	0 or 1	1

Setting 0: Disabled. RTS is always on.
Setting 1: Enabled. RTS switches while sending.

Use this setting when using RS-485 signals for communications.

■ H5-09: CE Detection Time

Sets the time the communications must be lost before the drive triggers a CE fault. Adjustment may be needed when networking several drives.

No.	Name	Setting Range	Default
H5-09	CE Detection Time	0.0 to 10.0 s	2.0 s

■ H5-11: Communications ENTER Function Selection

Selects if an Enter command is needed to change parameter values via MEMOBUS/Modbus communications. *Refer to Enter Command on page 252*.

No.	Name	Setting Range	Default
H5-11	Communications ENTER Function Selection	0 or 1	0

Setting 0: Enter command necessary

Parameter changes become effective after an Enter command. An Enter command must only be sent after the last parameter change, not for each single parameter.

Setting 1: Enter command not necessary

Parameter value changes become effective immediately without the need to send an Enter command.

■ H5-12: Run Command Method Selection

Selects the type of sequence used when the Run command source is set to MEMOBUS/Modbus communications (b1-02, b1-16 = 2).

No.	Name	Setting Range	Default
H5-12	Run Command Method Selection	0 or 1	0

Setting 0: FWD/Stop, REV/Stop

Setting bit 0 of MEMOBUS/Modbus register 0001H will start and stop the drive in the forward direction. Setting bit 1 will start and stop the drive in reverse.

Setting 1: Run/Stop, FWD/REV

Setting bit 0 of MEMOBUS/Modbus register 0001H will start and stop the drive. Setting bit 1 changes the direction.

C.5 Drive Operations by MEMOBUS/Modbus

The drive operations that can be performed by MEMOBUS/Modbus communications depend on drive parameter settings. This section explains the functions that can be used and related parameter settings.

◆ Observing the Drive Operation

A master can perform the following actions with MEMOBUS/Modbus communications at any time regardless of parameter settings (except H5-□□).

- Observe drive status and drive control terminal status from a master.
- Read and write parameters.
- Set and reset faults.
- Set multi-function inputs. Inputs settings from the input terminals and from MEMOBUS/Modbus communications are both linked by an OR operation.

◆ Controlling the Drive

To start and stop the drive or set the frequency reference using MEMOBUS/Modbus communications, an external reference must be selected and the parameters listed in *Table C.2* must be adjusted accordingly.

Table C.2 Setting Parameters for Drive Control from MEMOBUS/Modbus

Reference Source	Parameter	Name	Required Setting
External Reference 1	b1-01	Frequency Reference Selection 1	2
	b1-02	Run Command Selection 1	2
External Reference 2	b1-15	Frequency Reference Selection 2	2
	b1-16	Run Command Selection 2	2

Refer to b1-01: Frequency Reference Selection 1 and b1-02: Run Command Selection 1 in the FSDrive-MV1000 Parameter Guide (TOEP C710687 03) for details on external reference parameter selections. Refer to Setting 2: External reference 1/2 selection for H1 contact inputs in the FSDrive-MV1000 Parameter Guide (TOEP C710687 03) for instructions on how to select external reference 1 and 2.

C.6 Communications Timing

The master should wait a certain time between sending and receiving data.

◆ Command Messages from Master to Drive

In order to prevent data loss, the master must wait between receiving a response and sending the same type of command as before to the same slave drive. The minimum wait time depends on the command as shown in *Table C.3*.

Table C.3 Minimum Wait Time for Sending Messages

Command Type	Example	Minimum Wait Time
1	• Control command (Run, Stop) • Set inputs/outputs • Read monitors and parameter values	5 ms <1>
2	• Write parameters	H5-11 = 0: 50 ms H5-11 = 1: 200 ms <1>
3	• Save changes using an Enter command	200 ms to 2 s, depending on the number of parameters that were changed <1>
4	• Enter with storage to drive EEPROM after initialization	5 s

<1> If the drive receives command type 1 data during the minimum wait time, it will perform the command and then respond. However, if it receives a command type 2 or 3 during that time, either a communication error will result or the command will be ignored.

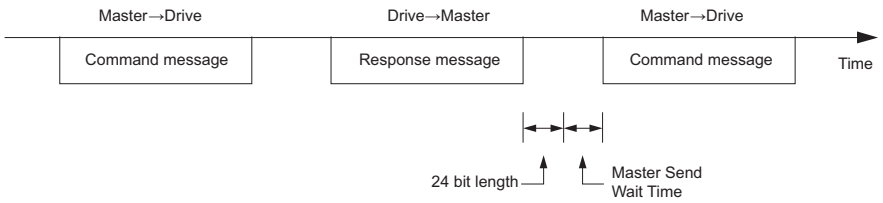


Figure C.5 Minimum Wait Time for Sending Messages

A timer should be set in the master to check how long it takes for the slave drive (s) to respond to the master. If no response is received within a certain amount of time, the master should try resending the message.

◆ Response Messages from Drive to Master

If the drive receives a command from the master, it will process the data received and wait for the time set in H5-06 until it responds. Increase H5-06 if the drive response causes data loss in the master.

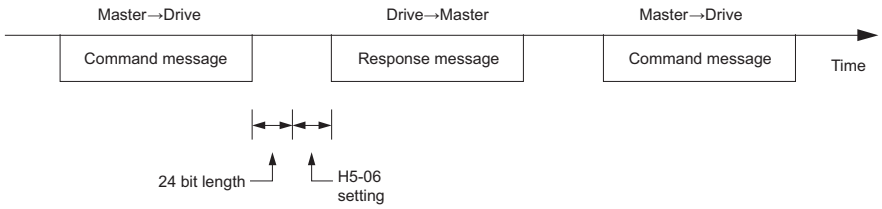
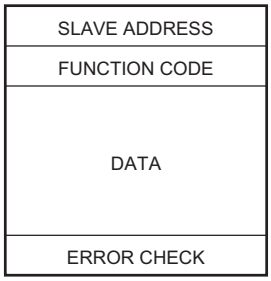


Figure C.6 Minimum Response Wait Time

C.7 Message Format

◆ Message Content

In MEMOBUS/Modbus communications, the master sends commands to the slave, and the slave responds. The message format is configured for both sending and receiving as shown below, and the length of data packets depends on the command (function) content.



◆ Slave Address

The slave address in the message defines the note the message is sent to. Use addresses between 0 and FF (hex). If a message with slave address 0 is sent (broadcast), the command from the master will be received by all slaves. The slaves do not provide a response to a broadcast type message.

◆ Function Code

The three types of function codes are shown in the table below.

Function Code	Function Name	Data Length (bytes)			
		Command Message		Response Message	
		Minimum	Maximum	Minimum	Maximum
03H	Read MEMOBUS/Modbus registers	8	8	7	37
08H	Loopback test	8	8	8	8
10H	Write to multiple MEMOBUS/Modbus registers	11	41	8	8

◆ Data

Configure consecutive data by combining the MEMOBUS/Modbus register address (test code in case of a loopback test) and the data the register contains. The data length changes depending on the command details.

A drive MEMOBUS/Modbus register always has a data length of two bytes. Therefore data written into drive registers must also always have a length of two bytes. Register data read out from the drive will always consist of two bytes.

◆ Error Check

The drive uses a CRC-16 (cyclic redundancy check, checksum method) for checking data validity. Use the procedure described below when calculating the CRC-16 checksum for command data or when verifying response data.

