13. OPERATION OF DIGITAL OPERATOR

Notes on use of the digital operator

This section explains the functions, operation method, and control constants of the digital operator. Become thoroughly familiar with the different procedures before turning power ON.

13.1 FUNCTIONS OF THE DIGITAL OPERATOR

VS-626VM3 supports the multi-functional display operator that enables the following:

(1) Display of Control Signal Status

Status of control signals of individual points is displayed by monitoring the status of operation. For the display items, see Table 13.3.

(2) Display and Setup of Control Constants

Control constants must be set up for normal operation in compliance with the specifications. Tables 13.4 to 13.6 list the control constants.

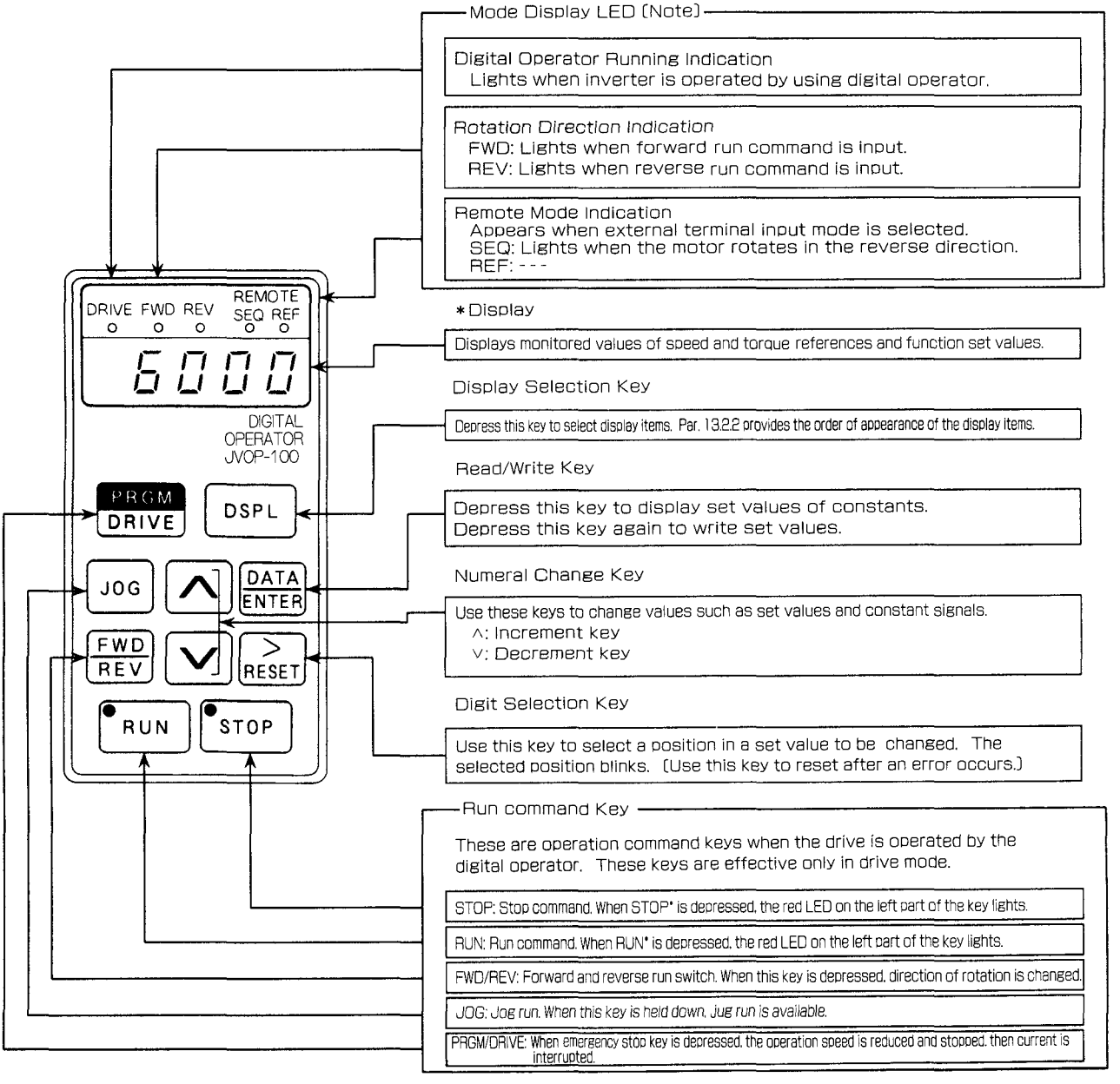
(3) Display of Protective functions

If an error occurs during operation, protective functions are displayed. Table 13.7 lists the protective functions. Nothing is displayed when operation is normal.

(4) Function by the Digital Operator

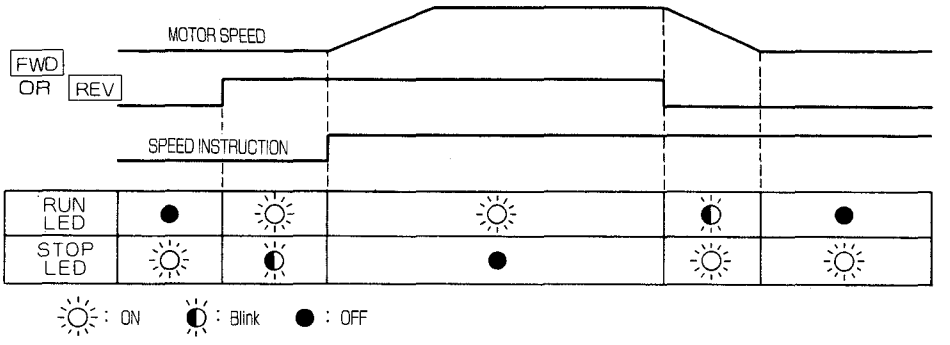
Stand-alone operation without sequence input signals or speed reference is possible by setting control constant C1-37 with the digital operator. This function is effective for test run when the inverter is connected only with a motor. For the details of the operation, see Paragraph. 8.1.

Fig 13.1 shows the display unit and operation keys of the digital operator (JVOP-100).



*Digital display LEDs and status display LEDs are used.

Fig. 13.1 Display Unit and Operation Keys of the Digital Operator (JVOP-100)



Note: RUN and STOP LEDs light, blink, and go OFF depending on the status of operation.

Fig. 13.2 Digital Operator Display

13.2 KEY OPERATIONS AND DISPLAY

Operations of the keys and indications of the digital operator are explained below. Table 13.1 corresponds displayed characters to alphanumeric characters.

Table 13.1 Indication of Numbers and Letters by 7-segment LED

No.		Letters			
0	0	A	A	N	–
1	1	B	b	O	–
2	2	C	C	P	P
3	3	D	d	Q	–
4	4	E	E	R	–
5	5	F	F	S	–
6	6	G	–	T	–
7	7	H	–	U	–
8	8	I	–	V	U
9	9	J	–	W	–
•	•	K	–	X	–
–	-	L	–	Y	–
		M	–	Z	–

Note: "–" is not displayed.

