YASKAWA

YASKAWA AC Drive P1000

Industrial Fan and Pump Drive

Safety Precautions

Type: CIMR-PU□□□□□□□

Models: 200 V Class: 3/4 to 175 HP ND
400 V Class: 3/4 to 1000 HP ND
600 V Class: 1 to 250 HP ND

To properly use the product, read these precautions and refer to the CD-ROM packaged with the product. Ensure the end user receives these precautions and the CD-ROM No. TOECC71061615.

MANUAL NO. TOEP YAIP1U 03B

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P1000 Safety Precautions

This document provides essential safety information for the P1000 series AC drive.
Refer to the P1000 Quick Start Procedure TM.P1000.01 packaged with the drive to configure the drive for basic operation.
Refer to the CD-ROM packaged with the product for complete product instructions necessary for proper installation, set-up, troubleshooting and maintenance. CD part number TOECC71061615. The 1000 Series CD-ROM contains the P1000 Technical Manual No. SIEPYAIP1U01 and additional 1000 Series manuals.

◆ Applicable Models

This Safety Precautions document applies to the drive models in ***Table i.1***.

Table i.1 Applicable Models

Drive Series	Drive Model Number	Software Version
P1000	CIMR-PU2A□□□□	All
	CIMR-PU2A□□□□	
	CIMR-PU5A□□□□	

◆ Warranty Information

■ Restrictions

The drive is not designed or manufactured for use in devices or systems that may directly affect or threaten human lives or health.

Customers who intend to use the product described in this manual for devices or systems relating to transportation, health care, space aviation, atomic power, electric power, or in underwater applications must first contact their Yaskawa representatives or the nearest Yaskawa sales office.

WARNING! *Injury to Personnel. 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.*

i.1 General Safety

◆ Supplemental Safety Information

General Precautions
• The diagrams in this manual may be indicated without covers or safety shields to show details. Replace the 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.

⚠ WARNING

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 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 death or serious injury.

⚠ WARNING

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

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

◆ Safety Messages

⚠ DANGER

Heed the safety messages in this manual.

Failure to comply will result in death or serious injury.

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

⚠ DANGER

Electrical Shock Hazard

Do not connect or disconnect wiring while the power is on.

Failure to comply will result in death or serious injury.

Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. After shutting off the power, wait for at least the amount of time specified on the drive before touching any components.

⚠ WARNING

Sudden Movement Hazard

System may start unexpectedly upon application of power, resulting in death or serious injury.

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.

Electrical Shock Hazard

Do not attempt to modify or alter the drive in any way not explained in this manual.

Failure to comply could result in death or serious injury.

Yaskawa is not responsible for any modification of the product made by the user. This product must not be modified.

Do not allow unqualified personnel to use equipment.

Failure to comply could result in death or serious injury.

Maintenance, inspection, and replacement of parts must be performed only by authorized personnel familiar with installation, adjustment and maintenance of AC drives.

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

Failure to comply could result in death or serious injury.

Make sure the protective earthing conductor complies with technical standards and local safety regulations.

Because the leakage current exceeds 3.5 mA in models 4A0414 and larger, IEC/EN 61800-5-1 states that either the power supply must be automatically disconnected in case of discontinuity of the protective earthing conductor or a protective earthing conductor with a cross-section of at least 10 mm^2 (Cu) or 16 mm^2 (Al) must be used. Failure to comply may result in death or serious injury.

Always use appropriate equipment for Ground Fault Circuit Interrupters (GFCIs).

The drive can cause a residual current with a DC component in the protective earthing conductor. Where a residual current operated protective or monitoring device is used for protection in case of direct or indirect contact, always use a type B GFCI according to IEC/EN 60755.

Fire Hazard

Do not use an improper voltage source.

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

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

Install adequate branch circuit protection according to applicable local codes and this Installation Manual. Failure to comply could result in fire and damage to the drive or injury to personnel.

The device is suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical amperes, 240 Vac maximum (200 V class) and 480 Vac maximum (400 V class), and 600 Vac maximum (600 V class) when protected by branch circuit protection devices specified in this document.

⚠ WARNING

Crush Hazard

Do not use this drive in lifting applications without installing external safety circuitry to prevent accidental dropping of the load.

The drive does not possess built-in load drop protection for lifting applications.

Failure to comply could result in death or serious injury from falling loads.

Install electrical and/or mechanical safety circuit mechanisms independent of drive circuitry.

⚠ CAUTION

Crush Hazard

Do not carry the drive by the front cover.

Failure to comply may result in minor or moderate injury from the main body of the drive falling.

NOTICE

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

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

Do not perform a withstand voltage test on any part of the drive.

Failure to comply could result in damage to the sensitive devices within the drive.

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.

If a fuse is blown or a Ground Fault Circuit Interrupter (GFCI) is tripped, check the wiring and the selection of the peripheral devices.

Contact your supplier if the cause cannot be identified after checking the above.

Do not restart the drive immediately operate the peripheral devices if a fuse is blown or a GFCI is tripped.

Check the wiring and the selection of peripheral devices to identify the cause. Contact your supplier before restarting the drive or the peripheral devices if the cause cannot be identified.

Do not expose the drive to halogen group disinfectants.

Failure to comply may cause damage to the electrical components in the drive.

Do not pack the drive in wooden materials that have been fumigated or sterilized.

Do not sterilize the entire package after the product is packed.

◆ Periodic Maintenance Safety

WARNING! ***Electrical Shock Hazard.*** *Capacitors in the drive do not immediately discharge after shutting off the power. Wait for at least the amount of time specified on the drive before touching any components after shutting off the power. Failure to comply may cause injury to personnel from electrical shock.*

WARNING! ***Burn Hazard.*** *Because the heatsink can get very hot during operation, take proper precautions to prevent burns. When replacing the cooling fan, shut off the power and wait at least 15 minutes to be sure that the heatsink has cooled down. Failure to comply may cause burn injury to personnel.*

◆ Motor Application Safety

NOTICE: *Equipment Damage.* ***A motor connected to a PWM drive may operate at a higher temperature than a utility-fed motor and the operating speed range may reduce motor cooling capacity.*** *Ensure that the motor is suitable for drive duty and/or the motor service factor is adequate to accommodate the additional heating with the intended operating conditions.*

Insulation Tolerance

NOTICE: *Consider motor voltage tolerance levels and motor insulation in applications with an input voltage of over 440 V or particularly long wiring distances.*

High-Speed Operation

NOTICE: *Problems may occur with the motor bearings and dynamic balance of the machine when operating a motor beyond its rated speed. Contact the motor or machine manufacturer.*

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.

Audible Noise

The audible noise of the motor varies based on the carrier frequency setting. However, drive current derating may be required. When using a high carrier frequency, audible noise from the motor is comparable to the motor noise generated when running from line power.

◆ Receiving Safety

⚠ CAUTION

Do not carry the drive by the front cover or the terminal cover.

Failure to comply may cause the main body of the drive to fall, resulting in minor or moderate injury.

NOTICE

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

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

Transporting the Drive

NOTICE: *Never steam clean the drive. During transport, keep the drive from coming into contact with salts, fluorine, bromine, phthalate ester, and other such harmful chemicals.*

i.2 Mechanical Installation Safety

⚠ WARNING

Fire Hazard

Provide sufficient cooling when installing the drive inside an enclosed panel or cabinet.

Failure to comply could result in overheating and fire.

When multiple drives are placed inside the same enclosure panel, install proper cooling to ensure air entering the enclosure does not exceed 40 °C.

Crush Hazard

Only allow qualified personnel to operate a crane or hoist to transport the drive.

Failure to comply may result in serious injury or death from falling equipment.

Use a dedicated lifter when transporting the drive by a lifter.

Failure to comply may result in serious injury or death from falling equipment.

Only use vertical suspension to temporarily lift the drive during installation to an enclosure panel. Do not use vertical suspension to transport the drive.

Failure to comply may result in serious injury or death from falling equipment.

Use screws to securely affix the drive front cover, terminal blocks, and other drive components prior to vertical suspension.

Failure to comply may result in serious injury or death from falling equipment.

Do not subject the drive to vibration or impact greater than 1.96 m/s^2 (0.2 G) while it is suspended by the cables.

Failure to comply may result in serious injury or death from falling equipment.

Do not attempt to flip the drive over or leave the drive unattended while it is suspended by the wires.

Failure to comply may result in serious injury or death from falling equipment.

NOTICE

Equipment Hazard

Prevent foreign matter such as metal shavings or wire clippings from falling into the drive during drive installation and project construction.

Failure to comply could result in damage to the drive. Place a temporary cover over the top during installation. Be sure to remove the temporary cover before start-up, as the cover will reduce ventilation and cause the unit to overheat.

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

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

When the input voltage is 440 V or higher or the wiring distance is greater than 100 meters, pay special attention to the motor insulation voltage or use a drive-rated motor with reinforced insulation.

Failure to comply could lead to motor winding failure.

Never lift the drive up while the cover is removed.

This can damage the terminal board and other components.

◆ Installation Environment

Install the drive in an environment matching the specifications in ***Table i.2*** to help prolong the optimum performance life of the drive.

Table i.2 Installation Environment

Environment	Conditions
Installation Area	Indoors
Ambient Temperature	-10 °C to +40 °C (IP20/NEMA Type 1 enclosure) -10 °C to +50 °C (IP00/Open Type enclosure) Drive reliability improves in environments without wide temperature fluctuations. When using the drive in an enclosure panel, install a cooling fan or air conditioner in the area to ensure that the air temperature inside the enclosure does not exceed the specified levels. Do not allow ice to develop on the drive.
Humidity	95% RH or less and free of condensation
Storage Temperature	-20 to +60 °C
Surrounding Area	Install the drive in an area free from: • oil mist and dust • metal shavings, oil, water, or other foreign materials • radioactive materials • combustible materials (e.g., wood) • harmful gases and liquids • excessive vibration • chlorides • direct sunlight.
Altitude	1000 m or lower, up to 3000 m with derating
Vibration	10 to 20 Hz at 9.8 m/s^2 (32.15 ft/s^2) <1> 20 to 55 Hz at 5.9 m/s^2 (19.36 ft/s^2) (Models 2A0004 to 2A0211, 4A0002 to 4A0165, and 5A0003 to 5A0099) or 2.0 m/s^2 (6.56 ft/s^2) (Models 2A0250 to 2A0415, 4A0208 to 4A1200, and 5A0125 to 5A0242)
Orientation	Install the drive vertically to maintain maximum cooling effects.

<1> Models 4A0930 and 4A1200 are rated at 5.9 m/s^2 (19.36 ft/s^2)

NOTICE: *Avoid placing drive peripheral devices, transformers, or other electronics near the drive as the noise created can lead to erroneous operation. If such devices must be used in close proximity to the drive, take proper steps to shield the drive from noise.*

NOTICE: *Prevent foreign matter such as metal shavings and wire clippings from falling into the drive during installation. Failure to comply could result in damage to the drive. Place a temporary cover over the top of the drive during installation. Remove the temporary cover before drive start-up, as the cover will reduce ventilation and cause the drive to overheat.*

◆ Instructions on Installation Using the Eye Bolts

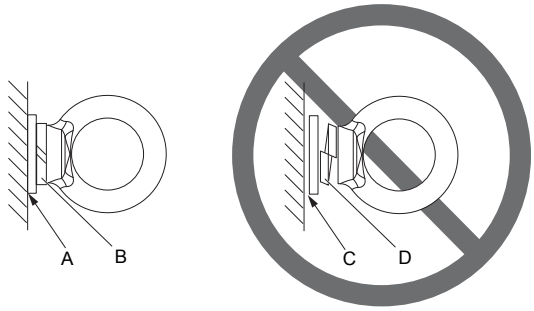
Eye bolts are used to install the drive or to temporarily lift the drive when replacing it. Using the eye bolts, the drive can be installed in an enclosure panel or on a wall. Do not leave the drive suspended by the wires in a horizontal or vertical position for long periods of time. Do not transport the drive over long distances. Read the following precautions and instructions before installing the drive.

WARNING! *Crush Hazard. Observe the following instructions and precautions. Failure to comply could result in serious injury or death from falling equipment.*
Only use vertical suspension to temporarily lift the drive during installation to an enclosure panel. Do not use vertical suspension to transport the drive.
Use screws to securely affix the drive front cover, terminal blocks, and other drive components prior to vertical suspension.
Do not subject the drive to vibration or impact greater than 1.96 m/s^2 (0.2 G) while it is suspended by the wires.
Do not leave the drive unattended while it is suspended by the wires.
Do not attempt to flip the drive over while it is suspended by the wires.

■ Horizontal Suspension of Drive Models 2A0360, 2A0415, and 4A0250 to 4A0675

To make a wire hanger or frame for use when lifting the drive with a crane, lay the drive in a horizontal position and pass a wire through the holes of the four eye bolts.

NOTICE: *Damage to Equipment. When lifting the drive, confirm that the spring washer is fully closed. Failure to comply may deform or damage the drive when lifted.*



A – No space between drive and washer
B – Spring washer fully closed
C – Space between drive and washer
D – Spring washer open

Figure i.1 Spring Washer

■ Vertical Suspension of Drive Models 2A0360, 2A0415, and 4A0250 to 4A1200

Models 2A0360, 2A0415, and 4A0250 to 4A0675

When vertical suspension of the drive is required in an enclosure panel, change the orientation of the eye bolts for these models by turning the eye bolts counterclockwise 90 degrees.

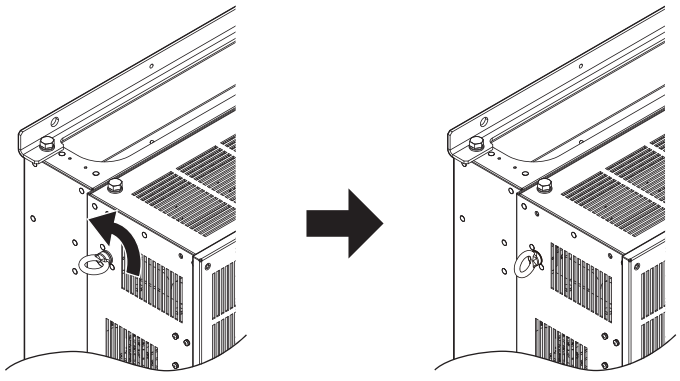


Figure i.2 Adjusting Angle of Eye Bolts

Models 4A0930 and 4A1200

When suspending models 4A0930 or 4A1200 with wires, follow the procedure described below.

WARNING! *Crush Hazard. Use an adequate length of wire to ensure a 50° or wider suspension angle as illustrated in Figure i.4. The maximum allowable load of the eye bolts cannot be guaranteed when the drive is suspended with the wires at angles less than 50°. Failure to comply may result in serious injury or death from falling equipment.*

1. Remove the four eye bolts from the drive side panels and fix them securely on the top panel.

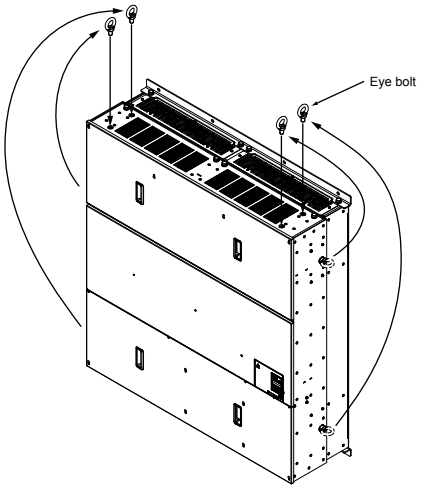
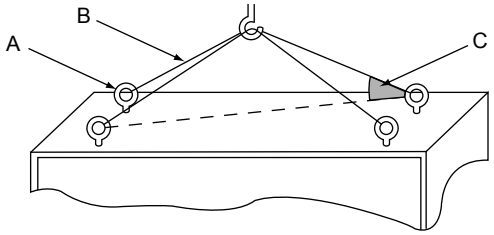


Figure i.3 Eye Bolt Repositioning

2. Pass wire through the holes of all four eye bolts.



A – Eye bolt
B – Wires
C – Suspending angle: 50° or greater

Figure i.4 Suspension Wire Angle Example

3. Gradually take up the slack in the wires and hoist the drive after the wires are stretched tight.
4. Lower the drive when ready to install in the enclosure panel. Stop lowering the drive when it is near the floor then begin lowering the drive again very slowly until the drive is placed correctly.

◆ Installation Orientation and Spacing

Install the drive upright as illustrated in ***Figure i.5*** to maintain proper cooling.

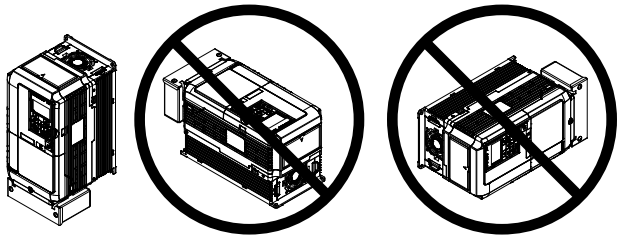
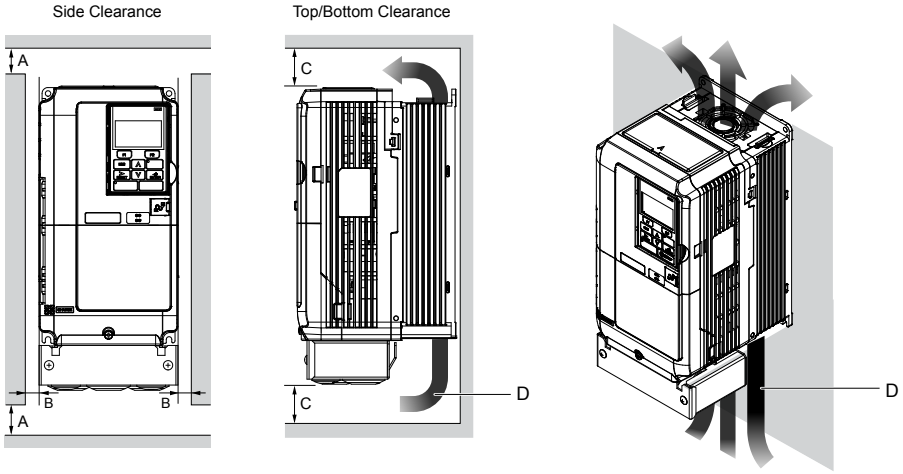


Figure i.5 Correct Installation Orientation

NOTICE: *Install the drive upright as specified in the manual. Failure to comply may damage the drive due to improper cooling.*

■ Single Drive Installation

Figure i.6 shows the installation distance required to maintain sufficient space for airflow and wiring. Install the heatsink against a closed surface to avoid diverting cooling air around the heatsink.



A – 50 mm minimum
B – 30 mm minimum
C – 120 mm minimum
D – Airflow direction

Figure i.6 Correct Installation Spacing

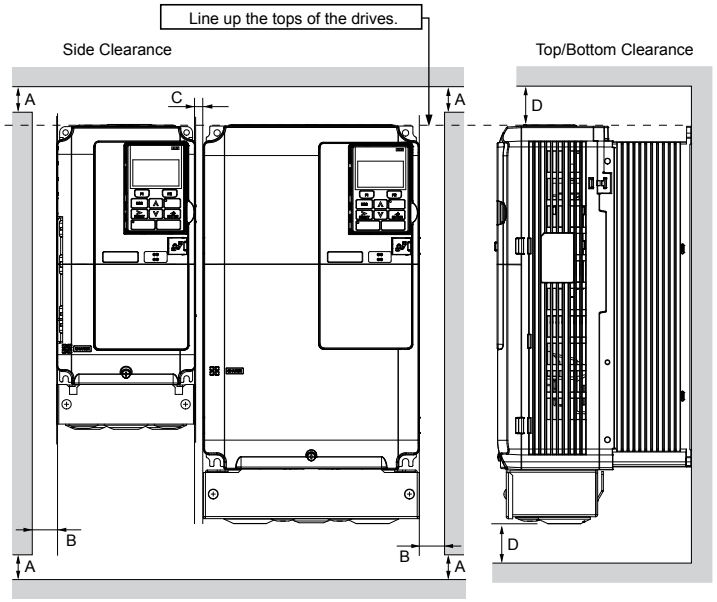
Note: IP20/NEMA Type 1 enclosure and IP00/Open Type enclosure models require the same amount of space above and below the drive for installation.

■ Multiple Drive Installation (Side-by-Side Installation)

Models 2A0004 to 2A0081, 4A0002 to 4A0044, and 5A0003 to 5A0032 can take advantage of Side-by-Side installation.

When installing multiple drives into the same enclosure panel, mount the drives according to ***Figure i.6*** and set L8-35, Installation Method Selection, to 1 (Side-by-Side Mounting).

When mounting drives with the minimum clearance of 2 mm according to ***Figure i.7***, set parameter L8-35 to 1 while considering derating.



A – 50 mm minimum
B – 30 mm minimum
C – 2 mm minimum
D – 120 mm minimum

Figure i.7 Space Between Drives (Side-by-Side Mounting)

Note: Align the tops of the drives when installing drives of different heights in the same enclosure panel. Leave space between the tops and bottoms of stacked drives for easier cooling fan replacement.

Remove the top protective covers of all drives as shown in ***Figure i.8*** when mounting IP20/NEMA Type 1 enclosure drives side-by-side.

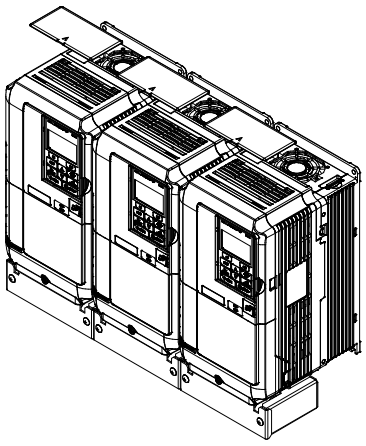


Figure i.8 IP20/NEMA 1 Side-by-Side Mounting in Enclosure

◆ Drive Dimensions

NOTICE

Refer to the P1000 Technical Manual SIEPYAIP1U01 for IP20/NEMA Type 1, IP00/Open Chassis and Flange Type Enclosure (NEMA 12 Backside) drive dimensions.

The 1000 Series CD-ROM No. TOECC71061615, packaged with the drive contains the P1000 Technical Manual No. SIEPYAIP1U01 and additional 1000 Series manuals.

i.3 Electrical Installation Safety

NOTICE

Refer to the P1000 Technical Manual SIEPYAIP1U01 on the CD-ROM packaged with the product for more information regarding the ***Electrical Installation*** and for complete product instructions necessary for proper installation, set-up, troubleshooting and maintenance. CD-ROM part number TOECC71061615.