■ Command Data

When the drive receives data, it calculates the CRC-16 checksum from the data and compares it to the CRC-16 value received within the message. Both must match before a command is processed.

The starting value for CRC-16 calculations must be FFFFH (i.e., all 16 bits equal 1) in the MEMOBUS/Modbus communications.

Calculate the CRC-16 checksum using the following steps:

1. The starting value is FFFFH.
2. Perform an XOR operation of this value and the slave address.
3. Right shift the result.
4. When the overflow bit of the shift operation becomes 1, perform an XOR operation of the result from step 3 above and the fix value A001H.
5. Repeat steps 3 and 4 until eight shift operations have been performed.
6. After eight shift operations, perform an XOR operation with the result and the next data in the message (function code, register address, data). Continue with steps 3 to 5 until the last data has been processed.
7. The result of the last shift or XOR operation is the checksum.

The example in *Table C.4* shows the CRC-16 calculation of the slave address 02H and the function code 03H, yielding the result D140H.

Note: This example does not show the calculation for a complete MEMOBUS/Modbus command. Normally data would follow in the calculation.

Table C.4 CRC-16 Checksum Calculation Example

Description	Calculation	Overflow	Description	Calculation	Overflow
Initial Value (FFFFH)	1111 1111 1111 1111		Function Code 03H	0000 0000 0000 0011	
Address 02H	0000 0000 0000 0010		XOR w result	1000 0001 0011 1101	
XOR w initial value	1111 1111 1111 1101		Shift 1	0100 0000 1001 1110	1
Shift 1	0111 1111 1111 1110	1	XOR w A001H	1010 0000 0000 0001	
XOR w A001H	1010 0000 0000 0001		XOR result	1110 0000 1001 1111	
XOR result	1101 1111 1111 1111		Shift 2	0111 0000 0100 1111	1
Shift 2	0110 1111 1111 1111	1	XOR w A001H	1010 0000 0000 0001	
XOR w A001H	1010 0000 0000 0001		XOR result	1101 0000 0100 1110	
XOR result	1100 1111 1111 1110		Shift 3	0110 1000 0010 0111	0
Shift 3	0110 0111 1111 1111	0	Shift 4	0011 0100 0001 0011	1
Shift 4	0011 0011 1111 1111	1	XOR w A001H	1010 0000 0000 0001	
XOR w A001H	1010 0000 0000 0001		XOR result	1001 0100 0001 0010	
XOR result	1001 0011 1111 1110		Shift 5	0100 1010 0000 1001	0
Shift 5	0100 1001 1111 1111	0	Shift 6	0010 0101 0000 0100	1
Shift 6	0010 0100 1111 1111	1	XOR w A001H	1010 0000 0000 0001	
XOR w A001H	1010 0000 0000 0001		XOR result	1000 0101 0000 0101	
XOR result	1000 0100 1111 1110		Shift 7	0100 0010 1000 0010	1
Shift 7	0100 0010 0111 1111	0	XOR w A001H	1010 0000 0000 0001	
Shift 8	0010 0001 0011 1111	1	XOR result	1110 0010 1000 0011	
XOR w A001H	1010 0000 0000 0001		Shift 8	0111 0001 0100 0001	1
XOR result	1000 0001 0011 1110		XOR w A001H	1010 0000 0000 0001	
Perform operations with next data (function code)			XOR result	1101 0001 0100 0000	
			CRC-16	1101 0001 0100 0000	
				D 1 4 0 (upper) (lower)	
			Continue from here with next data.		

■ Response Data

To be sure that the data is valid, perform a CRC-16 calculation on the response message data as described above. Compare the result to the CRC-16 checksum that was received within the response message. Both should match.

C.8 Message Examples

Below are some examples of command and response messages.

◆ Reading Drive MEMOBUS/Modbus Register Contents

Using the function code 03H (Read), a maximum of 16 MEMOBUS/Modbus registers can be read out at a time.

The following table shows message examples when reading status signals, error details, data link status, and frequency references from the slave 2 drive.

Command Message			Response Message (normal)			Response Message (fault)		
Slave Address		02H	Slave Address		02H	Slave Address		02H
Function Code		03H	Function Code		03H	Function Code		83H
Starting No.	Upper	00H	Data Quantity		08H	Error Code		03H
	Lower	20H	1st storage register	Upper	00H	CRC-16	Upper	F1H
Data Quantity	Upper	00H		Lower	65H		Lower	31H
	Lower	04H	Next storage register	Upper	00H			
CRC-16	Upper	45H		Lower	00H			
	Lower	F0H	Next storage register	Upper	00H			
				Lower	00H			
			Next storage register	Upper	01H			
				Lower	F4H			
			CRC-16	Upper	AFH			
				Lower	82H			

◆ Loopback Test

Function code 08H performs a loopback test. This test returns a response message with exactly the same content as the command message and can be used to check communications between the master and slave. User-defined test code and data values can be set.

The following table shows a message example when performing a loopback test with the slave 1 drive.

Command Message			Response Message (normal)			Response Message (fault)		
Slave Address		01H	Slave Address		01H	Slave Address		01H
Function Code		08H	Function Code		08H	Function Code		88H
Test Code	Upper	00H	Test Code	Upper	00H	Error Code		01H
	Lower	00H		Lower	00H	CRC-16	Upper	86H
Data	Upper	A5H	Data	Upper	A5H		Lower	50H
	Lower	37H		Lower	37H			
CRC-16	Upper	DAH	CRC-16	Upper	DAH			
	Lower	8DH		Lower	8DH			

◆ Writing to Multiple Registers

Function code 10h allows the user to write multiple drive MEMOBUS/Modbus registers with one message. This process works similar to reading registers, i.e., the address of the first register that is to be written and the data quantity must be set in the command message. The data to be written must be consecutive so that the register addresses are in order, starting from the specified address in the command message. The data order must be high byte, then lower byte.

The following table shows an example of a message where a forward operation has been set with a frequency reference of 60.0 Hz for the slave 1 drive.

If parameter values are changed using the Write command, depending on the setting of H5-11, an Enter command will be necessary to activate the data or save them. *Refer to H5-11: Communications ENTER Function Selection on page 230* and *Refer to Enter Command on page 252* for detailed descriptions.

Command Message			Response Message (normal)			Response Message (fault)		
Slave Address		01H	Slave Address		01H	Slave Address		01H
Function Code		10H	Function Code		10H	Function Code		90H
Starting No.	Upper	00H	Starting No.	Upper	00H	Error Code		02H
	Lower	01H		Lower	01H	CRC-16	Upper	CDH
Data Quantity	Upper	00H	Data Quantity	Upper	00H		Lower	C1H
	Lower	02H		Lower	02H			
Number of Bytes		04H	CRC-16	Upper	10H			
Starting Data	Upper	00H		Lower	08H			
	Lower	01H						
Next Data	Upper	02H						
	Lower	58H						
CRC-16	Upper	63H						
	Lower	39H						

Note: For the number of bytes in the command message, take double the number of the data quantity.

C.9 MEMOBUS/Modbus Data Table

Table below lists all MEMOBUS/Modbus data. There are three types of data: command data, monitor data, and broadcast data.

◆ Command Data

It is possible to both read and write command data.

Note: Bits that are not used should be set to 0. Refrain from writing to reserved registers.