13.2.1 Indication at Power-ON

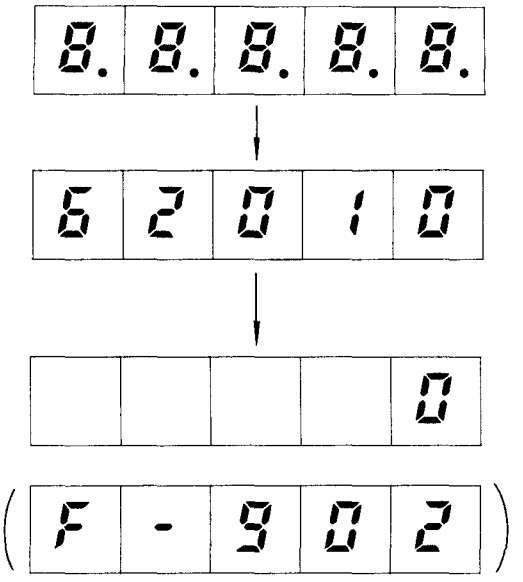
When power is turned ON, all the LEDs of the digital operator light for LEDs selfcheck.

↓

Then the PROM version is displayed. The upper five digits of the PROM number are displayed. The example is for PROM number "NSN620100."

↓

Finally, operation status data V1-01 (motor speed) is displayed. Since the motor is not rotating immediately after the power is turned ON, 0 is displayed.
If a protective function is activated because of a failure, the failure indication number lights. The example indicates a break in a wire in the motor thermistor, which appears when the motor encoder signal connector (3CN) is disconnected.



13.2.2 Switching Display Functions

Depress the DSPL key on the digital operator to change the mode of display.

↓

Depressing the DSPL key once changes the display from motor speed data to a data number. The first letter V indicates that operation status display mode has been selected.

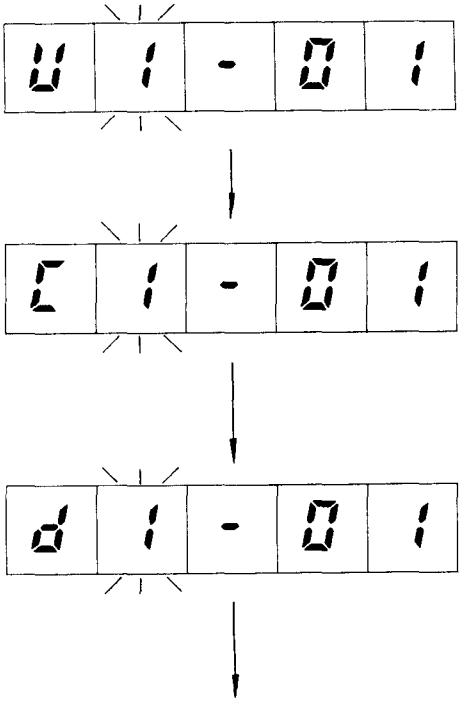
↓

Depress the DSPL key again. Operation status display mode is changed to control constant display mode. In this mode, control constants can be set and changed.

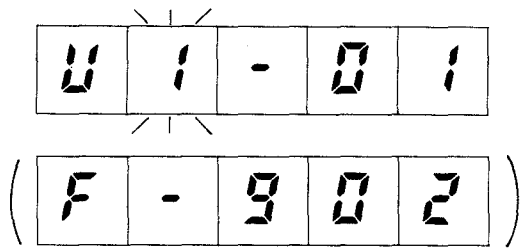
↓

Depress the DSPL key again. Usually, if no protective function is activated, operation status display mode is restored. If bits 0 or 1 of control constant C1-37 are set ON, reference display mode of operation by the digital operator is entered.

↓



When the DSPL key is depressed in digital operator operation mode, operation status display mode is restored provided that no protective function has been activated.
If a protective function is activated because of a failure, the failure indication number lights.
The example indicates a break in a wire in the motor thermistor.



13.2.3 Operation Status Display Mode

To check data in operation status display mode, do as follows.

To change a data number, depress [>] key once. The blinking cursor moves to the displayed data number. Depress [>] key again to return the blinking cursor to its initial position.

↓

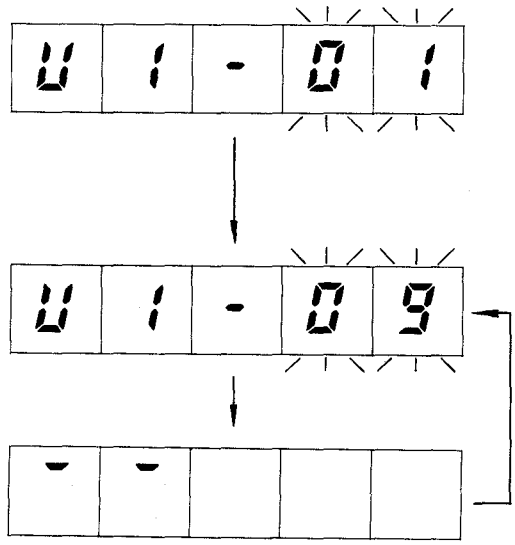
Search for the data number to be checked (in this example, V1-09) using [∧] or [∨] key.

↓

Depress the [DATA] key to change data number display to data contents display.
The display example is the status when [RDY] and [EMG] signals are closed.

↓

To return to data number display from data contents display, depress the [DSPL] key.



For explanations of operation status display, see Table 13.3.

13.2.4 Control Constant Display Mode

To check data or set or change a constant in control constant display mode, do as follows.

To change a data number, depress [>] key once. The blinking cursor moves to the displayed data number. Depress [>] key again to return the blinking cursor to its initial position.

↓

Search for the data number to be checked (in this example, C1-10) using [∧] or [∨] key.

↓

Depress the [DATA] key to change data number display to data contents display.

↓

Select the position in the data to be changed and depress [>] key to move the blinking cursor.