⚠ DANGER

Electrical Shock Hazard

Do not connect or disconnect wiring while the power is on.

Failure to comply will result in death or serious injury.

⚠ WARNING

Electrical Shock Hazard

Make sure the protective earthing conductor complies with technical standards and local safety regulations.

Because the leakage current exceeds 3.5 mA in models 4A0414 and larger, IEC/EN 61800-5-1 states that either the power supply must be automatically disconnected in case of discontinuity of the protective earthing conductor or a protective earthing conductor with a cross-section of at least 10 mm^2 (Cu) or 16 mm^2 (Al) must be used. Failure to comply may result in death or serious injury.

Always use appropriate equipment for Ground Fault Circuit Interrupters (GFCIs).

The drive can cause a residual current with a DC component in the protective earthing conductor. Where a residual current operated protective or monitoring device is used for protection in case of direct or indirect contact, always use a type B GFCI according to IEC/EN 60755.

⚠ WARNING

Electrical Shock Hazard

Do not operate equipment with covers removed.

Failure to comply could result in death or serious injury.

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

Always ground the motor-side grounding terminal.

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

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

Failure to comply could result in death or serious injury.

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

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

Failure to comply could result in death or serious injury.

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

Failure to comply could result in death or serious injury.

Installation, maintenance, inspection, and servicing must be performed only by authorized personnel familiar with installation, adjustment, and maintenance of AC drives.

⚠ WARNING

Do not touch any terminals before the capacitors have fully discharged.

Failure to comply could result in death or serious injury.

Before wiring terminals, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. After shutting off the power, wait for at least the amount of time specified on the drive before touching any components.

Fire Hazard

Tighten all terminal screws to the specified tightening torque.

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

Do not use improper combustible materials.

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

Do not install the drive to a combustible surface. Never place combustible materials on the drive.

Do not use an improper voltage source.

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

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

When installing dynamic braking options, perform all wiring exactly as specified in the wiring diagrams provided.

Failure to do so can result in fire. Improper wiring may damage braking components.

Shut off the drive with a magnetic contactor (MC) when a fault occurs in any external equipment such as braking resistors. Failure to comply may cause resistor overheating, fire, and injury to personnel.

⚠ CAUTION

Do not carry the drive by the front cover or the terminal cover.

Failure to comply may cause the main body of the drive to fall, resulting in minor or moderate injury.

NOTICE

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

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

Never connect or disconnect the motor from the drive while the drive is outputting voltage.

Improper equipment sequencing could result in damage to the drive.

Do not use unshielded cable for control wiring.

Failure to comply may cause electrical interference resulting in poor system performance. Use shielded, twisted-pair wires and ground the shield to the ground terminal of the drive.

Do not allow unqualified personnel to use the product.

Failure to comply could result in damage to the drive or braking circuit.

Carefully review instruction manual TOBPC72060000 or TOBPC72060001 when connecting a dynamic braking option to the drive.

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 product made by the user. This product must not be modified.

NOTICE

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

Failure to comply could result in damage to the drive.

Do not connect power supply lines to output terminals U/T1, V/T2, or W/T3. Failure to comply will destroy the drive. Be sure to perform a final check of all sequence wiring and other connections before turning on the power and also check for short circuits on the control terminals, which may damage the drive.

To get the full performance life out of the electrolytic capacitors and circuit relays, refrain from switching the drive power supply off and on more than once every 30 minutes. Frequent use can damage the drive. Use the drive to stop and start the motor.

NOTICE

Install a fuse and a GFCI in models 4A0930 and 4A1200. Failure to comply may result in serious damage to the facilities if the drive is defective. *Refer to Wiring Fuses for Models 4A0930 and 4A1200 on page 22* for details.

◆ Standard Connection Diagram

WARNING! *Sudden Movement Hazard. Do not close the wiring for the control circuit unless the multifunction input terminal parameters are properly set. Improper sequencing of run/stop circuitry could result in death or serious injury from moving equipment.*

WARNING! *Sudden Movement Hazard. Ensure start/stop and safety circuits are wired properly and in the correct state before energizing the drive. Failure to comply could result in death or serious injury from moving equipment. When programmed for 3-Wire control, a momentary closure on terminal S1 may cause the drive to start.*

WARNING! *Sudden Movement Hazard. When using a 3-Wire sequence, set the drive to 3-Wire sequence prior to wiring the control terminals and set parameter b1-17 to 0 so the drive will not accept a Run command at power up (default). If the drive is wired for a 3-Wire sequence but set up for a 2-Wire sequence (default), and parameter b1-17 is set to 1 so the drive accepts a Run command at power up, the motor will rotate in reverse direction at drive power up and may cause injury.*

WARNING! *Sudden Movement Hazard. Confirm the drive I/O signals and external sequence before executing the application preset function. Executing the application preset function or setting A1-06 ≠ 0 will change the drive I/O terminal functions and may cause unexpected equipment operation. Failure to comply may cause death or serious injury.*

NOTICE: *When using the automatic fault restart function with wiring designed to shut off the power supply upon drive fault, make sure the drive does not trigger a fault output during fault restart (L5-02 = 0, default). Failure to comply will prevent the automatic fault restart function from working properly.*

NOTICE: *Inadequate wiring could result in damage to the drive. Install adequate branch circuit short circuit protection per applicable codes. The drive is suitable for circuits capable of delivering not more than 100,000 RMS symmetrical amperes, 240 Vac maximum (200 V class), 480 Vac maximum (400 V class), 600 Vac maximum (600 V class).*

NOTICE: *When the input voltage is 440 V or higher or the wiring distance is greater than 100 meters, pay special attention to the motor insulation voltage or use a drive duty motor. Failure to comply could lead to motor insulation breakdown.*

NOTICE: *Do not connect AC control circuit ground to drive enclosure. Improper drive grounding can cause control circuit malfunction.*

NOTICE: *Route motor leads U/T1, V/T2, and W/T3 separate from all other leads to reduce possible interference related issues. Failure to comply may result in abnormal operation of drive and nearby equipment.*

NOTICE: *Correctly set Sink/Source jumper S3 for internal power supply. Failure to comply may result in damage to the drive.*

Note: The minimum load for the relay outputs M1-M2, M3-M4, MA-MB-MC, and MD-ME-MF is 10 mA.

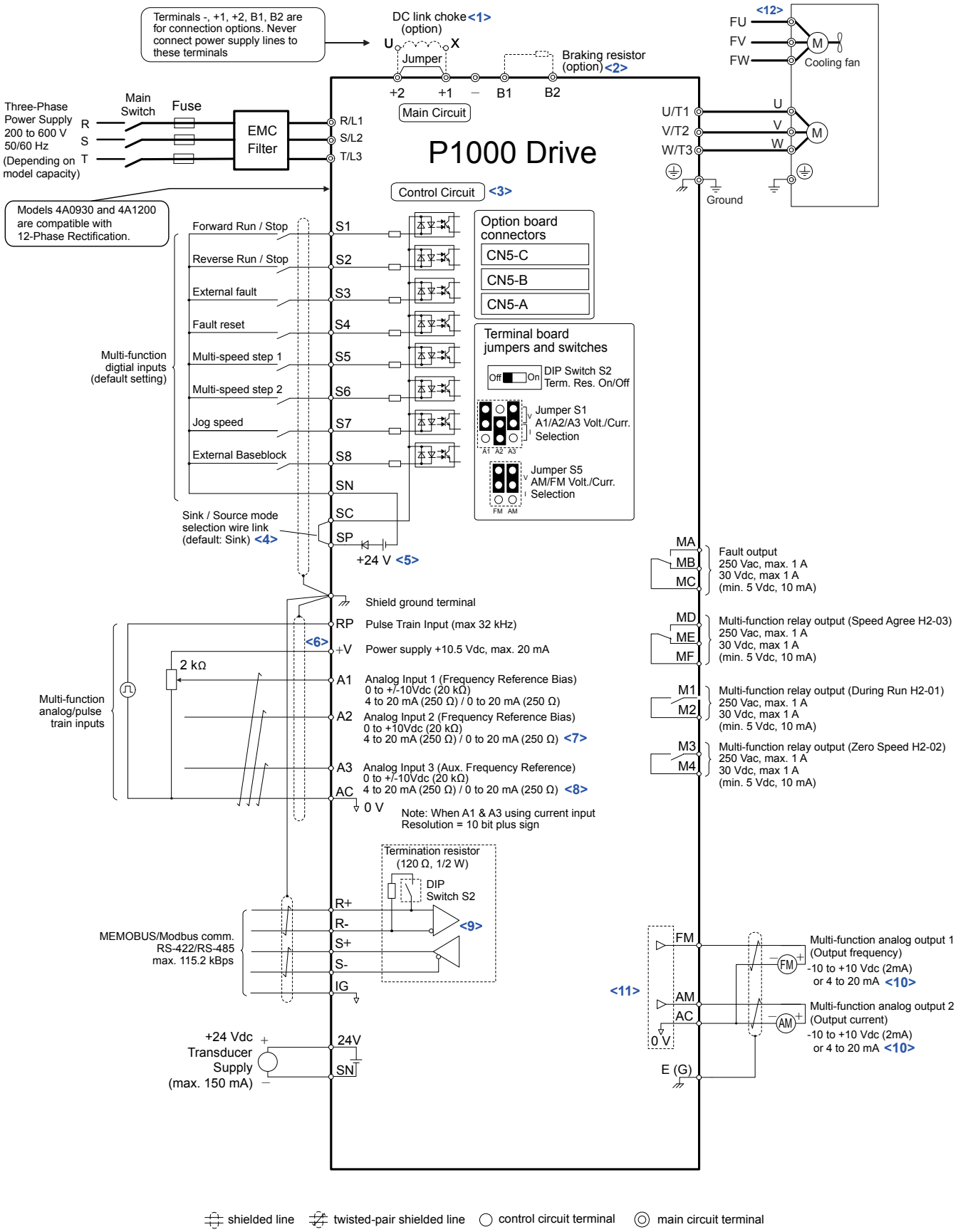


Figure i.9 Drive Standard Connection Diagram (example: model 2A0040)

<1> Remove the jumper when installing a DC link choke. Models 2A0110 to 2A0415 and 4A0058 to 4A1200 come with a built-in DC link choke.

<2> Set L8-55 to 0 to disable the protection function of the built-in braking transistor of the drive when using an optional regenerative converter or dynamic braking option. Leaving L8-55 enabled may cause a braking resistor fault (rF). Additionally, disable Stall Prevention (L3-04 = 0) when using an optional regenerative converter, regenerative or braking units, or dynamic braking option. Leaving If L3-04 enabled may prevent the drive from stopping within the specified deceleration time.

<3> Supplying power to the control circuit separately from the main circuit requires 24 V power supply (option).

<4> This figure illustrates an example of a sequence input to S1 through S8 using a non-powered relay or an NPN transistor. Install the wire link between terminals SC-SP for Sink mode, between SC-SN for Source mode, or leave the link out for external power supply. Never short terminals SP and SN, as it will damage the drive.

<5> This voltage source supplies a maximum current of 150 mA.

<6> The maximum output current capacity for the +V terminal on the control circuit is 20 mA. Never short terminals +V and AC, as it can cause erroneous operation or damage the drive.

<7> Set jumper S1 to select between a voltage or current input signal to terminal A2. The default setting is for current input.

<8> Set jumper S1 to select between a voltage or current input signal to terminal A1 and A3. The default setting is for voltage input.

<9> Set DIP switch S2 to the ON position to enable the termination resistor in the last drive in a MEMOBUS/Modbus network.

<10> Monitor outputs work with devices such as analog frequency meters, ammeters, voltmeters, and wattmeters. They are not intended for use as a feedback-type signal.

<11> Use jumper S5 to select between voltage or current output signals at terminals AM and FM. Set parameters H4-07 and H4-08 accordingly.

<12> Self-cooling motors do not require the same wiring necessary for motors with cooling fans.

◆ Main Circuit Wiring

WARNING! *Electrical Shock Hazard. Do not connect the AC power line to the drive output terminals U/T1, V/T2, and W/T3 . Failure to comply could result in death or serious injury by fire as a result of drive damage from line voltage application to output terminals.*

NOTICE

Refer to the P1000 Technical Manual SIEPYAIP1U01 on the CD-ROM packaged with the product for complete product instructions necessary for proper installation, set-up, troubleshooting and maintenance. CD part number TOECC71061615.

NOTICE: *Route motor leads U/T1, V/T2, and W/T3 separate from all other leads to reduce possible interference related issues. Failure to comply may result in abnormal operation of drive and nearby equipment.*

NOTICE: *Do not use the negative DC bus terminal "–" as a ground terminal. This terminal is at high DC voltage potential. Improper wiring connections could damage the drive.*

NOTICE: *Do not solder the ends of wire connections to the drive. Soldered wiring connections can loosen over time. Improper wiring practices could result in drive malfunction due to loose terminal connections.*

NOTICE: *Do not switch the drive input to start or stop the motor. Frequently switching the drive on and off shortens the life of the DC bus charge circuit and the DC bus capacitors, and can cause premature drive failures. For the full performance life, refrain from switching the drive on and off more than once every 30 minutes.*

NOTICE: *When connecting the motor to the drive output terminals U/T1, V/T2, and W/T3, the phase order for the drive and motor should match. Failure to comply with proper wiring practices may cause the motor to run in reverse if the phase order is backward.*

NOTICE: *Do not connect phase-advancing capacitors or LC/RC noise filters to the output circuits. Failure to comply could result in damage to the drive, phase-advancing capacitors, LC/RC noise filters or ground fault circuit interrupters.*

Note: Wire gauge recommendations based on drive continuous current ratings (ND) using 75 °C 600 Vac vinyl-sheathed wire assuming ambient temperature within 40 °C and wiring distance less than 100 m.

Yaskawa recommends using closed-loop crimp terminals on all drive models. To maintain UL/cUL approval, UL Listed closed-loop crimp terminals are specifically required when wiring the drive main circuit terminals on models 2A0110 to 2A0415, 4A0058 to 4A1200, and 5A0041 to 5A0242. Use only the tools recommended by the terminal manufacturer for crimping.

◆ Main Circuit Terminal Functions

Table i.3 Main Circuit Terminal Functions

<table>
<tr><th colspan="2" rowspan="2">Terminal</th><th colspan="4">Type</th><th rowspan="2">Function</th><th rowspan="2">Page</th></tr>
<tr><th>200 V Class</th><th rowspan="3">Drive Model</th><th>2A0004 to 2A0081</th><th>2A0110, 2A0138</th><th>2A0169 to 2A0415</th><th>–</th></tr>
<tr><th>400 V Class</th><th>4A0002 to 4A0044</th><th>4A0058, 4A0072</th><th>4A0088 to 4A0675</th><th>4A0930, 4A1200</th></tr>
<tr><th>600 V Class</th><th>5A0003 to 5A0032</th><th>5A0041, 5A0052</th><th>5A0062 to 5A0242</th><th>–</th></tr>
<tr><td colspan="2">R/L1</td><td colspan="4" rowspan="3">Main circuit power supply input</td><td rowspan="3">Connects line power to the drive</td><td rowspan="6">19</td></tr>
<tr><td colspan="2">S/L2</td></tr>
<tr><td colspan="2">T/L3</td></tr>
<tr><td colspan="2">R1-L11</td><td colspan="3" rowspan="3">Not available</td><td rowspan="3">Main circuit power supply input</td><td rowspan="3">Connects line power to the drive Remove the shorting bars connecting R/L1-R1/L11, S/L2-S1/L21, T/L3-T1/L31 when using 12-phase rectification.</td></tr>
<tr><td colspan="2">S1-L21</td></tr>
<tr><td colspan="2">T1-L31</td></tr>
<tr><td colspan="2">U/T1</td><td colspan="4" rowspan="3">Drive output</td><td rowspan="3">Connects to the motor</td><td rowspan="3">19</td></tr>
<tr><td colspan="2">V/T2</td></tr>
<tr><td colspan="2">W/T3</td></tr>
<tr><td colspan="2">B1</td><td colspan="2" rowspan="2">Braking resistor</td><td colspan="2" rowspan="2">Not available</td><td rowspan="2">Available for connecting a braking resistor or a braking resistor unit option</td><td rowspan="2">–</td></tr>
<tr><td colspan="2">B2</td></tr>
</table>

Terminal		Type				Function	Page
200 V Class	Drive Model	2A0004 to 2A0081	2A0110, 2A0138	2A0169 to 2A0415	–		
400 V Class		4A0002 to 4A0044	4A0058, 4A0072	4A0088 to 4A0675	4A0930, 4A1200		
600 V Class		5A0003 to 5A0032	5A0041, 5A0052	5A0062 to 5A0242	–		
⊕2		• DC link choke connection (⊕1, ⊕2) (remove the shorting bar between ⊕1 and ⊕2) • DC power supply input (⊕1, ⊖)	Not available			For connecting: • the drive to a DC power supply • dynamic braking options • a DC link choke	–
⊕1			DC power supply input (⊕1, ⊖)	• DC power supply input (⊕1, ⊖) • Braking unit connection (⊕3, ⊖)			
⊖							
⊕3		Not available					
⏚		For 200 V class: 100 Ω or less For 400 V class: 10 Ω or less For 600 V class: 10 Ω or less				Grounding terminal	*35*

Note: Use terminals B1 and ⊖ when installing a CDBR-type braking unit on drives with built-in braking transistors (Models 2A0004 to 2A0138, 4A0002 to 4A0072, and 5A0003 to 5A0052).

Wiring Fuses for Models 4A0930 and 4A1200

NOTICE: *If a fuse is blown or an Ground Fault Circuit Interrupter (GFCI) is tripped, check the wiring and the selection of peripheral devices to identify the cause. Contact Yaskawa before restarting the drive or the peripheral devices if the cause cannot be identified.*

Install a fuse on the input side to protect drive wiring and prevent other secondary damage. Wire the fuse so that leakage current in the upper controller power supply will trigger the fuse and shut off the power supply.

Select the appropriate fuse from *Table i.4*.

Table i.4 Input Fuses for Models 4A0930 and 4A1200

Voltage Class	Model	Selection			Input Fuse (Example)			
		Input Voltage	Current	Pre-arc I^2t (A^2s)	Model	Manufacturer	Rating	Pre-arc I^2t (A^2s)
Three-Phase 400 V Class	4A0930	480 V	1500 A	140000 to 3100000	CS5F-1200	Fuji Electric	AC500 V, 1200 A	276000
					FWH-1200A	Bussman	AC500 V, 1200 A	–
	4A1200	480 V	1500 A	320000 to 3100000	CS5F-1500	Fuji Electric	AC500 V, 1500 A	351000
					FWH-1600A	Bussman	AC500 V, 1600 A	–

◆ Protecting Main Circuit Terminals

■ Insulation Caps or Sleeves

Use insulation caps or sleeves when wiring the drive with crimp terminals. Take particular care to ensure that the wiring does not touch nearby terminals or the surrounding case.

■ Insulation Barrier

Insulation barriers are packaged with drive models 4A0414 through 4A1200 to provide added protection between terminals. Yaskawa recommends using the provided insulation barriers to ensure proper wiring. Refer to ***Figure i.10*** for instructions on placement of the insulation barriers.

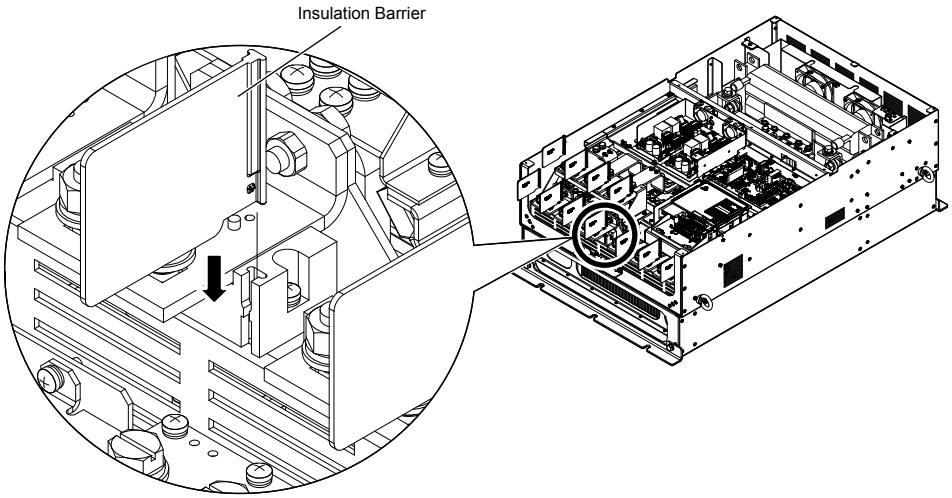


Figure i.10 Installing Insulation Barriers

◆ Main Circuit Wire Gauges and Tightening Torque

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

Gauges listed in the tables are for use in the United States.

Note:
1. Wire gauge recommendations based on drive continuous current ratings (ND) using 75 °C 600 Vac vinyl-sheathed wire assuming ambient temperature within 40 °C and wiring distance less than 100 m.
2. Terminals ⊕1, ⊕2, ⊕3, ⊖, B1 and B2 are for connecting optional power devices. Use caution to connect only approved devices to the correct terminal(s).

- Consider the amount of 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) = √3 × wire resistance (Ω/km) × wire length (m) × current (A) × 10^{-3}
- Refer to instruction manual TOBP C720600 00 for braking transistor option or braking resistor option wire gauges.
- Use terminals ⊕1 and ⊖ when connecting a regenerative converter or a regen unit.

  NOTICE: *Do not connect a braking resistor to terminals ⊕1 or ⊖. Failure to comply may cause damage to the drive circuitry.*
- Use terminals B1 and ⊖ when installing a CDBR-type braking unit on drives with built-in braking transistors (models 2A0004 to 2A0138, 4A0002 to 4A0072, and 5A0003 to 5A0052).

  NOTICE: *Do not connect a braking resistor to terminals ⊕1 or ⊖. Failure to comply may cause damage to the drive circuitry.*
- ***Refer to UL Standards Compliance on page 61*** for information on UL compliance.

Yaskawa recommends using closed-loop crimp terminals on all drive models. UL/cUL approval requires the use of closed-loop crimp terminals when wiring the drive main circuit terminals on models 2A0110 to 2A0415 and 4A0058 to 4A1200. Use only the tools recommended by the terminal manufacturer for crimping. ***Refer to Closed-Loop Crimp Terminal Size on page 31*** for closed-loop crimp terminal recommendations.

