YASKAWA

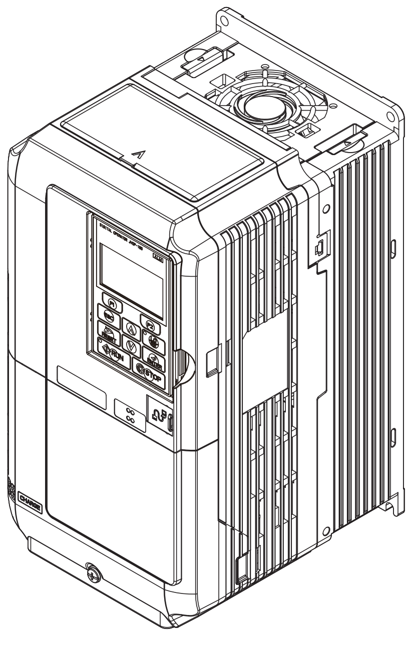
YASKAWA AC Drive A1000

Crane Software

Quick Start Guide

Type: CIMR-AC☐A☐☐☐☐☐☐
Models: 200 V Class: 0.4 to 110 kW
400 V Class: 0.4 to 315 kW

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



MANUAL NO. TOEP C710616 49A

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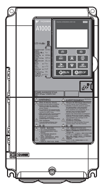
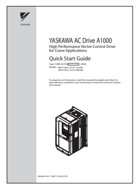
1 Safety Instructions and General Warnings

YASKAWA supplies component parts for use in a wide variety of industrial applications. The selection and application of YASKAWA products remain the responsibility of the equipment designer or end user. YASKAWA accepts no responsibility for the way its products are incorporated into the final system design. Under no circumstances should any YASKAWA product be incorporated into any product or design as the exclusive or sole safety control. Without exception, all controls should be designed to detect faults dynamically and fail safely under all circumstances. All products designed to incorporate a component part manufactured by YASKAWA must be supplied to the end user with appropriate warnings and instructions as to the safe use and operation of that part. Any warnings provided by YASKAWA must be promptly provided to the end user. YASKAWA offers an express warranty only as to the quality of its products in conforming to standards and specifications published in the manual. NO OTHER WARRANTY, EXPRESS OR IMPLIED, IS OFFERED. YASKAWA assumes no liability for any personal injury, property damage, losses, or claims arising from misapplication of its products.

◆ Scope of Delivery

The following items are delivered with A1000 Series drives for Crane applications:

A1000 Drive	Quick Start Guide
	

◆ Applicable Documentation

YASKAWA AC Drive A1000 Crane Software Quick Start Guide (this book)	Read this manual first. This guide is packaged together with the product. It contains basic information required to install and wire the drive, in addition to an overview of fault diagnostics, maintenance, and parameter settings. Use the information in this book to prepare the drive for a trial run with the application and for basic operation.
A1000 Crane Software Application Manual EZZ021069.1	Read this manual to gain understanding of advanced functions for crane applications.
YASKAWA AC Drive A1000 Technical Manual SIEP C710616 27□	This manual provides detailed information on parameter settings, drive functions, and MEMOBUS/Modbus specifications. Note that not all functions described here are applicable for A1000 Crane Application drives.

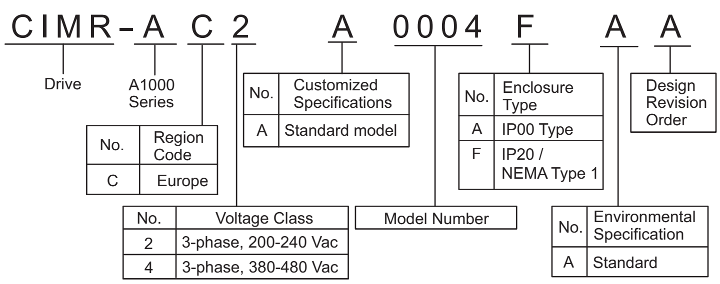
◆ Receiving

Please perform the following tasks after receiving the drive:

- Inspect the drive for damage. If the drive appears damaged upon receipt, contact your supplier.
- Verify receipt of all components.
- Verify receipt of the correct model by checking the information on the nameplate. If you have received the wrong model contact your supplier.

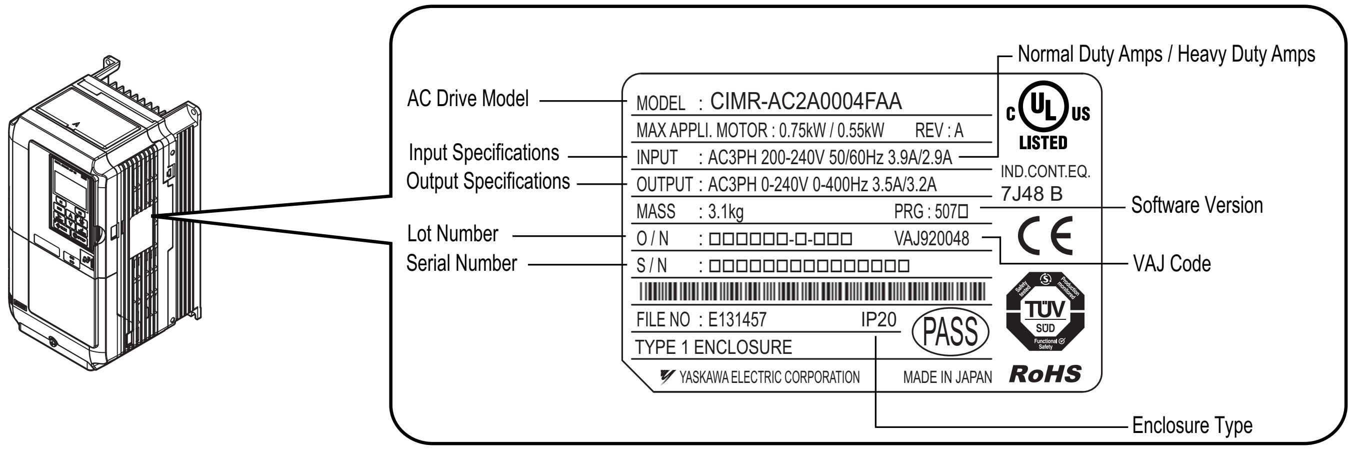
■ Drive Model Identification

A1000 Series drives for Crane Applications have the same model code as standard A1000 drives.



■ Nameplate

A1000 Series drives for Crane Applications are labeled with a special VAJ code on the nameplate. Also, the software number shown on the nameplate is “507□”.



Note: Even though Normal Duty values are printed on the nameplate, A1000 Crane drives do not offer Normal Duty ratings and should always be selected considering Heavy Duty values.

◆ General Warnings

⚠ WARNING
• **Read and understand this manual before installing, operating or servicing this drive.** • **All warnings, cautions, and instructions must be followed.** • **All work must be performed by qualified personnel.** • **The drive must be installed according to this manual and local codes.**
Heed the safety messages in this manual. The operating company is responsible for any injuries or equipment damage resulting from failure to heed the warnings in this manual.

The following conventions are used to indicate Safety messages in this manual:

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

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

NOTICE
Indicates a property damage message.

◆ Safety Warnings

⚠ WARNING

Electrical Shock Hazard

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

YASKAWA is not responsible for the damage caused by modification of the product made by the user. Failure to comply could result in death or serious injury from operation of damaged equipment.

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. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait at least five minutes after all indicators are off and measure the DC bus voltage level to confirm safe level.

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 change wiring, remove covers, connectors or options cards, or attempt to service the drive with power applied to the drive.

Failure to comply could result in death or serious injury. Disconnect all power to the drive and check for unsafe voltages before servicing.

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.

Never short the output circuits of the drive.

Do not short the output circuits of the drive. Failure to comply could result in death or serious injury.

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

When an EMC filter is installed or with models CIMR-AC□4A0414 and larger, the leakage current exceeds 3.5 mA. Therefore according to IEC 61800-5-1 automatic power supply interruption in case of discontinuity of the protective earthing conductor must be provided or a protective earthing conductor with a cross section of at least 10 mm^2 (Cu) or 16 mm^2 (Al) must be used.

Use appropriate equipment for residual current monitoring/detection (RCM/RCD).

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

Sudden Movement Hazard

Stay clear of the motor during rotational Auto-Tuning. The motor may start operating suddenly.

During automatic starting of equipment, the machine may start moving suddenly, which could result in death or serious injury.

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.

WARNING

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.

Do not use improper combustible materials in drive installation, repair or maintenance.

Failure to comply could result in death or serious injury by fire. Attach the drive or braking resistors to metal or other noncombustible material.

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

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.

- Do not connect AC line power to output terminals U, V, and W.
- Make sure that the power supply lines are connected to main circuit input terminals R/L1, S/L2, T/L3 (or R/L1 and S/L2 for single-phase power).

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.

Crush Hazard

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

Improper lifter may cause the drive to drop, resulting in serious injury.

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

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

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.

Burn Hazard

Do not touch the heatsink or braking resistor hardware until a powered-down cooling period has elapsed.

NOTICE

Equipment Hazard

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 perform a withstand voltage test on any part of the unit.

Failure to comply could result in damage to the sensitive devices within the drive. Use power off resistance checks to determine shortcircuits.

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.

NOTICE
If a fuse is blown or equipment for residual current monitoring/detection (RCM/RCD) is tripped, check the wiring and the selection of the peripheral devices. Contact your supplier if the cause cannot be identified after checking the above. **Do not restart the drive until 5 minutes passes and CHARGE lamp is OFF or immediately operate the peripheral devices if a fuse is blown or equipment for residual current monitoring/detection (RCM/RCD) is tripped.** Check the wiring and the selection of peripheral devices to identify the cause. Contact your supplier before restarting the drive or the peripheral devices if the cause cannot be identified. **Do not 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 carelessly connect parts or devices to the drives braking transistor terminals.** Failure to comply could result in damage to the drive or braking circuit. Carefully review instruction manual TOBP C720600 00 when connecting a 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 modification of the product made by the user. This product must not be modified. **Check all the wiring to ensure that all connections are correct after installing the drive and connecting other devices.** Failure to comply could result in damage to the drive. **Improper application of devices on drive output circuits can damage the drive** Do not connect unapproved LC or RC interference suppression filters, capacitors, ground fault circuits, or overvoltage protection devices to the drive.
Fire Hazard
Install adequate branch circuit short circuit protection per applicable codes. The drive is suitable for circuits capable of delivering not more than 100,000 RMS symmetrical Amperes, 240 Vac maximum (200 V Class) and 480 Vac maximum (400V Class). Inadequate branch short circuit protection damage or serious injury by fire.

◆ Precautions for CE Low Voltage Directive Compliance

This drive has been tested according to European standard EN61800-5-1, and it fully complies with the Low Voltage Directive. The following conditions must be met to maintain compliance when combining this drive with other devices:

Do not use drives in areas with pollution higher than severity 2 and overvoltage category 3 in accordance with IEC664.

Ground the neutral point of the main power supply for 400 V Class drives.

2 Mechanical Installation

◆ Upon Receipt

Perform the following tasks after receiving the drive:

- Inspect the drive for damage. If the drive appears damaged upon receipt, contact your supplier.
- Verify receipt of the correct model by checking the information on the nameplate. If you have received the wrong model, contact your supplier.

◆ Installation Environment

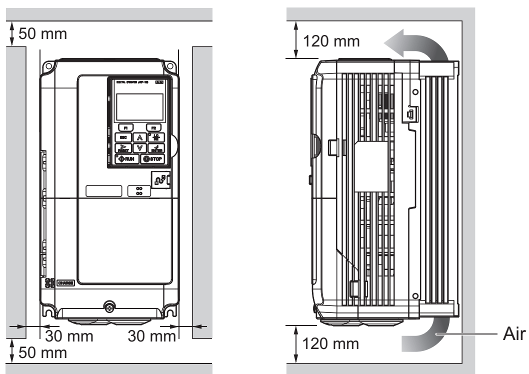
For optimum performance life of the drive, install the drive in an environment that meets the conditions listed below.

Environment	Conditions
Installation Area	Indoors
Ambient Temperature	-10°C to +40°C (IP20/NEMA Type 1 Enclosure) -10°C to +50°C (IP00 Enclosure) Drive reliability improves in environments without wide temperature fluctuations. When using the drive in an enclosure panel, install a cooling fan or air conditioner in the area to ensure that the air temperature inside the enclosure does not exceed the specified levels. Do not allow ice to develop on the drive.
Humidity	95% RH or less and free of condensation
Storage Temperature	-20 to +60°C
Surrounding Area	Install the drive in an area free from: • oil mist and dust • metal shavings, oil, water or other foreign materials • radioactive materials • combustible materials (e.g., wood) • harmful gases and liquids • excessive vibration • chlorides • direct sunlight
Altitude	1000 m, up to 3000 m with derating (for details, refer to the Technical Manual)
Vibration	10 to 20 Hz at 9.8 m/s^2 20 to 55 Hz at 5.9 m/s^2 (Models CIMR-AC□2A0004 to 2A0211 and 4A0002 to 4A0165) 2.0 m/s^2 (Models CIMR-AC□2A0250 to 2A0415 and 4A0208 to 4A0675)
Orientation	Install the drive vertically to maintain maximum cooling effects.

◆ Installation Orientation and Spacing

Always install the drive in an upright position. Leave space around the unit for proper cooling as shown in the figure on the right.

Note: Several units can be installed closer together than shown in the figure by using "Side-by-Side" mounting. For details refer to the Technical Manual.



◆ Dimensions

■ IP20/NEMA Type 1 Enclosure Drives

Note: IP20/NEMA Type 1 Enclosure drives are equipped with a top protective cover. Removing this cover voids NEMA Type 1 protection but still keeps IP20 conformity.

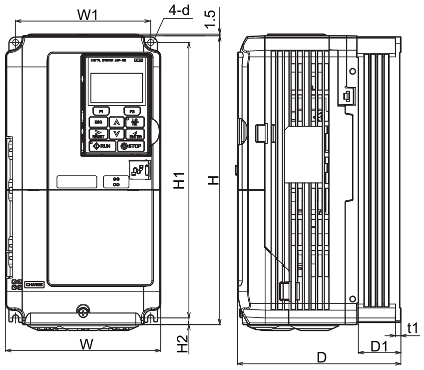


Figure 1

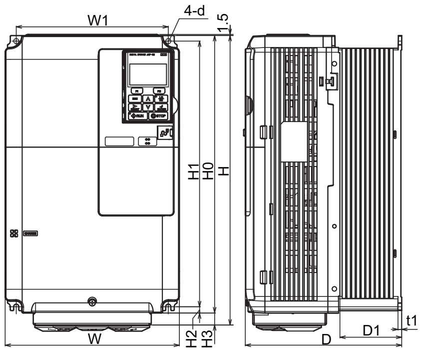


Figure 2

Model CIMR-AC□	Fig.	Dimensions (mm)												Weight (kg)
		W	H	D	W1	H0	H1	H2	H3	D1	t1	t2	d	
2A0004		140	260	147	122	–	248	6	–	38	5	–	M5	3.1
2A0006		140	260	147	122	–	248	6	–	38	5	–	M5	3.1
2A0010		140	260	147	122	–	248	6	–	38	5	–	M5	3.2
2A0012		140	260	147	122	–	248	6	–	38	5	–	M5	3.2
2A0021	1	140	260	164	122	–	248	6	–	55	5	–	M5	3.5
2A0030		140	260	167	122	–	248	6	–	55	5	–	M5	4.0
2A0040		140	260	167	122	–	248	6	–	55	5	–	M5	4.0
2A0056		180	300	187	160	–	284	8	–	75	5	–	M5	5.6
2A0069		220	350	197	192	–	335	8	–	78	5	–	M6	8.7
2A0081	2	220	365	197	192	350	335	8	15	78	5	–	M6	9.7
4A0002		140	260	147	122	–	248	6	–	38	5	–	M5	3.2
4A0004		140	260	147	122	–	248	6	–	38	5	–	M5	3.2
4A0005		140	260	147	122	–	248	6	–	38	5	–	M5	3.2
4A0007		140	260	164	122	–	248	6	–	55	5	–	M5	3.4
4A0009		140	260	164	122	–	248	6	–	55	5	–	M5	3.5
4A0011	1	140	260	164	122	–	248	6	–	55	5	–	M5	3.5
4A0018		140	260	167	122	–	248	6	–	55	5	–	M5	3.9
4A0023		140	260	167	122	–	248	6	–	55	5	–	M5	3.9
4A0031		180	300	167	160	–	284	8	–	55	5	–	M5	5.4
4A0038		180	300	187	160	–	284	8	–	75	5	–	M5	5.7
4A0044		220	350	197	192	–	335	8	–	78	5	–	M6	8.3

■ IP00 Enclosure Drives

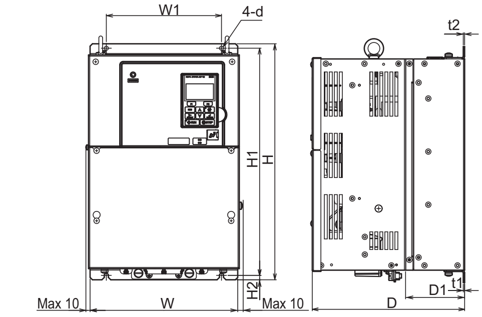


Figure 3

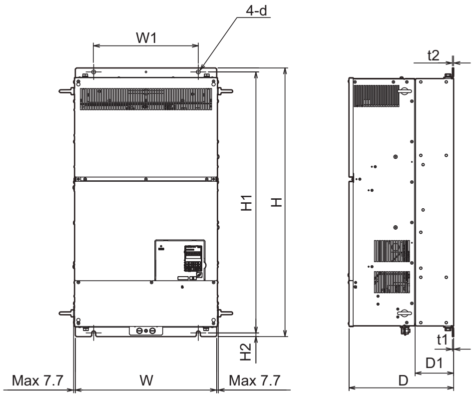


Figure 4

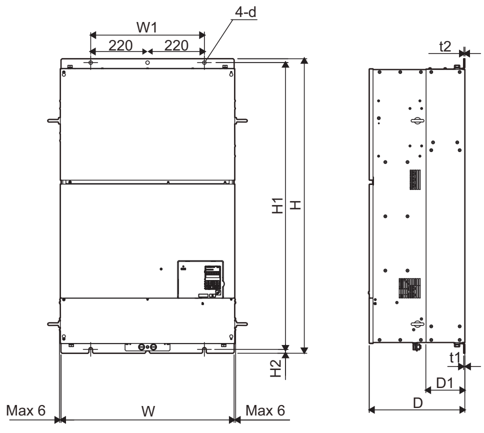
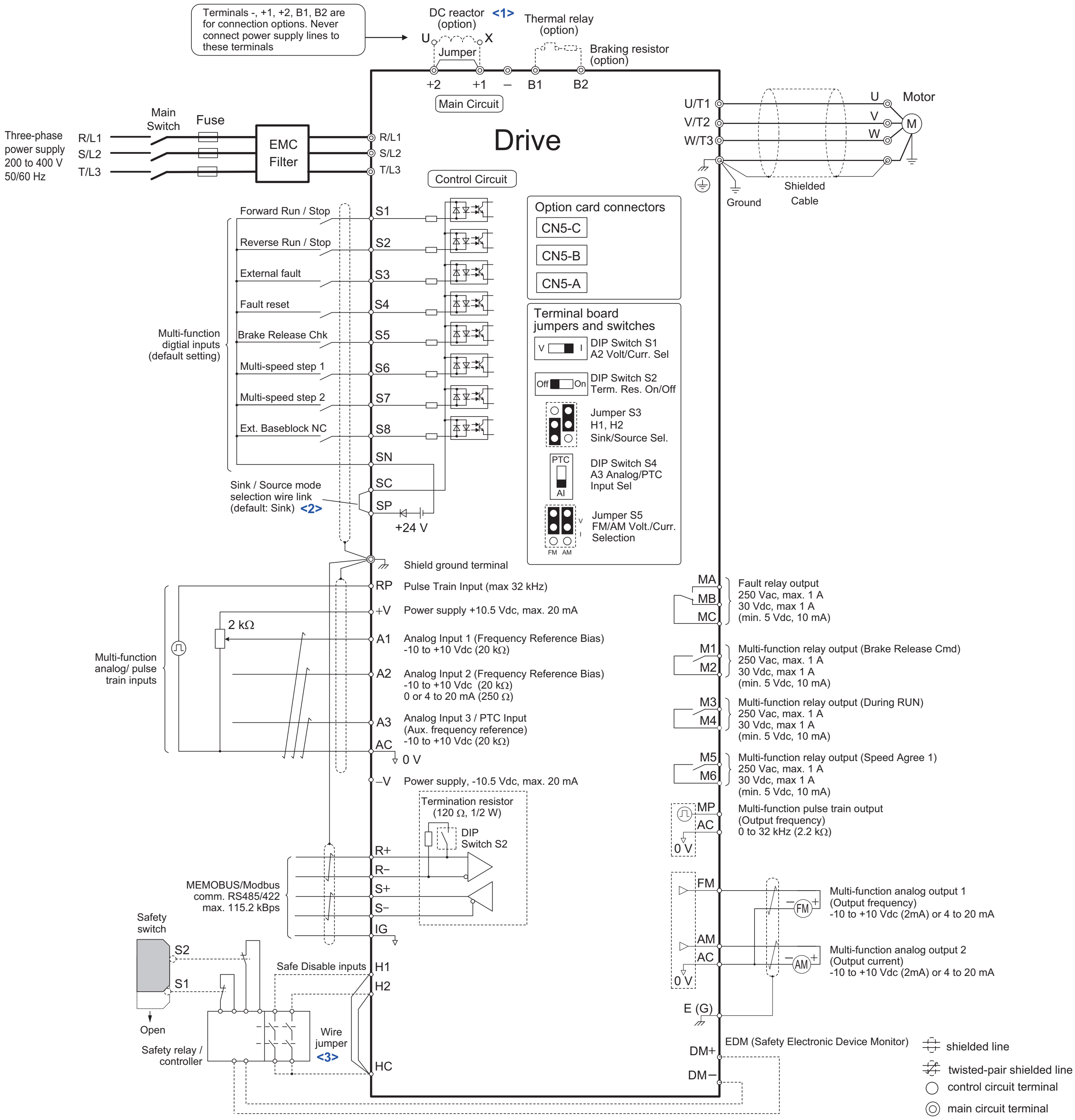


