

# YASKAWA

## YASKAWA AC Drive Z1000

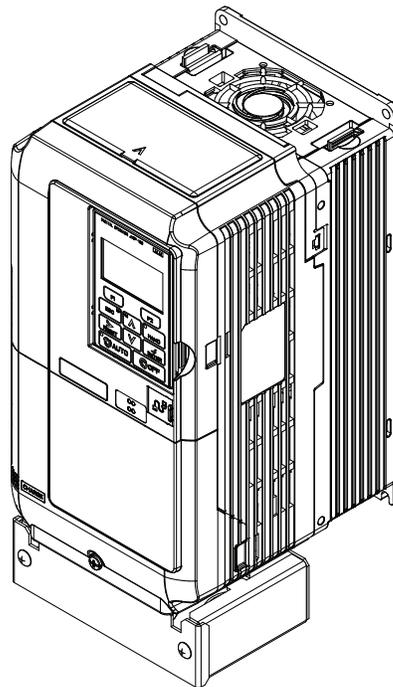
### AC Drive for HVAC Fan and Pump

## Quick Start Guide

Type: CIMR-ZU

Models: 600 V Class: 2 to 250 HP

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



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# Z1000 Quick Start Guide

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

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## ◆ Applicable Models

This Quick Start Guide document applies to the drive models in *Table i.1*.

**Table i.1 Applicable Models**

Drive Series	Drive Model Number	Software Version
Z1000 (600 V models)	CIMR-ZU5A□□□□	PRG: 4800

## 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 Yaskawa or a Yaskawa representative and provide the manual number shown on the front cover.
- If nameplate becomes worn or damaged, order a replacement from Yaskawa or a Yaskawa representative.

#### 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**

**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, once all indicators are OFF, measure for unsafe voltages to confirm the drive is safe prior to servicing.

Failure to comply will result in death or serious injury.

**⚠ 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.

Unpredictable equipment operation may result in death or serious injury.

Take special note of custom I/O programming in the drive before attempting to operate equipment.

**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.

**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, 600 Vac maximum (600 V class) when protected by branch circuit protection devices specified in this document.

Branch circuit protection shall be provided by any of the following: Non-time delay Class J, T, or CC fuses sized at 300% of the drive input rating, or Time delay Class J, T, or CC fuses sized at 175% of the drive input rating, or MCCB sized at 200% maximum of the drive input rating.

**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 or megger 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.**

Check for short circuits or ground faults on the secondary side of fuses and GFCIs and check the wiring and the selection of peripheral devices. Remove the cause of the problem and then turn the power supply off and on again. If the cause cannot be identified, do not turn on the power supply or attempt to operate the equipment.

**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 Yaskawa or a Yaskawa representative 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.

## i.1 General Safety

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### ◆ 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.

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### ◆ Motor Application Safety

**WARNING! Electrical Shock Hazard.** When a drive is running a PM motor, voltage continues to be generated at the motor terminals after the drive is shut off while the motor coasts to stop. Take the precautions described below to prevent shock and injury:

- In applications where the machine can still rotate after the drive has fully stopped a load, install a switch to the drive output side to disconnect the motor and the drive.
- Do not allow an external force to rotate the motor beyond the maximum allowable speed or to rotate the motor when the drive has been shut off.
- Wait for at least the time specified on the warning label after opening the load switch on the output side before inspecting the drive or performing any maintenance.
- Do not open and close the load switch while the motor is running.
- If the motor is coasting, make sure the power to the drive is turned on and the drive output has completely stopped before closing the load switch.

**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.

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### ◆ 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<sup>2</sup> (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**

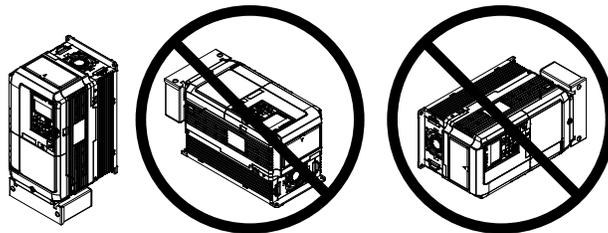
Environment	Conditions
Installation Area	Indoors
Ambient Temperature	IP20/UL Type 1 enclosure: -10 °C to +40 °C (14 °F to 104 °F) IP00/Open Type enclosure: -10 °C to +50 °C (14 °F to 122 °F) Drive reliability improves in environments without wide temperature fluctuations. When using the drive in an enclosure 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 °C to +60 °C (-4 °F to +104 °F)
Surrounding Area	Install the drive in an area free from: <ul style="list-style-type: none"> <li>• oil mist and dust</li> <li>• metal shavings, oil, water, or other foreign materials</li> <li>• radioactive materials</li> <li>• combustible materials (e.g., wood)</li> <li>• harmful gases and liquids</li> <li>• excessive vibration</li> <li>• chlorides</li> <li>• direct sunlight.</li> </ul>
Altitude	1000 m (3281 ft.) or lower, up to 3000 m (9843 ft.) with derating
Vibration	10 to 20 Hz at 9.8 m/s <sup>2</sup> (32.15 ft/s <sup>2</sup> ) 20 to 55 Hz at 5.9 m/s <sup>2</sup> (19.36 ft/s <sup>2</sup> ) (Models 5A0003 to 5A0099) or 2.0 m/s <sup>2</sup> (6.56 ft/s <sup>2</sup> ) (Models 5A0125 to 5A0242)
Orientation	Install the drive vertically to maintain maximum cooling effects.

**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.

### ◆ Installation Orientation and Spacing

**NOTICE:** Install the drive upright as illustrated in [Figure i.1](#). Failure to comply may damage the drive due to improper cooling.



**Figure i.1 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.2 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.

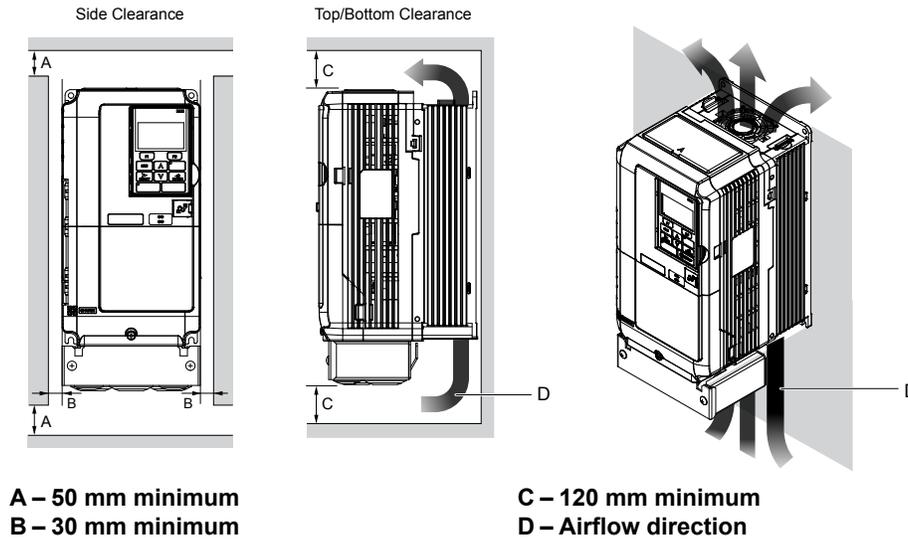


Figure i.2 Correct Installation Spacing

**Note:** IP20/UL 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 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.2 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.3, set parameter L8-35 to 1 while considering derating.

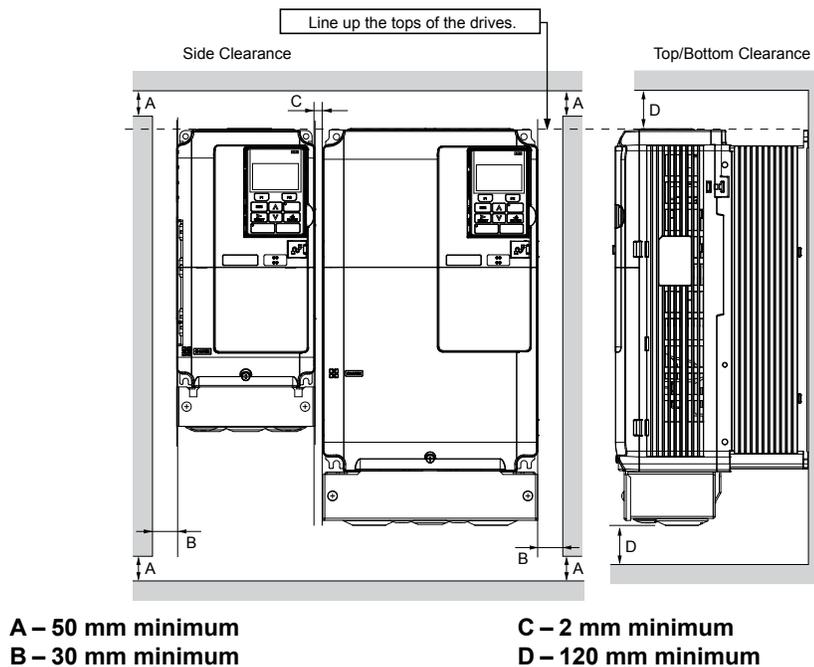


Figure i.3 Space Between Drives (Side-by-Side Mounting)

**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.

## i.2 Mechanical Installation Safety

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Remove the top protective covers of all drives as shown in *Figure i.4* when mounting IP20/UL Type 1 enclosure drives side-by-side.

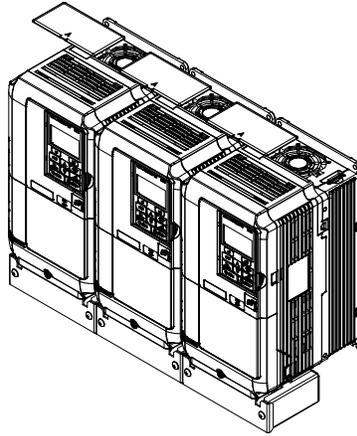


Figure i.4 IP20/UL Type 1 Side-by-Side Mounting in Enclosure

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### ◆ Drive Dimensions

#### NOTICE

Refer to the Z1000 User Manual TOEPYAIZ1U03 (600 V models) for IP20/UL Type 1 and IP00/Open Chassis drive dimensions.

To obtain instruction manuals for Yaskawa products access : <http://www.yaskawa.com>

## i.3 Electrical Installation Safety

### NOTICE

Refer to the Z1000 User Manual (600 V models) TOEPYAIZ1U03 for more information regarding the **Electrical Installation** and for complete product instructions necessary for proper installation, set-up, troubleshooting and maintenance. To obtain instruction manuals for Yaskawa products access : <http://www.yaskawa.com>

### DANGER

#### Electrical Shock Hazard

**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, once all indicators are OFF, measure for unsafe voltages to confirm the drive is safe prior to servicing.

Failure to comply will result in death or serious injury.

### WARNING

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

Failure to comply may result in death or serious injury.

### 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.

**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.

#### WARNING

##### 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.

#### WARNING

##### Fire Hazard

**Properly handle the HOA keypad battery.**

Improper use of the battery may cause fire by explosion and personal injury. Correctly install the battery, paying attention to polarity (+/-). Do not attempt to charge the battery or improperly disassemble the HOA keypad.

#### 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**

**Do not heat or throw the battery into fire.**

The battery remains in use even when power to the drive has been shut off. Be sure to also remove the battery in the HOA keypad when the drive will be shut off for long periods of time. A dead battery left inside the HOA keypad may leak and damage the keypad and drive. Be sure to replace the battery with a new one immediately after the expected lifespan has passed or when the “bAT” error is displayed on the HOA keypad.

**Be sure to observe the Perchlorate Best Management Practices (BMPs).**

BMPs apply to primary lithium (manganese dioxide) coin batteries sold or distributed in California. Perchlorate Material special handling may apply, please refer to: [www.dtsc.ca.gov/hazardouswaste/perchlorate](http://www.dtsc.ca.gov/hazardouswaste/perchlorate).

### i.4 Standard Connection Diagram

Connect the drive and peripheral devices as shown in *Figure i.5*. It is possible to set and run the drive via the HOA keypad without connecting digital I/O wiring.

**WARNING! Fire Hazard.** Install adequate branch circuit protection according to applicable local codes and this 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 600 Vac maximum (600 V class), when protected by branch circuit protection devices specified in this manual. Branch circuit protection shall be provided by any of the following: Non-time delay Class J, T, or CC fuses sized at 300% of the drive input rating, or Time delay Class J, T, or CC fuses sized at 175% of the drive input rating, or MCCB sized at 200% maximum of the drive input rating.

**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  $\neq$  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:** 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.

**Note:** The minimum load for the relay outputs M1-M2, M3-M4, M5-M6, and MA-MB-MC is 10 mA.

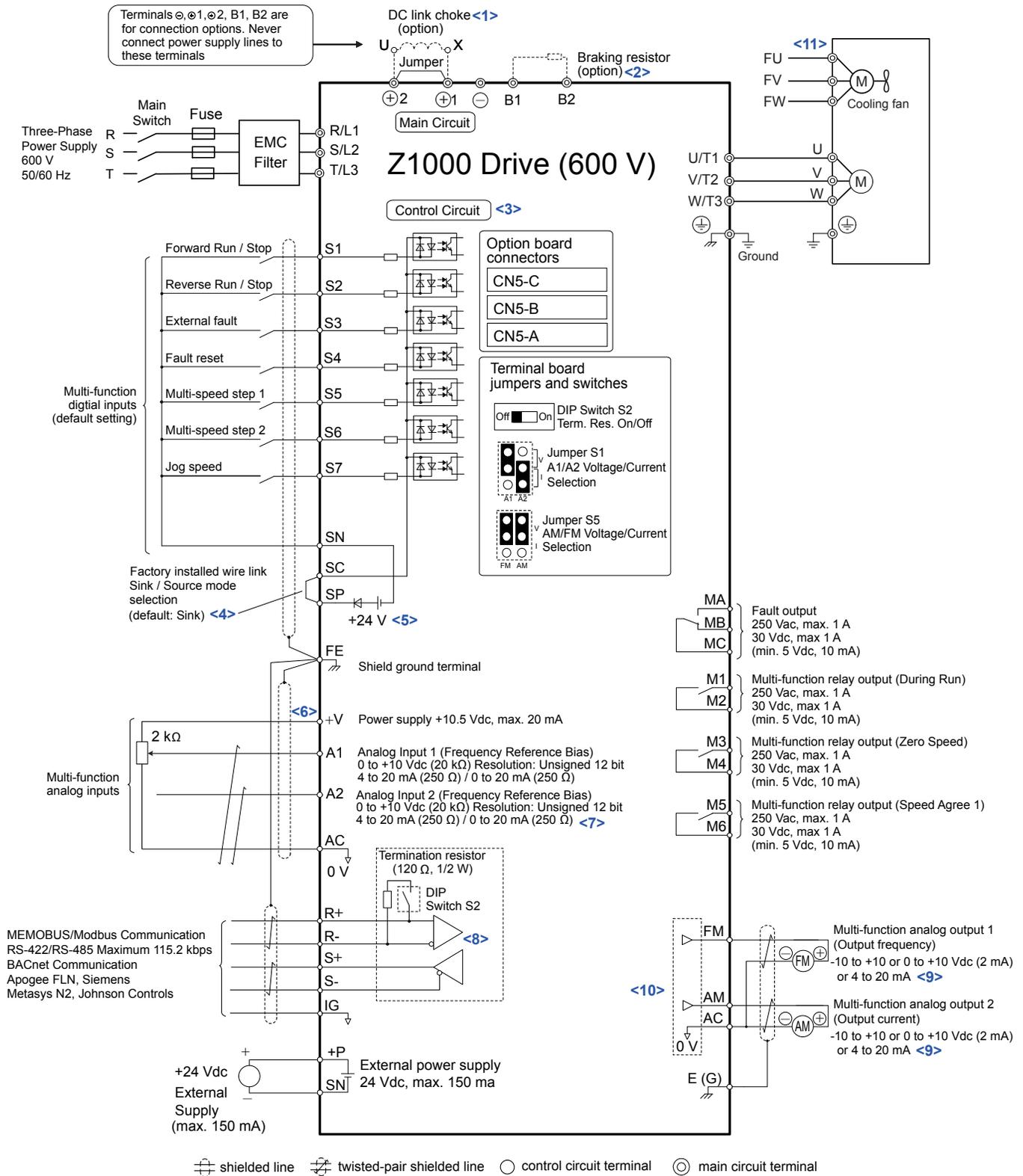


Figure i.5 Drive Standard Connection Diagram

- <1> Remove the jumper when installing a DC link choke. Models 5A0041 to 5A0242 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 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).