↓

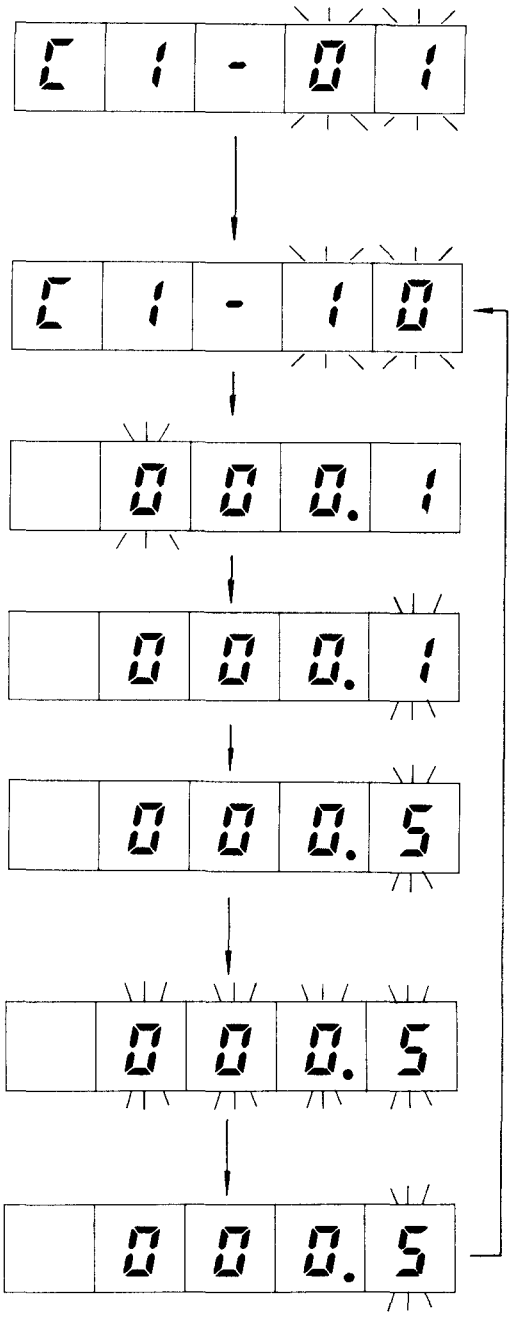
Use [∧] or [∨] key to change the data. (In this case, from "1" to "5")

↓

Hold down the [DATA] key for several seconds. The entire data blinks for several seconds, then stops blinking. The data has been changed. (The entire data continuously blinks if the data is out of the setting range. If this occurs, depress the [DSPL] key to change from data contents display to data number display, then restart setting from the beginning.

↓

To return to data contents display from data number display, depress the [DSPL] key.



For explanations of control constants, see Tables 13.4 to 13.6.

Note: C1-01 to 24, C2-01 to 08, C3-01 to 08 can be changed during operation or stop. C1-25 to 48, C2-09 to 24, C3-09 to 24 can be changed only during stop.

13.2.5 Protective Function Operation Display Mode

If a protective function is activated because of a failure, the protective function indication number is displayed. After an error is reset, up to four protective operations are recorded to view the order of a series of failures.

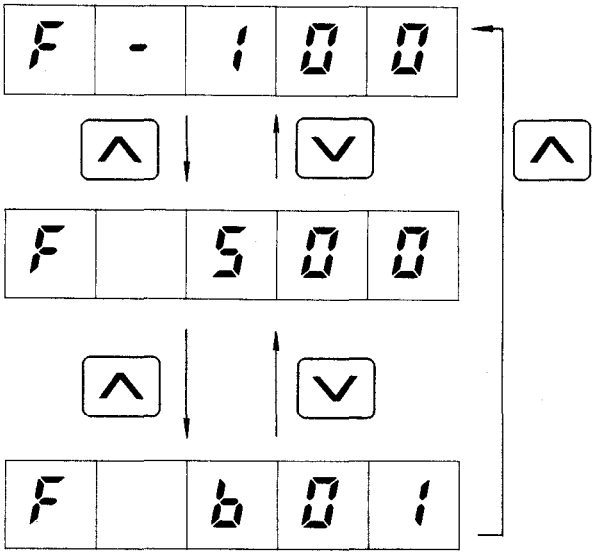
First protective function operation is indicated with an F followed by a hyphen.

↓

Depress [∧] key to display the protect display number which activated the next protective function.

↓

If [∧] key is depressed when the last failure display number is displayed, the first failure display number is displayed again. Depress [∨] key to display failure display numbers in reverse order of occurrence.



Notes on resetting failures

To reset a failure by the digital operator after removing the cause, depress the [RESET] key in protective function operation display mode. In other modes, the [RESET] key cannot reset the failure. Before resetting, turn OFF [FWD], [REV], and [ORT] signals.

13.2.6 Digital Operator Operation Mode

To operate by the digital operator, do as follows.

Select C1-37 in control constant display mode.

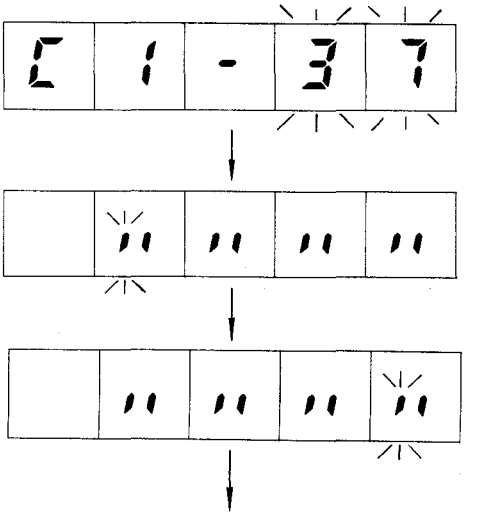
↓

Depress the [DATA] key to change from data number display to data contents display.

↓

Select the position in the data to be changed and depress [>] key to move the blinking cursor. Set the lower two bits ON.

↓



Use [∧] or [∨] key to change the data. (In this case, the lower two bits are changed from " ,, " to " ;; ")
Operation step (;; [∧] , ;; [>] , ;; [∧] , ;;)

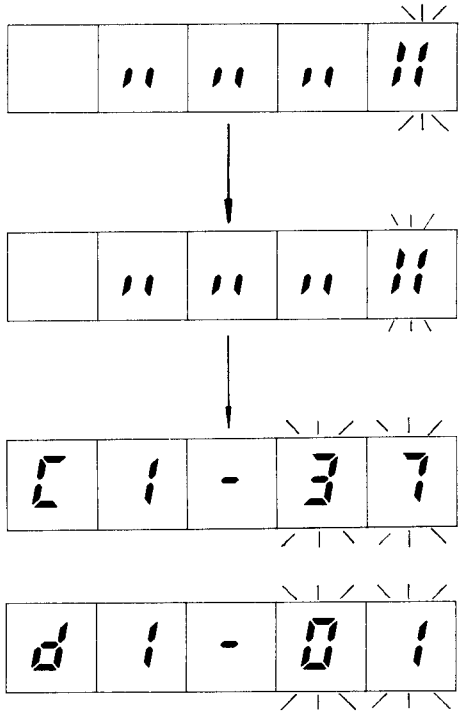
↓

Hold down the [DATA] key for several seconds. The entire data blinks for several seconds, then stops blinking. The data has been changed.

↓

Depress the [DSPL] key to return to data number display from data contents display. Digital operator operation mode is entered.

