# MITSUBISHI ELECTRIC

# VECTOR INVERTER

## -INSTRUCTION MANUAL-

SSCNET COMMUNICATION OPTION

# FR-V5NS

**Thank you for choosing the Mitsubishi vector inverter option unit.**
**This instruction manual gives handling information and precautions for use of this equipment. Incorrect handling might cause an unexpected fault. Before using the equipment, please read this manual carefully to use the equipment to its optimum.**
**Please forward this manual to the end user.**

## This section is specifically about safety matters

**Do not attempt to install, operate, maintain or inspect this product until you have read through this instruction manual and appended documents carefully and can use the equipment correctly. Do not use this product until you have a full knowledge of the equipment, safety information and instructions.**
**In this instruction manual, the safety instruction levels are classified into "WARNING" and "CAUTION".**

| ⚠ **WARNING** | **Assumes that incorrect handling may cause hazardous conditions, resulting in death or severe injury.** |
|---|---|
| ⚠ **CAUTION** | **Assumes that incorrect handling may cause hazardous conditions, resulting in medium or slight injury, or may cause physical damage only.** |

**Note that the ⚠ CAUTION level may lead to a serious consequence according to conditions. Please follow the instructions of both levels because they are important to personnel safety.**

## SAFETY INSTRUCTIONS

**1. Electric Shock Prevention**

## ⚠ WARNING

- **While power is on or when the inverter is running, do not open the front cover. You may get an electric shock.**
- **Do not run the inverter with the front cover removed. Otherwise, you may access the exposed high-voltage terminals and charging part and get an electric shock.**
- **Even if power is off, do not remove the front cover except for wiring or periodic inspection. You may access the charged inverter circuits and get an electric shock.**
- **Before starting wiring or inspection, check to make sure that the inverter power indicator lamp is off, wait for at least 10 minutes after the power supply has been switched off, and check that there are no residual voltage using a tester or the like..**

## ⚠ **WARNING**

● **Any person who is involved in the wiring or inspection of this equipment should be fully competent to do the work.**
● **Always install the option unit before wiring. Otherwise, you may get an electric shock or be injured.**
● **Handle this option unit with dry hands to prevent an electric shock.**
● **Do not subject the cables to scratches, excessive stress, heavy loads or pinching. Otherwise, you may get an electric shock.**

### 2. Injury Prevention

## ⚠ **CAUTION**

● **While power is on or for some time after power-off, do not touch the inverter as it is hot and you may get burnt.**

### 3. Additional Instructions
**Also note the following points to prevent an accidental failure, injury, electric shock, etc.:**
### (1) Transportation and mounting

## ⚠ **CAUTION**

● **Do not install or operate the option unit if it is damaged or has parts missing.**
● **Do not stand or rest heavy objects on the product.**
● **Check that the mounting orientation is correct.**
● **Prevent screws, metal fragments or other conductive bodies or oil or other flammable substance from entering the inverter.**

### (2) Test operation and adjustment

## ⚠ **CAUTION**

● **Before starting operation, confirm and adjust the parameters. A failure to do so may cause some machines to make unexpected motions.**

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**(3) Usage**

## ⚠ WARNING

● **Do not modify the equipment.**

## ⚠ CAUTION

● **When parameter clear or all parameter clear is performed, each parameter returns to the factory setting. Re-set the required parameters before starting operation.**
● **For prevention of damage due to static electricity, touch nearby metal before touching this product to eliminate static electricity from your body.**

**(4) Maintenance, inspection and parts replacement**

## ⚠ CAUTION

● **Do not test the equipment with a megger (measure insulation resistance).**

**(5) Disposal**

## ⚠ CAUTION

● **Treat as industrial waste.**

**(6) General instruction**

**All illustrations given in this manual may have been drawn with covers or safety guards removed to provide in-depth description. Before starting operation of the product, always return the covers and guards into original positions as specified and operate the equipment in accordance with the manual.**

# CONTENTS

# 1.PRE-OPERATION INSTRUCTIONS

## 1.1 Unpacking and Product Confirmation

Take the option unit out of the package, check the unit name, and confirm that the product is as you ordered and intact.

This product is a plug-in option unit designed for exclusive use in the Mitsubishi FR-V500 series vector inverter. Before using it, check the type and SERIAL number of the inverter.

- This product may be used with the FR-V520-1.5k to 55k series manufactured in and after May 2002. Any of the models may be used with this unit if its SERIAL number indicated on the rating plate and package has "O25OOOOOO" or later version. For details on the SERIAL number, please contact your sales representative.

SERIAL is made up of 1 version symbol, 1 alphabet letter or numeric character indicating month, and 7 numeric characters indicating the year and control number as shown below. (Only the first three digits of the control number are printed on the package.)

<u>O</u>    <u>2</u>    <u>5</u>    <u>OOOOOO</u>
Symbol Year Month Control number
SERIAL number

## 1.2 Packing Confirmation

Make sure that the package includes the following

- Instruction manual .............................................................................1
- Mounting screws M3 × 10 ...............................................................2 (Refer to page 7.)
- Ferrite core ......................................................................................2 (Refer to page 9.)

## 1.3 Caution

(1) Refer to the following manuals or software HELP for full information on the motion controller.
- Q173CPU/Q172 CPU user's manual .............................................IB-0300021
- Q173CPU/Q172 CPU motion controller (SV13/SV22)
  programming manual (real mode version) ....................................IB-0300024
(2) Servo System Controller NETwork is abbreviated to SSCNET in this manual.

## 1.4 Structure
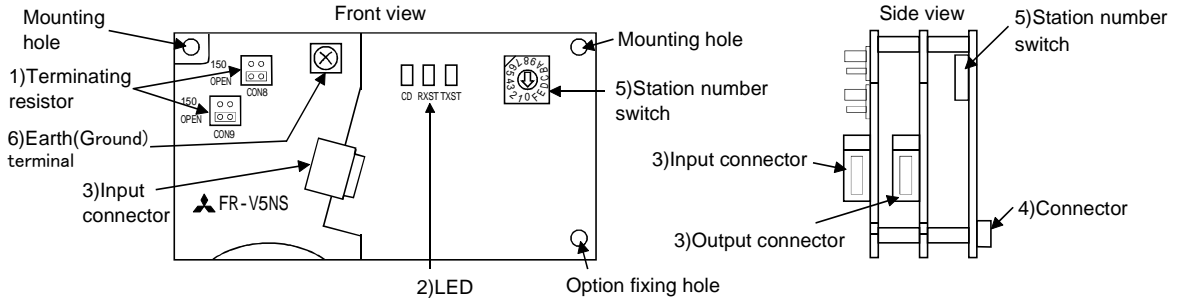


| Name | | Function | Refer to page |
|---|---|---|---|
| 1) Terminating resistor | | Set terminating resistor present/absent using a jumper connector. | 6 |
| 2) LED | CD(carrier disconnection alarm) | Lit when the inverter and host computer have been physically disconnected. | - |
| | RXST (receiving) | Lit while receiving. | |
| | TXST (transmitting) | Lit while transmitting. | |
| 3) Communication connector | Input | Communication cable input connector for connecting SSCNET from the motion controller or other FR-V500 series (servo amplifier). | - |
| | Output | Communication cable output connector for connecting SSCNET to other FR-V500 series or the servo amplifier. | |
| 4) Connector | | To be connected to the option unit connector of the inverter. | |
| 5) Station number switch | | Set the station number of the inverter when connected to the motion controller. | 5 |
| 6) Earth (Ground) terminal | | To be connected to the ground terminal of the inverter. | 11 |

