4H358D0030007

TECO – Westinghouse

MOTOR COMPANY

# Operation Manual

# GA7200

*AC Inverter*

**380 to 460V 1HP~450HP**

**200 to 230V 1HP~100HP**

The GA7200 is a high-performance/low noise general-purpose inverter. This manual describes the operation procedures for the digital operator (JNEP--12) provided with the GA7200.

A thorough understanding of this operation manual and the GA7200 installation manual is recommended before using the GA7200.

# CONTENTS

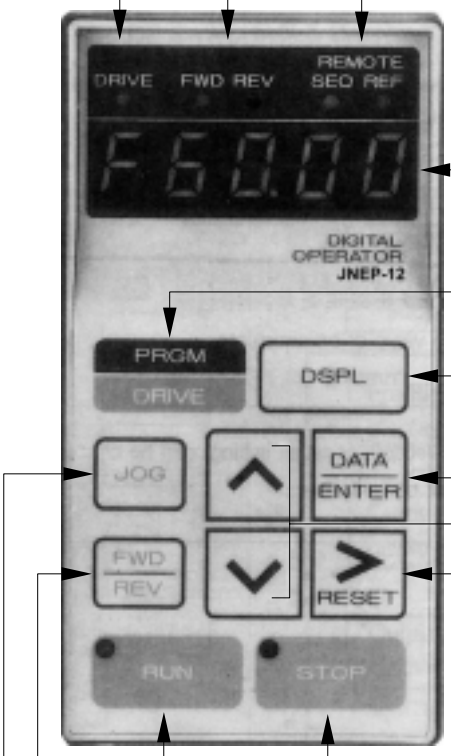
Page

# 1. OUTLINE

## 1.1 MAIN FUNCTIONS

| Function | Description |
|---|---|
| Drive Mode | GA7200 can be operated easily with the digital operator. |
| Program Mode | Function selection and constant setting for GA7200 can be performed with the digital operator. |
| Monitor Function | Monitoring of output frequency, output current, output voltage or status of run / stop commands can be performed with the digital operator. |
| Fault Contents Display | If a fault occurs, its contents order of occurrence is displayed. When the power supply is turned ON, maintenance inspection or troubleshooting can be performed since fault is recorded. |

## 1.2 DIGITAL OPERATOR KEYPAD




**Mode Display**

Drive Mode Display
Red lamp lights in DRIVE mode and goes out in PRGM mode.

Rotation Direction Display
Red lamp lights in DRIVE mode and goes out in PRGM mode.

REMOTE Mode
Red lamp lights when controlled by external terminal commands.
SEQ: When RUN/STOP signal is selected from terminals.
REF: When frequency reference is selected from terminals.

**Display**

Displays set value of each function or monitoring values such as frequency and output current. (5 digits)

**Mode Selection Key**

Depressing this key changes mode. (DRIVE or PRGM)

**Display Selection Key**

Depressing this key changes the display.

**Read/Write Key**

Depressing this key recalls and displays data from memory.
Depressing it a second time enters display data into memory.

**Numeral Change Key**

Changes numeral such as set values and constant signals.
: Increment key
: Decrement key

**Digit Selection Key**

Selects numerical digits. Selected digit blinks.
This key resets operation when fault occurs.

**Run Command Key**

Run Command Key to operate by digital operator.
Effective only in drive mode.

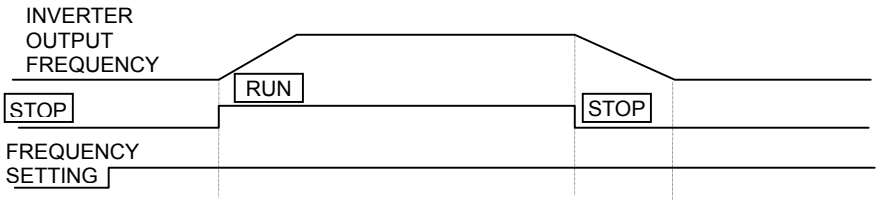
STOP command is input. (Motor stops in either mode.)*

Red lamp lights by depressing STOP. *

Selects FWD or REV run.
Effective only in DRIVE mode.

While depressing this key, JOG speed is selected.
Effective only in DRIVE mode.

* RUN or STOP lamp changes in accordance with the following operations.




| | | | | |
|---|---|---|---|---|
| RUN Lamp | ● | ☼ | ◐ | ● |
| STOP Lamp | ☼ | ● | ☼ | ☼ |

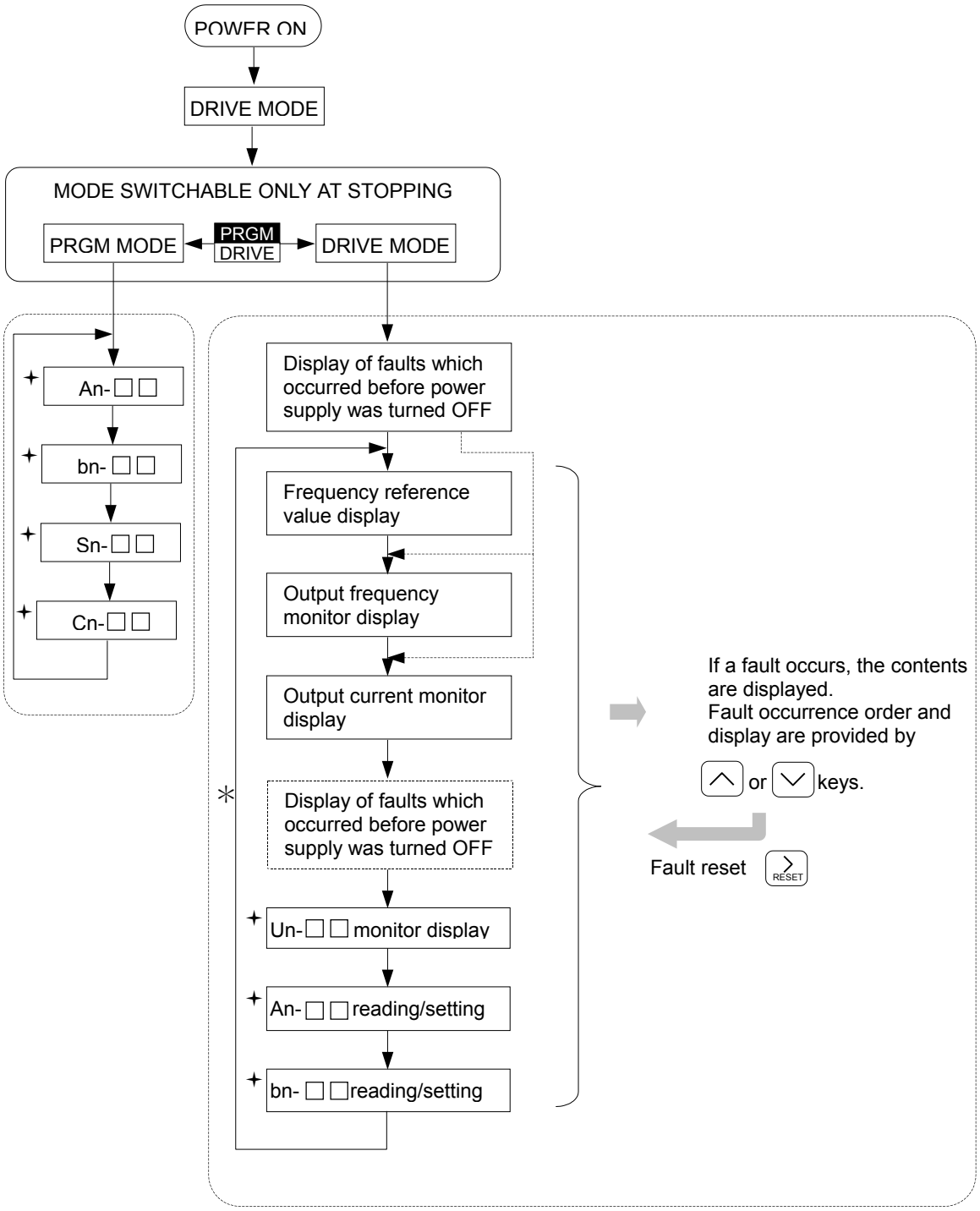
☼: Lit ◐: Blink ●: Off

# 2. DRIVE MODE AND PRGM (PROGRAM) MODE

Selection of DRIVE mode or PRGM mode can be performed by using the PRGM/DRIVE key when the inverter is stopped. When function selection or a change of set value is required, switch to the PRGM mode.

| | |
|---|---|
| DRIVE mode functions | ● Operation is enabled.<br>● An operation can be performed by RUN, STOP, JOG and FWD/REV keys.<br>● Frequency reference value or bn constants can be changed while running. |
| PRGM mode functions | ● Program (function selection, constant setting) can be changed.<br>Note: Cannot be performed while running. |

## 2.1 DISPLAY CONTENTS




∗The constant group to be displayed is changed each time display selection key DSPL is depressed.

✦For details of constants ( An-□□, bn-□□, Cn-□□, Sn-□□, Un-□□, refer to Section 7, "CONSTANTS/FUNCTION LIST."

## 2.2 CONSTANT GROUPS

Constants of GA7200 are classified as follows:

| Constant Group | Contents |
|---|---|
| An- □□ | Frequency reference setting |
| bn- □□ | Constant group able to be changed while running |
| Cn- □□ | Constant, among control constant groups, related to operation change characteristics |
| Sn- □□ | Constant, among system constant groups, to be used for function selection |

The ability to set or read the different groups of constants is determined by Sn-03 as shown below.

| Sn-03 | DRIVE Mode | | PRGM Mode | | Remarks |
|---|---|---|---|---|---|
| | Setting | Reading | Setting | Reading | |
| 0000 | An, bn | Sn, Cn | An, bn, Sn, Cn | … | Factory set |
| 0101 | An | bn, Sn, Cn | An | bn, Sn, Cn | * |

* It is recommended that Sn-03 be set to 0101 and reading mode entered after test run adjustment.
Note: To read the Sn or Cn constants while in the DRIVE mode, depress the DSPL key with RESET key depressed.

# 3. CONSTANTS SETTING AND CHANGE

## 3.1 STANDARD FACTORY SETTING

| Contents | Set Value |
|---|---|
| Frequency Reference Input | Can be set by digital operator. |
| Run Command Input | Can be set by digital operator.<br>(RUN/STOP/FWD/REV/JOG) |
| V/f Pattern | 60Hz, constant torque characteristics (Standard motor) |
| Acceleration Time | 10 seconds |
| Motor Protection | Electronic overload thermal protection (Standard motor) |

Note: For more details, refer to Section 7 “CONSTANTS/FUNCTION LIST. ”

## 3.2 FREQUENCY REFERENCE SETTING AND CHANGE

(Example) Frequency reference value is set to 15Hz.

| Description | Keypad Operation | Digital Operator Display | Remarks |
|---|---|---|---|
| • Frequency reference value is displayed. | DSPL | F 0.00<br>Blinking | |
| • Set or change reference value. (Input “1”). | ^ v | F 0.00 | |
| • Select digit. | RESET | F 10.00 | |
| • Set or change reference value. (Input “5”.) | ^ v | F 15.00 | |
| • Write-in constant. | DATA ENTER | F 15.00 | Stops blinking for 2 seconds. |

## 3.3 CONSTANTS CHANGE AND FUNCTION SELECTION

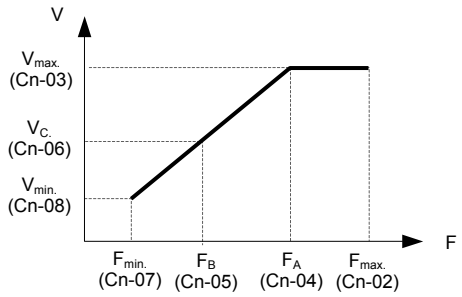
- All constants are changed and functions are selected in the same manner.
- When changing Cn- ☐☐ and Sn- ☐☐ constants, program mode must be selected.

(Example) Jog frequency (An-09) set value is changed from 6Hz to 10Hz.

| Description | Keypad Operation | Digital Operator Display | Remarks |
|---|---|---|---|
| • Constant group to be set or changed is displayed. | DSPL | An-01 | |
| • Select constant No. to be set or changed. | ∧ ∨ | An-09 | |
| • Constant set value is displayed. | DATA ENTER | 06.00 | |
| • Constant is set or changed. | ∧ ∨ | 10.00 | |
| • Set value is written in. | DATA ENTER | End | ("End" is displayed for 0.5 second). Confirm "End" displayed for each constant. |

## 3.4 OPERATION ERRORS " oPE □ □"

The constant setting fault oPE is checked when power is applied or PRGM is changed to DRIVE mode. Digital operator displays faults if the oPE is detected. The fault contact output of the inverter is not executed. If the following "conditions" occur at power ON or changing PRGM into DRIVE , it becomes oPE.

| Display | Fault | Conditions | Example |
|---|---|---|---|
| oPE01 | kVA Constant Setting Fault (Sn-01) | ● When 460V class constant is set for 230V class inverter or 230V class constant is set for 460V. | |
| oPE02 | Constant Setting Range Fault | ● When "out of setting range" constant is set. | |
| oPE03 | Multi-function Input Setting Fault (Sn-15 to-18) | When multi-function inputs Sn-15 to -18 are set as follows:<br>● Set values are not arranged in numerical order. (including equal values)<br>● Both search references "61" and "62" are set.<br>● Up command (set value = 10) and DOWN command (set value = 11) cannot be set simultaneously.<br>● Up command (set value = 10), DOWN command (set value = 11) and accel prohibit command (set value = 0A) are set together.<br>● More than two set values except FF are set. | Sn-15 = 3<br>Sn-16 = 4<br>Sn-17 = 6<br>Sn-18 = 5 |
| oPE10 | V/f Data Set Fault (Cn-02 to-08) | When Cn-02 to 08 do not satisfy the following conditions.<br>● $F_{max.} \geqq F_A > F_B \geqq F_{MIN.}$<br>(Cn-02) (Cn-04) (Cn-05) (Cn-07)<br>  <br> | Cn-02 = 50<br>Cn-04 = 60<br>Cn-05 = 3<br>Cn-07 = 1.5 |
| oPE11 | Constant Set Fault | When any following set fault:<br>● Carrier frequency upper limit (Cn-23) > 5kHz and Carrier frequency lower limit (Cn-24) $\leqq$ 5kHz.<br>● Carrier frequency proportional Gain (Cn-25) > 6 and (Cn-23) < (Cn-24) | Cn-23 = 6kHz<br>Cn-24 = 5kHz |
| Err | Constant Write-in Fault | ● The constant is not written in correctly to NV-RAM. (Only at initialization) | |

# 4. WIRING

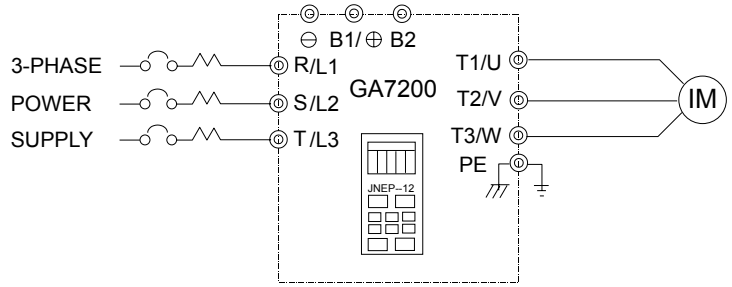
GA7200 has been programmed to operate from the digital operator when shipped from the factory. Therefore, just connecting the main circuit power enables drive operation.

Note: When external signals or external devices and digital operator are used, refer to Section 7, “CONSTANTS/FUNCTION LIST”, in this manual.

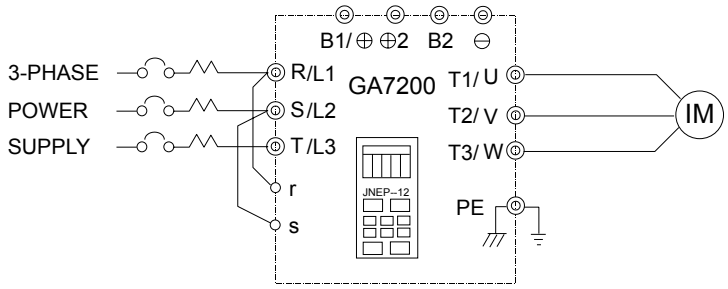
## 4.1 CONNECTION DIAGRAM

**230V Class**

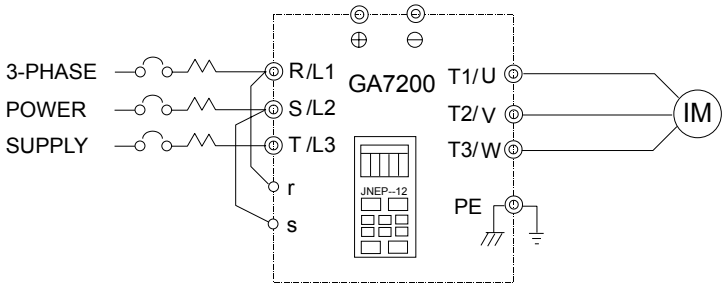
- 10 HP (7.5kW, 13.7kVA) or smaller




- 15/20 HP (11/15kW, 20.6/27.4kVA)

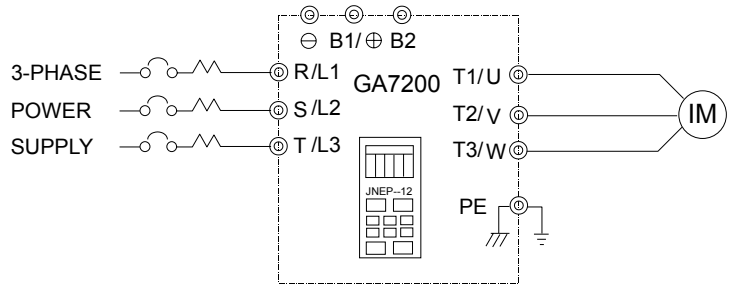



- 25 HP (18.5kW, 34kVA) or larger

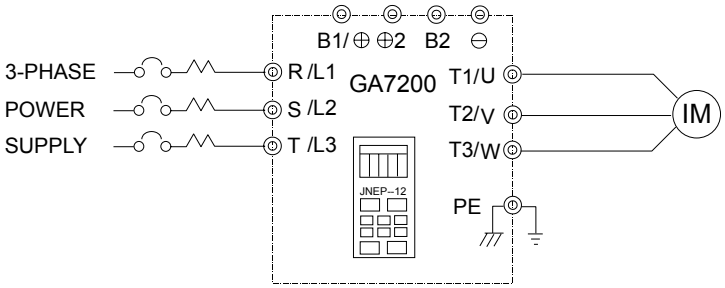


### 460V Class

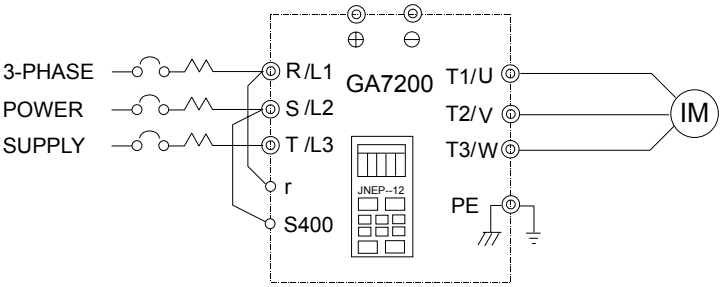
- 10 HP (7.5kW, 13.7kVA) or smaller




- 15/20 HP (11/15kW, 20.6/27.4kVA)




- 25 HP (18.5kW, 34kVA) or larger



## 4.2 TERMINAL FUNCTIONS

### ■ MAIN CIRCUIT

<table>
<tr><td>VOLTAGE</td><td colspan="4">230V CLASS</td><td colspan="4">460V CLASS</td></tr>
<tr><td>Rating / Terminal</td><td>1~10HP</td><td>15~20HP</td><td>25~30HP</td><td>40~100HP</td><td>1~10HP</td><td>15~20HP</td><td>25~60HP</td><td>75~450HP</td></tr>
<tr><td>R(L1)</td><td colspan="8" rowspan="3">Circuit input power supply</td></tr>
<tr><td>S(L2)</td></tr>
<tr><td>T(L3)</td></tr>
<tr><td>U(T1)</td><td colspan="8" rowspan="3">Inverter output</td></tr>
<tr><td>V(T2)</td></tr>
<tr><td>W(T3)</td></tr>
<tr><td>B1/⊕</td><td rowspan="2">● B1/⊕,B2: braking resistor<br>● B1/⊕,⊖: DC power supply</td><td rowspan="3">● B1/⊕, B2: braking resistor<br>● B1/⊕, ⊕ 2:optional DCL<br>● B1/⊕,⊖: DC power supply</td><td>-</td><td>-</td><td rowspan="2">● B1/⊕,B2: braking resistor<br>● B1/⊕,⊖: DC power supply</td><td rowspan="2">● B1/⊕,B2: braking resistor<br>● B1/⊕, ⊕ 2:optional DCL<br>● B1/⊕,⊖: DC power supply</td><td>-</td><td>-</td></tr>
<tr><td>B2</td><td rowspan="3">● ⊕1, ⊖: DC power supply or Braking Unit<br>● ⊕2,⊕ 3: DCL</td><td rowspan="2">⊕, ⊖: DC power supply or Braking Unit</td><td rowspan="3">● ⊕1, ⊖: DC power supply or Braking Unit<br>● ⊕2,⊕ 3: DCL</td><td rowspan="3">● ⊕, ⊖: DC power supply or Braking Unit</td></tr>
<tr><td>⊖</td><td rowspan="3">-</td><td rowspan="3">-</td></tr>
<tr><td>⊕1, ⊕</td></tr>
<tr><td>⊕2</td><td rowspan="2">-</td><td rowspan="2">-</td><td rowspan="2">-</td><td rowspan="2">-</td></tr>
<tr><td>⊕3</td><td>-</td><td>-</td></tr>
<tr><td>s</td><td colspan="2" rowspan="3">-</td><td rowspan="3">● r-s: cooling fan power supply</td><td rowspan="3">● r-s: cooling fan power supply</td><td colspan="2" rowspan="3">-</td><td rowspan="3">● r-s: cooling fan power supply</td><td rowspan="3">● r-s: cooling fan power supply</td></tr>
<tr><td>r</td></tr>
<tr><td>s400</td></tr>
<tr><td>PE (⏚)</td><td colspan="8">Grounding</td></tr>
</table>

## ■ CONTROL CIRCUIT

| Classification | Terminal | Signal Function | Description | | Signal Level |
|---|---|---|---|---|---|
| Sequence Output Signal | 1 | Forward operation-stop signal | Forward run at closed, stop at open | | Photo-coupler insulation input +24V DC 8mA |
| | 2 | Reverse operation-stop signal | Reverse run at closed, stop at open | | |
| | 3 | External fault input | Fault at closed, normal state at open | | |
| | 4 | Fault reset input | Reset at closed | | |
| | 5 | Master/Aux. Multi-step speed ref. 1 | Auxiliary freq. ref. at "closed" | Multi-function contact input: the following signals are available to select. Forward/reverse select, run mode select, multi-speed select, jog frequency select, accel/decel time select, external fault, external base clock stop, hold command, aux. input effective, speed search, energy-saving operation. | |
| | 6 | Multi-step speed ref. 2 | Effective at "closed" | | |
| | 7 | Jog command | Jog run at "closed" | | |
| | 8 | External coast to stop | Inv. output stop at "closed" | | |
| | 11 | Sequence common | - | | |
| Analog Input Signal | 15 | Power supply terminal for speed reference | Speed reference power supply | | +15V (Allowable current 20mA max.) |
| | 13 | Master speed frequency reference | 0 to +10V/100% freq. | | 0 to +10V (20kΩ) |
| | 14 | | 4 to 20mA/100% freq. | | 4 to 20mA (250Ω) |
| | 16 | Aux. frequency reference | 0-10V/100% | Multi-function contact input: one of the following signals are available to select. Speed command, speed gain, speed bias, over torque, over voltage bias, rate of accel/decel, DB current. | 0 to +10V (10kΩ) |
| | 17 | Common terminal for control circuit | 0 | | - |
| | 12 | Shield connection | - | | - |
| Sequence Output Signal | 9 | During running (NO) | Run at "closed" | Multi-function contact input: one of the following signals available to output. Output during running, zero speed, synchronized speed, arbitrary speed agreed, frequency detection, overtorque, undervoltage, run mode, coast to stop, braking resistor overheat.. | Dry contact Contact capacity: 250V AC 1A or less 30VDC 1A or less |
| | 10 | | | | |
| | 25 | Zero speed detection | Occurs at minimum freq. (Cn-07) or less | | |
| | 26 | Speed agreed detection | Occurs when the frequency reaches ± 1% of set freq. | | Open collector output +48V 50mA or less |
| | 27 | Open collector output common | | | - |
| | 18 | Fault contact output common (NO, NC) | Fault at closed between terminals 18 and 20 Fault at open between terminals 19 and 20 | | Dry contact Contact capacity: 250VAC 1A or less 30VDC 1A or less |
| | 19 | | | | |
| | 20 | | | | |
| Analog Output Signal | 21 | Frequency meter output | 0 to 10V/100% freq. | Ammeter/voltmeter/wattmeter output selection available | 0 to11V max. 2mA or less |
| | 22 | Common | | | |

# 5. DIGITAL OPERATOR PROGRAMMING

The following is an operation example for the digital operator keypad.

**PRECAUTION**

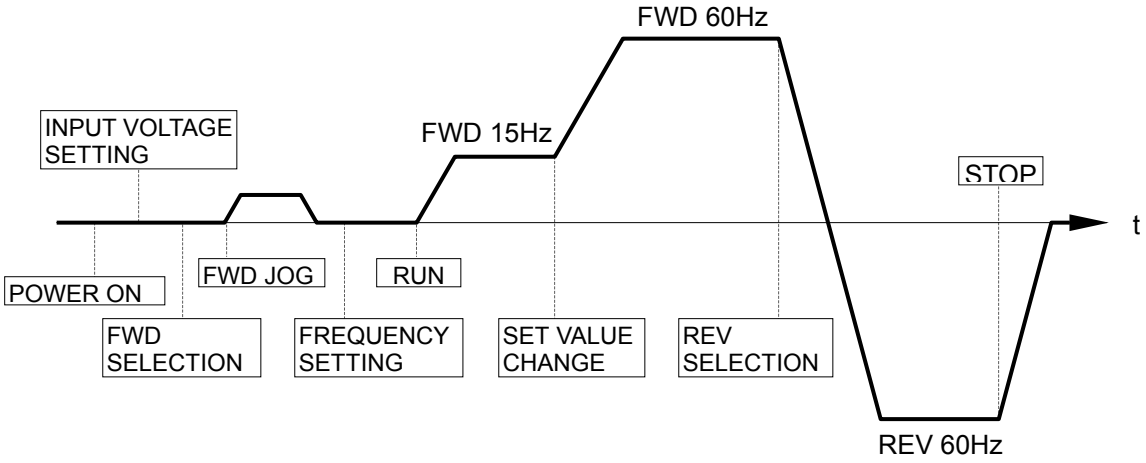
Before Power ON

- For the 460V class, 25HP (18.5kW, 34kVA) or larger inverter, change the supply voltage selection tap of control transformer to the same tap as input voltage. Refer to Installation Manual.

Before Operation

- Be sure to set input voltage in control constant Cn-01. The initial value is 220 for 230V class, 440 for 460V class.

## ■ Operation Pattern




## ■ Typical Operation

| Description | Keypad Operation | Digital Operator Display | Remarks |
|---|---|---|---|
| ① Turn on power supply<br>• Frequency reference value is displayed. | | F 0.00 | LED DRIVE OFF |
| • Select PRGM mode. | PRGM DRIVE | | |
| ② Set input voltage power supply<br>• Select control constant (Cn-□□)<br>(ex: 220V) | DSPL Depress three times.<br>DATA ENTER | An-01<br>Cn-01<br>220 | |
| • Display Cn-01 data. | RESET ∧ ∨ | 220 | Displayed for 0.5 second. |
| • Set 220V as input voltage. | DATA ENTER | End | Confirm the display. |
| Cont'd | | | |

| Description | Keypad Operation | Digital Operator Display | Remarks |
|---|---|---|---|
| Cont'd | | | |
| ③ FWD JOG<br>• Select DRIVE mode. | PRGM<br>DRIVE | F 0.00 | LED DRIVE lights. |
| • Select output frequency monitor display. | DSPL | 0.00 | |
| • Select rotating direction. (FWD is default at power ON.) | | | LED FWD lights. |
| • Jog operation. | JOG | 6.00 | |
| ④ Frequency Setting<br>• Frequency reference value display is selected. | DSPL Depress Six times. | F 0.00 | |
| 15Hz | | | |
| • Change reference value. | RESET ^ v | F 15.00 | Stops blinking for two seconds. |
| • Set value is written in. | DATA ENTER | F 15.00 | |
| • Select output frequency monitor display. | DSPL | 0.00 | |
| ⑤ FWD RUN<br>• Running operation. | RUN | 15.00 | LED RUN lights. |
| ⑥ Change frequency reference value<br>• Select frequency reference value display. | DSPL | F 15.00 | |
| 60Hz | | | |
| • Change reference value. | RESET ^ v | F 60.00 | Stops blinking for two seconds. |
| • Set value is written in. | DATA ENTER | F 60.00 | |
| • Select output frequency monitor value. | DSPL | 60.00 | |
| ⑦ REV RUN<br>• Switch to reverse run. | FWD REV | -60.00 | LED REV lights. |
| ⑧ STOP<br>• Decelerate to a stop. | STOP | 0.00 | LED STOP lights.<br>(RUN blinks while decelerating) |

# 6. PROGRAM MODE SETTING AND CHANGE

The following shows an example of main functions and characteristics.

## 6.1 V/f PATTERN SETTING Sn-02

16 types of V/f patterns are available according to motor type, load characteristics and operating conditions.

**PRECAUTION**

- To select V/f pattern, set the inverter input voltage to Cn-01.
- For details on the different V/f patterns, refer to Par. 7.3 SYSTEM CONSTANTS “V/f PATTERN SELECTION” on page 67.

### ■■ FIXED V/f PATTERN SELECTION

(Example) Change to variable torque characteristics (Set “7”.)

| Description | Keypad Operation | Digital Operator Display | Remarks |
|---|---|---|---|
| • Select PRGM mode. | PRGM DRIVE | An-01 | LED DRIVE OFF |
| • Select Sn-02. | DSPL Depress twice. ∧ ∨ | Sn-02 | |
| • Constant display value is displayed. | DATA ENTER | 01 | |
| • Set or change constant. | RESET ∧ ∨ | 07 | |
| • Constant value is written in. | DATA ENTER | End | Displayed for 0.5 second. Confirm the display for each constant. |

## ■ INPUT VOLTAGE SETTING

(Example) Set input voltage to 220V.

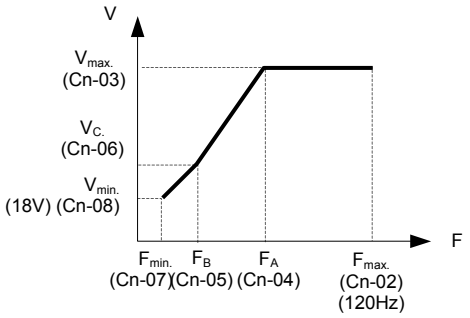
| Description | Keypad Operation | Digital Operator Display | Remarks |
|---|---|---|---|
| • Select PRGM mode. | PRGM / DRIVE | A n - 0 1 | LED DRIVE OFF |
| • Select Cn-01. | DSPL Depress three times.  | C n - 0 1 | |
| • Constant set value is displayed. | DATA ENTER | 0 0.0 | |
| • Set or change constant. |  | 2 0.0 | |
| • Constant value is written in. | DATA ENTER | End | Displayed for 0.5 second. Confirm the display for each constant. |

## ■ ARBITRARY V/f SETTING (Sn-02, Cn-02 to -08)

(Example) Change to "$F_{max}$ = 120Hz, $V_{min}$ = 18V".

| Description | Keypad Operation | Digital Operator Display | Remarks |
|---|---|---|---|
| • Select PRGM mode. | PRGM / DRIVE | An-01 | LED DRIVE OFF |
| • Select Sn-02. | DSPL Depress twice. | Sn-02 | |
| • Constant set value is displayed. | ∧ ∨ DATA ENTER | 01 | |
| • Set or change constant. Set to "F". | RESET ∧ ∨ | 0F | |
| • Constant is written in. | DATA ENTER | End | |
| • Select Cn-02. | DSPL ∧ ∨ | Cn-02 | |
| • Constant set value is displayed. | DATA ENTER | 060.0 | |
| • Set or change constant. | RESET ∧ ∨ | 120.0 | Refer to the next page |
| • Constant value is written in. | DATA ENTER | End | |
| • Select Cn-02. | DSPL ∧ ∨ | Cn-03 | |
| ⋮ | ⋮ | ⋮ | |
| • Select Cn-08 | DSPL ∧ ∨ | Cn-08 | |
| • Constant set value is displayed. | DATA ENTER | 010.0 | |
| • Set or change constant. | RESET ∧ ∨ | 018.0 | |
| • Constant value is written in. | DATA ENTER | End | Displayed for 0.5 second. Confirm the display for each constant. |

- Set Sn-02 to F.




- If $F_{MAX.} \geqq F_A > F_B \geqq F_{MIN.}$ is not satisfied, a setting error occurs.
- When V/f pattern is selected to be linear, set the same value for Cn-07 and Cn-05. (Cn-06 setting is disregarded). Refer to pages 67, 68 and 69 for V/f pattern selection.

## 6.2 ACCEL/DECEL TIME SETTING bn-01 to -04 (Sn-06, Sn-15 to -18)

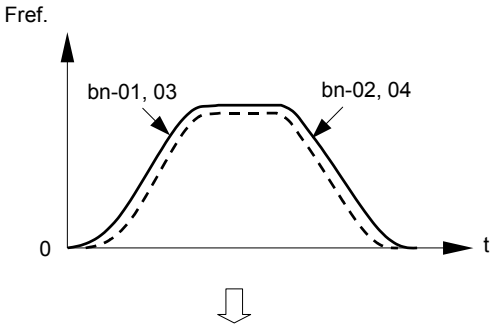
Accel/decel time can be changed in DRIVE mode during running.

- Acceleration and deceleration time each has two set values. When " accel/decel time change" is selected (7 is set in Sn-15, Sn-16, Sn-17 or Sn-18) as a multi-function terminal function, the values set in bn-03 and-04 become effective.
- S-curve characteristics of soft start can be selected in the 1-and 2-digits of Sn-06.