The wire gauges listed in the following tables are Yaskawa recommendations. Refer to local codes for proper wire gauge selections.

■ Three-Phase 200 V Class

Table i.5 Wire Gauge and Torque Specifications (Three-Phase 200 V Class)

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
2A0004 2A0006 2A0008 2A0010	R/L1, S/L2, T/L3	14	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	⊖, ⊕1, ⊕2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10 <1>	14 to 10		
2A0012	R/L1, S/L2, T/L3	12	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	⊖, ⊕1, ⊕2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10 <1>	14 to 10		
2A0018	R/L1, S/L2, T/L3	10	12 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	10	14 to 10		
	⊖, ⊕1, ⊕2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10 <1>	14 to 10		
2A0021	R/L1, S/L2, T/L3	10	12 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	10	12 to 10		
	⊖, ⊕1, ⊕2	–	12 to 10		
	B1, B2	–	14 to 10		
	⏚	10 <1>	12 to 10		
2A0030	R/L1, S/L2, T/L3	8	10 to 6	M4	2.1 to 2.3 (18.6 to 20.4)
	U/T1, V/T2, W/T3	8	10 to 6		
	⊖, ⊕1, ⊕2	–	10 to 6		
	B1, B2	–	14 to 10		
	⏚	8 <2>	10 to 8	M5	2.0 to 2.5 (17.7 to 22.1)
2A0040	R/L1, S/L2, T/L3	6	8 to 6	M4	2.1 to 2.3 (18.6 to 20.4)
	U/T1, V/T2, W/T3	8	8 to 6		
	⊖, ⊕1, ⊕2	–	6		
	B1, B2	–	12 to 10		
	⏚	8 <2>	10 to 8	M5	2.0 to 2.5 (17.7 to 22.1)
2A0056	R/L1, S/L2, T/L3	4	6 to 4	M6	5.4 to 6.0 (47.8 to 53.1)
	U/T1, V/T2, W/T3	4	6 to 4		
	⊖, ⊕1, ⊕2	–	6 to 4		
	B1, B2	–	10 to 6	M5	2.7 to 3.0 (23.9 to 26.6)
	⏚	6	8 to 6	M6	5.4 to 6.0 (47.8 to 53.1)
2A0069	R/L1, S/L2, T/L3	3	4 to 3	M8	9.9 to 11.0 (87.6 to 97.4)
	U/T1, V/T2, W/T3	3	4 to 3		
	⊖, ⊕1, ⊕2	–	4 to 3		
	B1, B2	–	8 to 6	M5	2.7 to 3.0 (23.9 to 26.6)
	⏚	6	6 to 4	M6	5.4 to 6.0 (47.8 to 53.1)

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
2A0081	R/L1, S/L2, T/L3	2	3 to 2	M8	9.9 to 11.0 (87.6 to 97.4)
	U/T1, V/T2, W/T3	2	3 to 2		
	⊖, ⊕1, ⊕2	–	3 to 2		
	B1, B2	–	6	M5	2.7 to 3.0 (23.9 to 26.6)
	⏚	6	6 to 4	M6	5.4 to 6.0 (47.8 to 53.1)
2A0110	R/L1, S/L2, T/L3	1/0	3 to 1/0	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	1/0	3 to 1/0		
	⊖, ⊕1	–	2 to 1/0		
	B1, B2	–	6 to 1/0		
	⏚	6	6 to 4		
2A0138	R/L1, S/L2, T/L3	2/0	1 to 2/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	2/0	1 to 2/0		
	⊖, ⊕1	–	1/0 to 3/0		
	B1, B2	–	4 to 2/0		
	⏚	4	4	M8	9 to 11 (79.7 to 97.4)
2A0169	R/L1, S/L2, T/L3	4/0	2/0 to 4/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	4/0	3/0 to 4/0		
	⊖, ⊕1	–	1 to 4/0		
	⊕3	–	1/0 to 4/0		
	⏚	4	4 to 2		
2A0211	R/L1, S/L2, T/L3	1/0 × 2P	1/0 to 2/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	1/0 × 2P	1/0 to 2/0		
	⊖, ⊕1	–	1 to 4/0		
	⊕3	–	1/0 to 4/0		
	⏚	4	4 to 1/0		
2A0250	R/L1, S/L2, T/L3	3/0 × 2P	3/0 to 300	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	3/0 × 2P	3/0 to 300		
	⊖, ⊕1	–	3/0 to 300		
	⊕3	–	2 to 300	M10	18 to 23 (159 to 204)
	⏚	3	3 to 300	M12	32 to 40 (283 to 354)
2A0312	R/L1, S/L2, T/L3	4/0 × 2P	3/0 to 300	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	3/0 × 2P	3/0 to 300		
	⊖, ⊕1	–	3/0 to 300		
	⊕3	–	3/0 to 300	M10	18 to 23 (159 to 204)
	⏚	2	2 to 300	M12	32 to 40 (283 to 354)
2A0360	R/L1, S/L2, T/L3	250 × 2P	4/0 to 600	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	4/0 × 2P	4/0 to 600		
	⊖, ⊕1	–	250 to 600		
	⊕3	–	3/0 to 600	M10	18 to 23 (159 to 204)
	⏚	1	1 to 350	M12	32 to 40 (283 to 354)

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
2A0415	R/L1, S/L2, T/L3	350 × 2P	250 to 600	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	300 × 2P	300 to 600		
	⊖, ⊕1	–	300 to 600		
	⊕3	–	3/0 to 600	M10	18 to 23 (159 to 204)
	⏚	1	1 to 350	M12	32 to 40 (283 to 354)

<1> Install a GFCI when using this wire gauge in accordance with IEC/EN 61800-5-1.

<2> Install a GFCI, or use 10 mm^2 (AWG 8) copper wire when using this wire gauge in accordance with IEC/EN 61800-5-1.

Note: When connecting peripheral devices or options to terminals ⊖, ⊕1, ⊕3, B1, and B2, refer to the instruction manual for each device. For more information, contact Yaskawa or your nearest sales representative.

■ Three-Phase 400 V Class

Table i.6 Wire Gauge and Torque Specifications (Three-Phase 400 V Class)

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
4A0002 4A0004	R/L1, S/L2, T/L3	14	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	⊖, ⊕1, ⊕2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	12 <1>	14 to 12		
4A0005 4A0007 4A0009	R/L1, S/L2, T/L3	14	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	⊖, ⊕1, ⊕2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10 <1>	14 to 10		
4A0011	R/L1, S/L2, T/L3	12	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	⊖, ⊕1, ⊕2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10 <1>	14 to 10		
4A0018	R/L1, S/L2, T/L3	10	12 to 6	M4	2.1 to 2.3 (18.6 to 20.4)
	U/T1, V/T2, W/T3	10	12 to 6		
	⊖, ⊕1, ⊕2	–	12 to 6		
	B1, B2	–	12 to 10		
	⏚	10 <1>	14 to 10	M5	2.0 to 2.5 (17.7 to 22.1)
4A0023	R/L1, S/L2, T/L3	10	10 to 6	M4	2.1 to 2.3 (18.6 to 20.4)
	U/T1, V/T2, W/T3	10	10 to 6		
	⊖, ⊕1, ⊕2	–	12 to 6		
	B1, B2	–	12 to 10		
	⏚	10 <1>	12 to 10	M5	2.0 to 2.5 (17.7 to 22.1)
4A0031	R/L1, S/L2, T/L3	8	8 to 6	M5	3.6 to 4.0 (31.8 to 35.4)
	U/T1, V/T2, W/T3	8	10 to 6		
	⊖, ⊕1, ⊕2	–	10 to 6		
	B1, B2	–	10 to 8		2.7 to 3.0 (23.9 to 26.6)
	⏚	8 <2>	10 to 8	M6	5.4 to 6.0 (47.8 to 53.1)

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
4A0038	R/L1, S/L2, T/L3	6	8 to 6	M5	3.6 to 4.0 (31.8 to 35.4)
	U/T1, V/T2, W/T3	8	8 to 6		
	⊖, ⊕1, ⊕2	–	6		
	B1, B2	–	10 to 8		2.7 to 3.0 (23.9 to 26.6)
	⏚	6	10 to 6	M6	5.4 to 6.0 (47.8 to 53.1)
4A0044	R/L1, S/L2, T/L3	6	6 to 4	M6	5.4 to 6.0 (47.8 to 53.1)
	U/T1, V/T2, W/T3	6	6 to 4		
	⊖, ⊕1, ⊕2	–	6 to 4		
	B1, B2	–	10 to 8	M5	2.7 to 3.0 (23.9 to 26.6)
	⏚	6	8 to 6	M6	5.4 to 6.0 (47.8 to 53.1)
4A0058	R/L1, S/L2, T/L3	4	6 to 4	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	4	6 to 4		
	⊖, ⊕1	–	6 to 1		
	B1, B2	–	8 to 4		
	⏚	6	8 to 6		
4A0072	R/L1, S/L2, T/L3	3	4 to 3	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	3	4 to 3		
	⊖, ⊕1	–	4 to 1		
	B1, B2	–	6 to 3		
	⏚	6	6		
4A0088	R/L1, S/L2, T/L3	2	3 to 1/0	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	2	3 to 1/0		
	⊖, ⊕1	–	3 to 1/0		
	⊕3	–	6 to 1/0		
	⏚	4	6 to 4		
4A0103	R/L1, S/L2, T/L3	1/0	2 to 1/0	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	1	2 to 1/0		
	⊖, ⊕1	–	3 to 1/0		
	⊕3	–	4 to 1/0		
	⏚	4	6 to 4		
4A0139	R/L1, S/L2, T/L3	3/0	1/0 to 4/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	2/0	1/0 to 4/0		
	⊖, ⊕1	–	1/0 to 4/0		
	⊕3	–	3 to 4/0		
	⏚	4	4		
4A0165	R/L1, S/L2, T/L3	4/0	3/0 to 4/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	4/0	3/0 to 4/0		
	⊖, ⊕1	–	1 to 4/0		
	⊕3	–	1/0 to 4/0		
	⏚	4	4 to 2		
4A0208	R/L1, S/L2, T/L3	300	2 to 300	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	300	2 to 300		
	⊖, ⊕1	–	1 to 250		
	⊕3	–	3 to 3/0		
	⏚	4	4 to 300		

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
4A0250	R/L1, S/L2, T/L3	400	1 to 600	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	400	1/0 to 600		
	⊖, ⊕1	–	3/0 to 600		
	⊕3	–	1 to 325		
	⏚	2	2 to 350		
4A0296	R/L1, S/L2, T/L3	500	2/0 to 600	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	500	2/0 to 600		
	⊖, ⊕1	–	3/0 to 600		
	⊕3	–	1 to 325	M10	18 to 23 (159 to 204)
	⏚	2	2 to 350	M12	32 to 40 (283 to 354)
4A0362	R/L1, S/L2, T/L3	4/0 × 2P	3/0 to 600	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	4/0 × 2P	3/0 to 600		
	⊖, ⊕1	–	4/0 to 600		
	⊕3	–	3/0 to 600	M10	18 to 23 (159 to 204)
	⏚	1	1 to 350	M12	32 to 40 (283 to 354)
4A0414	R/L1, S/L2, T/L3	300 × 2P	4/0 to 300	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	300 × 2P	4/0 to 300		
	⊖, ⊕1	–	3/0 to 300		
	⊕3	–	3/0 to 300		
	⏚	1	1 to 3/0		
4A0515	R/L1, S/L2, T/L3	3/0 × 4P	3/0 to 300	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	4/0 × 4P	3/0 to 300		
	⊖, ⊕1	–	1/0 to 300		
	⊕3	–	1/0 to 300		
	⏚	1/0	1/0 to 300		
4A0675	R/L1, S/L2, T/L3	300 × 4P	4/0 to 300	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	300 × 4P	4/0 to 300		
	⊖, ⊕1	–	1/0 to 300		
	⊕3	–	1/0 to 300		
	⏚	2/0	2/0 to 300		
4A0930	R/L1, S/L2, T/L3, R1/L11, S1/L21, T1/L31	4/0 × 4P×2	3/0 to 300	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	4/0 × 4P×2	3/0 to 300		
	⊖, ⊕1	–	4/0 to 300		
	⊕3	–	4/0 to 300		
	⏚	3/0	3/0 to 250		
4A1200	R/L1, S/L2, T/L3, R1/L11, S1/L21, T1/L31	300 × 4P×2	4/0 to 300	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	300 × 4P×2	4/0 to 300		
	⊖, ⊕1	–	250 to 300		
	⊕3	–	4/0 to 300		
	⏚	4/0	4/0 to 250		

<1> Install a GFCI when using this wire gauge in accordance with IEC/EN 61800-5-1.

<2> Install a GFCI or use 10 mm ^{2} (AWG 8) copper wire when using this wire gauge in accordance with IEC/EN 61800-5-1.

Note: When connecting peripheral devices or options to terminals ⊖, ⊕1, ⊕3, B1, and B2, refer to the instruction manual for each device. For more information, contact Yaskawa or your nearest sales representative.

■ Three-Phase 600 V Class

Table i.7 Wire Gauge and Torque Specifications (Three-Phase 600 V Class)

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
5A0003 5A0004 5A0006	R/L1, S/L2, T/L3	14	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	⊖, ⊕1, ⊕2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10	14 to 10		
5A0009	R/L1, S/L2, T/L3	14	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	⊖, ⊕1, ⊕2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10	12 to 10		
5A0011	R/L1, S/L2, T/L3	10	14 to 6	M4	2.1 to 2.3 (18.6 to 20.4)
	U/T1, V/T2, W/T3	14	14 to 6		
	⊖, ⊕1, ⊕2	–	14 to 6		
	B1, B2	–	14 to 10		
	⏚	8	12 to 8	M5	2.0 to 2.5 (17.7 to 22.1)
5A0017	R/L1, S/L2, T/L3	10	10 to 6	M5	3.6 to 4.0 (31.8 to 35.4)
	U/T1, V/T2, W/T3	10	10 to 6		
	⊖, ⊕1, ⊕2	–	10 to 6		
	B1, B2	–	10 to 8		2.7 to 3.0 (23.9 to 26.6)
	⏚	8	12 to 8	M6	5.4 to 6.0 (47.8 to 53.1)
5A0022	R/L1, S/L2, T/L3	8	10 to 6	M5	3.6 to 4.0 (31.8 to 35.4)
	U/T1, V/T2, W/T3	10	10 to 6		
	⊖, ⊕1, ⊕2	–	10 to 6		
	B1, B2	–	10 to 8		2.7 to 3.0 (23.9 to 26.6)
	⏚	8	10 to 6	M6	5.4 to 6.0 (47.8 to 53.1)
5A0027 5A0032	R/L1, S/L2, T/L3	6	6 to 4	M6	5.4 to 6.0 (47.8 to 53.1)
	U/T1, V/T2, W/T3	6	6 to 4		
	⊖, ⊕1, ⊕2	–	6 to 4		
	B1, B2	–	10 to 8	M5	2.7 to 3.0 (23.9 to 26.6)
	⏚	6	10 to 6	M6	5.4 to 6.0 (47.8 to 53.1)
5A0041	R/L1, S/L2, T/L3	6	10 to 3	M8	9.0 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	6	10 to 3		
	⊖, ⊕1	–	6 to 1		
	B1, B2	–	12 to 3		
	⏚	6	6		
5A0052	R/L1, S/L2, T/L3	4	10 to 3	M8	9.0 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	6	10 to 3		
	⊖, ⊕1	–	6 to 1		
	B1, B2	–	8 to 3		
	⏚	6	6		

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
5A0062	R/L1, S/L2, T/L3	4	10 to 4/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	4	10 to 4/0		
	⊖, ⊕1	–	4 to 4/0		
	⊕3	–	6 to 4/0		
	⏚	4	4		
5A0077	R/L1, S/L2, T/L3	3	10 to 4/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	3	10 to 4/0		
	⊖, ⊕1	–	3 to 4/0		
	⊕3	–	6 to 4/0		
	⏚	4	4		
5A0099	R/L1, S/L2, T/L3	1/0	10 to 4/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	1	10 to 4/0		
	⊖, ⊕1	–	2 to 4/0		
	⊕3	–	4 to 4/0		
	⏚	4	4		
5A0125	R/L1, S/L2, T/L3	2/0	1 to 300	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	2/0	1 to 300		
	⊖, ⊕1	–	2/0 to 3/0		
	⊕3	–	1 to 1/0		
	⏚	3	4 to 300		
5A0145	R/L1, S/L2, T/L3	3/0	2/0 to 300	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	3/0	2/0 to 300		
	⊖, ⊕1	–	3/0 to 4/0		
	⊕3	–	1/0 to 2/0		
	⏚	3	4 to 300		
5A0192	R/L1, S/L2, T/L3	300	2/0 to 600	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	250	2/0 to 600		
	⊖, ⊕1	–	2/0 to 400		
	⊕3	–	2/0 to 250	M10	18 to 23 (159 to 204)
	⏚	1	1 to 350	M12	32 to 40 (283 to 354)
5A0242	R/L1, S/L2, T/L3	400	2/0 to 600	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	350	2/0 to 600		
	⊖, ⊕1	–	2/0 to 500		
	⊕3	–	250 to 300	M10	18 to 23 (159 to 204)
	⏚	1	1 to 350	M12	32 to 40 (283 to 354)

Note: When connecting peripheral devices or options to terminals ⊖, ⊕1, ⊕3, B1, and B2 , refer to the instruction manual for each device. For more information, contact Yaskawa or your nearest sales representative.

Closed-Loop Crimp Terminal Recommendations

To maintain UL/cUL approval, UL Listed closed-loop crimp terminals are specifically required when wiring the drive main circuit terminals on models 2A0110 to 2A0415, 4A0058 to 4A1200, and 5A0041 to 5A0242. Use only the tools recommended by the terminal manufacturer for crimping. Yaskawa recommends crimp terminals made by JST and Tokyo DIP (or equivalent) for the insulation cap. ***Table i.8*** matches the wire gauges and terminal screw sizes with Yaskawa-recommended crimp terminals, tools, and insulation caps. Refer to the appropriate Wire Gauge and Torque Specifications table for the wire gauge and screw size for your drive model. Place orders with a Yaskawa representative or the Yaskawa sales department.

Wire gauge values shown in ***bold italic*** are the recommended values. Refer to local codes for proper selections.

Table i.8 Closed-Loop Crimp Terminal Size

Drive Model	Wire Gauge (AWG, kcmil)		Screw Size	Crimp Terminal Model Number	Tool		Insulation Cap Model No.	Code <1>
	R/L1, S/L2, T/L3	U/T1, V/T2, W/T3			Machine No.	Die Jaw		
200 V Class								
2A0004 2A0006 2A0008 2A0010	***14***		M4	R2-4	YA-4	AD-900	TP-003	100-054-028
	12			R5.5-4			TP-005	100-054-029
	10							
2A0012	14	***14***	M4	R2-4	YA-4	AD-900	TP-003	100-054-028
	12	12		R5.5-4			TP-005	100-054-029
	10							
2A0018	–	14	M4	R2-4	YA-4	AD-900	TP-003	100-054-028
	12			R5.5-4			TP-005	100-054-029
	10							
2A0021	12		M4	R5.5-4	YA-4	AD-900	TP-005	100-054-029
	10							
2A0030	10		M4	R5.5-4	YA-4	AD-900	TP-005	100-054-029
	8			8-4		AD-901	TP-008	100-054-031
	6			14-NK4		AD-902	TP-014	100-054-033
2A0040	8	***8***	M4	8-4	YA-4	AD-901	TP-008	100-054-031
	6	6		14-NK4		AD-902	TP-014	100-054-033
2A0056	6		M6	R14-6	YA-5	AD-952	TP-014	100-051-261
	4			R22-6		AD-953	TP-022	100-051-262
2A0069	4		M8	R22-8	YA-5	AD-953	TP-022	100-051-263
	3			R38-8		AD-954	TP-038	100-051-264
2A0081	3		M8	R38-8	YA-5	AD-954	TP-038	100-051-264
	2							
2A0110	3		M8	R38-8	YA-5	AD-954	TP-038	100-051-264
	2							
	1							
	1/0			R60-8	YA-5	AD-955	TP-060	100-051-265
2A0138	1		M10	R38-10	YF-1 YET-300-1	TD-321, TD-311	TP-060	100-061-114
	1/0			R60-10				100-051-266
	2/0			70-10		TD-323, TD-312	TP-080	100-054-036
2A0169	2/0	–	M10	70-10	YF-1 YET-300-1	TD-323, TD-312	TP-080	100-054-036
	3/0			80-10				100-051-267
	4/0			R100-10		TD-324, TD-312	TP-100	100-051-269
2A0211	***1/0 × 2P***		M10	R60-10	YF-1 YET-300-1	TD-321, TD-311	TP-060	100-051-266
	2/0 × 2P			70-10		TD-323, TD-312	TP-080	100-054-036

