Cat. No. I537-E2-01

3G3PV

Inverters

User's Manual

OMRON

Contents

General Precautions

Observe the following Precautions when using the SYSDRIVE Inverters and peripheral devices. This manual may include illustrations of the product with protective covers removed in order to describe the components of the product in detail. Make sure that these protective covers are on the product before use.

Consult your OMRON representative when using the product after a long period of storage.

Definition of Precautionary Information

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

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

Caution Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or property damage.

⚠	**WARNING**	Do not touch the inside of the Inverter. Doing so may result in electric shock or injury.
⚠	**WARNING**	Wiring or inspection must be performed only after turning OFF the power supply, confirming that the CHARGE indicator (or status indicator) is OFF and after waiting for the time specified on the front cover. Not doing so may result in electrical shock.
⚠	**WARNING**	Do not damage, pull on, apply stress to, place heavy objects on or pinch the cables. Doing so may result in electrical shock.
⚠	**WARNING**	Do not touch the rotating parts of the motor under operation. Doing so may result in injury.
⚠	**WARNING**	Do not modify the product. Doing so may result in injury or damage to the product.

⚠	**Caution**	Do not store, install or operate the product in the following places. Doing so may result in electrical shock, fire or damage to the product. • Locations subject to direct sunlight. • Locations subject to temperatures or humidity outside the range specified in the specifications. • Locations subject to condensation as the result of severe changes in temperature. • Locations subject to corrosive or flammable gasses. • Locations very close to combustable materials. • Locations subject to dust (especially iron dust) or salts. • Locations subject to exposure to water, oil or chemicals. • Locations subject to shock or vibrations.
⚠	**Caution**	Do not touch the Inverters cooling fins, regenerative resistor or the motor while the power is being supplied or soon after the power is turned OFF. Doing so may result in a skinburn due to the hot surface.
⚠	**Caution**	Do not conduct a dielectric stregth test on any part of the Inverter. Doing so may result in damage to the product or malfunction.
⚠	**Caution**	Take appropriate and sufficient countermeasures when installing systems in the following locations. Not doing so may result in equipment damage. • Locations subject to static electricity or other forms of noise. • Locations subject to strong electromagnetic fields and magnetic fields. • Locations subject to possible exposure to radio activity. • Locations close to power supplies.

Transportation Precautions

⚠	**Caution**	Do not hold by front cover or panel. Instead hold by the cooling fins (heat sink) while transporting the product. Doing so may result in injury.
⚠	**Caution**	Do not pull on the cables. Doing so may result in damge to the product or malfunction.
⚠	**Caution**	Use the eyebolts only for transport of the Inverter. Using them to transport the Inverter and attached equipment may result in injury or malfunction.

Installation Precautions

⚠	**WARNING**	Provide an appropriate stopping device on the machine side to secure safety. (A holding brake is not a stopping device for securing safety) Not doing so may result in injury.
⚠	**WARNING**	Provide an external emergency stopping device that allows an instantaneous stop of operation and power interruption. Not doing so may result in injury.
⚠	**Caution**	Be sure to install the product in the correct direction and provide specified clearances between the Inverter and control panel or with other devices to allow for proper cooling. Not doing so may result in fire or malfunction.
⚠	**Caution**	Do not allow foreign objects to enter inside the product. Doing so may result in fire and malfunction.
⚠	**Caution**	Do not apply any strong imact. Doing so may result in damage to the product or malfunction.

Wiring Precautions

⚠	**WARNING**	Wiring must be performed only after turning OFF the power supply. Not doing so may result in electrical shock.
⚠	**WARNING**	Wiring must be performed by authorized personnel. Not doing so may result in electrical shock.
⚠	**WARNING**	Be sur to confirm operation only after wiring the emergency stop circuit. Not doing so may result in injury.
⚠	**Required**	Always connect the ground terminals to a ground of 100 Ohm or less for 200-V AC class or 10 Ohm or less for the 400-V class. Not connecting to a proper ground may result in electrical shock or fire.

⚠	**Caution**	Install external circuit breakers and take other safety measures against shortcircuiting in external wiring. Not doing so may result in fire.
⚠	**Caution**	Confirm that the rated input voltage of the Inverter is the same as the AC power supply voltage. An incorrect power supply may result in fire, injury or malfunction.
⚠	**Caution**	Connect the Braking Resistor or Braking Resistor Unit as specified in the manual. Not doing so may result in fire.
⚠	**Caution**	Be sure to wire correctly and securely. Not doing so may result in injury or damage to the product.
⚠	**Caution**	Be sure to firmly tighten the screws on the terminal block. Not doing so may result in fire, injury or damage to the product.
⚠	**Caution**	Do not connect an AC power source to the U,V,W output. Doing so may result in damage to the product or malfunction.
⚠	**Caution**	Do not connect a load to the machine during auto-tuning. Not doing so may result in equipment damage.

Operation and Adjustment Precautions

⚠	**WARNING**	Turn ON the input power supply only after mounting the front cover, terminal covers, bottom cover, Operator and optional items. Not doing so may result in electrical shock.
⚠	**WARNING**	Do not remove the front cover, terminal covers, bottom cover, Operator or optional items while the power is being supplied. Doing so may result in electrical shock or damage to the product
⚠	**WARNING**	Do not operate the Operator or switches with wet hands. Doing so may result in electrical shock.
⚠	**WARNING**	Do not touch the Inverter terminals while the power is being supplied. Doing so may result in electrical shock.
⚠	**WARNING**	Do not come close to the machine when using the error retry function because the machine may abruptly start when stopped by an alarm. Doing so may result in injury.
⚠	**WARNING**	Do not come close to the machine immediately after resetting momentary power interruption to avoid an unexpected restart (if operation is set to be continued in the processing selection function after momentary power is reset). Doing so may result in injury.
⚠	**WARNING**	Provide a separate emergency stop switch because the STOP Key on the Operator is valid only when function settings are performed. Not doing so may result in injury.
⚠	**WARNING**	Be sure to confirm that the RUN signal is turned OFF before tuning ON the power supply, resetting the alarm or switching the LOCAL/REMOTE selector. Doing so while the RUN signal is turned ON my result in injury.
⚠	**Caution**	Be sure to confirm permissible ranges of motors and machines before operation because the Inverter speed can be easily changed from low to high. Not doing so may result in damage to the product.
⚠	**Caution**	Provide a separate holding brake when neccessary. Not doing so may result in injury.
⚠	**Caution**	Do not perform a signal check during operation. Doing so may result in injury or damage to the product.
⚠	**Caution**	Do not carelessly change settings. Doing so may result in injury or damage to the product.

Maintenance and Inspection Precautions

⚠	**WARNING**	Do not touch the Inverter terminals while the power is being supplied. Doing so may result in electrical shock.
⚠	**WARNING**	Maintenance or inspection must be performed only after turning OFF the power supply, confirming that the CHARGE indicator (or status indicator) is OFF and after waiting for the time specified on the front cover. Not doing so may result in electrical shock.
⚠	**WARNING**	Maintenance, inspection or parts replacement must be performed by authorized personnel. Not doing so may result in electrical shock or injury.
⚠	**Prohibited**	Do not attempt to disassemble or repair the product. Doing so may result in electrical shock or injury.
⚠	**Caution**	Carefully handle the Inverter because it uses semiconductor elements. Careless handling may result in malfunction.
⚠	**Caution**	Do not exchange, wiring, the Operator, optional cover, disconnect connectors or replace fans while power is being supplied. Doing so may result in injury, damage to the product or malfunction.

Warning Information and Position

There is warning information on the Inverter in the positon shown in the following illustration.

Aways read the warnings.

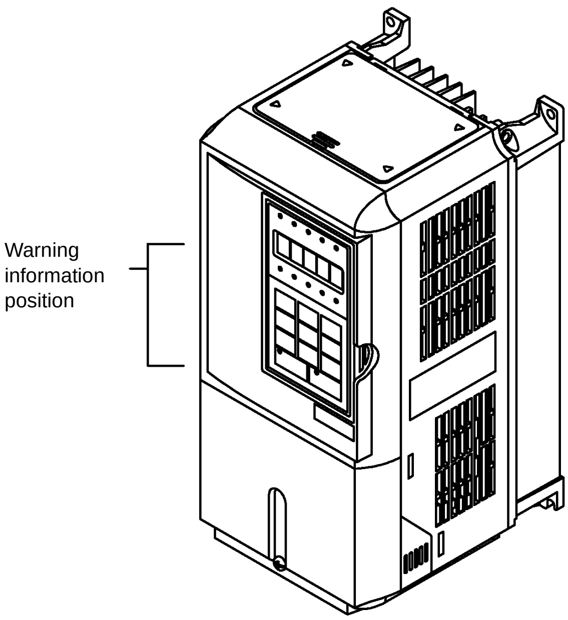

Illustration shows the 3G3PV-A2004-E

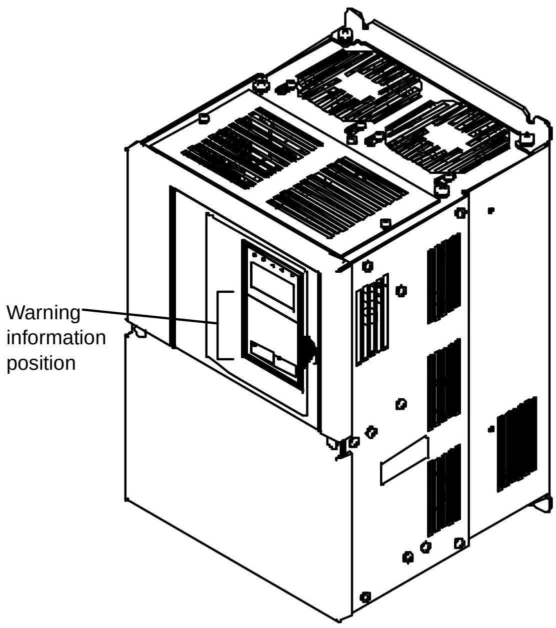

Illustration shows the 3G3PV-B2220-E

Warning information

WARNING

Risk of electric shock.

- Read manual before installing.
- Wait 5 minutes for capacitor discharge after disconnecting power supply.

AVERTISSEMENT

Risque de décharge électrique.

- Lire le manual avant l'installation.
- Attendre 5 minutes aprés la coupure de l'allmentation. Pour permettre la décharge des condensateurs.

Registered Trademarks

The following registered trademarks are used in this manual.

- DeviceNet is a registered trademark of the ODVA (Open DeviceNet Vendors Association, Inc.).
- MODBUS is a trademark of the AEG Schneider Automation, Inc.

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Chapter 1

Handling Inverters

This chapter describes the checks required upon receiving or installing an Inverter.

SYSDRIVE PV Introduction

◆ SYSDRIVE PV Applications

The SYSDRIVE PV is ideal for the following applications.

- Fan, blower and pump applications

Settings must be adjusted to the application for optimum operation. Refer to *Chapter 4 Trial Operation.*

◆ SYSDRIVE PV Models

The SYSDRIVE PV Series of Inverters includes two kinds of Inverters in two voltage classes: 200 V and 400 V. Maximum motor capacities vary from 0.4 to 160 kW.

Table 1.1 SYSDRIVE PV Models

Protective Structure	Maximum Motor Capacity	Basic Model Number
NEMA 1 type IP20 (200 V class)	0.4 kW	3G3PV-A2004-E
	0.75 kW	3G3PV-A2007-E
	1.5 kW	3G3PV-A2015-E
	2.2 kW	3G3PV-A2022-E
	3.7 kW	3G3PV-A2037-E
	5.5 kW	3G3PV-A2055-E
	7.5 kW	3G3PV-A2075-E
	11 kW	3G3PV-A2110-E
	15 kW	3G3PV-A2150-E
	18.5 kW	3G3PV-A2185-E
	22 kW	3G3PV-A2220-E
	30 kW	3G3PV-A2300-E
	37 kW	3G3PV-A2370-E
	45 kW	3G3PV-A2450-E
	55 kW	3G3PV-A2550-E
	75 kW	3G3PV-A2750-E
	90 kW	3G3PV-A2900-E
Open Chassis type IP00 (200 V class)	22 kW	3G3PV-B2220-E
	30 kW	3G3PV-B2300-E
	37 kW	3G3PV-B2370-E
	45 kW	3G3PV-B2450-E
	55 kW	3G3PV-B2550-E
	75 kW	3G3PV-B2750-E
	90 kW	3G3PV-B2900-E
	110 kW	3G3PV-B211K-E

Protective Structure	Maximum Motor Capacity	Basic Model Number
NEMA 1 type IP20 400 V class	0.4 kW	3G3PV-A4004-E
	0.75 kW	3G3PV-A4007-E
	1.5 kW	3G3PV-A4015-E
	2.2 kW	3G3PV-A4022-E
	3.7 kW	3G3PV-A4037-E
	4.0 kW	3G3PV-A4040-E
	5.5 kW	3G3PV-A4055-E
	7.5 kW	3G3PV-A4075-E
	11 kW	3G3PV-A4110-E
	15 kW	3G3PV-A4150-E
	18.5 kW	3G3PV-A4185-E
	22 kW	3G3PV-A4220-E
	30 kW	3G3PV-A4300-E
	37 kW	3G3PV-A4370-E
	45 kW	3G3PV-A4450-E
	55 kW	3G3PV-A4550-E
	75 kW	3G3PV-A4750-E
	90 kW	3G3PV-A4900-E
	110 kW	3G3PV-A411K-E
	132 kW	3G3PV-A413K-E
	160 kW	3G3PV-A416K-E
Open Chassis type IP00 (400 V class)	22 kW	3G3PV-B4220-E
	30 kW	3G3PV-B4300-E
	37 kW	3G3PV-B4370-E
	45 kW	3G3PV-B4450-E
	55 kW	3G3PV-B4550-E
	75 kW	3G3PV-B4750-E
	90 kW	3G3PV-B4900-E
	110 kW	3G3PV-B411K-E
	132 kW	3G3PV-B413K-E
	160 kW	3G3PV-B416K-E

Confirmations upon Delivery

◆ Checks

Check the following items as soon as the Inverter is delivered.

Table 1.2 Checks

Item	Method
Has the correct model of Inverter been delivered?	Check the model number on the nameplate on the side of the Inverter.
Is the Inverter damaged in any way?	Inspect the entire exterior of the Inverter to see if there are any scratches or other damage resulting from shipping.
Are any screws or other components loose?	Use a screwdriver or other tools to check for tightness.

If you find any irregularities in the above items, contact the agency from which you purchased the Inverter or your OMRON representative immediately.

◆ Nameplate Information

There is a nameplate attached to the side of each Inverter. The nameplate shows the model number, specifications, lot number, serial number and other information on the Inverter.

■ Example Nameplate

The following nameplate is an example for an European Inverter: 3-phase, 400 VAC, 37 kW, IEC IP00

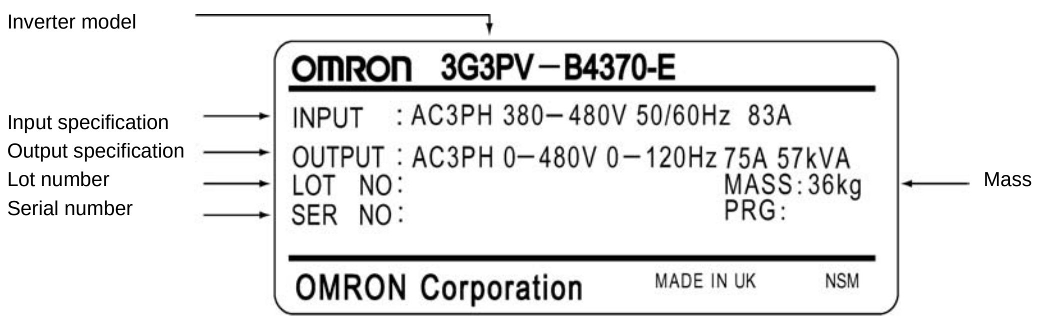


Fig 1.1 Nameplate

■Inverter Model Numbers

The model number of the Inverter on the nameplate indicates the specification, voltage class and maximum motor capacity of the Inverter in alphanumeric codes.

3G3PV -A 4 037 -E

Specifications -E (European Model)

Maximum Applicable Motor Capacity

004	0.4 kW	055	5.5 kW	220	22 kW	750	75 kW
007	0.75 kW	075	7.5 kW	300	30 kW	900	90 kW
015	1.5 kW	110	11 kW	370	37 kW	11K	110 kW
022	2.2 kW	150	15 kW	450	45 kW	13K	132 kW
037	3.7 kW	185	18.5 kW	550	55 kW	16K	160 kW
040	4.0 kW						

Voltage Class

2	AC-input, 3-phase, 200 V (200-V Class)
4	AC-input, 3-phase, 400 V (400-V Class)

Installation type

A	Panel mounting or closed wall-mounting (IEC IP20, NEMA 1)
B	Open Chassis (IEC IP00)

Series Name 3G3PV Series

Fig 1.2 Inverter Model Numbers

TERMS

Open Chassis Type (IEC IP00)

Protected so that parts of the human body cannot reach electrically charged parts from the front when the Inverter is mounted in a control panel.

Enclosed Wall-mounted Type (IEC IP20, NEMA Type 1)

The Inverter is structured so that the Inverter is shielded from the exterior and can thus be mounted to the interior wall of a standard building (not necessarily enclosed in a control panel). The protective structure conforms to the standards of NEMA 1 in the USA.

Top protective cover (Fig. 1.3) has to be installed to conform with IEC IP20 and NEMA Type 1 requirements.

◆ Component Names

■ Inverter Appearance

The external appearance and component names of the Inverter are shown in *Fig 1.3*. The Inverter with the terminal cover removed is shown in *Fig 1.4*.

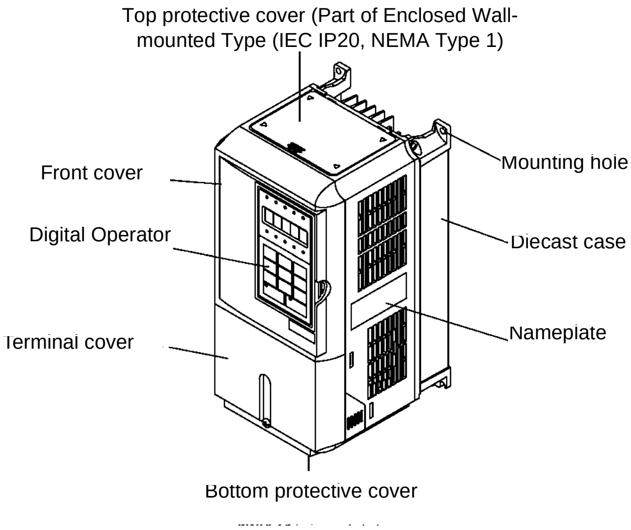
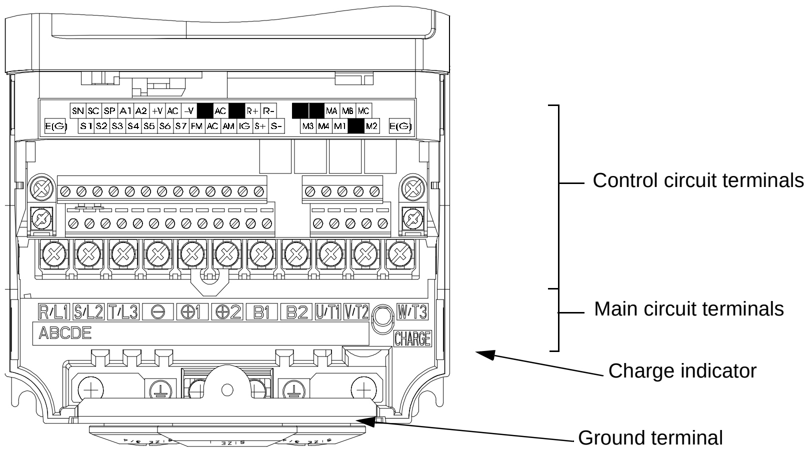


Fig 1.3 Inverter Appearance (18.5 kW or Less)



Note: B1 and B2 terminals are not used in PV inverters

Fig 1.4 Terminal Arrangement (18.5 kW or Less)

■ Inverters of 22 kW or More

The external appearance and component names of the Inverter are shown in *Fig 1.5*. The Inverter with the terminal cover removed is shown in *Fig 1.6*.

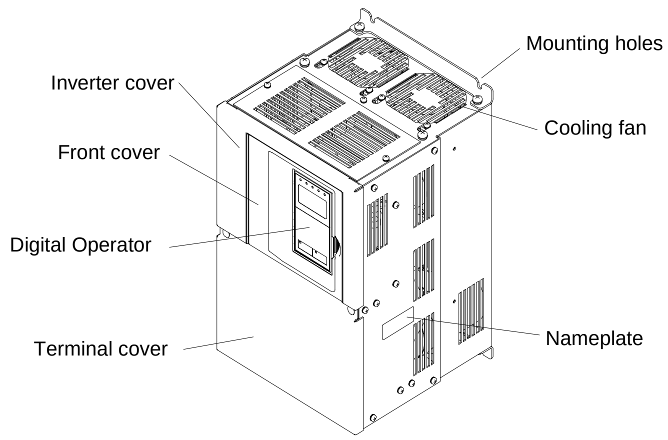


Fig 1.5 Inverter Appearance (22 kW or More)

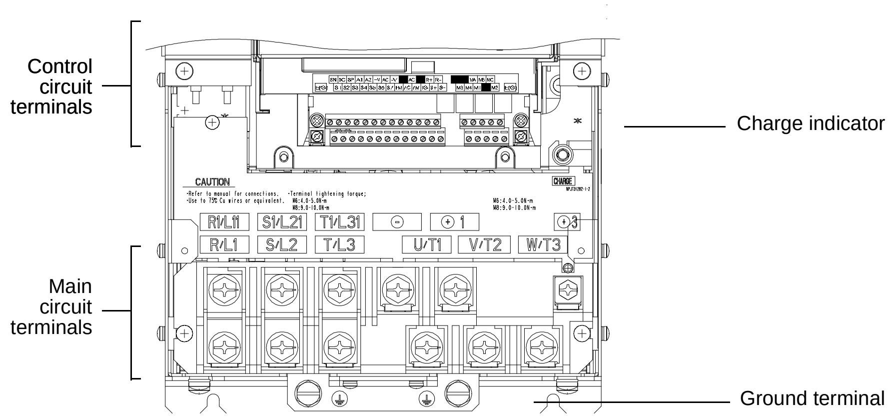
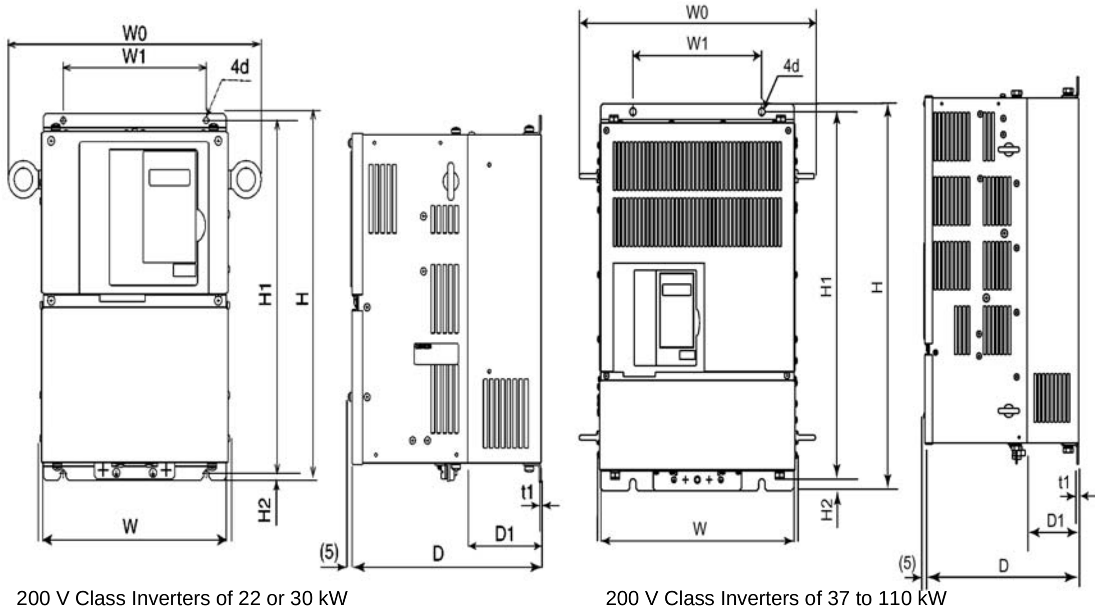


Fig 1.6 Terminal Arrangement (22 kW or More)

Exterior and Mounting Dimensions

◆ Open Chassis Inverters (IP00)

Exterior diagrams of the Open Chassis Inverters are shown below.



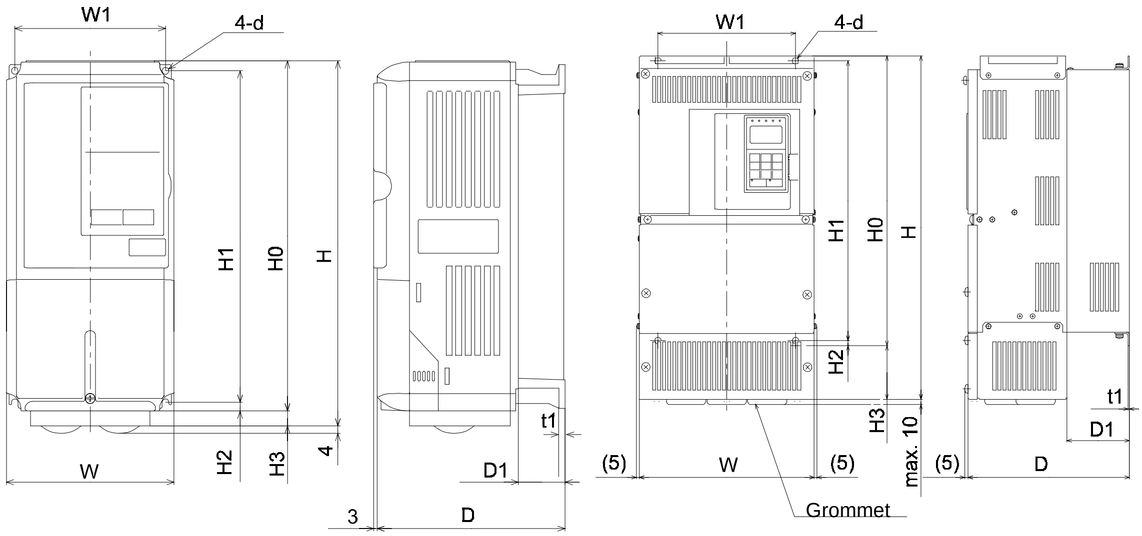
200 V Class Inverters of 22 or 30 kW
400 V Class Inverters of 22 to 55 kW

200 V Class Inverters of 37 to 110 kW
400 V Class Inverters of 75 to 160 kW

Fig 1.7 Exterior Diagrams of Open Chassis Inverters

◆ Enclosed Wall-mounted Inverters (NEMA1)

Exterior diagrams of the Enclosed Wall-mounted Inverters (NEMA1) are shown below.



200 V/400 V Class Inverters of 0.4 to 18.5 kW

200 V Class Inverters of 22 to 90 kW
400 V Class Inverters of 22 to 160 kW

Fig 1.8 Exterior Diagrams of Enclosed Wall-mounted Inverters

Table 1.3 Inverter Dimensions (mm) and Masses (kg)

<table>
<tr><th rowspan="3">Voltage Class</th><th rowspan="3">Max. Appli-cable Motor Output [kW]</th><th colspan="23">Dimensions (mm)</th><th colspan="3">Caloric Value(W)</th><th rowspan="3">Cool-ing Method</th></tr>
<tr><th colspan="10">Open Chassis (IP00)</th><th colspan="13">Enclosed Wall-mounted (NEMA1, IP20)</th><th rowspan="2">Exter nal</th><th rowspan="2">Inter-nal</th><th rowspan="2">Total Heat Gen-era-tion</th></tr>
<tr><th>W0</th><th>W</th><th>H</th><th>D</th><th>W1</th><th>H1</th><th>H2</th><th>D1</th><th>t1</th><th>Ap-prox. Mass</th><th>W0</th><th>W</th><th>H</th><th>D</th><th>W1</th><th>H0</th><th>H1</th><th>H2</th><th>H3</th><th>D1</th><th>t1</th><th>Ap-prox. Mass</th><th>Mount-ing Holes d*</th></tr>
<tr><td rowspan="18">200 V
(3-phase)</td><td>0.4</td><td rowspan="10">-</td><td rowspan="6">140</td><td rowspan="6">280</td><td rowspan="4">157</td><td rowspan="6">126</td><td rowspan="6">266</td><td rowspan="6">7</td><td rowspan="4">39</td><td rowspan="6">5</td><td rowspan="4">3</td><td rowspan="10">-</td><td rowspan="6">140</td><td rowspan="6">280</td><td rowspan="4">157</td><td rowspan="6">126</td><td rowspan="6">280</td><td rowspan="6">266</td><td rowspan="6">7</td><td rowspan="7">0</td><td rowspan="4">39</td><td rowspan="6">5</td><td rowspan="4">3</td><td rowspan="6">M5</td><td>20</td><td>39</td><td>59</td><td rowspan="4">Natu-ral</td></tr>
<tr><td>0.75</td><td>27</td><td>42</td><td>69</td></tr>
<tr><td>1.5</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>2.2</td><td>70</td><td>59</td><td>129</td></tr>
<tr><td>3.7</td><td rowspan="2">177</td><td rowspan="2">59</td><td rowspan="2">4</td><td rowspan="2">177</td><td rowspan="2">59</td><td rowspan="2">4</td><td>112</td><td>74</td><td>186</td><td rowspan="14">Fan</td></tr>
<tr><td>5.5</td><td>164</td><td>84</td><td>248</td></tr>
<tr><td>7.5</td><td rowspan="2">200</td><td rowspan="2">300</td><td rowspan="2">197</td><td rowspan="2">186</td><td rowspan="2">285</td><td rowspan="6">7.5</td><td rowspan="2">65.5</td><td rowspan="6">2.3</td><td>6</td><td rowspan="2">200</td><td>300</td><td rowspan="2">197</td><td rowspan="2">186</td><td rowspan="2">300</td><td rowspan="2">285</td><td rowspan="6">7.5</td><td rowspan="2">65.5</td><td rowspan="6">2.3</td><td>6</td><td rowspan="6">M6</td><td>219</td><td>113</td><td>332</td></tr>
<tr><td>11</td><td>7</td><td>310</td><td>10</td><td>7</td><td>374</td><td>170</td><td>544</td></tr>
<tr><td>15</td><td rowspan="2">240</td><td rowspan="2">350</td><td rowspan="2">207</td><td rowspan="2">216</td><td rowspan="2">335</td><td rowspan="2">78</td><td rowspan="2">11</td><td rowspan="2">240</td><td>350</td><td rowspan="2">207</td><td rowspan="2">216</td><td rowspan="2">350</td><td rowspan="2">335</td><td>0</td><td rowspan="2">78</td><td rowspan="2">11</td><td>429</td><td>183</td><td>612</td></tr>
<tr><td>18.5</td><td>380</td><td>30</td><td>501</td><td>211</td><td>712</td></tr>
<tr><td>22</td><td>345</td><td>254</td><td>400</td><td rowspan="2">258</td><td>195</td><td>385</td><td rowspan="2">100</td><td>21</td><td>345</td><td>255</td><td>535</td><td rowspan="2">258</td><td>195</td><td>400</td><td>385</td><td>135</td><td rowspan="2">100</td><td>24</td><td>586</td><td>274</td><td>860</td></tr>
<tr><td>30</td><td>370</td><td>279</td><td>450</td><td>220</td><td>435</td><td>24</td><td>370</td><td>280</td><td>615</td><td>220</td><td>450</td><td>435</td><td>165</td><td>27</td><td>865</td><td>352</td><td>1217</td></tr>
<tr><td>37</td><td rowspan="2">470</td><td rowspan="2">379</td><td rowspan="2">600</td><td>298</td><td rowspan="2">250</td><td rowspan="2">575</td><td rowspan="4">13</td><td>100</td><td rowspan="4">3.2</td><td>57</td><td rowspan="2">470</td><td rowspan="2">380</td><td rowspan="2">809</td><td>300</td><td rowspan="2">250</td><td rowspan="2">600</td><td rowspan="2">575</td><td rowspan="4">13</td><td rowspan="2">210</td><td>100</td><td rowspan="4">3.2</td><td>62</td><td rowspan="4">M10</td><td>1015</td><td>411</td><td>1426</td></tr>
<tr><td>45</td><td>328</td><td rowspan="4">130</td><td>63</td><td>330</td><td rowspan="3">130</td><td>68</td><td>1266</td><td>505</td><td>1771</td></tr>
<tr><td>55</td><td rowspan="2">545</td><td rowspan="2">454</td><td rowspan="2">725</td><td rowspan="2">348</td><td rowspan="2">325</td><td rowspan="2">700</td><td>86</td><td rowspan="2">545</td><td rowspan="2">455</td><td rowspan="2">1027</td><td rowspan="2">350</td><td rowspan="2">325</td><td rowspan="2">725</td><td rowspan="2">700</td><td rowspan="2">305</td><td>94</td><td>1588</td><td>619</td><td>2207</td></tr>
<tr><td>75</td><td>87</td><td>95</td><td>2019</td><td>838</td><td>997</td></tr>
<tr><td>90</td><td>615</td><td>505</td><td>850</td><td>358</td><td>370</td><td>820</td><td rowspan="2">15</td><td rowspan="2">4.5</td><td>108</td><td>615</td><td>504</td><td>1243</td><td>360</td><td>370</td><td>828</td><td>820</td><td>7.8</td><td>408</td><td>130</td><td>4.5</td><td>114</td><td rowspan="2">M12</td><td>2437</td><td>997</td><td>3434</td></tr>
<tr><td>110</td><td>690</td><td>579</td><td>885</td><td>378</td><td>445</td><td>855</td><td>140</td><td>150</td><td colspan="12">Not available. Use IP00 type.-</td><td>2733</td><td>1242</td><td>3975</td></tr>
<tr><td rowspan="24">400 V
(3-phase)</td><td>0.4</td><td rowspan="11">-</td><td rowspan="7">140</td><td rowspan="7">280</td><td rowspan="3">157</td><td rowspan="7">126</td><td rowspan="7">266</td><td rowspan="7">7</td><td rowspan="3">39</td><td rowspan="7">5</td><td rowspan="3">3</td><td rowspan="11">-</td><td rowspan="7">140</td><td rowspan="7">280</td><td rowspan="3">157</td><td rowspan="7">126</td><td rowspan="7">280</td><td rowspan="7">266</td><td rowspan="7">7</td><td rowspan="11">0</td><td rowspan="3">39</td><td rowspan="7">5</td><td rowspan="3">3</td><td rowspan="7">M5</td><td>14</td><td>39</td><td>53</td><td rowspan="3">Natu-ral</td></tr>
<tr><td>0.75</td><td>17</td><td>41</td><td>58</td></tr>
<tr><td>1.5</td><td>36</td><td>48</td><td>84</td></tr>
<tr><td>2.2</td><td rowspan="4">177</td><td rowspan="4">59</td><td rowspan="4">4</td><td rowspan="4">177</td><td rowspan="4">59</td><td rowspan="4">4</td><td>59</td><td>56</td><td>115</td><td rowspan="18">Fan</td></tr>
<tr><td>3.7</td><td>80</td><td>68</td><td>148</td></tr>
<tr><td>4.0</td><td>70</td><td>91</td><td>161</td></tr>
<tr><td>5.5</td><td>127</td><td>82</td><td>209</td></tr>
<tr><td>7.5</td><td rowspan="2">200</td><td rowspan="2">300</td><td rowspan="2">197</td><td rowspan="2">186</td><td rowspan="2">285</td><td rowspan="9">7.5</td><td rowspan="2">65.5</td><td rowspan="9">2.3</td><td rowspan="2">6</td><td rowspan="2">200</td><td rowspan="2">300</td><td rowspan="2">197</td><td rowspan="2">186</td><td rowspan="2">300</td><td rowspan="2">285</td><td rowspan="9">7.5</td><td rowspan="2">65.5</td><td rowspan="9">2.3</td><td rowspan="2">6</td><td rowspan="9">M6</td><td>193</td><td>114</td><td>307</td></tr>
<tr><td>11</td><td>252</td><td>158</td><td>410</td></tr>
<tr><td>15</td><td rowspan="2">240</td><td rowspan="2">350</td><td rowspan="2">207</td><td rowspan="2">216</td><td rowspan="2">335</td><td rowspan="2">78</td><td rowspan="2">10</td><td rowspan="2">240</td><td rowspan="2">350</td><td rowspan="2">207</td><td rowspan="2">216</td><td rowspan="2">350</td><td rowspan="2">335</td><td rowspan="2">78</td><td rowspan="2">10</td><td>326</td><td>172</td><td>498</td></tr>
<tr><td>18.5</td><td>426</td><td>208</td><td>634</td></tr>
<tr><td>22</td><td rowspan="2">370</td><td rowspan="2">280</td><td rowspan="2">450</td><td rowspan="2">258</td><td rowspan="2">220</td><td rowspan="2">435</td><td rowspan="2">100</td><td rowspan="2">21</td><td rowspan="2">370</td><td rowspan="2">280</td><td rowspan="2">535</td><td rowspan="2">258</td><td rowspan="2">220</td><td rowspan="2">450</td><td rowspan="2">435</td><td rowspan="3">85</td><td rowspan="2">100</td><td rowspan="2">24</td><td>466</td><td>259</td><td>725</td></tr>
<tr><td>30</td><td>678</td><td>317</td><td>995</td></tr>
<tr><td>37</td><td rowspan="3">420</td><td rowspan="3">329</td><td rowspan="3">550</td><td rowspan="3">283</td><td rowspan="3">260</td><td rowspan="3">535</td><td rowspan="3">105</td><td rowspan="3">36</td><td rowspan="3">420</td><td rowspan="3">329</td><td>635</td><td rowspan="3">283</td><td rowspan="3">260</td><td rowspan="3">550</td><td rowspan="3">535</td><td rowspan="3">105</td><td rowspan="3">40</td><td>784</td><td>360</td><td>1144</td></tr>
<tr><td>45</td><td rowspan="2">715</td><td rowspan="2">165</td><td>901</td><td>415</td><td>1316</td></tr>
<tr><td>55</td><td>1203</td><td>495</td><td>1698</td></tr>
<tr><td>75</td><td rowspan="2">545</td><td rowspan="2">454</td><td rowspan="2">725</td><td rowspan="2">348</td><td rowspan="2">325</td><td rowspan="2">700</td><td rowspan="2">13</td><td rowspan="4">130</td><td rowspan="2">3.2</td><td>88</td><td rowspan="2">545</td><td rowspan="2">454</td><td rowspan="2">1100</td><td rowspan="2">348</td><td rowspan="2">325</td><td rowspan="2">725</td><td rowspan="2">700</td><td rowspan="2">13</td><td rowspan="2">305</td><td rowspan="4">130</td><td rowspan="2">3.2</td><td>96</td><td rowspan="2">M10</td><td>1399</td><td>575</td><td>1974</td></tr>
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<tr><td>110</td><td rowspan="2">615</td><td rowspan="2">505</td><td rowspan="2">850</td><td rowspan="2">358</td><td rowspan="2">370</td><td rowspan="2">820</td><td rowspan="3">15</td><td rowspan="3">4.5</td><td>102</td><td rowspan="2">615</td><td rowspan="2">505</td><td rowspan="2">1245</td><td rowspan="2">358</td><td rowspan="2">370</td><td rowspan="2">850</td><td rowspan="2">820</td><td rowspan="3">15</td><td rowspan="2">395</td><td rowspan="3">4.5</td><td>122</td><td rowspan="3">M12</td><td>2097</td><td>853</td><td>2950</td></tr>
<tr><td>132</td><td>120</td><td>130</td><td>2388</td><td>1002</td><td>3390</td></tr>
<tr><td>160</td><td>689</td><td>579</td><td>916</td><td>378</td><td>445</td><td>855</td><td>140</td><td>160</td><td>689</td><td>579</td><td>1325</td><td>378</td><td>445</td><td>916</td><td>855</td><td>400</td><td>140</td><td>170</td><td>2791</td><td>1147</td><td>3938</td></tr>
<tr><td>185</td><td colspan="27" rowspan="3">These Inverters will be released soon</td></tr>
<tr><td>225</td></tr>
<tr><td>300</td></tr>
</table>

* Same for Open Chassis and Enclosed Wall-mounted Inverters.

1

Checking and Controlling the Installation Site

Install the Inverter in the installation site described below and maintain optimum conditions.

◆ Installation Site

Install the Inverter under the following conditions in a pollution degree 2 environment.

Table 1.4 Installation Site

Type	Ambient Operating Temperature	Humidity
Enclosed wall-mounted	-10 to + 40 °C	95% RH or less (no condensation)
Open chassis	-10 to + 45 °C	95% RH or less (no condensation)

Protection covers are attached to the top and bottom of the Inverter. Be sure to remove the protection covers before installing a 200 or 400 V Class Inverter with an output of 18.5 kW or less in a panel.

Observe the following precautions when mounting the Inverter.

- Install the Inverter in a clean location which is free from oil mist and dust. It can be installed in a totally enclosed panel that is completely shielded from floating dust.
- When installing or operating the Inverter, always take special care so that metal powder, oil, water or other foreign matter does not get into the Inverter.
- Do not install the Inverter on combustible material, such as wood.
- Install the Inverter in a location free from radioactive materials and combustible materials.
- Install the Inverter in a location free from harmful gasses and liquids.
- Install the Inverter in a location without excessive oscillation.
- Install the Inverter in a location free from chlorides.
- Install the Inverter in a location not in direct sunlight.

◆ Controlling the Ambient Temperature

To enhance the reliability of operation, the Inverter should be installed in an environment free from extreme temperature increases. If the Inverter is installed in an enclosed environment, such as a box, use a cooling fan or air conditioner to maintain the internal air temperature below 45°C.

◆ Protecting the Inverter from Foreign Matter

Place a cover over the Inverter during installation to shield it from metal power produced by drilling.

Always remove the cover from the Inverter after completing installation. Otherwise, ventilation will be reduced, causing the Inverter to overheat.

Installation Orientation and Space

⚠	**WARNING**	Provide an appropriate stopping device on the machine side to secure safety. (A holding brake is not a stopping device for securing safety) Not doing so may result in injury.
⚠	**WARNING**	Provide an external emergency stopping device that allows an instantaneous stop of operation and power interruption. Not doing so may result in injury.
⚠	**Caution**	Be sure to install the Inverter in the correct direction and provide specified clearances between the Inverter and control panel or with other devices to allow for proper cooling. Not doing so may result in fire or malfunction.
⚠	**Caution**	Do not allow foreign objects to enter inside the product. Doing so may result in fire and malfunction.
⚠	**Caution**	Do not apply any strong imact. Doing so may result in damage to the product or malfunction.

◆ Inverter Installation Orientation and Space

Install the Inverter vertically so as not to reduce the cooling effect. When installing the Inverter, always provide the following installation space to allow normal heat dissipation.

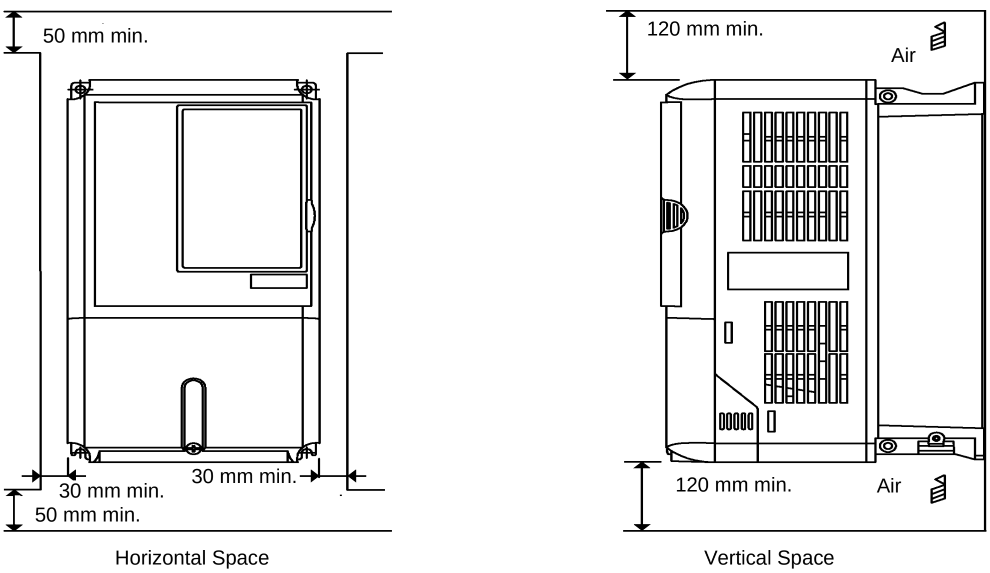


Fig 1.9 Inverter Installation Orientation and Space

◆ Digital Operator Panel Cutout Dimensions

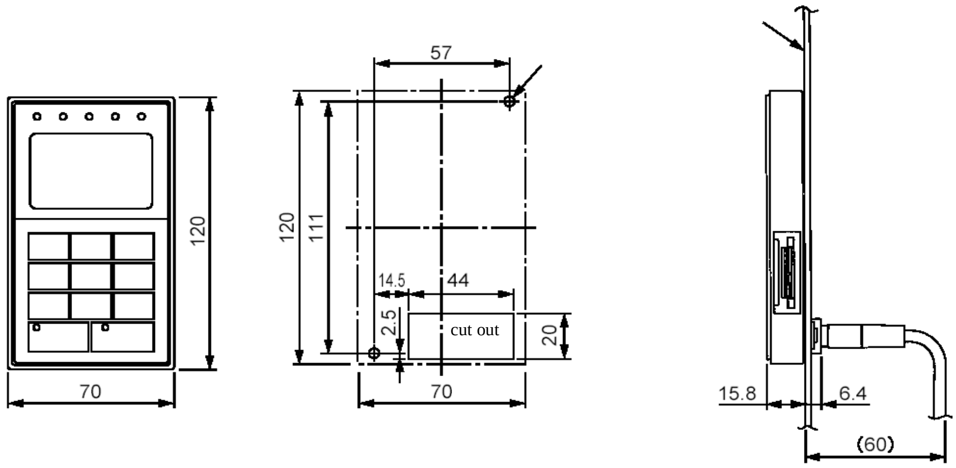


Fig 1.10 Digital Panel Cutout Dimensions

IMPORTANT

1. The same space is required horizontally and vertically for both Open Chassis (IP00) and Enclosed Wall-mounted (IP20, NEMA 1) Inverters.
2. Always remove the protection covers before installing a 200 or 400 V Class Inverter with an output of 18.5 kW or less in a panel.
   Always provide enough space for suspension eye bolts and the main circuit lines when installing a 200 or 400 V Class Inverter with an output of 22 kW or more in a panel.

Removing and Attaching the Terminal Cover

Remove the terminal cover to wire cables to the control circuit and main circuit terminals.

◆ Removing the Terminal Cover

■ Inverters of 18.5 kW or Less

Loosen the screw at the bottom of the terminal cover, press in on the sides of the terminal cover in the directions of arrows 1 and then lift up on the terminal in the direction of arrow 2.

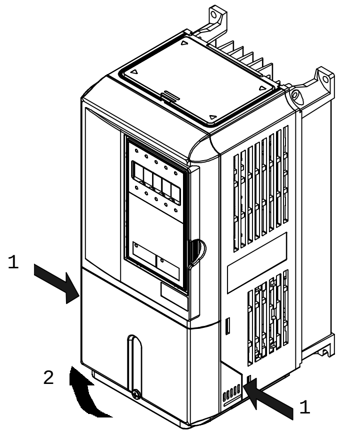


Fig 1.11 Removing the Terminal Cover (Model 3G3PV-A2055-E Shown Above)

■ Inverters of 22 kW or More

Loosen the screws on the left and right at the top of the terminal cover, pull out the terminal cover in the direction of arrow 1 and then lift up on the terminal in the direction of arrow 2.

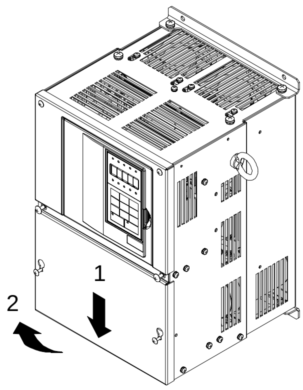


Fig 1.12 Removing the Terminal Cover (Model 3G3PV-B2220-E Shown Above)

◆ Attaching the Terminal Cover

When wiring the terminal block has been completed, attach the terminal cover by reversing the removal procedure.

For Inverters with an output of 18.5 kW or less, insert the tab on the top of the terminal cover into the groove on the Inverter and press in on the bottom of the terminal cover until it clicks into place.

Removing/Attaching the Digital Operator and Front Cover

◆ Inverters of 18.5 kW or Less

To attach optional cards or change the terminal card connector, remove the Digital Operator and front cover in addition to the terminal cover. Always remove the Digital Operator from the front cover before removing the terminal cover.

The removal and attachment procedures are given below.

■Removing the Digital Operator

Press the lever on the side of the Digital Operator in the direction of arrow 1 to unlock the Digital Operator and lift the Digital Operator in the direction of arrow 2 to remove the Digital Operator as shown in the following illustration.

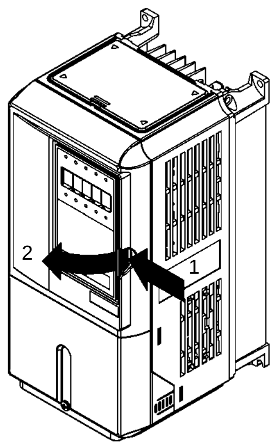


Fig 1.13 Removing the Digital Operator (Model 3G3PV-A4055-E Shown Above)

■Removing the Front Cover

Press the left and right sides of the front cover in the directions of arrows 1 and lift the bottom of the cover in the direction of arrow 2 to remove the front cover as shown in the following illustration.

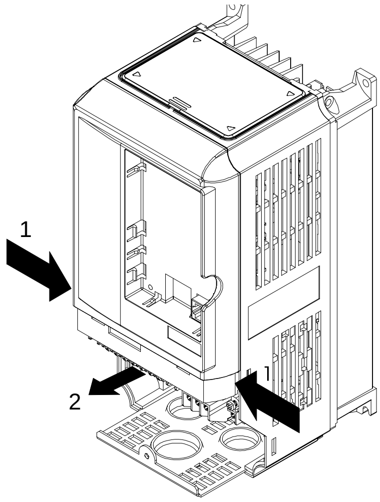


Fig 1.14 Removing the Front Cover (Model 3G3PV-A4055-E Shown Above)

■Mounting the Front Cover

After wiring the terminals or the option card , mount the front cover to the Inverter by performing the steps to remove the front cover in reverse order.

1. Do not mount the front cover with the Digital Operator attached to the front cover; otherwise, Digital Operator may malfunction due to imperfect contact.
2. Insert the tab of the upper part of the front cover into the groove of the Inverter and press the lower part of the front cover onto the Inverter until the front cover snaps shut.

■Mounting the Digital Operator

After attaching the terminal cover, mount the Digital Operator onto the Inverter using the following procedure.

1. Hook the Digital Operator at A (two locations) on the front cover in the direction of arrow 1 as shown in the following illustration.
2. Press the Digital Operator in the direction of arrow 2 until it snaps in place at B (two locations).

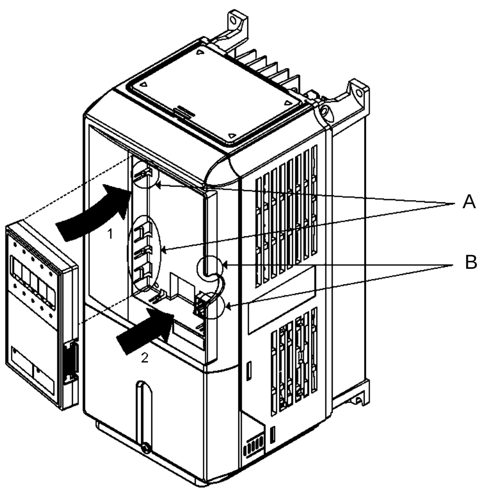


Fig 1.15 Mounting the Digital Operator

IMPORTANT

1. Do not remove or attach the Digital Operator or mount or remove the front cover using methods other than those described above, otherwise the Inverter may break or malfunction due to imperfect contact.
2. Never attach the front cover to the Inverter with the Digital Operator attached to the front cover. Imperfect contact can result.
   Always attach the front cover to the Inverter by itself first and then attach the Digital Operator to the front cover.

◆ Inverters of 22 kW or More

For Inverters with an output of 22 kW or more, remove the terminal cover and then use the following procedures to remove the Digital Operator and main cover.

■Removing the Digital Operator

Use the same procedure as for Inverters with an output of 18.5 kW or less.

■Removing the Front Cover

Lift up at the location label 1 at the top of the control circuit terminal card in the direction of arrow 2.

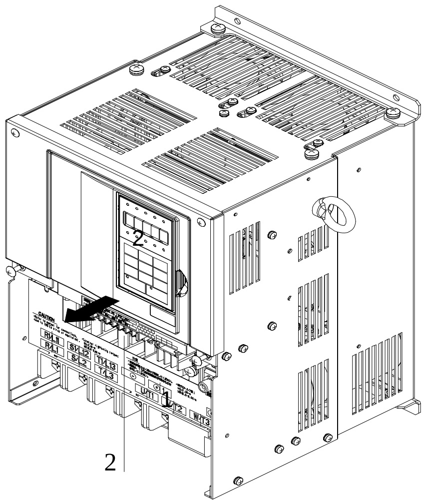


Fig 1.16 Removing the Front Cover (Model 3G3PV-B2220-E Shown Above)

■ Attaching the Front Cover

After completing required work, such as mounting an optional card or setting the terminal card, attach the front cover by reversing the procedure to remove it.

1. Confirm that the Digital Operator is not mounted on the front cover. Contact faults can occur if the cover is attached while the Digital Operator is mounted to it.
2. Insert the tab on the top of the front cover into the slot on the Inverter and press in on the cover until it clicks into place on the Inverter.

■Attaching the Digital Operator

Use the same procedure as for Inverters with an output of 18.5 kW or less.

2

Chapter 2

Wiring

This chapter describes wiring terminals, main circuit terminal connections, main circuit terminal wiring specifications, control circuit terminals and control circuit wiring specifications.

Wiring

⚠	**WARNING**	Wiring must be performed only after turning OFF the power supply. Not doing so may result in electrical shock.
⚠	**WARNING**	Wiring must be performed by authorized personnel. Not doing so may result in electrical shock.
⚠	**WARNING**	Be sure to confirm operation only after wiring the emergency stop circuit. Not doing so may result in injury.
⚠	**Required**	Always connect the ground terminals to a ground of 100 Ohm or less for 200-V AC class or 10 Ohm or less for the 400-V class. Not connecting to a proper ground may result in electrical shock or fire.
⚠	**Caution**	Install external circuit breakers and take other safety measures against short-circuiting in external wiring. Not doing so may result in fire.
⚠	**Caution**	Confirm that the rated input voltage of the Inverter is the same as the AC power supply voltage. An incorrect power supply may result in fire, injury or malfunction.
⚠	**Caution**	Connect the Braking Resistor or Braking Resistor Unit as specified in the manual. Not doing so may result in fire.
⚠	**Caution**	Be sure to wire correctly and securely. Not doing so may result in injury or damage to the product.
⚠	**Caution**	Be sure to firmly tighten the screws on the terminal block. Not doing so may result in fire, injury or damage to the product.
⚠	**Caution**	Do not connect an AC power source to the U,V,W output. Doing so may result in damage to the product or malfunction.

Connections to Peripheral Devices

Examples of connections between the Inverter and typical peripheral devices are shown in *Fig 2.1*.

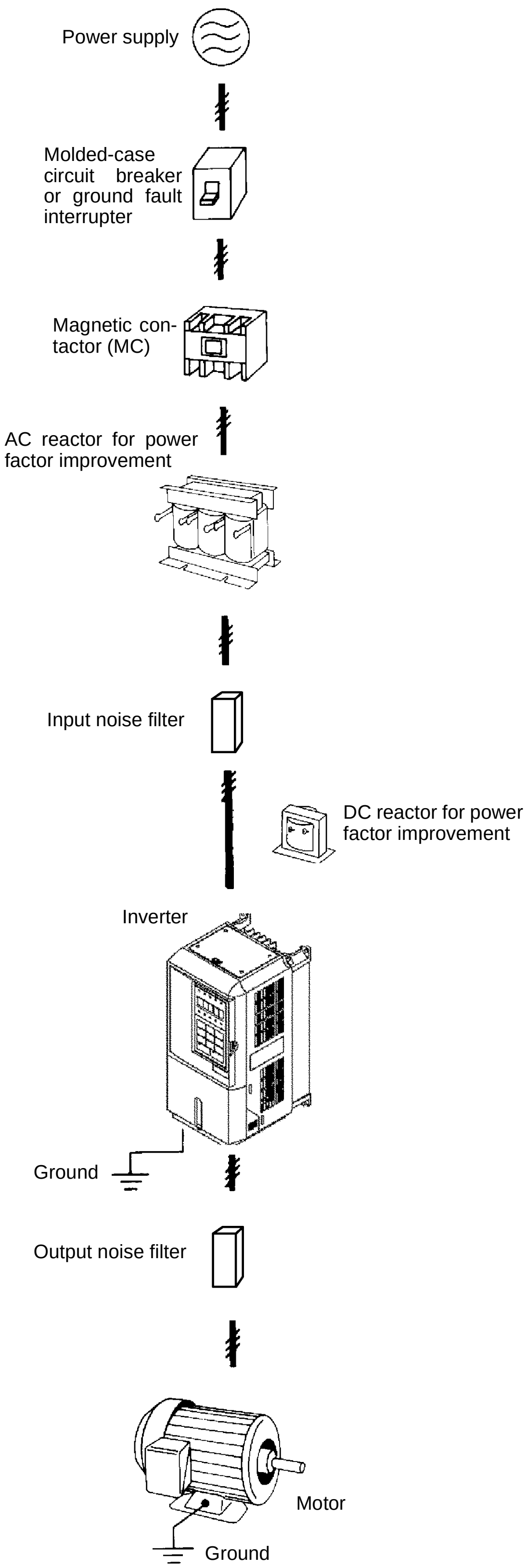


Fig 2.1 Example Connections to Peripheral Devices

Connection Diagram

The connection diagram of the Inverter is shown in *Fig 2.2*.

When using the Digital Operator, the motor can be operated by wiring only the main circuits.

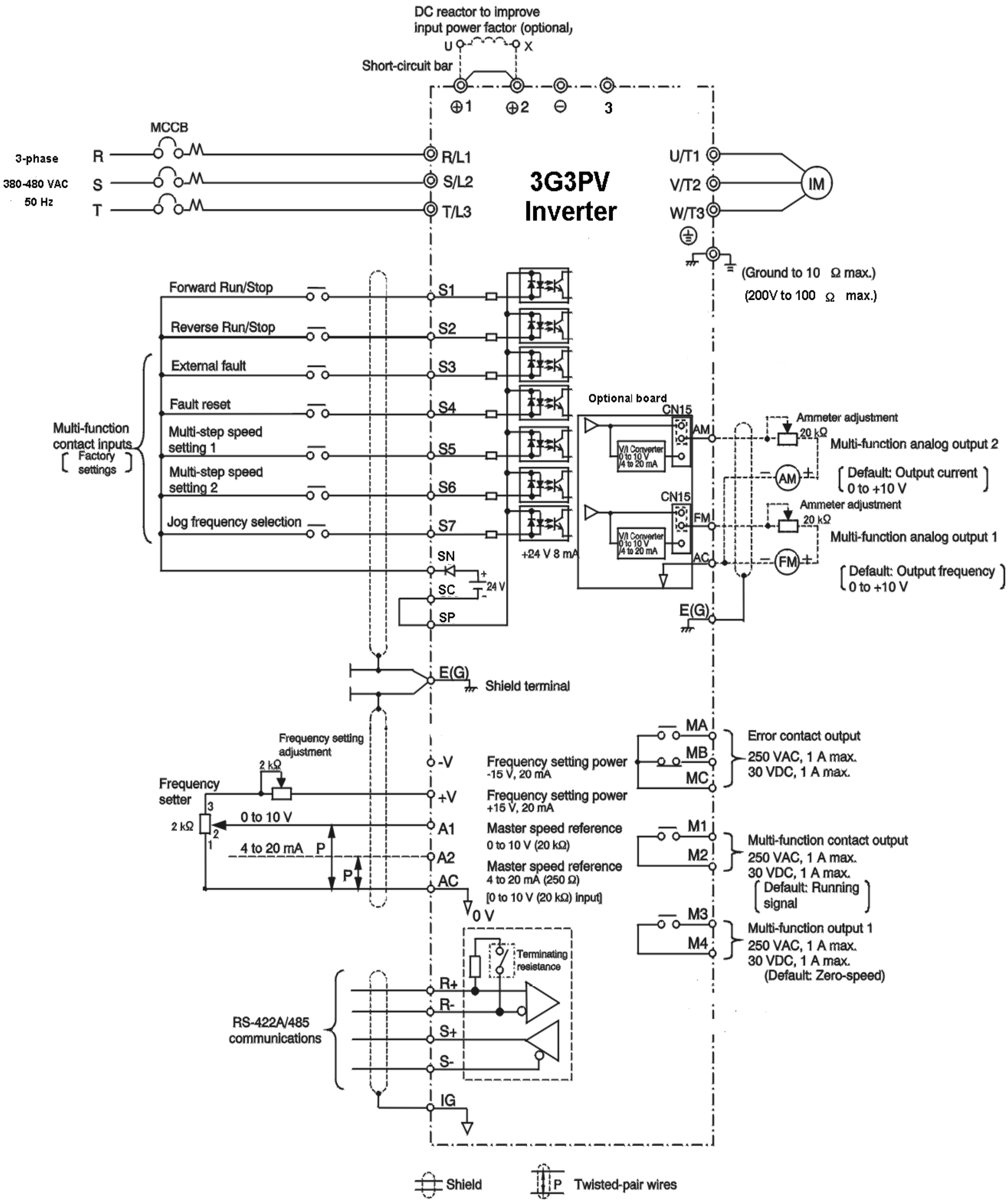
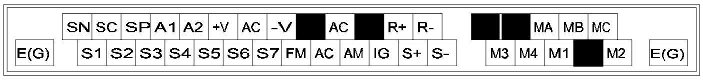


Fig 2.2 Connection Diagram

◆ Circuit Descriptions

IMPORTANT

1. Control circuit terminals are arranged as shown below.

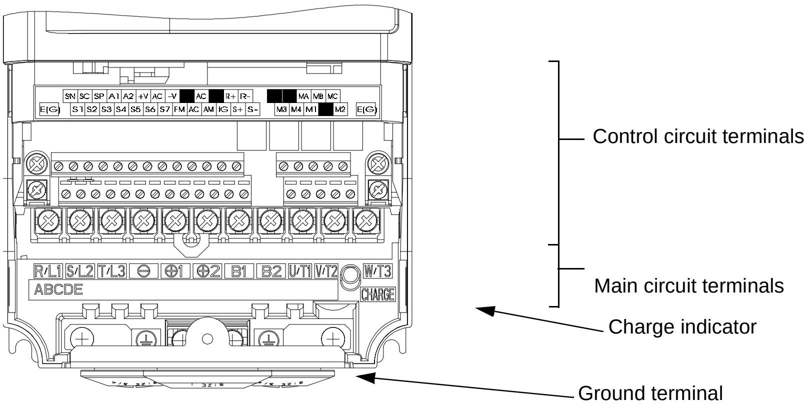


2. The output current capacity of the +V terminal is 20 mA.
3. Disable the stall prevention during deceleration (set parameter L3-04 to 0) when using a Braking Resistor Unit. If this user parameter is not changed to disable stall prevention, the system may not stop within deceleration time.
4. Main circuit terminals are indicated with double circles and control circuit terminals are indicated with single circles.
5. Sequence input signals S1 to S7 are labeled for sequence connections (0 V common and sinking mode) for no-voltage contacts or NPN transistors. These are the default settings.
   For PNP transistor sequence connections (+24V common and sourcing mode) or to provide a 24-V external power supply, refer to *Table 2.12*.
6. The master speed frequency reference can set to input either a voltage (terminal A1) or current (terminal A2) by changing the setting of parameter H3-13. The default setting is for a voltage reference input.
7. The multi-function analog output is a dedicated meter output for an analog frequency meter, current meter, voltmeter, wattmeter, etc. Do not use this output for feedback control or for any other control purpose.
8. DC reactors to improve the input power factor built into 200 V Class Inverters for 22 to 110 kW and 400 V Class Inverters for 22 to 160 kW. A DC reactor is thus an option only for Inverters for 18.5 kW or less. Remove the short bar when connecting a DC reactor to Inverters for 18.5 kW or less.
   Set parameter L8-01 to 1 when using an optional braking resistor unit and braking unit. When using this, a shutoff sequence for the power supply must be made using a thermal relay trip.

2

Terminal Block Configuration

The terminal arrangement for 200 V Class Inverters are shown in *Fig 2.3* and *Fig 2.4*.



note: B1 and B2 terminals are NOT USED in PV

Fig 2.3 Terminal Arrangement (200 V/400 V Class Inverter for 0.4 kW shown above)

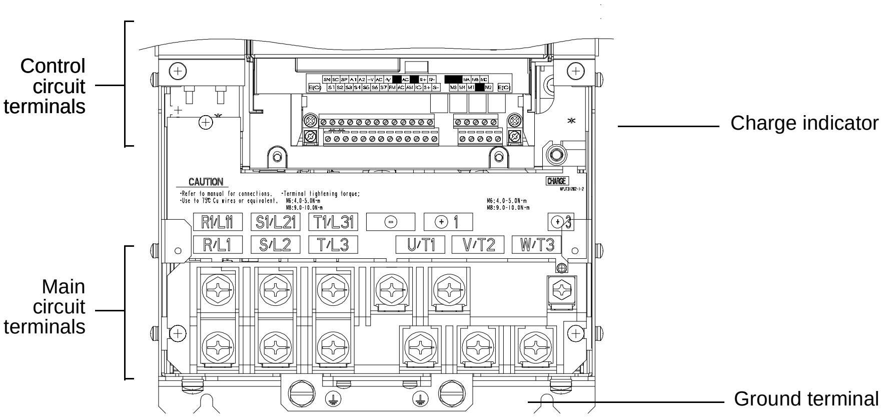


Fig 2.4 Terminal Arrangement (200 V/400 V Class Inverter for 22 kW)

Wiring Main Circuit Terminals

◆ Applicable Wire Sizes and Closed-loop Connector

Select the appropriate wires and crimp terminals from *Table 2.1* to *Table 2.3*. Refer to users manual (I526-E1-☐) for wire sizes for Braking Resistor Units and Braking Units.

Table 2.1 200 V Class Wire Sizes

Inverter Model 3G3PV-	Terminal Symbol	Termial Screws	Tightening Torque (N•m)	Possible Wire Sizes mm^2(AWG)	Recom-mended Wire Size mm^2 (AWG)	Wire Type
A2004-E	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	Power cables, e.g., 600 V vinyl power cables
	⏚					
A2007-E	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
	⏚					
A2015-E	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
	⏚					
A2022-E	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
	⏚					
A2037-E	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	3.5 to 5.5 (12 to 10)	3.5 (12)	
	⏚					
A2055-E	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	5.5 (10)	5.5 (10)	
	⏚					
A2075-E	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M5	2.5	8 to 14 (8 to 6)	8 (8)	
	⏚					
A2110-E	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M5	2.5	14 to 22 (6 to 4)	14 (6)	
	⏚					
A2150-E	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M6	4.0 to 5.0	30 to 38 (4 to 2)	30 (4)	
	⏚	M6	4.0 to 5.0	22 (4)	22 (4)	
A2185-E	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M8	9.0 to 10.0	30 to 38 (3 to 2)	30 (3)	
	⏚	M6	4.0 to 5.0	22 (4)	22 (4)	
A2220-E B2220-E	R/L1, S/L2, T/L3, ⊖, ⊕1, U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M8	9.0 to 10.0	30 to 60 (3 to 1)	30 (3)	
	⊕3	M6	4.0 to 5.0	8 to 22 (8 to 4)	-	
	⏚	M8	9.0 to 10.0	22 to 38 (4 to 2)	22 (4)	
A2300-E B2300-E	R/L1, S/L2, T/L3, ⊖, ⊕1 U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M8	9.0 to 10.0	50 to 60 (1 to 1/0)	50 (1)	
	⊕3	M6	4.0 to 5.0	8 to 22 (8 to 4)	-	
	⏚	M8	9.0 to 10.0	22 to 38 (4 to 2)	22 (4)	

Inverter Model 3G3PV-	Terminal Symbol	Termial Screws	Tightening Torque (N•m)	Possible Wire Sizes mm^2(AWG)	Recom-mended Wire Size mm^2 (AWG)	Wire Type
A2370-E B2370-E	R/L1, S/L2, T/L3, ⊖, ⊕1 U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M10	17.6 to 22.5	60 to 100 (2/0 to 4/0)	60 (2/0)	Power cables, e.g., 600 V vinyl power cables
	⊕3	M8	8.8 to 10.8	5.5 to 22 (10 to 4)	–	
	⏚	M10	17.6 to 22.5	30 to 60 (2 to 2/0)	30 (2)	
	r/l1, Δ/l2	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
A2450-E B2450-E	R/L1, S/L2, T/L3, ⊖, ⊕1 U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M10	17.6 to 22.5	80 to 100 (3/0 to 4/0)	80 (3/0)	
	⊕3	M8	8.8 to 10.8	5.5 to 22 (10 to 4)	–	
	⏚	M10	17.6 to 22.5	38 to 60 (1 to 2/0)	38 (1)	
	r/l1, Δ/l2	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
A2550-E B2550-E	R/L1, S/L2, T/L3, ⊖, ⊕1	M12	31.4 to 39.2	50 to 100 (1/0 to 4/0)	50 × 2P (1/0 × 2P)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M10	17.6 to 22.5	100 (4/0)	100 (4/0)	
	⊕3	M8	8.8 to 10.8	5.5 to 60 (10 to 2/0)	–	
	⏚	M10	17.6 to 22.5	30 to 60 (3 to 4/0)	50 (1/0)	
	r/l1, Δ/l2	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
A2750-E B2750-E	R/L1, S/L2, T/L3, ⊖, ⊕1	M12	31.4 to 39.2	80 to 125 (3/0 to 250)	80 × 2P (3/0 × 2P)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M10	17.6 to 22.5	80 to 100 (3/0 to 4/0)	80 × 2P (3/0 × 2P)	
	⊕3	M8	8.8 to 10.8	5.5 to 60 (10 to 2/0)	–	
	⏚	M10	17.6 to 22.5	100 to 200 (3/0 to 400)	100 (3/0)	
	r/l1, Δ/l2	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
A2900-E B2900-E	R/L1, S/L2, T/L3, ⊖, ⊕1	M12	31.4 to 39.2	150 to 200 (250 to 400)	150 × 2P (250 × 2P)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M12	31.4 to 39.2	100 to 150 (4/0 to 300)	100 × 2P (4/0 × 2P)	
	⊕3	M8	8.8 to 10.8	5.5 to 60 (10 to 2/0)	–	
	⏚	M12	31.4 to 39.2	60 to 150 (2/0 to 300)	60 × 2P (2/0 × 2P)	
	r/l1, Δ/l2	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
B211K	R/L1, S/L2, T/L3, ⊖, ⊕1	M12	31.4 to 39.2	200 to 325 (350 to 600)	200 × 2P or 50 × 4P (350 × 2P or 1/0 × 2P)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M12	31.4 to 39.2	150 to 325 (300 to 600)	150 × 2P or 50 × 4P (300 × 2P or 1/0 × 4P)	
	⊕3	M8	8.8 to 10.8	5.5 to 60 (10 to 2/0)	–	
	⏚	M12	31.4 to 39.2	150 (300)	150 × 2P (300 × 2P)	
	r/l1, Δ/l2	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	

* The wire thickness is set for copper wires at 75°C

Table 2.2 400 V Class Wire Sizes

Inverter Model 3G3PV-	Terminal Symbol	Terminal Screws	Tightening Torque (N•m)	Possible Wire Sizes mm^2 (AWG)	Recommended Wire Size mm^2 (AWG)	Wire Type
A4004-E	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	Power cables, e.g., 600 V vinyl power cables
	⏚					
A4007-E	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
	⏚					
A4015-E	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
	⏚					
A4022-E	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
	⏚					
A4037-E	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	3.5 (12)	
	⏚				2 (14)	
A4040-E	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	3.5 (12)	
	⏚				2 (14)	
A4055-E	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	3.5 to 5.5 (12 to 10)	3.5 (12)	
	⏚			2 to 5.5 (14 to 10)	2 (14)	
A4075-E	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M4	1.2 to 1.5	5.5(10)	5.5 (10)	
	⏚			3.5 to 5.5 (12 to 10)	3.5 (12)	
A4110-E	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M5	2.5	5.5 to 14 (10 to 6)	8 (8)	
	⏚				5.5 (10)	
A4150-E	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M5	2.5	8 to 14 (8 to 6)	8 (8)	
	⏚	M5 (M6)	2.5 (4.0 to 5.0)	5.5 to 14 (10 to 6)	5.5 (10)	
A4185-E	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M6	4.0 to 5.0	8 to 38 (8 to 2)	8 (8)	
	⏚	M6	4.0 to 5.0	8 to 22 (8 to 4)	8 (8)	
A4220-E B4220-E	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕3, U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M6	4.0 to 5.0	14 to 22 (6 to 4)	14 (6)	
	⏚	M8	9.0 to 10.0	14 to 38 (6 to 2)	14 (6)	
A4300-E B4300-E	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕3, U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M6	4.0 to 5.0	22 (4)	22 (4)	
	⏚	M8	9.0 to 10.0	22 to 38 (4 to 2)	22 (4)	
A4370-E B4370-E	R/L1, S/L2, T/L3, ⊖, ⊕1, U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M8	9.0 to 10.0	22 to 60 (4 to 1/0)	38 (2)	
	⊕3	M6	4.0 to 5.0	8 to 22 (8 to 4)	-	
	⏚	M8	9.0 to 10.0	22 to 38 (4 to 2)	22 (4)	

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Inverter Model 3G3PV-	Terminal Symbol	Terminal Screws	Tightening Torque (N•m)	Possible Wire Sizes mm^2 (AWG)	Recommended Wire Size mm^2 (AWG)	Wire Type
A4450-E B4450-E	R/L1, S/L2, T/L3, ⊖, ⊕1, U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M8	9.0 to 10.0	38 to 60 (2 to 1/0)	38 (2)	
	⊕3	M6	4.0 to 5.0	8 to 22 (8 to 4)	-	
	⏚	M8	9.0 to 10.0	22 to 38 (4 to 2)	22 (4)	
A4550-E B4550-E	R/L1, S/L2, T/L3, ⊖, ⊕1, U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M8	9.0 to 10.0	50 to 60 (1 to 1/0)	50 (1)	
	⊕3	M6	4.0 to 5.0	8 to 22 (8 to 4)	-	
	⏚	M8	9.0 to 10.0	22 to 38 (4 to 2)	22 (4)	
A4750-E B4750-E	R/L1, S/L2, T/L3, ⊖, ⊕1	M12	31.4 to 39.2	60 to 100 (2/0 to 4/0)	60 (2/0)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M10	17.6 to 22.5	50 to 100 (1/0 to 4/0)	50 (1/0)	
	⊕3	M8	8.8 to 10.8	5.5 to 22 (10 to 4)	-	
	⏚	M12	31.4 to 39.2	38 to 60 (2 to 2/0)	38 (2)	
	r/l1, Δ200/$_{l2}$200, Δ400/$_{l2}$400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
A4900-E B4900-E	R/L1, S/L2, T/L3, ⊖, ⊕1	M12	31.4 to 39.2	80 to 100 (3/0 to 4/0)	100 (4/0)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M10	17.6 to 22.5	80 to 100 (3/0 to 4/0)	100 (4/0)	
	⊕3	M8	8.8 to 10.8	8 to 22 (8 to 4)	-	
	⏚	M12	31.4 to 39.2	50 to 100 (1 to 4/0)	50 (1)	
	r/l1, Δ200/$_{l2}$200, Δ400/$_{l2}$400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
A411K-E B411K-E	R/L1, S/L2, T/L3, ⊖, ⊕1	M12	31.4 to 39.2	50 to 100 (1/0 to 4/0)	50 × 2P (1/0 × 2P)	Power cables, e.g., 600 V vinyl power cables
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L33	M12	31.4 to 39.2	50 to 100 (1/0 to 4/0)	50 × 2P (1/0 × 2P)	
	⊕3	M8	8.8 to 10.8	8 to 60 (8 to 2/0)	-	
	⏚	M12	31.4 to 39.2	60 to 150 (2/0 to 300)	600 (2/0)	
	r/l1, Δ200/$_{l2}$200, Δ400/$_{l2}$400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
A413K-E B413K-E	R/L1, S/L2, T/L3, ⊖, ⊕1	M12	31.4 to 39.2	80 to 100 (3/0 to 4/0)	80 × 2P (3/0 × 2P)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L33	M12	31.4 to 39.2	60 to 100 (2/0 to 4/0)	60 × 2P (2/0 × 2P)	
	⊕3	M8	8.8 to 10.8	8 to 60 (8 to 2/0)	-	
	⏚	M12	31.4 to 39.2	100 to 150 (4/0 to 300)	100 (4/0)	
	r/l1, Δ200/$_{l2}$200, Δ400/$_{l2}$400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
A416K-E B416K-E	R/L1, S/L2, T/L3, ⊖, ⊕1	M12	31.4 to 39.2	100 to 200 (4/0 to 400)	100 × 2P (4/0 × 2P)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L33	M12	31.4 to 39.2	80 to 200 (3/0 to 400)	80 × 2P (3/0 × 2P)	
	⊕3	M8	8.8 to 10.8	80 to 60 (8 to 2/0)	-	
	⏚	M12	31.4 to 39.2	50 to 150 (1/0 to 300)	50 × 2P (1/0 × 2P)	
	r/l1, Δ200/$_{l2}$200, Δ400/$_{l2}$400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	

* The wire thickness is set for copper wires at 75°C.

Table 2.3 Closed-loop Connector Sizes (JIS C2805) (200 V Class and 400 V Class)

Wire Thickness (mm^2)	Terminal Screws	Size
0.5	M3.5	1.25 to 3.5
	M4	1.25 to 4
0.75	M3.5	1.25 to 3.5
	M4	1.25 to 4
1.25	M3.5	1.25 to 3.5
	M4	1.25 to 4
2	M3.5	2 to 3.5
	M4	2 to 4
	M5	2 to 5
	M6	2 to 6
	M8	2 to 8
3.5/5.5	M4	5.5 to 4
	M5	5.5 to 5
	M6	5.5 to 6
	M8	5.5 to 8
8	M5	8 to 5
	M6	8 to 6
	M8	8 to 8
14	M6	14 to 6
	M8	14 to 8
22	M6	22 to 6
	M8	22 to 8
30/38	M8	38 to 8
50/60	M8	60 to 8
	M10	60 to 10
80	M10	80 to 10
100		100 to 10
100	M12	100 to 12
150		150 to 12
200		200 to 12
325	M12 x 2	325 to 12
	M16	325 to 16

IMPORTANT

Determine the wire size for the main circuit so that line voltage drop is within 2% of the rated voltage. Line voltage drop is calculated as follows:

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

◆ Main Circuit Terminal Functions

Main circuit terminal functions are summarized according to terminal symbols in *Table 2.4*. Wire the terminals correctly for the desired purposes.