## i.4 Standard Connection Diagram

- <4> This figure illustrates an example of a sequence input to S1 through S7 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 DIP switch S2 to the ON position to enable the termination resistor in the last drive in a MEMOBUS/Modbus network.
- <9> 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.
- <10> Use jumper S5 to select between voltage or current output signals at terminals AM and FM. Set parameters H4-07 and H4-08 accordingly.
- <11> 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 Z1000 User Manual (600 V models) TOEPYAIZ1U03 for complete product instructions necessary for proper installation, set-up, troubleshooting and maintenance.

To obtain instruction manuals for Yaskawa products access : <http://www.yaskawa.com>

**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 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

Terminal	Type			Function	Page
	Drive Model	5A0003 to 5A0032	5A0041, 5A0052		
R/L1	Main circuit power supply input			Connects line power to the drive	17
S/L2					
T/L3					
U/T1	Drive output			Connects to the motor	17
V/T2					
W/T3					

Terminal	Type			Function	Page
	5A0003 to 5A0032	5A0041, 5A0052	5A0062 to 5A0242		
B1	Braking resistor		Not available	Available for connecting a braking resistor or a braking resistor unit option	-
B2					
⊕2	<ul style="list-style-type: none"> <li>DC link choke connection (⊕1, ⊕2) (remove the shorting bar between ⊕1 and ⊕2)</li> <li>DC power supply input (⊕1, ⊖)</li> </ul>	Not available		For connecting: <ul style="list-style-type: none"> <li>the drive to a DC power supply</li> <li>dynamic braking options</li> <li>a DC link choke</li> </ul>	-
⊕1		DC power supply input (⊕1, ⊖)	<ul style="list-style-type: none"> <li>DC power supply input (⊕1, ⊖)</li> <li>Braking unit connection (⊕3, ⊖)</li> </ul>		
⊖					
⊕3	Not available				
⊕	10 Ω or less			Grounding terminal	24

**Note:** Use terminals B1 and ⊖ when installing a CDBR-type braking unit on drives with built-in braking transistors (Models 5A0003 to 5A0052).

## ◆ 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.

## ◆ 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:

$$\text{Line drop voltage (V)} = \sqrt{3} \times \text{wire resistance } (\Omega/\text{km}) \times \text{wire length (m)} \times \text{current (A)} \times 10^{-3}$$

- 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 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 53** for information on UL compliance.

Yaskawa recommends using closed-loop crimp terminals on all drive models. Use only the tools recommended by the terminal manufacturer for crimping. **Refer to Closed-Loop Crimp Terminal Size on page 23** for closed-loop crimp terminal recommendations.

The wire gauges listed below are Yaskawa recommendations. Refer to local codes for proper wire gauge selections.

## i.4 Standard Connection Diagram

### ■ Three-Phase 600 V Class

Table i.4 Wire Gauge and Torque Specifications (Three-Phase 600 V Class)

Drive Model	Terminal	Recomm. Gauge mm <sup>2</sup> (AWG, kcmil)	Wire Range mm <sup>2</sup> (AWG, kcmil)	Screw Size	Tightening Torque N·m (lb.in.)
5A0003 5A0004 5A0006	R/L1, S/L2, T/L3	2.5 (14)	2.5 to 6.0 (14 to 10)	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2.5 (14)	2.5 to 6.0 (14 to 10)		
	⊖, ⊕1, ⊕2	–	2.5 to 6.0 (14 to 10)		
	B1, B2	–	2.5 to 6.0 (14 to 10)		
	⊕	6.0 (10)	2.5 to 6.0 (14 to 10)		
5A0009	R/L1, S/L2, T/L3	2.5 (14)	2.5 to 6.0 (14 to 10)	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2.5 (14)	2.5 to 6.0 (14 to 10)		
	⊖, ⊕1, ⊕2	–	2.5 to 6.0 (14 to 10)		
	B1, B2	–	2.5 to 6.0 (14 to 10)		
	⊕	6.0 (10)	4.0 to 6.0 (12 to 10)		
5A0011	R/L1, S/L2, T/L3	6.0 (10)	2.5 to 16 (14 to 6)	M4	2.1 to 2.3 (18.6 to 20.4)
	U/T1, V/T2, W/T3	2.5 (14)	2.5 to 16 (14 to 6)		
	⊖, ⊕1, ⊕2	–	2.5 to 16 (14 to 6)		
	B1, B2	–	2.5 to 6.0 (14 to 10)		
	⊕	10 (8)	4.0 to 6.0 (12 to 8)	M5	2.0 to 2.5 (17.7 to 22.1)
5A0017	R/L1, S/L2, T/L3	6.0 (10)	6.0 to 16 (10 to 6)	M5	3.6 to 4.0 (31.8 to 35.4)
	U/T1, V/T2, W/T3	6.0 (10)	6.0 to 16 (10 to 6)		
	⊖, ⊕1, ⊕2	–	6.0 to 16 (10 to 6)		
	B1, B2	–	6.0 to 10 (10 to 8)		
	⊕	10 (8)	6.0 to 10 (12 to 8)	M6	5.4 to 6.0 (47.8 to 53.1)
5A0022	R/L1, S/L2, T/L3	10 (8)	6.0 to 16 (10 to 6)	M5	3.6 to 4.0 (31.8 to 35.4)
	U/T1, V/T2, W/T3	6.0 (10)	6.0 to 16 (10 to 6)		
	⊖, ⊕1, ⊕2	–	6.0 to 16 (10 to 6)		
	B1, B2	–	6.0 to 10 (10 to 8)		
	⊕	10 (8)	6.0 to 10 (10 to 6)	M6	5.4 to 6.0 (47.8 to 53.1)

## i.4 Standard Connection Diagram

Drive Model	Terminal	Recomm. Gauge mm <sup>2</sup> (AWG, kcmil)	Wire Range mm <sup>2</sup> (AWG, kcmil)	Screw Size	Tightening Torque N·m (lb.in.)
5A0027 5A0032	R/L1, S/L2, T/L3	16 (6)	16 to 25 (6 to 4)	M6	5.4 to 6.0 (47.8 to 53.1)
	U/T1, V/T2, W/T3	16 (6)	16 to 25 (6 to 4)		
	⊖, ⊕1, ⊕2	–	16 to 25 (6 to 4)		
	B1, B2	–	6.0 to 10 (10 to 8)	M5	2.7 to 3.0 (23.9 to 26.6)
	⊕	16 (6)	10 to 16 (10 to 6)	M6	5.4 to 6.0 (47.8 to 53.1)
5A0041	R/L1, S/L2, T/L3	16 (6)	6.0 to 25 (10 to 3)	M8	9.0 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	16 (6)	6.0 to 25 (10 to 3)		
	⊖, ⊕1	–	(6 to 1)		
	B1, B2	–	4.0 to 25 (12 to 3)		
	⊕	16 (6)	10 to 16 (6)		
5A0052	R/L1, S/L2, T/L3	25 (4)	6.0 to 25 (10 to 3)	M8	9.0 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	16 (6)	6.0 to 25 (10 to 3)		
	⊖, ⊕1	–	16 to 35 (6 to 1)		
	B1, B2	–	10 to 25 (8 to 3)		
	⊕	16 (6)	10 to 16 (6)		
5A0062	R/L1, S/L2, T/L3	25 (4)	6.0 to 95 (10 to 4/0)	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	25 (4)	6.0 to 95 (10 to 4/0)		
	⊖, ⊕1	–	25 to 95 (4 to 4/0)		
	⊕3	–	16 to 95 (6 to 4/0)		
	⊕	25 (4)	25 (4)		
5A0077	R/L1, S/L2, T/L3	25 (3)	6.0 to 95 (10 to 4/0)	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	25 (3)	6.0 to 95 (10 to 4/0)		
	⊖, ⊕1	–	25 to 95 (3 to 4/0)		
	⊕3	–	16 to 95 (6 to 4/0)		
	⊕	25 (4)	25 (4)		
5A0099	R/L1, S/L2, T/L3	70 (1/0)	6.0 to 95 (10 to 4/0)	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	50 (1)	6.0 to 95 (10 to 4/0)		
	⊖, ⊕1	–	35 to 95 (2 to 4/0)		
	⊕3	–	25 to 95 (4 to 4/0)		
	⊕	25 (4)	25 (4)		

## i.4 Standard Connection Diagram

Drive Model	Terminal	Recomm. Gauge mm <sup>2</sup> (AWG, kcmil)	Wire Range mm <sup>2</sup> (AWG, kcmil)	Screw Size	Tightening Torque N·m (lb.in.)
5A0125	R/L1, S/L2, T/L3	70 (2/0)	35 to 150 (1 to 300)	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	70 (2/0)	35 to 150 (1 to 300)		
	⊖, ⊕1	–	70 (2/0 to 3/0)		
	⊕3	–	35 to 50 (1 to 1/0)		
	⊕	35 (3)	35 to 150 (3 to 300)		
5A0145	R/L1, S/L2, T/L3	95 (3/0)	95 to 150 (2/0 to 300)	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	95 (3/0)	95 to 150 (2/0 to 300)		
	⊖, ⊕1	–	70 to 95 (3/0 to 4/0)		
	⊕3	–	70 to 95 (1/0 to 2/0)		
	⊕	35 (3)	35 to 150 (3 to 300)		
5A0192	R/L1, S/L2, T/L3	185 (300)	95 to 300 (2/0 to 600)	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	150 (250)	95 to 300 (2/0 to 600)		
	⊖, ⊕1	–	95 to 185 (2/0 to 400)		
	⊕3	–	95 to 120 (2/0 to 250)	M10	18 to 23 (159 to 204)
	⊕	50 (1)	35 to 300 (1 to 350)	M12	32 to 40 (283 to 354)
5A0242	R/L1, S/L2, T/L3	240 (400)	95 to 300 (2/0 to 600)	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	185 (350)	95 to 300 (2/0 to 600)		
	⊖, ⊕1	–	95 to 240 (2/0 to 500)		
	⊕3	–	150 (250 to 300)	M10	18 to 23 (159 to 204)
	⊕	50 (1)	35 to 300 (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 5A0041 to 5A0242. Use only the tools recommended by the terminal manufacturer for crimping. Yaskawa recommends UL listed crimp terminals made by JST and Tokyo DIP (or equivalent) for the insulation cap. **Table i.5** 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.

The closed-loop crimp terminal sizes and values listed in **Table i.5** are Yaskawa recommendations. Refer to local codes for proper selections.

**Table i.5 Closed-Loop Crimp Terminal Size**

Wire Gauge	Terminal Screws	Crimp Terminal Model Number	Tool		Insulation Cap Model No.	Code <1>
			Machine No.	Die Jaw		
8 AWG	M4	8-4	YA-4	AD-901	TP-008	100-054-031
	M5	R8-5	YA-4	AD-901	TP-008	100-054-032
	M8	R8-8	YA-4	AD-901	TP-008	100-061-111
6 AWG	M4	14-NK4	YA-4	AD-902	TP-014	100-054-033
	M5	R14-5	YA-4	AD-902	TP-014	100-054-034
	M6	R14-6	YA-5	AD-952	TP-014	100-051-261
	M8	R14-8	YA-5	AD-952	TP-014	100-054-035
	M10	R14-10	YA-5	AD-952	TP-014	100-061-112
4 AWG	M6	R22-6	YA-5	AD-953	TP-022	100-051-262
	M8	R22-8	YA-5	AD-953	TP-022	100-051-263
	M10	R22-10	YA-5	AD-953	TP-022	100-061-113
3 / 2 AWG	M8	R38-8	YA-5	AD-954	TP-038	100-051-264
	M10	R38-10	YA-5	AD-954	TP-038	100-061-114
1 AWG 1/0 AWG 1/0 AWG × 2P	M8	R60-8	YA-5	AD-955	TP-060	100-051-265
	M10	R60-10	YF-1, YET-300-1	TD-321, TD-311	TP-060	100-051-266
1 AWG × 2P 2 AWG × 2P	M10	38-L10	YF-1, YET-150-1	TD-224, TD-212	TP-038	100-051-556
2/0 / 3/0 AWG 2/0 AWG × 2P	M10	80-10	YF-1, YET-300-1	TD-323, TD-312	TP-080	100-051-267
3/0 AWG × 2P 3/0 AWG × 4P	M10	80-L10	YF-1, YET-150-1	TD-227, TD-214	TP-080	100-051-557
	M12	80-L12	YF-1, YET-300-1	TD-323, TD-312	TP-080	100-051-558
4/0 AWG	M10	R100-10	YF-1, YET-300-1 YF-1, YET-150-1	TD-324, TD-312 TD-228, TD-214	TP-100	100-051-269
4/0 AWG × 2P 4/0 AWG × 4P	M10	100-L10	YF-1, YET-150-1	TD-228, TD-214	TP-100	100-051-559
	M12	100-L12	YF-1, YET-300-1	TD-324, TD-312	TP-100	100-051-560
250 / 300 kcmil	M10	R150-10	YF-1, YET-150-1	TD-229, TD-215	TP-150	100-051-272
	M12	R150-12	YF-1, YET-300-1	TD-325, TD-313	TP-150	100-051-273
250 kcmil × 2P 250 kcmil × 4P 300 kcmil × 2P 300 kcmil × 4P	M10	150-L10	YF-1, YET-150-1	TD-229, TD-215	TP-150	100-051-561
	M12	150-L12	YF-1, YET-300-1	TD-325, TD-313	TP-150	100-051-562
350 kcmil 400 kcmil	M10	200-10	YF-1, YET-300-1	TD-327, TD-314	TP-200	100-051-563
	M12	R200-12	YF-1, YET-300-1	TD-327, TD-314	TP-200	100-051-275

- <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.