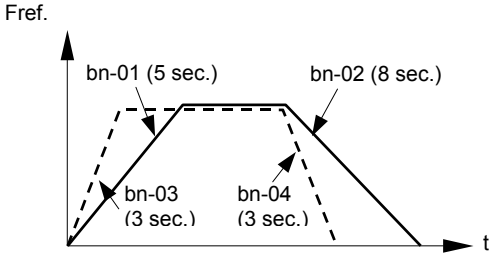
(Example) When S-curve not used, accel and decel times are set with bn-01 through bn-04.

| | bn- □□ | Set Value |
|---|---|---|
| Accel Time 1 | (bn-01) | 5 seconds |
| Decel Time 1 | (bn-02) | 8 seconds |
| Accel Time 2 | (bn-03) | 3 seconds |
| Decel Time 2 | (bn-04) | 3 seconds |

Factory setting
(S-curve characteristics: provided)
bn-01 to 04: 10 seconds



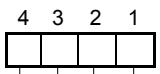

Setting change
(S-curve characteristics: not provided)



| Description | Keypad Operation | Digital Operator Display | Remarks |
|---|---|---|---|
| • Select PRGM mode. | PRGM / DRIVE | An-01 | LED DRIVE OFF |
| • Select bn-01. | DSPL ∧ ∨ | bn-01 | |
| • Constant set value is displayed. | DATA / ENTER | 0010.0 | |
| • Set or change constant. | RESET ∧ ∨ | 0005.0 | |
| • Constant value is written in. | DATA / ENTER | End | Displayed for 0.5 second. Confirm the display for each constant. |
| • Select bn-02. | DSPL ∧ ∨ | bn-02 | |
| ⋮ | | ⋮ | |
| • Select Sn-06. | DSPL ∧ ∨ | Sn-06 | |
| • Constant set value is displayed. | DATA / ENTER | 0000 | Refer to the next page |
| • Set or change constant. | RESET ∧ ∨ | 0001 | |
| • Constant value is written in. | DATA / ENTER | End | Displayed for 0.5 second. Confirm the display for each constant. |
| • Select Sn-18. | DSPL ∧ ∨ | Sn-18 | |
| • Constant set value is displayed. | DATA / ENTER | 0 | |
| • Set or change constant. | RESET ∧ ∨ | 0 | |
| • Constant value is written in. | DATA / ENTER | End | Displayed for 0.5 second. Confirm the display for each constant. |

✳ Input signal selection

Sn-06 Operation mode selection 3




| | Soft start S-curve characteristics |
|---|---|
| 00 | S-curve 0.2 sec. |
| 10 | S-curve 0.5 sec. |
| 11 | S-curve 1.0 sec. |

| | Master speed frequency reference |
|---|---|
| 0 | Normal characteristics |
| 1 | Reverse characteristics |

| | Processing when frequency reference is missing |
|---|---|
| 0 | Stop by reference input |
| 1 | Operation to continue with 80% of frequency reference |

**Application Example**

Machine requires soft start at acceleration and soft stop at deceleration.

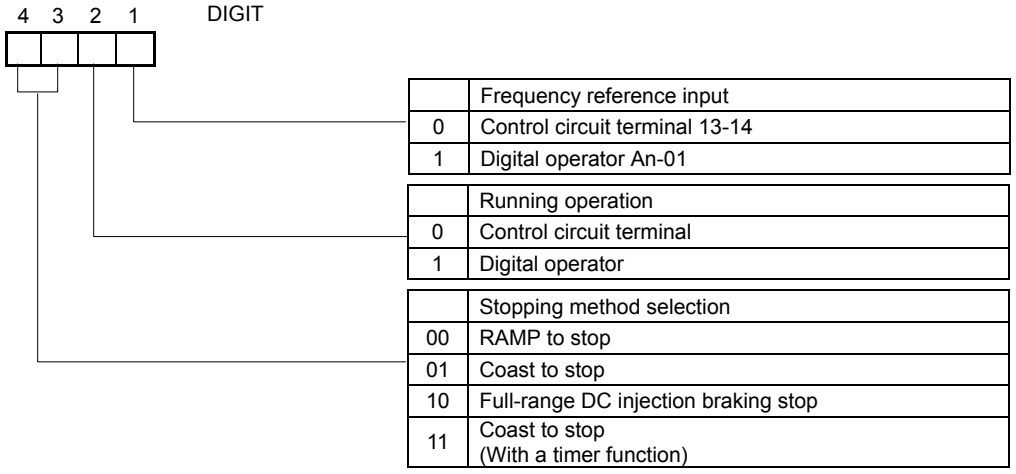
## 6.3 INPUT SIGNAL SELECTION Sn-04

(Example) Change from operator control to terminal control of run/stop and frequency reference.

| Description | Keypad Operation | Digital Operator Display | Remarks |
|---|---|---|---|
| • Select PRGM mode. | PRGM / DRIVE | An-01 | LED DRIVE OFF |
| • Select Sn-04. | DSPL ∧ ∨ | Sn-04 | |
| • Constant display value is displayed. | DATA ENTER | 0011 | ● Refer to the diagram shown below. |
| • Set or change constant. | RESET ∧ ∨ | 0003 | |
| • Constant value is written in. | DATA ENTER | End | Displayed for 0.5 second. Confirm the display for each constant. |

✳ Input signal selection Sn-04

Sn-04 Operation mode selection




| | Frequency reference input |
|---|---|
| 0 | Control circuit terminal 13-14 |
| 1 | Digital operator An-01 |

| | Running operation |
|---|---|
| 0 | Control circuit terminal |
| 1 | Digital operator |

| | Stopping method selection |
|---|---|
| 00 | RAMP to stop |
| 01 | Coast to stop |
| 10 | Full-range DC injection braking stop |
| 11 | Coast to stop<br>(With a timer function) |

## 6.4 PROTECTIVE CHARACTERISTICS SELECTION Sn-10 to -14

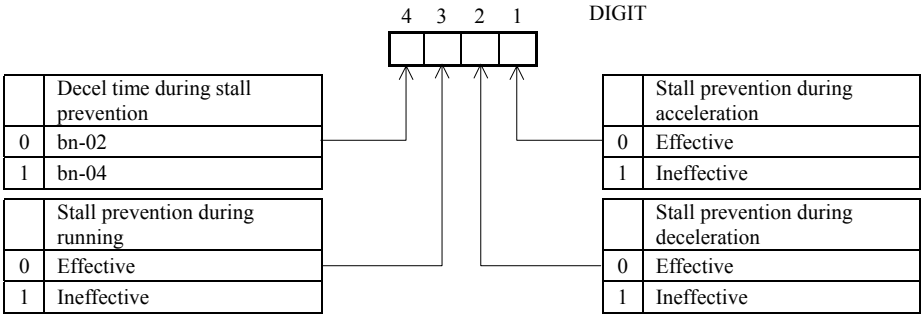
Protective characteristics can be selected by Sn-10, Sn-11, Sn-12 and Sn-14.

(Example) Operation is continued after recovery from momentary power loss and the electronic thermal protection is turned OFF.

| Description | Keypad Operation | Digital Operator Display | Remarks |
|---|---|---|---|
| • Select PRGM mode. | PRGM / DRIVE | An-01 | LED DRIVE OFF |
| • Select Sn-11. | DSPL ∧ ∨ | Sn-11 | |
| • Constant set value is displayed. | DATA ENTER | 0000 | ● Refer to pages 29 and 30. |
| • Set or change constant. | RESET ∧ ∨ | 0100 | |
| • Constant value is written in. | DATA ENTER | End | Displayed for 0.5 second. Confirm the display for each constant. |
| | DSPL ∧ ∨ | Sn-14 | |
| • Constant set value is displayed. | DATA ENTER | 0000 | |
| • Set or change constant. | RESET ∧ ∨ | 0001 | |
| • Constant value is written in. | DATA ENTER | End | Displayed for 0.5 second. Confirm the display for each constant. |

✳ Protective characteristics

## Sn-10 Protective characteristic 1 (stall prevention)



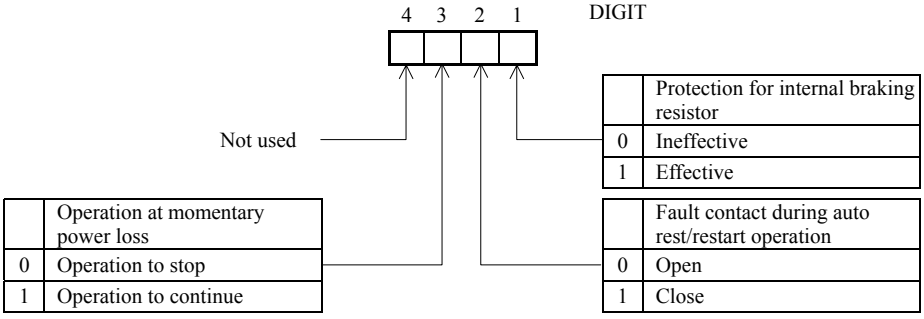

| | Decel time during stall prevention |
|---|---|
| 0 | bn-02 |
| 1 | bn-04 |

| | Stall prevention during acceleration |
|---|---|
| 0 | Effective |
| 1 | Ineffective |

| | Stall prevention during running |
|---|---|
| 0 | Effective |
| 1 | Ineffective |

| | Stall prevention during deceleration |
|---|---|
| 0 | Effective |
| 1 | Ineffective |

## Sn-11 Protective characteristic 2 (Momentary power loss ride-thru)

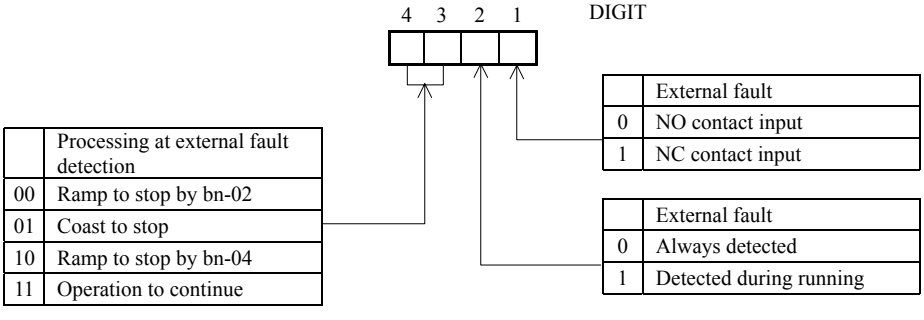



| | Protection for internal braking resistor |
|---|---|
| 0 | Ineffective |
| 1 | Effective |

| | Operation at momentary power loss |
|---|---|
| 0 | Operation to stop |
| 1 | Operation to continue |

| | Fault contact during auto rest/restart operation |
|---|---|
| 0 | Open |
| 1 | Close |

## Sn-12 Protective characteristic 3 (External fault terminal 3)

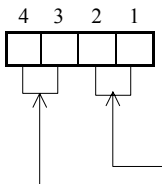



| | External fault |
|---|---|
| 0 | NO contact input |
| 1 | NC contact input |

| | Processing at external fault detection |
|---|---|
| 00 | Ramp to stop by bn-02 |
| 01 | Coast to stop |
| 10 | Ramp to stop by bn-04 |
| 11 | Operation to continue |

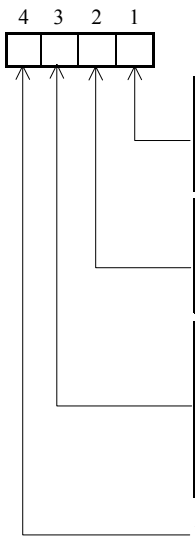
| | External fault |
|---|---|
| 0 | Always detected |
| 1 | Detected during running |

## Sn-13 Protective characteristic 4 (Fan fault protection)




| | Process at fan fault detection |
|---|---|
| 00 | Ramp to stop by bn-02 |
| 01 | Coast to stop |
| 10 | Ramp to stop by bn-04 |
| 11 | Operation to continue |

## Sn-14 Protective characteristic 5 (Motor protection)




| | Electronic thermal motor protection |
|---|---|
| 0 | Effective |
| 1 | Ineffective |

| | Electronic thermal characteristics |
|---|---|
| 0 | For standard motor |
| 1 | For constant torque motor |

| | Electronic thermal time constant |
|---|---|
| 0 | For standard motor and constant torque motor |
| 1 | For motor other than listed in 0 above. (Short time rating) |

## 6.5 MULTI-FUNCTION INPUT SELECTION Sn-04, Sn-15 to -19, bn-09

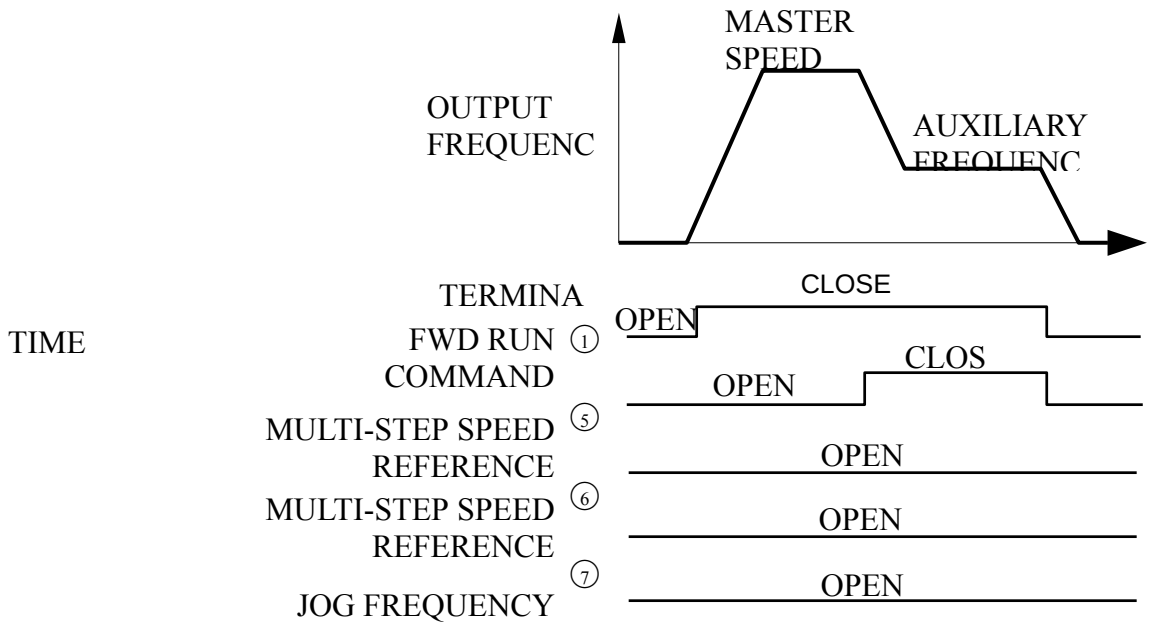
Response to constant input is selected by the setting of Sn-15 to -19.

(Example 1) 2-step speed operation by analog reference. (Set Sn-04 to 0000)

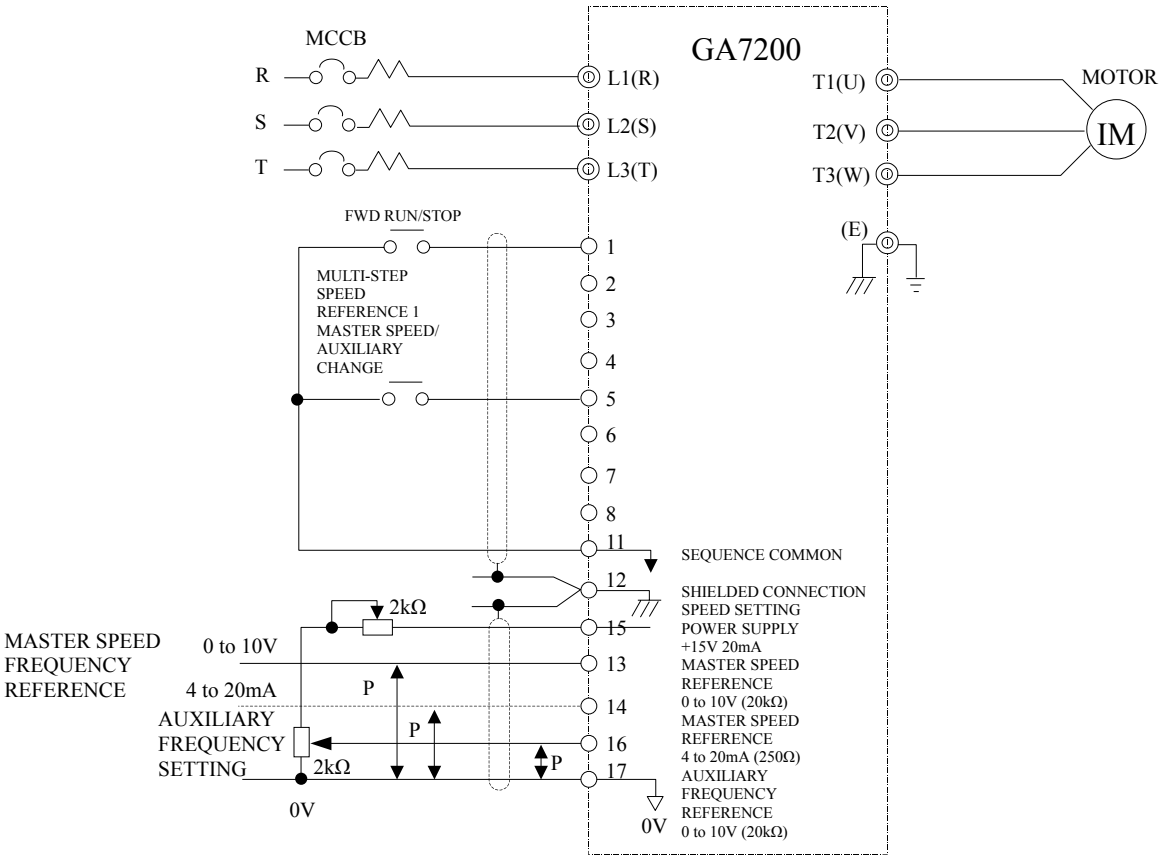
| Keypad Operation | Digital Operator Display |
|---|---|
| DSPL, ^, v, DATA ENTER | Sn-04 / 0000 |

| Constant Setting | | | | |
|---|---|---|---|---|
| Terminal | Sn- | Set Value | Factory Setting | Name |
| 5 | 15 | 3 | 3 | Multi-step speed reference 1 |
| 6 | 16 | 4 | 4 | Multi-step speed reference 2 |
| 7 | 17 | 6 | 6 | Jog frequency * |
| 8 | 18 | 8 | 8 | External baseblock command |
| 16 | 19 | 0 | 0 | Auxiliary frequency |

* If jog frequency reference and multi-step speed reference (1, 2) are turned ON simultaneously, jog frequency reference has priority.



# 6.5 MULTI-FUNCTION INPUT SELECTION Sn-04, Sn-15 to -19, bn-09 (Cont'd)



(Example 2) 5-step speed operation + energy-saving operation (terminal 8)

| Keypad Operation | Digital Operator Display | Remarks |
|---|---|---|
| DSPL<br>DATA ENTER<br>RESET<br>DATA ENTER<br>Only check set value<br>DSPL<br>DATA ENTER | Sn-18<br>0.0<br>60.0<br>End<br>bn-09<br>0.80 | Displayed for 0.5 second. Confirm the display for each constant. |

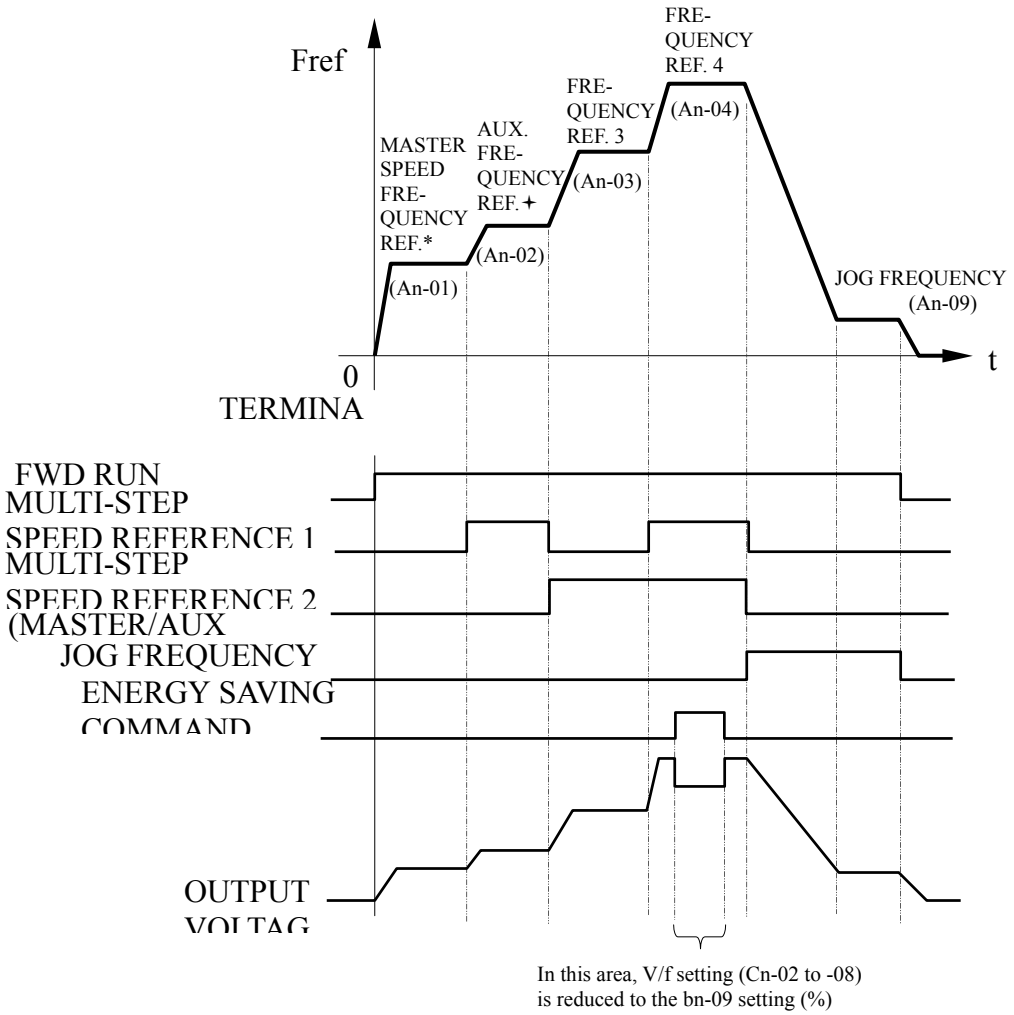
The following shows a sequence to perform 5-step speed operation.

| Constant Setting | | | | |
|---|---|---|---|---|
| Terminal | Sn- | Set Value | Factory Setting | Name |
| 5 | 1 | 3 | 3 | Multi-step speed reference 1 * |
| 6 | 16 | 4 | 4 | Multi-step speed reference 2 ✦ |
| 7 | 17 | 6 | 6 | Jog frequency ⁂ |
| 8 | 18 | 63 | 8 | Energy-saving operation |

* For combination of multi-step speed operations, refer to pages 85 and 86.

✦For frequency reference, set in the form□.□ An- .

⁂Jog reference has priority over multi-step speed reference (1,2) when they are turned ON simultaneously.




* When Sn-04 is set to × × × 1, that value will be the internal set value (An-01).

\+ When Sn-19 is set with any value other than 00, An-02 will be effective. When multi-function analog reference input is not used, set 0F as the set value.

(Example 3) 9-step speed operation

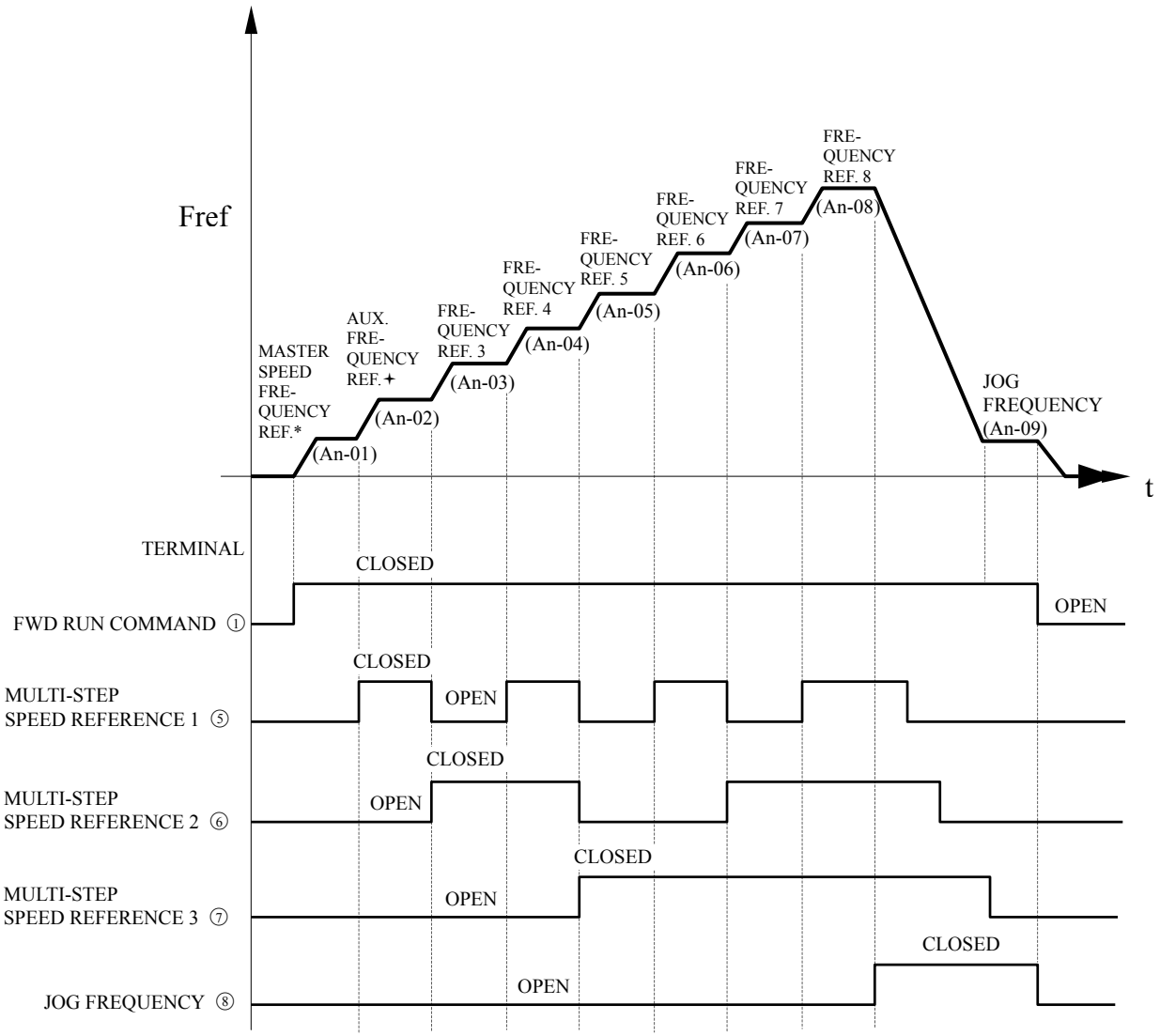
| Keypad Operation | Digital Operator Display | Remarks |
|---|---|---|
| DSPL, DATA/ENTER | Sn-17 | |
| | 06 | |
| RESET, DATA/ENTER | 05 | Displayed for 0.5 second. Confirm the display for each constant. |
| | End | |
| DSPL, DATA/ENTER | Sn-18 | |
| | 08 | |
| RESET, DATA/ENTER | 05 | Displayed for 0.5 second. Confirm the display for each constant. |
| | End | |

| Constant Setting | | | | |
|---|---|---|---|---|
| Terminal | Sn- | Set Value | Factory Setting | Name |
| 5 | 15 | 3 | 3 | Multi-step speed reference 1 * |
| 6 | 16 | 4 | 4 | Multi-step speed reference 2 ✦ |
| 7 | 17 | 6 | 6 | Multi-step speed reference 3 |
| 8 | 18 | 63 | 8 | Jog frequency ⁂ |

* For combination of multi-step speed operations, refer to pages 85 and 86.

✦For frequency reference, set in the form C An- .

⁂Jog reference has priority over multi-step speed reference (1 to 3) when they are turned ON simultaneously.




* When Sn-04 is set to × × × 1, that value will be the internal set value (An-01).

\+ When Sn-19 is set with any value other than 00, An-02 will be effective. When multi-function analog reference input is not used, set 0F as the set value.

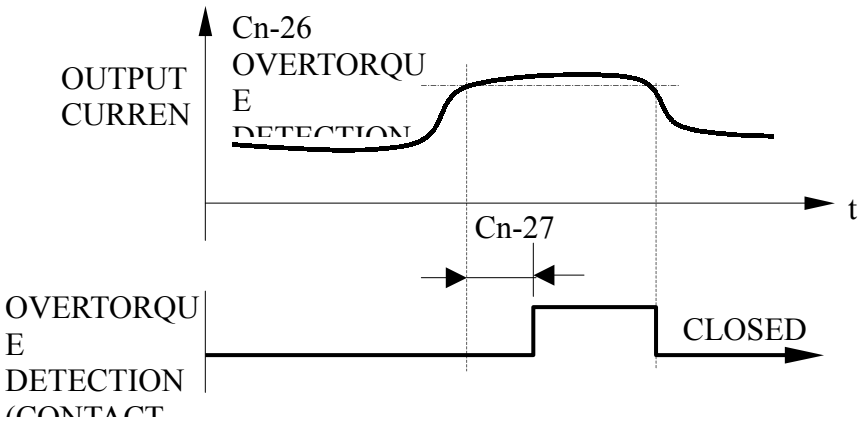
## 6.6 CONTACT OUTPUT SELECTION Sn-20

Contact output function can be selected by the setting of Sn-20.

**(Example) Overtorque signal is read out from contact output.**

- Applicable inverter: 230V, 10HP (rated current 32A)
- Applicable motor : 10HP (7.5kW), 4P (motor rated current 26.8A) (TECO MOTOR)

Overtorque detection level is equivalent to motor rated torque. Set a mode in which overtorque signal is output only when overtorque is detected during constant speed running. Inverter rated current is regarded as 100% value.



## 6.6 CONTACT OUTPUT SELECTION Sn-20 (Cont'd)

| Keypad Operation | Digital Operator Display | Remarks |
|---|---|---|
| DSPL, DATA ENTER | Sn-07 | |
| | 0000 | |
| RESET, DATA ENTER | 0001 | |
| | End | Displayed for 0.5 second. Confirm the display for each constant. |
| DSPL, DATA ENTER | Sn-20 | |
| | 0.0 | |
| RESET, DATA ENTER | 0.5 | |
| | End | |
| DSPL, DATA ENTER | Cn-26 | |
| | 160 | $\frac{26.8A}{32A}$ X100% |
| RESET, DATA ENTER | 084 | =84% |
| | End | Displayed for 0.5 second. Confirm the display for each constant. |
| DSPL, DATA ENTER | Cn-27 | |
| | 0.0.1 | |

**Application Example**

As with an extruder, a cutter, or other machines, when a load is applied beyond a given set value, the machines (particularly cutting tools) should be protected.

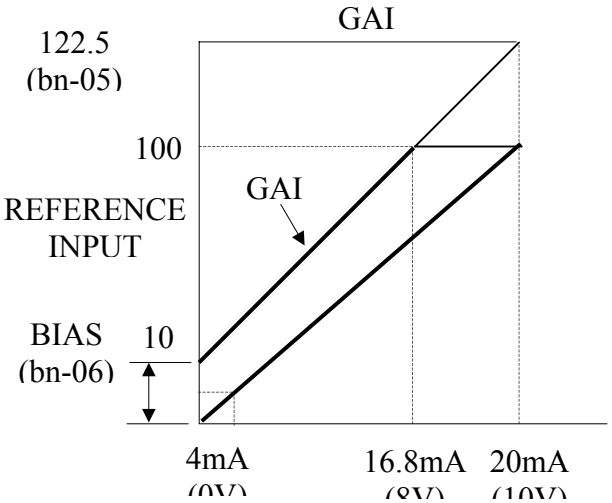
## 6.7 FREQUENCY REFERENCE CHANGE bn-05, -06

Any output frequency value for frequency set value (0 to 10V or 4 to 20mA) can be set.

(Example)
Adjust to 10% speed (6Hz) at frequency reference input 4mA and 100% speed at 16.8mA (Set bn-05 = 0122.5 and bn-06 = +010).

| Keypad Operation | Digital Operator Display | Remarks |
|---|---|---|
| DSPL | bn-05 | |
| DATA ENTER | 0100.0 | |
| RESET | 0122.5 *1 | Displayed for 0.5 second. Confirm the display for each constant. |
| DATA ENTER | End | |
| DSPL | bn-06 | |
| DATA ENTER | 0000 *2 | Displayed for 0.5 second. Confirm the display for each constant. |
| RESET | 0001 | |
| DATA ENTER | End | |

## 6.7 FREQUENCY REFERENCE CHANGE bn-05, -06 (Cont'd)




FREQUENCY REFERENCE INPUT

Note: Frequency reference gain (bn-05) and frequency reference bias (bn-06) can be changed while running in DRIVE mode.

*1 How to calculate gain

$X = \frac{100-b}{a}$ … (1) $G = X+b$ … (2)

X is obtained from equation (1)

$X = \frac{100-10}{0.8} = 112.5$

G is obtained by substituting X obtained in equation (1) to equation (2).

G = 112.5 + 10 = 122.5

a: Reference input ratio at 100% frequency. Since it is 100% speed (60 Hz) at 16.8mA in this example, the following equation is established.

$\frac{16.8mA-4mA}{20mA-4mA} = 0.8a = 0.8$

b: Bias level (%)
Since it is 10% (6Hz) at frequency requence input 4mA in this example, the following equation is established.
b = 10

G: Gain set value
122.5 in this example

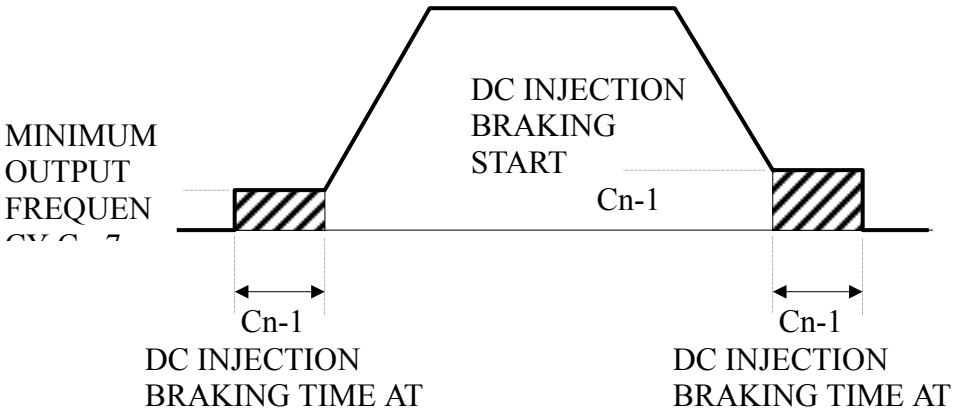
*2 in the uppermost digit indicates "+ (plus)."
－is displayed when it is "(－minus)."