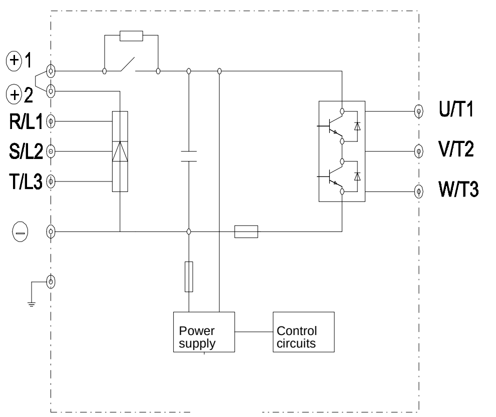
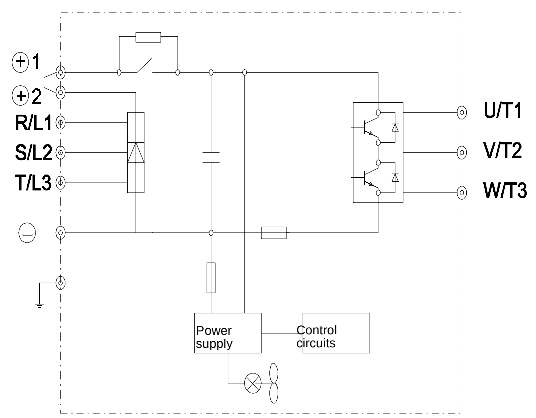
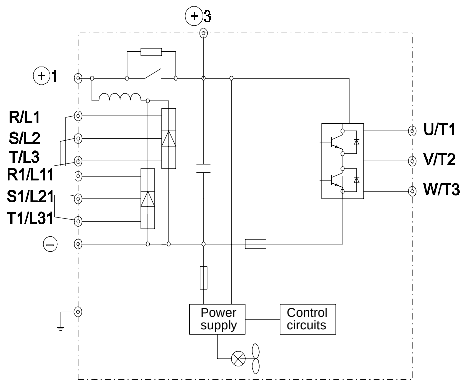
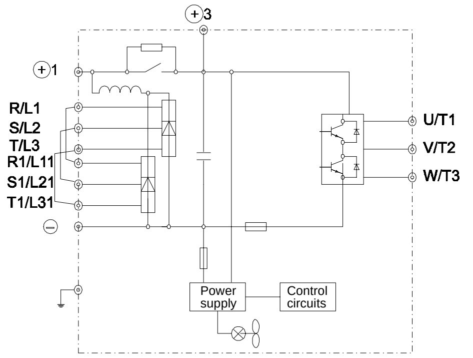
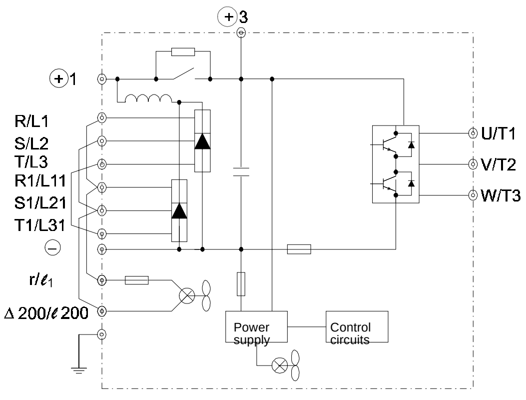
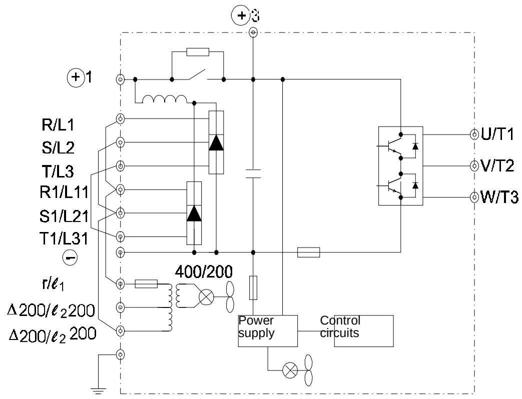
Table 2.4 Main Circuit Terminal Functions (200 V Class and 400 V Class)

Purpose	Terminal Symbol	Model: 3G3PV-	
		200 V Class	400 V Class
Main circuit power input	R/L1, S/L2, T/L3	A2004-E to A2900-E	A4004-E to A416K-E
		B2220-E to B211K-E	B4220-E to B416K-E
	R1/L11, S1/L21, T1/L31	A2220-E to A2900-E	A4220-E to A416K-E
		B2220-E to B211K-E	B4220-E to B416K-E
Inverter outputs	U/T1, V/T2, W/T3	A2004-E to A2900-E	A4004-E to A416K-E
		B2220-E to B211K-E	B4220-E to B416K-E
DC power input	⊕1, ⊖	A2004-E to A2900-E	A4004-E to A416K-E
		B2220-E to B211K-E	B4220-E to B416K-E
DC reactor connection	⊕1, ⊕2	A2004-E to A2185-E	A4004-E to A4185-E
Braking Unit connection	⊕3, ⊖	A2200-E to A2900-E	A4220-E to A416K-E
		B2220-E to B211K-E	B4220-E to B416K-E
Ground	⏚	A2004-E to A2900-E	A4004-E to A416K-E
		B2220-E to B211K-E	B4220-E to B416K-E

◆ Main Circuit Configurations

The main circuit configurations of the Inverter are shown in *Fig 2.5*.

Table 2.5 Inverter Main Circuit Configurations

200 V Class	400 V Class
3G3PV-A2004-E to A2185-E 	3G3PV-A4004-E to A4185-E 
3G3PV-A2220-E,A2300-E 3G3PV-B2220-E,B2300-E 	3G3PV-A4220-E to A4550-E 3G3PV-B4220-E to B4550-E 
3G3PV-A2370-E to A2900-E 3G3PV-B2370-E to B211K-E 	3G3PV-A4750-E to A416K-E 3G3PV-B4750-E to B416K-E 

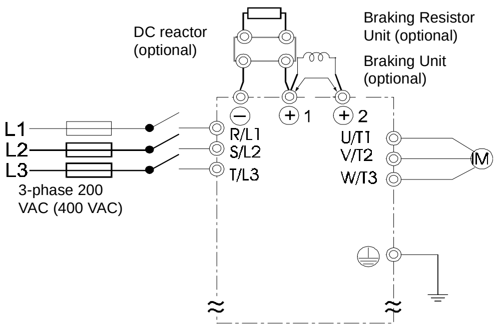
Note 1. Consult your OMRON representative before using 12-phase rectification.

2

◆ Standard Connection Diagrams

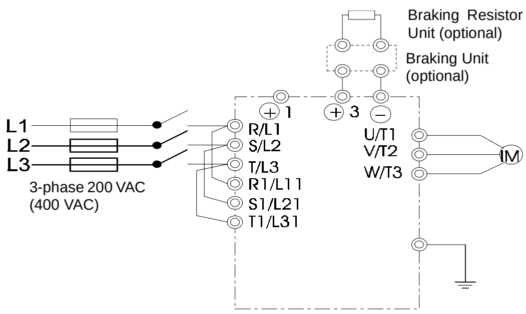
Standard Inverter connection diagrams are shown in *Fig 2.5*. These are the same for both 200 V Class and 400 V Class Inverters. The connections depend on the Inverter capacity.

3G3PV-A2004-E to A2185-E,A4004-E toA4185-E



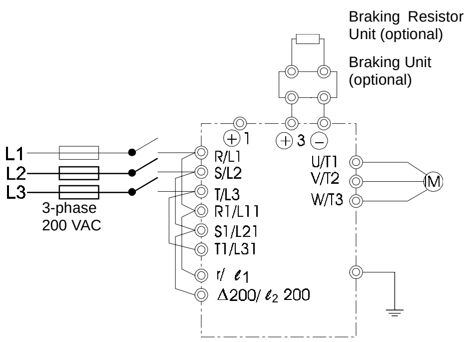
Be sure to remove the short-circuit bar before connecting the DC reactor.

3G3PV-A2220-E, A2300-E, A4220-E to A4550-E
3G3PV-B2220-E, B2300-E, B4220-E to B4550-E

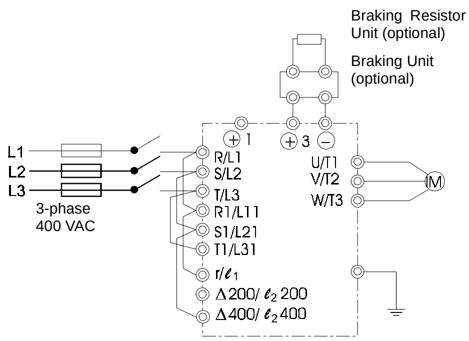


The DC reactor is built in.

3G3PV-A2370-E to A2900-E
3G3PV-B2370-E to B211K-E



3G3PV-A4750-E to A416K-E
3G3PV-B4750-E to B416K-E



Control power is supplied internally from the main circuit DC power supply for all Inverter models.

Fig 2.5 Main Circuit Terminal Connections

◆ Wiring the Main Circuits

This section describes wiring connections for the main circuit inputs and outputs.

■Wiring Main Circuit Inputs

Observe the following precautions for the main circuit power supply input.

Installing Fuses

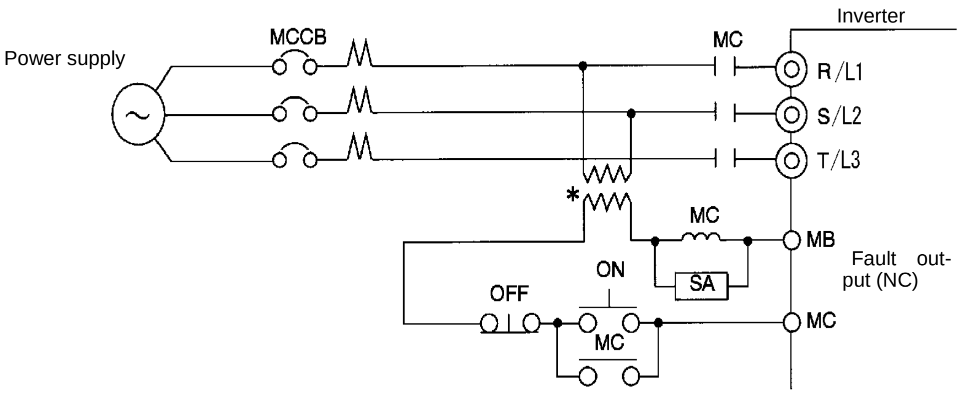
Table 2.6 Input Fuses

Inverter Type (3G3PV-)	FUSE		
	Voltage (V)	Current (A)	I^2t (A^2s)
A2004-E	240	10	12~25
A2007-E	240	10	12~25
A2015-E	240	15	23~55
A2020-E	240	20	34~98
A2037-E	240	30	82~220
A2055-E	240	40	220~610
A2075-E	240	60	290~1300
A2110-E	240	80	450~5000
A2150-E	240	100	1200~7200
A2185-E	240	130	1800~7200
A/B2200-E	240	150	870~16200
A/B2300-E	240	180	1500~23000
A/B2370-E	240	240	2100~19000
A/B2450-E	240	300	2700~55000
A/B2550-E	240	350	4000~55000
A/B2750-E	240	450	7100~64000
A/B2900-E	240	550	11000~64000
B211K-E	240	600	13000~83000
A4004-E	480	5	6~55
A4007-E	480	5	6~55
A4015-E	480	10	10~55
A4020-E	480	10	18~55
A4037-E	480	15	34~72
A4040-E	480	20	50~570
A4055-E	480	25	100~570
A4075-E	480	30	100~640
A4110-E	480	50	150~1300
A4150-E	480	60	400~1800
A4185-E	480	70	700~4100
A/B4200-E	480	80	240~5800
A/B4300-E	480	100	500~5800
A/B4370-E	480	125	750~5800
A/B4450-E	480	150	920~13000
A/B4550-E	480	150	1500~13000
A/B4750-E	480	250	3000~55000
A/B4900-E	480	300	3800~55000
A/B411K-E	480	350	5400~23000
A/B413K-E	480	400	7900~64000
A/B416K-E	480	450	14000~250000

Installing a Molded-case Circuit Breaker

When connecting the power input terminals (R/L1, S/L2 and T/L3) and power supply via a molded-case circuit breaker (MCCB) observe that the circuit breaker is suitable for the Inverter.

- Choose an MCCB with a capacity of 1.5 to 2 times the Inverter's rated current.
- For the MCCB's time characteristics, be sure to consider the Inverter's overload protection (one minute at 120% of the rated output current).
- If the same MCCB is to be used for more than one Inverter, or other devices, set up a sequence, that the powersupply will be turned OFF by a fault output, as shown below.



* For 400-V class Inverters, connect a 400/200-V transformer.

Fig 2.6 MCCB Installation

Installing a Ground Fault Interrupter

Inverter outputs use high-speed switching, so high-frequency leakage current is generated. Therefore, at the Inverter primary side, use a ground fault interrupter to detect only the leakage current in the frequency range that is hazardous to humans and exclude high-frequency leakage current.

- For the special-purpose ground fault interrupter for Inverters, choose a ground fault interrupter with a sensitivity amperage of at least 10 mA per Inverter.
- When using a general ground fault interrupter, choose a ground fault interrupter with a sensitivity amperage of 200 mA or more per Inverter and with an operating time of 0.1 s or more.

Installing a Magnetic Contactor

If the power supply for the main circuit is to be shut off during a sequence, a magnetic contactor can be used.

When a magnetic contactor is installed on the primary side of the main circuit to forcibly stop the Inverter, however, the regenerative braking does not work and the Inverter will coast to stop.

- The Inverter can be started and stopped by opening and closing the magnetic contactor on the primary side. Frequently opening and closing the magnetic contactor, however, may cause the Inverter to break down. Start and stop the Inverter at most once every 30 minutes.
- When the Inverter is operated with the Digital Operator, automatic operation cannot be performed after recovery from a power interruption.
- If a Braking Unit and a Braking Resistor Unit are used, program the sequence so that the magnetic contactor is turned OFF by the contact of the Braking Resistor Unit's thermal overload relay.

Connecting Input Power Supply to the Terminal Block

Input power supply can be connected to any terminal R, S or T on the terminal block; the phase sequence of input power supply is irrelevant to the phase sequence.

Installing an AC Reactor

If the Inverter is connected to a large-capacity power transformer (600 kW or more) or the phase advancing capacitor is switched, an excessive peak current may flow through the input power circuit, causing the converter unit to break down.

To prevent this, install an optional AC Reactor on the input side of the Inverter or a DC reactor to the DC reactor connection terminals (for units from 22 kW the DC reactor is standard).

This also improves the power factor on the power supply side.

Installing a Surge Absorber

Always use a surge absorber or diode for inductive loads near the Inverter. These inductive loads include magnetic contactors, electromagnetic relays, solenoid valves, solenoids and magnetic brakes.

Installing a Noise Filter on Power Supply Side

Install a noise filter to eliminate noise transmitted between the power line and the Inverter.

- Correct Noise Filter Installation

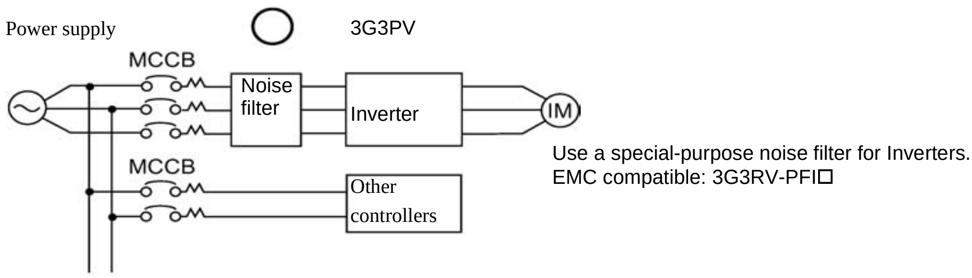
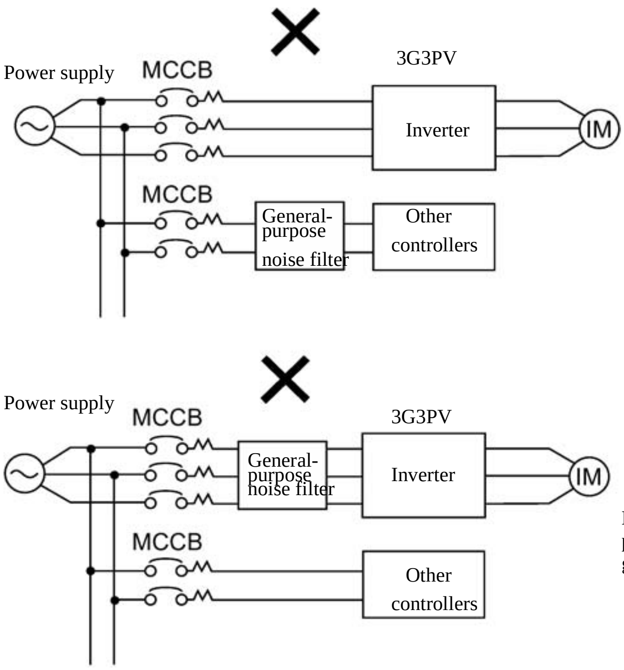


Fig 2.7 Correct Power supply Noise Filter Installation.

- Incorrect Noise Filter Installation



Do not use general-purpose noise filters. No general purpose noise filter can effectively suppress noise generated from the Inverter.

Fig 2.8 Incorrect Power supply Noise filter Installation.

■Wiring the Output Side of Main Circuit

Observe the following precautions when wiring the main output circuits.

Connecting the Inverter and Motor

Connect output terminals U/T1, V/T2 and W/T3 to motor lead wires U, V and W, respectively.

Check that the motor rotates forward with the forward run command. Switch over any two of the output terminals to each other and reconnect if the motor rotates in reverse with the forward run command.

Never Connect a Power Supply to Output Terminals

Never connect a power supply to output terminals U/T1, V/T2 and W/T3. If voltage is applied to the output terminals, the internal circuits of the Inverter will be damaged.

Never Short or Ground Output Terminals

If the output terminals are touched with bare hands or the output wires come into contact with the Inverter casing, an electric shock or grounding will occur. This is extremely hazardous. Do not short the output wires.

Do Not Use a Phase Advancing Capacitor or Noise Filter

Never connect a phase advancing capacitor or LC/RC noise filter to an output circuit. The high-frequency components of the Inverter output may result in overheating or damage to these part or may result in damage to the Inverter or cause other parts to burn.

Do Not Use an Electromagnetic Switch

Never connect an electromagnetic switch (MC) between the Inverter and motor and turn it ON or OFF during operation. If the MC is turned ON while the Inverter is operating, a large inrush current will be caused and the overcurrent protection in the Inverter will operate.

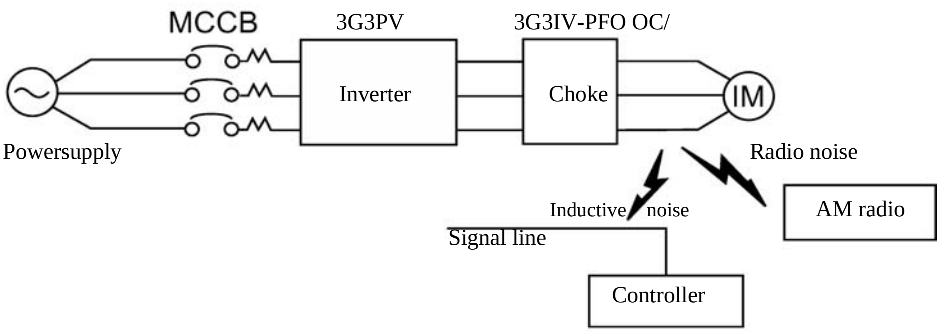
When using an MC to switch to a commercial power supply, stop the Inverter and motor before operating the MC. Use the speed search function if the MC is operated during operation. If measures for momentary power interrupts are required, use a delayed release MC.

Installing a Thermal Overload Relay

This Inverter has an electronic thermal protection function to protect the motor from overheating. If, however, more than one motor is operated with one Inverter or a multi-polar motor is used, always install a thermal relay (THR) between the Inverter and the motor and set L1-01 to 0 (no motor protection). The sequence should be designed so that the contacts of the thermal overload relay turn OFF the magnetic contactor on the main circuit inputs.

Installing a Noise Filter on Output Side

Connect a noise filter to the output side of the Inverter to reduce radio noise and inductive noise.



Inductive noise: Electromagnetic induction generates noise on the signal line, causing the controller to malfunction.
Radio noise: Electromagnetic waves from the Inverter and cables cause the broadcasting radio receiver to make noise.

Fig 2.9 Installing a noise filter on the output side

Countermeasures against Inductive Noise

As described previously, a noise filter can be used to prevent inductive noise from being generated on the output side of the Inverter. Alternatively, cables can be routed through a grounded metal pipe to prevent inductive noise. Keeping the metal pipe at least 30 cm away from the signal line considerably reduces inductive noise.

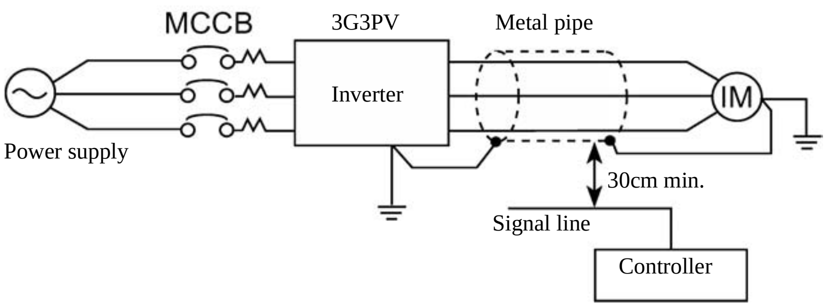


Fig 2.10 Countermeasures against Inductive noise

Countermeasures Against Radio Interference

Radio noise is generated from the Inverter as well as from the input and output lines. To reduce radio noise, install noise filters on both, input and output, sides and also install the Inverter in a totally enclosed steel box.

The cable between the Inverter and the motor should be as short as possible.

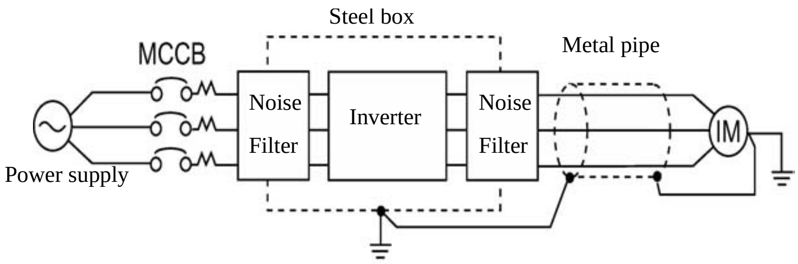


Fig 2.11 Countermeasures against Radio Interference

Cable Length between Inverter and Motor

If the cable between the Inverter and the motor is long, the high-frequency leakage current will increase, causing the Inverter output current to increase as well. This may affect peripheral devices. To prevent this, adjust the carrier frequency (set in C6-02) as shown in *Table 2.7*. (For details, refer to *Chapter 5 Parameter Tables.)*

Table 2.7 Cable Length between Inverter and Motor

Cable length	50 m max.	100 m max.	More than 100 m
Carrier frequency	15 kHz max.	10 kHz max.	5 kHz max.

■Ground Wiring

Observe the following precautions when wiring the ground line.

- Always use the ground terminal of the 200 V Inverter with a ground resistance of less than 100 Ω and that of the 400 V Inverter with a ground resistance of less than 10 Ω.
- Do not share the ground wire with other devices, such as welding machines or power tools.
- Always use a ground wire that complies with technical standards on electrical equipment and minimize the length of the ground wire.
  Leakage current flows through the Inverter. Therefore, if the distance between the ground electrode and the ground terminal is too long, potential on the ground terminal of the Inverter will become unstable.
- When using more than one Inverter, be careful not to loop the ground wire.

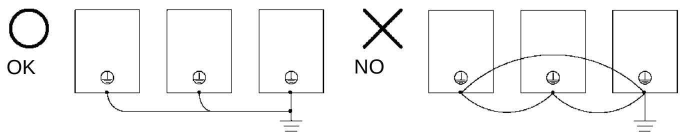


Fig 2.12 Ground Wiring

Wiring Control Circuit Terminals

◆ Wire Sizes

For remote operation using analog signals, keep the control line length between the Analog Operator or operation signals and the Inverter to 50 m or less and separate the lines from high-power lines (main circuits or relay sequence circuits) to reduce induction from peripheral devices.

When setting frequencies from an external frequency setter (and not from a Digital Operator), used shielded twisted-pair wires and ground the shield to terminal E (G), as shown in the following diagram.

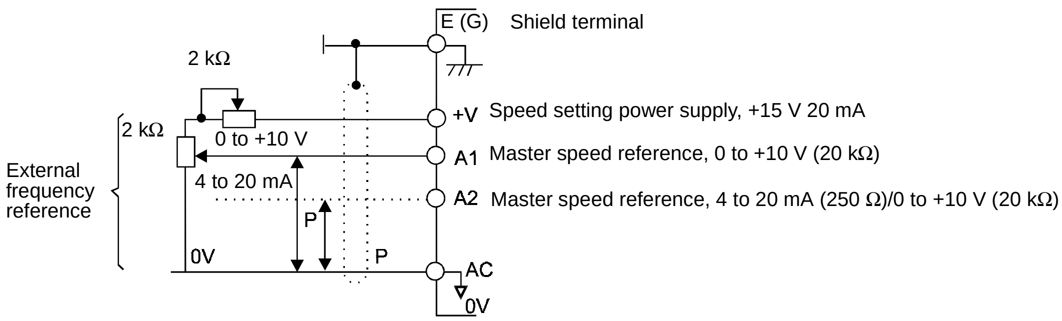


Fig 2.13

Terminal numbers and wire sizes are shown in *Table 2.8.*

Table 2.8 Terminal Numbers and Wire Sizes

Terminals	Terminal Screws	Tightening Torque (N•m)	Possible Wire Sizes mm^2(AWG)	Recommended Wire Size mm^2(AWG)	Wire Type
FM, AC, AM, A1, A2, +V, –V, SN, SC, SP, S1, S2, S3, S4, S5, S6, S7, MA, MB, MC, M1, M2, M3, M4 R+, R-, S+, S-, IG	Phoenix type	0.5 to 0.6	Single wire*3: 0.14 to 2.5 Stranded wire: 0.14 to 1.5 (26 to 14)	0.75 (18)	• Shielded, twisted-pair wire*1 • Shielded, polyethylene-covered, vinyl sheath cable (KPEV-S by Hitachi Electrical Wire or equivalent)
E (G)	M3.5	0.8 to 1.0	0.5 to 2*2 (20 to 14)	1.25 (12)	

* 1. Use shielded twisted-pair cables to input an external frequency reference.
* 2. Refer to *Table 2.3 Close-loop Connector Sizes* (JIS C2805, 200-V and 400-V class) for suitable closed-loop crimp terminal sizes for the wires.
* 3. We recommend using straight solderless terminal on signal lines to simplify wiring and improve reliability.

■ Straight Solderless Terminals for Signal Lines

Models and sizes of straight solderless terminal are shown in the following table.

Table 2.9 Straight Solderless Terminal Sizes

Wire Size mm^2 (AWG)	Model	d1	d2	L	Manufacturer
0.25 (24)	AI 0.25 - 8YE	0.8	2	12.5	Phoenix Contact
0.5 (20)	AI 0.5 - 8WH	1.1	2.5	14	
0.75 (18)	AI 0.75 - 8GY	1.3	2.8	14	
1.25 (16)	AI 1.5 - 8BK	1.8	3.4	14	
2 (14)	AI 2.5 - 8BU	2.3	4.2	14	

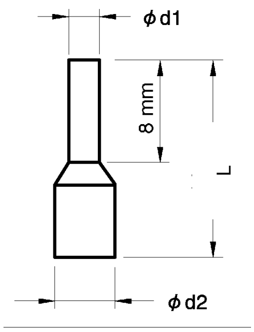


Fig 2.14 Straight Solderless Terminal Sizes

■ Wiring Method

Use the following procedure to connect wires to the terminal block.

1. Loosen the terminal screws with a thin-slot screwdriver.
2. Insert the wires from underneath the terminal block.
3. Tighten the terminal screws firmly.

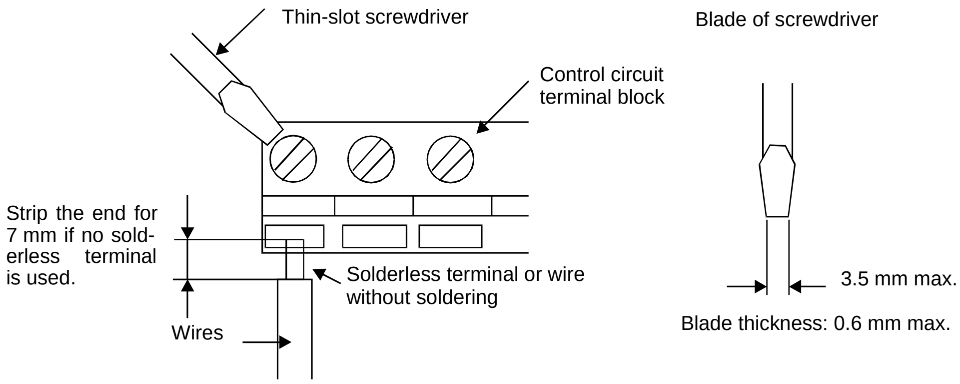


Fig 2.15 Connecting Wires to Terminal Block

◆ Control Circuit Terminal Functions

The functions of the control circuit terminals are shown in *Table 2.10*. Use the appropriate terminals for the correct purposes.

Table 2.10 Control Circuit Terminals

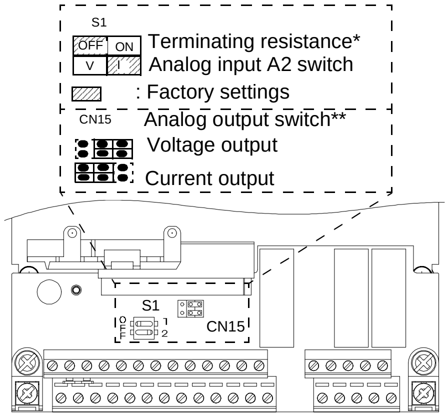
Type	No.	Signal Name	Function		Signal Level
Sequence input signals	S1	Forward run/stop command	Forward run when ON; stopped when OFF.		24 VDC, 8 mA Photo coupler isolation
	S2	Reverse run/stop command	Reverse run when ON; stopped when OFF.		
	S3	External fault input[*1]	Fault when ON.	Functions are selected by setting H1-01 to H1-05.	
	S4	Fault reset[*]	Reset when ON		
	S5	Multi-step speed reference 1[*1] (Master/auxiliary switch)	Auxiliary frequency reference when ON.		
	S6	Multi-step speed reference 2[*1]	Multi-step setting 2 when ON.		
	S7	Jog frequency reference[*1]	Jog frequency when ON.		
	SC	Sequence input common	–		–
Analog input signals	+V	15 V power output	15 V power supply for analog references		15 V (Max. current: 20 mA)
	–V	–15 V power output	not used		–15 V (Max. current: 20 mA)
	A1	Frequency reference	0 to +10 V/100%		0 to +10 V(20 kΩ)
	A2	Multi-function analog input	4 to 20 mA/100% 0 to +10 V/100%	Function is selected by setting H3-09.	4 to 20 mA(250Ω) 0 to +10 V(20kΩ)
	AC	Analog reference common	–		–
	E(G)	Shield wire, optional ground line connection point	–		–
Sequence output signals	M1	Running signal (1Normally Open contact)	Operating when ON.	Multi-function contact outputs	Dry contacts Contact capacity: 1 A max. at 250 VAC 1 A max. at 30 VDC
	M2				
	M3	Zero speed	Zero level (b2-01) or below, when ON		
	M4				
	MA	Fault output signal	Fault when CLOSED across MA and MC Fault when OPEN across MB and MC		Dry contacts Contact capacity: 1 A max. at 250 VAC 1 A max. at 30 VDC
	MB				
	MC				
Analog output signals	FM	Multi-function analog output (frequency output)	0 to +10 V/100% frequency maximum	Multi-function analog monitor 1	0 to +10 V max. ±5% 2 mA max.
	AC	Analog common	–		
	AM	Multi-function analog output (current monitor)	5 V/Inverter's rated current	Multi-function analog monitor 2	
RS-485/422	R+	communications input	For 2-wire RS-485, short R+ and S+ as well as R- and S-.		Differential input, PHC isolation
	R-				
	S+	communications output			Differential input, PHC isolation
	S-				
	IG	Signal common	-		-

2

* 1. The default settings are given for terminals S3 to S7. For a 3-wire sequence, the default settings are a 3-wire sequence for S5, multi-step speed setting 1 for S6 and multi-step speed setting 2 for S7.

■DIP Switch S1 and Shunt Connector CN15

The DIP switch S1 and shunt connector CN 15 of the optional terminal board (3G3PV-PETC618120) are described in this section.
For the standard terminal board only DIP switch S1 is present.



* Note: Refer to *Table 2.11* for S1 functions.
**Note: CN15 is not available at the standard terminal board.
An optional terminal board with CN15 Shunt Connector is available.
The standard setting is voltage output.

Fig 2.16 DIP Switch S1 and Shunt Connector CN15

The functions of DIP switch S1 are shown in the following table.

Table 2.11 DIP Switch S1

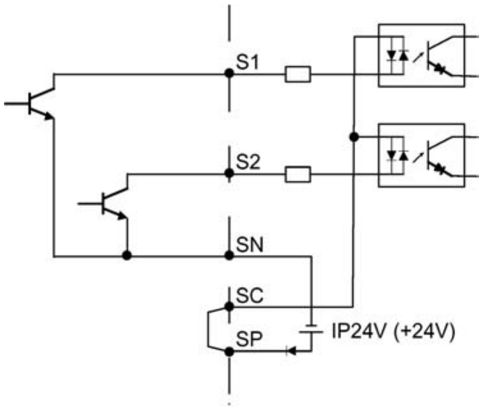
Name	Function	Setting
S1-1	RS-485 and RS-422 terminating resistance	OFF: No terminating resistance ON: Terminating resistance of 110 Ω
S1-2	Input method for analog input A2	OFF: 0 to 10 V (internal resistance: 20 kΩ) ON: 4 to 20 mA (internal resistance: 250 Ω)

■ Sinking/Sourcing Mode

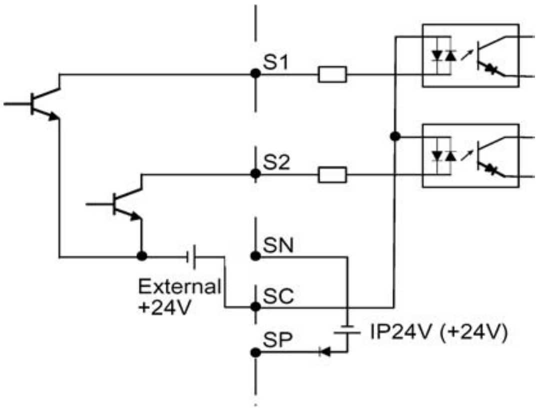
The input terminal logic can be switched between sinking mode (0-V common) and sourcing mode (+24V common) by using the terminals SN, SC and SP. An external power supply is also supported, providing more freedom in signal input methods.

Table 2.12 Sinking/Sourcing Mode and Input Signals

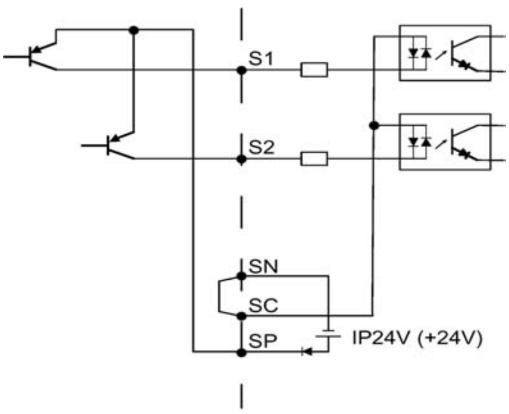
Internal Power Supply – Sinking Mode



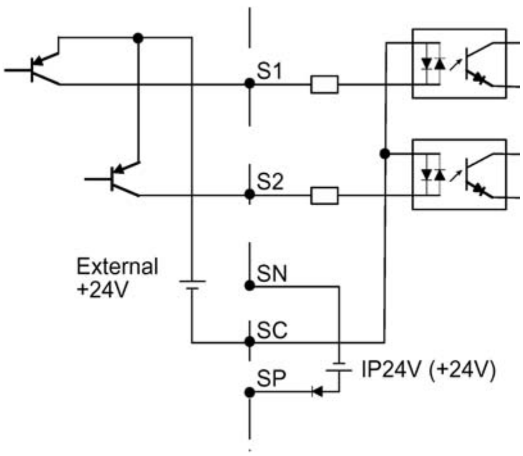
External Power Supply – Sinking Mode



Internal Power Supply – Sourcing Mode



External Power Supply – Sourcing Mode



2

◆ Control Circuit Terminal Connections

Connections to Inverter control circuit terminals are shown in *Fig 2.17*.

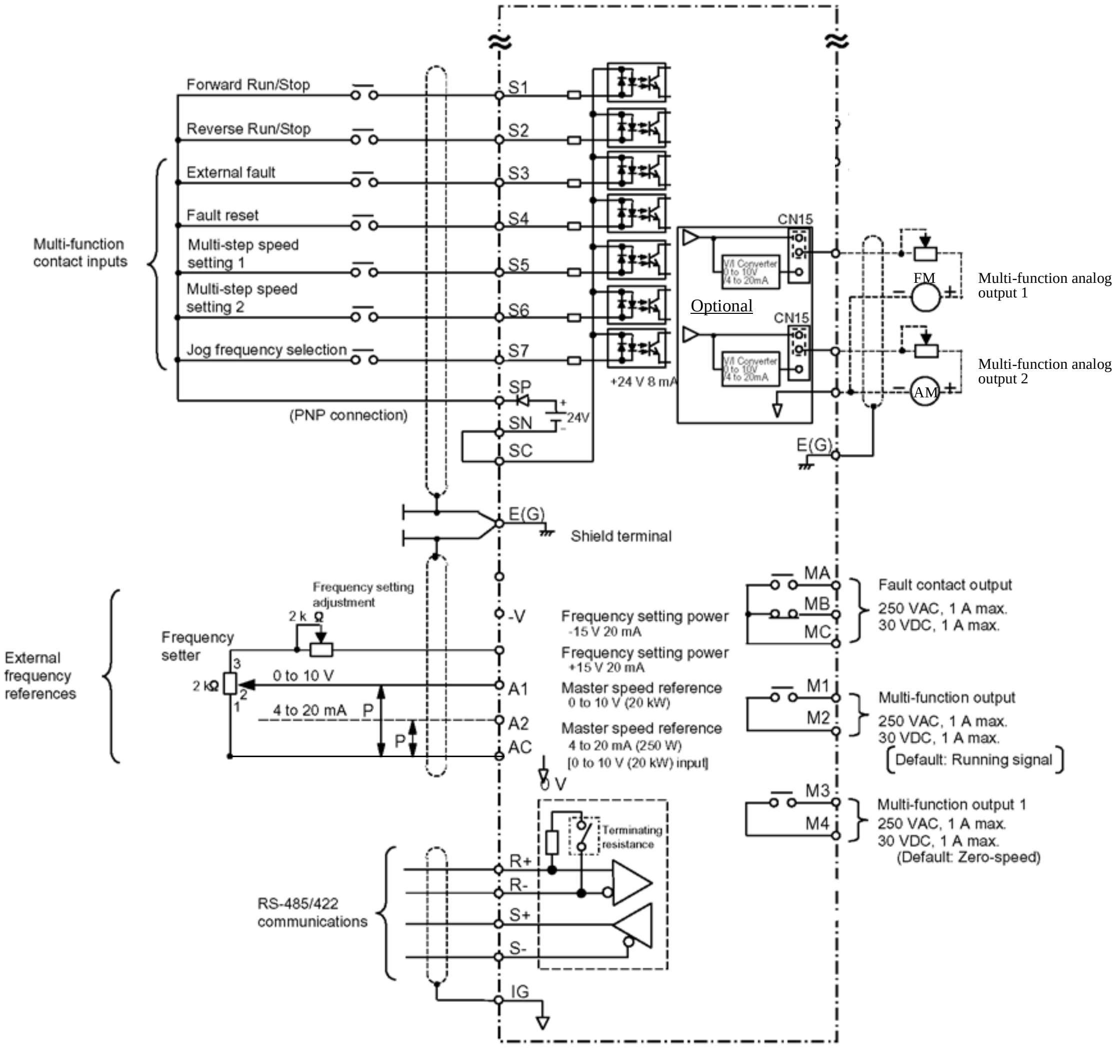


Fig 2.17 Control Circuit Terminal Connections

◆ Control Circuit Wiring Precautions

Observe the following precautions when wiring control circuits.

- Separate control circuit wiring from main circuit wiring (terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, ⊖, ⊕1, ⊕2 and ⊕3) and other high-power lines.
- Separate wiring for control circuit terminals MA, MB, MC, M1, M2, M3 and M4 (contact outputs) from wiring to other control circuit terminals.
- If using an optional external power supply, it shall be a UL Listed Class 2 power supply source.
- Use twisted-pair or shielded twisted-pair cables for control circuits to prevent operating faults. Process cable ends as shown in *Fig 2.18*.
- Connect the shield wire to terminal E (G).
- Insulate the shield with tape to prevent contact with other signal lines and equipment.

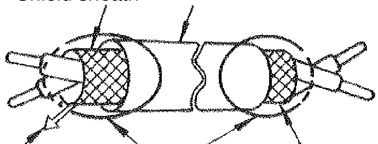


Fig 2.18 Processing the Ends of Twisted-pair Cables

Wiring Check

◆ Checks

Check all wiring after wiring has been completed. Do not perform a buzzer check on control circuits. Perform the following checks on the wiring.

- Is all wiring correct?
- Have any wire clippings, screws or other foreign material been left?
- Are all screws tight?
- Are any wire ends contacting other terminals?

Installing and Wiring Option Cards

◆ Option Card Models and Specifications

One Option Card can be mounted in the Inverter as shown in *Fig 2.19*.

Table 2.13 lists the type of Option Cards and their specifications.

Table 2.13 Option Card and their Specifications

Card	Model	Specifications	Mounting Location
Device Net Communications Card	3G3FV-PDRT1-SIN	DeviceNet communications support	Slot C

◆ Installation

Before mounting an Option Card, remove the terminal cover and be sure that the charge indicator inside the Inverter is not lit. After confirming that the charge indicator is not lit, remove the Digital Operator and front cover and then mount the Option Card.

Refer to documentation provided with the Option Card for actual mounting instructions for option slot C.

■ Preventing C Option Card Connectors from Rising

After installing an Option Card into slot C, insert an Option Clip to prevent the side with the connector from rising. The Option Clip can be easily removed by holding onto the protruding portion of the Clip and pulling it out.

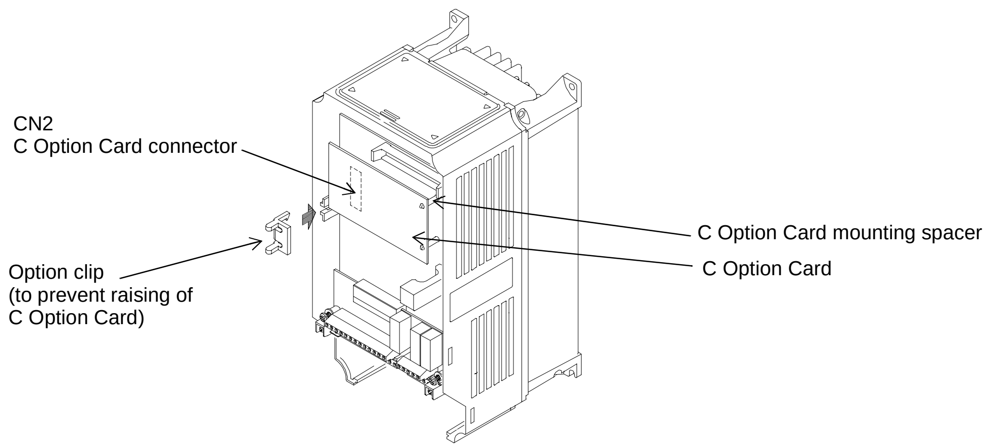


Fig 2.19 Mounting Option Cards

3

Chapter 3

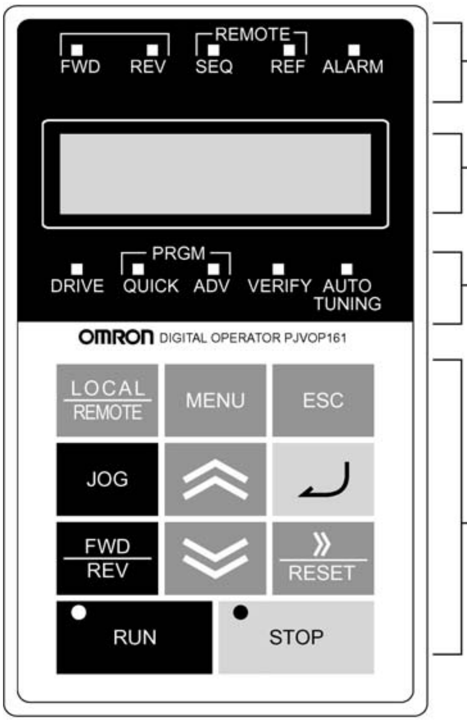
Digital Operator and Modes

This chapter describes Digital Operator displays and functions and provides an overview of operating modes and switching between modes.

Digital Operator

This section describes the displays and functions of the Digital Operator.The key names and functions of the Digital Operator are described below.

Digital Operator with LED Display (3G3IV-PJVOP161, standard)



Drive Mode Indicators

FWD: Lit when there is a forward run command input.
REV: Lit when there is a reverse run command input.
SEQ: Lit when the run command from the control circuit terminal is enabled.
REF: Lit when the frequency reference from control circuit terminals A1 or A2 is enabled.
ALARM: Lit when an error or alarm has occurred.

Data Display

Displays monitor data, parameter numbers and settings.

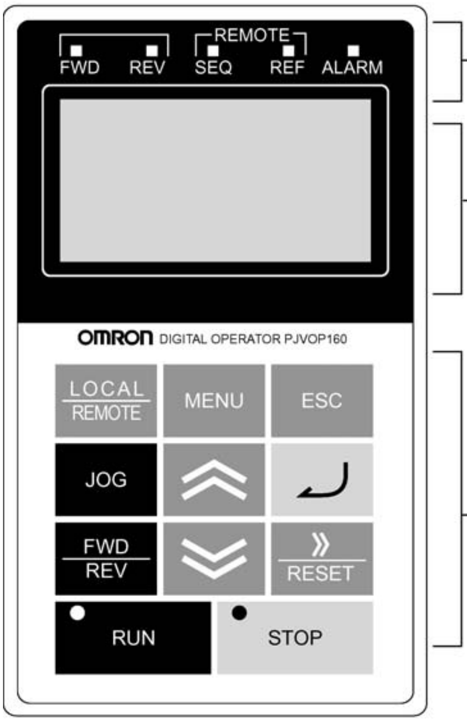
Mode Display

DRIVE: Lit in Drive Mode.
QUICK: Lit in Quick Programming Mode.
ADV: Lit in Advanced Programming Mode.
VERIFY: Lit in Verify Mode.
AUTO TUNING: Lit in Autotuning Mode.

Keys

Execute operations such as setting user parameters, monitoring, jogging and autotuning.

Digital Operator with LCD Display (3G3IV-PJVOP160, optional)



Drive Mode Indicators

FWD:Lit when there is a forward run command input.
REV: Lit when there is a reverse run command input.
SEQ:Lit when the run command from the control circuit terminal is enabled.
REF:Lit when the frequency reference from control circuit terminals A1 or A2 is enabled.
ALARM:Lit when an error or alarm has occurred.

Data Display

Displays monitor data, parameter numbers and settings.

Keys

Execute operations such as setting user parameters, monitoring, jogging and autotuning.

Fig 3.1 Digital Operator Component Names and Functions

◆ Digital Operator Keys

The names and functions of the Digital Operator Keys are described in *Table 3.1*.

Table 3.1 Key Functions

Key	Name	Function
LOCAL REMOTE	LOCAL/REMOTE Key	Switches between operation via the Digital Operator (LOCAL) and control circuit terminal operation (REMOTE). This Key can be enabled or disabled by setting user parameter o2-01.
MENU	MENU Key	Selects menu items (modes).
ESC	ESC Key	Returns to the status before the DATA/ENTER Key was pressed.
JOG	JOG Key	Enables jog operation when the Inverter is being operated from the Digital Operator.
FWD REV	FWD/REV Key	Selects the rotation direction of the motor when the Inverter is being operated from the Digital Operator.
» RESET	Digit Selection/RESET Key	Sets the number of digits for user parameter settings. Also acts as the Reset key when a fault has occurred.
	Increment Key	Selects menu items, sets user parameter numbers and increments set values. Used to move to the next item or data.
	Decrement Key	Selects menu items, sets user parameter numbers and decrements set values. Used to move to the previous item or data.
	ENTER Key	Pressed to enter menu items, user parameters and set values. Also used to switch from one screen to another.
RUN	RUN Key	Starts the Inverter operation when the Inverter is being controlled by the Digital Operator.
STOP	STOP Key	Stops Inverter operation. This Key can be enabled or disabled when operating from the control circuit terminal by setting user parameter o2-02.

Note Except in diagrams, Keys are referred to using the Key names listed in the above table.

3

There are indicators on the upper left of the RUN and STOP Keys on the Digital Operator. These indicators will light and flash to indicate operating status.

The RUN Key indicator will flash and the STOP Key indicator will light during initial excitation of the dynamic brake. The relationship between the indicators on the RUN and STOP Keys and the Inverter status is shown in the *Fig 3.2*.

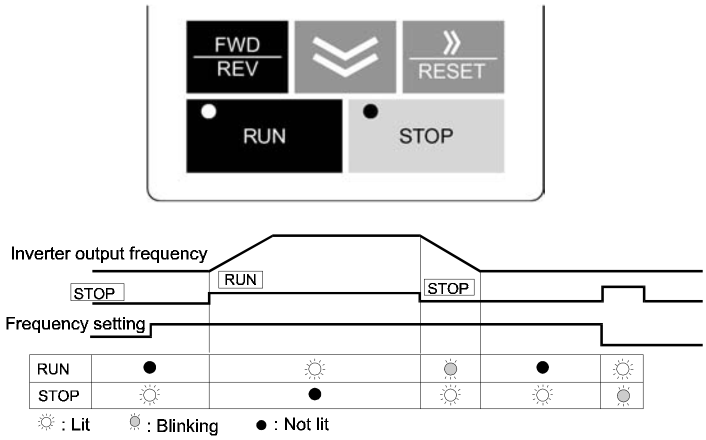


Fig 3.2 RUN and STOP Indicators

Modes

This section describes the Inverter's modes and switching between modes.

◆ Inverter Modes

The Inverter's user parameters and monitoring functions are organized in groups called modes that make it easier to read and set user parameters.The Inverter is equipped with 5 modes.

The 5 modes and their primary functions are shown in the *Table 3.2*.

Table 3.2 Modes

Mode	Primary function(s)
Drive mode	The Inverter can be run in this mode. Use this mode when monitoring values such as frequency references or output current, displaying fault information or displaying the fault history.
Quick programming mode	Use this mode to reference and set the minimum user parameters to operate the Inverter (e.g., the operating environment of the Inverter and Digital Operator).
Advanced programming mode	Use this mode to reference and set all user parameters.
Verify mode	Use this mode to read/set user parameters that have been changed from their factory-set values.
Autotuning mode	Use this mode when running a motor with unknown motor parameters . The motor parameters are calculated and set automatically. This mode can also be used to measure only the motor line-to-line resistance.

◆ Switching Modes

The mode selection display will appear when the MENU key is pressed from a monitor or setting display. Press the MENU key from the mode selection display to switch between the modes.

Press the ENTER key from the mode selection key to monitor data and from a monitor display to access the setting display.

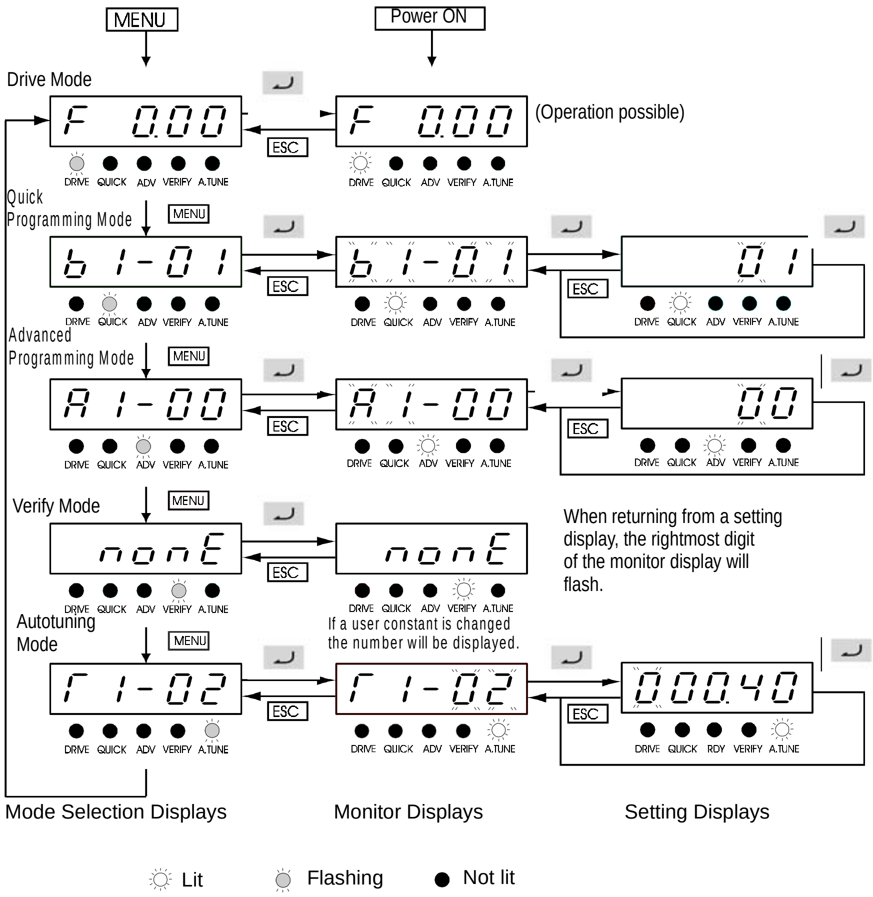


Fig 3.3 Mode Transitions

◆ Drive Mode

Drive mode is the mode in which the Inverter can be operated. The following monitor displays are possible in drive mode: The frequency reference, output frequency, output current and output voltage, as well as fault information and the fault history.

When b1-01 (Reference selection) is set to 0, the frequency can be changed from the frequency setting display. Use the Increment, Decrement and Digit Selection/RESET keys to change the frequency. The user parameter will be written and the monitor display will be returned to when the ENTER key is pressed after changing the setting.

■Example Operations

Key operations in drive mode are shown in the following figure.

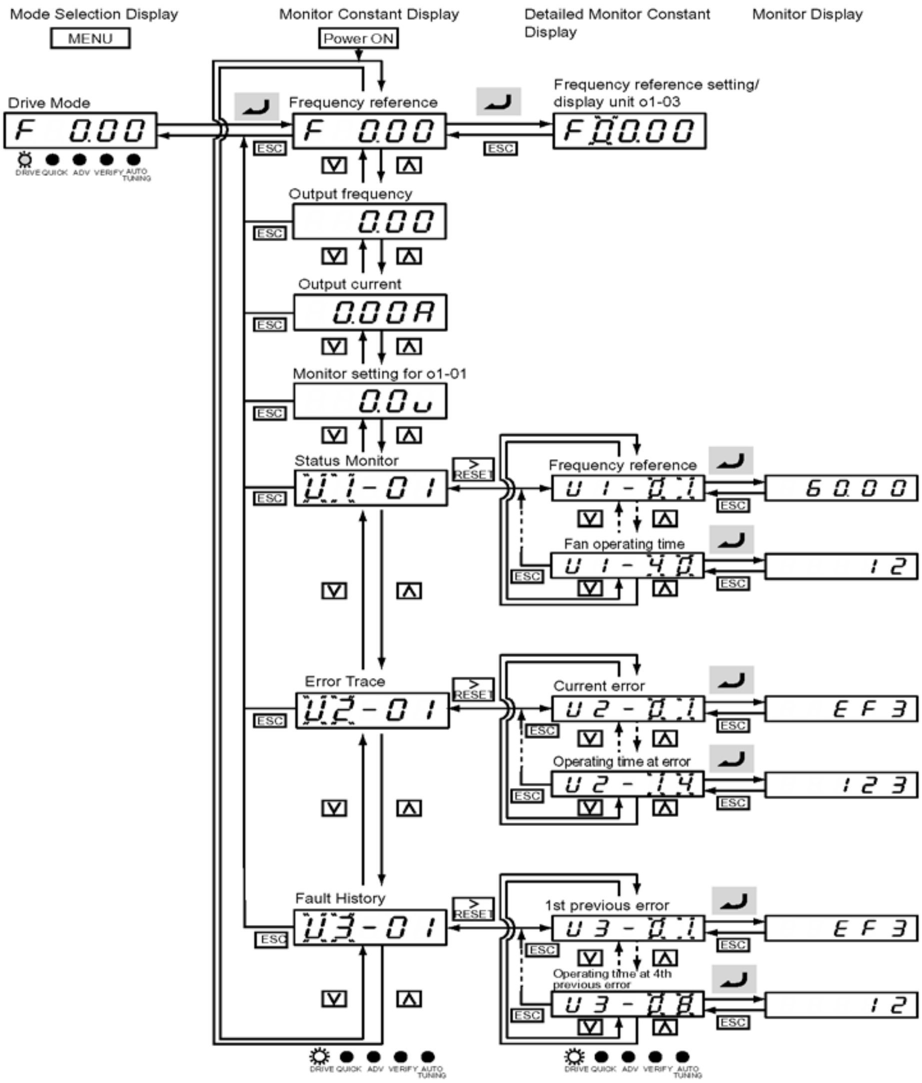


Fig 3.4 Operations in Drive Mode

IMPORTANT

The display for the first monitor parameter (frequency reference) will be displayed when power is turned ON. The monitor item displayed at startup can be set in o1-02 (Monitor Selection after Power Up).

Operation cannot be started from the mode selection display.

◆ Quick Programming Mode

In quick programming mode, the parameters required for Inverter trial operation can be monitored and set.

parameters can be changed from the setting displays. Use the Increment, Decrement and Digit Selection/ RESET keys to change the frequency. The user parameter will be written and the monitor display will be returned to when the ENTER key is pressed after changing the setting.

Refer to *Chapter 5 Parameters* for details on the parameters displayed in Quick Programming Mode.

■Example Operations

Key operations in quick programming mode are shown in the following figure.

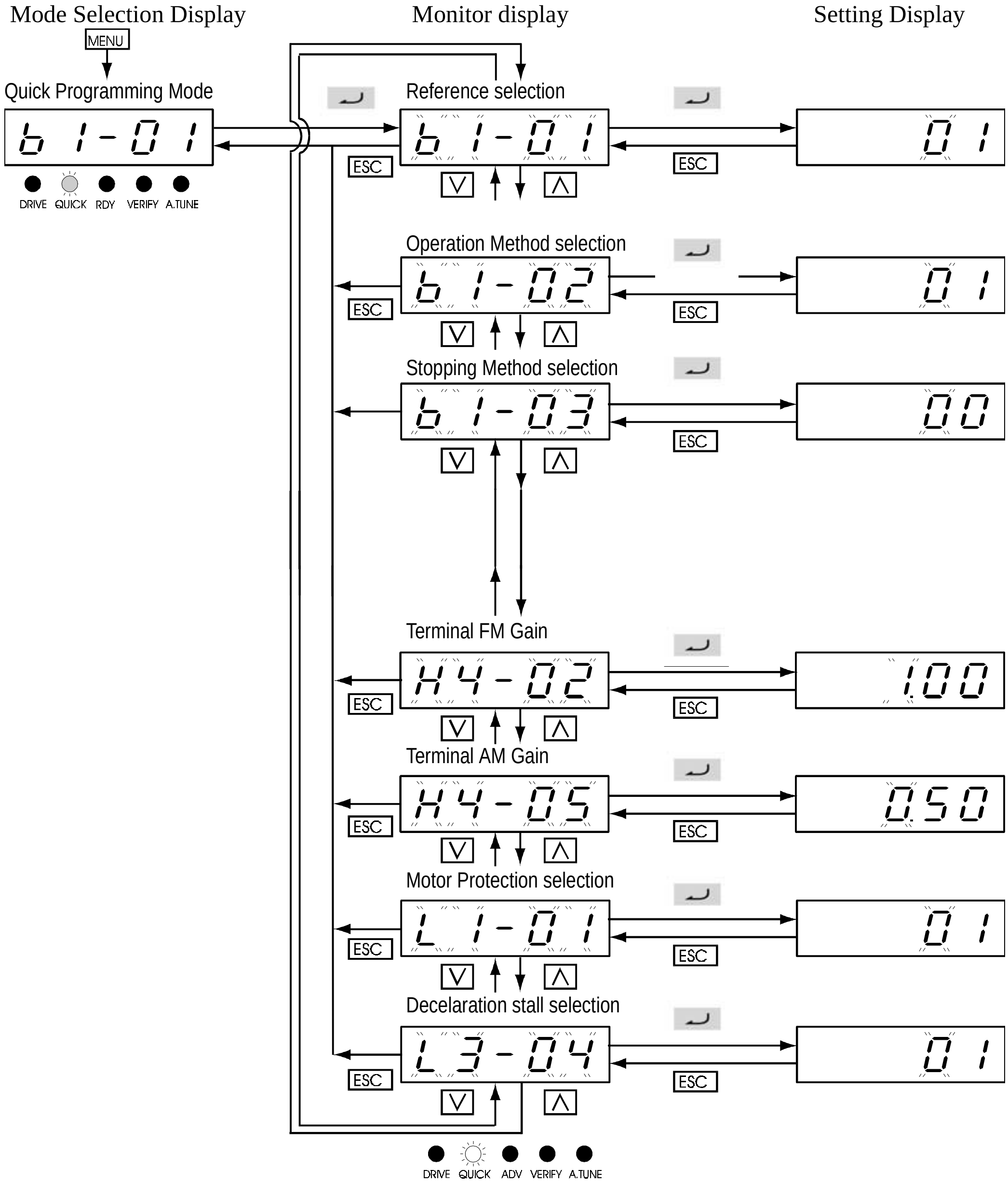


Fig 3.5 Operations in Quick Programming Mode

◆ Advanced Programming Mode

In advanced programming mode, all Inverter parameters can be monitored and set.

Parameters can be changed from the setting displays. Use the Increment, Decrement and Digit Selection/ RESET keys to change the frequency. The user parameter will be written and the display will return to monitor display when the ENTER key is pressed after changing the setting.

Refer to *Chapter 5 Parameters* for details on the parameters.

■Example Operations

Key operations in advanced programming mode are shown in the following figure.

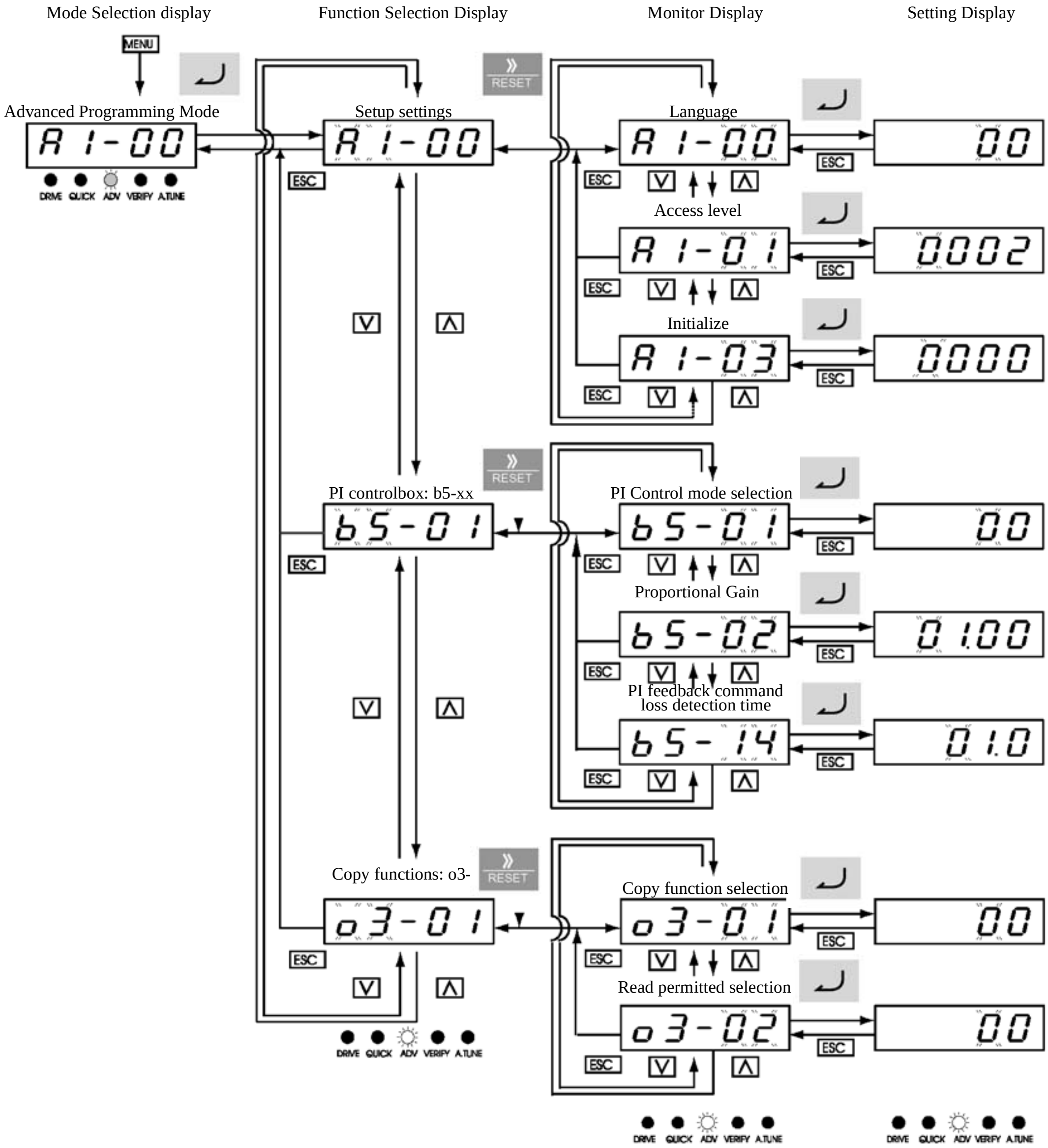
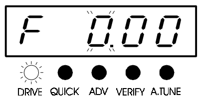
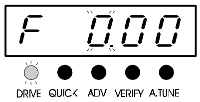
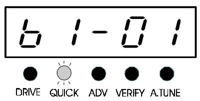
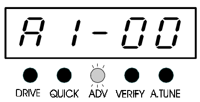
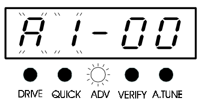
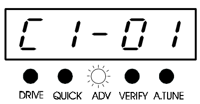
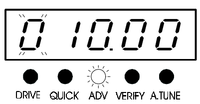
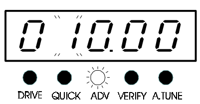
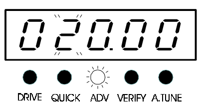
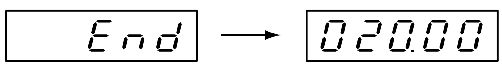
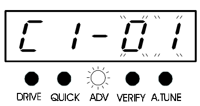


Fig 3.6 Operations in Advanced Programming Mode

■Setting Parameters

Here, the procedure is shown to change C1-01 (Acceleration Time 1) from 10 s to 20 s.

Table 3.3 Setting User parameters in Advanced Programming Mode

Step No.	Digital Operator Display	Description
1		Power supply turned ON.
2		MENU Key pressed to enter drive mode.
3		MENU Key pressed to enter quick programming mode.
4		MENU Key pressed to enter advanced programming mode.
5		ENTER pressed to access monitor display.
6		Increment or Decrement Key pressed to display C1-01 (Acceleration Time 1).
7		ENTER Key pressed to access setting display. The setting of C1-01 (10.00) is displayed.
8		Digit Selection/RESET Key pressed to move the flashing digit to the right.
9		Increment Key pressed to change set value to 20.00 s.
10		ENTER Key pressed to enter the set data. "END" is displayed for 1 s and then the entered value is displayed for 0.5 s.
11		The monitor display for C1-01 returns.

◆ Verify Mode

Verify mode is used to display any parameters that have been changed from their default settings in a programming mode or by autotuning. “None” will be displayed if no settings have been changed.

Even in verify mode, the same procedures can be used to change settings as they are used in the programming modes. Use the Increment, Decrement and Digit Selection/RESET keys to change the frequency. The user parameter will be written and the monitor display will be returned to when the ENTER key is pressed after changing the setting.

■Example Operations

An example of key operations is given below for when the following settings have been changed from their default settings: b1-01 (Reference Selection), C1-01 (Acceleration Time 1), E1-01 (Input Voltage Setting) and E2-01 (Motor Rated Current).

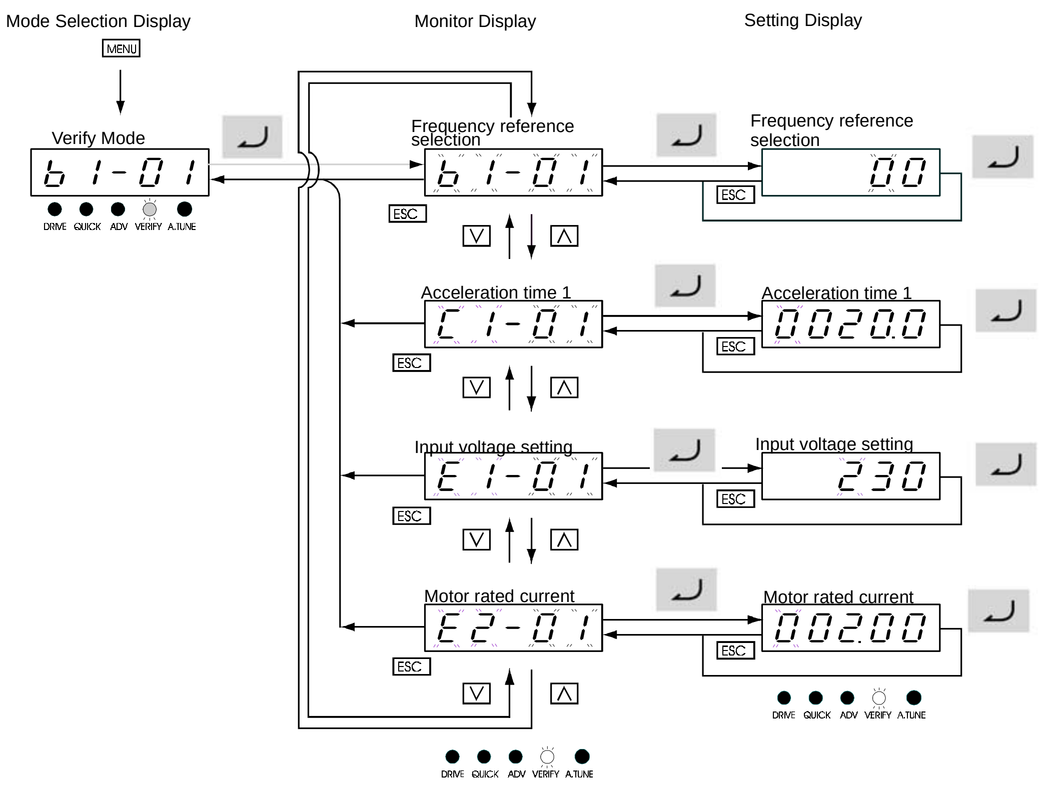


Fig 3.7 Operations in Verify Mode

◆ Autotuning Mode

Autotuning automatically tunes and sets the required motor parameters. Always perform autotuning before starting operation.

When the motor can not be disconnected from the load, perform stationary autotuning. Contact your dealer to set motorparameters by calculation.

The Inverter’s autotuning function automatically determines the motor parameters, while a servo system’s autotuning function determines the size of a load, so these autotunig functions are fundamentally different.

■Example of Operation

Set the motor output power (in kW) and rated current specified on the nameplate on the motor and then press the RUN key. The motor is automatically run and the motor line-to-line resistance measured based on these settings will be set.

Always set the above items. Autotuning cannot be started otherwise.

Parameters can be changed from the setting displays. Use the Increment, Decrement and Digit Selection/ RESET keys to change the frequency. The parameter will be written and the display will be returned to monitor display when the ENTER key is pressed after changing the setting.

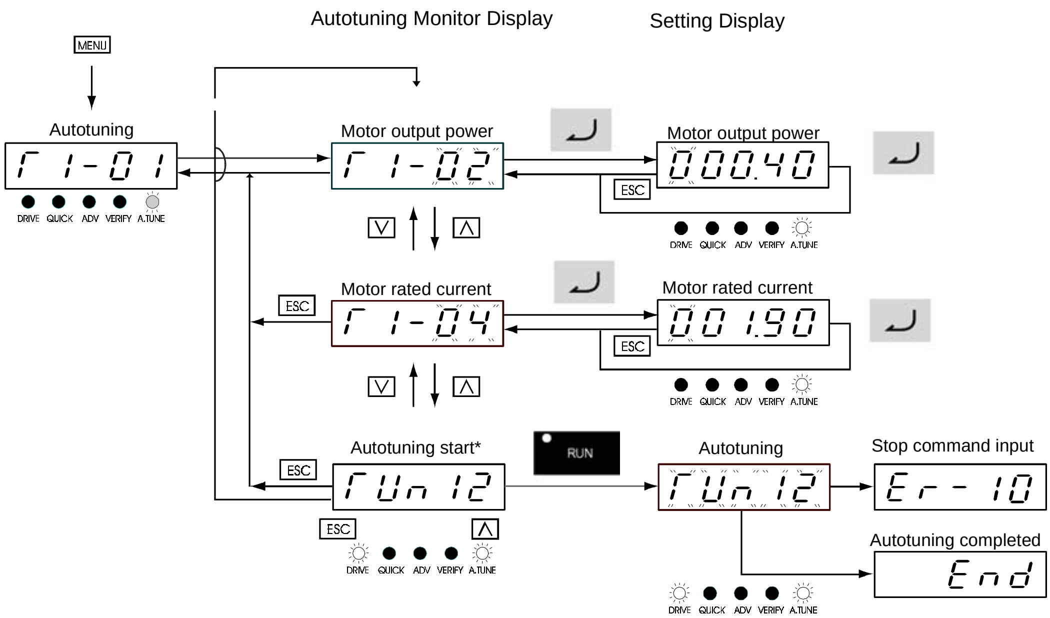


Fig 3.8 Operation in Autotuning Mode

IMPORTANT

If a fault occurs during autotuning, refer to *Chapter 7* .

4

Chapter 4

Trial Operation

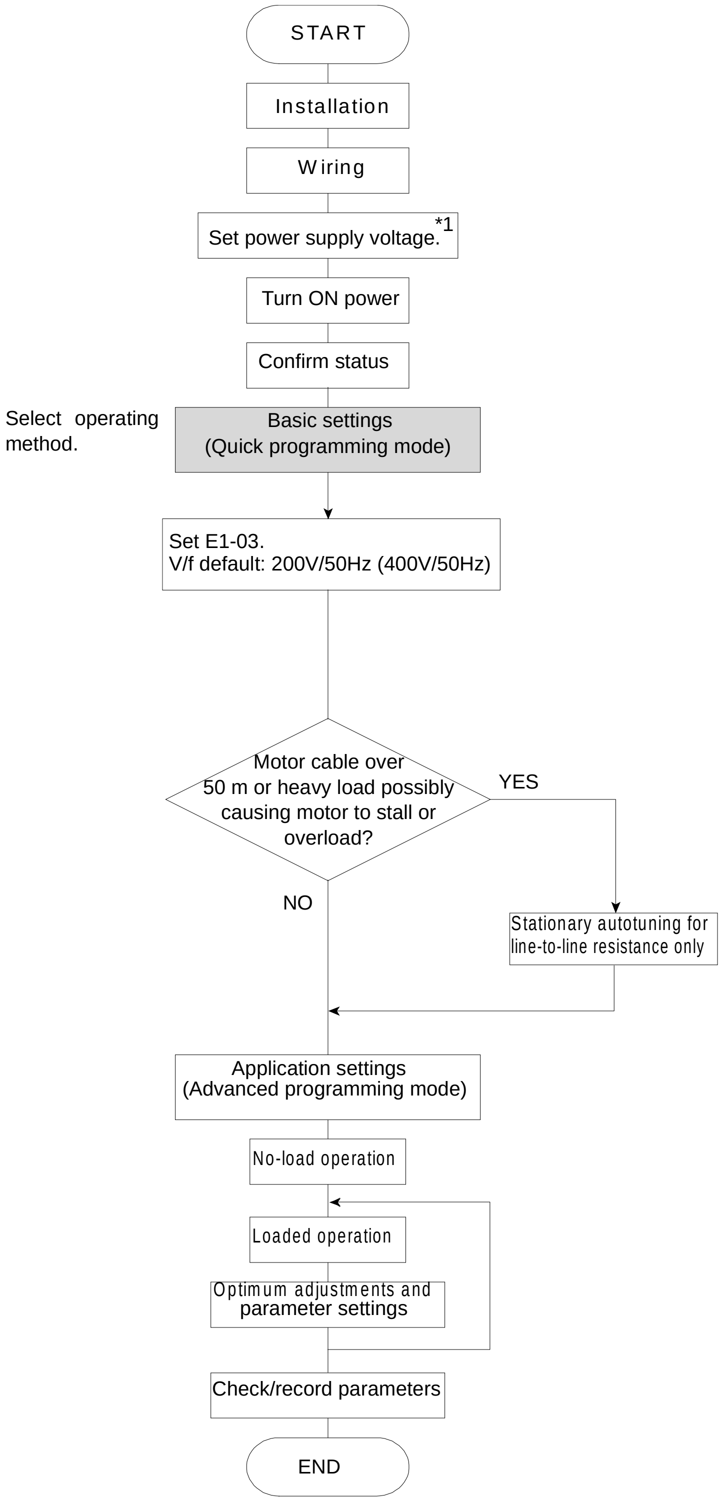
This chapter describes the procedures for trial operation of the Inverter and provides an example of trial operation.