## i.4 Standard Connection Diagram

### ■ 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. 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 (600 V class: ground to 10  $\Omega$  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.6](#) when using multiple drives. Do not loop the ground wire.

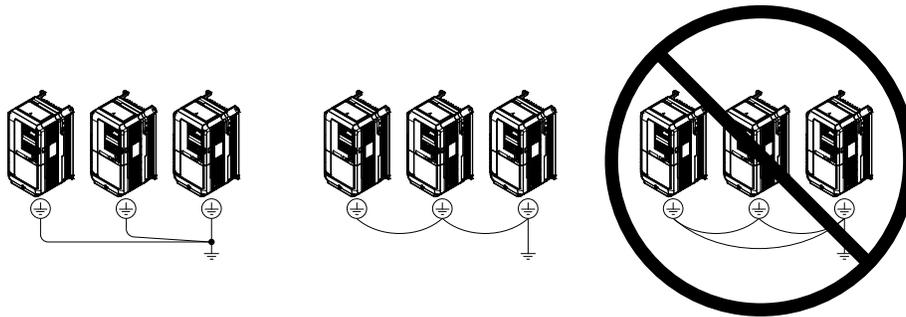


Figure i.6 Multiple Drive Wiring

### ◆ Control Circuit Connections

Drive parameters determine which functions apply to the multi-function digital inputs (S1 to S7), 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.5](#) on page 17.

**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.7*.

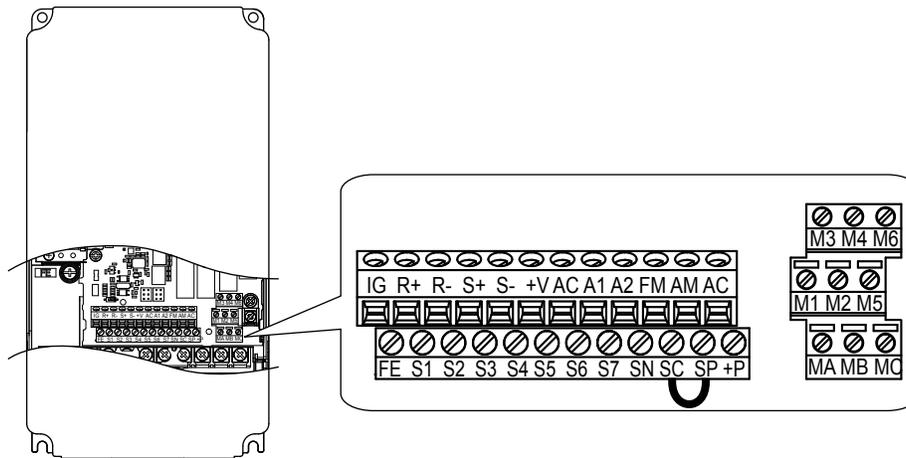


Figure i.7 Control Circuit Terminal Arrangement

## ◆ Control Circuit Input Terminals

*Table i.6* lists the input terminals on the drive. Text in parenthesis indicates the default setting for each multi-function input.

Table i.6 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)	<ul style="list-style-type: none"> <li>• Photocoupler</li> <li>• 24 Vdc, 8 mA</li> <li>• <i>Refer to Sinking/Sourcing Mode for Digital Inputs on page 30.</i></li> </ul>
	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)	
	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 (only when not using digital input option DI-A3)
	SN	Digital input power supply 0 V	<b>NOTICE:</b> Do not jumper or short terminals SP and SN. Failure to comply will damage the drive.
Analog Inputs / Pulse Train Input	+V	Power supply for analog inputs	10.5 Vdc (max allowable current 20 mA)
	A1	Multi-function analog input 1 (Frequency reference bias)	-10 to 10 Vdc, 0 to 10 Vdc (input impedance: 20 kΩ)
	A2	Multi-function analog input 2 (Frequency reference bias)	<ul style="list-style-type: none"> <li>• -10 to 10 Vdc, 0 to 10 Vdc (input impedance: 20 kΩ)</li> <li>• 4 to 20 mA, 0 to 20 mA (input impedance: 250 Ω)</li> <li>• Voltage or current input must be selected by Jumper S1 and H3-09.</li> </ul>
	AC	Frequency reference common	0 V
	FE	Ground for shielded lines and option cards	—

## i.4 Standard Connection Diagram

### ◆ Control Circuit Output Terminals

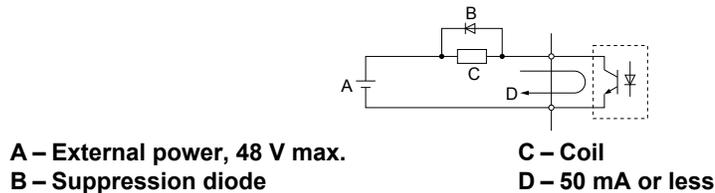
**Table i.7** lists the output terminals on the drive. Text in parenthesis indicates the default setting for each multi-function output.

**Table i.7 Control Circuit Output Terminals**

Type	No.	Terminal Name (Function)	Function (Signal Level) Default Setting
Fault Relay Output	MA	N.O. output (Fault)	30 Vdc, 10 mA to 1 A; 250 Vac, 10 mA to 1 A Minimum load: 5 Vdc, 10 mA
	MB	N.C. output (Fault)	
	MC	Fault output common	
Multi-Function Digital Output <1>	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		
	M5	Multi-function digital output (Speed Agree 1)	
	M6		
Monitor Output	FM	Analog monitor output 1 (Output frequency)	0 to 10 V / 0 to 100% 4 to 20 mA / 0 to 100% Voltage or current output must be selected by Jumper S5 and H4-07 for FM and H4-08 for AM.
	AM	Analog monitor output 2 (Output current)	
	AC	Monitor common	
External Power Supply	+P	External Power Supply	24 V (Max. 150 mA)

<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.8** when driving a reactive load such as a relay coil. Ensure the diode rating is greater than the circuit voltage.



**Figure i.8 Connecting a Suppression Diode**

### ■ Serial Communication Terminals

**Table i.8 Control Circuit Terminals: Serial Communications**

Type	No.	Signal Name	Function (Signal Level)
Serial Communication (APOGEE FLN, BACnet, MEMOBUS/Modbus, or Metasys N2) <1>	R+	Communications input (+)	APOGEE FLN, BACnet, MEMOBUS/Modbus, or Metasys N2 communication: Use an RS-422 or RS-485 cable to connect the drive.
	R-	Communications input (-)	
	S+	Communications output (+)	
	S-	Communications output (-)	
	IG	Communications ground	0 V
	FE	Option card ground	–

<1> Enable the termination resistor in the last drive in an APOGEE FLN, BACnet, MEMOBUS/Modbus, or Metasys N2 network by setting DIP switch S2 to the ON position.

## ■ Wire Size and Torque Specifications

Select appropriate wire type and gauges from [Table i.9](#). For simpler and more reliable wiring, use crimp ferrules on the wire ends.

Table i.9 Wire Gauges

Terminal	Screw Size	Tightening Torque N•m (lb. in)	Bare Wire Terminal		Ferrule-Type Terminal		Wire Type
			Recomm. wire size mm <sup>2</sup> (AWG)	Applicable wire size mm <sup>2</sup> (AWG)	Recomm. wire size mm <sup>2</sup> (AWG)	Applicable wire size mm <sup>2</sup> (AWG)	
S1-S7, SC, SN, SP	M3	0.5 to 0.6 (4.4 to 5.3)	0.75 (18)	Stranded wire: 0.2 to 1.0 (24 to 16) Solid wire: 0.2 to 1.5 (24 to 16)	0.5 (20)	0.25 to 0.5 (24 to 20)	Shielded wire, etc.
V+, A1, A2, AC							
MA, MB, MC							
M1-M6							
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, e, e1, e2) 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, and M1 to M6 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.*

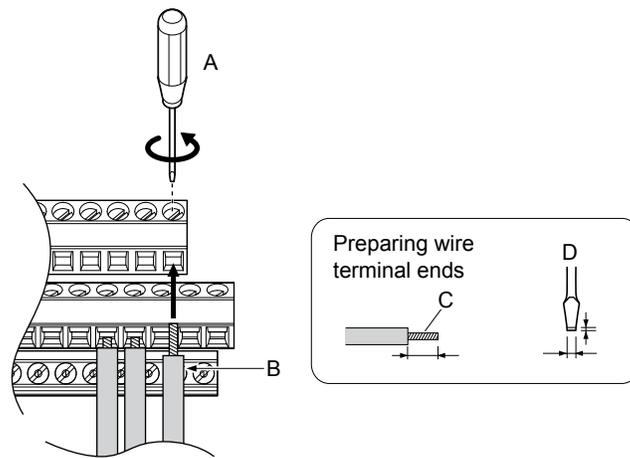
**NOTICE:** *Do not tighten screws beyond the specified tightening torque. Failure to comply may result in erroneous operation, damage to the terminal block, or cause a fire.*

**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 28](#) for details. Prepare the ends of control circuit wiring as shown in [Figure i.11](#).

Connect control wires as shown in [Figure i.9](#) and [Figure i.10](#).

## i.4 Standard Connection Diagram



**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.9 Terminal Board Wiring Guide

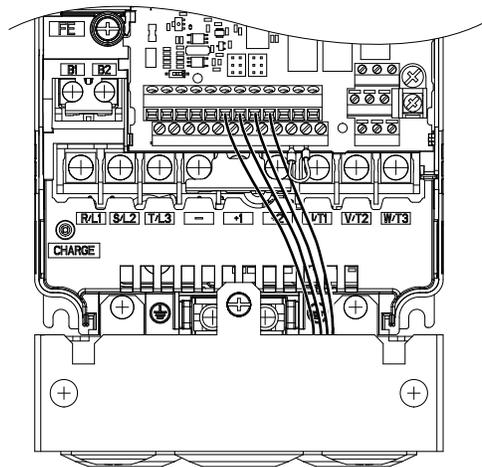
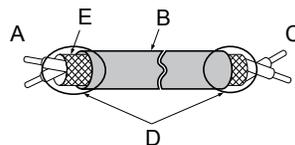


Figure i.10 Terminal Board Location Inside the Drive

When setting the frequency by analog reference from an external potentiometer, use shielded twisted-pair wires (preparing wire ends as shown in [Figure i.11](#)) 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.11 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.12* shows the location of these switches.

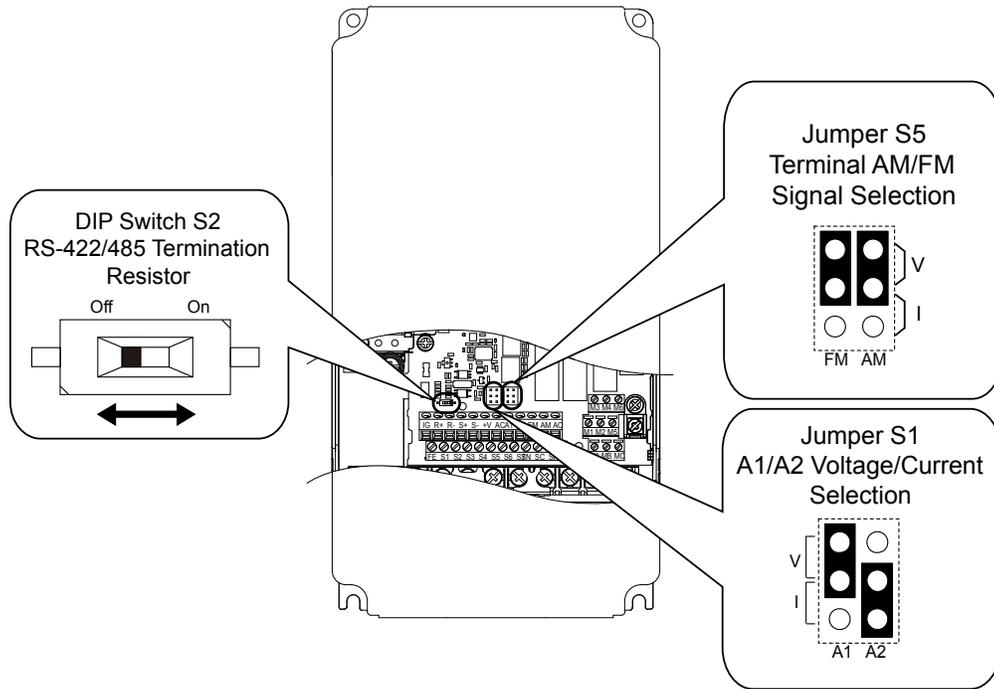


Figure i.12 Locations of Jumpers and Switches on the Terminal Board

### ◆ 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 S7 as shown in [Table i.10](#) (Default: Sink mode, internal power supply).

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

**Table i.10 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)		

### ◆ Input Signal Selection for Terminals A1 and A2

Terminals A1 and A2 can be used to input either a voltage or a current signal. Select the signal type using jumper S1 as explained in [Table i.11](#). Set parameters H3-01 and H3-09 accordingly as shown in [Table i.12](#).

**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.

**Table i.11 Jumper S1 Settings**

Terminal	Voltage Input	Current Input
Terminal A1	 (Factory Setting)	
Terminal A2		 (Factory Setting)

Table i.12 Parameters H3-01 and H3-09 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 V with Zero Limit 1: 0 to 10 V without Zero Limit 2: 4 to 20 mA Current Input 3: 0 to 20 mA Current Input	0 to 3	0
H3-09	Terminal A2 signal level selection	Selects the signal level for terminal A2. 0: 0 to 10 V with Zero Limit 1: 0 to 10 V without Zero Limit 2: 4 to 20 mA Current Input 3: 0 to 20 mA Current Input	0 to 3	2

### ◆ Terminal FM/AM Signal Selection

The signal type for terminals FM and AM can be set to either voltage or current output using jumper S5 on the terminal board as explained in [Table i.13](#). 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.13 Jumper S5 Settings

Terminal	Voltage Output	Current Output
Terminal FM		
Terminal AM		

Table i.14 Parameter H4-07 and H4-08 Details

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

### ◆ MEMOBUS/Modbus Termination

This drive is equipped with a built-in termination resistor for the RS-422/RS-485 communication port. DIP switch S2 enables or disabled the termination resistor as shown in [Table i.15](#). 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.

Table i.15 MEMOBUS/Modbus Switch Settings

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

## i.5 HOA Keypad Operation

### ◆ HOA Keypad and Keys

Use the HOA keypad to enter OFF commands, switch AUTO or HAND Mode, change parameters, and display data including fault and alarm information.