Figure 5

Model CIMR-AC□	Fig.	Dimensions (mm)										Weight (kg)
		W	H	D	W1	H1	H2	D1	t1	t2	d	
2A0110	3	250	400	258	195	385	7.5	100	2.3	2.3	M6	21
2A0138	3	275	450	258	220	435	7.5	100	2.3	2.3	M6	25
2A0169	3	325	550	283	260	535	7.5	110	2.3	2.3	M6	37
2A0211	3	325	550	283	260	535	7.5	110	2.3	2.3	M6	38
2A0250	3	450	705	330	325	680	12.5	130	3.2	3.2	M10	76
2A0312	3	450	705	330	325	680	12.5	130	3.2	3.2	M10	80
2A0360	3	500	800	350	370	773	13	130	4.5	4.5	M12	98
2A0415	3	500	800	350	370	773	13	130	4.5	4.5	M12	99
4A0058	3	250	400	258	195	385	7.5	100	2.3	2.3	M6	21
4A0072	3	275	450	258	220	435	7.5	100	2.3	2.3	M6	25
4A0088	3	325	510	258	260	495	7.5	105	2.3	3.2	M6	36
4A0103	3	325	510	258	260	495	7.5	105	2.3	3.2	M6	36
4A0139	3	325	550	283	260	535	7.5	110	2.3	2.3	M6	41
4A0165	3	325	550	283	260	535	7.5	110	2.3	2.3	M6	42
4A0208	3	450	705	330	325	680	12.5	130	3.2	3.2	M10	79
4A0250	3	500	800	350	370	773	13	130	4.5	4.5	M12	96
4A0296	3	500	800	350	370	773	13	130	4.5	4.5	M12	102
4A0362	3	500	800	350	370	773	13	130	4.5	4.5	M12	107
4A0414	4	500	950	370	370	923	13	135	4.5	4.5	M12	125
4A0515	5	670	1140	370	440	1110	15	150	4.5	4.5	M12	216
4A0675	5	670	1140	370	440	1110	15	150	4.5	4.5	M12	221

3 Electrical Installation

The figure below shows the main and control circuit wiring.



<1> Remove the jumper when installing a DC reactor. Models CIMR-AC□2A110 through 0415 and 4A0058 through 0675come with a built-in DC reactor.
<2> Never short terminals SP and SN as doing so will damage the drive.
<3> Disconnect the wire jumper between H1 - HC and H2 - HC when utilizing the Safe Disable input.

◆ Wiring Specification

■ Main Circuit

Use the fuses and line filters listed in the table below when wiring the main circuit. Make sure not to exceed the given tightening torque values.

<table>
<tr><th rowspan="2">Model
CIMR-AC□</th><th rowspan="2">EMC Filter
[Block]</th><th rowspan="2">Main Fuse
[Bussmann]</th><th rowspan="2">Recom. Motor cable (mm²)</th><th colspan="4">Main Circuit Terminal Sizes</th></tr>
<tr><th>R/L1,S/L2,T/L3, U/T1,V/T2,W/T3, – , +1, +2</th><th>+3</th><th>B1, B2</th><th>⏚</th></tr>
<tr><td>2A0004</td><td rowspan="2">FB-40008A</td><td rowspan="4">FWH-70B</td><td rowspan="5">2.5</td><td rowspan="7">M4</td><td rowspan="12">–</td><td rowspan="7">M4</td><td rowspan="5">M4</td></tr>
<tr><td>2A0006</td></tr>
<tr><td>2A0010</td><td rowspan="2">FB-40014A</td></tr>
<tr><td>2A0012</td></tr>
<tr><td>2A0021</td><td>FB-40025A</td><td>FWH-90B</td></tr>
<tr><td>2A0030</td><td rowspan="3">FB-40060A</td><td>FWH-100B</td><td>6</td><td rowspan="2">M5</td></tr>
<tr><td>2A0040</td><td rowspan="3">FWH-200B</td><td>10</td></tr>
<tr><td>2A0056</td><td rowspan="2">16</td><td>M6</td><td rowspan="3">M5</td><td rowspan="3">M6</td></tr>
<tr><td>2A0069</td><td>FB-40072A</td><td rowspan="3">M8</td></tr>
<tr><td>2A0081</td><td>FB-40105A</td><td rowspan="2">FWH-300A</td><td>25</td></tr>
<tr><td>2A0110</td><td rowspan="3">FB-40170A</td><td>35</td><td>M8</td><td rowspan="4">M8</td></tr>
<tr><td>2A0138</td><td>FWH-350A</td><td>50</td><td rowspan="3">M10</td><td>M10</td></tr>
<tr><td>2A0169</td><td rowspan="2">FWH-400A</td><td>70</td><td rowspan="6">M10</td><td rowspan="6">–</td></tr>
<tr><td>2A0211</td><td>FB-40250A</td><td>95</td></tr>
<tr><td>2A0250</td><td rowspan="3">FB-40414A</td><td>FWH-600A</td><td rowspan="2">95 × 2P</td><td rowspan="4">M12</td><td rowspan="4">M12</td></tr>
<tr><td>2A0312</td><td>FWH-700A</td></tr>
<tr><td>2A0360</td><td>FWH-800A</td><td>240</td></tr>
<tr><td>2A0415</td><td>FB-40675A</td><td>FWH-1000A</td><td>300</td></tr>
<tr><td>4A0002</td><td rowspan="4">FB-40008A</td><td>FWH-40B</td><td rowspan="7">2.5</td><td rowspan="8">M4</td><td rowspan="13">–</td><td rowspan="8">M4</td><td rowspan="6">M4</td></tr>
<tr><td>4A0004</td><td>FWH-50B</td></tr>
<tr><td>4A0005</td><td rowspan="2">FWH-70B</td></tr>
<tr><td>4A0007</td></tr>
<tr><td>4A0009</td><td rowspan="2">FB-40014A</td><td rowspan="2">FWH-90B</td></tr>
<tr><td>4A0011</td></tr>
<tr><td>4A0018</td><td rowspan="2">FB-40025A</td><td>FWH-80B</td><td rowspan="2">M5</td></tr>
<tr><td>4A0023</td><td>FWH-100B</td><td>4</td></tr>
<tr><td>4A0031</td><td rowspan="2">FB-40044A</td><td>FWH-125B</td><td rowspan="2">6</td><td rowspan="2">M5</td><td rowspan="3">M5</td><td rowspan="2">M6</td></tr>
<tr><td>4A0038</td><td>FWH-200B</td></tr>
<tr><td>4A0044</td><td rowspan="2">FB-40060A</td><td rowspan="5">FWH-250A</td><td rowspan="2">16</td><td>M6</td><td rowspan="5">M8</td></tr>
<tr><td>4A0058</td><td rowspan="4">M8</td><td rowspan="2">M8</td></tr>
<tr><td>4A0072</td><td>FB-40072A</td><td rowspan="2">25</td></tr>
<tr><td>4A0088</td><td rowspan="2">FB-40105A</td><td rowspan="8">M10</td><td rowspan="11">–</td></tr>
<tr><td>4A0103</td><td>35</td></tr>
<tr><td>4A0139</td><td rowspan="2">FB-40170A</td><td>FWH-350A</td><td>50</td><td rowspan="4">M10</td><td rowspan="4">M10</td></tr>
<tr><td>4A0165</td><td>FWH-400A</td><td>70</td></tr>
<tr><td>4A0208</td><td rowspan="2">FB-40250A</td><td>FWH-500A</td><td>95</td></tr>
<tr><td>4A0250</td><td>FWH-600A</td><td>120</td></tr>
<tr><td>4A0296</td><td rowspan="3">FB-40414A</td><td>FWH-700A</td><td>185</td><td rowspan="5">M12</td><td rowspan="5">M12</td></tr>
<tr><td>4A0362</td><td>FWH-800A</td><td>240</td></tr>
<tr><td>4A0414</td><td>FWH-800A</td><td>95 × 2P</td><td rowspan="3">M12</td></tr>
<tr><td>4A0515</td><td rowspan="2">FB-40675A</td><td>FWH-1000A</td><td>150 × 2P</td></tr>
<tr><td>4A0675</td><td>FWH-1200A</td><td>95 × 4P</td></tr>
</table>

Tightening Torque Values

Tighten the main circuit terminals using the torque values provided by the table below.

Terminal Size	M4	M5	M6	M8	M10	M12
Tightening Torque (N•m)	1.2 to 1.5	2.0 to 2.5	4.0 to 6.0	9.0 to 11.0	18.0 to 23.0	32.0 to 40.0

■ Control Circuit

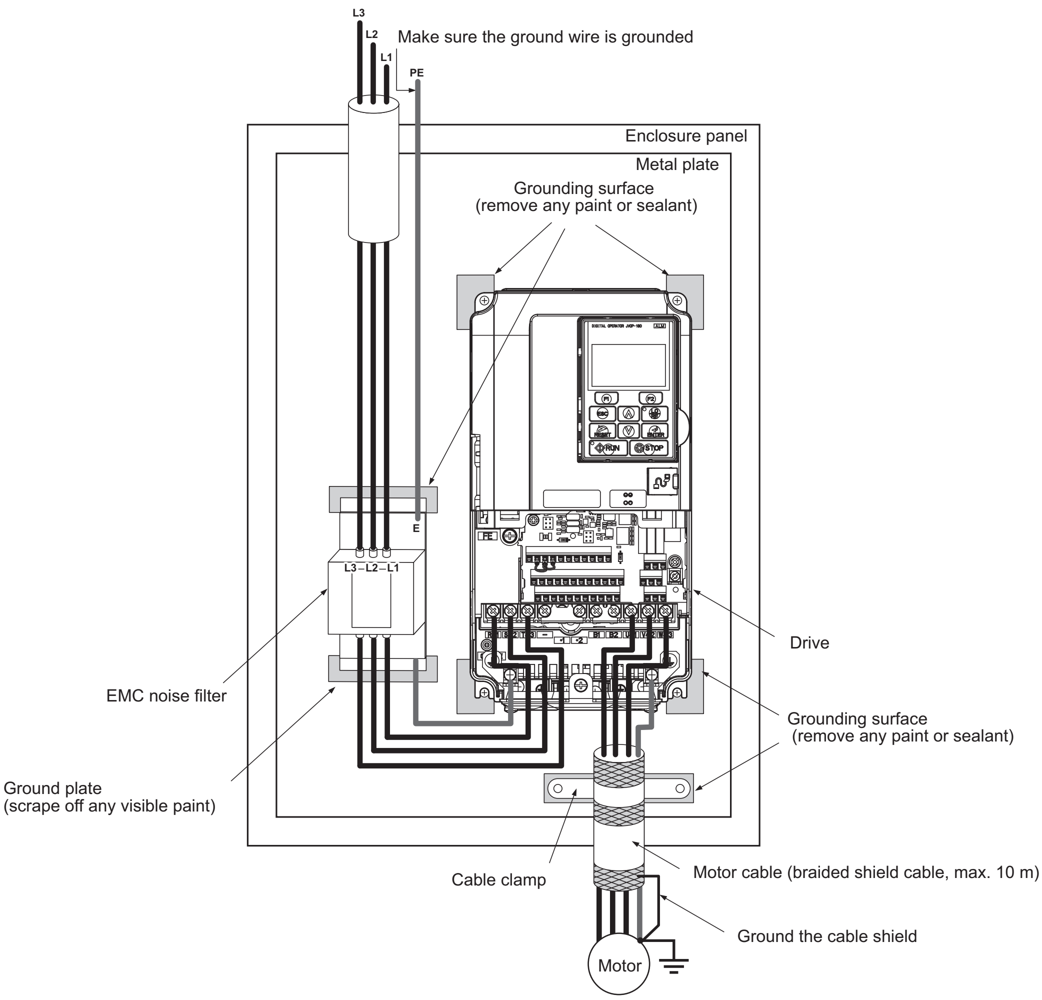
The control terminal board is equipped with screwless terminals. Always use wires within the specification listed below. For safe wiring it is recommended to use solid wires or flexible wires with ferrules. The stripping length respectively ferrule length should be 8 mm.

Wire Type	Wire size (mm^2)
Solid	0.2 to 1.5
Flexible	0.2 to 1.0
Flexible with ferrule	0.25 to 0.5

◆ EMC Filter Installation

This drive has been tested in accordance with European standards EN61800-3. In order to comply to the EMC standards, wire the main circuit as described below.

1. Install an appropriate EMC noise filter to the input side. See the table in *Main Circuit on page 13* or refer to the Technical Manual for details.
2. Place the drive and EMC noise filter in the same enclosure.
3. Use braided shield cable for the drive and motor wiring.
4. Remove any paint or dirt from ground connections for minimal ground impedance.
5. Install a DC reactor on drives smaller than 1 kW for compliance with the EN61000-3-2. Refer to the Technical Manual or contact your supplier for details.



◆ Main and Control Circuit Wiring

■ Wiring the Main Circuit Input

Consider the following precautions for the main circuit input.

- Use fuses recommended in *Main Circuit on page 13* only.
- When using residual current monitoring or detection devices (RCM/RCD), make sure the devices are designed for use with AC drives (e.g., type B according to IEC 60755).
- If using an input switch, make sure that it does not operate more than once every 30 minutes.
- Use insulation caps when wiring the drive with crimp terminals. Take particular care to ensure that wiring does not touch neighboring terminals or the surrounding case.
- Insulation barriers are packaged with drive models CIMR-AC□4A0414 through 0675 to provide added protection between terminals. YASKAWA recommends using the insulation barriers provided to ensure proper wiring.
- Use a DC reactor or AC reactor on the input side of the drive:
  –To suppress harmonic current.
  –To improve the power factor on the power supply side.
  –When using an advancing capacitor switch.
  –With a large capacity power supply transformer (over 600 kVA).

■ Wiring the Main Circuit Output

Consider the following precautions for the output circuit wiring.

- Do not connect any other load than a 3 phase motor to the drives output.
- Never connect a power source to the drives output.
- Never short or ground the output terminals.
- Do not use phase correction capacitors.
- If using a contactor between the drive and motor, it should never be operated when the drive is outputting a voltage. Operating while there is voltage output can cause large peak currents, thus tripping the over current detection or damaging the drive.

■ Ground Connection

Take the following precautions when grounding the drive.

- Make sure the ground conductor complies with general technical standards and local regulations.
- Keep ground wires as short as possible.
- Always make sure the ground impedance is conform with requirements of local safety and installation regulations.
- Never share the ground wire with other devices such as welding machines, etc.
- Do not loop the ground wire when using more than one drive.

■ Control Circuit Wiring Precautions

Consider the following precautions for wiring the control circuits.

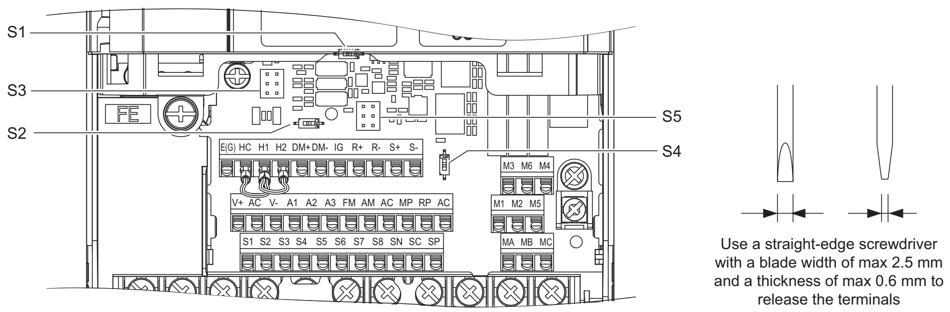
- Separate control circuit wiring from main circuit wiring and other high-power lines.
- Separate wiring for control circuit terminals M1-M2, M3-M4, M5-M6, MA, MB, MC (contact output) from wiring to other control circuit terminals.
- For external control power supply use a UL Listed Class 2 power supply.
- Use twisted-pair or shielded twisted-pair cables for control circuits to prevent operating faults.
- Ground the cable shields with the maximum contact area of the shield and ground.
- Cable shields should be grounded on both cable ends.
- If flexible wires with ferrules are connected they might fit tightly into the terminals. To disconnect them, grasp the wire end with a pair of pliers, release the terminal using a straight-edge screw driver, turn the wire for about 45°, and pull it gently out of the terminal. For details, refer to the Technical Manual. Use this procedure for removing the wire link between HC, H1 and H2 when the Safe Disable function is utilized.

■ Main Circuit Terminals

Terminal (200 V Class / 400 V Class; Model CIMR-AC□)	Type: 2A0004 to 2A0081 / 4A0002 to 4A0044	Type: 2A0110 to 2A0138 / 4A0058 to 4A0072	Type: 2A0169 to 2A0415 / 4A0088 to 4A0675	Function
R/L1, S/L2, T/L3	Main circuit power supply input			Connects line power to the drive
R1/L11, S1/L21, T1/L31	not available			
U/T1, V/T2, W/T3	Drive output			Connects to the motor
B1, B2	Braking resistor		not available	Available for connecting a braking resistor or a braking resistor unit option
+2	• DC reactor connection (+1, +2) (remove the shorting bar between +1 and +2) • DC power supply input (+1, –)	not available		For connection • of the drive to a DC power supply (terminals +1 and – are not CE or UL approved) • of braking options • connection of a DC reactor
+1, –		• DC power supply input (+1, –)	• DC power supply input (+1, –) • Braking transistor connection (+3, –)	
+3	not available			
⏚	–			Grounding terminal

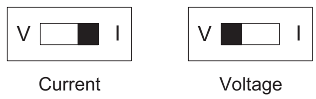
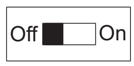
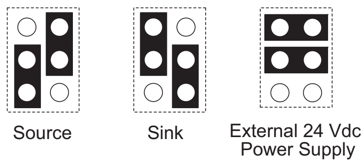
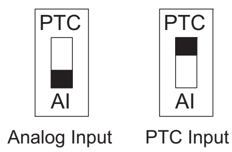
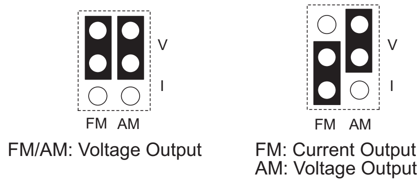
■ Control Circuit Terminals

The figure below shows the control circuit terminal arrangement. The drive is equipped with screwless terminals.