Cautions and warnings

⚠	**WARNING**	Turn ON the input power supply only after mounting the front cover, terminal covers, bottom cover, Operator and optional items. Not doing so may result in electrical shock.
⚠	**WARNING**	Do not remove the front cover, terminal covers, bottom cover, Operator or optional items while the power is being supplied. Doing so may result in electrical shock or damage to the product
⚠	**WARNING**	Do not operate the Operator or switches with wet hands. Doing so may result in electrical shock.
⚠	**WARNING**	Do not touch the Inverter terminals while the power is being supplied. Doing so may result in electrical shock.
⚠	**WARNING**	Do not come close to the machine when using the error retry function because the machine may abruptly start when stopped by an alarm. Doing so may result in injury.
⚠	**WARNING**	Do not come close to the machine immediately after resetting momentary power interruption to avoid an unexpected restart (if operation is set to be continued in the processing selection function after momentary power is reset). Doing so may result in injury.
⚠	**WARNING**	Provide a separate emergency stop switch because the STOP Key on the Operator is valid only when function settings are performed. Not doing so may result in injury.
⚠	**WARNING**	Be sure to confirm that the RUN signal is turned OFF before tuning ON the power supply, resetting the alarm or switching the LOCAL/REMOTE selector. Doing so while the RUN signal is turned ON my result in injury.
⚠	**Caution**	Be sure to confirm permissible ranges of motors and machines before operation because the Inverter speed can be easily changed from low to high. Not doing so may result in damage to the product.
⚠	**Caution**	Provide a separate holding brake when neccessary. Not doing so may result in injury.
⚠	**Caution**	Do not perform a signal check during operation. Doing so may result in injury or damage to the product.
⚠	**Caution**	Do not carelessly change settings. Doing so may result in injury or damage to the product.

Trial Operation Flowchart

Perform trial operation according to the following flowchart.



*1. Set for 400 V Class Inverter for 75 kW or higher.

Fig 4.1 Trial Operation Flowchart

4

Trial Operation Procedures

The procedure for the trial operation is described in order in this section.

◆ Application Confirmation

First, confirm the application before using the Inverter. The unit is designed for using with:

- Fan, blower, pump applications

◆ Setting the Power Supply Voltage Jumper (Inverters of 75 kW or Higher)

Set the power supply voltage jumper after setting E1-01 (Input Voltage Setting) for Inverters of 75 kW or higher. Insert the jumper into the voltage connector nearest to the actual power supply voltage.

The jumper is factory-set to 440 V when shipped. If the power supply voltage is not 440 V, use the following procedure to change the setting.

1. Turn OFF the power supply and wait for at least 5 minutes.
2. Confirm that the CHARGE indicator has gone out.
3. Remove the terminal cover.
4. Insert the jumper at the position for the voltage supplied to the Inverter (see *Fig 4.2*).
5. Return the terminal cover to its original position.

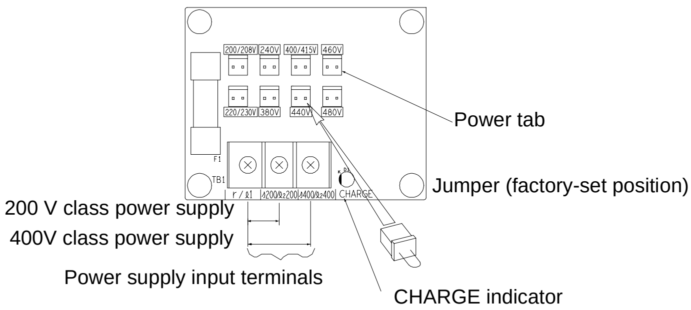


Fig 4.2 Large-capacity Inverter Connections

◆ Power ON

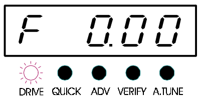
Confirm all of the following items and then turn ON the power supply.

- Check that the power supply is of the correct voltage.
  200 V class: 3-phase 200 to 240 VDC, 50/60 Hz
  400 V class: 3-phase 380 to 480 VDC, 50/60 Hz
- Make sure that the motor output terminals (U, V, W) and the motor are connected correctly.
- Make sure that the Inverter control circuit terminal and the control device are wired correctly.
- Set all Inverter control circuit terminals to OFF.
- Make sure that the motor is not connected to the mechanical system (no-load status).

◆ Checking the Display Status

If the Digital Operator's display at the time the power is connected is normal, it will read as follows:

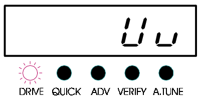
Display for normal operation



The frequency reference monitor is displayed in the data display section.

When an fault has occurred, the details of the fault will be displayed instead of the above display. In that case, refer to *Chapter 7*. The following display is an example of a display for faulty operation.

Display for fault operation



The display will differ depending on the type of fault.
A low voltage alarm is shown at left.

◆ Basic Settings

Switch to the quick programming mode (the QUICK indicator on the Digital Operation should be lit) and then set the following parameters.

Refer to *Chapter 3 Digital Operator and Modes* for Digital Operator operating procedures and to *Chapter 5 Parameters* and *Chapter 6 Parameter Settings by Function* for details on the parameters.

Table 4.1 Parameters that must be set

Class l : Must be set. O : Set as required.

Class	Parameter Number	Name	Description	Setting Range	Factory Setting	Page
l	b1-01	Reference selection	Set the frequency reference input method. 0: Digital Operator 1: Control circuit terminal (analog input) 2: RS-422A/485 communications 3: Option Card	0 to 3	1	5-8 6-4 6-46 6-55
l	b1-02	Operation method selection	Set the run command input method. 0: Digital Operator 1: Control circuit terminal (sequence input) 2: RS-422A/485 communications 3: Option Card	0 to 3	1	5-8 6-8 6-46 6-55
O	b1-03	Stopping method selection	Select stopping method when stop command is sent. 0: Deceleration to stop 1: Coast to stop 2: DC braking stop 3: Coast to stop with timer	0 to 3	0	5-8 6-10
l	C1-01	Acceleration time 1	Set the acceleration time in seconds for the output frequency to climb from 0Hz to the max.frequency..	0.0 to 6000.0	10.0 s	5-14 6-17
l	C1-02	Deceleration time 1	Set the deceleration time in seconds for the output frequency to fall from max. frequency to 0Hz.	0.0 to 6000.0	10.0 s	5-14 6-17
O	C6-02	Carrier frequency selection	The carrier frequency has to be set low if the motor cable is 50 m or longer or to reduce radio noise or leakage current.	0 to D, F	F	5-16
O	d1-01 to d1-04 and d1-17	Frequency references 1 to 4 and jog frequency reference	Set the required speed references for multi-step speed operation or jogging.	0 to 120.00 Hz	d1-01 to d1-04: 0.00 Hz d1-17: 6.00 Hz	5-17 6-6
l	E1-01	Input voltage setting	Set the Inverter's nominal input voltage in volts.	155 to 255 V (200 V class) 310 to 510 V (400 V class)	200 V (200 V class) 400 V (400 V class)	5-19 6-104

Table 4.1 Parameters that must be set (Continued)

Class l : Must be set. O : Set as required.

Class	Parameter Number	Name	Description	Setting Range	Factory Setting	Page
l	E2-01	Motor rated current	Set the motor rated current.	10% to 200% of Inverter's rated current	Setting for general-purpose motor of same capacity as Inverter	5-20 6-33 6-103
O	H4-02 and H4-05	FM and AM terminal output gain	Adjust when an instrument is connected to the FM or AM terminal.	0.00 to 2.50	H4-02: 1.00 H4-05: 0.50	5-25
l	L1-01	Motor protection selection	Set to enable or disable the motor overload protection function using the electronic thermal relay. 0: Disabled 1: General motor protection	0 or 1	1	5-27 6-33
O	L3-04	Stall prevention selection during deceleration	If using the dynamic brake option (Braking Resistor Units and Braking Units), be sure to set parameter L3-04 to 0 (disabled).	0 to 2	1	5-29 6-21

◆ Selecting the V/f pattern

- Set either one of the fixed patterns (0 to D) in E1-03 (V/f Pattern Selection) or set F in E1-03 to specify a user-set pattern as required for the motor and load characteristics from E1-04 to E1-13 in Advanced Programming Mode.

Simple operaton of a general-pupose motor at 50 Hz:	E1-03 = F (default) or 0 If E1-03 = F, the default setting in the user setting from E1-04 to E1-13 are for 50 Hz

- Perform autotuning for the line-to-line resistance only if the motor cable is 50 m or longer for the actual installation or when the load causes stalling.

◆ Autotuning for Line-to-Line Resistance

Autotuning can be used to prevent control errors when the motor cable is long or the cable length has changed or when the motor and Inverter have different capacities.

To perform autotuning set parameters T1-02 and T1-04 and then press the RUN Key on the Digital Operator. The Inverter will supply power to the motor for approximately 20 seconds and the Motor Line-to-Line Resistance (E2-05) and cable resistance will be automatically measured

IMPORTANT

Power will be supplied to the motor when autotuning is performed even though the motor will not turn. Do not touch the motor until autotuning has been completed.

■ Parameter Settings for Autotuning

The following parameters must be set before autotuning.

Table 4.2 Parameter Settings before Autotuning

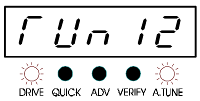
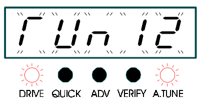
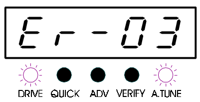
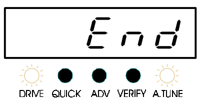
Parameter Number	Name	Display	Setting Range	Factory Setting
T1-02	Motor output power	Set the output power of the motor in Kilowatts.*1	10% to 200% of Inverter rated output	Same as Inverter rated output
T1-04	Motor rated current	Set the rated current of the motor in Amps.*1	10% to 200% of Inverter rated current	Same as general-purpose motor with same capacity as Inverter

* 1. For a parameter-output motor, set the value at the base speed.

■Digital Operator Displays during Autotuning

The following displays will appear on the Digital Operator during autotuning.

Table 4.3 Digital Operator Displays during Autotuning

Digital Operator Display	Description
Motor rated : T1-02 	The autotuning start display will appear when all settings through T1-04 have been completed. The A.TUNE and DRIVE indicators will be lit.
Autotuning started: TUn10 	Autotuning will start when the RUN Key is pressed from the autotuning start display.
Autotuning  Stop command input 	If the STOP Key is pressed or a measurement error occurs during autotuning and error message will be display and autotuning will be stopped. Refer to *Errors during Autotuning* on page 7-10.
Autotuning completed 	END will be displayed after approximately 1 to 2 minutes, indicating that autotuning has been completed.

4

◆ Application Settings

Parameters are set as required in advanced programming mode (i.e., with the ADV indicator lit on the Digital Operator). All the parameters that can be set in quick programming mode can also be displayed and set in advanced programming mode.

■Setting Examples

The following are examples of settings for applications.

- To increase the speed of a 50 Hz motor by 10%, set E1-04 to 55.0 Hz.
- To use a 0 to 10-V analog signal for a 50 Hz motor for variable-speed operation between 0 and 45 Hz (0% to 90% speed deduction), set H3-02 to 90.0%.
- To control speed between 20% and 80% to ensure smooth gear operation and limit the maximum speed of the machine, set d2-01 to 80.0% and set d2-02 to 20.0%.
- To allow the machine from being operated in reverse, set b1-04 to 0 to enable reverse operation.

◆ No-load Operation

This section describes trial operation in which the motor is in no-load state, that means the machine is not connected to the motor. To avoid failures caused due to the wiring of the control circuit it's recommended to use the LOCAL mode. Press the LOCAL/REMOTE Key on the Digital Operator to change to LOCAL mode (the SEQ and REF indicators on the Digital Operator should be OFF).

Always confirm safety around the motor and machine before starting Inverter operation from the Digital Operator. Confirm that the motor works normally and that no errors are displayed at the Inverter. For applications, at which the machine only can be driven in one direction, check the motor rotation direction.

Jog Frequency Reference (d1-17, default: 6.00 Hz) can be started and stopped by pressing and releasing the JOG Key on the Digital Operator. If the external sequence prevent operation from the Digital Operator, confirm that emergency stop circuits and machine safety mechanisms are functioning and then start operation in REMOTE mode (i.e., with a signal from the control signal terminals). The safety precautions must always be taken before starting the Inverter with the motor connected to the machine.

Both a RUN command (forward or reverse) and a frequency reference (or multi-step speed command) must be provided to start Inverter operation.
Input these commands and reference regardless of the operation method (i.e., LOCAL of REMOTE).

◆ Loaded Operation

■Connecting the Load

- After confirming that the motor has stopped completely, connect the mechanical system.
- Be sure to tighten all the screws when securing the motor shaft to the mechanical system.

■Operation using the Digital Operator

- Use the Digital Operator to start operation in LOCAL mode in the same way as in no-load operation.
- If fault occurs during operation, make sure the STOP Key on the Digital Operator is easily accessible.
- At first, set the frequency reference to a low speed of one tenth the normal operating speed.

■ Checking Operating Status

- Having checked that the operating direction is correct and that the machine is operating smoothly at slow speed, increase the frequency reference.
- After changing the frequency reference or the rotation direction, check that there is no oscillation or abnormal sound from the motor. Check the monitor display to ensure that U1-03 (Output Current) is not to high.
- Refer to *Adjustment Suggestions* on page 4-13 if hunting, vibration or other problems originating in the control system occur.

■Check and Recording Parameters

Use verify mode (i.e., when the VERIFY indicator on the Digital Operator is lit) to check parameters that have been changed for trial operation and record them in a parameter table.

Any parameters that have been changed by autotuning will also be displayed in verify mode.

If required, the copy function in parameters o3-01 and o3-02 displayed in advanced programming mode can be used to copy the changed settings from the Inverter to a recording area in the Digital Operator. If changed settings are saved in the Digital Operator, they can be easily copied back to the Inverter to speed up system recovery if for any reason the Inverter has to be replaced.

The following functions can also be used to manage parameters.

- Recording parameters
- Setting access levels for parameters
- Setting a password

■ Recording parameters (o2-03)

If o2-03 is set to 1 after completing trial operation, the settings of parameters will be saved in a separate memory area in the Inverter. When the Inverter settings have been changed for any reason, the parameters can be initialized to the settings saved in the separate memory area by setting A1-03 (Initialize) to 1110.

■Parameter Access Levels (A1-01)

A1-01 can be set to 0 (monitoring-only) to prevent parameters from being changed. If A1-01 is set to 2 (advanced programming) all parameters can be read or written.

■Password (A1-04 and A1-05)

When the access level is set to monitoring-only (A1-01 = 0), a password can be set so that parameters will be displayed only when the correct password is input.

Adjustment Suggestions

If hunting, vibration or other problems originating in the control system occur during trial operation, adjust the parameters listed in the following table. This table lists only the most commonly used parameters.

Table 4.4 Adjusted parameters

Name (Parameter Number)	Performance	Factory Setting	Recommended Setting	Adjustment Method
Hunting-prevention gain (N1-02)	Controlling hunting and vibration in middle-range speeds (10 to 40 Hz)	1.00	0.50 to 2.00	• Reduce the setting if torque is insufficient for heavy loads. • Increase the setting if hunting or vibration occurs for light loads.
Carrier frequency selection (C6-02)	• Reducing motor magnetic noise • Controlling hunting and vibration at low speeds	Depends on capacity	0 to default	• Increase the setting if motor magnetic noise is high. • Reduce the setting if hunting or vibration occurs at low to middle-range speeds.
Torque compensation primary delay time parameter (C4-02)	• Increasing torque and speed response • Controlling hunting and vibration	Depends on capacity	200 to 1000 ms	• Reduce the setting if torque or speed response is slow. • Increase the setting if hunting or vibration occurs.
Torque compensation gain (C4-01)	• Improving torque at low speeds (10 Hz or lower) • Controlling hunting and vibration	1.00	0.50 to 1.50	• Increase the setting if torque is insufficient at low speeds. • Reduce the setting if hunting or vibration occurs for light loads.
Middle output frequency voltage (E1-08) Minimum output frequency voltage (E1-10)	• Improving torque at low speeds • Controlling shock at startup	Depends on capacity and voltage	Default to Default + 3 to 5 V*	• Increase the setting if torque is insufficient at low speeds. • Reduce the setting if shock at startup is large.

* The setting is given for 200 V Class Inverters. Double the voltage for 400 V Class Inverters.

The following parameter will also affect the control system indirectly.

Table 4.5 Parameters Affecting Control and Applications Indirectly

Name (Parameter Number)	Application
Acceleration/deceleration times (C1-01 to C1-11)	Adjust torque during acceleration and deceleration.
S-curve characteristics (C2-01 and C2-02)	Used to prevent shock when completing acceleration.
Jump frequencies (d3-01 to d3-04)	Used to avoid resonance points during acceleration or deceleration.
Stall prevention (L3-01 to L3-06)	Used to prevent OV (overvoltage errors) and motor stalling for heavy loads or rapid acceleration/deceleration. Stall prevention is enabled by default and the setting normally has not to be changed. When using a braking resistor, however, disable stall prevention during deceleration by setting L3-04 to 0.

5

Chapter 5

Parameters

This chapter describes all parameters that can be set in the Inverter.

Parameter Descriptions

This section describes the contents of the parameters tables.

◆ Description of Parameter Tables

Parameters tables are structured as shown below. Here, b1-01 (Frequency Reference Selection) is used as an example.

The standard operator displays only the Parameter number.
Names of parameters can only be viewed from the Optional LCD operator.

Parameter Number	Name LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A-485 Register	Page
b1-01	Reference selection Reference Source	Set the frequency reference input method. 0: Digital Operator 1: Control circuit terminal (analog input) 2: RS-422A/485 communications 3: Option Card	0 to 3	1	No	Q	180H	-

- Parameter Number: The number of the parameter.
- Name: The name of the parameter.
- Description: Details on the function or settings of the parameter.
- Setting Range: The setting range for the parameter.
- Factory Setting: The factory setting.
- Change during Operation: Indicates whether or not the parameter can be changed while the Inverter is in operation.
  - Yes: Changes possible during operation.
  - No: Changes not possible during operation.
- Access Level: Indicates the access level in which the user parameter can be monitored or set.
  - Q: Items which can be monitored and set in either quick programming mode or advanced programming mode.
  - A: Items which can be monitored and set only in advanced programming mode.
- RS-422A/485 Register: The register number used for R-S422A/485 communications.
- Page: Reference page for more detailed information about the parameter.

Digital Operation Display Functions and Levels

The following figure shows the Digital Operator display hierarchy for the Inverter.

MENU

Drive Mode
Inverter can be operated and its status can be displayed.

Quick Programming Mode
Minimum parameters required for operation can be monitored or set.

Advanced Programming Mode
All parameters can be monitored or set.

Verify Mode
Parameters changed from the default settings can be monitored or set.

Autotuning Mode
Automatically sets motor parameters if autotuning data (from motor nameplate) is input for measure the line-to-line resistance.

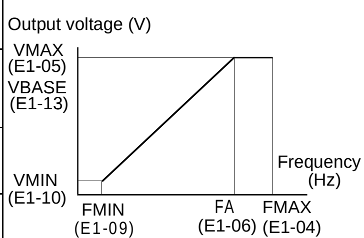
No.	Function	Display	Page
U1	Status Monitor Parameters	Monitor	5-38
U2	Fault Trace	Fault Trace	5-41
U3	Fault History	Fault History	5-43
A1	Initialize Mode	Initialization	5-7
A2	User set parameters	User Parameters	-
b1	Operation Mode Selections	Sequence	5-8
b2	DC Injection Braking	DC Braking	5-9
b3	Speed Search	Speed Search	5-10
b5	PI Control	PI Control	5-12
b8	Energy Saving	Energy Saving	5-13
C1	Acceleration/Deceleration	Accel/Decel	5-14
C2	S-curve Acceleration/Deceleration	S-curve Accel/Decel	5-15
C4	Torque Compensation	Torque Comp	5-15
C6	Carrier Frequency	Carrier Freq	5-16
d1	Preset Reference	Preset Reference	5-17
d2	Reference Limits	Reference Limits	5-17
d3	Jump Frequencies	Jump Frequencies	5-18
d6	Field Weakening	Field Weakening	5-18
E1	V/f Pattern	V/f Pattern	5-19
E2	Motor Setup	Motor Setup	5-20
F6	Communications Option Card	Com OPT Setup	5-20
H1	Multi-function Digital Inputs	Digital Inputs	5-21
H2	Multi-function Digital Outputs	Digital Outputs	5-22
H3	Analog Inputs	Analog Inputs	5-23
H4	Multi-function Analog Outputs	Analog Outputs	5-25
H5	RS-422A/485 Communications	Serial Com Setup	5-26
L1	Motor Overload	Motor Overload	5-27
L2	Power Loss Ridethrough	PwrLoss Ridethru	5-28
L3	Stall Prevention	Stall Prevention	5-29
L4	Reference Detection	Ref Detection	5-30
L5	Fault Restart	Fault Restart	5-30
L6	Torque Detection	Torque Detection	5-31
L8	Hardware Protection	Hdwe Protection	5-31
n1	Hunting Prevention Function	Hunting Prev	5-33
n3	High-slip Braking	High Slip	5-33
o1	Monitor Select	Monitor Select	5-34
o2	Multi-function Selections	Key Selections	5-36
o3	Copy Function	COPY Function	5-37
T	Motor Autotuning	Auto-Tuning	5-37

◆ Parameters Setable in Quick Programming Mode

The minimum parameters required for Inverter operation can be monitored and set in quick programming mode. The parameters displayed in quick programming mode are listed in the following table. These and all other parameters, are also displayed in advanced programming mode.

Refer to the overview of modes on page 3-5 for an overview of quick programming mode.

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/485 Register
b1-01	Reference selection Reference Source	Set the frequency reference input method. 0: Digital Operator 1: Control circuit terminal (analog input) 2: RS-422A/485 communications 3: Option Card	0 to 3	1	No	Q	180H
b1-02	Operation method selection Run Source	Set the run command input method 0: Digital Operator 1: Control circuit terminal (sequence input) 2: RS-422A/485 communications 3: Option Card	0 to 3	1	No	Q	181H
b1-03	Stopping method selection Stopping Method	Select stopping method when stop command is input. 0: Ramp to stop 1: Coast to stop 2: DC braking stop (Stops faster than coast to stop, without regenerative operation.) 3: Coast to stop with timer (Run commands are disregarded during deceleration time.)	0 to 3	0	No	Q	182H
C1-01	Acceleration time 1 Accel Time 1	Set the acceleration time in seconds for the output frequency to climb from 0Hz to the max. frequency	0.0 to 6000.0	10.0 s	Yes	Q	200H
C1-02	Deceleration time 1 Decel Time 1	Set the deceleration time in seconds for the output frequency to fall from max. frequency to 0Hz.	0.0 to 6000.0	10.0 s	Yes	Q	201H
C6-02	Carrier frequency selection CarrierFreqSel	Select carrier wave fixed pattern. Select F to enable detailed settings using parameters C6-03 to C6-07.	1 to F	6	No	Q	224H

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/ 485 Register
d1-01	Frequency reference 1 / Reference 1	Set the frequency reference in the unit specified in o1-03 (frequency units for reference setting and monitor, default: Hz)	0 to 50.00	0.00 Hz	Yes	Q	280H
d1-02	Frequency reference 2 / Reference 2	Frequency reference when multi-step speed command 1 is ON for a multi-function input (unit: Set in o1-03).		0.00 Hz	Yes	Q	281H
d1-03	Frequency reference 3 / Reference 3	Frequency reference when multi-step speed command 2 is ON for a multi-function input (unit: Set in o1-03).		0.00 Hz	Yes	Q	282H
d1-04	Frequency reference 4 / Reference 4	Frequency reference when multi-step speed command 1 and 2 are ON for a multi-function input (unit: Set in o1-03).		0.00 Hz	Yes	Q	283H
d1-17	Jog frequency reference / Jog Reference	Frequency reference when multi-function inputs „Jog Frequency Command“, „FJOG command“ or „RJOG command“ is ON (unit: Set in o1-03).		6.00 Hz	Yes	Q	292H
E1-01	Input voltage setting / Input Voltage	Set the Inverter input voltage in units of 1 volt. This set value will be the basis for the protection functions.	155 to 255 *2	200 V *2	No	Q	300H
E1-03	V/F pattern selection / V/F Selection	0 to D: Select from 14 preset patterns. F: Custom user-set patterns (Applicable for setting E1-04 to E1-10).	0 to D, F	F	No	Q	302H
E1-04	Max. output frequency (FMAX) / Max Frequency		0.0 to 120.0	50.0 Hz	No	Q	303H
E1-05	Max. voltage (VMAX) / Max Voltage		0.0 to 255.0 *2	200.0 V *2	No	Q	304H
E1-06	Base frequency (FA) / Base Frequency		0.0 to 120.0	50.0 Hz	No	Q	305H
E1-09	Min. output frequency (FMIN) / Min. Frequency		0.0 to 120.0	1.2 Hz	No	Q	308H

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Parameter Number	Name LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/ 485 Register
E2-01	Motor rated current Motor Rated FLA	Set the motor rated current in Amps. This set value becomes the base value for motor protection, torque limit and torque control. It is an input data for autotuning.	0.37 to 7.40 *5	1.90 A *4	No	Q	30EH
H4-02	Gain (terminal FM) Terminal FM Gain	Set the voltage level gain for multi-function analog output 1. Set the number of multiples of 10 V to be output as the 100% output for the monitor items. Voltage output from the terminals, however, have a 10 V max. meter calibration function.	0.0 to 1000.0	100%	Yes	Q	41EH
H4-05	Gain (terminal AM) Terminal AM Gain	Set the voltage level gain for multi-function analog output 2.	0.0 to 1000.0	50%	Yes	Q	421H
L1-01	Motor protection selection MOL Fault Select	Set to enable or disable the motor overload protection function using the Inverter electronic thermal relay. 0: Disabled 1: General-purpose motor protection In some applications when the Inverter power supply is turned off, the thermal value is reset, so even if this parameter is set to 1, protection may not be effective. When several motors are connected to one Inverter, set to 0 and ensure that each motor is equipped with a protection device.	0 or 1	1	No	Q	480H
L3-04	Stall prevention selection during deceleration StallP Decel Sel	0: Disabled (Deceleration Time as set. If deceleration time is too short, a main circuit overvoltage may result.) 1: Enabled (Deceleration is stopped when the main circuit voltage exceeds the stall prevention level. Deceleration restarts when voltage fallsbelow the stall level again.) 2: Intelligent deceleration mode (Deceleration rate is automatically adjusted so that in Inverter can decelerate in the shortest possible time. Set deceleration time is disregarded.) When a braking option (Braking Resistor Unit, Braking Unit) is used, always set to 0 to 2.	0 to 2	1	No	Q	492H

* 1. The factory setting depends on the Inverter capacity.
* 2. These are values for a 200 V class Inverter. Values for a 400 V class Inverter are double.
* 3. After autotuning, E1-13 will contain the same value as E1-05.
* 4. The factory setting depends on the Inverter capacity. (The value for a 200 V Class Inverter for 0.4 kW is given.)
* 5. The setting range is from 10% to 200% of the Inverter rated output current. (The value for a 200 V Class Inverter for 0.4 kW is given.)

Parameter Tables

The parameters displayed in Advanced programming mode are listed in the following table.

◆ A: Setup Settings

■ Initialize Mode: A1

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/ 485 Register	Page
A1-00	Language selection for Digital Operator display Select Language	Used to select the language displayed on the Digital Operator Display.(LCD) 0: English 1: Japanese 2: German 3: French 4: Italian 5: Spanish 6: Portugese This parameter is not initialized by the initialize operation.	0 to 6	0	Yes	A	100H	–
A1-01	Parameter access level Acces Level	Used to set the parameter access level (set/read.) 0: Monitoring only (Monitoring drive mode and setting A1-01 and A1-04.) 1: Used to select parameters (Only parameters set in A2-01 to A2-32 can be selected) 2: Advanced (Parameters can be read and set in both, quick programming mode (Q) and advanced programming (A) mode.)	0 to 2	2	Yes	A	101H	6-6 6-31 6-116
A1-03	Initialize Init Parameters	Used to initialize the parameters using the specified method. 0: No initializing 1110: Initilizes using the parameters 2220: Initializes using a two-wire sequence. (Initializes to the factory setting.) 3330: Initializes using a three-wire sequence.	0 to 3330	0	No	A	103H	6–116

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Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/485 Register	Page
A1-04	Password Enter Password	Password input when a password has been set in A1-05. This function write-protects some parameters of the initialize mode. If the password is changed, A1-01 to A1-03 parameters can no longer be changed. (Programming mode parameters can be changed after setting the correct password.)	0 to 9999	0	No	A	104H	6-116
A1-05	Password Select Password	Used to set a four digit number as password. The parameter is not usually displayed.	0 to 9999	0	No	A	105H	6-116

◆ Application Parameters: b

The following settings are made with the application parameters (B parameters): Operation Method Selection, DC injection braking, speed searching, timer functions, dwell functions and energy saving functions.

■Operation Mode Selections: b1

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/485 Register	Page
b1-01	Reference selection Reference-Source	Set the frequency reference input method. 0: Digital Operator 1: Control circuit terminal (analog input) 2: RS-422A/485 communications 3: Option Card	0 to 3	1	No	Q	180H	4-6 6-4 6-46 6-55
b1-02	Operation method selection Run Source	Set the run command input method. 0: Digital Operator 1: Control circuit terminal (sequence input) 2:RS-422A/485 communications 3: Option Card	0 to 3	1	No	Q	181H	4-6 6-8 6-46 6-55

Param-eter Number	Name: LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Access Level	RS-422A/485 Register	Page
b1-03	Stopping method selec-tion Stopping Method	Used to set the stopping method used when a stop command is input. 0: Ramp to stop 1: Coast to stop 2: DC injection braking stop (Stops faster than coast to stop, no regenerative ope-ration.) 3: Coast to stop with timer (Run commands are dis-regarded during decelera-tion.)	0 to 3	0	No	Q	182H	4-6 6-10
b1-04	Prohibition of reverse operation Reverse Oper	0: Reverse enabled 1: Reverse disabled 2: Switch phase order (reverse enabled)	0 to 2	0	No	A	183H	6-36
b1-07	Operation selection after switching to remote mode LOC/REM RUN Sel	Used to set the operation mode by switching to the Remote mode using the Local/Remote Key. 0: Run signals that are input during mode switching are disregarded. (Input Run signals after swit-ching the mode.) 1: Run signals become effective immediately after switching to the Remote mode.	0 or 1	0	No	A	186H	-
b1-08	Run com-mand selec-tion in programming modes RUN CMD at PRG	Used to set an operation interlock in programming modes. 0: Cannot operate. 1: Can operate (Disabled when Digital Operator is set to select run command (when b1-02 = 0)).	0 or 1	0	No	A	187H	-

■DC Injection Braking: b2

Param-eter Number	Name: LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Access Level	RS-422A/485Regist er	Page
b2-01	Zero speed level (DC injection brak-ing starting frequency) DCInj Start Freq	Used to set the frequency at which DC injection braking starts in units of Hz when deceleration to stop is selected. When b2-01 is less than E1-09, E1-09 becomes the DC injection braking starting frequency.	0.0 to 10.0	0.5 Hz	No	A	189H	6-10

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Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/ 485Register	Page
b2-02	DC injection braking current DCInj Current	Sets the DC injection braking current as a percentage of the Inverter rated current.	0 to 100	50%	No	A	18AH	6-10 6-13
b2-03	DC injection braking time at start DCInj Time@Start	Used to set the time to perform DC injection braking at start. Used to stop coasting motor and restart it. When the set value is 0, DC injection braking at start is not performed.	0.00 to 10.00	0.00 s	No	A	18BH	6-13
b2-04	DC injection braking time at stop DCInj Time@Stop	Used to set the time to perform DC injection braking at stop. Used to prevent coasting after the stop command is input. When the set value is 0.00, DC injection braking at stop is not performed.	0.00 to 10.00	0.50 s	No	A	18CH	6-10

■Speed Search: b3

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access level	RS-422A/ 485 Register	Page
b3-01	Speed search selection (current detection or speed calculation) SPDSrch at Start	Enables/disables the speed search function for the RUN command and sets the speed search method. 0:Disabled, speed calculation 1: Enabled, speed calculation 2: Disabled, current detection 3: Enabled, current detection Speed Calculation: When the search is started, the motor speed is calculated and acceleration/deceleration is performed from the calculated speed to the specified frequency (motor direction is also searched). Current Detection: The speed search is started from the frequency when power was momentarily lost and the maximum frequency and the speed is detected at the search current level.	0 to 3	2	No	A	191H	6-38

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access level	RS-422A/485 Register	Page
b3-02	Speed search operating current (current detection) SPDSrch Current	Sets the speed search operation current as a percentage, taking the Inverter rated current as 100%. Not usually necessary to set. When restarting is not possible with the factory settings, reduce the value.	0 to 200	120%	No	A	192H	6-38
b3-03	Speed search deceleration time (current detection) SPDScrh Dec Time	Sets the output frequency deceleration time during speed search. Set the time for deceleration from the maximum output frequency to the minimum output frequency.	0.1 to 10.0	2.0 s	No	A	193H	6-38
b3-05	Speed search wait time (current detection or speed calculation) Search Delay	Sets the contactor operating delay time when there is a contactor on the output side of the Inverter. When a speed search is performed after recovering from a momentary power loss, the search operation is delayed by the time set here.	0.0 to 20.0	0.2 s	No	A	195H	6-38

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■PI Control: b5

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/485 Register	Page
b5-01	PI control mode selection PI Mode	0: Disabled 1: Enabled	0 to 1	0	No	A	1A5H	6-96
b5-02	Proportional gain (P) PI Gain	Sets P-control proportional gain as a percentage. P-control is not performed when the setting is 0.00.	0.00 to 25.00	1.00	Yes	A	1A6H	6-96
b5-03	Integral (I) time PI I Time	Sets I-control integral time. I-control is not performed when the setting is 0.0.	0.0 to 360.0	1.0 s	Yes	A	1A7H	6-96
b5-04	Integral (I) limit PI I Limit	Sets the I-control limit as a percentage of the maximum output frequency.	0.0 to 100.0	100.0%	Yes	A	1A8H	6-96
b5-06	PI limit PI Limit	Sets the limit after PI-control as a percentage of the maximum output frequency.	0.0 to 100.0	100.0%	Yes	A	1AAH	6-96
b5-07	PI offset adjustment PI Offset	Sets the offset after PI-control as a percentage of the maximum output frequency.	-100.0 to 100.0	0.0%	Yes	A	1ABH	6-96
b5-08	PI primary delay time parameter PI Delay Time	Sets the time parameter for low pass filter for PI-control outputs. Usually not necessary to set.	0.00 to 10.00	0.00 s	Yes	A	1ACH	6-96
b5-12	Selection of PI feedback command loss detection Fb los Det Sel	0: No detection of loss of PI feedback. 1: Detection of loss of PI feedback. Operation continues during detection, with the fault contact not operating. 2: Detection of loss of PI feedback. Coasts to stop during detection and fault contact operates.	0 to 2	0	No	A	1B0H	6-96
b5-13	PI feedback command loss detection level Fb los Det Lvl	Sets the PI feedback loss detection level , with the maximum output frequency at 100%.	0 to 100	0%	No	A	1B1H	6-96
b5-14	PI feedback command loss detection time Fb los Det Time	Sets the PI feedback loss detection level.	0.0 to 25.5	1.0 s	No	A	1B2H	6-96
b5-15	PI sleep function operation level PI Sleep Level	Set the PI sleep function start level as a frequency.	0.0 to 120.0	0.0 Hz	No	A	1B3H	6-96
b5-16	PI sleep operation delay time PI Sleep Time	Set the delay time until the PI sleep function starts.	0.0 to 25.5	0.0 s	No	A	1B4H	6-96

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/485 Register	Page
b5-17	Accel/decel time for PI reference PI Acc/Dec Time	Set the accel/decel time for PI reference in seconds.	0.0 to 25.5	0.0 s	No	A	1B5H	6-96

■Energy Saving: b8

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/485 Register	Page
b8-01	Energy-saving mode selection Energy Save Sel	Select whether to enable or disable energy-saving control. 0: Disable 1: Enable	0 or 1	0	No	A	1CCH	–
b8-04	Energy-saving coefficient Energy Save COEF	Adjust the motor rated capacity value by 5% at a time until output power reaches a minimum value.	0.0 to 655.00 *1	*2	No	A	1CFH	–
b8-05	Power detection filter time parameter kW Filter Time	Set the time parameter for output power detection.	0 to 2000	20 ms	No	A	1D0H	–
b8-06	Search operation voltage limiter Search V Limit	Set the limit value of the voltage control range during search operation. Set to 0 to disable the search operation. 100% is the motor base voltage.	0 to 100	0%	No	A	1D1H	–

* 1. The same capacity as the Inverter will be set by initializing the parameters.
* 2. The factory settings depend on the Inverter capacity.

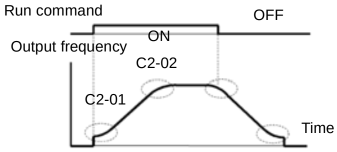
◆ Tuning Parameters: C

The following settings are made with the tuning parameters (C parameters): Acceleration/deceleration times, S-curve characteristics, torque compensation, speed control and carrier frequency functions

■ Acceleration/Deceleration: C1

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/485 Register	Page
C1-01	Acceleration time 1 Accel Time 1	Sets the acceleration time to accelerate from 0 to the maximum output frequency.	0.0 to 6000.0	10.0 s	Yes	Q	200H	4-6 6-17
C1-02	Deceleration time 1 Decel Time 1	Sets the deceleration time to decelerate from the maximum output frequency to 0.			Yes	Q	201H	4-6 6-17
C1-03	Acceleration time 2 Accel Time 2	The acceleration time when the multi-function input “accel/decel time 1” is set to ON.			Yes	A	202H	6-17
C1-04	Deceleration time 2 Decel Time 2	The deceleration time when the multi-function input “accel/decel time 1” is set to ON.			Yes	A	203H	6-17
C1-09	Emergency stop time Fast Stop Time	The deceleration time when the multi-function input “Emergency (fast) stop” is set to ON.			No	A	208H	6-16
C1-11	Accel/decel time switching frequency Acc/Dec SW Freq	Sets the frequency for automatic acceleration/deceleration switching. Below set frequency: Accel/decel time 2 Above set frequency: Accel/decel time 1 The multi-function input “accel/decel time 1” or “accel/decel time 2” has priority.	0.0 to 120.0	0.0 Hz	No	A	20AH	-

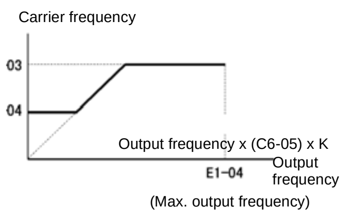
■S-curve Acceleration/Deceleration: C2

Param-eter-Number	Name LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Access Level	RS-422A/485 Register	Page
C2-01	S-curve characteristic time at acceleration start SCrv Acc @ Start	When the S-curve characteristic time is set, the accel/decel times will increase by only half of the S-curve characteristic times at start and end.  	0.00 to 2.50	0.20 s	No	A	20BH	-
C2-02	S-curve characteristic time at acceleration end SCrv Acc @ End	The S-curve characteristic time at start and end of deceleration is fixed to 0.2 sec and can not be changed.	0.00 to 2.50	0.20 s	No	A	20CH	-

■Torque Compensation: C4

Param-eter Number	Name LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Access Level	RS-422A/485 Register	Page
C4-01	Torque compensation gain Torq Comp Gain	Sets torque compensation gain as a ratio. Usually setting is not necessary. Adjust in the following circumstances: • When the cable is long; increase the set value. • When the motor capacity is smaller than the Inverter capacity (Max. applicable motor capacity), decrease the set values. • When the motor is oscillating, decrease the set values. Adjust the Torque compensation Gain so that at minimum speed rotation, the Inverter rated output current will not be exceeded.	0.00 to 2.50	1.00	Yes	A	215H	4-13 6-27
C4-02	Torque compensation primary delay time parameter Torq Comp Time	The torque compensation delay time is set in ms units. Usually setting is not necessary. Adjust in the following circumstances: • When the motor is oscillating, increase the set values. • When the responsiveness of the motor is low, decrease the set values.	0 to 10000	200 ms	No	A	216H	4-13 6-27

■Carrier Frequency: C6

Parameter Number	Name: LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/485 Register	Page
C6-02	Carrier frequency selection Carrier Freq Selection	Select carrier wave fixed pattern. Select F to enable detailed settings using parameters C6-03 to C6-05.	1 to F	6 *1	No	Q	224H	4-6 4-13 6-2
C6-03	Carrier frequency upper limit Carrier Freq Max	Set the carrier frequency upper limit and lower limit in kHz units. The carrier frequency gain is set as follows:	0.4 to 15.0 *2 *3	15.0 kHz *1	No	A	225H	-
C6-04	Carrier frequency lower limit Carrier Freq Min		0.4 to 15.0 *2 *3	15.0 kHz *1	No	A	226H	-
C6-05	Carrier frequency proportional gain Carrier Freq Gain	K is a coefficient that depends on the setting of C6-03. C6-03 ≥ 10.0 kHz: K = 3 10.0 kHz > C6-03 ≥ 5.0 kHz: K = 2 5.0 kHz > C6-03: K = 1	0 to 99 *3	0	No	A	227H	-

* 1. The factory setting depends on the capacity of the Inverter.
* 2. The setting range depends on the capacity of the Inverter.
* 3. This parameter can be monitored or set only when F is set for C6-02.

◆ Reference Parameters: d

■Preset Reference: d1

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/485 Register	Page
d1-01	Frequency reference 1 / Reference 1	Sets the frequency reference in the units used in o1-03.	0 to 50.00	0.00 Hz	Yes	Q	280H	4-7 6-4
d1-02	Frequency reference 2 / Reference 2	The frequency reference when multi-step speed command 1 is ON for a multi-function input.		0.00 Hz	Yes	Q	281H	4-7 6-4
d1-03	Frequency reference 3 / Reference 3	The frequency reference when multi-step speed command 2 is ON for a multi-function input.		0.00 Hz	Yes	Q	282H	4-7 6-6
d1-04	Frequency reference 4 / Reference 4	The frequency reference when multi-step speed commands 1 and 2 are ON for multi-function inputs.		0.00 Hz	Yes	Q	283H	4-7 6-6
d1-17	Jog frequency reference / Jog Reference	The frequency reference when the jog frequency reference selection, FJOG command or RJOG command is ON.		6.00 Hz	Yes	Q	292H	4-6 6-49

Note The unit is set in o1-03 (frequency units of reference setting and monitor, default: 0.01 Hz).

■Reference Limits: d2

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/485 Register	Page
d2-01	Frequency reference upper limit / Ref Upper Limit	Set the output frequency upper limit as a percentage of the max. output frequency.	0.0 to 110.0	100.0%	No	A	289H	6-26
d2-02	Frequency reference lower limit / Ref Lower Limit	Sets the output frequency lower limit as a percentage of the maximum output frequency.	0.0 to 110.0	0.0%	No	A	28AH	6-26
d2-03	Master speed reference lower limit / Ref1 Lower Limit	Set the master speed reference lower limit as a percentage of the max. output frequency.	0.0 to 110.0	0.0%	No	A	293H	6-26

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■Jump Frequencies: d3

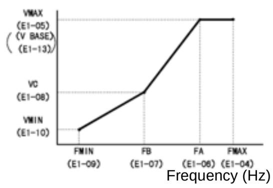
Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/485 Register	Page
d3-01	Jump frequency 1 Jump Freq 1	Set the center values of the jump frequencies in Hz. This function is disabled by setting the jump frequency to 0 Hz. Always ensure that the following applies: d3-01 ≥ d3-02 ≥ d3-03 Operation in the jump frequency range is prohibited but during acceleration and deceleration, the speed changes smoothly without jumping.	0.0 to 120.0	0.0 Hz	No	A	294H	6-24
d3-02	Jump frequency 2 Jump Freq 2			0.0 Hz	No	A	295H	6-24
d3-03	Jump frequency 3 Jump Freq 3			0.0 Hz	No	A	296H	6-24
d3-04	Jump frequency width Jump Bandwidth	Sets the jump frequency bandwidth in Hz. The jump frequency range will be the jump frequency ± d3-04.	0.0 to 20.0	1.0 Hz	No	A	297H	6-24

■Field Weakening: d6

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/485 Register	Page
d6-01	Field weakening level Field-Weak Lvl	Set the Inverter output voltage when the field weakening command is input. It is enabled when the field weakening command is set for a multi-function input. Set the level as a percentage taking the voltage set in the V/f pattern as 100%.	0 to 100	80%	No	A	2A0H	6-28
d6-02	Field frequency Field-Weak Freq	Set the lower limit in Hz of the frequency range where field control is valid. The field weakening command is valid only at frequencies above this setting and only when the speed is in agreement with the current speed reference.	0.0 to 120.0	0.0 Hz	No	A	2A1H	6-28

◆ Motor Costant Parameters: E

■V/f Pattern: E1

Parameter Number	Name LCD Diplay	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/485 Register	Page
E1-01	Input voltage setting Input Voltage	Sets the Inverter input voltage. This setting is used as a reference value in protection functions.	155 to 255 *1	200 V *1	No	Q	300H	4-6 6-104
E1-03	V/F pattern selection V/F Selection	0 to D: Select from the 14 preset patterns. F: Custom user-set patterns (Applicable for settings E1-04 to E1-10.)	0 to D, F	F	No	Q	302H	6-104
E1-04	Max. output frequency Max Frequency	 To set V/f characteristics in a straight line, set the same values for E1-07 and E1-09. In this case, the setting for E1-08 will be disregarded. Always ensure that the four frequencies are set in the following manner: E1-04 (FMAX) ≥ E1-06 (FA) > E1-07 (FB) ≥ E1-09 (FMIN)	0.0 to 120.0	50.0 Hz	No	Q	303H	6-104
E1-05	Max. voltage Max. voltage		0.0 to 255.0 *1	200.0 V *1	No	Q	304H	6-104
E1-06	Base frequency Base frequency		0.0 to 120.0	50.0 Hz	No	Q	305H	6-104
E1-07	Mid. output frequency Mid. Frequency A		0.0 to 120.0	2.5 Hz	No	A	306H	6-104
E1-08	Mid. output frequency voltage Mid. Voltage A		0.0 to 255 *1	15.0 V *1	No	A	307H	6-104
E1-09	Min. output frequency Min Frequency		0.0 to 120.0	1.2 Hz	No	Q	308H	6-104
E1-10	Min. output frequency voltage Min Voltage		0.0 to 255.0 *1	9.0 V *1	No	A	309H	4-13 6-104
E1-11	Mid. output frequency 2 Mid Frequency B	Set only to fine-adjust V/f for the output range. Normally, this setting is not required.	0.0 to 120.0	0.0 Hz *2	No	A	30AH	6-104
E1-12	Mid. output frequency voltage 2 Mid Voltage B		0.0 to 255.0 *1	0.0 V *2	No	A	30BH	6-104
E1-13	Base voltage Base voltage		0.0 to 255.0 *1	0.0 V *3	No	A	30CH	6-104

* 1. These are values for a 200 V Class Inverter. Values for a 400 V Class Inverter are double.
* 2. E1-11 and E1-12 are disregarded when set to 0.0.
* 3. E1-13 is set to the same value as E1-05 by autotuning.

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■Motor Setup: E2

Param-eter-Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Access Level	RS-422A/ 485 Register	Page
E2-01	Motor rated current / Motor Rated FLA	Sets the motor rated current. These set values will become the reference values for motor protection, torque limits and torque control. This parameter is an input data for autotuning.	0.37 to 7.40 *2	1.90 A *1	No	Q	30EH	6-33 6-103
E2-05	Motor line-to-line resistance / Term Resistance	Sets the motor phase-to-phase resistance in Ω units. This parameter is automatically set during autotuning.	0.000 to 65.000	9.842 Ω *1	No	A	312H	6-103

* 1. The factory setting depends upon the Inverter capacity. The value for a 200 V class Inverter of 0.4 kW is given.
* 2. The setting range is 10% to 200% of the Inverter's rated output current. The value for a 200 V class Inverter of 0.4 kW is given.

◆ Option Parameters: F

■Communications Option Cards: F6

Param-eter-Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Access Level	RS-422A/ 485 Register	Page
F6-01	DeviceNet fault operation selection / Comm Bus Flt Sel	Set the stopping method for communications errors. 0: Deceleration to stop using deceleration time in C1-02 1: Coast to stop/fault detection 2: Decelerates to stop using C1-09 deceleration time/fault detection 3: Continuous operating/alarm detection	0 to 3	1	No	A	3A2H	-
F6-02	Communications external fault input detection method selection / EF0 Detection	0: Fault detection during power ON 1: Fault detected during running only	0 or 1	0	No	A	3A3H	-
F6-03	Communications external fault input operation selection / EF0 Fault Action	0: Deceleration to a stop using C1-02 deceleration time/fault detection 1: Coast to stop/fault detection 2: Decelerates to a stop using C1-09 deceleration time/fault detection 3: Continuous operating/alarm detection	0 to 3	1	No	A	3A4H	-
F6-05	Display unit selection for Current monitor / Current Unit Sel	Sets the unit of current monitor 0: Ampere 1: 100%/8192	0 or 1	0	No	A	3A6H	-

◆ Terminal Function Parameters: H

The following settings are made with the terminal function parameters (H parameters): Settings for external terminal functions.

■Multi-function Digital Inputs: H1

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/485 Register	Page
H1-01	Terminal S3 function selection Terminal S3 Sel	Multi-function digital input 1	0 to 6A	24	No	A	400H	-
H1-02	Terminal S4 function selection Terminal S4 Sel	Multi-function digital input 2	0 to 6A	14	No	A	401H	-
H1-03	Terminal S5 function selection Terminal S5 Sel	Multi-function digital input 3	0 to 6A	3 (0)*	No	A	402H	-
H1-04	Terminal S6 function selection Terminal S6 Sel	Multi-function digital input 4	0 to 6A	4 (3)*	No	A	403H	-
H1-05	Terminal S7 function selection Terminal S7 Sel	Multi-function digital input 5	0 to 6A	6 (4)*	No	A	404H	-

* The values in parentheses indicate initial values when initialized in 3-wire sequence.

Multi-function Digital Input Functions

Setting Value	Function	Page
0	3-wire sequence (Forward/Reverse Run command)	6-9
1	Local/Remote selection (ON: Operator, OFF: parameter setting)	6-46
2	Option/Inverter selection (ON: Option Card)	6-49
3	Multi-step speed reference 1	6-6
4	Multi-step speed reference 2	6-6
6	Jog frequency command (higher priority than multi-step speed reference)	6-6
7	Accel/decel time 1	6-17
8	External baseblock NO (NO contact: Baseblock at ON)	6-46
9	External baseblock NC (NC contact: Baseblock at OFF)	6-46
F	Not used (Set when a terminal is not used)	-
10	Up command (Always set with the down command)	6-47
11	Down command (Always set with the up command)	6-47
12	FJOG command (ON: Forward run at jog frequency d1-17)	6-49
14	Fault reset (Reset when turned ON)	7-2
19	PI control disable (ON: PI control disabled)	6-97

Set-ting Value	Function	Page
1B	Parameters write enable (ON: All parameters can be written-in. OFF: All parameters other than frequency monitor are write protected.)	6-116
1E	Analog frequency reference sample/hold	6-48
20 to 2F	External fault (Desired settings possible) Input mode: NO contact/NC contact, Detection mode: Normal/during operation	6-50
34	PI soft starter	6-97
61	External search command 1 (ON: Speed search from maximum output frequency)	6-39
62	External search command 2 (ON: Speed search from set frequency)	6-39
63	Field weakening command (ON: Field weakening control set for d6-01 and d6-02)	6-28
64	External speed search command 3	6-39
67	Communications test mode	6-55
68	High-slip braking (HSB)	6-14
69	Jog Frequency 2	6–50
6A	Drive enable	6–51

■ Multi-function Digital Outputs: H2

Param-eter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Access Level	RS-422A/ 485 Register	Page
H2-01	Terminal M1-M2 function selection Term M1-M2 Sel	Multi-function contact output 1	0 to 38	0	No	A	40BH	-
H2-02	Terminal M3-M4 function selection Term M3-M4 Sel	Multi-function contact output 2	0 to 38	1	No	A	40CH	-

Multi-function Digital Output Functions

Setting Value	Function	Page
0	During run (ON: run command is ON or voltage is being output)	6-53
1	Zero-speed	6-26
2	Frequency agree 1 (L4-02 used.)	6-53
3	Desired frequency agree 1	6-53
4	Frequency (F-OUT) detection 1	6-53
5	Frequency (F-OUT) detection 2	6-53
6	Inverter operation ready	6-53
7	During DC bus undervoltage (UV) detection	6-53
8	During baseblock	6-53
9	Frequency reference selection	6-53
A	Run command selection status	6-53
B	Overtorque/undertorque detection 1 NO (NO contact: Overtorque/undertorque detection at ON)	6-31
C	Loss of frequency reference (Effective when 1 is set for L4-05)	6-43
E	Fault	6-53

Setting Value	Function	Page
F	Not used.	6-53
10	Minor fault	6-53
11	Fault reset command active	6-53
17	Overtorque/undertorque detection 1 NC (NC Contact: Torque detection at OFF)	6-30
1A	Reverse direction	6-53
1E	Restart enabled (ON: Restart enabled)	6-43
1F	Motor overload (OL1, including OH3) pre-alarm (ON: 90% or more of the detection level)	6-33
38	Drive enabled	–

■Analog Inputs: H3

Parameter Number	Name LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/ 485 Register	Page
H3-02	Gain (terminal A1) Terminal A1 Gain	Sets the frequency when 10 V is input, as a percentage of the maximum output frequency.	0.0 to 1000	100.0%	Yes	A	411H	6-22
H3-03	Bias (terminal A1) Terminal A1 Bias	Sets the frequency when 0 V is input, as a percentage of the maximum frequency.	-100.0 to 100.0	0.0%	Yes	A	412H	6-22
H3-08	Multi-function analog input terminal A2 signal level selection Term A2 Signal	0: Limit negative frequency settings for gain and bias settings to 0. 2: 4 to 20 mA (9-bit input). Switch current and voltage input using the switch S1 on the control panel.	0 or 2	2	No	A	417H	6-22
H3-09	Multi-function analog input terminal A2 function selection Terminal A2 Sel	Select multi-function analog input function for terminal A2. Refer to the next table.	0 to 1F	0	No	A	418H	6-22
H3-10	Gain (terminal A2) Terminal A2 Gain	Sets the input gain (level) when terminal 14 is 10 V (20 mA). Set according to the 100% value for the function set for H3-09.	0.0 to 1000	100.0%	Yes	A	419H	6-22
H3-11	Bias (terminal A2) Terminal A2 Bias	Sets the input gain (level) when terminal 14 is 0 V (4 mA). Set according to the 100% value for the function set for H3-09.	-100.0 to 100.0	0.0%	Yes	A	41AH	6-22
H3-13	Terminal A1/ A2 switching T A1/A2 Select	0: Use terminal A1 analog input as main speed frequency reference. 1: Use terminal A2 analog input as main speed frequency reference. Effective when H3-09 is set to 2.	0 or 1	0	No	A	41CH	-

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H3-09 Settings

Setting Value	Function	Contents (100%)	Page
0	Frequency bias (Add to terminal A1)	Maximum output frequency	6-23
2	Auxiliary frequency reference (2nd step analog)	Maximum output frequency	6-22
B	PI feedback	Maximum output frequency	6-97
D	Frequency reference 2	Maximum output frequency	6-23
E	Motor temperature input	10 V = 100%	6-36
1F	Analog input not used.	-	-

■Multi-function Analog Outputs: H4

Parameter Number	Name LCD Dispay	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/485 Register	Page
H4-01	Monitor selection (terminal FM) Terminal FM Sel	Sets the number of the monitor item to be output (U1-☐☐) from terminal FM. 10 to 14, 28, 34, 39, 40 cannot be set.	1 to 38	2	No	A	41DH	6-52
H4-02	Gain (terminal FM) Terminal FM Gain	Sets the multi-function analog output 1 voltage level gain. Sets whether the monitor item output will be output in multiples of 10 V. The maximum output from the terminal is 10 V. A meter calibration function is available.	0 to 1000	100%	Yes	Q	41EH	4-7 6-52
H4-03	Bias (terminal FM) Terminal FM Bias	Sets the multi-function analog output 1 voltage level bias. Sets output characteristic up/down parallel movement as a percentage of 10 V. The maximum output from the terminal is 10 V. A meter calibration function is available.	-110 to 110	0.0%	Yes	A	41FH	4-7
H4-04	Monitor selection (terminal AM) Terminal AM Sel	Sets the number of the monitor item to be output (U1-☐☐) from terminal AM. 10 to 14, 28, 34, 39, 40 cannot be set.	1 to 38	3	No	A	420H	4-7 6-52
H4-05	Gain (terminal AM) Terminal AM Gain	Set the voltage level gain for multi-function analog output 2. Set the number of multiples of 10 V to be output as the 100% output for the monitor items. The maximum output from the terminal is 10 V. A meter calibration function is available.	0 to 1000	50.0%	Yes	Q	421H	4-7 6-52
H4-06	Bias (terminal AM) Terminal AM Bias	Sets the multi-function analog output 2 voltage level bias. Sets output characteristic up/down parallel movement as a percentage of 10 V. The maximum output from the terminal is 10 V. A meter calibration function is available.	-110.0 to 110.0	0.0%	Yes	A	422H	6-53
H4-07	Analog output 1 signal level selection AO Level Select1	Sets the signal output level for multi-function output 1 (terminal FM) 0: 0 to +10 V output 2: 4 – 20 mA*	0 or 2	0	No	A	423H	-
H4-08	Analog output 2 signal level selection AO Level Select2	Sets the signal output level for multi-function output 2 (terminal AM) 0: 0 to +10 V output 2: 4 – 20 mA*	0 or 2	0	No	A	424H	-

* An analog output of 4-20 mA can not be used with the standard terminal board. Therefore an optional terminal board (with shunt connector CN15) is needed.

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■RS-422A/485 Communications: H5

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/485 Register	Page
H5-01	Station address Serial Comm Adr	Set the Inverter's node address.	0 to 20 *	1F	No	A	425H	6-55
H5-02	Communication speed selection Serial Baud Rate	Set the baud rate for RS-422A/485 communications. 0: 1200 bps 1: 2400 bps 2: 4800 bps 3: 9600 bps 4: 19200 bps	0 to 4	3	No	A	426H	6-55
H5-03	Communication parity selection Serial Com Sel	Set the parity for RS-422A/485 communications. 0: No parity 1: Even parity 2: Odd parity	0 to 2	0	No	A	427H	6-55
H5-04	Stopping method after communication error Serial Fault Sel	Set the stopping method for communications errors. 0: Deceleration to stop using deceleration time in C1-02 1: Coast to stop 2: Emergency stop using deceleration time in C1-09 3: Continue operation	0 to 3	3	No	A	428H	6-55
H5-05	Communication error detection selection Serial Flt Dtct	Set whether or not a communications timeout is to be detected as a communications error. 0: Do not detect. 1: Detect	0 or 1*	1	No	A	429H	6-55
H5-06	Send wait time Transmit Wait-TIM	Set the time from the Inverter receiving data to when the Inverter starts to send.	5 to 65	5 ms	No	A	42AH	6-55
H5-07	RTS control ON/OFF RTS Control Sel	Select to enable or disable RTS control. 0: Disabled (RTS is always ON) 1: Enabled (RTS turns ON only when sending)	0 or 1	1	No	A	42BH	6-55

* Set H5-01 to 0 to disable Inverter responses to RS-422A/485 communications.

◆ Protection Function Parameters: L

The following settings are made with the protection function parameters (L parameters): Motor selection function, power loss ridethrough function, stall prevention function, frequency detection, torque limits and hardware protection.

■Motor Overload: L1

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/485 Register	Page
L1-01	Motor protection selection MOL Fault Sel	Sets whether the motor overload function is enabled or disabled at electric thermal overload relay. 0: Disabled 1: General-purpose motor protection In some applications when the Inverter power supply is turned off, the thermal value is reset, so even if this parameter is set to 1, protection may not be effective.	0 or 1	1	No	Q	480H	4-7 6-33
L1-02	Motor protection time parameter MOL Time Const	Sets the electric thermal detection time. Usually changing this setting is not necessary. The factory setting is 120% overload for one minute. When the motor's overload resistance is known, also set the overload resistance protection time for when the motor is hot started.	0.1 to 5.0	1.0 min	No	A	481H	6-33
L1-03	Alarm operation selection during motor overheating Mtr OH Alarm Sel	Set H3-09 to E and select the operation when the input motor temperature (thermistor) input exceeds the alarm detection level (1.17 V). 0: Decelerate to stop 1: Coast to stop 2: Emergency stop using the deceleration time in C1-09. 3: Continue operation (OH3 on the Operator flashes).	0 to 3	3	No	A	482H	6-35
L1-04	Motor overheating operation selection Mtr OH Fault Sel	Set H3-09 to E and select the operation when the motor temperature (thermistor) input exceeds the operation detection level (2.34 V). 0: Decelerate to stop 1: Coast to stop 2: Emergency stop using the deceleration time in C1-09.	0 to 2	1	No	A	483H	6-35
L1-05	Motor temperature input filter time parameter Mtr Temp Filter	Set H3-09 to E and set the primary delay time parameter for motor temperature (thermistor) inputs in seconds.	0.00 to 10.00	0.20 s	No	A	484H	6-35

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■Power Loss Ridethrough: L2

Param-eter-Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Access Level	RS-422A/ 485 Register	Page
L2-01	Momentary power loss detection PwrL Selec-tion	0: Disabled (main circuit under-voltage (UV) detection) 1: Enabled (Restarted when the power returns within the time for L2-02. When L2-02 is exceeded, main circuit under-voltage detection.) 2: Enabled while CPU is opera-ting. (Restarts when power returns during control operati-ons. Does not detect main cir-cuit undervoltage.)	0 to 2	0	No	A	485H	6-37
L2-02	Momentary power loss ridethru time PwrL Ride-thru t	Ridethrough time, when Momen-tary Power Loss Selection (L2-01) is set to 1, in units of seconds.	0 to 25.5	0.1 s *1	No	A	486H	6-37
L2-03	Min. base-block time PwrL Base-block t	Sets the Inverter's minimum base-block time, when the Inverter is restarted after power loss ride-through. Sets the time to approximately 0.7 times the motor secondary circuit time parameter. When an overcurrent or overvolt-age occurs when starting a speed search or DC injection braking, increase the set values.	0.1 to 5.0	0.1 s *1	No	A	487H	6-37 6-38
L2-04	Voltage recov-ery time PwrL V/F Ramp t	Sets the time required to return the Inverter output voltage to nor-mal voltage at the completion of a speed search. Sets the time required to recover from 0 V to the maximum volt-age.	0.0 to 5.0	0.3 s *1	No	A	488H	6-37 6-38
L2-05	Undervoltage detection level PUV Det Level	Sets the main circuit undervolt-age (UV) detection level (main circuit DC voltage). Usually changing this setting is not necessary. Insert an AC reactor in the Inverter input side to lower the main circuit undervoltage detec-tion level.	150 to 210 *2	190 V *2	No	A	489H	6-37

* 1. The factory setting depends upon the Inverter capacity. The value for a 200 V Class Inverter of 0.4 kW is given.
* 2. These are values for a 200 V class Inverter. Value for a 400 V class Inverter is double.

■Stall Prevention: L3

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/485 Register	Page
L3-01	Stall prevention selection during accel StallP Accel Sel	0: Disabled (Acceleration as set. With a heavy load, the motor may stall.) 1: Enabled (Acceleration stopped when L3-02 level -15% is reached . Acceleration starts again when the current is returned.) 2: Intelligent acceleration mode (Accellerates to the L3-02 level . Set acceleration time is disregarded.)	0 to 2	1	No	A	48FH	6-19
L3-02	Stall prevention level during accel StallP Accel Lvl	Effective when L3-01 is set to 1 or 2. Set as a percentage of Inverter rated current. Usually changing this setting is not necessary. The factory setting reduces the set values when the motor stalls.	0 to 200	120%	No	A	490H	6-19
L3-04	Stall prevention selection during decel StallP Decel Sel	0: Disabled (Deceleration as set. If deceleration time is too short, a DC-Bus overvoltage may result.) 1: Enabled (Deceleration is stopped when the DC-Bus voltage exceeds the overvoltage level. Deceleration restarts when voltage level has been restored.) 2: Intelligent deceleration mode (Deceleration rate is automatically adjusted so that in Inverter can decelerate in the shortest possible time. Set deceleration time is disregarded.) When a braking option (Braking Resistor Unit and Braking Unit) is used, always set to 0.	0 to 2	1	No	Q	492H	4-7 6-21
L3-05	Stall prevention selection during running StallP Run Sel	0: Disabled (Runs as set. With a heavy load, the motor may stall.) 1: Deceleration time 1 (the deceleration time for the stall prevention function is C1-02.) 2: Deceleration time 2 (the deceleration time for the stall prevention function is C1-04.)	0 to 2	1	No	A	493H	6-30
L3-06	Stall prevention level during running StallP Run Level	Effective when L3-05 is 1 or 2. Set as a percentage of the Inverter rated current. Usually changing this setting is not necessary. The factory setting reduces the set values when the motor stalls.	30 to 200	120%	No	A	494H	6-30

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■Reference Detection: L4

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/485 Register	Page
L4-01	Speed agreement detection level Spd Agree Level	Effective when "Desired frequency (ref/setting) agree 1", "Frequency detection 1" or "Frequency detection 2" is set for a multi-function output.	0.0 to 120.0	0.0 Hz	No	A	499H	-
L4-02	Speed agreement detection width Spd Agree Width	Effective when "Frequency (speed) agree 1", "Desired frequency (speed) agree 1" or "Frequency (F-OUT) detection 1" is set for a multi-function output.	0.0 to 20.0	2.0 Hz	No	A	49AH	-
L4-05	Operation when frequency reference is missing Ref Loss Sel	0: Stop (Operation follows the frequency reference.) 1: Operation continues at the frequency, set in parameter L4-06. Frequency reference loss means that the frequency reference value drops over 90% in 400 ms.	0 or 1	0	No	A	49DH	6-43
L4-06	Frequency reference value at frequency reference loss Fref at Floss	Sets the frequency reference value when the frequency reference is missing	0.0 to 100.0	80%	No	A	4C2H	6-43

■Fault Restart: L5

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	Rs-422A/485 Register	Page
L5-01	Number of auto restart attempts Num of Restarts	Sets the number of auto restart attempts. Automatically restarts after a fault and conducts a speed search from the run frequency.	0 to 10	0	No	A	49EH	6-44
L5-02	Auto restart operation selection Restart Sel	Sets whether a fault contact output is activated during fault restart. 0: No output (Fault contact is not activated.) 1: Output (Fault contact is activated.)	0 or 1	0	No	A	49FH	6-44

■Torque Detection: L6

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/485 Register	Page
L6-01	Torque detection selection 1 Torq Det 1 Sel	0: Overtorque/undertorque detection disabled. 1: Overtorque detection only with speed agreement; operation continues after overtorque (warning). 2: Overtorque detected continuously during operation; operation continues after overtorque (warning). 3: Overtorque detection only with speed agreement; output stopped upon detection (protected operation). 4: Overtorque detected continuously during operation; output stopped upon detection (protected operation). 5: Undertorque detection only with speed agreement; operation continues after overtorque (warning). 6: Undertorque detected continuously during operation; operation continues after overtorque (warning). 7: Undertorque detection only with speed agreement; output stopped upon detection (protected operation). 8: Undertorque detected continuously during operation; output stopped upon detection (protected operation).	0 to 8	0	No	A	4A1H	6-31
L6-02	Torque detection level 1 Torq Det 1 Lvl	Inverter rated current is set as 100%.	0 to 300	150%	No	A	4A2H	6-31
L6-03	Torque detection time 1 Torq Det 1 Time	Sets the overtorque/undertorque detection time.	0.0 to 10.0	0.1 s	No	A	4A3H	6-31

■Hardware Protection: L8

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/485 Register	Page
L8-02	Overheat pre-alarm level OH Pre-alarm Lvl	Sets the detection temperature for the Inverter overheat detection pre-alarm in °C. The pre-alarm detects when the cooling fin temperature reaches the set value.	50 to 130	95 °C*	No	A	4AEH	6-45

Param-eter-Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Access Level	RS-422A/485 Register	Page
L8-03	Operation selection after overheat pre-alarm OH Pre alarm Sel	Sets the operation for when the Inverter overheat pre-alarm occurs. 0: Decelerate to stop in deceleration time C1-02. 1: Coast to stop 2: Fast stop in fast-stop time C1-09. 3: Continue operation (Monitor display only.) A fault will be given in setting 0 to 2 and a minor fault will be given in setting 3.	0 to 3	3	No	A	4AFH	6-45
L8-09	Ground protection selection Ground Fault Sel	0:Disabled 1:Enabled	0 or 1	1	No	A	4B5H	-
L8-11	Cooling fan control delay time Fan Delay Time	Set the time in seconds to delay turning OFF the cooling fan.	0 to 300	60 s	No	A	4B7H	-
L8-12	Ambient temperature Ambient Temp	Set the ambient temperature.	45 to 60	45 °C*	No	A	4B8H	-
L8-15	OL2 characteristics selection at low speeds OL2 Sel @ L-Spd	0: OL2 characteristics at low speeds disabled. 1: OL2 characteristics at low speeds enabled.	0 or 1	1	No	A	4BBH	-
L8-18	Soft CLA selection Soft CLA Sel	0: Disabled (gain = 0) 1: Enabled	0 or 1	1	No	A	4BFH	-

* The factory setting depends upon the Inverter capacity. The value for a 200 V Class Inverter of 0.4 kW is given.

◆ n: Special Adjustments

The following settings are made with the special adjustments parameters (n-parameters): Hunting prevention and High-slip braking.

■Hunting Prevention Function: n1

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/ 485 Register	Page
n1-01	Hunting-prevention function selection Hunt Prev Select	0: Hunting-prevention function disabled 1: Hunting-prevention function enabled The hunting-prevention function suppresses hunting when the motor is operating with a light load. If high response has the priority over vibration suppression, disable the hunting-prevention function.	0 or 1	1	No	A	580H	6-29
n1-02	Hunting-prevention gain Hunt Prev Gain	Set the hunting-prevention gain multiplication factor. Normally, there is no need to change this setting. Make the adjustments as follows: • If vibration occurs with light load, increase the setting. • If the motor stalls, reduce the setting. If the setting is too large, the voltage will be too suppressed and the motor may stall.	0.00 to 2.50	1.00	No	A	581H	4-13 6-29

■High-slip Braking: n3

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/ 485 Register	Page
n3-01	High-slip braking deceleration frequency width HSB Decel Width	Sets the frequency width for deceleration during high-slip braking in percent, taking the Maximum Frequency (E1-04) as 100%.	1 to 20	5%	No	A	588H	6-14
n3-02	High-slip braking current limit HSB Current Ref	Sets the current limit for deceleration during high-slip braking in percent, taking the motor rated current as 100%. The resulting limit must be 150% of the Inverter rated current or less.	100 to 200	150%	No	A	589H	6-14

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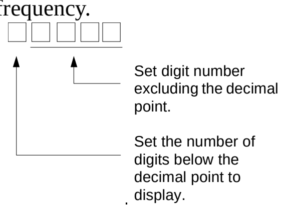
Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/ 485 Register	Page
n3-03	High-slip braking stop dwell time HSB Dwel-Tim@Stp	Sets the dwell time for the output frequency for FMIN (1.5 Hz) during V/f control. Effective only during deceleration for high-slip braking.	0.0 to 10.0	1.0 s	No	A	58AH	6-14
n3-04	High-slip braking OL time HSB Ol Time	Set the OL time when the output frequency does not change for some reason during deceleration for high-slip braking.	30 to 1200	40 s	No	A	58BH	6-14

◆ Digital Operator Parameters: o

■Monitor Select: o1

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/ 485 Register	Page
o1-01	Monitor selection User Monitor Sel	Set the number of the 3rd. monitor item to be displayed in the Drive Mode. (U1-□□) (Only LCD operator.)	4 to 33	6	Yes	A	500H	-
o1-02	Monitor selection after power up Power ON Monitor	Sets the monitor item to be displayed when the power is turned on. 1: Frequency reference 2: Output frequency 3: Output current 4: The monitor item set for o1-01	1 to 4	1	Yes	A	501H	6-110

Parameter Number	Name LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/ 485 Register	Page
o1-03	Frequency units of reference setting and monitor Display Scaling	Sets the units that will be set and displayed for the frequency reference and frequency monitor. 0: 0.01 Hz units 1: 0.01% units (Maximum output frequency is 100%) 2 to 39: r/min units (Sets the motor poles.) 40 to 39999: User desired display Set the desired values for setting and display for the max. output frequency.  Example: When the max. output frequency value is 200.0, set 12000	0 to 39999	0	No	A	502H	6-110
o1-05	LCD-Brightness LCD Contrast	1: light 2: 3: normal 4: 5: dark	0 to 5	3	Yes	A	509H	

■Multi-function Selections: o2

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/485 Register	Page
o2-01	LOCAL/REMOTE key enable/disable Local/Remote Key	Sets the Digital Operator Local/ Remote Key 0: Disabled 1: Enabled (Switches between the Digital Operator and the parameter settings.)	0 or 1	1	No	A	505H	6-110
o2-02	STOP key during control circuit terminal operation Oper STOP Key	Sets the Stop Key in the run mode. 0: Disabled (When the run command is issued from and external terminal, the Stop Key is disabled.) 1: Enabled (Effective even during run.)	0 or 1	1	No	A	506H	6-110
o2-03	Parameter initial value User Defaults	Clears or stores User Initial values. 0: Stores/not set 1: Begins storing (Records the set parameters as user initial values.) 2: All clear (Clears all recorded user initial values)	0 to 2	0	No	A	507H	6-110
o2-04	kVA selection Inverter Model	Do not set unless using a control board from an Inverter with a different capacity.	0 to FF	0*	No	A	508H	-
o2-05	Frequency reference setting method selection Operator M.O.P.	When the frequency reference is set on the Digital Operator frequency reference monitor, sets whether the Enter Key is necessary. 0: Enter Key needed 1: Enter Key not needed When set to 1, the Inverter accepts the frequency reference without Enter Key operation.	0 or 1	0	No	A	509H	6-110
o2-06	Operation selection when digital operator is disconnected Oper Detection	Sets the operation when the Digital Operator is disconnected. 0: Disabled (Operation continues even if the Digital Operator is disconnected.) 1: Enabled (OPR is detected at Digital Operator disconnection. Inverter output is cut off and fault contact is operated.)	0 or 1	0	No	A	50AH	-
o2-07	Cumulative operation time setting Elapsed Time Set	Sets the cumulative operation time in hour units. Operation time is calculated from the set values.	0 to 65535	0 hr	No	A	50BH	6-110

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/485 Register	Page
o2-08	Cumulative operation time selection / Elapsed Time Run	0: Cumulative time when the Inverter power is on. (All time while the Inverter power is on is accumulated.) 1: Cumulative Inverter run time. (Only Inverter output time is accumulated.)	0 or 1	0	No	A	50CH	-
o2-09	Initialize Mode / Init Mode Sel	2: European specification 5: PV-E specification	2 or 5	5	No	A	50DH	–
o2-10	Fan operation time setting / Fan ON Time Set	Set the initial value of the fan operation time. The operation time accumulates from the set value.	0 to 65535	0 hr	No	A	50EH	6-110
o2-12	Fault trace initialize / FLT Trace Init	0: Disable 1: Initialize (= zero clear) after setting ”1“ o2-12 will be returned to ”0“	0 or 1	0	No	A	511H	-

* This setting depends on the inverter capacity.

■ Copy Function: o3

Parameters for the copy function are shown in the following table.

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/485 Register	Page
o3-01	Copy function selection / Copy Function Sel	0: Normal operation 1: READ (Inverter to Operator) 2: COPY (Operator to Inverter) 3: Verify (compare)	0 to 3	0	No	A	515H	6-112
o3-02	Read permission selection / Read Allowable	0: Read prohibited 1: Read permitted	0 or 1	0	No	A	516H	6-112

◆ T: Motor Autotuning

The following settings are made with the motor autotuning parameters (T parameters): Settings for autotuning.

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/485 Register	Page
T1-02	Motor output power / Mtr Rated Power	Set the output power of the motor in kilowatts.	0.00 to 650.00	0.40 kW	No	A	702H	4-8

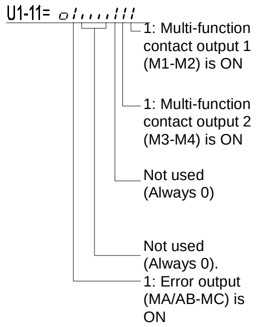
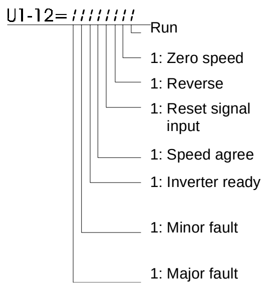
Param-eter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Access Level	RS-422A/ 485 Register	Page
T1-04	Motor rated current Rated Current	Set the rated current of the motor in Amps.	0.32 to 6.40	1.90 A	No	A	704H	4-8

◆ U: Monitor Parameters

The following settings are made with the monitor parameters (U parameters): Setting parameters for monitoring in drive mode.