Register No.	Contents	
0000H	Reserved	
0001H	Operation Commands and Multi-function Inputs	
	bit 0	H5-12 = 0: Forward Run Command (0 = Stop, 1 = Forward Run) H5-12 = 1: Run Command (0 = Stop, 1 = Run)
	bit 1	H5-12 = 0: Reverse Run Command (0 = Stop, 1 = Reverse Run) H5-12 = 1: Forward/Reverse (0 = Forward, 1 = Reverse)
	bit 2	External Fault (EF0)
	bit 3	Fault Reset
	bit 4	Multi-Function Input 1
	bit 5	Multi-Function Input 2
	bit 6	Multi-Function Input 3
	bit 7	Multi-Function Input 4
	bit 8	Multi-Function Input 5
	bit 9	Multi-Function Input 6
	bit A	Multi-Function Input 7
	bit B	Multi-Function Input 8
	bit C	Multi-Function Input 9
	bit D	Multi-Function Input 10
	bit E	Multi-Function Input 11
	bit F	Multi-Function Input 12
0002H	Frequency Reference	Units are determined by parameter o1-03, unsigned.
0003H	Output voltage gain	Unit: 0.1% Range: 20 (2.0%) to 2000 (200.0%), Default when power on: 1000 (100.0%)
0004H	Torque Reference/Torque Limit, 0.1% units, signed (Usable only if Torque Control is enabled)	
0005H	Torque Compensation, 0.1% units, signed (Usable only if Torque Control is enabled)	
0006H	PID Target, 0.01% units, signed	
0007H	Multi-Function Analog Output Terminal 1 Setting (10 V / 4000 H)	
0008H	Multi-Function Analog Output Terminal 2 Setting (10 V / 4000 H)	
0009H	Settings for Multi-Function Contact Outputs	
	bit 0	Multi-Function Contact Output 1
	bit 1	Multi-Function Contact Output 2
	bit 2	Multi-Function Contact Output 3
	bit 3	Multi-Function Contact Output 4
	bit 4	Multi-Function Contact Output 5
	bit 5	Multi-Function Contact Output 6
	bit 6	Multi-Function Contact Output 7
	bit 7	Multi-Function Contact Output 8
	bit 8	Multi-Function Contact Output 9
	bit 9	Multi-Function Contact Output 10
	bit A	Multi-Function Contact Output 11
	bit B	Multi-Function Contact Output 12
	bit C	Multi-Function Contact Output 13
	bit D	Multi-Function Contact Output 14
	bit E	Multi-Function Contact Output 15
	bit F	Multi-Function Contact Output 16
000AH	Reserved	

Register No.	Contents	
000BH	bit 0	Multi-Function Input 13
	bit 1	Multi-Function Input 14
	bit 2	Multi-Function Input 15
	bit 3	Multi-Function Input 16
	bit 4 to D	Reserved
	bit E	ComRef
	bit F	ComCtrl
000CH to 000EH	Reserved	
000FH	Control Selection Setting	
	bit 0	Reserved
	bit 1	PID Setpoint Input (enables the setting from MEMOBUS/Modbus)
	bit 2	Torque reference / torque limit input (enables the setting from MEMOBUS/Modbus)
	bit 3	Torque compensation input (enables the setting from MEMOBUS/Modbus)
	bit 4 to B	Reserved
	bit C	Enable Terminal Input 5 for Broadcast Data
	bit D	Enable Terminal Input 6 for Broadcast Data
	bit E	Enable Terminal Input 7 for Broadcast Data
	bit F	Enable Terminal Input 8 for Broadcast Data
0010H to 001AH	Reserved	
001BH	Analog Monitor Option AO-A3 Analog Output 1 (10 V/4000 H)	
001CH	Analog Monitor Option AO-A3 Analog Output 2 (10 V/4000 H)	
001DH	Digital Output Option DO-A3 Output (Binary)	
001EH to 001FH	Reserved	

◆ Monitor Data

Monitor data can be read only.

Register No.	Contents	
0020H	Drive Status 1	
	bit 0	During Run
	bit 1	During Reverse
	bit 2	Drive Ready
	bit 3	Fault
	bit 4	Data Setting Error
	bit 5	Multi-Function Contact Output 1
	bit 6	Multi-Function Contact Output 2
	bit 7	Multi-Function Contact Output 3
	bit 8	Multi-Function Contact Output 4
	bit 9	Multi-Function Contact Output 5
	bit A to D	Reserved
	bit E	ComRef status
	bit F	ComCtrl status
0021H	Fault Contents 1	
	bit 0	Overcurrent (CFA OC), Ground Fault (GF), IGBT Fault (CFA IGBT_FLT)
	bit 1	Overvoltage 1 (CFA OV)
	bit 2	Drive Overload (oL2)
	bit 3	IGBT Overheating 1 (CFA OH1), Drive Overheat Warning (oH2)
	bit 4, 5	Reserved
	bit 6	PID Feedback Loss (FbL), Excessive PID Feedback (FbH)
	bit 7	External Fault (EF0 to EF16)
	bit 8	CPF□□: Hardware Fault (includes oF□)
	bit 9	Motor Overload (oL1), Overtorque 1/2 (oL3/oL4), Undertorque Detection 1/2 (UL3/UL4)
	bit A	PG Disconnect (PGo), PG Hardware Fault (PGoH), Overspeed (oS), Speed Deviation (dEv)
	bit B	During Main Circuit Undervoltage (Uv) detection
	bit C	Undervoltage (Uv1)
	bit D	Output Phase Loss (LF)
	bit E	MEMOBUS/Modbus Communication Error (CE), Option Communication Error (bUS)
	bit F	External Digital Operator Connection Fault (oPr)
0022H	Data Link Status	
	bit 0	Writing data or switching motors
	bit 1, 2	Reserved
	bit 3	Upper or lower limit error
	bit 4	Data conformity error
	bit 5	Writing to EEPROM
	bit 6 to F	Reserved
0023H	Frequency Reference <1>	
0024H	Output Frequency <1>	
0025H	Output Voltage Reference, 1 V units	
0026H	Output Current	
0027H	Output Power	
0028H	Torque Reference	
0029H	Fault Contents 2	
	bit 0	IGBT Fault (CFA IGBT_FLT)
	bit 1	Ground Fault (GF)
	bit 2	Reserved
	bit 3	Output Phase Loss (LF)
	bit 4 to F	Reserved

Register No.	Contents	
002AH	Alarm Contents1	
	bit 0, 1	Reserved
	bit 2	Forward/Reverse Run Command Input Error (EF)
	bit 3	Drive Baseblock (bb)
	bit 4	Overtorque Detection 1 (oL3)
	bit 5	IGBT Overheating (oH)
	bit 6	Overvoltage (ov)
	bit 7	Undervoltage (Uv)
	bit 8	Fan Fault (FAn)
	bit 9	MEMOBUS/Modbus Communication Error (CE)
	bit A	Option Communication Error (bUS)
	bit B	Undertorque Detection 1/2 (UL3/UL4)
	bit C	Reserved
	bit D	PID Feedback Loss (FbL), Excessive PID Feedback (FbH)
	bit E	Reserved
	bit F	Serial Communication Transmission Error (CALL)
002BH	Input Terminal Status 1	
	bit 0	Contact Input 1 Closed
	bit 1	Contact Input 2 Closed
	bit 2	Contact Input 3 Closed
	bit 3	Contact Input 4 Closed
	bit 4	Contact Input 5 Closed
	bit 5	Contact Input 6 Closed
	bit 6	Contact Input 7 Closed
	bit 7	Contact Input 8 Closed
	bit 8	Contact Input 9 Closed
	bit 9	Contact Input 10 Closed
	bit A	Contact Input 11 Closed
	bit B	Contact Input 12 Closed
	bit C to F	Reserved
002CH	Drive Status 2	
	bit 0	During Run
	bit 1	Zero Speed
	bit 2	Speed Agree
	bit 3	User Speed Agree
	bit 4	Frequency Detection 1
	bit 5	Frequency Detection 2
	bit 6	Drive Ready
	bit 7	During Undervoltage
	bit 8	During Baseblock
	bit 9	Frequency Reference from Operator Keypad
	bit A	Run Command from Operator Keypad
	bit B	Over/Undertorque 1, 2
	bit C	Frequency Reference Loss
	bit D	During Fault Restart
	bit E	Fault
	bit F	Communication Timeout