Drive Model	Wire Gauge (AWG, kcmil)		Screw Size	Crimp Terminal Model Number	Tool		Insulation Cap Model No.	Code <1>
	R/L1, S/L2, T/L3	U/T1, V/T2, W/T3			Machine No.	Die Jaw		
2A0250	***3/0 × 2P***		M12	80-L12	YF-1 YET-300-1	TD-323, TD-312	TP-080	100-051-558
	4/0 × 2P			100-L12		TD-324, TD-312	TP-100	100-051-560
	–	250 × 2P		150-L12		TD-325, TD-313	TP-150	100-051-562
	250	–		R150-12			TP-150	100-051-273
	300							
2A0312	3/0 × 2P	***3/0 × 2P***	M12	80-L12	YF-1 YET-300-1	TD-323, TD-312	TP-080	100-051-558
	4/0 × 2P	4/0 × 2P		100-L12		TD-324, TD-312	TP-100	100-051-560
	250 × 2P			150-L12		TD-325, TD-313	TP-150	100-051-562
	300 × 2P							
2A0360	4/0 × 2P	***4/0 × 2P***	M12	100-L12	YF-1 YET-300-1	TD-324, TD-312	TP-100	100-051-560
	250 × 2P	250 × 2P		150-L12		TD-325, TD-313	TP-150	100-051-562
	300 × 2P							
	350 × 2P			180-L12		TD-327, TD-314	TP-200	100-066-688
	400 × 2P			200-L12				100-051-564
	500 × 2P			325-12		TD-328, TD-315	TP-325	100-051-277
	600	600 × 2P						
2A0415	250 × 2P	–	M12	150-L12	YF-1 YET-300-1	TD-325, TD-313	TP-150	100-051-562
	300 × 2P	***300 × 2P***						
	350 × 2P	350 × 2P		180-L12		TD-327, TD-314	TP-200	100-066-688
	400 × 2P			200-L12				100-051-564
	500 × 2P			325-12		TD-328, TD-315	TP-325	100-051-277
	600 × 2P							
400 V Class								
4A0002 4A0004 4A0005 4A0007 4A0009	***14***		M4	R2-4	YA-4	AD-900	TP-003	100-054-028
	12			R5.5-4			TP-005	100-054-029
	10							
4A0011	14	***14***	M4	R2-4	YA-4	AD-900	TP-003	100-054-028
	12	12		R5.5-4			TP-005	100-054-029
	10							
4A0018	12		M4	R5.5-4	YA-4	AD-900	TP-005	100-054-029
	10							
	8			8-4		AD-901	TP-008	100-054-031
	6			14-NK4		AD-902	TP-014	100-054-033
4A0023	**10**		M4	R5.5-4	YA-4	AD-900	TP-005	100-054-029
	8			8-4		AD-901	TP-008	100-054-031
	6			14-NK4		AD-902	TP-014	100-054-033
4A0031	–	10	M5	R5.5-5	YA-4	AD-900	TP-005	100-054-030
	8			R8-5		AD-901	TP-008	100-054-032
	6			R14-5		AD-902	TP-014	100-054-034
4A0038	8	***8***	M5	R8-5	YA-4	AD-901	TP-008	100-054-032
	6	6		R14-5		AD-902	TP-014	100-054-034
4A0044	***6***		M6	R14-6	YA-5	AD-952	TP-014	100-051-261
	4			R22-6		AD-953	TP-022	100-051-262
4A0058	6		M8	R14-8	YA-5	AD-952	TP-014	100-054-035
	4			R22-8		AD-953	TP-022	100-051-263

Drive Model	Wire Gauge (AWG, kcmil)		Screw Size	Crimp Terminal Model Number	Tool		Insulation Cap Model No.	Code <1>
	R/L1, S/L2, T/L3	U/T1, V/T2, W/T3			Machine No.	Die Jaw		
4A0072	4		M8	R22-8	YA-5	AD-953	TP-022	100-051-263
	3			R38-8		AD-954	TP-038	100-051-264
4A0088	3		M8	R38-8	YA-5	AD-954	TP-038	100-051-264
	2							
	1							
	1/0			R60-8		AD-955	TP-060	100-051-265
4A0103	2		M8	R38-8	YA-5	AD-954	TP-038	100-051-264
	1	***1***						
	1/0	1/0		R60-8		AD-955	TP-060	100-051-265
4A0139	1/0		M10	R60-10	YF-1 YET-300-1	TD-321, TD-311	TP-060	100-051-266
	2/0	***2/0***		70-10		TD-323, TD-312	TP-080	100-054-036
	3/0	3/0		80-10				100-051-267
	4/0			R100-10		TD-324, TD-312	TP-100	100-051-269
4A0165	3/0		M10	80-10	YF-1 YET-300-1	TD-323, TD-312	TP-080	100-051-267
	4/0			R100-10		TD-324, TD-312	TP-100	100-051-269
4A0208	2 × 2P		M10	38-L10	YF-1 YET-150-1	TD-224, TD-212	TP-038	100-051-556
	1 × 2P							
	3/0 × 2P			80-L10		TD-227, TD-214	TP-080	100-051-557
	4/0			R100-10		TD-228, TD-214	TP-100	100-051-269
	250			R150-10		TD-229, TD-215	TP-150	100-051-272
	300							
4A0250	1 × 2P	–	M10	38-L10	YF-1 YET-150-1	TD-224, TD-212	TP-038	100-051-556
	3/0 × 2P			80-L10		TD-227, TD-214	TP-080	100-051-557
	4/0 × 2P			100-L10		TD-228, TD-214	TP-100	100-051-559
	250 × 2P			150-L10		TD-229, TD-215	TP-150	100-051-561
	300			R150-10			TP-150	100-051-272
	350			180-10	YF-1 YET-300-1	TD-327, TD-314	TP-200	100-066-687
	400			200-10				100-051-563
	500			325-10		TD-328, TD-315	TP-325	100-051-565
	600							
4A0296	3/0 × 2P		M12	80-L12	YF-1 YET-300-1	TD-323, TD-312	TP-080	100-051-558
	4/0 × 2P			100-L12		TD-324, TD-312	TP-100	100-051-560
	250 × 2P			150-L12		TD-325, TD-313	TP-150	100-051-562
	300 × 2P							
	–	350 × 2P		180-L12		TD-327, TD-314	TP-200	100-066-688
	350	–		180-12				100-066-689
	400			R200-12				100-051-275
	500			325-12		TD-328, TD-315	TP-325	100-051-277
	600							

Drive Model	Wire Gauge (AWG, kcmil)		Screw Size	Crimp Terminal Model Number	Tool		Insulation Cap Model No.	Code <1>
	R/L1, S/L2, T/L3	U/T1, V/T2, W/T3			Machine No.	Die Jaw		
4A0362	3/0 × 2P		M12	80-L12	YF-1 YET-300-1	TD-323, TD-312	TP-080	100-051-558
	4/0 × 2P			100-L12		TD-324, TD-312	TP-100	100-051-560
	250 × 2P			150-L12		TD-325, TD-313	TP-150	100-051-562
	300 × 2P							
	350 × 2P			180-L12		TD-327, TD-314	TP-200	100-066-688
	400 × 2P			200-L12				100-051-564
	500			325-12		TD-328, TD-315	TP-325	100-051-277
	600							
4A0414	4/0 × 2P		M12	100-L12	YF-1 YET-300-1	TD-324, TD-312	TP-100	100-051-560
	250 × 2P			150-L12		TD-325, TD-313	TP-150	100-051-562
	300 × 2P							
4A0515	***3/0 × 4P***	3/0 × 4P	M12	80-L12	YF-1 YET-300-1	TD-323, TD-312	TP-080	100-051-558
	4/0 × 4P	***4/0 × 4P***		100-L12		TD-324, TD-312	TP-100	100-051-560
	250 × 4P			150-L12		TD-325, TD-313	TP-150	100-051-562
	300 × 2P							
4A0675	4/0 × 4P		M12	100-L12	YF-1 YET-300-1	TD-324, TD-312	TP-100	100-051-560
	250 × 4P			150-L12		TD-325, TD-313	TP-150	100-051-562
	300 × 4P							
4A0930	3/0 × 8P		M12	80-L12	YF-1 YET-300-1	TD-323, TD-312	TP-080	100-051-558
	4/0 × 8P			100-L12		TD-324, TD-312	TP-100	100-051-560
	250 × 8P			150-L12		TD-325, TD-313	TP-150	100-051-562
	300 × 8P							
4A1200	4/0 × 8P		M12	100-L12	YF-1 YET-300-1	TD-324, TD-312	TP-100	100-051-560
	250 × 8P			150-L12		TD-325, TD-313	TP-150	100-051-562
	300 × 8P							

<1> Codes refer to a set of three crimp terminals and three insulation caps. Prepare input and output wiring using two sets for each connection.
Example 1: Models with 300 kcmil for both input and output require one set for input terminals and one set for output terminals, so the user should order two sets of [100-051-272].
Example 2: Models with 4/0 AWG × 2P for both input and output require two sets for input terminals and two sets for output terminals, so the user should order four sets of [100-051-560].

Note: Use crimp insulated terminals or insulated shrink tubing for wiring connections. Wires should have a continuous maximum allowable temperature of 75 °C 600 Vac UL-approved vinyl-sheathed insulation.

■ Ground Wiring

Follow the precautions below when wiring the ground for one drive or a series of drives.

WARNING! *Electrical Shock Hazard. Make sure the protective earthing conductor complies with technical standards and local safety regulations. Because the leakage current exceeds 3.5 mA in models 4A0414 and larger, IEC/EN 61800-5-1 states that either the power supply must be automatically disconnected in case of discontinuity of the protective earthing conductor or a protective earthing conductor with a cross-section of at least 10 mm^2 (Cu) or 16 mm^2 (Al) must be used. Failure to comply may result in death or serious injury.*

WARNING! *Electrical Shock Hazard. Always use a ground wire that complies with technical standards on electrical equipment and minimize the length of the ground wire. Improper equipment grounding may cause dangerous electrical potentials on equipment chassis, which could result in death or serious injury.*

WARNING! *Electrical Shock Hazard. Be sure to ground the drive ground terminal (200 V class: ground to 100 Ω or less; 400 V class: ground to 10 Ω or less; 600 V class: ground to 10 Ω or less). Improper equipment grounding could result in death or serious injury by contacting ungrounded electrical equipment.*

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

NOTICE: *When using more than one drive, ground multiple drives according to instructions. Improper equipment grounding could result in abnormal operation of drive or equipment.*

Refer to ***Figure i.11*** when using multiple drives. Do not loop the ground wire.

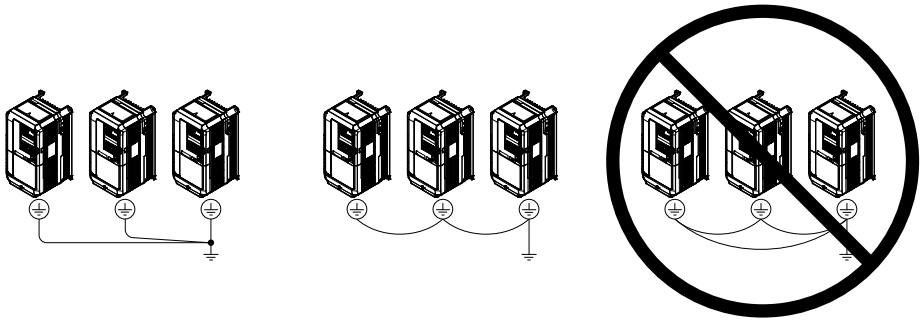


Figure i.11 Multiple Drive Wiring

◆ Control Circuit Connections

Drive parameters determine which functions apply to the multi-function digital inputs (S1 to S8), multi-function digital outputs (M1 to M4), multi-function analog inputs (A1 to A3), and multi-function analog monitor output (FM, AM). The default setting is listed next to each terminal in ***Figure i.9*** on page ***19***.

WARNING! *Sudden Movement Hazard. Always check the operation and wiring of control circuits after being wired. Operating a drive with untested control circuits could result in death or serious injury.*

WARNING! *Sudden Movement Hazard. Confirm the drive I/O signals and external sequence before starting test run. Setting parameter A1-06 may change the I/O terminal function automatically from the factory setting. Failure to comply may result in death or serious injury.*

◆ Terminal Configuration

The control circuit terminals are arranged as shown in ***Figure i.12***.

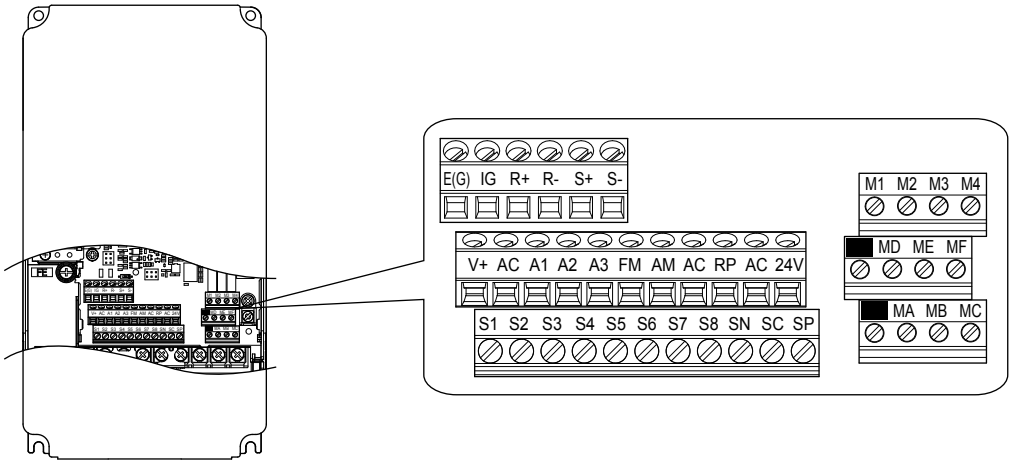


Figure i.12 Control Circuit Terminal Arrangement

◆ Control Circuit Input Terminals

Table i.9 lists the input terminals on the drive. Text in parenthesis indicates the default setting for each multi-function input.

Table i.9 Control Circuit Input Terminals

Type	No.	Terminal Name (Function)	Function (Signal Level) Default Setting
Multi-Function Digital Inputs	S1	Multi-function input 1 (Closed: Forward run, Open: Stop)	• Photocoupler • 24 Vdc, 8 mA • ***Refer to Sinking/Sourcing Mode for Digital Inputs on page 41***.
	S2	Multi-function input 2 (Closed: Reverse run, Open: Stop)	
	S3	Multi-function input 3 (External fault, N.O.)	
	S4	Multi-function input 4 (Fault reset)	
	S5	Multi-function input 5 (Multi-step speed reference 1)	
	S6	Multi-function input 6 (Multi-step speed reference 2)	
	S7	Multi-function input 7 (Jog reference)	
	S8	Multi-function input 8 (Baseblock command (N.O.))	
	SC	Multi-function input common	Multi-function input common
	SP	Digital input power supply +24 Vdc	24 Vdc power supply for digital inputs, 150 mA max
	SN	Digital input power supply 0 V 24 V transducer power supply 0 V	**NOTICE:** *Do not jumper or short terminals SP and SN. Failure to comply will damage the drive.*

Type	No.	Terminal Name (Function)	Function (Signal Level) Default Setting
Analog Inputs / Pulse Train Input	RP	Multi-function pulse train input (Frequency reference)	• Input frequency range: 0 to 32 kHz • Signal Duty Cycle: 30 to 70% • High level: 3.5 to 13.2 Vdc, low level: 0.0 to 0.8 Vdc • Input impedance: 3 kΩ
	+V	Power supply for analog inputs	10.5 Vdc (max allowable current 20 mA)
	24 V	+24 Vdc transducer power supply for customer use	150 mA maximum capacity
	A1	Multi-function analog input 1 (Frequency reference bias)	• -10 to 10 Vdc, 0 to 10 Vdc (input impedance: 20 kΩ) • 4 to 20 mA, 0 to 20 mA (input impedance: 250 Ω) • Voltage or current input must be selected by jumper S1 and H3-01.
	A2	Multi-function analog input 2 (Frequency reference bias)	• -10 to 10 Vdc, 0 to 10 Vdc (input impedance: 20 kΩ) • 4 to 20 mA, 0 to 20 mA (input impedance: 250 Ω) • Voltage or current input must be selected by jumper S1 and H3-09.
	A3	Multi-function analog input 3 (Frequency reference bias)	• -10 to 10 Vdc, 0 to 10 Vdc (input impedance: 20 kΩ) • 4 to 20 mA, 0 to 20 mA (input impedance: 250 Ω) • Voltage or current input must be selected by jumper S1 and H3-05.
	AC	Frequency reference common	0 V
	E (G)	Ground for shielded lines and option cards	–

◆ Control Circuit Output Terminals

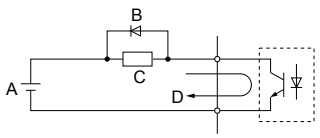
Table i.10 lists the output terminals on the drive. Text in parenthesis indicates the default setting for each multi-function output.

Table i.10 Control Circuit Output Terminals

Type	No.	Terminal Name (Function)	Function (Signal Level) Default Setting
Fault Relay Output	MA	N.O.	30 Vdc, 10 mA to 1 A; 250 Vac, 10 mA to 1 A Minimum load: 5 Vdc, 10 mA
	MB	N.C. output	
	MC	Fault output common	
Multi-Function Digital Output <1>	MD	N.O.	30 Vdc, 10 mA to 1 A; 250 Vac, 10 mA to 1 A Minimum load: 5 Vdc, 10 mA
	ME	N.C. Output	
	MF	Common (Speed agree)	
	M1	Multi-function digital output (During run)	30 Vdc, 10 mA to 1 A; 250 Vac, 10 mA to 1 A Minimum load: 5 Vdc, 10 mA
	M2		
	M3	Multi-function digital output (Zero speed)	
	M4		
Monitor Output	FM	Analog monitor output 1 (Output frequency)	-10 to +10 Vdc, or 0 to +10 Vdc
	AM	Analog monitor output 2 (Output current)	
	AC	Monitor common	0 V

<1> Refrain from assigning functions to digital relay outputs that involve frequent switching, as doing so may shorten relay performance life. Switching life is estimated at 200,000 times (assumes 1 A, resistive load).

Connect a suppression diode as shown in *Figure i.13* when driving a reactive load such as a relay coil. Ensure the diode rating is greater than the circuit voltage.



A – External power, 48 V max.
B – Suppression diode
C – Coil
D – 50 mA or less

Figure i.13 Connecting a Suppression Diode

■ Serial Communication Terminals

Table i.11 Control Circuit Terminals: Serial Communications

Type	No.	Signal Name	Function (Signal Level)	
MEMOBUS/Modbus Communication <1>	R+	Communications input (+)	MEMOBUS/Modbus communication: Use an RS-422 or RS-485 cable to connect the drive.	RS-422/RS-485 MEMOBUS/Modbus communication protocol 115.2 kbps (max.)
	R-	Communications input (-)		
	S+	Communications output (+)		
	S-	Communications output (-)		
	IG	Shield ground	0 V	

<1> Enable the termination resistor in the last drive in a MEMOBUS/Modbus network by setting DIP switch S2 to the ON position. Refer to the manual section on ***Control I/O Connections*** for more information.

■ Control Circuit Wire Size and Torque Specifications

Select appropriate wire type and gauges from ***Table i.12***. For simpler and more reliable wiring, use crimp ferrules on the wire ends. Refer to the Technical Manual on the CD-ROM packaged with the drive for ferrule terminal types and sizes.

Table i.12 Wire Gauges

Terminal	Screw Size	Tightening Torque N•m (lb. in)	Bare Wire Terminal		Ferrule-Type Terminal		Wire Type
			Applicable wire size mm² (AWG)	Recomm. wire size mm² (AWG)	Applicable wire size mm² (AWG)	Recomm. wire size mm² (AWG)	
S1-S8, SC, SN, SP	M3	0.5 to 0.6 (4.4 to 5.3)	Stranded wire: 0.2 to 1.0 (24 to 16) Solid wire: 0.2 to 1.5 (24 to 16)	0.75 (18)	0.25 to 0.5 (24 to 20)	0.5 (20)	Shielded wire, etc.
RP, V+, A1, A2, A3, AC, 24 V							
MA, MB, MC, MD, ME, MF							
M1-M4							
FM, AM, AC							
R+, R-, S+, S-, IG							

◆ Wiring the Control Circuit Terminal

This section describes the proper procedures and preparations for wiring the control terminals.

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

NOTICE: *Separate control circuit wiring from main circuit wiring (terminals R/L1, S/L2, T/L3, B1, B2, U/T1, V/T2, W/T3, ⊖, ⊕1, ⊕2) and other high-power lines. Improper wiring practices could result in drive malfunction due to electrical interference.*

NOTICE: *Separate wiring for digital output terminals MA, MB, MC, MD, ME, MF and M1 to M4 from wiring to other control circuit lines. Improper wiring practices could result in drive or equipment malfunction or nuisance trips.*

NOTICE: *Use a class 2 power supply when connecting to the control terminals. Improper application of peripheral devices could result in drive performance degradation due to improper power supply. Refer to NEC Article 725 Class 1, Class 2, and Class 3 Remote-Control, Signaling, and Power Limited Circuits for requirements concerning class 2 power supplies.*

NOTICE: *Insulate shields with tape or shrink tubing to prevent contact with other signal lines and equipment. Improper wiring practices could result in drive or equipment malfunction due to short circuit.*

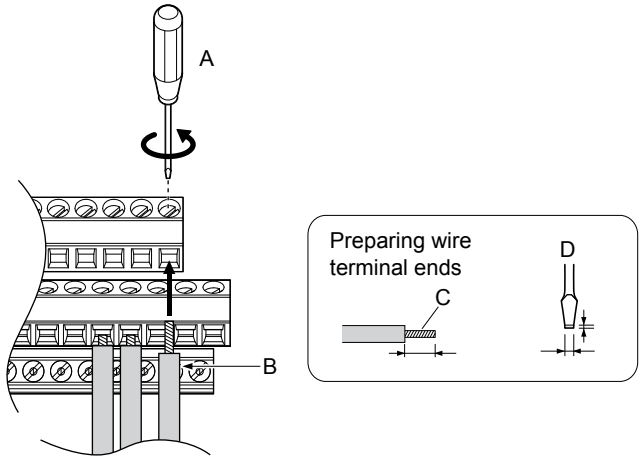
NOTICE: *Connect the shield of shielded cable to the appropriate ground terminal. Improper equipment grounding could result in drive or equipment malfunction or nuisance trips.*

NOTICE: *Do not tighten screws beyond the specified tightening torque. Failure to comply may result in erroneous operation, damage to the terminal block, or cause a fire.*

NOTICE: *Use shielded twisted-pair cables as indicated to prevent operating faults. Improper wiring practices could result in drive or equipment malfunction due to electrical interference.*

Wire the control circuit only after terminals have been properly grounded and main circuit wiring is complete. ***Refer to Terminal Board Wiring Guide on page 39*** for details. Prepare the ends of the control circuit wiring as shown in ***Figure i.16***. ***Refer to Wire Gauges on page 38***.

Connect control wires as shown in ***Figure i.14*** and ***Figure i.15***.



A – Loosen screw to insert wire.
B – Single wire or stranded wire
C – Avoid fraying wire strands when stripping insulation from wire. Strip length 5.5 mm.
D – Blade depth of 0.4 mm or less
Blade width of 2.5 mm or less

Figure i.14 Terminal Board Wiring Guide

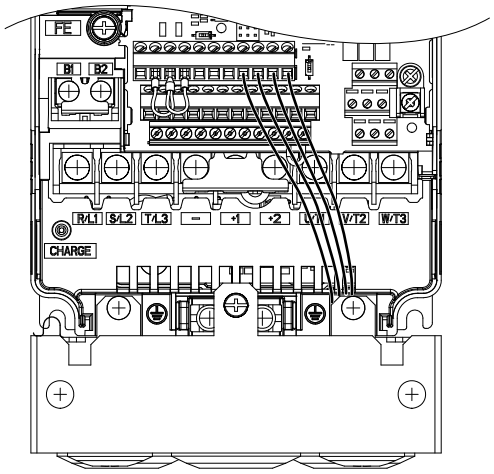
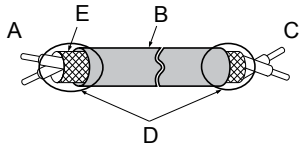


Figure i.15 Terminal Board Location Inside the Drive

When setting the frequency by analog reference from an external potentiometer, use shielded twisted-pair wires (preparing wire ends as shown in ***Figure i.16***) and connect the shield to the ground terminal of the drive.