↓



Then set up for speed reference.
Depress the [DSPL] key to select "reference constant" for digital operator operation. Use cursor keys [>] , [∧] , or [∨] to set a speed reference for d1-02. Speed reference is expressed as a percent of the rated speed setting (C1-26). If 25% is set when rated speed is 6000 r/min., the reference translates into 1500 r/min.

↓

For operation, stop, and forward/reverse run, use the [•RUN] , [•STOP] , and [FWD/REV] keys respectively on the digital operator. Display on the digital operator changes each time the [DSPL] key is depressed from constants (C1-01, and so on) to variables (V1-01, . . .) to reference (d1-01, . . .). Operation control signals and speed reference displayed among reference display are handled similar to constant setup. Table 13.2 lists the parameters.
To return from digital operator operation mode to normal operation by external run command, change the lower two bits of C1-37 from " ;; " to " ,, "

Table 13.2 Parameters for Digital Operator Operations

Constant No.	Explanation	Unit	Initial Value in Digital Operator Operation
d1-01	Sequence input	Binary	1 1 1 1 1 1 1 1 1 1 TLH TLL SSC --- CHW PPI ORT LGR MGR ---
d1-02	Speed reference	%	% display for rated speed setting (C1-26). Initial value: 0.00

13.3 OPERATION STATUS DISPLAY FUNCTION

Different groups of operation status indications are displayed for different modes of operation. V1 indications are for inverter operation. V2 indications are for optional encoder orientation control. V3 indications are for magnetic sensor orientation control, which is also optional. (Data marked with * are operation status display data for preset.)

Table 13.3 (a) Operation Status Display Functions (For Inverter Operation)

No.	Signal Name	Explanation	Unit
V1−01	Motor Speed	Speed detected by the motor encoder	r/min
V1−02	Speed Reference	Speed control reference. Ratio of analog or digital reference to the rated speed	%
V1−03	Load Shaft Speed	Product of motor speed and gear transmission ratio	r/min
V1−04	Torque Reference	Percentage to 30-minute rating (100%)	%
V1−05	—		
V1−06	Inverter Output Current	Detected inverter output current converted to amperes. Precision is ±3%.	A
V1−07	Output Frequency	Inverter current output frequency	Hz
*V1−08	Internal Status	Operation status signal (at logical level)	
V1−09	Input Signal Status	Sequence input signal ON/OFF state (Note)	
V1−10	Output Signal Status	Sequence output signal ON/OFF state (Note)	
V1−11	Inverter Capacity	Inverter unit 30-minute rated capacity	kW
V1−12	Panel Internal Temperature	Detected inverter ambient temperature. Precision is ±5℃.	℃
V1−13	Heat Sink Temperature	Detected heat sink temperature of inverter. Precision is ±5℃.	℃
*V1−14	DC Bus Voltage	Main circuit capacitor voltage. Precision is ±3%.	V
V1−15	Analog Speed Reference AD Converted Value	Converted value of analog reference to be used for speed reference offset adjustment. Available only during running.	
*V1−16	—		
*V1−17	Phase-U current	Detected phase-U current converted from analog to digital	
*V1−18	Phase-W current	Detected phase-W current converted from analog to digital	

Table 13.3 (b) List of Operation Status Display Functions (For Encoder Orientation Control)

No.	Signal Name	Explanation	Unit
V2−01	I/O Signal Status	Orientation I/O signal status (Note)	
V2−02	-----		
V2−03	Position Monitor	Actual position expressed by dividing one rotation by 4096 in reference to a set origin	Pulses
V2−04	Commanded Stop Position	Commanded stop position expressed by dividing one rotation by 4096 in reference to a set origin	Pulses
V2−05	Position Deviation	Difference between commanded stop position and current position in pulses	Pulses
V2−06	Positioning Time	Time from input of orientation command to output of completion signal	×2 ms

Table 13.3 (c) List of Operation Status Display Functions (For Magnetic Sensor Orientation Control)

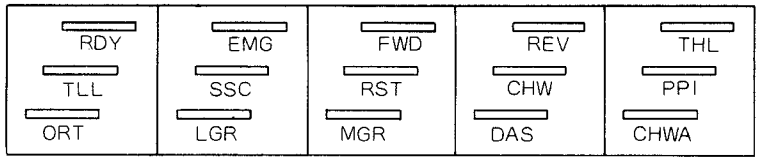
No.	Signal Name	Explanation	Unit
V3−01	I/O Signal Status	Orientation I/O signal status (Note)	
V3−02	Magnetic Sensor Signal Level	—	
V3−03	Position Monitor	Actual position expresssed in reference to a set origin	Pulses
V3−04	Commanded Stop Position	Commanded stop position expressed in reference to a set origin	Pulses
V3−05	Position Deviation	Difference between commanded stop position and current position in pulses	Pulses
V3−06	Positioning Time	Time from input of orientation command to output of completion signal	×2 ms

Table 13.3 (d) List of Operation Status Display Functions (Others)

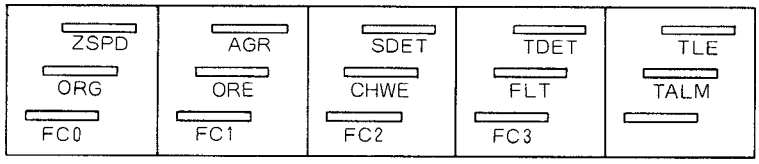
No.	Signal Name	Explanation	Unit
V7−01	Motor Temperature	Detected temperature for motor overheat protection	℃
*V7−02	Slip Frequency	Slip frequency to be applied to the motor	Hz

Note : Status of I/O signals are shown in the following
Lamps of input signals in the ON state light.

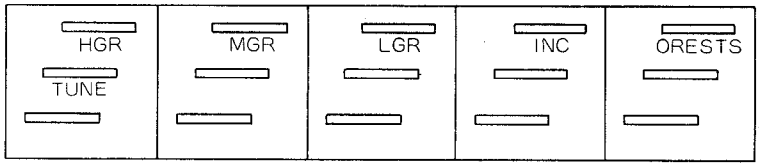
〈V1-09〉 Sequence Input Signal Status Display



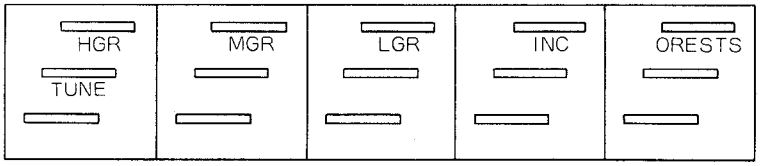
〈V1-10〉 Sequence Output Signal Status Display



〈V2-01〉 I/O Signal Status for Encoder Orientation Control Display



〈V3-01〉 I/O Signal Status for Magnetic Sensor Orientation Control Display



13.4 CONTROL CONSTANTS

Different groups of control constants are displayed for different modes of operation. User constants (C1) are for inverter operation. C2 constants are for optional encoder orientation control. C3 constants are for magnetic sensor orientation control, which is also optional.
The following constants cannot be changed during running:
C1-25 to C1-40, C2-09 to C2-24, C3-09 to C3-24
Change the constants after stopping the motor.