Register No.	Contents	
002DH	Output Terminal Status 1	
	bit 0	Multi-Function Contact Output 1
	bit 1	Multi-Function Contact Output 2
	bit 2	Multi-Function Contact Output 3
	bit 3	Multi-Function Contact Output 4
	bit 4	Multi-Function Contact Output 5
	bit 5	Multi-Function Contact Output 6
	bit 6	Multi-Function Contact Output 7
	bit 7	Multi-Function Contact Output 8
	bit 8	Multi-Function Contact Output 9
	bit 9	Multi-Function Contact Output 10
	bit A	Multi-Function Contact Output 11
	bit B	Multi-Function Contact Output 12
	bit C	Multi-Function Contact Output 13
	bit D	Multi-Function Contact Output 14
	bit E	Multi-Function Contact Output 15
	bit F	Multi-Function Contact Output 16
002EH	Reserved	
002FH	Frequency Reference Bias (from Up/Down 2 Function), 0.1% units	
0030H	Reserved	
0031H	DC Bus Voltage, 1 Vdc units	
0032H	Torque Reference (U1-09), 0.1% units	
0033H	Reserved	
0034H	Product Code 1 [ASCII], Product Type	
0035H	Product Code 2 [ASCII], Region Code	
0036H, 0037H	Reserved	
0038H	PID Feedback, 0.1% units, unsigned, 100% / max. output frequency	
0039H	PID Input, 0.1% units, signed, 100% / max. output frequency	
003AH	PID Output, 0.1% units, signed, 100% / max. output frequency	
003BH, 003CH	Reserved	
003DH	Communications Error Contents <2>	
	bit 0	CRC Error
	bit 1	Data Length Error
	bit 2	Reserved
	bit 3	Parity Error
	bit 4	Overrun Error
	bit 5	Framing Error
	bit 6	Timeout
	bit 7 to F	Reserved
003EH	Output Frequency	r/min units <3>
003FH		0.01% units
0040H to 004AH	Used for various monitors U1-□□. Refer to U: Monitors in the FSDrive-MV1000 Parameter Guide (TOEP C710687 03) for parameter details.	
004BH	Drive Status (U1-12)	
	bit 0	During Run
	bit 1	During Zero Speed
	bit 2	During Reverse Run
	bit 3	During Fault Reset Signal Input
	bit 4	During Speed Agree
	bit 5	Drive Ready
	bit 6	During Alarm Detection
	bit 7	During Fault Detection
	bit 8	During Operation Error (oPE□□)
	bit 9	During Momentary Power Loss
	bit A	Motor 2 selected
	bit B	Reserved
	bit E	ComRef status, NetRef status
	bit F	ComCtrl status, NetCtrl status

Register No.	Contents	
004CH to 007EH	Used for various monitors U1-☐☐, U4-☐☐, U5-☐☐ and U6-☐☐. Refer to U2: Fault Trace and U3: Fault History in the FSDrive-MV1000 Parameter Guide (TOEP C710687 03) for parameter details.	
007FH	Alarm Code, *Refer to Alarm Register Contents on page 251* for alarm codes.	
0080H to 0097H	Used for monitors U2-☐☐, U3-☐☐. Refer to U: Monitors in the FSDrive-MV1000 Parameter Guide (TOEP C710687 03) for parameter details and *Refer to Fault Trace Contents on page 249* for register value descriptions.	
0098H	High Word of Accumulated Operation Time Monitor, 10H units (U4-01)	
0099H	Low Word of Accumulated Operation Time Monitor, 1H units (U4-01)	
009AH to 00AAH	Reserved	
00ABH	Drive Rated Current	
00ACH	Motor Speed (U1-05)	r/min units <3>
00ADH		0.01% units
00AEH, 00AFH	Reserved	
00B0H	Option Code Connected to CN5-A	Register contains ASCII code of the option card. DI-A3 = 0001H DO-A3 = 0002H AI-A3 = 0003H AO-A3 = 0004H PG-B3 = 0011H PG-X3 = 0012H Communication Option: Register contains ASCII code of 1st and 3rd digit of the option card type number. Example: Register value is 5350H for “SP” if a SI-P3 option card is installed.
00B1H	Reserved	
00B2H	Option Code Connected to CN5-B	
00B3H	Option Code Connected to CN5-C	
00B4H	Reserved	
00B5H	Output Frequency after Soft Starter (U1-16)	r/min units <3>
00B6H		0.01% units
00B7H	Frequency Reference	r/min units <3>
00B8H		0.01% units
00B9H to 00BEH	Reserved	
00BFH	Lists the last to digits of operation error code oPE☐☐.	
00C0H	Fault Contents 3	
	bit 0	Fuse Blowout (CFA FU)
	bit 1	Undervoltage (Uv1)
	bit 2	Undervoltage (CFA CUV)
	bit 3	In-rush Prevention Circuit Error (Uv3)
	bit 4	IGBT Fault (CFA IGBT_FLT)
	bit 5	Ground Fault (GF)
	bit 6	Overcurrent (CFA OC)
	bit 7	Overvoltage 1 (CFA OV)
	bit 8	IGBT Overheating (CFA OH)
	bit 9	IGBT Overheating 1 (CFA OH1)
	bit A	Motor Overload (oL1)
	bit B	Drive Overload (oL2)
	bit C	Overtorque Detection 1 (oL3)
	bit D	Overtorque Detection 2 (oL4)
	bit E, F	Reserved