## 1.5 Operation Overview

In communication with the Mitsubishi motion controller, the inverter operation (speed control or position control or torque control under vector control with encoder), monitoring, or parameter setting can be performed from a program on the motion controller.
SSCNET enables less wiring, improved reliability, improved synchronous control performance and motion controller-driven multi-axis batch control.
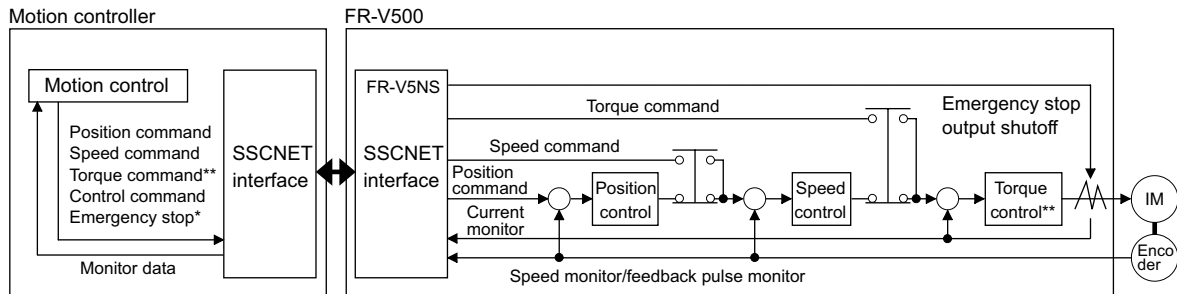


\* When the emergency stop signal is input, the inverter shuts off the output and the motor coasts.
\*\*Please contact your sales representative when performing torque control.

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===== CAUTION =====

**The inverter can perform vector control with encoder (speed control, position control, torque control) under the command from the motion controller. (Pr. 800 "control system selection" is made invalid.)**

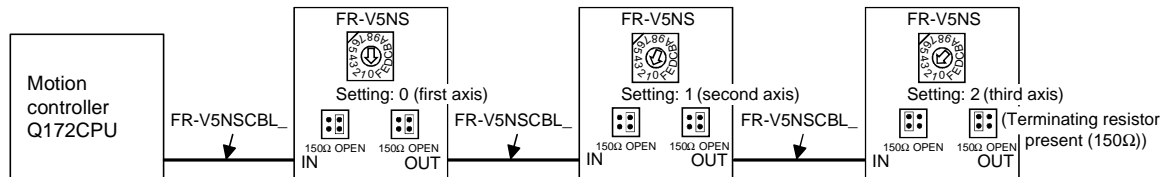---

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# 2.INSTALLATION

## 2.1  Pre-Installation Instructions

Make sure that the input power of the inverter is off.

> # ⚠ **CAUTION**
>
> ⚠ **With input power on, do not install or remove the option unit. Otherwise, the inverter and option unit may be damaged.**

## 2.2  Setting the Station Numbers and Terminating Resistor



### REMARKS

Refer to page 10 for the FR-V5NSCBL (SSCNET cable).

## 2.2.1  Setting the station numbers

Set the inverter station number before switching on the inverter and do not change the setting while power is on.
SSCNET allows up to eight axes to be connected in one communication system.

Station number switch

Move the arrow (⇧) to the position corresponding to the station number you want to set.
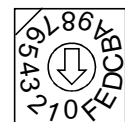
Factory setting

| Station Number | Description | Station Number | Description |
|---|---|---|---|
| 0 | First axis | 8 | Not used. |
| 1 | Second axis | 9 | Not used. |
| 2 | Third axis | A | Not used. |
| 3 | Fourth axis | B | Not used. |
| 4 | Fifth axis | C | Not used. |
| 5 | Sixth axis | D | Not used. |
| 6 | Seventh axis | E | Not used. |
| 7 | Eighth axis | F | Normal start. The inverter starts in the operation mode set in Pr. 79 "operation mode selection". |

### REMARKS

1. If any of the station No. 8 to No. E is set to the inverter, it is placed in a communication initialization waiting status after power-on, but communication is not established. Do not use 8 to E.
2. When the station No. F is set to the inverter, it starts in the external operation mode (when Pr. 79 = 0) and operates normally. It cannot perform SSCNET operation.
   Refer to the inverter manual for Pr. 79 "operation mode selection" for the station No. F.
3. Set the station numbers consecutively in connection order. (You can also set the station numbers independently of the connection order.)

=== CAUTION ===

1. **If you change any station number while the inverter power is on, the setting is not made valid. The setting is made valid after power is switched on again or the RES signal is turned on.**
2. **You cannot set the same station number to two or more inverters on the same bus. (Such setting disables normal communication.)**
3. **Set the switch securely into the switch numeral position.**
   **Setting it in a middle position disables normal data communication.**

## 2.2.2  Setting the terminating resistor

The terminating resistor setting jumper connectors are factory-set in the terminating resistor absent (OPEN) position. To make the terminating resistor present, change the positions of both jumper connectors on the FR-V5NS to the 150Ω positions. Only the terminating resistor of the inverter (servo amplifier) furthest from the motion controller should be made present (150Ω).
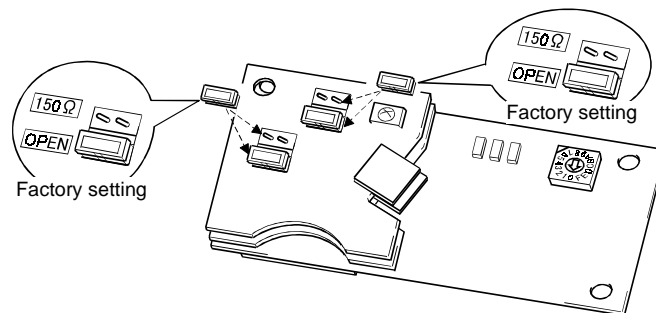


=======  CAUTION  =======

1. **Do not change the jumper connector positions while power is on.**
2. **Always fit the jumper connector to only one of either position. If they are fitted to both positions simultaneously, the option unit may be damaged.**
3. **For the handling of the servo amplifier terminating resistor, refer to the instruction manual of the servo amplifier.**

## 2.3  Installation and Removal

(1)  Install the option unit to Slot 3. (If you install it to Slot 1 or 2, E.OP1 (E.OP2) is displayed and operation is not performed.)
(2)  Insert the option unit connector into the Slot 3 connector of the inverter securely. At this time, also insert the option fixing holes securely.
Refer to the following diagram for the position of Slot 3. Push the option unit securely into the option fixing hook.
(3)  Fix the two right and left places of the option unit to the inverter securely with the accessory mounting screws. If the screw holes do not line-up, the connector may not have been inserted securely. Check for insecure insertion.



Inverter
(Without cover)

Slot 1

Slot 2

Inverter side connector

Slot 3

Option fixing hook

Accessory screw (2 pcs.)