Table 13.4 User Constant List

Constant No.	Constant Name	Explanation	Unit	Upper Limit / Lower Limit
C1−01	Speed Control Proportional Gain(H)K_{VHN}	Speed control proportional gain when high-speed gear is selected (MGR and LGR are OFF) or when high-speed winding is selected (CHW is OFF) . Raising K_{VHN} increases rigidity. Torque Reference P = K_{VHN} × Speed Tolerance	%/Hz	255 / 1
C1−02	Speed Control Integral Time Constant (H) τ_{VHN}	Speed control integral time constant when high-speed gear is selected (MGR and LGR are OFF) or when high-speed winding is selected (CHW is OFF) . Reducing τ_{VHN} quickens response. Torque Reference I =Speed tolerance×Time/ τ_{VHN}	ms	1000 / 5
C1−03	Speed Control Proportional Gain (M,L) K_{VLN}	Speed control proportional gain when low-speed gear is selected (MGRor LGR is ON) or when low-speed winding is selected (CHW is ON) . Raising K_{VLN} increases rigidity. Torque Reference P = K_{VLN} × Speed Tolerance	%/Hz	255 / 1
C1−04	Speed Control Integral Time Constant (M,L) τ_{VLN}	Speed control integral time constant when low-speed gear is selected (MGR or LGR is ON) or when low-speed winding is selected (CHW is ON) . Reducing τ_{VLN} quickens response. Torque Reference I = Speed Tolerance×Time / τ_{VLN}	ms	1000 / 5
C1−05	Speed Control Proportional Gain(H)K_{VHS}	Speed control proportional gain when high-speed gear is selected (MGR and LGR are OFF) or when high-speed winding is selected (CHW is OFF) in servo mode (SV is ON). Torque Reference P = K_{VHS} × Speed Tolerance	%/Hz	255 / 1
C1−06	Speed Control Integral Time Constant (H) τ_{VHS}	Speed control integral time constant when high-speed gear is selected (MGR and LGR are OFF) or when high-speed winding is selected (CHW is OFF) in servo mode (SV is ON). Torque Reference I = Speed Tolerance×Time/ τ_{VHS}	ms	1000 / 5
C1−07	Speed Control Proportional Gain (M,L) K_{VLS}	Speed control proportional gain when low-speed gear is selected (MGR or LGR is ON) or when low-speed winding is selected (CHW is ON) in servo mode (SV is ON). Torque Reference P = K_{VLS} × Speed Tolerance	%/Hz	255 / 1
C1−08	Speed Control Integral Time Constant (M,L) τ_{VLS}	Speed control integral time constant when low-speed gear is selected (MGR or LGR is ON) or when low-speed winding is selected (CHW is ON) in servo mode (SV is ON). Torque Reference I_N = Speed Tolerance×Time / τ_{VLS}	ms	1000 / 5
C1−09	Torque Reference Filter Time Constant τ_T	Time constant of low-pass filter of torque reference to be used in measures against gear chattering noise. Increasing the time constant may cause run-away depending on conditions.	ms	5.0 / 0.0
C1−10	Soft Start Time T_{SFS}	Setting of required time for soft starter. Variations in speed reference are suppressed according to the speed change ratio of the set time. Starting time from at rest state is obtained as follows: Starting Time = T_{SFS} × Speed Instruction (%)/100	s	180.0 / 0.1
C1−11	Speed Reference offset adjustment value SC_{OFS}	Offset adjustment value for analog speed reference. Set the values of V1-15 when operating at speed reference 0 for C1-11.		80 / −80
C1−12	Motor Speed Adjustment Value S_{ADJ}	Constant for fine control of motor speed when analog speed reference are used. Speed is increased in proportion to S_{ADJ}. This parameter is invalid when digital speed reference are used.		1.1000 / 0.9000

Table 13.4 User Constant List (Cont'd)

Constant No.	Constant Name	Explanation	Unit	Upper Limit / Lower Limit
*C1-13	Torque Reference Offset TC_{OFS}	------		80 / −80
*C1-14	Torque Reference Adjustment Value T_{ADJ}	------		1.100 / 0.900
*C1-15	Speed Limiter S_{LIM}	------	%	100 / 0
C1-16	Speedometer Signal Adjustment Value SM_{ADJ}	Constant for fine control to match the commanded torque and indication on the load ratio meter. Increasing LM_{ADJ} makes the meter indicator travel farther.		1.50 / 0.90
C1-17	Load Ratio Meter Signal Adjustment Value LM_{ADJ}	Constant for fine control to match the commanded torque and indication on the load ratio meter. Increasing LM_{ADJ} makes the meter indicator travel farther.		1.50 / 0.90
C1-18	Load Ratio Meter Full-scale LN_{FS}	Setting of full-scale value of the load ratio meter expressed as a percent of continuous rating. Note that the full-scale value depends on specifications of the load machine.	%	350 / 120
C1-19	Zero-speed Detection Level ZS_{LVL}	Detection level of zero-speed signal (ZSPD) Standard setting is 30r/min.	r/min	60 / 3
C1-20	Speed Agree Signal Detection Width AGR_{BD}	Detection width of speed-match signal at rated speed Standard setting is 15% .	%	50 / 10
C1-21	Speed Detection Signal Level SD_{LVL}	Speed detection signal (SDET) activation level used for winding selection. Expressed as a percent of the motor rated speed.	%	100 / 0
C1-22	Speed Detection Signal Detection Width SD_{HYS}	Hysteresis width adjustment level of speed signal detection. During acceleration, $SD_{LVL}+SD_{HYS}$ is detected. During deceleration, $SD_{LVL}-SD_{HYS}$ is detected. Expressed as a percent of the motor rated speed.	%	10.00 / 0.00
C1-23	Torque Detection Signal Operation Level TD_{LVL}	Torque detection signal (TDET) activation level used to detect abnormal loads. Expressed as a percent of the 30-minute rated torque. Hysteresis width is limited to ±10%.	%	120 / 5
C1-24	External Control Torque Limiting Level TL_{EXT}	Torque limit using external torque limiting signals (TLL and TLH) . Expressed as a percent of the 30-minute rated torque.	%	120 / 5
C1-25	Motor Code Selection MTR	Select applicable motor from the motor codes stored in inverter memory. Expressed in 2-digit hexadecimals 0 to F. Available after selecting the code and then turning power ON again.		FF / 01
C1-26	Rated Speed Setting S_{100}	Rated speed set according to load machine specifications. Must not be greater than the motor maximum speed. When speed reference is 100%, this speed is applied.	r/min	Max. Speed / 100
C1-27	Transmission Ratio 1 R_{HGR}	Transmission ratio determined by mechanical specifications. This parameter is valid when H gear is selected (MGR, LGR : OFF). Transmission Ratio = Spindle speed ÷ Motor Speed		2.5000 / 0.0400
C1-28	Transmission Ratio 2 R_{MGR}	Transmission ratio determined by mechanical specifications. This parameter is valid when M gear is selected (MGR : ON). Transmission Ratio = Spindle speed ÷ Motor Speed		2.5000 / 0.0400