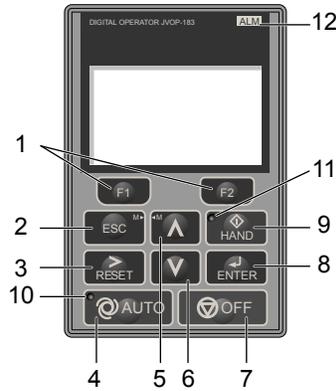


Figure i.13 Keys and Displays on the HOA Keypad

### ■ Keys and Functions

No.	Display	Name	Function
1		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 Key	<ul style="list-style-type: none"> <li>Returns to the previous display.</li> <li>Moves the cursor one space to the left.</li> <li>Pressing and holding this button will return to the Frequency Reference display.</li> </ul>
3		RESET Key	<ul style="list-style-type: none"> <li>Moves the cursor to the right.</li> <li>Resets the drive to clear a fault situation.</li> </ul>
4		AUTO Key	Selects the source of Run command and frequency reference. <ul style="list-style-type: none"> <li>Set the drive to AUTO mode.</li> <li>Run command input source depends on b1-02.</li> <li>Frequency reference input source depends on b1-01.</li> </ul>
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		OFF Key	Follows the stopping method set in b1-03 to stop drive operation. <b>Note:</b> The keypad OFF key is not functional when the drive is in Emergency Override.
8		ENTER Key	<ul style="list-style-type: none"> <li>Enters parameter values and settings.</li> <li>Selects a menu item to move between displays.</li> </ul>
9		HAND Key	The drive runs at a selectable frequency reference source by b1-12. <ul style="list-style-type: none"> <li>Set the drive to HAND mode.</li> <li>When b1-13 is set to 1, HAND and AUTO mode can be switched while the drive is running.</li> </ul>
10		AUTO Light	Lit while the drive is in AUTO mode.
11		HAND Light	Lit while the drive is in HAND mode.
12		ALM LED Light	Lit when the drive detects an alarm or error.

◆ Menu Structure for HOA Keypad

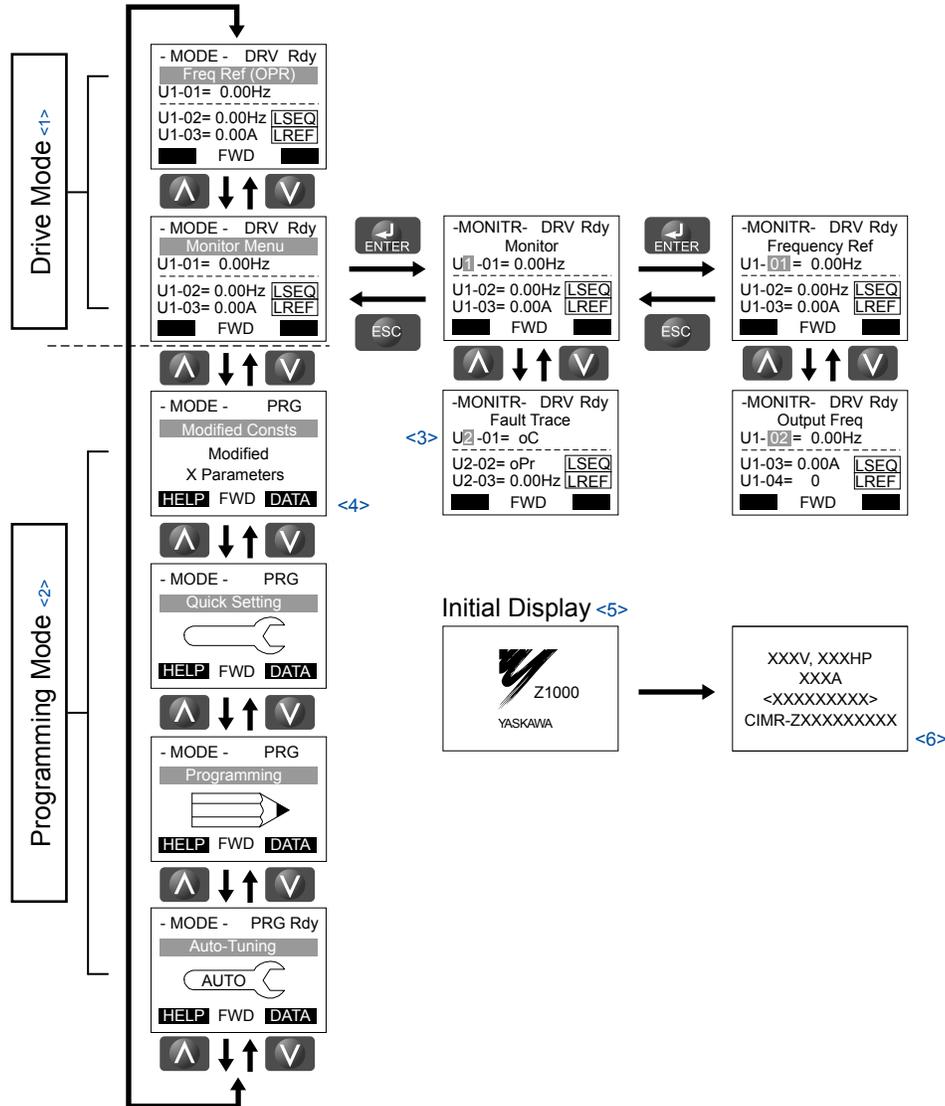


Figure i.14 HOA Keypad Menu and Screen Structure

- <1> Pressing or will start the motor.
- <2> Drive cannot operate motor.
- <3> Flashing characters are shown with white letters on gray background. (Example: **0** )
- <4> “X” characters are used as examples in this manual. The HOA keypad 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.6 Start Up

### ◆ Drive Setup Procedure

Flowchart A in [Figure i.15](#) describes a basic start-up sequence that varies slightly depending on the application. Use the drive default parameter settings in simple applications that do not require high precision.

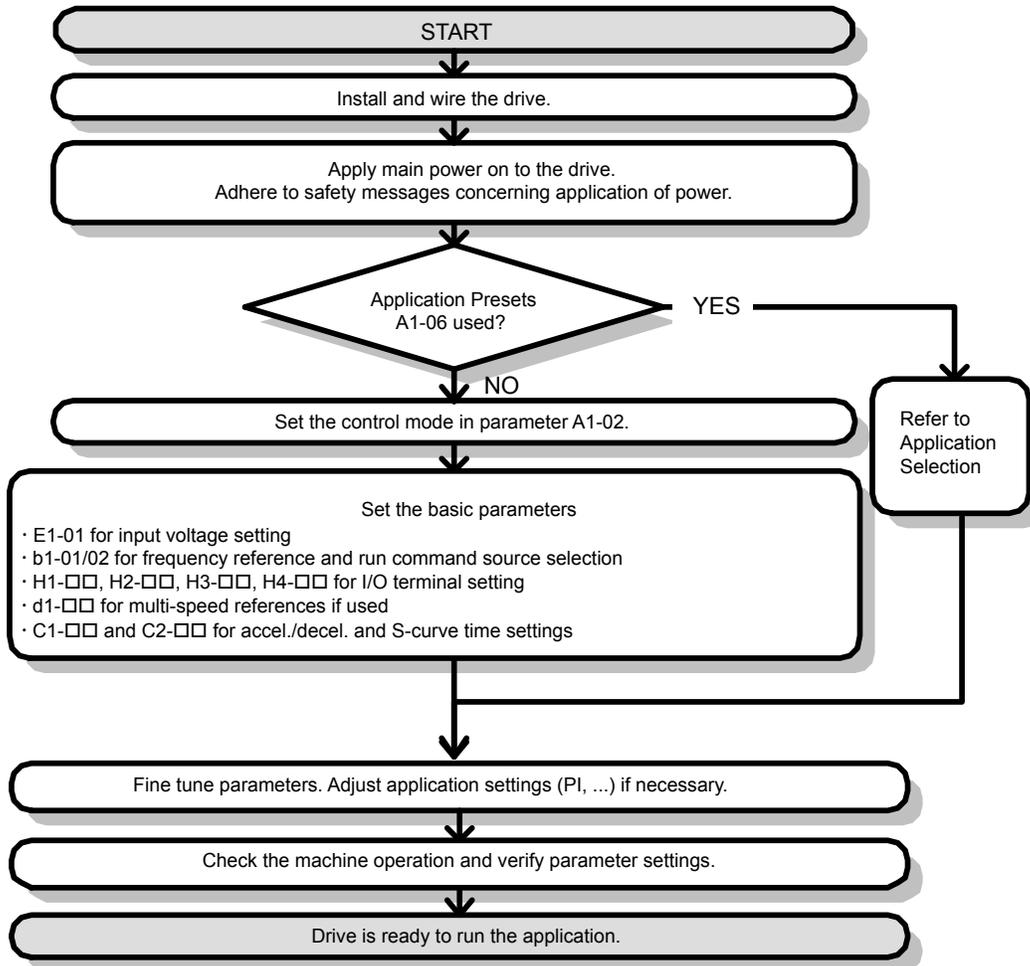


Figure i.15 Basic Start-Up

- 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

The drive offers different types of Auto-Tuning for induction motors and permanent magnet motors. The type of Auto-Tuning used differs further based on the control mode and other operating conditions. Refer to the tables below to select the type of Auto-Tuning that best suits the application.

Table i.16 Types of Auto-Tuning for Induction Motors

Type	Setting	Application Conditions and Benefits	Control Mode
			V/f
Stationary Auto-Tuning for Line-to-Line Resistance	T1-01 = 2	<ul style="list-style-type: none"> <li>The drive is used in V/f Control and other Auto-Tuning selections are not possible.</li> <li>Drive and motor capacities differ.</li> <li>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.</li> <li>Should not be used for any vector control modes unless the motor cable has changed.</li> </ul>	YES
Rotational Auto-Tuning for V/f Control	T1-01 = 3	<ul style="list-style-type: none"> <li>Recommended for applications using Speed Estimation Speed Search or using the Energy Saving function in V/f Control.</li> <li>Assumes motor can rotate while Auto-Tuning is executed. Increases accuracy for certain functions like torque compensation, slip compensation, Energy Saving, and Speed Search.</li> </ul>	YES

**Table i.17** 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.17 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

Table i.18 Types of Auto-Tuning for Permanent Magnet Motors

Type	Setting	Application Conditions and Benefits	Control Mode
			OLV/PM
PM Motor Parameter Settings	T2-01 = 0	<ul style="list-style-type: none"> <li>Motor does not rotate during Auto-Tuning.</li> <li>Motor test report or motor data similar to <a href="#">Table i.19</a> are available.</li> </ul>	YES

**Table i.19** lists the data that must be entered for Auto-Tuning. Make sure the 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.19 Auto-Tuning Input Data

Input Value	Input Parameter	Unit	Tuning Type (T2-01)
			0 Motor Parameter Settings
Control Mode	A1-02	–	5
Motor Type	T2-03	–	–
Motor Rated Power	T2-04	kW	YES
Motor Rated Voltage	T2-05	Vac	YES
Motor Rated Current	T2-06	A	YES
Motor Rated Frequency	T2-07	Hz	YES
Number of Motor Poles	T2-08	–	YES
Stator Single-phase Resistance	T2-10	Ω	YES

## i.6 Start Up

Input Value	Input Parameter	Unit	Tuning Type (T2-01)
			0 Motor Parameter Settings
Control Mode	A1-02	–	5
d-Axis Inductance	T2-11	mH	YES
q-Axis Inductance	T2-12	mH	YES
Induced Voltage Constant Unit Selection <1>	T2-13	mVs/rad (elec.)	YES
Voltage Constant <1> <2>	T2-14	mVmin (mech.)	YES
Tuning Pull-in Current	T2-15	A	–
T2 Tuning Start	T2-18	–	YES

<1> It is only necessary to input either T2-13 or T2-14. Select one and leave the other empty.

<2> Dependent upon T2-13 setting.

**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.

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 for AUTO Mode

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

b1-01	Reference Source	Frequency Reference Input
0	HOA keypad	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 or A2.
2	Serial communications	Serial Communications using the RS-422/RS-485 serial communications port (control terminals R+, R-, S+, and S-).
3	Option PCB	Communications option card

#### ■ b1-02: Run Command Selection for AUTO Mode

Set parameter b1-02 according to the Run command selection for AUTO mode.

b1-02	Reference Source	Run Command Input
1	Digital input terminals	Multi-Function digital input
2	Serial 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 17.

### ■ 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 is set for 0 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 Jumper S1 is in the correct position and parameter H3-09 is set up correctly.

### ■ 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.7 Parameter Table

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

No.	Name	Description	No.	Name	Description
A1-00	Language Selection	<b>0: English</b> 1: Japanese 3: French 5: Spanish 6: Portuguese	b2-09	Motor Pre-Heat Current 2	Determines the percentage of motor rated output current used for the motor pre-heat function.
A1-02	Control Method Selection	<b>0: V/f Control</b> 5: Open Loop Vector Control for PM	b3-01	Speed Search Selection at Start	0: Disabled 1: Enabled <b>Note:</b> Default setting is dependent upon parameter A1-02, Control Method Selection.
A1-03	Initialize Parameters	<b>0: No initialization</b> 1110: User Initialize (parameter values must be stored using parameter o2-03) 2220: 2-Wire Initialization 3330: 3-Wire Initialization 3410: HVAC Initialization 3420: OEM Bypass Initialization 5550: oPE04 Fault Reset	b3-02	Speed Search Deactivation Current	Sets the current level at which the speed is assumed to be detected and Speed Search is ended. Set as a percentage of the drive rated current.
A1-04	Password	When the value set into A1-04 does not match the value set into A1-05, parameters A1-01 through A1-03, A1-06, and A2-01 through A2-32 cannot be changed.	b3-03	Speed Search Deceleration Time	Sets output frequency reduction time during Speed Search.
A1-05	Password Setting		b3-04	V/f Gain during Speed Search	Determines how much to lower the V/f ratio during Speed Search. Output voltage during Speed Search equals the V/f setting multiplied by b3-04.
A1-06	Application Preset	<b>0: Standard</b> 1: Fan 2: Fan with PI Control 3: Return Fan with PI Control 4: Cooling Tower Fan 5: Cooling Tower Fan with PI Control 6: Pump (Secondary) 7: Pump with PI Control	b3-05	Speed Search Delay Time	When using an external contactor on the output side, b3-05 delays executing Speed Search after a momentary power loss to allow time for the contactor to close.
A2-01 to A2-32	User Parameters 1 to 32	Recently edited parameters are listed here. The user can also select parameters to appear here for quicker access.	b3-06	Output Current 1 during Speed Search	Sets the current injected to the motor at the beginning of Speed Estimation Speed Search. Set as a coefficient for the motor rated current.
b1-01	Frequency Reference Selection for AUTO Mode	0: HOA keypad <b>1: Terminals (Analog Input Terminals)</b> 2: Serial communications (APOGEE FLN, BACnet, MEMOBUS/Modbus, or Metasys N2) 3: Option card	b3-10	Speed Search Detection Compensation Gain	Sets the gain which is applied to the speed detected by Speed Estimation Speed Search before the motor is reaccelerated. Increase this setting if ov occurs when performing Speed Search after a relatively long period of baseblock.
b1-02	Run Command Selection for AUTO Mode	1: Control Circuit Terminal <b>2: Serial communications (APOGEE FLN, BACnet, MEMOBUS/Modbus, or Metasys N2)</b> 3: Option card	b3-14	Bi-Directional Speed Search Selection	0: Disabled (uses the direction of the frequency reference) 1: Enabled (drive detects which way the motor is rotating) <b>Note:</b> Default setting is dependent upon parameter A1-02, Control Method Selection.
b1-03	Stopping Method Selection	0: Ramp to stop <b>1: Coast to stop</b> 2: DC Injection Braking to stop 3: Coast with timer	b3-17	Speed Search Restart Current Level	Sets the Speed Search restart current level as a percentage of the drive rated current.
b1-04	Reverse Operation Selection	0: Reverse enabled <b>1: Reverse disabled</b>	b3-18	Speed Search Restart Detection Time	Sets the time to detect Speed Search restart.
b1-14	Phase Order Selection	<b>0: Standard</b> 1: Switch phase order (reverses the direction of the motor)	b3-19	Number of Speed Search Restarts	Sets the number of times the drive can attempt to restart when performing Speed Search.
b1-17	Run Command at Power Up	0: Disregarded A new Run command must be issued after power up. <b>1: Allowed</b> Motor will start immediately after power up if a Run command is already enabled.	b3-24	Speed Search Method Selection	<b>0: Current Detection</b> 1: Speed Estimation
b2-01	DC Injection Braking Start Frequency	Sets the frequency at which DC Injection Braking starts when "Ramp to stop" (b1-03 = 0) is selected.	b3-25	Speed Search Wait Time	Sets the time the drive must wait between each Speed Search restart attempt.
b2-02	DC Injection Braking Current	Sets the DC Injection Braking current as a percentage of the drive rated current.	b3-27	Start Speed Search Select	<b>0: Triggered when a Run command is issued. (normal).</b> 1: Triggered when an external baseblock is released.
b2-03	DC Injection Braking Time at Start	Sets DC Injection Braking time at start. Disabled when set to 0.00 seconds.	b5-01	PI Function Setting	<b>0: Disabled</b> 1: Enabled (PI output becomes output frequency reference) 3: Enabled (PI output added to frequency reference)
b2-04	DC Injection Braking Time at Stop	Sets DC Injection Braking time at stop.	b5-02	Proportional Gain Setting (P)	Sets the proportional gain of the PI controller.
			b5-03	Integral Time Setting (I)	Sets the integral time for the PI controller.