**Application Example**

For instrumentation input of 4 to 20mA , the amount should be adjusted at startup. Maximum frequency should be adjusted.

## 6.8 DC INJECTION BRAKING (DC) Cn-10 to -13

DC injection braking at starting or stopping function is selected by the setting of Cn-10 to -13.




Time Chart of DC injection braking time at starting.

(Example) Set 3 seconds to DC injection braking time at starting.

| Keypad Operation | Digital Operator Display | Remarks |
|---|---|---|
| DSPL, ∧, ∨, DATA ENTER, RESET, ∧, ∨, DATA ENTER | Cn-13<br>0.0<br>3.0<br>End | Displayed for 0.5 second. Confirm the display for each constant. |

**Application Example**

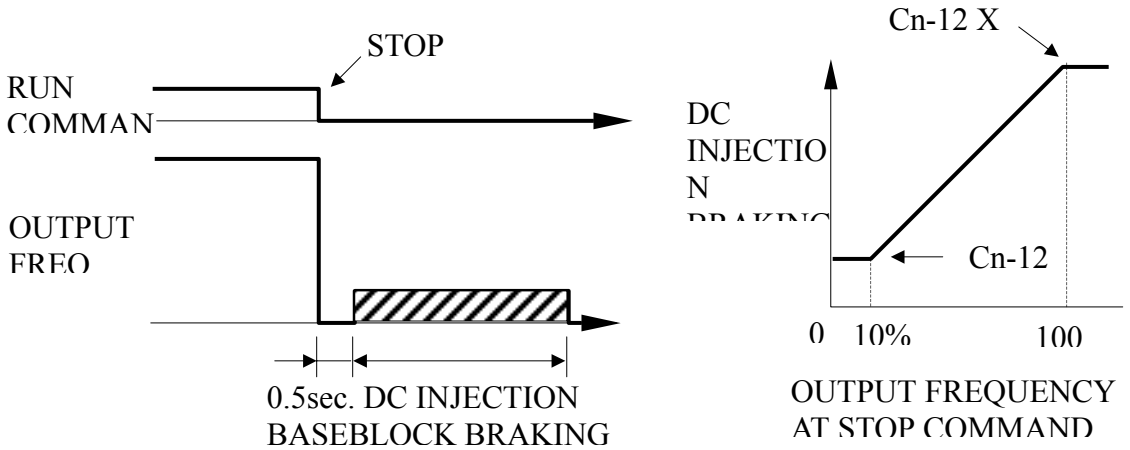
When an idle fan slips and the direction of rotation is indefinite, “OC” and “OV” trip should be avoided.

## 6.9 FULL-RANGE DC INJECTION BRAKING STOP (DCB STOP)

**Sn-04 = 10XX, Cn-12**

When the full-range DC injection braking stop function is used, the inverter can be stopped without a braking resistor. When stop command is input, DC injection braking stop is executed. DC injection braking time while stopping is set by Cn-12 at 10% speed and varies according to output frequency at stop command input as shown below.

<Time Chart>




(Example)
Full-range DC injection braking stop is selected to set DC injection braking time to 1 second.

| Keypad Operation | Digital Operator Display | Remarks |
|---|---|---|
| DSPL ▲ ▼<br>DATA ENTER | Sn-04 | |
| | 0011 | |
| ▲ ▼<br>DATA ENTER | 0011 | |
| | End | Displayed for 0.5 second. Confirm the display for each constant. |
| DSPL ▲ ▼<br>DATA ENTER | Cn-12 | |
| | 00.5 | |
| RESET ▲ ▼<br>DATA ENTER | 01.0 | |
| | End | Displayed for 0.5 second. Confirm the display for each constant. |

**Application Example**

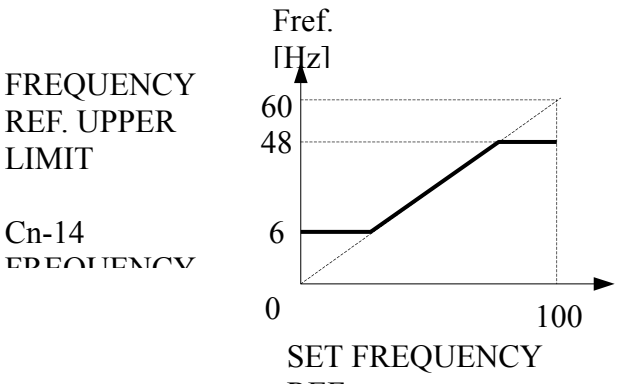
DC injection brake should be applied sparingly without a braking resistor. (Within 3 - 5% duty cycle).

## 6.10 UPPER/LOWER LIMT OF FREQUENCY REFERENCE Cn-14 , -15

Output frequency upper/lower limit value can be set.
When the lower limit value is less than minimum output frequency, rotation continues at the lower limit value until frequency reference reaches the value, by inputting the run command.

(Example)
Set upper, lower limit of frequency reference.
Upper limit: 80% of set frequency
Lower limit: 10% of set frequency

| Keypad Operation | Digital Operator Display | Remarks |
|---|---|---|
| DSPL | Cn-14 | |
| DATA ENTER | 100 | |
| RESET | 080 | |
| DATA ENTER | End | Displayed for 0.5 second. Confirm the display for each constant. |
| DSPL | Cn-15 | |
| DATA ENTER | 000 | |
| RESET | 010 | Displayed for 0.5 second. Confirm the display for each constant. |
| DATA ENTER | End | |




Note: Setting Cn-14 to 109% enables frequency up to Cn-02 × 1.09 to be output.

Example: Assuming Cn-02 = 60Hz, Cn-14 = 109Hz, up to 65.4Hz can be output. However, when 400Hz is exceeded, the value is clamped to 400Hz.

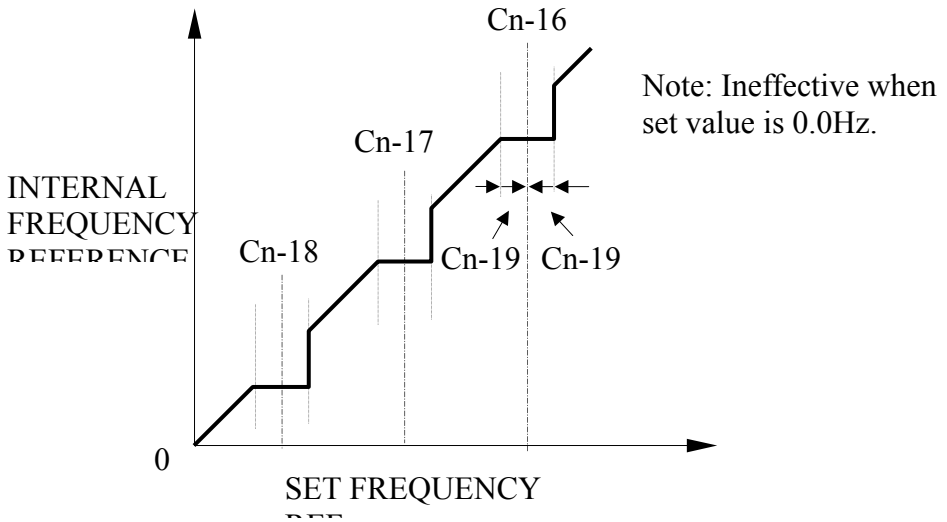
**Application Example**

The maximum air quantity (upper limit) allowed and the minimum air quantity (lower limit) required should be maintained for a fan or a blower.

## 6.11 PROHIBITED (SKIP) FREQUENCY Cn-16 to -19

When an operation is required to avoid mechanical resonance frequency, the setting prohibited frequency function is effective.

Setting prohibited frequency is set in Cn-16 to -18 in units of 0.1Hz.
Setting prohibited frequency width is set to Cn-19 in units of 0.1Hz.




(Example) 30Hz ± 0.5Hz setting is prohibited.

| Keypad Operation | Digital Operator Display | Remarks |
|---|---|---|
| DSPL<br>DATA ENTER | Cn-16 | |
| | 00.0 | |
| RESET<br>DATA ENTER | 030.0 | Displayed for 0.5 second. Confirm the display for each constant. |
| | End | |
| DSPL<br>DATA ENTER | Cn-19 | |
| | 01.0 | Initial value 1.0Hz |
| RESET<br>DATA ENTER | 00.5 | Displayed for 0.5 second. Confirm the display for each constant. |
| | End | |

**Application Example**

Operation avoiding mechanical resonance points in HVAC systems are required.

## 6.12 DISPLAY MODE CHANGE Cn-20

(Example)

Frequency reference Ar□□ is set or read in the units of 0.01%.

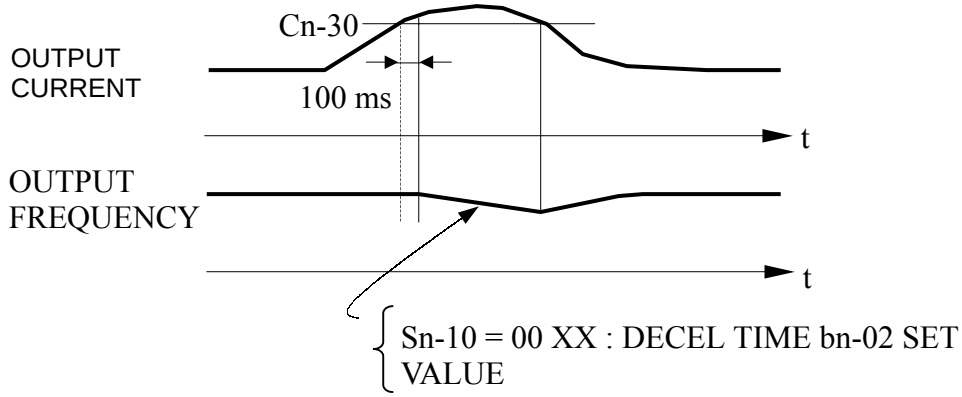
| Keypad Operation | Digital Operator Display | Remarks |
|---|---|---|
| DSPL, DATA ENTER, RESET, ▲, ▼, DATA ENTER | Cn-20 → 0000 → 0000 → End | Displayed for 0.5 second. Confirm the display for each constant. |

# Operator Display Mode

| Cn-20 | Unit of Setting / Reading |
|---|---|
| 0 | Units of 0.01Hz |
| 1 | Units of 0.01% |
| 2 to 39 | Unit of r/min (0 to 39999)<br>r/min = 120 × frequency reference (Hz) / Cn-20<br>(Cn-20 is the number of motor poles) |
| 40 to 39999 | The position of decimal point is set by the value of the 5th digit of Cn-20.<br>Value of 5th digit = 0 : Displayed as xxxx<br>Value of 5th digit = 1 : Displayed as xxx.x<br>Value of 5th digit = 2 : Displayed as xx.xx<br>Value of 5th digit = 3 : Displayed as x.xxx<br>A set value of 100% frequency is determined by the 1st digit to 4th digit of Cn-20.<br>Example 1 : when the set value of 100% speed is 200.0.<br>Cn-20 = 12000 is entered<br>Example 2 : when the set value of 100% speed is 65.00.<br>Cn-20 = 26500 is entered |

## 6.13 STALL PREVENTION LEVEL WHILE RUNNING Cn-30 (Sn-10)

If the inverter output current exceeds Cn-30 stall prevention level for more than 100ms, the output frequency will decrease until output current is below value in Cn-30. Once current has dropped below set value in Cn-30, the inverter rated current will increase back to set value operation. Inverter rated current is regarded as 100%.




(Example) Stall prevention level while ring running 120%.
Decel time bn-04 set value.

| Keypad Operation | Digital Operator Display | Remarks |
|---|---|---|
| DSPL ^ v<br>DATA ENTER | Cn-30<br>160 | |
| RESET ^ v<br>DATA ENTER | 120<br>End | Displayed for 0.5 second. Confirm the display for each constant. |
| DSPL ^ v<br>DATA ENTER | Sn-10<br>0000 | |
| RESET ^ v<br>DATA ENTER | 0000<br>End | Displayed for 0.5 second. Confirm the display for each constant. |

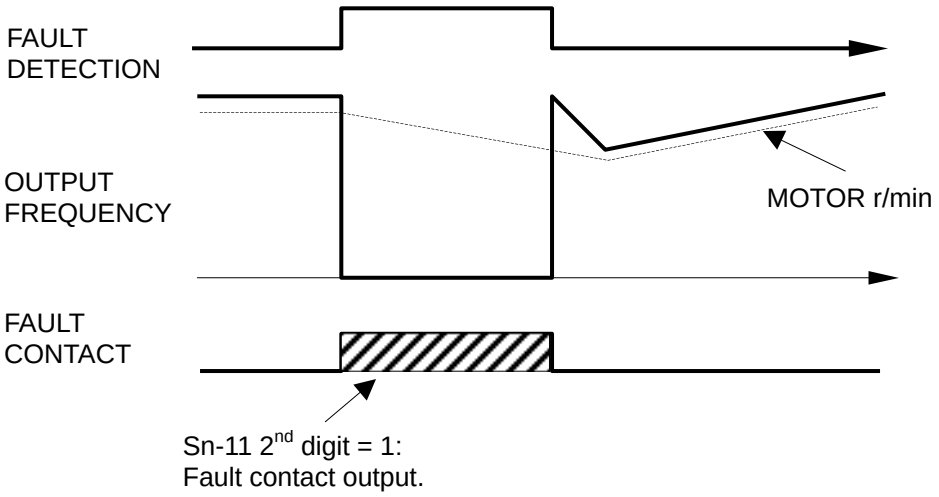
**Application Example**

Rotation speed should be automatically reduced for rated operation regardless of possible overload, and on return to normal load, the previous rotation speed should be maintained.

## 6.14 AUTO RESET/RESTART OPERATION AT FAULT (FAULT RETRY) Cn-36

If a protective function (OC, OV, OL1, OL2, OL3, OH, UV1) operates while running, auto reset/restart function can be selected. Reset/restart operation can be performed up to 10 times. By setting Cn-36 to 0, reset/restart operation at fault will not performed.

< Time Chart >




| Keypad Operation | Digital Operator Display | Remarks |
|---|---|---|
| DSPL ^ v<br>DATA ENTER | Sn-11 | |
| | 0000 | |
| RESET ^ v<br>DATA ENTER | 0010 | Displayed for 0.5 second. Confirm the display for each constant. |
| | End | |
| DSPL ^ v<br>DATA ENTER | Cn-36 | |
| | 00 | |
| RESET ^ v<br>DATA ENTER | 03 | Displayed for 0.5 second. Confirm the display for each constant. |
| | End | |

**Application Example**

If the inverter protection function operates due to lightning surge, automatic reset will be attempted about four or five times to continue operation without stopping the motor.

## 6.15 INITIALIZING CONSTANTS Sn-03

(Example) Replacing control board.

Select inverter capacity and set V/f pattern and initialize constants.
All constants except Sn-01 (inverter capacity) and Sn-02 (V/f pattern) are initialized to the data at the factory prior to shipment.

| Description | Keypad Operation | Digital Operator Display | Remarks |
|---|---|---|---|
| Power ON<br>• Frequency reference value is displayed. | | F 0.00 | |
| Set inverter capacity<br>• Select PRGM mode. | PRGM<br>DRIVE | An-01 | LED DRIVE OFF. |
| Select<br>• Select inverter capacity constant (Sn-01). | DSPL<br>Depress twice | Sn-01 | |
| • Sn-01 data is displayed. | DATA ENTER | 26 | |
| • Change set value. | RESET, ^, v | 02 | |
| • Set value is written in. | DATA ENTER | End | Displayed for 0.5 second. Confirm the display for each constant. |
| Set V/f pattern<br>• Select V/f pattern constant (Sn- ). | DSPL | Sn-01 | |
| Select 60HZ stand. patter<br>• Select Sn-02. | ^, v | Sn-02 | |
| • Sn-02 data is displayed. | DATA ENTER | 26 | |
| • Change set value. | RESET, ^, v | 01 | |
| • Set value is written in. | DATA ENTER | End | Displayed for 0.5 second. Confirm the display for each constant. |
| Cont’ | | | |

# 6.15 INITIALIZING CONSTANTS Sn-03

| Description | Keypad Operation | Digital Operator Display | Remarks |
|---|---|---|---|
| Cont' | | | |
| Constant is initialized<br>• Select initialization constant. | DSPL | Sn-02 | . |
| • Select Sn-03. | ∧ ∨ | Sn-03 | |
| • Data is displayed. | DATA ENTER | 0000 | |
| • Set to " 1110". | RESET ∧ ∨ | 1110 | |
| • Set value is written in. | DATA ENTER | End | Displayed for 0.5 second. Confirm the display for each constant. |
| ( DATA ENTER ) | | | |
| End<br>• Switch to DRIVE mode. | PRGM DRIVE | F 00.00 | LED DRIVE lights. |

# 7. CONSTANTS/FUNCTION LIST

## 7.1 FREQUENCY REFERENCE **An-□□ .**

These references are used during multi-speed operation. Set values of An-□ □can be changed or read during running in DRIVE mode.

List of An- □ □ constants

| An-□ □ | Data Name | Unit | Setting - Range | Factory Setting |
|---|---|---|---|---|
| 01 | Frequency reference 1 | 0.01Hz | 0.00Hz to 400.00Hz | 0.00Hz |
| 02* | Frequency reference 2 | 0.01Hz | 0.00Hz to 400.00Hz | 0.00Hz |
| 03 | Frequency reference 3 | 0.01Hz | 0.00Hz to 400.00Hz | 0.00Hz |
| 04 | Frequency reference 4 | 0.01Hz | 0.00Hz to 400.00Hz | 0.00Hz |
| 05 | Frequency reference 5 | 0.01Hz | 0.00Hz to 400.00Hz | 0.00Hz |
| 06 | Frequency reference 6 | 0.01Hz | 0.00Hz to 400.00Hz | 0.00Hz |
| 07 | Frequency reference 7 | 0.01Hz | 0.00Hz to 400.00Hz | 0.00Hz |
| 08 | Frequency reference 8 | 0.01Hz | 0.00Hz to 400.00Hz | 0.00Hz |
| 09 | Jog frequency reference 9 | 0.01Hz | 0.00Hz to 400.00Hz | 6.00Hz |

*Sn-19 must be set to 1.

Note: An-□□ setting/reading units differ according to operator display mode (Cn-20) set values. The factory setting is 0.01Hz.

## 7.2 CONSTANTS CHANGE WHILE RUNNING **bn-□□ .**

Set values of bn-□ □can be changed or read while running in DRIVE mode.

List of bn- □ □ constants

| bn-□□ | Data Name | Unit | Setting - Range | Factory Setting |
|---|---|---|---|---|
| 01 | Acceleration time 1 | 0.1s | 0.0 to 6000.0s | 10.0s |
| 02* | Deceleration time 1 | 0.1s | 0.0 to 6000.0s | 10.0s |
| 03 | Acceleration time 2 | 0.1s | 0.0 to 6000.0s | 10.0s |
| 04 | Deceleration time 2 | 0.1s | 0.0 to 6000.0s | 10.0s |
| 05 | Frequency reference gain | 0.1% | 0 to 1000.0% | I00% |
| 06 | Frequency reference bias | 1% | -100 to 100% | 0% |
| 07 | Torque compensation gain | 0.1 | 0.0 to 9.9 | 1.0 |
| 08 | Motor rated slip | 0.1% | 0.0 to 9.9% | 0.0% |
| 09 | Energy-saving level gain | 1% | 0 to 200% | 80% |
| 10 | Monitor no. after turning ON power supply | — | 1 to 3 | 1 |
| 11 | Analog monitor gain | 0.01 | 0.01 to 2.55 | 1.00 |
| 12 | Not used | — | — | — |

## 7.2 CONSTANT CHANGE WHILE RUNNING **bn- □□ (Cont'd)**

**(1) Acceleration Time 1 (bn-01)**
Acceleration time 1 is enabled when the accel/decel time change command of multi-function terminals is “open”, or the accel/decel time change function is not provided for the multifunction terminals. The acceleration time, in which frequency reference goes from 0% to 100%, is set in units of 0.1 second.

**(2) Deceleration Time 1 (bn-02)**
Deceleration time 1 is enabled when the accel/decel time change command of multi-function terminals is “open”, or the accel/decel time change function is not provided for the multifunction terminals. The deceleration time, in which frequency reference goes from 100% to 0%, is set in units of 0.1 second.

**(3) Acceleration Time 2 (bn-03)**
Acceleration time 2 is enabled when the accel/decel time change command of multi-function terminals is “closed”. The acceleration time, in which frequency reference goes from 0% to 100%, is set in units of 0.1 second.

**(4) Deceleration Time 2 (bn-04)**
Deceleration time 2 is enabled when the accel/decel time change command of multi-function terminals is “closed”. The deceleration time, in which frequency reference goes from 100% to 0%, is set in units of 0.1 second.

**(5) Frequency Reference Gain (bn-05)**
The input level when frequency reference voltage is 10V is set in units of 1%. Examples are shown below.

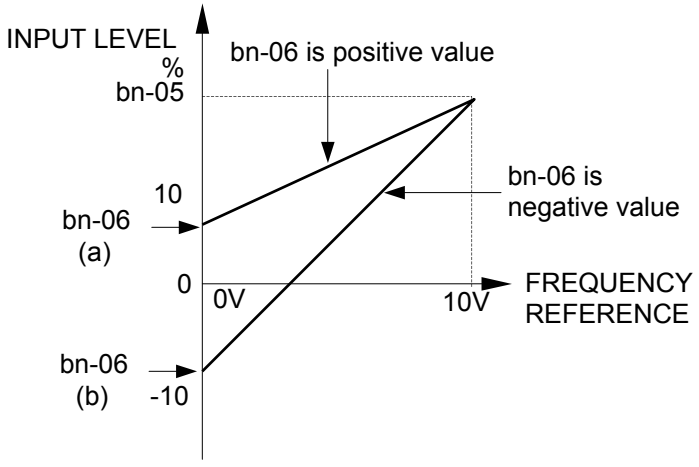
**(6) Frequency Reference Bias (bn-06)**
The input level when frequency reference voltage is 0V is set in units of 1%.

< Example >

① bn-05 = 50

② a: bn-06 = 10

b: bn-06 = -10

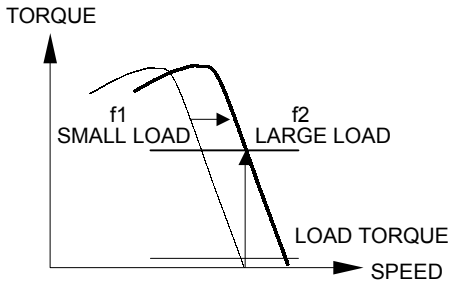


**(7) Torque Compensation Gain (bn-07)**

Torque compensation gain is set in units of 0.1.

**(8) Motor Rated Slip (bn-08)**

Motor Rated slip is set in units of 0.1%




Simplified speed control is performed without encoder (PG or TG).
With frequency offset $f_1$ to $f_2$, speed fluctuation due to load is reduced.

When the output current of the inverter is larger than motor no-load current (Cn-34), the output frequency of the inverter is compensated.

The amount of frequency compensation is determined by the formula below. The maximum voltage frequency (Cn-04) is 100%.

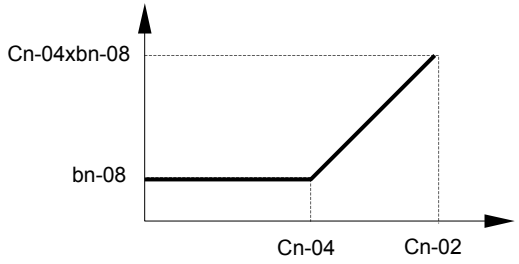
If the output current is equal to the motor rated current (Cn-09), the output frequency is compensated for by the motor rated slip (bn-08).

If frequency reference is equal to or smaller than minimum output frequency (Cn-07) or motor is in a regeneration mode, slip compensation is not performed.

The amount of output frequency compensation in a constant torque area and a constant output area is shown in the figure below.

Amount of output frequency compensation =

$$\frac{\text{motor rated slip}}{\left(\text{motor rated current} - \text{motor no-load current}\right)} \times \left(\text{output current} - \text{motor no-load current}\right)$$




Motor rated current: Cn-09
Motor no-load current: Cn-34
Motor rated slip: bn-08

When 0.0 is set in bn-08, output frequency compensation is not performed.

**(9) Energy-saving Level Gain (bn-09)**
Energy-saving level gain is set in units of 1%.

**(10) Monitor No. after Turning ON Power Supply (bn-10)**
Data to be monitored after turning ON power supply is selected with constant No. in the form of Un-□□.

① Frequency reference

② Output frequency

③ Output current

**(11) Multi-function Analog Output (bn-11)**
The multi-function analog output is set in the form of 10V × XX.

<Example> When 5V is set as the 100% level, specify bn-11=0.5.

**(12) Calibrating Meter**
Multi-function analog output.

When bn-11 is displayed in PRGM mode, a 100%-level voltage is output by the set value of bn-11.

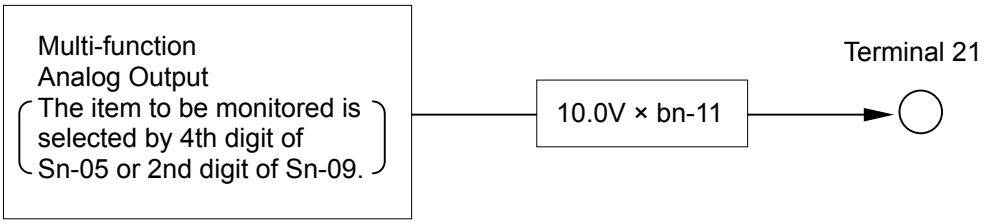



Diagram of Multi-function Analog Output

# 7.3 SYSTEM CONSTANTS **Sn-□□**

## System Constants List (1/5)

| Function | Sn-□□ | Data Name | Description | | 4th Digit | 3rd Digit | 2nd Digit | 1st Digit | Factory Setting |
|---|---|---|---|---|---|---|---|---|---|
| Basic Setting Constant | 01 | Inverter Capacity | Inverter capacity selection | | | | | | ——*1 |
| | 02 | V/f | V/f pattern selection | | | | | | 01 |
| Operator Status | 03 | Display of Operator | 0000 | Setting and reading of An-□□ , bn-□□ , Sn-□□ , Cn-□□ enabled | | | | | 0000 |
| | | | 0101 | Setting and reading of An-□□ : reading of bn-□□ , Sn-□□ , Cn-□□ enabled | | | | | |
| | | Constants Initialization | 1110 | Constants initialization (Multi-function terminals are preset prior to shipping) *2 | | | | | |
| | | | 1111 | Constants initialization (For multi-function terminals, refer to Table of *2) | | | | | |
| Operation Mode Selection 1 | 04 | | | | 4th Digit | 3rd Digit | 2nd Digit | 1st Digit | 0011 |
| | | Operation Method Selection | Master frequency reference by analog input of control circuit terminals 13, 14 | | — | — | — | 0 | |
| | | | Master frequency reference from keypad | | — | — | — | 1 | |
| | | | Control circuit terminal operation effective | | — | — | 0 | — | |
| | | | Keypad operation reference effective | | — | — | 1 | — | |
| | | Stopping Method Selection | RAMP stop | | 0 | 0 | — | — | |
| | | | Coast to stop | | 0 | 1 | — | — | |
| | | | Full-range DC injection braking stop | | 1 | 0 | — | — | |
| | | | Coast to stop (timer function provided) | | 1 | 1 | — | — | |
| Operation Mode Selection 2 | 05 | Priority of Stopping | STOP key effective during operation from control terminal. | | — | — | — | 0 | 0000 |
| | | | STOP key ineffective during operation from control terminal. | | — | — | — | 1 | |
| | | REV RUN Prohibit | REV RUN enabled | | — | — | 0 | — | |
| | | | REV RUN disabled | | — | — | 1 | — | |
| | | Control Input Scan | Control inputs are scanned twice before being accepted by MPU. | | — | 0 | — | — | |
| | | | Control inputs are scanned once before being accepted by MPU. | | — | 1 | — | — | |
| | | Analog Monitor Output | Selection of item to be analog output (terminals 21,22) *3 | | 0 | — | — | — | |
| | | | Selection of item to be analog output (terminals 21,22) *3 | | 1 | — | — | — | |

# System Constants List (2/5)

| Function | Sn-□□ | Data Name | Description | 4th Digit | 3rd Digit | 2nd Digit | 1st Digit | Factory Setting (4th Digit 3rd Digit 2nd Digit 1st Digit) |
|---|---|---|---|---|---|---|---|---|
| Operation Mode Selection 3 | 06 | S-curve at Accel / Decel Time | 0.2 second S-curve | — | — | 0 | 0 | 0000 |
| | | | No S-curve | — | — | 0 | 1 | |
| | | | S-curve 0.5 second | — | — | 1 | 0 | |
| | | | S-curve 1.0 second | — | — | 1 | 1 | |
| | | Input Reference | Response to master frequency reference: 0 to 100% at 0 to 10V (4 to 20mA) | — | 0 | — | — | |
| | | | Response to master frequency reference: 0 to 100% at 10 to 0V (20 to 4mA) | — | 1 | — | — | |
| | | Processing When Frequency Reference is Missing | Stop by reference input | 0 | — | — | — | |
| | | | Operation to continue with 80% of frequency reference | 1 | — | — | — | |
| Operation Mode Selection 4 (Overtorque Detection) | 07 | Overtorque Detection | Overtorque detection disabled | — | — | — | 0 | 0000 |
| | | | Overtorque detection enabled | — | — | — | 1 | |
| | | | Enabled only if at agreed frequency | — | — | 0 | — | |
| | | | Enabled during operation (except during DC injection) | — | — | 1 | — | |
| | | | Operation continued after overtorque is detected | — | 0 | — | — | |
| | | | Coasts to stop if overtorque is detected | — | 1 | — | — | |
| | | | Not used | 0 | — | — | — | |
| Operation Mode Selection 5 | 08 | Priority of Frequency Reference (When input option card is used) | Frequency reference is from option card (if installed) | — | — | — | 0 | 0100 |
| | | | Frequency reference is from inverter | — | — | — | 1 | |
| | | Priority of Run Command (When input option card is used) | Run command is from option card (if installed) | — | — | 0 | — | |
| | | | Run command is from inverter | — | — | 1 | — | |
| | | Stopping Method Selection at Communication Interface Card (SC-C) Communication Error | Ramp stop (decel time: bn-02) | 0 | 0 | — | — | |
| | | | Coast to stop | 0 | 1 | — | — | |
| | | | Ramp stop (decel time: bn-04) | 1 | 0 | — | — | |
| | | | Operation to continue | 1 | 1 | — | — | |

# 7.3 SYSTEM CONSTANTS Sn-□□ (Cont'd)

## System Constants List (3/5)

| Function | Sn-□□ | Data Name | Description | 4th Digit | 3rd Digit | 2nd Digit | 1st Digit | Factory Setting (4th Digit 3rd Digit 2nd Digit 1st Digit) |
|---|---|---|---|---|---|---|---|---|
| Operation Mode Selection 6 | 09 | Analog Output Selection Method | Analog output (terminals 21-22) depends on Sn-05 4th digit and Sn-09 2nd digit | — | — | — | 0 | 0000 |
| | | | Analog output (terminals 21-22) is set by communication interface card (SC-C) | — | — | — | 1 | |
| | | Analog Monitor Selection | Analog output (terminals 21-22) *3 | — | — | 0 | — | |
| | | | Analog output (terminals 21-22) *3 | — | — | 1 | — | |
| | | ——— | ——— | 0 | 0 | — | — | |
| Protective Characteristic Selection 1 (Stall Prevention) | 10 | Stall Prevention | Stall prevention during acceleration enabled | — | — | — | 0 | 0000 |
| | | | Stall prevention during acceleration disabled | — | — | — | 1 | |
| | | | Stall prevention during deceleration enabled | — | — | 0 | — | |
| | | | Stall prevention during deceleration disabled | — | — | 1 | — | |
| | | | Stall prevention during running enabled | — | 0 | — | — | |
| | | | Stall prevention during running disabled | — | 1 | — | — | |
| | | | Decel time during stall prevention: "DECEL TIME 1" (bn-02 set value) | 0 | — | — | — | |
| | | | Decel time during stall prevention: "DECEL TIME 2" (bn-04 set value) | 1 | — | — | — | |
| Protective Characteristic Selection 2 | 11 | DB Resistor | No. DB protection calculated or provided by inverter | — | — | — | 0 | 0000 |
| | | | Protection provided for TECO DB resistor only, if installed | — | — | — | 1 | |
| | | Fault Contact during Auto Reset/Restart Operation | Fault contact is not energized during auto reset/restart operation | — | — | 0 | — | |
| | | | Fault contact is energized during auto reset/restart operation | — | — | 1 | — | |
| | | | Operation stopped by momentary power loss detection | — | 0 | — | — | |
| | | | Operation continues after momentary power loss | — | 1 | — | — | |
| | | ——— | Not used | 0 | — | — | — | |

# 7.3 SYSTEM CONSTANTS Sn-□□ (Cont'd)

## System Constants List (4/5)

| Function | Sn-□□ | Data Name | Description | 4th Digit | 3rd Digit | 2nd Digit | 1st Digit | Factory Setting (4th Digit 3rd Digit 2nd Digit 1st Digit) |
|---|---|---|---|---|---|---|---|---|
| Protective Characteristic Selection 3 | 12 | External Fault Signal Level | External fault input: NO-contact input | — | — | — | 0 | 0100 |
| | | | External fault input: NC-contact input | — | — | — | 1 | |
| | | Receiving External Fault Signal | External fault signal: Always detected | — | — | 0 | — | |
| | | | External fault signal: Detected during running only | — | — | 1 | — | |
| | | Processing at External Fault Detection | Ramp stop (major fault) | 0 | 0 | — | — | |
| | | | Coast to stop (major fault) | 0 | 1 | — | — | |
| | | | Ramp stop (major fault): ramp stop (bn-04 set value) | 1 | 0 | — | — | |
| | | | Operation to continue (minor fault) | 1 | 1 | — | — | |
| Protective Characteristic Selection 4 | 13 | Not used | ——— | — | — | — | — | —— |
| Protective Characteristic Selection 5 | 14 | Motor Protection (Electronic Thermal) | Electronic thermal motor protection effective | — | — | — | 0 | 0000 |
| | | | Electronic thermal motor protection ineffective | — | — | — | 1 | |
| | | | Electronic thermal characteristics are in accordance with standard motor | — | — | 0 | — | |
| | | | Electronic thermal characteristics are in accordance with constant torque motor | — | — | 1 | — | |
| | | | Electronic thermal time constants are standard | — | 0 | — | — | |
| | | | Electronic thermal time constants are short-time rated | — | 1 | — | — | |
| | | Inverter Protection (Electronic Thermal) *4 | Inverter Protection OL: 103% continuous, 150% for one minute | 0 | — | — | — | |
| | | | Inverter Protection OL: 113% continuous, 123% for one minute | 1 | — | — | — | |

# 7.3 SYSTEM CONSTANTS Sn-□□ (Cont'd)

## System Constants List (5/5)

| Function | | Sn-□□ | Data Name | Description | | | | | | Factory Setting |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 4th Digit | 3rd Digit | 2nd Digit | 1st Digit | 4th Digit 3rd Digit 2nd Digit 1st Digit |
| Multi-function Selection | Contact Input Signal | 15 | | Set Data | | | | | | |
| | | | Terminal 5 Function | 00 - FF | Selects terminal 5 function (factory preset for multi-step speed reference 1) | | | | | 03 |
| | | 16 | Terminal 6 Function | 00 - FF | Selects terminal 6 function (factory preset for multi-step speed reference 2) | | | | | 04 |
| | | 17 | Terminal 7 Function | 00 - FF | Selects terminal 7 function (factory preset for jog frequency reference) | | | | | 06 |
| | | 18 | Terminal 8 Function | 00 - FF | Selects terminal 8 function (factory preset for internal baseblock by NO contact input) | | | | | 08 |
| | Analog Input | 19 | Multi-function Analog Input | 00 - FF | Selects multi-function analog input (terminal 16) function | | | | | 00 |
| | Output Signal | 20 | Multi-function Output 1 | 00 - FF | Selects multi-function contact output (terminals 9, 10) function (factory preset for during running) | | | | | 00 |
| | | 21 | Multi-function Output 2 | 00 - FF | Selects multi-function open collector (terminal 25) function (factory preset for zero speed) | | | | | 01 |
| | | 22 | Multi-function Output 3 | 00 - FF | Selects multi-function open collector (terminal 26) function (factory preset for agreed frequency) | | | | | 02 |
| Option Card Function Selection | | 25 | Not used | —— | —— | | | | | —— |
| | | 26 | Not used | —— | —— | | | | | —— |
| | | 27 | Pulse Monitor Card PM-C (Number of Output Pulses) F: Inverter Output Frequency | X1 of inverter output frequency (1F) | | 0 | 0 | 0 | — | 001— |
| | | | | X6 of inverter output frequency (6F) | | 0 | 0 | 1 | — | |
| | | | | X10 of inverter output frequency (10F) | | 0 | 1 | 0 | — | |
| | | | | X12 of inverter output frequency (12F) | | 0 | 1 | 1 | — | |
| | | | | X36 of inverter output frequency (36F) | | 1 | 0 | 0 | — | |
| | | 28 | Not used | —— | —— | | | | | —— |

*1 Differs according to inverter capacity.