A – Drive side
B – Insulation
C – Control device side
D – Shield sheath (insulate with tape)
E – Shield

Figure i.16 Preparing the Ends of Shielded Cables

NOTICE: *The analog signal wiring between the drive and the operator station or peripheral equipment should not exceed 50 meters when using an analog signal from a remote source to supply the frequency reference. Failure to comply could result in poor system performance.*

◆ Switches and Jumpers on the Terminal Board

The terminal board is equipped with several switches used to adapt the drive I/Os to the external control signals. ***Figure i.17*** shows the location of these switches.

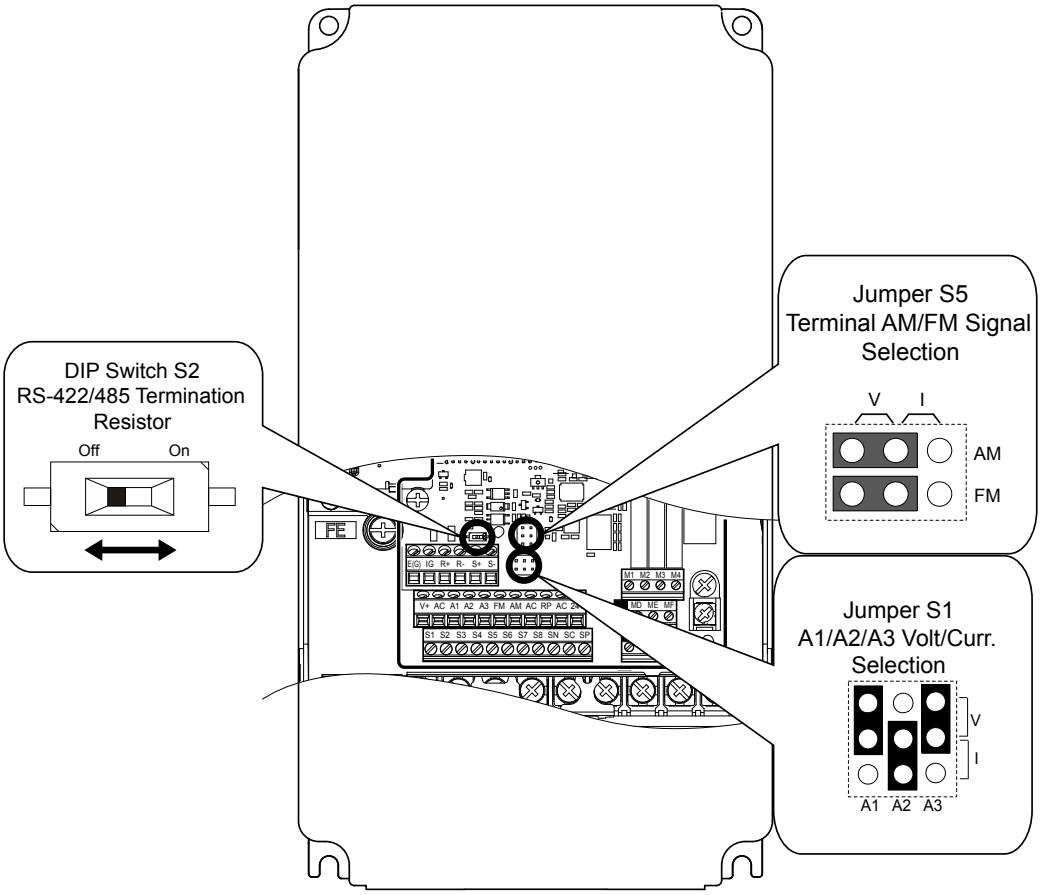


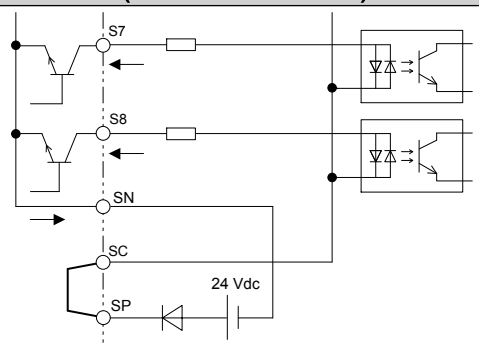
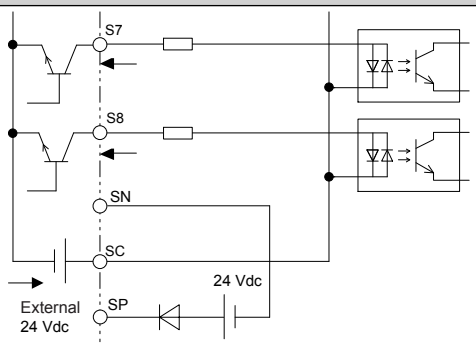
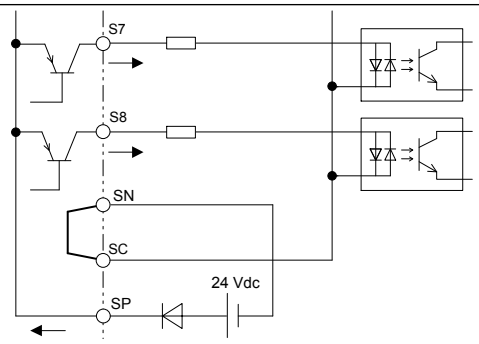
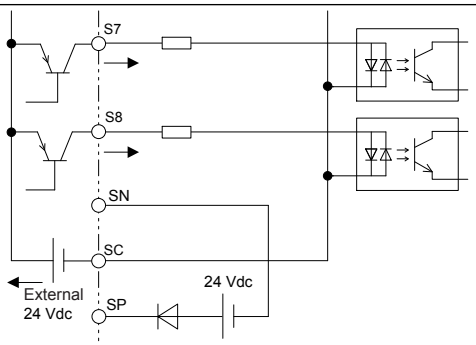
Figure i.17 Locations of Jumpers and Switches on the Terminal Board

◆ Sinking/Sourcing Mode for Digital Inputs

Use the wire jumper between terminals SC and SP or SC and SN to select between Sink mode, Source mode or external power supply for the digital inputs S1 to S8 as shown in ***Table i.13*** (Default: Sink mode, internal power supply).

NOTICE: *Do not short terminals SP and SN. Failure to comply will damage the drive.*

Table i.13 Digital Input Sink/Source/External Power Supply Selection

Mode	Drive Internal Power Supply (Terminals SN and SP)	External 24 Vdc Power Supply
Sinking Mode (NPN)		
Sourcing Mode (PNP)		

■ Using External Power Supply (Sink Mode)

The high voltage level of the pulse output signal depends on the external voltage applied. The voltage must be between 12 and 15 Vdc. The load resistance must be adjusted so that the current is lower than 16 mA.

External Power Supply (V)	Load Impedance (kΩ)
12 to 15 Vdc ±10%	1.0 kΩ or higher

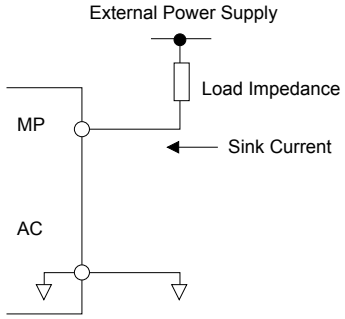


Figure i.18 Pulse Output Connection Using External Voltage Supply

◆ Terminals A1, A2, and A3 Input Signal Selection

Terminals A1, A2, and A3 can be used to input either a voltage or a current signal. Select the signal type using jumper S1 as explained in ***Table i.14***. Set parameters H3-01, H3-05, and H3-09 accordingly as shown in ***Table i.15***.

Note: If terminals A1 and A2 are both set for frequency bias (H3-02 = 0 and H3-10 = 0), both input values will be combined to create the frequency reference.

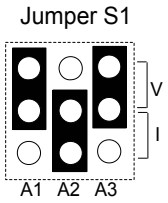


Figure i.19 Terminal A2 Set to Current Input; A1 and A3 Set to Voltage Input

Table i.14 Jumper S1 Settings

Setting	Description
V (top position)	Voltage input (-10 to +10 V or 0 to 10 V)
I (bottom position)	Current input (4 to 20 mA or 0 to 20 mA)

Table i.15 Voltage/Current Selection Parameter Details

No.	Parameter Name	Description	Setting Range	Default Setting
H3-01	Terminal A1 signal level selection	Selects the signal level for terminal A1. 0: 0 to 10 Vdc 1: 0 to 10 Vdc Bipolar 2: 4 to 20 mA 3: 0 to 20 mA	0 to 3	0
H3-05	Terminal A3 signal level selection	Selects the signal level for terminal A3. 0: 0 to 10 Vdc 1: 0 to 10 Vdc Bipolar 2: 4 to 20 mA 3: 0 to 20 mA	0 to 3	0
H3-09	Terminal A2 signal level selection	Selects the signal level for terminal A2. 0: 0 to 10 Vdc 1: 0 to 10 Vdc Bipolar 2: 4 to 20 mA 3: 0 to 20 mA	0 to 3	2

■ Motor Protection Using a Positive Temperature Coefficient (PTC) Thermistor

Connect a motor PTC can to an analog input of the drive for motor overheat protection.

The motor overheat alarm level triggers an oH3 alarm and the drive continues the operation selected in L1-03. The overheat fault level triggers an oH4 fault, outputs a fault signal, and the drive stops the motor using the stop method selected in L1-04.

Connect the PTC between terminals AC and A3 and install a 12 kOhm resistor between terminals V+ and A3 as shown in ***Figure i.20***. Set H3-05 to 0 and H3-06 to E.

Note: A 12 kOhm resistor must be connected between one of the terminals A1, A2, or A3 and V+ for PTC functionality. Connect the 12 kOhm resistor to the same terminal as the PTC input. Do not connect terminals V+ to AC, or damage to the drive may result.

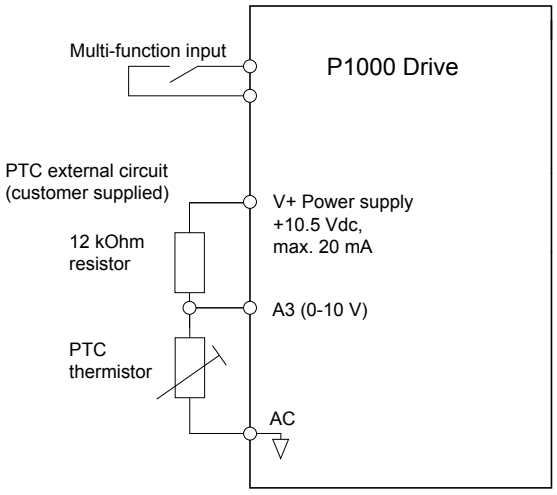


Figure i.20 Connection of a Motor PTC

The PTC must exhibit the characteristics shown in ***Figure i.21*** in one motor phase. The motor overload protection of the drive expects 3 of these PTCs to be connected in a series.

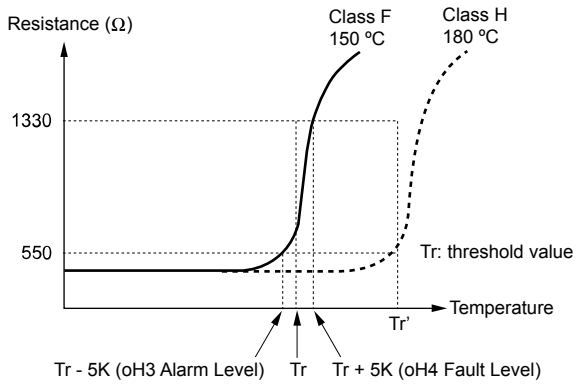


Figure i.21 Motor PTC Characteristics

Set up overheat detection using a PTC using parameters L1-03, L1-04, and L1-05 as explained in the following sections.

◆ Terminal AM/FM Signal Selection

The signal type for terminals AM and FM can be set to either voltage or current output using jumper S5 on the terminal board as explained in ***Table i.16***. When changing the setting of jumper S5, parameters H4-07 and H4-08 must be set accordingly. The default selection is voltage output for both terminals.

Table i.16 Jumper S5 Settings

Terminal	Voltage Output	Current Output
Terminal AM		
Terminal FM		

Table i.17 Parameter H4-07 and H4-08 Details

No.	Parameter Name	Description	Setting Range	Default Setting
H4-07	Terminal AM signal level selection	0: 0 to 10 Vdc 1: -10 to 10 Vdc 2: 4 to 20 mA	0 to 2	0
H4-08	Terminal FM signal level selection			

◆ MEMOBUS/Modbus Termination

This drive is equipped with a built-in termination resistor for the RS-422/485 communication port. DIP switch S2 enables or disabled the termination resistor as shown in ***Table i.18***. The OFF position is the default. The termination resistor should be placed to the ON position when the drive is the last in a series of slave drives. ***Refer to Switches and Jumpers on the Terminal Board on page 40*** to locate switch S2.

Table i.18 MEMOBUS/Modbus Switch Settings

S2 Position	Description
ON	Internal termination resistor ON
OFF	Internal termination resistor OFF (default setting)

i.4 Keypad Operation

◆ Digital Operator and Keys

The digital operator is used to program the drive, start and stop the drive, and to display fault information. The LEDs indicate the drive status.

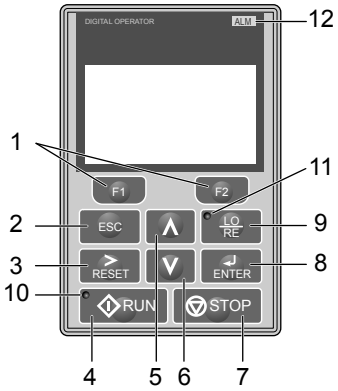


Figure i.22 Keys and Displays on the Digital Operator

■ Keys and Functions

No.	Display	Name	Function
1	F1 F2	Function Key (F1, F2)	The functions assigned to F1 and F2 vary depending on the currently displayed menu. The name of each function appears in the lower half of the display window.
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	Starts the drive in LOCAL mode. The Run LED: • is on, when the drive is operating the motor. • flashes during deceleration to stop or when the frequency reference is 0 • flashes quickly the drive is disabled by a DI, the drive was stopped using a fast stop DI or a run command was active during power up.
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 previous 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 operator (LOCAL) and an external source (REMOTE) for the Run command and frequency reference. The LED is on when the drive is in the LOCAL mode (operation from keypad).
10	RUN	RUN Light	Lit while the drive is operating the motor.
11	LO RE	LO/RE Light	Lit while the operator is selected to run the drive (LOCAL mode).

No.	Display	Name	Function
12	ALM	ALM LED Light	On: When the drive detects a fault. Flashing: • When an alarm occurs. • When oPE is detected. • When a fault or error occurs during Auto-Tuning.

<1> The STOP key has highest priority. Pressing the STOP key 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.

◆ Menu Structure for Digital Operator

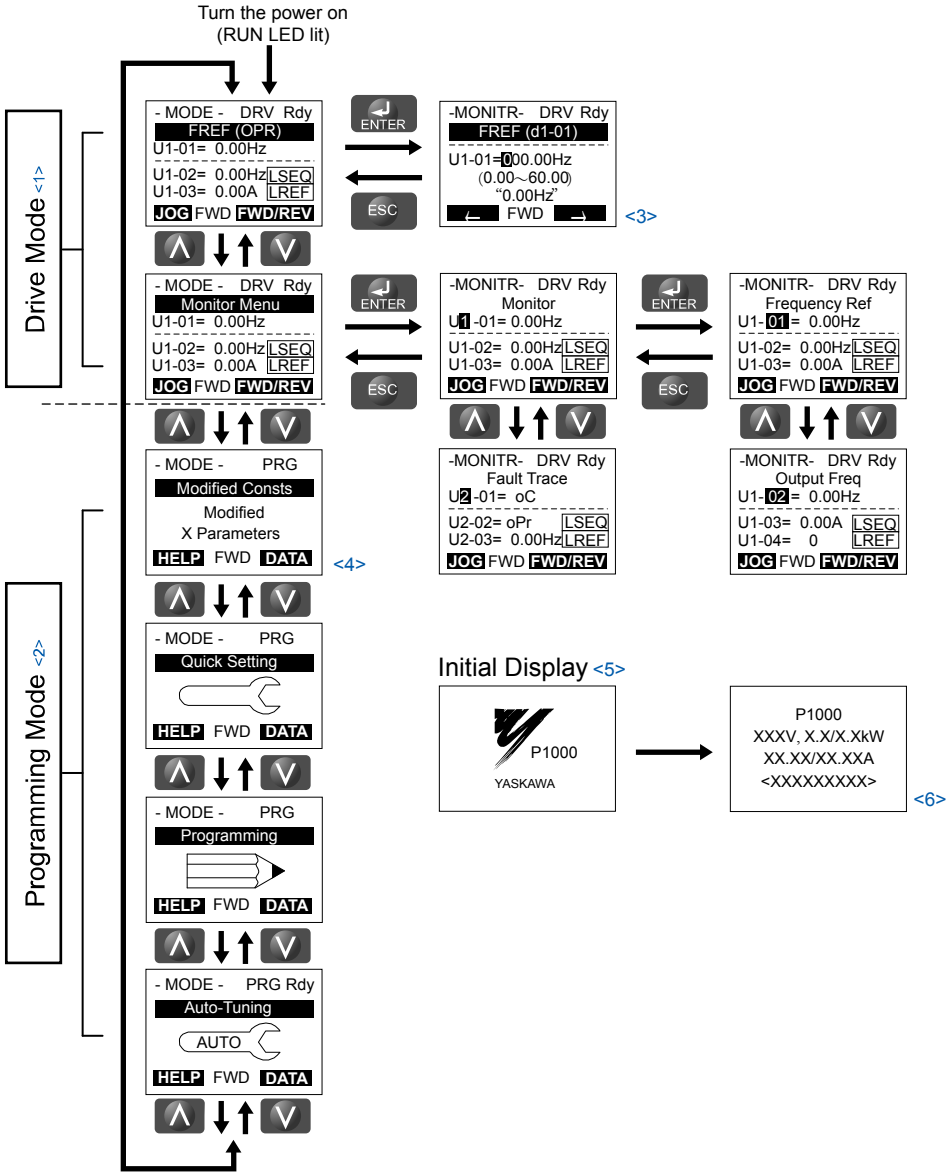


Figure i.23 Digital Operator Menu and Screen Structure

<1> Pressing RUN will start the motor.

<2> Drive cannot operate motor.

<3> Flashing characters are shown as 0.

<4> "X" characters are used as examples in this manual. The LCD Operator will display the actual setting values.

<5> The Frequency Reference appears after the initial display that shows the product name.

<6> The information that appears on the display will vary depending on the drive.

i.5 Start Up

◆ Drive Setup Procedure

Figure i.24 summarizes steps to start the drive and gives quick references to familiarize the user with start-up procedures.

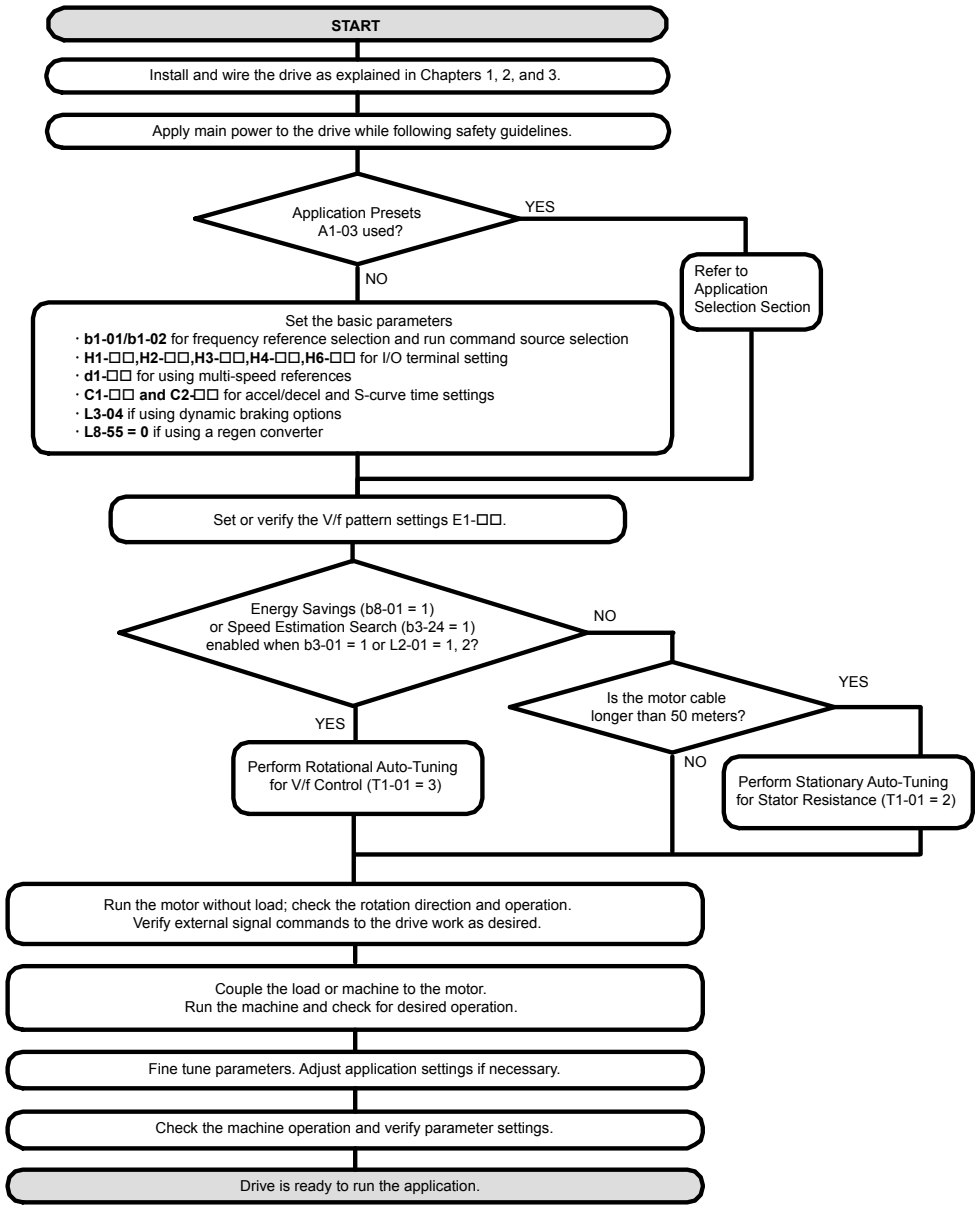


Figure i.24 Simple Setup with Energy Savings or Speed Search

Note:
1. Execute Stationary Auto-Tuning for Line-to-Line Resistance if the drive has been Auto-Tuned and then moved to a different location where the motor cable length exceeds 50 m.
2. Perform Auto-Tuning again after installing an AC reactor or other such components to the output side of the drive.