■ Status Monitor Parameters: U1

Param-eter-Number	Name / LCD Display	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Access Level	RS-422A/ 485 Register
U1-01	Frequency reference Frequency Ref	Monitors/sets the frequency value.*	10 V: Max. frequency (0 to + 10 V possible)	0.00 Hz	A	40H
U1-02	Output frequency Output Freq	Monitors the output frequency.*	10 V: Max. frequency (0 to + 10 V possible)	0.00 Hz	A	41H
U1-03	Output current Output Current	Monitors the output current.	10 V: Inverter rated output current (0 to +10 V, absolute value output)	0.0 A	A	42H
U1-06	Output voltage Output Voltage	Monitors the output voltage reference value in the Inverter.	10 V: 200 VAC (400 VAC) (0 to +10 V output)	0.0 V	A	45H
U1-07	DC bus voltage DC Bus Voltage	Monitors the main DC voltage in the Inverter.	10 V: 400 VDC (800 VDC)	0 V	A	46H
U1-08	Output power Output kWatts	Monitors the output power (internal detected value)	10V: Inverter maximum capacity (max. applicable motor capacity) (0 to +10 V possible)	0.0 kW		
U1-10	Input terminal status Input Term Sts	Shows input ON/OFF status. U1-10=□□□□□□□ 1: FWD command (S1) is ON 1: REV command (S2) is ON 1: Multi input 1 (S3) is ON 1: Multi input 2 (S4) is ON 1: Multi input 3 (S5) is ON 1: Multi input 4 (S6) is ON 1: Multi input 5 (S7) is ON	(Cannot be output.)	-	A	49H

Parameter Number	Name / LCD Display	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Access Level	RS-422A/ 485 Register
U1-11	Output terminal status Output Term Sts	Shows output ON/OFF status.  	(Cannot be output.)	-	A	4AH
U1-12	Operation status Int Ctl Sts 1	Inverter operating status.  	(Cannot be output.)	-	A	4BH
U1-13	Cumulative operation time Elapsed Time	Monitors the total operating time of the Inverter. The initial value and the operating time/power ON time selection can be set in o2-07 and o2-08.	(Cannot be output.)	0 hr	A	4CH
U1-14	Software No. (flash memory) FLASH ID	(Manufacturer's ID number)	(Cannot be output.)	-	A	4DH
U1-15	Terminal A1 input voltage Term A1 Level	Monitors the input voltage of the voltage frequency reference. An input of 10 V corresponds to 100%.	10 V: 100% (10 V) (0 to + 10 V possible)	0.0%	A	4EH
U1-16	Terminal A2 input voltage Term A2 Level	Monitors the input voltage of the multi-function analog input. An input of 10 V corresponds to 100%.	10 V: 100% (10 V) (0 to +10 V possible)	0.0%	A	4FH
U1-18	Motor secondary current (Iq) Mot Sec Current	Monitors the calculated value of the motor secondary current. The motor rated secondary current corresponds to 100%.	10 V:Motor rated secondary current) (0 to +10 V output)	0.0%	A	51H
U1-20	Output frequency after soft-starter (SFS output) SFS Output	Monitors the output frequency after the soft starter. The frequency given does not include compensations. The unit is set in o1-03.	10 V: Max. frequency (0 to + 10 V possible)	0.00 Hz	A	53H

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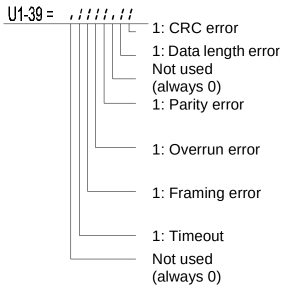
Parameter Number	Name LCD Display	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Access Level	RS-422A/485 Register
U1-24	PI feedback value PI Feedback	Monitors the feedback value when PI control is used. The input for the max. frequency corresponds to 100%.	10 V: Max. frequency (0 to + 10 V possible)	0.00 %	A	57H
U1-28	Software No. (CPU) CPU ID	(Manufacturer’s CPU software No.)	(Cannot be output.)	-	A	5BH
U1-34	OPE fault parameter OPE Detected	Shows the first parameter number where an OPE fault was detected.	(Cannot be output.)	-	A	61H
U1-36	PI input volume PI Input	PI feedback volume Given as maximum frequency/ 100%	10 V: Max. frequency (0 to + 10 V possible)	0.00 %	A	63H
U1-37	PI output volume PI Output	PI control output Given as maximum frequency/ 100%	10 V: Max. frequency (0 to + 10 V possible)	0.00 %	A	64H
U1-38	PI command PI Setpoint	PI command + PI command bias Given as maximum frequency/ 100%	10 V: Max. frequency	0.00 %	A	65H
U1-39	RS-422A/485 communications error code Transmit Err	Shows RS-422A/485 errors. 	(Cannot be output.)	-	A	66H
U1-40	Cooling fan operating time FAN Elapsed Time	Monitors the total operating time of the cooling fan. The time can be set in 02-10.	(Cannot be output.)	0 hr	A	68H

* The unit is set in o1-03 (frequency units of reference setting and monitor).

■ Fault Trace: U2

Parameter Number	Name / LCD Diplay	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Access Level	RS-422A/485 Register
U2-01	Current fault Current Fault	The content of the current fault.	(Cannot be output.)	-	A	80H
U2-02	Last fault Last Fault	The error content of the last fault.		-	A	81H
U2-03	Reference frequency at fault Frequency Ref	The reference frequency when the last fault occurred.		0.00 Hz	A	82H
U2-04	Output frequency at fault Output Freq	The output frequency when the last fault occurred.		0.00 Hz	A	83H
U2-05	Output current at fault Output Current	The output current when the last fault occurred.		0.0 A	A	84H
U2-07	Output voltage reference at fault Output Voltage	The output reference voltage when the last fault occurred.		0.0 V	A	86H
U2-08	DC bus voltage at fault DC Bus Voltage	The main current DC voltage when the last fault occurred.		0 V	A	87H
U2-09	Output power at fault Output kWatts	The output power when the last fault occurred.		0.0 kW	A	88H
U2-11	Input terminal status at fault Input Term Sts	The input terminal status when the last fault occurred. The format is the same as for U1-10.		-	A	8AH

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Param-eter-Number	Name / LCD Diplay	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Access Level	RS-422A/485 Register
U2-12	Output terminal status at fault / Output Term Sts	The output terminal status when the last fault occurred. The format is the same as for U1-11.	(Cannot be output.)	-	A	8BH
U2-13	Operation status at fault / Inverter Status	The operating status when the last fault occurred. The format is the same as for U1-12.	(Cannot be output.)	-	A	8CH
U2-14	Cumulative operation time at fault / Elapsed Time	The operating time when the last fault occurred.	(Cannot be output.)	0 hr	A	8DH

Note The following errors are not included in the error trace: CPF00, 01, 02, 03, UV1 and UV2.

■Fault History: U3

Parameter Number	Name / LCD Display	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Access Level	RS-422A/ 485 Register
U3-01	Last fault Last Fault	The error content of 1st last fault.	(Cannot be output.)	-	A	90H
U3-02	Second last fault Fault Message 2	The error content of 2nd last fault.		-	A	91H
U3-03	Third last fault Fault Message 3	The error content of 3rd last fault.		-	A	92H
U3-04	Fourth last fault Fault Message 4	The error content of 4th last fault.		-	A	93H
U3-05	Cumulative operation time at fault Elapsed Time 1	The total operating time when the 1st last fault occurred.		0 hr	A	94H
U3-06	Accumulated time of second fault Elapsed Time 2	The total operating time when the 2nd last fault occurred.		0 hr	A	95H
U3-07	Accumulated time of third fault Elapsed Time 3	The total operating time when the 3rd last fault occurred.		0 hr	A	96H
U3-08	Accumulated time of fourth/ oldest fault Elapsed Time 4	The total operating time when the 4th last fault occurred.		0 hr	A	97H
U3-09 - U3-14	Fifth last to 10th last faultt Fault Message ..	The error content of the 5th to 10th fault		–	A	804H 805H 806H 807H 808H 809H
U3-15 – U3-20	Accumulated time of fifth to tenth fault Elapsed Time ..	Total generating time when 5th ... 10th pevious fault occured		0hr	A	80EH 80FH 810H 811H 812H 813H

Note The following errors are not recorded in the error log: CPF00, 01, 02, 03, UV1 and UV2.

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■200 V and 400 V Class Inverters of 0.4 to 1.5 kW

Para meter Num- ber	Unit	Factory Setting														
E1-03	-	0	1	2	3	4	5	6	7	8	9	A	B	C	D	F
E1-04	Hz	50.0	60.0	60.0	72.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	90.0	120.0	60.0
E1-05 *	V	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0
E1-06	Hz	50.0	60.0	50.0	60.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	60.0	60.0	60.0
E1-07 *	Hz	2.5	3.0	3.0	3.0	25.0	25.0	30.0	30.0	2.5	2.5	3.0	3.0	3.0	3.0	3.0
E1-08 *	V	15.0	15.0	15.0	15.0	35.0	50.0	35.0	50.0	19.0	24.0	19.0	24.0	15.0	15.0	15.0
E1-09	Hz	1.3	1.5	1.5	1.5	1.3	1.3	1.5	1.5	1.3	1.3	1.5	1.5	1.5	1.5	1.5
E1-10 *	V	9.0	9.0	9.0	9.0	8.0	9.0	8.0	9.0	11.0	13.0	11.0	15.0	9.0	9.0	9.0

* The settings shown are for 200 V class Inverters. The values will double for 400 V class Inverters.

■200 V and 400 V Class Inverters of 2.2 to 45 kW

Para meter Num- ber	Unit	Factory Setting														
E1-03	-	0	1	2	3	4	5	6	7	8	9	A	B	C	D	F
E1-04	Hz	50.0	60.0	60.0	72.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	90.0	120.0	60.0
E1-05 *	V	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0
E1-06	Hz	50.0	60.0	50.0	60.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	60.0	60.0	60.0
E1-07 *	Hz	2.5	3.0	3.0	3.0	25.0	25.0	30.0	30.0	2.5	2.5	3.0	3.0	3.0	3.0	3.0
E1-08 *	V	14.0	14.0	14.0	14.0	35.0	50.0	35.0	50.0	18.0	23.0	18.0	23.0	14.0	14.0	14.0
E1-09	Hz	1.3	1.5	1.5	1.5	1.3	1.3	1.5	1.5	1.3	1.3	1.5	1.5	1.5	1.5	1.5
E1-10 *	V	7.0	7.0	7.0	7.0	6.0	7.0	6.0	7.0	9.0	11.0	9.0	13.0	7.0	7.0	7.0

* The settings shown are for 200 V class Inverters. The values will double for 400 V class Inverters.

■200 V Class Inverters of 55 to 110 kW and 400 V Class Inverters of 55 to 300 kW

Para meter Num- ber	Unit	Factory Setting														
E1-03	-	0	1	2	3	4	5	6	7	8	9	A	B	C	D	F
E1-04	Hz	50.0	60.0	60.0	72.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	90.0	120.0	60.0
E1-05 *	V	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0
E1-06	Hz	50.0	60.0	50.0	60.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	60.0	60.0	60.0
E1-07 *	Hz	2.5	3.0	3.0	3.0	25.0	25.0	30.0	30.0	2.5	2.5	3.0	3.0	3.0	3.0	3.0
E1-08 *	V	12.0	12.0	12.0	12.0	35.0	50.0	35.0	50.0	15.0	20.0	15.0	20.0	12.0	12.0	12.0
E1-09	Hz	1.3	1.5	1.5	1.5	1.3	1.3	1.5	1.5	1.3	1.3	1.5	1.5	1.5	1.5	1.5
E1-10 *	V	6.0	6.0	6.0	6.0	5.0	6.0	5.0	6.0	7.0	9.0	7.0	11.0	6.0	6.0	6.0

* The settings shown are for 200 V class Inverters. The values will double for 400 V class Inverters.

◆ Factory Settings that Change with the Inverter Capacity (o2-04)

■200 V Class Inverters

Param-eter-Number	Name	Unit	Factory Setting								
-	Inverter Capacity	kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15
o2-04	kVA selection	-	0	1	2	3	4	5	6	7	8
b8-04	Energy-saving coeffi-cient	-	288.20	223.70	169.40	156.80	122.90	94.75	72.69	70.44	63.13
C4-02	Torque compensation primary delay time	ms	200	200	200	200	200	200	200	200	200
C6-02	Carrier frequency selec-tion	-	6	6	6	6	6	6	6	6	6
E2-01	Motor rated current	A	1.90	3.30	6.20	8.50	14.00	19.60	26.60	39.7	53.0
E2-05	Motor line-to-line resis-tance	Ω	9.842	5.156	1.997	1.601	0.771	0.399	0.288	0.230	0.138
L2-02	Momentary power loss ridethru time	s	0.1	0.1	0.2	0.3	0.5	1.0	1.0	1.0	2.0
L2-03	Min. baseblock (BB) time	s	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
L2-04	Voltage recovery time	s	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
L8-02	Overheat pre-alarm level	°C	95	95	95	95	95	95	95	95	95

Param-eter Number	Name	Unit	Factory Setting								
-	Inverter Capacity	kW	18.5	22	30	37	45	55	75	90	110
o2-04	kVA selection	-	9	A	B	C	D	E	F	10	11
b8-04	Energy-saving coeffi-cient	-	57.87	51.79	46.27	38.16	35.78	31.35	23.10	23.10	23.10
C4-02	Torque compensation primary delay time	ms	200	200	1000	1000	1000	1000	1000	1000	1000
C6-02	Carrier frequency selec-tion*	-	6	6	4	3	3	3	3	3	1
E2-01	Motor rated current	A	65.8	77.2	105.0	131.0	160.0	190.0	260.0	260.0	260.0
E2-05	Motor line-to-line resis-tance	Ω	0.101	0.079	0.064	0.039	0.030	0.022	0.023	0.023	0.023
L2-02	Momentary power loss ridethru time	s	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
L2-03	Min. baseblock (BB) time	s	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.5	1.7
L2-04	Voltage recovery time	s	0.6	0.6	0.6	0.6	0.6	1.0	1.0	1.0	1.0
L8-02	Overheat pre-alarm level	°C	95	95	95	95	95	95	95	95	95

Note Attach a Momentary Power Interruption Compensation Unit if compensation for power interruptions of up to 2.0 seconds is required for 200 V class Inverters with outputs of 0.4 to 11 kW.

* If C6-02 is set to 0, 1 or F and the initial value of C6-03 and C6-04 is 2.0 kHz, the initial settings for C6-02 are as follows: 2: 5.0 kHz, 3: 8.0 kHz, 4: 10 kHz, 5: 12.5 kHz and 6: 15 kHz. If the carrier frequency is set higher than the factory setting for Inverters with outputs of 7.5 kW or more, the Inverter rated current will need to be reduced.

■400 V Class Inverters

Parameter Number	Name	Unit	Factory Setting									
-	Inverter Capacity	kW	0.4	0.75	1.5	2.2	3.7	4.0	5.5	7.5	11	15
o2-04	kVA selection	-	20	21	22	23	24	25	26	27	28	29
b8-04	Energy-saving coefficient	-	576.40	447.40	338.80	313.60	245.80	236.44	189.50	145.38	140.88	126.26
C4-02	Torque compensation primary delay time	ms	200	200	200	200	200	200	200	200	200	200
C6-02	Carrier frequency selection *	-	6	6	6	6	6	6	6	6	6	6
E2-01	Motor rated current	A	1.00	1.60	3.10	4.20	7.00	7.00	9.80	13.30	19.9	26.5
E2-05	Motor line-to-line resistance	Ω	38.198	22.459	10.100	6.495	3.333	3.333	1.595	1.152	0.922	0.550
L2-02	Momentary power loss ridethru time	s	0.1	0.1	0.2	0.3	0.5	0.5	0.8	0.8	1.0	2.0
L2-03	Min. baseblock (BB) time	s	0.1	0.2	0.3	0.4	0.5	0.6	0.6	0.7	0.8	0.9
L2-04	Voltage recovery time	s	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
L8-02	Overheat pre-alarm level	°C	95	95	95	95	95	95	95	95	95	95

Parameter Number	Name	Unit	Factory Setting									
-	Inverter Capacity	kW	18.5	22	30	37	45	55	75	90	110	132
o2-04	kVA selection	-	2A	2B	2C	2D	2E	2F	30	31	32	33
b8-04	Energy-saving coefficient	-	115.74	103.58	92.54	76.32	71.56	67.20	46.20	41.22	36.23	33.18
C4-02	Torque compensation primary delay time	ms	200	200	200	200	200	1000	1000	1000	1000	1000
C6-02	Carrier frequency selection *	-	6	6	4	4	4	4	3	3	3	2
E2-01	Motor rated current	A	32.9	38.6	52.3	65.6	79.7	95.0	130.0	156.0	190.0	223.0
E2-05	Motor line-to-line resistance	Ω	0.403	0.316	0.269	0.155	0.122	0.088	0.092	0.056	0.046	0.035
L2-02	Momentary power loss ridethru time	s	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
L2-03	Min. baseblock (BB) time	s	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.5	1.7	1.7
L2-04	Voltage recovery time	s	0.6	0.6	0.6	0.6	0.6	1.0	1.0	1.0	1.0	1.0
L8-02	Overheat pre-alarm level	°C	95	95	95	95	95	100	95	110	110	110

Param-eter-Number	Name	Unit	Fac-tory Set-ting
-	Inverter Capacity	kW	160
o2-04	kVA selection	-	34
b8-04	Energy-saving coeffi-cient	-	30.13
C4-02	Torque compensation primary delay time	ms	1000
C6-02	Carrier frequency selec-tion *	-	2
E2-01	Motor rated current	A	270.0
E2-05	Motor line-to-line resis-tance	Ω	0.029
L2-02	Momentary power loss ridethru time	s	2.0
L2-03	Min. baseblock (BB) time	s	1.8
L2-04	Voltage recovery time	s	1.0
L8-02	Overheat pre-alarm level	°C	100

Note Attach a Momentary Power Interruption Compensation Unit if compensation for power interruptions of up to 2.0 seconds is required for 200 V class Inverters with outputs of 0.4 to 11 kW.

* If C6-02 is set to 0, 1 or F and the initial value of C6-03 and C6-04 is 2.0 kHz, the initial settings for C6-02 are as follows: 2: 5.0 kHz, 3: 8.0 kHz, 4: 10 kHz, , 5: 12.5 kHz and 6: 15 kHz. If the carrier frequency is set higher than the factory setting for Inverters with outputs of 7.5 kW or more, the Inverter rated current will need to be reduced.

6

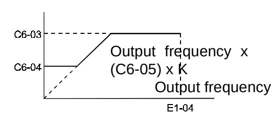
Chapter 6

Parameter Settings by function

Carrier Frequency Selections

◆ Select the Carrier Frequency to Suit the Application

■Related Parameters

<table>
<tr><th rowspan="2">Parame-ter No.</th><th>Name</th><th rowspan="2">Details</th><th rowspan="2">Setting Range</th><th rowspan="2">Factory Setting</th><th rowspan="2">Changes During Opera-tion?</th><th rowspan="2">Access Level</th></tr>
<tr><th>LCD Display</th></tr>
<tr><td rowspan="2">C6-02</td><td>Carrier frequency selection</td><td rowspan="2">Select carrier wave fixed pattern.
Select F to enable detailed settings using parameters C6-03 to C6-05.
1: Carrier 2 kHz
2: Carrier 5 kHz
3: Carrier 8,0 kHz
4: Carrier 10.0 kHz
5: Carrier 12.5 kHz
6: Carrier 15 kHz
F: User set*1</td><td rowspan="2">1 to F</td><td rowspan="2">6
*1</td><td rowspan="2">No</td><td rowspan="2">Q</td></tr>
<tr><td>CarrierFreq Sel</td></tr>
<tr><td rowspan="2">C6-03</td><td>Carrier frequency upper limit</td><td rowspan="6">Set upper and lower carrier frequency limits in kHz.
Set the carrier wave gain as shown below.
In vector control method, the carrier frequency is fixed according to C6-03 (Carrier Frequency Upper Limit).
Carrier frequency


(Maximum output frequency)
K is the coefficient determined by the set value in C6-03.
C6-03 Š 10.0 kHz: K = 3
10.0 kHz > C6-03 Š 5.0 kHz
: K = 2
5.0 kHz > C6-03: K = 2</td><td rowspan="2">2.0 to 15.0
*2 *3</td><td rowspan="2">15.0 kHz
*1</td><td rowspan="2">No</td><td rowspan="2">A</td></tr>
<tr><td>CarrierFreq Max</td></tr>
<tr><td rowspan="2">C6-04</td><td>Carrier frequency lower limit</td><td rowspan="2">0.4 to 15.0
*2 *3</td><td rowspan="2">15.0 kHz
*1</td><td rowspan="2">No</td><td rowspan="2">A</td></tr>
<tr><td>CarrierFreq Min</td></tr>
<tr><td rowspan="2">C6-05</td><td>Carrier frequency proportional gain</td><td rowspan="2">00 to 99
*3</td><td rowspan="2">00</td><td rowspan="2">No</td><td rowspan="2">A</td></tr>
<tr><td>CarrierFreq Gain</td></tr>
</table>

* 1. The factory settings depend on the Inverter capacity.
* 2. The setting ranges depend on the Inverter capacity.
* 3. Can be set and referenced only when C6-02 is set to F.

Carrier Frequency

When selecting the carrier frequency, observe the following precautions:

- Adjust the carrier frequency according to the cases shown below.
  If the wiring distance between Inverter and motor is long: Set the carrier frequency low. (Use the following values as guidelines.

Wiring Length	50 m or less	100 m or less	Over 100 m
C6-02 (carrier frequency) setting	1 to 6 (15 kHz)	1 to 4 (10 kHz)	1 to 2 (5 kHz)

  If speed and torque are inconsistent at low speeds: Set the carrier frequency low.
  If Inverter noise is affecting peripheral devices: Set the carrier frequency low.
  If leakage current from the Inverter is large: Set the carrier frequency low.
  If metallic noise from the motor is large: Set the carrier frequency high.

- The carrier frequency can be varied to match the output frequency, as shown in the following diagram, by setting C6-03 (Carrier Frequency Upper Limit), C6-04 (Carrier Frequency Lower Limit) and C6-05 (Carrier Frequency Proportional Gain).

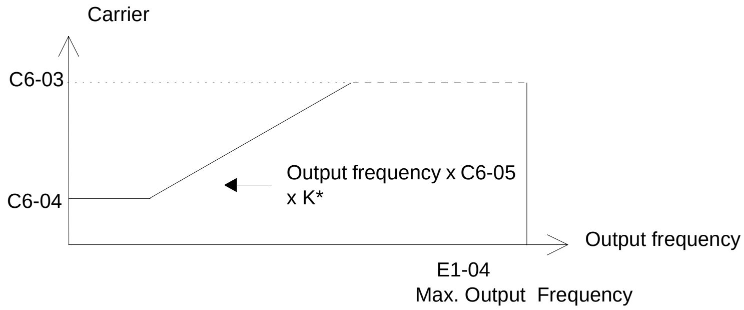


Fig 6.1

*K is the coefficient determined by the set value in C6-03.
C6-03 Š 10.0 kHz: K=3
10.0 kHz > C6-03 ≥ 5.0 kHz: K=2
5.0 kHz < C6-03: K=1

- To fix the carrier frequency, set C6-03 and C6-04 to the same value or set C6-05 to 0.
- If Carrier Frequency Proportional Gain (C6-05) < 6 and C6-03 < C6-04, OPE11 (Data setting error) will occur.

■Carrier Frequency and Inverter Overload Current Level

When using a 200 V Class Inverter 30 to 110 kW or a 400 V Class Inverter for 30 to 160 kW with a carrier frequency higher than 10 kHz, the Inverter overload level will be reduced. Even when the overload current is below 120%, in this case an OL2 (Inverter overload) will be detected. The Inverter overload current reduction level is shown below.

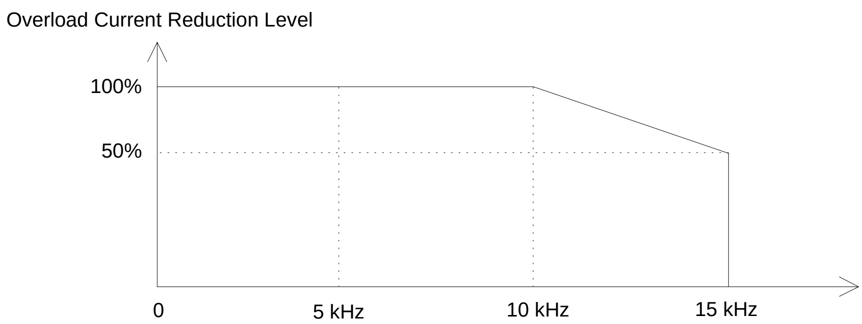


Fig 6.2 Overload Current Reduction Level

Frequency Reference

This section explains how to input the frequency reference.

◆ Selecting the Frequency Reference Source

Set parameter b1-01 to select the frequency reference source.

■Related Parameters

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level
b1-01	Reference selection Reference Source	Set the frequency reference source 0: Digital Operator 1: Control circuit terminal (analog input) 2: RS-422A/485 communications 3: Option Card	0 to 3	1	No	Q

■Input the Reference Frequency from the Digital Operator

When b1-01 is set to 0, you can input the reference frequency from the Digital Operator.

For details on setting the reference frequency, refer to *Chapter 3 Digital Operator and Modes*.

Fig 6.3 Frequency Setting Display

■Inputting the Frequency Reference Using Voltage (Analog Setting)

When b1-01 is set to 1, you can input the frequency reference from control circuit terminal A1 (voltage input) or control circuit terminal A2 (voltage or current input).

Inputting Master Speed Frequency Reference Only

If inputting the master speed frequency reference only, input the voltage reference to control circuit terminal A1.

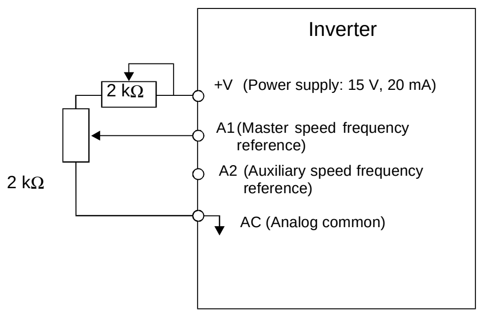


Fig 6.4 Master Speed Frequency Reference Input

2-Step Switching: Master/Auxiliary

If performing 2-step switching between master and auxiliary speed frequencies, input the master speed frequency reference to control circuit terminal A1 and input the auxiliary speed frequency reference to A2.

When terminal S3 (multi-step speed command 1) is OFF, terminal A1 (master speed frequency reference) will be the Inverter frequency reference and when terminal S3 is ON, terminal A2 (auxiliary speed frequency reference) will be the Inverter frequency reference.

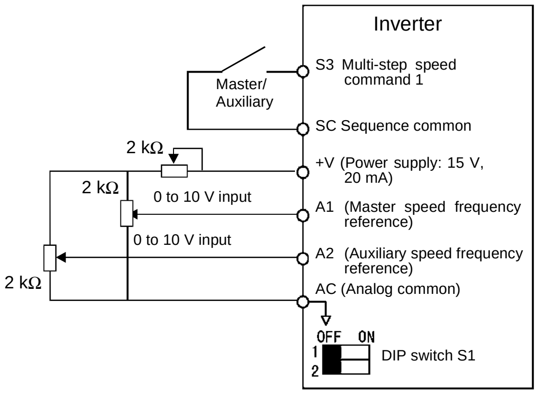


Fig 6.5 Master/Auxiliary Frequency Reference Input

Setting Precautions

When inputting a voltage signal to terminal A2, observe the following precautions.

- Turn OFF pin 2 on DIP switch S1 for switching between voltage and current (factory setting is ON).
- The parameter H3-08 has to be set to 0.

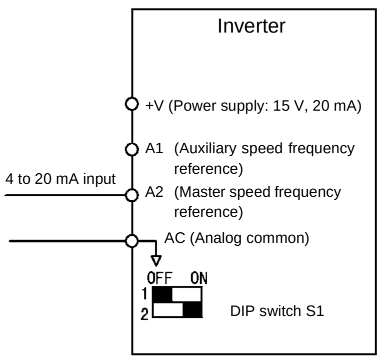
6

■Inputting Frequency Reference Using Current

When b1-01 is set to 1, you can input the frequency reference from control circuit terminal A2. Input the current (4 to 20 mA) in control circuit terminal A2.

When H3-09 (Multi-Function Analog Input Terminal A2 Function Selection) is set to 0 (factory setting) the input on A2 is added to A1.

Fig 6.6 Frequency Reference Using Current



Setting Precautions

- When inputting a current signal to terminal A2, turn ON pin 2 on DIP switch S1 (factory setting: ON).
- The parameter H3-08 has to be set to 2 (4 - 20 mA input).
- If using terminal A2 to input the master speed reference and terminal A1 to input the auxiliary frequency reference, set H3-13 (Terminal A1/A2 Switching) to 1.

◆ Using Multi-Step Speed Operation

With SYSDRIVE PV series Inverters, you can change the speed to a maximum of 5 steps, using 4 frequency references and one jog frequency reference.

The following example of a multi-function input terminal function shows a 5-step operation using multi-step references 1 to 3 and jog frequency selection functions.

Related Parameters

To switch frequency references, set multi-step references 1 to 4 and the jog reference selection in the multi-function digital inputs.

Multi-function digital Inputs (H1-01 to H1-05)

Terminal	Parameter Number	Set Value	Details
S5	H1-03	4	Multi-step speed command 1 (Also used for master speed/auxiliary speed switching when multi-function analog input H3-09 is set to 2 (auxiliary frequency reference).)
S6	H1-04	5	Multi-step speed command 2
S7	H1-05	6	Jog frequency selection (given priority over multi-step speed command)

Combining Multi-Function References and Multi-Function digital Inputs

You can change the selected frequency reference by combining the ON/OFF status of S4 to S7 (multi-function digital input terminals) to set multi-step speed commands 1 to 3 and the jog frequency selection. The following table shows the possible combinations.

Speed	TerminalS5	TerminalS6	TerminalS7	Selected Frequency
	Multi-step Speed Command 2	Multi-step Speed Command 3	Jog Frequency Selection	
1	OFF	OFF	OFF	Frequency reference 1 d1-01, master speed frequency
2	ON	OFF	OFF	Frequency reference 2 d1-02, auxiliary frequency
3	OFF	ON	OFF	Frequency reference 3 d1-03
4	ON	ON	OFF	Frequency reference 4 d1-04
5	-	-	ON*	Jog frequency d1-17

* Terminal S7's jog frequency selection is given priority over multi-step speed commands.

Setting Precautions

When setting analog inputs to step 1 and step 2, observe the following precautions.

- When setting terminal A1's analog input to step 1, set b1-01 to 1 and when setting d1-01 (Frequency Reference 1) to step 1, set b1-01 to 0.
- When setting terminal A2's analog input to step 2, set H3-09 to 2 (auxiliary frequency reference). When setting d1-02 (Frequency Reference 2) to step 2, set H3-09 to 1F (do not use analog inputs).

■Connection Example and Time Chart

The following diagram shows a time chart and control circuit terminal connection example during a 5-step operation.

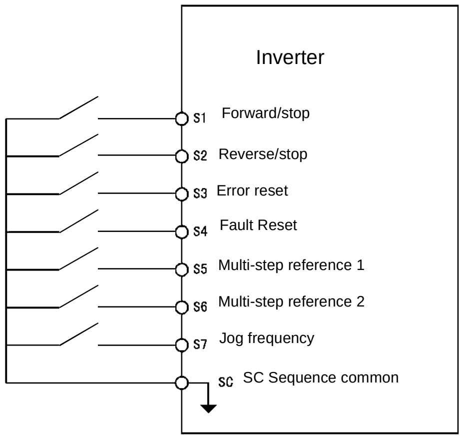


Fig 6.7 Control Circuit Terminal During 5-step Operation

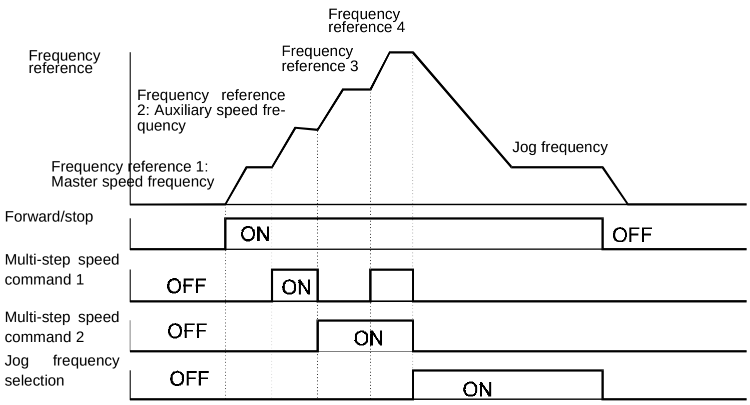


Fig 6.8 Multi-step speed command/Jog Frequency Selection Time Chart

Run Command

This section explains input methods for the run command.

◆ Selecting the Run Command Source

Set parameter b1-02 to select the source for the run command.

■Related Parameters

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level
b1-02	Operation method selection Run Source	Set the run command source. 0: Digital operator 1: Control circuit terminal (sequence input) 2: RS-422A/485 communications 3: Option Card	0 to 3	1	No	Q

■Performing Operations Using a Digital Operator

When b1-02 is set to 0, you can perform Inverter operations using the Digital Operator keys (RUN, STOP, JOG and FWD/REV). For details on the Digital Operator, refer to *Chapter 3 Digital Operator and Modes*.

■Performing Operations Using Control Circuit Terminals

When b1-02 is set to 1, you can perform Inverter operations using the control circuit terminals.

Performing Operations Using a 2-wire Sequence

The factory setting is set to a 2-wire sequence. When control circuit terminal S1 is set to ON, forward operation will be performed and when S1 is turned OFF, the Inverter will stop. In the same way, when control circuit terminal S2 is set to ON, reverse operation will be performed and when S2 is turned OFF, the Inverter will stop.

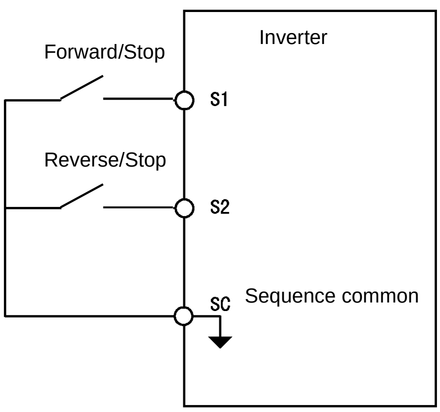


Fig 6.9 2-wire Sequence Wiring Example

Performing Operations Using a 3-wire Sequence

When any parameter from H1-01 to H1-05 (multi-function digital input terminals S3 to S7) is set to 0, terminals S1 and S2 are used for a 3-wire sequence and the multi-function input terminal has been set as a forward/reverse run command terminal.

When the Inverter is initialized for 3-wire sequence control with A1-03, multi-function input 3 becomes the input terminal for the forward/reverse run command.

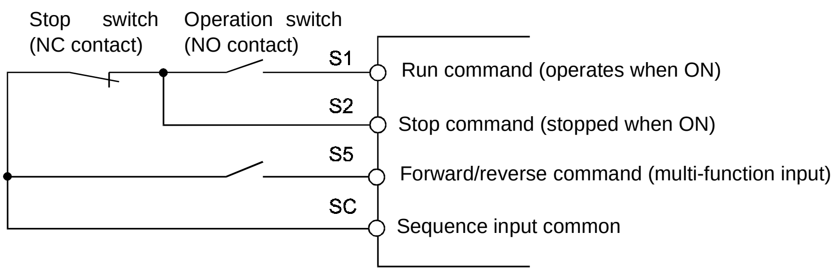


Fig 6.10 3-wire Sequence Wiring Example

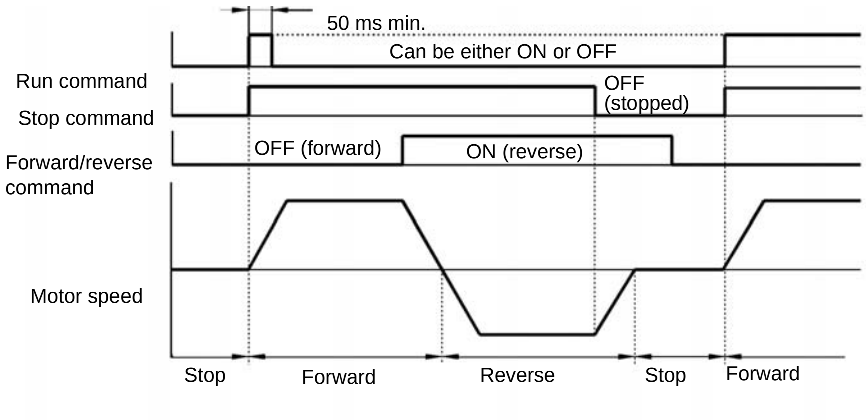


Fig 6.11 Three-wire Sequence Time Chart

INFO

Use a sequence that turns ON terminal S1 for 50 ms or longer for the run command. This will make the run command self-holding in the Inverter.

Stopping Methods

◆ Selecting the Stopping Method when a Stop Command is Input

There are four methods of stopping the Inverter when a stop command is input:

- Deceleration to stop
- Coast to stop
- DC braking stop
- Coast to stop with timer

Set parameter b1-03 to select the Inverter stopping method.

■Related Parameters

Parameter number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level
b1-03	Stopping method selection Stopping Method	Select stopping method when stop command is sent. 0: Deceleration to stop 1: Coast to stop 2: DC braking stop (Stops faster than coast to stop, without regenerative operation.) 3: Coast to stop with timer (Run commands are ignored during deceleration time.)	0 to 3	0	No	Q
b2-01	Zero speed level (DC injection braking starting frequency) DCInj Start Freq	Set the frequency to start the DC injection braking in units of Hz when deceleration to stop is selected. DC injection braking starts from E1-09 when b2-01 < E1-09.	0.0 to 10.0	0.5 Hz	No	A
b2-02	DC injection braking current DCInj Current	Set the DC injection braking current as a percentage, taking the Inverter rated current as 100%.	0 to 100	50%	No	A
b2-04	DC injection braking time at stop DCInj Time @Stop	Set the DC injection braking time at stop. Use when stopping if rotations continue due to momentum. Set to 0.00 to disable DC injection braking time at stop.	0.00 to 10.00	0.50 s	No	A

■Deceleration to Stop

If the stop command is input (i.e., the run command is turned OFF) when b1-03 is set to 0, the motor decelerates to a stop according to the deceleration time that has been set. (Factory setting: C1-02 (Deceleration Time 1))

If the output frequency when decelerating to a stop falls below b2-01, the DC injection brake will be applied using the DC current set in b2-02 only for the time set in b2-04.

For deceleration time settings, refer to *page 6-17 Setting Acceleration and Deceleration Times*.

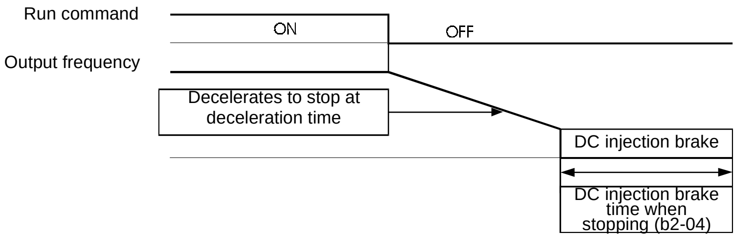


Fig 6.12 Deceleration to Stop

■Coast to Stop

If the stop command is input (i.e., the run command is turned OFF) when b1-03 is set to 1, the Inverter output voltage is interrupted. The motor coasts to a stop.

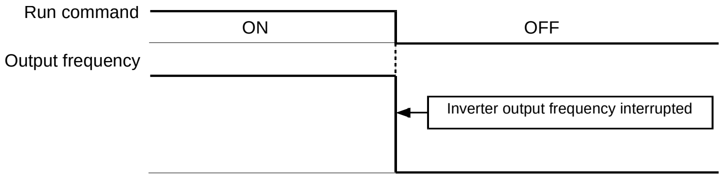


Fig 6.13 Coast to Stop

INFO

After the stop command is input, run commands are ignored until the Minimum Baseblock Time (L2-03) has elapsed.

■DC Braking Stop

After the stop command is input and the minimum baseblock time (L2-03) is elapsed, DC injection will be applied to the motor. The applied DC injection current is programmed in parameter b2-02. The DC injection brake time is determined by the set value in b2-04 and the output frequency when the stop command is input.

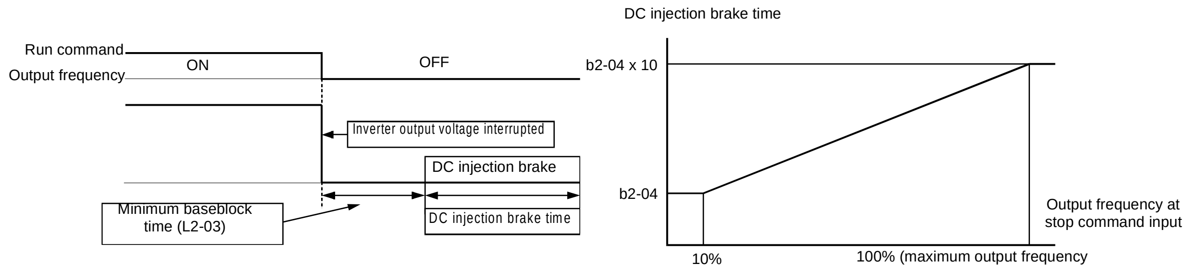


Fig 6.14 DC Injection Braking (DB) Stop

INFO

Lengthen the Minimum Baseblock Time (L2-03) when an overcurrent (OC) occurs during stopping.

■Coast to Stop with Timer

If the stop command is input (i.e., the run command is turned OFF) when b1-03 is set to 3, the Inverter output is interrupted to coast the motor to a stop. After the stop command is input, run commands are ignored until the time T has elapsed. The time T depends upon the output frequency when the stop command is input and the deceleration time.

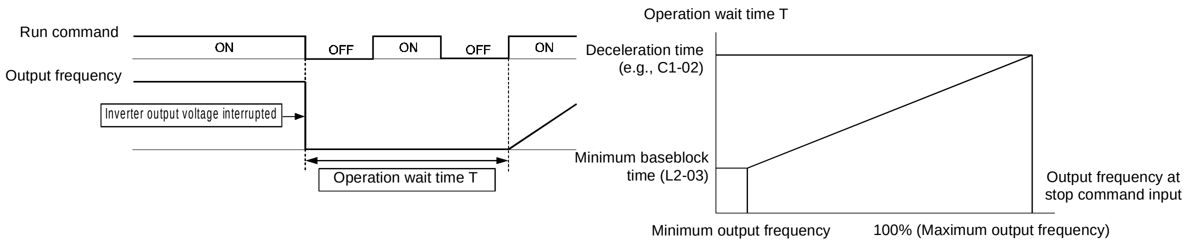


Fig 6.15 Coast to Stop with Timer

◆ Using the DC Injection Brake

Set parameter b2-03 to apply DC injection to the motor, before it starts to accelerate. Applying DC injection at start will stop the motor before starting, if it was coasting through inertia or wind mill effect.

Set b2-03 to 0 to disable the DC injection brake at start.

Set the DC injection brake current using b2-02.

■Related Parameters

Parame-terNum-ber	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level
b2-02	DC injection braking current DCInj Current	Set the DC Injection Braking Current as a percentage of the Inverter rated current.	0 to 100	50%	No	A
b2-03	DC injection braking time at start DCInj Time@Start	Used to set the time to perform DC injection braking at start. Used to stop coasting motor and restart it. When the set value is 0, DC injection braking at start is not performed.	0.00 to 10.00	0.00 s	No	A

■Inputting the DC Injection Brake Command from Control Circuit Terminals

If you set a multi-function digital input terminal (H1-□□) to 60 (DC injection brake command), you can apply the DC injection brake to the motor by turning ON the terminal for which the DC injection brake command has been set, when the Inverter is being stopped.

The time chart for the DC injection brake is shown below.

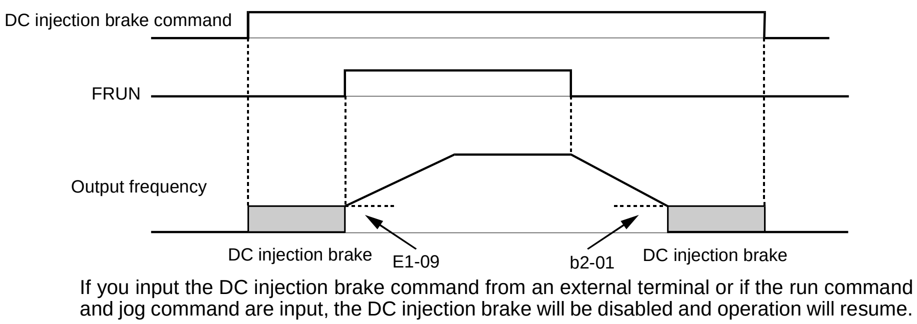


Fig 6.16 DC Injection Brake Time Chart

◆ Using Highslip braking

When the system is operating, the Inverter is delivering an amount of electrical energy to the motor, this energy is transformed into mechanical and thermal energy.

When the motor is operating as a generator, the motor efficiency is still high. Most of the energy returns to the Inverter as current flow. This regenerated current is stored in the DC bus capacitors, increasing the DC bus voltage. If the regenerated energy is bigger than the Inverter losses (10% or less) the DC bus will increase to a level where the braking resistor starts working. If no braking resistor is installed the DC voltage will increase up to a level where the Inverter operation will be stopped and an overvoltage (OV) is shown.

■Related parameters

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/485 Register
n3-01	High-slip braking deceleration frequency width HSB Decel Width	Sets the frequency width for deceleration during high-slip braking in percent, taking the Maximum Frequency (E1-04) as 100%.	1 to 20	5%	No	A	588H
n3-02	High-slip braking current limit HSB Current Ref	Sets the current limit for deceleration during high-slip braking in percent, taking the motor rated current as 100%. The resulting limit must be 150% of the Inverter rated current or less.	100 to 200	150%	No	A	589H
n3-03	High-slip braking stop dwell time HSB Dwel-Tim@Stp	Sets the dwell time for the output frequency for FMIN (1.5 Hz) during V/f control. Effective only during deceleration for high-slip braking.	0.0 to 10.0	1.0 s	No	A	58AH
n3-04	High-slip braking OL time HSB Ol Time	Set the OL time when the output frequency does not change for some reason during deceleration for high-slip braking.	30 to 1200	40 s	No	A	58BH
H1-01 - H1-05	Terminal sel S3-S7 Terminal sel S3-S7	Multifunction Digital Inputs	0 to 77		No	A	400H to 404H

■The concept of HSB

If we want to stop very fast without using a braking resistor, the only way is to reduce the amount of current regeneration. This is done by reducing the motor efficiency. Most of the energy will be dissipated as heat within the motor and just a little bit of energy is regenerated to the Inverter.

The way to reduce the motor efficiency is to force a high slip in the motor and keep it working in the non-linear zone of its Torque/slip curve.

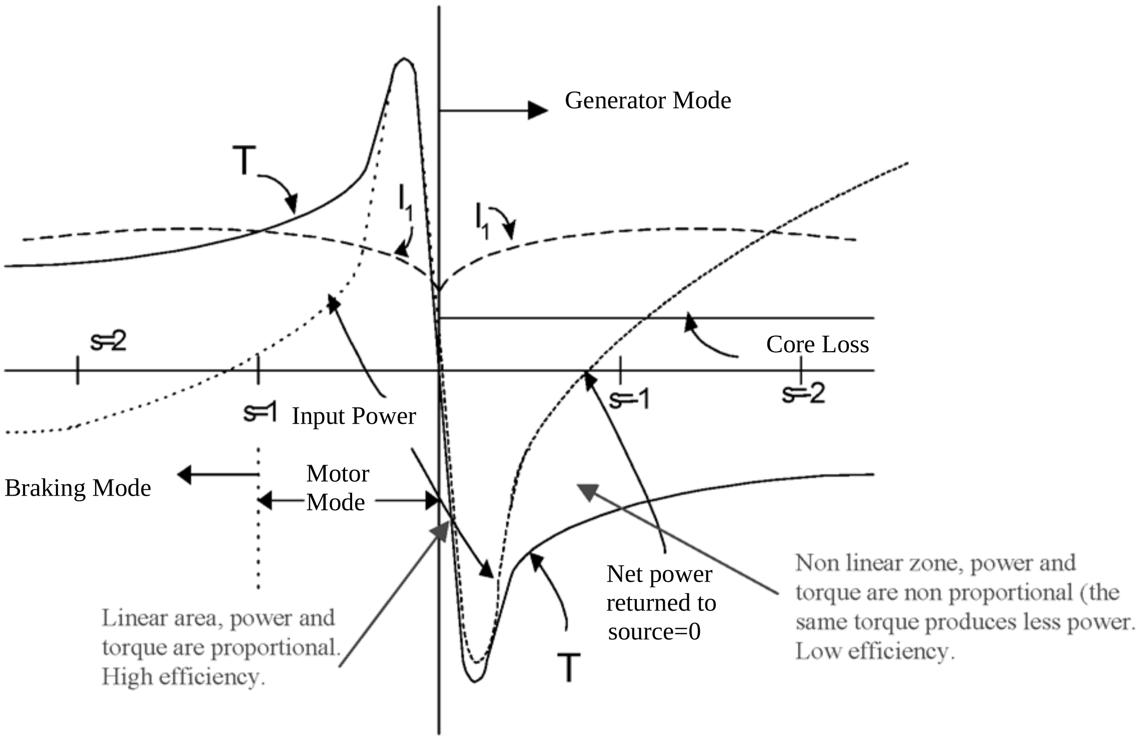


Fig 6.17 Torque/ slip curve

The normal behaviour is to work in the linear area with a small slip (s<<1).

High Slip Braking Procedure

- 1. When HSB is applied, suddenly you output frequency will decrease to half of the actual value. That means that you are working at the point of Torque/slip curve near S=0.5. This is the low efficiency area and the mechanical energy is dissipated mainly as thermal losse in the motor. As the electrical regeneration is low the DC voltage does not increase.
  The voltage applied to the motor is the corresponding voltage according the V/f curve. The voltage might be higher if the regenerated current is bigger than the value programmed in N3-02.
  As the mechanical speed is approaching the output frequency, the slip is decreasing and the motor is going back to the linear zone where it increases efficiency.

- 2. When the motor is in the linear area of the Torque/slip curve (normal behaviour) the efficiency is high and the regenaration to the inverter is big. This causes the increase of the DC bus. If the DC voltage reaches the Overvoltage (OV) level the inverter reduces suddenly the frequency, according the value programmed in N3-01 and returning to the High slip/ low efficiency zone of the Torque/slip curve and the process of step 1 is repeated.

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• 3. This step is not always necessary. If step 2 is not sufficient enough to stop the motor and the DC voltage increases again, the inverter takes an other action similar like step 2.

After these steps the inverter runs during 1.5s at minimum speed and decellerates to zero following the programmed ramp. This last process is to be sure that the output frequency decreases to zero so that the linear area of the Torque/slip curve is reached.

The motor will overheat with this stopping method. Be carefull to guarantee good ventilation to the motor.
Most AC motors have a thermal resistor or a clixon built in.
It is strongly recommended to use the thermal resistor in case of overheating

◆ Using an Emergency Stop

Set a multi-function input terminal (H1-☐☐) 28 to 2B (emergency stop) to decelerate to a stop at the deceleration time set in C1-09. If inputting the emergency stop with a NO digital, set the multi-function input terminal (H1-☐☐) 28 or 2A or if inputting the emergency stop with a NC contact, set the multi-function input terminal (H1-☐☐) 29 or 2B.

After the emergency stop command has been input, operation cannot be restarted until the Inverter has stopped. To cancel the emergency stop, turn OFF the run command and emergency stop command.

■Related Parameters

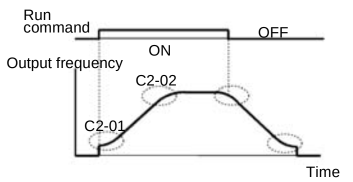
Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level
C1-09	Emergency stop time Fast Stop Time	The deceleration time when the multi-function input “Emergency (fast) stop” is ON. This time will be used when a fault is detected, for which emergency stop was programmed.	0.0 to 6000.0	10.0 s	No	A

Acceleration and Deceleration Characteristics

◆ Setting Acceleration and Deceleration Times

Acceleration time indicates the time to increase the output frequency from 0Hz to the maximum output frequency (E1-04). Deceleration time indicates the time to decrease the output frequency from max. frequency to 0Hz (E1-04).

■Related Parameters

Parameter Number	Name LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level
C1-01	Acceleration time 1 Accel Time 1	Set the acceleration time to accelerate from 0 to the maximum output frequency.	0.0 to 6000.0	10.0 s	Yes	Q
C1-02	Deceleration time 1 Decel Time 1	Set the deceleration time in seconds for the output frequency to fall from the max. frequency to 0Hz.			Yes	Q
C1-03	Acceleration time 2 Accel Time 2	Acceleration time when multi-function input "Acceleration/deceleration time selection 1" is ON.			Yes	A
C1-04	Deceleration time 2 Decel Time 2	Deceleration time when multi-function input "Acceleration/deceleration time selection 1" is ON.			Yes	A
C1-11	Acceleration/deceleration time switching frequency Acc.Dec SW Freq	Set the frequency at which acceleration/deceleration time switches automatically. Less than set frequency: Acceleration/deceleration time 2 Set frequency or above: Acceleration/deceleration time 1 Multi-function inputs "Acceleration/deceleration time selection 1" and "Acceleration/deceleration time selection 2" are given priority.	0.0 to 120.0	0.0 Hz	No	A
C2-01	S-curve characteristic time at acceleration start SCrv Acc@Start	Set the S-curve characteristic time for each part in seconds. When you set the S-curve characteristic time, the start time and end time S-curve characteristic time's acceleration time is lengthened by 1/2 only.  The S-curve characteristic time at start and end of deceleration is fixed to 0.2 sec. and can not be changed.	0.00 to 2.50	0.20 s	No	A
C2-02	S-curve characteristic time at acceleration end SCrv Dec@ End		0.00 to 2.50	0.20 s	No	A

■Switching Acceleration and Deceleration Time Using Multi-Function Input Terminal Commands

Using the SYSDRIVE PV, you can set two acceleration times and two deceleration times. When the multi-function input terminals (H1-☐☐) are set to 7 (acceleration/deceleration time selection 1), you can switch the acceleration/deceleration time even during operation.

The following table shows the acceleration/deceleration time switching combinations.

Acceleration/Deceleration Time Selection 1 Terminal	Acceleration Time	Deceleration Time
OFF	C1-01	C1-02
ON	C1-03	C1-04

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■Switching Acceleration and Deceleration Time Automatically

Use this setting when you want to switch acceleration/deceleration time automatically using the output frequency.

When the output frequency reaches the set value in C1-11, the Inverter switches the acceleration/deceleration time automatically as shown in the following diagram.

Set C1-11 to a value other than 0.0 Hz. If C1-11 is set to 0.0 Hz, the function will be disabled.

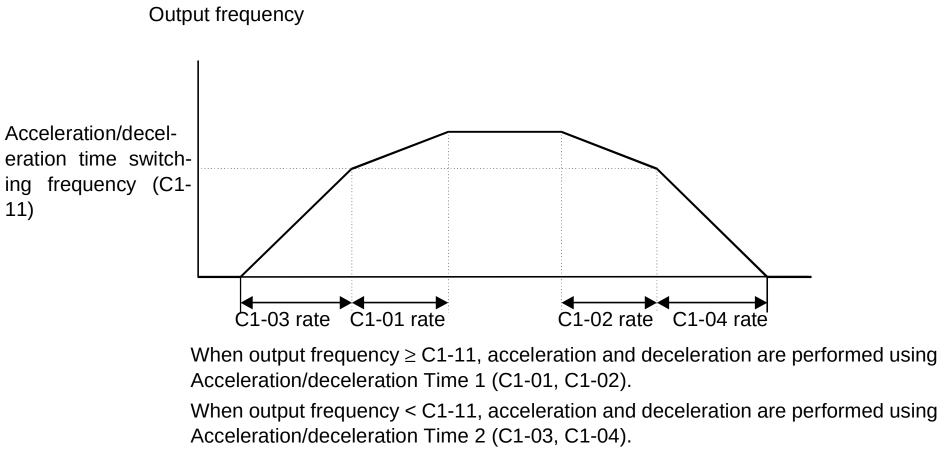

Fig 6.18 Acceleration/deceleration Time Switching Frequency

■Entering S-curve Characteristics in the Acceleration and Deceleration Time

By performing acceleration using an S-curve pattern, you can reduce shock when starting the machine.

By using the SYSDRIVE PV inverter, you can set an S-curve characteristic time for each of the following: At acceleration start and at acceleration end.

For deceleration start and deceleration end the S-curve characteristic times are fixed to 0.2 sec. They can not be switched off or changed.

INFO

When S-curve is set, calculate acceleration/deceleration time as follows:

Acceleration time = Selected acceleration time + (Acceleration start time S-curve characteristic time + Acceleration end time S-curve characteristic time) / 2

◆ Preventing the Motor from Stalling During Acceleration (Stall Prevention During Acceleration Function)

The Stall Prevention During Acceleration function prevents the motor from stalling if a heavy load is applied to the motor or sudden rapid acceleration is performed.

If you set L3-01 to 1 (enabled) and the Inverter output current exceeds the -15% level of the set value in L3-02, the acceleration rate will begin to slow down. When L3-02 is exceeded, acceleration will stop.

If you set L3-01 to 2 (optimum adjustment), the motor current increases to the value set in L3-02. With this setting, the acceleration time setting is ignored.

■Related Parameters

Parame-terNum-ber	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level
L3-01	Stall prevention selection during acceleration StallP Accel Sel	0: Disabled (Accelerates according to the setting. Motor may stall if the load is too high.) 1: Enabled (Acceleration stops when the level set in L3-02 is exceeded. Acceleration continues when current value is reduced.) 2: Optimum adjustment (Adjusts acceleration using the level set in L3-02 as the standard. The acceleration time setting is ignored.)	0 to 2	1	No	A
L3-02	Stall prevention level during acceleration StallP Accel Lvl	Set as a percentage taking the Inverter rated current to be 100%. Normally, it is not necessary to change this setting. Lower the set value if the motor stalls using the factory setting.	0 to 200	120%	No	A

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■Time Chart

The following figure shows the frequency characteristics when L3-01 is set to 1.

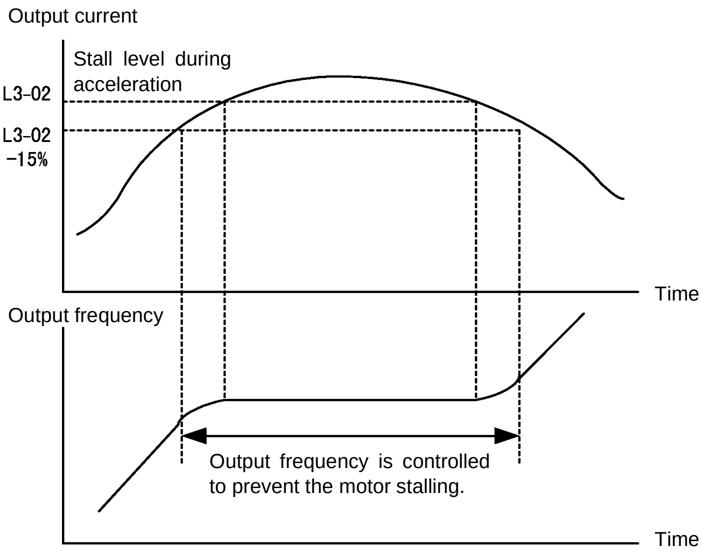


Fig 6.19 Time Chart for Stall Prevention During Acceleration

■Setting Precautions

- If the motor capacity is small compared to the Inverter capacity or if the motor is operated using the factory settings, resulting in the motor stalling, lower the value of L3-02.
- If the motor is running in the constant output range, L3-02 will be automatically lowered to prevent stalling.
- Set the parameters as a percentage taking the inverter rated current to be 100%.

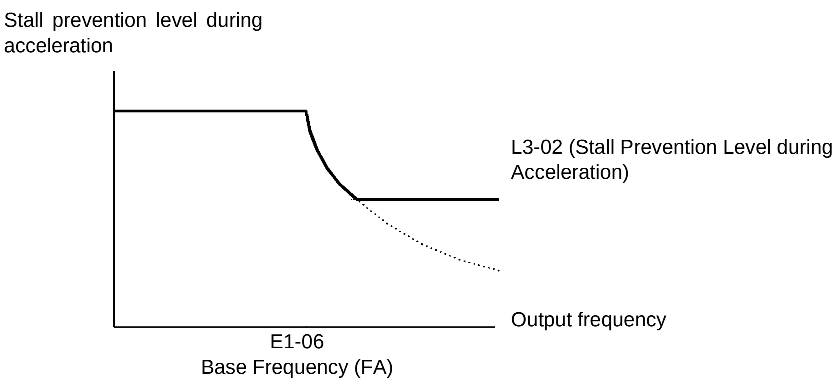


Fig 6.20 Stall Prevention Level and Limit During Acceleration

◆ Preventing Overvoltage During Deceleration (Stall Prevention During Deceleration Function)

This function automatically lengthens the deceleration time with respect to the DC-bus voltage to avoid overvoltage tripping.

■Related Parameters

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Acess Level
L3-04	Stall prevention selection during deceleration function selection StallP Decel Sel	0: Disabled (Motor decelerates according to setting. When the deceleration time is short, there is a risk of DC bus overvoltage (0V) occurring.) 1: Enabled (Prevents deceleration when DC bus voltage reaches the overvoltage level. Deceleration restarts after overvoltage level has been exceeded.) 2: Optimum adjustment (Minimizes deceleration judging from DC bus voltage. The deceleration time setting is ignored.) If using the dynamic brake option (Braking Resistor Units and Braking Units), be sure to set parameter L3-04 to 0.	0 to 2	1	No	A

■Setting Example

An example of stall prevention during deceleration when L3-04 is set to 1 as shown below

.

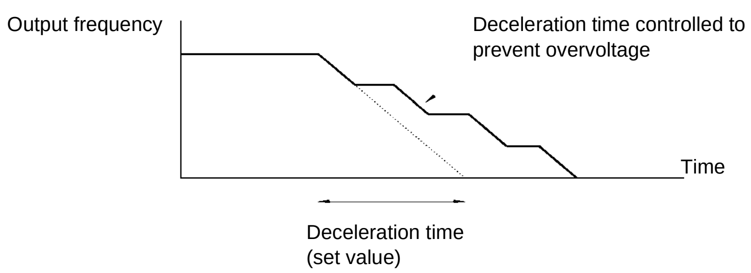


Fig 6.21 Stall Prevention During Deceleration Operation

■Setting Precautions

- The stall prevention level during deceleration differs depending on the inverter rated voltage and the input voltage. Refer to the following table for details.

Inverter Rated/Input Voltage		Stall Prevention Level during Deceleration (VDC)
200 V class		380
400 V class	E1-01 ≥ 400 V	760
	E1-01 < 400 V	660

- When using the braking option (Braking Resistor Units and Braking Units), be sure to set parameter L3-04 to 0.

Adjusting Frequency References

◆ Adjusting Analog Frequency References

Gain and bias are among the parameters used to adjust analog inputs.

■Related Parameters

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level
H3-02	Frequency reference (voltage) terminal A1 input gain Term A1 Lvl Sel	Set the frequency during 10 V input as a percentage, taking max. output frequency to be 100%.	0.0 to 1000.0	100.0%	Yes	A
H3-03	Frequency reference (voltage) terminal A1 input bias Terminal A1 Bias	Set the frequency during 0 V input as a percentage, taking max. output frequency to be 100%.	-100.0 to +100.0	0.0%	Yes	A
H3-08	Multi-function analog input terminal A2 signal level selection Term A2 Signal	0: 0 to +10V input. 2: 4 to 20 mA (9-bit input). Switch current and voltage input using the switch S1 on the Inverter terminal board.	0 or 2	2	No	A
H3-09	Multi-function analog input terminal A2 function selection Terminal A2 Sel	Select multi-function analog input function for terminal A2.	0 to 1F	0	No	A
H3-10	Multi-function analog input terminal A2 input gain Terminal A2 Gain	Set the reference capacity for each function during 10 V (20 mA) input as a percentage. Set the 100% content function selected using H3-09 to 100%.	0.0 to 1000.0	100.0%	Yes	A
H3-11	Multi-function analog input terminal A2 input bias Terminal A2 BIas	Set the reference capacity for each function during 0 V (4 mA) input as a percentage. Set the 100% content function selected using H3-09 to 100%.	-100.0 to +100.0	0.0%	Yes	A

■Adjusting Analog Frequency Reference Using Parameters

The frequency reference is input from the control circuit terminals using analog voltage and current.

If using frequency reference terminal A1 as an input terminal, perform adjustments using parameters H3-02 and H3-03. If using multi-function analog input terminal A2 as a frequency reference terminal, perform adjustments using H3-10 and H3-11.

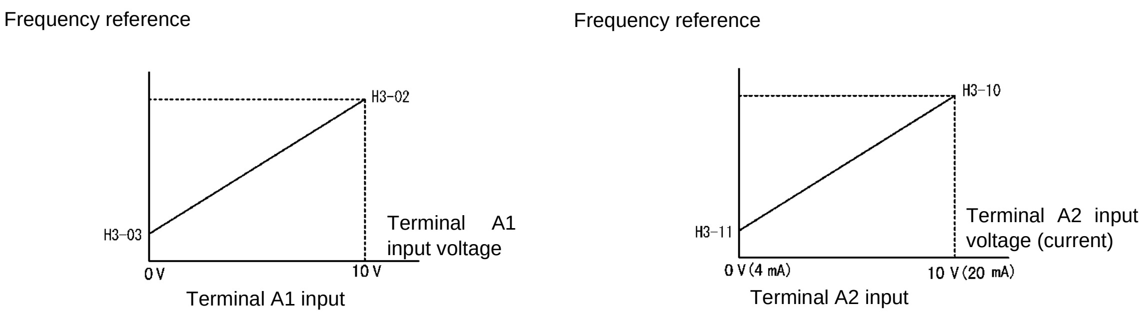


Fig 6.22 Terminals A1 and A2 Inputs

■Adjusting Frequency Bias Using an Analog Input

When parameter H3-09 is set to D (frequency reference 2), the frequency equivalent to the terminal A2 input voltage is added to A1 as a bias.(If H3-09 is set to 0 the A2 reference is added to any master reference.)

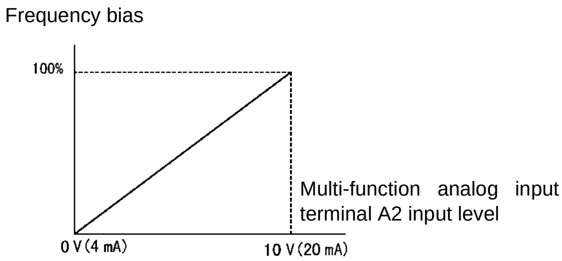
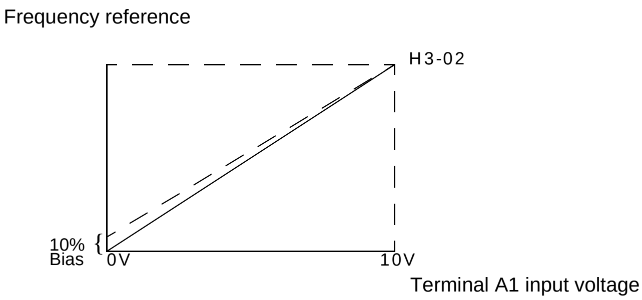


Fig 6.23 Frequency Bias Adjustment (Terminal A2 Input)

For example, if H3-02 is 100%, H3-03 is 0% and terminal A2 is set to 1 V, the frequency reference from terminal A1 when 0 V is input to A1 will be 10%.



◆ Operation Avoiding Resonance (Jump Frequency Function)

- This function allows the prohibition or „jumping" of certain frequencies within the Inverter's output frequency range so that the motor can operate without resonant oscillations caused by some machine systems.
- It is also used for deadband control.

■Related Parameters

Parameter Number	Name / LCD DIsplay	Description	Setting Range	Factory Setting	Change during Operation	Access Level
d3-01	Jump frequency 1 Jump Freq 1	Set the frequency center value at which to prohibit settings. Set to 0.0 to disable the jump frequency. Make sure the settings are as follows: d3-01 ≥ d3-02 ≥ d3-03. Operation within the jump frequency range is prohibited. Changes during acceleration and deceleration are made gradually without performing jumps.	0.0 to 120.0	0.0 Hz	No	A
d3-02	Jump frequency 2 Jump Freq 2			0.0 Hz	No	A
d3-03	Jump frequency 3 Jump Freq 3			0.0 Hz	No	A
d3-04	Jump frequency width Jump Bandwith	Set the jump frequency width in hertz. The jump frequency range is as follows: (Jump frequency ±d3-04).	0.0 to 20.0	1.0 Hz	No	A

The relationship between the output frequency and the jump frequency reference is as follows:

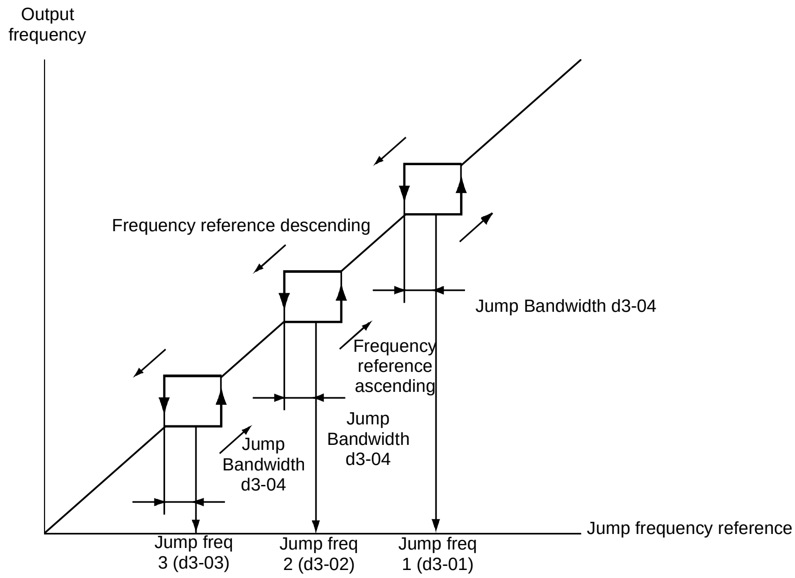


Fig 6.24 Jump Frequency

■Setting Precautions

- Set the jump frequency according to the following formula: d3-01 ≥ d3-02 ≥ d3-03 .
- When parameters d3-01 to d3-03 are set to 0 Hz, the jump frequency function is disabled.

Speed Limit (Frequency Reference Limit Function)

◆ Limiting Maximum Output Frequency

If you do not want the motor to rotate above a given frequency, use parameter d2-01.

Set the upper limit value of the Inverter output frequency as a percentage, taking E1-04 (Maximum Output Frequency) to be 100%.

■Related Parameters

Param-eter-Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Access Level
d2-01	Frequency reference upper limit Ref Upper Limit	Set the output frequency upper limit, taking the max. output frequency to be 100%.	0.0 to 110.0	100.0%	No	A

◆ Limiting Minimum Frequency

If you do not want the motor to rotate at below a given frequency, use parameters d2-02 or d2-03.

There are two methods of limiting the minimum frequency, as follows:

- Adjust the minimum level for all frequencies.
- Adjust the minimum level for the master speed frequency (i.e., the lower levels of the jog frequency, multi-step speed frequency and auxiliary frequency will not be adjusted).

■Related Parameters

Param-eter-Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Access Level
d2-02	Frequency reference lower limit Ref Lower LImit	Set the output frequency lower limit, taking the base reference to be 100%.	0.0 to 110.0	0.0%	No	A
d2-03	Master speed reference lower limit Ref1 Lower Limit	Set the master speed reference lower limit, taking the max. output frequency to be 100%.	0.0 to 110.0	0.0%	No	A

Zero speed setting

If zerospeed setting is set within parameter H2-01 or H2-02, option 1 , the Inverter will operate at the set minimumfrequency level programmed in parameter E1-09. One of the programmed outputs will close its contact.

Improved Operating Efficiency

This section explains functions for improving motor operating efficiency.

◆ Compensating for Insufficient Torque at Start and Low-speed Operation (Torque Compensation)

The torque compensation function detects that the motor load has increased and increases the output torque.

The Torque Compensation function calculates and adjusts the motor primary loss voltage according to the output voltage (V) and compensates for insufficient torque at startup and during low-speed operation. Calculate the compensation voltage as follows: Motor primary voltage loss x parameter C4-01.

■Related Parameters

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level
C4-01	Torque compensation gain Torq Comp Gain	Set the torque compensation gain using the multiplication factor. Normally, there is no need to set this parameter. Adjust the torque compensation gain in the following circumstances. • If the cable is very long, increase the set value. • If the (maximum applicable) motor capacity is smaller than the Inverter capacity, decrease the set value. • If the motor is vibrating, reduce the set value. Adjust this parameter so that the output current during low-speed rotation does not exceed the Inverter rated output current range.	0.00 to 2.50	1.00	Yes	A
C4-02	Torque compensation primary delay time Torq Comp Time	Set the primary delay for the torque compensation function in ms. Normally, there is no need to make this setting. Adjust this parameter in the following circumstances. • If the motor is vibrating, increase the set value. • If the motor response is low, decrease the set value.	0 to 10000	200 ms	No	A

■Adjusting Torque Compensation Gain

Normally, there is no need to make this adjustment.

Adjust the torque compensation gain under the following circumstances.

- If the cable is very long, increase the set value.
- If the (maximum applicable) motor capacity is smaller than the Inverter capacity, decrease the set value.
- If the motor is vibrating, reduce the set value.

Adjust this parameter so that the output current during low-speed rotation does not exceed the Inverter's rated output current range.

■Adjusting the Torque Compensation Primary Delay Time parameter

Set the torque compensation function primary delay in ms.

Normally, there is no need to make this setting. Adjust the parameter as shown below.

- If the motor is vibrating, increase the set value.
- If the motor response is low, decrease the set value.

◆ Field weakening option

The field weakening function is used to reduce the output voltage to the motor when the following conditions are matched:

- The frequency reference is above the value set in d6-02.
- Speed agree is matched.
- A digital input (H1-01 to H1-05) is set to 63.

In this case the output voltage is set to the value programmed in parameter d6-01 as a percentage of the corresponding value for this frequency in the V/f curve.

■Related parameters

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level	RS-422A/485 Register
d6-01	Field weakening level Field-Weak Lvl	Set the Inverter output voltage when the field weakening command is input. It is enabled when the field weakening command is set for a multi-function input. Set the level as a percentage taking the voltage set in the V/f pattern as 100%.	0 to 100	80%	No	A	2A0H
d6-02	Field frequency Field-Weak Freq	Set the lower limit in Hz of the frequency range where field control is valid. The field weakening command is valid only at frequencies above this setting and only when the speed is in agreement with the current speed reference.	0.0 to 120.0	0.0 Hz	No	A	2A1H
H1-01 - H1-05	Terminal sel S3-S7	Multifunction Digital Inputs	0 to 77		No	A	400H to 404H

Advantage of the function

- Reducing the output voltage in quadratic loads is a simple way to save energy.
- Having better speed and torque stability at frequencies near or above motor rated frequency.

Decreasing the voltage means decreasing the maximum torque in the same percentage.

However if the voltage is decreased only during speed agree, then the rated torque can be kept during acceleration and deceleration.

◆ Hunting-prevention Function

The hunting-prevention function suppresses hunting when the motor is operating with a light load.

■Related Parameters

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level
N1-01	Hunting-prevention function selection Hunt Prev Select	0: Hunting-prevention function disabled 1: Hunting-prevention function enabled The hunting-prevention function suppresses hunting when the motor is operating with a light load. If high response is to be given priority over vibration suppression, disable the hunting-prevention function.	0 or 1	1	No	A
N1-02	Hunting-prevention gain Hunt Prev Gain	Set the hunting-prevention gain multiplication factor. Normally, there is no need to make this setting. Make the adjustments as follows: • If vibration occurs with light load, increase the setting. • If the motor stalls, reduce the setting. If the setting is too large, the voltage will be too suppressed and the motor may stall.	0.00 to 2.50	1.00	No	A

◆ Preventing Motor Stalling During Operation

Stall prevention during operation prevents the motor from stalling by automatically lowering the Inverter's output frequency when a transient overload occurs while the motor is operating at a constant speed.

If the Inverter output current continues to exceed the setting in parameter L3-06 for 100 ms or longer, the motor speed is reduced. Set the enable or disable deceleration time using parameter L3-05. Set the deceleration time using C1-02 (Deceleration time 1) or C1-04 (Deceleration Time 2).

If the Inverter output current reaches the set value in L3-06 – 2%, the motor will accelerate again to the set frequency.

■Related Parameters

Parameter Number	Name LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level
L3-05	Stall prevention selection during running function selection StallP Run Sel	0: Disabled (Operates according to the setting. Motor may stall when the load is large.) 1: Enabled--Deceleration time 1 (Stall prevention function during operation deceleration time is set in C1-02.) 2: Enabled--Deceleration time 2 (Stall prevention function during operation deceleration time is set in C1-04.)	0 to 2	1	No	A
L3-06	Stall prevention level during running StallP Run Level	Enabled when L3-05 is set to 1 or 2. Set as a percentage, taking Inverter rated current to be 100%. Normally, there is no need to make this setting. Lower the set value if the motor stalls at the factory setting.	30 to 200	120%	No	A

◆ Detecting Motor Torque

If an excessive load is placed on the machinery (overtorque) or the load is suddenly lightened (undertorque), you can output an alarm signal to multi-function output terminal M1-M2 or M3-M4.

To use the overtorque/undertorque detection function, set B or 17 (overtorque/undertorque detection NO/NC) in one of the following parameters: H2-01 and H2-02 (multi-function output terminals M1-M2 and M3-M4 function selection).

The overtorque/undertorque detection level is the current level (Inverter rated output current 100%).

■Related Parameters

Param-eter-Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Access Level
L6-01	Torque detection selection 1 Torq Det Sel	0: Overtorque/undertorque detection disabled. 1: Overtorque detection only with speed agreement; operation continues after overtorque (warning). 2: Overtorque detected continuously during operation; operation continues after overtorque (warning). 3: Overtorque detection only with speed agreement; output stopped upon detection (protected operation). 4: Overtorque detected continuously during operation; output stopped upon detection (protected operation). 5: Undertorque detection only with speed agreement; operation continues after overtorque (warning). 6: Undertorque detected continuously during operation; operation continues after overtorque (warning). 7: Undertorque detection only with speed agreement; output stopped upon detection (protected operation). 8: Undertorque detected continuously during operation; output stopped upon detection (protected operation).	0 to 8	0	No	A
L6-02	Torque detection level 1 Toq Det 1 Lvl	V/f control: Inverter rated current is set as 100%.	0 to 300	150%	No	A
L6-03	Torque detection time 1 Torq Det 1 Time	Set the overtorque/undertorque detection time.	0.0 to 10.0	0.1 s	No	A

Multi-function Output (H2-01 and H2-02)

Set Value	Function
B	Overtorque/undertorque detection 1 NO (NO contact: Overtorque detection and undertorque detection enabled when contact is ON)
17	Overtorque/undertorque detection 1 NC (NC contact: Overtorque detection and undertorque detection enabled when contact is OFF)

■L6-01 Set Values and LED Indicators

The relationship between alarms displayed by the Digital Operator when overtorque or undertorque is detected and the set values in L6-01, is shown in the following table.

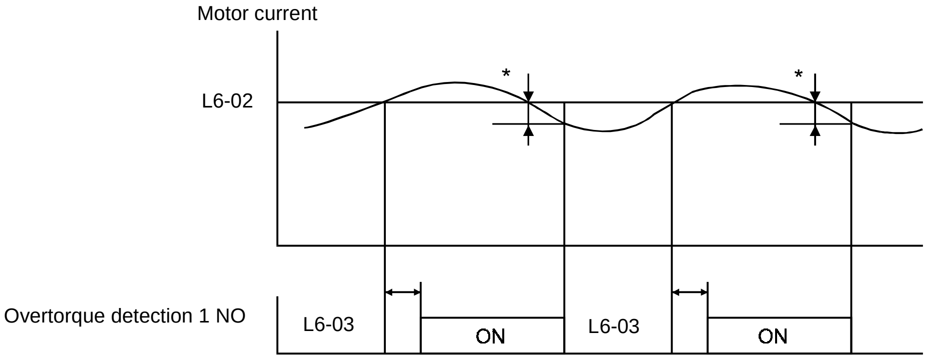
Set Value	Function	LED Indicator: Overtorque/Undertorque Detection 1
0	Overtorque/undertorque detection disabled.	-
1	Overtorque detection only with speed matching; operation continues after overtorque (warning).	OL3 flashes
2	Overtorque detected continuously during operation; operation continues after overtorque (warning).	OL3 flashes
3	Overtorque detection only with speed matching; output stopped upon detection (protected operation).	OL3 lit
4	Overtorque detected continuously during operation; output stopped upon detection (protected operation).	OL3 lit
5	Undertorque detection only with speed matching; operation continues after overtorque (warning).	UL3 flashes
6	Undertorque detected continuously during operation; operation continues after overtorque (warning).	UL3 flashes
7	Undertorque detection only with speed matching; output stopped upon detection (protected operation).	UL3 lit

Set Value	Function	LED Indicator
		Overtorque/Undertorque Detection 1
8	Undertorque detected continuously during operation; output stopped upon detection (protected operation).	UL3 lit

■Setting Example

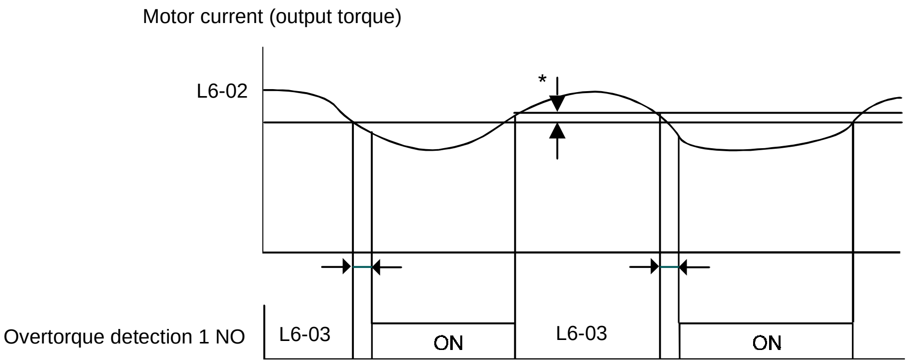
The following diagram shows the time chart for overtorque and undertorque detection.