Table 13.4 User Constant List (Cont'd)

Constant No.	Constant Name	Explanation	Unit	Upper Limit / Lower Limit
C1-29	Transmission Ratio 3 (L) R_{LGR}	Transmission ratio determined by mechanical specifications. This parameter is valid when L gear is selected (LGR : ON). Transmission Ratio = Load Shaft Speed ÷ Motor Speed		2.5000 / 0.0400
C1-30	Motor Flux Lower Limit Level ϕ_{WL}	Level limit motor flux reduction control lower.	%	100 / 15
C1-31	Servo Mode Flux Level (H) ϕ_{SVH}	Motor flux level when high-speed gear is selected (MGR) and LGR are OFF) or when high-speed winding is selected (CHW is OFF) in servo mode (SV is ON).	%	100 / 30
C1-32	Servo Mode Basic Speed Ratio (H) R_{BSH}	Base speed ratio when high-speed gear is selected (MGR and LGR are OFF) or when high-speed winding is selected (CHW is OFF) in servo mode (SV is ON). Base Speed (Servo) = R_{BSL} × Base Speed (Motor)		5.00 / 1.00
C1-33	Servo Mode Flux Level (M,L) ϕ_{SVL}	Motor flux level when low-speed gear is selected (MGR or LGR is ON) or when low-speed winding is selected (CHW is ON) in servo mode (SV is ON).	%	100 / 30
C1-34	Servo Mode Basic Speed Ratio (M, L) R_{BSL}	Base speed ratio when low-speed gear is selected (MGR or LGR is ON) or when low-speed winding is selected (CHW is ON) in servo mode (SV is ON). Base Speed (Servo) = R_{BSL} × Base Speed (Motor)		5.00 / 1.00
C1-35	Zero-speed Brake Time T_{BLK}	Time for generating braking force after deceleration and zero-speed is reached to stop.	s	100 / 0
C1-36	Select Signal 1 SEL 1*	Setting signal for multi-functional selection. For further explanation, see Par. 4.8.1, "Sequence Input Signals." • Bits 1 and 0 : 1CN, pin 11 00 : TLL 01 : −− 10 : INC 11 : −− • Bit 2: 1CN pin 10 0 : TLH 1 : −− • Bit 3: 1CN pin 10 0 : SSC 1 : SV • Bit 4: 1CN pin 15 0 : PPI 1 : LM10 • Bit 7: 2CN 12-bit digital reference 0 : Digital speed reference 1 : Orientation control stop position reference		−−− / −−−
C1-37	Select Signal 2 SEL 2*	Setting signal for multi-functional selection. For further explanation, see Par.4.8.2, "Speed Reference." Bits 1 and 0: Operation mode 00: Operation by speed reference 11: Operation by the digital operator Bits 3 and 2: Preparation for operation signal selection 00: Free run by current interruption 01: After deceleration stop, interrupts current and MC is OFF. 10: After deceleration stop, interrupts current and MC is ON. Bits 7 and 6: Digital speed reference selection 00: 2-digit BCD 01: 12-bit binary 10: 3-digit BCD 11: Internal speed setting		−−− / −−−

* In explanation of select signals, 0 stands for "ı" and 1 for "¦".

Table 13.4 User Constant List (cont'd)

Constant No.	Constant Name	Explanation	Unit	Upper Limit / Lower Limit
C1−38	Select Signal 3 SEL 3*	Select signal for control mode and level • Bits 1 and 0: Load factor meter filter 00: 2ms filter 01: 10ms filter 10: 100ms filter 11: 500ms filter • Bit 2: Torque limiting auto judgement 0: Not judged 1: Judged • Bit 3: Servo mode sensitivity 0: reference (10V/100%) 1: reference (10V/5000r/min) • Bit 4: Speed over-deviation protective (F800) operation threshold 0: 1/2 or less of speed reference 1: 1/4 or less of speed reference • Bit 5: Speed limiting level 0: 105% of rating reference 1: 110% of rating reference • Bit 6: Speed agreed signal output select at zero-speed 0: Outputs (AGR is close) 1: Does not output (AGR is open) • Bit 7: Load factor meter adjustment method 0: Outputs 120% signal of 30-minute rating 1: Outputs 100% signal of continuous rating		--- ---- ---
C1−39	Select Signal 4 SEL 4*	Control mode select signal • Bits 0: Orientation method 0: Encoder 1: Magnetic sensor		---
C1-40	Select Signal 5 SEL 5*	Control mode select signal • Bits 1 and 0: Excess speed deviation protective (F800) operation delay time select 00: 0 sec 01: 0.3sec 10: 0.4sec 11: 0.5sec • Bit 3: NC orientation selection 0: Invalid 1: Valid. Even if orientation signal (ORT) is input, orientation operation does not start. The rotation direction of the motor is decided depending on the polarity of analog speed reference. • Bit 4: Output selection of load factor meter 0: Continuous rating output 1: 30-minute rating output • Bit 5: Speed reference read gain selection in servo mode 0: Analog speed reference of 10V is regarded as rated speed setting (C1-26) 1: When bit 3 of C1-38 is "1", analog speed reference read gain can be changed		---
C1−41 to C1−48	Internal Speed Reference Set Values SPD 1 SPD 8	Internal speed setting for digital speed reference. The values correspond to input command (from 2CN) as follows. Expressed as a percent of the rated speed. Pin 1 : SPD 1 Pin 5 : SPD 5 Pin 2 : SPD 2 Pin 6 : SPD 6 Pin 3 : SPD 3 Pin 7 : SPD 7 Pin 4 : SPD 4 Pin 8 : SPD 8	%	100.0 0.00

∗Note: In explanation of select signals, 0 stands for "ı" and 1 for "¦".