◆ Power On

Before turning on the power supply:
- Make sure all wires are connected properly.
- Make sure no screws, loose wire ends or tools are left in the drive.
- After turning the power on, the drive mode display should appear and no fault or alarm should be displayed.

◆ Auto-Tuning

Auto-Tuning automatically sets up the motor data relevant drive parameters. Two different modes are supported.

Table i.19 Types of Auto-Tuning for Induction Motors

Type	Setting	Application Conditions and Benefits
Stationary Auto-Tuning for Line-to-Line Resistance	T1-01 = 2	• The drive is used in V/f Control and other Auto-Tuning selections are not possible. • Perform when entering motor data manually while using motor cables longer than 50 m. • Drive and motor capacities differ. • 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.
Rotational Auto-Tuning for V/f Control	T1-01 = 3	• Recommended for applications using Speed Estimation Speed Search or using the Energy Saving function in V/f Control. • Assumes motor can rotate while Auto-Tuning is executed. Increases accuracy for certain functions like torque compensation, slip compensation, Energy Saving, and Speed Search.

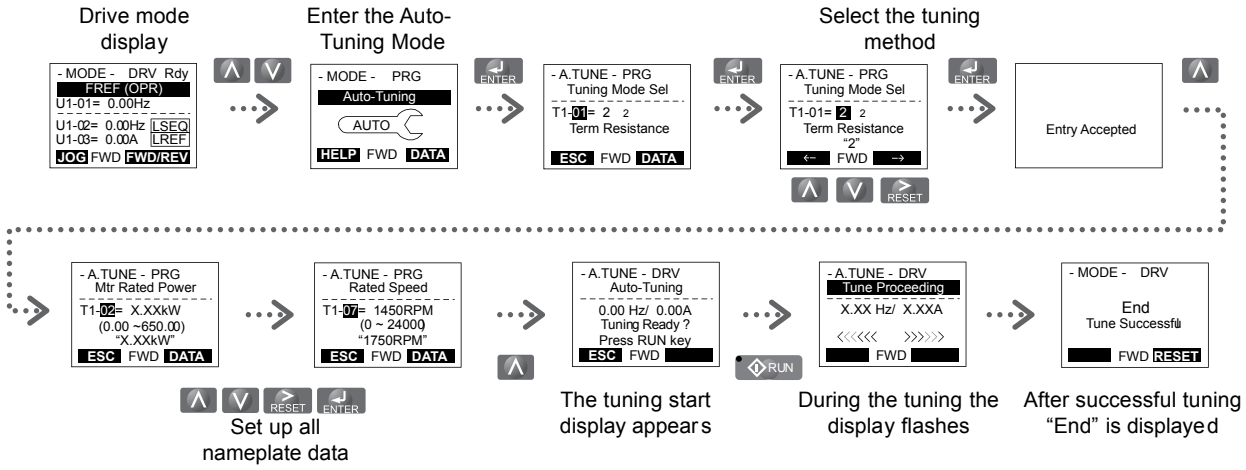
Table i.20 lists the data that must be entered for Auto-Tuning. Make sure this data is available before starting Auto-Tuning. The necessary information is usually listed on the motor nameplate or in the motor test report provided by the motor manufacturer.

Table i.20 Auto-Tuning Input Data

Input Value	Input Parameter	Unit	Tuning Type (T1-01)	
			2 Line-to-Line Resistance	3 Rotational for V/f Control
Motor rated power	T1-02	kW	YES	YES
Motor rated voltage	T1-03	Vac	–	YES
Motor rated current	T1-04	A	YES	YES
Motor rated frequency	T1-05	Hz	–	YES
Number of motor poles	T1-06	-	–	YES
Motor rated Speed	T1-07	r/min	–	YES
Motor iron loss	T1-11	W	–	YES

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 death or serious injury. Do not touch the motor until Auto-Tuning has been completed.*

For Auto-Tuning enter the Auto-Tuning menu and perform the steps shown in the figure below. The number of name plate data to be entered depends on the selected type of Auto-Tuning. This example shows Rotational Auto-Tuning.



When Auto-Tuning cannot be performed, set up the maximum frequency and voltage in the E1-☐☐ parameters and enter the motor data manually into the E2-☐☐ parameters.

◆ External Reference Selection and Acceleration/Deceleration Times

■ b1-01: Frequency Reference Selection

Set parameter b1-01 according to the frequency reference used.

b1-01	Reference Source	Frequency Reference Input
0	Digital operator	Set the frequency references in the d1-□□ parameters and use digital inputs to switch over between different reference values.
1	Analog input terminals	Apply the frequency reference signal to terminal A1, A2, or A3.
2	MEMOBUS/Modbus communications	Serial Communications using the RS422/485 port
3	Option PCB	Communications option card
4	Pulse input (terminal RP)	Set the frequency reference at terminal RP using a pulse train signal.

■ b1-02: Run Command Selection

Set parameter b1-02 according to the Run command used.

b1-02	Reference Source	Run Command Input
0	Digital operator	RUN and STOP keys on the operator
1	Digital input terminals	Multi-Function digital input
2	MEMOBUS/Modbus communications	Serial Communications using the RS-422/RS-485 port
3	Option PCB	Communications option card

■ Acceleration/ Deceleration Times and S-Curves

There are two sets of acceleration and deceleration times which can be set in the C1-□□ parameters. The default activated accel/decel times are C1-01/C1-02. Adjust these times to the appropriate values required by the application. If necessary, S-curves can be activated in the C2-□□ parameters for softer accel/decel start and end.

◆ Reference and Run Source

The drive has a LOCAL and a REMOTE mode.

Status	Description
LOCAL	The Run/Stop command and the frequency reference are entered at the operator keypad.
REMOTE	The Run command source entered in parameter b1-02 and the frequency reference source entered in parameter b1-01 are used.

If the drive is operated in the REMOTE mode, make sure that the correct sources for the frequency reference and run command are set in parameters b1-01/b1-02 and that the drive is in the REMOTE mode.

The LED in the LO/RE key indicates where the Run command is input from.

LO/RE LED	Description
ON	Run command is issued from operator.
OFF	Run command is issued from a different source than the operator.

◆ I/O Setup

The default setting functions can be seen in the connection diagram on page *19*.

■ Multi-Function Digital Inputs (H1-□□)

The function of each digital input can be assigned in the H1-□□ parameters.

■ Multi-Function Digital Outputs (H2-□□)

The function of each digital output can be assigned in the H2-□□ parameters. The setting value of these parameters consist of 3 digits, where the middle and right digit set the function and the left digit sets the output characteristics (0: Output as selected; 1: Inverse output).

■ Multi-Function Analog Inputs (H3-□□)

The function of each analog input can be assigned in the H3- parameters. Input A1 and A3 are set for -10 to +10 VDC input. A2 is set for 4-20 mA input.

NOTICE: *If the input signal level of input A2 is switched between voltage and current, make sure that DIP switch S1 is in the correct position and parameter H3-09 is set up correctly.*

NOTICE: *When using analog input A3 as PTC input, set DIP switch S4 to PTC and parameter H3-06 = E.*

■ Multi-Function Analog Outputs (H4-□□)

Use the H4-□□ parameters to set up the output value of the analog monitor outputs and to adjust the output signal levels. When changing signal levels in parameter H4-07/H4-08, make sure jumper S5 is set accordingly.

◆ Test Run

Perform the following steps to start up the machine after setting all applicable parameters:

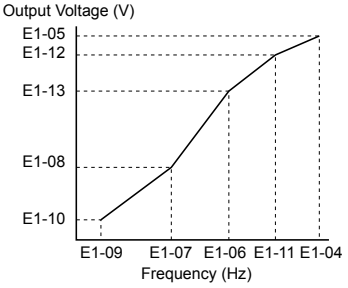
1. Run the motor without load and confirm that all inputs, outputs, and the sequence work as desired.
2. Connect the load to the motor.
3. Run the motor with load and confirm that there are no vibrations, hunting, or motor stalling.

After taking the steps listed above, the drive should be ready to run the application and perform the basic functions.

i.6 Parameter Table

This parameter table shows the most important parameters. Default settings are in **bold type**. Refer to the Technical Manual for a complete list of parameters.

No.	Name	Description
A1-03	Initialize Parameters	**0: No initialization** 1110: User Initialize (parameter values must be stored using parameter o2-03) 2220: 2-Wire initialization 3330: 3-Wire initialization 5550: oPE04 error reset 8008: Pump 8009: Pump w/ PI 8010: Fan 8011: Fan w/ PI
A1-06	Application Preset	**0: General-purpose** 8: Pump 9: Pump w/PI 10: Fan 11: Fan w/PI Note: This parameter is not settable. It is used as a monitor only.
b1-01	Frequency Reference Selection 1	0: Digital operator **1: Analog input terminals** 2: MEMOBUS/Modbus communications 3: Option PCB 4: Pulse input (terminal RP)
b1-02	Run Command Selection 1	0: Digital operator **1: Digital input terminals** 2: MEMOBUS/Modbus communications 3: Option PCB
b1-03	Stopping Method Selection	**0: Ramp to stop** 1: Coast to stop 2: DC Injection Braking to stop 3: Coast with timer
b1-04	Reverse Operation Selection	**0: Reverse enabled.** 1: Reverse disabled.
b3-01	Speed Search Selection at Start	**0: Disabled** 1: Enabled
b3-24	Speed Search Method Selection	**0: Current Detection** 1: Speed Estimation
b8-01	Energy Saving Control Selection	**0: Disabled** 1: Enabled
C1-01	Acceleration Time 1	Sets the time to accelerate from 0 to maximum frequency.
C1-02	Deceleration Time 1	Sets the time to decelerate from maximum frequency to 0.
C1-03	Acceleration Time 2	Sets the time to accelerate from 0 to maximum frequency.
C1-04	Deceleration Time 2	Sets the time to decelerate from maximum frequency to 0.
C1-09	Fast-Stop Time	Sets the time for the Fast Stop function.
C1-10	Accel/Decel Time Setting Units	0: 0.01 s (0.00 to 600.00 s) **1: 0.1 s (0.0 to 6000.0 s)**
C1-11	Accel/Decel Time Switching Frequency	Sets the frequency to switch between accel/decel time settings
C2-01	S-Curve Characteristic at Accel Start	S-curve at acceleration start.
C2-02	S-Curve Characteristic at Accel End	S-curve at acceleration end.
C2-03	S-Curve Characteristic at Decel Start	S-curve at deceleration start.
C2-04	S-Curve Characteristic at Decel End	S-curve at deceleration end.

No.	Name	Description
C6-02	Carrier Frequency Selection	1: 2.0 kHz 2: 5.0 kHz (4.0 kHz) 3: 8.0 kHz (6.0 kHz) 4: 10.0 kHz (8.0 kHz) 5: 12.5 kHz (10.0 kHz) 6: 15.0 kHz (12.0 kHz) **7: Swing PWM1 (Audible sound 1)** 8: Swing PWM2 (Audible sound 2) 9: Swing PWM3 (Audible sound 3) A: Swing PWM4 (Audible sound 4) B to E: No setting possible F: User-defined (determined by C6-03 through C6-05)
d1-01 to d1-16	Frequency Reference 1 to 16	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.
d1-17	Jog Frequency Reference	Sets the Jog frequency reference. Setting units are determined by parameter o1-03.
d2-01	Frequency Reference Upper Limit	Sets the frequency reference upper limit as a percentage of the maximum output frequency.
d2-02	Frequency Reference Lower Limit	Sets the frequency reference lower limit as a percentage of the maximum output frequency.
E1-01	Input Voltage Setting	This parameter must be set to the power supply voltage.
E1-03	V/f Pattern Selection	0: 50 Hz, Constant torque 1 1: 60 Hz, Constant torque 2 2: 60 Hz, Constant torque 3 (50 Hz base) 3: 72 Hz, Constant torque 4 (60 Hz base) 4: 50 Hz, Variable torque 1 5: 50 Hz, Variable torque 2 6: 60 Hz, Variable torque 1 7: 60 Hz, Variable torque 2 8: 50 Hz, High starting torque 1 9: 50 Hz, High starting torque 2 A: 60 Hz, High starting torque 3 B: 60 Hz, High starting torque 4 C: 90 Hz (60 Hz base) D: 120 Hz (60 Hz base) E: 180 Hz (60 Hz base) **F: Custom V/f, E1-04 through E1-13 settings define the V/f pattern**
E1-04	Maximum Output Frequency	These parameters are only applicable when E1-03 is set to F. To set linear V/f characteristics, set the same values for E1-07 and E1-09. In this case, the setting for E1-08 will be disregarded. Ensure that the four frequencies are set according to these rules: E1-09 ≤ E1-07 < E1-06 ≤ E1-11 ≤ E1-04 
E1-05	Maximum Voltage	
E1-06	Base Frequency	
E1-07	Middle Output Frequency	
E1-08	Middle Output Frequency Voltage	
E1-09	Minimum Output Frequency	
E1-10	Minimum Output Frequency Voltage	
E1-11	Middle Output Frequency 2	
E1-12	Middle Output Frequency Voltage 2	
E1-13	Base Voltage	
E2-01	Motor Rated Current	Sets the motor nameplate full load current in amps. Automatically set during Auto-Tuning.

No.	Name	Description
H1-01 to H1-08	Multi-Function Digital Input Terminal S1 to S8 Function Selection	Selects the function of terminals S1 to S8.
H2-01	Multi-Function Contact Output (terminal M1-M2)	Sets the function for the relay output M1-M2.
H2-02	Multi-Function Contact Output 2 (terminal M3-M4)	Sets the function for the relay output M3-M4.
H2-03	Multi-Function Contact Output (terminal MD-ME-MF)	Sets the function for the relay output MD-ME-MF.
H2-06	Watt Hour Output Unit Selection	**0: 0.1 kWh units** 1: 1 kWh units 2: 10 kWh units 3: 100 kWh units 4: 1000 kWh units
H3-01	Terminal A1 Signal Level Selection	**0: 0 to 10 V** 1: -10 to 10 V 2: 4 to 20 mA 3: 0 to 20 mA Note: Use Jumper S1 to set input terminal A1 for a current or voltage input signal.
H3-02	Terminal A1 Function Selection	Sets the function of terminal A1.
H3-03	Terminal A1 Gain Setting	Sets the level of the input value selected in H3-02 when 10 V is input at terminal A1.
H3-04	Terminal A1 Bias Setting	Sets the level of the input value selected in H3-02 when 0 V is input at terminal A1.
H3-05	Terminal A3 Signal Level Selection	**0: 0 to 10 V** 1: -10 to 10 V 2: 4 to 20 mA 3: 0 to 20 mA Note: Use Jumper S1 to set input terminal A3 for a current or voltage input signal.
H3-06	Terminal A3 Function Selection	Sets the function of terminal A3.
H3-07	Terminal A3 Gain Setting	Sets the level of the input value selected in H3-06 when 10 V is input at terminal A3.
H3-08	Terminal A3 Bias Setting	Sets the level of the input value selected in H3-06 when 0 V is input at terminal A3.
H3-09	Terminal A2 Signal Level Selection	0: 0 to 10 V 1: -10 to 10 V **2: 4 to 20 mA** 3: 0 to 20 mA Note: Use Jumper S1 to set input terminal A2 for a current or voltage input signal.
H3-10	Terminal A2 Function Selection	Sets the function of terminal A2.
H3-11	Terminal A2 Gain Setting	Sets the level of the input value selected in H3-10 when 10 V (20 mA) is input at terminal A2.
H3-12	Terminal A2 Bias Setting	Sets the level of the input value selected in H3-10 when 0 V (0 or 4 mA) is input at terminal A2.
H3-13	Analog Input Filter Time Constant	Sets a primary delay filter time constant for terminals A1, A2, and A3. Used for noise filtering.
H3-14	Analog Input Terminal Enable Selection	1: Terminal A1 only 2: Terminal A2 only 3: Terminals A1 and A2 only 4: Terminal A3 only 5: Terminals A1 and A3 6: Terminals A2 and A3 **7: All terminals enabled**
H3-16	Terminal A1 Offset	Adds an offset when the analog signal to terminal A1 is at 0 V.
H3-17	Terminal A2 Offset	Adds an offset when the analog signal to terminal A2 is at 0 V.
H3-18	Terminal A3 Offset	Adds an offset when the analog signal to terminal A3 is at 0 V.
H4-01	Multi-Function Analog Output Terminal FM Monitor Selection	Selects the data to be output through multi-function analog output terminal FM. Set the desired monitor parameter to the digits available in U□-□□. For example, enter “103” for U1-03.
H4-02	Multi-Function Analog Output Terminal FM Gain	Sets the signal level at terminal FM that is equal to 100% of the selected monitor value.
H4-03	Multi-Function Analog Output Terminal FM Bias	Sets the signal level at terminal FM that is equal to 0% of the selected monitor value.
H4-04	Multi-Function Analog Output Terminal AM Monitor Selection	Selects the data to be output through multi-function analog output terminal AM. Set the desired monitor parameter to the digits available in U□-□□. For example, enter “103” for U1-03.
H4-05	Multi-Function Analog Output Terminal AM Gain	Sets the signal level at terminal AM that is equal to 100% of the selected monitor value.
H4-06	Multi-Function Analog Output Terminal AM Bias	Sets the signal level at terminal AM that is equal to 0% of the selected monitor value.
H4-07	Multi-Function Analog Output Terminal FM Signal Level Selection	**0: 0 to 10 V** 1: -10 to 10 V 2: 4 to 20mA
H4-08	Multi-Function Analog Output Terminal AM Signal Level Selection	**0: 0 to 10 V** 1: -10 to 10 V 2: 4 to 20 mA
H5-01	Drive Node Address	Selects drive station node number (address) for MEMOBUS/Modbus terminals R+, R-, S+, S-. Cycle power for the setting to take effect.
H5-02	Communication Speed Selection	0: 1200 bps 1: 2400 bps 2: 4800 bps **3: 9600 bps** 4: 19200 bps 5: 38400 bps 6: 57600 bps 7: 76800 bps 8: 115200 bps Cycle power for the setting to take effect.
H5-03	Communication Parity Selection	**0: No parity** 1: Even parity 2: Odd parity Cycle power for the setting to take effect.
H5-04	Stopping Method After Communication Error (CE)	0: Ramp to stop 1: Coast to stop 2: Fast Stop **3: Alarm only**
H5-05	Communication Fault Detection Selection	0: Disabled **1: Enabled. If communication is lost for more than two seconds, a CE fault will occur.**
H5-06	Drive Transmit Wait Time	Set the wait time between receiving and sending data.
H5-07	RTS Control Selection	0: Disabled. RTS is always on. **1: Enabled. RTS turns on only when sending.**
H5-09	CE Detection Time	Sets the time required to detect a communications error.
H5-10	Unit Selection for MEMOBUS/Modbus Register 0025H	**0: 0.1 V units** 1: 1 V units

No.	Name	Description
H5-11	Communications ENTER Function Selection	0: Drive requires an Enter command before accepting any changes to parameter settings. **1: Parameter changes are activated immediately without the Enter command.**
H5-12	Run Command Method Selection	0: FWD/Stop, REV/Stop **1: Run/Stop, FWD/REV**
H6-01	Pulse Train Input Terminal RP Function Selection	**0: Frequency reference** 1: PID feedback value 2: PID setpoint value
H6-02	Pulse Train Input Scaling	Sets the terminal RP input signal frequency that is equal to 100% of the value selected in H6-01.
H6-03	Pulse Train Input Gain	Sets the level of the value selected in H6-01 when a frequency with the value set in H6-02 is input.
H6-04	Pulse Train Input Bias	Sets the level of the value selected in H6-01 when 0 Hz is input.
H6-05	Pulse Train Input Filter Time	Sets the pulse train input filter time constant.
H6-08	Pulse Train Input Minimum Frequency	Sets the minimum frequency for the pulse train input to be detected. Enabled when H6-01 = 0, 1, or 2.
L2-01	Momentary Power Loss Operation Selection	0: Disabled. Drive trips on Uv1 fault when power is lost. 1: Recover within the time set in L2-02. Uv1 will be detected if power loss is longer than L2-02. **2: Recover as long as CPU has power. Uv1 is not detected.** 3: KEB deceleration for the time set to L2-02. 4: KEB deceleration as long as CPU has power. 5: KEB deceleration to stop.
L3-04	Stall Prevention Selection during Deceleration	0: Disabled. Deceleration at the active deceleration rate. An ov fault may occur. **1: General purpose. Deceleration is paused when the DC bus voltage exceeds the Stall Prevention level.** 2: Intelligent. Decelerate as fast as possible while avoiding ov faults. 3: Stall Prevention with braking resistor. Stall Prevention during deceleration is enabled in coordination with dynamic braking. 4: Overexcitation Deceleration. Decelerates while increasing the motor flux. 5: Overexcitation Deceleration 2. Adjust the deceleration rate according to the DC bus voltage.
L5-01	Number of Auto Restart Attempts	Sets the number of times the drive may attempt to restart after the following faults occur: GF, LF, oC, ov, PF, rH, rr, oL1, oL2, oL3, oL4, STo, Uv1.