- Overtorque Detection



*Overtorque detection disabled band is approximately 10% of the Inverter rated output current.

- Undertorque Detection



*Overtorque detection disabled band is approximately 10% of the Inverter rated output current.

◆ Motor Overload Protection

You can protect the motor from overload using the Inverter's built-in electronic thermal overload relay.

■Related Parameters

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods
E2-01	Motor rated current Motor Rated FLA	Set the motor rated current. This set value becomes the base value for motor protection and torque limit. It is an input data for autotuning.	0.32 to 6.40 *2	1.90 A *1	No	Q
L1-01	Motor protection selection MOL Fault Select	Set to enable or disable the motor overload protection function using the electronic thermal relay. 0: Disabled 1: General motor protection With applications where the power supply is often turned ON and OFF, there is a risk that the circuit cannot be protected even if this parameter has been set to 1, as the thermal value will be reset. If multiple motors are connected to one Inverter, set this parameter to 0 and install a thermal relay in each motor.	0 or 1	1	No	Q
L1-02	Motor protection time parameter MOL Time Const	Set the electronic thermal detection time in minutes. Normally, there is no need to make this setting. The factory setting is 120% for 1 min. If the motor overload resistance is clear, set the overload protection time during hot start to suit the motor.	0.1 to 5.0	1.0 min	No	A

* 1. Factory settings depend on Inverter capacity. (The shown values are for a 200 V Class Inverter for 0.4 kW.)
* 2. The settings range is 10% to 200% of the Inverter rated output current. (The values shown are for a 200 V Class Inverter for 0.4 kW.)

Multi-Function Outputs (H2-01 and H2-02)

Set Value	Function
1F	Motor overload (OL1, including OH3) pre-alarm (ON: 90% or more of the detection level)

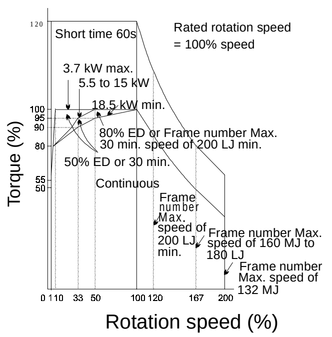
■Setting Motor Rated Current

Set the rated current value on the motor nameplate in parameter E2-01.

■Motor Overload Protection Characteristics

Set the overload protection function L1-01 according to the applicable motor.

The following table shows the motor type and tolerance load characteristics.

L1-01 Set Value	Motor Type	Tolerance Load Characteristics	Cooling Ability	Electronic Thermal Operation (at 100% Motor Load)
1	General-purpose motor (standard motor)		Use this motor for operations using a commercial power supply. This motor construction yields best cooling effect when operating at 50/60 Hz.	When operating continuously at 50/60 Hz or less, motor overload detection (OL1) is detected. The Inverter outputs the error contact and the motor coasts to a stop.

■Setting Motor Protection Operation Time

Set the motor protection operation time in L1-02.

If, after operating the motor continuously at the rated current, a 120% overload is experienced, set the (hot start) electronic thermal protection operation time. The factory setting is resistance to 120% for 60 seconds.

The following diagram shows an example of the characteristics of the electronic thermal protection operation time (L1-02 = 1.0 min., operation at 60 Hz, general-purpose motor characteristics, when L1-01 is set to 1)

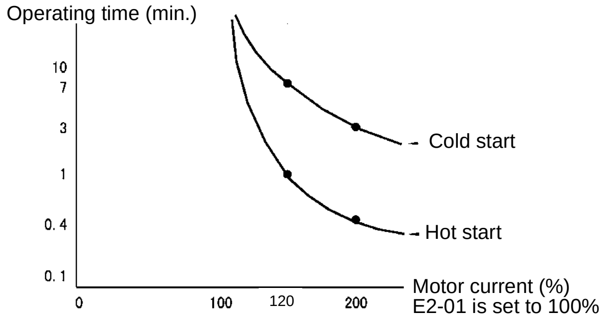


Fig 6.25 Motor Protection Operation Time

■Setting Precautions

- If multiple motors are connected to one Inverter, set parameter L1-01 to 0 (disabled). To protect the motor, install a thermal relay in the motor power cable and perform overload protection on each motor.
- With applications where the power supply is often turned ON and OFF, there is a risk that the circuit cannot be protected even if this parameter has been set to 1 (enabled), because the thermal value will be reset.
- For save overload tripping, set the set value in parameter L1-02 to a low setting.
- When using a general-purpose motor (standard motor), the cooling ability will be lowered by $f^{1/4}$ (frequency). Consequently, the frequency may cause motor overload protection (OL1) to occur, even below the rated current. If operating on the rated current at a low frequency, use a special motor.

■Setting the Motor Overload Pre-Alarm

If the motor overload protection function is enabled (i.e., L1-01 is set to 1) and you set H2-01 or H2-02 (multi-function output terminals M1-M2 and M3-M4 function selection) to 1F (motor overload OL1 pre-alarm), the motor overload pre-alarm will be enabled. If the electronic thermal value reaches minimum 90% of the overload detection level, the output terminal that has been set will be turned ON.

◆ Motor Overheating Protection Using PTC Thermistor Inputs

Perform motor overheating protection using the thermistor temperature resistance characteristics of the PTC (Positive Temperature Coefficient) built into the windings of each motor phase.

■Related Parameters

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level
L1-03	Alarm operation selection during motor overheating Mtr OH Alarm Sel	Set H3-09 to E and select the operation when the input motor temperature (thermistor) input exceeds the alarm detection level (1.17 V). 0: Decelerate to stop 1: Coast to stop 2: Emergency stop using the deceleration time in C1-09. 3: Continue operation (OH3 on the Digital Operator flashes).	0 to 3	3	No	A
L1-04	Motor overheating operation selection Mtr OH Fault Sel	Set H3-09 to E and select the operation when the motor temperature (thermistor) input exceeds the operation detection level (2.34 V). 0: Decelerate to stop 1: Coast to stop 2: Emergency stop using the deceleration time in C1-09.	0 to 2	1	No	A
L1-05	Motor temperature input filter time parameter Mtr Temp Filter	Set H3-09 to E and set the primary delay time parameter for motor temperature (thermistor) inputs in seconds.	0.00 to 10.00	0.20 s	No	A

■PTC Thermistor Characteristics

The following diagram shows the characteristics of the PTC thermistor temperature to the resistance value.

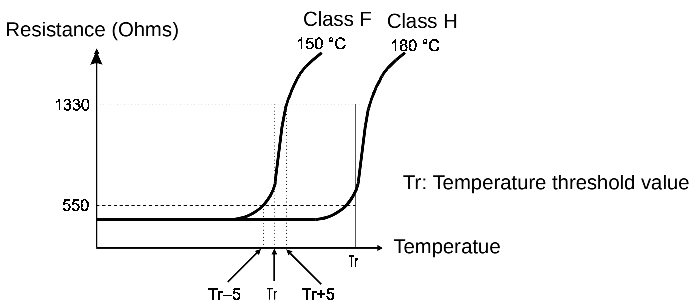


Fig 6.26 PTC Thermistor Temperature-Resistance Value Characteristics

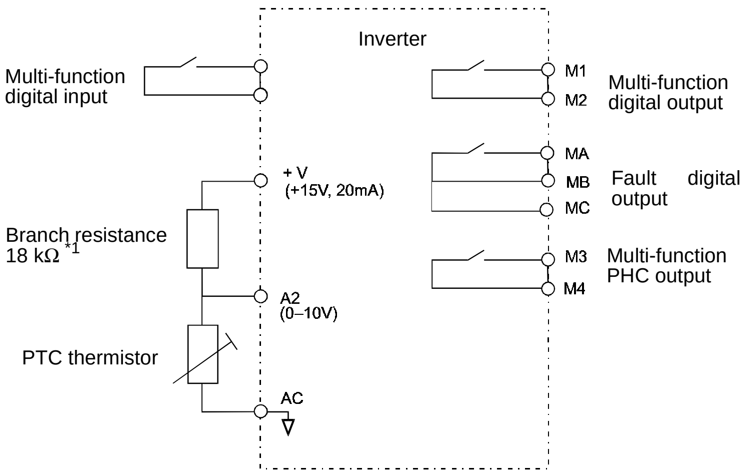
■Operation during Motor Overheating

Set the operation if the motor overheats in parameters L1-03 and L1-04. Set the motor temperature input filter time parameter in L1-05. If the motor overheats, the OH3 and OH4 error codes will be displayed on the Digital Operator.

Error Codes If the Motor Overheats

Error Code	Details
OH3	Inverter stops or continues to operate, according to the setting in L1-03.
OH4	Inverter stops according to the setting in L1-04.

By setting H3-09 (Multi-function Analog Input Terminal A2 Function Selection) to E (Motor temperature input), you can detect alarm OH3 or OH4 using the PTC temperature-resistance characteristics and protect the motor. The terminal connections are shown in the following diagram.



*1 The resistance value of 18 kΩ is only valid for using a 3-phase PTC with the characteristic shown on the previous page.

Fig 6.27 Mutual Connections for Motor Overheating Protection

Setting Precautions

- When inputting a voltage signal to terminal A2, pin 2 of the DIP-switch S1 on the control terminal board has to be turned to OFF (A2 voltage input). The factory setting is ON (A2 current input).
- The parameter H3-08 (analog input terminal A2 signal level) has to be set to 0 (0-10V input).

◆ Limiting Motor Rotation Direction

If the motor is set to reverse rotation prohibited, a reverse run command will not be accepted even if it is input. Use this setting for applications in which reverse motor rotation can cause problems (e.g. fans, pumps, etc.).

■ Related Parameters

b1-04	Prohibition of reverse operation Reverse Oper	0: Reverse enabled 1: Reverse disabled 2: Switch phase order (reverse enabled)	0 to 2	0	No	A	183H

Continuing Operation

This section explains functions for continuing or automatically restarting Inverter operation after a momentary power loss.

◆ Restarting Automatically After Power Is Restored

After a momentary power loss, the Inverter can be restarted automatically to continue motor operation.

To restart the Inverter after power is recovered, set L2-01 to 1 or 2.

If L2-01 is set to 1, when power is recovered within the time set in L2-02, the Inverter will restart. If the power loss time exceeds the time set in L2-02, an alarm UV1 (main circuit undervoltage) will be detected.

If L2-01 is set to 2, when the main power supply is recovered while the control power supply (i.e., power supply to the control circuit) is backed up, the Inverter will restart. Consequently, alarm UV1 (main circuit undervoltage) will not be detected.

■Related Parameters

Parameter Number	Name LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level
L2-01	Momentary power loss detection PwrL Selection	0: Disabled (main circuit undervoltage (UV) detection) 1: Enabled (Restarted when the power is restored within the time for L2-02. If this is not the case , main circuit undervoltage will be detected.) 2: Enabled while CPU is operating. (Restarts when power returns during control operations. Does not detect main circuit undervoltage.)	0 to 2	0	No	A
L2-02	Momentary power loss ride-thru time PwrL Ridethru t	Ridethrough time, when momentary power loss selection (L2-01) is set to 1.	0 to 2.0	0.1 s *1	No	A
L2-03	Min. baseblock (BB) time PwrL Baseblock t	Set the Inverter's minimum baseblock time; when the Inverter is restarted after power loss ridethrough. Sets the time to approximately 0.7 times of the motor secondary circuit time parameter. When an overcurrent or overvoltage occurs during a speed search or DC injection braking, increase the set values.	0.1 to 5.0	0.1 s	No	A
L2-04	Voltage recovery time PwrL V/f Ramp t	Set the time required to return the Inverter output voltage to normal voltage at the completion of a speed search. Set the time required to recover from 0 V to the maximum voltage.	0.0 to 5.0	0.3 s *1	No	A
L2-05	Undervoltage (UV) detection level PUV Det Level	Sets the main circuit undervoltage (UV) detection level (main circuit DC voltage). Usually changing this setting is not necessary. Insert an AC reactor in the Inverter input side to lower the main circuit undervoltage detection level.	150 to 210 *2	190 V *2	No	A

* 1. Factory settings depend on Inverter capacity. (The values shown are for a 200 V Class Inverter for 0.4 kW.)
* 2. These values are for a 200 V Class Inverter. For a 400 V Class Inverter, double the values.

■Setting Precautions

- Error output signals are not output during momentary power loss recovery.
- To continue Inverter operation after power has been restored, make settings so that run commands from the control main circuit terminal are stored even while power is suspended.
- If the momentary power loss operation selection is set to 0 (Disabled), when the momentary power loss exceeds 15 ms during operation, alarm UV1 (main circuit undervoltage) will be detected.

◆ Speed Search

The speed search function finds the actual speed of a motor that is coasting without control and then starts smoothly from that speed. It is also activated after momentary power loss detection when L2-01 is set to enabled.

■Related Parameters

Param-eter-Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Access Level
b3-01	Speed search selection (current detection or speed calculation) Slip Comp Gain	Enables/disables the speed search function for the RUN command and sets the speed search method. 0: Disabled, speed calculation 1: Enabled, speed calculation 2: Disabled, current detection 3: Enabled, current detection Speed Calculation When the search is started, the motor speed is calculated and acceleration/deceleration is performed from the calculated speed to the specified frequency (motor direction is also searched). Current Detection The speed search is started from the frequency when power was momentarily lost or the maximum frequency and the speed is detected when the set search current level is reached.	0 to 4	2	No	A
b3-02	Speed search operating current (current detection) SpdSrch Current	Sets the speed search operation current as a percentage, taking the Inverter rated current as 100%. Not usually necessary to set. When restarting is not possible with the factory settings, reduce the value.	0 to 200	120%	No	A
b3-03	Speed search deceleration time (current detection) SpdSrch Dec Time	Sets the output frequency deceleration time during speed search. Set the time for deceleration from the maximum output frequency to the minimum output frequency.	0.1 to 10.0	2.0 s	No	A
b3-05	Speed search wait time (current detection or speed calculation) Search Delay	Sets the contactor operating delay time when there is a contactor on the output side of the Inverter. When a speed search is performed after recovering from a momentary power loss, the search operation is delayed by the time set here.	0.0 to 20.0	0.2 s	No	A
L2-01	Momentary power loss detection PwrL Selection	0: Disabled (main circuit undervoltage (UV) detection) 1: Enabled (Restarted when the power is restored within the time for L2-02. If this is not the case , main circuit undervoltage will be detected.) 2: Enabled while CPU is operating. (Restarts when power returns during control operations. Does not detect main circuit undervoltage.)	0 to 2	0	No	A
L2-03	Min. baseblock time PwrL Baseblock t	Sets the Inverter's minimum baseblock time, when the inverter is restarted after power loss ridethrough. Sets the time to approximately 0.7 times the motor secondary circuit time parameter. If an overcurrent or undercurrent occurs when starting a speed search or DC injection braking, increase the set values.	0.1 to 5.0	0.1 s	No	A
L2-04	Voltage recovery time PwrL V/f Ramp t	Sets the time required to return the Inverter output voltage to normal voltage at the completion of a speed search. Sets the time required to recover from 0 V to the maximum voltage.	0.0 to 5.0	0.3 s[*1]	No	A

* 1. Factory settings depend on Inverter capacity. (The values shown are for a 200 V Class Inverter for 0.4 kW.)

Multi-function digital Inputs

Set Value	Function	Access Level
61	External search command 1 OFF: Speed search disabled) ON: Speed estimation (Estimate the motor speed and start search from estimated speed) Current detection (Start speed search from maximum output frequency)	Yes
62	External search command 2 OFF: Speed search disabled ON: Speed estimation (Estimate the motor speed and start search from estimated speed) (Same operation as external search command 1) Current detection: Start speed search from set frequency (reference frequency when search command was input).	Yes
64	External search command 3 OFF: Speed search disabled ON: Speed estimation (Estimate the motor speed and start search from estimated speed) (Same operation as external search command 1) Current detection: Start speed search from output frequency.	Yes

■Setting Precautions

- When both external search commands 1 and 2 are set for the multi-function digital terminals, an OPE03 (invalid multi-function input selection) operation error will occur. Set either external search command 1 or external search command 2.
- If performing speed search using external search commands, add an external sequence so that the run command and external search command are both ON. This two commands must be kept on, at least for the time set in parameter L2-03.
- If the Inverter output is equipped with a contactor, set the contactor operation delay time in the Speed Search Wait Time (b3-05). The factory setting is 0.2 s. When not using the contact, you can reduce the search time by setting 0.0 s. After waiting for the speed search wait time, the Inverter starts the speed search.
- Parameter b3-02 is a current detection speed search (current detection level for search completion). When the current falls below the detection level, the speed search is viewed as completed and the motor accelerates or decelerates to the set frequency.
- If an overcurrent (OC) is detected when using speed search after power recovery, lengthen the Minimum Baseblock Time (L2-03).

■Application Precautions for Speed Searches Using Estimated Speed

- Always perform stationary autotuning for line-to-line resistance before using speed searches based on estimated speeds.
- If the cable length between the motor and Inverter is changed after autotuning has been performed, perform autotuning again.

■ **Speed Search Selection**

Set whether to enable or disable speed search at start and set the type of speed search (estimated speed or current detection) using setting b3-01. To perform speed search when inputting the run command, set b3-01 to 1 or 3.

Table 6.1   Search Methods

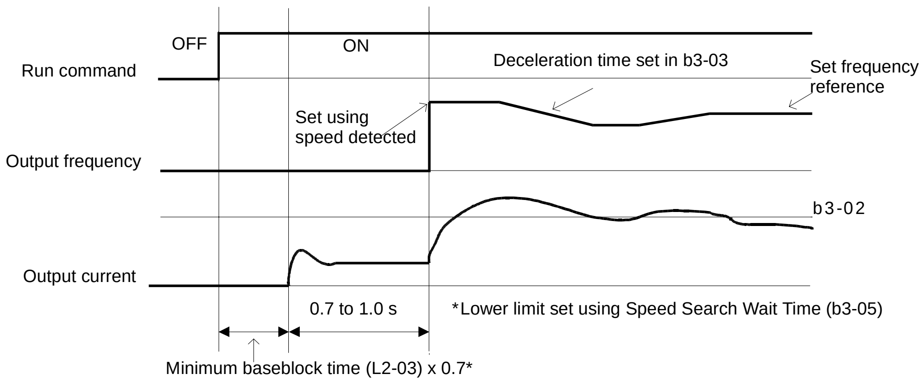
Search Name	Estimated Speed	Current Detection
Search Method	Estimates the motor speed when the search starts and accelerates and decelerates from the estimated speed to the set frequency. You can also search including direction of motor rotation.	Starts speed search from the frequency when the temporary power loss was detected or from the highest frequency and performs speed detection by watching the current level during the search.
External Speed Search Command	External search command 1, external search command 2 and external search command 3 become the same operation, estimating the motor speed and starting the search from the estimated speed.	External speed search command 1: Starts speed search from the maximum output frequency. External speed search command 2: Starts speed search from the frequency reference set before the search command. External speed search command 2: Starts speed search from the output frequency.
Application Precautions	Cannot be used multi-motor drives, motors two or more frames smaller than the Inverter capacity.	The motor may accelerate suddenly with light loads.

■ **Estimated Speed Search**

The time chart for estimated speed searches is shown below.

Search at Startup

The time chart for when speed search at startup and speed search to multi-function input terminals is shown below.



Note: If the stopping method is set to coast to stop and the run command turns ON in a short time, the operation may be the same as the search in case 2.

Fig 6.28   Speed Search at Startup (Estimated Speed)

Speed Search after Short Baseblock (during Power Loss Recovery, etc.)

- Loss Time shorter than the Minimum Baseblock Time (L2-03)

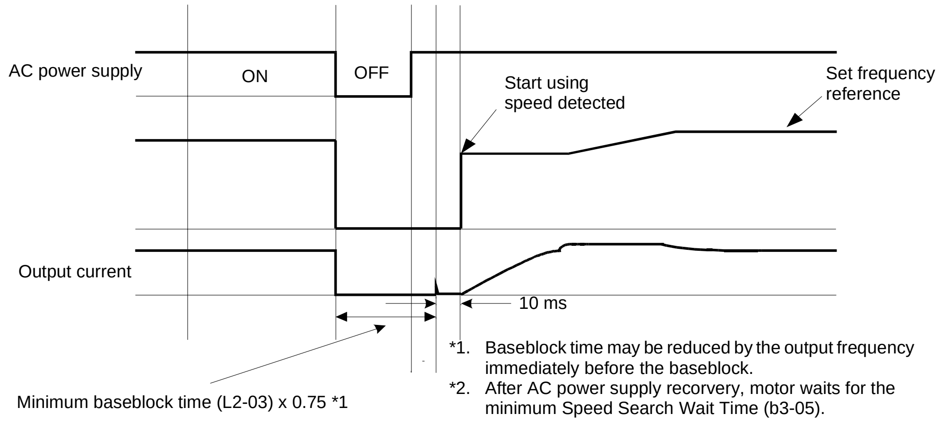


Fig 6.29 Speed Search after Baseblock (When Estimated Speed: Loss Time Is Set in L2-03)

- Loss Time longer than the Minimum Baseblock Time (L2-03)

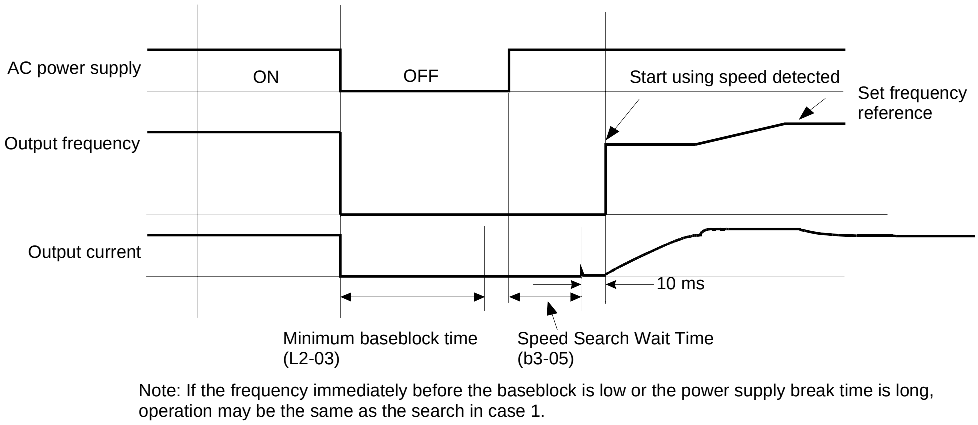


Fig 6.30 Speed Search after Baseblock (Estimated Speed: Loss Time > L2-03)

6

■Current Detection Speed Search

Speed Search at Startup

The time chart when speed search at startup or external speed search command is selected is shown below.

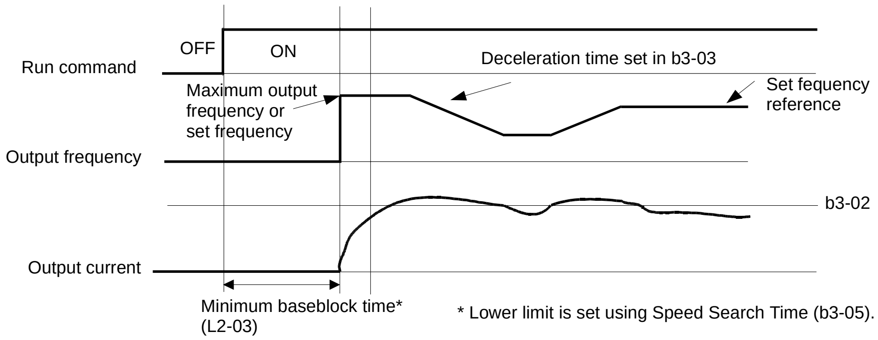


Fig 6.31 Speed Search at Startup (Using Current Detection)

Speed Search after Short Baseblock (during Power Loss Recovery, etc.)

- Loss Time Shorter Than Minimum Baseblock Time

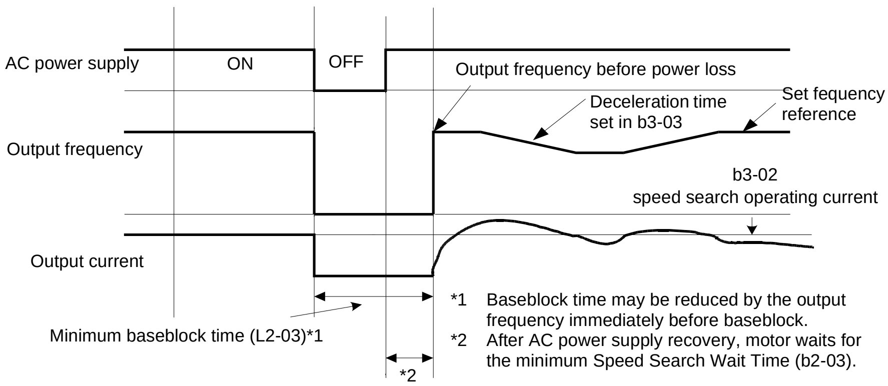


Fig 6.32 Speed Search After Baseblock (Current Detection: Loss Time < L2-03)

- Loss Time Longer Than Minimum Baseblock Time

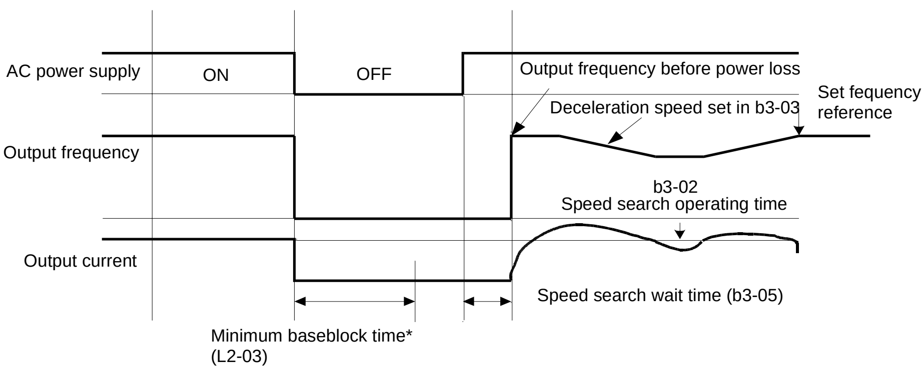


Fig 6.33 Speed Search After Baseblock (Current Detection: Loss Time > L2-03)

◆ Continuing Operation at Constant Speed When Frequency Reference Is Lost

The frequency reference loss detection function continues operation at reduced speed using the set value in parameter L4-06 as frequency reference value. When using an analog input as frequency reference, a frequency reference loss is detected, when the reference value drops over 90 % in 400 ms or less.

When the error signal during frequency reference loss is output externally, set H2-01 or H2-02 (multi-function digital output terminal M1-M2 and M3-M4 function selection) to C (frequency reference lost).

■Related Parameters

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level
L4-05	Operation when frequency reference is missing Ref Loss Sel	0: Stop 1: Operation (L4-06*fref@loss) inverter runs with reduced speed. Frequency reference is lost: Frequency reference dropped over 90% in 400 ms.	0 or 1	0	No	A
L4-06	Output frequency adjustment after freq. reference loss Fref at Floss	If L4-05 is set to 1 and the reference is lost, inverter will run at: fout = L4-06*fref before lossing.	0 – 100%	80%	No	A

◆ Restarting Operation After Transient Error (Auto Restart Function)

If an Inverter error occurs during operation, the Inverter will perform self-diagnosis. If no error is detected, the Inverter will automatically restart. This is called the auto restart function.

Set the number of auto restarts in parameter L5-01.

The auto restart function can be applied to the following errors. If an error not listed below occurs, the protection function will operate and the auto restart function will not work.

- OC (Overcurrent)
- GF (Ground fault)
- PUF (Fuse blown)
- OV (Main circuit overvoltage)
- UV1 (Main Circuit Undervoltage, Main Circuit MC Operation Failure)
- PF (Main circuit voltage fault)
- LF (Output phase failure)
- OL1 (Motor overload)
- OL2 (Inverter overload)
- OH1 (Motor overheat)
- OL3 (Overtorque)

■Auto Restart External Outputs

To output auto restart signals externally, set H2-01 or H2-02 (multi-function digital output terminals M1-M2 and M3-M4 function selection) to 1E (auto restart).

■Related Parameters

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level
L5-01	Number of auto restart attempts / Num of Restarts	Set the number of auto restarts attempts. Automatically restarts after a fault and conducts a speed search from the run frequency.	0 to 10	0	No	A
L5-02	Auto restart operation selection / Restart Sel	Sets whether a fault digital output is activated during fault restart. 0: No output (Fault contact is not activated.) 1: Output (Fault contact is activated.)	0 or 1	0	No	A

■ Application Precautions

- The number of auto restarts counter is reset under the following conditions:

  After auto restart, normal operation has continued for 10 minutes.

  After the protection operation has been performed and the error has been verified and an error reset has been input.

  After the power supply is turned OFF and then ON again.

Inverter Protection

◆ Reducing Inverter Overheat Pre-Alarm Warning Levels

The Inverter detects the temperature of the cooling fin using the thermistor and protects the Inverter from overheating.

The following overheating pre-alarm warnings are available: Stopping the Inverter as error protection and continuing operation, with the alarm OH (Radiation fin overheating) on the Digital Operator flashing.

■Related Parameters

Param- eter- Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera- tion	Access Level
L8-02	Overheat pre-alarm level OH Pre-Alarm Lvl	Sets the detection temperature for the Inverter overheat detection pre-alarm in °C. The pre-alarm is detected when the cooling fin temperature reaches the set value.	50 to 130	95°C	No	A
L8-03	Inverter overheat (OH) pre-alarm operation selection OH-Pre-Alarm Sel	Sets the operation for when the Inverter overheat pre-alarm goes ON. 0: Decelerate to stop in deceleration time C1-02. 1: Coast to stop 2: Fast stop in fast-stop time C1-09. 3: Continue operation (Monitor display only.) A fault will be given in setting 0 to 2 and a minor fault will be given in setting 3.	0 to 3	3	No	A

Input Terminal Functions

◆ Temporarily Switching Operation between Digital Operator and Control Circuit Terminals

You can switch the Inverter run command inputs and frequency reference inputs between local (i.e., Digital Operator) and remote (input method using b1-01 and b1-02).

You can switch between local and remote by turning ON and OFF the terminals if an input from H1-01 to H1-05 (multi-function digital input terminal S3 to S7 function selection) has been set to 1 (local/remote selection).

To set the control circuit terminals to remote, set b1-01 and b1-02 to 1 (Control circuit terminals).

■Related Parameters

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level
b1-01	Reference selection Reference Source	Set the frequency reference input method. 0: Digital Operator 1: Control circuit terminal (analog input) 2: RS-422A/485 communications 3: Option Card	0 to 3	1	No	Q
b1-02	Operation method selection Run Source	Set the run command input method 0: Digital Operator 1: Control circuit terminal (sequence input) 2: RS-422A/485 communications 3: Option Card	0 to 3	1	No	Q

INFO

You can also perform local/remote switching using the LOCAL/REMOTE Key on the Digital Operator. When the local/remote function has been set in the external terminals, the LOCAL/REMOTE Key function on the Digital Operator will be disabled.

◆ Blocking Inverter Outputs (Baseblock Commands)

Set 8 or 9 (Baseblock command NO/NC) in one of the parameters H1-01 to H1-05 (multi-function digital input terminal S3 to S7 function selection) to perform baseblock commands using the terminal's ON/OFF operation and prohibit Inverter output using the baseblock commands.

Clear the baseblock command to restart the operating using speed search from the frequency reference value before the baseblock command was input.

Multi-function digital Inputs (H1-01 to H1-05)

Set Value	Function
8	External baseblock NO (Normally Open contact: Baseblock when ON)
9	External baseblock NC (Normally Closed contact: Baseblock when OFF)

■Time Chart

The time chart when using baseblock commands is shown below.

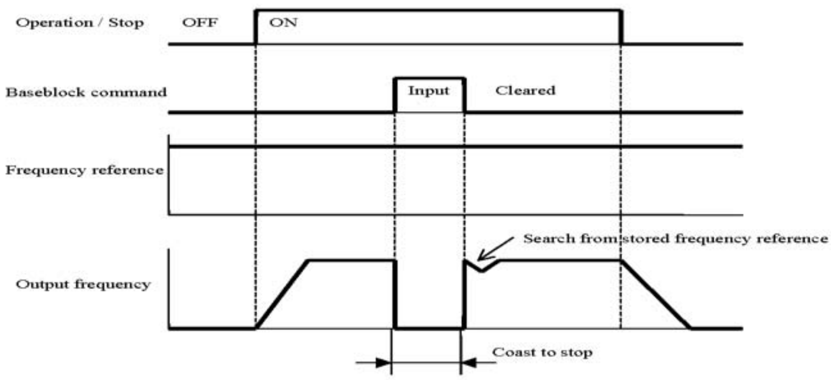


Fig 6.34 Baseblock Commands

IMPORTANT

If using baseblock commands with a variable load, do not frequently input baseblock commands during operation, as this may cause the motor to suddenly start coasting and this may result in the motor falling or slipping.

- Always use base block command when a contactor between inverter and motor is installed.

◆ Raising and Lowering Frequency References Using digital Signals (UP/DOWN)

The UP and DOWN commands raise and lower Inverter frequency references by turning ON and OFF a multifunction digital input terminal S3 to S7.

To use this function, set one of the parameters H1-01 to H1-05 to 10 (UP command) and 11 (DOWN command). Be sure to allocate two terminals.

The output frequency depends on the acceleration and deceleration time. Be sure to set b1-02 (Run command) to 1 (Control circuit terminal)

■Related parameters

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level
d2-01	Frequency reference upper limit / Ref Upper Limit	Set the output frequency upper limit as a percentage of the max. output frequency.	0.0 to 110.0	100.0%	No	A
d2-02	Frequency reference lower limit / Ref Lower Limit	Sets the output frequency lower limit as a percentage of the maximum output frequency.	0.0 to 110.0	0.0%	No	A
d2-03	Master speed reference lower limit / Ref1 Lower Limit	Set the master speed reference lower limit as a percentage of the max. output frequency.	0.0 to 110.0	0.0%	No	A

■Precautions

When setting and using UP and DOWN commands, observe the following precautions.

Setting Precautions

If multi-function input terminals S3 to S7 are set as follows, operation error OPE03 (Invalid multi-function input selection) will occur:

- Only either the UP command or DOWN command has been set.
- UP/DOWN commands and Acceleration/Deceleration Ramp Hold have been allocated at the same time.

Application Precautions

- Frequency outputs using UP/DOWN commands are limited by the frequency reference upper and lower limits set in parameters d2-01 to d2-03. Here, frequency references from analog frequency reference terminal A1 becomes the frequency reference lower limit. If using a combination of the frequency reference from terminal A1 and the frequency reference lower limit set in either parameter d2-02 or d2-03, the larger lower limit will become the frequency reference lower limit.
- If inputting the run command when using UP/DOWN commands, the output frequency accelerates to the frequency reference lower limit.
- When using UP/DOWN commands, multi-step operations are disabled.
- When d4-01 (Frequency Reference Hold Function Selection) is set to 1, the frequency reference held using the UP/DOWN functions is stored even after the power supply is turned OFF. When the power supply is turned ON and the run command is input, the motor accelerates to the frequency reference that has been stored. To reset (i.e., to 0 Hz) the stored frequency reference, turn ON the UP or DOWN command while the run command is ON.

◆ Hold Analog Frequency Using User-set Timing

When one of H1-01 to H1-05 (multi-function digital input terminal S3 to S7 function selection) is set to 1E (sample/hold analog frequency command), the analog frequency reference will be held from 100 ms after the terminal is turned ON and operation will continue thereafter at that frequency.

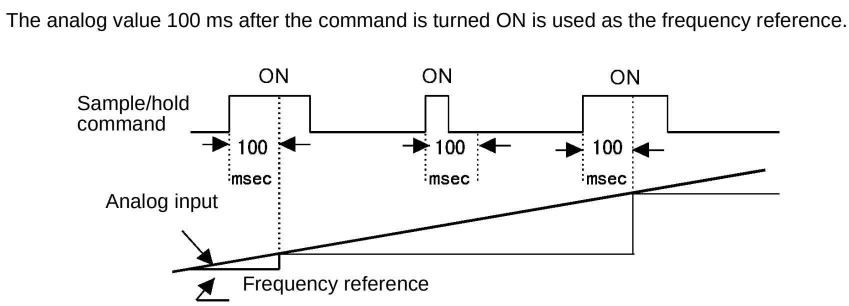


Fig 6.35 Sample/Hold Analog Frequency

■Application Precautions

When setting, executing sample and hold for analog frequency references, observe the following precautions.

- When performing sample/hold of analog frequency reference, be sure to store reference for 100 ms minimum. If the sample/hold time is less than 100 ms, the frequency reference will not be held.
- The analog frequency reference that is held will be deleted when the power supply is turned OFF.

◆ Switching Operations between a Communications Option Card and Control Circuit Terminals

You can switch frequency reference input between the Communications Option Card and the control circuit terminals. Set one of the parameters H1-01 to H1-05 (multi-function digital input terminal S3 to S7 function selection) to 2 (Option/Inverter selection) to enable switching reference input using the terminal ON/OFF status when the Inverter is stopped.

■Setting Precautions

To switch command inputs between the Communications Option Card and the control circuit terminals, set the following parameters.

- Set b1-01 (Reference Selection) to 1 (Control circuit terminal [analog input])
- Set b1-02 (Operation Method Selection to 1 (Control circuit terminal [sequence inputs])
- Set one of the parameters H1-01 to H1-05 (multi-function digital input terminal S3 to S7 function selection) to 2 (Option/Inverter selection).

Terminal Status	Frequency Reference and Run Command Selection
OFF	Inverter (Can be operated from frequency reference or control circuit terminal from analog input terminal.)
ON	Communications Option Card (Frequency reference and run command are enabled from communications Option Card.)

◆ Jog Frequency Operation without Forward and Reverse Commands (FJOG/RJOG)

The FJOG/RJOG command functions operate the Inverter using jog frequencies by using the terminal ON/OFF operation. When using the FJOG/RJOG commands, there is no need to input the run command.

To use this function, set one of the parameters H1-01 to H1-05 (multi-function digital input terminal S3 to S7 function selection) to 12 (FJOG command) or 13 (RJOG command).

Another function is the JOG2 function

■Related Parameters

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level
d1-17	Jog frequency reference Jog Reference	The frequency reference when the jog frequency reference selection, FJOG command or RJOG command is ON.	0 to 120.00	6.00 Hz	Yes	Q

Multi-Function digital Inputs (H1-01 to H1-05)

Set Value	Function
12	FJOG command (ON: Forward run at jog frequency d1-17)
13	RJOG command (ON: Reverse run at jog frequency d1-17)
69	Jog2 Frequency reference

6

JOG2 frequency reference

By selecting one of the Digital Inputs, H1-01 to H1-05, option 69 Jog2 Frequency will be enabled.

This function enables you to drive a motor without a RUN command.

JOG2 can only be selected in a 3-wire sequence. If a 2-wire sequence is selected OPE03 will be displayed.

If a RUN command is issued from the Operator, JOG2 command will be ignored. If parameter B1-04=1 the H1-0* =0 will be ignored.

JOG2's priority is higher than any other frequency reference. It's priority is even higher than STOP Command (S2 term selected in 3-wire sequence) and DB command.

Emergency Stop and HSB have higher priority.

Application Precautions

- Jog frequencies using FJOG and RJOG commands are given priority over other frequency references.
- When both FJOG command and RJOG commands are ON for 500 ms or longer at the same time, the Inverter stops according to the setting in b1-03 (stopping method selection).

◆ Stopping the Inverter by Notifying Programming Device Errors to the Inverter (External Error Function)

The external error function performs the error contact output and stops the Inverter operation if the Inverter peripheral devices break down or an error occurs. The digital operator will display EFx (External error [input terminal Sx]). The x in EFx shows the terminal number of the terminal that input the external error signal. For example, if an external error signal is input to terminal S3, EF3 will be displayed.

To use the external error function, set one of the values 20 to 2F in one of the parameters H1-01 to H1-05 (multi-function digital input terminal S3 to S7 function selection).

Select the value to be set in H1-01 to H1-05 from a combination of any of the following three conditions.

- Signal input level from peripheral devices
- External error detection method
- Operation during external error detection

The following table shows the relationship between the combinations of conditions and the set value in H1-□□.

Set Value	Input Level (See Note 1.)		Error Detection Method (See Note 2.)		Operation During Error Detection			
	NO Contact	NC Contact	Parameter Detection	Detection During Operation	Decelerate to Stop (Error)	Coast to Stop (Error)	Emergency Stop (Error)	Continue Operation (Warning)
20	Yes		Yes		Yes			
21		Yes	Yes		Yes			
22	Yes			Yes	Yes			
23		Yes		Yes	Yes			
24	Yes		Yes			Yes		
25		Yes	Yes			Yes		
26	Yes			Yes		Yes		
27		Yes		Yes		Yes		
28	Yes		Yes				Yes	

Set Value	Input Level (See Note 1.)		Error Detection Method (See Note 2.)		Operation During Error Detection			
	NO Contact	NC Contact	Parameter Detection	Detection During Operation	Decelerate to Stop (Error)	Coast to Stop (Error)	Emergency Stop (Error)	Continue Operation (Warning)
29		Yes	Yes				Yes	
2A	Yes			Yes			Yes	
2B		Yes		Yes			Yes	
2C	Yes		Yes					Yes
2D		Yes	Yes					Yes
2E	Yes			Yes				Yes
2F		Yes		Yes				Yes

Note1.Set the input level to detect errors using either signal ON or signal OFF. (NO contact: External error when ON; NC contact: External error when OFF).

2. Set the detection method to detect errors using either parameter detection or detection during operation.
parameter detection: Detects while power is supplied to the Inverter.
Detection during operation: Detects only during Inverter operation.

Drive Enable

When the Drive Enable and During RUN (RUNX) are active OR the internal RUN command and During RUN are active the Inverter Ready signal becomes active. When the Run command is given before the Drive Enable signal an alarm “DNE”is displayed. “DNE”will be displayed until Drive Enable becomes active. The RUN command must cycle for the Inverter to restart.

When the Drive Enable signal is removed during running, the Inverter stops according the method selected in b1-03.

The Inverter Ready signal turns low because there is no Drive Enable as the Inverter has stopped. An alarm “DNE”is displayed until the RUN command of the Inverter has been removed. As the RUN command has been cleared the alarm will extinguish.

Monitor Parameters

◆ Using the Analog Monitor Parameters

This section explains the analog monitor parameters.

■Related Parameters

Param-eter-Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Access Level
H4-01	Monitor selection (terminal FM) Terminal FM Sel	Sets the number of the monitor item to be output (U1-□□) at terminal FM. 4,10 to 14, 28, 34, 39, 40 cannot be set.	1 to 38	2	No	A
H4-02	Gain (terminal FM) Terminal FM Gain	Sets the multi-function analog output 1 (FM) voltage level gain. Sets whether the monitor item output will be output in multiples of 10 V. The maximum output from the terminal is 10 V. A meter calibration function is available.	0 ~ 100%	100%	Yes	Q
H4-03	Bias (terminal FM) Terminal FM Bias	Sets the multi-function analog output 1 voltage level bias. Sets output characteristic up/down parallel movement as a percentage of 10 V. The maximum output from the terminal is 10 V. A meter calibration function is available.	-110.0 ~ +110.0%	0.0%	Yes	A
H4-04	Monitor selection (terminal AM) Terminal AM Sel	Sets the number of the monitor item to be output (U1-□□) from terminal AM. 4,10 to 14, 28, 34, 39, 40 cannot be set.	1 to 38	3	No	A
H4-05	Gain (terminal AM) Terminal AM Gain	Set the voltage level gain for multi-function analog output 2. Set the number of multiples of 10 V to be output as the 100% output for the monitor items. The maimum output from the terminal is 10 V. A meter calibration function is available.	0 ~ 100%	50%	Yes	Q
H4-06	Bias (terminal AM) Terminal AM Bias	Set the multi-function analog output 2 voltage level bias. Sets output characteristic up/down parallel movement as a percentage of 10 V. The maximum output from the terminal is 10 V. A meter calibration function is available.	-110.0 ~ +110.0%	0.0%	Yes	A
H4-07	Analog output 1 signal level selection (FM) AO Level Select 1	Sets the signal output level for multi-function output 1 (terminal FM)* 0: 0 to 10 V output 2: 4 to 20 mA	0 or 2	0	No	A
H4-08	Analog output signal 2 level selection (AM) AO Level Select 2	Sets the signal output level for multi-function output 2 (terminal AM)* 0: 0 to 10 V output 2: 4 to 20 mA	0 or 2	0	No	A

* These parameters can only be used with the optional terminal board.

■Selecting Analog Monitor Items

The digital operator monitor items (U1-□□ [status monitor]) are output from multi-function analog output terminals FM-AC and AM-AC. Refer to *Chapter 5 Parameters* and set the values for the □□ part of U1-□□ (status monitor).

■Adjusting the Analog Monitor Items

Adjust the output voltage for multi-function analog output terminals FM-AC and AM-AC using the gain and bias in H4-02, H4-03, H4-05 and H4-06.

Adjusting the Meter

The influence of the settings of gain and bias on the analog output channel is shown in Fig. 6.51.

10 V/100% monitor output x output gain + output bias

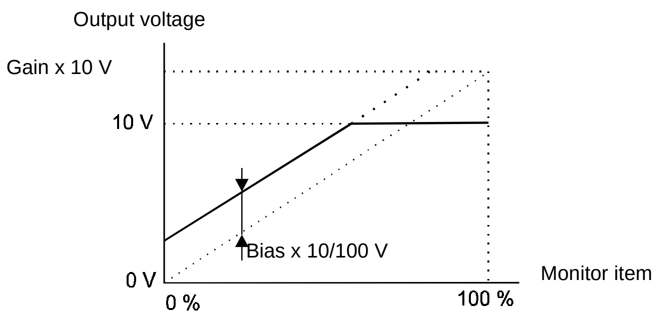


Fig 6.36 Monitor Output Adjustment

■Setting the Digital Outputs H2

The digital output can be set to different options:

Setting	Function	Description
0	During Run	The selected Output will close if the RUN command has been issued.
2	Frequency agree	The selected Output will close if the Inverter output frequency is within the frequency reference zone. The zone is defined by L4-02.
3	Desired frequency agree 1	The selected output will close if the output frequency is within a frequency detection zone. L4-01 - L4-02 ≤ F_{out} ≤ L4-01 + L4-02
4	Frequency (F-OUT) detection 1	The selected output will close if the output frequency is below the frequency level specified (L4-01). A hysterisis width op L4-02 can be set. (Acceleration F_{out} ≤ L4-01 + L4-02, Decelaration F_{out} ≤ L4-01)
5	Frequency (F-OUT) detection 2	The selected output will close if the output frequency is above the frequency level specified (L4-01). A hysterisis width op L4-02 can be set. (Acceleration F_{out} ≤ L4-01 , Decelaration F_{out} ≤ L4-01 + L4-02)
6	Inverter operation ready	The selected output will close if Inverter is ready for operation. This means no faults or alarms are recorded.
7	During DC bus undervoltage (UV) detection	The selected output will be closed if under voltage is detected.
8	During baseblock	The selected output will close when a normally open (NO) baseblock command is issued.

Setting	Function	Description
9	Frequency reference selection	The selected output will close if the frequency reference from the operator is received.
A	Run command selection status	The selected output will close if the Inverter receives the RUN command from the Operator.
E	Fault	The selected output will close if a Fault is detected. Exceptions are CPF00 and CPF01 faults.
F	Not used.	This output has to be selected if the output is not used.
10	Minor fault	The selected output will close if an Alarm is displayed.
11	Fault reset command active	The selected output will close if a Reset command is active.
1A	Reverse direction	The selected output will close during a reverse RUN command.

Communications Functions

This section explains the individual communications functions.

◆ Using RS-422A/485 Communications

You can perform serial communications with SYSMAC CS-series Programmable Controllers (PLCs) or similar devices using the RS-422A/485 protocol.

■Related Parameters

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods
b1-01	Reference selection Reference Source	Set the frequency reference input method 0: Digital Operator 1: Control circuit terminal (analog input) 2: RS-422A/485 communications 3: Option Card 4: Pulse train input	0 to 4	1	No	Q
b1-02	Operation method selection Run Source	Set the run command input method 0: Digital Operator 1: Control circuit terminal (sequence input) 2: RS-422A/485 communications 3: Option Card	0 to 3	1	No	Q
H5-01	Slave address Serial Comm Adr	Set the Inverter slave address.	0 to 20 *	1F	No	A
H5-02	Communication speed selection Serial Baud Rate	Set the baud rate for 6CN RS-422A/485 communications. 0: 1200 bps 1: 2400 bps 2: 4800 bps 3: 9600 bps 4: 19200 bps	0 to 4	3	No	A
H5-03	Communications parity selection Serial Com Sel	Set the parity for 6CN RS-422A/485 communications. 0: No parity 1: Even parity 2: Odd parity	0 to 2	0	No	A
H5-04	Stopping method after communication error Serial Fault Sel	Set the stopping method for communications errors. 0: Deceleration to stop using deceleration time in C1-02 1: Coast to a stop 2: Emergency stop using deceleration time in C1-02 3: Continue operation	0 to 3	3	No	A
H5-05	Communications error detection selection Serial Flt Dtct	Set whether or not a communications timeout is to be detected as a communications error. 0: Do not detect 1: Detect	0 or 1	1	No	A
H5-06	Send wait time Transmit Wait TIM	Set the time from the Inverter receiving data to when the Inverter starts to send.	5 to 65	5 ms	No	A
H5-07	RTS control ON/OFF RTS Control Sel	Select to enable or disable RTS control. 0: Disabled (RTS is always ON) 1: Enabled (RTS turns ON only when sending)	0 or 1	1	No	A
o1-03	Frequency units of reference setting and monitor Display Scaling	0: 0.01 Hz units 1: 0.01% units 2 to 39: r/min units 40 to 39999: User desired display	0 to 39999	0	No	A

Param-eter Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Con-trol Meth-ods
	LCD Display					
U1-39	RS-422A/485 communica-tions error Transmit Err	Bit 0: CRC error Bit 1: Data length error Bit 2: Not used. Bit 3: Parity error Bit 4: Overrun error Bit 5: Framing error Bit 6: Timeout Bit 7: Not used. Refer to the parameter tables for Digital Operator displays.	0 to FF	-	-	A

* Set H5-01 to 0 to disable Inverter responses to RS-422A/485 communications.

RS-422A/485 communications can perform the following operations regardless of the settings in b1-01 and b1-02.

- Monitoring operation status from the PLC
- Setting and reading parameters
- Resetting errors
- Inputting multi-function commands

An OR operation is performed between the multi-function commands input from the PLC and commands input from multi-function digital input terminals S3 to S7.

■RS-422A/485 Communications Configuration

RS-422A/485 communications are configured using 1 master (PLC) and a maximum of 32 slaves. Serial communications between master and slave are normally started by the master, and the slave responds.

The master performs signal communications with one slave at a time. Consequently, you must set the address of each slave beforehand, so the master can perform signal communications using that address. Slaves receiving commands from the master perform the specified function, and send a response to the master.

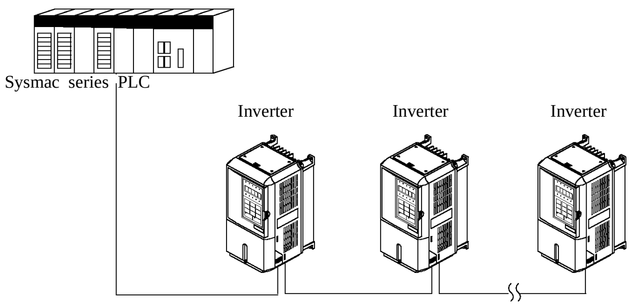


Fig 6.37 Example of Connections between PLC and Inverter

■Communications Specifications

The RS-422A/485 communications specifications are shown in the following table.

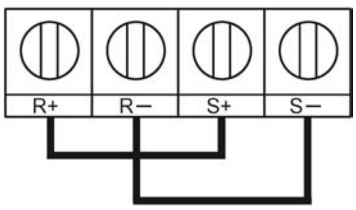
Item	Specifications
Interface	RS-422, RS-485
Communications Cycle	Asynchronous (Start-stop synchronization)
Communications Parameters	Baud rate: Select from 1,200, 2,400, 4,800, 9,600, and 19,200 bps. Data length: 8 bits fixed Parity: Select from even, odd, or none. Stop bits: 1 bit fixed
Communications Protocol	MODBUS
Number of Connectable Units	32 units max. (when using RS-485)

■Communications Connection Terminal

RS-422A/485 communications use the following terminals: S+, S-, R+, and R-. Set the terminating resistance by turning ON pin 1 of switch S1 for the last Inverter only, as seen from the PLC.

Fig 6.38 Communications Connection Terminal

1. Separate the communications cables from the main circuit cables and other wiring and power cables.
2. Use shielded cables for the communications cables, connect the shield cover to the Inverter earth terminal, and arrange the terminals so that the other end is not connected to prevent operating errors due to noise.
3. When using RS-485 communications, connect S+ to R+, and S- to R-, on the Inverter exterior.

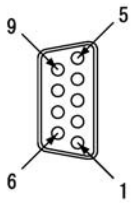


■Connection Example to a PLC

This section provides a connector pin arrangements and standard wiring diagram for the Serial Communications Boards/Units.

Connector Pin Arrangement for Serial Communications Board/Unit

The connector pin arrangement for the CS1W-SCB41, CS1W-SCU41, and C200HW-COM06-V1 Serial Communications Boards/Units is shown below.



Pin No.	Code	Signal name	I/O	Pin No.	Code	Signal name	I/O
1	SDA	Send data (-)	Output	6	RDA	Receive data (-)	Input
2	SDB	Send data (+)	Output	7	NC	-	-
3	NC	-	-	8	RBD	Receive data (+)	Input
4	NC	-	-	9	NC	-	-
5	NC	-	-	Frame	FG	FG	-

Standard Wiring Diagrams

Wiring diagrams are provided below for RS-485 and RS-422A.

- RS-485 (2-wire)

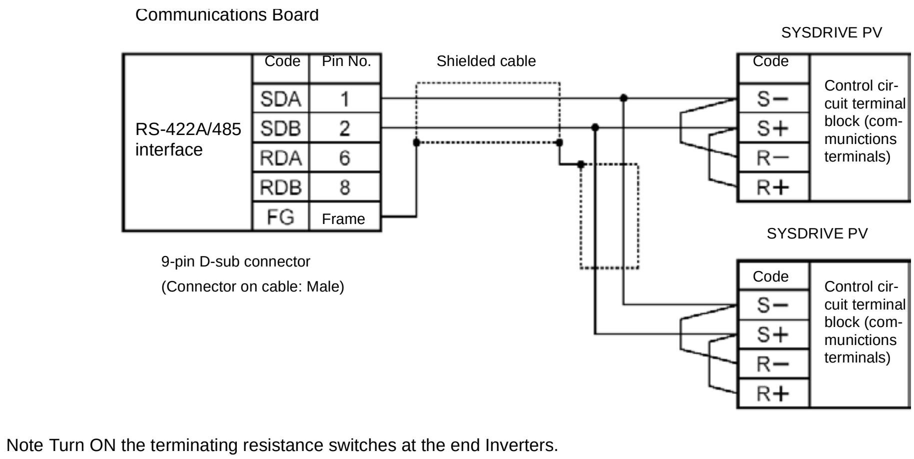


Fig 6.39 RS-485 Wiring

• RS-422A (4-wire)

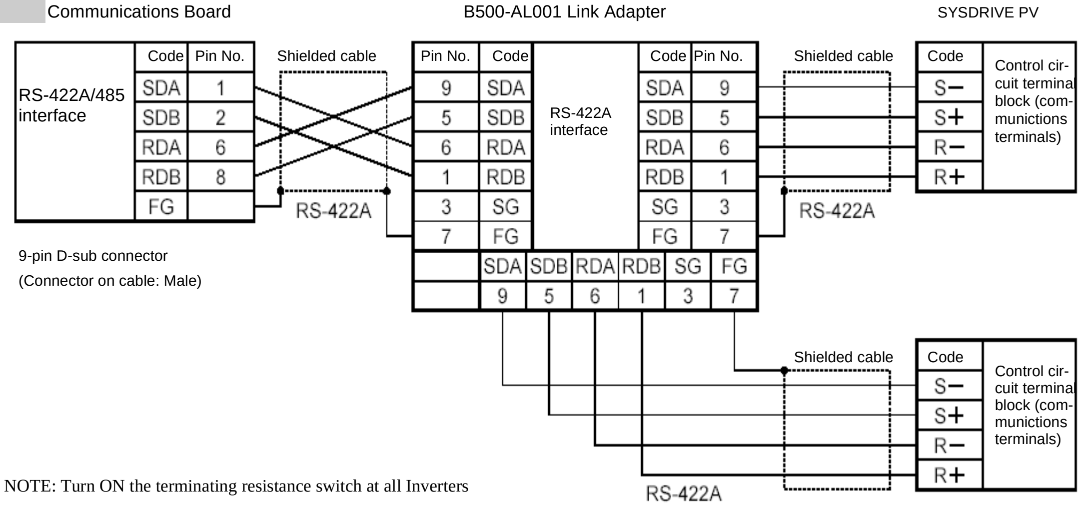


Fig 6.40 RS-422A Wiring

■Message Format

In RS-422A/485 communications, the master sends commands to the slave, and the slave responds. The message format is configured for both sending and receiving as shown below, and the length of data packets is changed by the command (function) contents.

Message data (Request message or response =

Slave address (1 byte)	Function code (1 byte)	Communications data	Error check (2 bytes)

The space between messages must support the following.

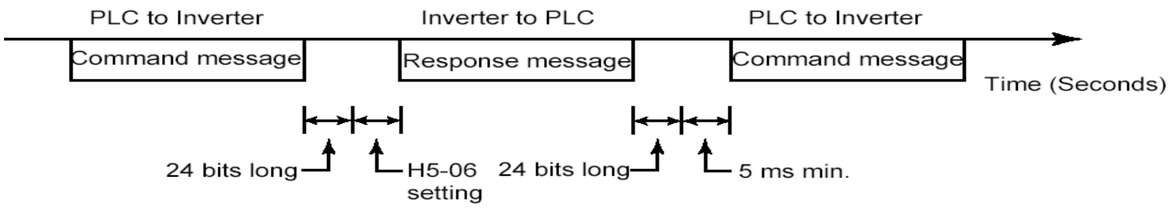


Fig 6.41 Message Spacing

6

Slave Address

Set the Inverter address from 0 to 32. If you set 0, commands from the master will be broadcast (i.e., the Inverter will not return responses).

Function Code

The function code specifies commands. There are three function codes, as shown below.

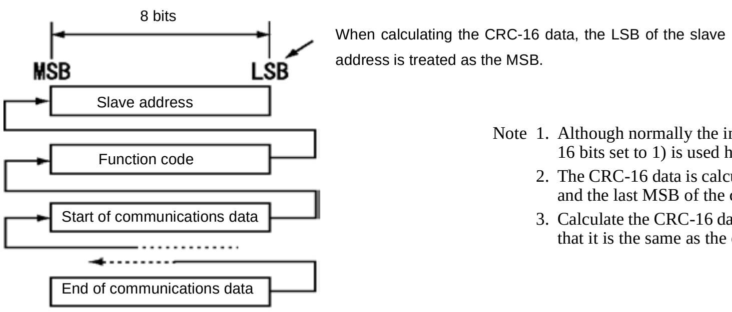
Function Code (Hexa-decimal)	Function	Command Message		Response Message	
		Min. (Bytes)	Max. (Bytes)	Min. (Bytes)	Max. (Bytes)
03H	Read storage register contents	8	8	7	37
08H	Loopback test	8	8	8	8
10H	Write multiple storage registers	11	41	8	8

Data

Configure consecutive data by combining the storage register address (test code for a loopback address) and the data the register contains. The data length changes depending on the command details.

Error Check

Errors are detected during communications using CRC-16. The CRC-16 data is the remainder of dividing all of the message data blocks as a continuous string of data by a specific binary number (1 1000 0000 0000 0101), as shown in the following diagram.



Note
1. Although normally the initial value for the CRC-16 calculation is 0, “-1” (all 16 bits set to 1) is used here instead.
2. The CRC-16 data is calculated using the LSB of the slave address as the MSB and the last MSB of the communications data as the LSB.
3. Calculate the CRC-16 data for the response message from the slave and verify that it is the same as the one in the response message.

Fig 6.42

■DSR Message

An example of command/response messages is given below.

Reading Storage Register Contents (Function Code: 03 Hex)

Read the contents of the storage register only for specified quantities whose addresses are consecutive, starting from a specified address. The contents of the storage register are separated into higher place 8 bits and lower place 8 bits, and comprise the data within response messages in address order.

The following table shows message examples when reading status signals, error details, data link status, and frequency references from the slave 2 Inverter.

Command Message

Slave Address		02H
Function Code		03H
Start Address (register number)	Higher place	00H
	Lower place	20H
Quantity (10H max.)	Higher place	00H
	Lower place	04H
CRC-16	Higher place	45H
	Lower place	F0H

Response Message (Normal Meesage)

Slave Address		02H
Function Code		03H
Number of attached data bytes		08H
Lead storage register	Higher place	00H
	Lower place	65H
Next storage register	Higher place	00H
	Lower place	00H
Next storage register	Higher place	00H
	Lower place	00H
Next storage register	Higher place	01H
	Lower place	F4H
CRC-16	Higher place	AFH
	Lower place	82H

Response Message (Error Message)

Slave Address		02H
Function Code		83H
Error code		03H
CRC-16	Higher place	F1H
	Lower place	31H

Note The MSB of the function code will be set to 1 when an error occurs.

6

Loopback Test (Function Code: 08 Hex)

The loopback test returns command messages directly as response messages without changing the contents to check the communications between the master and slave. You can set user-defined test code and data values.

The following table shows a message example when performing a loopback test with the slave 1 Inverter.

Command Message

Slave address		01H
Function code		08H
Test Code	Higher place	00H
	Lower place	00H
Data	Higher place	A5H
	Lower place	37H
CRC-16	Higher place	DAH
	Lower place	8DH

Response Message
(Normal Message)

Slave address		01H
Function code		08H
Test Code	Higher place	00H
	Lower place	00H
Data	Higher place	A5H
	Lower place	37H
CRC-16	Higher place	DAH
	Lower place	8DH

Response Message
(Error Message)

Slave address		01H
Function code		88H
Error Code		01H
CRC-16	Higher place	86H
	Lower place	50H

Note The MSB of the function code will be set to 1 when an error occurs.

Writing to Multiple Storage Registers (Function Code: 10 Hex)

Write the specified data to each specified storage register from the specified addresses. The written data must be in the following order in the command message: Higher place 8 bits, then lower place 8 bits, in storage register address order.

The following table shows an example of a message when forward operation has been set at a frequency reference of 60.0 Hz in the slave 1 Inverter by the PLC.

Command Message

Slave Address		01H
Function Code		10H
Start Address (register number)	Higher place	00H
	Lower place	01H
Quantity (10H max.)	Higher place	00H
	Lower place	02H
Number of attached data bytes		04H
Lead data	Higher place	00H
	Lower place	01H
Next data	Higher place	02H
	Lower place	58H
CRC-16	Higher place	63H
	Lower place	39H

Response Message
(Normal Message)

Slave Address		01H
Function Code		10H
Start Address	Higher place	00H
	Lower place	01H
Quantity	Higher place	00H
	Lower place	02H
CRC-16	Higher place	10H
	Lower place	08H

Response Message
(Error Message)

Slave Address		01H
Function Code		90H
Error code		02H
CRC-16	Higher place	CDH
	Lower place	C1H

Note The MSB of the function code will be set to 1 when an error occurs.

Set the number of data specified using command messages as quantity of specified messages x 2. Handle response messages in the same way.

■Data Tables

The data tables are shown below. The types of data are as follows: Reference data, monitor data, and broadcast data.

Reference Data

The reference data table is shown below. You can both read and write reference data.

Register No.	Contents	
0000H	Reserved	
0001H	Frequency reference	
	Bit 0	Run/stop command 1: Run 0: Stop
	Bit 1	Forward/reverse operation 1: Reverse 0: Forward
	Bit 2	External error 1: Error (EFO)
	Bit 3	Error reset 1: Reset command
	Bit 4	ComNet
	Bit 5	ComCtrl
	Bit 6	Multi-function input command 3
	Bit 7	Multi-function input command 4
	Bit 8	Multi-function input command 5
	Bit 9	Multi-function input command 6
	Bit A	Multi-function input command 7
	Bits B to F	Not used
0002H	Frequency reference (Set units using parameter o1-03)	
0003H to 0005H	Not used	
0006H	Not used	
0007H	Analog output 1 setting	
0008H	Analog output 2 setting	
0009H	Multi-function digital output setting	
	Bit 0	Digital output 1(Terminal M1-M2) 1: ON 0: OFF
	Bit 1	Digital output 2(Terminal M3-M4) 1: ON0: OFF
	Bit 2	Not used
	Bits 3 to 5	Not used
	Bit 6	Set error contact (terminal MA-MC) output using bit 7. 1: ON 0: OFF
	Bit 7	Error contact (terminal MA-MC) 1: ON 0: OFF
	Bits 8 to F	Not used
000AH to 000EH	Not used	

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Register No.	Contents	
000FH	Reference selection settings	
	Bit 0	Not used
	Bit 1	Not used
	Bits 3 to B	Not used
	C	Broadcast data S5 1: Enabled 0: Disabled
	D	Broadcast data S6 1: Enabled 0: Disabled
	E	Broadcast data S7 1: Enabled 0: Disabled
	F	Not used

Note Write 0 to all unused bits. Also, do not write data to reserved registers.

Monitor Data

The following table shows the monitor data. Monitor data can only be read.

Register No.	Contents	
0020H	Inverter status	
	Bit 0	Operation 1: Operating 0: Stopped
	Bit 1	Reverse operation 1: Reverse operation 0: Forward operation
	Bit 2	Inverter startup complete 1: Completed 2: Not completed
	Bit 3	Error 1: Error
	Bit 4	Data setting error 1: Error
	Bit 5	Multi-function digital output 1 (terminal M1 - M2) 1: ON 0: OFF
	Bit 6	Multi-function digital output 2 (terminal M3 - M4) 1: ON 0: OFF
	Bit 7	Not used
	Bits 8 to F	Not used
0021H	Error details	
	Bit 0	Overcurrent (OC) Ground fault (GF)
	Bit 1	Main circuit overvoltage (OV)
	Bit 2	Inverter overload (OL2)
	Bit 3	Inverter overheat (OH1, OH2)
	Bit 4	Not used
	Bit 5	Fuse blown (PUF)
	Bit 6	PI feedback reference lost (FbL)
	Bit 7	External error (EF, EFO)
	Bit 8	Hardware error (CPF)
	Bit 9	Motor overload (OL1) or overtorque 1 (OL3) detected
	Bit A	Not used
	Bit B	Main circuit undervoltage (UV) detected
	Bit C	Main circuit undervoltage (UV1), control power supply error (UV2), inrush prevention circuit error (UV3), power loss
	Bit D	Missing output phase (LF)
	Bit E	RS-422A/485 communications error (CE)
	Bit F	Operator disconnected (OPR)

Register No.	Contents	
0022H	Data link status	
	Bit 0	Writing data
	Bit 1	Not used
	Bit 2	Not used
	Bit 3	Upper and lower limit errors
	Bit 4	Data integrity error
	Bits 5 to F	Not used
0023H	Frequency reference	Monitors U1-01
0024H	Output frequency	Monitors U1-02
0025H	Output voltage reference (U1-06)	
0026H	Output current	U1-03
0027H	Output power	U1-08
0028H	Not used	
0029H	Not used	
002AH	Not used	
002BH	Sequence input status	
	Bit 0	Multi-function input terminal S1 1: ON 0: OFF
	Bit 1	Multi-function input terminal S2 1: ON 0: OFF
	Bit 2	Multi-function input terminal S3 1: ON 0: OFF
	Bit 3	Multi-function input terminal S4 1: ON 0: OFF
	Bit 4	Multi-function input terminal S5 1: ON 0: OFF
	Bit 5	Multi-function input terminal S6 1: ON 0: OFF
	Bit 6	Multi-function input terminal S7 1: ON 0: OFF
	Bits 7 to F	Not used

Register No.	Contents		
002CH	Inverter status		
	Bit 0	Operation	1: Operating
	Bit 1	Zero speed	1: Zero speed
	Bit 2	Frequency matching	1: Matched
	Bit 3	User-defined speed matching	1: Matched
	Bit 4	Frequency detection 1	1: Output frequency £ L4-01
	Bit 5	Frequency detection 2	Output frequency Š L4-01
	Bit 6	Inverter startup completed	1: Startup completed
	Bit 7	Low voltage detection	1: Detected
	Bit 8	Baseblock	1: Inverter output baseblock
	Bit 9	Frequency reference mode	1: Not communications 0: Communications
	Bit A	Run command mode	1: Not communications 0: Communications
	Bit B	Overtorque detection	1: Detected
	Bit C	Frequency reference lost	1: Lost
	Bit D	Retrying error	1: Retrying
	Bit E	Error (including RS-422A/485 communications time-out) 1:Error occurred	
	Bit F	Communications time-out	1: Timed out
002DH	Multi-function output status		
	Bit 0	Multi-function output 1 (terminal M1-M2) 1: ON 0: OFF	
	Bit 1	Multi-function output 2 (terminal M3-M4): 1: ON 0: OFF	
	Bit 2	Not used	
	Bits 3 to F	Not used	
002EH - 0030H	Not used		
0031H	Main circuit DC voltage		
0032H - 0037H	Not used		
0038H	PI feedback quantity (Input equivalent to 100%/Max. output frequency; 10/1%; without sign)		
0039H	PI input quantity (±100%/±Max. output frequency; 10/1%; with sign)		
003AH	PI output quantity (±100%/±Max. output frequency; 10/1%; with sign)		
003BH	CPU software number		
003CH	Flash software number		
003DH	Communications error details		
	Bit 0	CRC error	
	Bit 1	Invalid data length	
	Bit 2	Not used	
	Bit 3	Parity error	
	Bit 4	Overrun error	
	Bit 5	Framing error	
	Bit 6	Time-out	
	Bits 7 to F	Not used	
003EH	kVA setting		

Register No.	Contents
003FH	Not used

Note Communications error details are stored until an error reset is input (you can also reset while the Unit is operating).

Broadcast Data

The following table shows the broadcast data. This is write data only.

Register Address	Contents	
0001H	Operation signal	
	Bit 0	Run command 1: Operating 0: Stopped
	Bit 1	Reverse operation command 1: Reverse 0: Forward
	Bits 2 and 3	Not used
	Bit 4	External error 1: Error (set using H1-01)
	Bit 5	Error reset 1: Reset command (set using H1-02)
	Bits 6 to B	Not used
	Bit C	Multi-function digital input terminal S5
	Bit D	Multi-function digital input terminal S6
	Bit E	Multi-function digital input terminal S7
	Bit F	Not used.
0002H	Frequency reference	30000/100%

Note Bit signals not defined in the broadcast operation signals use local node data signals continuously.

■ENTER Command

When writing parameters to the Inverter from the PLC using RS-422A/485 communications, the parameters are temporarily stored in the parameter data area in the Inverter. To enable these parameters in the parameter data area, use the ENTER command.

There are two types of ENTER commands: ENTER commands that enable parameter data in RAM, and ENTER commands that write data to EEPROM (non-volatile memory) in the Inverter at the same time as enabling data in RAM.

The following table shows the ENTER command data. ENTER command data can only be written.

The ENTER command is enabled by writing 0 to register number 0900H or 0901H.

Register No.	Contents
0900H	Write parameter data to EEPROM
0910H	Parameter data is not written to EEPROM, but refreshed in RAM only.

The maximum number of times you can write to EEPROM using the Inverter is 100,000. Do not frequently execute ENTER commands (0900H) written to EEPROM.
The ENTER command registers are write-only. Consequently, if reading these registers, the register address will become invalid (Error code: 02H).

■Error Codes

The following table shows RS-422A/485 communications error codes.

Error Code	Contents
01H	Function code error A function code other than 03H, 08H, or 10H has been set by the PLC.
02H	Invalid register number error • The register address you are attempting to access is not recorded anywhere. • With broadcast sending, a start address other than 0000H, 0001H, or 0002H has been set.
03H	Invalid quantity error • The Quantity (number of data item) in the command message must be in range between 1 to 16. • In the write command message, the Numbers of attached data bytes must be twice of the Quantity.
21H	Data setting error • A simple upper limit or lower limit error has occurred in the control data or when writing parameters. • When writing parameters, the parameter setting is invalid.
22H	Write mode error • Attempting to write parameters during operation. • Attempting to write an ENTER command during operation. • Attempting to write parameters other than A1-00 to A1-05, E1-03, or 02-04 when warning alarm CPF03 (defective EEPROM) has occurred. • Attempting to write read-only data.
23H	Writing during main circuit undervoltage (UV) error • Writing parameters from the PLC during UV (main circuit undervoltage) alarm. • Writing ENTER commands from the PLC during UV (main circuit undervoltage) alarm.
24H	Writing error during parameters processing Attempting to write parameters from the PLC while processing parameters in the Inverter.

■Slave Not Responding

In the following cases, the slave will ignore the write function. If the slave address specified in the command message is 0, all slaves execute the write function, but do not return response messages to the master.

- When a communications error (overrun, framing, parity, or CRC-16) is detected in the command message.
- When the slave address in the command message and the slave address in the Inverter do not agree.
- When the data that configures the message and the data time length exceeds 24 bits.
- When the command message data length is invalid.

Application Precautions

Set a timer in the master to monitor response time from the slaves. Make the setting so that if no response is sent to the master from the slave within the set time, the same command message is sent again from the master.

■Self-Diagnosis

The Inverter has a built-in function for self-diagnosing the operations of serial communications interface circuits. This function is called the self-diagnosis function. The self-diagnosis function connects the communications parts of the send and receive terminals, receives the data sent by the Inverter, and checks if communications are being performed normally.

Perform the self-diagnosis function using the following procedure.

1. Turn ON the power supply to the Inverter, and set 67 (communications test mode) in parameter H1-05 (Terminal S7 Function Selection).
2. Turn OFF the power supply to the Inverter.
3. Perform wiring according to the following diagram while the power supply is turned OFF.
4. Turn ON the terminating resistance. (Turn ON pin 1 on DIP switch 1.)
5. Turn ON the power supply to the Inverter again.

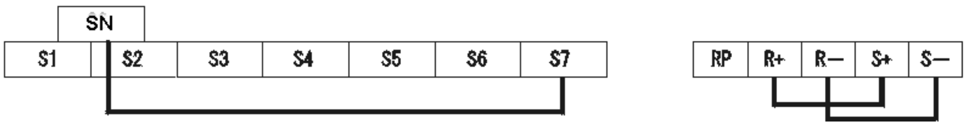


Fig 6.43 Details of Communications Terminals

Pass will be displayed on the Digital Operator if the diagnosis have finished correctly.

If an error occurs, a CE (RS-422A/485 communications error) alarm will be displayed on the Digital Operator, the error contact output will be turned ON, and the Inverter operation ready signal will be turned OFF.

6

■Converting Register Data

Register data (such as monitor values or parameter set value data) is placed in the communications data block of the message data (i.e., request message or response data). The data in each register is sent as 2-byte data. It is processed under the following rules and sent in hexadecimal.

The data is converted to a hexadecimal value using a minimum setting unit for each register of 1

For example, if the frequency reference is 60 Hz and the minimum unit of setting is 0.01 Hz, the data will be converted as follows:

60 Hz/0.01 (Hz) = 6000 = 1770 Hex

The minimum unit of setting of each parameter is given in the description of the parameter and in the parameter tables in *Chapter 5 Parameters*.

The minimum unit of setting of frequency reference data or frequency monitor data is determined by o1-03 (register 502 Hex: frequency reference/monitor unit selection). The unit of setting of each of the three registers below is determined by the set value in o1-03. The set value in o1-03 has nothing to do with frequency data items set as parameters (e.g., frequency references 1 through 16, inching frequency reference, maximum frequency, minimum output frequency, jump frequency). For these items, the unit of setting is as shown in *Chapter 5 Parameters*.

- Monitor Items
  Register 0023H: Frequency reference monitor
  Register 0024H: Output frequency monitor
- Communications Register
  Register 0002H: Frequency reference
  In spite of the set value in o1-03, however, set the maximum frequency to 30000 when the frequency reference is executed with a broadcast message. In this case, the Inverter rounds off any value less than 0.01 Hz.

If the jump frequency is 100.0 Hz and the minimum unit of setting is 0.01 Hz, the data will be converted as follows:

100.0 (Hz)/0.01 (Hz) = 10000 = 2710 Hex

Negative values are expressed in 2's complements

If the frequency bias in H3-03 is -100%, the minimum unit of setting will be 1% and the data will be converted as follows:

100 (%)/1 (%) = 100 = 0064 Hex

Æ 2's complement: FF9C Hex

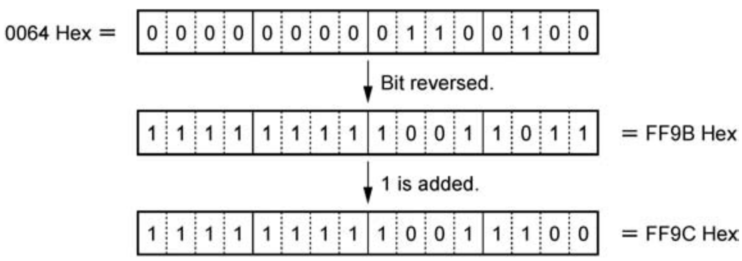


Fig 6.44

Whether the data is positive or negative is determined by the parameter set value.
The MSB of negative-value data is always set to 1. Data with its MSB set to 1 is not, however, always negative-value data.
For example, the setting range of parameter d3-01 (register 294 Hex: jump frequency 1) is within a range from 0.00 to 400.0 Hz. If the jump frequency is 400.0 Hz, the data is obtained from the following formula and its

MSB will be 1.
400.0 (Hz)/0.01 (Hz) = 40000 = 9C40 Hex

Set All Unused Bits to 0

Bits 11 through 15 of the RUN command (register 0001H) are not used. When writing the data, be sure to set all of these bits to 0. These bits when read are set to 0.