Use a straight-edge screwdriver with a blade width of max 2.5 mm and a thickness of max 0.6 mm to release the terminals

There are three DIP switches and two jumpers, S1 to S5, located on the terminal board.

S1	Terminal A2 Signal Selection	
S2	RS422/485 Termination Resistor	
S3	Safe Disable Input Sink/Source/External Supply Selection	
S4	Terminal A3 Analog/PTC Input Selection	
S5	Terminal FM/AM Signal Selection	

■ Control Circuit Terminal Functions

Type	No.	Terminal Name (Function)	Function (Signal Level) Default Setting
Multi-Function Digital Inputs	S1	Multi-function input 1 (Closed: Forward run, Open: Stop)	Photocoupler 24 Vdc, 8 mA Use the wire link between terminals SC and SN or SC and SP to select between sinking, sourcing mode, and the power supply.
	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 (Brake release check)	
	S6	Multi-function input 6 (Multi-step speed reference 1)	
	S7	Multi-function input 7 (Multi-step speed reference 2)	
	S8	Multi-function input 8 (External baseblock, NC)	
	SC	Multi-function input common	–
	SN	Multi-function input 0 V	24 Vdc power supply for digital inputs, 150 mA max (if no digital input option DI-A3 is used) Never short terminals SP and SN as doing so will damage the drive.
	SP	Multi-function input 24 Vdc	
Safe Disable Inputs	H1	Safe Disable input 1	24 Vdc, 8 mA One or both open: Drive output disabled Both closed: Normal operation Internal impedance: 3.3 kΩ Off time of at least 1 ms Disconnect the wire jumpers shorting terminals H1, H2, and HC to use the Safe Disable inputs. Set the S3 jumper to select between sinking, sourcing mode, and the power supply.
	H2	Safe Disable input 2	
	HC	Safe Disable function common	Safe disable function common
Analog Inputs / Pulse Train Input	RP	Multi-function pulse train input (Frequency reference)	Input frequency range: 0 to 32 kHz Signal Duty Cycle: 30 to 70% High level: 3.5 to 13.2 Vdc, low level: 0.0 to 0.8 Vdc Input impedance: 3 kΩ
	+V	Power supply for analog inputs	10.5 Vdc (max allowable current 20 mA)
	-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)	-10 to 10 Vdc, 0 to 10 Vdc (input impedance: 20 kΩ) 4 to 20 mA, 0 to 20 mA (input impedance: 250 Ω) Voltage or current input must be selected by DIP switch S1 and H3-09
	A3	Multi-function analog input 3 / PTC Input (Auxiliary frequency reference)	-10 to 10 Vdc, 0 to 10 Vdc (input impedance: 20 kΩ) Use switch S4 on the control terminal board to select between analog input or PTC input. If PTC is selected, set H3-06 = E.
	AC	Frequency reference common	0 V
	E (G)	Ground for shielded lines and option cards	–
Fault Relay	MA	N.O.	30 Vdc, 10 mA to 1 A; 250 Vac, 10 mA to 1 A Minimum load: 5 Vdc, 10 mA
	MB	N.C. output	
	MC	Fault output common	
Multi-Function Digital Output	M1 M2	Multi-function digital output (Brake release command)	
	M3 M4	Multi-function digital output (During Run)	
	M5 M6	Multi-function digital output (Speed agree 1)	
Monitor Output	MP	Pulse train output (Output frequency)	32 kHz (max)
	FM	Analog monitor output 1 (Output frequency)	-10 to +10 Vdc, 0 to +10 Vdc, or 4 to 20 mA Use jumper S5 on the control terminal board to select between voltage or current output at terminals AM and FM. Set parameters H4-07 and H4-08 accordingly when changing the jumper setting.
	AM	Analog monitor output 2 (Output current)	
	AC	Monitor common	0 V

Type	No.	Terminal Name (Function)	Function (Signal Level) Default Setting
Safety Monitor Output	DM+	Safety monitor output	Outputs status of Safe Disable function. Closed when both Safe Disable channels are closed. Up to +48 Vdc 50 mA
	DM-	Safety monitor output common	

NOTICE: *The terminals HC, H1, H2 are used for the Safe Disable function. Do not remove the wire link between HC, H1, or H2 unless the Safe Disable function is used.* ***Refer to Safe Disable Input Function on page 41*** *when using this function.*

NOTICE: *The wiring length to the terminals HC, H1 and H2 should not exceed 30 m.*

4 Keypad Operation

◆ Digital Operator and Keys

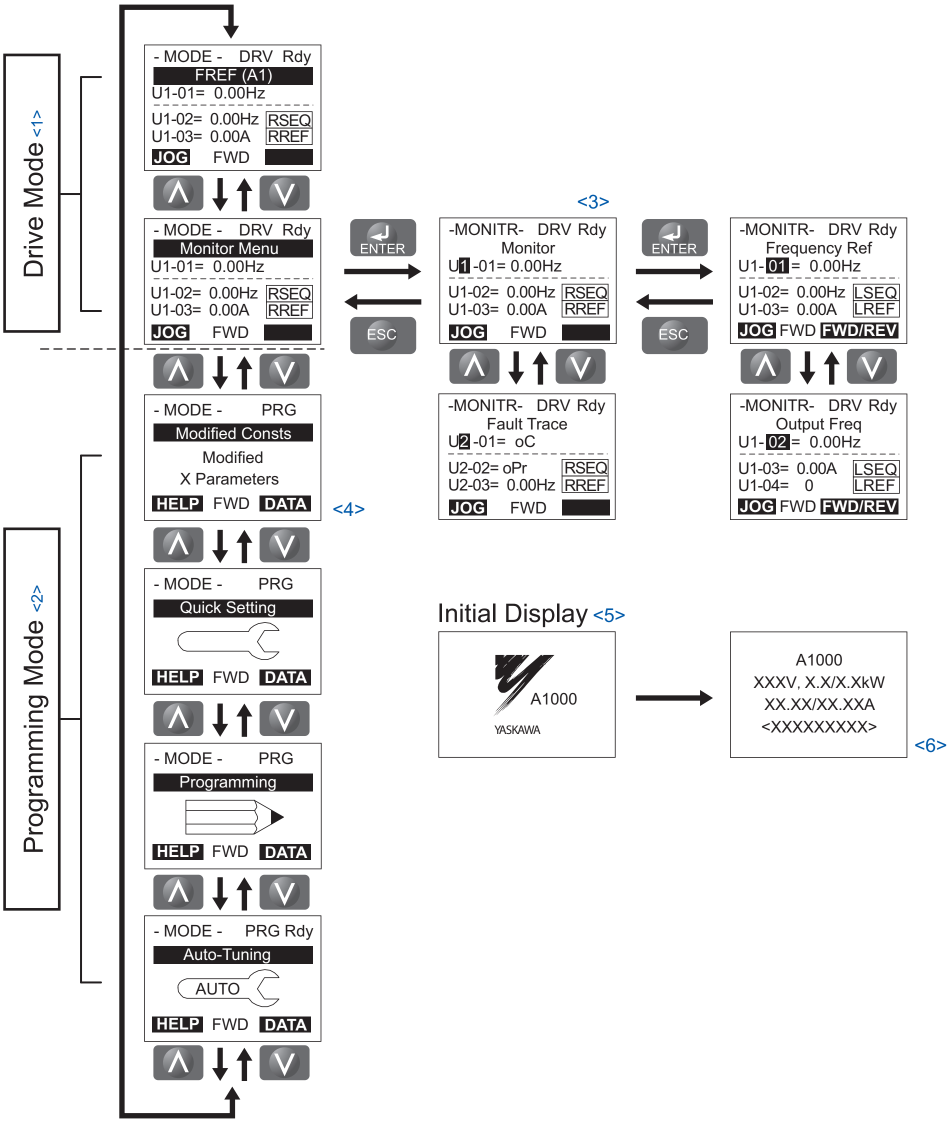
The digital operator is used to program the drive, to start/stop it, and to display fault information. The LEDs indicate the drive status.

■ Keys and Functions

Key	Name	Function
F1 F2	Function Key (F1, F2)	The functions assigned to F1 and F2 vary depending on the menu that is currently displayed. The name of each function appears in the lower half of the display window.
ESC	ESC Key	• Returns to the previous display. • Moves the cursor one space to the left. • Pressing and holding this button will return to the Frequency Reference display.
> RESET	RESET Key	• Moves the cursor to the right. • Resets the drive to clear a fault situation.
RUN	RUN Key	Starts the drive in the LOCAL mode. The Run LED • is on, when the drive is operating the motor. • flashes during deceleration to stop or when the frequency reference is 0. • flashes quickly the drive is disabled by a DI, the drive was stopped using a fast stop DI or a run command was active during power up.
∧	Up Arrow Key	Scrolls up to display the next item, selects parameter numbers and increments setting values.
∨	Down Arrow Key	Scrolls down to display the previous item, selects parameter numbers and decrements setting values.
STOP	STOP Key	Stops drive operation.
ENTER	ENTER Key	• Enters parameter values and settings. • Selects a menu item to move between displays.
LO/RE	LO/RE Selection Key	This key is not active with Crane Software.
ALM	ALM LED Light	On: When the drive detects a fault. Flashing: • When an alarm occurs. • When oPE is detected. • When a fault or error occurs during Auto-Tuning.

◆ Menu Structure and Modes

The following illustration explains the operator keypad menu structure.



<1> Pressing RUN will start the motor.
<2> Drive cannot operate the motor.
<3> Flashing characters are shown as 0.
<4> X characters are shown in this manual. The LCD Operator will display the actual setting values.
<5> The Frequency Reference appears after the initial display which shows the product name.
<6> The information that appears on the display will vary depending on the drive.

5 Changes from Standard Software

This section lists the software differences between the standard and crane versions of the A1000 drive.

◆ Functions

In the Crane version of the A1000 drive some functions were added, others removed, and some modified. For more details on the additional functions *Refer to Special Crane Functions on page 26* or the A1000 Crane Software Application Manual.

■ New Functions

- Brake Sequence Settings
- Run Command Timers
- Impact Stop Detection
- Low Load Ultra Lift
- Overload Detection
- Overtorque Detection
- Overtravel Limit

■ Removed Functions

- PM motor control
- Local/Remote Key
- 3 Wire Operation
- Timer Function
- PID Control
- Speed Search
- Energy Saving Function
- Torque Control
- Power Loss Ride-Thru/KEB
- Automatic Fault Restart
- Speed Limit Detection
- Frequency Lower Limit
- Magnetic Field Weakening
- High Slip Braking

◆ Digital I/O

The default functions of some of the digital inputs and outputs have been modified on the A1000 Crane drive. The changes are summarized in the following tables.

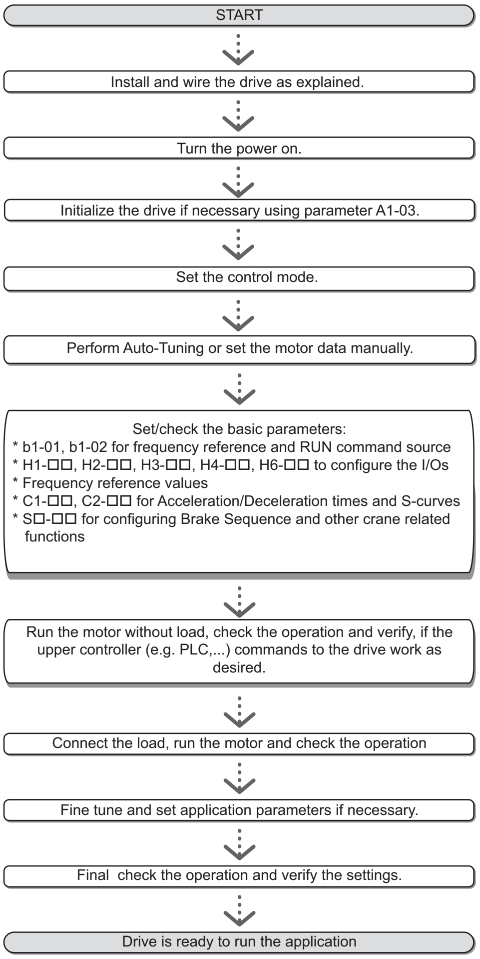
Parameter	Description	A1000 Standard Drive	A1000 Crane Drive
H1-03	Terminal S3 Function	24: External Fault	24: External Fault
H1-04	Terminal S4 Function	14: Fault Reset	14: Fault Reset
H1-05	Terminal S5 Function	3: Multi-Step Speed Reference 1	0: Brake Release Check
H1-06	Terminal S6 Function	4: Multi-Step Speed Reference 2	3: Multi-Step Speed Reference 1
H1-07	Terminal S7 Function	6: Jog Frequency Reference Select	4: Multi-Step Speed Reference 2
H1-08	Terminal S8 Function	8: External Baseblock N.O.	9: External Baseblock N.C.

Parameter	Description	A1000 Standard Drive	A1000 Crane Drive
H2-01	Relay M1-M2 Function	0: During Run	21: Brake Release Command
H2-02	Relay M3-M4 Function	1: Zero Speed	0: During Run
H2-03	Relay M5-M6 Function	2: Speed Agree	2: Speed Agree

6 Start Up

◆ Drive Setup Procedure

The illustration below shows the basic setup procedure. Each step is explained more detailed on the following pages.



◆ 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.

◆ Control Mode Selection (A1-02)

There are four control modes available. Select the control mode that best suits the application the drive will control.

Control Mode	Parameter	Application
V/f Control for Induction Motors	A1-02 = 0	V/f control without encoder feedback. Ideal for replacing a drive in which parameter settings are unknown.
V/f Control with PG Speed Feedback	A1-02 = 1	V/f control with encoder feedback for accurate slip compensation.
Open Loop Vector Control	A1-02 = 2 (default)	Precise motor control without encoder feedback at low speed. High starting torque.
Closed Loop Vector Control <1>	A1-02 = 3	Precise motor control with encoder feedback. Allows full torque at stop and zero speed control.

<1> For explanations of these control modes, refer to the Technical Manual.

◆ Overload Capability

The drive is only capable of handling heavy duty overload condition.

Overload capability (OL2)	150% of drive rated current for 60 s
L3-02 Stall Prevention during Acceleration	150%
L3-06 Stall Prevention during Run	150%
Default carrier frequency	2 kHz

◆ Auto-Tuning (T1-□□)

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

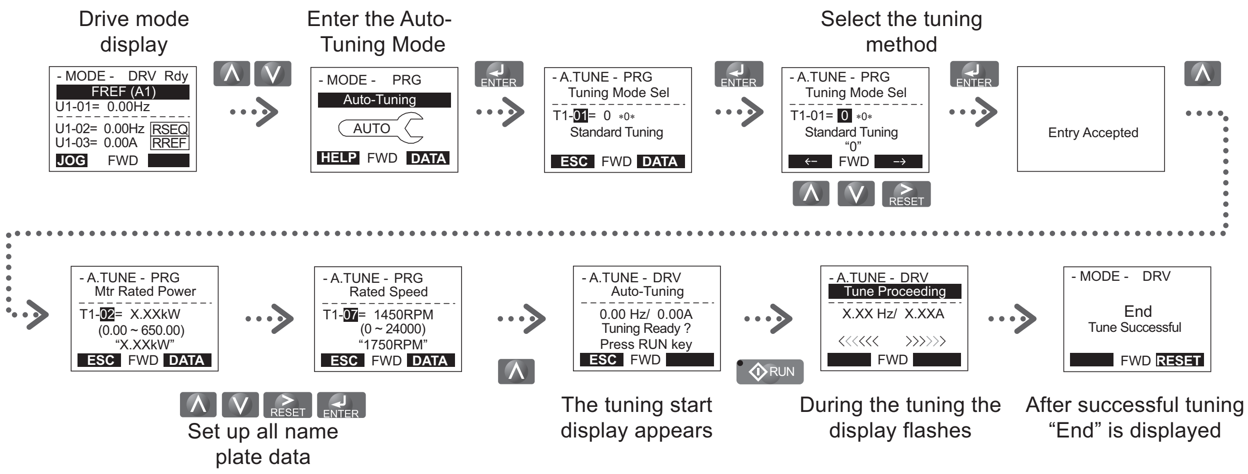
Type	Setting	Application Conditions and Benefits	Control Mode (A1-02)			
			V/f (0)	V/f w/PG (1)	OLV (2)	CLV (3)
Rotational Auto-Tuning	T1-01 = 0	• Motor can be decoupled from the load and rotate freely while Auto-Tuning is performed. • Motor and load can not be decoupled but the motor load is below 30%. • Rotational Auto-Tuning gives the most accurate results, and is therefore highly recommended if possible.	N/A	N/A	YES	YES
Stationary Auto-Tuning 1	T1-01 = 1	• Motor and load can not be decoupled and the load is higher than 30%. • A motor test report listing motor data is not available. • Automatically calculates motor parameters needed for vector control.	N/A	N/A	YES	YES
Stationary Auto-Tuning 2	T1-01 = 4	• Motor and load can not be decoupled and the load is higher than 30%. • A motor test report is available. Once the no-load current and the rated slip have been entered, the drive calculates and sets all other motor-related parameters.	N/A	N/A	YES	YES
Stationary Auto-Tuning for Line-to-Line Resistance	T1-01 = 2	• The drive is used in V/f Control and other Auto-Tuning selections not possible. • Drive and motor capacities differ. • Tunes the drive after the cable between the drive and motor has been replaced with a cable over 50 m long. Assumes Auto-Tuning has already been performed. • Should not be used for any vector control modes unless the motor cable has changed.	YES	YES	YES	YES

⚠ CAUTION

Do not touch the motor until the Auto-Tuning is finished.

Failure to comply may result in minor or moderate injury. Voltage is still applied to the motor during the tuning process, even thought the motor may not be rotating.

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



If Auto-Tuning can not be performed for some reason (no-load operation impossible etc.), then set up the maximum frequency and voltage in the E1-□□ parameters and enter the motor data manually into the E2-□□ parameters.

NOTICE: *The Safe Disable inputs must be closed during Auto-Tuning.*

◆ External Reference Selection and Acceleration/ Deceleration Times

■ Frequency Reference Selection (b1-01)

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

b1-01	Reference source	Frequency reference input
0	Operator keypad	Set the frequency references in the d1-□□ parameters and use digital inputs to switch over between different reference values.
1	Analog input	Apply the frequency reference signal to terminal A1, A2, or A3.
2	Serial Comm.	Serial Communications using the RS422/485 port
3	Option Card	Communications option card
4	Pulse input	Set the frequency reference at terminal RP using a pulse train signal.

■ Run Command Selection (b1-02)

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

b1-02	Reference source	Run command input
0	Operator keypad	RUN and STOP keys on the operator
1	Multi-Function digital input	Multi-Function digital input
2	Serial Comm.	Serial Communications using the RS422/485 port3
3	Option Card	Communications option card

■ Acceleration / Deceleration Times and S-Curves

There are four sets of acceleration and deceleration times which can be set in the C1-□□ parameters. The default activated accel/decel times are C1-01/02. 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 transitions.

◆ 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 b1-01/02.

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

Note: The default setting functions can be seen in the connection diagram on page *12*.

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

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

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

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

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

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

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

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

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

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

◆ Test Run

Perform the following steps to start up the machine after all parameter settings have been done.

1. Run the motor without load and check if all input, outputs and the sequence work as desired.
2. Connect the load to the motor.
3. Run the motor with load and make sure that there is no vibrations, hunting or motor stalling occurs.