No.	Name	Description
L6-01	Torque Detection Selection 1	**0: Disabled** 1: oL3 detection only active during speed agree, operation continues after detection 2: oL3 detection always active during run, operation continues after detection 3: oL3 detection only active during speed agree, output shuts down on an oL3 fault 4: oL3 detection always active during run, output shuts down on an oL3 fault 5: UL3 detection only active during speed agree, operation continues after detection 6: UL3 detection always active during run, operation continues after detection 7: UL3 detection only active during speed agree, output shuts down on an oL3 fault 8: UL3 detection always active during run, output shuts down on an oL3 fault 9: UL6 Alarm at Speed Agree 10: UL6 Alarm during Run 11: UL6 Fault at Speed Agree 12: UL6 Fault during Run
L6-02	Torque Detection Level 1	Sets the overtorque and undertorque detection level.
L6-03	Torque Detection Time 1	Sets the time an overtorque or undertorque condition must exist to trigger torque detection 1.
L8-55	Internal Braking Transistor Protection	0: Disabled. Disable when using a regen converter or optional braking unit. **1: Protection enabled.**
o1-03	Digital Operator Display Selection	**0: 0.01 Hz** 1: 0.01% (100% = E1-04) 2: r/min (calculated using the number of motor poles setting in E2-04) 3: User-selected units (set by o1-09, o1-10 and o1-11)
o1-06	User Monitor Selection Mode	**0: 3 Monitor Sequential (displays the next two sequential monitors)** 1: 3 Monitor Selectable (set by o1-07 and o1-08)
o1-07	Second Line Monitor Selection	Selects the monitor that is shown in the second line. Enter the last three digits of the monitor parameter number to be displayed: U□-□□. For example, set "403" to display monitor parameter U4-03.
o1-08	Third Line Monitor Selection	Selects the monitor that is shown in the third line. Enter the last three digits of the monitor parameter number to be displayed: U□-□□. For example, set "403" to display monitor parameter U4-03.
T1-01	Auto-Tuning Mode Selection	**2: Stationary Auto-Tuning for Line-to-Line Resistance** 3: Rotational Auto-Tuning for V/f Control (necessary for Energy Savings and Speed Estimation Speed Search)

i.7 Troubleshooting

NOTICE

Refer to the P1000 Technical Manual SIEPYAIP1U01 on the CD-ROM packaged with the product for information on ***Troubleshooting*** and complete product instructions necessary for proper installation, set-up, troubleshooting and maintenance. CD part number TOECC71061615.

⚠ WARNING

Electrical Shock Hazard

Do not connect or disconnect wiring while the power is on.

Failure to comply could result in death or serious injury.

Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait for at least the time specified on the warning label; after all indicators are OFF, measure for unsafe voltages to confirm the drive is safe prior to servicing.

Do not operate equipment with covers removed.

Failure to comply could result in death or serious injury.

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

Do not touch terminals before the capacitors have fully discharged.

Failure to comply could result in death or serious injury.

Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait for at least the time specified on the warning label; after all indicators are OFF, measure for unsafe voltages to confirm the drive is safe prior to servicing.

After blowing a fuse or tripping a GFCI, do not attempt to restart the drive or operate peripheral devices until five minutes pass and CHARGE lamp is OFF.

Failure to comply could result in death, serious injury, and damage to the drive.

Check wiring and peripheral device ratings to identify the cause of trips.

Contact your supplier if the cause cannot be identified.

Installation, maintenance, inspection and servicing must be performed only by authorized personnel familiar with installation, adjustment and maintenance of AC drives.

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

Failure to comply could result in death or serious injury.

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

Failure to comply could result in death or serious injury.

◆ General Faults and Alarms

Faults and alarms indicate problems in the drive or in the machine.

An alarm is indicated by a code on the data display and the flashing ALM LED. The drive output is not necessarily switched off.

A fault is indicated by a code on the data display and the ALM LED is on. The drive output is always switched off immediately and the motor coast to stop.

To remove an alarm or reset a fault, trace the cause, remove it and reset the drive by pushing the Reset key on the operator or cycling the power supply.

The table below lists the most important alarms and faults and most common causes and possible solutions. Refer to the Technical Manual for a complete list.

Digital Operator	ALM	FLT	Cause	Possible Solution
Baseblock bb	O		External baseblock signal was entered via one of the multi-function input terminals (S1 to S8).	Check external sequence and baseblock signal input timing. **Note:** Baseblock alarm “bb” will not activate a digital output programmed for minor fault H2-0□ = 10. Set H2-0□ = 8 or 1B to activate a digital output for “bb”.
Control Circuit Fault CPF02 to CPF24		O	There is a problem in the drive control circuit.	• Cycle the drive power supply. • Initialize the drive. • Replace the drive if the fault occurs again.
Control Circuit Fault CPF25		O	Terminal board is not connected correctly	Reconnect the terminal board to the connector on the drive, then cycle the power to the drive.
Option External Fault EF0	O	O	An external fault was received from the PLC and F6-03 is set to a value other than 3.	• 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.
Forward/Reverse Run Command Input Error EF	O		Sequence error	Check the forward and reverse command sequence and correct the problem. **Note:** When minor fault EF detected, motor ramps to stop.
External Faults EF1 to EF8	O	O	An external fault was triggered by an external device via one of the digital inputs S1 to S8.	Remove the cause of the external fault and reset the fault.
			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.
			Multi-function contact inputs are set incorrectly.	• Check if the unused terminals have been set for H1-□□ = 2C to 2F (External Fault). • Change the terminal settings.
Ground Fault GF		O	Motor insulation is damaged	• Check the insulation resistance of the motor. • Replace the motor.
			A damaged motor cable is creating a short circuit	• Check the motor cable. • Remove the short circuit and reapply power to the drive • Check the resistance between the cable and the ground terminal ⏚. • Replace the cable.
			Excessive leakage current at the drive output	• Reduce the carrier frequency. • Reduce the amount of stray capacitance.
Output Phase Loss LF		O	The output cable is disconnected	• Check for wiring errors and properly connect the output cable. • Correct the wiring.
			The motor winding is damaged	• Check the resistance between motor lines. • Replace the motor if the winding is damaged.

Digital Operator	ALM	FLT	Cause	Possible Solution
Overcurrent oC		O	The motor has been damaged due to overheating or the motor insulation is damaged	• Check the insulation resistance. • Replace the motor.
			One of the motor cables has shorted out or there is a grounding problem	• Check the motor cables. • Remove the short circuit and reapply power to the drive. • Check the resistance between the motor cables and the ground terminal ⏚. • Replace damaged cables.
			The load is too heavy	• Measure the current flowing into the motor. • Replace the drive with a larger capacity drive if the current value exceeds the rated current. • Determine if there is sudden fluctuation in the current level. • Reduce the load to avoid sudden changes in the current level or switch to a larger drive.
Heatsink Overheat oH or oH1	O	O	Surrounding temperature is too high	• Check the temperature surrounding the drive. Verify temperature is within drive specifications. • Improve the air circulation within the enclosure panel. • Install a fan or air conditioner to cool the surrounding area. • Remove anything near the drive that might be producing excessive heat.
			Load is too heavy	• Measure the output current. • Decrease the load. • Lower the carrier frequency (C6-02).
Motor Overload oL1		O	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 C1-04).
			A general-purpose motor is driven below the rated speed with a 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.
Drive Overload oL2		O	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 C1-04).
			The output voltage is too high	• Adjust the preset V/f pattern (E1-04 through E1-10) by reducing E1-08 and E1-10. • Do not lower E1-08 and E1-10 excessively. This reduces load tolerance at low speeds.
Overvoltage ov	O	O	Deceleration time is too short and regenerative energy is flowing from the motor into the drive	• Increase the deceleration time (C1-02 and C1-04). • Install a dynamic braking resistor or a dynamic braking resistor unit. • Set L3-04 to 1 to enable stall prevention during deceleration. Stall Prevention is enabled as the default setting.
			Fast acceleration time causes the motor to overshoot the speed reference	• Check if sudden drive acceleration triggers an overvoltage alarm. • Increase the acceleration time. • Use longer S-curve acceleration and deceleration times. • Enable the Overvoltage Suppression function (L3-11 = 1). • Lengthen the S-curve at acceleration end.
			Excessive braking load	The braking torque was too high, causing regenerative energy to charge the DC bus. Reduce the braking torque, use a dynamic braking option, or lengthen decel time.

Digital Operator	ALM	FLT	Cause	Possible Solution
Input Phase Loss PF		O	There is phase loss in the drive input power	• Check for wiring errors in the main circuit drive input power. • Correct the wiring.
			There is excessive fluctuation in the drive input power voltage	• Check the voltage from the drive input power. • Review the possible solutions for stabilizing the drive input power.
			There is poor balance between voltage phases	Stabilize drive input power or disable phase loss detection.
Braking Transistor Fault rr		O	The braking transistor is damaged	• Cycle power to the drive and check for reoccurrence of the fault. • Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or a Yaskawa representative.
			The control circuit is damaged	
DC Bus Undervoltage Uv1	O	O	Input power phase loss	• The main circuit drive input power is wired incorrectly. • Correct the wiring.
			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 magnetic contactor.
			The main circuit capacitors are worn	• Check the maintenance time for the capacitors (U4-05). • Replace either the control board or the entire drive if U4-05 exceeds 90%. For instructions on replacing the control board, contact Yaskawa or a Yaskawa representative.
Control Power Supply Voltage Fault Uv2		O	Control power supply wiring is damaged	• Cycle power to the drive. Check if the fault reoccurs. • If the problem continues, replace the control board, the entire drive, or the control power supply. For instructions on replacing the control board, contact Yaskawa or a Yaskawa representative.
			Internal circuitry is damaged	
Undervoltage 3 (Soft-Charge Bypass Relay Fault) Uv3		O	The relay or contactor on the soft-charge bypass relay is damaged	• Cycle power to the drive and see if the fault reoccurs. • Check monitor U4-06 for the performance life of the soft-charge bypass relay. • Replace either the control board or the entire drive if U4-06 exceeds 90%. For instructions on replacing the control board, contact Yaskawa or a Yaskawa representative.

◆ Operator Programing Errors

An Operator Programming Error (oPE) occurs when an inapplicable parameter is set or an individual parameter setting is inappropriate. When an oPE error is displayed, press the ENTER button to display U1-18 (oPE fault constant) and show the parameter causing the oPE error.

Digital Operator	Cause	Possible Solution
oPE01	The drive model selection (o2-04) and the actual capacity of the drive are not the same.	Correct the value set to o2-04.
oPE02	Parameters were set outside the possible setting range.	Use U1-18 to find parameters set outside the range. and set parameters to the proper values.
oPE03	A contradictory setting is assigned to multi-function contact inputs H1-01 to H1-08 (Excludes "Not used" and "External Fault.")	Ensure all multi-function inputs are assigned to different functions.
	The Up command was set but the Down command was not, or vice versa (settings 10 vs. 11).	Properly set the functions that required for use 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. • "Drive Enable" is set to multi-function input S1 or S2 (H1-01 = 6A or H1-02 = 6A).	Properly set the functions that required for use in combination with other functions.
oPE04	The drive, control board, or terminal board have been replaced and the parameter settings between the control board and the terminal board no longer match.	Set A1-03 to 5550 to load the parameter settings stored in the terminal board to the drive. Initialize parameters after drive replacement by setting A1-03 to 1110 or 2220.
oPE05	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.	
	Frequency reference is assigned to the pulse train input (b1-01 = 4) and terminal RP is not set for frequency reference input (H6-01 > 0)	Set H6-01 to 0.
oPE07	At least two analog input terminals are set to the same function (i.e., at least two of these parameters have the same setting: H3-02, H3-10, or H3-06).	Change the settings to H3-02, H3-10, and H3-06 so that functions no longer conflict. **Note:** Both 0 (Frequency Reference Bias) and F (Not Used) can be set to H3-02, H3-10, or H3-06 simultaneously.
	The following simultaneous contradictory settings: • H3-02, H3-10, or H3-06 = B (PID Feedback) while H6-01 (Pulse Train Input) = 1 (PID Feedback) • H3-02, H3-10, or H3-06 = C (PID Target Value) while H6-01 = 2 (pulse train input sets the PID target value) • H3-02, H3-10, or H3-06 = C (PID Target Value) while b5-18 = 1 (enables b5-19 as the target PID value) • H6-01 = 2 (PID target) while b5-18 = 1 (enables b5-19 as the target PID value)	Disable one of the PID selections.
oPE09	The following simultaneous contradictory settings have occurred: • b5-15 is not set to 0.0 (PID Sleep Function Operation 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 a value other than 0.0. • Set the stopping method to coast to stop or ramp to stop (b1-03 = 0 or 1).
oPE10	V/f pattern setting error. E1-09 ≤ E1-07 < E1-06 ≤ E1-11 ≤ E1-04	Correct the settings for E1-04, E1-06, E1-07, E1-09, and E1-11.
oPE11	The following simultaneous contradictory settings have occurred: C6-05 > 6 and C6-04 > C6-03 (carrier frequency lower limit is greater than the upper limit). If C6-05 ≤ 6, the drive operates at C6-03.	Correct the parameter settings.
	The upper and lower limits between C6-02 and C6-05 are contradictory.	
oPE28	• S2-01 > S2-02 • S2-06 > S2-07 • S2-11 > S2-12 • S2-16 > S2-17	Correct the parameter settings.

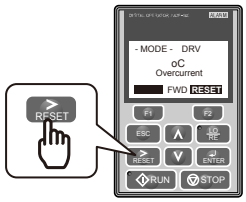
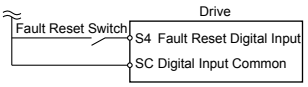
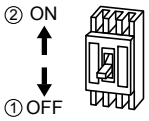
◆ Auto-Tuning Errors

Digital Operator	Cause	Possible Solution
End1	Excessive V/f Setting • The torque reference exceeded 20% during Auto-Tuning. • The results from Auto-Tuning the no-load current exceeded 80%.	• Prior to Auto-Tuning, verify the information on the motor nameplate. • Enter proper values from motor nameplate to parameters T1-02 and T1-04 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.
End2	Motor iron-core saturation alarm. Motor data entered during Auto-Tuning was incorrect.	• Make sure the data entered to the T1 parameters match the information written on the motor nameplate. • Restart Auto-Tuning and enter the correct information.
End3	Rated current alarm The correct current rating printed on the motor nameplate was not entered into T1-04.	• Check the setting of parameter T1-04. • Check the motor data and repeat Auto-Tuning.
End4	Adjusted Slip Calculation Error The calculated slip is outside the allowable range.	• Make sure the data entered for Auto-Tuning is correct. • If possible, perform Rotational Auto-Tuning. If not possible, perform Stationary Auto-Tuning 2.
End5	Resistance Tuning Error The calculated slip is outside the allowable range.	• Double-check the data entered for the Auto-Tuning process. • Check the motor and motor cable connection for faults.
End6	Leakage Inductance Alarm The calculated leakage inductance value is outside the allowable range.	Double-check the data entered for the Auto-Tuning process.
End7	No-Load Current Alarm 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-check the data entered for the Auto-Tuning process.
Er-01	Motor data error 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.
	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 inconsistent.	• Check the motor rated current and no-load current. • Correct the settings of parameters T1-04 and E2-03.
Er-02	Minor Fault An alarm was triggered during Auto-Tuning.	Exit the Auto-Tuning menu, check the alarm code, remove the alarm cause, and repeat Auto-Tuning.
Er-03	Auto-Tuning canceled by pressing STOP button.	Auto-Tuning did not complete properly. Restart Auto-Tuning.
Er-04	Line-to-Line Resistance Error Motor data entered during Auto-Tuning was incorrect.	• Make sure the data entered to the T1 parameters match the information written on the motor nameplate. • Restart Auto-Tuning and enter the correct information.
	Faulty motor cable or cable connection.	Check and correct faulty motor wiring.
Er-05 Er-08	No-Load Current Error/Rated Slip Error Motor data entered during Auto-Tuning was incorrect. Results from Auto-Tuning are outside the parameter setting range or the tuning process took too long.	• Make sure the data entered to the T1 parameters match the information written on the motor nameplate. • Restart Auto-Tuning and enter the correct information.
	Results from Auto-Tuning are outside the parameter setting range or the tuning process took too long.	• Check and correct faulty motor wiring. • Perform Rotational Auto-Tuning.
Er-09	Acceleration Error The motor did not accelerate for the specified acceleration time.	• Increase the acceleration time (C1-01). • Disconnect the machine from the motor if possible.
	The load was too high during Rotational Auto-Tuning.	• Disconnect the motor from machine and restart Auto-Tuning. If motor and load cannot be uncoupled make sure the load is lower than 30%. • If a mechanical brake is installed, make sure it is fully lifted during tuning.
Er-11	Motor Speed Fault Torque reference is too high.	• Increase the acceleration time (C1-01). • Disconnect the machine from the motor if possible.

Digital Operator	Cause	Possible Solution
Er-12	Current Detection Error One of the motor phases is missing: (U/T1, V/T2, W/T3).	Check motor wiring and correct any problems.
	The current exceeded the current rating of the drive.	• Check motor wiring for a short between motor lines. • Close any magnetic contactors used between motors. • 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.	
Er-13	Leakage Inductance Error Drive was unable to complete tuning for leakage inductance within 300 seconds.	• Check all wiring and correct any mistakes. • Check the motor rated current value written on the motor nameplate and enter the correct value to T1-04.
Er-17	Reverse Prohibited Error Drive is prohibited from rotating the motor in reverse while attempting to perform Inertia Tuning.	• Inertia Auto-Tuning cannot be performed if the drive is restricted from rotating in reverse. • Assuming it is acceptable for the application to rotate in reverse, set b1-04 to 0 and then perform Inertia Tuning.

◆ 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 ways to restart the drive.

After the Fault Occurs	Procedure	
Fix the cause of the fault, restart the drive, and reset the fault	Press RESET on the digital operator when the error code is displayed.	
Resetting via Fault Reset Digital Input S4	Close then open the fault signal digital input via terminal S4. S4 is set for “Fault Reset” as default (H1-04 = 14).	
Turn off the main power supply if the above methods do not reset the fault. Reapply power after the digital operator display has turned off.		

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.

i.8 UL and CSA Standards

◆ UL Standards Compliance

The UL/cUL mark applies to products in the United States and Canada. It indicates that UL has performed product testing and evaluation, and determined that their stringent standards for product safety have been met. For a product to receive UL certification, all components inside that product must also receive UL certification.

Figure i.25 UL/cUL Mark

This drive is tested in accordance with UL standard UL508C and complies with UL requirements. The conditions described below must be met to maintain compliance when using this drive in combination with other equipment:

■ Installation Area

Do not install the drive to an area greater than pollution degree 2 (UL standard).

■ Ambient Temperature

IP20/NEMA Type 1 Enclosure: -10 to +40 °C

IP00 Open Type Enclosure: -10 to +50 °C

■ Main Circuit Terminal Wiring

Yaskawa recommends using closed-loop crimp terminals on all drive models. To maintain UL/cUL approval, UL Listed closed-loop crimp terminals are specifically required when wiring the drive main circuit terminals on models 2A0110 to 2A0415, 4A0058 to 4A1200, and 5A0041 to 5A0242. Use only the tools recommended by the terminal manufacturer for crimping. *Refer to Closed-Loop Crimp Terminal Size on page 31* for closed-loop crimp terminal recommendations.

Wire Gauges and Tightening Torques

Refer to Main Circuit Wire Gauges and Tightening Torque on page 23.

Closed-Loop Crimp Terminal Recommendations

Refer to Closed-Loop Crimp Terminal Recommendations on page 31.

Factory Recommended Branch Circuit Protection

NOTICE: *If a fuse is blown or a Ground Fault Circuit Interrupter (GFCI) is tripped, check the wiring and the selection of the peripheral devices. Check the wiring and the selection of peripheral devices to identify the cause. Contact Yaskawa before restarting the drive or the peripheral devices if the cause cannot be identified.*

Yaskawa recommends installing one of the following types of branch circuit protection to maintain compliance with UL508C. Semiconductor protective type fuses are preferred. Alternate branch circuit protection devices are also listed in the tables below.

Table i.21 Factory Recommended AC Drive Branch Circuit Protection (Normal Duty)

Drive Model	Nominal Output Power HP	AC Drive Input Amps	MCCB Rating Amps <1>	Time Delay Fuse Rating Amps <2>	Non-time Delay Fuse Rating Amps <3>	Bussman Semi-conductor Fuse Rating (Fuse Ampere) <4>
200 V Class						
2A0004	0.75	3.9	15	6.25	10	FWH-70B (70)
2A0006	1 - 1.5	7.3	15	12	20	FWH-70B (70)
2A0008	2	8.8	15	15	25	FWH-70B (70)
2A0010	3	10.8	20	17.5	30	FWH-70B (70)
2A0012	3	13.9	25	20	40	FWH-70B (70)
2A0018	5	18.5	35	30	50	FWH-90B (90)

Drive Model	Nominal Output Power HP	AC Drive Input Amps	MCCB Rating Amps <1>	Time Delay Fuse Rating Amps <2>	Non-time Delay Fuse Rating Amps <3>	Bussman Semi-conductor Fuse Rating (Fuse Ampere) <4>
2A0021	7.5	24	45	40	70	FWH-90B (90)
2A0030	10	37	60	60	110	FWH-100B (100)
2A0040	15	52	100	90	150	FWH-200B (200)
2A0056	20	68	125	110	200	FWH-200B (200)
2A0069	25	80	150	125	225	FWH-200B (200)
2A0081	30	96	175	150	275	FWH-300A (300)
2A0110	40	111	200	175	300	FWH-300A (300)
2A0138	50	136	250	225	400	FWH-350A (350)
2A0169	60	164	300	250	450	FWH-400A (400)
2A0211	75	200	400	350	600	FWH-400A (400)
2A0250	100	271	500	450	800	FWH-600A (600)
2A0312	125	324	600	500	800	FWH-700A (700)
2A0360	150	394	700	600	1000 <5>	FWH-800A (800)
2A0415	175	471	900	800	1400 <5>	FWH-1000A (1000)
400 V Class						
4A0002	1	2.1	15	3.5	6	FWH-40B (40)
4A0004	2	4.3	15	7.5	12	FWH-50B (50)
4A0005	3	5.9	15	10	17.5	FWH-70B (70)
4A0007	3	8.1	15	12	20	FWH-70B (70)
4A0009	5	9.4	15	15	25	FWH-90B (90)
4A0011	7.5	14	25	20	40	FWH-90B (90)
4A0018	10	20	40	35	60	FWH-80B (80)
4A0023	15	24	45	40	70	FWH-100B (100)
4A0031	20	38	75	60	110	FWH-125B (125)
4A0038	25	44	75	75	125	FWH-200B (200)
4A0044	30	52	100	90	150	FWH-250A (250)
4A0058	40	58	100	100	150	FWH-250A (250)
4A0072	50	71	125	110	200	FWH-250A (250)
4A0088	60	86	150	150	250	FWH-250A (250)
4A0103	75	105	200	175	300	FWH-250A (250)
4A0139	100	142	250	225	400	FWH-350A (350)
4A0165	125	170	300	250	500	FWH-400A (400)
4A0208	150	207	400	350	600	FWH-500A (500)
4A0250	200	248	450	400	700	FWH-600A (600)
4A0296	250	300	600	500	800	FWH-700A (700)
4A0362	300	346	600	600	1000 <5>	FWH-800A (800)
4A0414	350	410	800	700	1200 <5>	FWH-800A (800)
4A0515	400 - 450	465	900	800	1350 <5>	FWH-1000A (1000)
4A0675	500 - 600	657	1200	1100 <5>	1800 <5>	FWH-1200A (1200)
4A0930	700 - 800	922	Not Applicable			FWH-1200A (1200)
4A1200	900 - 1000	1158				FWH-1600A (1600)
600 V Class						
5A0003	2	3.6	15	6.25	10	FWP-50B (50)
5A0004	3	5.1	15	8	15	FWP-50B (50)
5A0006	5	8.3	15	12	20	FWP-60B (60)
5A0009	7.5	12	20	20	35	FWP-60B (60)
5A0011	10	16	30	25	45	FWP-70B (70)

Drive Model	Nominal Output Power HP	AC Drive Input Amps	MCCB Rating Amps <1>	Time Delay Fuse Rating Amps <2>	Non-time Delay Fuse Rating Amps <3>	Bussman Semi-conductor Fuse Rating (Fuse Ampere) <4>
5A0017	15	23	40	40	60	FWP-100B (100)
5A0022	20	31	60	50	90	FWP-100B (100)
5A0027	25	38	75	60	110	FWP-125A (125)
5A0032	30	45	75	75	125	FWP-125A (125)
5A0041	40	44	75	75	125	FWP-175A (175)
5A0052	50	54	100	90	150	FWP-175A (175)
5A0062	60	66	125	110	175	FWP-250A (250)
5A0077	75	80	150	125	225	FWP-250A (250)
5A0099	100	108	175	175	300	FWP-250A (250)
5A0125	125	129	225	225	350	FWP-350A (350)
5A0145	150	158	300	275	450	FWP-350A (350)
5A0192	200	228	400	350	600	FWP-600A (600)
5A0242	250	263	500	450	700	FWP-600A (600)

<1> Maximum MCCB Rating is 15 A, or 200 % of drive input current rating, whichever is larger. MCCB voltage rating must be 600 VAC or greater.