No.	Name	Description	No.	Name	Description
b5-04	Integral Limit Setting	Sets the maximum output possible from the integrator as a percentage of the maximum output frequency.	b5-25	PI Setpoint Boost Setting	Temporarily increases the PI setpoint to create an overshoot of the intended PI setpoint.
b5-06	PI Output Limit	Sets the maximum output possible from the entire PI controller as a percentage of the maximum output frequency.	b5-26	PI Maximum Boost Time	Sets the maximum boost time when PI feedback does not reach boost level. The Snooze Function starts when the PI feedback exceeds the boost setting level or when the boost time expires.
b5-07	PI Offset Adjustment	Applies an offset to the PI controller output. Set as a percentage of the maximum output frequency.	b5-27	PI Snooze Feedback Level	Sets the PI feedback level above which Snooze mode is activated. Set as a percentage of the maximum frequency.
b5-08	PI Primary Delay Time Constant	Sets a low pass filter time constant on the output of the PI controller.	b5-28	PI Feedback Function Selection	<b>0: Disabled</b> 1: Square root
b5-09	PI Output Level Selection	<b>0: Normal output (direct acting)</b> 1: Reverse output (reverse acting)	b5-29	PI Square Root Gain	A multiplier applied to the square root of the feedback.
b5-10	PI Output Gain Setting	Sets the gain applied to the PI output.	b5-30	PI Feedback Offset	PI feedback offset set as a percentage of the maximum frequency.
b5-11	PI Output Reverse Selection	<b>0: Negative PI output triggers zero limit.</b> 1: Rotation direction reverses with negative PI output. <b>Note:</b> When using setting 1, make sure reverse operation is permitted by b1-04.	b5-34	PI Output Lower Limit	Sets the minimum output possible from the PI controller as a percentage of the maximum output frequency.
b5-12	PI Feedback Loss Detection Selection	<b>0: Digital Output Only</b> (Remains active when PI is disabled by digital input) 1: Alarm output, drive continues operation (Remains active when PI is disabled by digital input) 2: Fault output, drive output is shut off (Remains active when PI is disabled by digital input) 3: Digital output only. No detection when PI is disabled by digital input. 4: Alarm detection. No detection when PI is disabled by digital input. 5: Fault detection. No detection when PI is disabled by digital input.	b5-35	PI Input Limit	Limits the PI control input (deviation signal) as a percentage of the maximum output frequency. Acts as a bipolar limit.
b5-13	PI Feedback Loss Detection Level	Sets the PI feedback loss detection level as a percentage of the maximum output frequency.	b5-36	PI Feedback High Detection Level	Sets the PI feedback high detection level as a percentage of the maximum output frequency.
b5-14	PI Feedback Loss Detection Time	Sets a delay time for PI feedback loss.	b5-37	PI Feedback High Detection Time	Sets the PI feedback high level detection delay time.
b5-15	PI Sleep Function Start Level	Sets the frequency level that triggers the sleep/snooze function.	b5-38	PI Setpoint User Display	Sets the display value of U5-01 and U5-04 when the maximum frequency is output.
b5-16	PI Sleep Delay Time	Sets a delay time before the sleep/snooze function is triggered.	b5-39	PI Setpoint Display Digits	0: No decimal places 1: One decimal place 2: Two decimal places 3: Three decimal places <b>Note:</b> Default setting is dependent upon parameter b5-20, PI Setpoint Scaling.
b5-17	PI Accel/Decel Time	Sets the acceleration and deceleration time to PI setpoint.	b5-40	Frequency Reference Monitor Content during PI	0: Display the frequency reference (U1-01) after PI compensation has been added. 1: Display the frequency reference (U1-01) before PI compensation has been added.
b5-18	PI Setpoint Selection	<b>0: Disabled</b> 1: Enabled	b5-41	PI Unit Selection	<b>0: WC (Inch of water)</b> 1: PSI (Pounds per square inch) 2: GPM (Gallons per minute) 3: F (Degrees Fahrenheit) 4: CFM (Cubic feet per minute) 5: CMH (Cubic meters per hour) 6: LPH (Liters per hour) 7: LPS (Liters per second) 8: Bar (Bar) 9: Pa (Pascal) 10: C (Degrees Celsius) 11: Mtr (Meters) 12: Ft (Feet) 13: LPM (Liters per minute) 14: CMM (Cubic meters per minute)
b5-19	PI Setpoint Value	Sets the PI target value when b5-18 = 1. Set as a percentage of the maximum output frequency.	b5-42	PI Output Monitor Calculation Method	<b>0: Linear - the monitor displays PI output</b> 1: Square root - the monitor displays square root PI output 2: Quadratic - the monitor displays 1/(PI output) 3: Cubic - the monitor displays 1/(PI output)
b5-20	PI Setpoint Scaling	0: 0.01 Hz units <b>1: 0.01% units (100% = max output frequency)</b> 2: r/min (number of motor poles must entered) 3: User-set (set scaling to b5-38 and b5-39)	b5-43	PI Output 2 Monitor Max Upper 4 Digits	Sets the upper four digits of the maximum monitor value. Used with b5-44 to set maximum monitor value of U5-14 and U5-15 at maximum frequency. <b>Note:</b> Used for U5-14 and U5-15 only.
b5-21	PI Sleep Input Source	Input source selection for Sleep Function mode. 0: PI Setpoint <b>1: SFS Input</b> 2: Snooze			
b5-22	PI Snooze Level	Sets the PI Snooze Function start level as a percentage of the maximum frequency.			
b5-23	PI Snooze Delay Time	Sets the PI Snooze Function delay time in seconds.			
b5-24	PI Snooze Deactivation Level	When the PI feedback level drops below this level, the drive returns to normal operation. Set as a percentage of the maximum frequency.			

## i.7 Parameter Table

No.	Name	Description	No.	Name	Description
b5-44	PI Output 2 Monitor Max Lower 4 Digits	Sets the lower four digits of the maximum monitor value. Used with b5-43 to set maximum monitor value of U5-14 and U5-15 at maximum frequency. <b>Note:</b> Used for U5-14 and U5-15 only.	C6-03	Carrier Frequency Upper Limit	Determines the upper and lower limits for the carrier frequency.
		b5-45			
b5-46	PI Setpoint Monitor Unit Selection		<b>0: WC (Inch of water)</b> 1: PSI (Pounds per square inch) 2: GPM (Gallons per minute) 3: F (Degrees Fahrenheit) 4: CFM (Cubic feet per minute) 5: CMH (Cubic meters per hour) 6: LPH (Liters per hour) 7: LPS (Liters per second) 8: Bar (Bar) 9: Pa (Pascal) 10: C (Degrees Celsius) 11: Mtr (Meters) 12: Ft (Feet) 13: LPM (Liters per minute) 14: CMM (Cubic meters per minute)	C6-05	Carrier Frequency Proportional Gain
		b5-47			
b8-01	Energy Saving Control Selection		0: Disabled 1: Enabled <b>Note:</b> Default setting is dependent upon parameter A1-02, Control Method Selection.	d1-17	Jog Frequency Reference
		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.		
		C1-11		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.
C6-02	Carrier Frequency Selection		1: 2.0 kHz 2: 5.0 kHz 3: 8.0 kHz 4: 10.0 kHz 5: 12.5 kHz 6: 15.0 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) <b>Note:</b> Default setting value is dependent upon parameters A1-02, Control Method Selection and o2-04, Drive Model Selection		
		E2-01		Motor Rated Current	Sets the motor nameplate full load current in amps. Automatically set during Auto-Tuning.
E2-11	Motor Rated Power		Sets the motor rated power in kilowatts (1 HP = 0.746 kW). Automatically set during Auto-Tuning.		
		E1-07		Middle Output Frequency	
E1-08	Middle Output Frequency Voltage				
		E1-09		Minimum Output Frequency	
E1-10	Minimum Output Frequency Voltage				

No.	Name	Description	No.	Name	Description
F6-01	Communications Error Operation Selection	0: Ramp to stop. Decelerate to stop using the deceleration time in C1-02. <b>1: Coast to stop</b> 2: Fast Stop. Decelerate to stop using the deceleration time in C1-09. 3: Alarm only	H5-09	CE Detection Time	Sets the time required to detect a communications error. Adjustment may be needed when networking several drives.
H1-01 to H1-07	Multi-Function Digital Input Terminal S1 to S7 Function Selection	Selects the function of terminals S1 to S7.	H5-10	Unit Selection for MEMOBUS/Modbus Register 0025H	<b>0: 0.1 V units</b> 1: 1 V units
H3-01	Terminal A1 Signal Level Selection	<b>0: 0 to 10 V with zero limit</b> 1: 0 to 10 V without zero limit 2: 4-20 mA 3: 0-20 mA <b>Note:</b> Use Jumper S1 to set input terminal A1 for a current or voltage input signal.	H5-11	Communications ENTER Function Selection	<b>0: Drive requires an Enter command before accepting any changes to parameter settings.</b> 1: Parameter changes are activated immediately without the Enter command.
H3-02	Terminal A1 Function Selection	Sets the function of terminal A1.	H5-12	Run Command Method Selection	<b>0: FWD/Stop, REV/Stop</b> 1: Run/Stop, FWD/REV
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.	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. <b>2: Recover as long as CPU has power.</b> Uv1 is not detected.
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.	L2-02	Momentary Power Loss Ride-Thru Time	Sets the Power Loss Ride-Thru time. Enabled only when L2-01 = 1 or 3.
H3-09	Terminal A2 Signal Level Selection	0: 0 to 10 V with zero limit 1: 0 to 10 V without zero limit <b>2: 4 to 20 mA</b> 3: 0 to 20 mA <b>Note:</b> Use Jumper S1 to set input terminal A2 for a current or voltage input signal.	L2-03	Momentary Power Loss Minimum Baseblock Time	Sets the minimum wait time for residual motor voltage decay before the drive output reenergizes after performing Power Loss Ride-Thru. Increasing the time set to L2-03 may help if overcurrent or overvoltage occur during Speed Search or during DC Injection Braking. <b>Note:</b> Default setting is dependent upon parameter o2-04, Drive Model Selection.
H3-10	Terminal A2 Function Selection	Sets the function of terminal A2.	L4-05	Frequency Reference Loss Detection Selection	0: Stop. Drive stops when the frequency reference is lost. <b>1: Run. Drive runs at a reduced speed when the frequency reference is lost.</b>
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.	L4-06	Frequency Reference at Reference Loss	Sets the percentage of the frequency reference that the drive should run with when the frequency reference is lost.
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.	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, oL1, oL2, oL3, STo, Uv1.
H5-01	Drive Node Address	Selects drive station slave number (address) for MEMOBUS/Modbus terminals R+, R-, S+, S-. Cycle power for the setting to take effect.	L5-02	Auto Restart Fault Output Operation Selection	<b>0: Fault output not active.</b> 1: Fault output active during restart attempt.
H5-02	Communication Speed Selection	0: 1200 bps 1: 2400 bps 2: 4800 bps <b>3: 9600 bps</b> 4: 19200 bps 5: 38400 bps 6: 57600 bps 7: 76800 bps 8: 115200 bps Cycle power for the setting to take effect.	L5-03	Time to Continue Making Fault Restarts	Enabled only when L5-05 is set to 0. Causes a fault if a fault restart cannot occur after the set time passes.
H5-03	Communication Parity Selection	<b>0: No parity</b> 1: Even parity 2: Odd parity Cycle power for the setting to take effect.	L5-04	Fault Reset Interval Time	Sets the amount of time to wait between performing fault restarts.
H5-04	Stopping Method After Communication Error (CE)	0: Ramp to stop 1: Coast to stop 2: Fast Stop <b>3: Alarm only</b> 4: Run at d1-04	L5-05	Fault Reset Operation Selection	0: Continuously attempt to restart while incrementing restart counter only at a successful restart. <b>1: Attempt to restart with the interval time set in L5-04 and increment the restart counter with each attempt.</b>
H5-05	Communication Fault Detection Selection	0: Disabled <b>1: Enabled. If communication is lost for more than two seconds, a CE fault will occur.</b>			
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. <b>1: Enabled. RTS turns on only when sending.</b>			
H5-08	Communication Protocol Selection	<b>0: MEMOBUS/Modbus</b> 1: N2 (Metasys) 2: P1 (APOGEE FLN) 3: BACnet			

## i.7 Parameter Table

No.	Name	Description
L6-01	Torque Detection Selection 1	<b>0: Disabled</b> 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 at speed agree (alarm) 10: UL6 at run (alarm) 11: UL6 at speed agree (fault) 12: UL6 at run (fault)
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.
L6-13	Motor Underload Protection Selection	<b>0: Overtorque/undertorque detection enabled</b> 1: Base frequency motor load enabled
L6-14	Motor Underload Protection Level at Minimum Frequency	Sets the UL6 detection level at minimum frequency by percentage of drive rated current.
L8-01	Internal Dynamic Braking Resistor Protection Selection (ERF type)	<b>0: Resistor overheat protection disabled</b> 1: Resistor overheat protection enabled
L8-02	Overheat Alarm Level	An overheat alarm occurs when heatsink temperature exceeds the L8-02 level.
L8-03	Overheat Pre-Alarm Operation Selection	0: Ramp to stop. A fault is triggered. 1: Coast to stop. A fault is triggered. 2: Fast Stop. Decelerate to stop using the deceleration time in C1-09. A fault is triggered. 3: Continue operation. An alarm is triggered. <b>4: Continue operation at reduced speed as set in L8-19.</b>
L8-05	Input Phase Loss Protection Selection	Selects the detection of input current phase loss, power supply voltage imbalance, or main circuit electrolytic capacitor deterioration. 0: Disabled <b>1: Enabled</b>
L8-06	Input Phase Detection Level	When ripple is observed in the DC bus, expansion of the input bias is calculated. This value becomes the input phase if the difference between the maximum and minimum values of the ripple is greater than the value set to L8-06. Detection Level = 100% = Voltage class x $\sqrt{2}$
L8-07	Output Phase Loss Protection Selection	0: Disabled <b>1: Enabled (triggered by a single phase loss)</b> 2: Enabled (triggered when two phases are lost)
L8-09	Output Ground Fault Detection Selection	0: Disabled 1: Enabled <b>Note:</b> Default setting is dependent upon parameter o2-04, Drive Model Selection.