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

7 Special Crane Functions

In this chapter the special functions that have been implemented in the A1000 Crane drive are described.

◆ Brake Sequence (S1)

For the brake to open and close while the drive is generating the necessary torque for the load to maintain a stationary position, the brake sequence on the A1000 Crane Drive has been specially modified. In this section the manner in which the brake sequence works is described.

■ Starting Sequence

When the drive receives a Run command, the following procedure must be executed for the brake to be released.

1. After receiving the Run command, the drive will accelerate up to the *Brake Delay Frequency* **BF** (S1-03) with the brake clamped shut. If torque compensation is enabled, it will be applied during this time.
2. When all three conditions listed below are met, the *Brake Release Command* **BR** relay will close, opening the brake. The drive expects that in a time frame shorter than the S1-18 parameter a *Brake Release Check* **BX** feedback signal is received from external circuitry to confirm that the brake has been opened, or a brake sequence fault (SE3) will occur.

Conditions that must be met before the brake is released (AND conditions)
Drive Output Frequency ≥ Brake Release Frequency (S1-01, -02)
Drive Output Current ≥ Brake Release Current (S1-05, -06)
Drive Output Torque ≥ Brake Release Torque (S1-07, -08) <1>

<1> Condition exists only in vector control modes.

If these conditions are not met in a time frame shorter than S1-17, a brake sequence fault (SE2) will occur. If SE2 is disabled, the drive will hold at the *Brake Delay Frequency* **BF** (S1-03) indefinitely waiting for the conditions to be met and the brake will remain clamped shut.

3. Once the *Brake Release Check* **BX** signal has been received, the drive will hold output frequency at the *Brake Delay Frequency* **BF** (S1-03) until the *Brake Delay Time* **BT** (S1-04) expires. Then the drive will accelerate to the main frequency reference. If **BT** is set to zero, then the drive will ramp directly to the main frequency reference.

■ Stopping Sequence

When the Run command is removed, the following procedure is executed before the brake is closed.

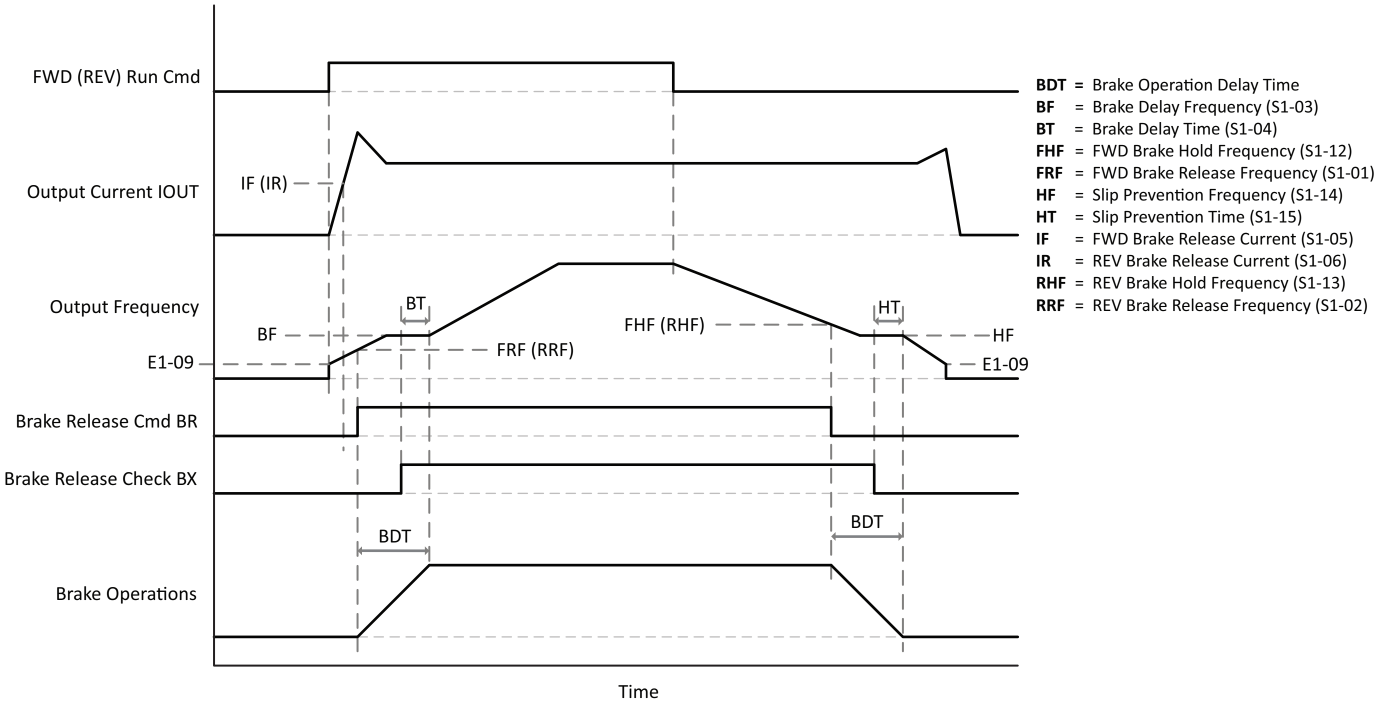
1. When the Run command is removed, the drive will stop the motor using the method chosen in b1-03. If Coast to Stop method is chosen, the brake will immediately clamp shut and sudden load jerking is likely. When using Ramp to Stop, the drive will decelerate using the programmed ramp time until the *Slip Prevention Frequency* **HF** (S1-14) is reached, except in CLV control mode where the drive will decelerate to zero speed.
2. When the output frequency reaches the *Brake Hold Frequency* (S1-12, -13), the *Brake Release Command* **BR** relay will be opened, and the brake will clamp shut. The drive will expect to stop receiving the *Brake Release Check* **BX** feedback signal from external circuitry in a time frame shorter than the S1-19 parameter, or a brake sequence fault (SE4) will be triggered.
3. The drive will hold output frequency at the *Slip Prevention Frequency* **HF** (S1-14) level until the *Slip Prevention Time* **HT** (S1-15) has expired, and then ramp down to b2-01 or E1-09, whichever is lower. This time should be long enough to allow the brake to be completely clamped shut.

Note: If the frequency reference falls below the *Brake Release Frequency* (S1-01, -02) or the *Brake Hold Frequency* (S1-12, -13) without a Run command removal, the drive will continue running at the higher of these two frequencies. If the frequency reference is input from analog terminal A1, and the signal level for this terminal is set to -10V - +10V (H3-01 = 1), the stopping sequence is executed when the frequency reference falls below the setting of parameter b2-01, or if the frequency reference equals the minimum output frequency (E1-09) for more than 100 ms. Also when H3-01 = 1, if a frequency reference lower than E1-09 is input, drive output will be interrupted (baseblock) and the brake will close immediately.

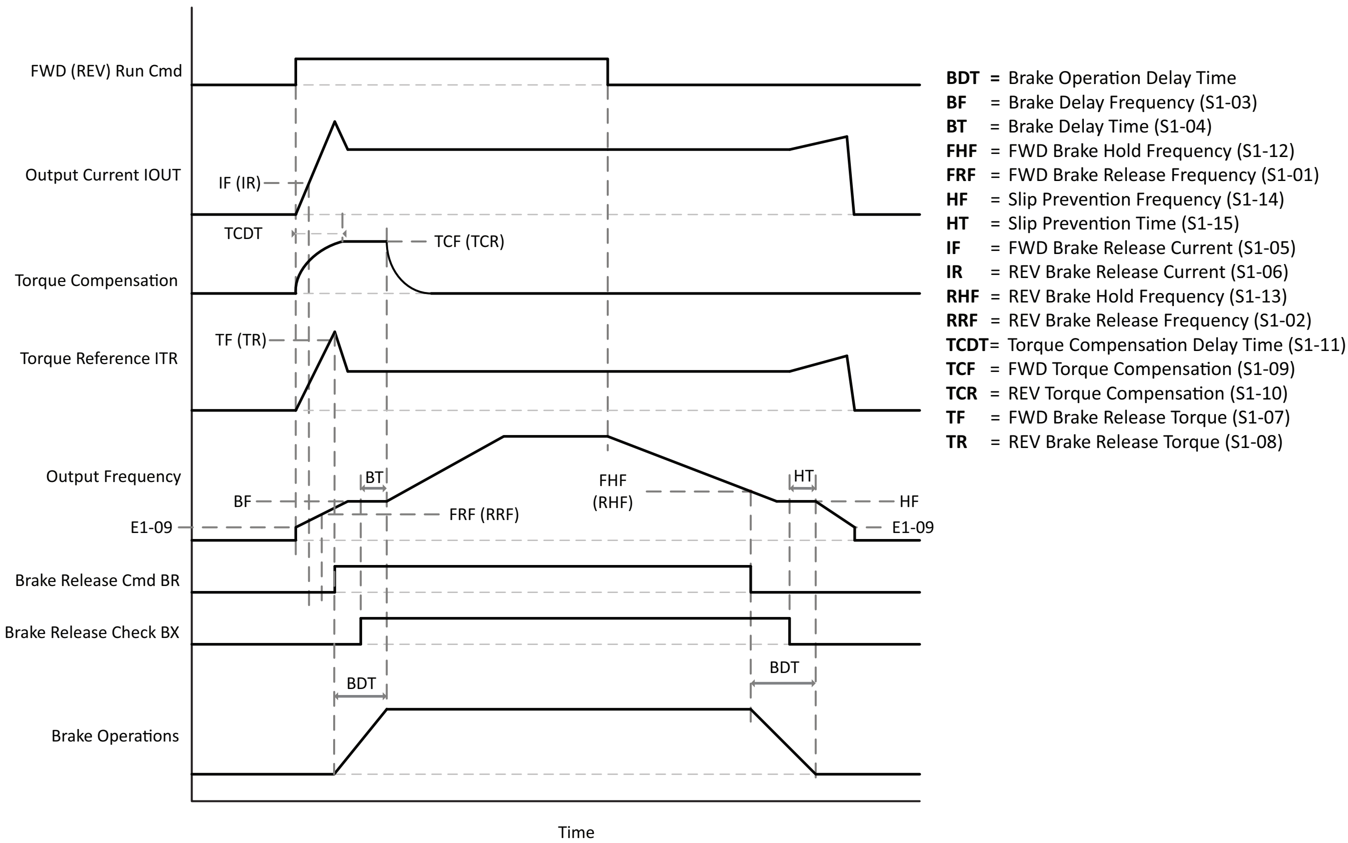
■ Time Charts

In this section Braking Sequence time charts are shown for each control mode. In these charts it is assumed that the run command does not come from the digital operator and that the frequency reference is constant and higher than the *Brake Release Frequency* (S1-01, -02).

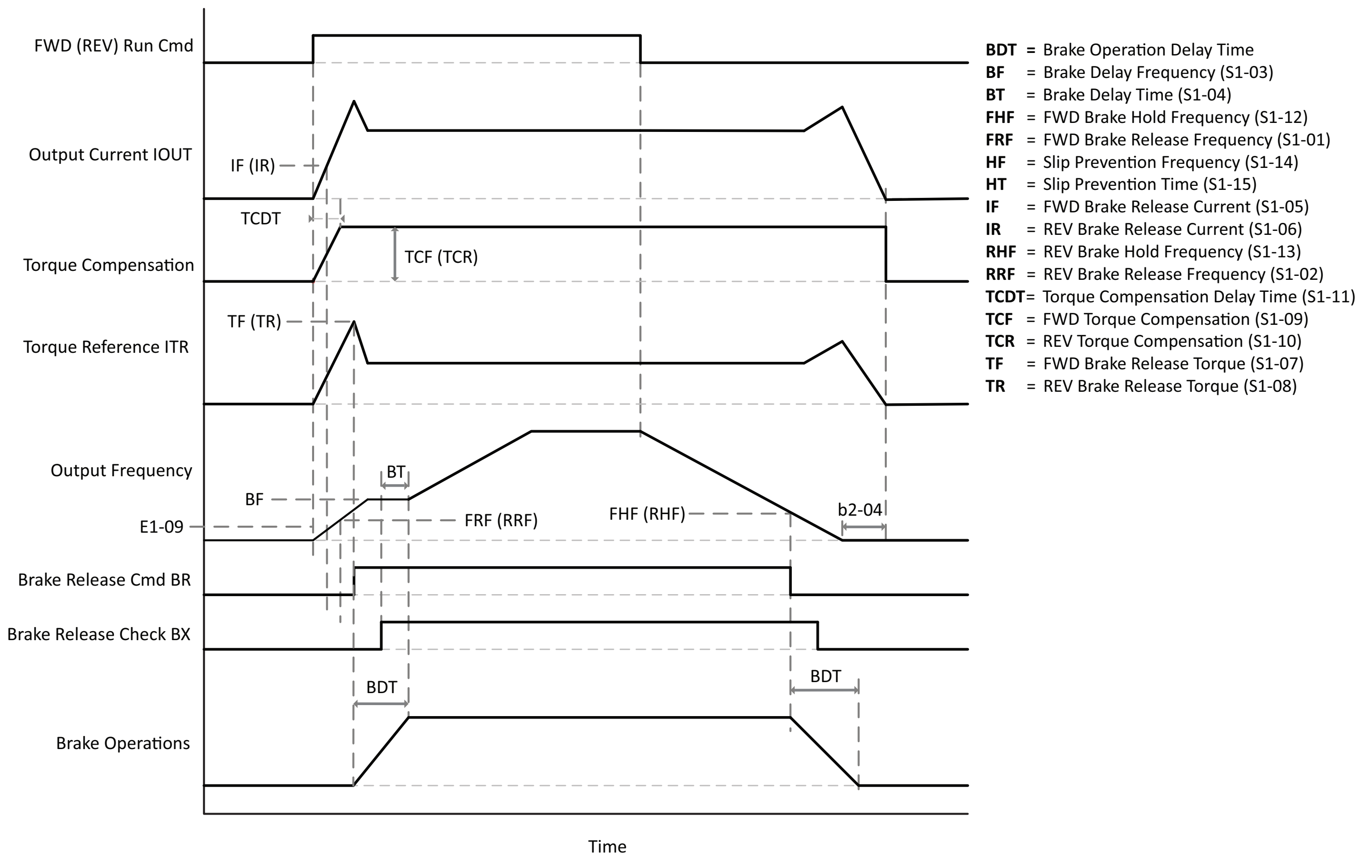
V/f Control (Open and Closed Loop)



Open Loop Vector Control



Closed Loop Vector Control



Note:
1. This chart assumes that *Slip Prevention Time* **HT** (S1-15) is zero (default for CLV). The Stop Timer (b2-04) should be set to a value similar to the *Brake Operation Delay Time*.
2. The last condition that was met before the brake was released is the *Brake Release Torque* (S1-07, -08). For the brake to be released, it does not matter in which order the starting sequence conditions are met.
3. The *Torque Compensation Delay Time* (S1-11) is the time it takes for torque compensation to go from 0 to 100%. If torque compensation is set to a value lower than 100%, the delay time will be proportionately shorter.

■ Forward/Reverse Switching

In control modes without encoder feedback (open loop), the drive cannot switch between forward and reverse directions (zero speed cross) without activating the brake. When a Run command is entered for the direction opposite to the one the drive is going, the complete stopping sequence described in the last section will be executed and the drive will only begin the starting sequence when the brake has been completely clamped shut.

In closed loop control modes, the drive can switch continuously between FWD and REV directions (zero speed cross) without activating the brake. Note that in some situations the brake may still be activated, especially when using the Run Command Adjustment function.

The brake will be applied in all control modes when switching between FWD and REV directions if the frequency reference is below the *Brake Release Frequency* (S1-01, -02) level.

◆ Run Command Adjustments (S2)

The way the drive internally processes run commands that have been entered, for example by applying a delay timer, can be modified with this function. For more detailed information refer to the A1000 Crane Software Application Manual.

◆ Impact Stop Function (S3)

If the load at some point receives an impact, this can trigger a digital input signal to the drive from external circuitry or sensors. If the Run command is also removed, the drive will monitor the torque reference and if it exceeds a preset value, the drive will stop. For this function to be active, a multi-function digital input must be programmed to setting 35 (*Impact Stop Command*). Do not use on applications where an impact does not generate a higher torque reference. For more detailed information refer to the A1000 Crane Software Application Manual.

◆ Ultra Lift Function (S4)

Depending on the load, the A1000 Crane Drive can modify the frequency reference or acceleration rate in order to shorten operation time or protect the load. By changing parameter settings, this function can have two different effects. With the Ultra Lift Function 1, the cycle time of the crane can be shortened when a load lighter than the crane's capabilities is hoisted or lowered, by allowing a higher frequency reference. With the Ultra Lift Function 2 the acceleration time is smoothened in order to protect a heavy load and to avoid a situation where the motor could stall and the load slip. When the function is activated and the drive detects that output power has reached a predefined value, the acceleration time is scaled to keep output power at or below this value. For more detailed information refer to the A1000 Crane Software Application Manual.

◆ Overload Detection (S5)

As a protective feature, the A1000 Crane Drive has incorporated an Overload Detection function. When the drive detects that the load is too large, it can change its behavior depending on parameter settings. In this section the parameters associated with the Overload Protection function are described. It is important to note that this function is disabled when the Run Command is entered from the digital operator (b1-02 = 0), and is only active once the brake has been released. Two independent overload detection conditions can be set.

Parameter	Description	Setting Range	Default
S5-01	Overload Detection Operation Selection 1	0: Disabled 1: Detection at Speed Agree. Alarm only, acceleration halted, drive continues to run. 2: Detection during Run. Alarm only, acceleration halted, drive continues to run. 3: Detection at Speed Agree. Alarm only, emergency stop using C1-09 ramp, Run command must be cycled. 4: Detection during Run. Alarm only, emergency stop using C1-09 ramp, Run command must be cycled. 5: Detection at Speed Agree. Fault, motor coasts to stop. 6: Detection during Run. Fault, motor coasts to stop.	0
S5-02	Overload Detection Torque 1	0 - 300 %	150%
S5-03	Overload Detection Time 1	0.0 -10.0 s	0.1 s
S5-04	Overload Detection Operation Selection 2	Same as S5-01	0
S5-05	Overload Detection Torque 2	0 - 300 %	150%
S5-06	Overload Detection Time 2	0.0 - 10.0 s	0.1 s

It is possible to trigger one of the drive's multi-function digital outputs when an overload condition occurs using the following settings:

H2-□□ Setting	Name	Description
22	Overload Detection N.O.	If conditions for either Overload Detection 1 or 2 arise, then the output relay will close. It will remain closed for the duration that "OL5" appears on the digital operator screen.
23	Overload Detection N.C.	If conditions for either Overload Detection 1 or 2 arise, then the output relay will open. It will remain open for the duration that "OL5" appears on the digital operator screen.

◆ Overtorque Detection (S6)

As a protective feature, the A1000 Crane Drive has incorporated an Overtorque Detection function. When the drive detects that the torque or current reference is too large, it can change its behavior depending on parameter settings. It is important to note that this function is disabled when the Run Command is entered from the digital operator (b1-02 = 0), and only works when the brake has been released. Two independent overtorque detection conditions can be set. This function is similar to the Overload Detection function described in the previous section. For more detailed information refer to the A1000 Crane Software Application Manual.

◆ Overtravel Limit Function

In the A1000 Crane Drive an Overtravel Limit Function has been implemented. On horizontal applications, it can prevent the cart/container from traveling past a predetermined location, and in hoisting applications it can prevent the load from being hoisted too high or too low. The function is controlled by multi-function digital inputs that can be programmed in the FWD or REV directions and as Normally Open (N.O.) or Normally Closed (N.C.) contacts. For more detailed information refer to the A1000 Crane Software Application Manual.

◆ Motor Switch Function

The A1000 Crane Drive can operate two motors if an external sequence is used to switch between them. There are some limitations to the drive's functions when driving the second motor. For more detailed information refer to the A1000 Crane Software Application Manual.