Option side connector (rear)

The option fixing hooks
are provided for Slots 1, 2, 3.
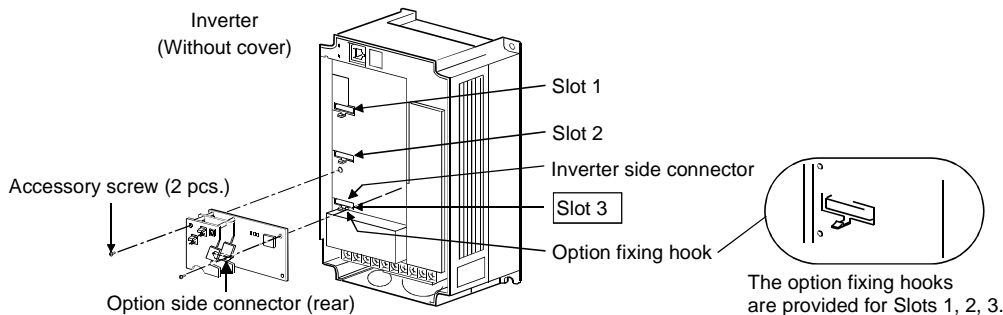
(4)  To remove the option unit, remove the two left and right screws, and then hold the option unit and pull its bottom toward you as shown in the figure. (The option unit is fixed by the hook of the inverter.)
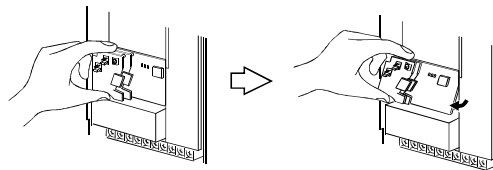
=== CAUTION ===

**You cannot use this option with any other communication options. Also, there are restrictions on some of the other option functions. (Refer to page 24.)**

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# 3. WIRING

## 3.1 Wiring Example
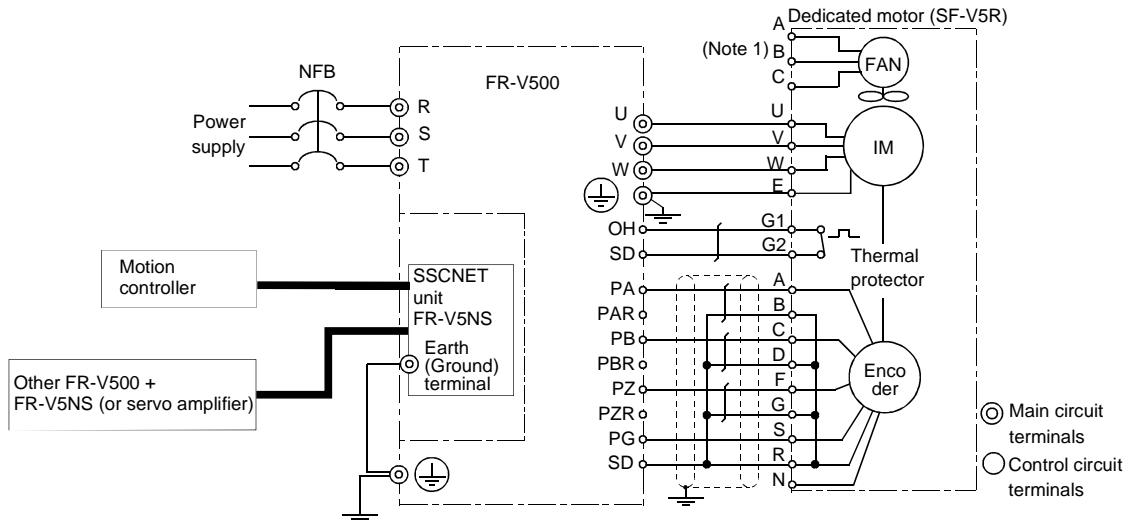


Note 1: The fan power supply of the 7.5kW or
less dedicated motor is single-phase.

## 3.2 Connection Example
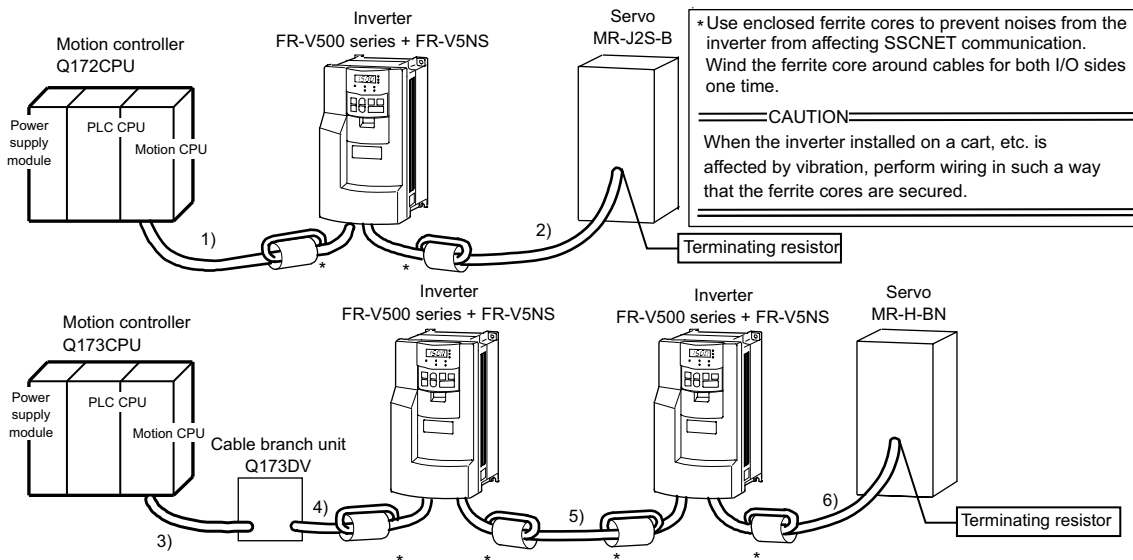


| Motion controller CPU | | | Q173CPU or Q172CPU |
|---|---|---|---|
| Inverter | | | FR-V500 series + FR-V5NS (SSCNET communication unit) |
| Cables | 1), 5) | FR-V5NSCBL_ | For connection of Q172CPU and FR-V5NS, for connection of FR-V5NS and FR-V5NS |
| | 2), 4) | Q172J2BCBL_M(-B) | For connection of Q172CPU/FR-V5NS and MR-J2-B/MR-J2S-B/MR-J2-03B5, for connection of Q173DV and FR-V5NS |
| | 6) | Q172HBCBL_M(-B) | For connection of Q172CPU/FR-V5NS and MR-H-BN |
| | 3) | Q173DVCBL_M | For connection of Q173CPU and Q173DV |

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## 3.3 SSCNET Cables and Ground Cable

Use our optional SSCNET connection cables.

(1) Cable type

| Type | Length [m] | Cable Type |
|------|-----------|------------|
| Q172J2BCBL_M(-B) | 0.5, 1, 5 | UL20276 AWG#28 7 pair (cream) |
| Q172HBCBL_M(-B) | | |
| FR-V5NSCBL_ | 0.5, 1, 5, 10, 20 | UL20276 AWG#28 7 pair (ivory) |
| Q173DVCBL_M | 0.5, 1 | UL20276 AWG#28 13 pair (cream) |

### REMARKS

• _ in the type represents the cable length.

| Symbol | Cable Length (m) |
|--------|------------------|
| 005 | 0.5 |
| 01 | 1 |
| 05 | 5 |
| 10 | 10 |
| 20 | 20 |

• If the necessary length is not found in the optional cables, fabricate it on the customer side. For SSCNET cables, use the twisted pair shielded cables indicated above or equivalent.
When fabricating a cable, refer to the instruction manual of the motion controller.
The overall wiring length of the bus cables on the same bus is 30m.