Table 13.5 Encoder Orientation Constants

Constant No.	Constant Name	Explanation	Unit	Upper Limit / Lower Limit
C2−01	Load Axis Positioning Origin P_{ORG}	Mechanical origin of the load axis. Set difference from encoder origin signal (phase-C) pulses.	Pulses	4095 / 0
C2−02	Position Control Proportional Gain (H) K_{PH}	Position control proportional gain when high-speed gear is selected (MGR and LGR are OFF) or when high-speed winding is selected (CHW is OFF) . Raising K_{PH} increases rigidity. Speed Reference (pps) = K_{PH} × Position Tolerance (pulses)	1/s	99 / 1
C2−03	Position Control Proportional Gain (M) K_{PM}	Position control proportional gain when medium-speed gear is selected (MGR is ON) . Raising K_{PM} increases rigidity. Speed Reference (pps) = K_{PM} × Position Tolerance(pulses)	1/s	99 / 1
C2−04	Position Control Proportional Gain (L) K_{PL}	Position control proportional gain when low-speed gear is selected (LGR is ON) or when low-speed winding is selected (CHW is ON) . Raising K_{PL} increases rigidity. Speed Reference (pps) K_{PL} × Position Tolerance (pulses)	1/s	99 / 1
C2−05	Speed Control Proportional Gain (H) K_{VHO}	Speed control proportional gain when high-speed gear is selected (MGR and LGR are OFF)or when high-speed winding is selected (CHW is OFF) in orientation control (ORT is ON). Torque Reference P = K_{VHO} × Speed Tolerance	%/Hz	255 / 1
C2−06	Speed Control Integral Time Constant (H) τ_{VHO}	Speed control integral time constant when high-speed gear is selected (MGR and LGR are OFF) or when high-speed winding is selected (CHW is OFF) in orientation control (ORT is ON) . Torque Reference I = Speed Tolerance × Time/ τ_{VHO}	ms	1000 / 5
C2−07	Speed Control Proportional Gain (M,L) K_{VLO}	Speed control proportional gain when low-speed gear is selected (MGR or LGR is ON) or when low-speed winding is selected (CHW is ON) in orientation control(ORT is ON). Torque Reference P = K_{VLO} × Speed Tolerance	%/Hz	255 / 1
C2−08	Speed Control Integral Time Constant (M,L) τ_{VLO}	Speed control integral time constant when low-speed gear is selected (MGR or LGR is ON) or when low-speed winding is selected (CHW is ON) in orientation control (ORT is ON) . Torque Reference I = Speed Tolerance × Time / τ_{VLO}	ms	1000 / 5
C2−09	Positioning Completion Detection Width Z_{FIN}	Detection width for outputting completion signal when the spindle reaches near the commanded stop position. Detection width is commanded stop position ± Z_{FIN}	Pulses	200 / 0
C2−10	Positioning Completion Cancel Width Z_{CAN}	Set value for canceling completion signal when the spindle is moved after completion signal is output. Cancel width is commanded stop position ± Z_{CAN}	Pulses	200 / Z_{FIN}
C2−11	Orientation Speed S_{ORT}	Speed applied (after detecting encoder origin) until changing to the servo loop during orientation	r/min	600 / 40
C2−12	BCD Stop Position Reference Resolution P_{BCD}	Angle set value per minimum increment of stop position BCD reference	°	180.0 / 0.5
C2−13	Arbitrary Stop Position Offset P_{IMG}	Stop position offset for smoothing stop operation when the servo loop is used When Z_{FIN} is reached, offset becomes 0.	Pulses	100 / 0

Table 13.5 Encoder Orientation Constants (Cont'd)

Constant No.	Constant Name	Explanation	Unit	Upper Limit / Lower Limit
C2−14	Orientation Speed Change Ratio R_{SOR}	Speed change ratio for gradually reducing orientation speed to reduce gear noise when switching from orientation speed to servo loop speed		100 / 0
C2−15	Starting Soft Start Time T_{SFO}	Soft start time for accelerating from at rest state to orientation speed. Use this parameter to reduce gear noise at starting Acceleration rate is (500 r/min.) /s.	ms	50 / 0
C2−16	Flux Level ϕ_{ORT}	Flux level at completion of orientation. Motor noise and torque changes in proportion to flux level.		100 / 15
C2−17	Orientation Speed Reduction Coefficient K_{SOR}	Reduction coefficient to set orientation speed in proportion to the angle of traveling for incremental positioning.		32767 / 0
C2−18	− − −			
C2−19	− − −			
C2−20	− − −			
C2−21				
C2−22	Orientation Control Select Signal 1 SEL-E1*	Control mode setting signal for specifying the direction of rotation in orientation control • Bits 1 and 0: Positioning rotation direction 00: Automatically selected rotation direction 01: Same direction as the commanded operation direction 10: Fixed rotation direction 11: Automatically selected rotation direction • Bits 2: Selection for fixed rotation direction 0: Forward rotation of the spindle 1: Reverse rotation of the spindle • Bits 3: Stop position reference code 0: 12-bit binary 1: 3-digit BCD • Bits 4: Tune-up operation 0: Tune-up available 1: Tune-up unavailable • Bits 5: Incremental positioning reference point 0: Formerly commanded stop position 1: Present stop position • Bits 6: Encoder 0: Spindle encoder 1: Motor encoder • Bits 7: Rotation direction of motor and spindle 0: Reverse 1: The same		− − −

* In explanation of select signals, 0 stands for " ¦ " and 1 for " ¦ ".

Table 13.5 Encoder Orientation Constants (Cont'd)

Constant No.	Constant Name	Explanation	Unit	Upper Limit / Lower Limit
C2−23	Orientation Control Select Signal 2 SEL-E2*	Dither signal pattern and gain • Bit 0: DB selection upon orientation completion 0: Invalid 1: Stops by braking torque orientation completion • Bit 1: Dither signal pattern 0: 6 steps (83Hz) 1: 2 steps (250Hz) • Bit 4, 3, and 2: Dither signal level (H) (MGR, LGR: OFF) 000: 0.0% 011: 7.5% 110: 15.0% 001: 2.5% 100: 10.0% 111: 17.5% 010: 5.0% 101: 12.5% • Bit 7, 6, and 5: Dither signal level (L) (MGR or LGR: ON) 000: 0% 011: 3% 110: 6% 001: 1% 100: 4% 111: 7% 010: 2% 101: 5%		— — —
C2−24	Orientation Control Select Signal 3 SEL-E3*	Orientation Control parameters • Bits 5 and 4: Speed reference differential compensation gain 00 : 10 01 : 15 10 : 20 11 : 30 • Bits 7 and 6 : Flux level for positioning servo loop control 00 : 100 % 01 : 80 % 10 : 60 % 11 : 40 %		— — —

* In explanation of select signals, 0 stands for "｜" and 1 for "¦."