No.	Name	Description
L8-10	Heatsink Cooling Fan Operation Selection	<b>0: During run only. Fan operates only during run for L8-11 seconds after stop.</b> 1: Fan always on. Cooling fan operates whenever the drive is powered up.
L8-11	Heatsink Cooling Fan Off Delay Time	Sets a delay time to shut off the cooling fan after the Run command is removed when L8-10 = 0.
L8-12	Ambient Temperature Setting	Enter the ambient temperature. This value adjusts the oL2 detection level.
L8-15	oL2 Characteristics Selection at Low Speeds	0: No oL2 level reduction below 6 Hz. <b>1: oL2 level is reduced linearly below 6 Hz. It is halved at 0 Hz.</b>
L8-18	Software Current Limit Selection	<b>0: Disabled</b> 1: Enabled
L8-19	Frequency Reduction Rate during Overheat Pre-Alarm	Specifies the frequency reference reduction gain at overheat pre-alarm when L8-03 = 4.
L8-27	Overcurrent Detection Gain	Sets the gain for overcurrent detection as a percentage of the motor rated current. Overcurrent is detected using the lower value between the overcurrent level of the drive or the value set to L8-27.
L8-29	Current Unbalance Detection (LF2)	0: Disabled <b>1: Enabled</b>
L8-32	Main Contactor and Cooling Fan Power Supply Failure Selection	0: Ramp to stop <b>1: Coast to stop</b> 2: Fast stop (Decelerate to stop using the deceleration time set to C1-09) 3: Alarm only ("FAn" will flash) 4: Continue operation at reduced speed as set to L8-19.
L8-35	Installation Method Selection	0: IP00/Open-Chassis enclosure 2: IP20/UL Type 1 enclosure 3: External Heatsink Installation <b>Note:</b> Default setting is dependent upon parameter o2-04, Drive Model Selection.
L8-38	Carrier Frequency Reduction	0: Disabled 1: Enabled below 6 Hz 2: Enabled for the entire speed range <b>Note:</b> Default setting is dependent upon parameters A1-02, Control Method Selection, and o2-04, Drive Model Selection.
L8-40	Carrier Frequency Reduction Off Delay Time	Sets the time that the drive continues running with reduced carrier frequency after the carrier reduction condition is gone. Setting 0.00 s disables the carrier frequency reduction time.
L8-41	High Current Alarm Selection	<b>0: Disabled</b> 1: Enabled. An alarm is triggered at output currents above 150% of drive rated current.
L8-55	Internal Braking Transistor Protection	0: Disabled. Disable when using a regen converter or optional braking unit. <b>1: Protection enabled.</b>
o1-01	Drive Mode Unit Monitor Selection	Selects the content of the last monitor that is shown when scrolling through Drive Mode display. Enter the last three digits of the monitor parameter number to be displayed: U□-□□.
o1-02	User Monitor Selection after Power Up	<b>1: Frequency reference (U1-01)</b> 2: Direction 3: Output frequency (U1-02) 4: Output current (U1-03) 5: User Monitor

No.	Name	Description	No.	Name	Description
o1-03	HOA Keypad Operator Display Selection	<b>0: 0.01 Hz</b> 1: 0.01% (100% = E1-04) 2: r/min (calculated using the number of motor poles setting in E2-04, E4-04, or E5-04) 3: User-selected units (set by o1-10 and o1-11)	o2-03	User Parameter Default Value	<b>0: No change</b> 1: Set defaults. Saves parameter settings as default values for a User Initialization. 2: Clear all. Clears the default settings that have been saved for a User Initialization.
o1-06	User Monitor Selection Mode	<b>0: 3 Monitor Sequential</b> (Displays the next two sequential monitors) 1: 3 Monitor Selectable (o1-07 and o1-08 selected monitor are shown)	o2-04	Drive Model Selection	Enter the drive model. Setting required only if installing a new control board.
o1-70	Second Line Monitor Selection	Selects the monitor that is shown in the second line.	o2-05	Frequency Reference Setting Method Selection	<b>0: ENTER key must be pressed to enter a frequency reference.</b> 1: ENTER key is not required. The frequency reference can be adjusted using the up and down arrow keys only.
o1-08	Third Line Monitor Selection	Selects the monitor that is shown in the third line.	o2-06	Operation Selection when HOA Keypad is Disconnected	<b>0:</b> The drive continues operating if the HOA keypad is disconnected. <b>1: An oPr fault is triggered and the motor coasts to stop.</b>
o1-09	Frequency Reference Display Units	Sets unit display for the frequency reference parameters and frequency related monitors when o1-03 > 40. <b>0:</b> WC (Inch of water) <b>1:</b> PSI (Pounds per square inch) <b>2:</b> GPM (Gallons per minute) <b>3:</b> F (Degrees Fahrenheit) <b>4:</b> CFM (Cubic feet per minute) <b>5:</b> CMH (Cubic meters per hour) <b>6:</b> LPH (Liters per hour) <b>7:</b> LPS (Liters per second) <b>8:</b> Bar (Bar) <b>9:</b> Pa (Pascal) <b>10:</b> C (Degrees Celsius) <b>11:</b> Mtr (Meters) <b>12:</b> Ft (Feet) <b>13:</b> LPM (Liters per minute) <b>14:</b> CMM (Cubic meters per minute) <b>15:</b> Custom units (Determined by o1-12) <b>16: No unit</b>	o2-07	Motor Direction at Power Up when Using Operator	<b>0: Forward</b> 1: Reverse This parameter requires assigning drive operation to the HOA keypad.
o1-10	User-Set Display Units Maximum Value	These settings define the display values when o1-03 is set to 3.	o3-01	Copy Function Selection	<b>0: No action</b> 1: Read parameters from the drive, saving them onto the HOA keypad. 2: Copy parameters from the HOA keypad, writing them to the drive. 3: Verify parameter settings on the drive to check if they match the data saved on the HOA keypad.
o1-11	User-Set Display Units Decimal Display	o1-10 sets the display value that is equal to the maximum output frequency. o1-11 sets the position of the decimal position.	o3-02	Copy Allowed Selection	<b>0: Read operation prohibited</b> 1: Read operation allowed
o1-13	Frequency Reference and Frequency Related Monitor Custom Units 1	Sets the customer-specified unit display for the frequency reference parameters and frequency related monitors when o1-03 = 3 and o1-09 = 15 as custom units.	o4-01	Cumulative Operation Time Setting	Sets the value for the cumulative operation time of the drive in units of 10 h.
o1-14	Frequency Reference and Frequency Related Monitor Custom Units 2	Sets the customer-specified unit display for the frequency reference parameters and frequency related monitors when o1-03 = 3 and o1-09 = 15 as custom units	o4-02	Cumulative Operation Time Selection	<b>0:</b> Logs power-on time <b>1: Logs operation time when the drive output is active (output operation time).</b>
o1-15	Frequency Reference and Frequency Related Monitor Custom Units 3	Sets the customer-specified unit display for the frequency reference parameters and frequency related monitors when o1-03 = 3 and o1-09 = 15 as custom units	o4-03	Cooling Fan Operation Time Setting	Sets the value of the fan operation time monitor U4-03 in units of 10 h.
o1-16	F1 Key Function Selection	<b>0: Standard</b> 1: Monitor 2: Drive/Bypass (DRV/BYP) 3: Bypass Run Command (RUN BYP) 4: Toggle Relay Output (RLY)	o4-05	Capacitor Maintenance Setting	Sets the value of the Maintenance Monitor for the capacitors. See U4-05 to check when the capacitors may need to be replaced.
o1-17	F2 Key Function Selection	<b>0: Standard</b> 1: Monitor 2: Drive/Bypass (DRV/BYP) 3: Bypass Run Command (RUN BYP) 4: Toggle Relay Output (RLY)	o4-07	DC Bus Pre-Charge Relay Maintenance Setting	Sets the value of the Maintenance Monitor for the soft charge bypass relay. See U4-06 to check when the bypass relay may need to be replaced.
o1-18	User Defined Parameter Upper	Allows the user to set values that can be used as reference information.	o4-11	U2, U3 Initialization	<b>0: U2-□□ and U3-□□ monitor data is not reset when the drive is initialized (A1-03).</b> 1: U2-□□ and U3-□□ monitor data is reset when the drive is initialized (A1-03).
o1-19	User Defined Parameter Lower	Allows the user to set values that can be used as reference information.	o4-12	kWh Monitor Initialization	<b>0: U4-10 and U4-11 monitor data is not reset when the drive is initialized (A1-03).</b> 1: U4-10 and U4-11 monitor data is reset when the drive is initialized (A1-03).
o2-02	OFF Key Function Selection	<b>0:</b> Disabled. OFF key is disabled in REMOTE operation. <b>1: Enabled. OFF key is always enabled.</b>	o4-13	Number of Run Commands Counter Initialization	<b>0: Number of Run commands counter is not reset when the drive is initialized (A1-03).</b> 1: Number of Run commands counter is reset when the drive is initialized (A1-03).
			o4-17	Set/Reset Real Time Clock	<b>0: — — No Setting</b> 1: Real Time Clock Set 2: Real Time Clock Reset
			U1-01	Frequency Reference	Monitors the frequency reference. Display units are determined by o1-03.
			U1-02	Output Frequency	Displays the output frequency. Display units are determined by o1-03.
			U1-03	Output Current	Displays the output current.
			U1-06	Output Voltage Reference	Displays the output voltage.

## i.7 Parameter Table

No.	Name	Description
U1-10	Input Terminal Status	<p>Displays the input terminal status. U1 - 10=00000000</p> <ul style="list-style-type: none"> <li>1 Digital input 1 (terminal S1 enabled)</li> <li>1 Digital input 2 (terminal S2 enabled)</li> <li>1 Digital input 3 (terminal S3 enabled)</li> <li>1 Digital input 4 (terminal S4 enabled)</li> <li>1 Digital input 5 (terminal S5 enabled)</li> <li>1 Digital input 6 (terminal S6 enabled)</li> <li>1 Digital input 7 (terminal S7 enabled)</li> </ul>
U1-11	Output Terminal Status	<p>Displays the output terminal status. U1 - 11=00000000</p> <ul style="list-style-type: none"> <li>1 Multi-Function Digital Output (terminal MD-ME-MF) enabled</li> <li>1 Multi-Function Digital Output (terminal M1-M2) enabled</li> <li>1 Multi-Function Digital Output (terminal M3-M4) enabled</li> <li>0 Not Used</li> <li>1 Fault Relay (terminal MA-MC closed, MA open) enabled</li> </ul>
U1-12	Drive Status	<p>Verifies the drive operation status. U1 - 12=00000000</p> <ul style="list-style-type: none"> <li>1 During run</li> <li>1 During zero-speed</li> <li>1 During REV</li> <li>1 During fault reset signal input</li> <li>1 During speed agree</li> <li>1 Drive ready</li> <li>1 During alarm detection</li> <li>1 During fault detection</li> </ul>

No.	Name	Description
U1-13	Terminal A1 Input Level	Displays the signal level to analog input terminal A1.
U1-14	Terminal A2 Input Level	Displays the signal level to analog input terminal A2.
U5-01	PI Feedback	Displays the PI feedback value.
U5-02	PI Input	Displays the amount of PI input (deviation between PI setpoint and feedback).
U5-03	PI Output	Displays PI control output.
U5-04	PI Setpoint	Displays the PI setpoint.

## i.8 Troubleshooting

### NOTICE

Refer to the Z1000 User Manual (600 V models) TOEPYAIZ1U03 for information on **Troubleshooting** and complete product instructions necessary for proper installation, set-up, troubleshooting and maintenance.

To obtain instruction manuals for Yaskawa products access : <http://www.yaskawa.com>

### 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 an illuminated ALM LED. The drive output is always switched off immediately and the motor coasts 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 HOA keypad 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 drive User Manual for a complete list.