No Data Settings in Unused Registers

Registers described “not used” may be used for internal processing. Do not write any data to such registers.

◆ Communications with a Programmable Controller

The RS-422A/485 communications of the 3G3PV Inverter conform to the MODBUS Communications Protocol. This protocol cannot share the same line with any other communications protocol.
To control the 3G3PV through RS-422A/485 communications with the Programmable Controller, mount a Serial Communications Board or Unit to the Programmable Controller and use the protocol macro function.
The following settings and operations are necessary for serial communications using the protocol macro function.

- Configure system settings for the Serial Communications Board or Unit
- Create Send & Recv procedures conforming to the MODBUS Communications Protocol by means of protocol macro tools (CX-Protocol or Protocol Support Tool), and transfer them to the Serial Communications Board.
- Execute the PMCR instruction on the CPU Unit of the Programmable Controller.

■ Applicable Programmable Controllers and Peripheral Devices

A Serial Communications Board or Unit can be mounted to the following SYSMAC CPU Units.

Table 6.2 Applicable Programmable Controllers

Series	CPU Unit models
SYSMAC CS	High-speed models: CS1H-CPU67-E/66-E/65-E/64-E/63-E Low-speed models: CS1G-CPU45-E/44-E/43-E/42-E
SYSMAC CJ	CJ1G-CPU44/45
SYSMAC C200HX/HG/HE	C200HX-CPU34-E/44-E/54-E/64-E/34-ZE/44-ZE/54-ZE/64-ZE/65-ZE/85-ZE C200HG-CPU33-E/43-E/53-E/63-E/33-ZE/43-ZE/53-ZE/63-ZE C200HE-CPU32-E/42-E/32-ZE/42-ZE
SYSMAC CQM1H	CQM1H-CPU61/51

■ Applicable Serial Communications Boards and Unit

The following Serial Communications Boards and Unit can be used with the RS-422A/485 port.
The RS-232C port can be used if an RS-422/485 Conversion Adapter is installed. For ease of wiring, however, it is recommended that the RS-422/485 port be used. The following information is for the RS-422/485 port.

Table 6.3 Applicable Serial Communications Boards

Series	Serial Communications Board/Unit	Mounting method	Specifications
SYSMAC CS	CS1W-SCB41	As an Inner Board of the CPU Unit	• One RS-232C port • One RS-422A/485 port • Protocol macro function
SYSMAC CJ	CJ1W-SCU41	CPU Bus Unit	• One RS-232C port • One RS-422A/485 port • Protocol macro function
SYSMAC C200HX/HG/HE	C200HW-COM06-EV1 Make sure that the model number has the suffix “EV1,” otherwise the CRC-16 check code can-not be used.	Mounted to an optional slot of the CPU Unit	• One RS-232C port • One RS-422A/485 port • Protocol macro function
SYSMAC CQM1H	CQM1H-CPU61/51-E	As an Inner Board of the CPU Unit	• One RS-232C port • One RS-422A/485 port • Protocol macro function

■Peripheral Devices

The following peripheral devices are required to use the protocol macro function.

Table 6.4 Peripheral Devices

<table>
<tr><th>Name</th><th>Model</th><th colspan="2">Specification</th></tr>
<tr><td rowspan="9">CX-Protocol</td><td rowspan="9">WS02-PSTC1-E</td><td colspan="2">The following peripheral devices support the protocol macro function of the entire SYSMAC series.</td></tr>
<tr><td colspan="2">Personal computer environment</td></tr>
<tr><td>Personal com-puter</td><td>IBM PC/AT or compatible computer</td></tr>
<tr><td>CPU</td><td>Minimum requirement: Pentium 90 MHz
Recommended: Pentium 166 MHz or faster</td></tr>
<tr><td>OS</td><td>Microsoft Windows 95 or Windows 98</td></tr>
<tr><td>Memory</td><td>Minimum: 16 MB
Recommended: 24 MB min.</td></tr>
<tr><td>Hard disk</td><td>Minimum: Available space of 24 MB
Recommended: Available space of 50 MB</td></tr>
<tr><td>Monitor</td><td>SVGA or better</td></tr>
<tr><td>Drive</td><td>FDD: 1 or more
CD-ROM drive: 1 or more</td></tr>
</table>

Table 6.4 Peripheral Devices

Name	Model	Specification	
Protocol Support Tool	WS01-PSTF1-E	The following peripheral devices support the protocol macro function of the SYSMAC C200HX/HG/HE series.	
		Personal computer environment	
		Personal computer	IBM PC/AT or compatible computer
		CPU	Minimum requirement: Pentium 90 MHz Recommended: Pentium 166 MHz or faster
		OS	Microsoft Windows 95 or Windows 98
		Memory	Minimum: 16 MB Recommended: 24 MB min.
		Hard disk	Minimum: Available space of 24 MB Recommended: Available space of 50 MB
		Monitor	SVGA or better
		Drive	FDD: 1 or more CD-ROM drive: 1 or more

■Manuals for Related Equipment and the Support Tool

The following manuals provide details on equipment and the Protocol Support Tool.

Table 6.5 List of manuals

Name, series, model	Cat. No.
SYSMAC CS series, CPU Unit	W339 Users Manual W340 Instruction Reference Manual W394 Programming Manual
SYSMAC CJ series, CPU Unit	W393 Operation Manual W340 Instruction Reference Manual W394 Programming Manual
SYSMAC C200HX/HG/HE, CPU Unit	W302 Installation Guide W303 Operation Manual
SYSMAC CQM1H CPU Unit	W363 Operation Manual W364 Programming Manual
Serial Communications Board, CS1W-SCB21/41 Serial Communications Unit, CS1W-SCU21 Serial Communications Unit, CS1W-SCU41	W336 Users Manual
Serial Communications Board, C200HW-COM06-V1	W304 Operation Manual
Serial Communications Board, CQM1H-SCB41	W365 Operation Manual
CX-Protocol, WS02-PSTC1-E	W344 Operation Manual
Protocol Support Tool WS01-PSTF1-E	W319 Operation Manual

■Serial Communications Board/Unit SystemSettings

The system settings for the Serial Communications Board and Unit are given below.

For the CS/CJ series:

Use the following ports for the CS/CJ series.

- CS1W-SCB41 Serial Communications Board: Port 2
- CJ1W-SCU41 Serial Communications Unit: Port 2

m = D30000 + 100 x Unit No. (Wd)

DM Area				Bit	Setting	Value
Board		Unit				
Port 1	Port 2	Port 1	Port 2			
D32000	D32010	m	m+10	15	Port setting -- 0: Default, 1*: Desired setting	860E
				14 to 12	Reserved	
				11 to 08	Serial communications mode (6 Hex*: Protocol macro)	
				07 to 05	Reserved	
				04	Start bit -- 0*: 1 bit, 1: 1 bit (fixed at 1 bit regardless of the setting)	
				03	Data length -- 0: 7 bits, 1*: 8 bits	
				02	Stop bit -- 0: 2 bits, 1*: 1 bit	
				01	Parity -- 0: With, 1*: Without	
				00	Parity -- 0*: Even, 1: Odd	
D32001	D32011	m+1	m+11	15 to 04	Reserved	0006
				03 to 00	Transmission rate (unit: bps) 0: Default (9,600), 3: 1,200, 4: 2,400, 5: 4,800, 6*: 9,600, 7: 19,200, 8: 38,400	
-	-	-	-			-
D32008	D32018	m+8	m+18	15	Transmission method -- 0: Half-duplex, 1*: Full-duplex	8000
				14 to 00	Reserved	
D32009	D32019	m+9	m+19	15 to 00	Max. number of bytes in send/receive data -- 00C8* to 03E8 Hex	00C8

* Set to this value.

For the SYSMAC C200HX/HG/HE and CQM1H Series:

Use the following ports for the SYSMAC C200HX/HG/HE and CQM1H series.

- C200HW-COM06-V1 Communications Board: Port A
- CQM1H-SCB41 Serial Communications Board: Port 2

Communications Board		Bit	Setting	Value
Port 1 Port A	Port 2 Port B			
DM6555	DM6550	00 to 03	Standard format setting 0 Hex: Standard setting (default) 1 Hex*: Settings in bits 00 to 15 of DM6656 and DM 6551 are used.	6001
		04 to 11	00: Default	
		12 to 15	Serial Communications Board 0 Hex: Host link (default) 1 Hex: Not protocol 2 Hex: 1:1 Link slave 3 Hex: 1:1 Link master 4 Hex: NT link (1:1 mode) 5 Hex: Hex: NT link (1:N mode) 6 Hex*: Protocol macro	

Communications Board		Bit	Setting	Value
Port 1 Port A	Port 2 Port B			
DM6556	DM6551	00 to 07	Communications speed 00 Hex: 1,200 bps (default) 01 Hex: 2,400 bps 02 Hex: 4,800 bps 03 Hex*: 9,600 bps 04 Hex: 19,200 bps	0803
		08 to 15	Frame format Start bits / Data / Stop bits / Parity 00 Hex: 1 / 7 / 1 / Even (default) 01 Hex: 1 / 7 / 1 / Odd 02 Hex: 1 / 7 / 1 / None 03 Hex: 1 / 7 / 2 / Even 04 Hex: 1 / 7 / 2 / Odd 05 Hex: 1 / 7 / 2 / None 06 Hex: 1 / 8 / 1 / Even 07 Hex: 1 / 8 / 1 / Odd 08 Hex*: 1 / 8 / 1 / None 09 Hex: 1 / 8 / 2 / Even 10 Hex: 1 / 8 / 2 / Odd 11 Hex: 1 / 8 / 2 / None	

* Set to this value.

6

■Protocol Macro Function

The protocol macro function makes it possible to customize a communications protocol in order to create a macro according to the specifications of the serial communications port of a general-purpose peripheral device.

The protocol macro function is mainly used for the following jobs.

- Creation of the message communications frame
- Creation of Send & Recv procedures for the message communications frame

TERMS

This manual uses the terms “message, DSR message, and response” to express the communications data exchanged.

Message: A DSR message or response.

DSR message: A message sent by the Master for instructions to the Inverter.

Response: A message that the Inverter returns in compliance with a DSR message from the Master.

Creating a Message

The message can be created according to the communications specifications of the general-purpose peripheral device (Inverter) as a counterpart.

A DSR message can include variables to set data in the I/O memory (such as data memory) of the CPU Unit or write response data to the I/O memory.

Each component of a message is in the memory of the Communications Board. Therefore, the CPU Unit can just execute the PMCR instruction to send or receive the data, with no need to write ladder programs for the communications protocol.

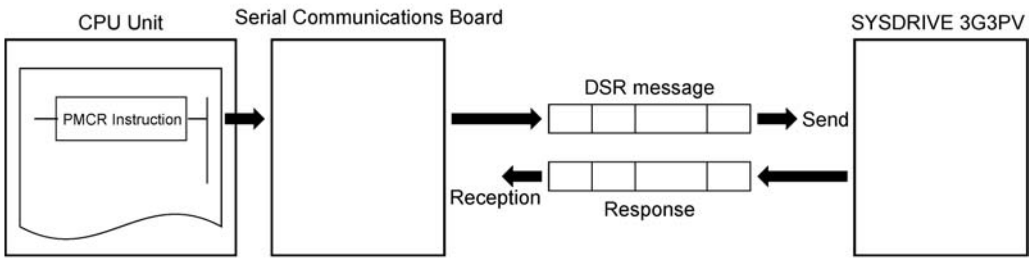


Fig 6.45 Creating a Message

Step to Send and Receive Messages

Sending and receiving messages as a single step includes step-type commands, such as Send, Recv, Send & Recv, and Wait commands.

The step can be finished or switched to another step according to the result of the step.

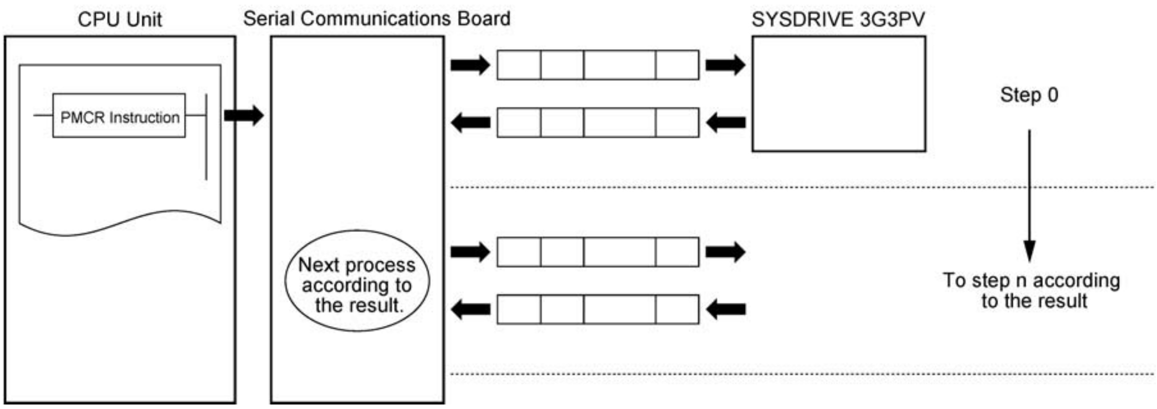


Fig 6.46 Sending and Receiving Messages

■Configuration of the Protocol Macro Function

The protocol consists of one or more sequences. A sequence is an independent set of actions to perform together with a general-purpose peripheral device, such as an Inverter. For example, the RUN command and the frequency reference are given to the Inverter and the status of the Inverter is read in a single sequence.
A sequence consists of one or more steps. A step consists of a Send & Recv command + a Send & Recv message + a step branch in accordance with the processing result + Completion.

Sequence

When repeating actions to give the RUN command and frequency reference to the Inverter and read the status of the Inverter, for example, the actions can be registered as one sequence, or more than one if necessary. On page *80* under *Creating a Project File*, an example is shown with all actions registered as a single sequence.
A sequence may include the following parameters.

Parameter	Description
Transmission control	Set the method of control, such as flow control. Select only modem control for communications with the 3G3PV.
Link word	Set the area for sharing the data between the Programmable Controller and Communications Board. On page *80* under *Creating a Project File*, an example is shown without such an area set.
Monitor time	Set the periods to monitor the transmission and reception steps with timers Tr, Tfr, and Tfs. Set a period of approximately 0.5 s each for communictions with the 3G3PV.
Response notify method	A method to write reception data to the I/O memory of the Programmable Controller. Select “notify by scan” for communictions with the 3G3PV.

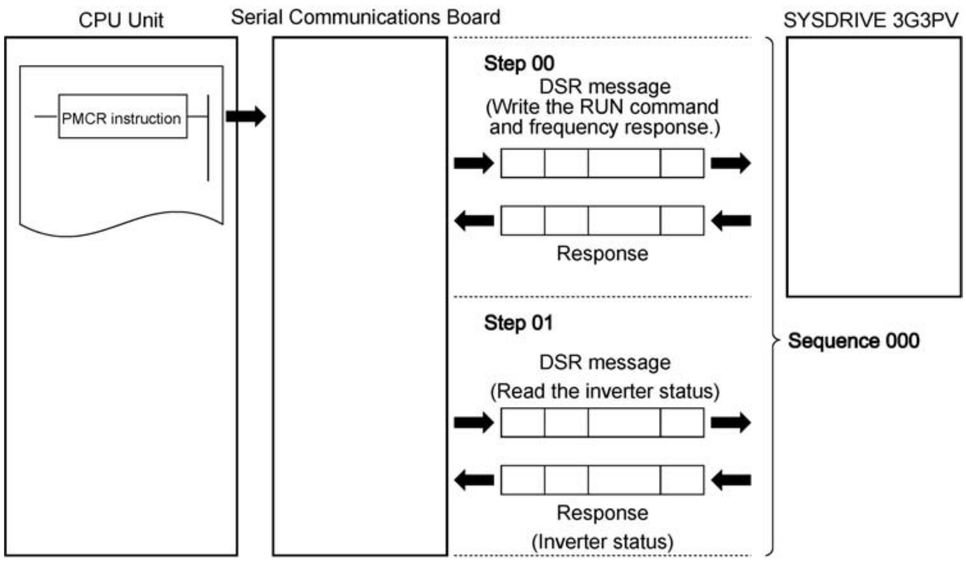


Fig 6.47

Step

In a single step, a DSR message is sent and a response for the DSR message is received. A step may not include a response if it is a broadcast message.
In the case of repetitive actions to issue the RUN command and frequency reference to the Inverter and read the status of the Inverter, for example, the actions to give the RUN command and frequency reference constitute one step. The reason is that these register numbers are consecutive and can be sent with a single DSR message. The action to read the status of the Inverter is another step.
A step includes a command and a maximum of two messages. The above example uses the Send & Recv command. The DSR message and response are both messages.
A step may include the following parameters.

Parameter		Description
Command		The Send, Recv, Send & Recv, Wait, Flush, Open (ER-ON) or Close (ER-OFF) is set. Under *Creating a Project File*, an example is shown with the Send & Recv command used. The Send command is used for a broadcast message.
Message	Send message	A DSR message is set for the Send command used.
	Recv message	A response is set for the Recv command.
	Send & Recv message	A DSR message and response are set for the Send & Recv command.
	Recv matrix	If there are two or more responses for the Send or Send & Recv command, the next process is selected per response.
Repeat counter		The number (N) of times to repeat the step is set within a range from 0 to 255. It is possible to change messages by making use of the number (N). Under *Creating a Project File*, an example is shown with this function used for enabling three Slaves to repeat the same process.
Number of retries		The number of times to retry the command can be set within a range from 0 to 9 only when the Send & Recv command is used. It is recommended that the number be set to 3 or larger.
Send Wait Time		The waiting time until data is sent with the Send or Send & Recv command executed.
Response Write (with operand specified)		Determines whether or not to write the reception data in the response. Under *Creating a Project File*, an example is shown with this function used for writing the Inverter status to the memory.
Next process		Determines which step is to be processed next, or finishes the opertion after the step is finished normally.
Error processing		Determines which step is to be processed next, or finishes the operation, if the the step has an error.

■Data Created by Protocol Support Tool and CX-Protocol

A project file is used by the Protocol Support Tool to create and control data. A project file consists of the following data.

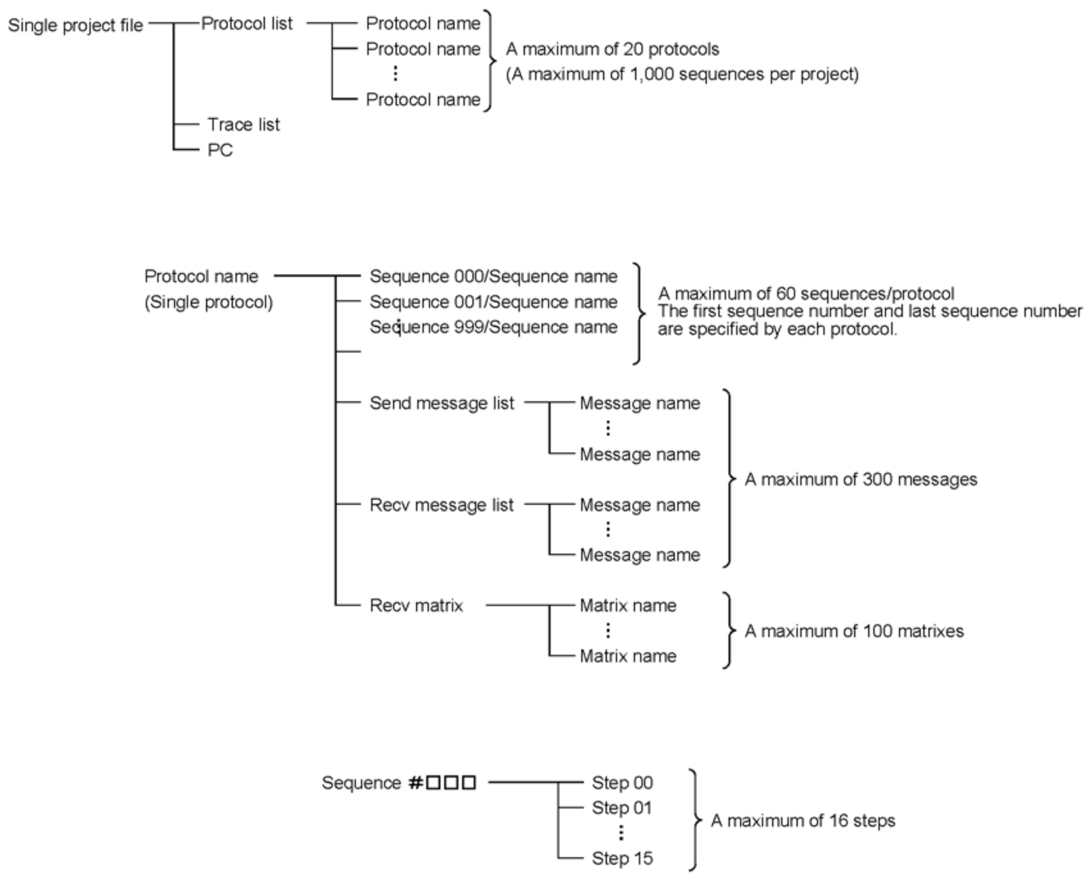


Fig 6.48 Project File Configuration

The standard system protocol incorporated by the Communications Board cannot be edited or transferred. To make use of the standard system protocol, copy it to the project file and edit it.

Under *Creating a Project File*, an example to create a new project file is shown without making use of the standard system protocol.

■Creating a Project File

The following descripton provides information about how to create a project file to send the RUN command and frequency references to three Inverters and read the Inverter status. (“PST” indicates the WS01-PSTF1-J Protocol Support Tool.)
First, select from I/O items, monitor items, and parameters the data to be exchanged according to the application. Then consider what sequence is required by using the protocol macro function.
Example: Writes control input items (such as the RUN command and multi-function input) of the Inverter and frequency reference, monitors the control output (such as error output and RUN output) of the Inverter, and monitors the Inverter status.
Three Inverters with Slave addresses from 01 to 03 are installed for communications.

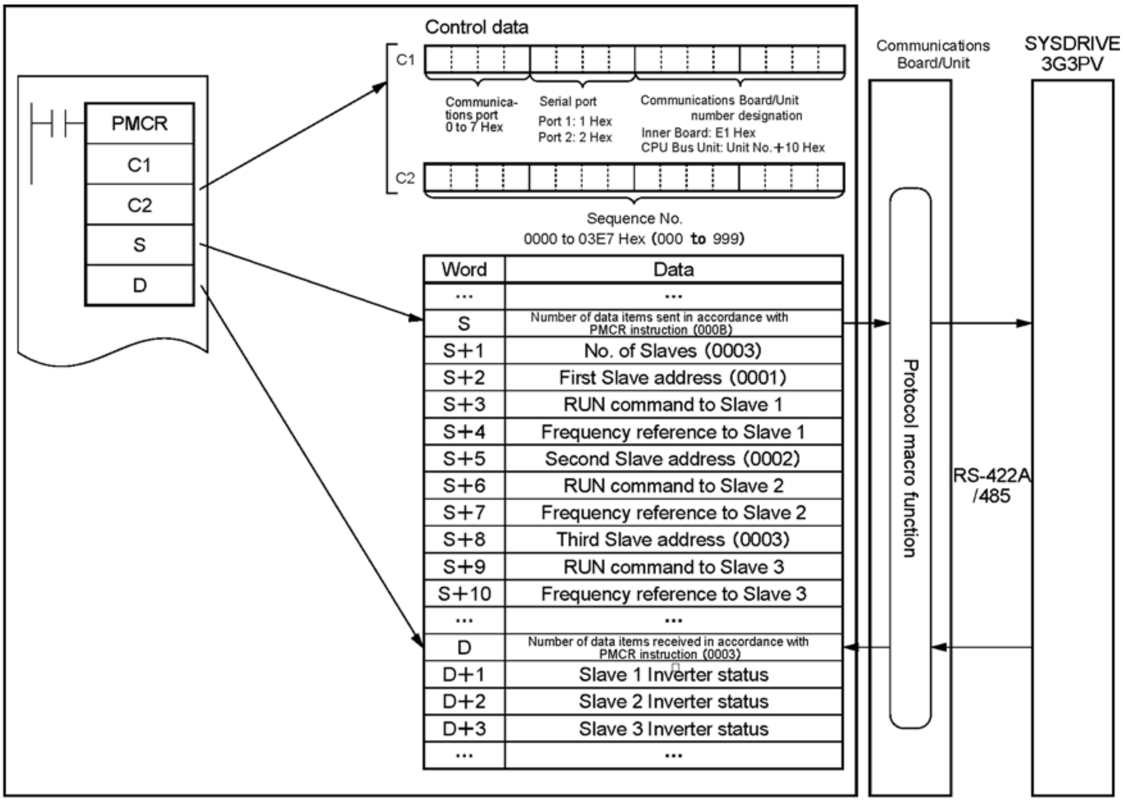
Checking the Register Numbers

In the above example, the following three registers are required.

Control Input: Register 0001 Hex for RUN command
Frequency Reference: Register 0002 Hex
Control Output: Register 002C Hex for Inverter status

Memory Allocations

The PMCR instruction sends each Slave the data in consecutive words specified by the operand and beginning with the first word (S), and writes in the memory area beginning with the first word (D) the data received.
The following memory allocations are made in the above example.



SYSMAC CS or CJ-series Programmable Controllers

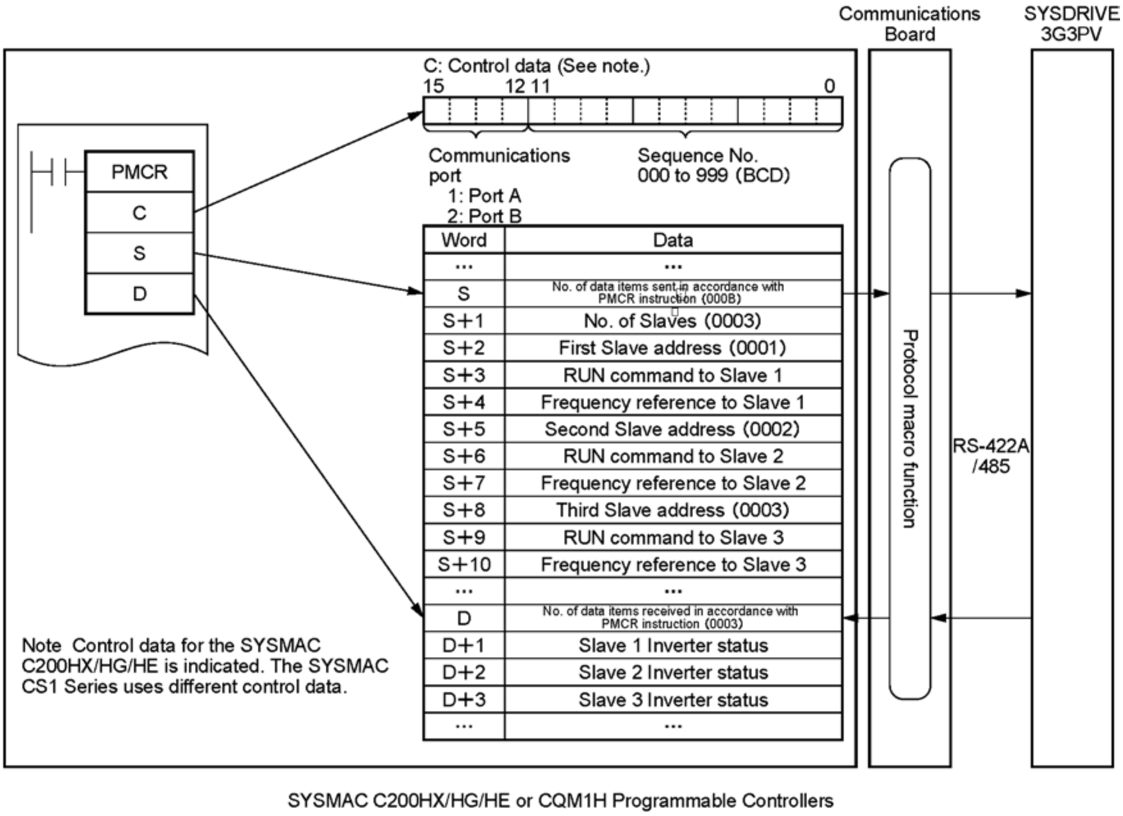


Fig 6.49 Memory Allocations

■Creating a New Project and Protocol

Use the following procedure to create a new project and protocol.

1. Select **New** from **File** in the Menu Bar or click on the **New** icon with the left button of the mouse to create a new project.
2. If CX-Protocol is used, set the PC name, PC model, and network type according to the actual conditions. The network type refers to the type of the network conected to the Support Software and it does not refer to the communications configuration between the Programmable Controller and the SYSDRIVE PV.
   The above settings will not be displayed if the PST is used.
3. Double-click on **New Project** with the left button of the mouse to display **Protocol List**.
4. Click on **Protocol List** with the left button of the mouse and click on a blank space with the right button of the mouse.
5. Select **Create Protocol**.

■Creating a Sequence

Use the following procedure to create a new sequence.

1. Click on **New Protocol** with the left button of the mouse. Then click on a blank space with the right button of the mouse.
2. Select **Create Communication Sequence**.
   The following table will appear. Set the parameters related to the sequence in the table.

*	#	Communication sequence	Link word	Control	Response	Timer Tr	Timer Tfr	Timer Tfs
	000	Inverter I/O Send & Recv	- - -	Set (Setting required)	Scan	0.5	0.5	0.5

#

Sequence number. The sequence number is automatically set.

Communication Sequence

The label (name) of the sequence. Input an appropriate, easy-to-distinguish name.

Link Word

Set the area for sharing the data between the Programmable Controller and Communications Board.
In this example, the link word is specified by the operand of the PMCR instruction. Therefore no link word is set here.

Control

Set the control method, such as flow control.

Select only “modem control” for communications with the 3G3PV.

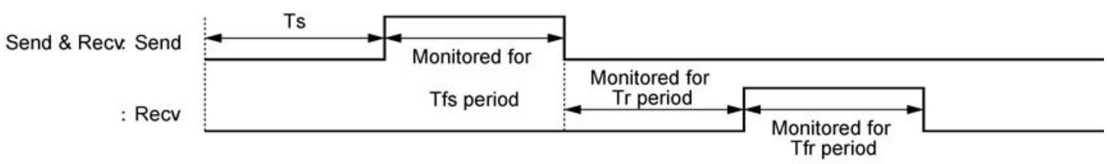
Response

A method to write reception data to the I/O memory of the Programmable Controller.
Select “notify by scan” for communications with the 3G3PV.

Timer Tr, Timer Tfr, and Timer Tfs

Set the periods to monitor the transmission and reception steps with timers Tr, Tfr, and Tfs. The following timing chart shows the meaning of each monitor.
Be sure to set the periods according to the application.
The step will be retried if the step is not completed within the monitor periods. An error will occur if the step is not completed within the monitor time again.

Set a period of approximately 0.5 s each for communications with the 3G3PV.



Ts: Send wait time set per step. Nothing is sent during this period.
Tfs: Monitors the completion of the data sent. If the data transmission is not finished within this period, the data will be re-transmitted.
Tr: Monitors the response to be received. If the response is not returned within this period, the response will be re-transmitted.
Tfr: Monitors the reception completion of the response. If the response transmission is not finished within this period, the response will be re-transmitted.

Note If the Tr period is too long, the time to detect a communications error will be longer, during which the Inverter cannot be controlled. Therefore, be sure to set an appropriate period.

Fig 6.50

■Creating a Step

1. Double-click on **New Protocol** with the left button of the mouse.
2. Click on **New Sequence** with the left button of the mouse and click on a blank space with the right button of the mouse.
3. Select **Create Step**.

The following table will appear. Set the parameters related to the step in the table.

*	Step	Repeat	Command	Retry	Send wait	Send message	Recv message	Response	Next	Error
	00	Reset/R (1)	Send & Recv	3	0.02	Input send	Input response	Yes	Next	Abort
	01	Reset/R (1)	Send & Recv	3	0.02	Status	Read response	Yes	End	Abort

Step

Step number. The step number is automatically set.

Repeat

The number (N) of times to repeat the step is set within a range from 0 to 255. It is possible to change messages by making use of the number (N).

In this example, the same message is sent to three Slaves with addresses different to each other. Therefore, the number is set to 3 in word S + 1. The number of Slaves is specified by the operand. Therefore, select **Channel**, use the Edit command to set **Data Address** to **Operand**, and set 0N + 1 in order to select word S + 1. In the above table, “Reset” means that the repeat counter must be reset first in the step.

Command

Set the commands, such as Send, Recv, and Send & Recv.

Only the Send & Recv command is used for communications with the 3G3PV except for broadcasting messages, in which case the Send command is used.

Retry

Set the number of times to retry the command within a range from 0 to 9.

It is recommended that the number be set to 3 or larger. If a transmission error occurs due to noise, the transmission of the command will be retried. If the number is set to 3, an error will be detected if the transmission fails three times.

Send Wait

The waiting time until the data is sent.

For communications with the 3G3PV, if data is repeatedly transmitted to the same Slave, set the waiting time to 20 ms or more.

Send Message and Recv Message

Set the labels of the DSR message and response to be used.

Make these settings after deciding the labels in **Send Message Detail Settings** and **Recv Message Detail Settings**.

Response

Determine whether or not to write the reception data in the response.

Always set this parameter to Yes for communications with the 3G3PV.

Next

Determine which step is to be processed next or finish the operation after the step finishes normally.

In this example, step 00 is set to Next and step 01 is set to END because the sequence completes be executing steps 00 and 01.

Error

If the step has an error, determine which step is to be processed next or finish the operation.

In this example, the parameter will be set to Abort to interrupt the sequence if an error occurs.

■Send Message Detail Settings

1. Click on **Send Message List** with the left button of the mouse, and then click on a blank space with the right button of the mouse.
2. Select **Create Send Message**. The following table will appear. Set the send message in the table.

●	Message name	Header <h>	Terminator <t>	Check code <c>	Length <l>	Address <a>	Data
→□	Input send			~CRC-16(65535)(2Byte BIN)	(0)(1Byte BIN)	~(R(3N+2), 1)	<a>+[10]+[00]+[01]+[00]+[02]+<l>+(R(3N+3), 4)+<c>
→□	Status			~CRC-16(65535)(2Byte BIN)		~(R(3N+2), 1)	<a>+[03]+[00]+[2C]+[00]+[01]+<c>
→□							

Message name

The label (name) of the sequence. Input an appropriate, easy-to-distinguish name.

Set the label in the send message box in the table shown under *Creating a Step*.

Header <h> and Terminator <t>

Set the header and terminator.

No header or terminator is used for communications with the 3G3PV. Therefore, set both to **None**.

Check code <c>

Set the check code.

The CRC-16 check code is used for communications with the 3G3PV. Select the CRC-16 check code and set the default value to 65535.
Select **Reverse** for the conversion method. Then select **BIN** for data type.

Length <l>

Set the length of the data.

All communications with the 3G3PV are performed in byte units. Select **1 Byte** and **BIN**. Select **No** for reading data because there is no data to be read.

Address <a>

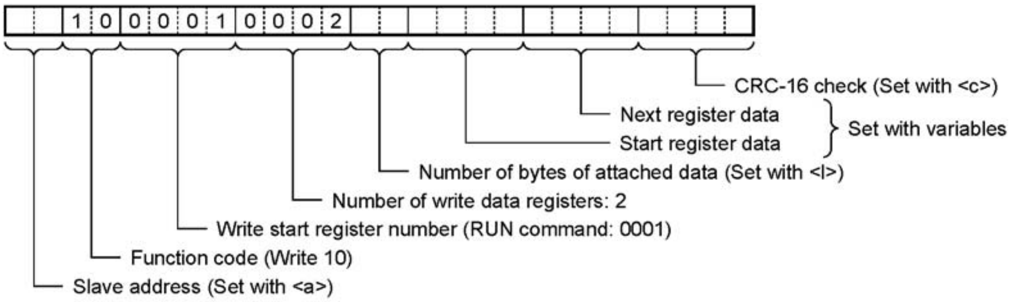
Set the addresses of the Slaves.

In this example, the Slave addresses are set in S + 2, S + 5, and S + 8. Therefore, retrieve the data from those locations.
The address is set in the LSB of each word. To read the byte, select **Variable Reverse**, otherwise the data is read from the MSB. Then click on **Edit Variable** with the left button of the mouse. Select **Read R ()** and set **Data/Address** to the operand (3N + 2) using the number (N) of times to repeat the step.
Set **Edit Length** to 1 byte as a default. If the default value has been changed, set it to 0N + 1.

Data

Set the DSR message in detail.

- DSR Message Requesting that the RUN Command and Frequency Reference Be Written
  The DSR message to write data to two registers from register 0001 Hex (the RUN command) consists of the following items.



Set data → ⟨a⟩+[10]+[00]+[01]+[00]+[02]+⟨l⟩+(R(3N+3), 4)+⟨c⟩

⟨a⟩

The Slave address is set in the address box. Insert the address with the Insert icon.

[10]+[00]+[01]+[00]+[02]

Set the constants contained in the DSR message.

Use Set Constant and set the constants in Hex.

⟨l⟩

The length is set in the length box. Insert the length by using the Insert icon. The length is the number of bytes of the succeeding data (R(3N +3), 4). The length is automatically set by the CX-Protocol.

(R(3N +3), 4)

The Inverter's actual data to be sent. This example selects Variable and Read R() and sets the operand. Set Data to 3N + 3 because the RUN command data uses four bytes each from S + 3, S +6, and S + 9.

Set Edit Length to 0N + 4 so that it will be set to four bytes.

⟨c⟩

The check code is set in the check code box. Insert the check code by using the Insert icon. All the data including the address data before the check code is operated. Mark all the items if the PST is used. The check code is automatically set by the CX-Protocol.

Fig 6.51 DSR Message to Write Data

- DSR Message to Read the Inverter Status
  The DSR message to read the Inverter status from register 002C Hex consists of the following items.

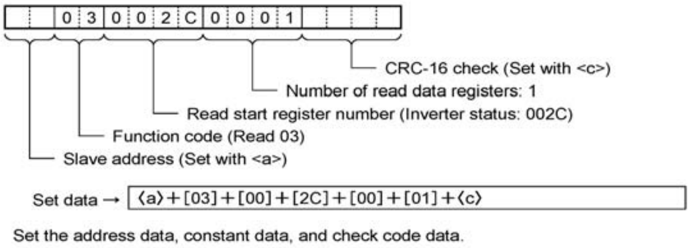


Fig 6.52 DSR Message to Read

■Recv Message Detail Settings

1. With the left button of the mouse, click on **Receive Message List**. Then click on a blank space with the right button of the mouse.
2. Select Create Receive Message.

The following table will appear. Set the Receive message in the table.

*	Message	Header <h>	Terminator <t>	Check code <c>	Length <l>	Address <a>	Data
→☐	Input response			~CRC-16(65535)(2Byte BIN)		~(R(3N+2), 1)	〈a〉+[10]+[00]+[01]+[00]+[02]+〈c〉
→☐	Read response			~CRC-16(65535)(2Byte BIN)	(0)(1Byte BIN)	~(R(3N+2), 1)	〈a〉+[03]+〈l〉+(W(1N+1), 2)+〈c〉
→☐							

Message

The label (name) of the response. Input an appropriate, easy-to-distinguish name.

Set the label in the Recv message box in the table shown under *Creating a Step*.

Header <h> and Terminator <t>

Set the header and terminator.

No header or terminator is used for communications with the 3G3RV. Therefore, set both to **None**.

Check Code <c>

Set the check code.
The CRC-16 check code is used for communications with the 3G3RV. Select the CRC-16 check code and set the initial value to 65535.
Select **Reverse** for the conversion method. Then select **BIN** as the data type.

Length <l>

Set the length of the data.

All communications with the 3G3RV are performed in byte units. Select **1 Byte** and **BIN**. Select **No** for reading data because there is no data to be read.

Address <a>

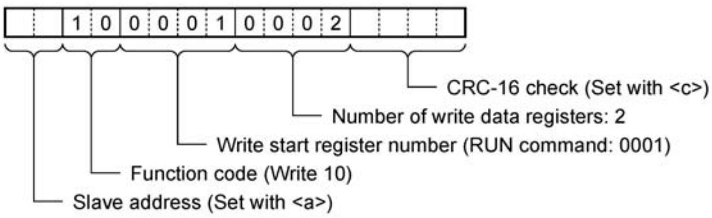
Set the addresses of the Slaves.

In this example, the Slave addresses are set in S + 2, S + 5, and S + 8. Therefore, retrieve the data from those locations.
The address is set in the LSB of each word. To read the byte, select **Variable Reverse**, otherwise the data will be read from the MSB. Then click on **Edit Variable** with the left button of the mouse. Select **Read R ()** and set **Data/Address** to the operand (3N + 2) using the number (N) of times to repeat the step.
Set **Edit length** to 1 byte as a default. If the default value has been changed, set it to 0N + 1.

Data

Set the expected response in detail.

- Response to the RUN Command and Frequency Reference
  The response to the DSR message written consists of the following items.



Set data → 〈a〉+[10]+[00]+[01]+[00]+[02]+〈c〉

〈a〉

The Slave address is set in the address box. Insert the address with the Insert icon.

[10]+[00]+[01]+[00]+[02]

Set the constants contained in the response.

Use Set Constant and set the constants in Hex.

〈c〉

The check code is set in the check code box. Insert the check code by using the Insert icon. All the data including the address data before the check code is used. Mark all the items if the PST is used. The check code is automatically set by the CX-Protocol.

Fig 6.53 Response to DSR Message Written

- Response to the Inverter Status Read
  The response to the DSR message to request the Inverter status in register 002C Hex consists of the following items.

Inverter status data (Set with variable)
Number of bytes of attached data (Set with <l>)
Function code (Write 10)
Slave address (Set with <a>)

Set data → 〈a〉+[03]+〈l〉+(W(1N+1), 2)+〈c〉

〈a〉, [03], 〈c〉

The address data, constant data, and check code data are the same as the above.

〈l〉

The length is set in the length box. Insert the length by using the Insert icon. The length is the number of bytes of succeeding data (W(1N + 1), 2). The length is automatically set by the CX-Protocol.

(W(1N+1), 2)

The Inverter's actual data is to be sent. This example selects Variable and Write W () (ntlp: English reference mistakenly(?) says Read R () here) and sets the operand. Set the data to 1N + 1 because the RUN command da uses two bytes each from D + 1, D + 2, and D + 3. (ntlp: English reference mistakenly(?) says the RUN commanc uses four bytes each from D + 3, D + 6, and D + 9. here)

Set Edit Length to 0N + 2 so that it will be set to two bytes.

Fig 6.54 Response to DSR Message Read

■Ladder Program

Connect the PST and the Communications Board, and read the Communications Board system settings from the PST. Set the start/stop bits both to 1 bit, and data length to 8 bits.
Transfer the created protocol to the Communications Board. The following example describes how to control the Inverter with this protocol.

1. Before using this program in your system, be sure to check the word and data memory allocations and change them if necessary so that there will be no word or data memory duplication.
2. This program will stop all communications if a communications error or fault occurs. Be sure to set H5-05 for communications error detection selection to 1 (effective) and H5-04 for communications error detection operation selection to 0 through 2 so that the system will stop with time-over detection.

■Memory Allocations

Starting Communications and Status Signals

Word	Functions common to all Slaves
00000	Inverter control communications (continued when set to ON)
00001	Communications error output (on hold when a communications error or fault occurs
00002	Communications fault reset

Inverter Control Inputs (Register 0001 RUN Command)

The Inverter control inputs for the register 0001 RUN command are listed in the following table.

Word	Slave 1 function	Word	Slave 2 function	Word	Slave 3 function
00100	RUN command	00200	RUN command	00300	RUN command
00101	Forward/Reverse	00201	Forward/Reverse	00301	Forward/Reverse
00102	External fault	00202	External fault	00302	External fault
00103	Fault reset	00203	Fault reset	00303	Fault reset
00104	Multi-function input 1	00204	Multi-function input 1	00304	Multi-function input 1
00105	Multi-function input 2	00205	Multi-function input 2	00305	Multi-function input 2
00106	Multi-function input 3	00206	Multi-function input 3	00306	Multi-function input 3
00107	Multi-function input 4	00207	Multi-function input 4	00307	Multi-function input 4
00108	Multi-function input 5	00208	Multi-function input 5	00308	Multi-function input 5
00109	Multi-function input 6	00209	Multi-function input 6	00309	Multi-function input 6
00110	Multi-function input 7	00210	Multi-function input 7	00310	Multi-function input 7
00111	Always set to 0.	00211	Always set to 0.	00311	Always set to 0.
00112	Always set to 0.	00212	Always set to 0.	00312	Always set to 0.
00113	Always set to 0.	00213	Always set to 0.	00313	Always set to 0.
00114	Always set to 0.	00214	Always set to 0.	00314	Always set to 0.
00115	Always set to 0.	00215	Always set to 0.	00315	Always set to 0.

Frequency References of Inverter (Register 0002 Frequency Reference)

The frequency references of the Inverter for register 0002 frequency references are listed in the following table.

DM	Function
D0001	Slave 1 frequency reference
D0002	Slave 2 frequency reference
D0003	Slave 3 frequency reference

Inverter Control Outputs (Register 002C Inverter Status)

The Inverter control outputs for register 002C Inverter status are listed in the following table.

Word	Slave 1 function	Word	Slave 2 function	Word	Slave 3 function
01100	During RUN	01200	During RUN	01300	During RUN
01101	Zero speed	01201	Zero speed	01301	Zero speed
01102	Frequency agree	01202	Frequency agree	01302	Frequency agree
01103	Custom speed agree	01203	Custom speed agree	01303	Custom speed agree
01104	Frequency detection 1	01204	Frequency detection 1	01304	Frequency detection 1
01105	Frequency detection 2	01205	Frequency detection 2	01305	Frequency detection 2
01106	Inverter ready	01206	Inverter ready	01306	Inverter ready
01107	UV	01207	UV	01307	UV
01108	Base block	01208	Base block	01308	Base block
01109	Frequency reference mode	01209	Frequency reference mode	01309	Frequency reference mode
01110	RUN command mode	01210	RUN command mode	01310	RUN command mode
01111	Overtorque detection	01211	Overtorque detection	01311	Overtorque detection
01112	Frequency reference loss	01212	Frequency reference loss	01312	Frequency reference loss
01113	Fault retry	01213	Fault retry	01313	Fault retry
01114	Fault	01214	Fault	01314	Fault
01115	Communications time-over	01215	Communications time-over	01315	Communications time-over

Area Used by Operand of PMCR Instruction

The area used by the operand of the PMCR instruction in the CS-series is shown here.

Control Data: C1

DM	Word
D0100	0 1 1 1 0 0 1 0 1 1 1 0 0 0 0 1

Communications port 7 / Serial port 2 / Communications port E1

Control Data: C2

DM	Word
D0101	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

Sequence 000 set

Send Data: S

DM	Area
D1000	000B (Number of Send data items: 11) See note 1.)
D1001	0003 (Number of Slaves)
D1002	0001 (Slave 1 address)
D1003	RUN command to Slave 1
D1004	Frequency reference to Slave 1
D1005	0002 (Slave 2 address)
D1006	RUN command to Slave 2
D1007	Frequency reference to Slave 2
D1008	0003 (Slave 3 address)
D1009	RUN command to Slave 3
D1010	Frequency reference to Slave 3

Recv Data: D

DM	Area
D2000	0003(Number of Recv data items: 3) See note 2.)
D2001	Slave 1 Inverter status
D2002	Slave 2 Inverter status
D2003	Slave 3 Inverter status

Note 1. Set the number of Send data items in Hex to the number of words of D1000 through D1010 (11).

Note 2. The number of words of D2001 through D2003 is written in Hex for the number of Recv data items.

Status flags

- Communications Port Enabled Flag
  Flag bit for communications port 7: A20207
- Protocol Macro Execution Flag
  The Protocol Macro Execution Flag is described below.

Unit/Board	Port 1	Port 2
CS1 Board	CIO 190915	CIO 191915
CS1 Unit	Bit 15 of CIO n + 9	Bit 15 of CIO n + 19

n = CIO 1500 + (25 x number of units)

- Communications Port Abort Flag
  The Communications Port Abort Flag is described below.

Unit/Board	Port 1	Port 2
CS1 Board	CIO 190913	CIO 191913
CS1 Unit	Bit 13 of CIO N + 9	Bit 13 of CIO n+19

n = CIO 1500 + (25 x number of units)

Ladder Program

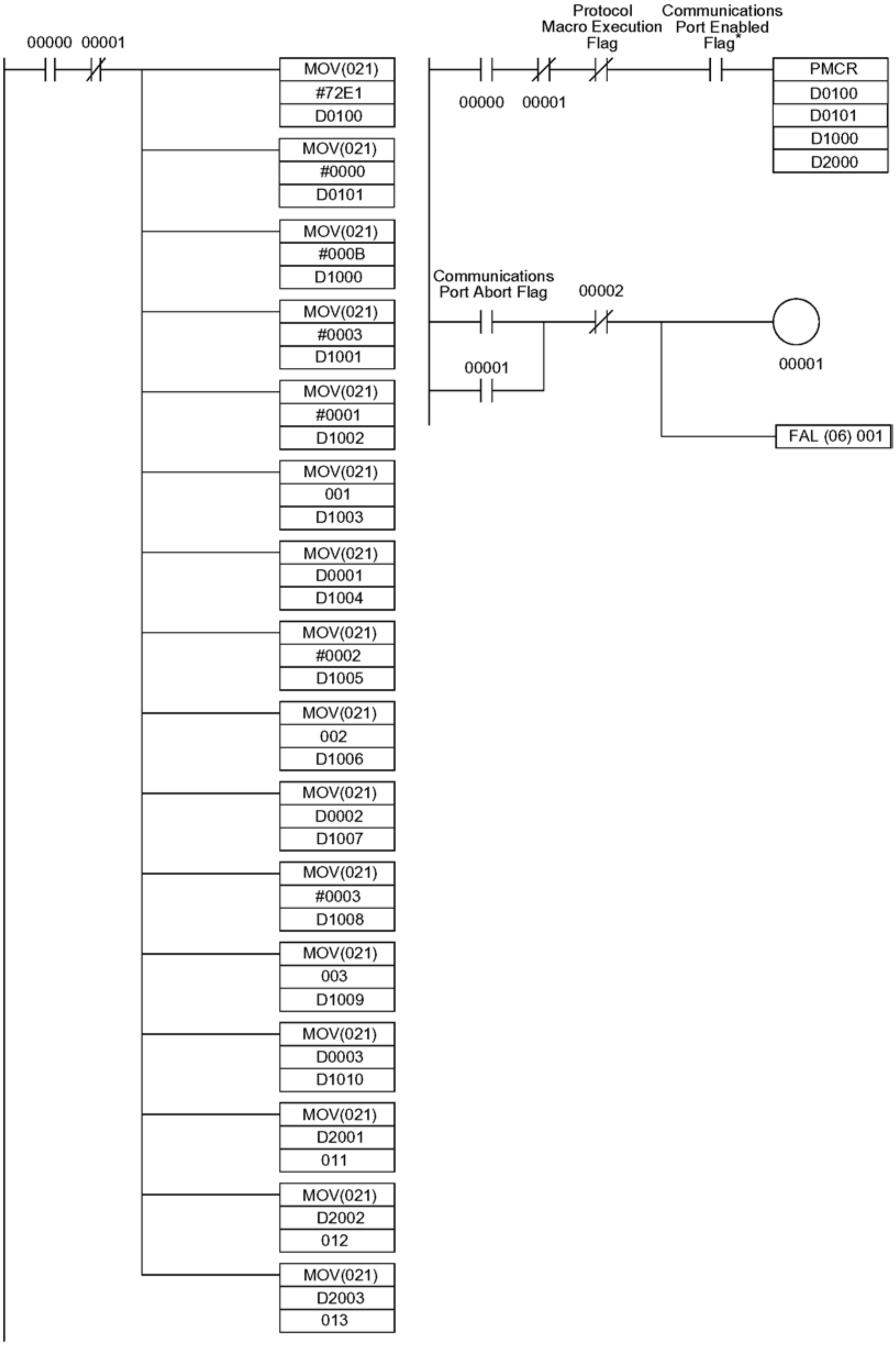


Fig 6.55 Ladder Program

Communications Response Time

The communications response times for communications with an Inverter via the RS-422/485 port of an Omron-made Communications Board are detailed below. Use this information as a reference when deciding the number of Slaves to be connected to one network, and when considering the timing of input and output signals.

Communications Time for One Message

A wide variety of programs for RS-422/485 communications can be created using the protocol macro function. The communications times will vary according to the contents of the program.
In general, the communications time for one message can be calculated using the following formula.

Communications time = [Number of bytes in DSR message x 10 (See note 1.) x (1/baud rate) x 1,000 (ms)]

+ [Number of bytes in response x 10 x (1/baud rate) x 1,000 (ms)] + [24 x (1/baud rate) x 1,000 (ms)] + send wait time setting (ms) + protocol macro waiting time (See note 2.) (ms)

The reason that the number of bytes in the DSR message and response is multiplied by 10 is because both the start bit and the stop bit require one bit each.
(1 byte = 8 bits) + (start bit: 1 bit) + (stop bit: 1 bit) = 10 bits

With RS-422A/485 communications, set at least 20 ms as the protocol macro waiting time.

Calculation Example

The communications time required for one Slave in the protocol macro created under *Creating a Project File*, can be calculated according to the following formula. (Baud rate = 19,200 bps.)

Communications time = [DSR message to write data (13 bytes) + DSR message to read (8 bytes)) x 10 x (1/19,200) x 1,000 (ms)] + [write response (8 bytes) + read response (7 bytes)) x 10 x (1/19,200) x 1,000 (ms)] + [24 x (1/19,200) x 1,000 (ms) x 2] + [10 (ms) x 2] + [20 (ms) x 2] = 81.2 (ms)

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If there are N Slaves, the total communications time will be N x 81.2 ms. Consequently, the more Slaves that are used, the longer the communications time will be. If the number of Slaves is too high, it is possible that the detection time of 2 s for communications time-over will be exceeded. In this case, either disable the time-over detection function and use a different sequence to detect communications errors, or increase the number of Masters thereby decreasing the number of Slaves per Master.

I/O Response Time

The communications processing times for the Inverter are as follows.

- Inverter communications input scan: 8 ms
- Inverter communications output scan: 8 ms
- Internal processing time for the Inverter: Approx. 20 ms

The I/O response times for the Inverter are illustrated in the following diagram.

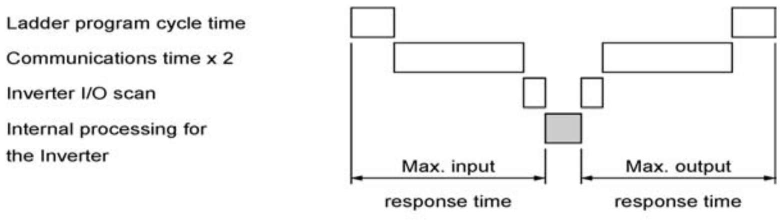

Fig 6.56 I/O Response Time

◆ Using PI Control

PI control is a method of making the feedback value (detection value) match the set target value. By combining proportional control (P) and integral control (I), you can even control targets (machinery) with play time.

The characteristics of the PI control operations are given below.

P control — Outputs the amount of operation proportional to the deviation. You cannot, however, set the deviation to zero using P control alone.

I control — Outputs the amount of operation that integrates the deviation. Used for matching feedback value to the target value.

■PI Control Operation

To understand the differences between the PI control operations P and I, the variation in the amount of operation (output frequency) is as shown in the following diagram when the deviation (the difference between the target value and feedback value) is fixed.

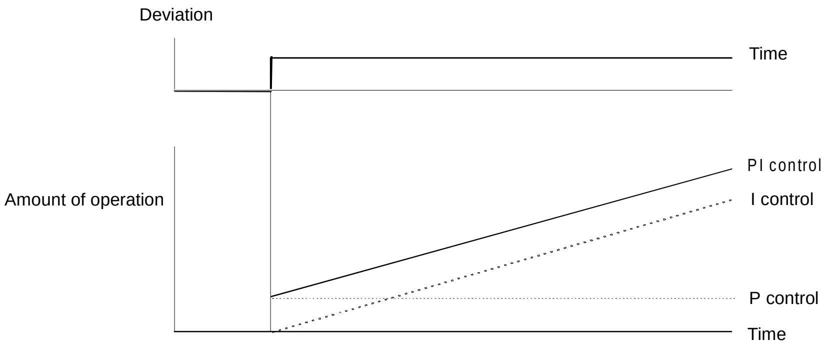

Fig 6.57 PI Control Operation

■PI Control Applications

The following table shows examples of PI control applications using the Inverter.

Application	Control Details	Example of Sensor Used
Speed Control	• Feeds back machinery speed information and matches speed to the target value. • Inputs speed information from other machinery as the target value and performs synchronous control using the actual speed feedback.	Tachometer generator
Pressure Control	Feeds back pressure information and performs parameter pressure control.	Pressure sensor
Flow Rate Control	Feeds back flow rate information and controls the flow rate highly accurately.	Flow rate sensor
Temperature Control	Feeds back temperature information and performs temperature adjustment control by rotating the fan.	• Thermocouple • Thermistor

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■Related Parameters

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level
b5-01	PI control mode selection PI Mode	0: Disabled 1: Enabled	0 or 1	0	No	A
b5-02	Proportional gain (P) PI Gain	Sets P-control proportional. P-control is not performed when the setting is 0.00.	0.00 to 25.00	1.00	Yes	A
b5-03	Integral (I) time PI I Time	Sets I-control integral time. I-control is not performed when the setting is 0.0.	0.0 to 360.0	1.0 s	Yes	A
b5-04	Integral (I) limit PI I Limit	Sets the I-control limit as a percentage of the maximum output frequency.	0.0 to 100.0	100.0%	Yes	A
b5-06	PI limit PI Limit	Sets the limit after PI-control as a percentage of the maximum output frequency.	0.0 to 100.0	100.0%	Yes	A
b5-07	PI offset adjustment PI Offset	Sets the offset after PI-control as a percentage of the maximum outut frequency.	-100.0 to +100.0	0.0%	Yes	A
b5-08	PI primary delay time parameter PI Delay Time	Sets the time parameter for low pass filter for PI-control outputs. Not usually necessary to set.	0.00 to 10.00	0.00 s	Yes	A
b5-12	Selection of PI feedback command loss detection Fb loss Det Sel	0: No detection of loss of PI feedback 1: Detection of loss of PI feedback. Operation continues during detection, with the fault contact not operating. 2: Detection of loss of PI feedback. Coasts to stop during detection and fault contact operates.	0 to 2	0	No	A
b5-13	PI feedback command loss detection level Fb loss Det Lvl	Set the PI feedback loss detection level as a percent, with the maximum output frequency at 100%.	0 to 100	0%	No	A
b5-14	PI feedback command loss detection time Fb loss Det Time	Sets the PI feedback loss detection level in s units.	0.0 to 25.5	1.0 s	No	A
b5-15	PI sleep function operation level PI Sleep Level	Set the PI sleep function start level as a frequency.	0.0 to 120.0	0.0 Hz	No	A
b5-16	PI sleep operation delay time PI Sleep Time	Set the delay time until the PI sleep function starts.	0.0 to 25.5	0.0 s	No	A
b5-17	Accel/decel time for PI reference PI Acc/Dec Time	Set the accel/decel time for PI reference.	0.0 to 25.5	0.0 s	No	A
H6-01	Pulse train input function selection Pulse Input Sel	0: Frequency reference 1: PI feedback value 2: PI target value	0 to 2	0	No	A

Parameter Number	Name / LCD Display	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Access Level
U1-24	PI feedback value PI Feedback	Monitors the feedback value when PI control is used. The input for the max. frequency corresponds to 100%.	10 V: Max. frequency (0 to + 10 V possible)	0.01	A
U1-36	PI input volume PI Input	PI feedback volume Given as maximum frequency/100%	10 V: Max. frequency (0 to + 10 V possible)	0.01%	A
U1-37	PI output volume PI Output	PI control output Given as maximum frequency/100%	10 V: Max. frequency (0 to + 10 V possible)	0.01%	A
U1-38	PI command PI Setpoint	PI command + PI command bias Given as maximum frequency/100%	10 V: Max. frequency	0.01%	A

Multi-Function digital Inputs (H1-01 to H1-05)

Set Value	Function
19	PI control disable (ON: PI control disabled)

Multi-Function Analog Input (H3-09)

Set Value	Function	
B	PI feedback	Max. output frequency

■PI Control Methods

The PI control method can be enabled or disabled by setting parameter b5-01.

Set Value	Control Method
0	PI disabled
1	PI output becomes the Inverter output frequency.

PI Feedback Input Methods

The multifunction analog input A2 can be used for PI control feedback input.

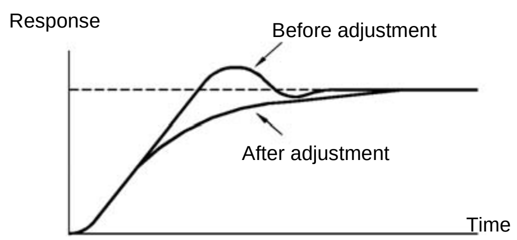
Therefore the parameter H3-09 (Multi-Function Analog Input Terminal A2 Selection) has to be set to B (PI-feedback).

The PI feedback value can be adjusted by using the analog input terminal gain and bias.

■PI Adjustment Examples

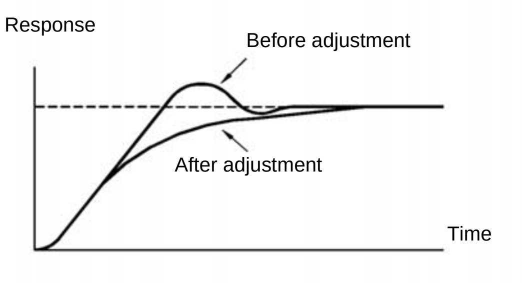
Suppressing Overshoot

If overshoot occurs, reduce Proportional gain (P) and increase integral time (I).



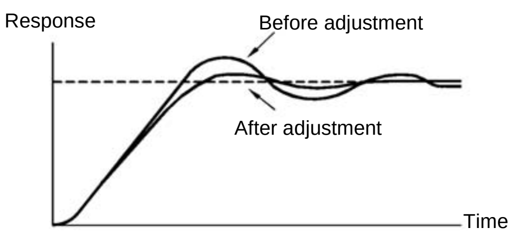
Set a Rapidly Stabilizing Control Condition

To rapidly stabilize the control even if overshoot occurs, reduce integral time (I).



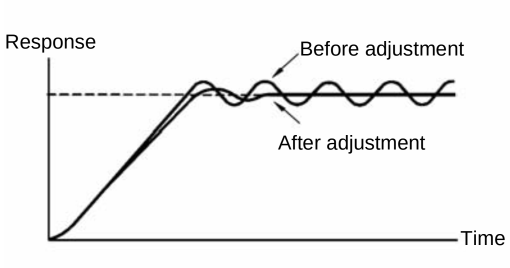
Suppressing Long-cycle Vibration

If vibration occurs with a longer cycle than the integral time (I) set value, lengthen the integral time (I) to suppress the vibration.



Suppressing Short Cycle Vibration

If vibration occures, reduce the proportional gain (P) or increase the PI primary delay time parameter.



■Setting Precautions

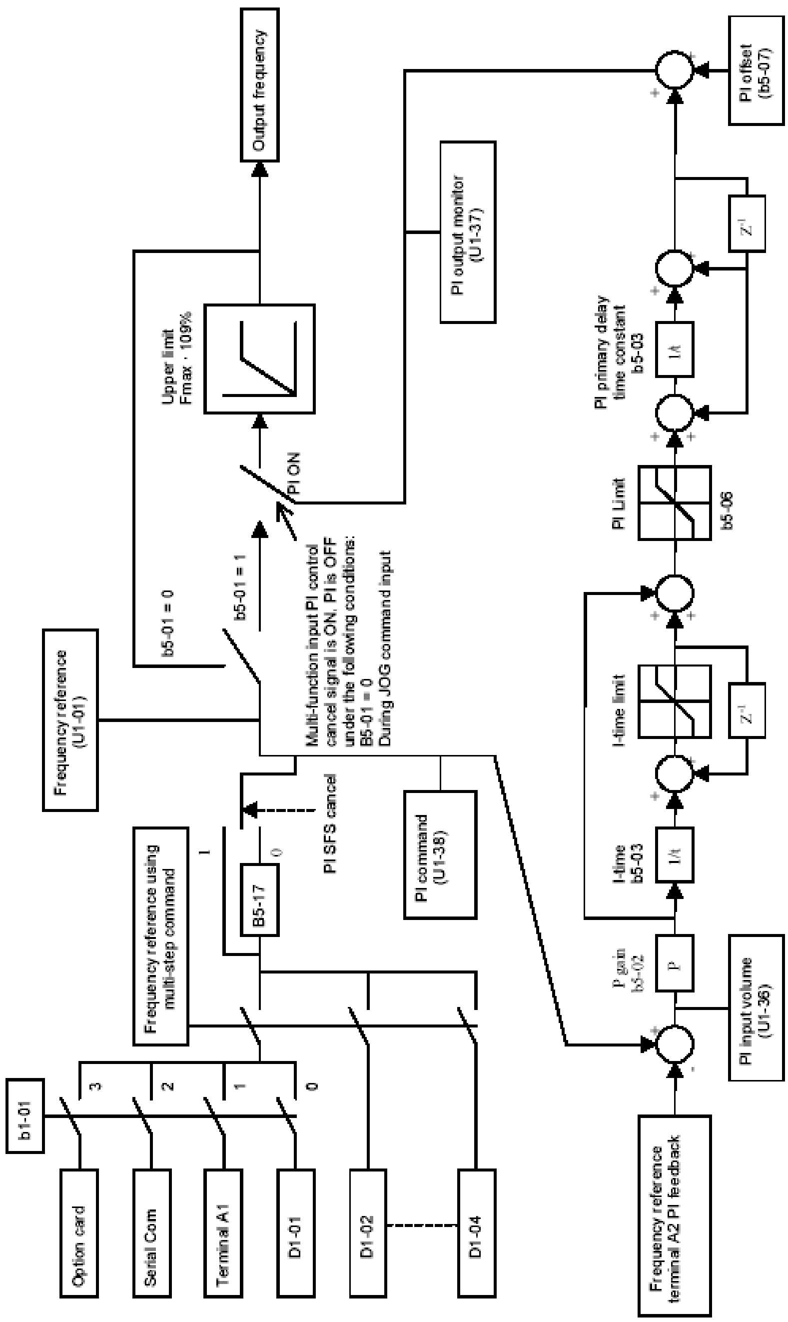
- In PI control, the b5-04 parameter is used to prevent the calculated integral control value from exceeding a specified amount. When the load varies rapidly, Inverter response is delayed and the machine may be damaged or the motor may stall. In this case, reduce the set value to speed up Inverter response.
- The b5-06 parameter is used to prevent the arithmetic operation following the PI control calculation from exceeding a specified amount. Set taking the maximum output frequency to be 100%.
- The b5-07 parameter is used to adjust PI control offset. Set in increments of 0.1%, taking the maximum output frequency to be 100%.

- Set the low pass filter time parameter for the PI control output in b5-08. Enable this parameter to prevent machinery resonance when machinery adhesive abrasion is great or rigidity is poor. In this case, set the parameter to be greater than the resonance frequency cycle. Increase this time parameter to reduce Inverter responsiveness.
- With the Inverter, by setting an independent acceleration/deceleration time in parameter b5-17, you can increase or decrease the PI target value using the acceleration/deceleration time. The acceleration/deceleration function (parameter C1) that is normally used, however, is allocated after PI control, so depending on the settings, resonance with PI control and hunting in the machinery may occur. If this happens, reduce parameter C1 until hunting does not occur and maintain the acceleration/deceleration time using b5-17. Also, you can disable the set value in b5-17 from the external terminals during operation using multi-function input set value 34 (PI soft starter).

■PI Control Block

The following diagram shows the PI control block in theInverter.

Fig 6.58 PI Control Block



■PI Feedback Loss Detection

When performing PI control, be sure to use the PI feedback loss detection function. If PI feedback is lost, the Inverter output frequency may accelerate to the maximum output frequency.

When setting b5-12 to 1 and the status of the PI feedback value detection level in b5-13 is insufficient and continues for the time set in b5-14, a FbL (PI feedback reference lost) alarm will be displayed on the Digital Operator and Inverter operation will continue.

When b5-12 is set to 2, a FbL (PI feedback reference lost) error alarm will be displayed on the Digital Operator, the error contact will operate and Inverter operation will be stopped.

The time chart for PI feedback loss detection (set b5-12 to 2) is shown below.

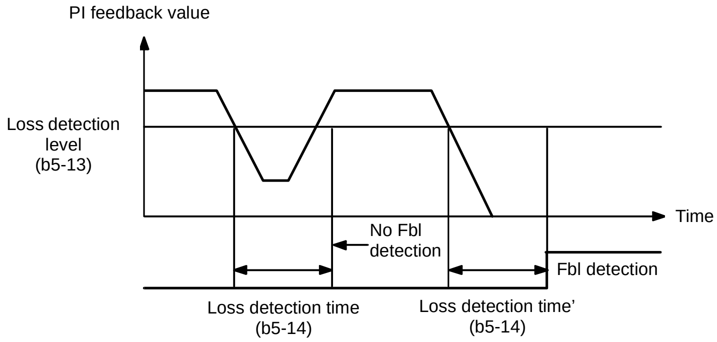


Fig 6.59 PI Feedback Loss Detection Time Chart

■PI Sleep

The PI sleep function stops the Inverter when the PI target value falls below the sleep operation level (b5-15) for the sleep operation time set in parameter b5-16 or longer. The inverter operation will resume, if the PI target value exceeds the sleep operation level for the time set in parameter b5-16 or longer.

When PI control is disabled, the PI sleep function is also disabled. When using the PI sleep function, select decelerate to stop or coast to stop as the stopping method.

The PI sleep time chart is shown below.

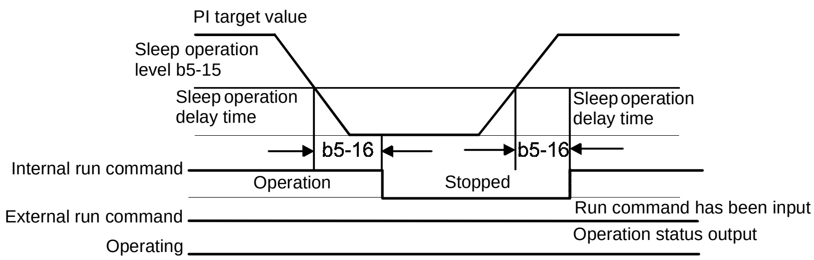


Fig 6.60 PI Sleep Time Chart

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◆ Energy-saving

To perform energy saving, set b8-01 (Energy Saving Mode Selection) to 1.

■Related parameters

param-eter Number	Name	Details	Setting Range	Factory Setting	Change During Opera-tion	Access Level
	LCD Display					
b8-01	Energy-saving mode selec-tion Energy Save Sel	Select whether to enable or disable energy-saving control. 0: Disable 1: Enable	0 or 1	0	No	A
b8-04	Energy-saving coefficient Energy Save COEF	Set the maximum motor efficiency value. Set the motor rated capacity in E2-11 and adjust the value by 5% at a time until output power reaches a minimum value.	0.0 to 655.00*1	*2	No	A
b8-05	Power detection filter time parameter kW Filter Time	Set the time parameter for output power detection.	0 to 2000	20 ms	No	A
b8-06	Search operation voltage limiter Search V Limit	Set the limit value of the voltage control range during search operation. Perform search operation to optimize operations using minute variations in voltage using energy-saving control. Set to 0 to disable the search operation. 100% is the motor base voltage.	0 to 100	0%	No	A

* 1. The same capacity as the Inverter will be set by initializing the parameters.
* 2. The factory settings depend on the Inverter capacity.

■Adjusting Energy-saving Control

By the Energy Saving function the voltage for optimum motor efficiency is calculated and becomes the output voltage reference.

- b8-04 (Energy-saving Coefficient) is set at the factory for motor use applied to the Inverter. If the motor capacity differs from the motor applied to the Inverter, set the motor capacity in E2-11 (Motor Rated Output). Also, adjust b8-04 in steps of 5 until reaches it’s minimum. The larger the energy-saving coefficient, the greater the output voltage.
- To improve response when the load fluctuates, reduce the power detection filter time parameter b8-05. If b8-05 is set too small. However, motor rotations, when the load is light, may become unstable.
- Motor efficiency varies due to temperature fluctuations and differences in motor characteristics. Consequently the motor efficiency has to be controlled. To have optimized efficiency, the search operation is used by varieting voltage. Parameter b8-06 (Search Operation Voltage Limiter) controls the range that control the voltage using the search operation. For 200 V Class Inverters, set the range to 100%/200 V and for 400 V Class Inverters, set the range to 100%/400 V. Set to 0 to disable the search operation.

◆ Setting Motor parameters

Normally the motor parameters are set automatically using autotuning. If autotuning does not complete normally, set them manually.

■Related parameters

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level
E2-01	Motor rated current Motor Rated FLA	Sets the motor rated current. These set values will become the reference values for motor protection, torque limits and torque control. This parameter is an input data for autotuning.	0.32 to 6.40 *2	1.90 A *1	No	Q
E2-05	Motor line-to-line resistance Term Resistance	Sets the motor phase-to-phase resistance.	0.000 to 65.000	9.842 Ω *1	No	A

Note The factory-set parameters are for a standard 4-pole motor.

* 1. The factory settings depend on Inverter capacity (the values shown are for a 200 V Class Inverter for 0.4 kW).

* 2. The setting range is 10% to 200% of the Inverter rated output current (the values shown are for a 200 V Class Inverter for 0.4 kW).

■Manual Motor Parameter Setting Methods

The motor parameters settings methods are given below. To enter settings refer to the motor test report.

Motor Rated Voltage Setting

Set E2-01 to the rated current on the motor nameplate.

Motor Line-to-Line Resistance Setting

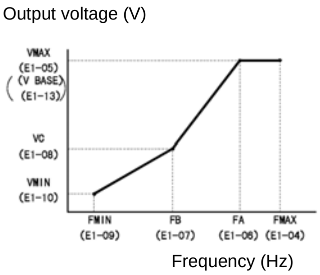
E2-05 is set automatically when performing motor line-to-line resistance autotuning. When you cannot perform Auto-tuning, consult the motor manufacturer for the line-to-line resistance value. Calculate the resistance from the line-to-line resistance value in the motor test report using the following formula and then make the setting accordingly.

- E-type insulation: [Line-to line resistance (Ω) at 75°C of test report] x 0.92 (Ω)
- B-type insulation: [Line-to line resistance (Ω) at 75°C of test repor]t x 0.92 (Ω)
- F-type insulation: [Line-to line resistance (Ω) at 115°C of test report] x 0.87 (Ω)

◆ Setting the V/f Pattern

Inverter input voltage and the V/f pattern can be set as the need arises.

■Related Parameters

Parameter Number	Name	LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level
E1-01	Input voltage setting	Input Voltage	Set the Inverter input voltage. This setting is used as a reference value in protection functions.	155 to 255 *1	200 V *1	No	Q
E1-03	V/f pattern selection	V/f Selection	0 to D: Select from the 14 preset V/f patterns. F: Custom user-set patterns (Application for settings E1-04 to E1-10.)	0 to F	F	No	Q
E1-04	Max. output frequency (FMAX)	Max Frequency	 To set V/f characteristics in a straight line, set the same values for E1-07 and E1-09. In this case, the setting for E1-08 will be disregarded. Always ensure that the four frequencies are set in the following manner: E1-04 (FMAX) ≥ E1-06 (FA) >E1-07 (FB) ≥ E1-09 (FMIN)	0.0 to 120.0	50.0 Hz	No	Q
E1-05	Max. voltage (VMAX)	Max voltage		0.0 to 255.0 *1	200.0 V *1	No	Q
E1-06	Base frequency (FA)	Base frequency		0.0 to 120.0	50.0 Hz	No	Q
E1-07	Mid. output frequency	Mid Frequency A		0.0 to 255.0 *1	2.5 Hz	No	A
E1-08	Mid. output frequency voltage	Mid Voltage A		0.0 to 120.0	15.0 V *1	No	A
E1-09	Min. output frequency (FMIN)	Min Frequency		0.0 to 120.0	1.2 Hz	No	Q
E1-10	Min. output frequency voltage	Min Voltage		0.0 to 255.0 *1	9.0 V *1	No	A
E1-11	Mid. output frequency 2	Mid Frequency B	Set only to fine-adjust V/f for the output range. Normally, this setting is not required.	0.0 to 120.0	0.0 Hz *2	No	A
E1-12	Mid. output frequency voltage 2	Mid Voltage B		0.0 to 255.0 *1	0.0 V *2	No	A
E1-13	Base voltage	Base Voltage		0.0 to 255.0 *1	0.0 V *2	No	A

* 1. These are values for a 200 V Class Inverter. Values for a 400 V Class Inverter are double.
* 2. The contents of parameters E1-11 and E1-12 are ignored when set to 0.00.
* 3. E1-13 is set to the same value as E1-05 by autotuning.

■Setting Inverter Input Voltage

Set the Inverter input voltage correctly in E1-01 to match the power supply voltage. This set value will be the standard value for the protection function and similar functions (overvoltage level, stall trip).

■Setting V/f Pattern

Set the V/f pattern in E1-03. There are two methods of setting the V/f pattern: Select one of the 14 pattern types (set value: 0 to D) that have been set beforehand or set a user-defined V/f pattern (set value: F).

The factory setting for E1-03 is F. The contents of E1-03 when factory-set to F are the same as when E1-03 is set to 0.

To select one of the existing patterns, refer to the following table.

Characteristic	Application	Set Value	Specifications
Parameter Torque Characteristic	This pattern is used in general applications. Used when the load torque is fixed, regardless of rotation speed.	0 (F)	50 Hz specifications
		1	60 Hz specifications
		2	60 Hz specifications, voltage saturation at 50 Hz
		3	72 Hz specifications, voltage saturation at 60 Hz
Variable torque characteristic	This pattern is used for loads with torque proportional to two or three times the rotation speed, such as fans and pumps.	4	50 Hz specifications,× 3 decrement
		5	50 Hz specifications, × 2 decrement
		6	60 Hz specifications, × 3 decrement
		7	60 Hz specifications, × 2 decrement
High Startup Torque (See Note)*	Select the high startup torque V/f pattern only in the following cases. • The wiring distance between Inverter and motor is large (approx. 150 m min.) • A large torque is required at startup (elevator loads, etc.) • An AC reactor is inserted in the Inverter input or output. • You are operating a motor that is less than optimum.	8	50 Hz specifications, medium startup torque
		9	50 Hz specifications, large startup torque
		A	60 Hz specifications, medium startup torque
		B	60 Hz specifications, large startup torque
Fixed Output Operation	This pattern is used for frequencies of 60 Hz or higher. A fixed voltage is applied.	C	90 Hz specifications, voltage saturation at 60 Hz
		D	120 Hz specifications, voltage saturation at 60 Hz

* The torque is protected by the fully automatic torque boost function, so normally there is no need to use this pattern.