(2) Earth (Ground) Cable

For wiring to the earth (ground) terminal of the FR-V5NS, use a crimping terminal with sleeve.
•Cable gause: 2 mm$^2$
•Crimping terminal: 2-3.5 (with sleeve)

## 3.4  Wiring Route

•Route the SSCNET cables using the space on the right side of the control circuit terminal.
•Connect the earth (ground) cable to the earth (ground) terminal of the inverter using the space on the left side of the control circuit terminal. (For the position of the earth (ground) terminal of the inverter, refer to the inverter manual.)
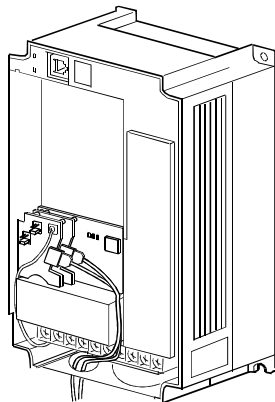


### ⚠ **CAUTION**

⚠ **When reinstalling the front cover of the inverter, route the cables in the wiring space securely so that the inverter control circuit terminal and option connection cables are not caught between the inverter and cover.**

# 4. SSCNET COMMUNICATION STATUS

When the inverter is fitted with the SSCNET communication unit (FR-V5NS) and has any of station No. 0 to No. 7, powering it on places it in the SSCNET communication initialization waiting status. In this status, the inverter is put in the SSCNET operation mode and cannot be switched to the external or PU operation mode. In addition, the Pr. 79 "operation mode selection" setting is disabled. How SSCNET communication is performed is shown below.
The status of communication with the motion controller can be monitored as a communication status.
To monitor it, set "39" (communication status) in Pr. 52 "DU/PU main display data selection". (Refer to page 16.)
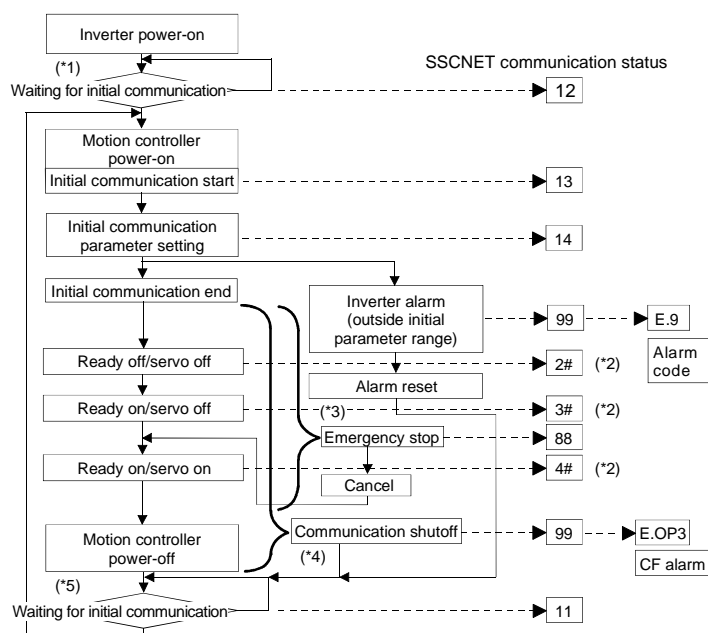


| Communica-tion Status | Description |
|---|---|
| 0 | The V5NS is not fitted or the station number is F |
| 11 | After SSCNET communication had been established, the motion controller powered off. |
| 12 | Immediately after the inverter has been powered on, it is waiting for motion controller power-on and initial communication. |
| 13 | Initialization communication start |
| 14 | The initial parameters are being received during initialization. |
| 2# | Ready off was received. |
| 3# | Servo off was received. |
| 4# | Servo on was received. |
| 88 | Emergency stop (inverter output shutoff) |
| 99 | Inverter trip |

#: Axis number
*1. The inverter is put in the SSCNET operation mode.
*2. In the part #, the axis number appears.
    ("21" appears when the station number is 0.)
*3. To reset the alarm, the alarm reset signal from the SSCNET or the RES terminal is valid.
    A power-on reset recovers the inverter from the alarm in the initialization waiting status.
*4. When communication is interrupted, an inverter reset (CF alarm) or inverter alarm (E.OP3) occurs.
    To select alarm output presence/absence and stop operation, use Pr. 499 "action selection at SSCNET communication interruption". (Refer to page 18.)
*5. If the motion controller is powered off during inverter power input, the inverter is placed in the initialization waiting status.

# 5. INITIAL COMMUNICATION SETTING FROM MOTION CONTROLLER

The following parameters are set during initial communication with the motion controller.
For the setting method, refer to the manual of the motion controller (Refer to page 1 for the manual types.)

|  | No. | Name | Inverter Parameter No. |
|---|---|---|---|
| Basic parameters | 1 | Maximum speed | 1 |
| | 2 | Electronic thermal O/L relay | 9 |
| | 3 | Regenerative function selection | 30 |
| | 4 | Special regenerative brake duty | 70 |
| | 5 | Applied motor | 71 |
| | 6 | Motor capacity | 80 |
| | 7 | Number of motor poles | 81 |
| | 8 | Online auto tuning selection | 95 |
| | 9 | Torque restriction level | 22 |
| | 10 | Torque restriction level (regeneration) | 812 |
| | 11 | Torque restriction level (3rd quadrant) | 813 |
| | 12 | Torque restriction level (4th quadrant) | 814 |
| | 13 | Easy gain tuning response level setting | 818 |
| | 14 | Easy gain tuning selection | 819 |
| | 15 | Number of encoder pulses | 851 |
| | 16 | Encoder rotation direction | 852 |
| | 17 | Thermal protector input | 876 |
| Adjustment parameters | 18 | Position loop gain | 422 |
| | 19 | Position feed forward gain | 423 |
| | 20 | In-position width | 426 |
| | 21 | Error excessive level | 427 |
| | 22 | Speed control P gain 1 | 820 |
| | 23 | Speed control integral time 1 | 821 |
| | 24 | Model speed control gain | 828 |

|  | No. | Name | Inverter Parameter No. |
|---|---|---|---|
| Adjustment parameters | 25 | Notch filter frequency | 862 |
| | 26 | Notch filter depth | 863 |
| | 27 | Speed feed forward control/model adaptive speed control selection | 877 |
| | 28 | Speed feed forward filter | 878 |
| | 29 | Speed feed forward torque restriction | 879 |
| | 30 | Load inertia ratio | 880 |
| | 31 | Speed feed forward gain | 881 |
| Extended parameters | 32 | DA1 terminal function selection | 54 |
| | 33 | Speed monitoring reference | 55 |
| | 34 | Current monitoring reference | 56 |
| | 35 | DA2 terminal function selection | 158 |
| | 36 | Overspeed detection level | 374 |
| | 37 | Torque characteristic selection | 801 |
| | 38 | Constant output region torque characteristic selection | 803 |
| | 39 | Torque monitoring reference | 866 |

### ══ CAUTION ══

**If any of the initial communication setting parameter values is outside the setting range, "E.9" is displayed at the time of initial communication.**

### REMARKS

Refer to the inverter manual for details of the parameters.