Register No.	Contents	
00C1H	Fault Contents 4	
	bit 0	External Fault at contact input terminal 3 (EF3)
	bit 1	External Fault at contact input terminal 4 (EF4)
	bit 2	External Fault at contact input terminal 5 (EF5)
	bit 3	External Fault at contact input terminal 6 (EF6)
	bit 4	External Fault at contact input terminal 7 (EF7)
	bit 5	External Fault at contact input terminal 8 (EF8)
	bit 6	Fan Fault (FAn)
	bit 7	Overspeed (oS)
	bit 8	Speed Deviation (dEv)
	bit 9	PG Disconnect (PGo)
	bit A	Reserved
	bit B	Output Phase Loss (LF)
	bit C	Reserved
	bit D	External Digital Operator Connection Fault (oPr)
	bit E	EEPROM Write Error (Err)
	bit F	Reserved
00C2H	Fault Contents 5	
	bit 0	MEMOBUS/Modbus Communication Error (CE)
	bit 1	Option Communication Error (bUS)
	bit 2, 3	Reserved
	bit 4	Control Fault (CF)
	bit 5	Reserved
	bit 6	Option Card External Fault (EF0)
	bit 7	PID Feedback Loss (FbL)
	bit 8	Undertorque Detection 1 (UL3)
	bit 9	Undertorque Detection 2 (UL4)
	bit A	High Slip Braking oL (oL7)
	bit B	External Fault at contact input terminal 9 (EF9)
	bit C	External Fault at contact input terminal 10 (EF10)
	bit D	External Fault at contact input terminal 11 (EF11)
	bit E	External Fault at contact input terminal 12 (EF12)
	bit F	Hardware Fault (includes oF□)
00C3H	Fault Contents 6	
	bit 0	Main Circuit Capacitor Neutral Point Potential Error (CFA VCF OV)
	bit 1 to 6	Reserved
	bit 7	PG Hardware Fault (PGoH)
	bit 8, 9	Reserved
	bit A	Too Many Speed Search Restarts (SEr)
	bit B to F	Reserved
00C4H	Fault Contents 7	
	bit 0	PID Feedback Loss (FbH)
	bit 1	External Fault at contact input terminal 1 (EF1)
	bit 2	External Fault at contact input terminal 2 (EF2)
	bit 3	Mechanical Weakening Detection 1 (oL5)
	bit 4	Mechanical Weakening Detection 2 (UL5)
	bit 5	Current Offset Fault (CFA COF)
	bit 6 to F	Reserved

Register No.	Contents	
00C5H	Fault Contents 8	
	bit 0	Reserved
	bit 1	Node Setup Fault (nSE)
	bit 2	Reserved
	bit 3	Transformer Temperature Fault (TME)
	bit 4	Transformer Temperature Fault 1 (TME1)
	bit 5	Transformer Temperature DI Fault (TME2)
	bit 6	Output Overvoltage (OOV)
	bit 7	Voltage Unbalance (VUB)
	bit 8	Overvoltage 2 (CFA OV2)
	bit 9	Commercial Synchronous Switching Error (SYNC)
	bit A	Door Open (dO)
	bit B	Reserved
	bit C	CCB-MB Communication Error (Link Fault) (LIN)
	bit D to F	Reserved
00C6H	Fault Contents 9	
	bit 0 to 2	Reserved
	bit 3	Transformer Temperature Sensor Disconnection (TME3)
	bit 4	Reserved
	bit 5	Power Supply Undervoltage (IUV)
	bit 6	Input Overvoltage (IOV)
	bit 7	Optional Power Supply Error (24V)
	bit 8 to B	Reserved
	bit C	External Fault at contact input terminal 13 (EF13)
	bit D	External Fault at contact input terminal 14 (EF14)
	bit E	External Fault at contact input terminal 15 (EF15)
	bit F	External Fault at contact input terminal 16 (EF16)
00C7H	Reserved	
00C8H	Alarm Contents 2	
	bit 0	Undervoltage (Uv)
	bit 1	Overvoltage (ov)
	bit 2	IGBT Overheating (oH)
	bit 3	Drive Overheat Warning (oH2)
	bit 4	Overtorque 1 (oL3)
	bit 5	Overtorque 2 (oL4)
	bit 6	Forward/Reverse Run Commands Input Error (EF)
	bit 7	Drive Baseblock (bb)
	bit 8	External Fault at contact input terminal 3 (EF3)
	bit 9	External Fault at contact input terminal 4 (EF4)
	bit A	External Fault at contact input terminal 5 (EF5)
	bit B	External Fault at contact input terminal 6 (EF6)
	bit C	External Fault at contact input terminal 7 (EF7)
	bit D	External Fault at contact input terminal 8 (EF8)
	bit E	Fan Fault (FAn)
	bit F	Overspeed (oS)

Register No.	Contents	
00C9H	Alarm Contents 3	
	bit 0	Speed Deviation (dEv)
	bit 1	PG Disconnect (PGo)
	bit 2	Reserved
	bit 3	MEMOBUS/Modbus Communication Error (CE)
	bit 4	Option Communication Error (bUS)
	bit 5	Serial Communication Transmission Error (CALL)
	bit 6	Motor Overload (oL1)
	bit 7, 8	Reserved
	bit 9	Option Card External Fault (EF0)
	bit A	Motor Switch during Run (rUn)
	bit B	Reserved
	bit C	Serial Communication Transmission Error (CALL)
	bit D	Undertorque Detection 1 (UL3)
	bit E	Undertorque Detection 2 (UL4)
	bit F	MEMOBUS/Modbus Test Mode Error (SE)
00CAH	Alarm Contents 4	
	bit 0, 1	Reserved
	bit 2	External Fault at contact input terminal 9 (EF9)
	bit 3	External Fault at contact input terminal 10 (EF10)
	bit 4	External Fault at contact input terminal 11 (EF11)
	bit 5	External Fault at contact input terminal 12 (EF12)
	bit 6	PID Feedback Loss (FbL)
	bit 7	Excessive PID Feedback (FbH)
	bit 8	Reserved
	bit 9	Drive Disabled (dnE)
	bit A	PG Hardware Fault (PGoH)
	bit B to F	Reserved
00CBH	Alarm Contents 5	
	bit 0 to 3	Reserved
	bit 4	Cooling Fan Maintenance Time (LT1)
	bit 5	Capacitor Maintenance Time (LT-2)
	bit 6, 7	Reserved
	bit 8	External Fault at contact input terminal 1 (EF1)
	bit 9	External Fault at contact input terminal 2 (EF2)
	bit A, B	Reserved
00CCH	Alarm Contents 6	
	bit 0 to 3	Reserved
	bit 4	IGBT Maintenance Time (90%) (TrPC)
	bit 5	Soft Charge Bypass Relay Maintenance Time (LT-3)
	bit 6	IGBT Maintenance Time (50%) (LT-4)
	bit 7 to F	Reserved
00CDH	Alarm Contents 7	
	bit 0 to 2	IGBT Maintenance Time (90%) (TrPC)
	bit 3	Input Overvoltage (IOV)
	bit 4 to F	Reserved
00CEH	Alarm Contents 8	
	bit 0 to 2	Reserved
	bit 3	Battery Voltage Low (BAT)
	bit 4 to 7	Reserved
	bit 8	Transformer Temperature Fault (TMA1)
	bit 9, A	Reserved
	bit B	Voltage Unbalance (VUB)
	bit C	External Fault at contact input terminal 13 (EF13)
	bit D	External Fault at contact input terminal 14 (EF14)
	bit E	External Fault at contact input terminal 15 (EF15)
	bit F	External Fault at contact input terminal 16 (EF16)
00CFH	Reserved	