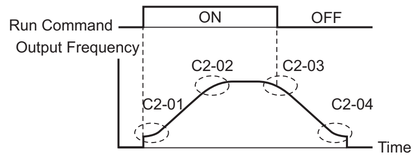
◆ External Baseblock Command

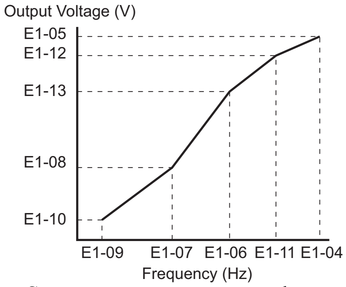
To avoid sudden slipping or dropping of the load when an external baseblock command is entered and cleared, the function has been modified from its standard behavior. In the A1000 Crane Drive, when an external baseblock command is received, output current is interrupted for a minimum of 0.1 seconds and the SFS output is set to zero. The brake will be immediately applied.

When the baseblock command is cleared, a Run Command must be entered for the drive to start. No speed search will be performed and the drive will start from 0 Hz. If the baseblock command is cleared but no Run Command is entered, the drive will maintain baseblock.

8 Parameter Table

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

No.	Name	Description
Initialization Parameters		
A1-01	Access Level Selection	0: View and set A1-01 and A1-04. U□-□□ parameters can also be viewed. 1: User Parameters (access to a set of parameters selected by the user, A2-01 to A2-32) **2: Advanced Access (access to view and set all parameters)**
A1-02	Control Method Selection	**0: V/f Control** 1: V/f Control with PG 2: Open Loop Vector Control 3: Closed Loop Vector Control
A1-03	Initialize Parameters	**0: No initialization** 1110: User Initialize (parameter values must be stored using parameter o2-03) 2220: 2-wire initialization 5550: oPE04 error reset
Operation Mode Selection		
b1-01	Frequency Reference Selection 1	0: Digital operator **1: Analog input terminals** 2: MEMOBUS/Modbus communications 3: Option PCB 4: Pulse input (terminal RP)
b1-02	Run Command Selection 1	0: Digital operator **1: Digital input terminals** 2: MEMOBUS/Modbus communications 3: Option PCB
b1-03	Stopping Method Selection	**0: Ramp to stop** 1: Coast to stop 2: DC Injection Braking to stop 3: Coast with timer 9: Simple Positioning Stop
b1-04	Reverse Operation Selection	**0: Reverse enabled.** 1: Reverse disabled.
b1-14	Phase Order Selection	**0: Standard** 1: Switch phase order (reverses the direction of the motor)
DC Injection Braking		
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.
b2-02	DC Injection Braking Current	Sets the DC Injection Braking current as a percentage of the drive rated current.
b2-03	DC Injection Braking Time at Start	Sets DC Injection Braking (Zero Speed Control when in CLV/PM) time at start. Disabled when set to 0.00 seconds.
b2-04	DC Injection Braking Time at Stop	Sets DC Injection Braking time at stop.
Acceleration/ Deceleration		
C1-01	Acceleration Time 1	Sets the time to accelerate from 0 to maximum frequency.
C1-02	Deceleration Time 1	Sets the time to decelerate from maximum frequency to 0.
C1-03 to C1-08	Acceleration/ Deceleration Time 2 to 4	Set the accel/decel times 2 to 4 (set like C1-01/02).
C2-01	S-Curve at Accel Start	
C2-02	S-Curve at Accel End	
C2-03	S-Curve at Decel Start	
C2-04	S-Curve at Decel End	
Slip Compensation		
C3-01	Slip Compensation Gain	Sets the gain for the motor slip compensation function used for motor 1.
C3-02	Slip Compensation Primary Delay Time	Adjusts the slip compensation function delay time used for motor 1.
Torque Compensation		
C4-01	Torque Compensation Gain	Sets the gain for the automatic torque (voltage) boost function and helps to produce better starting torque. Used for motor 1.
C4-02	Torque Compensation Primary Delay Time	Sets the torque compensation filter time.
Carrier Frequency		
C6-01	Drive Duty Selection	**0: Heavy Duty (HD) for constant torque applications.**
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 to E: No setting possible F: User defined (determined by C6-03 through C6-05)
Frequency Reference		
d1-01 to d1-16	Frequency Reference 1 to 16	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.
d1-17	Jog Frequency Reference	Sets the Jog frequency reference. Setting units are determined by parameter o1-03.
V/f Pattern for Motor 1		
E1-01	Input Voltage Setting	This parameter must be set to the power supply voltage. WARNING! Drive input voltage (not motor voltage) must be set in E1-01 for the protective features of the drive to function properly. Failure to do so may result in equipment damage and/or death or personal injury.

<table>
<tr><th>No.</th><th>Name</th><th>Description</th></tr>
<tr><td>E1-04</td><td>Maximum Output Frequency</td><td rowspan="7">These parameters are only applicable when E1-03 is set to F.
To set linear V/f characteristics, set the same values for E1-07 and E1-09. In this case, the setting for E1-08 will be disregarded. Ensure that the four frequencies are set according to these rules: E1-09 ≤ E1-07 < E1-06 ≤ E1-11 ≤ E1-04


Note: Some parameters may not be available depending on the control mode.
• E1-07, E1-08 and E-10 are available only in the following control modes: V/f Control, V/f with PG, Open Loop Vector.
• E1-11, E1-12 and E-13 are available only in the following control modes: V/f Control, V/f with PG, Open Loop Vector, Closed Loop Vector.</td></tr>
<tr><td>E1-05</td><td>Maximum Voltage</td></tr>
<tr><td>E1-06</td><td>Base Frequency</td></tr>
<tr><td>E1-07</td><td>Middle Output Frequency</td></tr>
<tr><td>E1-08</td><td>Middle Output Frequency Voltage</td></tr>
<tr><td>E1-09</td><td>Minimum Output Frequency</td></tr>
<tr><td>E1-10</td><td>Minimum Output Frequency Voltage</td></tr>
<tr><td>E1-13</td><td>Base Voltage</td></tr>
<tr><th colspan="3">Motor 1 Parameters</th></tr>
<tr><td>E2-01</td><td>Motor Rated Current</td><td>Sets the motor nameplate full load current in Amps. Automatically set during Auto-Tuning.</td></tr>
<tr><td>E2-02</td><td>Motor Rated Slip</td><td>Sets the motor rated slip. Automatically set during Auto-Tuning.</td></tr>
<tr><td>E2-03</td><td>Motor No-Load Current</td><td>Sets the no-load current for the motor. Automatically set during Auto-Tuning.</td></tr>
<tr><td>E2-04</td><td>Number of Motor Poles</td><td>Sets the number of motor poles. Automatically set during Auto-Tuning.</td></tr>
<tr><td>E2-05</td><td>Motor Line-to-Line Resistance</td><td>Sets the phase-to-phase motor resistance. Automatically set during Auto-Tuning.</td></tr>
<tr><td>E2-06</td><td>Motor Leakage Inductance</td><td>Sets the voltage drop due to motor leakage inductance as a percentage of motor rated voltage. Automatically set during Auto-Tuning.</td></tr>
<tr><th colspan="3">Multi-Function Digital Inputs</th></tr>
<tr><td>H1-03</td><td>Digital Input Terminal S3</td><td>Selects the function of terminal S3. Default setting is External Fault (24).</td></tr>
<tr><td>H1-04</td><td>Digital Input Terminal S4</td><td>Selects the function of terminal S4. Default setting is Fault Reset (14).</td></tr>
<tr><td>H1-05</td><td>Digital Input Terminal S5</td><td>Selects the function of terminal S5. Default setting is Brake Release Check (0).</td></tr>
<tr><td>H1-06</td><td>Digital Input Terminal S6</td><td>Selects the function of terminal S6. Default setting is Multi-Step Speed Reference 1 (3).</td></tr>
<tr><td>H1-07</td><td>Digital Input Terminal S7</td><td>Selects the function of terminal S7. Default setting is Multi-Step Speed Reference 2 (4).</td></tr>
<tr><td>H1-08</td><td>Digital Input Terminal S8</td><td>Selects the function of terminal S8. Default setting is External Baseblock N.C. (9).</td></tr>
<tr><td colspan="3">Note: Major functions are listed at the end of the table.</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name</th><th>Description</th></tr>
<tr><th colspan="3">Multi-Function Digital Outputs</th></tr>
<tr><td>H2-01</td><td>Terminal M1-M2 function selection</td><td>Set the function for the relay output M1-M2. Default setting is Brake Release Command (21).</td></tr>
<tr><td>H2-02</td><td>Terminal M3-M4 function selection</td><td>Sets the function for the relay output M3-M4. Default setting is During Run (0).</td></tr>
<tr><td>H2-03</td><td>Terminal M5-M6 function selection</td><td>Sets the function for the relay output M5-M6. Default setting is Speed Agree (2).</td></tr>
<tr><td>H2-06</td><td>Watt Hour Output Unit Selection</td><td>Outputs a 200 ms pulse signal when the watt-hour counter increases by the units selected.
0: 0.1 kWh units
1: 1 kWh units
2: 10 kWh units
3: 100 kWh units
4: 1000 kWh units</td></tr>
<tr><td colspan="3">Note: Major functions are listed at the end of the table.</td></tr>
<tr><th colspan="3">Multi-Function Analog Inputs</th></tr>
<tr><td>H3-01</td><td>Terminal A1 Signal Level Selection</td><td>0: 0 to 10 V
1: –10 to 10 V</td></tr>
<tr><td>H3-02</td><td>Terminal A1 Function Selection</td><td>Sets the function of terminal A1.</td></tr>
<tr><td>H3-03</td><td>Terminal A1 Gain Setting</td><td>Sets the level of the input value selected in H3-02 when 10 V is input at terminal A1.</td></tr>
<tr><td>H3-04</td><td>Terminal A1 Bias Setting</td><td>Sets the level of the input value selected in H3-02 when 0 V is input at terminal A1.</td></tr>
<tr><td>H3-05</td><td>Terminal A3 Signal Level Selection</td><td>0: 0 to 10 V
1: –10 to 10 V</td></tr>
<tr><td>H3-06</td><td>Terminal A3 Function Selection</td><td>Sets the function of terminal A3.</td></tr>
<tr><td>H3-07</td><td>Terminal A3 Gain Setting</td><td>Sets the level of the input value selected in H3-06 when 10 V is input at terminal A3.</td></tr>
<tr><td>H3-08</td><td>Terminal A3 Bias Setting</td><td>Sets the level of the input value selected in H3-06 when 0 V is input at terminal A3.</td></tr>
<tr><td>H3-09</td><td>Terminal A2 Signal Level Selection</td><td>0: 0 to 10 V
1: –10 to 10 V
2: 4 to 20 mA
3: 0 to 20 mA
Note: Use DIP switch S1 to set input terminal A2 for a current or a voltage input signal.</td></tr>
<tr><td>H3-10</td><td>Terminal A2 Function Selection</td><td>Sets the function of terminal A2.</td></tr>
<tr><td>H3-11</td><td>Terminal A2 Gain Setting</td><td>Sets the level of the input value selected in H3-10 when 10 V (20 mA) is input at terminal A2.</td></tr>
<tr><td>H3-12</td><td>Terminal A2 Bias Setting</td><td>Sets the level of the input value selected in H3-10 when 0 V (0 or 4 mA) is input at terminal A2.</td></tr>
<tr><td>H3-13</td><td>Analog Input Filter Time Constant</td><td>Sets a primary delay filter time constant for terminals A1, A2, and A3. Used for noise filtering.</td></tr>
</table>

No.	Name	Description
H3-14	Analog Input Terminal Enable Selection	Determines which of the analog input terminals will be enabled when a digital input programmed for “Analog input enable” (H1-□□ = C) is activated. 1: Terminal A1 only 2: Terminal A2 only 3: Terminals A1 and A2 only 4: Terminal A3 only 5: Terminals A1 and A3 6: Terminals A2 and A3 **7: All terminals enabled**
Multi-Function Analog Inputs		
H4-01	Multi-Function Analog Output Terminal FM Monitor Selection	Selects the data to be output through multi-function analog output terminal FM. Set the desired monitor parameter to the digits available in U□-□□. For example, enter “103” for U1-03.
H4-02	Multi-Function Analog Output Terminal FM Gain	Sets the signal level at terminal FM that is equal to 100% of the selected monitor value.
H4-03	Multi-Function Analog Output Terminal FM Bias	Sets the signal level at terminal FM that is equal to 0% of the selected monitor value.
H4-04	Multi-Function Analog Output Terminal AM Monitor Selection	Selects the data to be output through multi-function analog output terminal AM. Set the desired monitor parameter to the digits available in U□-□□. For example, enter “103” for U1-03.
H4-05	Multi-Function Analog Output Terminal AM Gain	Sets the signal level at terminal AM that is equal to 0% of the selected monitor value.
H4-06	Multi-Function Analog Output Terminal AM Bias	Sets the bias value added to the terminal AM output signal.
H4-07	Multi-Function Analog Output Terminal FM Signal Level Selection	**0: 0 to 10 V** 1: -10 to 10 V 2: 4 to 20 mA
H4-08	Multi-Function Analog Output Terminal AM Signal Level Selection	**0: 0 to 10 V** 1: -10 to 10 V 2: 4 to 20 mA
Pulse Input Setting (Freq.)		
H6-02	Pulse Train Input Scaling	Sets the terminal RP input signal frequency that is equal to 100% of the value selected in H6-01.
H6-03	Pulse Train Input Gain	Sets the level of the value selected in H6-01 when a frequency with the value set in H6-02 is input.
H6-04	Pulse Train Input Bias	Sets the level of the value selected in H6-01 when 0 Hz is input.
Pulse Output Setting		
H6-06	Pulse Train Monitor Selection	Select the pulse train monitor output function (value of the □-□□ part of U□-□□). Example: To select U5-01, set 501.
H6-07	Pulse Train Monitor Scaling	Sets the terminal MP output signal frequency when the monitor value is 100%. To have the pulse train monitor output equal the output frequency, set H6-06 to 102 and H6-07 to 0.
Motor Protection		
L1-01	Motor Overload Protection Selection	0: Disabled **1: General purpose motor (standard fan cooled)** 2: Drive dedicated motor with a speed range of 1:10 3: Vector motor with a speed range of 1:100 4: PM motor with variable torque 5: PM motor with constant torque control 6: General purpose motor (50 Hz) The drive may not be able to provide protection when multiple motors are used, even if overload is enabled in L1-01. Set L1-01 to 0 and install separate thermal relay to each motor.
L1-02	Motor Overload Protection Time	Sets the motor thermal overload protection (oL1) time.
Stall Prevention		
L3-01	Stall Prevention Selection during Acceleration	0: Disabled. **1: General purpose. Acceleration is paused as long as the current is above the L3-02 setting.** 2: Intelligent. Accelerate in the shortest possible time without exceeding the L3-02 level. Note: Setting 2 is not available when using OLV/PM.
L3-02	Stall Prevention Level during Acceleration	Used when L3-01 = 1 or 2. 100% is equal to the drive rated current.
L3-04	Stall Prevention Selection during Deceleration	**0: Disabled. Deceleration at the active deceleration rate. An ov fault may occur.** 1: General purpose. Deceleration is paused when the DC bus voltage exceeds the Stall Prevention level. 2: Intelligent. Decelerate as fast as possible while avoiding ov faults. 3: Stall Prevention with braking resistor. Stall Prevention during deceleration is enabled in coordination with dynamic braking. 4: Overexcitation Deceleration. Decelerates while increasing the motor flux. 5: Overexcitation Deceleration 2. Adjust the deceleration rate according to the DC bus voltage. 6: Enabled. Decelerates adjusting the deceleration rate according to the output current and the DC bus voltage.

No.	Name	Description
L3-05	Stall Prevention Selection during Run	0: Disabled. Drive runs at a set frequency. A heavy load may cause speed loss. **1: Decel time 1. Uses the deceleration time set to C1-02 while Stall Prevention is performed.** 2: Decel time 2. Uses the deceleration time set to C1-04 while Stall Prevention is performed.
L3-06	Stall Prevention Level during Run	Enabled when L3-05 is set to 1 or 2. 100% is equal to the drive rated current.
Brake Sequence Parameters		
S1-01 S1-02	Brake Release Frequency FWD/REV	Sets the output frequency value at which the brake is released when driving in the forward (-01) or reverse (-02) direction.
S1-05 S1-06	Brake Release Current FWD/ REV	Sets the output current value as a % of motor rated current at which the brake is released when driving in the forward (-05) or reverse (-06) direction.
S1-07 S1-08	Brake Release Torque FWD/ REV	Sets the output torque value as a % of motor rated torque at which the brake is released when driving in the forward (-07) or reverse (-08) direction. Available only in Vector Control modes.
S1-09 S1-10	Torque Compensation FWD/REV	Sets the output torque compensation value as a % of motor rated torque when driving in the forward (-09) or reverse (-10) direction. Available only in Vector Control modes.Used to hold the load at low speed.
S1-12 S1-13	Brake Hold Frequency FWD/REV	Sets the output frequency value at which the brake is closed when stopping in the forward (-12) or reverse (-13) direction.
Overload Detection		
S5-01	Overload Detection Operation Selection 1	**0: Disabled** 1: During Speed Agree. Acceleration prohibited, Alarm only. 2: During Run. Acceleration prohibited, Alarm only 3: During Speed Agree. Decelerate to stop with fast stop time (C1-09). Alarm only 4: During Run. Decelerate to stop with fast stop time (C1-09). Alarm only 5: During Speed Agree. Interrupt output current, Fault 6: During Run. Interrupt output current, Fault
S5-02	Overload Detection Level 1	Sets motor overload 1 detection threshold as a percentage of motor rated current (in V/f) or motor rated torque (in vector control)
S5-03	Overload Detection Time 1	Time during which the current or torque reference must exceed Overload Detection Level 1 before the overload detection function is triggered.

No.	Name	Description
Induction Motor Auto-Tuning		
T1-01	Auto-Tuning Mode Selection	**0: Rotational Auto-Tuning** 1: Stationary Auto-Tuning 1 2: Stationary Auto-Tuning for Line-to-Line Resistance 3: Rotational Auto-Tuning for V/f Control (necessary for Energy Savings and Speed Estimation Speed Search) 4: Stationary Auto-Tuning 2 8: Inertia Tuning (perform Rotational Auto-Tuning prior to Inertia Tuning) 9: ASR Gain Tuning (perform Rotational Auto-Tuning prior to ASR Gain Auto-Tuning)
T1-02	Motor Rated Power	Sets the motor rated power as specified on the motor nameplate.
T1-03	Motor Rated Voltage	Sets the motor rated voltage as specified on the motor nameplate.
T1-04	Motor Rated Current	Sets the motor rated current as specified on the motor nameplate.
T1-05	Motor Base Frequency	Sets the rated frequency of the motor as specified on the motor nameplate.
T1-06	Number of Motor Poles	Sets the number of motor poles as specified on the motor nameplate.
T1-07	Motor Base Speed	Sets the rated speed of the motor as specified on the motor nameplate.
T1-08	PG Number of Pulses Per Revolution	Set the number of pulses per revolution for the PG being used (pulse generator or encoder).
T1-09	Motor No-Load Current (Stationary Auto-Tuning)	Sets the no-load current for the motor. After setting the motor capacity to T1-02 and the motor rated current to T1-04, this parameter will automatically display the no-load current for a standard 4 pole YASKAWA motor. Enter the no-load current as indicated on the motor test report.
T1-10	Motor Rated Slip (Stationary Auto-Tuning)	Sets the motor rated slip. After setting the motor capacity to T1-02, this parameter will automatically display the motor slip for a standard 4 pole YASKAWA motor. Enter the motor slip as indicated on the motor test report.
T1-11	Motor Iron Loss	Sets the iron loss for determining the Energy Saving coefficient. The value is set to E2-10 (motor iron loss) set when the power is cycled. If T1-02 is changed, a default value appropriate for the motor capacity that was entered will appear.