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# 6. INVERTER SETTINGS AND INDICATIONS

## 6.1 Operation Mode Switchover
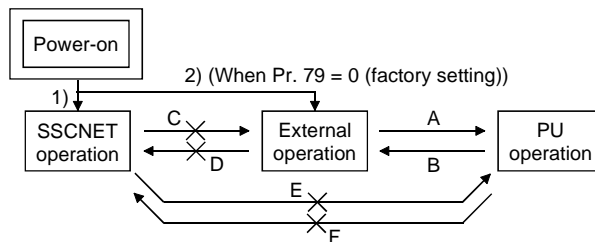


(1) Starting operation mode

| Symbol | Switchover Type | Switchover Method |
|--------|-----------------|-------------------|
| 1) | SSCNET operation mode | When the station number setting is any of 0 to 7 (first to eighth axes). (SSCNET operation is enabled at completion of initial communication.) |
| 2) | External operation (Pr. 79 = 0 (factory setting)) | When the FR-V5NS is not fitted or the station number setting is F. |

(2) Operation mode switchover (When Pr. 79 = 0)

| Symbol | Switchover Type | Switchover Method |
|--------|-----------------|-------------------|
| A | External operation → PU operation | Operate the PU operation key on the PU. |
| B | PU operation → external operation | Operate the external operation key on the PU. |
| C | SSCNET operation → external operation | Switchover is disabled while power is on. After switching power off, remove the FR-V5NS or set the station number to F and switch power on. |
| D | External operation → SSCNET operation | Switchover is disabled while power is on. After switching power off, set the station number to any of 0 to 7 and switch power on with the FR-V5NS fitted. |
| E | SSCNET operation → PU operation | Switchover is disabled while power is on. After switching power off, remove the FR-V5NS or set the station number to F, switch power on, and then press the PU button to switch the operation mode. |
| F | PU operation → SSCNET operation | Switchover is disabled while power is on. After switching power off, set the station number to any of 0 to 7 and switch power on with the FR-V5NS fitted. |

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——— **CAUTION** ———

1. **In the SSCNET operation mode, the Pr. 79 "operation mode selection" setting is invalid.**
2. **Any station number changed with power on is invalid. The setting is made valid when power is switched on again or a reset is made with the RES terminal.**
3. **Even if SSCNET operation is being performed, $\boxed{\begin{array}{c}\text{STOP}\\\text{RESET}\end{array}}$ of the PU (FR-DU04-1/FR-PU04V) can be used to make a stop (when Pr. 75 = 14 (factory setting) to 17). At this time, the deceleration time is 0s. Refer to the inverter manual for Pr. 75 "PU stop selection".**

**REMARKS**

During SSCNET operation, "NET" is displayed on the FR-PU04V and the "EXT" LED is lit on the FR-DU04-1 to indicate the operation mode.

## 6.2 Initial Communication Waiting Status ("CF" alarm)

If SSCNET communication is disabled due to the fault of the communication cable and the power-off of the communication equipment (personal computer) or motion controller, etc., the output is shut off and the CF alarm is displayed on the FR-DU04-1 (or FR-PU04V).
Pr. 499 "action selection at SSCNET communication interruption" can be used to select the operation to be performed at occurrence of communication interruption.

## 6.2.1 Pr. 499 "action selection at SSCNET communication interruption"

You can select the operation to be performed at occurrence of communication interruption.

| Pr. 499 Setting | Operation | |
|---|---|---|
| 0 (Factory setting) | Output shutoff (coasting) | Reset the inverter. The inverter is placed in the initial communication waiting status (CF alarm) and can be recovered from the alarm when initial communication is restarted. |
| 1 | Output shutoff (coasting) | "E.OP3" is displayed. Resetting the inverter places it in the initial communication waiting status (CF alarm) and allows it to be recovered from the alarm when initial communication is restarted. |

**REMARKS**

If communication data is in a CRC error etc., E.OP3 occurs regardless of the Pr. 499 setting.

## 6.2.2 Pr. 52 "DU/PU main display data selection"

You can select the SSCNET communication status to be displayed on the operation panel or parameter unit. To display it, set "39" in Pr. 52 and select the voltage monitor (third monitor). Refer to page 12 for the monitored data.

| Pr.No | Function | Setting Range | Remarks |
|---|---|---|---|
| 52 | DU/PU main display data selection | 0, 5 to 12, 17 to 20, 23, 24, 32 to 35, 38, 39 | Set 39 to display the SSCNET communication status monitor. |

**REMARKS**

For the set values of other than "39", refer to the inverter manual.

# 7. RESTRICTIONS ON THE FUNCTIONS

## 7.1 Inverter Parameter List

Function validity: There are restrictions on the inverter functions in the SSCNET communication operation mode. O indicates the valid parameter, and X the invalid parameter.

| Inverter Parameter No. | Name | Function Validity |
|---|---|---|
| 0 | Torque boost (manual) | X |
| 1 | Maximum speed | O |
| 2 | Minimum speed | X |
| 3 | Base frequency | X |
| 4 | Multi-speed setting (high speed) | X |
| 5 | Multi-speed setting (middle speed) | X |
| 6 | Multi-speed setting (low speed) | X |
| 7 | Acceleration time | X |
| 8 | Deceleration time | X |
| 9 | Electronic thermal O/L relay | O |
| 10 | DC injection brake operation speed | X |
| 11 | DC injection brake operation time | X |
| 12 | DC injection brake voltage | X |
| 13 | Starting speed | X |
| 15 | Jog speed setting | X |
| 16 | Jog acceleration/deceleration time | X |
| 17 | MRS input selection | O |
| 19 | Base frequency voltage | X |
| 20 | Acceleration/deceleration reference speed | X |

| Inverter Parameter No. | Name | Function Validity |
|---|---|---|
| 21 | Acceleration/deceleration time increments | X |
| 22 | Torque restriction level | O |
| 24 | Multi-speed setting (speed 4) | X |
| 25 | Multi-speed setting (speed 5) | X |
| 26 | Multi-speed setting (speed 6) | X |
| 27 | Multi-speed setting (speed 7) | X |
| 28 | Multi-speed input compensation | X |
| 29 | Acceleration/deceleration pattern | X |
| 30 | Regenerative function selection | O |
| 31 | Speed jump 1A | X |
| 32 | Speed jump 1B | X |
| 33 | Speed jump 2A | X |
| 34 | Speed jump 2B | X |
| 35 | Speed jump 3A | X |
| 36 | Speed jump 3B | X |
| 37 | Speed display | O |
| 41 | Up-to-speed sensitivity | X |
| 42 | Speed detection | O |
| 43 | Speed detection for reverse rotation | O |

| Inverter Parameter No. | Name | Function Validity |
|---|---|---|
| 44 | Second acceleration/deceleration time | X |
| 45 | Second deceleration time | X |
| 50 | Second speed detection | O |
| 52 | DU/PU main display data selection | O |
| 53 | PU level display data selection | O |
| 54 | DA1 terminal function selection | O |
| 55 | Speed monitoring reference | O |
| 56 | Current monitoring reference | O |
| 57 | Restart coasting time | X |
| 58 | Restart cushion time | X |
| 59 | Remote setting function selection | X |
| 60 | Intelligent mode selection | X |
| 65 | Retry selection | X |
| 67 | Number of retries at alarm occurrence | X |
| 68 | Retry waiting time | X |
| 69 | Retry count display erasure | X |
| 70 | Special regenerative brake duty | O |
| 71 | Applied motor | O |
| 72 | PWM frequency selection | O |

| Inverter Parameter No. | Name | Function Validity |
|---|---|---|
| 73 | Speed setting signal | X |
| 75 | Reset selection/disconnected PU detection/PU stop selection | O |
| 77 | Parameter write disable selection | O |
| 78 | Reverse rotation prevention selection | O |
| 79 | Operation mode selection | X |
| 80 | Motor capacity | O |
| 81 | Number of motor poles | O |
| 82 | Motor excitation current (no load current) | O |
| 83 | Rated motor voltage | O |
| 84 | Rated motor frequency | O |
| 90 | Motor constant R1 | O |
| 91 | Motor constant R2 | O |
| 92 | Motor constant L1 | O |
| 93 | Motor constant L2 | O |
| 94 | Motor constant X | O |
| 95 | Online auto tuning selection | O |
| 96 | Auto tuning setting/status | O |
| 110 | Third acceleration/deceleration time | X |
| 111 | Third deceleration time | X |
| 116 | Third speed detection | O |
| 117 | Station number | O |
| 118 | Communication speed | O |