Register No.	Contents	
00D0H	CPF Contents 1	
	bit 0, 1	Reserved
	bit 2	A/D Conversion Error (CPF02)
	bit 3 to 5	Reserved
	bit 6	EEPROM Memory Data Error (CPF06)
	bit 7 to F	Reserved
00D1H	CPF Contents 2	
	bit 0 to 3	Reserved
	bit 4	Hardware fault at power up (CPF20)
	bit 5	Hardware fault at communication start up (CPF21)
	bit 6	A/D Conversion Fault (CPF22)
	bit 7	PWM Feedback Fault (CPF23)
	bit 8, 9	Reserved
	bit A	ASIC BB Circuit Error (CPF26)
	bit B	ASIC PWM Setting Register Error (CPF27)
	bit C	ASIC PWM Pattern Error (CPF28)
	bit D	ASIC On-delay Error (CPF29)
	bit E	Reserved
	bit F	ASIC Code Error (CPF31)
00D2H	CPF Contents 3	
	bit 0	ASIC Start-up Error (CPF32)
	bit 1	Watch-dog Error (CPF33)
	bit 2	ASIC Power/Clock Error (CPF34)
	bit 3 to 7	Reserved
	bit 8	Control Circuit Error (CPF40)
	bit 9	Control Circuit Error (CPF41)
	bit A	Control Circuit Error (CPF42)
	bit B	Control Circuit Error (CPF43)
	bit C to F	Reserved
00D3H to 00D7H	Reserved	
00D8H	oFA0x Contents (CN5-A)	
	bit 0	Option Compatibility Error (oFA00)
	bit 1	Option not properly connected (oFA01)
	bit 2	Same type of option card already connected (oFA02)
	bit 3, 4	Reserved
	bit 5	A/D Conversion Error (oFA05)
	bit 6	Option Response Error (oFA06)
	bit 7 to F	Reserved
00D9H	oFA1x Contents (CN5-A)	
	bit 0	Option RAM Fault (oFA10)
	bit 1	Option Operation Mode Fault (SLMOD) (oFA11)
	bit 2	Drive Receive CRC Error (oFA12)
	bit 3	Drive Receive Frame Error (oFA13)
	bit 4	Drive Receive Abort Error (oFA14)
	bit 5	Option Receive CRC Error (oFA15)
	bit 6	Option Receive Frame Error (oFA16)
	bit 7	Option Receive Abort Error (oFA17)
	bit 8 to F	Reserved
00DAH	Reserved	

Register No.	Contents	
00DBH	oFA3x Contents (CN5-A)	
	bit 0	Comm. ID Error (oFA30)
	bit 1	Model Code Error (oFA31)
	bit 2	Sumcheck Error (oFA32)
	bit 3	Comm. option timeout waiting for response (oFA33)
	bit 4	MEMOBUS Timeout (oFA34)
	bit 5	Drive timeout waiting for response (oFA35)
	bit 6	CI Check Error (oFA36)
	bit 7	Drive timeout waiting for response (oFA37)
	bit 8	Control Command Selection Error (oFA38)
	bit 9	Drive timeout waiting for response (oFA39)
	bit A	Control Response Selection 1 Error (oFA40)
	bit B	Drive timeout waiting for response (oFA41)
	bit C	Control Response Selection 2 Error (oFA42)
	bit D	Control Response Selection Error (oFA43)
	bit E, F	Reserved
00DCH	oFb0x Contents (CN5-B)	
	bit 0	Option compatibility error (oFb00)
	bit 1	Option not properly connected (oFb01)
	bit 2	Same type of option card already connected (oFb02)
	bit 3, 4	Reserved
	bit 5	A/D Conversion Fault (oFb05)
	bit 6	Option Response Error (oFb06)
	bit 7 to F	Reserved
00DDH	oFb1x Contents (CN5-B)	
	bit 0	Option RAM Fault (oFb10)
	bit 1	Option Operation Mode Fault (SLMOD) (oFb11)
	bit 2	Drive Receive CRC Error (oFb12)
	bit 3	Drive Receive Frame Error (oFb13)
	bit 4	Drive Receive Abort Error (oFb14)
	bit 5	Option Receive CRC Error (oFb15)
	bit 6	Option Receive Frame Error (oFb16)
	bit 7	Option Receive Abort Error (oFb17)
	bit 8 to F	Reserved
00DEH	Reserved	
00DFH	oFb3x Contents (CN5-B)	
	bit 0	Comm. ID Error (oFb30)
	bit 1	Model Code Error (oFb31)
	bit 2	Sumcheck Error (oFb32)
	bit 3	Comm. option timeout waiting for response (oFb33)
	bit 4	MEMOBUS Timeout (oFb34)
	bit 5	Drive timeout waiting for response (oFb35)
	bit 6	CI Check Error (oFb36)
	bit 7	Drive timeout waiting for response (oFb37)
	bit 8	Control Command Selection Error (oFb38)
	bit 9	Drive timeout waiting for response (oFb39)
	bit A	Control Response Selection 1 Error (oFb40)
	bit B	Drive timeout waiting for response (oFb41)
	bit C	Control Response Selection 2 Error (oFb42)
	bit D	Control Response Selection Error (oFb43)
	bit E, F	Reserved

Register No.	Contents	
00E0H	oFC0x Contents (CN5-C)	
	bit 0	Option compatibility error (oFC00)
	bit 1	Option not properly connected (oFC01)
	bit 2	Same type of option card already connected (oFC02)
	bit 3, 4	Reserved
	bit 5	A/D Conversion Fault (oFC05)
	bit 6	Option Response Error (oFC06)
	bit 7 to F	Reserved
00E1H	oFC1x Contents (CN5-C)	
	bit 0	Option RAM Fault (oFC10)
	bit 1	Option Operation Mode Fault (SLMOD) (oFC11)
	bit 2	Drive Receive CRC Error (oFC12)
	bit 3	Drive Receive Frame Error (oFC13)
	bit 4	Drive Receive Abort Error (oFC14)
	bit 5	Option Receive CRC Error (oFC15)
	bit 6	Option Receive Frame Error (oFC16)
	bit 7	Option Receive Abort Error (oFC17)
	bit 8 to F	Reserved
00E2H	Reserved	
00E3H	oFC3x Contents (CN5-C)	
	bit 0	Comm. ID Error (oFC30)
	bit 1	Model Code Error (oFC31)
	bit 2	Sumcheck Error (oFC32)
	bit 3	Comm. option timeout waiting for response (oFC33)
	bit 4	MEMOBUS Timeout (oFC34)
	bit 5	Drive timeout waiting for response (oFC35)
	bit 6	CI Check Error (oFC36)
	bit 7	Drive timeout waiting for response (oFC37)
	bit 8	Control Command Selection Error (oFC38)
	bit 9	Drive timeout waiting for response (oFC39)
	bit A	Control Response Selection 1 Error (oFC40)
	bit B	Drive timeout waiting for response (oFC41)
	bit C	Control Response Selection 2 Error (oFC42)
	bit D	Control Response Selection Error (oFC43)
	bit E, F	Reserved
00E4H to 00FAH	Reserved	
00FBH	Output Current	
00FCH to 00FFH	Reserved	

<1> Units are determined by parameter o1-03.
<2> The contents of a communication error are saved until the fault is reset.
<3> Depending on the motor used, the correct motor pole number must be set to parameter E2-04 and E4-04.

◆ Broadcast Messages

Data can be written from the master to all slave devices at the same time.

The slave address in a broadcast command message must be set to 00H. All slaves will receive the message, but will not respond.

Register No.	Contents	
0001H	Digital Input Command	
	bit 0	Forward Run (0: Stop 1: Run)
	bit 1	Direction Command (0: Forward, 1: Reverse)
	bit 2, 3	Reserved
	bit 4	External Fault
	bit 5	Fault Reset
	bit 6 to B	Reserved
	bit C	Multi-Function Contact Input 5
	bit D	Multi-Function Contact Input 6
	bit E	Multi-Function Contact Input 7
	bit F	Multi-Function Contact Input 8
0002H	Frequency Reference	30000/100%

◆ Fault Trace Contents

The table below shows the fault codes that can be read out by MEMOBUS/Modbus commands from the U2-□□ and U3-□□ monitor parameters.