*2 Initialization (Sn-03 = 1110, 1111)

After depressing the ENTER key, input the initial value of An-□□, bn-□□, Sn-□□, Cn-□□ , (except Sn-01,Sn-02) into NV-RAM. When the value is written in without an error, is displayed. When the value is written in with an error, is displayed. The values of Sn-15 to -18 differ as follows between initializations with Sn-03 = 1110 and with Sn-03 = 1111.

| Multi-function Terminal | 1110 (2 Wire Sequence) | 1111 (3 Wire Sequence) |
|---|---|---|
| Terminal 5 (Sn-15) | 3* (Multi-step speed command 1) | 0 (FWD/REV run select) |
| Terminal 6 (Sn-16) | 4* (Multi-step speed command 2) | 3 (Multi-step speed reference 1) |
| Terminal 7 (Sn-17) | 6* (Jog frequency reference) | 4 (Multi-step speed reference 2) |
| Terminal 8 (Sn-18) | 8* (External baseblock command) | 6 (Jog frequency reference) |

* Values have been factory-set.

*3 Setting of Sn-05 4th digit and Sn-09 2nd digit.

| Sn-05 4th Digit | Sn-09 2nd Digit | Description |
|---|---|---|
| 0 | 0 | Output analog signal proportional to inverter output frequency. (Max. frequency/100%) |
| 1 | 0 | Output analog signal proportional to inverter output current. (Rated current/100%) |
| 0 | 1 | Output analog signal proportional to inverter output voltage reference. (Cn-01/100%) |
| 1 | 1 | Output analog signal proportional to inverter output power. (Max. applicable motor capacity/100%) |

*4 Effective only for inverter models of capacity 230V 40HP (30kW) or more, 460V 75HP (55kW) or more.

## Inverter Capacity Selection **Sn-01**

Inverter capacity has been preset at the factory. However, if a spare control board is used, reset the inverter capacity referring to the table below. Control constant Cn- □□ factory setting values (initial values) differ according to Sn-01 setting.

Inverter Capacity Selection

230V Class

| Name \ Data of Sn-01 | | | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 |
|---|---|---|---|---|---|---|---|---|---|---|
| Inverter rating HP | | | 0.5 | 1 | 2 | 3 | 5 | 7.5 | 10 | 15 |
| Inverter rated capacity kVA | | | 1.4 | 2.1 | 2.7 | 4.1 | 6.9 | 10.3 | 13.7 | 20.6 |
| Max. applicable motor capacity HP (kW) | | | 0.5 (0.4) | 1 (0.75) | 2 (1.5) | 3 (2.2) | 5 (3.7) | 7.5 (5.5) | 10 (7.5) | 15 (11) |
| Inverter rated current A | | | 3.2 | 4.8 | 6.4 | 9.6 | 16 | 24 | 32 | 48 |
| Factory Setting | Cn-09 | Motor rated current A | 1.9 | 3.4 | 6.1 | 8.7 | 13.5 | 20.1 | 25.1 | 36.7 |
| | Cn-23 | Carrier frequency upper limit kHz | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 |
| | Cn-24 | Carrier frequency lower limit kHz | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 |
| | Cn-25 | Carrier frequency proportional gain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Cn-31 | Motor phase-to-phase resistance Ω | 11.760 | 5.732 | 2.407 | 1.583 | 0.684 | 0.444 | 0.288 | 0.159 |
| | Cn-32 | Torque compensation iron loss W | 48 | 64 | 108 | 142 | 208 | 252 | 285 | 370 |
| | Cn-33 | Torque compensation limit V | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| | Cn-37 | Momentary power loss assurance time s | 0.7 | 1.0 | 1.0 | 1.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| | Cn-40 | Minimum baseblock time s | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.7 | 0.7 | 0.7 |
| | Cn-41 | V/f during speed search % | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

# 7.3 SYSTEM CONSTANTS **Sn-□□ (Cont'd)**

## Inverter Capacity Selection

### 230V Class

| Name \ Data of Sn-01 | | | 08 | 09 | 0A | 0B | 0C | 0D | 0E | 0F |
|---|---|---|---|---|---|---|---|---|---|---|
| Inverter rating HP | | | 20 | 25 | 30 | 40 | 50 | 60 | 75 | 100 |
| Inverter rated capacity kVA | | | 27.4 | 34 | 41 | 54 | 68 | 78 | 95 | 130 |
| Max. applicable motor capacity HP (kW) | | | 20 (15) | 25 (18.5) | 30 (22) | 40 (30) | 50 (37) | 60 (45) | 75 (55) | 100 (75) |
| Inverter rated current A | | | 64 | 80 | 96 | 130 | 160 | 183 | 224 | 300 |
| Factory Setting | Cn-09 | Motor rated current A | 50.3 | 62.9 | 72.9 | 96.7 | 124 | 143.5 | 183.5 | 230 |
| | Cn-23 | Carrier frequency upper limit kHz | 15.0 | 15.0 | 15.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 |
| | Cn-24 | Carrier frequency lower limit kHz | 15.0 | 15.0 | 15.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 |
| | Cn-25 | Carrier frequency proportional gain | 0 | 0 | 0 | 36 | 36 | 36 | 36 | 36 |
| | Cn-31 | Motor phase-to-phase resistance Ω | 0.109 | 0.077 | 0.060 | 0.041 | 0.033 | 0.028 | 0.019 | 0.007 |
| | Cn-32 | Torque compensation iron loss W | 471 | 425 | 582 | 536 | 641 | 737 | 790 | 1800 |
| | Cn-33 | Torque compensation limit V | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| | Cn-37 | Momentary power loss assurance time s | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| | Cn-40 | Minimum baseblock time s | 0.7 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| | Cn-41 | V/f during speed search % | 100 | 100 | 100 | 80 | 80 | 80 | 80 | 80 |

## Inverter Capacity Selection

460V Class

| Name \ Data of Sn-01 | | | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 2A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inverter rating HP | | | 0.5 | 1 | 2 | 3 | 5 | 7.5 | 10 | 15 | 20 | 25 | 30 |
| Inverter rated capacity kVA | | | 1.4 | 2.1 | 3.4 | 4.1 | 6.9 | 10.3 | 13.7 | 20.6 | 27.4 | 34 | 41 |
| Max. applicable motor capacity HP (kW) | | | 0.5 (0.4) | 1 (0.75) | 2 (1.5) | 3 (2.2) | 5 (3.7) | 7.5 (5.5) | 10 (7.5) | 15 (11) | 20 (15) | 25 (18.5) | 30 (22) |
| Inverter rated current A | | | 1.6 | 2.6 | 4.0 | 4.8 | 8 | 12 | 16 | 24 | 32 | 40 | 48 |
| Factory Setting | Cn-09 | Motor rated current A | 1.0 | 1.7 | 2.9 | 4.0 | 6.8 | 10.0 | 12.6 | 18.6 | 24.8 | 31.1 | 36.3 |
| | Cn-23 | Carrier frequency upper limit kHz | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 |
| | Cn-24 | Carrier frequency lower limit kHz | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 |
| | Cn-25 | Carrier frequency proportional gain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Cn-31 | Motor phase-to-phase resistance Ω | 47.02 | 22.929 | 9.629 | 6.333 | 2.735 | 1.776 | 1.151 | 0.634 | 0.436 | 0.308 | 0.239 |
| | Cn-32 | Torque compensation iron loss W | 48.1 | 63.9 | 108 | 142 | 208 | 252 | 285 | 370 | 471 | 425 | 582 |
| | Cn-33 | Torque compensation limit V | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Cn-37 | Momentary power loss assurance time s | 1.0 | 1.0 | 1.0 | 1.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| | Cn-40 | Minimum baseblock time s | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.7 | 0.7 | 0.7 | 1.0 | 1.0 | 1.0 |
| | Cn-41 | V/f during speed search % | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

# 7.3 SYSTEM CONSTANTS **Sn-□□ (Cont'd)**

Inverter Capacity Selection

460V Class

| Name \ Data of Sn-01 | | | 2B | 2C | 2D | 2E | 2F | 30 | 31 | 32 | 33 | 34 | 35 | 36 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inverter rating HP | | | 40 | 50 | 60 | 75 | 100 | 125 | 150 | 175 | 215 | 250 | 350 | 450 |
| Inverter rated capacity kVA | | | 54 | 68 | 82 | 110 | 138 | 180 | 195 | 230 | 260 | 290 | 385 | 514 |
| Max. applicable motor capacity HP (kW) | | | 40 (30) | 50 (37) | 60 (45) | 75 (55) | 100 (75) | 125 | 150 (110) | 175 | 215 (160) | 250 (185) | 350 (264) | 450 (330) |
| Inverter rated current A | | | 64 | 80 | 96 | 128 | 165 | 192 | 224 | 270 | 300 | 340 | 450 | 600 |
| Factory Setting | Cn-09 | Motor rated current A | 48.7 | 59.0 | 70.5 | 88.0 | 114 | 143 | 175 | 206 | 235 | 290 | 348 | 465 |
| | Cn-23 | Carrier frequency upper limit kHz | 15.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 2.0 | 2.0 | 2.0 |
| | Cn-24 | Carrier frequency lower limit kHz | 15.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 1.0 | 1.0 | 1.0 |
| | Cn-25 | Carrier frequency proportional gain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Cn-31 | Motor phase-to-phase resistance Ω | 0.164 | 0.133 | 0.110 | 0.074 | 0.027 | 0.036 | 0.036 | 0.020 | 0.022 | 0.020 | 0.022 | 0.014 |
| | Cn-32 | Torque compensation iron loss W | 536 | 641 | 737 | 790 | 1800 | 2900 | 2900 | 2600 | 2500 | 2600 | 1850 | 3600 |
| | Cn-33 | Torque compensation limit V | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Cn-37 | Momentary power loss assurance time s | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| | Cn-40 | Minimum baseblock time s | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| | Cn-41 | V/f during speed search % | 100 | 100 | 100 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 |

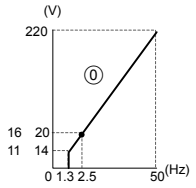
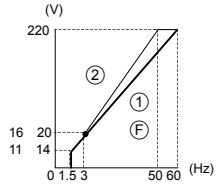
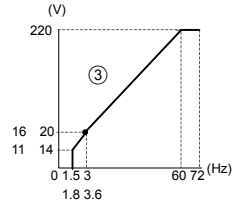
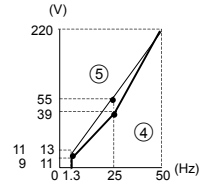
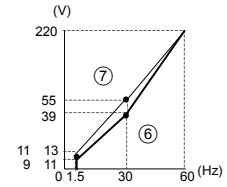
## ■ V/f Pattern Selection **Sn-02**

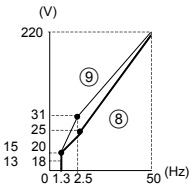
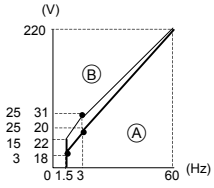
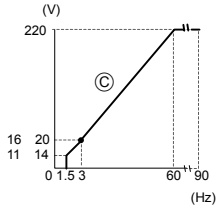
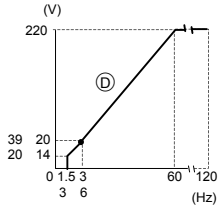
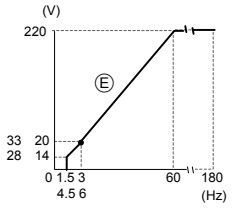
V/f pattern is selected by the setting of Sn-02. When V/f pattern is selected, set input voltage of the inverter in Cn-01.

- Data ⓪ - Ⓔ (of Sn-02): Change disabled
- Data Ⓕ (of Sn-02): Change enabled
  (V/f patterns are shown on the following pages).

# 7.3 SYSTEM CONSTANTS **Sn-□□ (Cont'd)**

## V/f Pattern for 230V Class* 0.5 to 2 HP (0.4 to 1.5kW)

| | Specifications | | Sn-02 | V/f Pattern + |
|---|---|---|---|---|
| General-purpose | 50Hz | | ⓪ |  |
| | 60Hz | 60Hz Saturation | ① F |  |
| | | 50Hz Saturation | ② | |
| | 72Hz | | ③ |  |
| Variable Torque Characteristics | 50Hz | Variable torque 1 | ④ |  |
| | | Variable torque 2 | ⑤ | |
| | 60Hz | Variable torque 3 | ⑥ |  |
| | | Variable torque 4 | ⑦ | |

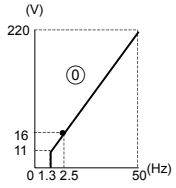
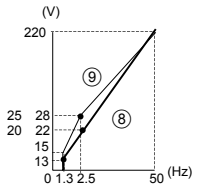
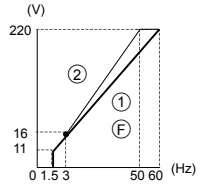
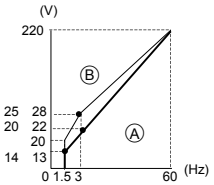
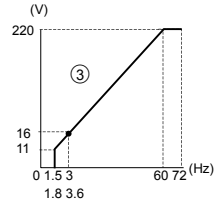
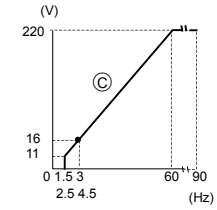
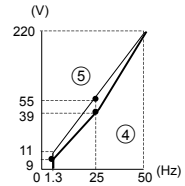
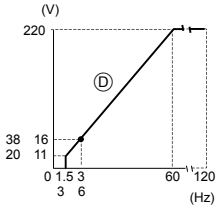
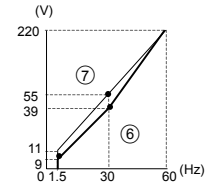
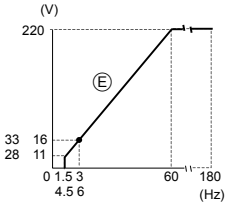
| | Specifications | | Sn-02 | V/f Pattern + |
|---|---|---|---|---|
| High Starting Torque※ | 50Hz | Low Starting torque | ⑧ |  |
| | | High Starting torque | ⑨ | |
| | 60Hz | Low Starting torque | A |  |
| | | High Starting torque | B | |
| Rated Output Operation (Machine tool) | 90Hz | | C |  |
| | 120Hz | | D |  |
| | 180Hz | | E |  |

* For 460V class, 2 times voltage value shown in table above.

\+ Consider the following items as conditions for selecting a V/f pattern.
They must be suitable for:
(1) The voltage and frequency characteristics of the motor.
(2) The maximum rotation speed of the motor.

※ Select high starting torque only in the following conditions. Normally, this selection is not required.
(1) The wiring distance is long [492ft (150m) and above].
(2) Voltage drop at startup is large.
(3) AC reactor is inserted in the input or output of the inverter.
(4) A motor smaller than the maximum applicable inverter is used.

## V/f Pattern of 230V Class* 3 to 60 HP (2.2 to 45kW)

| | Specifications | | Sn-02 | V/f Pattern + | | Specifications | | Sn-02 | V/f Pattern + |
|---|---|---|---|---|---|---|---|---|---|
| General-purpose | 50Hz | | ⓪ |  | High Starting Torque※ | 50Hz | Low Starting torque | ⑧ |  |
| | | | | | | | High Starting torque | ⑨ | |
| | 60Hz | 60Hz Saturation | ① F |  | | 60Hz | Low Starting torque | A |  |
| | | 50Hz Saturation | ② | | | | High Starting torque | B | |
| | 72Hz | | ③ |  | Rated Output Operation (Machine tool) | 90Hz | | C |  |
| Variable Torque Characteristics | 50Hz | Variable torque 1 | ④ |  | | 120Hz | | D |  |
| | | Variable torque 2 | ⑤ | | | | | | |
| | 60Hz | Variable torque 3 | ⑥ |  | | 180Hz | | E |  |
| | | Variable torque 4 | ⑦ | | | | | | |

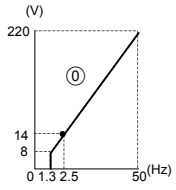
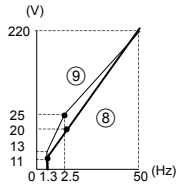
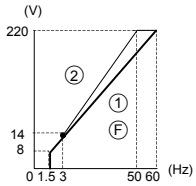
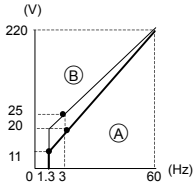
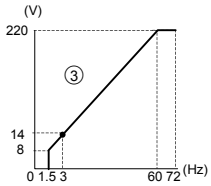
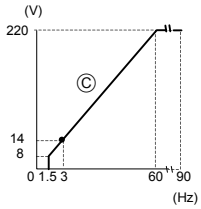
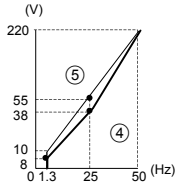
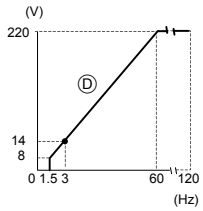
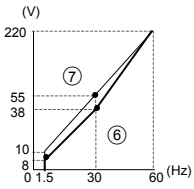
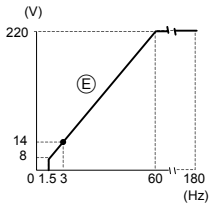
* For 460V class, 2 times voltage value shown in table above.

\+ Consider the following items as conditions for selecting a V/f pattern.
They must be suitable for:
(1) The voltage and frequency characteristics of the motor.
(2) The maximum rotation speed of the motor.

※ Select high starting torque only in the following conditions. Normally, this selection is not required.
(1) The wiring distance is long [492ft (150m) and above].
(2) Voltage drop at startup is large.
(3) AC reactor is inserted in the input or output of the inverter.
(4) A motor smaller than the maximum applicable inverter is used.

# 7.3 SYSTEM CONSTANTS **Sn-□□ (Cont'd)**

V/f Pattern of 230V Class* 75 and 100HP (55 and 75kW), (75 to 450HP for 460V class)

| | Specifications | | Sn-02 | V/f Pattern + | | Specifications | | Sn-02 | V/f Pattern + |
|---|---|---|---|---|---|---|---|---|---|
| General-purpose | 50Hz | | ⓪ |  | High Starting Torque※ | 50Hz | Low Starting torque | ⑧ |  |
| | | | | | | | High Starting torque | ⑨ | |
| | 60Hz | 60Hz Saturation | ① F |  | | 60Hz | Low Starting torque | A |  |
| | | 50Hz Saturation | ② | | | | High Starting torque | B | |
| | 72Hz | | ③ |  | Rated Output Operation (Machine tool) | 90Hz | | C |  |
| Variable Torque Characteristics | 50Hz | Variable torque 1 | ④ |  | | 120Hz | | D |  |
| | | Variable torque 2 | ⑤ | | | | | | |
| | 60Hz | Variable torque 3 | ⑥ |  | | 180Hz | | E |  |
| | | Variable torque 4 | ⑦ | | | | | | |

* For 460V class, 2 times voltage value shown in table above.

\+ Consider the following items as conditions for selecting a V/f pattern.
They must be suitable for:
(1) The voltage and frequency characteristics of the motor.
(2) The maximum rotation speed of the motor.

※ Select high starting torque only in the following conditions. Normally, this selection is not required.
(1) The wiring distance is long [492ft (150m) and above].
(2) Voltage drop at startup is large.
(3) AC reactor is inserted in the input or output of the inverter.
(4) A motor smaller than the maximum applicable inverter is used.
# Up to 100HP (75kW) for 230V class.

## ■ Operation Mode Selection 1 **Sn-04**

### (1) 1st digit (frequency reference selection)

1st digit = 0: Reference input from control circuit terminal 13 or 14 is the master speed frequency reference.

1st digit = 1: Frequency reference 1 (An-01) is the master speed frequency reference.

Note: For combination of multi-step speed operation, refer to pages 36 and 85.

### (2) 2nd digit (run command selection)

2nd digit = 0: Run command from control circuit terminal is accepted.

2nd digit = 1: Run command from the digital operator is accepted.

Valid run command and frequency references differ as shown in the table below, depending on the combination of the 1st and 2nd digits.

| CONSTANT REFERENCE | SYSTEM CONSTANTS 4 | 2nd digit | 1st digit | 2nd digit | 1st digit | 2nd digit | 1st digit | 2nd digit | 1st digit |
|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 |
| Control Terminal | Master Speed Frequency Reference | Control circuit terminal 13, 14 | | An-01 | | Control circuit terminal 13, 14 | | An-01 | |
| | FWD Run Command (Terminal 1) | ○ | | ○ | | × | | × | |
| | REV Run Command (Terminal 2) | ○ | | ○ | | × | | × | |
| | External Fault (Terminal 3) | ○ | | ○ | | ○ | | ○ | |
| | Fault Reset (Terminal 4) | ✱ | | ✱ | | ✱ | | ✱ | |
| | Command of Terminal 5 | ○ | | ○ | | + | | + | |
| | Command of Terminal 6 | ○ | | ○ | | ○ | | ○ | |
| | Command of Terminal 7 | ○ | | ○ | | ○ | | ○ | |
| | Command of Terminal 8 | ○ | | ○ | | ○ | | ○ | |
| | Aux. Input | ○ | | ○ | | ○ | | ○ | |
| | Fault Contact Output | ○ | | ○ | | ○ | | ○ | |
| | Multi-function Contact Output | ○ | | ○ | | ○ | | ○ | |
| | Multi-function PHC Output | ○ | | ○ | | ○ | | ○ | |
| Operator | RUN Key | × | | × | | ○ | | ○ | |
| | JOG Key | × | | × | | ○ | | ○ | |
| | STOP Key | ※ | | ※ | | ○ | | ○ | |
| | FWD/REV Key | × | | × | | ○ | | ○ | |
| | >/RESET Key | ✱ | | ✱ | | ✱ | | ✱ | |
| | DRIVE/PRGM Key | Valid only when inverter stopped | | Valid only when inverter stopped | | Valid only when inverter stopped | | Valid only when inverter stopped | |
| | REF LED | Lit | | OFF | | Lit | | OFF | |
| | SEQ LED | Lit | | Lit | | OFF | | OFF | |
| | Monitor display | ○ | | ○ | | ○ | | ○ | |

✱ Valid only when the inverter stops. (FWD run command, REV run command, and DC injection braking command are "open".)

+ FWD/REV run command is not accepted.

※ When the STOP key is depressed, processing differs as follows, depending on the setting of the 1st digit of Sn-05.

1st digit = 0: During running by signals from control circuit terminals, the STOP key from the operator is accepted.

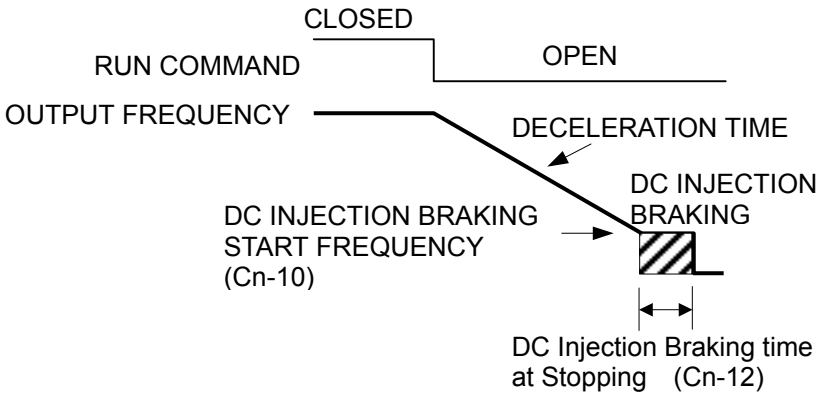
If the STOP key is depressed, the inverter stops according to the setting of 3rd and 4th digits of Sn-04, while the STOP LED indicator blinks. This stop command is held within the inverter until both the FWD run command and REV run command of control circuit terminals become "open", or another frequency reference is selected in the multi-step speed command or jog frequency reference section.

1st digit=1: During running by signals from control circuit terminals, the STOP key from the operator is not accepted.

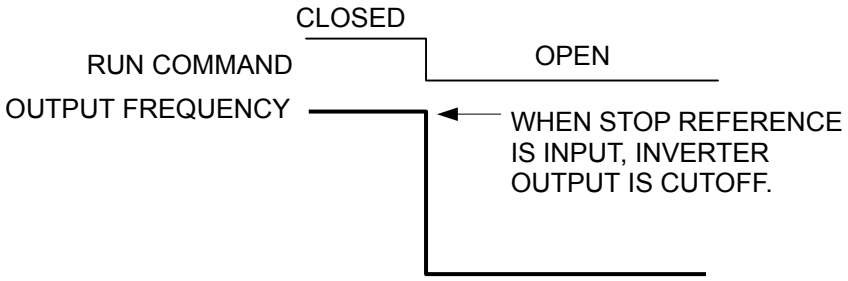
**(3) 3rd digit, 4th digit** (stop method selection)

Stop method differs by the setting of 3rd and 4th digits as shown below.

① Sn-04 = 00 XX RAMP stop

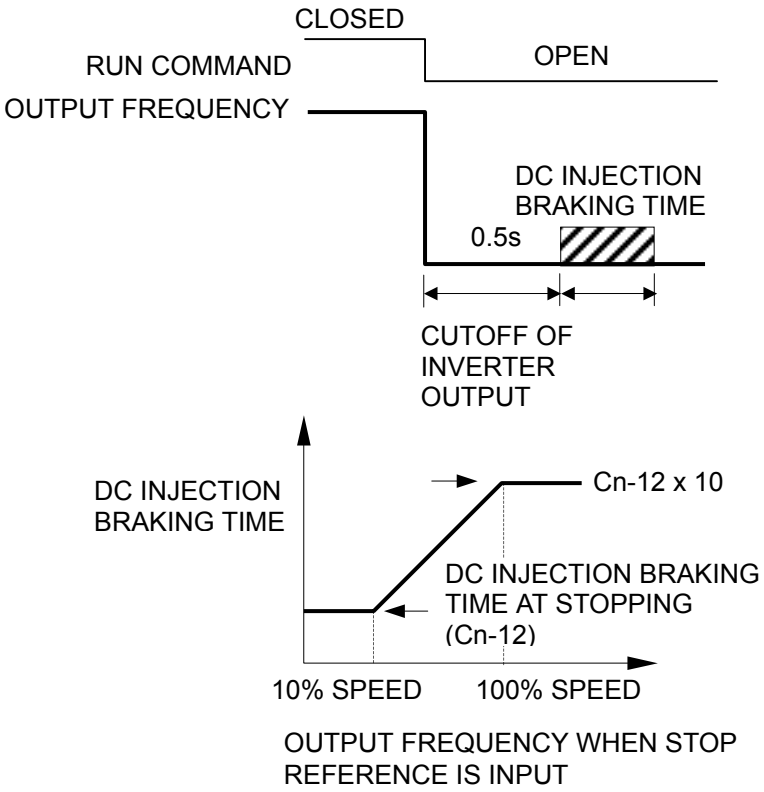



② Sn-04 = 01 XX Coast to stop



③ Sn-04 = 10 XX Full-range DC injection braking stop

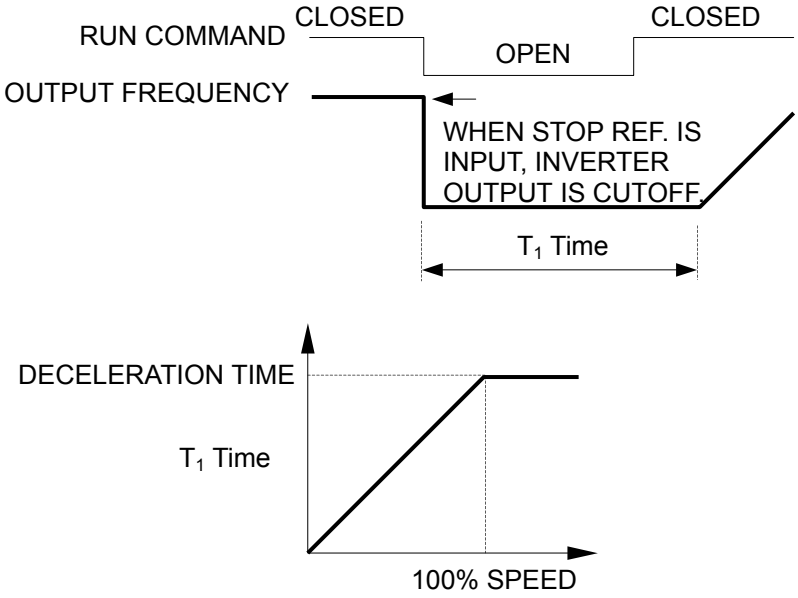
DC injection braking time differs by the output frequency when stop command is input as shown below.




OUTPUT FREQUENCY WHEN STOP REFERENCE IS INPUT

④ Sn-04 = 11 XX Coasting to a Stop (timer function provided)

Once stop command is input, run command is disregarded during $T_1$ time.




OUTPUT FREQUENCY WHEN STOP REFERENCE IS INPUT.

## 7.3 SYSTEM CONSTANTS **Sn-□□** **(Cont'd)**

### ■ Operation Mode Selection 2 **Sn-05**

**(1) 1st digit**

Select processing to be performed when the STOP key of the digital operator is depressed during running by control circuit terminals.

1st digit 0: During running by signals from control circuit terminals, the STOP key from the digital operator is accepted. If the STOP key is depressed, the inverter stops according to the setting of the 3rd and 4th digits of Sn-04 while the STOP LED indicator blinks. This stop command is held within the inverter until both the FWD run command and REV run command of control circuit terminals become "open", or other frequency reference is selected in the multi-step speed command or jog frequency reference section.

1st digit 1: During running by signals from control circuit terminals, the STOP key from the digital operator is not accepted.

**(2) 2nd digit** (REV run prohibited)

2nd digit = 0: REV run command from control circuit terminals or the digital operator is accepted.

2nd digit = 1: REV run command from control circuit terminals or the digital operator is not accepted.

**(3) 3rd digit** (selection of double scanning sequence command)

3rd digit = 0: Sequence command (control circuit terminals 1 to 8) is scanned twice.

3rd digit = 1: Sequence command (control circuit terminals 1 to 8) is scanned once.

**(4) 4th digit** (selection of the multi-function analog output)

Multi-function analog output (control circuit terminals 21, 22) output signal can be selected by Sn-05 4th digit and Sn-09 2nd digit.

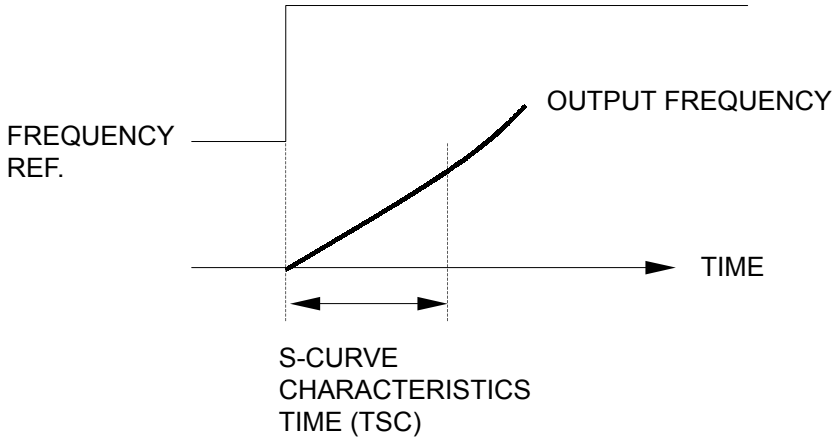
| Sn-05<br>4th Digit | Sn-09<br>2nd Digit | Description |
|---|---|---|
| 0 | 0 | Outputs analog signal proportional to inverter output frequency.<br>(Max. frequency/100%) |
| 1 | 0 | Outputs analog signal proportional to inverter current.<br>(Rated current/100%) |
| 0 | 1 | Outputs analog signal proportional to inverter output voltage reference.<br>(Cn-01/100%) |
| 1 | 1 | Outputs analog signal proportional to inverter output power.<br>(Max motor capacity/100%) |

## ■■ Operation Mode Selection 3 **Sn-06**

**(1) 1st digit, 2nd digit** (S-curve selection of soft starter)

The S-curve characteristics of the soft starter depend on the setting of the 1st and 2nd digits as follows:

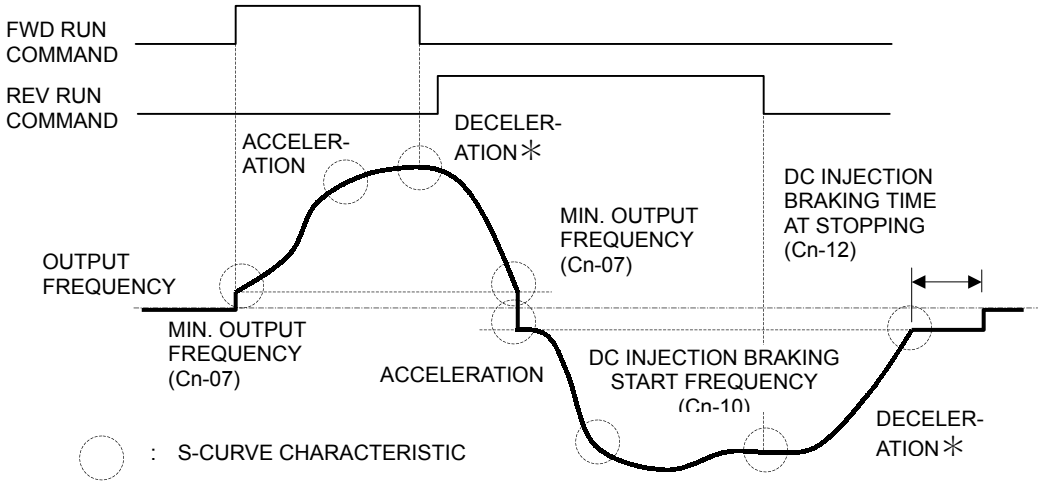
| 2nd digit | 1st digit | Contents |
|---|---|---|
| 0 | 0 | The S-curve characteristic is 0.2 second. |
| 0 | 1 | No S-curve characteristics. |
| 1 | 0 | The S-curve characteristic is 0.5 second. |
| 1 | 1 | The S-curve characteristic is 1 second. |




Note: S-curve characteristic time refers to the time from acceleration rate 0 to the time when a normal acceleration rate determined by a specified acceleration time is obtained.