| Inverter Parameter No. | Name | Function Validity |
|---|---|---|
| 119 | Stop bit length/data length | O |
| 120 | Parity check presence/absence | O |
| 121 | Number of communication retries | O |
| 122 | Communication check time interval | O |
| 123 | Waiting time setting | O |
| 124 | CR, LF presence/absence selection | O |
| 128 | PID action selection | X |
| 129 | PID proportional band | X |
| 130 | PID integral time | X |
| 131 | Upper limit | X |
| 132 | Lower limit | X |
| 133 | PID action set point for PU operation | X |
| 134 | PID differential time | X |
| 140 | Backlash acceleration stopping speed | X |
| 141 | Backlash acceleration stopping time | X |
| 142 | Backlash deceleration stopping speed | X |
| 143 | Backlash deceleration stopping time | X |
| 144 | Speed setting switchover | X |
| 145 | PU display language selection | O |
| 150 | Output current detection level | O |

| Inverter Parameter No. | Name | Function Validity |
|---|---|---|
| 151 | Output current detection time | O |
| 152 | Zero current detection level | O |
| 153 | Zero current detection time | O |
| 156 | Stall prevention operation selection | O |
| 157 | OL signal output timer | O |
| 158 | DA2 terminal function selection | O |
| 160 | Extended function selection | O |
| 162 | Automatic restart after instantaneous power failure selection | X |
| 163 | First cushion time for restart | X |
| 164 | First cushion voltage for restart | X |
| 165 | Restart current restriction level | X |
| 171 | Actual operation hour meter clear | O |
| 180* | DI1 terminal function selection | O |
| 181* | DI2 terminal function selection | O |
| 182* | DI3 terminal function selection | O |
| 183* | DI4 terminal function selection | O |
| 187* | STR terminal function selection | O |
| 190* | DO1 terminal function selection | O |
| 191* | DO2 terminal function selection | O |
| 192* | DO3 terminal function selection | O |
| 195* | A,B,C terminal function selection | O |
| 232 | Multi-speed setting (speed 8) | X |
| 233 | Multi-speed setting (speed 9) | X |

*Some functions of the I/O signals set using these parameters are invalid. Refer to page 23.

## RESTRICTIONS ON THE FUNCTIONS

| Inverter Parameter No. | Name | Function Validity |
|---|---|---|
| 234 | Multi-speed setting (speed 10) | X |
| 235 | Multi-speed setting (speed 11) | X |
| 236 | Multi-speed setting (speed 12) | X |
| 237 | Multi-speed setting (speed 13) | X |
| 238 | Multi-speed setting (speed 14) | X |
| 239 | Multi-speed setting (speed 15) | X |
| 240 | Soft-PWM setting | O |
| 244 | Cooling fan operation selection | O |
| 250 | Stop selection | X |
| 251 | Output phase failure protection selection | O |
| 252 | Override bias | X |
| 253 | Override gain | X |
| 261 | Power failure stop selection | X |
| 262 | Subtracted speed at deceleration start | X |
| 263 | Subtraction starting speed | X |
| 264 | Power-failure deceleration time 1 | X |
| 265 | Power-failure deceleration time 2 | X |
| 266 | Power-failure deceleration time switchover speed | X |
| 278 | Brake opening speed | X |
| 279 | Brake opening current | X |
| 280 | Brake opening current detection time | X |

| Inverter Parameter No. | Name | Function Validity |
|---|---|---|
| 281 | Brake operation time at start | X |
| 282 | Brake operation speed | X |
| 283 | Brake operation time at stop | X |
| 284 | Deceleration detection function selection | X |
| 285 | Overspeed detection speed | X |
| 286 | Droop gain | O |
| 287 | Droop filter constant | O |
| 288 | Droop function activation selection | O |
| 306 | Analog output signal selection | O |
| 307 | Setting for zero analog output | O |
| 308 | Setting for maximum analog output | O |
| 309 | Analog output signal voltage/current switchover | O |
| 310 | Analog meter voltage output selection | O |
| 311 | Setting for zero analog meter voltage output | O |
| 312 | Setting for maximum analog meter voltage output | O |
| 313 | Y0 output selection | O |
| 314 | Y1 output selection | O |
| 315 | Y2 output selection | O |
| 316 | Y3 output selection | O |
| 317 | Y4 output selection | O |

| Inverter Parameter No. | Name | Function Validity |
|---|---|---|
| 318 | Y5 output selection | O |
| 319 | Y6 output selection | O |
| 320 | RA1 output selection | O |
| 321 | RA2 output selection | O |
| 322 | RA3 output selection | O |
| 330 | RA output selection | O |
| 331 | Station number | X |
| 332 | Communication speed | X |
| 333 | Stop bit length | X |
| 334 | Parity check presence/absence | X |
| 335 | Number of communication retries | X |
| 336 | Communication check time interval | X |
| 337 | Waiting time setting | X |
| 341 | CR/LF presence/absence selection | X |
| 342 | $E^2$PROM write selection | O |
| 350 | Stop position command selection | X |
| 351 | Orientation switchover speed | X |
| 356 | Internal stop position command | X |
| 357 | In-position zone | X |
| 360 | External position command selection | X |
| 361 | Position shift | X |
| 362 | Orientation position loop gain | X |

*Some functions of the I/O signals set using these parameters are invalid. Refer to page 23.

| Inverter Parameter No. | Name | Function Validity |
|---|---|---|
| 374 | Overspeed detection level | O |
| 380 | Acceleration S pattern 1 | X |
| 381 | Deceleration S pattern 1 | X |
| 382 | Acceleration S pattern 2 | X |
| 383 | Deceleration S pattern 2 | X |
| 393 | Orientation selection | X |
| 396 | Orientation speed gain (P term) | X |
| 397 | Orientation speed integral time | X |
| 398 | Orientation speed gain (D term) | X |
| 399 | Orientation deceleration ratio | X |
| 400* | DI11 terminal function selection | O |
| 401* | DI12 terminal function selection | O |
| 402* | DI13 terminal function selection | O |
| 403* | DI14 terminal function selection | O |
| 404* | DI15 terminal function selection | O |
| 405* | DI16 terminal function selection | O |
| 406 | High resolution analog input selection | X |
| 407 | Motor temperature detection filter | O |
| 410* | DO11 terminal function selection | O |
| 411* | DO12 terminal function selection | O |
| 412* | DO13 terminal function selection | O |
| 413 | Encoder pulse output division ratio | O |
| 419 | Position command right selection | X |
| 420 | Command pulse scaling factor numerator | X |