Monitor	Description
U1-01	Frequency Reference (Hz)
U1-02	Output Frequency (Hz)
U1-03	Output Current (A)
U1-05	Motor Speed (Hz)
U1-06	Output Voltage Reference (Vac)
U1-07	DC Bus Voltage (Vdc)
U1-08	Output Power (kW)
U1-09	Torque Reference (% of motor rated torque)
U1-10	Displays the input terminal status. U1-10=00000000 1 Digital input 1 (terminal S1 enabled) 1 Digital input 2 (terminal S2 enabled) 1 Digital input 3 (terminal S3 enabled) 1 Digital input 4 (terminal S4 enabled) 1 Digital input 5 (terminal S5 enabled) 1 Digital input 6 (terminal S6 enabled) 1 Digital input 7 (terminal S7 enabled) 1 Digital input 8 (terminal S8 enabled)
U1-11	Displays the output terminal status. U1-11=00000000 1 Multi-Function Digital Output (terminal M1-M2) 1 Multi-Function Digital Output (terminal M3-M4) 1 Multi-Function Digital Output (terminal M5-M6) Not Used 1 Fault Relay (terminal MA-MC closed MA-MC open)
U1-12	Verifies the drive operation status. U1-12=00000000 1 During run 1 During zero-speed 1 During REV 1 During fault reset signal input 1 During speed agree 1 Drive ready 1 During alarm detection 1 During fault detection
U1-13	Terminal A1 Input Level
U1-14	Terminal A2 Input Level
U1-15	Terminal A3 Input Level
U1-16	Output Frequency after Soft Starter
U1-18	oPE Fault Parameter
U1-24	Input Pulse Monitor
Fault Trace	
U2-01	Current Fault
U2-02	Previous Fault
U2-03	Frequency Reference at Previous Fault
U2-04	Output Frequency at Previous Fault
U2-05	Output Current at Previous Fault
U2-06	Motor Speed at Previous Fault
U2-07	Output Voltage at Previous Fault
U2-08	DC Bus Voltage at Previous Fault
U2-09	Output Power at Previous Fault
U2-10	Torque Reference at Previous Fault
U2-11	Input Terminal Status at Previous Fault
U2-12	Output Terminal Status at Previous Fault
U2-13	Drive Operation Status at Previous Fault
U2-14	Cumulative Operation Time at Previous Fault
U2-15	Soft Starter Speed Reference at Previous Fault
U2-16	Motor q-Axis Current at Previous Fault
U2-17	Motor d-Axis Current at Previous Fault
U2-20	Heatsink Temperature at Previous Fault
Fault History	
U3-01 to U3-04	First to 4th Most Recent Fault
U3-05 to U3-10	5th to 10th Most Recent Fault
U3-11 to U3-14	Cumulative Operation Time at 1st to 4th Most Recent Fault
U3-15 to U3-20	Cumulative Operation Time at 5th to 10th Most Recent Fault
Note: The following faults are not recorded in the error log. CPF00 to 03, Uv1, and Uv2	

DI/DO Sel.	Description
Digital Input Function Selections	
0	Brake Release Check
3	Multi-step speed reference 1
4	Multi-step speed reference 2
5	Multi-step speed reference 3
6	Jog reference selection (higher priority than multi-step speed reference)
7	Accel/decel time selection 1
F	Through mode (Set when a terminal is not used)
14	Fault reset (Reset when turned ON)
17	Emergency Stop N.C.
20 to 2F	External fault; Input mode: N.O. contact / N.C. contact, Detection mode: Normal/during operation
Digital Output Function Selections	
0	During Run (ON: run command is ON or voltage is being output)
1	Zero Speed
2	Speed Agree 1
6	Drive Ready
E	Fault
F	Through mode
10	Minor fault (Alarm) (ON: Alarm displayed)
21	Brake Release Command
22	Overload Detection N.O.

9 Troubleshooting

◆ General Fault and Alarms

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

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

A fault is indicated by a code on the data display and the ALM LED is on. The drive output is always switched off immediately and the motor 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 operator or cycling the power supply.

This lists up the most important alarms and faults only. Please refer to the Technical Manual for a complete list.

Digital Operator	AL	FLT	Cause	Corrective Action
Base Block bb	❍		The software base block function is assigned to one of the digital inputs and the input is off. The drive does not accept Run commands.	• Check the digital inputs function selection. • Check the upper controller sequence.
Control Fault CF		❍	The torque limit was reached during deceleration for longer than 3 s. when in Open Loop Vector control • The load inertia is too big. • The torque limit is too low. • The motor parameters are wrong.	• Check the load. • Set the torque limit to the most appropriate setting (L7-01 through L7-04). • Check the motor parameters.
Control Circuit Fault CPF02 to CPF24		❍	There is a problem in the drive's control circuit.	• Cycle the drive power supply. • Initialize the drive. • Replace the drive if the fault occurs again.
Control Circuit Fault CPF25		❍	There is no terminal board connected to the control board.	• Check if the terminal board is installed properly. • Uninstall and Reapply the terminal board. • Change the drive.
Cannot Reset CrST	❍		Fault reset was input when a Run command was active.	Turn off the Run command and reset the drive.
Option External Fault EF0	❍	❍	An external fault was tripped by the upper controller via an option card.	• Remove the fault cause, reset the fault and restart the drive. • Check the upper controller program.
External Fault EF	❍		A forward and reverse command were input simultaneously for longer than 500 ms. This alarm stops a running motor.	• Check the sequence and make sure that the forward and reverse input are not set at the same time.
External Faults EF1 to EF8	❍	❍	• An external fault was triggered by an external device via one of the digital inputs S1 to S8. • The digital inputs are set up incorrectly.	• Find out why the device tripped the EF. Remove the cause and reset the fault. • Check the functions assigned to the digital inputs.
Ground Fault GF		❍	• Ground leakage current has exceeded 50% of the drives rated output current. • Cable or motor insulation is broken. • Excessive stray capacitance at drive output.	• Check the output wiring and the motor for short circuits or broken insulation. Replace any broken parts. • Reduce the carrier frequency.
Safe Disable Hbb	❍		Both Safe Disable inputs are open. The drive output is safely disabled and the motor can not be started.	• Check why the upper controller's safety device disabled the drive. Remove the cause and restart. • Check the wiring. • If the Safe Disable function is not utilized for the ISO13849-1, Category 3 PLd, and IEC61508, SIL2 or for disabling the drive, the terminals HC, H1, H2 must be linked.
Safe Disable Fault HbbF	❍		Drive output is disabled while only one of the Safe Disable inputs is open. (normally both input signals H1 and H2 should be open) • One channel is internally broken and does not switch off, even if the external signal is removed. • Only one channel is switched off by the upper controller.	• Check the wiring from the upper controller and make sure that both signals are set correctly by the controller. • If the signals are set correctly and the alarm does not disappear, replace the drive.

Digital Operator	AL	FLT	Cause	Corrective Action
Output Phase Loss PF		❍	Output cable is disconnected or the motor winding is damaged. Loose wires at the drive output. Motor is too small (less than 5% of drive current).	• Check the motor wiring. • Make sure all terminal screws in the drive and motor are properly tightened. • Check the motor and drive capacity.
Overcurrent oC		❍	Short circuit or ground fault on the drive output side The load is too heavy. The accel./decel. times are too short. Wrong motor data or V/f pattern settings. A magnetic contactor was switched at the output.	• Check the output wiring and the motor for short circuits or broken insulation. Replace the broken parts. • Check the machine for damages (gears, etc.) and repair any broken parts. • Check the drive parameter settings. • Check the output contactor sequence.
Heatsink Overheat oH or oH1	❍	❍	Surrounding temperature is too high. The cooling fan has stopped. The heatsink is dirty. The airflow to the heatsink is restricted.	• Check the surrounding temperature and install cooling devices if necessary. • Check the drive cooling fan. • Clean the heatsink. • Check the airflow around the heatsink.
Motor Overload oL1		❍	The motor load is too heavy. The motor is operated at low speed with heavy load. Cycle times of accel./ decel. are too short. Incorrect motor rated current has been set.	• Reduce the motor load. • Use a motor with external cooling and set the correct motor in parameter L1-01 • Check the sequence. • Check the rated current setting.
Drive Overload oL2		❍	The load is too heavy. The drive capacity is too small. Too much torque at low speed.	• Check the load. • Make sure that the drive is big enough to handle the load. • The overload capability is reduced at low speeds. Reduce the load or increase the drive size.
Overtorque Detection 1 oL3	❍	❍	The load is too heavy for the crane. The Overtorque Detection 1 threshold is too low. The Overtorque Detection 1 Time is too short.	• Check the load on the crane. • Set the correct Overtorque Detection Level in parameter S6-02. • Set the correct Overtorque Detection Time in parameter S6-03.
Overtorque Detection 2 oL4	❍	❍	The load is too heavy for the crane. The Overtorque Detection 2 threshold is too low. The Overtorque Detection 2 Time is too short.	• Check the load on the crane. • Set the correct Overtorque Detection Level in parameter S6-05. • Set the correct Overtorque Detection Time in parameter S6-06.
Overload Detection oL5	❍	❍	The load is too heavy for the crane. The Overload Detection threshold is too low. The Overload Detection Time is too short.	• Check the load on the crane. • Set the correct Overload Detection Level in parameters S5-02 and/or S5-05. • Set the correct Overload Detection Time in parameters S5-03 and/or S5-06.
Ultra Lift 2 Fault oL6	❍	❍	Drive output frequency is higher than the Ultra Lift 2 Activation frequency and the drive's output power exceeds the level set to S4-15 (Ultra Lift 2 Fault Detection Level) for a time longer than S4-16 (Ultra Lift 2 Fault Detection Time).	• Check the load on the crane. • Set the correct Ultra Lift 2 Fault values in parameters S4-15 and S4-16.
DC Overvoltage ov	❍	❍	DC bus voltage rose too high. The deceleration time is too short. Stall prevention is disabled. Braking chopper / resistor broken. Unstable motor control in OLV. Too high input voltage.	• Increase the deceleration time. • Enable stall prevention by parameter L3-04. • Make sure the braking resistor and braking chopper are working correctly. • Check motor parameter settings and adjust torque and slip compensation as needed. • Make sure that the power supply voltage meets the drives specifications.
Input Phase Loss LF		❍	Input voltage drop or phase imbalance. One of the input phases is lost. Loose wires at the drive input.	• Check the power supply. • Make sure that all cables are properly fixed to the correct terminals.
Braking Transistor Fault rr		❍	The internal braking transistor is broken.	• Cycle the power supply. • Replace the drive if the fault reoccurs.
Brake Sequence Fault 1 SE1		❍	Forward and Reverse Run commands were received simultaneously.	Check controller settings and external circuitry.

Digital Operator	AL	FLT	Cause	Corrective Action
Brake Sequence Fault 2 SE2		❍	The drive has received a Run command but brake release conditions are not met before the time set in parameter S1-17. The motor is not connected properly. Brake Release Current (S1-06, -06) and/or Brake Release Torque (S1-07, -08) are set too high.	• Check motor connections. • Lower Brake Release Current and/or Brake Release Torque to a value appropriate for the load. • Increase Brake Sequence Fault 2 detection time in parameter S1-17
Brake Sequence Fault 3 SE3		❍	The drive has output a Brake Release Command but did not receive the Brake Release Check signal before the time set to S1-18. Sequence error in the external brake circuit. Response time for the feedback signal from the external brake circuit is too slow.	• Check external brake circuitry. • Increase Brake Sequence Fault 3 detection time in parameter S1-18 or decrease the feedback signal response time.
Brake Sequence Fault 4 SE4		❍	The drive received a Brake Release Check feedback signal without having output a Brake Release Command. Sequence error in the external brake circuit.	Check external brake circuitry.
DC Undervoltage Uv1	❍	❍	The voltage in the DC bus fell below the undervoltage detection level (L2-05). The power supply failed or one input phase has been lost. The power supply is too weak.	• Check the power supply. • Make sure, that the power supply is strong enough.
Controller Undervoltage Uv2		❍	The drives controller power supply voltage is too low.	• Cycle power to the drive. Check if the fault reoccurs. • Replace the drive if the fault continues to occur.
DC Charge Circuit Fault Uv3		❍	The charge circuit for the DC bus is broken.	• Cycle power to the drive. Check if the fault reoccurs. • Replace the drive if the fault reoccurs.

◆ Operator Programing Errors

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

Digital Operator	Cause	Corrective Action
oPE01	Drive capacity and value set to o2-04 do not match.	Correct the value set to o2-04.
oPE02	Parameters were set outside the allowable setting range.	Set parameters to the proper values.
oPE03	A contradictory setting is assigned to multi-function contact inputs H1-01 through to H1-08. • The same function is assigned to two inputs. (this excludes “External fault” and “Not used”) • Input functions which require the setting of other input functions were set alone. • Input functions that are not allowed to be used simultaneously have been set.	• Fix any incorrect settings. • Refer to the Technical Manual for more details.
oPE05	• The run command source (b1-02) or frequency reference source (b1-01) is set to 3 but no option card is installed. • The frequency reference source is set to pulse input but H6-01 is not 0.	• Install the required option card. • Correct the values set to b1-01 and b1-02.
oPE07	Settings to multi-function analog inputs H3-02 and H3-10 conflict. • H3-02 and H3-10 are set to the same value. (this excludes settings 0 and F)	• Fix any incorrect setting. • Refer to the Technical Manual for more details.
oPE08	A function has been set that cannot be used in the control mode selected.(might appear after control mode change)	• Fix any incorrect setting. • Refer to the Technical Manual for more details.
oPE10	The V/f pattern setting is incorrect.	• Check the V/f pattern settings. • Refer to the Technical Manual for more details.
oPE11	The Carrier Frequency upper/lower limit settings are incorrect.	• Check the Carrier Frequency settings (parameters C6). • Refer to the Technical Manual for more details.

Digital Operator	Cause	Corrective Action
oPE18	One of the following setting errors has occurred while Online Tuning is enabled in OLV (A1-02 = 2): • E2-02 has been set below 30% of the original default value • E2-06 has been set below 50% of the original default value • E2-03 = 0	Make sure E2-02, E2-03, and E2-06 are set to the correct values.
oPE22	Brake sequence setting error: • Brake Delay Time (S1-04) $\neq$ 0 and Brake Release Frequency (S1-01, -02) $\leq$ Brake Delay Frequency (S1-03) • Slip PreventionTime (S1-15) $\neq$ 0 and Brake Hold Frequency (S1-12, -13) $\geq$ Slip Prevention Freq. (S1-14) • Impact Stop Function (H1-□□=35) has been assigned to a digital input and Impact Stop Clip Frequency (S3-01) $>$ Brake Hold Frequency (S1-12, -13) • Brake Release Check is set to a digital input (H1-□□=0) and the Brake Release Command has not been set to a digital output (H2-□□=21).	• Fix any incorrect setting. • Refer to the A1000 Crane Software Application Manual for more details.
oPE23	In vector control, one of the following parameters is greater than the torque limit (L7-01, -02): • Brake Release Torque (S1-07, -08) • Impact Stop Detection Torque (S3-03, -04) • Ultra Lift 1 Detection Torque (S4-04, -05) • Overload Detection Level (S5-02, -05) • Overtorque Detection Level (S6-02, -05)	• Fix any incorrect setting. • Refer to the A1000 Crane Software Application Manual for more details.

◆ Auto-Tuning Errors

Digital Operator	Cause	Corrective Action
Er-01	Motor data fault The input motor data are not valid. (e.g. the base frequency and base speed do not fit).	Re-enter the data and repeat Auto-Tuning.
Er-02	Minor Fault • The wiring is faulty. • The load is too heavy.	• Check the wiring. • Check the load. Always perform Auto-Tuning with the load decoupled from the motor.
Er-03	The STOP button was pressed and Auto-Tuning was canceled.	Repeat the Auto-Tuning.
Er-04	Resistance fault • Wrong input data. • Auto tuning exceeded the given time frame. • Calculated values out of range.	• Check the input data. • Check the wiring. • Re-enter the data and repeat the Auto-Tuning.
Er-05	No-Load Current Error • Incorrect data was entered. • Auto tuning took too long. • Calculated values out of range.	
Er-08	Rated Slip Error • Wrong data input. • Auto tuning exceeded the given time frame. • Calculated values out of range.	
Er-09	Acceleration error The motor did not accelerate for the specified acceleration time.	• Increase the acceleration time C1-01. • Check the torque limits L7-01 and L7-02.
Er-11	Motor speed fault. The torque reference was too high.	• Increase the acceleration time (C1-01). • If possible, disconnect the load.
Er-12	Current detection error • One or all output phases are lost. • Current is either too low or exceeds the drives rating. • The current sensors are faulty.	• Check the wiring. • Make sure, that the drive rating fits to the motor. • Check the load. (Auto-Tuning should have been performed without the load connected.) • Replace the drive.
Er-13	Leakage Inductance Error Drive was unable to complete tuning for leakage inductance within 300 s.	• Check all wiring and correct any mistakes. • Double check the motor rated current value that was entered to T1-04 for Auto-Tuning. • Check the motor rated current value written on the motor nameplate and enter the correct value.

Digital Operator	Cause	Corrective Action
End1	Excessive V/f Setting • The torque reference exceeded 20% during Auto-Tuning. • The calculated no-load current is above 80% of the motor rated current.	• Check the V/f pattern setting. • Perform Auto-Tuning without the load connected. • Check the input data and repeat Auto-Tuning.
End2	Motor iron-core saturation alarm • Calculated core saturation values out of range. • Incorrect data was entered.	• Check the input data. • Check the motor wiring. • Perform Auto-Tuning without load connected.
End3	Rated current alarm	Check the input data and repeat tuning.
End4	Adjusted Slip Calculation Error The slip that was calculated is outside the allowable range.	• Make sure the data entered for Auto-Tuning is correct. • Execute Rotational Auto-Tuning instead. If not possible, try Stationary Auto-Tuning 2.
End5	Resistance Tuning Error The resistance value that was calculated is outside the allowable range.	• Double check the data that was entered for the Auto-Tuning process. • Check the motor and motor cable connection for faults.
End6	Leakage Inductance Alarm The leakage inductance value that was calculated is outside the allowable range.	Double check the data that was entered for the Auto-Tuning process.
End7	No-Load Current Alarm • The entered no-load current value was outside the allowable range. • Auto-Tuning results were less than 5% of the motor rated current.	• Check and correct faulty motor wiring. • Double check the data that was entered for the Auto-Tuning process.

◆ Troubleshooting without Alarm or Fault Display

Problem	Control Mode	Possible Cause	Corrective Action
Fluctuation when lowering the load without a counter weight.	OLV	Setting Error when operating in reverse direction.	Set S1-20 to “1”
Some Crane functions like Impact Stop and Overload Detection are not working.	All	The Run command is set to come from the digital operator.	Set the Run command to come from external terminals. (b1-01=1)
The drive remains stopped even though a Run command has been entered.	All	The external baseblock signal is active. The frequency reference is zero.	Input external baseblock signal correctly (default to S8, NC contact). Make sure the frequency reference is higher than zero.
Deceleration rate is not always constant.	All	Deceleration time is being influenced by the Stall Prevention function.	Increase deceleration time. Check Stall Prevention parameter settings.
Excessive current at hoist start when the crane has just lowered the load.	All	Lowering and hoisting movements are too close to one another.	Adjust the Run command delay timer.
The load slips at start.	V/f, V/f with PG	V/f pattern is not tuned correctly.	Increase the E1-08 and/or E1-10 parameter settings gradually.
	OLV	Motor has not been tuned. Torque Limit is too low. Torque Compensation is too low.	Perform Auto-Tuning (if possible rotational) Increase the E1-08 and/or E1-10 parameter settings gradually. Increase Torque Compensation parameter setting (S1-09, -10). Increase Torque Limit.
	CLV	Torque Compensation is too low.	Increase Torque Compensation parameter setting (S1-09, -10).
	All	Brake Sequence settings are not correct.	Check Brake Sequence parameters (S1).
The brake slips at start.	All	Brake Release Current and/or Brake Release Torque are too high.	Lower Brake Release Current and/or Torque parameter settings.
The brake slips at stop.	All	Slip Prevention Frequency is too high. Slip Prevention Time is too long.	Check Slip Prevention parameter settings (S1-14, -15).