Table C.5 Fault Trace / History Register Contents

Fault Code	Fault Name	Fault Code	Fault Name
0001H	Fuse Blowout (CFA FU)	0098H	PWM Feedback Fault (CPF23)
0002H	Undervoltage (Uv1)	0099H	Drive Unit Signal Fault (CPF24)
0003H	Undervoltage (CFA CUV)	009BH	ASIC BB Circuit Error (CPF26)
0004H	In-rush Prevention Circuit Error (Uv3)	009CH	ASIC PWM Setting Register Error (CPF27)
0005H	IGBT Fault (CFA IGBT_FLT)	009DH	ASIC PWM Pattern Error (CPF28)
0006H	Ground Fault (GF)	009EH	ASIC On-Delay Error (CPF29)
0007H	Overcurrent (CFA OC)	00A0H	ASIC Code Error (CPF31)
0008H	Overvoltage 1 (CFA OV)	00A1H	ASIC Start-p Error (CPF32)
0009H	IGBT Overheating (CFA OH)	00A2H	Watch-dog Error (CPF33)
000AH	IGBT Overheating 1 (CFA OH1)	00A3H	ASIC Power/Clock Error (CPF34)
000BH	Motor Overload (oL1)	00A9H	Control Circuit Error (CPF40)
000CH	Drive Overload (oL2)	00AAH	Control Circuit Error (CPF41)
000DH	Overtorque Detection 1 (oL3)	00ABH	Control Circuit Error (CPF42)
000EH	Overtorque Detection 2 (oL4)	00ACH	Control Circuit Error (CPF43)
0011H	External Fault at contact input terminal 3 (EF3)	0101H	Option compatibility error (oFA00)
0012H	External Fault at contact input terminal 4 (EF4)	0102H	Option not properly connected (oFA01)
0013H	External Fault at contact input terminal 5 (EF5)	0103H	Same type of option card already connected (oFA02)
0014H	External Fault at contact input terminal 6 (EF6)	0106H	A/D Conversion Error (oFA05)
0015H	External Fault at contact input terminal 7 (EF7)	0107H	Option Response Error (oFA06)
0016H	External Fault at contact input terminal 8 (EF8)	0111H	Option RAM Fault (oFA10)
0017H	Fan Fault (FAn)	0112H	Option Operation Mode Fault (SLMOD) (oFA11)
0018H	Overspeed (oS)	0113H	Drive Receive CRC Error (oFA12)
0019H	Speed Deviation (dEv)	0114H	Drive Receive Frame Error (oFA13)
001AH	PG Disconnect (PGo)	0115H	Drive Receive Abort Error (oFA14)
001CH	Output Phase Loss (LF)	0116H	Option Receive CRC Error (oFA15)
001EH	External Digital Operator Connection Fault (oPr)	0117H	Option Receive Frame Error (oFA16)
001FH	EEPROM Write Error (Err)	0118H	Option Receive Abort Error (oFA17)
0021H	MEMOBUS/Modbus Communication Error (CE)	0131H	Comm. ID Error (oFA30)
0022H	Option Communication Error (bUS)	0132H	Model Code Error (oFA31)

Fault Code	Fault Name	Fault Code	Fault Name
0025H	Control Fault (CF)	0133H	Sumcheck Error (oFA32)
0027H	Option Card External Fault (EF0)	0134H	Comm. option timeout waiting for response (oFA33)
0028H	PID Feedback Loss (FbL)	0135H	MEMOBUS Timeout (oFA34)
0029H	Undertorque Detection 1 (UL3)	0136H	Drive timeout waiting for response (oFA35)
002AH	Undertorque Detection 2 (UL4)	0137H	CI Check Error (oFA36)
002BH	High Slip Braking oL (oL7)	0138H	Drive timeout waiting for response (oFA37)
002CH	External Fault at contact input terminal 9 (EF9)	0139H	Control Command Selection Error (oFA38)
002DH	External Fault at contact input terminal 10 (EF10)	013AH	Drive timeout waiting for response (oFA39)
002EH	External Fault at contact input terminal 11 (EF11)	013BH	Control Response Selection 1 Error (oFA40)
002FH	External Fault at contact input terminal 12 (EF12)	013CH	Drive timeout waiting for response (oFA41)
0030H	Hardware Fault (including oF□)	013DH	Control Response Selection 2 Error (oFA42)
0031H	Main Circuit Capacitor Neutral Point Potential Error (CFA VCF OV)	013EH	Control Response Selection Error (oFA43)
0038H	PG Hardware Fault (PGoH)	0201H	Option Connection Error (oFb01)
003BH	Too Many Speed Search Restarts (SEr)	0202H	Same type of option card already connected (oFb02)
0041H	PID Feedback Loss (FbH)	0205H	A/D Conversion Error (oFb05)
0042H	External Fault at input terminal 1 (EF1)	0206H	Option Response Error (oFb06)
0043H	External Fault at input terminal 2 (EF2)	0210H	Option RAM Fault (oFb10)
0044H	Mechanical Weakening Detection 1 (oL5)	0211H	Option Operation Mode Fault (SLMOD) (oFb11)
0045H	Mechanical Weakening Detection 2 (UL5)	0212H	Drive Receive CRC Error (oFb12)
0046H	Current Offset Fault (CFA COF)	0213H	Drive Receive Frame Error (oFb13)
0052H	Node Setup Fault (nSE)	0214H	Drive Receive Abort Error (oFb14)
0054H	Transformer Temperature Fault (TME)	0215H	Option Receive CRC Error (oFb15)
0055H	Transformer Temperature Fault 1 (TME1)	0216H	Option Receive Frame Error (oFb16)
0056H	Transformer Temperature DI Fault (TME2)	0217H	Option Receive Abort Error (oFb17)
0057H	Output Overvoltage (OOV)	0231H	Comm. ID Error (oFb30)
0058H	Voltage Unbalance (VUB)	0232H	Model Code Error (oFb31)
0059H	Overvoltage 2 (CFA OV2)	0233H	Sumcheck Error (oFb32)
005AH	Commercial Synchronous Switching Error (SYNC)	0234H	Comm. option timeout waiting for response (oFb33)
005BH	Door Open (dO)	0235H	MEMOBUS Timeout (oFb34)
005DH	CCB-MB Communication Error (Link Fault) (LIN)	0236H	Drive timeout waiting for response (oFb35)
0064H	Transformer Temperature Sensor Disconnection (TME3)	0237H	CI Check Error (oFb36)
0066H	Power Supply Undervoltage (IUV)	0238H	Drive timeout waiting for response (oFb37)
0067H	Input Overvoltage (IOV)	0239H	Control Command Selection Error (oFb38)
0068H	Optional Power Supply Error (24V)	023AH	Drive timeout waiting for response (oFb39)
006DH	External Fault at contact input terminal 13 (EF13)	023BH	Control Response Selection 1 Error (oFb40)
006EH	External Fault at contact input terminal 14 (EF14)	023CH	Drive timeout waiting for response (oFb41)
006FH	External Fault at contact input terminal 15 (EF15)	023DH	Control Response Selection 2 Error (oFb42)
0070H	External Fault at contact input terminal 16 (EF16)	023EH	Control Response Selection Error (oFb43)
0083H	A/D Conversion Error (CPF02)	0300H	Option Compatibility Error (oFC00)
0087H	EEPROM Memory Data Error (CPF06)	0301H	Option not properly connected (oFC01)
0095H	Hardware fault at power up (CPF20)	0302H	Same type of option card already connected (oFC02)
0096H	Hardware fault at communication start up (CPF21)	0305H	A/D Conversion Error (oFC05)
0097H	A/D Conversion Fault (CPF22)	0306H	Option Response Error (oFC06)

◆ Alarm Register Contents

The table below shows the alarm codes that can be read out from MEMOBUS/Modbus register 007FH.