When you select these patterns, the values of parameters E1-04 to E1-10 are changed automatically. There are three types of values for E1-04 to E1-10, depending on the Inverter capacity.

- 0.4 to 1.5 kW V/f pattern
- 2.2 to 45 kW V/f pattern
- 55 to 160 kW V/f pattern

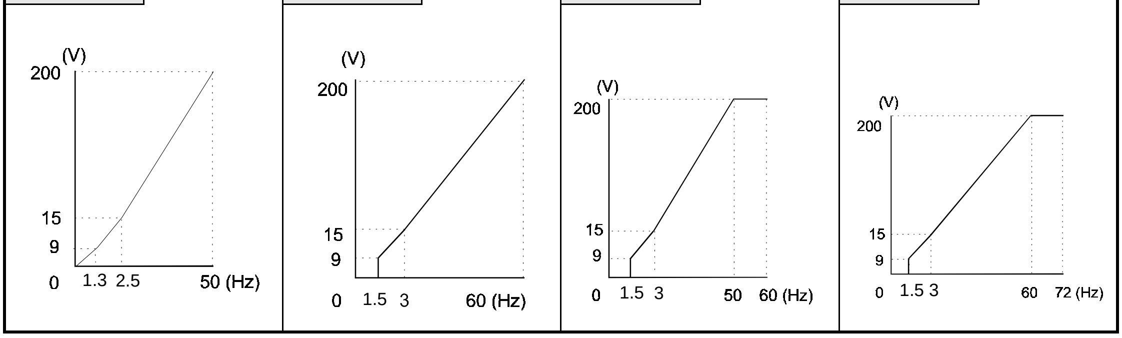
The characteristics diagrams for each are shown in the following pages.

0.4 to 1.5 kW V/f Pattern

The diagrams show characteristics for a 200-V class motor. For a 400-V class motor, multiply all voltages by 2.

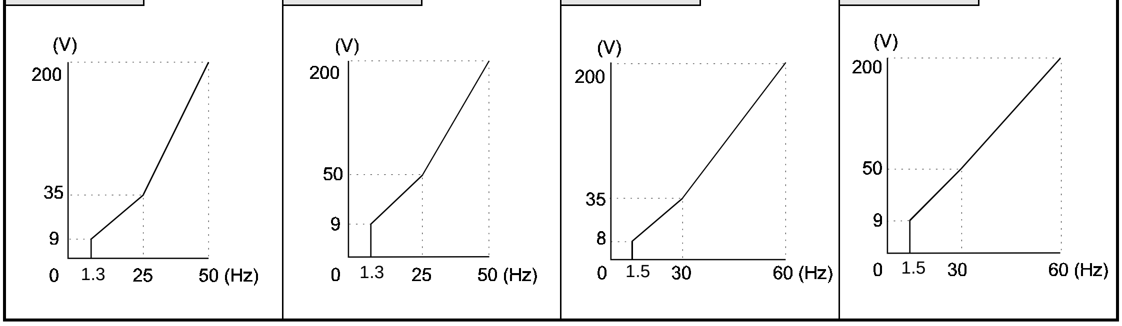
- Parameter Torque Characteristics (Set Value: 0 to 3)

Set Value 0	50 Hz	Set Value 1	60 Hz	Set Value 2	60 Hz	Set Value 3	72 Hz



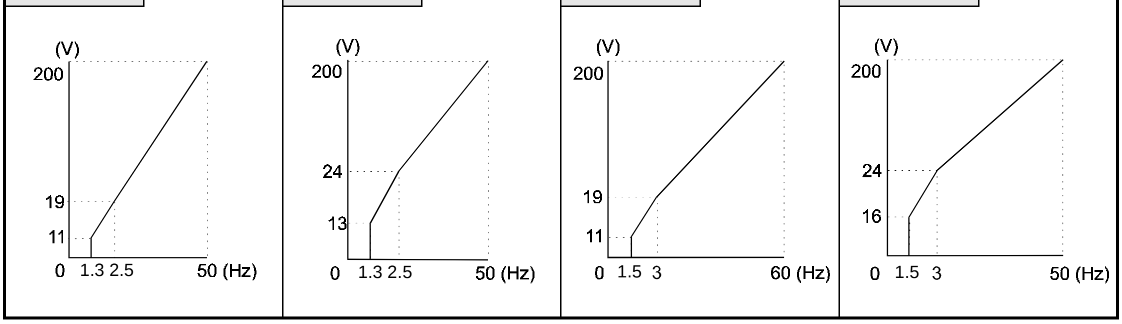
- Decrement Torque Characteristics (Set Value: 4 to 7)

Set Value 4	50 Hz	Set Value 5	50 Hz	Set Value 6	60 Hz	Set Value 7	60 Hz



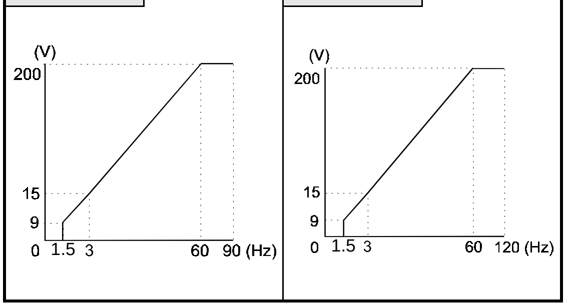
- High startup torque (Set value 8: to b)

Set Value 8	50 Hz	Set Value 9	50 Hz	Set Value A	60 Hz	Set Value B	60 Hz



- Fixed Output Operation (Set Value: C to D)

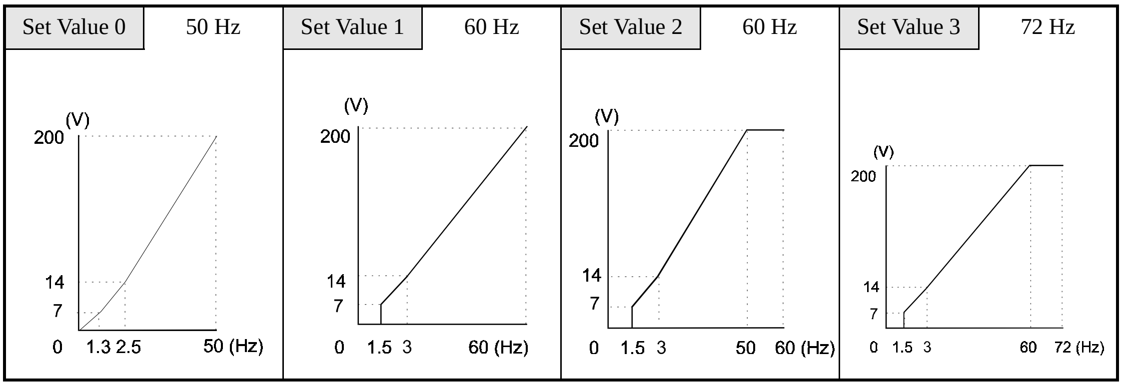
Set Value C	90 Hz	Set Value D	120 Hz



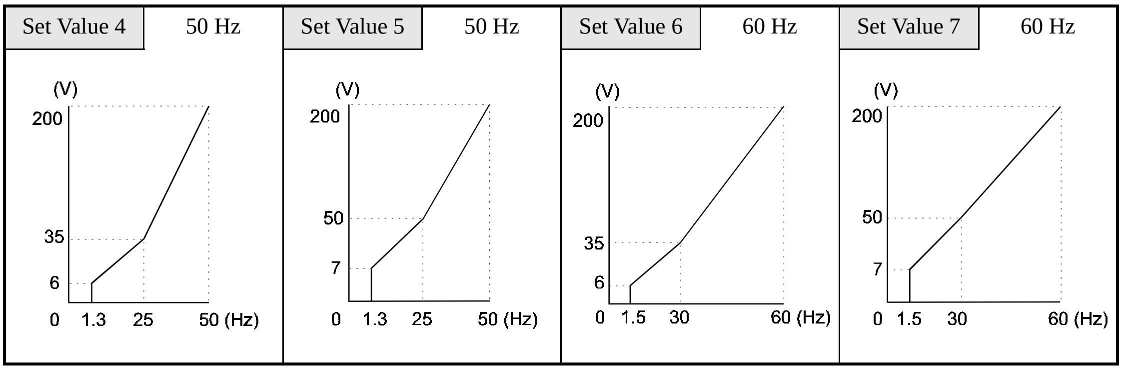
2.2 to 45 kW V/f Pattern

The diagrams show characteristics for a 200-V class motor. For a 400-V class motor, multiply all voltages by 2.

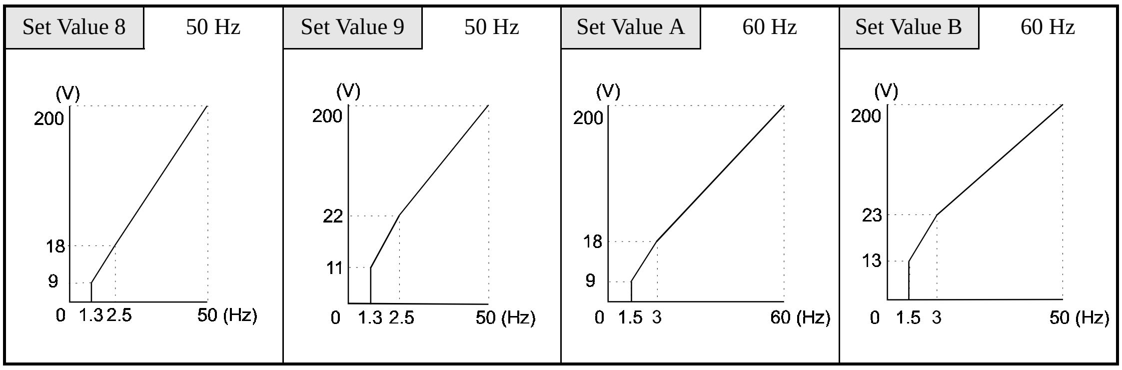
- Parameter Torque Characteristics (Set Value: 0 to 3)



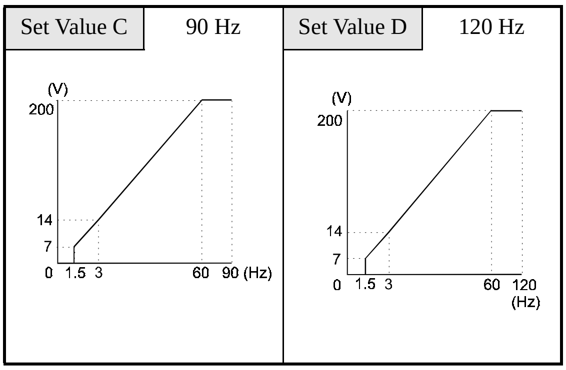
- Decrement Torque Characteristics (Set Value: 4 to 7)



- High Startup Torque (Set Value: 8 to b)



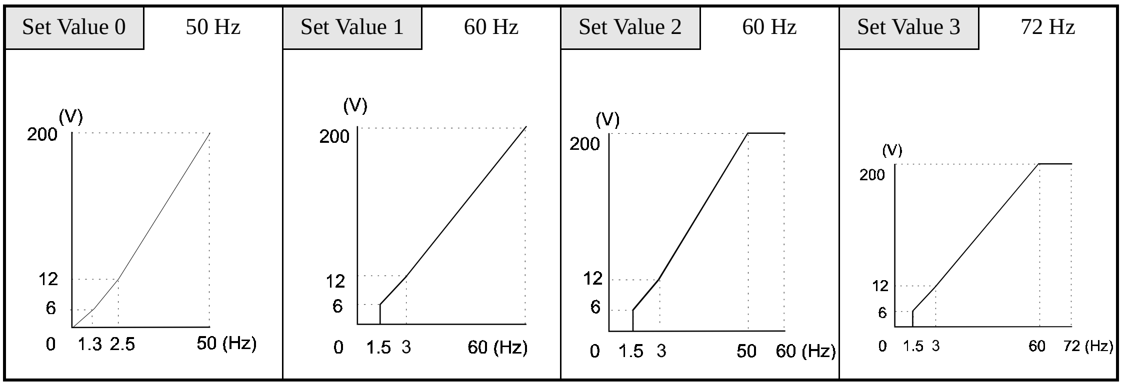
- Fixed Output Operation (Set Value: C to D)



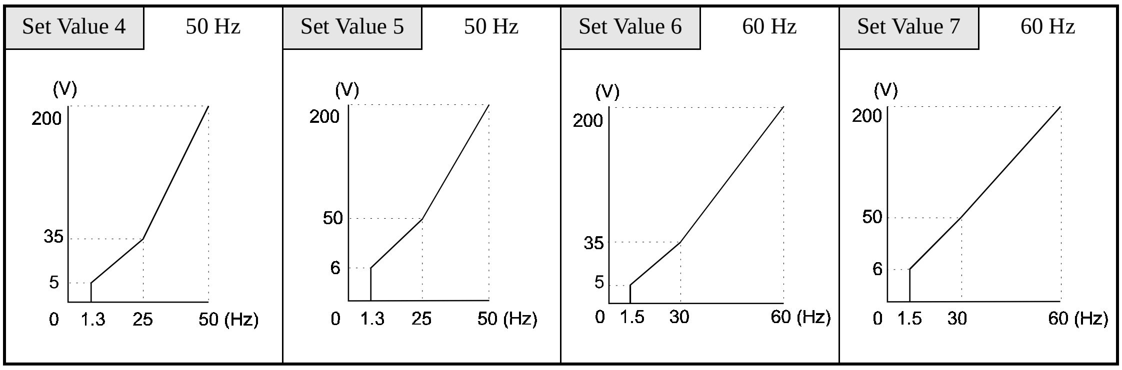
55 to 160 kW V/f Pattern

The diagrams show characteristics for a 200-V class motor. For a 400-V class motor, multiply all voltages by 2.

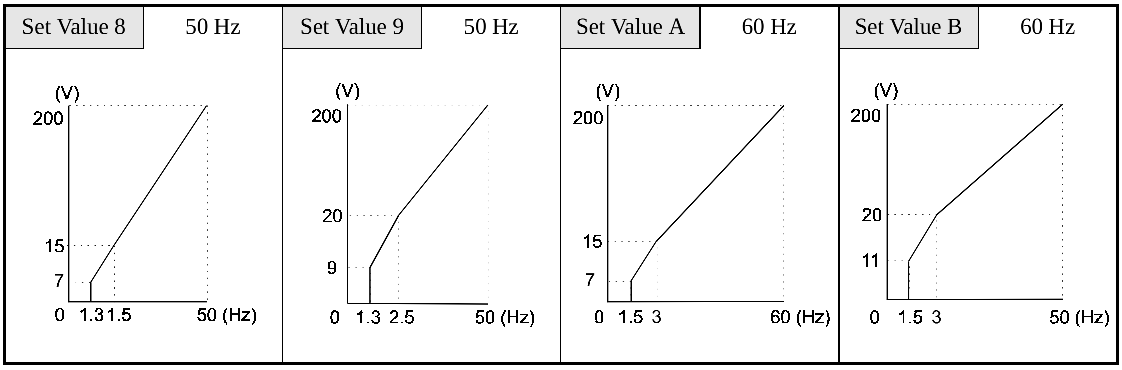
- Parameter Torque Characteristics (Set Value: 0 to 3)



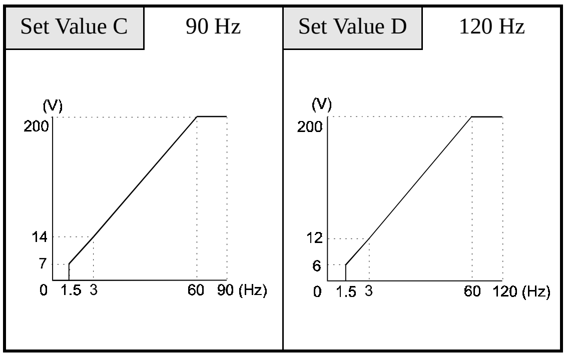
- Decrement Torque Characteristics (Set Value: 4 to 7)



- High Startup Torque (Set Value: 8 to b)



- Fixed Output Operation (Set Value: C to D)



INFO

When E1-03 is set to F (User-defined V/f pattern), you can set parameters E1-04 to E1-10. If E1-03 is set to anything other than F, you can only refer to parameters E1-04 to E1-10. If the V/f characteristics are linear, set E1-07 and E1-09 to the same value. In this case, E1-08 will be ignored.

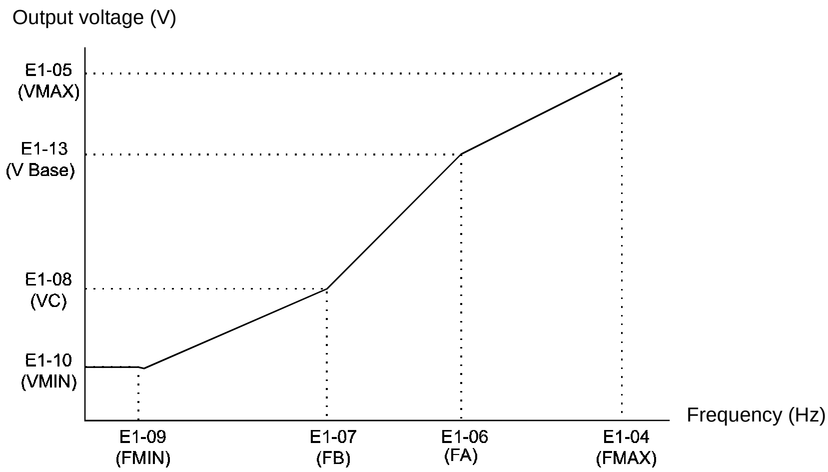


Fig 6.61 User-Set V/f Pattern

■Setting Precautions

When the setting is to user-defined V/f pattern, beware of the following points.

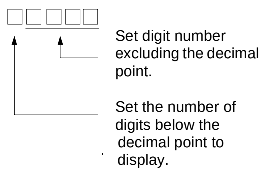
- Be sure to set the four frequencies as follows:
  E1-04 (FMAX) ≥ E1-06 (FA) > E1-07 (FB) ≥ E1-09 (FMIN)

6

Digital Operator Functions

◆ Setting Digital Operator Functions

■Related Parameters

Parameter Number	Name	LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level
o1-02	Monitor selection after power up	Power-ON Monitor	Set the monitor item to be displayed when the power supply is turned ON. 1: Frequency reference 2: Output frequency 3: Output current 4: The monitor item set for o1-01	1 to 4	1	Yes	A
o1-03	Frequency units of reference setting and monitor	Display Scaling	Sets the units that will be set and displayed for the frequency reference and frequency monitor. 0: 0.01 Hz units 1: 0.01% (Maximum output frequency is 100%) 2 to 39: rotation per minute (rpm) (Sets the motor poles) 40 to 39999: User desired display Set the desired values for setting and display for the max. output frequency.  Example: When the max. output frequency value is 200.0, set 12000.	0 to 39999	0	No	A
o2-01	LOCAL/REMOTE key enable/disable	Local/Remote Key	Set the run method selection key (LOCAL/REMOTE Key) function. 0: Disabled 1: Enabled (Switches between the Digital Operator and the parameter settings.)	0 or 1	1	No	A
o2-02	STOP Key during control circuit terminal operation	Oper STOP Key	Set the STOP Key in the run mode. 0: Disabled (When the run command is issued from an external terminal, the Stop Key is disabled.) 1: Enabled (Effective even during run.)	0 or 1	1	No	A
o2-03	User parameter initial value	User Defaults	Clears or stores user initial values. 0: Stores/not set 1: Begins storing (Records the set parameters as user initial values.) 2: All clear (Clears all recorded user initial values) When the set parameters are recorded as user initial values, 1110 will be set in A1-03.	0 to 2	0	No	A
o2-05	Frequency reference setting method selection	Operator M.O.P.	When the frequency reference is set on the Digital Operator frequency reference monitor, sets whether the Enter Key is necessary. 0: Enter Key needed 1: Enter Key not needed When set to 1, the Inverter accepts the frequency reference without Enter Key operation.	0 or 1	0	No	A
o2-07	Cumulative operation time setting	Elapsed Time Set	Sets the cumulative operation time in hour units. Operation time is calculated from the set values.	0 to 65535	0	No	A
o2-10	Fan operation time setting	Fan ON Time Set	Set the initial value of the fan operation time using hour units. The operation time accumulates from the set value.	0 to 65535	0	No	A

■Changing Frequency Reference and Display Units

Set the Digital Operator frequency reference and display units using parameter o1-03. You can change the units for the following parameters using o1-03.

- U1-01 (Frequency Reference)
- U1-02 (Output Frequency)
- U1-05 (Motor Speed)
- U1-20 (Output Frequency after Soft Start)
- d1-01 to d1-04 and d1-17 (Frequency references)

■Switching Monitors when the Power Supply Is ON

Using parameter o1-02 selects the monitor item (U1-☐☐ [status monitor]) that is to be displayed on the Digital Operator when the power supply is turned ON. For monitors that can be displayed, refer to U1-☐☐ in *Chapter 5 Parameters*.

Setting Precautions

INFO

If selecting monitor parameters other than U1-01 (Frequency Reference), U1-02 (Output Frequency) and U1-03 (Output Current), first select the monitor items to be displayed in o1-01 (monitor selection) and then set o1-02 to 4.

■Disabling the STOP Key

If b1-02 (Operation Method Selection) is set to 1, 2 or 3, the stop command from the STOP Key on the Digital Operator is an emergency stop command.

Set o2-02 to 0 to disable emergency stop commands from the STOP Key on the Digital Operator.

■Disabling the LOCAL/REMOTE Key

Set o2-01 to 0 to disable the LOCAL/REMOTE Key on the Digital Operator. If the key is disabled, you cannot use it to switch over the frequency reference source or the RUN-command source.

■Initializing Changed Parameter Values

You can save to the Inverter parameter set values that you have changed as parameter initial values. Change the set values from the Inverter factory settings and then set o2-03 to 1.

■Setting the Frequency Reference using the UP and DOWN Keys without Using the Enter Key

Use this function when inputting frequency references from the Digital Operator. When o2-05 is set to 1, you can increment and decrement the frequency reference using the UP and DOWN keys without using the Enter key.

For example, enter the Run command using a 0 Hz reference and then continuously press the UP key to increment the frequency reference by 0.01 Hz only for the first 0.5 s and then by 0.01 Hz every 80 ms for 3 s thereafter. Press and hold down the UP key for 3 s minimum to reach the maximum output frequency 10 s after that. The frequency reference that has been set will be stored in memory 5 s after the UP or DOWN keys are released.

■Clearing Cumulative Operation Time

Set the cumulative operation time initial value in time units in parameter o2-07. Set o2-07 to 0 to clear U1-13 (inverter Operating Time).

■Clearing Inverter Cooling Fan Operation Time

Set the fan operation time initial value in time units in parameter o2-10. Set o2-10 to 0 to clear U1-40 (Cooling Fan Operating Time).

◆ Copying Parameters

The Digital Operator can perform the following three functions using the built-in EEPROM (non-volatile memory).

- Store Inverter parameter set values in the Digital Operator (READ)
- Write parameter set values stored in the Digital Operator to the Inverter (COPY)
- Compare parameter set values stored in the Digital Operator with Inverter parameters (VERIFY)

■Related Parameters

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level
o3-01	Copy function selection Copy Func Select	0: Normal operation 1: READ (Inverter to Operator) 2: COPY (Operator to Inverter) 3: Verify (compare)	0 to 3	0	No	A
o3-02	Read permitted selection Copy Allowable	0: Read prohibited 1: Read permitted	0 or 1	0	No	A

■Storing Inverter set values in the Digital Operator (READ)

To store Inverter set values in the Digital Operator, make the settings using the following method.

Table 6.6 READ Function Procedure

Step No.	Digital Operator Display	Explanation
1	A1-00 DRIVE QUICK ADV VERIFY A.TUNE	Press the MENU key and select advanced programming mode.
2	A1-00 DRIVE QUICK ADV VERIFY A.TUNE	Press the ENTER key and select the parameters monitor display.
3	o3-01 DRIVE QUICK ADV VERIFY A.TUNE	Display o3-01 (Copy Function Selection) using the Increment key and Decrement key.
4	00 DRIVE QUICK ADV VERIFY A.TUNE	Press the ENTER key and select the parameters setting display.
5	01 DRIVE QUICK ADV VERIFY A.TUNE	Change the set value to 1 using the Increment key.
6	rEd DRIVE QUICK ADV VERIFY A.TUNE	Set the changed data using the ENTER key. The READ function will start.
7	End → o3-01	If the READ function ends normally, End is displayed on the Digital Operator. Parameter o3-01 is automatically reset to 0 and then the display returns to o3-01.

If an error is displayed, press any key to cancel the error display and return to the o3-01 display. Error displays and their descriptions are shown below. (Refer to *Chapter 7 Errors when Using Digital Operator Copy Function.)*

Error Display	Description
PrE	You are attempting to set o3-01 to 1 while o3-02 is set to 0.
iFE	Read data length mismatch or read data error.
rdE	Unable to write parameters to EEPROM on the Digital Operator.

Select READ Permitted

Prevent overwriting the data stored in EEPROM in the Digital Operator by mistake. With o3-02 set to 0, if you set o3-01 to 1 and perform the write operation, PrE will be displayed on the Digital Operator and the write operation will be stopped.

■Writing parameter Set Values Stored in the Digital Operator to the Inverter (COPY)

To write parameter set values stored in the Digital Operator to the Inverter, make the settings using the following method.

Table 6.7 COPY Function Procedure

Step No.	Digital Operator Display	Explanation
1	A1-00 DRIVE QUICK ADV VERIFY A.TUNE	Press the MENU key and select advanced programming mode.
2	A1-00 DRIVE QUICK ADV VERIFY A.TUNE	Press the ENTER key and select the parameters monitor display.
3	o3-01 DRIVE QUICK ADV VERIFY A.TUNE	Display o3-01 (Copy Function Selection) using the Increment key and Decrement key.
4	00 DRIVE QUICK ADV VERIFY A.TUNE	Press the ENTER key and select the parameters setting display.
5	02 DRIVE QUICK ADV VERIFY A.TUNE	Change the set value to 2 using the Increment Key.
6	CPY DRIVE QUICK ADV VERIFY A.TUNE	Set the changed data using the ENTER key. The COPY function will start.
7	End → o3-01	If the COPY function ends normally, End is displayed on the Digital Operator. Parameter o3-01 is automatically reset to 0 and then the display returns to o3-01.

If an error is displayed, set the parameters again. Error displays and their descriptions are shown below. (Refer to *Chapter 7 Errors when Using Digital Operator Copy Function.)*

Error Display	Description
CPE	Inverter product code and Inverter software number are different.
uAE	Inverter capacity with which you are trying to copy and the Inverter capacity stored in the Digital Operator are different.
CrE	The Inverter control method in which you are trying to copy and the Inverter control method stored in the Digital Operator are different.
CYE	Comparison between the parameter written to the Inverter and the parameter in the Digital Operator are different.
CSE	After copying has ended, the checksum between the sum value of the Inverter parameter and the sum value of the Digital Operator parameter are different.

■Comparing Inverter Parameters and Digital Operator Parameter Set Values (VERIFY)

To compare Inverter parameters and Digital Operator parameter set values, make the settings using the following method.

Table 6.8 VERIFY Function Procedure

Step No.	Digital Operator Display	Explanation
1	A1-00 DRIVE QUICK ADV VERIFY A.TUNE	Press the MENU key. and select advanced programming mode.
2	A1-00 DRIVE QUICK ADV VERIFY A.TUNE	Press the ENTER key and select the parameters monitor display.
3	o3-01 DRIVE QUICK ADV VERIFY A.TUNE	Display o3-01 (Copy Function Selection) using the Increment key and Decrement key.
4	00 DRIVE QUICK ADV VERIFY A.TUNE	Press the ENTER key and select the function setting display.
5	03 DRIVE QUICK ADV VERIFY A.TUNE	Change the set value to 3 using the Increment key.
6	vFY DRIVE QUICK ADV VERIFY A.TUNE	Set the changed data using the ENTER key. The VERIFY function will start.
7	End → o3-01	If the VERIFY function ends normally, End is displayed on the Digital Operator. Parameter o3-01 is automatically reset to 0 and then the display returns to o3-01.

If an error is displayed, press any key to cancel the error display and return to the o3-01 display. Error displays and their descriptions are shown below. (Refer to *Chapter 7 Errors when Using Digital Operator Copy Function.*)

Error Display	Description
vYE	Verify error (Settings in the Digital Operator and the Inverter do not match).

■Application Precautions

INFO

When using the copy function, check that the following settings are the same between the Inverter and the Digital Operator.

- Inverter product and type
- Software number
- Inverter capacity and voltage
- Control method

◆ Prohibiting Writing Parameters from the Digital Operator

If you set A1-01 to 0, you can refer to and set the A1 and A2 parameter groups and refer to drive mode, using the Digital Operator.

If you set one of the parameters H1-01 to H1-05 (multi-function digital input terminal S3 to S7 function selection) to 1B (write parameters permitted), you can write parameters from the digital operator when the terminal that has been set is ON. When the set terminal is OFF, writing parameters other than the frequency reference is prohibited. You can, however, reference parameters.

Parameter Number	Name / LCD DIsplay	Description	Setting Range	Factory Setting	Change during Operation	Access Level
A1-01	Parameter access level Acces Level	Used to set the parameter access level (set/read.) 0: Monitoring only (Monitoring drive mode and setting A1-01 and A1-04.) 2: ADVANCED (Parameters can be read and set in both quick programming mode and advanced programming (A) mode.)	0 or 2	2	Yes	A

◆ Using the User parameters

For parameter A1-03 the setting 1 is not automattically displayed.

To make the setting available use the following steps.

- Select A2-01 and program a parameter.
- Go to the parameter and change the factory setting.
- Go to parameter o2-03 and select 1 to store the User parameter.
- After this the parameter A1-01 setting 1 becomes available.

◆ Setting a Password

When a pasword is set in A1-05, if the set values in A1-04 and A1-05 do not match, you can not refer or change the settings of parameters A1-01 to A1-03.

You can prohibit the setting and referencing of all parameters except A1-00 by using the password function in combination with setting A1-01 to 0 (Monitor only).

■Related Parameters

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level
A1-01	Parameter access level Acces Level	Used to set the parameter access level (set/read.) 0: Monitoring only (Monitoring drive mode and setting A1-01 and A1-04.) 2: ADVANCED (Parameters can be read and set in both quick programming mode and advanced programming (A) mode.)	0 or 2	2	Yes	A

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Access Level
A1-04	Password Enter Password	Password input when a password has been set in A1-05. This function write-protects some parameters of the initialize mode. If the password is not similar to A1-05, A1-01 to A1-03 parameters can no longer be changed. (Programming mode parameters can be changed.)	0 to 9999	0	No	A
A1-05	Password setting Select password	Used to set a four digit number as the password. This parameter is not usually displayed. When the password (A1-04) is displayed, hold down the reset key and press the Menu key and the password will be displayed.	0 to 9999	0	No	A

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Chapter 7

Troubleshooting

This chapter describes the fault displays and countermeasure for the Inverter and motor problems and countermeasures.

Protective and Diagnostic Functions

This section describes the alarm functions of the Inverter. The alarm functions include fault detection, alarm detection, operation error detection and autotuning error detection.

◆ Fault Detection

When the Inverter detects a fault, the fault contact output operates and the Inverter output is shut OFF causing the motor to coast to a stop. (The stopping method can be selected for some faults and the selected stopping method will be used with these faults.) A fault code is displayed on the Digital Operator.

When a fault has occurred, refer to the following table to identify and correct the cause of the fault.

Use one of the following methods to reset the fault after restarting the Inverter:

- Set a multi-function contact input (H1-01 to H1-05) to 14 (Fault Reset) and turn ON the error reset signal.
- Press the RESET key on the Digital Operator.
- Turn the main circuit power supply OFF and then ON again.

Table 7.1 Fault Displays and Processing

Display	Description	Probable Causes	Corrective Actions
oC	Overcurrent The Inverter output current exceeded the overcurrent detection level.	• A short-circuit or ground fault occurred at the Inverter output. (A short or ground fault can be caused by motor burn damage, worn insulation or a damaged cable.) • The load is too large or the acceleration/deceleration time is too short. • A special-purpose motor or motor with a capacity too large for the Inverter is being used. • A magnetic switch was switched at the Inverter output.	Reset the fault after correcting its cause.
GF	Ground Fault The ground fault current at the Inverter output exceeded approximately 50% of the Inverter rated output current.	A ground fault occurred at the Inverter output. (A ground fault can be caused by motor burn damage, worn insulation or a damaged cable.)	Reset the fault after correcting its cause.
PUF	Fuse Blown The fuse in the main circuit is blown.	The output transistor has failed because of a short-circuit or ground fault at the Inverter output. Check whether there is a short-circuit between the following terminals. A short-circuit will damage the output transistor: U, V, W ⊖, ← →U, V, W	Replace the Inverter after correcting the cause.
ou	Main Circuit Overvoltage The main circuit DC voltage exceeded the overvoltage detection level. 200 V class: Approx. 410 V 400 V class: Approx. 820 V	The deceleration time is too short and the regenerative energy from the motor is too large.	Increase the deceleration time or connect a Braking Resistor Unit and Braking Unit.
		The power supply voltage is too high.	Decrease the voltage so it's within specifications.

Table 7.1 Fault Displays and Processing (Continued)

Display	Description	Probable Causes	Corrective Actions
Uv1	Main Circuit Undervoltage The main circuit DC voltage is below the Undervoltage Detection Level (L2-05). 200 V class: Approx. 190 V 400 V class: Approx. 380 V Main Circuit MC Operation Failure The MC stopped responding during Inverter operation. Applicable Inverter Capacities 200 V class: 37 to 110 kW 400 V class: 75 to 300 kW	• An open-phase occurred with the input power supply. • A momentary power loss occurred. • The wiring terminals for the input power supply are loose. • The voltage fluctuations in the input power supply are too large. • A fault occurred in the surge prevention circuit.	Reset the fault after correcting its cause.
Uv2	Control Power Fault The control power supply voltage dropped.	---	• Try turning the power supply off and on. • Replace the Inverter if the fault continues to occur.
Uv3	Inrush Prevention Circuit Fault Overheating occurred in the inrush resistor. The MC did not respond for 10 s even though the MC ON signal has been output. Applicable Inverter Capacities 200 V class: 37 to 110 kW 400 V class: 75 to 300 kW	• The MC in the main circuit failed. • The MC excitation coil is burned out.	• Try turning the power supply off and on. • Replace the Inverter if the fault continues to occur.
PF	Main Circuit Voltage Fault The main circuit DC voltage oscillates unusually (not when regenerating).	• An open-phase occurred in the input power supply. • A momentary power loss occurred. • The wiring terminals for the input power supply are loose. • The voltage fluctuations in the input power supply are too large. • The voltage balance between phases is bad.	Reset the fault after correcting its cause.
LF	Output Open-phase An open-phase occurred at the Inverter output.	• There is a broken wire in the output cable. • There is a broken wire in the motor-winding. • The output terminals are loose.	Reset the fault after correcting its cause.
		The motor being used has a capacity less than 5% of the Inverter's maximum motor capacity.	Check the motor and Inverter capacity.
oH (oH1)	Cooling Fin Overheating The temperature of the Inverter's cooling fin exceeded the setting in L8-02 or 105°C. OH: The temperature exceeded the setting in L8-02 (Stopping method can be changed by L8-03.). OH1: The temperature exceeded 100°C (Stopping method: Coast to stop).	The ambient temperature is too high.	Install a cooling unit.
		There is a heat source nearby.	Remove the heat source.
		The Inverter's cooling fan has stopped.	Replace the cooling fan. (Contact our sales representative.)
	Inverter's Cooling Fan Stopped	The Inverter's cooling fan has stopped.	

Table 7.1 Fault Displays and Processing (Continued)

Display	Description	Probable Causes	Corrective Actions
oH3	Motor Overheating Alarm The Inverter will stop or will continue to operate according to the setting of L1-03.	The motor has overheated.	Check the size of the load and the length of the acceleration, deceleration and cycle times.
			Check the V/f characteristics.
			Check the motor temperature input on terminals A1 and A2.
oH4	Motor Overheating Fault The Inverter will stop according to the setting of L1-04.	The motor has overheated.	Check the size of the load and the length of the acceleration, deceleration and cycle times.
			Check the V/f characteristics.
			Check the motor temperature input on terminals A1 and A2.
oL1	Motor Overload The motor overload protection function has operated based on the internal electronic thermal value.	The load is too heavy. The acceleration time, deceleration time and cycle time are too short.	Check the size of the load and the length of the acceleration, deceleration and cycle times.
		The V/f characteristics voltage is too high or too low.	Check the V/f characteristics.
		The Motor Rated Current (E2-01) is incorrect.	Check the Motor Rated Current (E2-01).
oL2	Inverter Overload The Inverter overload protection function has operated based on the internal electronic thermal value.	The load is too heavy. The acceleration time, deceleration time and cycle time are too short.	Check the size of the load and the length of the acceleration, deceleration and cycle times.
		The V/f characteristics voltage is too high or too low.	Check the V/f characteristics.
		The Inverter capacity is too low.	Replace the Inverter with one that has a larger capacity.
oL3	Overtorque Detected 1 There has been a current greater than the setting in L6-02 for longer than the setting in L6-03.	-	• Make sure that the settings in L6-02 and L6-03 are appropriate. • Check the mechanical system and correct the cause of the overtorque.
oL7	High-slip Braking OL The output frequency did not change for longer than the time set in N3-04.	The inertia returned to the load is too large.	• Make sure the load is an inertial load. • Set the system so that the deceleration time that does not produce 0 V is 120 s or less.
UL3	Undertorque Detected 1 There has been a current less than the setting in L6-02 for longer than the setting in L6-03.	-	• Make sure that the settings in L6-02 and L6-03 are appropriate. • Check the mechanical system and correct the cause of the overtorque.

Table 7.1 Fault Displays and Processing (Continued)

Display	Description	Probable Causes	Corrective Actions
FbL	PI Feedback Reference Lost A PI feedback reference loss was detected (b5-12 = 2) and the PI feedback input was less than b5-13 (PI feedback loss detection level) for longer than the time set in b5-14 (PI feedback loss detection time).	-	-
EF0	External fault input from Communications Option Card	-	Check the Communications Option Card and communications signals.
EF3	External fault (Input terminal 3)	An "external fault" was input from a multi-function input terminal (S3 to S7).	• Reset external fault inputs to the multi-function inputs. • Remove the cause of the external fault.
EF4	External fault (Input terminal 4)		
EF5	External fault (Input terminal 5)		
EF6	External fault (Input terminal 6)		
EF7	External fault (Input terminal 7)		
oPr	Digital Operator Connection Fault The connection to the Digital Operator was broken during operation for a RUN command from the Digital Operator.	-	Check the connection to the Digital Operator.
CE	RS-422A/485 Communications Error A normal reception was not possible for 2 s or longer after control data was received once.	-	Check the communications devices and communications signals.
bUS	Option Communications Error A communications error was detected during a run command or while setting a frequency reference from a Communications Option Card.	-	Check the communications devices and communications signals.
CPF00	Digital Operator Communications Error 1 Communications with the Digital Operator were not established within 5 seconds after the power was turned on.	The Digital Operator's connector isn't connected properly.	Disconnect the Digital Operator and then connect it again.
		The Inverter's control circuits are faulty.	Replace the Inverter.
	CPU External RAM Fault	-	Try turning the power supply off and on again.
		The control circuits were destroyed.	Replace the Inverter.
CPF01	Digital Operator Communications Error 2 After communications were established, there was a communications error with the Digital Operator for more than 2 seconds.	The Digital Operator isn't connected properly.	Disconnect the Digital Operator and then connect it again.
		The Inverter's control circuits are faulty.	Replace the Inverter.

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Table 7.1 Fault Displays and Processing (Continued)

Display	Description	Probable Causes	Corrective Actions
CPF02	Baseblock circuit error	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
CPF03	EEPROM error	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
CPF04	CPU internal A/D converter error	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
CPF05	CPU internal A/D converter error	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
CPF06	Option Card connection error	The Option Card is not connected properly.	Turn off the power and insert the Card again.
		The Inverter or Option Card is faulty.	Replace the Option Card or the Inverter.
CPF07	ASIC internal RAM fault	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
CPF08	Watchdog timer fault	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
CPF09	CPU-ASIC mutual diagnosis fault	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
CPF10	ASIC version fault	The Inverter control circuit is faulty	Replace the Inverter.
CPF20	Communications Option Card A/D converter error	The Option Card is not connected properly.	Turn off the power and insert the Card again.
		The Option Card's A/D converter is faulty.	Replace the Communications Option Card.
CPF21	Communications Option Card self diagnostic error	Communications Option Card fault.	Replace the Option Card.
CPF22	Communications Option Card model code error		
CPF23	Communications Option Card DPRAM error		

◆ Alarm Detection

Alarms are detected as a type of Inverter protection function that does not operate the fault contact output. The system will automatically return to its original status once the cause of the alarm has been removed.

The Digital Operator display flashes and the alarm is output at the multi-function outputs (H2-01 to H2-03).

When an alarm occurs, take appropriate countermeasures according to the table below.

Table 7.2 Alarm Displays and Processing

Display	Meaning	Probable causes	Corrective Actions
EF (blinking)	Forward/Reverse Run Commands Input Together Both the forward and reverse run commands have been ON for more than 0.5 s.	-	Check the sequence of the forward and reverse run commands. Since the rotational direction is unknown, the motor will be decelerated to a stop when this minor fault occurs.
Uu (blinking)	Main Circuit Undervoltage The following conditions occurred when there was no Run signal. • The main circuit DC voltage was below the Undervoltage Detection Level Setting (L2-05). • The surge current limiting contactor opened. • The control power supply voltage when below the CUV level.	See causes for UV1, UV2 and UV3 faults in the previous table.	See corrective actions for UV1, UV2 and UV3 faults in the previous table.
ou (blinking)	Main Circuit Overvoltage The main circuit DC voltage exceeded the overvoltage detection level. 200 V class: Approx. 400 V 400 V class: Approx. 800 V	The power supply voltage is too high.	Decrease the voltage so it's within specifications.
oH (blinking)	Cooling Fin Overheating The temperature of the Inverter's cooling fin exceeded the setting in L8-02.	The ambient temperature is too high.	Install a cooling unit.
		There is a heat source nearby.	Remove the heat source
		The Inverter cooling fan has stopped.	Replace the cooling fan. (Contact your OMRON representative.)
oH2 (blinking)	Inverter Overheating Pre-alarm An OH2 alarm signal (Inverter overheating alarm signal) was input from a multi-function input terminal (S3 to S7).	-	Clear the multi-function input terminal's overheating alarm input.
oH3 (blinking)	Motor overheating E was set for H3-09 and the motor temperature thermistor input exceeded the alarm detection level.	The motor has overheated.	Check the size of the load and the length of the acceleration, deceleration and cycle times.
			Check the V/f characteristics.
			Check the motor temperature input on terminals A1 and A2.
oL3 (blinking)	Overtorque 1 There has been a current greater than the setting in L6-02 for longer than the setting in L6-03.	-	• Make sure that the settings in L6-02 and L6-03 are appropriate. • Check the mechanical system and correct the cause of the overtorque.

Table 7.2 Alarm Displays and Processing (Continued)

<table>
<tr><th>Display</th><th>Meaning</th><th>Probable causes</th><th>Corrective Actions</th></tr>
<tr><td>EF0</td><td>External error detected for Communications Card other than SI-K2
Continuing operation was specified for EF0 (F6-03 = 3) and an external fault was input from the Option Card.</td><td>-</td><td>Remove the cause of the external fault.</td></tr>
<tr><td>EF3
(blinking)</td><td>External fault (Input terminal S3)</td><td rowspan="5">An external fault was input from a multi-function input terminal (S3 to S7).</td><td rowspan="5">• Reset external fault inputs to the multi-function inputs.
• Remove the cause of the external fault.</td></tr>
<tr><td>EF4
(blinking)</td><td>External fault (Input terminal S4)</td></tr>
<tr><td>EF5
(blinking)</td><td>External fault (Input terminal S5)</td></tr>
<tr><td>EF6
(blinking)</td><td>External fault (Input terminal S6)</td></tr>
<tr><td>EF7
(blinking)</td><td>External fault (Input terminal S7)</td></tr>
<tr><td>FbL
(blinking)</td><td>PI Feedback Reference Lost
A PI feedback reference loss was detected (b5-12 = 2) and the PI feedback input was less than b5-13 (PI feedback loss detection level) for longer than the time set in b5-14 (PI feedback loss detection time).</td><td>-</td><td>-</td></tr>
<tr><td>CF
(blinking)</td><td>RS-422A/485 Communications Error
Normal reception was not possible for 2 s or longer after received control data.</td><td>-</td><td>Check the communication devices and signals.</td></tr>
<tr><td>bUS
(blinking)</td><td>Option Card Communication Error
A communication error occurred in a mode where the run command or a frequency reference is set from a Communications Option Card.</td><td>-</td><td>Check the communication devices and signals.</td></tr>
<tr><td>CALL
(blinking)</td><td>Communications on Standby
Control data was not normally received when power was turned ON.</td><td>-</td><td>Check the communication devices and signals.</td></tr>
</table>

◆ Operation Errors

An operation error will occur if there is an invalid setting or a contradiction between two parameter settings. It will not be possible to start the Inverter until the parameters have been set correctly. (The alarm output and fault contact outputs will not operate.)

When an operation error has occurred, refer to the following table to identify and correct the cause of the errors.

Table 7.3 Operation Error Displays and Incorrect Settings

Display	Meaning	Incorrect settings
oPE01	Incorrect Inverter capacity setting	The Inverter capacity setting doesn't match the Unit. (Contact your OMRON representative.)
oPE02	Parameter setting range error	The Parameter setting is outside of the valid setting range.
oPE03	Multi-function input selection error	One of the following errors has been made in the multi-function input (H1-01 to H1-05) settings: • The same setting has been selected for two or more multi-function inputs. • Speed Search 1 (61, maximum output frequency) and Speed Search 2 (62. set frequency) were selected at the same time. • External Baseblock NO (8) and External Baseblock NC (9) were selected at the same time.
oPE05	Option Card selection error	The Option Card was selected as the frequency reference source by setting b1-01 to 3, but an Option Card is not mounted or connected (C option).
oPE07	Multi-function analog input selection error	• H3-09 = B
oPE09	PI control selection error	The following settings have been made at the same time. • b5-01 (PI Control Mode Selection) has been set to a value other than 0. • b5-15 (PI Sleep Function Operation Level) has been set to a value other than 0. • b1-03 (Stopping Method Selection) has been set to 2 or 3.
oPE09	V/f data setting error	Parameters E1-04, E1-06, E1-07 and E1-09 do not satisfy the following conditions: • E1-04 (FMAX) ≥ E1-06 (FA) > E1-07 (FB) ≥ E1-09 (FMIN)
oPE11	Parameter setting error	One of the following Parameter setting errors exists. • C6-05 (Carrier Frequency Gain) > 6, the Carrier Frequency Lower Limit (C6-04) > the Carrier Frequency Gain(C6-05) • Upper/lower limit error in C6-03 to 05.
Err	EEPROM write error	A verification error occurred when writing EEPROM. • Try turning the power supply off and on again. • Try setting the Parameters again.

7

◆ Errors During Autotuning

The errors that can occur during autotuning are given in the following table. If an error is detected, an error code will be displayed on the Digital Operator. The error contact output and alarm output will not function.

Table 7.4 Errors During Autotuning

Display	Meaning	Probable causes	Corrective Actions
Er-01	Motor data error	There is an error in the data input for autotuning. There is an error in the relationship between the motor output and the motor rated current.	• Check the input data. • Check the capacity of the Inverter and motor.
Er-02	Alarm	A minor fault occurred during autotuning .	• Check the input data. • Check wiring and the machine. • Check the load.
Er-03	STOP key input	The STOP Key was pressed to cancel autotuning.	
Er-04	Line-to-line resistance error	Autotuning was not completed in the specified time. The results of autotuning has exceeded the setting range for a user Parameter.	• Check the input data. • Check motor wiring. • If the motor is connected to the machine, disconnect it.
Er-12	Current detection error	The current flow exceeded the motor rated current.	Check the current detection circuit, motor wiring, current detector and installation methods.
		The detected current sign was the opposite of what it should be.	
		There is a phase fault for U, V or W.	
End1	V/f settings excessive*	The torque reference exceeded 100% and the no-load torque exceeded 70% during autotuning.	• Check and correct the settings. • Disconnect the load from the motor.
End3	Rated current setting alarm*	The rated current is set high.	Check the input data (particularly the motor output current and motor rated current).

* Displayed after autotuning has been completed.

◆ Errors when Using the Digital Operator Copy Function

The errors that can occur when using the copy function from the Digital Operator are given in the following table. An error code will be displayed on the Digital Operator. If a Digital Operator key is pressed when an error code is being displayed, the display will be cleared and o3-01 will be displayed. The error contact output and alarm output will not function.

Table 7.5 Errors during Copy Function

Function	Display	Meaning	Probable causes	Corrective Actions
Read	PrE	Digital Operator write-protected	o3-01 was set to 1 to write a Parameter when the Digital Operator was write-protected (o3-02 = 0).	Set o3-02 to 1 to enable writing Parameters with the Digital Operator.
	iFE	Illegal read data	The read data length does not agree.	Repeat the read. Check the Digital Operator cable. Replace the Digital Operator.
			The write data is incorrect.	
	rdE	Illegal write status	An attempted write of a Parameter to EEPROM on the Digital Writer failed.	A low Inverter voltage has been detected. Repeat the read. Replace the Digital Operator.
Copy	CPE	ID not matched	The Inverter product code or software number is different.	Use the copy function for the same product code and software number.
	vAE	Inverter capacity matched	The capacity of the Inverter being copied and the capacity in the Digital Operator are different.	Use the copy function for the same Inverter capacity.
	CyE	Verify error	The parameter written to the Inverter was compared with the parameter in the Digital Operator and they were different.	Retry the copy.
	CSE	Checksum error	The checksum in the Inverter parameter area was compared with the checksum in the Digital Operator parameter area and they were different.	Retry the copy.

Troubleshooting

Due to parameter setting errors, faulty wiring and so on, the Inverter and motor may not operate as expected when the system is started up. If that occurs, use this section as a reference and apply the appropriate measures.

If the contents of the fault are displayed, refer to *Protective and Diagnostic Functions*.

◆ If Parameters Cannot Be Set

Use the following information if an Inverter parameter cannot be set.

■The display does not change when the Increment and Decrement Keys are pressed.

The following causes are possible.

The Inverter is operating (drive mode).

There are some parameters that cannot be set during operation. Turn the Inverter off and then make the settings.

Parameter write enable is input.

This occurs when "parameter write enable" (set value: 1B) is set for a multi-function input terminal (H1-01 to H1-05). If the parameter write enable input is OFF, the parameters cannot be changed. Turn it ON and then set the parameters.

Passwords do not match. (Only when a password is set.)

If the parameter A1-04 (Password) and A1-05 (Password Setting) numbers are different, the parameters for the initialize mode cannot be changed. Reset the password.

If you cannot remember the password, display A1-05 (Password Setting) by pressing the Reset/Select Key and the Menu Key simultaneously while in the A1-04 display. Then reset the password. (Input the reset password in parameter A1-04.)

■OPE01 through OPE11 is displayed.

The set value for the parameter is wrong. Refer to *Operation Errors* in this chapter and correct the setting.

■CPF00 or CPF01 is displayed.

This is a Digital Operator communications error. The connection between the Digital Operator and the Inverter may be faulty. Remove the Digital Operator and then re-install it.

◆ If the Motor Does Not Operate

■The motor does not operate when the RUN key on the Digital Operator is pressed.

The following causes are possible.

IMPORTANT

If the Inverter is not in drive mode, it will remain in ready status and will not start. Press the Menu Key to make the DRIVE indicator flash and enter the drive mode by pressing the ENTER key. The DRIVE indicator will light when drive mode is entered.

The operation method setting is wrong.

If parameter b1-02 (Operation Method Selection) is set to 1 (control circuit terminal), the motor will not operate when the Run key is pressed. Either press the LOCAL/REMOTE key to switch to Digital Operator operation or set b1-02 to 0 (Digital Operator).

INFO

The LOCAL/REMOTE key is enabled by setting o2-01 to 1 and disabled by setting o2-01 to 0. It is enabled when the drive mode is entered.

The frequency reference is too low.

If the frequency reference is set below the frequency set in E1-09 (Minimum Output Frequency), the Inverter will not operate.

Raise the frequency reference to at least the minimum output frequency.

■The motor does not operate when an external operation signal is input.

The following causes are possible.

The Inverter is not in drive mode.

If the Inverter is not in drive mode, it will remain in ready status and will not start. Pressing the MENU key makes the DRIVE indicator flash and enter the drive mode by pressing the ENTER key. The DRIVE indicator will light when drive mode is entered.

The operation method selection is wrong.

If parameter b1-02 (reference selection) is set to 0 (Digital Operator), the motor will not operate when an external operation signal is input. Set b1-02 to 1 (control circuit terminal) and try again.

Similarly, the motor will also not operate if the LOCAL/REMOTE key has been pressed to switch to Digital Operator operation. In that case press the LOCAL/REMOTE key again to return to the original setting.

INFO

The LOCAL/REMOTE key is enabled by setting o2-01 to 1 and disabled by setting o2-01 to 0. It is enabled when the drive mode is entered.

A 3-wire sequence is in effect.

The input method for a 3-wire sequence is different than when operating by forward/stop and reverse/stop (2-wire sequence). When 3-wire sequence is set, the motor will not operate even when an input terminal suitable for forward run/stop and reverse run/stop is turned ON.

When using a 3-wire sequence, refer to the timing chart and input the proper signals.

When using a 2-wire sequence, set the multi-function input terminal (H1-01 through H1-05, terminals S3 to S7) to a value other than 0.

The frequency reference is too low.

If the frequency reference is set below the frequency set in E1-09 (Minimum Output Frequency), the Inverter will not operate. Raise the frequency reference to at least the minimum output frequency.

There is a multi-function analog input setting error.

If multi-function analog input H3-09 is set to 1 (frequency gain) and if no voltage (current) is input, then the frequency reference will be zero. Check to be sure that the set value and analog input value are correct.

■The motor stops during acceleration or when a load is connected.

The load may be too heavy. The Inverter has a stall prevention function and an automatic torque boost function, but the motor responsiveness limit may be exceeded if acceleration is too rapid or if the load is too heavy. Lengthen the acceleration time or reduce the load. Also consider increasing the motor capacity.

■The motor only rotates in one direction

“Reverse run prohibited is selected. If b1-04 (Prohibition of reverse operation) is set to 1 (reverse run prohibited), the Inverter will not receive reverse run commands. To use both forward and reverse operation, set b1-04 to 0.

◆ If the Direction of the Motor Rotation is Reversed

If the motor operates in the wrong direction, the motor output wiring is faulty. When the Inverter T1(U), T2(V) and T3(W) are properly connected to the motor T1(U), T2(V) and T3(W), the motor operates in a forward direction when a forward run command is executed. The forward direction depends on the manufacturer and the motor type, so be sure to check the specifications.

The direction of rotation can be reversed by switching two wires among U, V and W.

◆ If the Motor Does Not Put Out Torque or If Acceleration is Slow

■The stall prevention level during acceleration is too low.

If the value set for L3-02 (Stall Prevention Level during Acceleration) is too low, the acceleration time will be too long. Check to be sure that the set value is suitable.

■The stall prevention level during running is too low.

If the value set for L3-06 (Stall Prevention Level during Running) is too low, the speed will drop before outputting torque. Check to be sure that the set value is suitable.

◆ If the Motor Operates Higher Than the Reference

Use the following information if the motor operates on a higher level than the reference.

■The analog frequency reference bias setting is wrong (the gain setting is wrong).

The frequency reference bias set in parameter H3-03 is added to the frequency reference. Check to be sure that the set value is suitable.

■A signal is being input to the frequency reference (current) terminal A1.

When 1F (frequency reference) is set for parameter H3-09 (Multi-function Analog Input Terminal A2 Function Selection), a frequency corresponding to the terminal A2 input voltage (current) is added to the frequency reference. Check to be sure that the set value and analog input value are suitable.

◆ If Motor Deceleration is Slow

Use the following information when the motor deceleration is slow.

■The deceleration time is long even when braking resistor unit and braking unit is connected.

The following causes are possible.

"Stall prevention during deceleration enabled" is set.

When Braking Resistor Unit and Braking Unit is connected, set parameter L3-04 (Stall Prevention Selection during Deceleration) to 0 (disabled). When this parameter is set to 1 (enabled, the factory setting), braking resistor unit and the braking unit do not fully function.

The deceleration time setting is too long.

Check the deceleration time setting (parameters C1-02 and C1-04).

Motor torque is insufficient.

If the parameters are correct and there is no overvoltage fault, then the motor's power is limited. Consider increasing the motor capacity.

■If the Vertical-axis Load Drops When Brake is Applied

The sequence is incorrect. The Inverter goes into DC injection braking status for 0.5 seconds after deceleration is completed. (This is the factory-set default.)

To ensure that the brake holds, set frequency detection 2 (H2-01 = 5) for the multi-function contact output terminals (M1 and M2) so that the contacts will turn OFF when the output frequency is greater than L4-01 (3.0 to 5.0 Hz). (The contacts will turn ON below L4-01.)

There is hysteresis in frequency detection 2 (i.e., a frequency detection width, L4-02 = 2.0 Hz) . Change the setting to approximately 0.5 Hz if there are drops during stop. Do not use the multi-function contact output run signal (H2-01 = 0) for the brake ON/OFF signal.

◆ If the Motor Overheats

■The load is too big.

If the motor load is too heavy and the motor is used with the effective torque exceeding the motor's rated torque, the motor will overheat. Reduce the load amount by either lightening the load or lengthening the acceleration/deceleration time. Also consider increasing the motor capacity.

■The ambient temperature is too high.

The motor rating is determined within a particular ambient operating temperature range. The motor will burn out if it is run continuously at the rated torque in an environment in which the maximum ambient operating temperature is exceeded. Lower the motor's ambient temperature to within the acceptable ambient operating temperature range.

■The withstand voltage between the motor phases is insufficient.

When the motor is connected to the Inverter output, a surge is generated between the Inverter switching and the motor coil. Normally the maximum surge voltage is three times the Inverter's input power supply voltage (i.e., 1,200 V for 400 V class). Be sure to use a motor with a withstand voltage between the motor phases that is greater than the maximum surge voltage. In particular, when using a 400 V class Inverter, use a special motor for Inverters.

◆ If peripheral devices like PLC’s or other are influenced by the starting or running inverter

If noise is generated by Inverter switching, implement the following countermeasures:

- Change the Inverter's Carrier Frequency Selection (C6-02) to lower the carrier frequency. This will help to some extent by reducing the amount of internal switching.
- Install an Input Noise Filter at the Inverter's power supply input area.
- Install an Output Noise Filter at the Inverter's power supply output area.
- Use metal tubing. Electric waves can be shielded by metal, so encase the Inverter with metal (steel).
- Ground the Inverter and motor.
- Separate main circuit wiring from control wiring.

◆ If the Ground Fault Interrupter Operates When the Inverter is Run

The Inverter performs internal switching, so there is a certain amount of leakage current. This may cause the ground fault interrupter to operate and cut off the power supply. Change to a ground fault interrupter with a high leakage detection level (i.e., a sensitivity current of 200 mA or greater per Unit, with an operating time of 0.1 s or more) or one that incorporates high frequency countermeasures (i.e., one designed for use with Inverters). It will also help to some extent to change the Inverter's Carrier Frequency Selection (C6-02) to lower the carrier frequency. In addition, remember that the leakage current increases as the cable is lengthened.

◆ If There is Mechanical Oscillation

■The machinery is making unusual sounds.

The following causes are possible.

There may be resonance between the mechanical system's characteristic frequency and the carrier frequency.

If the motor is running with no problems and the machinery is oscillating with a high-pitched whine, it may indicate that this is occurring. To prevent this type of resonance, adjust the carrier frequency with parameters C6-02 to C6-05.

There may be resonance between a machine's characteristic frequency and the output frequency of the Inverter.

To prevent this from occurring, either use the jump frequency functions in parameters d3-01 to d3-04 or install rubber padding on the motor base to reduce oscillation.

■Oscillation and hunting are occurring.

The gain adjustment may be insufficient. Reset the gain to a more effective level by adjusting parameters C4-02 (Torque Compensation Primary Delay Time parameter) and N1-02 (Hunting Prevention Gain) in order. Lower the gain setting and raise the primary delay time setting.

■Oscillation and hunting are occurring with PI control.

If there is oscillation or hunting during PI control, check the oscillation cycle and individually adjust P and I parameters. (Refer to page 6-196)

◆ If the Motor Rotates Even When Inverter Output is Stopped

If the motor rotates even when the Inverter output is stopped, the DC injection braking is insufficient. If the motor continues operating at low speed, without completely stopping and after a deceleration stop has been executed, it means that the DC injection braking is not decelerating enough. Adjust the DC injection braking as follows:

- Increase the parameter b2-02 (DC Injection Braking Current) setting.
- Increase the parameter b2-04 (DC Injection Braking (initial excitation) Time at Stop) setting.

◆ If OV is Detected When a Fan is Started or Fan Stalls

Generation of OV (Over Voltage) and stalling can occur if a fan is turning when it is started. The DC injection braking is insufficient when starting.

This can be prevented by slowing fan rotation by DC injection braking before starting the fan. Increase the parameter b2-03 (DC injection braking time (initial excitation) at start) setting.

◆ If Output Frequency Does Not Rise to Frequency Reference

■The frequency reference is within the jump frequency range.

When the jump frequency function is used, the output frequency does not change within the jump frequency range. Check to be sure that the Jump Frequency (parameters d3-01 to d3-03) and Jump Frequency Width (parameter d3-04) settings are suitable.

■The frequency reference upper limit has been reached.

The output frequency upper limit is determined by the following formula:
Maximum Output Frequency (E1-04) × Frequency Reference Upper Limit (d2-01) / 100
Check to be sure that the parameter E1-04 and d2-01 settings are suitable.

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Chapter 8

Maintenance and Inspection

This chapter describes basic maintenance and inspection for the Inverter

Maintenance and Inspection

◆ Daily Inspection

Check the following items with the system in operation.

- The motor should not be vibrating or making unusual noises.
- There should be no abnormal heat generation.
- The ambient temperature should not be too high.
- The output current value shown on the monitor displays should not be higher than normal.
- The cooling fan on the bottom of the Inverter should be operating normally.

◆ Periodic Inspection

Check the following items during periodic maintenance.

Always turn OFF the power supply before beginning inspection. Confirm that the LED indicators on the front cover have all turned OFF and then wait until at least five minutes have elapsed before beginning the inspection. Be sure not to touch terminals right after the power has been turned off. Doing so can result in electric shock.

Table 8.1 Periodic Inspections

Item	Inspection	Corrective Procedure
External terminals, mounting bolts, connectors, etc.	Are all screws and bolts tight?	Tighten loose screws and bolts firmly.
	Are connectors tight?	Reconnect the loose connectors.
Cooling fins	Are the fins dirty or dusty?	Clean off any dirt and dust with an air gun using dry air at a pressure of 39.2×10^4 to 58.8×10^4 Pa (4 to 6 kg•cm^2).
PCBs	Is there any conductive dirt or oil mist on the PCBs?	Clean off any dirt and dust with an air gun using dry air at a pressure of 39.2×10^4 to 58.8×10^4 Pa (4 to 6 kg•cm^2). Replace the boards if they cannot be made clean.
Cooling fan	Is there any abnormal noise or vibration or has the total operating time exceeded 20,000 hours?	Replace the cooling fan.
Power elements	Is there any conductive dirt or oil mist on the elements?	Clean off any dirt and dust with an air gun using dry air at a pressure of 39.2×10^4 to 58.8×10^4 Pa (4 to 6 kg•cm^2).
Smoothing capacitor	Are there any irregularities, such as discoloration or odor?	Replace the capacitor or Inverter.

◆ Periodic Maintenance of Parts

The Inverter is configured of many parts and these parts must be operating properly in order to make full use of the Inverter functions.

Among the electronic components, there are some that require maintenance depending on their usage conditions. In order to keep the Inverter operating normally over a long period of time, it is necessary to perform period inspections and replace parts according to their service life.

Periodic inspection standards vary depending the Inverter's installation environment and usage conditions. The Inverter's maintenance periods are noted below. Keep them as reference.

Table 8.2 Part Replacement Guidelines

Part	Standard Replacement Period	Replacement Method
Cooling fan	2 to 3 years	Replace with new part.
Smoothing capacitor	5 years	Replace with new part. (Determine need by inspection.)
Breaker relays	-	Determine need by inspection.
Fuses	10 years	Replace with new part.
Aluminum capacitors on PCBs	5 years	Replace with new board. (Determine need by inspection.)

Note The standard replacement period is based on the following usage conditions:
Ambient temperature:Yearly average of 30°C
Load factor: 80% max.
Operating rate: 12 hours max. per day

◆ Cooling Fan Replacement Outline

■200 V and 400 V Class Inverters of 18.5 kW or Less

A cooling fan is attached to the bottom of the Inverter.

If the Inverter is installed using the mounting holes on the back of the Inverter, the cooling fan can be replaced without removing the Inverter from the installation panel. The list of fans are given in Chapter 9.

Removing the Cooling Fan

1. Press in on the right and left sides of the fan cover in the direction of arrows 1 and then pull the fan out in the direction of arrow 2.
2. Pull out the cable connected to the fan from the fan cover and disconnect the relay connector.
3. Open the fan cover on the left and right sides and remove the fan cover from the fan.

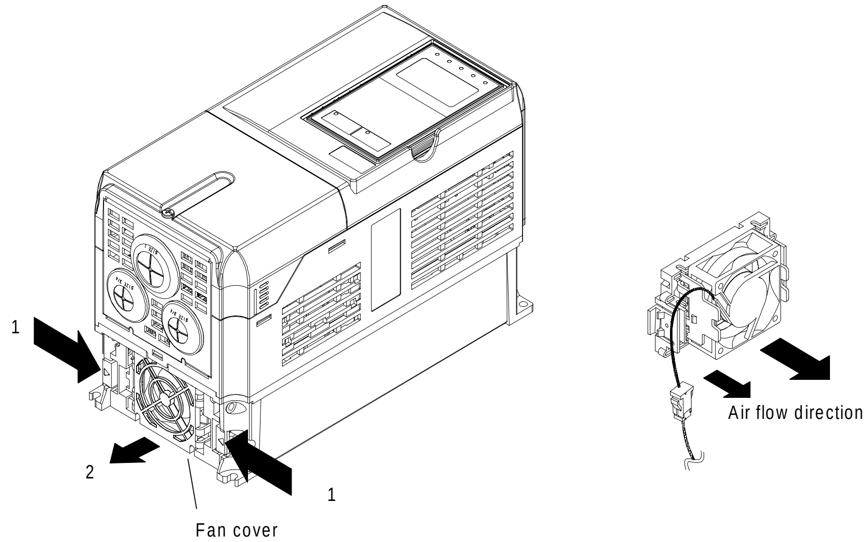


Fig 8.1 Cooling Fan Replacement (Inverters of 18.5 kW or Less)

Mounting the Cooling Fan

1. Attach the fan cover to the cooling fan. Be sure that the air flow direction indicated by the arrows above faces into the Inverter.
2. Connect the power connector securely and place the relay connector and cable into the fan cover.
3. Mount the fan cover on the Inverter. Be sure that the tabs on the sides of the fan cover click into place on the Inverter.

■200 V and 400 V Class Inverters of 22 kW or More

A cooling fan is attached to the top panel inside the Inverter.

The cooling fan can be replaced without removing the Inverter from the installation panel.

Removing the Cooling Fan

1. Remove the terminal cover, Inverter cover, Digital Operator and front cover from the front of the Inverter.
2. Remove the controller bracket to which the cards are mounted. Remove all cables connected to the controller.
3. Remove the cooling fan power cable connectors (CN26 and CN27) from the gate driver positioned at the back of the controller.
4. Remove the fan cover screws and pull out the fan cover from the Inverter.
5. Remove the cooling fan from the fan cover.

Mounting the Cooling Fan

After attaching a new cooling fan, reverse the above procedure to attach all of the components.
When attaching the cooling fan to the mounting bracket, be sure that the air flow faces the top of the Inverter.

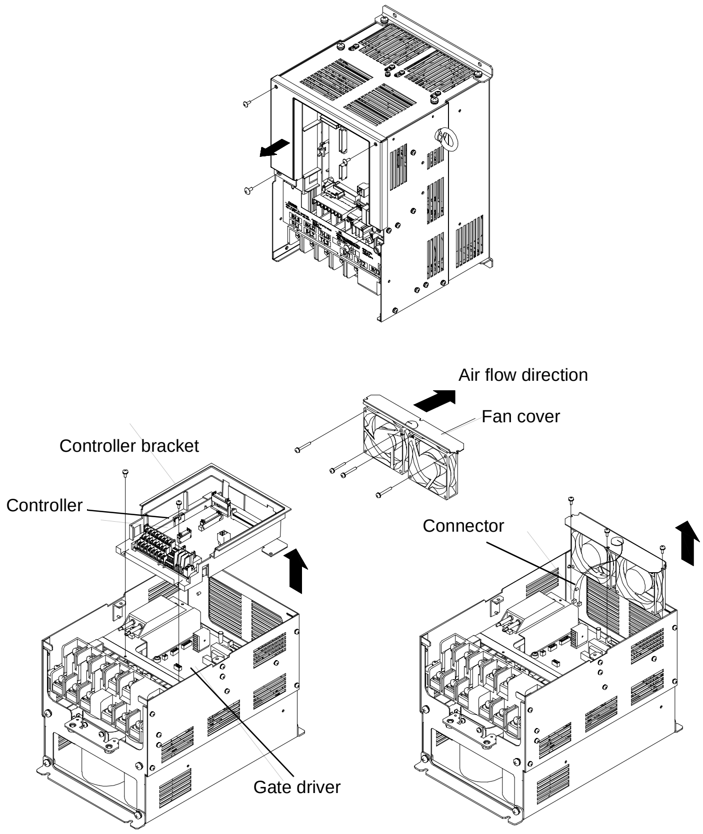


Fig 8.2 Cooling Fan Replacement (Inverters of 22 kW or More)

◆ Removing and Mounting the Control Circuit Terminal Card

The control circuit terminal card can be removed and mounted without disconnecting the cables.

The list of terminal cards are given in Chapter 9.

IMPORTANT

Always confirm that the charge indicator is not lit before removing or mounting the control circuit terminal card.

■Removing the Control Circuit Terminal Card

1. Remove the Digital Operator and front cover.
2. Remove the connecting line connectors connected to FE and NC on the control circuit terminal card.
3. Loosen the mounting screws (1) on the left and right sides of the control terminals until they are free. (It is not necessary to remove these screws completely. They are self-rising.)
4. Pull the terminal card out sideways (in direction 2) with the screws sticking out from the card.

■Mounting the Control Circuit Terminal Card

Reverse the removal procedure to mount the terminal card.

Confirm that the terminal circuit card and the controller properly meet at connector CN5 before pressing in on the card.

The connector pins may be bent if the card is forced into place, possibly preventing correct Inverter operation.

Removing and Mounting the
Control Circuit Terminal Card

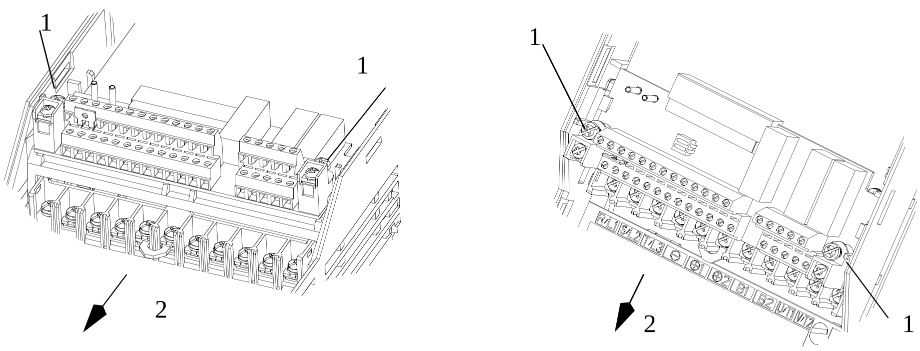


Fig 8.3   Removing the Control Circuit Terminal Card

9

Chapter 9

Specifications

This chapter describes the basic specifications of the Inverter and specifications for options and peripheral devices.

Standard Inverter Specifications

◆ Specifications by Model

Specifications are given by model in the following tables.

■200V Class

Table 9.1 200 V Class Inverters

Model Number 3G3PV-		A2004	A2007	A2015	A2022	A2037	A2055	A2075	A2110	A2150	A2185	A2220	A2300	A2370
Max. applicable motor output (kW)		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37
Output ratings	Rated output capacity (kVA)	1.2	1.6	2.7	3.7	5.7	8.8	12	17	22	27	32	44	55
Output ratings	Rated output current (A)	3.2	4.1	7.0	9.6	15	23	31	45	58	71	85	115	145
Output ratings	Max. output voltage (V)	3-phase; 200, 208, 220, 230 or 240 VAC (Proportional to input voltage.)												
Output ratings	Max. output frequency (Hz)	120 Hz max.												
Power supply characteristics	Rated voltage (V) Rated frequency (Hz)	3-phase, 200/208/220/230/240 VAC, 50/60 Hz												
Power supply characteristics	Allowable voltage fluctuation	+ 10%, - 15%												
Power supply characteristics	Allowable frequency fluctuation	±5%												
Control characteristics	Measures for power supply harmonics: DC reactor	Optional										Built in		
Control characteristics	Measures for power supply harmonics: 12-phase rectification	Not possible										Possible*2		

Model Number 3G3PV-		A2450	A2550	A2750	A2900	B2220	B2300	B2370	B2450	B2550	B2750	B2900	B211K
Max. applicable motor output (kW)		45	55	75	90	22	30	37	45	55	75	90	110
Output ratings	Rated output capacity (kVA)	69	82	110	130	32	44	55	69	82	110	130	160
Output ratings	Rated output current (A)	180	215	283	346	85	115	145	180	215	283	346	415
Output ratings	Max. output voltage (V)	3-phase 200, 208, 220, 230 or 240 VAC (Proportional to input voltage)											
Output ratings	Max. output frequency (Hz)	120 Hz max.											
Power supply characteristics	Rated voltage (V) Rated frequency (Hz)	3-phase, 200/208/220/230/240 VAC, 50/60 Hz											
Power supply characteristics	Allowable voltage fluctuation	+ 10%, - 15%											
Power supply characteristics	Allowable frequency fluctuation	±5%											
Control characteristics	Measures for power supply harmonics: DC reactor	Built in											
Control characteristics	Measures for power supply harmonics: 12-phase rectification	Possible*2											

* 1. The maximum applicable motor output is given for a standard 4-pole motor. When selecting the actual motor and Inverter, be sure that the Inverter's rated current is applicable for the motor's rated current.

* 2. A 3-wire transformer is required on the power supply for 12-phase rectification.

■400 V Class

Table 9.2 400 V Class Inverters

Model Number 3G3PV-			A4004	A4007	A4015	A4022	A4037	A4040	A4055	A4075	A4110	A4150	A4185	A/B 4220	A/B 4300	A/B 4370	A/B 4450
Max. applicable motor output (kW)			0.4	0.75	1.5	2.2	3.7	4.0	5.5	7.5	11	15	18.5	22	30	37	45
Output ratings	Rated output capacity (kVA)		1.4	1.6	2.8	4.0	5.8	6.6	9.5	13	18	24	30	34	46	57	69
Output ratings	Rated output current (A)		1.8	2.1	3.7	5.3	7.6	8.7	12.5	17	24	31	39	45	60	75	91
Output ratings	Max. output voltage (V)		3-phase; 380, 400, 415, 440, 460 or 480 VAC (Proportional to input voltage.)														
Output ratings	Max. output frequency (Hz)		120 Hz max.														
Power supply characteristics	Rated voltage (V) Rated frequency (Hz)		3-phase, 380, 400, 415, 440, 460 or 480 VAC, 50/60 Hz														
Power supply characteristics	Allowable voltage fluctuation		+ 10%, - 15%														
Power supply characteristics	Allowable frequency fluctuation		±5%														
Control characteristics	Measures for power supply harmonics	DC reactor	Optional											Built-in			
Control characteristics	Measures for power supply harmonics	12-phase rectification	Not possible											Possible*2			

Model Number 3G3PV-			A/B 4550	A/B 4750	A/B 4900	A/B 411K	A/B 413K	A/B 416K
Max. applicable motor output (kW)			55	75	90	110	132	160
Output ratings	Rated output capacity (kVA)		85	110	140	160	200	230
Output ratings	Rated output current (A)		112	150	180	216	260	304
Output ratings	Max. output voltage (V)		3-phase, 380, 400, 415, 440, 460 or 480 VAC (Proportional to input voltage.)					
Output ratings	Max. output frequency (Hz)		120 Hz max.					
Power supply characteristics	Max. voltage (V) Rated frequency (Hz)		3-phase, 380, 400, 415, 440, 460 or 480 VAC, 50/60 Hz					
Power supply characteristics	Allowable voltage fluctuation		+ 10%, - 15%					
Power supply characteristics	Allowable frequency fluctuation		±5%					
Control characteristics	Measures for power supply harmonics	DC reactor	Built in					
Control characteristics	Measures for power supply harmonics	12-phase rectification	Possible*2					

* 1. The maximum applicable motor output is given for a standard 4-pole motor. When selecting the actual motor and Inverter, be sure that the Inverter's rated current is applicable for the motor's rated current.

* 2. A 3-wire transformer is required on the power supply for 12-phase rectification.

9

◆ Common Specifications

The following specifications apply to both 200 V and 400 V Class Inverters.