HOA Keypad	ALM	FLT	Cause	Possible Solution
HOA Keypad Battery Voltage Low bAT	O	O	The HOA keypad battery is low	Replace the HOA keypad battery.
Baseblock bb	O		External baseblock signal was entered via one of the multi-function input terminals (S1 to S7).	Check external sequence and baseblock signal input timing.
Option Communication Error bUS	O	O	Connection is broken or master controller stopped communicating.	<ul style="list-style-type: none"> <li>Check for faulty wiring.</li> <li>Correct the wiring.</li> <li>Check for disconnected cables and short circuits. Repair as needed.</li> </ul>
			The option is not properly connected to the drive.	<ul style="list-style-type: none"> <li>The connector pins on the option are not properly lined up with the connector pins on the drive.</li> <li>Reinstall the option.</li> </ul>
Serial Communication Transmission Error CALL	O		Communications wiring is faulty, there is a short circuit, or something is not connected properly.	<ul style="list-style-type: none"> <li>Check for wiring errors.</li> <li>Correct the wiring.</li> <li>Check for disconnected cables and short circuits. Repair as needed.</li> </ul>
MEMOBUS/Modbus Communication Error CE	O	O	A data error occurred due to noise.	<ul style="list-style-type: none"> <li>Check options available to minimize the effects of noise.</li> <li>Take steps to counteract noise in the control circuit wiring, main circuit lines, and ground wiring.</li> <li>Reduce noise on the controller side.</li> <li>Separate all wiring for communication devices from drive input power lines. Install an EMC noise filter to the drive input power supply.</li> </ul>
			Communication protocol is incompatible.	<ul style="list-style-type: none"> <li>Check the H5 parameter settings and the protocol setting in the controller.</li> <li>Ensure settings are compatible.</li> </ul>
Control Circuit Error CPF11 to CPF14 CPF16 to CPF19		O	There is a self-diagnostic error in the control circuit	<ul style="list-style-type: none"> <li>Cycle power to the drive.</li> <li>If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.</li> </ul>
A/D Conversion Error CPF02		O	Control circuit is damaged	<ul style="list-style-type: none"> <li>Cycle power to the drive.</li> <li>If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.</li> </ul>
Control Board Connection Error CPF03		O	There is a connection error	<ul style="list-style-type: none"> <li>Turn off the power and check the connection between the control board and the drive.</li> <li>If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.</li> </ul>
EEPROM Memory Data Error CPF06		O	There is an error in EEPROM control circuit	<ul style="list-style-type: none"> <li>Turn off the power and check the connection between the control board and the drive.</li> <li>If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.</li> </ul>
Cannot Reset CrST	O		Fault reset was being executed when a Run command was entered.	<ul style="list-style-type: none"> <li>Ensure that a Run command cannot be entered from the external terminals or option during fault reset.</li> <li>Turn off the Run command.</li> </ul>

HOA Keypad	ALM	FLT	Cause	Possible Solution
Drive Disabled dnE	O		“Drive Enable” is set to a multi-function contact input (H1-□□ = 6A) and that signal was switched off.	Check the operation sequence.
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.	<ul style="list-style-type: none"> <li>Remove the cause of the external fault.</li> <li>Remove the external fault input from the PLC.</li> </ul>
			Problem with the PLC program	Check the PLC program and correct problems.
External Fault EF1 to EF7	O	O	An external device tripped an alarm function	Remove the cause of the external fault and reset the fault.
			Multi-function contact input setting is incorrect	<ul style="list-style-type: none"> <li>Check for unused terminals set for H1-□□ = 20 to 2B (External Fault).</li> <li>Change the terminal settings.</li> </ul>
EEPROM Write Error Err		O	Noise has corrupted data while writing to the EEPROM	<ul style="list-style-type: none"> <li>Press “ENTER” on the HOA keypad.</li> <li>Correct the parameter setting.</li> <li>Cycle power to the drive.</li> <li>If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.</li> </ul>
Internal Fan Fault FAn	O	O	Internal cooling fan has malfunctioned	<ul style="list-style-type: none"> <li>Cycle power to the drive.</li> <li>Check for fan operation.</li> <li>Verify the cumulative operation time of the fan with monitor U4-03, and verify the cumulative operation time of the fan maintenance timer with U4-04.</li> <li>If the cooling fan has exceeded its expected performance life or is damaged in any other way, replace the fan.</li> </ul>
Excessive PID Feedback FbH	O	O	Parameters are set inappropriately	Check b5-36 and b5-37 settings.
			Incorrect PID feedback wiring	Correct the wiring.
PID Feedback Loss FbL	O	O	Parameters are set inappropriately	Check b5-13 and b5-14 settings.
			Incorrect PID feedback wiring	Correct the wiring.
Ground Fault GF		O	Motor insulation is damaged	<ul style="list-style-type: none"> <li>Check the insulation resistance of the motor.</li> <li>Replace the motor.</li> </ul>
			A damaged motor cable is creating a short circuit	<ul style="list-style-type: none"> <li>Check the motor cable.</li> <li>Remove the short circuit and reapply power to the drive</li> <li>Check the resistance between the cable and the ground terminal ⊕.</li> <li>Replace the cable.</li> </ul>
			Excessive leakage current at the drive output	<ul style="list-style-type: none"> <li>Reduce the carrier frequency.</li> <li>Reduce the amount of stray capacitance.</li> </ul>
Output Phase Loss LF		O	The output cable is disconnected	<ul style="list-style-type: none"> <li>Check for wiring errors and properly connect the output cable.</li> <li>Correct the wiring.</li> </ul>
			The motor winding is damaged	<ul style="list-style-type: none"> <li>Check the resistance between motor lines.</li> <li>Replace the motor if the winding is damaged.</li> </ul>
Output Current Imbalance LF2		O	Phase loss has occurred on the output side of the drive	<ul style="list-style-type: none"> <li>Check for faulty wiring or poor connections on the output side of the drive.</li> <li>Correct the wiring.</li> </ul>
			Motor impedance or motor phases are uneven	<ul style="list-style-type: none"> <li>Measure the line-to-line resistance for each motor phase. Ensure all values match.</li> <li>Replace the motor.</li> </ul>
Cooling Fan Maintenance Time LT-1	O		The cooling fan has reached 90% of its expected performance life.	Replace the cooling fan and set o4-03 to 0 to reset the Maintenance Monitor.

## i.8 Troubleshooting

HOA Keypad	ALM	FLT	Cause	Possible Solution
Overcurrent oC		O	The motor has been damaged due to overheating or the motor insulation is damaged	<ul style="list-style-type: none"> <li>Check the insulation resistance.</li> <li>Replace the motor.</li> </ul>
			One of the motor cables has shorted out or there is a grounding problem	<ul style="list-style-type: none"> <li>Check the motor cables.</li> <li>Remove the short circuit and reapply power to the drive.</li> <li>Check the resistance between the motor cables and the ground terminal ⊕.</li> <li>Replace damaged cables.</li> </ul>
			The load is too heavy	<ul style="list-style-type: none"> <li>Measure the current flowing into the motor.</li> <li>Replace the drive with a larger capacity drive if the current value exceeds the rated current.</li> <li>Determine if there is sudden fluctuation in the current level.</li> <li>Reduce the load to avoid sudden changes in the current level or switch to a larger drive.</li> </ul>
Heatsink Overheat oH or oH1	O	O	Surrounding temperature is too high	<ul style="list-style-type: none"> <li>Check the temperature surrounding the drive. Verify temperature is within drive specifications.</li> <li>Improve the air circulation within the enclosure panel.</li> <li>Install a fan or air conditioner to cool the surrounding area.</li> <li>Remove anything near the drive that might be producing excessive heat.</li> </ul>
			Load is too heavy	<ul style="list-style-type: none"> <li>Measure the output current.</li> <li>Decrease the load.</li> <li>Lower the carrier frequency (C6-02).</li> </ul>
Drive Overheat Warning oH2	O		An external device triggered an overheat warning in the drive.	Search for the device that tripped the overheat warning. Remove the cause of the problem.
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	<ul style="list-style-type: none"> <li>Reduce the load.</li> <li>Increase the speed.</li> <li>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.</li> </ul>
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	<ul style="list-style-type: none"> <li>Adjust the preset V/f pattern (E1-04 through E1-10) by reducing E1-08 and E1-10.</li> <li>Do not lower E1-08 and E1-10 excessively. This reduces load tolerance at low speeds.</li> </ul>
Overtorque Detection 1 oL3	O	O	Parameter settings are not appropriate for the load	Check L6-02 and L6-03 settings.
			Fault on the machine side (e.g., machine is locked up)	Check the status of the load. Remove the cause of the fault.
External HOA Keypad Connection Fault oPr		O	External operator is not properly connected to the drive	<ul style="list-style-type: none"> <li>Check the connection between the operator and the drive.</li> <li>Replace the cable if damaged.</li> <li>Turn off the drive input power and disconnect the operator. Reconnect the operator and reapply drive input power.</li> </ul>

HOA Keypad	ALM	FLT	Cause	Possible Solution
Overvoltage ov	O	O	Deceleration time is too short and regenerative energy is flowing from the motor into the drive	<ul style="list-style-type: none"> <li>• Increase the deceleration time (C1-02 and C1-04).</li> <li>• Install a dynamic braking resistor or a dynamic braking resistor unit.</li> <li>• Set L3-04 to 1 to enable stall prevention during deceleration. Stall Prevention is enabled as the default setting.</li> </ul>
			Fast acceleration time causes the motor to overshoot the speed reference	<ul style="list-style-type: none"> <li>• Check if sudden drive acceleration triggers an overvoltage alarm.</li> <li>• Increase the acceleration time.</li> <li>• Use longer S-curve acceleration and deceleration times.</li> <li>• Enable the Overvoltage Suppression function (L3-11 = 1).</li> <li>• Lengthen the S-curve at acceleration end.</li> </ul>
			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.
MEMOBUS/Modbus Comm. Test Mode Complete PASS	O		MEMOBUS/Modbus test has finished normally	This verifies that the test was successful.
Input Phase Loss PF		O	There is phase loss in the drive input power	<ul style="list-style-type: none"> <li>• Check for wiring errors in the main circuit drive input power.</li> <li>• Correct the wiring.</li> </ul>
			There is excessive fluctuation in the drive input power voltage	<ul style="list-style-type: none"> <li>• Check the voltage from the drive input power.</li> <li>• Review the possible solutions for stabilizing the drive input power.</li> </ul>
			There is poor balance between voltage phases	Stabilize drive input power or disable phase loss detection.
Too Many Speed Search Restarts SEr		O	Parameters related to Speed Search are set to the wrong values	<ul style="list-style-type: none"> <li>• Reduce the detection compensation gain during Speed Search (b3-10).</li> <li>• Increase the current level when attempting Speed Search (b3-17).</li> <li>• Increase the detection time during Speed Search (b3-18).</li> <li>• Repeat Auto-Tuning.</li> </ul>
			The motor is coasting in the opposite direction of the Run command	Set b3-14 to 1 to enable Bi-Directional Speed Search.
Time Data Error TdE		O	An error has occurred in the Real-Time Clock function of the HOA keypad	Replace the HOA keypad. For replacement instructions, contact Yaskawa or your nearest sales representative.
Time Not Set TIM	O	O	The Real-Time Clock for the HOA keypad is not set in parameter o4-17	Set o4-17 to 1 to set the time for the HOA keypad. The drive will display the "TIM" alarm (Time Not Set) when the Real time Clock is not set. Additionally, at power up, if the "TIM" condition is present, the drive will automatically switch to the time setting screen (o4-17 = 1) for 30 seconds to prompt the user to set the Real-Time Clock.
Undertorque Detection 1 UL3	O	O	Parameter settings are not appropriate for the load	Check the settings of parameters L6-02 and L6-03.
			There is a fault on the machine side	Check the load for any problems.
Motor Underload UL6	O	O	The output current has fallen below the motor underload curve defined in L6-14 for longer than the time set to L6-03	Adjust the value set to L6-14 so that output current remains above the motor underload curve during normal operation.
Undervoltage Uv	O		There is a problem with the drive input power voltage	<ul style="list-style-type: none"> <li>• Check the voltage.</li> <li>• Lower the voltage of the drive input power so that it is within the limits listed in the specifications.</li> </ul>
			Phase loss in the drive input power.	Check for wiring errors in the main circuit drive input power. Correct the wiring.
			Drive internal circuitry is worn.	<ul style="list-style-type: none"> <li>• Check the maintenance time for the capacitors (U4-05).</li> <li>• Replace either the control board or the entire drive if U4-05 exceeds 90%. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.</li> </ul>

## i.8 Troubleshooting

HOA Keypad	ALM	FLT	Cause	Possible Solution
DC Bus Undervoltage Uv1	O	O	Input power phase loss	<ul style="list-style-type: none"> <li>The main circuit drive input power is wired incorrectly.</li> <li>Correct the wiring.</li> </ul>
			There is a problem with the voltage from the drive input power	<ul style="list-style-type: none"> <li>Check the voltage.</li> <li>Correct the voltage to be within the range listed in drive input power specifications.</li> <li>If there is no problem with the power supply to the main circuit, check for problems with the main circuit magnetic contactor.</li> </ul>
			The main circuit capacitors are worn	<ul style="list-style-type: none"> <li>Check the maintenance time for the capacitors (U4-05).</li> <li>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.</li> </ul>

### ◆ Operator Programming 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.

HOA Keypad	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).	
oPE04	<ul style="list-style-type: none"> <li>Run/Stop command for a 2-wire sequence was set (H1-□□ = 42), but Forward/Reverse command (H1-□□ = 43) was not.</li> <li>“Drive Enable” is set to multi-function input S1 or S2 (H1-01 = 6A or H1-02 = 6A).</li> </ul>	Properly set the functions that required for use in combination with other functions.
	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.
	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.
oPE05	The Run command is assigned to an option card (b1-02 = 3) and an input option card is not connected to the drive.	Set H6-01 to 0.
	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)	
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. <b>Note:</b> 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: <ul style="list-style-type: none"> <li>H3-02, H3-10, or H3-06 = B (PID Feedback) while H6-01 (Pulse Train Input) = 1 (PID Feedback)</li> <li>H3-02, H3-10, or H3-06 = C (PID Target Value) while H6-01 = 2 (pulse train input sets the PID target value)</li> <li>H3-02, H3-10, or H3-06 = C (PID Target Value) while b5-18 = 1 (enables b5-19 as the target PID value)</li> <li>H6-01 = 2 (PID target) while b5-18 = 1 (enables b5-19 as the target PID value)</li> </ul>	Disable one of the PID selections.
oPE08	Attempted to use a function that is not valid for the selected control mode.	Check the motor control method and the functions available.

HOA Keypad	Cause	Possible Solution
oPE09	The following simultaneous contradictory settings have occurred: <ul style="list-style-type: none"> <li>b5-15 is not set to 0.0 (PID Sleep Function Operation Level)</li> <li>The stopping method is set to either DC Injection Braking or coast to stop with a timer (b1-03 = 2 or 3).</li> </ul>	<ul style="list-style-type: none"> <li>Set b5-15 to a value other than 0.0.</li> <li>Set the stopping method to coast to stop or ramp to stop (b1-03 = 0 or 1).</li> </ul>
oPE10	V/f pattern setting error. $E1-09 \leq E1-07 < E1-06 \leq E1-11 \leq E1-04$	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.	
oPE16	The following contradictory settings are true: A1-02 = 0, S1-01 = 1, and b8-01 = 1	Correct the parameter settings.
oPE27	If digital inputs A4, A5, or A7 or digital outputs A4 or A5 are programmed, then all must be programmed	Correct the parameter settings.
oPE28	<ul style="list-style-type: none"> <li>S2-01 &gt; S2-02</li> <li>S2-06 &gt; S2-07</li> <li>S2-11 &gt; S2-12</li> <li>S2-16 &gt; S2-17</li> </ul>	Correct the parameter settings.