Table C.6 Alarm Register 007FH Contents

Alarm Code	Fault Name	Alarm Code	Fault Name
0001H	Undervoltage (Uv)	0020H	MEMOBUS/Modbus Test Mode Error (SE)
0002H	Overvoltage (ov)	0023H	External Fault at contact input terminal 9 (EF9)
0003H	IGBT Overheating (oH)	0024H	External Fault at contact input terminal 10 (EF10)
0004H	Drive Overheat Warning (oH2)	0025H	External Fault at contact input terminal 11 (EF11)
0005H	Overtorque 1 (oL3)	0026H	External Fault at contact input terminal 12 (EF12)
0006H	Overtorque 2 (oL4)	0027H	PID Feedback Loss (FbL)
0007H	Forward/Reverse Run Commands Input Error (EF)	0028H	Excessive PID Feedback (FbH)
0008H	Drive Baseblock (bb)	002AH	Drive Disabled (dnE)
0009H	External Fault at contact input terminal 3 (EF3)	002BH	PG Hardware Fault (PGoH)
000AH	External Fault at contact input terminal 4 (EF4)	0035H	Cooling Fan Maintenance Time (LT-1)
000BH	External Fault at contact input terminal 5 (EF5)	0036H	Capacitor Maintenance Time (LT-2)
000CH	External Fault at contact input terminal 6 (EF6)	0039H	External Fault at contact input terminal 1 (EF1)
000DH	External Fault at contact input terminal 7 (EF7)	003AH	External Fault at contact input terminal 2 (EF2)
000EH	External Fault at contact input terminal 8 (EF8)	003DH	Mechanical Weakening Detection 1 (oL5)
000FH	Fan Fault (FAn)	003EH	Mechanical Weakening Detection 2 (UL5)
0010H	Overspeed (oS)	0042H	IGBT Maintenance Time (90%) (TrPC)
0011H	Speed Deviation (dEv)	0043H	Soft Charge Bypass Relay Maintenance Time (LT-3)
0012H	PG Disconnect (PGo)	0044H	IGBT Maintenance Time (50%) (LT-4)
0014H	MEMOBUS/Modbus Communication Error (CE)	0054H	Input Overvoltage (IOV)
0015H	Option Communication Error (bUS)	0064H	Battery Voltage Low (BAT)
0016H	Serial Communication Transmission Error (CALL)	0069H	Transformer Temperature Alarm 1 (TMA1)
0017H	Motor Overload (oL1)	006CH	Voltage Unbalance (VUB)
001AH	Option Card External Fault (EF0)	006DH	External Fault at contact input terminal 13 (EF13)
001BH	Motor Switch during Run (rUn)	006EH	External Fault at contact input terminal 14 (EF14)
001DH	Serial Communication Transmission Error (CALL)	006FH	External Fault at contact input terminal 15 (EF15)
001EH	Undertorque Detection 1 (UL3)	0070H	External Fault at contact input terminal 16 (EF16)
001FH	Undertorque Detection 2 (UL4)	–	–

C.10 Enter Command

When writing parameters to the drive from the master using MEMOBUS/Modbus communications, parameter H5-11 determines if an Enter command must be issued to enable these parameters or not. This sections the types of Enter commands and how they work.

◆ Enter Command Types

The drive supports two types of Enter commands as shown in *Table C.7*. An Enter command is enabled by writing 0 to register number 0900H or 0910H. These registers can only be written to. An error will occur if the user attempts to read from these registers.

Table C.7 Enter Command Types

Register No.	Description
0900H	Writes data into the EEPROM (non-volatile memory) of the drive and enables the data in RAM at the same time. Parameter changes remain even if the power supply is cycled.
0910H	Writes data in the RAM only. Parameter changes are lost when the drive is shut off.

Note: Because the EEPROM can be written to a maximum of 100,000 times, refrain from writing to the EEPROM too often. The Enter command registers are write-only. Consequently, if these registers are read, then the register address will be invalid (Error code: 02H). An Enter command is not required if reference or broadcast data are sent to the drive.

◆ H5-11 and the Enter Command

An Enter command is not required when writing registers 0000H to 001FH. Changes to those registers take effect immediately, independent of the setting in parameter H5-11.

H5-11 Settings	H5-11 = 0	H5-11 = 1
How parameter settings are enabled	When the Enter command is received from the master.	As soon as the value is changed.
Upper/lower limit check	Upper/lower limit check is performed, taking the settings of related parameters into account.	Checks only the upper/lower limits of the parameters that were changed.
Default value of related parameters	Not affected. The settings of related parameters remain unchanged. They must be changed manually if needed.	Default settings of related parameters are changed automatically.
Error handling when setting multiple parameters	Data is accepted even if one setting is invalid. The invalid setting will be discarded. No error message occurs.	Error occurs if only one setting is invalid. All data that was sent are discarded.

C.11 Communication Errors

◆ MEMOBUS/Modbus Error Codes

A list of MEMOBUS/Modbus errors appears in *Table C.8*.

When an error occurs, remove whatever caused the error and restart communications.

Table C.8 MEMOBUS/Modbus Error Codes

Error Code	Error Name Cause
01H	Function Code Error
	• Attempted to set a function code from a master other than 03H, 08H, and 10H.
02H	Register Number Error
	• A register number specified in the command message does not exist. • Attempted to send a broadcast message using other register numbers than 0001H or 0002H.
03H	Bit Count Error
	• Read data or write data is greater than 16 bits. Invalid command message quantity. • In a write message, the "Number of Data Items" contained within the message does not equal twice the amount of data words (i.e., the total of Data 1+ Data 2, etc.).
21H	Data Setting Error
	• Control data or parameter write data is outside the allowable setting range. • Attempted to write a contradictory parameter setting.
22H	Write Mode Error
	• During run, the user attempted to write a parameter that cannot be written to during run. • During an EEPROM memory data error (CPF06), the master attempted to write to a parameter other than A1-00 to A1-05, E1-03, or o2-04. • Attempted to write to read-only data.
23H	DC Bus Undervoltage Write Error
	• During an undervoltage situation, the master attempted to write to parameters that cannot be written to during undervoltage.
24H	Write Error During Parameter Process
	• Master attempted writing to the drive while the drive was processing parameter data.

◆ Slave Not Responding

In the following situations, the slave drive will ignore the command message sent from the master, and not send a response message:

- When a communications error (data loss, framing, parity, or CRC-16) is detected in the command message.
- When the slave address in the command message and the slave address in the drive do not match (remember to set the slave address for the drive using H5-01).
- When the gap between two blocks (8 bit) of a message exceeds 24 bits.
- When the command message data length is invalid.

Note: If the slave address specified in the command message is 00H, all slaves execute the write function, but do not return response messages to the master.

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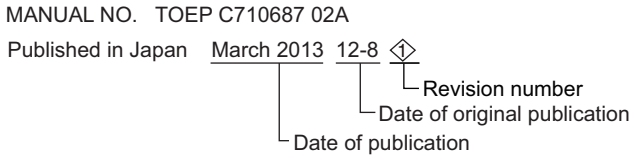
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FSDrive-MV1000

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