| Inverter Parameter No. | Name | Function Validity |
|---|---|---|
| 421 | Command pulse scaling factor denominator | X |
| 422 | Position loop gain | O |
| 423 | Position feed forward gain | O |
| 424 | Position command acceleration/deceleration time constant | X |
| 425 | Position feed forward command filter | X |
| 426 | In-position width | O |
| 427 | Excessive level error | O |
| 430 | Pulse monitor selection | O |
| 450 | Second applied motor | X |
| 451 | Second motor control method selection | X |
| 452 | Second electronic thermal O/L relay | X |
| 453 | Second motor capacity | X |
| 454 | Number of second motor poles | X |
| 464 | Digital position control sudden-stop deceleration time | X |
| 465 | First position feed amount lower 4 digits | X |
| 466 | First position feed amount upper 4 digits | X |
| 467 | Second position feed amount lower 4 digits | X |
| 468 | Second position feed amount upper 4 digits | X |

| Inverter Parameter No. | Name | Function Validity |
|---|---|---|
| 469 | Third position feed amount lower 4 digits | X |
| 470 | Third position feed amount upper 4 digits | X |
| 471 | Fourth position feed amount lower 4 digits | X |
| 472 | Fourth position feed amount upper 4 digits | X |
| 473 | Fifth position feed amount lower 4 digits | X |
| 474 | Fifth position feed amount upper 4 digits | X |
| 475 | Sixth position feed amount lower 4 digits | X |
| 476 | Sixth position feed amount upper 4 digits | X |
| 477 | Seventh position feed amount lower 4 digits | X |
| 478 | Seventh position feed amount upper 4 digits | X |
| 479 | Eighth position feed amount lower 4 digits | X |
| 480 | Eighth position feed amount upper 4 digits | X |
| 481 | Ninth position feed amount lower 4 digits | X |
| 482 | Ninth position feed amount upper 4 digits | X |

| Inverter Parameter No. | Name | Function Validity |
|---|---|---|
| 483 | Tenth position feed amount lower 4 digits | X |
| 484 | Tenth position feed amount upper 4 digits | X |
| 485 | Eleventh position feed amount lower 4 digits | X |
| 486 | Eleventh position feed amount upper 4 digits | X |
| 487 | Twelfth position feed amount lower 4 digits | X |
| 488 | Twelfth position feed amount upper 4 digits | X |
| 489 | Thirteenth position feed amount lower 4 digits | X |
| 490 | Thirteenth position feed amount upper 4 digits | X |
| 491 | Fourteenth position feed amount lower 4 digits | X |
| 492 | Fourteenth position feed amount upper 4 digits | X |
| 493 | Fifteenth position feed amount lower 4 digits | X |
| 494 | Fifteenth position feed amount upper 4 digits | X |
| 495 | Remote output selection | O |
| 496 | Remote output data 1 | O |
| 497 | Remote output data 2 | O |
| 499 | Action selection at SSCNET communication interruption | O |

| Inverter Parameter No. | Name | Function Validity |
|---|---|---|
| 800 | Control system selection | X |
| 801 | Torque characteristic selection | O |
| 802 | Pre-excitation selection | O |
| 803 | Constant output region torque characteristic selection | O |
| 804 | Torque command right selection | X |
| 805 | Torque command value (RAM) | X |
| 806 | Torque command value (RAM, E2PROM) | X |
| 807 | Speed restriction selection | X |
| 808 | Forward rotation speed restriction | X |
| 809 | Reverse rotation speed restriction | X |
| 810 | Torque restriction input method selection | X |
| 812 | Torque restriction level (regeneration) | O |
| 813 | Torque restriction level (3 quadrant) | O |
| 814 | Torque restriction level (4 quadrant) | O |
| 815 | Torque restriction level 2 | X |
| 816 | Acceleration torque restriction | X |
| 817 | Deceleration torque restriction | X |
| 818 | Easy gain tuning response level setting | O |
| 819 | Easy gain tuning selection | O |

| Inverter Parameter No. | Name | Function Validity |
|---|---|---|
| 820 | Speed control P gain 1 | O |
| 821 | Speed control integral time 1 | O |
| 822 | Speed setting filter 1 | X |
| 823 | Speed detection filter 1 | O |
| 824 | Torque control P gain 1 | O |
| 825 | Torque control integral time 1 | O |
| 826 | Torque setting filter 1 | X |
| 827 | Torque detection filter 1 | O |
| 828 | Model speed control gain | O |
| 830 | Speed control P gain 2 | X |
| 831 | Speed control integral time 2 | X |
| 832 | Speed setting filter 2 | X |
| 833 | Speed detection filter 2 | X |
| 834 | Torque control P gain 2 | X |
| 835 | Torque control integral time 2 | X |
| 836 | Torque setting filter 2 | X |
| 837 | Torque detection filter 2 | X |
| 840 | Torque bias selection | X |
| 841 | Torque bias 1 | X |
| 842 | Torque bias 2 | X |
| 843 | Torque bias 3 | X |
| 844 | Torque bias filter | X |
| 845 | Torque bias operation time | X |
| 846 | Torque bias balance compensation | X |

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| Inverter Parameter No. | Name | Function Validity |
|---|---|---|
| 847 | Fall-time torque bias No. 3 bias | X |
| 848 | Fall-time torque bias No. 3 gain | X |
| 849 | Analog input offset adjustment | X |
| 851 | Number of PLG pulses | O |
| 852 | PLG rotation direction | O |
| 854 | Excitation ratio | O |
| 859 | Torque current | O |
| 862 | Notch filter frequency | O |
| 863 | Notch filter depth | O |
| 864 | Torque detection | O |
| 865 | Low speed detection | O |
| 866 | Torque monitoring reference | O |
| 867 | DA1 output filter | O |
| 868 | No. 1 terminal function assignment | X |
| 870 | Speed deviation level | O |
| 871 | Speed deviation time | O |
| 873 | Speed restriction | X |
| 874 | OLT level setting | O |
| 875 | Fault definition | X |
| 876 | Thermal protector input | O |
| 877 | Speed feed forward/model adaptive speed control selection | O |
| 878 | Speed feed forward filter | O |

| Inverter Parameter No. | Name | Function Validity |
|---|---|---|
| 879 | Speed feed forward torque restriction | O |
| 880 | Load inertia ratio | O |
| 881 | Speed feed forward gain | O |
| 890 | Maintenance output setting time | O |
| 891 | Maintenance output timer | O |
| 892 | Maintenance output signal clear | O |
| 900 | DA1 terminal calibration | O |
| 901 | DA2 terminal calibration | O |
| 902 | Speed setting No.2 bias | X |
| 903 | Speed setting No.2 gain | X |
| 904 | Torque command No.3 bias | X |
| 905 | Torque command No.3 gain | X |
| 917 | No. 1 terminal bias (speed) | X |
| 918 | No. 1 terminal gain (speed) | X |
| 919 | No. 1 terminal bias (torque/ magnetic flux) | X |
| 920 | No. 1 terminal gain (torque/ magnetic flux) | X |
| 990 | PU buzzer control | O |
| 991 | PU contrast adjustment | O |

### REMARKS

Whether the I/O terminal function in the SSCNET communication operation mode is valid or invalid is indicated by O or X.