**(a) Time chart at FWD/REV run change with S-curve characteristic**

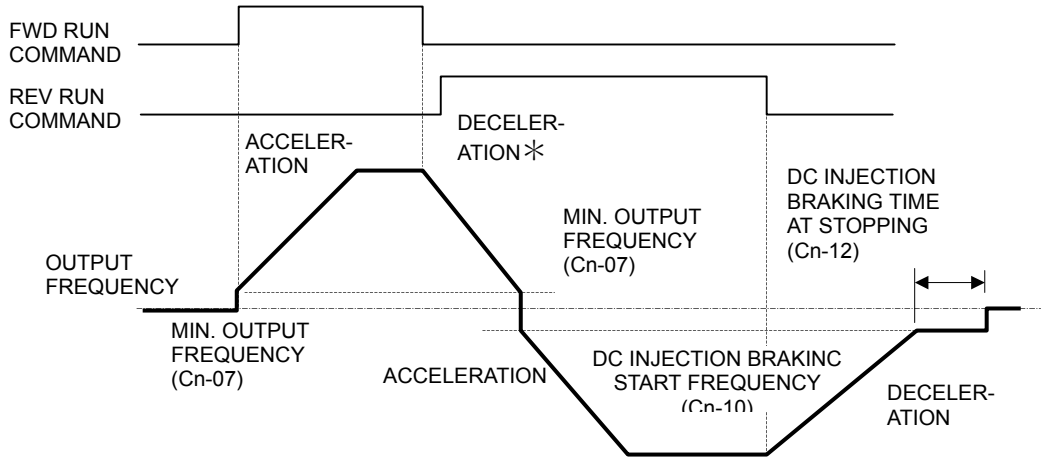
The figure below shows the time chart at FWD/REV run change during deceleration and stop.




✳ When 1st and 2nd digits are 00, no S-curve characteristic at completion of deceleration.

**(b) The chart at FWD/REV run change without S-curve characteristic**

The figure below shows the time chart at FWD/REV run change during deceleration and stop.

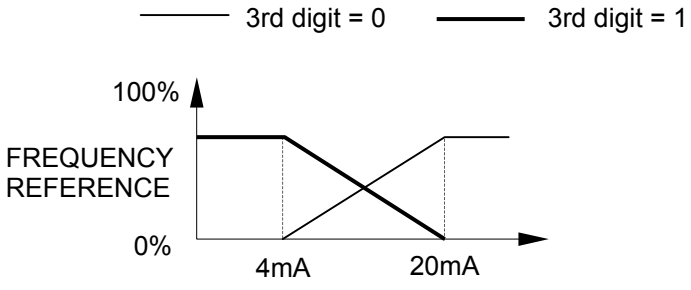



**(2) 3rd digit** (reverse characteristic selection)

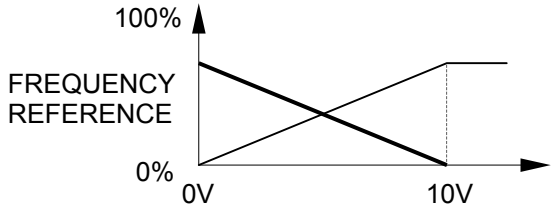
The input characteristics of the master speed frequency reference depend on the set value as follows. For the reverse characteristic, only + input is valid.

3rd digit = 0: Normal characteristic (0-10V or 4-20mA/0-100%)

3rd digit = 1: Reverse characteristic (10-0V or 20-4mA/0-100%)




CURRENT INPUT (TERMINAL 14)




VOLTAGE INPUT (TERMINAL 13)

**(3) 4th digit** (operation selection when frequency reference is missing)

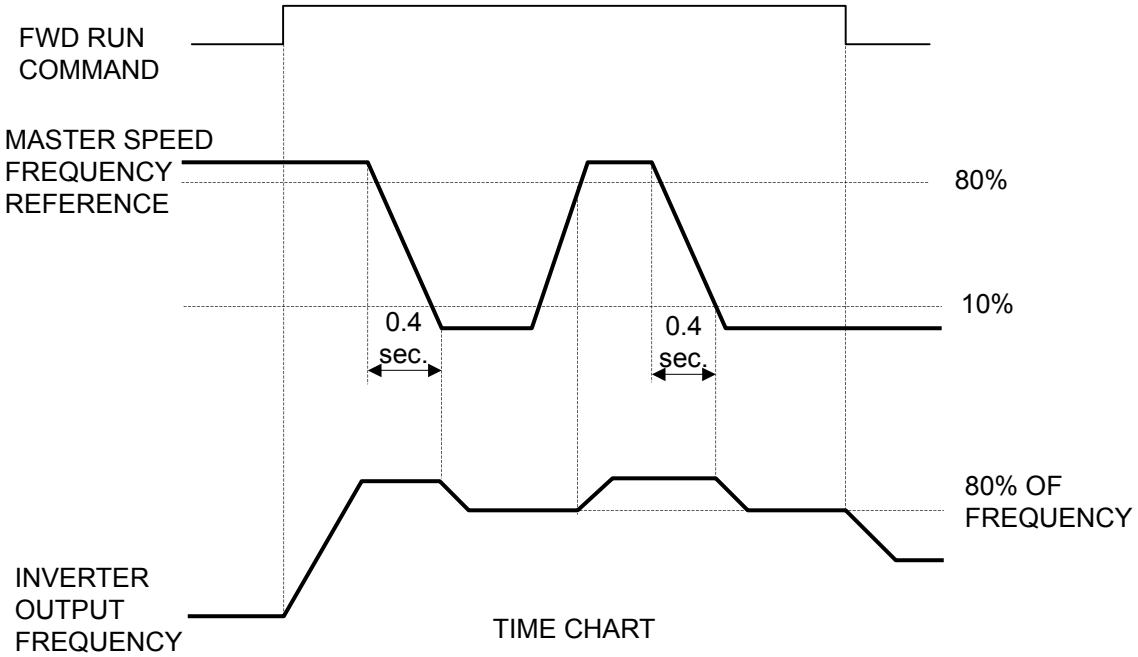
4th digit = 0: Normal operation (varies with change of reference)

4th digit = 1: Operation continues with 80% frequency.

When 4th digit = 1 is set, the current master speed frequency reference is compared at all times with the one that occurred 0.4 second before. When the current master speed frequency reference goes below 10% of the one that occurred 0.4 second before, operation continues with 80% (80% frequency) of the master speed frequency reference of the prior one. Consequently, the master speed frequency reference of the previous one (0.4 second before) is used as the current frequency reference.

In the following cases, this operation is released and the inverter returns to normal operation:

- Master speed frequency reference exceeding 80% frequency is input.
- Stop reference is input.
- Reference is missing during operation at less than 5% of frequency.




TIME CHART

## ■ Operation Mode Selection 4 Sn-07

Define the operation at overtorque detection. Overtorque is detected by the following formula:

Inverter output current B overtorque detection level (Cn-26, Initial value: 160%)
(Detection time Cn-27, Initial value: 0.1 second, Hysteresis fixed at 10%)

**(1) 1st digit**

1st digit = 0: Overtorque is not detected.

1st digit = 1: Overtorque is detected.

**(2) 2nd digit**

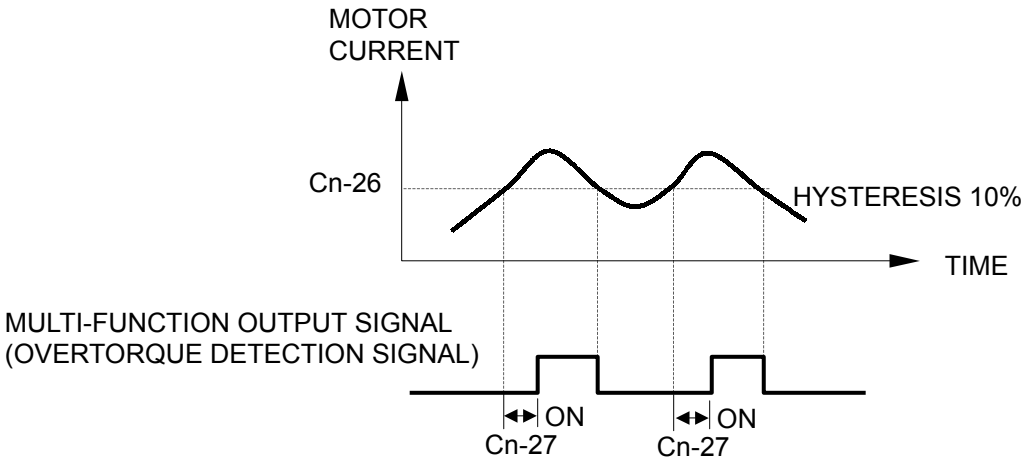
2nd digit = 0: Overtorque is detected only during agreed frequency.

2nd digit = 1: Overtorque is detected during stop or during running except for DB.

**(3) 3rd digit**

3rd digit = 0: When overtorque is detected, oL3 blinks on the digital operator and the operation continues.

3rd digit = 1: When overtorque is detected, oL3 is displayed on the digital operator and the inverter output is shut OFF. Fault contact signal is output. (Treated as a fault).




Setting either Sn-20 or 22 to "0B" enables signal to be output at overtorque detection.

## ■ Operation Mode Selection 5 **Sn-08**

**(1) 1st digit** (option/inverter change)

Specify whether option card or inverter frequency reference is used for operation.

1st digit = 0: Option card frequency reference is accepted.

1st digit = 1: Frequency reference from inverter control circuit terminals or the digital operator is accepted.

**(2) 2nd digit** (run command option/inverter change)

Select whether operation is performed by the option card or inverter run command.

2nd digit = 0: Run command from option card received.

2nd digit = 1: Run command from inverter control circuit terminal or digital operator received.

**(3) 3rd digit, 4th digit** (selection of stopping method at communication error detection)

Stopping method at communication error detection can be selected by communication interface card (SC-C).

| 4th digit | 3rd digit | Contents |
|---|---|---|
| 0 | 0 | Ramp stop by bn-02 (major fault) |
| 0 | 1 | Coast to stop (major fault) |
| 1 | 0 | Ramp stop by bn-04 (major fault) |
| 1 | 1 | Operation to continue (minor fault) |

## 7.3 SYSTEM CONSTANT **Sn-□□** **(Cont'd)**

### ■ Operation Mode Selection 6 **Sn-09**

**(1) 1st digit** (selection of analog output)

Multi-function analog output signal contents can be set either by the inverter or option card.

1st digit = 0: Output according to Sn-05 4th digit and Sn-09 2nd digit setting contents.

1st digit = 1: Output according to contents set by communication interface card (SC-C).

**(1) 2nd digit** (selection of multi-function analog output signal)

Multi-function analog output (control circuit terminals 21 - 22) output signal can be selected according to Sn-05 4th digit and Sn-09 2nd digit set value. Output signal level is set by bn-11.

| Sn-05<br>4th Digit | Sn-09<br>2nd Digit | Description |
|---|---|---|
| 0 | 0 | Outputs analog signal proportional to inverter output frequency.<br>(Max. frequency/100%) |
| 1 | 0 | Outputs analog signal proportional to inverter current.<br>(Rated current/100%) |
| 0 | 1 | Outputs analog signal proportional to inverter output voltage reference.<br>(Cn-01/100%) |
| 1 | 1 | Outputs analog signal proportional to inverter output power.<br>(Max. applicable motor capacity/100%) |

## ■ Protective Characteristic Selection 1 **Sn-10**

**(1) 1st digit** (selection of stall prevention during acceleration)

1st digit = 0: Stall prevention during acceleration is enabled.

1st digit = 1: Stall prevention during acceleration is disabled.

The function of stall prevention during acceleration automatically extends acceleration according to load status (inverter output current), thus preventing the motor from stalling during acceleration. The stall prevention level during acceleration in a constant output area is reduced as follows:

$$\text{Acceleration stall prevention level of constant output field} = \frac{\text{acceleration stall prevention level (Cn-28)} \times \text{maximum voltage frequency (Cn-04)}}{\text{output frequency}}$$

When the 1st digit of Sn-10 is 1, the output frequency increases at the rate determined by acceleration time:

**(2) 2nd digit** (selection of stall prevention during deceleration)

2nd digit = 0: Stall prevention during deceleration is enabled.

2nd digit = 1: Stall prevention during deceleration is disabled.

The function of stall prevention during deceleration automatically extends deceleration time according to the magnitude of the main circuit DC voltage, thus preventing overvoltage during deceleration.

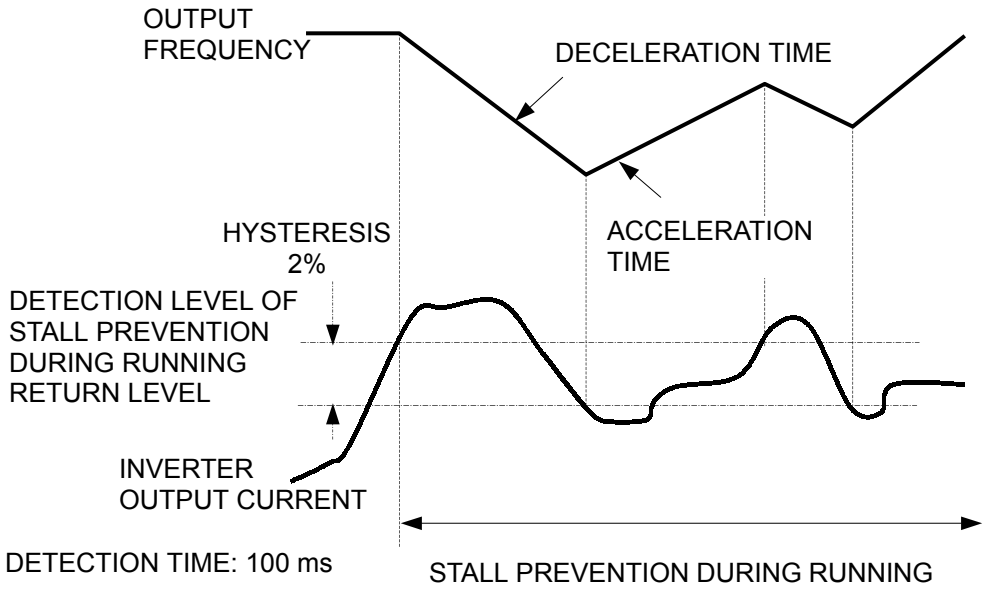
When the 2nd digit of Sn-10 is 1, the output frequency decreases at the rate determined by deceleration time. For positioning applications, specify "stall prevention during deceleration not provided" (2nd digit = 1) in order to obtain stopping accuracy. With large inertia loads, use a braking resistor to prevent overvoltage.

**(3) 3rd digit** (stall prevention during running)

3rd digit = 0: Stall prevention during running is enabled.

3rd digit = 1: Stall prevention during running is disabled.

Stall prevention operation during running starts decelerating when the output current reaches 100ms or greater than the set value of Cn-30 during frequency coincidence (operation level of stall prevention during running). The inverter decelerates as long as the output current exceeds the set value of Cn-30 (operation level of stall prevention during running). When the output current goes below the set value, the inverter reaccelerates. The deceleration time selected in the 4th digit of Sn-10 is taken. Even during stall prevention while running, stall prevention during deceleration and stall prevention during acceleration are enabled.




**(4) 4th digit** (selection of deceleration time during stall prevention while running)

4th digit = 0: The inverter decelerates for the deceleration time specified in bn-02.

4th digit = 1: The inverter decelerates for the deceleration time specified in bn-04.

## ■ Protective Characteristic Selection 2 **Sn-11**

**(1) 1st digit** (existence of braking resistor)

1st digit = 0: Braking resistor protection not provided (braking resistor is not protected from overheating).

1st digit = 1: Braking resistor protection provided (braking resistor is protected from overheating).

On detecting overheating in the braking resistor, the inverter lights rH on the operator, shuts off inverter output, and outputs fault contacts. When braking contact failure (set value = D) is selected in the multi-function contact output, the pertinent multifunction contact output is output.

The following inverters can optionally accept braking resistors:

230V class: 5HP (3.7kW) or less

460V class: 3HP (2.2kW) or less

Notes:

1. Braking transistor operation level

Braking transistor operation levels depend on input voltage as shown below.

When the set value of Cn-01 is larger than the motor rated voltage, the following problems may occur. (Set Cn-01 to match the motor rated voltage).

(a) The motor is excited excessively during deceleration and heated.

(b) The motor vibrates during deceleration.

(c) The motor is saturated during deceleration and the main circuit devices are damaged.

| Input Voltage (Cn-01) | | LVH Signal | 0V Level | | BTR Level | | UV Level | |
|---|---|---|---|---|---|---|---|---|
| Inverter | Set value | | Detection | Return | Detection | Return | Detection | Return |
| 230V Class | 255 or less | L | 400 | 380 | 380 | 375 | 210 | 220 |
| 460V Class | Set value≧400 | L | 800 | 760 | 760 | 750 | 420 | 440 |
| 460V Class | Set value＜400 | H | 700 | 660 | 660 | 650 | 420 | 440 |

2. Protection of braking transistor

The braking transistors are incorporated into the following models:

- 230V : 20HP (15kW) or smaller
- 460V : 20HP (15kW) or smaller to protect them.

On detecting a fault in the braking transistors, the inverter lights ‾/‾/‾ at the operator and shuts off the inverter output and braking transistor drive signal (BTA). It outputs fault contacts.

**(2) 2nd digit** (fault contact signal during auto reset/restart operation)

2nd digit = 0: A fault contact signal is not output during auto reset/restart operation.

2nd digit = 1: A fault contact signal is output during auto reset/restart operation.

**(3) 3rd digit** (operation continued at momentary power loss)

3rd digit = 0: When momentary power loss is detected, undervoltage fault ( UV1 ) occurs and the inverter output is shut OFF.

3rd digit = 1: If momentary power loss time is within momentary power loss ride-thru time (Cn-37), the operation continues after the momentary power loss. If the momentary power loss ride-thru time is exceeded, undervoltage fault ( UV1 ) occurs and the inverter output is shut OFF.

Notes:

1. When the 3rd digit = 1, be sure not to shut OFF the external sequence signal. (e.g. FWD, REV)
2. For lifters, do not use this function. (the 3rd digit = 0)

## ■ Protective Characteristic Selection 3 Sn-12

When an external fault signal of terminal 3 is input, EF3 is displayed and a fault contact signal is output immediately. The inverter stops according to the setting of the 3rd and 4th digits. The external fault signal is held within the inverter until a fault reset signal is input.

**(1) 1st digit** (level selection of external fault signal)

1st digit = 0: NO contact input (when "closed", external fault operation is performed).

1st digit = 1: NC contact input (when "open", external fault operation is performed).

**(2) 2nd digit** (acceptance of external fault signal)

2nd digit = 0: External fault signals are always accepted.

2nd digit = 1: External fault signals are accepted only during running. (Not accepted during baseblock).

**(3) 3rd digit, 4th digit** (selection of processing at external fault detection)

| 4th digit | 3rd digit | Contents |
|---|---|---|
| 0 | 0 | Ramp stop by bn-02 (major fault) |
| 0 | 1 | Coast to stop (major fault) |
| 1 | 0 | Ramp stop by bn-04 (major fault) |
| 1 | 1 | Operation to continue (minor fault) |

## ■ Protective Characteristic Selection 5 **Sn-14**

**(1) 1st digit** (motor protection)

1st digit = 0: Electronic thermal motor protection is enabled.

1st digit = 1: Electronic thermal motor protection is disabled.

**(2) 2nd digit** (selection of electronic thermal characteristics)

2nd digit = 0: Electronic thermal characteristics are in accordance with reduced torque motor (standard motor).

2nd digit = 1: Electronic thermal characteristics are in accordance with constant torque motor (special motor).

**(3) 3rd digit** (electronic thermal time constant)

3rd digit = 1: Used for standard motor and special motor (standard ratings).

3rd digit = 1: Used for motors other than the above (short-time ratings).

**(4) 4th digit** (selection of inverter protective characteristics)

4th digit = 0: When inverter output current exceeds 103%, the inverter protection electronic thermal characteristics start operating: Inverter protection ( oL2 ) operates at 150% for one minute to shut OFF inverter output.

4th digit = 1: When inverter output current exceeds 113%, the inverter protection electronic thermal characteristics start operating: Inverter protection ( oL2 ) operates at 123% for one minute to shut OFF inverter output.

Note: This function is effective only for inverter models with capacity 40HP (30kW) or larger (230V class), and 75HP (55kW) or larger (460V class).

# 7.4 MULTI - FUNCTION CONTACT INPUT SELECTION **Sn-15 to -18**

Select the set values shown below for Sn-15 to -18.

| Terminal No. | Sn- □□ |
|---|---|
| Terminal 5 | 15 |
| Terminal 6 | 16 |
| Terminal 7 | 17 |
| Terminal 8 | 18 |

| Set Value | Function | Description |
|---|---|---|
| 00 | FWD / REV RUN selection | Open: FWD run,<br>Closed: REV run,<br>( 3-wire sequence mode (00 set in Sn-15) terminal 1-run , 2-stop, 5 FWD / REV selection. ) |
| 01 | Operation signal selection Local/Remote | Open: Operated according to setting of Sn-04 1st and 2nd digits.<br>Closed: Operated by frequency reference and run command from digital operator. |
| 02 | Option / inverter reference selection | Open: Operated by frequency reference from option card.<br>Closed: Operated by frequency reference from the inverter. |
| 03 | Multi-step speed reference 1 | Combination of multi-step speed references 1 to 3 correspond to speed reference (master speed An-01) and speed references 2 to 8 (An-02 to 08). Refer to “SYSTEM CONSTANTS MULTI-STEP SPEED REFERENCE LIST”. |
| 04 | Multi-step speed reference 2 | |
| 05 | Multi-step speed reference 3 | |
| 06 | Jog frequency reference selection | Closed: Jog frequency reference is selected. |
| 07 | Accel / decel time selection | Open: Accelerates/decelerates with ACCEL time 1 and DECEL time 1. (bn-01, bn-02 set values)<br>Closed: Accelerates/decelerates with ACCEL time 2 and DECEL time 2. (bn-03, bn-04 set values) |
| 08 | External baseblock (NO contact input) | Closed: Inverter output is shut OFF. (Frequency reference is held). |
| 09 | External baseblock (NC contact input) | Open: Inverter output is shut OFF. (Frequency reference is held). |
| 0A | Accel / decel speed prohibit command (HOLD command) | Frequency reference is held. (SFS operation is stopped). |
| 0B | Inverter overheat alarm | Closed: OH2 blinks on operator and operation continues. (Mirror fault) |
| 0C | Multi-function analog input enabled / disabled | Closed: Multi-function analog input is enabled. (terminal 16)<br>Open: Multi-function analog input is disabled. (terminal 16) |
| 0D to 0F | Not used | —— |

| Set Value | Function | Description |
|---|---|---|
| 10 | UP command | Closed: Output frequency increment |
| 11 | DOWN command | Closed: Output frequency decrement |
| 12 | FJOG command | Closed: Forward log run<br>FWD LED lights. Display: 6Hz |
| 13 | RJOG command | Closed: Reverse jog run<br>Digital operator REV LED does not light.<br>Display: 6Hz |
| 14 to 1F | Not used | — |
| 20 to 2F | External fault 1 | External fault signal input |
| 30 to 3F | External fault 2 | |
| 40 to 4F | External fault 3 | |
| 50 to 5F | External fault 4 | |
| 60 | DC injection braking command<br>(JOG with priority) | Closed: DC injection braking applied when the frequency output is less than the DC injection start frequency and the DC injection braking command is closed. |
| 61 | Search 1 | Closed: Search from max frequency |
| 62 | Search 2 | Closed: Search from set frequency |
| 63 | Energy-saving operation | Closed: Energy-saving |
| 64 | Not used | — |
| 65 to FF | Not used | — |

Setting error (OPE3) occurs by setting to Sn-15 to -18 in the following cases.

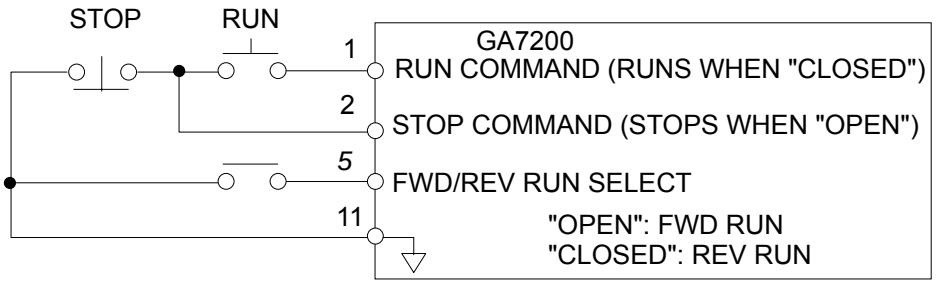
- When set values are not listed from smaller to the larger.
- When more than two search references of set values 61, 62 and 64 are set simultaneously.

When the following combination is set at Sn-15 to -18, set value fault (OPE3) occurs.

1. Set values are not in descending order.
2. More than two search commands of set values 61 and 62 are set.
3. UP/DOWN commands are not set simultaneously. (only one command can be set)
4. UP/DOWN and accel/decel prohibit commands are set simultaneously.
5. More than two set values except FF are set.

**(1) FWD/REV run selection** (set value = 0)

When 0 is set in Sn-15, the mode becomes 3-wire sequence mode.




**(2) Operation signal selection** (set value = 1)

Selection of operation signals is enabled only while the inverter is not running.

Open: The inverter operates according to the setting of 1st, 2nd digits.

Closed: The inverter operates by frequency reference and run command from the digital operator.

< Example >

For local/remote mode selection, set Sn-04 = x x 00.

Open: Frequency reference and run command from control circuit terminals are accepted.

Closed: Frequency reference and run command from the digital operator is accepted.

**(3) Option card/inverter reference selection** (set value = 2)

Specify which of the option cards or inverter references is used for operation. The option card/inverter selection is effective only while the inverter is not running.

Open: Option card frequency reference and operation signals are accepted.

Closed: Frequency reference and operation signals from the inverter control circuit terminals or the digital operator are accepted.

**(4) Selection of multi-step speed references 1 to 3 and jogging frequency selection** (set values = 3 to 6)

Up to nine step speeds can be selected by combinations of multi-step speed references and jog frequencies.

○: Closed ×: Open —: No relation

| Jog Frequency Reference Selection | Multi-Step Reference | | | Frequency Reference |
|---|---|---|---|---|
| | 3 | 2 | 1 | |
| × | × | × | × | Master speed frequency reference* |
| × | × | × | ○ | Auxiliary analog reference |
| × | × | ○ | × | Frequency reference 3 (An-03) |
| × | × | ○ | ○ | Frequency reference 4 (An-04) |
| × | ○ | × | × | Frequency reference 5 (An-05) |
| × | ○ | × | ○ | Frequency reference 6 (An-06) |
| × | ○ | ○ | × | Frequency reference 7 (An-07) |
| × | ○ | ○ | ○ | Frequency reference 8 (An-08) |
| ○ | — | — | — | Jog frequency reference 3 (An-09) |

* In operator mode (1st digit of Sn-04 is 1), frequency reference 1 (An-01) is enabled.

+ When the multi-function analog input is selected by functions other the frequency reference (Sn-19 = 0), frequency reference 2 (An-02) becomes effective. When the multi-function analog input is not used, set F to the set value.

- For multi-step speed operation with frequency reference from digital operator, perform the following setting:

① Sn-04 = xxx1 → An-01 becomes effective.

② Sn-19 = 0F → An-02 becomes effective.

**(5) Accel/decel time selection** (select value = 7)

Accel/decel time is switched when "closed". Switching is permitted even during acceleration or deceleration.

Open: The accel/decel time set by bn-01 and bn-02 is accepted.

Closed: The accel/decel time set by bn-03 and bn-04 is accepted.

**(6) External baseblock** (set value = 8)

Baseblock is performed when "closed". External baseblock differs as follows depending on the input status of the run command:

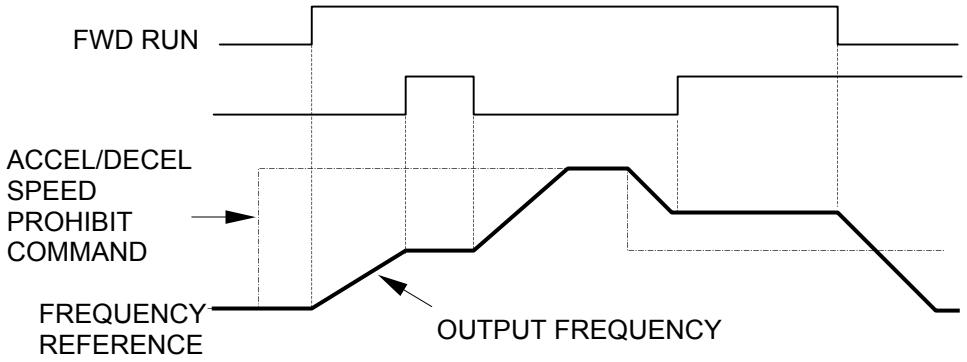
- When an external baseblock signal is input during running, bb blinks on the digital operator and inverter output is shut OFF. When the external baseblock signal disappears, the inverter restarts with the frequency reference at that time. The voltage returns to the set value in the voltage recovery time.
- When a stop signal is input and an external baseblock signal is input while the inverter is decelerating, bb blinks on the digital operator, the inverter output is shut OFF, and the output frequency is set to 0Hz.

**(7) External baseblock** (set value =9)

Baseblock is performed when "open". All other operations are the same as when set value = 8.

**(8) Accel/decel speed prohibit command** (set value = A)

As long as accel/decel speed prohibit command is input, accel/decel speed is prohibited and the output frequency at that time is held. When stop command is input, accel/decel speed prohibit state is freed and the system enters stop state. The figure below shows a time chart.




Note: If the run command is input again after the stop command is input while the accel/decel prohibit command is input, the holding output frequency is stored unless the accel/decel prohibit command is released. Therefore, operation is performed at the stored output frequency. Also when the power supply is turned OFF in the accel/decel prohibit command input status, the holding output frequency is still stored.

**(9) Inverter overheat alarm** (set value = B)

As long as an inverter overheat signal is input, OH2 blinks on the digital operator.

**(10) Auxiliary analog reference input** (set value = C)

When this function is selected by the multi-function terminal, the function set in the multi-function analog input is subject to the following restrictions.

Open: Multi-function analog input is not accepted.
(Same operation as when F is set in Sn-19)

Closed: Multi-function analog input is accepted.

**(11) UP command/DOWN command** (set value = 10, 11)

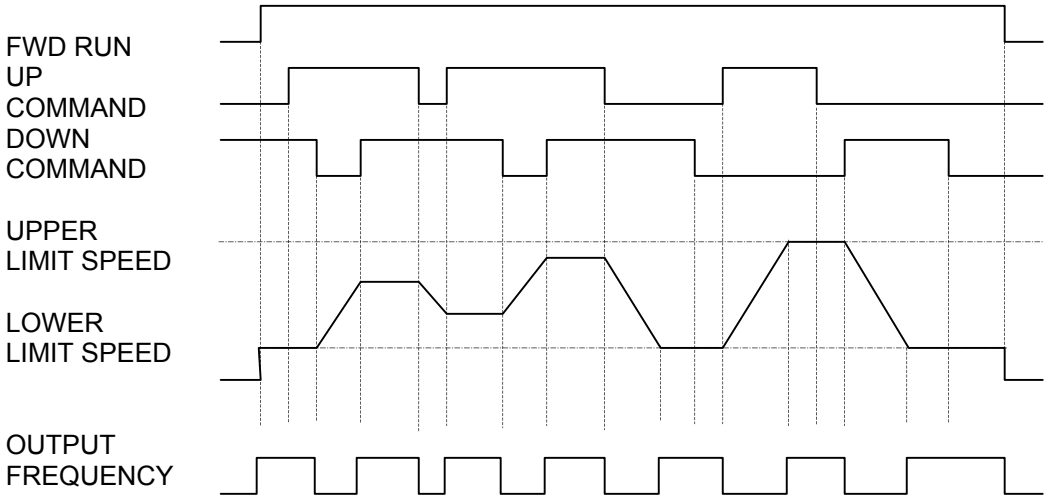
Acceleration/deceleration is performed by inputting the UP/DOWN commands without changing frequency reference in the forward (reverse) run command input status and operation can be performed at a desired speed.

Set value = 10: UP command

Set value = 11: DOWN command

| | | | | |
|---|---|---|---|---|
| UP command | Closed | Open | Open | Closed |
| DOWN command | Open | Closed | Open | Closed |
| Status | Accel | Decel | Hold | Hold |

The following time chart indicates when the UP/DOWN commands are used.




U = UP (accel) status
D = DOWN (decel) status
H = HOLD (constant speed) status
U1 = During clamp at upper limit speed even in UP status
D1 = During clamp at lower limit speed even in DOWN status

Notes:

1. When the UP/DOWN commands are used, set Sn-04 1st digit (frequency reference selection) as shown below.

   Set 1st digit = 0 without fail.
   Setting 1st digit = 1 disables the UP/DOWN commands.