10 Safe Disable Input Function

◆ Specifications

Inputs / Outputs		Two Safe Disable inputs and one EDM output according to ISO13849-1 Cat. 3 PLd, IEC61508 SIL2.
Operation Time		Time from input open to drive output stop is less than 1 ms.
Failure Probability	**Demand Rate Low**	PFD = 5.15E^{-5}
	Demand Rate High or Continuous	PFH = 1.2E^{-9}
Performance Level		The Safe Disable feature satisfies all requirements of performance level d (PLd) as defined by ISO13849-1 (this includes DC from EDM).

◆ Precautions

DANGER! *Improper use of the Safe Disable function can result in serious injury or even death. Make sure the whole system or machinery that the Safe Disable function is used in complies with safety requirements. When implementing the Safe Disable function into the safety system of a machine, a thorough risk assessment for the whole system has to be carried out to assure it complies with relevant safety norms (e.g., EN954/ISO13849, IEC61508, EN/IEC62061,...).*

DANGER! *When using a PM motor, even if the drive output is shut off by the Safe Disable function, a break down of two output transistors can cause current to flow through the motor winding, resulting in a rotor movement for a maximum angle of 180 degree (electrically). Make sure such a situation would have no effect on the safety of the application when using the Safe Disable function. This is not a concern with induction motors.*

DANGER! *The Safe Disable function can switch off the drive output, but does not cut the drive power supply and cannot electrically isolate the drive output from the input. Always shut off the drive power supply when performing maintenance or installations on the drive input side as well as the drive output side.*

DANGER! *When using the Safe Disable inputs, make sure to remove the wire links between terminals H1, H2, and HC that were installed prior to shipment. Failing to do so will keep the Safe Disable circuit from operating properly and can cause injury or even death.*

DANGER! *All safety features (including Safe Disable) should be inspected daily and periodically. If the system is not operating normally, there is a risk of serious personal injury.*

DANGER! *Only a qualified technician with a thorough understanding of the drive, the instruction manual, and safety standards should be permitted to wire, inspect, and maintain the Safe Disable input.*

NOTICE: *From the moment terminal inputs H1 and H2 have opened, it takes up to 1 ms for drive output to shut off completely. The sequence set up to trigger terminals H1 and H2 should make sure that both terminals remain open for at least 1 ms in order to properly interrupt drive output.*

NOTICE: *The Safe Disable Monitor (output terminals DM+ and DM-) should not be used for any other purpose than to monitor the Safe Disable status or to discover a malfunction in the Safe Disable inputs. The monitor output is not considered a safe output.*

NOTICE: *When utilizing the Safe Disable function, use only the EMC filters recommended in* ***EMC Filter Installation on page 14***.

◆ Using the Safe Disable Function

The Safe Disable inputs provide a stop function in compliance with “Safe Torque Off” as defined in the IEC61800-5-2. Safe Disable inputs have been designed to meet the requirements of the ISO13849-1, Category 3 PLd, and IEC61508, SIL2.

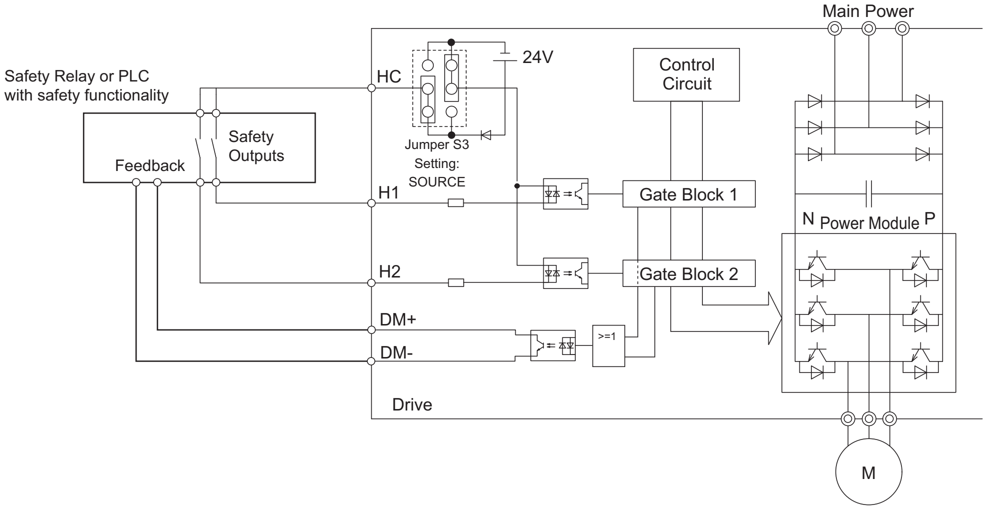
A Safe Disable Status Monitor for error detection in the safety circuit is also provided.

■ Safe Disable Circuit

The Safe Disable circuit consists of two independent input channels that can block the output transistors. In addition, it provides a monitoring channel that indicates the status of those two input channels.

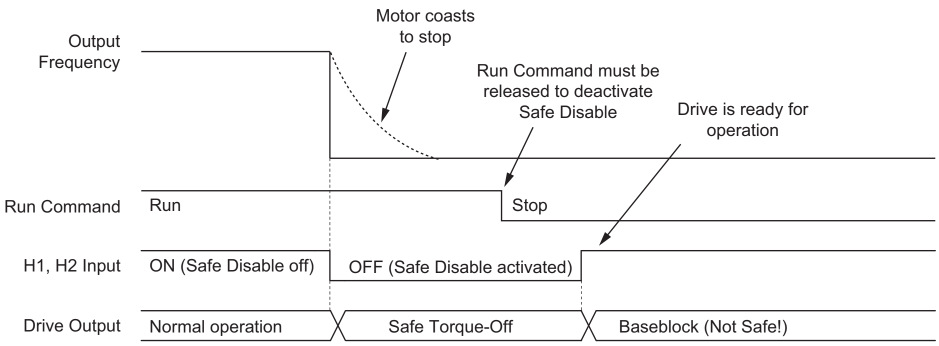
The input can either use the drive internal power supply or an external power supply. Use jumper S3 on the terminal board to select between Sink or Source mode with either internal or external power supply.

A single photocoupler output is available to monitor the status of the Safe Disable terminals. ***Refer to Control Circuit Terminal Functions on page 17*** for signal specifications when using this output.



Disabling and Enabling the Drive Output ("Safe Torque Off")

The diagram below illustrates the Safe Disable input operation.



Entering the "Safe Torque Off" State

Whenever either one Safe Disable input or both inputs open, the motor torque is shut off by switching off the drive output. If the motor was running before the Safe Disable inputs opened, then the motor will coast to stop, regardless of the stopping method set in parameter b1-03.

Notice that the "Safe Torque Off" state can only be achieved using the Safe Disable function. Removing the Run command stops the drive and shuts the output off (baseblock), but does not create a "Safe Torque Off" status.

Note: To avoid an uncontrolled stop during normal operation, make sure that the Safe Disable inputs are opened first when the motor has completely stopped.

Returning to Normal Operation after Safe Disable

The Safe Disable function can only be deactivated when a Run command is not active.

When Safe Disable was activated during stop, normal operation can be resumed by simply turning on both Safe Disable inputs (i.e., by deactivating "Safe Torque Off").

When Safe Disable was activated during run, first the Run command has to be removed and then the Safe Disable inputs have to be turned on before the drive can be restarted.

Safe Disable Monitor Output Function and Digital Operator Display

The table below explains the drive output and Safe Disable monitor state depending on the Safe Disable inputs.

Safe Disable Input Status		Safe Disable Status Monitor, DM+ - DM-	Drive Output Status	Digital Operator Display
Input 1, H1-HC	Input 2, H2-HC			
OFF	**OFF**	OFF	Safely disabled, "Safe Torque Off"	Hbb (flashes)
ON	**OFF**	ON	Safely disabled, "Safe Torque Off"	HbbF (flashes)

Safe Disable Input Status		Safe Disable Status Monitor, DM+ - DM-	Drive Output Status	Digital Operator Display
Input 1, H1-HC	Input 2, H2-HC			
OFF	**ON**	ON	Safely disabled, “Safe Torque Off”	HbbF (flashes)
ON	**ON**	ON	Baseblock, ready for operation	Normal display

Safe Disable Status Monitor

With the Safe Disable monitor output (terminals DM+ and DM-), the drive provides a safety status feedback signal. This signal should be read by the device that controls the Safe Disable inputs (PLC or a safety relay) in order to prohibit leaving the “Safe Torque Off” status in case the safety circuit malfunctions. Refer to the instruction manual of the safety device for details on this function.

Digital Operator Display

When both Safe Disable inputs are open, Hbb will flash in the digital operator display.

Should only one of the Safe Disable channels be on while the other is off, HbbF will flash in the display to indicate that there is a problem in the safety circuit or in the drive. This display should not appear under normal conditions if the Safe Disable circuit is utilized properly. ***Refer to General Fault and Alarms on page 36*** to resolve possible errors.

11 UL 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.

UL/cUL Mark

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

Note: Model CIMR-AC☐4A1200 is UL compliant when the air entering the drive-installed panel or cabinet is 45°C or less. For more information, contact your nearest YASKAWA representative or our sales office.

■ Installation Area

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

■ Main Circuit Terminal Wiring

YASKAWA recommends using closed-loop crimp terminals on all drive models. UL/cUL approval requires the use of closed-loop crimp terminals when wiring the drive main circuit terminals on models CIMR-AC☐2A0110 to 2A0415 and 4A0058 to 4A1200. Use only the tools recommended by the terminal manufacturer for crimping.

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

Note: The mark ⏚ indicates the terminals for protective ground connection. (as defined in IEC60417-5019)
Grounding impedance;
200 V: 100 Ω or less
400 V: 10 Ω or less

Model CIMR-AC☐	Terminal	For Europe and China <1>		For U.S.A <2>		For Asia <3>		Screw Size	Tightening Torque N•m (lb.in.)
		Recommended Gauge mm^2	Applicable Gauge mm^2	Recommended Gauge AWG, kcmil	Applicable Gauge AWG, kcmil	Recommended Gauge mm^2	Applicable Gauge mm^2		
2A0004 2A0006 2A0010	R/L1, S/L2, T/L3	2.5	2.5 to 6	14	14 to 10	2	2 to 5.5	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2.5	2.5 to 6	14	14 to 10	2	2 to 5.5		
	–, +1, +2	–	2.5 to 6	–	14 to 10	2	2 to 5.5		
	B1, B2	–	2.5 to 6	–	14 to 10	2	2 to 5.5		
	⏚	2.5	2.5 to 6	10	14 to 10	2	2 to 5.5		
2A0012	R/L1, S/L2, T/L3	2.5	2.5 to 6	12	14 to 10	2	2 to 5.5	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2.5	2.5 to 6	14	14 to 10	2	2 to 5.5		
	–, +1, +2	–	2.5 to 6	–	14 to 10	2	2 to 5.5		
	B1, B2	–	2.5 to 6	–	14 to 10	2	2 to 5.5		
	⏚	2.5	2.5 to 6	10	14 to 10	3.5	2 to 5.5		
2A0021	R/L1, S/L2, T/L3	4	2.5 to 6	10	12 to 10	5.5	3.5 to 5.5	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2.5	2.5 to 6	10	12 to 10	3.5	3.5 to 5.5		
	–, +1, +2	–	4 to 6	–	12 to 10	5.5	3.5 to 5.5		
	B1, B2	–	2.5 to 6	–	14 to 10	2	2 to 5.5		
	⏚	4	4 to 6	10	12 to 10	3.5	3.5 to 5.5		

Model CIMR-AC□	Terminal	For Europe and China <1>		For U.S.A <2>		For Asia <3>		Screw Size	Tightening Torque N•m (lb.in.)
		Recommended Gauge mm^2	Applicable Gauge mm^2	Recommended Gauge AWG, kcmil	Applicable Gauge AWG, kcmil	Recommended Gauge mm^2	Applicable Gauge mm^2		
2A0030	R/L1, S/L2, T/L3	6	4 to 16	8	10 to 6	14	5.5 to 14	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	6	4 to 16	8	10 to 6	8	5.5 to 14		
	–, +1, +2	–	6 to 16	–	10 to 6	14	5.5 to 14		
	B1, B2	–	4 to 6	–	14 to 10	3.5	2 to 5.5		
	⏚	6	6 to 10	8	10 to 8	5.5	5.5 to 8	M5	2 to 2.5 (17.7 to 22.1)
2A0040	R/L1, S/L2, T/L3	10	6 to 16	6	8 to 6	14	14	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	10	6 to 16	8	8 to 6	14	8 to 14		
	–, +1, +2	–	16	–	6	14	14		
	B1, B2	–	4 to 6	–	12 to 10	5.5	3.5 to 5.5		
	⏚	10	6 to 10	8	10 to 8	5.5	5.5 to 8	M5	2 to 2.5 (17.7 to 22.1)
2A0056	R/L1, S/L2, T/L3	16	16 to 25	4	6 to 4	22	14 to 22	M6	4 to 6 (35.4 to 53.1)
	U/T1, V/T2, W/T3	16	16 to 25	4	6 to 4	14	14 to 22		
	–, +1, +2	–	16 to 25	–	6 to 4	22	14 to 22		
	B1, B2	–	6 to 10	–	10 to 6	14	5.5 to 14	M5	2 to 2.5 (17.7 to 22.1)
	⏚	16	10 to 16	6	8 to 6	8	8 to 14	M6	4 to 6 (35.4 to 53.1)
2A0069	R/L1, S/L2, T/L3	25	16 to 25	3	4 to 3	30	22 to 30	M8	9 to11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	16	16 to 25	3	4 to 3	22	14 to 30		
	–, +1, +2	–	25	–	4 to 3	30	22 to 30		
	B1, B2	–	10 to 16	–	8 to 6	14	8 to 14	M5	2 to 2.5 (17.7 to 22.1)
	⏚	16	16 to 25	6	6 to 4	8	8 to 22	M6	4 to 6 (35.4 to 53.1)
2A0081	R/L1, S/L2, T/L3	35	25 to 35	2	3 to 2	38	30 to 38	M8	9 to11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	25	25 to 35	2	3 to 2	30	22 to 38		
	–, +1, +2	–	25 to 35	–	3 to 2	38	30 to 38		
	B1, B2	–	16	–	6	14	14	M5	2 to 2.5 (17.7 to 22.1)
	⏚	16	16 to 25	6	6 to 4	14	14 to 22	M6	4 to 6 (35.4 to 53.1)
2A0110 <4>	R/L1, S/L2, T/L3	35	25 to 50	1/0	3 to 1/0	38	30 to 50	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	35	25 to 50	1/0	3 to 1/0	38	30 to 50		
	–, +1	–	35 to 50	–	2 to 1/0	60	38 to 60		
	B1, B2	–	16 to 50	–	6 to 1/0	22	14 to 50		
	⏚	16	16 to 25	6	6 to 4	14	14 to 38		
2A0138 <4>	R/L1, S/L2, T/L3	50	35 to 70	2/0	1 to 2/0	60	50 to 60	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	50	35 to 70	2/0	1 to 2/0	60	50 to 60		
	–, +1	–	50 to 70	–	1/0 to 3/0	80	60 to 80		
	B1, B2	–	25 to 70	–	4 to 2/0	30	22 to 60		
	⏚	25	25	4	4	22	22 to 38	M8	9 to 11 (79.7 to 97.4)

Model CIMR-AC□	Terminal	For Europe and China <1> Recommended Gauge mm^2	For Europe and China <1> Applicable Gauge mm^2	For U.S.A <2> Recommended Gauge AWG, kcmil	For U.S.A <2> Applicable Gauge AWG, kcmil	For Asia <3> Recommended Gauge mm^2	For Asia <3> Applicable Gauge mm^2	Screw Size	Tightening Torque N•m (lb.in.)
2A0169 <4>	R/L1, S/L2, T/L3	70	50 to 95	4/0	2/0 to 4/0	80	60 to 100	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	70	50 to 95	4/0	3/0 to 4/0	80	60 to 100		
	–, +1	–	35 to 95	–	1 to 4/0	50 × 2P	50 to 100		
	+3	–	50 to 95	–	1/0 to 4/0	60	50 to 100		
	⏚	35	25 to 35	4	4 to 2	22	22 to 60		9 to 11 (79.7 to 97.4)
2A0211 <4>	R/L1, S/L2, T/L3	95	70 to 95	1/0 × 2P	1/0 to 2/0	100	80 to 100	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	95	70 to 95	1/0 × 2P	1/0 to 2/0	50 × 2P	50 to 60		
	–, +1	–	35 to 95	–	1 to 4/0	50 × 2P	50 to 100		
	+3	–	50 to 95	–	1/0 to 4/0	80	60 to 100		
	⏚	50	25 to 50	4	4 to 1/0	22	22 to 60		9 to 11 (79.7 to 97.4)
2A0250 <4>	R/L1, S/L2, T/L3	95 × 2P	95 to 150	3/0 × 2P	3/0 to 300	80 × 2P	38 to 150	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	95 × 2P	95 to 150	3/0 × 2P	3/0 to 300	80 × 2P	38 to 150		
	–, +1	–	70 to 150	–	3/0 to 300	80 × 2P	80 to 150		
	+3	–	35 to 150	–	2 to 300	80 × 2P	30 to 150	M10	18 to 23 (159 to 204)
	⏚	95	95 to 150	3	3 to 300	22	22 to 150	M12	32 to 40 (283 to 354)
2A0312 <4>	R/L1, S/L2, T/L3	95 × 2P	95 to 150	4/0 × 2P	3/0 to 300	80 × 2P	70 to 150	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	95 × 2P	95 to 150	3/0 × 2P	3/0 to 300	80 × 2P	70 to 200		
	–, +1	–	70 to 150	–	3/0 to 300	150 × 2P	80 to 150		
	+3	–	70 to 150	–	3/0 to 300	80 × 2P	80 to 150	M10	18 to 23 (159 to 204)
	⏚	95	95 to 150	2	2 to 300	38	38 to 150	M12	32 to 40 (283 to 354)
2A0360 <4>	R/L1, S/L2, T/L3	240	95 to 300	250 × 2P	4/0 to 600	100 × 2P	80 to 325	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	240	95 to 300	4/0 × 2P	4/0 to 600	100 × 2P	80 to 325		
	–, +1	–	125 to 300	–	250 to 600	150 × 2P	125 to 325		
	+3	–	70 to 300	–	3/0 to 600	80 × 2P	80 to 325	M10	18 to 23 (159 to 204)
	⏚	120	120 to 240	1	1 to 350	38	38 to 200	M12	32 to 40 (283 to 354)
2A0415 <4>	R/L1, S/L2, T/L3	120 × 2P	95 to 300	350 × 2P	250 to 600	125 × 2P	100 to 325	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	300	95 to 300	300 × 2P	300 to 600	125 × 2P	125 to 325		
	–, +1	–	150 to 300	–	300 to 600	200 × 2P	150 to 325		
	+3	–	70 to 300	–	3/0 to 600	100 × 2P	80 to 325	M10	18 to 23 (159 to 204)
	⏚	120	120 to 240	1	1 to 350	60	60 to 200	M12	32 to 40 (283 to 354)

<1> Gauges listed here are for use in Europe and China.
<2> Gauges listed here are for use in the United States.
<3> Gauges listed here are for use in Asia except for China.
<4> Drive models CIMR-AC□2A0110 to 4A0415 require the use of closed-loop crimp terminals for UL/cUL compliance. Use only the tools recommended by the terminal manufacturer for crimping.

Note: Use crimp insulated terminals or insulated tubing for wiring these connections. Wires should have a continuous maximum allowable temperature of 75°C 600 V UL approved vinyl sheathed insulation. Ambient temperature should not exceed 40°C.