### ◆ Auto-Tuning Errors

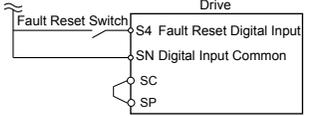
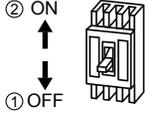
HOA Keypad	Cause	Possible Solution
End3	Rated current alarm The correct current rating printed on the motor nameplate was not entered into T1-04.	<ul style="list-style-type: none"> <li>Check the setting of parameter T1-04.</li> <li>Check the motor data and repeat Auto-Tuning.</li> </ul>
End4	Adjusted Slip Calculation Error The calculated slip is outside the allowable range.	<ul style="list-style-type: none"> <li>Make sure the data entered for Auto-Tuning is correct.</li> <li>If possible, perform Rotational Auto-Tuning. If not possible, perform Stationary Auto-Tuning 2.</li> </ul>
End5	Resistance Tuning Error The calculated slip is outside the allowable range.	<ul style="list-style-type: none"> <li>Double-check the data entered for the Auto-Tuning process.</li> <li>Check the motor and motor cable connection for faults.</li> </ul>
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.	<ul style="list-style-type: none"> <li>Check that the motor data entered to T1 parameters matches motor nameplate input before Auto-Tuning.</li> <li>Restart Auto-Tuning and enter the correct information.</li> </ul>
	Motor output power and motor-rated current settings (T1-02 and T1-04) do not match.	<ul style="list-style-type: none"> <li>Check the drive and motor capacities.</li> <li>Correct the settings of parameters T1-02 and T1-04.</li> </ul>
	Motor rated current and detected no-load current are inconsistent.	<ul style="list-style-type: none"> <li>Check the motor rated current and no-load current.</li> <li>Correct the settings of parameters T1-04 and E2-03.</li> </ul>
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.	<ul style="list-style-type: none"> <li>Make sure the data entered to the T1 parameters match the information written on the motor nameplate.</li> <li>Restart Auto-Tuning and enter the correct information.</li> </ul>
	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.	<ul style="list-style-type: none"> <li>Make sure the data entered to the T1 parameters match the information written on the motor nameplate.</li> <li>Restart Auto-Tuning and enter the correct information.</li> </ul>
	Results from Auto-Tuning are outside the parameter setting range or the tuning process took too long.	<ul style="list-style-type: none"> <li>Check and correct faulty motor wiring.</li> <li>Perform Rotational Auto-Tuning.</li> </ul>

## i.8 Troubleshooting

HOA Keypad	Cause	Possible Solution
Er-09	Acceleration Error The motor did not accelerate for the specified acceleration time.	<ul style="list-style-type: none"> <li>• Increase the acceleration time (C1-01).</li> <li>• Disconnect the machine from the motor if possible.</li> </ul>
	The load was too high during Rotational Auto-Tuning.	<ul style="list-style-type: none"> <li>• Disconnect the motor from machine and restart Auto-Tuning. If motor and load cannot be uncoupled make sure the load is lower than 30%.</li> <li>• If a mechanical brake is installed, make sure it is fully lifted during tuning.</li> </ul>
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.	<ul style="list-style-type: none"> <li>• Check motor wiring for a short between motor lines.</li> <li>• Close any magnetic contactors used between motors.</li> </ul>
	The current is too low.	<ul style="list-style-type: none"> <li>• Replace the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.</li> </ul>

### ◆ 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  on the HOA keypad 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 HOA keypad display has turned off. When an "SC" error occurs, contact Yaskawa or a Yaskawa agent before cycling the power to the drive.		

**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.9 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.

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

IP00/Open Type Enclosure: -10 °C to +50 °C (14 °F to 122 °F)

IP20/UL Type 1 Enclosure: -10 to +40 °C (14 °F to 104 °F)

Finless Type: IP20/IP00 Enclosure: -10 to +45 °C (14 °F to 113 °F)

#### ■ Main Circuit Terminal Wiring

##### Wire Gauges and Tightening Torques

*Refer to Main Circuit Wire Gauges and Tightening Torque on page 19* for details.

##### Closed-Loop Crimp Terminal Recommendations

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 5A0041 to 5A0242. Use only the tools recommended by the terminal manufacturer for crimping. *Refer to Closed-Loop Crimp Terminal Recommendations on page 23* for closed-loop crimp terminal recommendations.

**Note:** The ⊕ mark indicates the terminals for protective ground connection.  
Grounding impedance: 600 V: 10 Ω or less

#### Factory Recommended Branch Circuit Protection for UL Compliance

**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 [Table i.20](#).

**Table i.20 Factory Recommended Drive Branch Circuit Protection**

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>	Bussmann Semiconductor Fuse Rating (Fuse Ampere) <4>
<b>600 V Class</b>						
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)
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)

## i.9 UL and CSA Standards

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>	Bussmann Semiconductor Fuse Rating (Fuse Ampere) <4>
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 FWP are required for UL compliance.

<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. Refer to NEC Article 725 Class 1, Class 2, and Class 3 Remote-Control, Signaling, and Power Limited Circuits for requirements concerning class 1 circuit conductors and class 2 power supplies.

**Table i.21 Control Circuit Terminal Power Supply**

Input / Output	Terminal Signal	Power Supply Specifications
Multi-function digital inputs	S1, S2, S3, S4, S5, S6, S7, SC, SP, SN	Use the internal control power supply of the drive or an external class 2 power supply.
Multi-function analog inputs	+V, A1, A2, AC, FM, AM	

### ■ Drive Short Circuit Rating

The drive is suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical Amperes, 600 Vac maximum (600 V Class) when protected by Bussmann Type FWH or FWP fuses as specified in [Table i.20 Factory Recommended Drive Branch Circuit Protection](#) on page 53.

### ◆ CSA Standards Compliance



Figure i.16 CSA Mark

## ■ CSA for Industrial Control Equipment

The drive is CSA-certified as Industrial Control Equipment Class 3211–06.

Specifically, the drive is certified to: CAN/CSA C22.2 No. 14-13 and CAN/CSA C22.2 No.274-13.

## ◆ 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.22 Overload Protection Settings

Setting	Description	
0	Disabled	Disabled the internal motor overload protection of the drive.
1	Standard fan-cooled motor (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.
4	Permanent Magnet motor with variable torque	Selects protection characteristics for a variable torque PM motor. The motor overload detection level (oL1) is automatically reduced when running below the motor rated speed.
5	Permanent Magnet motor with constant torque	Selects protection characteristics for a constant torque PM motor. The motor overload detection level (oL1) is constant over the whole 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 = 1 to 6) 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.

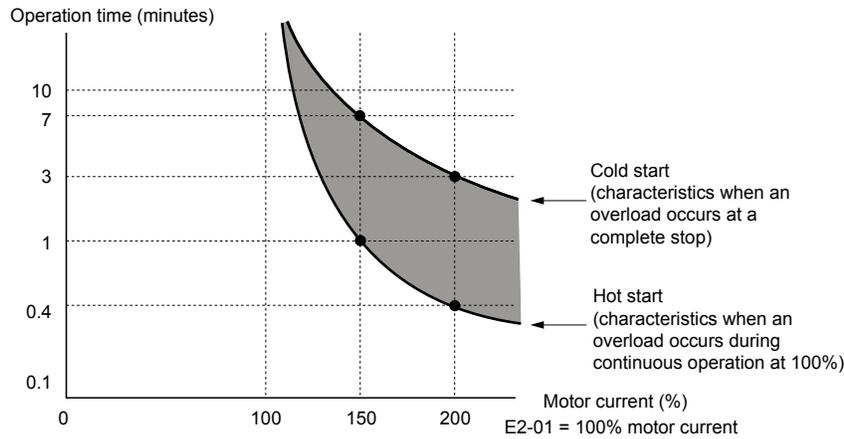


Figure i.17 Motor Overload Protection Time

◆ **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 Z1000 User Manual (600 V models) TOEPYAIZ1U03 for more information regarding **Precautionary Notes on External Heatsink** and complete product instructions necessary for proper installation, set-up, troubleshooting and maintenance.

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## ◆ Drive Specifications

Item		Specification
Control Characteristics	Control Method	The following control methods can be set using drive parameters: <ul style="list-style-type: none"> <li>• V/f Control (V/f)</li> <li>• Open Loop Vector Control for PM (OLV/PM)</li> </ul>
	Frequency Control Range	0.01 to 240 Hz
	Frequency Accuracy (Temperature Fluctuation)	Digital input: within $\pm 0.01\%$ of the max output frequency (-10 to +50 °C [14 to 122 °F]) Analog input: within $\pm 0.1\%$ of the max output frequency (25 °C $\pm 10$ °C [77 $\pm 50$ °F])
	Frequency Setting Resolution	Digital inputs: 0.01 Hz Analog inputs: 1/1000 of the maximum output frequency setting (10 bit unsigned)
	Output Frequency Resolution	0.001 Hz
	Frequency Setting Signal	DC 0 to +10 V (20 k $\Omega$ ), 4 to 20 mA (250 $\Omega$ ) 0 to 20 mA (250 $\Omega$ )
	Starting Torque </>	V/f: 140% at 3 Hz OLV/PM: 50% at 6 Hz
	Speed Control Range </>	V/f: 1:40 OLV/PM: 1:20
	Speed Response </>	OLV/PM: 10 Hz
	Accel/Decel Time	0.0 to 6000.0 s (4 selectable combinations of independent acceleration and deceleration settings)
	Braking Torque	Approximately 20%
	V/f Characteristics	User-selected programs and V/f preset patterns possible
Main Control Functions	Momentary Power Loss Ride-Thru, Speed Search, Overtorque/Undertorque Detection, 4 Step Speed (max), Accel/Decel Switch, S-curve Accel/decel, 3-Wire Sequence, Auto-Tuning (Stationary for Line-to-Line Resistance, Rotational for V/f Control), 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, APOGEE FLN Comm. (RS-422/RS-485 4.8 kbps), BACnet Comm. (RS-485 max. 76.8 kbps), MEMOBUS/Modbus Comm. (RS-422/RS-485 max, 115.2 kbps), Metasys N2 Comm. (RS-422/RS-485 9.6 kbps), Fault Restart, Application Presets, KEB, Overexcitation Deceleration, Overvoltage Suppression, Sequence Timer Operation, Secondary PI Control, Bypass Operation, HOA Keypad, Dynamic Noise Control	

## i.9 UL and CSA Standards

Item		Specification
Protection Functions	Motor Protection	Electronic thermal overload relay
	Momentary Overcurrent Protection	Drive stops when rated output current exceeds 175%
	Overload Protection	Drive stops after 60 s at 110% of rated output current <2> Drive stops after 0.5 s at 140% of rated output current <2>
	Overvoltage Protection	600 V class: Stops when DC bus voltage exceeds approx. 1040 V
	Undervoltage Protection	600 V class: Stops when DC bus voltage falls below approx. 475 V
	Momentary Power Loss Ride-Thru	Immediately stop after 15 ms or longer power loss <3> Continuous operation during power loss shorter than 2 s by speed search function
	Heatsink Overheat Protection	Thermistor
	Stall Prevention	Stall Prevention is available during acceleration, deceleration, and during run.
	Ground Protection	Electronic circuit protection <4>
	DC Bus Charge LED	Remains lit until DC bus voltage falls below 50 V
Environment	Area of Use	Indoors
	Ambient Temperature	-10 °C to +40 °C (14 to 104 °F) IP20/UL Type 1 Enclosure -10 °C to +50 °C (14 to 122 °F) IP00/Open Type Enclosure
	Humidity	95% RH or less (no condensation)
	Storage Temperature	-20 °C to +70 °C (-4 to +158 °F) (short-term temperature during transportation)
	Altitude	Up to 1000 meters without derating, up to 3000 m with output current and voltage derating. <i>Refer to Altitude Derating on page 59</i> for details.
	Vibration/Shock	10 to 20 Hz: 9.8 m/s <sup>2</sup> 20 to 55 Hz: 5.9 m/s <sup>2</sup> (5A0003 to 5A0099) 2.0 m/s <sup>2</sup> (5A0125 to 5A0242)
Standards		<ul style="list-style-type: none"> <li>UL508C</li> <li>CSA</li> </ul>
Protection Design		IP00/Open Type enclosure, IP20/UL Type 1 enclosure <5>

- <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> Overload protection may be triggered when operating with 150% of the rated output current if the output frequency is less than 6 Hz.
- <3> May be shorter due to load conditions and motor speed.
- <4> 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.
- <5> Removing the top protective cover or bottom conduit bracket from an IP20/UL Type 1 enclosure drive voids UL Type 1 protection while maintaining IP20 conformity. This is applicable to models 5A0003 to 5A0242.

### ◆ Drive Derating Data

#### ■ Rated Current Depending on Carrier Frequency

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

#### NOTICE

Refer to the Z1000 User Manual (600 V models) TOEPYAIZ1U03 – **Drive Derating Data section** to assist in model selection and adjustment when the application requires changing the drive carrier frequency from factory defaults.

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### ◆ Temperature Derating

To ensure the maximum performance life, the drive output current must be derated as shown in **Figure i.18** 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.	40 to 60	40 °C
L8-35	Installation Method Selection	0: IP00/Open-Chassis Enclosure 2: IP20/UL Type 1 Enclosure 3: External Heatsink Installation	0, 2, 3	2

### IP00/Open-Chassis Enclosure

Drive operation between -10 °C and +50 °C (14 and 122 °F) allows 100% continuous current without derating. Models 2A0343A, 2A0396A, 4A0361A, 4A0414A, 4A0480A, and 4A0590A are sold as IP00/Open-Chassis.

### IP20/UL Type 1 Enclosure

Drive operation between -10 °C and +40 °C (14 and 104 °F) allows 100% continuous current without derating. Operation between 40 °C and 50 °C (104 and 122 °F) requires output current derating.

**Note:** The temperature derating remains unchanged when removing the top protective cover and the bottom conduit bracket to change IP20/UL Type 1 enclosure models 2A0011F and 4A0005F through 4A0302F to IP00/Open-Type enclosures (derating required for temperatures over 40 °C [104 °F]).

### External Heatsink Installation

Drive operation between -10 °C and +40 °C (14 and 104 °F) allows 100% continuous current without derating. Operation between 40 °C and 50 °C (104 and 122 °F) requires output current derating.

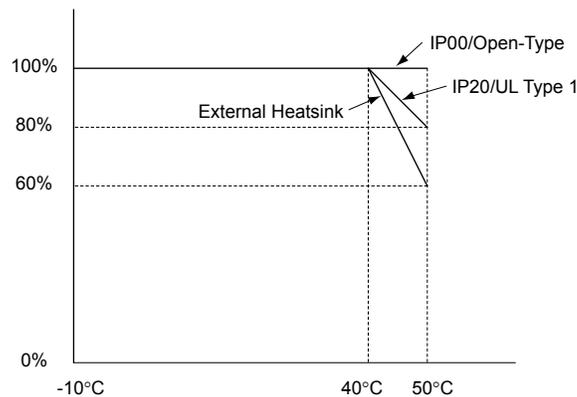


Figure i.18 Ambient Temperature and Installation Method Derating

## 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 *Z1000 User Manual (600 V models) TOEPYAIZ1U03*.

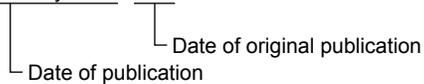
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## i.10 Revision History

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

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Date of Publication	Revision Number	Section	Revised Content
October 2021	<2>	All	Revision: Corrected Jumper S1 settings.
June 2021	<1>-2	All	Revision: Removed CE Standards from relevant sections.
May 2017	<1>-1	Preface	Revision: Removed restrictions
May 2015	<1>	Document Title	Document title changed from Safety Precautions to Quick Start Guide.
		Chapter I	Revision: Table i.14 - Parameters H4-07 and H4-08 details
			Revision: Section i.7 - Parameter Table for parameters A1-03, b5-43, b5-45 and b5-46
			Revision: CSA certification class
All	Addition: UL description to enclosure types		
February 2014	–	–	First Edition. This manual supports drive software version PRG: 4800.

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# YASKAWA AC Drive Z1000

## AC Drive for HVAC Fan and Pump

### Quick Start Guide

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