2. When the UP/DOWN commands are selected, upper limit speed is set disregarding frequency reference.

   Upper limit speed = max. output freq. (Cn-02) × freq. reference lower limit (Cn-14)

3. The largest value among minimum output frequency (Cn-07), frequency reference lower limit (Cn-15) and main frequency reference input from control circuit terminal 13 or 14 is employed as lower limit speed.

4. By inputting the FWD/REV run commands, operation is started at the lower limit speed even if the UP/DOWN command is not input.

   When the power supply is turned OFF in the HOLD status, the held output frequency is stored. By inputting the FWD/REV run commands in the HOLD status continuously after the power supply is turned ON, operation is performed at the stored output frequency.

5. When the JOG run command is input during running by UP/DOWN commands, the JOG run command has priority.

**(12) FJOG command, RJOG command** (set value = 12, 13)

Forward and reverse jog frequency operation is enabled.

Set value = 12 FJOG command: Forward run by jog frequency reference (An-09) at closed.

Set value = 13 RJOG command: Reverse run by jog frequency reference (An-09) at closed.

Notes:

1. When FJOG command or RJOG command is input during running, FJOG command or RJOG command has priority.
2. When both FJOG and RJOG commands are closed for 500ms or more, the inverter stops according to the stopping method selection (Sn-04).
3. FJOG or RJOG command can be set individually.

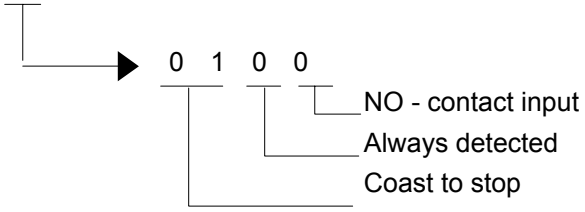
**(13) External faults 1 to 4** (set values = 2X, 3X, 4X, 5X: X is O to F)

When external faults 1 to 4 are input, EF5 to EF8 is displayed on the digital operator, and the inverter operates according to combinations of four bits shown in the table below. The hexadecimal equivalent of combinations of four bits show below is set in the 1st digit of the setting value (2X, 3X, 4X, 5X) of external faults 1 to 4.

| Bit No. | 0 | 1 |
|---|---|---|
| 0 | External fault input:<br>NO - contact input | External fault input:<br>NC - contact input |
| 1 | External fault signal:<br>Always detected | External fault signal:<br>Detected during running only |
| 3,2 | Selection of processing at external fault detection | 00: Ramp to stop (major fault)<br>01: Coast to stop (major fault)<br>10: Ramp to stop by bn-04 (major fault)<br>11: Operation to continue (minor fault) |

<Example> External fault 1 is set as follows.
: NO - contact input
: Signal is always detected
: Processing is coast to stop

Set value 24H




The inverter operates differently as described below when experiencing major faults or minor faults. The digits in the error display EF5 to EF8 indicate the terminal numbers in which external faults 1 to 4 are set.

Major faults

If an external fault is input, the fault is displayed and the inverter stops according to process selection at external fault detection. Fault contact output relay is output immediately.

Minor faults

Fault display blinks only when external fault is input (the display is made for 0.5 second even when input is less than 0.5 second).

<Example> External faults 1 to 4 are set to multi-function terminals 1 to 4.
(Nos. of terminal 5 to 8)

| No. of Fault | Multi-function Terminal | Display on Digital Operator | |
|---|---|---|---|
| | | (Major Fault) | (Minor Fault) |
| External Fault 1 | Terminal 5 | EF5 lights (holding) | EF5 blinks |
| External Fault 2 | Terminal 6 | EF6 lights (holding) | EF6 blinks |
| External Fault 3 | Terminal 7 | EF7 lights (holding) | EF7 blinks |
| External Fault 4 | Terminal 8 | EF8 lights (holding) | EF8 blinks |

Additional Notes of External Faults:

1.External fault reset is enabled in baseblock status.

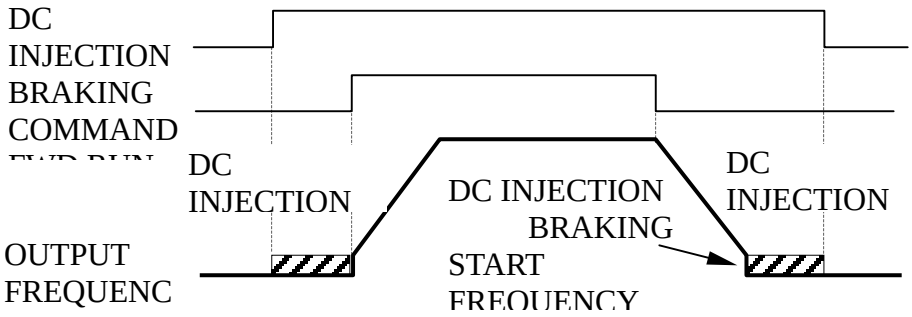
2. The following shows the priority order of process selection when more than one external fault is input.

Coast to stop > ramp stop by bn-04 > ramp stop by bn-02.

3. Fault retry is disabled when an external fault is input.

**(1) DC injection braking command** (set value = 60)

When DC braking command is input when the inverter stops, DC braking operation is performed. When operation signal or jog operation command is input, the DC braking operation is stopped and the operation is started. (Privileged operation)



**(2) Search command** (set value = 61,62)

To start the motor during coasting when commercial power supply/inverter changing operation is performed, the motor can be operated without tripping by using the speed search function.

Set value = 61: Speed search starts with the maximum frequency.

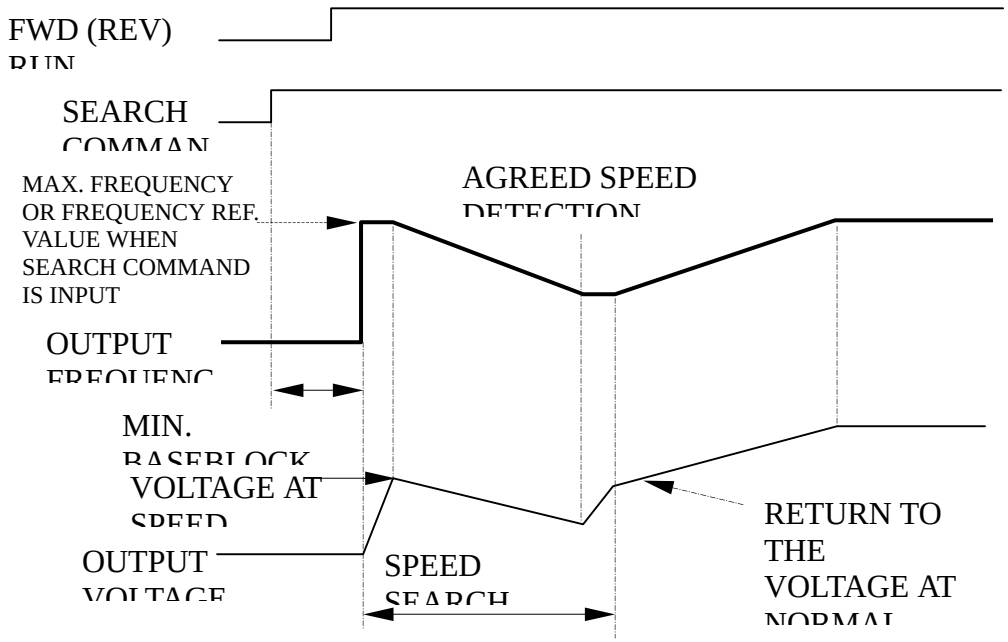
Set value = 62: Speed search starts with the frequency reference value when search command is input.

Search commands with set values of 61 and 62 cannot be set at the same time.

By inputting the run command with the search command “closed" during baseblock, speed search starts after shutting down the inverter output for the minimum baseblock time (Cn-40).

Speed search operation starts when inverter output current is larger than the set value of the speed search operation level (Cn-38). The frequency at which inverter output current is smaller is determined as the speed synchronous point: Re-acceleration/deceleration is performed in the set accel/decel time up to the set frequency.

The following shows the time chart where the speed search command is input.

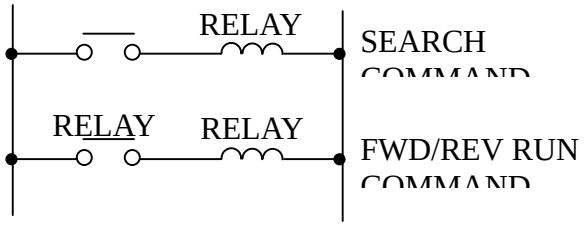



Notes:

1. In momentary power loss operation continuation mode, speed search operation is performed beginning with current output frequency, regardless of the existence of search command. After completion of speed search, the operation is performed according to the run command.

2. Determine a sequence so that FWD/REV run command enters at the same time or later than search command.

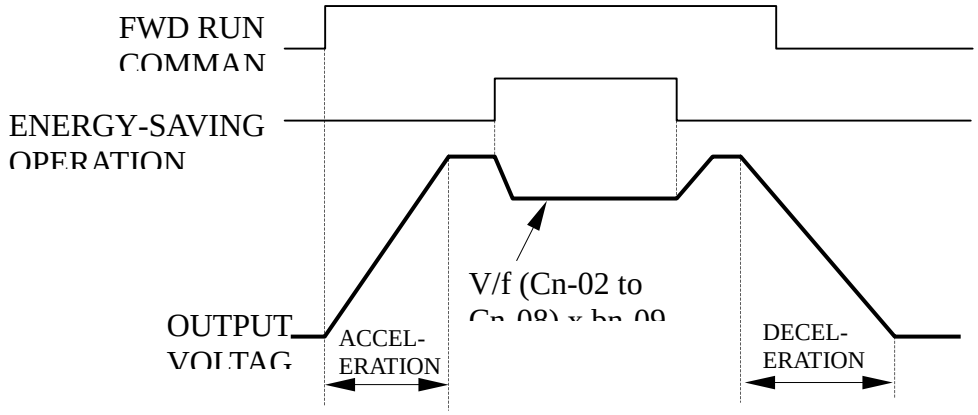
<Example of




3. More than two search commands for set values of 61 and 62 cannot be set.

**(12) Energy-saving operation command** (set value = 63)

When energy-saving operation command is input, output voltage is reduced only during agreed frequency and energy-saving operation is performed. The output voltage during energy-saving operation command is the product of normal V/f (Cn-02 to Cn-08) and energy-saving gain (bn-09 initial value 80%). Output voltage attenuates and returns in voltage recovery time.




Time Chart - When energy-saving operation command is input

## 7.5 MULTI-FUNCTION ANALOG INPUT SELECTION **Sn-19**

Select the set values shown below for Sn-19.

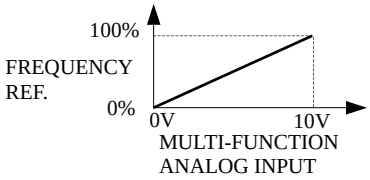
| Set value | Function | Remarks |
|---|---|---|
| 00 | AUX frequency reference* | Used for MASTER/AUX frequency reference selection. |
| 01 | Frequency reference gain (F GAIN) | Total gain: Internal gain (bn-05) x F GAIN |
| 02 | Frequency reference bias 1 (F BIAS 1) | Total bias: Internal bias (bn-06) + F BIAS 1 |
| 03 | Frequency reference bias 2 (F BIAS 2)<br>(+ -) | Total bias: Internal bias (bn-06) + F BIAS 2 |
| 04 | Overtorque detection level | Internal overtorque detection level (Cn-26) ineffective. |
| 05 | V BIAS ✦ | V BIAS addition after V/f conversion. |
| 06 | Accel/decel time reduction coefficient | Accel/decel time varied by analog input. |
| 07 | DC braking current | DC injection braking current varied by analog input.<br>(10V/inverter rated current)<br>Internal DC braking current setting (Cn-11) ineffective. |
| 08 | Stall level during running | Stall level during running is set by analog input.<br>Cn-30 becomes ineffective. |
| 09 | Frequency reference lower limit | Frequency reference lower limit value is set by analog input. Either Cn-15 set value or analog input whichever is larger becomes effective. |
| 0A | Setting prohibit frequency 4 | Setting prohibit frequency is set.<br>The fourth value in addition to frequency values set by Cn-16 to 18 can be set. |
| 0B to 0F | Not used (no function provided) | |

* Not to be used with An-02.
✦460 class: V BIAS value 0 to 200V
Note: For combinations of multi-step speed references at set value = 00, refer to pages 85 and 86.

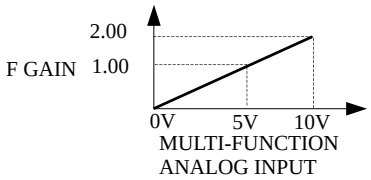
## 7.5 MULTI-FUNCTION ANALOG INPUT SELECTION **Sn-19** **(Cont'd)**

Multi-function Analog Input Characteristics

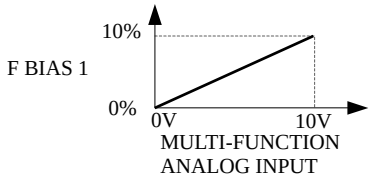
(1) Sn-19 = 0



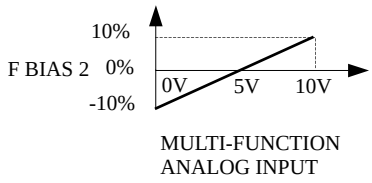

(2) Sn-19 = 1



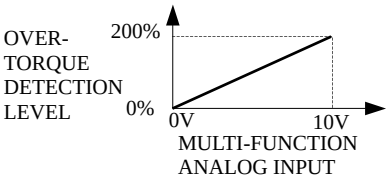

(3) Sn-19 = 2



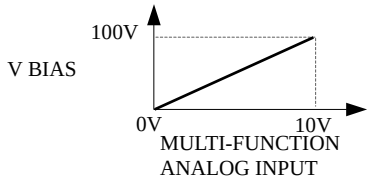

(4) Sn-19 = 3



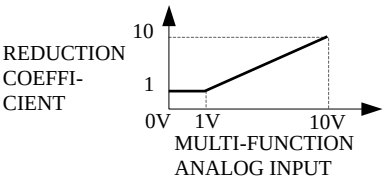

(5) Sn-19 = 4



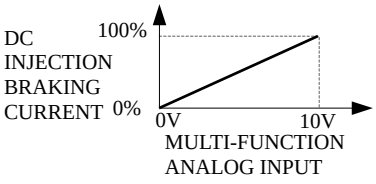

(6) Sn-19 = 5




(7) Sn-19 = 6

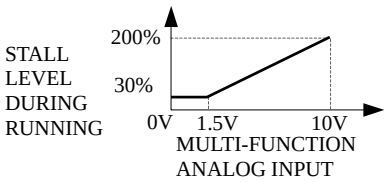



(8) Sn-19 = 7

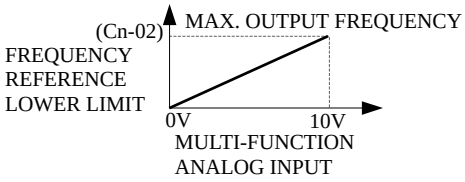



$$\text{Actual accel/decel time} = \frac{\text{Accel/decel time (bn-01 to -04)}}{\text{Reduction coefficient}}$$

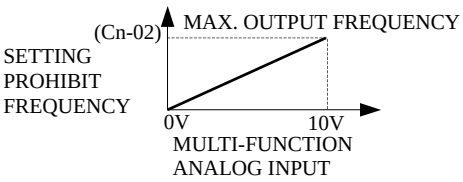
(9) Sn-19 = 08




(10) Sn-19 = 09




(11) Sn-19 = 0A



# 7.6 MULTI-FUNCTION CONTACT OUTPUT SELECTION **Sn-20 to -22**

Select the set values shown below for Sn-20 to -22.
Contact output for 0.1 sec. while detecting signal.

| Terminal No. | Sn-□□ |
|---|---|
| Control circuit terminal 9, 10 (Contact output) | 20 |
| Control circuit terminal 25, 27 (Open collector output) | 21 |
| Control circuit terminal 26, 27 (Open collector output) | 22 |

| Set Value | Description | |
|---|---|---|
| | Name | Signal Level (Closed) |
| 00 | During running | Closed: During running |
| 01 | Zero speed | Closed: Zero speed |
| 02 | Agreed frequency | Closed: (Frequency ref -Cn-22) ≦ Output frequency ≦ (Frequency ref. +Cn-22) |
| 03 | Agreed frequency setting | Closed: Set value 2 in agreed frequency status and (Cn-21-Cn-22) ≦output frequency≦(Cn-21 +Cn-22) |
| 04 | Frequency detection | Closed: Output frequency ≦ Cn-21 |
| 05 | Frequency detection | Closed: Output frequency ≧ Cn-21 |
| 06 | Inverter operation ready | Closed: Inverter operation ready |
| 07 | During undervoltage detection | Closed: During undervoltage detection |
| 08 | During baseblock | Closed: During inverter output baseblock |
| 09 | Frequency reference mode | Open: From control circuit terminal<br>Closed: From operator |
| 0A | Control command | Open: From control circuit terminal<br>Closed: From operator |
| 0B | Overtorque detection | Closed: During overtorque reference missing |
| 0C | Frequency reference missing | Closed: While frequency reference missing |
| 0D | Braking resistor fault | Open: From control circuit terminal<br>Closed: From operator |
| 0E | Fault | Closed: Fault (except CPF 00, CPF 01) |
| 0F | Not used | — |

**(1) Operation** (set value = 0)

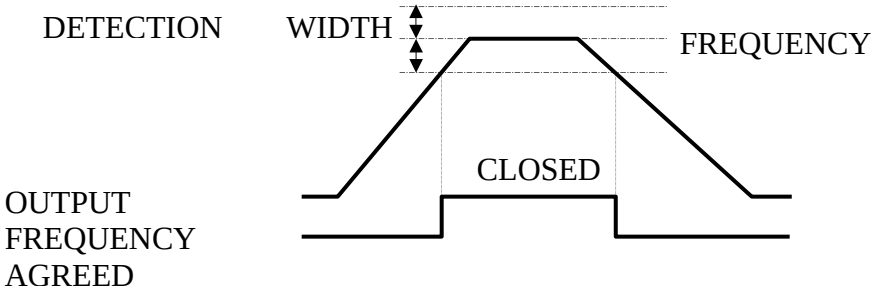
The operation contact is "closed" when FWD or REV run command is input, or the inverter outputs voltage.

**(2) Zero-speed** (set value = 1)

The zero-speed contact is "closed" when inverter output frequency is less than the minimum output frequency.

**(3) Agreed frequency** (set value = 2)

This is "closed" when output frequency is within the detection width shown in the figure below.

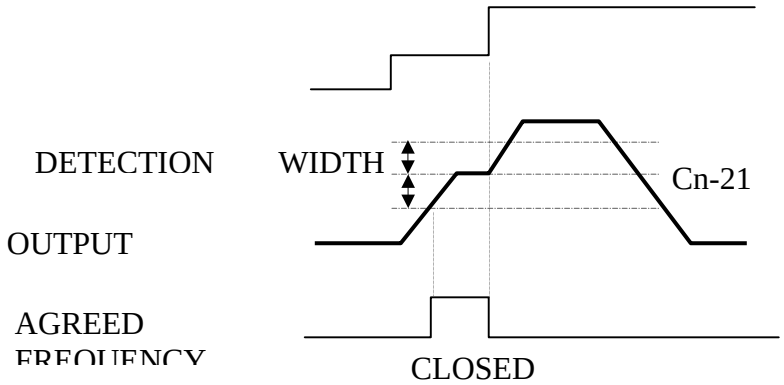



(Frequency ref. -Cn-22) ≦ Output frequency ≦ (Frequency ref. + Cn-22)

Cn-22: Agreed frequency detection width.

**(4) Agreed frequency** (Set value = 3)

This is "closed" when acceleration or deceleration is completed and output frequency is within the detection width shown in the figure below.



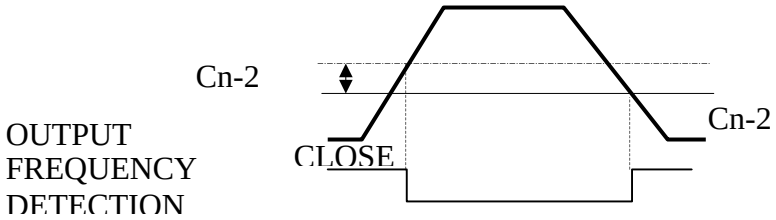

(Cn-21 -Cn-22) ≦ Output frequency ≦ Cn-21 +Cn-22)

Cn-21: Agreed frequency point.

Cn-22: Agreed frequency detection width.

**(5) Frequency detection** (set value = 4)

This contact is "closed" when output frequency is equal to or less than Cn-21, as shown in the figure below.



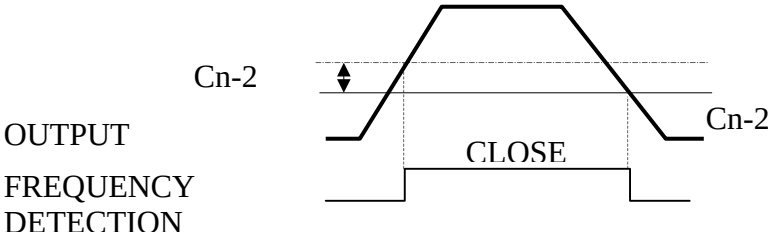

Output frequency $\leqq$ Cn-21

Cn-21: Agreed frequency point.

Cn-22: Agreed frequency detection width.

**(6) Frequency detection** (set value = 5)

This contact is "closed" when output frequency is equal to or greater than Cn-21, as shown in the figure below.




Output frequency $\geqq$ Cn-21

Cn-21: Agreed frequency point.

Cn-22: Agreed frequency detection width.

**(7) Inverter operation ready** (set value = 6)

This is "closed" when the inverter has become ready for operation.

**(8) During undervoltage (UV) detection** (set value = 7)

This contact remains "closed" as long as the inverter is detecting undervoltage.

**(9) During baseblock** (set value = 8)

This contact is always "closed" when inverter output is shut OFF.

**(10) Frequency reference mode** (set value = 9)

This contact is "closed" when the frequency reference mode from the operator is selected.

**(11) Control command** (set value = A)

This contact is "closed" when the control command from the keyboard is selected.

**(12) Overtorque detection** (set value = B)

This contact remains "closed" as long as the inverter is detecting overtorque. Set overtorque detection level in Cn-26 and set overtorque detection time in Cn-27.

**(13) Frequency reference missing** (set value = C)

This is "closed" when frequency reference missing is detected.

**(14) Braking resistor fault** (set value = D)

This is "closed" when the braking resistor is overheated or a fault is detected in the braking transistor.

**(15) Fault** (set value = E)

This contact is "closed" when the inverter detects a major fault. However, in the event of a fault in the watchdog (CPF00) or transmission between the mainframe and operator, the inverter is not operated.

**(16) Not used** (set value = F)

Multi-function contact output not used.

## 7.7 CONTROL CONSTANTS Cn-□□

| Function | Cn-□□ | Data Name | Set Unit | Set Range | Factory Setting |
|---|---|---|---|---|---|
| V/f Patten Setting | 01 | Input voltage | 0.1V | 150 - 255.0*1 | 220.0 *2 |
| | 02 | Max. output frequency | 0.1Hz | 50.0 - 400.0 | 60.0 |
| | 03 | Max. voltage | 0.1V | 0.1 - 255.0 *1 | 220.0 *2 |
| | 04 | Max. voltage frequency | 0.1Hz | 0.1 - 400.0 | 60.0 |
| | 05 | Mid. output frequency | 0.1Hz | 0.1 - 400.0 | 3.0 |
| | 06 | Mid. output frequency voltage | 0.1V | 0.1 - 255.0 *1 | 16.5 |
| | 07 | Min. output frequency | 0.1Hz | 0.1 - 400.0 | 1.5 |
| | 08 | Min. output frequency voltage | 0.1V | 0.1 - 255.0 *1 | 11.0 *2 |
| Electronic Thermal Reference Current | 09 | Motor rated current | 0.1A | *3 | 3.3 *4 |
| DC Injection Braking Function | 10 | DC braking start frequency | 0.1Hz | 0.1 - 10.0 | 1.5 |
| | 11 | DC braking current | 1% | 0 - 100 | 50 |
| | 12 | DC braking time at stopping | 0.1sec | 0.0 - 25.5 | 0.5 |
| | 13 | DC braking time at starting | 0.1sec | 0.0 - 25.5 | 0.0 |
| Frequency Limit Control | 14 | Frequency reference upper limit | 1% | 0 - 109 | 100 |
| | 15 | Frequency reference lower limit | 1% | 0 - 109 | 0 |
| Frequency Prohibited Control | 16 | Setting prohibit (skip) frequency 1 | 0.1Hz | 0.0 - 400.0 | 0.0 |
| | 17 | Setting prohibit (skip) frequency 2 | 0.1Hz | 0.0 - 400.0 | 0.0 |
| | 18 | Setting prohibit (skip) frequency 3 | 0.1Hz | 0.0 - 400.0 | 0.0 |
| | 19 | Setting prohibit frequency range | 0.1Hz | 0.0 - 25.5 | 1.0 |
| Operator Display | 20 | Operator display mode | 1 | 0 - 39999 | 0 |

| | | | | | |
|---|---|---|---|---|---|
| Change | | | | | |
| Agreed Speed Detection | 21 | Agreed frequency | 0.1Hz | 0.0 - 400.0 | 0.0 |
| | 22 | Agreed frequency detection width | 0.1Hz | 0.1 - 25.5 | 2.0 |

## 7.7 CONTROL CONSTANTS Cn-□□.

| Function | Cn-□□ | Data Name | Set Unit | Set Range | Factory Setting |
|---|---|---|---|---|---|
| Carrier Frequency Adjustment | 23 | Carrier frequency upper limit | 0.1kHz | 0.4 - 15.0*6 | 15.0 *6 |
| | 24 | Carrier frequency lower limit | 0.1kHz | 0.4 - 15.0*6 | 15.0 *6 |
| | 25 | Carrier frequency proportion gain | 1 | 0 - 99 | 0 *6 |
| Overtorque Detection | 26 | Overtorque detection level | 1% | 30 - 200 | 160 |
| | 27 | Overtorque detection time | 0.1sec | 0.0 - 25.5 | 0.1 |
| Stall Prevention | 28 | Stall prevention level during acceleration | 1% | 30 - 200 | 170 |
| | 29 | Constant HP (kW) area stall prevention | 1% | 30 - 200 | 50 |
| | 30 | Stall prevention level during running | 1% | 30 - 200 | 160 |
| Torque Boost Control | 31 | Motor terminal resistance (Motor phase to phase resistance) | 0.001 | 0.000-65.535 | 5.732*4 |
| | 32 | Motor iron loss | 1W | 0 - 65535 | 64 *4 |
| | 33 | Torque compensation limiter | 1V | 0 - 50 *1 | 50 *4 |
| Simplified Speed Control | 34 | Motor no load current | 1% | 0 - 99 *5 | 30 |
| | 35 | Slip compensation primary delay time | 0.1sec | 0.0 - 25.5 | 2.0 |
| Fault Retry | 36 | No. of auto reset/restart operation | 1 | 0 - 10 | 0 |
| Corrective Action for Momentary Power Loss | 37 | Power loss ride-thru time | 0.1sec | 0.0 - 2.0 | 0.7 *4 |
| Speed Search Control | 38 | Speed search deactivation current level | 1% | 0 - 200 | 150 |
| | 39 | Speed search decel time | 0.1sec | 0.1 - 25.5 | 2.0 |
| | 40 | Min. baseblock time | 0.1sec | 0.5 - 5.0 | 0.5 *4 |
| | 41 | V/f during speed search | 1% | 10 - 100 | 100 |
| | 42 | Voltage recovery time | 0.1sec | 0.1 - 5.0 | 0.3 |

*1 For 230V class. ×2 for 460V class.
*2 For 230V class. ×2 for 460V class.
*3 Setting range becomes 10 to 200% of inverter rated current.
*4 Factory settings differ depending on inverter capacity. (Sn-01 set value).
This example shows combination of (1HP 0.75kW) and TECO standard motor 220v 60Hz 1HP 0.75kW. (Refer to the table on pages 62 to 65).
At setting Sn-01, the set value changes to the factory setting. For any application other than TECO standard motors, set the value shown on the nameplate of the motor.
*5 Motor rated current (Cn-09) becomes 100% level.
*6 Factory setting and setting range differ depending on inverter capacity. (Sn-01 set value).

**(1) Input voltage** (Cn-01)

Set inverter input voltage. (in units of 0.1V).

**(2) V/f constant** (Cn-02 to Cn-08)

Set inverter output frequency/voltage characteristics. (V/f characteristics).

(a) Changing V/f characteristics

Sn-02 = 0 to E: V/f characteristics determined by set value. Settings of Cn-02 to Cn-08 cannot be changed. (Refer to page 66).

Sn-02 = F: Any V/f characteristic can be obtained by the set values of constants Cn-02 to Cn-08.

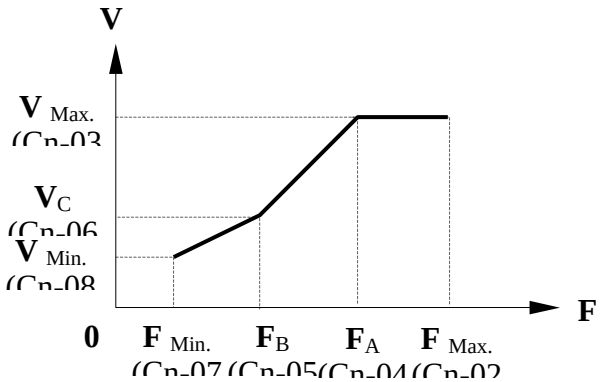
(b) Voltage values (Cn-03, Cn-06, Cn-08) displayed in the operator depend on the set value of Sn-02 (V/f selection) as follows:

- Sn-02 = 0 to E: Proportional computation is performed with input voltage (Cn-01) as 100%

<Example> When Cn-01 = 220V and V/f pattern Sn-02 = 1, the following display is shown on the operator:

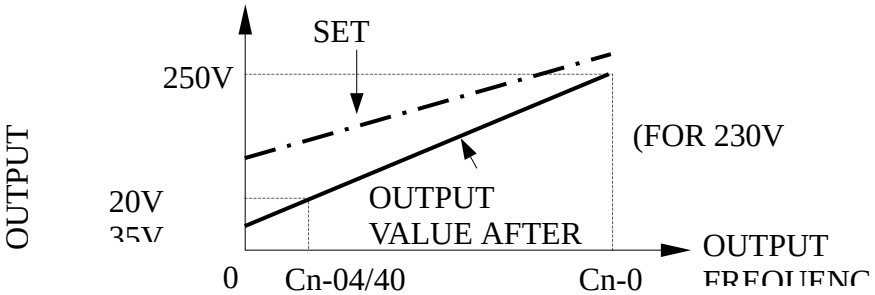
- Cn-03 = 220
- Cn-06 = 15V x $\frac{220}{200}$ = 16.5V
- Cn-08 = 10V x $\frac{220}{200}$ = 11V
- Sn-02 = F: The set value is displayed.

(c) When V/f characteristics are a straight line, the same value as Cn-07 is set in Cn-05. The set value of Cn-06 is disregarded.

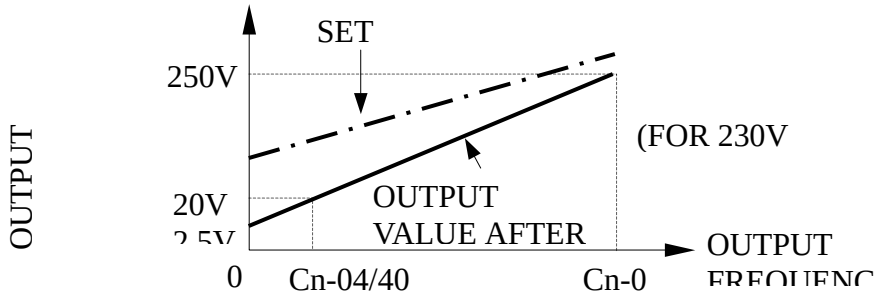


Notes:
1. The maximum output voltage is limited by input voltage.
2. When the set values of Cn-02 to Cn-08 do not satisfy the following conditions, a setting error occurs and OPE18 is displayed. The set value is checked at power ON and switching from PRGM mode to DRIVE mode. FMax. ≥ FA > FB ≥ FMin.
3. Actual output voltage is limited to the following value even if an arbitrary V/f is set as Sn-02 = F. For setting without limit, set Sn-02 = FF. In this case, the inverter may malfunction unless V/f suitable for the motor characteristics is set.

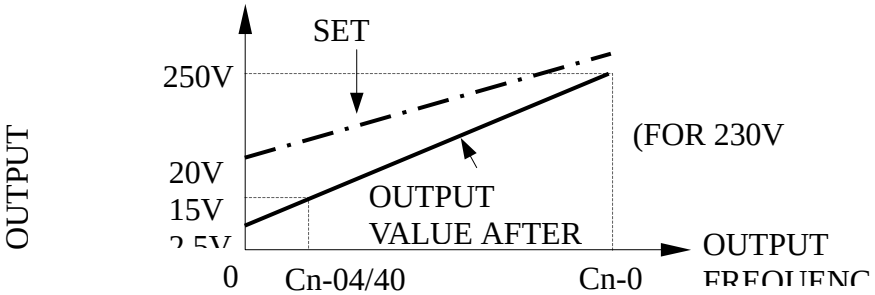
0.5 to 5HP (0.4 to 3.7kW)




7.5 to 30HP (5.5 to 22kW)




40 to 100HP (30 to 75kW), (40 to 400HP for 460V class)



**(3) Motor rated current** (Cn-09)

Set motor rated current by the electronic thermal function in units of 0.1A for motor overload protection. The range of setting is 10% to 200% of inverter rated current. When the 1st digit of Sn-14 is 1, the electronic thermal function is disabled and the motor is not protected from overheating due to overload.

**(4) DC braking start frequency** (Cn-10)

Set a frequency for starting DC braking at deceleration stop in units of 0.1Hz. When a set value is not greater than Cn-07 (minimum output frequency), DC braking is started with the minimum output frequency.

**(5) DC braking current** (Cn-11)

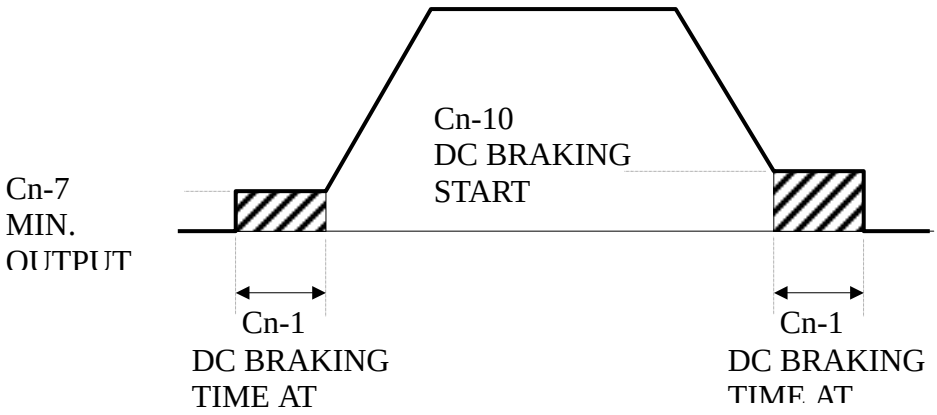
Set DC braking current in units of 1%. Inverter rated current is 100%.