Model CIMR-AC□	Terminal	For Europe and China <1>		For U.S.A <2>		For Asia <3>		Screw Size	Tightening Torque N•m (lb.in.)
		Recommended Gauge mm²	Applicable Gauge mm²	Recommended Gauge AWG, kcmil	Applicable Gauge AWG, kcmil	Recommended Gauge mm²	Applicable Gauge mm²		
4A0002 4A0004	R/L1, S/L2, T/L3	2.5	2.5 to 6	14	14 to 10	2	2 to 5.5	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2.5	2.5 to 6	14	14 to 10	2	2 to 5.5		
	–, +1, +2	–	2.5 to 6	–	14 to 10	2	2 to 5.5		
	B1, B2	–	2.5 to 6	–	14 to 10	2	2 to 5.5		
	⏚	2.5	2.5 to 4	12	14 to 12	2	2 to 5.5		
4A0005 4A0007 4A0009	R/L1, S/L2, T/L3	2.5	2.5 to 6	14	14 to 10	2	2 to 5.5	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2.5	2.5 to 6	14	14 to 10	2	2 to 5.5		
	–, +1, +2	–	2.5 to 6	–	14 to 10	2	2 to 5.5		
	B1, B2	–	2.5 to 6	–	14 to 10	2	2 to 5.5		
	⏚	2.5	2.5 to 6	10	14 to 10	3.5	2 to 5.5		
4A0011	R/L1, S/L2, T/L3	2.5	2.5 to 6	12	14 to 10	2	2 to 5.5	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2.5	2.5 to 6	14	14 to 10	2	2 to 5.5		
	–, +1, +2	–	2.5 to 6	–	14 to 10	2	2 to 5.5		
	B1, B2	–	2.5 to 6	–	14 to 10	2	2 to 5.5		
	⏚	2.5	2.5 to 6	10	14 to 10	3.5	2 to 5.5		
4A0018	R/L1, S/L2, T/L3	2.5	2.5 to 16	10	12 to 6	3.5	2 to 14	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2.5	2.5 to 16	10	12 to 6	3.5	2 to 14		
	–, +1, +2	–	4 to 16	–	12 to 6	3.5	2 to 14		
	B1, B2	–	4 to 6	–	12 to 10	2	2 to 5.5		
	⏚	2.5	2.5 to 6	10	14 to 10	3.5	2 to 5.5	M5	2 to 2.5 (17.7 to 22.1)
4A0023	R/L1, S/L2, T/L3	4	2.5 to 16	10	10 to 6	5.5	3.5 to 14	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	4	2.5 to 16	10	10 to 6	5.5	3.5 to 14		
	–, +1, +2	–	4 to 16	–	12 to 6	5.5	3.5 to 14		
	B1, B2	–	4 to 6	–	12 to 10	2	2 to 5.5		
	⏚	4	4 to 6	10	12 to 10	3.5	3.5 to 5.5	M5	2 to 2.5 (17.7 to 22.1)
4A0031	R/L1, S/L2, T/L3	6	6 to 16	8	8 to 6	14	5.5 to 14	M5	2 to 2.5 (17.7 to 22.1)
	U/T1, V/T2, W/T3	6	6 to 16	8	10 to 6	8	5.5 to 8		
	–, +1, +2	–	6 to 16	–	10 to 6	14	5.5 to 14		
	B1, B2	–	6 to 10	–	10 to 8	3.5	2 to 8	M5	2 to 2.5 (17.7 to 22.1)
	⏚	6	6 to 10	8	10 to 8	5.5	5.5 to 8	M6	4 to 6 (35.4 to 53.1)
4A0038	R/L1, S/L2, T/L3	10	10 to 16	6	8 to 6	14	14	M5	2 to 2.5 (17.7 to 22.1)
	U/T1, V/T2, W/T3	6	6 to 16	8	8 to 6	14	8 to 14		
	–, +1, +2	–	6 to 16	–	6	14	14		
	B1, B2	–	6 to 10	–	10 to 8	5.5	3.5 to 8	M5	2 to 2.5 (17.7 to 22.1)
	⏚	10	6 to 16	6	10 to 6	8	5.5 to 14	M6	4 to 6 (35.4 to 53.1)

Model CIMR-AC□	Terminal	For Europe and China <1>		For U.S.A <2>		For Asia <3>		Screw Size	Tightening Torque N•m (lb.in.)
		Recommended Gauge mm^2	Applicable Gauge mm^2	Recommended Gauge AWG, kcmil	Applicable Gauge AWG, kcmil	Recommended Gauge mm^2	Applicable Gauge mm^2		
4A0044	R/L1, S/L2, T/L3	16	16 to 25	6	6 to 4	14	14 to 22	M6	4 to 6 (35.4 to 53.1)
	U/T1, V/T2, W/T3	16	16 to 25	6	6 to 4	14	14 to 22		
	–, +1, +2	–	16 to 25	–	6 to 4	14	14 to 22		
	B1, B2	–	6 to 10	–	10 to 8	8	5.5 to 8	M5	2 to 2.5 (17.7 to 22.1)
	⏚	16	10 to 16	6	8 to 6	8	8 to 14	M6	4 to 6 (35.4 to 53.1)
4A0058 <4>	R/L1, S/L2, T/L3	16	10 to 16	4	6 to 4	14	14	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	16	10 to 16	4	6 to 4	14	14		
	–, +1	–	16 to 35	–	6 to 1	22	14 to 38		
	B1, B2	–	10 to 16	–	8 to 4	14	8 to 14		
	⏚	16	10 to 16	6	8 to 6	8	8 to 14		
4A0072 <4>	R/L1, S/L2, T/L3	16	16 to 25	3	4 to 3	22	14 to 22	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	25	16 to 25	3	4 to 3	22	14 to 22		
	–, +1	–	25 to 35	–	4 to 1	30	22 to 38		
	B1, B2	–	16 to 25	–	6 to 3	14	14 to 22		
	⏚	16	16 to 25	6	6	14	14 to 22		
4A0088 <4>	R/L1, S/L2, T/L3	25	16 to 50	2	3 to 1/0	30	22 to 60	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	25	25 to 50	2	3 to 1/0	30	22 to 60		
	–, +1	–	25 to 50	–	3 to 1/0	38	30 to 60		
	+3	–	16 to 50	–	6 to 1/0	22	14 to 60		
	⏚	16	16 to 25	4	6 to 4	22	14 to 22		
4A0103 <4>	R/L1, S/L2, T/L3	35	25 to 50	1/0	2 to 1/0	38	30 to 60	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	35	25 to 50	1	2 to 1/0	38	30 to 60		
	–, +1	–	25 to 50	–	3 to 1/0	60	30 to 60		
	+3	–	25 to 50	–	4 to 1/0	30	22 to 60		
	⏚	16	16 to 25	4	6 to 4	22	14 to 22		
4A0139 <4>	R/L1, S/L2, T/L3	50	35 to 95	3/0	1/0 to 4/0	60	38 to 100	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	50	35 to 95	2/0	1/0 to 4/0	60	50 to 100		
	–, +1	–	50 to 95	–	1/0 to 4/0	100	60 to 100		
	+3	–	25 to 95	–	3 to 4/0	50	30 to 100		
	⏚	25	25	4	4	22	22		
4A0165 <4>	R/L1, S/L2, T/L3	70	50 to 95	4/0	3/0 to 4/0	80	60 to 100	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	70	70 to 95	4/0	3/0 to 4/0	80	80 to 100		
	–, +1	–	35 to 95	–	1 to 4/0	50 × 2P	50 to 100		
	+3	–	50 to 95	–	1/0 to 4/0	60	50 to 100		
	⏚	35	25 to 35	4	4 to 2	22	22 to 30		
4A0208 <4>	R/L1, S/L2, T/L3	95	35 to 95	300	2 to 300	150	30 to 150	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	95	35 to 95	300	2 to 300	150	30 to 150		
	–, +1	–	35 to 150	–	1 to 250	80 × 2P	38 to 150		
	+3	–	25 to 70	–	3 to 3/0	80	22 to 80		
	⏚	50	50 to 150	4	4 to 300	22	22 to 150		

Model CIMR-AC□	Terminal	For Europe and China <1>		For U.S.A <2>		For Asia <3>		Screw Size	Tightening Torque N•m (lb.in.)
		Recommended Gauge mm²	Applicable Gauge mm²	Recommended Gauge AWG, kcmil	Applicable Gauge AWG, kcmil	Recommended Gauge mm²	Applicable Gauge mm²		
4A0250 <4>	R/L1, S/L2, T/L3	120	95 to 300	400	1 to 600	150	38 to 325	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	120	95 to 300	400	1/0 to 600	150	38 to 325		
	–, +1	–	70 to 300	–	3/0 to 600	200	80 to 325		
	+3	–	35 to 300	–	1 to 325	125	38 to 325		
	⏚	70	70 to 240	2	2 to 350	22	22 to 200		
4A0296 <4>	R/L1, S/L2, T/L3	185	95 to 300	500	2/0 to 600	200	80 to 325	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	185	95 to 300	500	2/0 to 600	200	80 to 325		
	–, +1	–	70 to 300	–	3/0 to 600	325	80 to 325		
	+3	–	35 to 300	–	1 to 325	150	38 to 325	M10	18 to 23 (159 to 204)
	⏚	95	95 to 240	2	2 to 350	30	30 to 200	M12	32 to 40 (283 to 354)
4A0362 <4>	R/L1, S/L2, T/L3	240	95 to 300	4/0 × 2P	3/0 to 600	250	80 to 325	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	240	95 to 300	4/0 × 2P	3/0 to 600	250	80 to 325		
	–, +1	–	95 to 300	–	4/0 to 600	325	100 to 325		
	+3	–	70 to 300	–	3/0 to 600	200	80 to 325	M10	18 to 23 (159 to 204)
	⏚	120	120 to 240	1	1 to 350	30	30 to 200	M12	32 to 40 (283 to 354)
4A0414 <4>	R/L1, S/L2, T/L3	95 × 2P	95 to 150	300 × 2P	4/0 to 300	100 × 2P	80 to 150	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	95 × 2P	95 to 150	300 × 2P	4/0 to 300	125 × 2P	80 to 150		
	–, +1	–	70 to 150	–	3/0 to 300	150 × 2P	80 to 150		
	+3	–	70 to 150	–	3/0 to 300	80 × 2P	80 to 150		
	⏚	95	35 to 95	1	1 to 3/0	38	38 to 100		
4A0515 <4>	R/L1, S/L2, T/L3	120 × 2P	95 to 150	3/0 × 4P	3/0 to 300	125 × 2P	80 to 150	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	150 × 2P	95 to 150	4/0 × 4P	3/0 to 300	150 × 2P	80 to 150		
	–, +1	–	70 to 150	–	1/0 to 300	60 × 4P	60 to 150		
	+3	–	70 to 150	–	1/0 to 300	100 × 2P	60 to 150		
	⏚	150	50 to 150	1/0	1/0 to 300	60	50 to 150		
4A0675 <4>	R/L1, S/L2, T/L3	95 × 4P	95 to 150	300 × 4P	4/0 to 300	80 × 4P	80 to 150	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	95 × 4P	95 to 150	300 × 4P	4/0 to 300	80 × 4P	80 to 150		
	–, +1	–	70 to 150	–	1/0 to 300	125 × 4P	60 to 150		
	+3	–	70 to 150	–	1/0 to 300	60 × 4P	60 to 150		
	⏚	95 × 2P	60 to 150	2/0	2/0 to 300	60	70 to 150		

<1> Gauges listed here are for use in Europe and China.
<2> Gauges listed here are for use in the United States.
<3> Gauges listed here are for use in Asia except for China.
<4> Drive models CIMR-AC□4A0058 to 4A675 require the use of closed-loop crimp terminals for UL/cUL compliance. Use only the tools recommended by the terminal manufacturer for crimping.

Note: Use crimp insulated terminals or insulated tubing for wiring these connections. Wires should have a continuous maximum allowable temperature of 75°C 600 V UL approved vinyl sheathed insulation. Ambient temperature should not exceed 40°C.

Closed-Loop Crimp Terminal Recommendations

YASKAWA recommends using closed-loop crimp terminals on all drive models. UL approval requires the use of crimp terminals when wiring the drive main circuit terminals on models CIMR-AC□2A0110 to 2A0415 and 4A0058 to 4A675. Use only crimping tools as specified by the crimp terminal manufacturer. YASKAWA recommends crimp terminals made by JST and Tokyo DIP (or equivalent) for the insulation cap.

The table below 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 representatives the YASKAWA sales department.

Wire Gauge	Terminal Screws	Crimp Terminal Model Number	Tool		Insulation Cap Model No.	Code <1>
			Machine No.	Die Jaw		
2 mm² 14 AWG	M4	R2-4	YA-4	AD-900	TP-003	100-054-028
3.5 / 5.5 mm² 12 / 10 AWG	M4	R5.5-4	YA-4	AD-900	TP-005	100-054-029
	M5	R5.5-5	YA-4	AD-900	TP-005	100-054-030
8 mm² 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
14 mm² 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
22 mm² 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
30 / 38 mm² 3 / 2 AWG	M8	R38-8	YA-5	AD-954	TP-038	100-051-264
50 / 60 mm² 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
80 mm² 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
100 mm² 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
150 mm² 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
200 mm² 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
350 kcmil × 2P 400 kcmil × 2P	M12	200-L12	YF-1, YET-300-1	TD-327, TD-314	TP-200	100-051-564
325 mm² 500 kcmil 600 / 650 kcmil 500 kcmil × 2P 600 kcmil × 2P	M10	325-10	YF-1, YET-300-1	TD-328, TD-315	TP-325	100-051-565
	M12	325-12	YF-1, YET-300-1	TD-328, TD-315	TP-325	100-051-277

<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].

Input Fuse Installation

The installation manual specifies that branch circuit protection should be provided by fuses listed in the table below.

Model CIMR-AC□	Fuse Type	
	Manufacturer: Bussmann	
	Model	Fuse Ampere Rating (A)
Three-Phase 200 V Class		
2A0004	FWH-70B	70
2A0006	FWH-70B	70
2A0010	FWH-70B	70
2A0012	FWH-70B	70
2A0021	FWH-90B	90
2A0030	FWH-100B	100
2A0040	FWH-200B	200
2A0056	FWH-200B	200
2A0069	FWH-200B	200
2A0081	FWH-300A	300
2A0110	FWH-300A	300
2A0138	FWH-350A	350
2A0169	FWH-400A	400
2A0211	FWH-400A	400
2A0250	FWH-600A	600
2A0312	FWH-700A	700
2A0360	FWH-800A	800
2A0415	FWH-1000A	1000
Three-Phase 400 V Class		
4A0002	FWH-40B	40
4A0004	FWH-50B	50
4A0005	FWH-70B	70
4A0007	FWH-70B	70
4A0009	FWH-90B	90
4A0011	FWH-90B	90
4A0018	FWH-80B	80
4A0023	FWH-100B	100
4A0031	FWH-125B	125
4A0038	FWH-200B	200
4A0044	FWH-250A	250
4A0058	FWH-250A	250
4A0072	FWH-250A	250
4A0088	FWH-250A	250
4A0103	FWH-250A	250
4A0139	FWH-350A	350
4A0165	FWH-400A	400
4A0208	FWH-500A	500
4A0250	FWH-600A	600
4A0296	FWH-700A	700
4A0362	FWH-800A	800
4A0414	FWH-800A	800
4A0515	FWH-1000A	1000
4A0675	FWH-1200A	1200

■ 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. Use a class 2 power supply for the control circuit terminal when not using the internal control power supply of the drive. 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.

Input / Output	Terminal Signal	Power Supply Specifications
Open Collector Outputs	DM+, DM-	Requires class 2 power supply.
Digital inputs	S1-S8, SN, SC, SP, HC, H1, H2	Use the internal LVLC power supply of the drive. Use class 2 for external power supply.
Analog inputs / outputs	+V, -V, A1, A2, A3, AC, AM, FM	Use the internal LVLC power supply of the drive. Use class 2 for external power supply.

■ Drive Short-Circuit Rating

This drive is suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical amperes, 600 Vac maximum (Up to 240 V in 200 V class drives, up to 480 V for 400 V class drives) when protected by Bussmann Type FWH fuses as specified in ***Input Fuse Installation on page 51***.

◆ 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 (motor rated current) protects the motor if parameter L1-01 is not set to 0 (default is 1, enabling protection for standard induction motors).

If Auto-Tuning has been performed successfully, the motor data entered to T1-04 is automatically written into 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, which 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.

Setting	Description	
0	Disabled	Disabled the drive’s internal motor overload protection.
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 reduces 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 reduces 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 reduces 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.

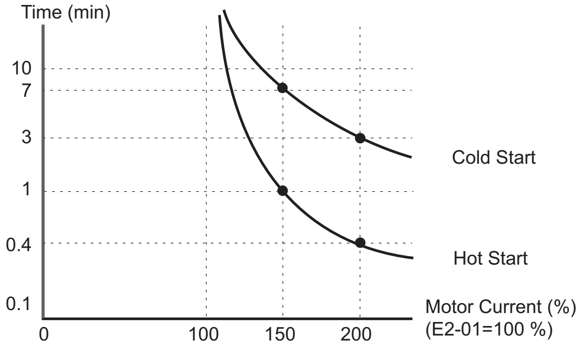
Enable the motor overload protection (L1-01 = 1 to 5) when connecting the drive to a single motor, unless another motor overload preventing device is installed. The drive electronic thermal overload function causes an oL1 fault, which shuts off the output of the drive and prevents additional overheating of the motor. The motor temperature is continually calculated as long as 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 at 50 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.



◆ Precautionary Notes on External Heatsink (IP00 Enclosure)

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

The portion of the external heatsink that projects out can either be protected with the enclosure, or with the appropriate capacitor cover after drive installation is complete. Use the table below to match drive models and capacitor cover. Capacitor covers can be ordered from a YASKAWA representative or directly from the YASKAWA sales department. The table below lists available capacitor covers.

Drive Model CIMR-AC□	Code Number	Model	Figure
2A0110	100-061-273	ECAT31875-11	7
2A0138	100-061-274	ECAT31876-11	
2A0169	100-061-275	ECAT31877-11	
2A0211			
2A0250	100-061-277	ECAT31726-11	
2A0312			
2A0360	100-061-278	ECAT31698-11	
2A0415			
4A0058	100-061-273	ECAT31875-11	
4A0072	100-061-274	ECAT31876-11	
4A0088	100-061-276	ECAT31878-11	
4A0103			
4A0139	100-061-275	ECAT31877-11	
4A0165			
4A0208	100-061-277	ECAT31726-11	
4A0250	100-061-278	ECAT31698-11	
4A0296			
4A0362			
4A0414	100-061-279	ECAT31740-11	
4A0515	100-061-280	ECAT31746-11	
4A0675			

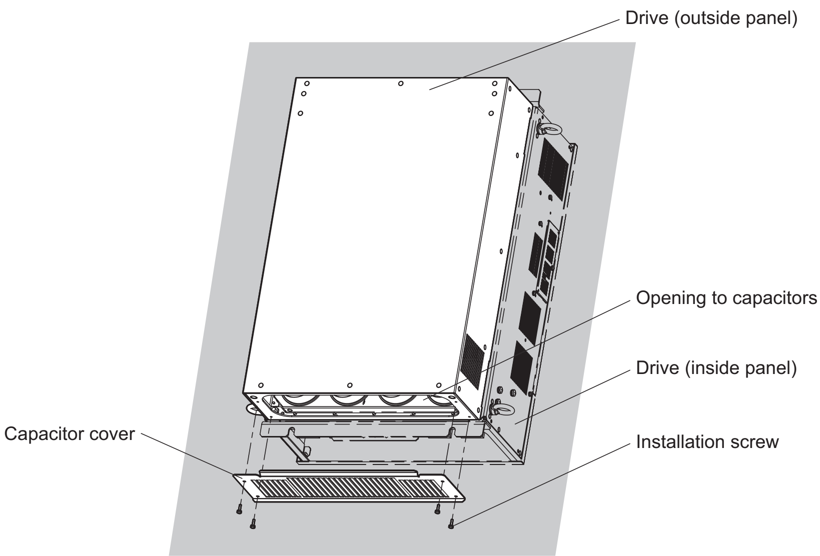


Figure 7

Revision History

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

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YASKAWA AC Drive A1000

Crane Software

Quick Start Guide

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