<2> Maximum Time Delay fuse is 175% of drive input current rating. This covers any Class CC, J or T class fuse.

<3> Maximum Non-time Delay fuse is 300% of drive input current rating. This covers any CC, J or T class fuse.

<4> When using semiconductor fuses, Bussman FWH and FWP are required for UL compliance. Select FWH for 200 V Class and 400 V Class models and FWP fuses for 600 V models.

<5> Class L fuse is also approved for this rating.

■ Low Voltage Wiring for Control Circuit Terminals

Wire low voltage wires with NEC Class 1 circuit conductors. Refer to national state or local codes for wiring. The external power supply shall be a UL listed Class 2 power supply source or equivalent only.

Table i.22 Control Circuit Terminal Power Supply

Input / Output	Terminal Signal	Power Supply Specifications
Digital inputs	S1 to S8, SC	Use the internal LVLC power supply of the drive. Use class 2 for external power supply.
Analog inputs / outputs	+V, A1, A2, A3, AC, AM, FM	Use the internal LVLC power supply of the drive. Use class 2 for external power supply.

■ Drive Short Circuit Rating

The drive is suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical Amperes, 240 Vac maximum (200 V Class), 480 Vac maximum (400 V Class), and 600 Vac maximum (600 V Class) when protected by Factory recommended branch circuit protection as specified in this document.

◆ CSA Standards Compliance

Figure i.26 CSA Mark

■ CSA for Industrial Control Equipment

The drive is CSA-certified as Industrial Control Equipment Class 3211.

Specifically, the drive is certified to: CAN/CSA C22.2 No. 04-04 and CAN/CSA C22.2 No.14-05.

◆ Drive Motor Overload Protection

Set parameter E2-01 (motor rated current) to the appropriate value to enable motor overload protection. The internal motor overload protection is UL listed and in accordance with the NEC and CEC.

■ E2-01: Motor Rated Current

Setting Range: Model-dependent

Default Setting: Model-dependent

Parameter E2-01 protects the motor when parameter L1-01 is not set to 0. The default for L1-01 is 1, which enables protection for standard induction motors.

If Auto-Tuning has been performed successfully, the motor data entered to T1-04 is automatically written to parameter E2-01. If Auto-Tuning has not been performed, manually enter the correct motor rated current to parameter E2-01.

■ L1-01: Motor Overload Protection Selection

The drive has an electronic overload protection function (oL1) based on time, output current, and output frequency that protects the motor from overheating. The electronic thermal overload function is UL-recognized, so it does not require an external thermal relay for single motor operation.

This parameter selects the motor overload curve used according to the type of motor applied.

Table i.23 Overload Protection Settings

Setting	Description	
0	Disabled	Disabled the internal motor overload protection of the drive.
1	Standard fan-cooled motor (60 Hz default)	Selects protection characteristics for a standard self-cooled motor with limited cooling capabilities when running below the rated speed. The motor overload detection level (oL1) is automatically reduced when running below the motor rated speed.
2	Drive duty motor with a speed range of 1:10	Selects protection characteristics for a motor with self-cooling capability within a speed range of 10:1. The motor overload detection level (oL1) is automatically reduced when running below 1/10 of the motor rated speed.
3	Vector motor with a speed range of 1:100	Selects protection characteristics for a motor capable of cooling itself at any speed including zero speed (externally cooled motor). The motor overload detection level (oL1) is constant over the entire speed range.
6	Standard fan-cooled motor (50 Hz)	Selects protection characteristics for a standard self-cooled motor with limited cooling capabilities when running below the rated speed. The motor overload detection level (oL1) is automatically reduced when running below the motor rated speed.

When connecting the drive to more than one motor for simultaneous operation, disable the electronic overload protection (L1-01 = 0) and wire each motor with its own motor thermal overload relay.

Enable motor overload protection (L1-01 ≠ 0) when connecting the drive to a single motor, unless another motor overload preventing device is installed. The drive electronic thermal overload function causes an oL1 fault, which shuts off the output of the drive and prevents additional overheating of the motor. The motor temperature is continually calculated while the drive is powered up.

■ L1-02: Motor Overload Protection Time

Setting Range: 0.1 to 5.0 min

Factory Default: 1.0 min

Parameter L1-02 determines how long the motor is allowed to operate before the oL1 fault occurs when the drive is running a hot motor at 60 Hz and at 150% of the full load amp rating (E2-01) of the motor. Adjusting the value of L1-02 can shift the set of oL1 curves up the y axis of the diagram below, but will not change the shape of the curves.

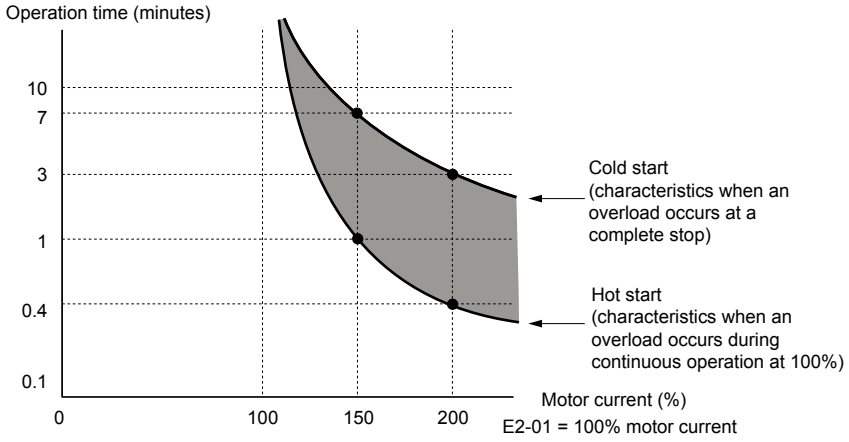


Figure i.27 Motor Overload Protection Time

◆ Precautionary Notes on External Heatsink (IP00/Open Type Enclosure)

When using an external heatsink, UL compliance requires covering exposed capacitors in the main circuit to prevent injury to surrounding personnel.

NOTICE
Refer to the P1000 Technical Manual SIEPYAIP1U01 on the CD-ROM packaged with the product for more information regarding ***Precautionary Notes on External Heatsink*** and complete product instructions necessary for proper installation, set-up, troubleshooting and maintenance. CD part number TOECC71061615.

i.9 European Standards

Figure i.28 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 Machinery Directive for machine manufacturers, the Low Voltage Directive for electronics manufacturers, and the EMC guidelines for controlling noise.

This drive displays the CE mark based on the EMC guidelines and the Low Voltage Directive.

- **Low Voltage Directive:** 2006/95/EC
- **EMC Guidelines:** 2004/108/EC

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.

Note: 600 V class drives (models 5□□□□□□) are not compliant with European Standards.

◆ CE Low Voltage Directive Compliance

This drive has been tested according to European standard IEC/EN 61800-5-1, and it fully complies with the Low Voltage Directive.

To comply with the Low Voltage Directive, 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.

■ Factory Recommended Branch Circuit Protection

NOTICE

Refer to the P1000 Technical Manual SIEPYAIP1U01 on the CD-ROM No. TOECC71061615 packaged with the product; Chapter- ***Standards Compliance***, **Section-*European Standards*** , for more information on ***Factory Recommended Branch Circuit Protection*** for CE Compliance.

■ Grounding

The drive is designed to be used in T-N (grounded neutral point) networks. If installing the drive in other types of grounded systems, contact your Yaskawa representative for instructions.

■ Guarding Against Harmful Materials

When installing IP00/Open Type enclosure drives, use an enclosure that prevents foreign material from entering the drive from above or below.

◆ EMC Guidelines Compliance

This drive is tested according to European standards IEC/EN 61800-3: 2004.

■ EMC Filter and DC Link Chokes for IEC/EN 61000-3-2 Compliance

EMC filter and DC link choke requirements must be met to ensure continued compliance with CE guidelines.

NOTICE

Refer to the P1000 Technical Manual SIEPYAIP1U01 on the CD-ROM packaged with the product for more information on ***EMC Filter Installation*** and complete product instructions necessary for proper installation, set-up, troubleshooting and maintenance. CD part number TOECC71061615.

◆ Drive Derating Data

■ Single-Phase Derating

P1000 drives are optimized and compatible for use with both three-phase and single-phase input power supplies. The P1000 output to the motor is fixed at three-phase.

P1000 output capacity to the motor is reduced or derated when single-phase input power is used.

Refer to the drive **Technical Manual - Drive Derating Data section** to assist in model selection when using the drive in single-phase input power applications.

■ Rated Current Depending on Carrier Frequency

Normal Duty Rating (ND)

Increasing the carrier frequency above 2 kHz will reduce the ND rated output current of the drive.

NOTICE

Refer to the P1000 Technical Manual – ***Drive Derating Data section*** to assist in model selection and adjustment when the application requires changing the drive carrier frequency from factory defaults.

◆ Temperature Derating

To ensure the maximum performance life, the drive output current must be derated as shown in ***Figure i.29*** when the drive is installed in areas with high ambient temperature or if drives are mounted side-by-side in a cabinet. In order to ensure reliable drive overload protection, set parameters L8-12 and L8-35 according to the installation conditions.

■ Parameter Settings

No.	Name	Description	Range	Def.
L8-12	Ambient Temperature Setting	Adjust the drive overload (oL2) protection level when the drive is installed in an environment that exceeds its ambient temperature rating.	-10 to +50	+40 °C
L8-35	Installation Method Selection	0: IP00/Open-Chassis Enclosure 1: Side-by-Side Mounting 2: IP20/NEMA Type 1 Enclosure 3: Finless Drive or External Heatsink Installation	0 to 3	<1>

<1> Default setting is determined by drive model.
Setting 0: (Models 2A0250 to 2A0415 and 4A0208 to 4A1200)
Setting 2: (Models 2A0004 to 2A0211, 4A0002 to 4A0165, and 5A0003 to 5A0242).

Setting 0: IP00/Open-Chassis Enclosure

Drive operation between -10 °C and +50 °C allows 100% continuous current without derating.

Setting 1: Side-by-Side Mounting

Drive operation between -10 °C and +30 °C allows 100% continuous current without derating. Operation between +30 °C and +50 °C requires output current derating.

Setting 2: IP20/NEMA Type 1 Enclosure

Drive operation between -10 °C and +40 °C allows 100% continuous current without derating. Operation between +40 °C and +50 °C requires output current derating.

Setting 3: External Heatsink Installation, Finless Drive

Drive operation between -10 °C and +40 °C allows 100% continuous current without derating. Operation between +40 °C and +50 °C requires output current derating.

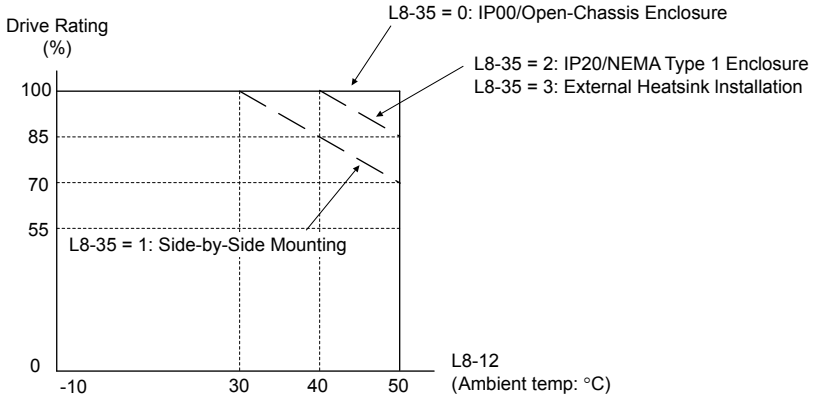


Figure i.29 Ambient Temperature and Installation Method Derating

◆ Altitude Derating

The drive standard ratings are valid for installation altitudes up to 1000 m. For installations from 1000 m to 3000 m, the drive rated voltage and the rated output current must be derated for 0.2% per 100 m.

◆ Dimensions, Weight, Heat Loss

NOTICE

Refer to the ***Mechanical Installation Chapter*** and the ***Specifications Chapter*** of the ***P1000 Technical Manual SIEPYAIP1U01*** which can be found on the CD-ROM packaged with the product.

◆ Drive Specifications

Item		Specification
Control Character-istics	**Control Method**	V/f Control (V/f)
	Frequency Control Range	0.01 to 400 Hz
	Frequency Accuracy (Temperature Fluctuation)	Digital input: within ±0.01% of the max output frequency (-10 to +40 °C) Analog input: within ±0.1% of the max output frequency (25 °C ±10 °C)
	Frequency Setting Resolution	Digital inputs: 0.01 Hz Analog inputs: 1/2048 of the maximum output frequency setting (11 bit plus sign) Resolution of analog inputs A1 and A3 is 10 bit + sign in current mode
	Output Frequency Resolution	0.001 Hz
	Frequency Setting Signal	Main speed frequency reference: DC -10 to +10 V (20 kΩ), DC 0 to +10 V (20 kΩ), 4 to 20 mA (250 Ω), 0 to 20 mA (250 Ω) Main speed reference: Pulse train input (max. 32 kHz)
	Starting Torque <1>	V/f: 150% at 3 Hz
	Speed Control Range <1>	V/f: 1:40
	Accel/Decel Time	0.0 to 6000.0 s (2 selectable combinations of independent acceleration and deceleration settings)
	Braking Torque	Approx. 20% (approx. 125% when using braking resistor) <2> • Short-time decel torque <3> : over 100% for 0.4/ 0.75 kW motors, over 50% for 1.5 kW motors, and over 20% for 2.2 kW and above motors <4> (overexcitation braking/High Slip Braking: approx. 40%) • Continuous regenerative torque: approx. 20% <4> (approx. 125% with dynamic braking resistor option <2> : 10% ED, 10s)
	Braking Transistor	Models 2A0004 to 2A0138, 4A0002 to 4A0072, and 5A0003 to 5A0052 have a built-in braking transistor.
	V/f Characteristics	User-selected programs and V/f preset patterns possible
	Main Control Functions	Droop Control, Feed Forward Control, Momentary Power Loss Ride-Thru, Speed Search, Overtorque/ Undertorque Detection, Torque Limit, 17 Step Speed (max), Accel/decel Switch, S-curve Accel/decel, 3-wire Sequence, Auto-tuning (rotational, stationary tuning), Dwell, Cooling Fan on/off Switch, Slip Compensation, Torque Compensation, Frequency Jump, Upper/lower Limits for Frequency Reference, DC Injection Braking at Start and Stop, Overexcitation Braking, High Slip Braking, PI Control (with sleep function), Energy Saving Control, MEMOBUS/Modbus Comm. (RS-422/RS-485 max, 115.2 kbps), Fault Restart, Application Presets, Removable Terminal Block with Parameter Backup Function, Online Tuning, KEB, Overexcitation Deceleration, Overvoltage Suppression, High Frequency Injection, Dynamic Noise Control
Protection Functions	**Motor Protection**	Electronic thermal overload relay
	Momentary Overcurrent Protection	Drive stops when output current exceeds 170% of rated output current
	Overload Protection	Drive stops when rated output current is 120% for 60 s <5>
	Overvoltage Protection	200 V class: Stops when DC bus voltage exceeds approx. 410 V 400 V class: Stops when DC bus voltage exceeds approx. 820 V 600 V class: Stops when DC bus voltage exceeds approx. 1040 V
	Undervoltage Protection	200 V class: Stops when DC bus voltage falls below approx. 190 V 400 V class: Stops when DC bus voltage falls below approx. 380 V 600 V class: Stops when DC bus voltage falls below approx. 475 V

Item		Specification
Protection Functions	**Momentary Power Loss Ride-Thru**	Immediately stop after 15 ms or longer power loss <6> . Continuous operation during power loss than 2 s (standard) <7>
	Heatsink Overheat Protection	Thermistor
	Braking Resistor Overheat Protection	Overheat input signal for braking resistor (Optional ERF-type, 3% ED)
	Stall Prevention	Stall Prevention is available during acceleration, deceleration, and during run.
	Ground Protection	Electronic circuit protection <8>
	DC Bus Charge LED	Remains lit until DC bus voltage falls below 50 V
Environment	**Area of Use**	Indoors
	Ambient Temperature	-10 to +40 °C (IP20/NEMA Type 1 enclosure), -10 to +50 °C (IP00/Open Type enclosure)
	Humidity	95 RH% or less (no condensation)
	Storage Temperature	-20 to +60 °C (short-term temperature during transportation)
	Altitude	Up to 1000 meters without derating, up to 3000 m with output current and voltage derating.
	Vibration/Shock	10 to 20 Hz: 9.8 m/s^2 <9> 20 to 55 Hz: 5.9 m/s^2 (2A0004 to 2A0211, 4A0002 to 4A0165, and 5A0003 to 5A0099) 2.0 m/s^2 (2A0250 to 2A0415, 4A0208 to 4A1200, and 5A0125 to 5A0242)
Safety Standard		UL 508C (Power Conversion), UL/cUL listed, CSA 22.2 No. 14-05 (Industrial Control Equipment), CE marked, RoHS compliant, EN 61800-5-1 (LVD), EN 61800-3 (EMC), IEC60529
Protection Design		IP00/Open Type enclosure, IP20/NEMA Type 1 enclosure <10>

<1> The accuracy of these values depends on motor characteristics, ambient conditions, and drive settings. Specifications may vary with different motors and with changing motor temperature. Contact Yaskawa for consultation.

<2> Disable Stall Prevention during deceleration (L3-04 = 0) when using a regenerative converter, a regenerative unit, a braking resistor or the Braking Resistor Unit. The default setting for the Stall Prevention function will interfere with the braking resistor.

<3> Instantaneous average deceleration torque refers to the torque required to decelerate the motor (uncoupled from the load) from the rated motor speed down to zero in the shortest time.

<4> Actual specifications may vary depending on motor characteristics.

<5> Overload protection may be triggered when operating with 150% of the rated output current if the output frequency is less than 6 Hz.

<6> May be shorter due to load conditions and motor speed.

<7> A separate Momentary Power Loss Ride-Thru Unit is required for models 2A0004 to 2A0056 and 4A0002 to 4A0031 if the application needs to continue running for up to 2 seconds during a momentary power loss.

<8> Ground protection cannot be provided when the impedance of the ground fault path is too low, or when the drive is powered up while a ground fault is present at the output.

<9> Models 4A0930 and 4A1200 are rated at 5.9 m/s^2.

<10> Removing the top protective cover or bottom conduit bracket from an IP20/NEMA Type 1 enclosure drive voids NEMA Type 1 protection while maintaining IP20 conformity. This is applicable to models 2A0004 to 2A0211, 4A0002 to 4A0165, and 5A0003 to 5A0242.

i.10 Revision History

The revision dates and the numbers of the revised manuals appear on the bottom of the back cover.

Example:
MANUAL NO. TOEP YAIP1U 03B
Published in U.S.A. January 2014 13-5 ◇2
Date of publication
Date of original publication
Revision number

Date of Publication	Revision Number	Section	Revised Content
January 2014	3	All	Added support for models 4A0930 and 4A1200. Added sections for Keypad Operation, Start-up, Parameter Table, and Troubleshooting. Removed Parameter Setting Reference Table.
July 2013	2	Electrical Installation/ Standards Compliance	Content arrangement of this text: To maintain UL/cUL approval, UL Listed closed-loop crimp terminals are specifically required when wiring the drive main circuit terminals on models 2A0110 to 2A0415, 4A0058 to 4A0675, (4A1200 series-dependent), and 5A0041 to 5A0242.
June 2013	1	i.5	Figure i.9
May 2013	–	–	First Edition

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In the event that the end user of this product is to be the military and said product is to be employed in any weapons systems or the manufacture thereof, the export will fall under the relevant regulations as stipulated in the Foreign Exchange and Foreign Trade Regulations. Therefore, be sure to follow all procedures and submit all relevant documentation according to any and all rules, regulations and laws that may apply.

Specifications are subject to change without notice for ongoing product modifications and improvements.

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