**(6) DC braking time at stopping** (Cn-12)

Set the duration of DC braking at stopping in units of 0.1 second. When a set value is 0, DC braking is not performed, and inverter output is shut OFF at the start of DC braking.

**(7) DC braking time at starting** (Cn-13)

Set the duration of DC braking at starting in units of 0.1 second. When a set value is 0, DC braking is not performed, and acceleration begins with the minimum output frequency.

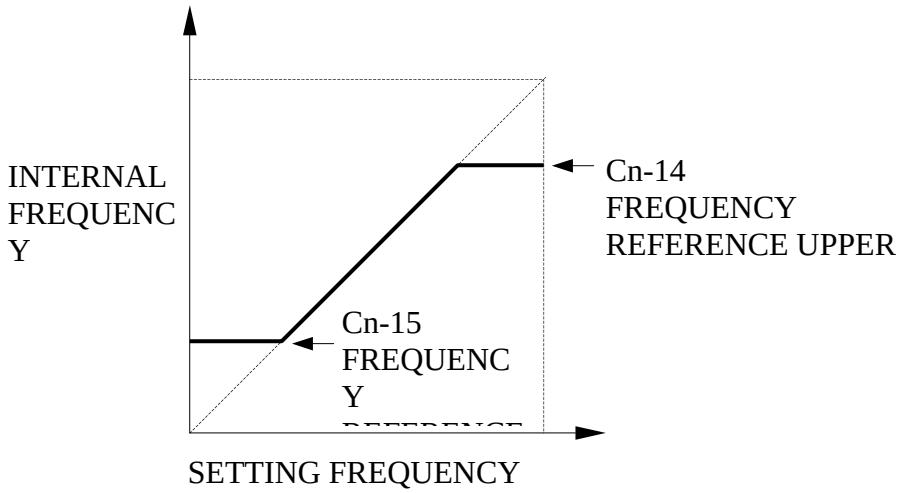



**(8) Frequency reference upper limit** (Cn-14)

Set the upper limit of frequency reference in units of 1%. Cn-02 (maximum frequency) is regarded as 100%.

**(9) Frequency reference lower limit** (Cn-15)

Set the lower limit of frequency reference in units of 1%. Cn-02 (maximum frequency) is regarded as 100%. When the run command is input with a frequency reference of 0, acceleration continues from the minimum frequency to the lower frequency reference limit, and operation continues in the lower frequency reference limit.




**(10) Setting prohibit (skip) frequencies 1 to 3** (Cn-16 to Cn-18)

Set a setting prohibit frequency in units of 0.1Hz. A set value of 0.0Hz disables this function.

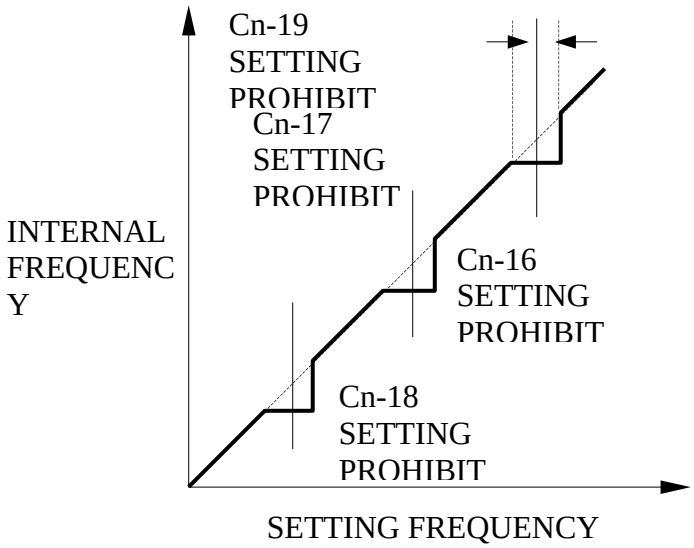
Note: If the setting prohibit frequency ranges overlap, set prohibit (skip) frequency 1 to 3 as shown below:

$$\left(\begin{array}{c}\text{Cn-18}\\ \text{setting prohibit}\\ \text{frequency 3}\end{array}\right) \leq \left(\begin{array}{c}\text{Cn-17}\\ \text{setting prohibit}\\ \text{frequency 2}\end{array}\right) \leq \left(\begin{array}{c}\text{Cn-16}\\ \text{setting prohibit}\\ \text{frequency 1}\end{array}\right)$$

**(11) Setting prohibit (skip) frequency range** (Cn-19)

Set the range of setting prohibit (skip) frequency in units of 0.1Hz. The range of the setting prohibit (skip) frequency is determined a follows, depending on combinations with Cn-16 to Cn-18.

Cn-16 to Cn-18 -Cn-19 $\leq$ the range of the setting prohibit frequency $\leq$ Cn-16 to Cn-18 $+$Cn-19.




Note: Constant speed operation is prohibited in the setting prohibit frequency range. Output frequency does not jump during acceleration or deceleration, which is performed smoothly.

**(12) Operator display mode** (Cn-20)

The setting unit of frequency references 1 to 8 and jog frequency reference depends on the set value of operator display mode (Cn-20) as follows:

| Cn-20 | Setting / Reading Unit |
|---|---|
| 0 | Units of 0.01Hz |
| 1 | Units of 0.01% |
| 2 to 39 | Set in the units of r/min (0 to 39999).<br>r/min = 120 x frequency reference (Hz)/Cn-20<br>(Set the number of motor poles in Cn-20). |
| 40 to 39999 | The position of decimal point is set by the value of the 5th digit of Cn-20.<br>Value of 5th digit = 0: Displayed as XXXX<br>Value of 5th digit = 1: Displayed as XXX.X<br>Value of 5th digit = 2: Displayed as XX.XX<br>Value of 5th digit = 3: Displayed as X.XXX<br>A set value of 100% frequency is determined by the 1st digit to 4th digit of Cn-20.<br>Example 1: When the set value of 100% speed is 200.0, Cn-20 = 12000 is set.<br>100% speed is displayed as 200.0 at Cn-20 = 12000.<br>60% speed is displayed as 120.0<br>Example 2: When the set value of 100% speed is 65.00, Cn-20 = 26500 is set.<br>60% speed is displayed as 39.00 at Cn-20 = 26500. |

**(13) Agreed frequency** (Cn-21)

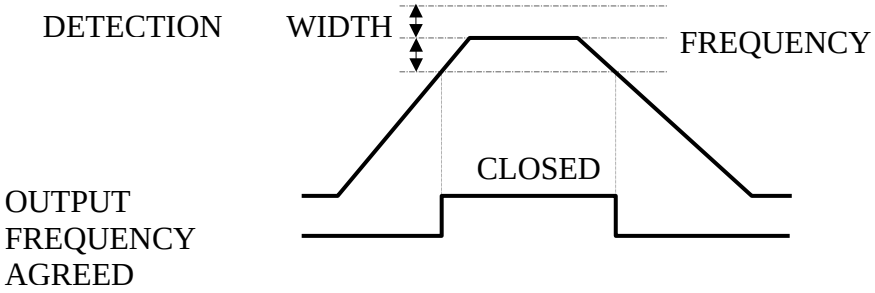
Set an agreed frequency point in units of 0.1Hz.

**(14) Agreed frequency detection width** (Cn-22)

Set an agreed frequency detection width in units of 0.1Hz. The relationship with the multi-function contact outputs are shown in the four figures below [(a) to (d)].

(a) Agreed frequency (set value of multi-function contact output = 2)

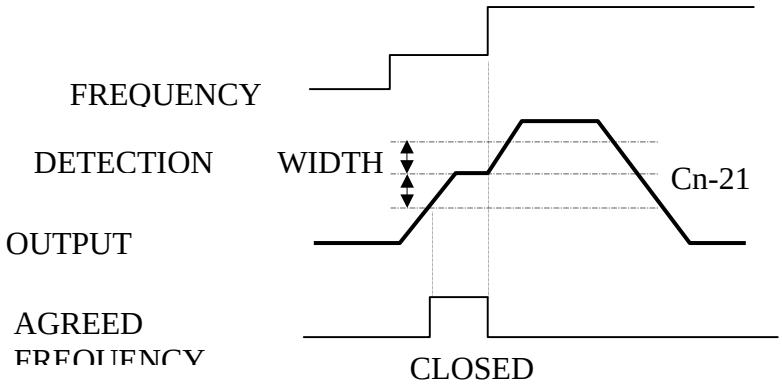
This is "closed" when output frequency is within the detection width shown in the following figure.




(Frequency ref. -Cn-22) $\leq$ Output frequency $\leq$ (Frequency ref. +Cn-22)
Cn-21: Agreed frequency point.
Cn-22: Agreed frequency detection width.

(b) Agreed frequency (set value of multi-function contact output = 3)

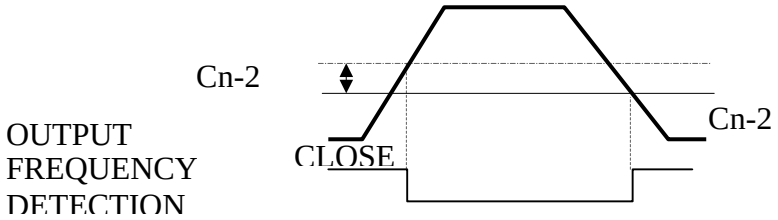
This is "closed" when acceleration or deceleration is completed and output frequency is within the detection width shown in the figure below.




(Cn-21 -Cn-22) $\leq$ Output frequency $\leq$ (Cn-21 +Cn-22)
Cn-21: Agreed frequency point.
Cn-22: Agreed frequency detection width.

(c) Frequency detection contact (set value of multi-function contact output = 4)

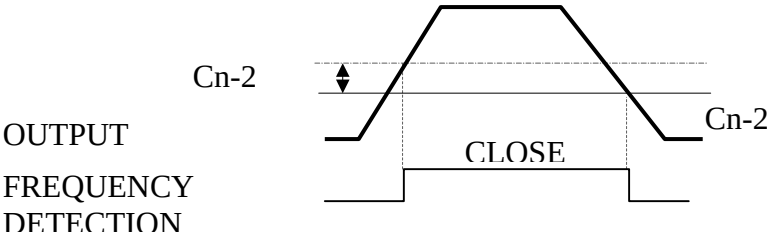
This contact is "closed" when output frequency is equal to or less than Cn-21, as shown in the figure below.




Output frequency $\leq$ Cn-21
Cn-21: Agreed frequency point.
Cn-22: Agreed frequency detection width.

(d) Frequency detection contact (set value of multi-function contact output = 5)

This contact is "closed" when output frequency is equal to or more than Cn-21, as shown in the figure below.




Output frequency $\geq$ Cn-21
Cn-21: Agreed frequency point.
Cn-22: Agreed frequency detection width.

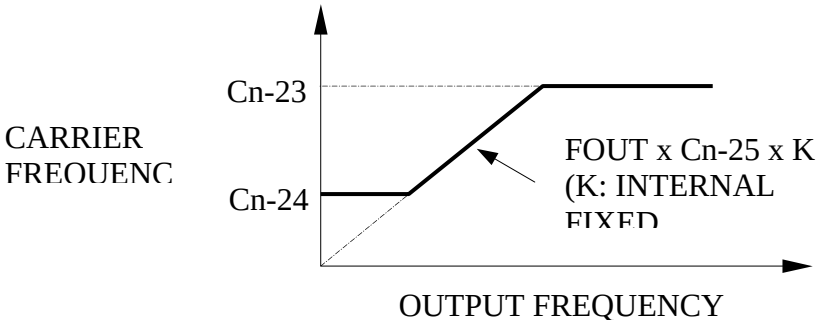
**(15) Carrier frequency upper/lower limit, proportion gain** (Cn-23 to Cn-25)

The relationship between output frequency and carrier frequency is determined as follows from the set values of Cn-23 to Cn-25.

(a) For constant carrier frequency (set value of Cn-23):

Set 0 in Cn-25 and set the same value in Cn-23 and Cn-24.

(b) For carrier frequency: Carrier frequency changes according to Cn -23 to Cn-25 set values and output frequency as shown below.




oPE11 is displayed in the following cases:

① Cn-25 > 6 and Cn-24 > Cn-23
② Cn-23 > 5kHz and Cn-24 ≤ 5kHz

**(16) Overtorque detection level** (Cn-26)

Set overtorque level in units of 1%. Inverter rated current is regarded as 100%.

**(17) Overtorque detection time** (Cn-27)

Set overtorque detection time in units of 0.1 second.

**(18) Stall prevention level during acceleration** (Cn-28)

Set stall prevention level during acceleration in units of 1%. Inverter rated current is regarded as 100%.

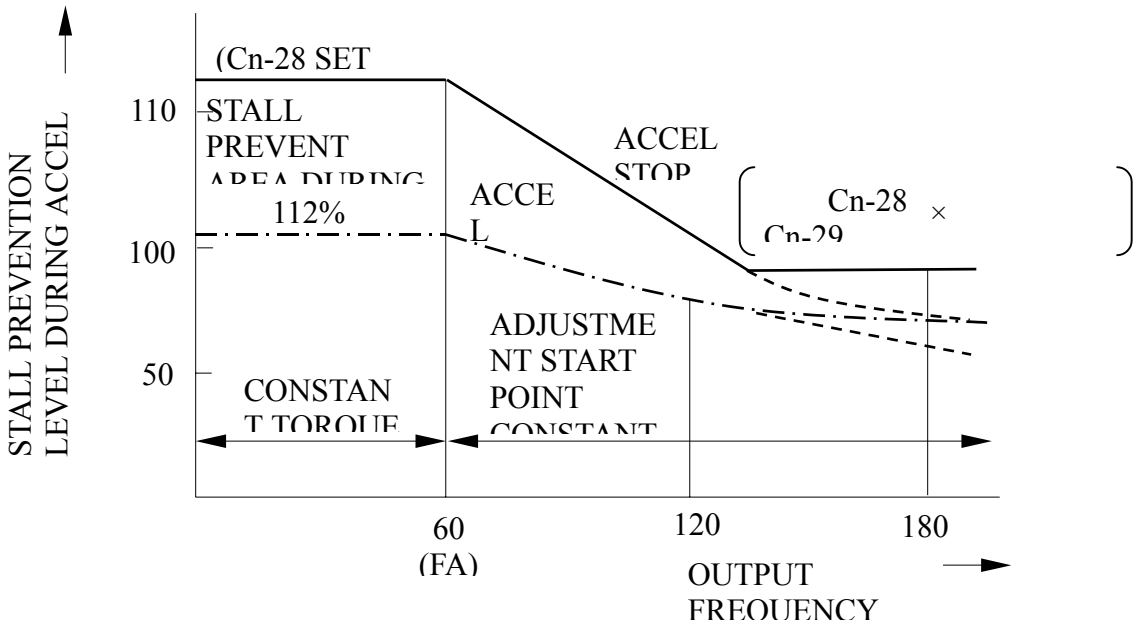
**(1) Constant HP (kW) area stall prevention limiter** (Cn-29)

Set constant HP (kW) area stall prevention level in units of 1%. Inverter rated current is regarded as 100%.

The function of stall prevention during acceleration automatically extends acceleration according to load status (inverter output current), thus preventing the motor from stalling during acceleration. The stall prevention level during acceleration in a constant output area is reduced as follows:

When the 1st digit of Sn-10 is 1, the output frequency increases at the rate determined by acceleration time:

$$\text{Acceleration stall prevention level of constant output area} = \frac{\text{Acceleration stall prevention level} \times \text{Maximum voltage}}{\text{Output frequency}}$$

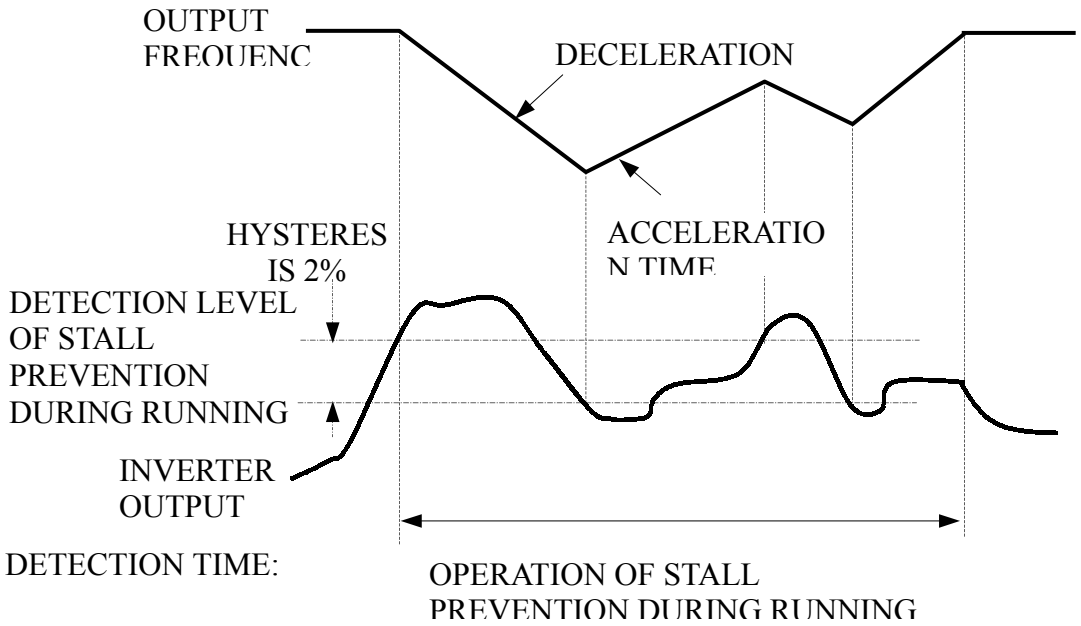


**(2) Stall prevention level during running** (Cn-30)

Set a proportion as a stall prevention level during running in units of 1%. Inverter rated current is regarded as 100%

Stall prevention during running starts deceleration when the output current is greater than the setting value of Cn-30 during agreed frequency for more than 100ms. The inverter decelerates as long as the output current exceeds the setting value of Cn-30 (stall prevention level during running). When the output current goes below the setting value, the inverter reaccelerates. The deceleration time selected in the 4th digit of Sn-10 is taken.

Even during stall prevention while running, stall prevention during deceleration and stall prevention during acceleration are enabled.



**(3) Motor no-load current** (Cn-34)

Set motor no load current in units of 1%. Motor rated current (Cn-09) is regarded as 100%.

When the output current of the inverter is larger than motor no-load current (Cn-34), the output frequency of the inverter is compensated.

The amount of frequency compensation is determined by the formula below.

The maximum voltage frequency (Cn-04) is 100% level.

If the output current is compensated for by the motor rated slip (bn-08).

If frequency reference is equal to or smaller than minimum output frequency (Cn-07) or motor is in a regeneration mode, slip compensation is not performed.

Amount of output frequency compensation =

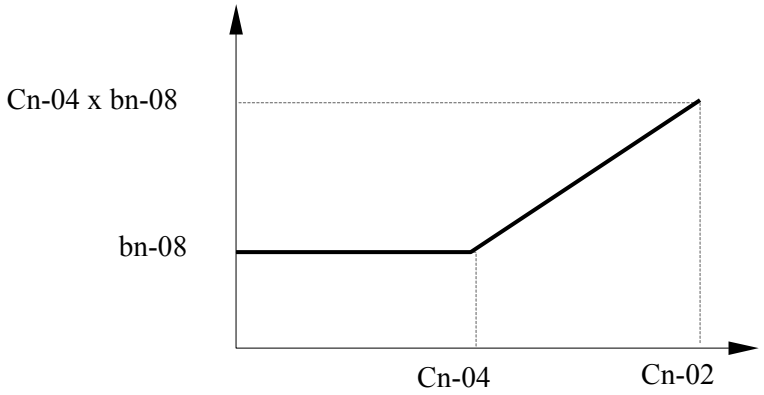
$$\left(\frac{\text{Motor rated slip}}{\text{Motor rated current} - \text{Motor no-load current}}\right) \times \left(\text{Output current} - \text{Motor no-load current}\right)$$

Motor rated current: Cn-09

Motor no load current: Cn-34

Motor rated slip: bn-08

The amount of output frequency compensation in a constant torque area and a constant output area is shown in the figure below.




**(4) Slip compensation primary delay time** (Cn-35)

Set slip compensation primary delay time in units of 0.1 second.

**No. of auto reset/restart operation** (Cn-36)

Set the number of auto reset/restart operation. Setting of zero causes no auto reset/restart operation.

Each time one of these faults occur: OC, OV, OL1, OL2, OL3, OH, UV1 (OC, GF, OV, rr or UV1), one is added to the number of auto reset/restart operation, and auto reset/restart operation is performed according to the following procedure. However, auto reset/restart operation is not performed in the following case:

① When operation not continued at momentary power loss (3rd digit of Sn-11 = 0) is specified, UV1 fault is not automatically reset.

② When OC or OV fault occurs due to external fault during deceleration stop or DC injection braking stop, inverter output is shut OFF.

The number of auto reset/restart operation is cleared to zero when:

① No fault occurs for 10 minutes or more.

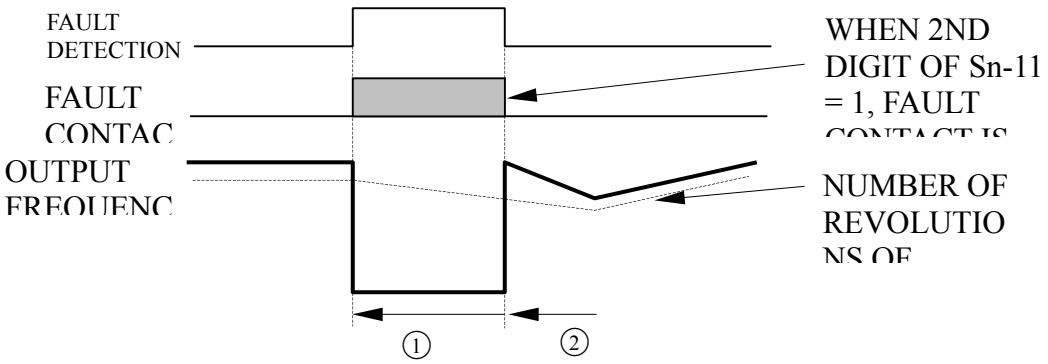
② A fault reset signal is input from control circuit terminals or digital operator.

**Auto reset/restart operation**

① When a fault is detected, inverter output is shut OFF for the minimum baseblock time (Cn-40). During shut OFF of inverter output, a fault occurring in the operator is displayed.

② When the minimum baseblock time (Cn-40) elapses, the fault is automatically reset, and speed search operation is performed with the output frequency at the time of the fault.

③ When the total number of faults exceeds the number of auto restart attempts (Cn-36), automatic reset is not performed and inverter output is shut OFF. At this time, fault contact output is output.




**(5) Power loss ride-thru time** (Cn-37)

Set in units of 0.1 second. The initial value depends on the inverter capacity.

**(6) Speed search deactivation current level** (Cn-38)

When inverter output current immediately after power recovery is larger than the set value of Cn-38, speed search operation is started. When inverter output current is smaller than the set value of Cn-38, the frequency is interpreted as a speed synchronization point and acceleration or deceleration is performed again up to a specified frequency.

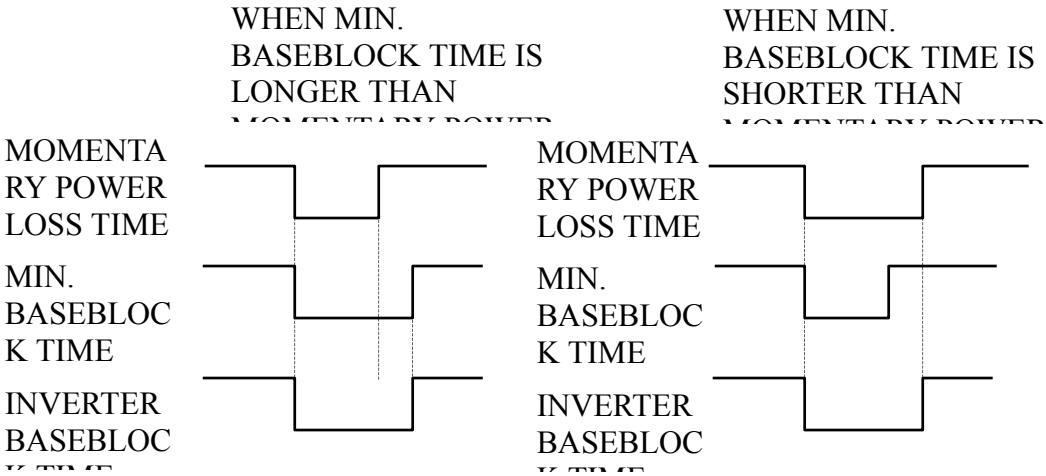
**(7) Speed search decel time** (Cn-39)

Set deceleration time during speed search in units of 0.1 second. A setting of 0.0 second causes no speed search.

**(8) Minimum baseblock time** (Cn-40)

On detecting momentary power loss, the inverter shuts OFF output and maintains the baseblock state for a given time. Set a time in Cn-40 when residual voltage is expected to be almost zero.

When momentary power loss time is longer than the minimum baseblock time, speed search operation is started immediately after power recovery.




**(9) V/f during speed search** (Cn-41)

To ensure that a fault such as OC does not occur during speed search operation, V/f must be reduced during speed search operation, as compared with that during normal operation. Set V/f during speed search as follows by the set value of Cn-41:

V/f during speed search = V/f at normal operation × Cn-41

**(10) Voltage recovery time** (Cn-42)

Set in Cn-42 the time between completion of speed search operation and return to V/f at normal operation. The setting of voltage recovery time is set as follows:

230V class: Time required to raise voltage from 0 to 230V

460V class: Time required to raise voltage from 0 to 460V

## 7.8 MONITOR DISPLAY Cn-□□.

Items to be monitor displayed differ as follows, according to Un-xx.

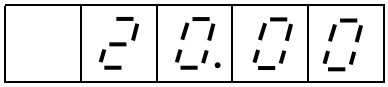
| Un-□□ | Monitor Item | Display Example |
|---|---|---|
| 01 | Frequency reference | 60.0 *2 |
| 02 | Output frequency | 60.0 |
| 03 | Output current | 12.5A |
| 04 | Output voltage | 200V |
| 05 | DC voltage | Pn 310 |
| 06 | Output power (± display) *1 | 12.5 *3 |
| 07 | Input terminal status | *4 |
| 08 | Output terminal status | *5 |
| 09 | LED lamp check | 88888 |
| 10 | PROM No. | *6 |

*1 + is not displayed.

*2 Display of frequency reference (Un-01).

Frequency reference is displayed with five significant digits.

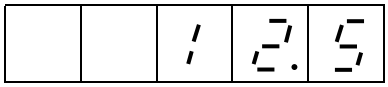
< Example >



*3 Display of output power (Un-06).

Output power is displayed in units of 0.1kW.

< Example >

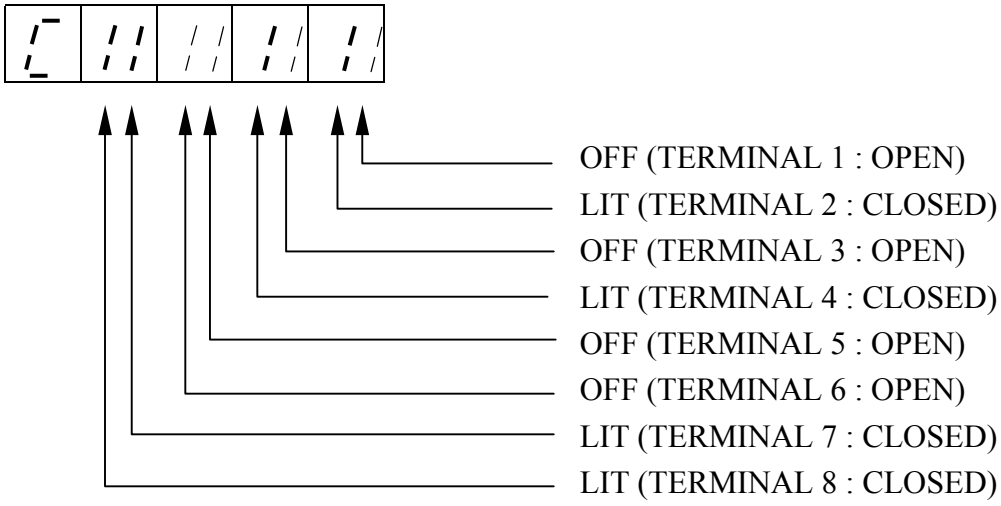


*4 Display of input terminal status (Un-07).

Input terminal status is displayed.

<Example> External terminals 1, 3, 5 and 6: open

External terminals 2, 4, 7 and 8: closed


OFF (TERMINAL 1 : OPEN)
LIT (TERMINAL 2 : CLOSED)
OFF (TERMINAL 3 : OPEN)
LIT (TERMINAL 4 : CLOSED)
OFF (TERMINAL 5 : OPEN)
OFF (TERMINAL 6 : OPEN)
LIT (TERMINAL 7 : CLOSED)
LIT (TERMINAL 8 : CLOSED)

*5 Display of output terminal status (Un-08).

Output terminal status is displayed.

< Example > Control circuit terminals 9 - 10: closed

Control circuit terminals 25 - 27, 26 - 27: open

LIT (TERMINALS 9 - 10 : CLOSED)
OFF (TERMINALS 25 - 27 : OPEN)
OFF (TERMINALS 26 - 27 : OPEN)

*6 Display of PROM No. (Un-10).

PROM No. is displayed

< Example > PROM No. is SD72006

# 8. FAULT DISPLAY AND TROUBLESHOOTING

The GA7200 has protection functions and warning self-diagnosis functions. If a fault a occurs, the protection functions operate to shut OFF the inverter output and the motor coasts to stop, at the same time, the fault contact signal (terminal ⑱-⑳,⑲-⑳) is output.