Table 9.3 Common Specifications

Model Number 3G3PV-		Specification
Control characteristics	Control method	Sine wave PWM V/f control
	Speed control range	1:40
	Speed control accuracy	±2 to 3% (25°C ± 10°C)
	Frequency accuracy (temperature characteristics)	Digital references: ± 0.01% (-10°C to +40°C)
		Analog references: ±0.1% (25°C ±10°C)
	Frequency setting resolution	Digital references: 0.01 Hz
		Analog references: 0.05/50 Hz (10 bit no sign)
	Overload capacity and maximum current*1	120% of rated output current per minute
	Frequency setting signal	0 to 10 V, 4 to 20 mA
	Acceleration/Deceleration time	0.0 to 6000.0 s (4 selectable combinations of independent acceleration and deceleration settings)
	Main control functions	Restarting for momentary power loss, speed searches, overtorque detection, 4-speed control (maximum), acceleration/deceleration time changes, S-curve acceleration, 3-wire sequence, autotuning, cooling fan ON/OFF control, torque compensation, jump frequencies, upper and lower limits for frequency references, DC braking for starting and stopping, high-slip braking, PI control (with sleep function), energy-saving control, RS-422A/485 communications (19.2 kbps maximum), fault reset and function copying.
Protective functions	Motor protection	Protection by electronic thermal overload relay.
	Fuse blown protection	Stops for fuse blown.
	Overload protection	120% of rated output current for 1 minute
	Overvoltage protection	200 Class Inverter: Stops when main-circuit DC voltage is above 410 V. 400 Class Inverter: Stops when main-circuit DC voltage is above 820 V.
	Undervoltage protection	200 Class Inverter: Stops when main-circuit DC voltage is below 190 V. 400 Class Inverter: Stops when main-circuit DC voltage is below 380 V.
	Momentary power loss ridethru	Stops for 15 ms or more. By selecting the momentary power loss method, operation can be continued if power is restored within 2 s.
	Cooling fin overheating	Protection by thermistor.
	Stall prevention	Stall prevention during acceleration, deceleration or running.
	Grounding protection	Protection by electronic circuits. (50% of inverter rated current)
	Charge indicator	Lit when the main circuit DC voltage is approx. 50 V or more.
Protective structure		Enclosed wall-mounted type (NEMA 1): 18.5 kW or less (same for 200 V and 400 V class Inverters) Open chassis type (IP00): 22 kW or more (same for 200 V and 400 V class Inverters)
Environment	Ambient operating temperature	-10°C to 40°C (Enclosed wall-mounted type) –10°C to 45°C (Open chassis type)
	Ambient operating humidity	95% max. (with no condensation)
	Storage temperature	- 20°C to + 60°C (short-term temperature during transportation)
	Application site	Indoor (no corrosive gas, dust, etc.)
	Altitude	1000 m max.*2
	Vibration	10 to 20 Hz, 9.8 m/s^2 max.; 20 to 50 Hz, 2 m/s^2 max

* 1. Increase the Inverter capacity if loads exceeding these current values are expected.

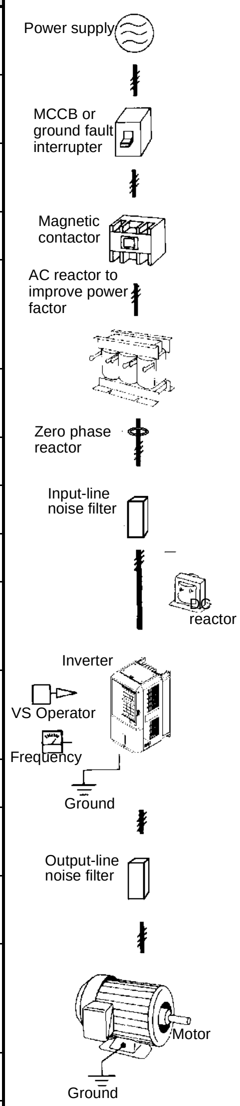
* 2. If applied in higher altitudes contact your OMRON representative.

Specifications of Options and Peripheral Devices

The following options and peripheral devices can be used for the Inverter. Select them according to the application.

Table 9.4 Options and Peripheral Devices

Purpose	Name	Model (Code)	Descriptions
Protect Inverter wiring	MCCB or Ground Fault Interrupter[*1]	Example: Mitsibushi Electronics NV series.	Always connect a breaker to the power supply line to protect Inverter wiring. Use a ground fault interrupter suitable for high frequencies.
Prevents burning when a Braking Resistor is used.	Magnetic Contactor	OMRON J7K-**	Install to prevent the braking resistor from burning out when one is used. Always attach a surge absorber to the coil.
Contains switching surge	Surge Absorber	DCR2-□	Absorbs surge from the magnetic contactor and control relays. Connect surge absorbers to all magnetic contactors and relays near the Inverter.
Isolates I/O signals	Isolator	DGP□	Isolates the I/O signals of the Inverter and is effective against inductive noise.
Improves the input power factor of the Inverter	DC Reactor AC Reactor	3G3HV-PUZDAB□ 3G3IV-PUZBAB□	Used to improve the input power factor of the Inverter. All Inverters of 22 kW or higher contain built-in DC reactors. These are optional for Inverters of 18.5 kW or less. Install DC and AC reactors for applications with a large power supply capacity (600 kVA or higher).
Enables stopping the machine in a set time	Braking Resistor Unit	3G3IV-PLKEB□	Consumes the regenerative motor energy with a resistor to reduce deceleration time (use rate: 10% ED). (Braking Unit is needed.)
	Braking Unit	3G3IV-PCDBR□B	Used with a Braking Resistor Unit to reduce the deceleration time of the motor.
Operates the Inverter externally	Digital Operator with LCD Display	3G3IV-PJVOP160	Displays messages on a LCD.
	Digital Operator with LED Display	3G3IV-PJVOP161	Display messages on a LED display. Standard in Europe.
	Analog Operator (small plastic Operator)	3G3IV-PJVOP95□	Allows frequency reference settings and ON/OFF operation control to be performed by analog references from a remote location (50 m max.). Frequency counter specifications: 60/120 Hz, 90/180Hz
	Analog Operator (Standard steel-plate Operator)	3G3IV-PJVOP96□	Allows frequency reference settings and ON/OFF operation control to be performed by analog references from a remote location (50 m max.). Frequency counter specifications: 75 Hz, 150 Hz, 220 Hz
	Digital Operator Connection Cable	3 m cable: (3G3IV-PCN326-E)	Extension cable to use a Digital Operator remotely. Cable length: 3 m
	Personal Computer cable	3G3IV-PCN329-E	Connection cable for connecting the 3G3PV series Inverter to the SYSDrive configurator (software tool) on Personal Computer.
Sets/monitors frequencies and voltages externally.	Scaling Meter	K3TJ-V11□	Measurs the output voltage externally and designed for use with a PWM meter.
Special Mounted Options	Fan Unit	3G3IV-PFAN□	Replacement fan for Inverters equipped with a cooling fan. Replace the Cooling Fan when the fan replacement time has come or a cooling fan fault (FAN) alarm has been displayed.
Option cards[*2]	DeviceNet Communications Card	3G3FV-PDRT1-SIN	Used for DeviceNet communications with a Programmable Controller or other DeviceNet master device.
Terminal cards	Standard terminal card	3G3PV-PETC61814*	Standard terminal card.
	Optional terminal card	3G3PV-PETC61812*	Optional terminal card (with shunt connector CN15) for switching the analog output levels between (0-10V) or (4 to 20 mA).
Reduces the affects of radio and control device noise	Input Noise Filter		Reduces noise coming into the inverter from the power supply line and to reduce noise flowing from the inverter into the power supply line. Connect as close to the Inverter as possible.
	Output Noise Filter	3G3IV-PFO OC/□	Reduces noise generated by the inverter. Connect as close to the inverter as possible.
	Input Noise Filter (Schaffner) for EMC Directive	3G3RV-PFI□-SE	Required for the 3G3PV Inverter to meet the EMC Directive.
	Input Noise Filter (Rasmi) for EMC Directive	3G3RV-PFI□-E	Required for the 3G3PV Inverter to meet the EMC Directive.



* 1. Use a ground fault interrupter with a current sensitivity of 200 mA minimum and an operating time of 0.1 s minimum to prevent operating errors

* 2. For other Communications options, contact your OMRON representative.

Options and Peripheral Devices

There are several types of options and peripheral devices for Inverters: Separately installed options, special options, Option Cards, and recommended separately installed options. The specifications of these options are provided in these sections.

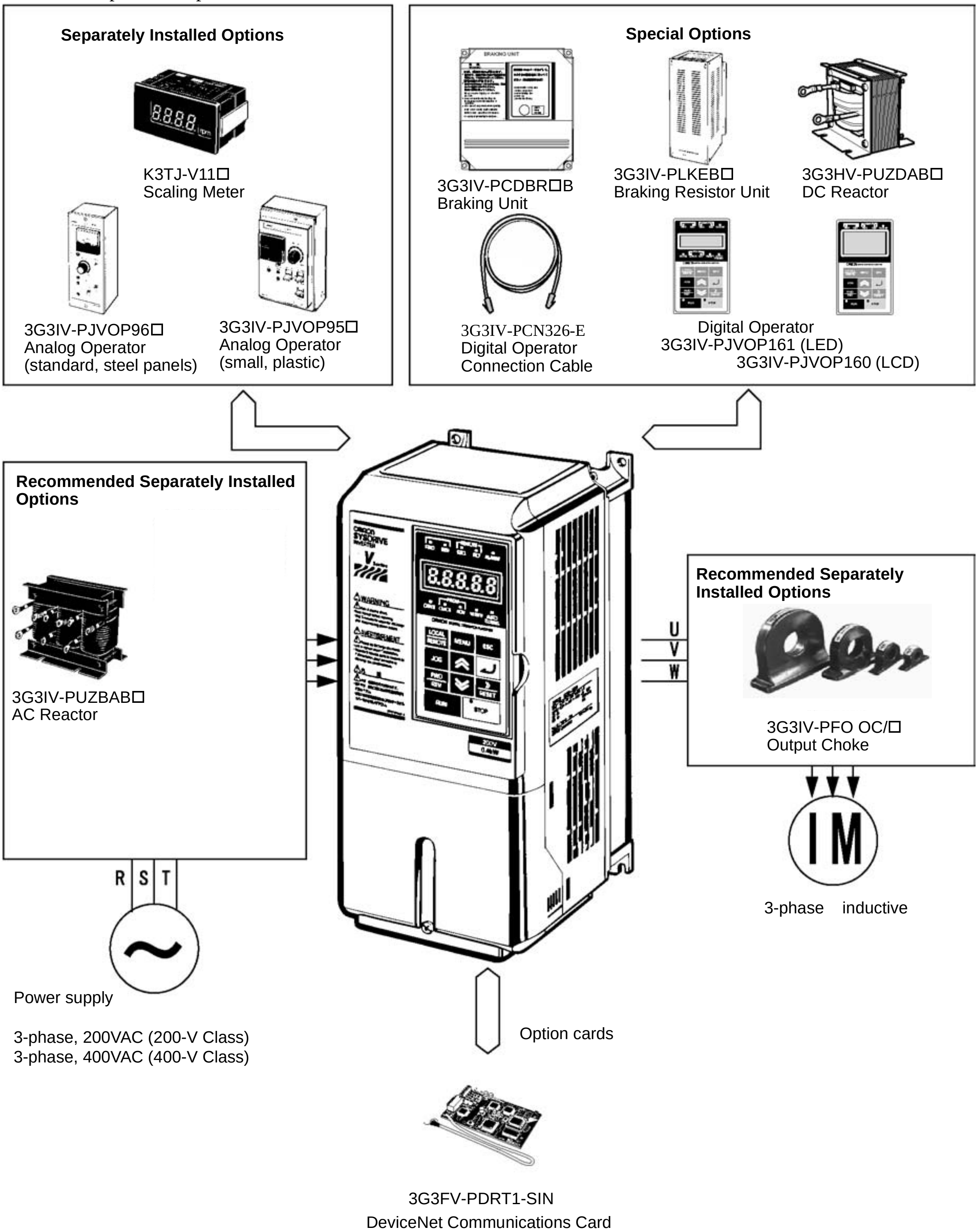


Fig 9.1 Options and Peripheral Devices

◆ Special Mounted Options

The special mounted options are described in this section.

■ Fan Unit

Replacement fan for Inverters equipped with a cooling fan.

Replace the Cooling Fan when the fan replacement time has come or a cooling fan fault (FAN) alarm has been displayed.

Models and Application

The standard models of Fan Units are listed in the following table.

Inverter			Replacement Cooling Fan	
Voltage Class	Max. Applicable Motor Capacity (kW)	Model No.	Model No.	Qty Used
3-phase, 200 VAC	0.4	3G3PV-A2004	No Fan	-
	0.75	3G3PV-A2007		
	1.5	3G3PV-A2015		
	2.2	3G3PV-A2022		
	3.7	3G3PV-A2037	3G3IV-PFAN001041	1
	5.5	3G3PV-A2055		
	7.5	3G3PV-A2075		2
	11	3G3PV-A2110		
	15	3G3PV-A2150	3G3IV-PFAN001042	2
	18.5	3G3PV-A2185		
	22	3G3PV-A/B2220	3G3IV-PFAN001039	2
	30	3G3PV-A/B2300		
	37	3G3PV-A/B2370	3G3IV-PFAN001049	2
	45	3G3PV-A/B2450		
	55	3G3PV-A/B2550	3G3IV-PFAN001052	2
	75	3G3PV-A/B2750		
	90	3G3PV-A/B2900	3G3IV-PFAN000111	2
	110	3G3PV-B211K		
3-phase, 400 VAC	0.4	3G3PV-A4004	No Fan	-
	0.75	3G3PV-A4007		
	1.5	3G3PV-A4015		
	2.2	3G3PV-A4022	3G3IV-PFAN001041	1
	3.7	3G3PV-A4037		
	4.0	3G3PV-A4040		
	5.5	3G3PV-A4055		
	7.5	3G3PV-A4075	3G3IV-PFAN001042	2
	11	3G3PV-A4110		
	15	3G3PV-A4150		
	18.5	3G3PV-A4185		
	22	3G3PV-A/B4220	3G3IV-PFAN001039	2
	30	3G3PV-A/B4300		
	37	3G3PV-A/B4370	3G3IV-PFAN001044	2
	45	3G3PV-A/B4450		
	55	3G3PV-A/B4550		
	75	3G3PV-A/B4750	3G3IV-PFAN001052	2
	90	3G3PV-A/B4900		
	110	3G3PV-A/B411K	3G3IV-PFAN001056	2
	132	3G3PV-A/B413K		
	160	3G3PV-A/B416K		

Refer to *Chapter 8 Maintenance and Inspection* for the Fan Unit replacement procedure.

◆ Separately Installed Options

The separately installed options include Scaling Meters and Analog Operators.

■ Scaling Meters

A Scaling Meter is attached to a multi-function analog output from the Inverter and is used to display rotational speeds of motors, line speeds, etc., in physical units.

K3TJ-V11□

Models and Application

The standard models of Scaling Meters are listed in the following table.

Model No.	Control Power Supply	Display
K3TJ-V111R	100 to 200 VAC	Red LED
K3TJ-V111G		Green LED
K3TJ-V116R	24 VDC, isolated (See note.)	Red LED
K3TJ-V116G		Green LED

Note The power supply circuit is isolated from the input circuits.

Standard Specifications

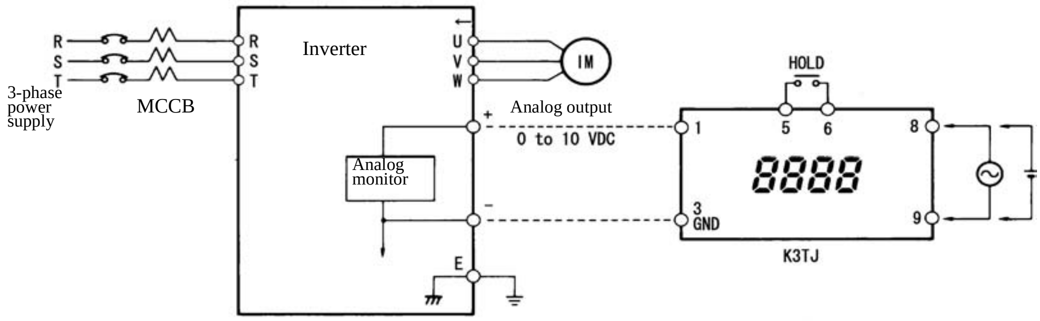
The standard specifications of the Scaling Meters are listed below.

K3TJ-V11□	Specifications
Sampling Period	2 times/s
Display Refresh Cycle	2 times/s
Measurement Averaging Methods	Simple average or moving average
Number of Samples for Averaging	1, 2, 4, or 8 samples
Max. No. of Display Digits	4 digits (-1999 to 9999)
Display	7-segment LEDs, character height: 14.2 mm
Decimal Point Display	User-set using function selection switch and up/down keys.
Scaling Method	Shifting and scaling are user-set using function selection switch and up/down keys.
Scaling Range	-1999 to 9999
Zero Limit Range	0 to 99 digits
Overrange Values	Flashing display
Zero Suppression	Supported
External Controls	Present value hold (by short-circuiting terminal on front panel)
Protective Structure (conforming to IEC standards)	Front panel display: IP51* Case: IP20 Terminal section: IP00
Memory Protection	Non-volatile memory

* IP51 requires that the optional K32-L49SC Drop-proof Cover is used. The protective structure is IP50 without it.

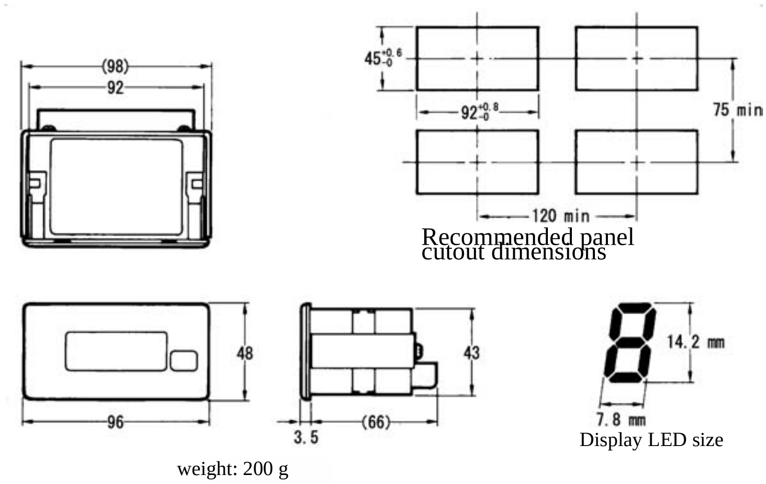
Wiring Example

A wiring example for a Scaling Meter is shown below.



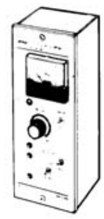
Dimensions

The dimensions of a Scaling Meter are given below.

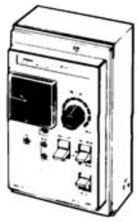


■ Analog Operators: Standard with Steel Panels or Small in Plastic

An Analog Operator allows frequency reference settings and ON/OFF operation control to be performed by analog references from a remote location (50 m max.)



3G3IV-PJV0P96@
Analog Operator



3G3IV-PJV0P95@
Analog Operator

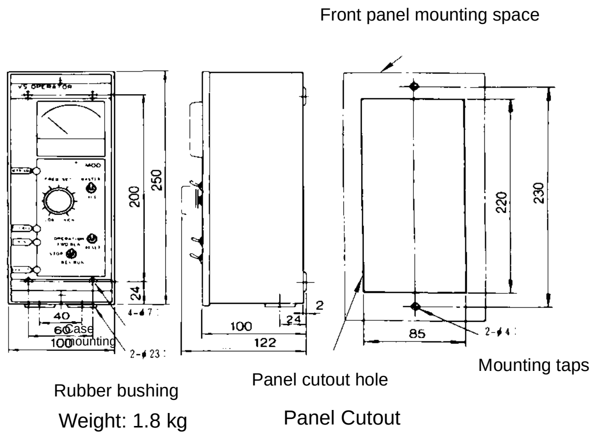
Models and Application

The standard models of Analog Operators are listed in the following table.

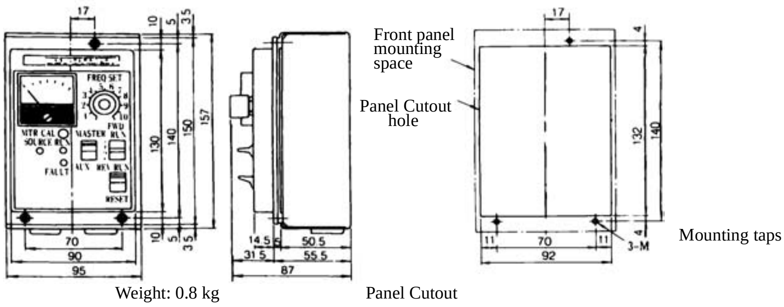
Model No.	Frequency Meter Specifications
3G3IV-PJVOP961	DCF-6A, 3 V, 1 mA, 75 Hz
3G3IV-PJVOP962	DCF-6A, 3 V, 1 mA, 150 Hz
3G3IV-PJVOP963	DCF-6A, 3 V, 1 mA, 220 Hz
3G3IV-PJVOP951	TRM-45, 3 V, 1 mA, 60/120 Hz
3G3IV-PJVOP952	TRM-45, 3 V, 1 mA, 60/120 Hz

Dimensions

The dimensions of an Analog Operator are given below.



Standard Analog Operator with Steel Panels



Small Plastic Analog Operator

■ Braking Unit

A Braking Unit is used with a Braking Resistor Unit to reduce the deceleration time of the motor. It is not required with Inverters of 18.5 kW or less.

3G3IV-PCDBR□B

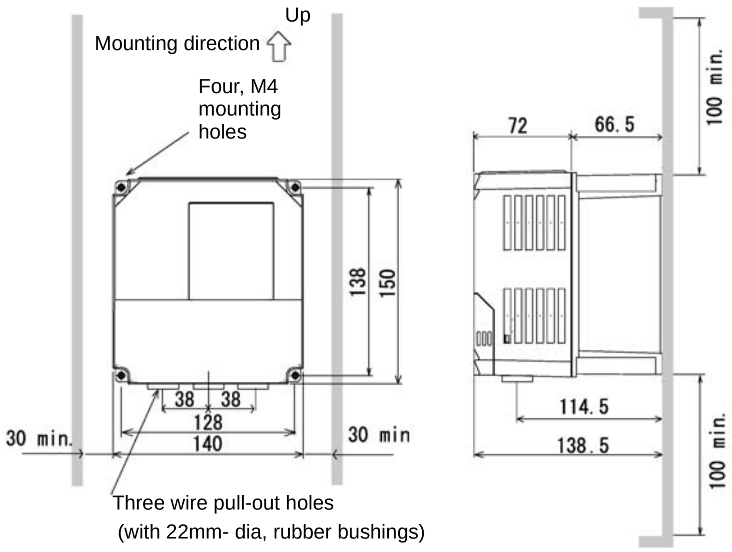
Models and Application

The standard models of Braking Units are listed in the following table.

Inverter		Braking Unit		Min. Resistance* (Ω)
Voltage Class	Max. Applicable Motor Capacity (kW)	Model No.	Qty Used.	
200-V Class	0.4			48
	0.75			48
	1.5			48
	2.2			16
	3.7			16
	5.5			16
	7.5			9.6
	11			9.6
	15			9.6
	18.5			9.6
	22	3G3IV-CDBR2022B	1	6.4
	30	3G3IV-CDBR2015B	2	9.6
	37	3G3IV-CDBR2015B	2	9.6
	45	3G3IV-CDBR2022B	2	6.4
	55	3G3IV-CDBR2022B	2	6.4
	75	3G3IV-CDBR2022B	3	6.4
	90	3G3IV-CDBR2022B	4	6.4
	110	3G3IV-CDBR2022B	5	6.4
400-V Class	0.4			96
	0.75			96
	1.5			64
	2.2			64
	3.7			32
	5.5			32
	7.5			32
	11			20
	15			20
	18.5			19.2
	22	3G3IV-CDBR4030B	1	19.2
	30	3G3IV-CDBR4030B	1	19.2
	37	3G3IV-CDBR4045B	1	12.8
	45	3G3IV-CDBR4045B	1	12.8
	55	3G3IV-CDBR4030B	2	19.2
	75	3G3IV-CDBR4045B	2	12.8
	90	3G3IV-CDBR4045B	2	12.8
	110	3G3IV-CDBR4030B	3	19.2
	132	3G3IV-CDBR4045B	3	12.8
	160	3G3IV-CDBR4045B	4	12.8

Dimensions

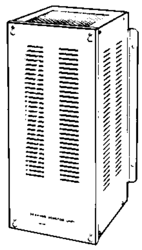
The dimensions of a Braking Unit are given below.



■ Braking Resistor Unit

A Braking Resistor Unit is used to absorb the regenerative motor energy with a resistor to reduce deceleration time (use rate: 10% ED). A 10% ED means that the 10% of the operating cycle time can be used to control braking (deceleration time).

The following models are Asian models. For Europe use Braking Resistor Unit that have equivalent Power and Resistance specifications.



Models and Application

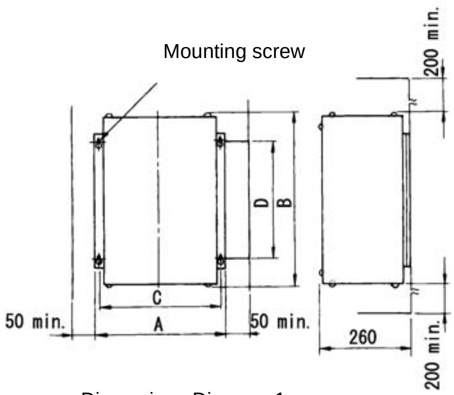
The standard models of Braking Resistor Units are listed below.

Inverter	Braking Resistor Unit				
Voltage Class	Applicable Motor Capacity (kW)	Model No.	Resistor Specifications (per Unit)	Qty Used	Approx Braking Torque (%)
200-V Class	22	3G3IV-PLKEB2022	4800 W, 6.8 Ω	1	125
	30	3G3IV-PLKEB2015	3000 W, 10 Ω	2	125
	37	3G3IV-PLKEB2015	3000 W, 10 Ω	2	100
	45	3G3IV-PLKEB2022	4800 W, 6.8 Ω	2	120
	55	3G3IV-PLKEB2022	4800 W, 6.8 Ω	2	100
	75	3G3IV-PLKEB2022	4800 W, 6.8 Ω	3	110
	90	3G3IV-PLKEB2022	4800 W, 6.8 Ω	4	120
	110	3G3IV-PLKEB2018	4800 W, 8 Ω	5	100
400-V Class	22	3G3IV-PLKEB4022	4800 W, 27.2Ω	1	125
	30	3G3IV-PLKEB4030	6000 W, 20 Ω	1	125
	37	3G3IV-PLKEB4037	9600 W, 16 Ω	1	125
	45	3G3IV-PLKEB4045	9600 W, 13.6 Ω	1	125
	55	3G3IV-PLKEB4030	6000 W, 20 Ω	2	135
	75	3G3IV-PLKEB4045	9600 W, 13.6 Ω	2	145
	90	3G3IV-PLKEB4045	9600 W, 13.6 Ω	2	100
	110	3G3IV-PLKEB4030	6000 W, 20 Ω	3	100
	132	3G3IV-PLKEB4045	9600 W, 13.6 Ω	4	140
	160	3G3IV-PLKEB4045	9600 W, 13.6 Ω	4	140

Dimensions

The dimensions of a Braking Resistor Unit are given below.

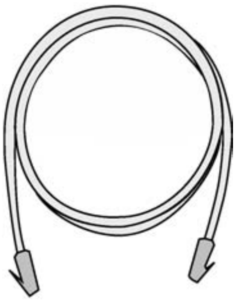
Voltage Class	Model No. 3G3IV-PLKEB□	Dimensions Diagram	Dimensions (mm) A	B	C	D	Mounting Screws	Weight (kg)
200-V Class	2015	1	356	543	336	340	M8X4	15
	2018	1	446	543	426	340	M8 × 4	19
	2022	1	446	543	426	340	M8 × 4	19
400-V Class	4022	1	446	543	426	340	M8 × 4	19
	4030	1	356	956	336	740	M8 × 4	25
	4037	1	446	956	426	740	M8 × 4	33
	4045	1	446	956	426	740	M8 × 4	33



Dimensions Diagram 1

■ Digital Operator Connection Cable

Connected the Inverter to a Digital Operator in a remote locations. Both 1-m and 3-m Cables are available.



3G3IV-PCN□26

Models and Application

Model No.	Specifications
3G3IV-PCN326-E	Cable length: 3 m

■Personal computer Cable

Connect the Inverter and the Personal Computer. Only available in 3m.

Model no.	Specifications
3G3IV-PCN329-E	Cable length: 3 m

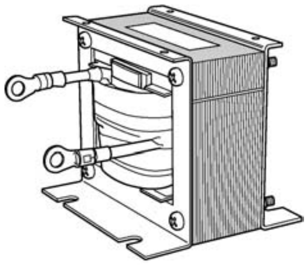
■Software tool SYSDrive Configurator

Software tool for programming, downloading, uploading and monitoring for OMRON Inverters.

Model no.	Specifications
995005*/*	SYSDrive Configurator V*.*

■ DC Reactor

A DC Reactor is used to control harmonics generated by the Inverter. It is more effective than and can be used in combination with an AC Reactor. It is also used to increase the power factor.



3G3HV-PUZDAB□

Models and Application

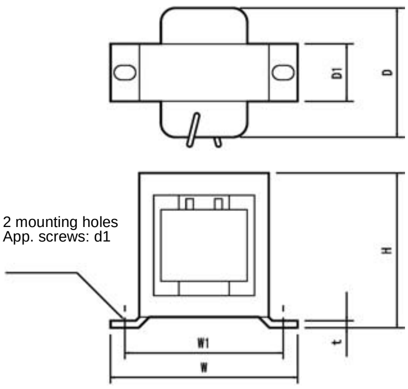
The standard models of DC Reactors are listed below.

Inverter		DC Reactor				
Voltage Class	Max. Applicable Motor Capacity (kW)	Model No.	Rated Voltage (V)	Rated Current (A)	Inductance (mH)	Loss (W)
200-V Class	0.4/0.75	3G3HV-PUZDAB5.4A8MH	DC800	5.4	8	8
	1.5 to 3.7	3G3HV-PUZDAB18A3MH		18	3	18
	5.5/7.5	3G3HV-PUZDAB36A1MH		36	1	22
	11/15	3G3HV-PUZDAB72A0.5MH		72	0.5	29
	18.5	3G3HV-PUZDAB90A0.4MH		90	0.4	45
400-V Class	0.4/0.75	3G3HV-PUZDAB3.2A28MH	DC800	3.2	28	9
	1.5 to 2.2	3G3HV-PUZDAB5.7A11MH		5.7	11	11
	3.7	3G3HV-PUZDAB12A6.3MH		12	6.3	16
	5.5/7.5	3G3HV-PUZDAB23A3.6MH		23	3.6	27
	11/15	3G3HV-PUZDAB33A1.9MH		33	1.9	26
	18.5	3G3HV-PUZDAB47A1.3MH		47	1.3	42

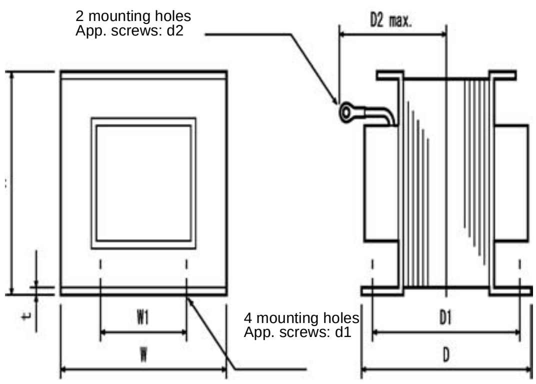
Dimensions

The dimensions of a DC Reactor are given below.

Model 3G3HV-PUZDAB☐	Dimensions Diagram	Dimensions (mm)									Weight (kg)
		H	W	W1	D	D1	D2	t	d1	d2	
5.4A8MH	1	53	85	74	60	32	-	0.8	M4	-	0.8
18A3MH	2	76	86	60	72	55	80	1.2	M4	M5	2.0
36A1MH	2	93	105	64	92	80	90	1.6	M6	M6	3.2
72A0.5MH	2	93	105	64	112	100	105	1.6	M6	M8	4.9
90A0.4MH	2	117	133	86	105	80	120	1.6	M6	M8	6.5
3.2A28MH	1	53	85	74	60	32	-	0.8	M4	-	0.8
5.7A11MH	1	60	90	80	60	32	-	0.8	M4	-	1.0
12A6.3MH	2	76	86	60	72	55	80	1.2	M4	M5	2.0
23A3.6MH	2	93	105	64	92	80	90	1.6	M6	M5	3.2
33A1.9MH	2	93	105	64	102	90	95	1.6	M6	M6	4.0
47A1.3MH	2	100	115	72	115	90	125	1.6	M6	M6	6.0



Dimensions Diagram 1

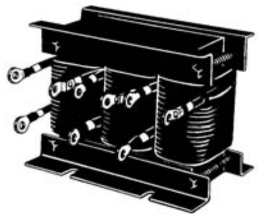


Dimensions Diagram 2

9

■ AC Reactor

An AC Reactor is used to control harmonics generated by the Inverter or when the power supply capacity is greatly larger than the Inverter's capacity. It is also used to increase the power factor. Select the AC Reactor from the following table according to the motor capacity.



3G3IV-PUZBAB□

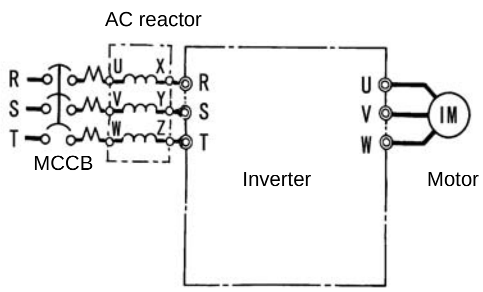
Models and Application

The standard models of AC Reactors are listed in the following table.

Inverter		AC Reactor			
Voltage Class	Max. Applicable Motor Capacity (kW)	Model No.	Current (A)	Inductance (mH)	Loss (W)
200-V Class	0.4	3G3IV-PUZBAB2.5A4.2MH	2.5	4.2	15
	0.75	3G3IV-PUZBAB5A2.1MH	5	2.1	15
	1.5	3G3IV-PUZBAB10A1.1MH	10	1.1	25
	2.2	3G3IV-PUZBAB15A0.71MH	15	0.71	30
	3.7	3G3IV-PUZBAB20A0.53MH	20	0.53	35
	5.5	3G3IV-PUZBAB30A0.35MH	30	0.35	45
	7.5	3G3IV-PUZBAB40A0.265MH	40	0.265	50
	11	3G3IV-PUZBAB60A0.18MH	60	0.18	65
	15	3G3IV-PUZBAB80A0.13MH	80	0.13	75
	18.5	3G3IV-PUZBAB90A0.12MH	90	0.12	90
	22	3G3IV-PUZBAB120A0.09MH	120	0.09	90
	30	3G3IV-PUZBAB160A0.07MH	160	0.07	100
	37	3G3IV-PUZBAB200A0.05MH	200	0.05	110
	45	3G3IV-PUZBAB240A0.044MH	240	0.044	125
	55	3G3IV-PUZBAB280A0.038MH	280	0.038	130
400-V Class	0.4	3G3IV-PUZBAB1.3A18.0MH	1.3	18.0	15
	0.75	3G3IV-PUZBAB2.5A8.4MH	2.5	8.4	15
	1.5	3G3IV-PUZBAB5A4.2MH	5	4.2	25
	2.2	3G3IV-PUZBAB7.5A3.6MH	7.5	3.6	35
	3.7	3G3IV-PUZBAB10A2.2MH	10	2.2	43
	5.5	3G3IV-PUZBAB15A1.42MH	15	1.42	50
	7.5	3G3IV-PUZBAB20A1.06MH	20	1.06	50
	11	3G3IV-PUZBAB30A0.7MH	30	0.7	65
	15	3G3IV-PUZBAB40A0.53MH	40	0.53	90
	18.5	3G3IV-PUZBAB50A0.42MH	50	0.42	90
	22	3G3IV-PUZBAB60A0.36MH	60	0.36	90
	30	3G3IV-PUZBAB80A0.26MH	80	0.26	95
	37	3G3IV-PUZBAB90A0.24MH	90	0.24	110
	45	3G3IV-PUZBAB120A0.18MH	120	0.18	130
	55	3G3IV-PUZBAB150A0.15MH	150	0.15	150

Wiring Example

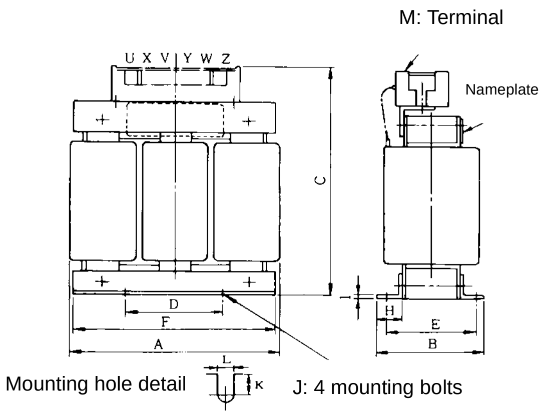
A wiring example for an AC Reactor is shown below.



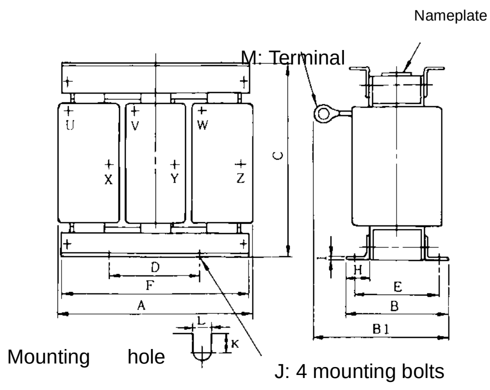
Dimensions

The dimensions of a DC Reactor are given below.

Model 3G3IV -PUZBAB☐	Dimen-sions Diagram	Dimensions (mm)												Weight (kg)
		A	B	B1	C	D	E	F	H	J	K	L	M	
2.5A4.2MH	1	120	71	-	120	40	50	105	20	M6	10.5	7	M4	2.5
5A2.1MH		120	71	-	120	40	50	105	20	M6	10.5	7	M4	2.5
10A1.1MH		130	88	-	130	50	65	130	22	M6	11.5	7	M4	3
15A0.71MH		130	88	-	130	50	65	130	22	M6	11.5	7	M4	3
20A0.53MH	2	130	88	114	105	50	65	130	22	M6	11.5	7	M5	3
30A0.35MH		130	88	119	105	50	70	130	22	M6	9	7	M5	3
40A0.265MH		130	98	139	105	50	75	130	22	M6	11.5	7	M6	4
60A0.18MH		160	105	147.5	130	75	85	160	25	M6	10	7	M6	6
80A0.13MH		180	100	155	150	75	80	180	25	M6	10	7	M8	8
90A0.12MH		180	100	150	150	75	80	180	25	M6	10	7	M8	8
120A0.09MH		180	100	155	150	75	80	180	25	M6	10	7	M10	8
160A0.07MH		210	100	170	175	75	80	205	25	M6	10	7	M10	12
200A0.05MH		210	115	182.8	175	75	95	205	25	M6	10	7	M10	15
240A0.044MH		240	126	218	215±5	150	110	240	25	M6	8	7	M10	23
280A0.038MH		240	126	218	215±5	150	110	240	25	M8	8	10	M12	23
1.3A18.0MH	1	120	71	-	120	40	50	105	20	M6	10.5	7	M4	2.5
2.5A8.4MH		120	71	-	120	40	50	105	20	M6	10.5	7	M4	2.5
5A4.2MH		130	88	-	130	50	70	130	22	M6	9	7	M4	3
7.5A3.6MH		130	88	-	130	50	70	130	22	M6	9	7	M4	3
10A2.2MH		130	88	-	130	50	65	130	22	M6	11.5	7	M4	3
15A1.42MH		130	98	-	130	50	75	130	22	M6	11.5	7	M4	4
20A1.06MH	2	160	90	115	130	75	70	160	25	M6	10	7	M5	5
30A0.7MH		160	105	132.5	130	75	85	160	25	M6	10	7	M5	6
40A0.53MH		180	100	140	150	75	80	180	25	M6	10	7	M6	8
50A0.42MH		180	100	145	150	75	80	180	25	M6	10	7	M6	8
60A0.36MH		180	100	150	150	75	75	180	25	M6	10	7	M6	8.5
80A0.26MH		210	100	150	175	75	80	205	25	M6	10	7	M8	12
90A0.24MH		210	115	177.5	175	75	95	205	25	M6	10	7	M8	15
120A0.18MH		240	126	193	205±5	150	110	240	25	M8	8	10	M10	23
150A0.15MH		240	126	193	205±5	150	110	240	25	M8	8	10	M10	23



Dimensions Diagram 1



Dimensions Diagram 2

■ Input Noise Filters for EMC Directives (3G3RV-PFI□, by Schaffner)

When conformance to the EMC Directives in the EC Directives is required, always use one of these Filters. The Filter is connected between the Inverter’s power supply input terminals (R/L1, S/L2, T/L3) and the power supply.

There are holes for mounting the Noise Filters to Inverters on the top of the Noise Filters. Use these holes to secure the Noise Filters to the Inverters.

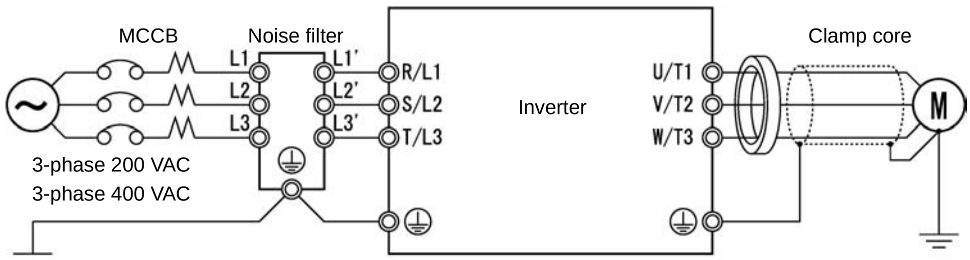
Models and Application

The standard models of Input Noise Filters for EMC Directives are listed in the following table.

Inverter		Input Noise Filter for EMC Directives				
Voltage Class	Max. Applicable Motor Capacity (kW)	Rated Current (A)	Model No.	Mounting	Weight (kg)	Dimensions Diagram
3-phase, 200 VAC	0.4	10	3G3RV-PFI3010-SE	foot/book	1.1	1
	0.75					
	1.5					
	2.2	18	3G3RV-PFI3018-SE		1.3	
	3.7	35	3G3RV-PFI2035-SE		1.4	
	5.5					
	7.5	60	3G3RV-PFI2060-SE		3	2
	11					
	15	100	3G3RV-PFI2100-SE		4.9	3
	18.5					
	22	130	3G3RV-PFI2130-SE	book	4.3	5
	30					
	37	160	3G3RV-PFI2160-SE		6	6
	45	240	3G3RV-PFI2200-SE		11	7
	55					
	75	320	3G3RV-PFI3400-SE		18.5	8
	90	390				
3-phase, 400 VAC	0.4	10	3G3RV-PFI3010-SE	foot/book	1.1	1
	0.75					
	1.5					
	2.2					
	3.7	18	3G3RV-PFI3018-SE		1.3	
	4.0					
	5.5					
	7.5	35	3G3RV-PFI3035-SE		2.1	2
	11					
	15	60	3G3RV-PFI3060-SE		4	3
	18.5					
	22	70	3G3RV-PFI3070-SE	book	3.4	4
	30					
	37	130	3G3RV-PFI3130-SE		4.7	5
	45					
	55					
	75	170	3G3RV-PFI3170-SE		6.0	6
	90	200	3G3RV-PFI3200-SE		11.0	7
	110	250				
	132	300	3G3RV-PFI3400-SE		18.5	8
	160	350				

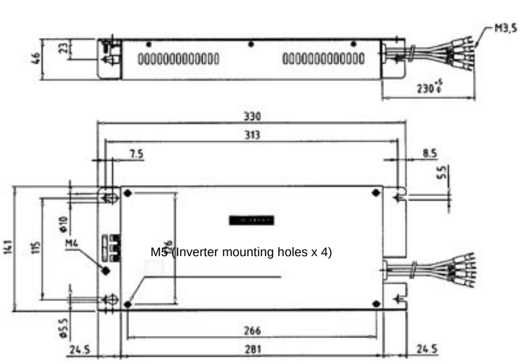
Wiring Example

A wiring example for an Input Noise Filter for EMC Directives is shown below.

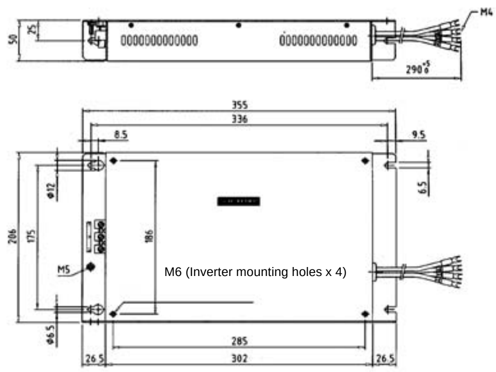


Dimensions

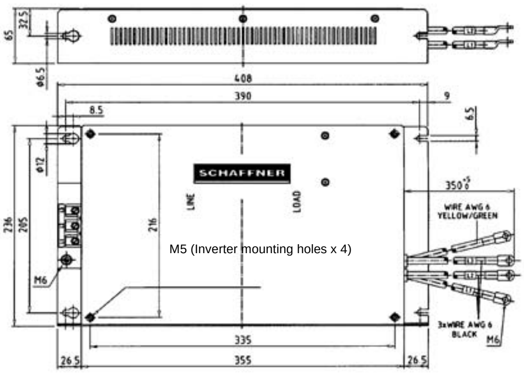
The dimensions of an Input Noise Filter (by Schaffner)for EMC Directives are given below.



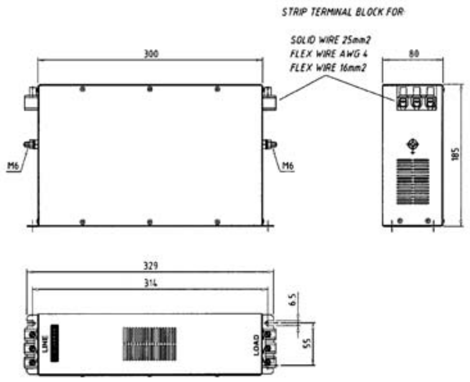
Dimensions Diagram 1



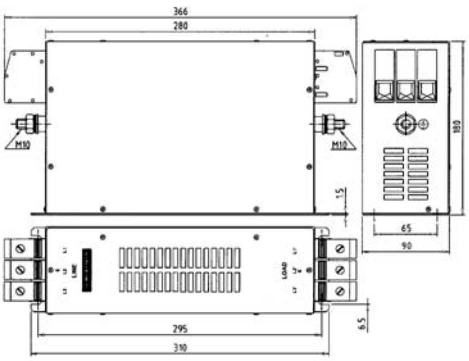
Dimensions Diagram 2



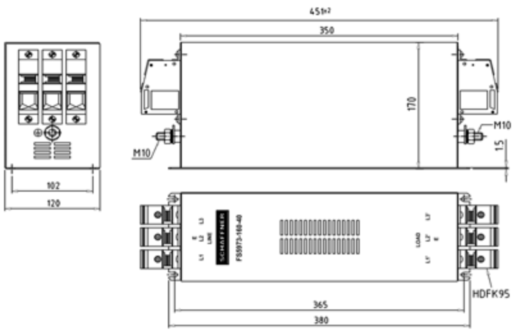
Dimensions Diagram 3



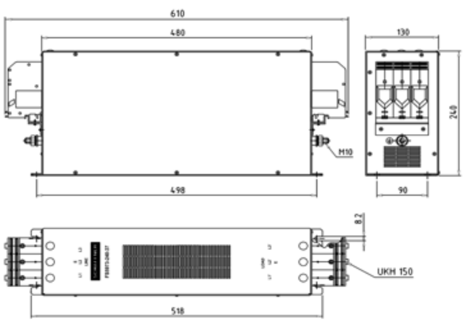
Dimensions Diagram 4



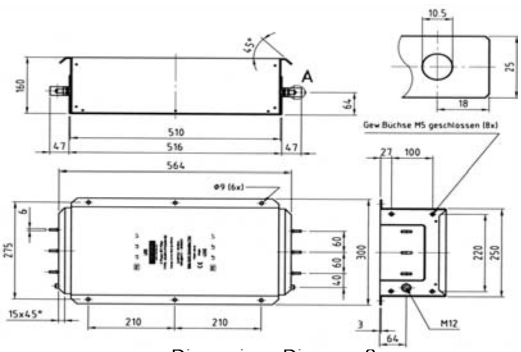
Dimensions Diagram 5



Dimensions Diagram 6



Dimensions Diagram 7



Dimensions Diagram 8

■Input Noise Filters for EMC Directives (3G3RV-PFI□, by Rasmi Electronics)

When conformance to the EMC Directives in the EC Directives is required, always use one of these Filters. The Filter is connected between the Inverter's power supply input terminals (R/L1, S/L2, T/L3) and the power supply.

The Noise Filters can be mounted to the Inverters.

Models and Application

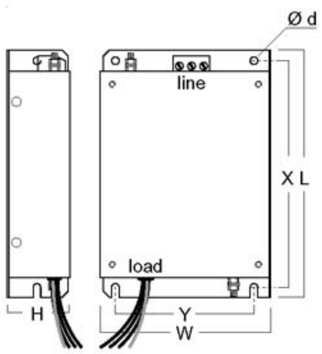
The standard models of Input Noise Filters for EMC Directives are listed in the following table.

Inverter		Input Noise Filter for EMC Directives		
Voltage Class	Max. Applicable Motor Capacity (kW)	Rated Current (A)	Model No.	Dimensions Diagram
3-phase, 200 VAC	0.4	10	3G3RV-PFI3010-E	1
	0.75			
	1.5			
	2.2	18	3G3RV-PFI3018-E	
	3.7	35	3G3RV-PFI2035-E	
	5.5			
	7.5	60	3G3RV-PFI2060-E	
	11			
	15	100	3G3RV-PFI2100-E	
	18.5			
	22	130	3G3RV-PFI2130-E	2
	30			
	37	160	3G3RV-PFI2160-E	
	45	200	3G3RV-PFI2200-E	
	55	Under Development		
	75			
	90			
	110			
3-phase, 400 VAC	0.4	10	3G3RV-PFI3010-E	1
	0.75			
	1.5			
	2.2			
	3.7	18	3G3RV-PFI3018-E	
	4.0			
	5.5			
	7.5	35	3G3RV-PFI3035-E	
	11			
	15	60	3G3RV-PFI3060-E	
	18.5			
	22	70	3G3RV-PFI3070-E	2
	30			
	37	100	3G3RV-PFI3100-E	
	45			
	55	130	3G3RV-PFI3130-E	
	75	170	3G3RV-PFI3170-E	
	90	200	3G3RV-PFI3200-E	
	110	Under Development		
	132			
	160			

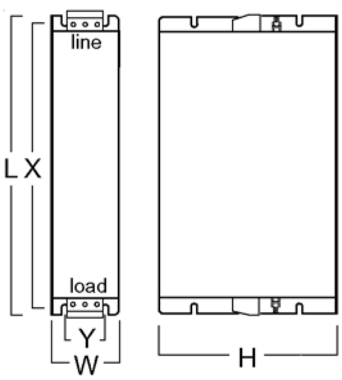
Dimensions

The dimensions of an Input Noise Filter (by Rasmi)for EMC Directives are given below.

Model 3G3IV PFI☐	Dimen-sions Diagram	Dimensions (mm)					
		L	W	H	X	Y	d
3G3RV-PFI3010-E	1	330	143	46	313	115	M5
3G3RV-PFI3018-E							
3G3RV-PFI2035-E							
3G3RV-PFI2060-E		355	213	60	336	175	M6
3G3RV-PFI2100-E		408	238	80	390	205	M6
3G3RV-PFI2130-E	2	310	90	180	295	65	M6
3G3RV-PFI2160-E		380	120	170	365	102	M6
3G3RV-PFI2200-E		518	130	240	498	90	M8
3G3RV-PFI3010-E	1	330	143	46	313	115	M5
3G3RV-PFI3018-E							
3G3RV-PFI3035-E		355	213	51	336	175	M6
3G3RV-PFI3060-E		408	238	60	390	205	M6
3G3RV-PFI3070-E	2	329	80	220	314	55	M6
3G3RV-PFI3100-E		310	90	180	295	65	M6
3G3RV-PFI3130-E							
3G3RV-PFI3170-E		380	120	170	365	102	M6
3G3RV-PFI3200-E		518	130	240	498	90	M8



Dimension diagram 1



Dimension diagram 2

■ PFO Motor Cable Chokes

The PFO output chokes can be used in conjunction with the filters to improve EMC performance. They are especially effective where radiated emissions from long, drive to motor, cables are a problem.

The table below gives motor kW ratings, but the selection is ultimately governed by the type and thickness of the motor cable fitted. The motor cable must fit through the choke centre hole.

Models and Application

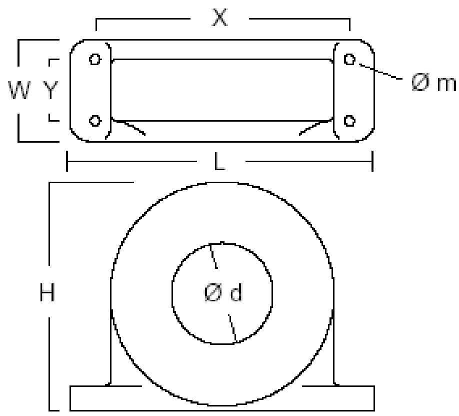
The standard models of Output Noise Filters are listed in the following table.

Inverter			Output Noise Filter
Voltage Class	Max. Applicable Motor Capacity (kW)	Inverter Capacity (kVA)	
200-V Class	0.4	1.2	3G3IV-PFO OC/1
	0.75	1.6	
	1.5	2.7	
	2.2	3.7	
	3.7	5.7	3G3IV-PFO OC/2
	5.5	8.8	
	7.5	12	
	11	17	
	15	22	
	18.5	27	3G3IV-PFO OC/3
	22	32	
	30	44	
	37	55	
	45	69	
	55	82	3G3IV-PFO OC/4
	75	110	
	90	130	
	110	160	
400-V Class	0.4	1.4	3G3IV-PFO OC/1
	0.75	1.6	
	1.5	2.8	
	2.2	4	
	3.7	5.8	3G3IV-PFO OC/2
	5.5	9.5	
	7.5	13	
	11	18	
	15	24	
	18.5	30	3G3IV-PFO OC/3
	22	34	
	30	46	
	37	57	
	45	69	
	55	85	3G3IV-PFO OC/4
	75	110	
	90	140	
	110	160	
	132	200	
	160	230	

Dimensions

The dimensions of an Output Noise Filter are given below.

Model 3G3IV-	H(mm)	L(mm)	W(mm)	X(mm)	Y(mm)	∅m(mm)	∅D(mm)
PFO OC/1	46	85	22	70	-	5	21
PFO OC/2	62	105	25	90	-	5	28
PFO OC/3	110	150	50	125	30	5	50
PFO OC/4	170	200	65	180	45	6	60



10

Chapter 10

Appendix

This chapter provides precautions for the Inverter, motor and peripheral devices and also provides lists of parameters.

Inverter Application Precautions

This section provides precautions for selecting, installing, setting and handling Inverters.

◆ Selection

Observe the following precautions in selecting an Inverter.

■Installing Reactors

A large peak current will flow in the power input circuit when the Inverter is connected to a large-capacity power transformer (600 kVA or higher) or when switching a phase capacitor. Excessive peak current can destroy the convertor section. To prevent this, install a DC or AC reactor (optional) to improve the power supply power factor.

DC reactors are built into 200 V class Inverters of 22 to 110 kW and 400 V class Inverters of 22 to 160 kW.

If a thyristor convertor, such as a DC drive, is connected in the same power supply system, connect a DC or AC reactor regardless of the power supply conditions shown in the following diagram.

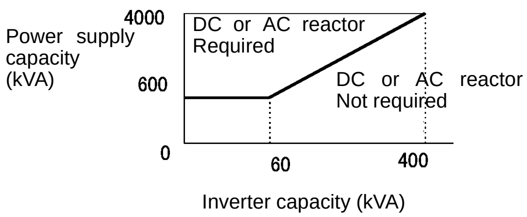


Fig 10.1

■Inverter Capacity

When connecting special motors or multiple motors in parallel to an Inverter, select the Inverter capacity so that the rated output current of the Inverter is minimum 1.1 times the sum of all the motor rated currents.

■Initial Torque

The startup and acceleration characteristics of the motor are restricted by the overload current ratings of the Inverter that is driving the motor. The torque characteristics are generally less than those required when starting using a normal commercial power supply. If a large initial torque is required, select an Inverter with a somewhat larger capacity or increase the capacity of both the motor and the inverter.

■Emergency Stop

Although the Inverter's protective functions will stop operation when a fault occurs, the motor will not stop immediately. Always provide mechanical stop and protection mechanisms on equipment requiring an emergency stop.

■Options

Terminals ⊖, ⊕1, ⊕2, ⊕3 are for connecting only the options specifically provided by OMRON. Never connect any other devices to these terminals.

◆ Installation

Observe the following precautions when installing an Inverter.

■Installation in Enclosures

Either install the Inverter in a clean location not subject to oil mist, air-bourne matter, dust and other contaminants or install the Inverter in a completely enclosed panel. Provide cooling measures and sufficient panel space so that the temperature surrounding the Inverter does not go beyond the allowable temperature. Do not install the Inverter on wood or other combustible materials.

■Installation Direction

Mount the Inverter vertically to a wall or other vertical surface.

◆ Settings

Observe the following precautions when making settings for an Inverter.

■Upper Limits

The Digital Operator can be used to set high-speed operation up to a maximum of 120 Hz. Incorrect settings can be dangerous. Use the maximum frequency setting functions to set upper limits. (The maximum output frequency is factory-set to 50 Hz.)

■DC Injection Braking

The motor can overheat if the DC injection braking voltage or braking time is set to a large value.

■Acceleration/Deceleration Times

The motor's acceleration and deceleration times are determined by the torque generated by the motor, the load torque and the load's inertial moment ($GD^2/4$). If the stall prevention functions are activated during acceleration or deceleration, increase the acceleration or deceleration time. The stall prevention functions will increase the acceleration or deceleration time by the amount of time the stall prevention function is active.

To reduce the acceleration or deceleration times, increase the capacity of the motor and Inverter.

◆ Handling

Observe the following precautions when wiring or performing maintenance for an Inverter.

■Wiring Check

The Inverter will be internally damaged if the power supply voltage is applied to output terminal U, V or W. Check wiring for any mistakes before supplying power. Check all wiring and sequences carefully.

■Magnetic Contactor Installation

Do not start and stop operation frequently with a magnetic contactor installed on the power supply line. Doing so can cause the Inverter to malfunction. Do not turn the Inverter ON and OFF with a magnetic contactor more than one time every 30 minutes.

■Maintenance and Inspections

After turn OFF the main circuit power supply, always confirm that the CHARGE indicator does not lit anymore before performing maintenance or inspections. The voltage remaining in the capacitor may cause electric shock.

Motor Application Precautions

◆ Using the Inverter for an Existing Standard Motor

When a standard motor is operated by the Inverter, power loss is slightly higher than when operated by a commercial power supply. Observe the following precautions when using an Inverter for an existing standard motor.

■Low Speed Range

Cooling effects diminish in the low-speed range, resulting in an increase in the motor temperature. Therefore, the motor torque should be reduced in the low-speed range whenever using a standard AC motor . If 100% torque is required continuously at low speed, consider using a vector motor or a forced external ventilatation for a standard AC motor.

■Installation Withstand Voltage

If the input voltage is high (440 V or higher) or the wiring distance is long, the motor insulation voltage must be considered. Contact your OMRON representative for details.

■High-speed Operation

When using the motor at a high speed (50 Hz or more), problems may arise in dynamic balance and bearing durability. Contact your OMRON representative for details.

■Torque Characteristics

The motor may require more acceleration torque when the motor is operated with the Inverter than when operated with a commercial power supply. Check the load torque characteristics of the machine to be used with the Inverter. Set a proper V/f pattern in the Inverter.

■Vibration

When the motor is operated with the Inverter, motor vibration is almost the same as when operated with a commercial power supply.
Motor vibration may, however, become greater in the following cases.

Resonance with the Natural Frequency of the Mechanical System

If using the Inverter, a resonance occurs, use the Inverter’s frequency jump function to skip any frequency resonance in the machine.

Imbalanced Rotor

Take special care when the motor is operated at a higher speed (50 Hz or more).

■Acoustic Noise

Noise varies with the carrier frequency. At high carrier frequencies, the noise is almost the same when the motor is operated with a commercial power supply. Motor noise, however, becomes louder when the motor is operated at a speed higher than the rated speed (50 Hz).

◆ Using the Inverter for Special Motors

Observe the following precautions when using a special motor.

■Pole-changing Motor

The rated input current of pole-changing motors differs from that of standard motors. Select, therefore, an appropriate Inverter according to the maximum input current of the motor to be used. Before changing the number of poles, always make sure that the motor has stopped. Otherwise, the overvoltage protective or overcurrent protective mechanism will be actuated, resulting in an error.

■Submersible Motor

The rated input current of submersible motors is higher than that of standard motors. Therefore, always select an Inverter by checking its rated output current. When the distance between the motor and Inverter is long, use a cable thick enough to connect the motor and Inverter to prevent motor torque reduction.

■Explosion-proof Motor

When an explosion-proof motor is to be used, it must be subject to an explosion-proof test in conjunction with the Inverter. This is also applicable when an existing explosion-proof motor is to be operated with the Inverter. Since the Inverter itself is, however, not explosion-proof, always install it in a safe place.

■Gearmotor

The speed range for continuous operation differs according to the lubrication method and motor manufacturer. In particular, continuous operation of an oil-lubricated motor in the low speed range may result in burning. If the motor is to be operated at a speed higher than 50 Hz, consult with the manufacturer.

■Synchronous Motor

A synchronous motor is not suitable for Inverter control. If a group of synchronous motors is individually turned ON and OFF, synchronism may be lost.

■Single-phase Motor

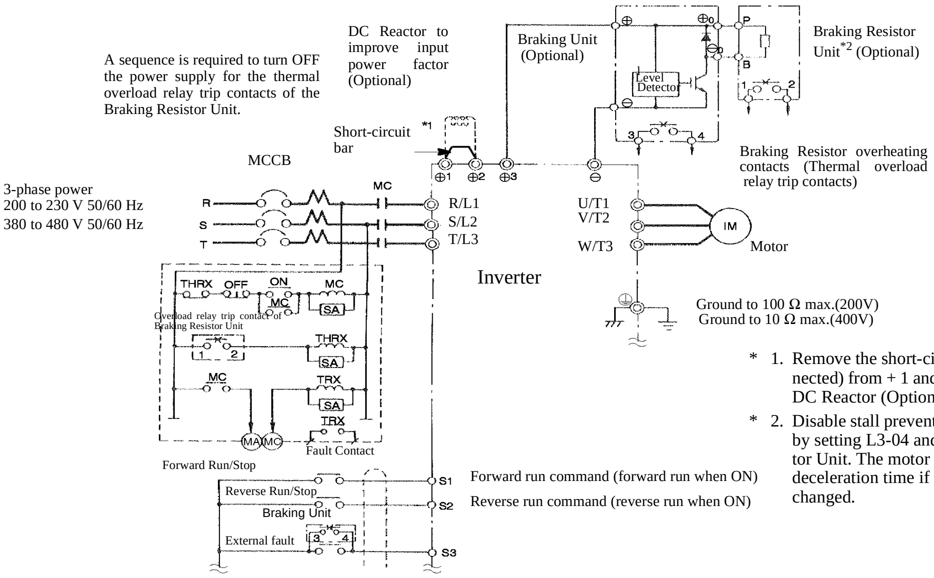
Do not use an Inverter for a single-phase motor. The motor should be replaced with a 3-phase motor.

◆ Power Transmission Mechanism (Speed Reducers, Belts and Chains)

If an oil-lubricated gearbox or speed reducer is used in the power transmission mechanism, oil lubrication will be affected when the motor operates only in the low speed range. The power transmission mechanism will make noise and experience problems with service life and durability if the motor is operated at a speed higher than 50 Hz.

◆ Using a Braking Unit and Braking Resistor Unit

This example shows wiring for a Braking Unit and Braking Resistor Unit for 3G3PV-A2220-E, B2220-E, A4220-E to A4450-E and B4220-E to B4450-E.



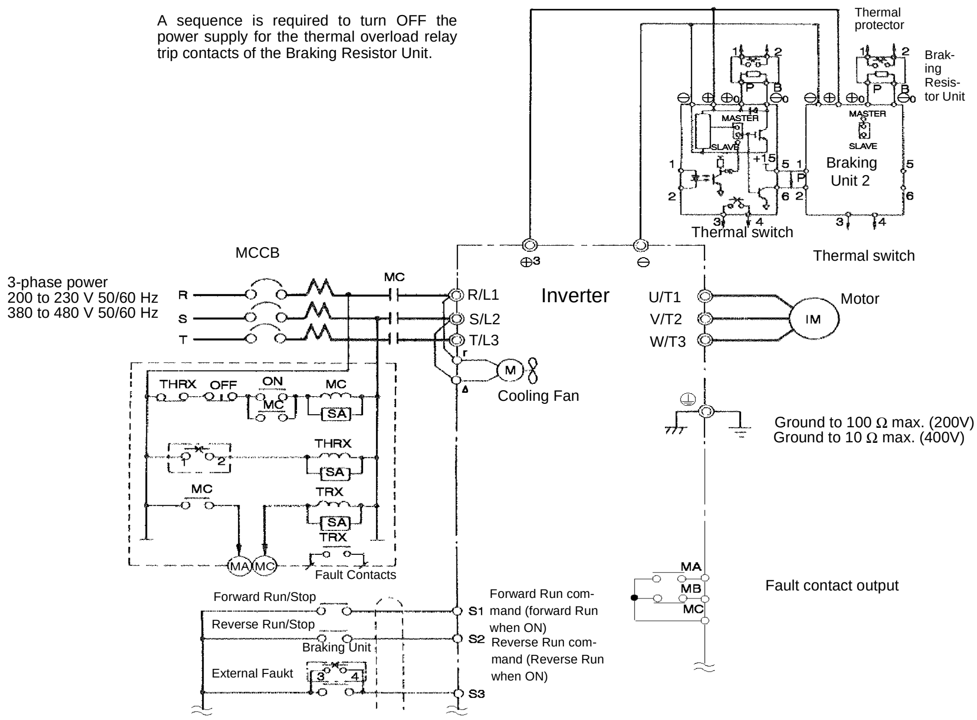
* 1. Remove the short-circuit bar (normally connected) from + 1 and + 2 when connecting a DC Reactor (Optional).

* 2. Disable stall prevention during deceleration by setting L3-04 and using a Braking Resistor Unit. The motor may not stop within the deceleration time if this setting is not changed.

Fig 10.2

◆ Using Braking Units in parallel

This example shows wiring for using two Braking Units in parallel for A2300-E toA2550-E, B2300-E to B2550-E, A4550-E to A4900-E and B4550-E to B4900-E.



* Disable stall prevention during deceleration by setting L3-04 to Resistor Unit. The motor may not stop within the deceleration time if this setting is not changed.

Fig 10.3

If more Parallel Braking units are needed expand the above connection. A list of Braking Units can be found at Chapter 9.

◆ Using an Analog Operator

This example shows wiring for using an Analog Operator. The Analog Operator model number is 3G3IV-PJVOP95☐ or 3G3IV-PJVOP96☐.

This example shows wiring for the 3G3PV-A2075-E (200-V class Inverters of 7.5 kW)

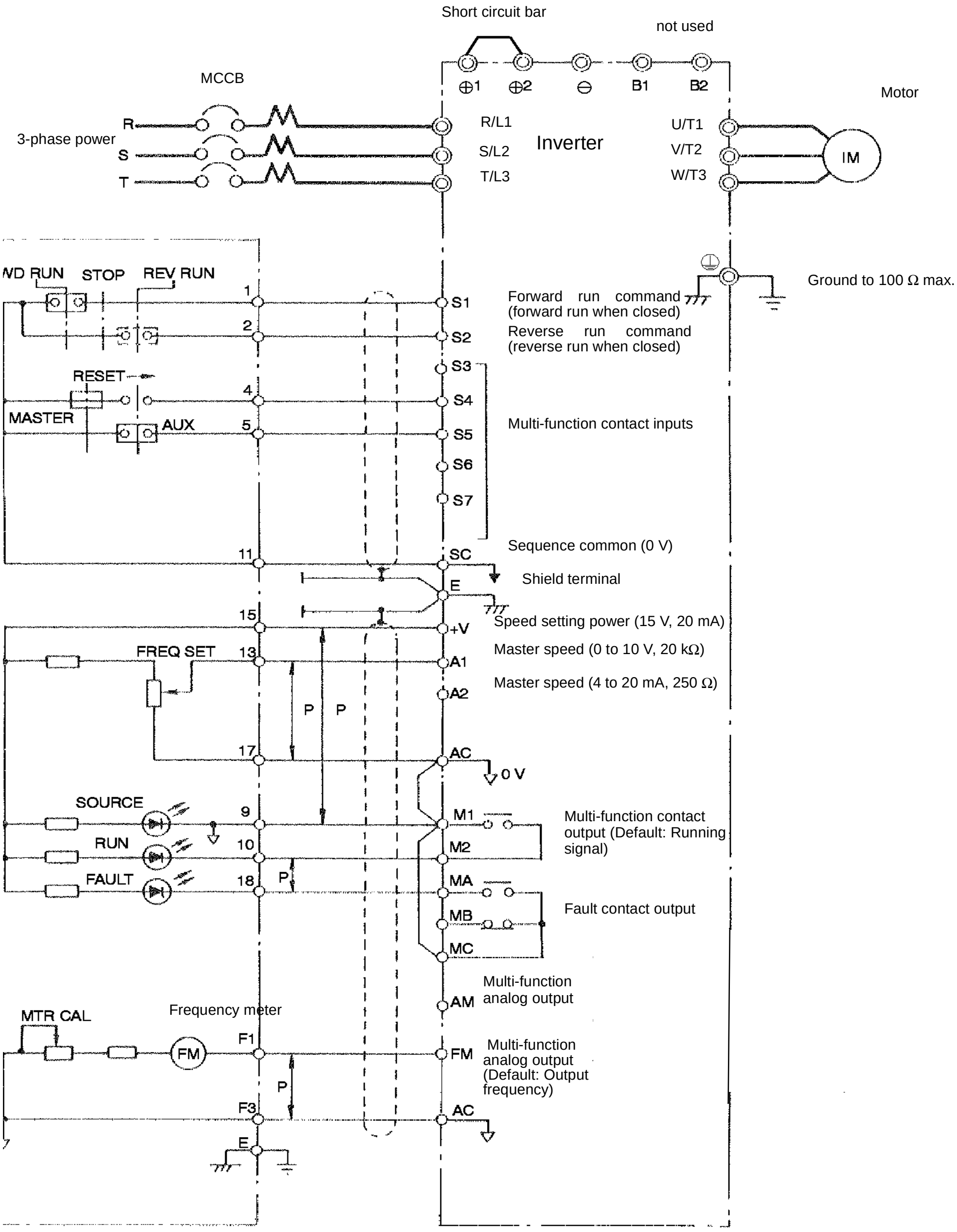


Fig 10.4

User Parameters

Factory settings are given in the following table. These setting are for a 200 V Class Inverter of 0.4 kW.

Table 10.1 Parameters

No.	Name	Factory Setting	Setting
A1-00	Language selection for digital LCD operator display	0*1	
A1-01	Parameter access level	2	
A1-03	Initialize	0	
A1-04	Password	0	
A1-05	Password setting	0	
b1-01	Reference selection	1	
b1-02	Operation method selection	1	
b1-03	Stopping method selection	0	
b1-04	Prohibition of reverse operation	0	
b1-07	Operation selection after switching to remote mode	0	
b1-08	Run command selection in programming modes	0	
b2-01	Zero speed level (DC injection braking starting frequency)	0.5	
b2-02	DC injection braking current	50	
b2-03	DC injection braking time at start	0.00	
b2-04	DC injection braking time at stop	0.50	
b3-01	Speed search selection	2	
b3-02	Speed search operating current	100	
b3-03	Speed search deceleration time	2.0	
b3-05	Speed search wait time	0.2	
b5-01	PI control mode selection	0	
b5-02	Proportional gain (P)	1.00	
b5-03	Integral (I) time	1.0	
b5-04	Integral (I) limit	100.0	
b5-06	PI limit	100.0	
b5-07	PI offset adjustment	0.0	
b5-08	PI primary delay time	0.00	
b5-12	Selection of PI feedback command loss detection	0	
b5-13	PI feedback command loss detection level	0	
b5-14	PI feedback command loss detection time	1.0	
b5-15	PI sleep function operation level	0.0	
b5-16	PI sleep operation delay time	0.0	
b5-17	Acceleration/deceleration time for PI reference	0.0	
b8-01	Energy saving mode selection	0.0	
b8-04	Energy-saving coefficient	0	
b8-05	Power detection filter time	20	
b8-06	Search operation voltage limiter	0	
C1-01	Acceleration time 1	10.0	
C1-02	Deceleration time 1	10.0	
C1-03	Acceleration time 2	10.0	
C1-04	Deceleration time 2	10.0	
C1-09	Fast Stop Time	10.0	
C1-11	Accel/decel time switching frequency	0.0	
C2-01	S-curve characteristic time at acceleration start	0.20	
C2-02	S-curve characteristic time at acceleration end	0.20	
C4-01	Torque compensation gain	1.00	
C4-02	Torque compensation time	200	
C6-02	Carrier frequency selection	6*3	
C6-03	Carrier Frequency Upper Limit	15.0*3	
C6-04	Carrier Frequency Lower Limit	15.0*3	
C6-05	Carrier Freq. Proportional Gain	00	
d1-01	Frequency reference 1	0.00	
d1-02	Frequency reference 2	0.00	
d1-03	Frequency reference 3	0.00	
d1-04	Frequency reference 4	0.00	

Table 10.1 Parameters (Continued)

No.	Name	Factory Setting	Setting
d1-17	Jog frequency reference	6.00	
d2-01	Frequency reference upper limit	100.0	
d2-02	Frequency reference lower limit	0.0	
d2-03	Master speed reference lower limit	0.0	
d3-01	Jump frequency 1	0.0	
d3-02	Jump frequency 2	0.0	
d3-03	Jump frequency 3	0.0	
d3-04	Jump frequency width	1.0	
d6-01	Field weakening level	80	
d6-02	Field frequency	0.0	
E1-01	Input voltage setting	200*4	
E1-03	V/f pattern selection	F	
E1-04	Max. output frequency	50.0	
E1-05	Max. voltage	200.0*4	
E1-06	Base frequency	50.0	
E1-07	Mid. output frequency	2.5	
E1-08	Mid. output frequency voltage	15.0 *4	
E1-09	Min. output frequency	1.2	
E1-10	Min. output frequency voltage	9.0*4	
E1-11	Mid. output frequency 2	0.0*6	
E1-12	Mid. output frequency voltage 2	0.0*6	
E1-13	Base voltage	0.0*4	
E2-01	Motor rated current	1.90*3	
E2-05	Terminal Resistance	9.842	
F6-01	Operation selection after communications error	1	
F6-02	Input level of external error from Communications Option Card	0	
F6-03	Stopping method for external error from Communications Option Card	1	
F6-05	I monitor unit selection	0	
H1-01	Terminal S3 function selection	24	
H1-02	Terminal S4 function selection	14	
H1-03	Terminal S5 function selection	3 (0)*5	
H1-04	Terminal S6 function selection	4 (3)*5	
H1-05	Terminal S7 function selection	6 (4)*5	
H2-01	Terminal M1-M2 function selection (contact)	0	
H2-02	Terminal M3-M4 function selection (contact)	1	
H3-02	Gain (terminal A1)	0	
H3-03	Bias (terminal A1)	100.0	
H3-08	Multi-function analog input terminal A2 signal level selection	0	
H3-09	Multi-function analog input terminal A2 function selection	2	
H3-10	Gain (terminal A2)	100.0	
H3-11	Bias (terminal A2)	0.0	
H3-13	Terminal A1/A2 switching	0	
H4-01	Monitor selection (terminal FM)	2	
H4-02	Gain (terminal FM)	100%	
H4-03	Bias (terminal FM)	0.0	
H4-04	Monitor selection (terminal AM)	3	
H4-05	Gain (terminal AM)	50%	
H4-06	Bias (terminal AM)	0.0	
H4-07	Analog output 1 signal level selection	0	
H4-08	Analog output 2 signal level selection	0	
H5-01	Station address	1F	
H5-02	Communication speed selection	3	
H5-03	Communication parity selection	0	
H5-04	Stopping method after communication error	3	
H5-05	Communication error detection selection	1	
H5-06	Send wait time	5	
H5-07	RTS control ON/OFF	1	
L1-01	Motor protection selection	1	

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Table 10.1 Parameters (Continued)

No.	Name	Factory Setting	Setting
L1-02	Motor protection time	1.0	
L1-03	Alarm operation selection during motor overheating	3	
L1-04	Motor overheating operation selection	1	
L1-05	Motor temperature input filter time	0.20	
L2-01	Momentary power loss detection	0	
L2-02	Momentary power loss ridethru time	0.1*3	
L2-03	Min. baseblock time	0.1	
L2-04	Voltage recovery time	0.3	
L2-05	Undervoltage detection level	190*4	
L3-01	Stall prevention selection during accel	1	
L3-02	Stall prevention level during accel	120	
L3-04	Stall prevention selection during decel	1	
L3-05	Stall prevention selection during running	1	
L3-06	Stall prevention level during running	120	
L4-01	Speed agreement detection level	0.0	
L4-02	Speed agreement detection width	2.0	
L4-05	Operation when frequency reference is missing	0	
L4-06	Frequency Reference for loss of Frequency Reference	80%	
L5-01	Number of auto restart attempts	0	
L5-02	Auto restart operation selection	0	
L6-01	Torque detection selection 1	0	
L6-02	Torque detection level 1	150	
L6-03	Torque detection time 1	0.1	
L8-02	Overheat pre-alarm level	95	
L8-03	Operation selection after overheat pre-alarm	3	
L8-09	Ground protection selection	1	
L8-11	Cooling fan control delay time	60	
L8-12	Ambient temperature	45	
L8-15	OL2 characteristics selection at low speeds	1	
L8-18	Soft CLA selection	1	
N1-01	Hunting-prevention function selection	1	
N1-02	Hunting-prevention gain	1.00	
N3-01	High-slip braking deceleration frequency width	5	
N3-02	High-slip braking current limit	150	
N3-03	High-slip braking stop dwell time	1.0	
N3-04	High-slip braking OL time	40	
o1-01	Monitor selection	6	
o1-02	Monitor selection after power up	1	
o1-03	Frequency units of reference setting and monitor	0	
o1-05	LCD Brightness	3	
o2-01	LOCAL/REMOTE key enable/disable	1	
o2-02	STOP key during control circuit terminal operation	1	
o2-03	Parameter initial value	0	
o2-04	kVA selection	0*3	
o2-05	Frequency reference setting method selection	0	
o2-06	Operation selection when digital operator is disconnected	0	
o2-07	Cumulative operation time setting	0	
o2-08	Cumulative operation time selection	0	
o2-09	Initialize mode	5	
o2-10	Fan operation time setting	0	
o2-12	Fault trace history initialisation	0	
o3-01	Copy function selection	0	
o3-02	Read permitted selection	0	

* 1. Not initialized. (PV-E specifications: A1-00 = 0)
* 2. For Inverters with a capacity of 55 kW or more: 2.00
* 3. Setting range and initial setting depend on Inverter capacity.
* 4. Setting for 200 V class Inverters. For 400 V class Inverters, double the value.
* 5. Factory setting in the parentheses is for 3-wire sequence.
* 6. The contents is ignored if the setting is 0.0.

Revision History

A manual revision code appears as a suffix to the catalog number on the front cover of the manual.

Cat.No. I537-E2-01

Revision Code

The following table outlines the changes made to the manual during each revision. Page numbers refer to the previous version.

Revision code	Date	Revised content
01	Februari 2002	Original production