| Input Signal | | Va-lidity |
|---|---|---|
| RL | Low-speed operation command (Pr. 59 = 0) | X |
| | Remote setting (setting clear) (Pr. 59 = other than 0) | X |
| RM | Mid-speed operation command (Pr. 59 = 0) | X |
| | Remote setting (deceleration) (Pr. 59 = other than 0) | X |
| RH | High-speed operation command (Pr. 59 = 0) | X |
| | Remote setting (acceleration) (Pr. 59 = other than 0) | X |
| RT | Second function selection/ second motor switchover | X |
| JOG | Jog operation selection | X |
| REX | 15 speed selection (Combination with three speeds RL, RM, RH) | X |
| X9 | Third function selection | X |
| X10 | FR-HC, FR-CV connection (Inverter operation enable signal) | O |
| X11 | FR-HC connection (instantaneous power failure detection) | X |
| X12 | PU operation external interlock signal | X |

| Input Signal | | Va-lidity |
|---|---|---|
| X14 | PID control enable terminal | X |
| BRI | Brake sequence opening signal | X |
| X16 | PU operation/external operation switchover | X |
| X20 | S-pattern acceleration/ deceleration C switchover terminal | X |
| X22 | Orientation command | X |
| LX | Pre-excitation/servo on | X |
| MRS | Output stop | O |
| STOP | Start self-hold selection | X |
| MC | Control mode switchover | X |
| TL | Torque restriction selection | X |
| X42 | Torque bias selection 1 | X |
| X43 | Torque bias selection 2 | X |
| X44 | P control selection (P/PI control switchover) | X |
| X45 | Servo on (position control) | X |
| STR | Reverse rotation command | X |
| STF | Forward rotation command | X |
| OH | External thermal relay | O |
| - | No function | O |
| RES | Reset | O |
| 1 | Speed setting auxiliary input | X |
| 2 | Speed setting input | X |

| Output Signal | | Va-lidity |
|---|---|---|
| RUN | Inverter running | O |
| SU | Up to speed | X |
| IPF | Instantaneous power failure or undervoltage | O |
| OL | Overload alarm | O |
| FU, FB | Output speed detection | O |
| FU2, FB2 | Second output speed detection | O |
| FU3, FB3 | Third output speed detection | O |
| RBP | Regenerative brake prealarm | O |
| THP | Electronic thermal overload protection prealarm | O |
| PU | PU operation mode | X |
| RY | Inverter operation ready | O |
| Y12 | Output current detection | O |
| Y13 | Zero current detection | O |
| FDN | PID lower limit | X |
| FUP | PID upper limit | X |
| RL | PID forward/reverse rotation output | X |
| BOF | Brake opening request | X |

| Output Signal | | Va-lidity |
|---|---|---|
| FAN | Fan fault output | O |
| FIN | Heatsink overheat prealarm | O |
| ORA | Orientation in-position | X |
| Y30 | Output during forward rotation | O |
| Y31 | Output during reverse rotation | O |
| Y32 | Regeneration status output | O |
| RY2 | Operation ready 2 | O |
| LS | Low speed output | O |
| TU | Torque detection | O |
| Y36 | In-position | O |
| MT | Maintenance timer output | O |
| Y40 | Trace status | O |
| RUN 2 | Inverter running 2 | O |
| REM | Remote output* | O |
| ER | Minor fault output 2 | X |
| LF | Minor fault output | O |
| ABC | Alarm output | O |
| - | No function | O |

\* The function using the PU connector is valid.

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# 8. PRECAUTIONS

- The inverter parameter values cannot be changed from the motion controller. Use the PU (FR-DU04-1/ FR-PU04V) to change them. (Except the initial communication setting parameters)
- The usable encoder pulses are 1000 to 4096 pulses.
- Start and stop are SSCNET commands, and STR and STF are disabled. Among the external inputs (commands), only MRS, RES and OH are enabled.
- Before starting operation, always give the servo ON signal from the host controller to put the motor in the servo lock status, and then start operation.
- The running speed and rotation direction are as commanded from the motion controller.
- During SSCNET operation, the acceleration/deceleration of the inverter is automatically set to 0 s. When "0" is set in Pr.288 "droop function activation selection", droop control can not be performed. Set "1" or "2" in Pr.288. (For details, refer to the inverter manual.)
- The overcurrent and overvoltage alarms in the SSCNET operation mode are "E.OC3" and "E.OV3", respectively. (For details, refer to the inverter manual.)
- The restrictions on the I/O signals (refer to page 23) also apply to the case where any of the other options (FR-A5AY, FR-A5AR, FR-A5NR, FR-V5AX, FR-V5AY) is used with this option. (When the FR-A5NR is used with this option, RS-485 communication is disabled.)
- Offline auto tuning cannot be performed from the motion controller. Perform it from the PU before starting communication.

# 9. ALARM INDICATION DEFINITIONS AND CORRECTIVE ACTIONS

This section provides the definitions of the alarm indications and their corrective actions.

## (1) Faults

When any of the protective functions is activated, the inverter shuts off the output and outputs the corresponding alarm.

When the protective function is activated, find the cause, and then refer to the inverter manual and reset the inverter to resume operation.

| Operation panel indication | E.OP3 | $E.OP3$ | FR-PU04V | Option slot alarm 3 |
|---|---|---|---|---|
| **Name** | Option slot 3 alarm | | | |
| **Description** | • If communication shutoff occurs at the Pr. 499 "action selection at SSCNET communication interruption" setting of "1", this alarm is displayed and the inverter output is stopped. If a communication line alarm occurs between the motion controller and plug-in option, the inverter output is stopped. | | | |
| **Check point** | • Check for communication shutoff.<br>• Check that the plug-in option is connected to the connector securely.<br>• Check the communication cable for wire break.<br>• Check that the terminating resistor is set correctly.<br>• Check that the option card is normal. | | | |
| **Corrective action** | • Recover communication from shutoff.<br>• Check the option function settings, etc.<br>• Connect the plug-in option securely. | | | |

| Operation panel indication | E. 3 | $E.\ 3$ | FR-PU04V | Fault 3 |
|---|---|---|---|---|
| **Name** | Option alarm | | | |
| **Description** | If poor contact etc. occurs at the connector between the inverter and communication option, the inverter output is stopped. | | | |
| **Check point** | Check that the communication option is plugged into the connector securely. | | | |
| **Corrective action** | • Connect the communication option securely.<br>• Contact your sales representative. | | | |

| Operation panel indication | E. 9 | $\mathcal{E}. \ \mathcal{G}$ | FR-PU04V | Fault 9 |
|---|---|---|---|---|
| Name | Initial communication alarm | | | |
| Description | If any of the values set in the initial communication parameters is outside the setting range at the time of initial communication of the motion controller and inverter (FR-V5NS), the alarm is displayed and initial communication is stopped. | | | |
| Check point | Check that the initial communication parameter values are set within the setting ranges. | | | |
| Corrective action | Refer to page 13 and check the initial communication parameter values. | | | |

## (2) Alarm

When the protective function is activated, the output is not shut off.

| Operation panel indication | CF | $\mathcal{CF}$ | FR-PU04V | CF |
|---|---|---|---|---|
| Name | Initial communication waiting status | | | |
| Description | If SSCNET communication is disabled due to the fault of the communication cable or the power-off of the communication equipment (personal computer) or motion controller, the output is shut off and the alarm is displayed.<br>The operation to be performed at occurrence of communication shutoff can be selected using Pr. 499 "action selection at SSCNET communication interruption". | | | |
| Check point | • Check the communication cable for a fault.<br>• Check that the communication equipment (personal computer) and motion controller have not been powered off.<br>• Check that the setting of Pr. 499 "action selection at SSCNET communication interruption" is correct. | | | |
| Corrective action | • Change the communication cable.<br>• Power on the communication equipment (personal computer) and motion controller.<br>• Check the Pr. 499 "action selection at SSCNET communication interruption" setting. | | | |

REVISIONS

| Print Date | *Manual Number | Revision |
|---|---|---|
| May, 2002 | IB(NA)-0600106E-A | First edition |
| Jul., 2003 | IB(NA)-0600106E-B | Additions<br>Torque control setting |
|  |  |  |