## A). PROTECTIVE FUNCTIONS AND TROUBLESHOOTING

| Protective Function | | Explanation | Monitor Display | Fault Cont. Output |
|---|---|---|---|---|
| Low voltage protection | Main circuit low voltage | When the inverter power voltage drops, torque becomes insufficient and motor is overheated.<br>Inverter output is stopped when the main circuit DC voltage becomes lower than the low voltage detection level for 15ms or longer, or about 2 seconds or longer if the momentary power loss ride-thru function is used.<br>Detection level: Approximately 210V or less for 230V class and 420V or less for 460V class | UU 1 (UV1) | Operation |
| | Momentary power loss protection | | | |
| | Control circuit low voltage | The inverter output is shut OFF when the control circuit voltage drops below the low voltage level. | UU2 (UV2) | Operation |
| | Main circuit soft charge contactor def. | The inverter output is shut OFF when no answer is received back from the main circuit soft-start contactor. | UU3 (UV3) | |
| Overcurrent protection | | The inverter output is shut OFF when the inverter output current becomes approx. 200% above the inverter rated current. | oC (OC) | Operation |
| Ground fault protection | | The inverter output is shut OFF when a ground fault occurs at the inverter output side and the ground fault current exceeds approximately 50% of the inverter rated current. | GF | Operation |
| Overvoltage protection | | The inverter output is shut OFF when the main circuit DC voltage becomes excessive because of regeneration energy caused by motor deceleration and negative load.<br>Detection: Approx. 800V for input voltage set 400V and above<br>level: Approx. 700V for input voltage set 400V or less<br>Appox. 400V for 200V class | oU (OV) | Operation |
| Fuse blown | | The inverter output is shut OFF when the main circuit transistor fails. The fuse clears to prevent wiring from being by the short-circuit current. | FU (FU) | Operation |
| Cooling fin overheat | | The inverter output is shut OFF when the ambient temperature rises and the heat sink fin reaches 90 ℃. Please check for a defective cooling fan or clogged filter. | oH (OH) | Operation |
| Overload protection | Motor | Inverter output is stopped when motor overload is detected by the electronic thermal overload in the inverter. Either an inverter duty constant-torque specialized motor or general-purpose motor can be selected. If more than one motor is driven, overload protection should be disabled. Use a thermal relay or thermal protector for each motor. | OL 1 (OL1) | Operation |
| | Inverter | The inverter output is shut OFF when the electronic thermal overload reaches or exceeds the inverse time limit of 112% of the inverter's rated current. Maximum rated overload: 150%, 1 min. | OL2 (OL2) | Operation |
| | Overtorque detection | The motor operates according to a preset mode when the inverter output current exceeds the overtorque detection level. This function is used to protect the machine or to monitor the output torque. | OL 3 (OL3) | Operation |
| Braking transistor fault | | Inverter output is shut OFF when an error occurs in the braking transistor. | rr (rr) | Operation |
| Braking resistor overheat | | For 20HP(15kW) or less (200V), 20HP (15kW) or less (400V), an optional dedicated resistor can be installed. The resistor is monitored by the electronic thermal switch for overheating. The inverter output is shut OFF when a specified temperature is reached. | rH (rH) | Operation |
| External fault signal input | | When an external alarm signal is input, the inverter operates according to a preset stop method (coast to stop, ramp stop, or continuous operation) | EF□ EF3 to EF8 | Operation |
| Control circuit fault, option fault | | The inverter output is shut OFF when a transmission error occurs in the control circuit or a component fails. The inverter output is also shut OFF when a specialized option such as the digital operator is not properly connected. | CPF02<br>CPF03<br>CPF04<br>CPF05<br>CPF06<br>CPF20<br>Err | Operation |
| Communication error | | When any communication error between communication interface card SC-C, (option) and master controller occurs, the inverter operates according to a preset stop method (coast to stop, ramp stop, or continuous operation). | bUS (BUS) | Operation |

The warning and self-diagnosis functions do not operate fault contact output (except OH2 warning function) and returns to the former operation status automatically when the factor is removed. The fault display and troubleshooting are provided as shown in the table below.

| | Error Causes | Action to be taken |
|---|---|---|
| | ● Inverter capacity is too small.<br>● Voltage drop due to wiring.<br>● Inverter power voltage selection is wrong.<br>● A motor of large capacity (11kW or greater) connected to the same power system has been started.<br>● Rapid acceleration with generator power supply<br>● Operation sequence when power is OFF<br>● Defective electromagnetic contactor | ● Check the power capacity and power system.<br>● UV display appears when the inverter power is turned OFF while operation signal is input. Remove the power after stopping the inverter. (Set the third and fourth bits of Sn-04 = 01). |
| | ● Extremely rapid accel/decel<br>● Motor on/off switching at the inverter output side<br>● Short-circuit or ground fault at the inverter output side<br>● Motor of a capacity greater than the inverter rating has been started<br>● High-speed motor or pulse motor has been started. | Transistor error may occur. Investigate the error cause, correct it, then restart. |
| | ● Motor dielectric strength is insufficient.<br>● Load wiring is not proper. | Check for ground fault in motor or load wiring. |
| | ● Overvoltage<br>● Insufficient deceleration time<br>● Regenerative load (Motor is turned by the load).<br>● High input voltage compared to motor rated voltage | If braking torque is not proper, extend the decel time or use a braking resistor. (If braking resistor is already installed, verify that Sn-10, 2nd digit = 1). |
| | ● Repeated overcurrent protection (OC)<br>● Repeated overload protection (OL2) power reset<br>● Rapid deceleration in excess excitation (improper V/f characteristic setting)<br>● External noise | Correct the cause, check the main circuit transistor, replace the fuse, then restart. |
| | ● Defective cooling fan<br>● Ambient temperature rise<br>● Clogged filter | Replace the cooling fan and clean the filter.<br>Ambient temperature: 104°F (40°C) or less for enclosed type<br>122°F (50°C) or less for open chassis |
| | Overload, low speed operation or extended acceleration time, improper V/f characteristic setting | Investigate the cause of overload and review the operation pattern, V/f characteristic, and motor/inverter capacities. (If inverter is repeatedly reset after an overload occurs, the inverter may fault. Investigate and correct the cause of overload.) |
| | Motor Current exceeds the preset value because of machine error or overload. | Check the use of the machine. Correct the overload cause or set a higher detection level which is within the allowable range. |
| | ● Insufficient resistance of braking resistor<br>● Short-circuit or ground fault in braking resistor | Review the resistance of the braking resistor and braking duty cycle. Change the resistance or increase the inverter capacity. |
| | ● Frequent operation stop<br>● Long-time continuous regeneration<br>● Rapid deceleration | Shorten deceleration time or review the braking torque and brake duty cycle (%ED). Use optional braking resistor or braking unit. |
| | External fault condition occurred. | Correct the cause of the fault input. See Un-07 for the state of input signal. |
| | ● External noise<br>● Excess vibration or shock<br>● CPF 02: Control circuit fault<br>● CPF 03: NVRAM (SRAM) fault<br>● CPF 04: NVRAM BCC Code error<br>● CPF 05: AD converter fault in CPU<br>● CPF 06: option card fault<br>● Err: Parameter setting error | ● Check data in Sn-01 and Sn-02. Record all data, then use Sn-03 for initializing.<br>● Turn off power, then turn on again. If error is persistent, contact your local distributor or TECO representative. |
| | ● External noise<br>● Excessive vibration or shock<br>● Poor connection | ● Check data in Sn-01 and Sn-02. Record all data, then use Sn-03 for initializing.<br>● Turn OFF power, then turn ON again. If error is persistent, contact your local distributor or TECO representative.<br>● Check for communication cable between communication interface card (SC-C) and master controller. |

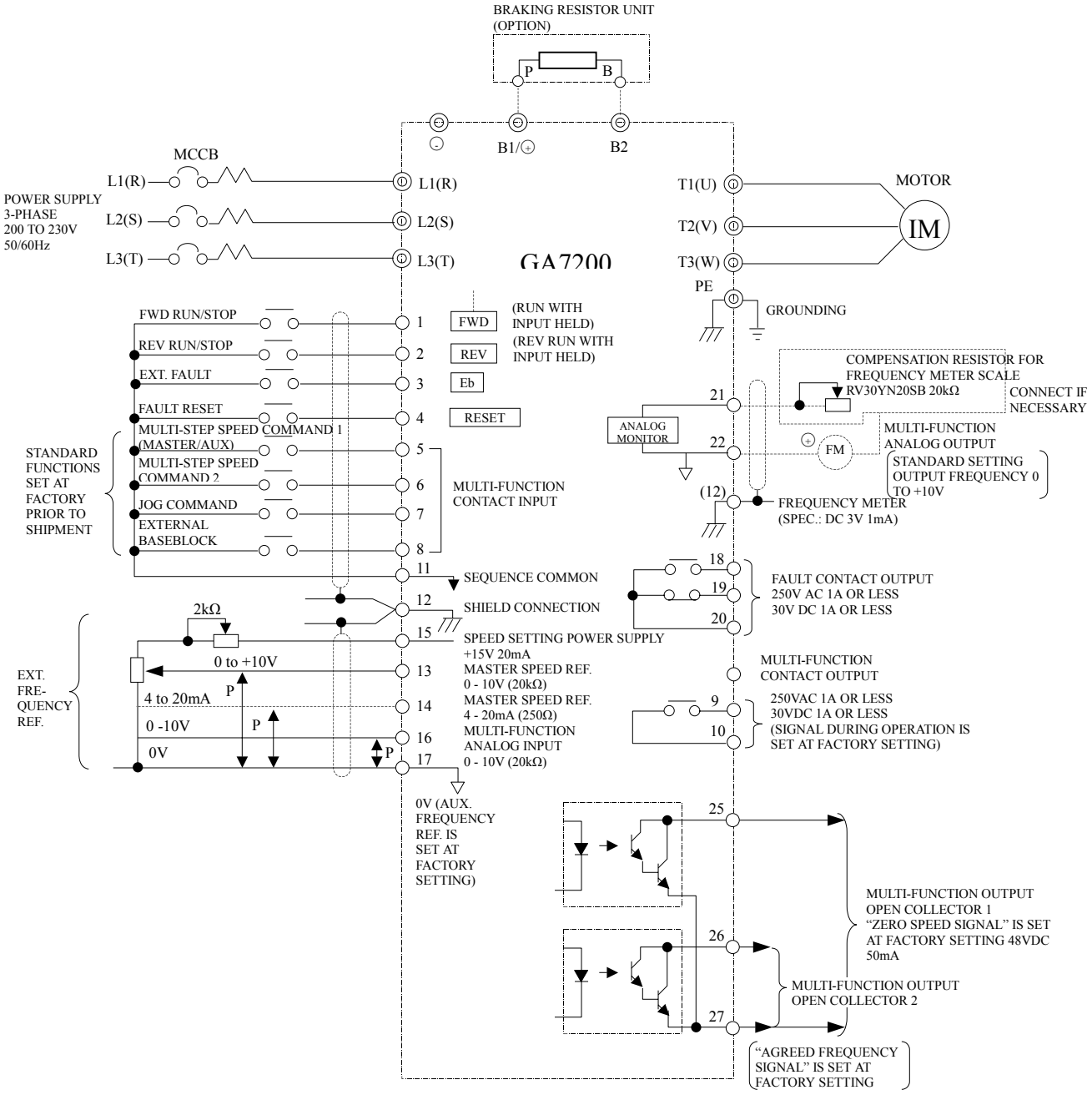
## B.) Warning and Self-Diagnosis Functions

| Protective Function | | Explanation | Monitor Display | Fault Cont. Output |
|---|---|---|---|---|
| Low-voltage protection (main circuit voltage insufficient) | | Monitor display appears if low voltage protection conditions such as a drop in main circuit voltage or momentary power loss occur while the inverter output is OFF. | UV (UV) (Blink) | Non operation |
| High voltage protection | | Monitor display appears when the main circuit DC voltage rises above the detection level while the inverter output is OFF. | OV (OV) (Blink) | Non operation |
| Cooling fin overheat warning | | Monitor display appears when a separate thermal protector contact is input to the external terminal. | OH3 (OH2) (Blink) | Non operation |
| Overtorque detection | | This function is used to protect the machine and to monitor the inverter output torque. The inverter output reacts in a preset manner when the inverter output current exceeds the overtorque detection level. The monitor display blinks when "operation continue" is preset. | OL 3 (OL3) (Blink) | Non operation |
| Stall prevention (Accel/decel is accomplished with maximum capacity of the inverter without trip- ping on over- current or overvoltage) | During acceleration | Inverter acceleration is stopped when 170% or more of the inverter rated current is required by the load. This prevents overload protection (OL2) or overcurrent (OC) from occurring. When current is reduced to less than 170%, acceleration is enabled. | — | Non operation |
| | During normal operation | Output frequency is decreased when 160% of the inverter rated current or greater is required by the load. This prevents motor and inverter overload (OL1, OL2). When current is reduced below 160%, inverter acceleration is enabled. | | |
| | During deceleration | Deceleration is stopped when the DC voltage is caused to rise by motor regenerative energy. This prevents overvoltage trips (OV). When DC voltage decreases, deceleration to the set value resumes. | | |
| Simultaneous normal and reverse rotation commands | | When forward and reverse rotation commands are simultaneously detected for a period of time exceeding 500ms, the inverter is stopped according to the preset stop method. | (EF) (Blink) | Non operation |
| External fault signal input (Minor failure) | | It is indicated on the monitor when the mode after external signal input is set to "operation continue." | EF□ (Blink) EF3 to EF8 | Non operation |
| External baseblock signal input (Minor failure) (main circuit transistor instantaneous shut off) | | When an external baseblock signal is input, the motor coasts to a stop. When the external base block signal is removed, the inverter output is immediately turned on at the previously set frequency. | bb (BB) (Blink) | Non operation |
| Invalid parameter setting | | When an invalid parameter is set, it is indicated on the monitor at power up or when the inverter is changed from the PRGM mode to the DRIVE mode. | oPE01 oPE11 | Non operation |
| Communication error | | When any communication error between communication interface card SC-C, (option) and master controller (PLC) occurs and a preset stop method of the inverter is set to "continuous operation," a monitor display blinks. | bUS (BUS) (Blink) | Non operation |
| Communication ready | | When the inverter with communication interface card SC-C (option) does not receive correct data from master controller (PLC), " " is displayed. | CALL (CALL) | Non operation |
| Digital operator communication error | | Digital operator communication error 1 | CPF00 | Non operation |
| | | Digital operator communication error 2 | CPF01 | |

| | Error Causes | Action to be taken |
|---|---|---|
| | ● Input voltage drop | Check the main circuit DC voltage in Un-xx. If the voltage is low, adjust the input voltage. |
| | ● Input voltage rise | Check the main circuit DC voltage in Un-xx. If the voltage is high, adjust the input voltage. |
| | ● Overload<br>● Cooling fan fault<br>● Ambient temperature rise<br>● Clogged filter | Replace the cooling fan and clean the filter.<br>Ambient temperature: 104°F (40°C) or less for enclosed type<br>122°F (50°C) or less for open chassis |
| | ● Motor current exceeded the set value because of machine fault or overload. | Check the driven machine and correct the cause of the fault or set to a higher value. |
| | ● Insufficient power for accel/decel<br>● Overload<br>● Phase loss | ● Set proper accel/decel time for smooth operation.<br>● For stall prevention during normal operation, lighten the load or increase inverter capacity. |
| | ● Operation sequence error<br>● 3-wire/2-wire selection error | ● Recheck the control sequence.<br>● Recheck system constants (Sn-15 to -18). |
| | ● External fault conditions set-up | Take appropriate measurements for the cause of external fault input. |
| | —— | —— |
| | ● Invalid parameter setting<br>● OPE01: Inverter KVA setting (Sn-01) error.<br>● OPE02: Parameter setting range error.<br>● OPE03: Multi-function contact input setting error. | ● Review the parameter setting range and conditions. |
| | ● External noise<br>● Excessive vibration or shock<br>● Poor connection | ● Check data in Sn-01 and Sn-02. Record all data, then use Sn-03 for initializing.<br>● Turn OFF power, then turn ON again. If error is persistent, contact your local distributor or TECO representative.<br>● Check the cable connection between communication interface card SC-C (option) and master controller (PLC). |
| | ● Poor connection<br>● Defective communication software (PLC) | ● Check the cable connection between communication interface card SC-C (option) and master controller (PLC).<br>● Check the communication software. |
| | ● External noise<br>● Excess vibration or shock<br>● Digital operator fault<br>● Control board fault | ● Check the digital operator connection.<br>● Turn OFF the power supply once and turn it ON again. If the fault still exists, replace the digital operator or control board. |

# 9. GA7200 TERMINAL FUNCTIONS

TYPICAL CONNECTION DIAGRAM [230V class, 10HP (7.5kW) or less]



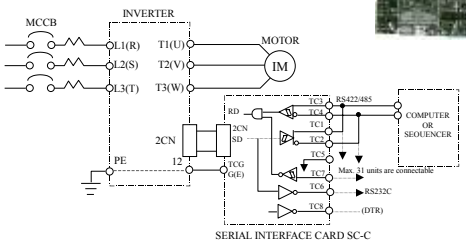

Notes:

1. indicates shielded wire and indicates twisted pair shielded wire.
2. Output current capacity of +15 volts in external terminal 15 is max. 20mA.
3. For master speed reference, use control circuit terminal 13 or 14.
4. Terminal Symbols: ◎ indicates main circuit; ○ indicates control circuit.
5. Multi-function analog output is used for an indicator (e.g. frequency meter). It cannot be used for control system such as feedback control.

# 10. APPENDIX (OPTION PERIPHERAL)

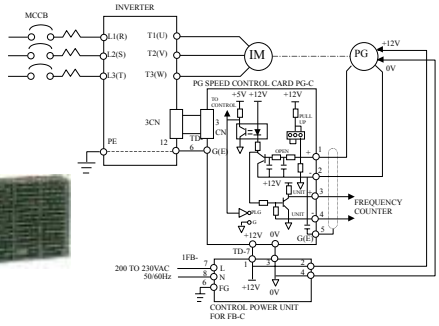
## 10.1 OPTION CARDS

### COMMUNICATION INTERFACE CARD (SC-C)




- Permits operation or constant setting by command from master controller.
  - Communication method: Synchronous
  - Communication speed: up to 19.2 KBPS
  - Interface : RS-232
    RS-422
    RS-485

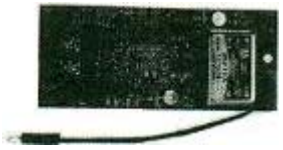
### PG SPEED CONTROL CARD (FB-C)

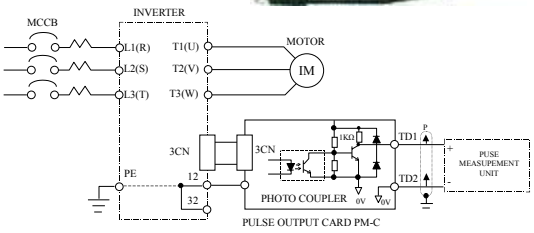



Control Power

- Permits compensation of speed variation caused by slip, by speed feedback using a pulse generator (PG) provided to the motor.

### PULSE MONITOR CARD (PM-C)

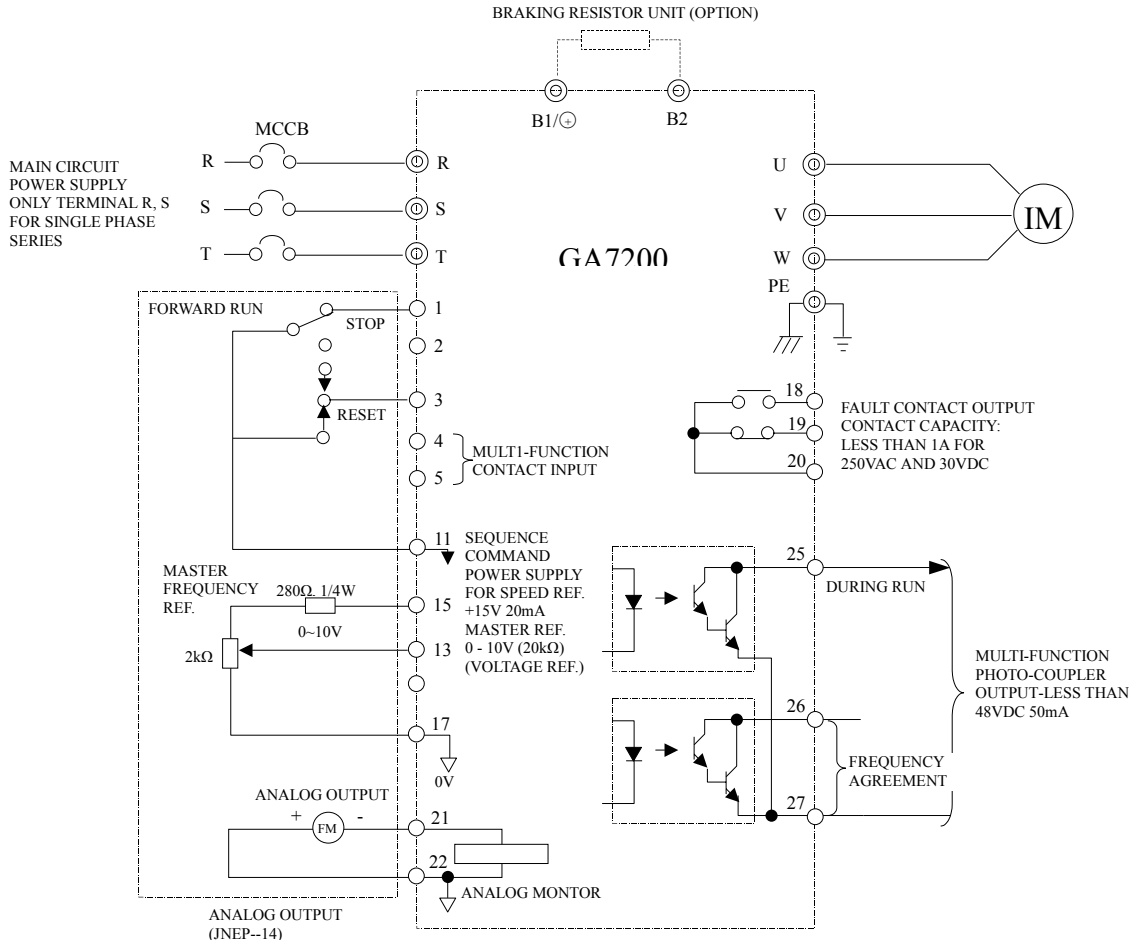





- Outputs pulse train signal corresponding to the inverter output frequency.

## 10.2 ANALOG OPERATOR

The GA7200 has two types of operator panels: digital operator (JNEP--12) and analog operator (JNEP--14). The optional analog operator is used for simple applications where no complicated constant settings are necessary.

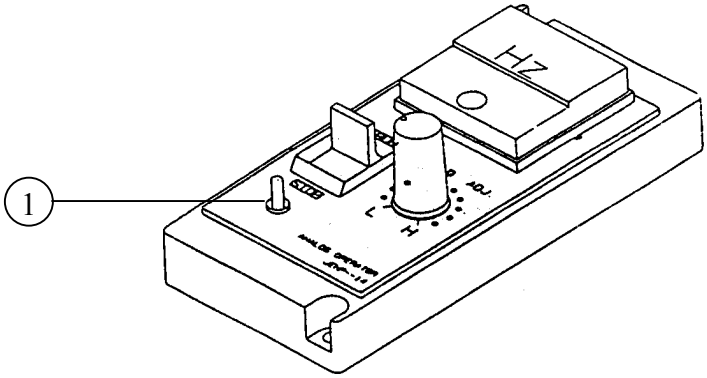



Notes:

1.  indicates shielded leads and  indcates twisted-pair shielded leads

2. External terminal (10) of +12V has maximum output current capacity of 20mA.
3. Terminal Symbols: ◎ indicates main circuit; ○ indicates control circuit.
4. Analog operator as shown in figure below, ① is used for RESET function.

5. Constant setting
   Sn-04 = x x 00



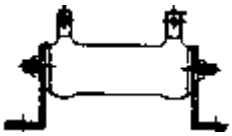
## 10.3 BRAKING RESISTOR AND BRAKING UNIT

- GA7200 230V class 20HP (15kW) or below and 460V class 20HP or below, the braking transistor is built-in as standard, it is only necessary to connect braking resistor to B1/⊕, B2 terminal.
- When connecting braking resistor or braking unit with braking resistor, set system constant Sn-10 = XX10.
- Braking resistor (inverter mounted type or separately mounted type) and braking unit selection table is shown below.

Inverter mounted type braking

Braking unit

Separately mounted type



| Inverter | | Inverter Mounted Type | | | | Separately Mounted Type | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Braking Resistor | | | Braking Torque % | Braking Unit | | | Braking Resistor | | No. of Units | | Braking torque % (10%ED) |
| V | HP | Type (150W) | Code No 3H333C001 □ | Number used | (3%ED) | Type JUVP□-□--- | Code No 3H333C003 □ | Number used | Code No 3H333C002 □ | Type (1 set) | Number used | Connectable Maximum | |
| 230V | 1 | 200Ω | 0013 | 1 | 125 | — | — | — | 0019 | 70W 220Ω | 1 | 4 | 125 |
| | 2 | 100Ω | 0021 | 1 | 125 | — | — | — | 0027 | 260W 200Ω | 1 | 5 | 125 |
| | 3 | 70Ω | 0030 | 1 | 120 | — | — | — | 0035 | 260W 70Ω | 1 | 4 | 120 |
| | 5 | 62Ω | 0048 | 1 | 100 | — | — | — | 0043 | 390W 40Ω | 1 | 2 | 125 |
| | 7.5 | — | — | — | — | — | — | — | 0051 | 520W 30Ω | 1 | 3 | 115 |
| | 10 | — | — | — | — | — | — | — | 0060 | 780W 20Ω | 1 | 2 | 125 |
| | 15 | — | — | — | — | — | — | — | 0078 | 2400W 13.6Ω | 1 | 1 | 125 |
| | 20 | — | — | — | — | — | — | — | 0086 | 3000W 10Ω | 1 | 1 | 125 |
| | 25 | — | — | — | — | LV-0060 | 0022 | 1 | 0094 | 4800W 8Ω | 1 | 1 | 125 |
| | 30 | — | — | — | — | LV-0060 | 0022 | 1 | 0108 | 4800W 6.8Ω | 1 | 1 | 125 |
| | 40 | — | — | — | — | LV-0040 | 0014 | 2 | 0086 | 3000W 10Ω | 2 | 1 | 125 |
| | 50 | — | — | — | — | LV-0040 | 0014 | 2 | 0086 | 3000W 10Ω | 2 | 1 | 100 |
| | 60 | — | — | — | — | LV-0060 | 0022 | 2 | 0094 | 4800W 6.8Ω | 2 | 1 | 120 |
| | 75 | — | — | — | — | LV-0060 | 0022 | 3 | 0094 | 4800W 6.8Ω | 2 | 1 | 100 |
| | 100 | — | — | — | — | LV-0060 | 0022 | 3 | 0094 | 4800W 6.8Ω | 3 | 1 | 110 |
| 460V | 1 | 750Ω | 0056 | 1 | 130 | — | — | — | 0116 | 75W 750Ω | 1 | 7 | 130 |
| | 2 | 400Ω | 0064 | 1 | 125 | — | — | — | 0124 | 260W 400Ω | 1 | 6 | 125 |
| | 3 | 300Ω | 0072 | 1 | 115 | — | — | — | 0132 | 260W 250Ω | 1 | 3 | 135 |
| | 5 | 200Ω | 0013 | 1 | 110 | — | — | — | 0141 | 390W 150Ω | 1 | 4 | 135 |
| | 7.5 | — | — | — | — | — | — | — | 0159 | 520W 100Ω | 1 | 3 | 135 |
| | 10 | — | — | — | — | — | — | — | 0167 | 780W 75Ω | 1 | 2 | 130 |
| | 15 | — | — | — | — | — | — | — | 0175 | 1040W 50Ω | 1 | 2 | 135 |
| | 20 | — | — | — | — | — | — | — | 0175 | 1040W 50Ω | 1 | 2 | 100 |
| | 25 | — | — | — | — | HV-0040 | 0031 | 1 | 0191 | 4800W 32Ω | 1 | 1 | 125 |
| | 30 | — | — | — | — | HV-0040 | 0031 | 1 | 0205 | 4800W 27.2Ω | 1 | 1 | 125 |
| | 40 | — | — | — | — | HV-0040 | 0049 | 1 | 0213 | 6000W 20Ω | 1 | 1 | 125 |
| | 50 | — | — | — | — | HV-0060 | 0049 | 1 | 0221 | 9600W 16Ω | 1 | 1 | 125 |
| | 60 | — | — | — | — | HV-0060 | 0031 | 1 | 0230 | 9600W 13.6Ω | 1 | 1 | 125 |
| | 75 | — | — | — | — | HV-0040 | 0049 | 2 | 0213 | 600W 20Ω | 2 | 1 | 135 |
| | 100 | — | — | — | — | HV-0060 | 0031 | 2 | 0230 | 9600W 13.6Ω | 2 | 1 | 145 |
| | 150 | — | — | — | — | HV-0040 | 0049 | 3 | 0213 | 600W 20Ω | 3 | 1 | 100 |
| | 215 | — | — | — | — | HV-0060 | 0049 | 4 | 0230 | 9600W 13.6Ω | 4 | 1 | 140 |
| | 250 | — | — | — | — | HV-0060 | 0049 | 4 | 0230 | 9600W 13.6Ω | 4 | 1 | 120 |
| | 300 | — | — | — | — | HV-0060 | 0049 | 5 | 0230 | 9600W 13.6Ω | 5 | 1 | 125 |
| | 300 | — | — | — | — | HV-0060 | 0049 | 6 | 0230 | 9600W 13.6Ω | 6 | 1 | 110 |

## 10.4 AC REACTOR

- When power capacity is significantly large compared to inverter capacity, or when the power factor needs to be improved, externally connect an AC reactor.
- GA7200 230V/460V 20HP (15kW) or smaller have external DC reactor connecting terminals, external connecting optional DC reactor is possible. GA7200 230V/460V 25HP (18.5kW) or larger have built-in DC reactor.

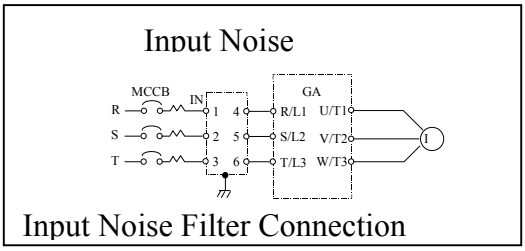
| Voltage | Max. Applicable Motor Output HP | Current Value A | Inductance mH | Code NO. 3M200D161 |
|---|---|---|---|---|
| 230V | 0.5 | 2.5 | 4.2 | 0013 |
| | 1 | 5 | 2.1 | 0021 |
| | 2 | 10 | 1.1 | 0030 |
| | 3 | 15 | 0.71 | 0048 |
| | 5 | 20 | 0.53 | 0056 |
| | 7.5 | 30 | 0.35 | 0064 |
| | 10 | 40 | 0.265 | 0072 |
| | 15 | 60 | 0.18 | 0081 |
| | 20 | 80 | 0.13 | 0099 |
| | 25 | 90 | 0.12 | 0102 |
| | 30 | 120 | 0.09 | 0111 |
| | 40 | 160 | 0.07 | 0269 |
| | 50 | 200 | 0.05 | 0277 |
| | 60 | 240 | 0.044 | 0285 |
| | 75 | 280 | 0.038 | 0293 |
| | 100 | 360 | 0.026 | 0307 |
| 460V | 0.5 | 1.3 | 18.0 | 0129 |
| | 1 | 2.5 | 8.4 | 0137 |
| | 2 | 5 | 4.2 | 0145 |
| | 3 | 7.5 | 3.6 | 0153 |
| | 5 | 10 | 2.2 | 0161 |
| | 7.5 | 15 | 1.42 | 0170 |
| | 10 | 20 | 1.06 | 0188 |
| | 15 | 30 | 0.7 | 0196 |
| | 20 | 40 | 0.53 | 0200 |
| | 25 | 50 | 0.42 | 0218 |
| | 30 | 60 | 0.36 | 0226 |
| | 40 | 80 | 0.26 | 0234 |
| | 50 | 90 | 0.24 | 0242 |
| | 60 | 120 | 0.18 | 0251 |
| | 75 | 150 | 0.15 | 0315 |
| | 100 | 200 | 0.11 | 0323 |
| | 150 | 250 | 0.09 | 0331 |

| | | | | |
|---|---|---|---|---|
| | 215 | 330 | 0.06 | 0340 |
| | 250 | **CONSULT FACTORY** | | |
| | 300 | | | |
| | 400 | | | |

## 10.5 NOISE FILTER

### A. INPUT NOISE FILTER

There are two types of input noise filters: board type (open chassis) and standard type (enclosed). When EMC filter is installed as indicated, the GA7200 will comply with the EN50081-2 (1994) noise interference suppression directive.



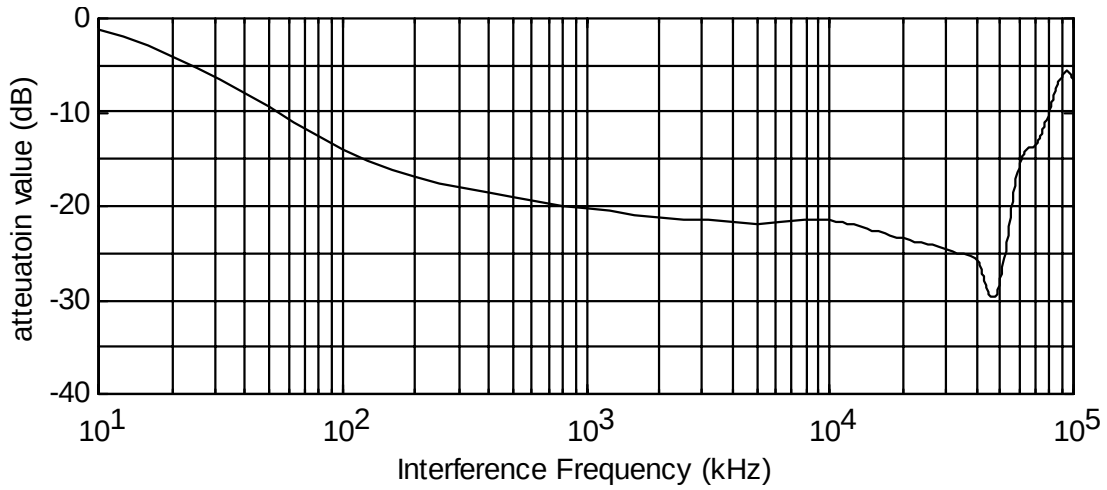

| Voltage | HP (KW) | Standard Type (enclosed) | | |
|---|---|---|---|---|
| | | Code JUNG | Q'ty | Rated Current (A) |
| 230V | 0.5 (0.4) | JUNF32006S | 1 | 6A |
| | 1 (0.75) | JUNF32006S | 1 | 6A |
| | 2 (15) | JUNF32012S | 1 | 12A |
| | 3 (2.2) | JUNF32012S | 1 | 12A |
| | 5 (3.7) | JUNF32024S | 1 | 24A |
| | 7.5 (5.5) | JUNF32024S | 1 | 24A |
| | 10 (7.5) | JUNF32048S | 1 | 48A |
| | 15 (11) | JUNF32048S | 1 | 48A |
| | 20 (15) | JUNF32070S | 1 | 70A |
| | 25 (18.5) | JUNF32100S | 1 | 100A |
| | 30 (22) | JUNF32100S | 1 | 100A |
| | 40 (30) | JUNF32130S | 1 | 130A |
| | 50 (37) | JUNF32170S | 1 | 170A |
| | 60 (45) | — | 1 | — |
| | 75 (55) | — | 1 | — |
| | 100 (75) | — | 1 | — |
| 460V | 0.5 (0.4) | JUNF34006S | 1 | 6A |
| | 1 (0.75) | JUNF34006S | 1 | 6A |
| | 2 (15) | JUNF34006S | 1 | 6A |
| | 3 (2.2) | JUNF34006S | 1 | 6A |
| | 5 (3.7) | JUNF34012S | 1 | 12A |
| | 7.5 (5.5) | JUNF34012S | 1 | 12A |
| | 10 (7.5) | JUNF34024S | 1 | 24A |
| | 15 (11) | JUNF34024S | 1 | 24A |
| | 20 (15) | JUNF34048S | 1 | 48A |
| | 25 (18.5) | JUNF34048S | 1 | 48A |
| | 30 (22) | JUNF34048S | 1 | 48A |
| | 40 (30) | JUNF34070S | 1 | 70A |
| | 50 (37) | JUNF34100S | 1 | 100A |
| | 60 (45) | JUNF34100S | 1 | 100A |
| | 75 (55) | JUNF34130S | 1 | 130A |
| | 100 (75) | JUNF34170S | 1 | 170A |
| | 125 (94) | JUNF34280R | 1 | 280A |
| | 150 (113) | JUNF34280R | 1 | 280A |
| | 175 (131) | JUNF34400R | 1 | 400A |
| | 215 (161) | JUNF34480R | 1 | 400A |

## B. ZERO PHASE NOISE SUPPRESSOR

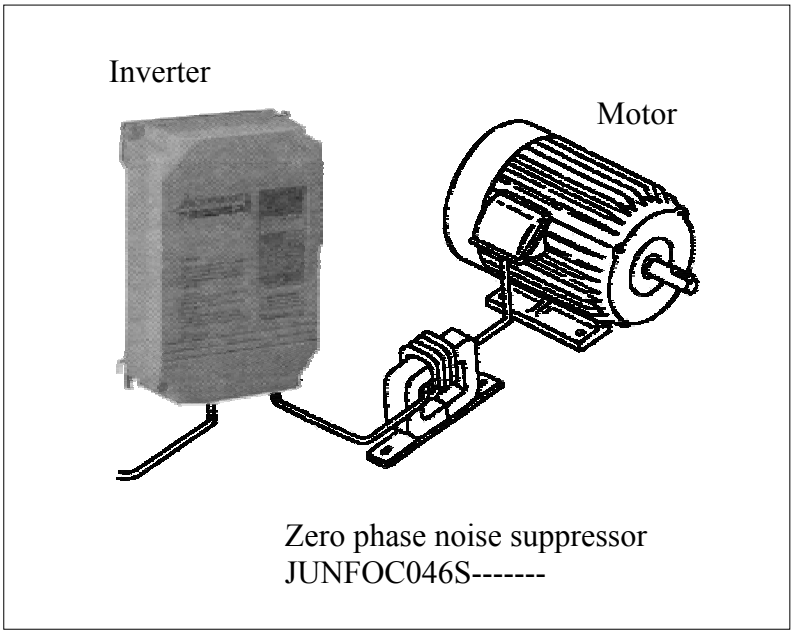
- MODEL : JUNFOC046S-------
- CODE NO: 4H000D0250001
- Feature

1. high attenuation, as shown in curve below.
2. simple connection.
3. single type suitable for all series inverter, can be used on inverter's input side or output side.

- NOISE Attenuation Characteristics (10 turns)




- Application example



DISTRIBUTED BY:


M O T O R C O M P A N Y

5100 NORTH IH-35 ROUND ROCK, TEXAS 78691

www. tecowestinghouse. com 12/1/2