Table 13.6 Magnetic Sensor Orientation Constants

Constant No.	Constant Name	Explanation	Unit	Upper Limit / Lower Limit
C3−01	Load Axis Positioning Origin P_{ORG}	Mechanical origin of the load axis. Set difference from magnetic sensor signal in degrees.	°	2.00 −2.00
C3−02	Position Control Proportional Gain (H) K_{PH}	Position control proportional gain when high-speed gear is selected (MGR and LGR are OFF) or when high-speed winding is selected (CHW is OFF) . Boosting K_{PH} increases rigidity. Speed Reference (pps) = K_{PH} × Position Tolerance (pulses)	1/s	99 1
C3−03	Position Control Proportional Gain (M) K_{PM}	Position control proportional gain when medium-speed gear is selected (MGR is ON) . Boosting K_{PM} increases rigidity. Speed Reference (pps) = K_{PM} × Position Tolerance (pulses)	1/s	99 1
C3−04	Position Control Proportional Gain (L) K_{PL}	Position control proportional gain when low-speed gear is selected (LGR is ON) orwhen low-speed winding is selected (CHW is ON) . Boosting K_{PL} increases rigidity. Speed Reference(pps) = K_{PL} × Position Tolerance (pulses)	1/s	99 1
C3−05	Speed Control Proportional Gain (H) K_{VHO}	Speed control proportional gain when high-speed gear is selected (MGRand LGR are OFF) or when high-speed winding is selected (CHW is OFF) in orientation control (ORT is ON). Torque Reference P = K_{VHO} × Speed Tolerance	%/Hz	255 1
C3−06	Speed Control Integral Time Constant (H) τ_{VHO}	Speed control integral time constant when high-speed gear is selected (MGR and LGR are OFF) or when high-speed winding is selected (CHW is OFF) in orientation control (ORT is ON) . Torque Reference I = Speed Tolerance × time/ τ_{VHO}	ms	1000 5
C3−07	Speed Control Proportional Gain (M,L) K_{VLO}	Speed control proportional gain when low-speed gear is selected (MGR or LGR is ON) or when low-speed winding is selected (CHW is ON) in orientation control (ORT is ON) . Torque Reference P = K_{VLO} × Speed Tolerance	%/Hz	255 1
C3−08	Speed Control Integral Time Constant (M,L) τ_{VLO}	Speed control integral time constant when low-speed gear is selected (MGR or LGR is ON) or when low-speed winding is selected (CHW is ON) in orientation control (ORT is ON). Torque Reference I =Speed Tolerance × time/ τ_{VLO}	ms	1000 5
C3−09	Positioning Completion Detection Width Z_{FIN}	Detection width for outputting completion signal when the load axis reaches near the commanded stop position. Detection width is commanded stop position ± Z_{FIN}	°	20.0 0.0
C3−10	Positioning Completion Detection Width Z_{CAN}	Set value for canceling completion signal when the load axis is moved after completion signal is output. Cancel width is commanded at stop position ± Z_{CAN}	°	20.0 ZFIN
C3−11	Orientation Speed S_{ORT}	Speed applied (after detecting magnetic sensor signal) until changing to the servo loop during orientation	r/min	600 40
C3−12	BCD Stop Position Reference Resolution P_{BCD}	Completion signal cancel angle per minimum increment for determining stop position for incremental positioning with BCD command after stopping at home position.	°	180.0 0.5
C3−13	Arbitrary Stop Position Offset P_{IMG}	Stop position offset for smoothing stop operation when the servo loop is used When Z_{FIN} is reached, offset becomes 0.	°	10.0 0

Table 13.6 Magnetic Sensor Orientation Constants (Cont'd)

Constant No.	Constant Name	Explanation	Unit	Upper Limit / Lower Limit
C3−14	Orientation Speed Change Ratio	Speed change ratio for gradually reducing orientation speed to reduce gear noise when switching from orientation speed to servo loop speed		100 / 0
C3−15	Starting Soft Start Time T_{SFO}	Soft start time for accelerating from stop to orientation speed. Use this parameter to reduce gear noise at starting. Acceleration rate is (500 r/min) /s.	ms	50 / 0
C3−16	Flux Level ϕ_{ORT}	Flux level at completion of orientation. Motor noise and torque change in proportion to flux level.		100 / 15
C3−17	Orientation Speed Reduction Coefficient K_{SOR}	Reduction coefficient to set orientation speed in proportion to the traveling angle for incremental positioning.		32767 / 0
C3−18	------			
C3−19	------			
C3−20	Sensor Signal Standardization Angle θ_{CEN}	Angle for standardizing magnetic sensor signal detection sensitivity $\theta_{SEN}=180°\times$Detection Range (mm)$\div$Mounting Radius$\div\pi$ Set 20.0 to θ_{SEN} when $\theta_{SEN}>20.0$ For detection range, check the specifications of the magnet and apply the values below : MG-1378BS (15mm) MG-1444S (7mm)	°	20.0 / 5.0
C3−21	------			
C3−22	Orientation Control Select Signal 1 SEL-M1*	Control mode setting signal for specifying the direction of rotation in orientation control • Bits 1 and 0 : Positioning rotation direction 00 : Automatically selected rotation direction 01 : Same direction as the commanded forward/reverse rotation direction 10 : Fixed rotation direction 11 : Automatically selected rotation direction • Bits 2 : Selection for fixed rotation direction 0 : Forward rotation of the spindle 1 : Reverse rotation of the spindle • Bits 3 : Stop position reference code 0 : 12-bit binary 1 : 3-digit BCD • Bits 4 : Tune-up operation 0 : Tune-up possible 1 : Tune-up not possible • Bits 5 : Incremental positioning reference point 0 : Formerly commanded stop position 1 : Present stop position • Bits 6 : Encoder 0 : Spindle encoder 1 : Motor encoder • Bits 7 : Rotation direction of motor and spindle 0 : Reverse 1 : The same		---

* In explanation of select signals, 0 stands for "↓" and 1 for "↑."

Table 13.6 Magnetic Sensor Orientation Constants (Cont'd)

Constant No.	Constant Name	Explanation	Unit	Upper Limit / Lower Limit
C3−23	Orientation Control Select Signal 2 SEL-M2*	Dither signal pattern and gain • Bit 1 : Dither signal pattern 0 : 6 steps (83 Hz) 1 : 2 steps (250 Hz) • Bit 4, 3, and 2 : Dither signal level (H) 000 : 0.0% 011 : 7.5% 110 : 15.0% 001 : 2.5% 100 : 10.0% 111 : 17.5% 010 : 5.0% 101 : 12.5% • Bit 7, 6, and 5 : Dither signal level (L) 000 : 0% 011 : 3% 110 : 6% 001 : 1% 100 : 4% 111 : 7% 010 : 2% 101 : 5%		— — —
C3−24	Orientation Control Select Signal 3 SEL-M3*	Orientation control parameters • Bit 5 and 4 : Speed reference differential compensation gain 00 : 10 01 : 15 10 : 20 11 : 30 • Bit 7 and 6 : Flux level for positioning servo loop control 00 : 100% 01 : 80% 10 : 60% 11 : 40%		— — —

* In explanation of select signals, 0 stands for "|" and 1 for "¦."

13.5 PROTECTIVE FUNCTION DISPLAY

If an error occurs during operation, protective functions are activated depending on the failure and operation is stopped. The activated protective functions are indicated on the digital operator in F codes.
Failure codes are output as signals to pins 23 to 27 of 1CN as shown in Fig. 13.3. In the figure, ○ indicates ON and ● indicates OFF.

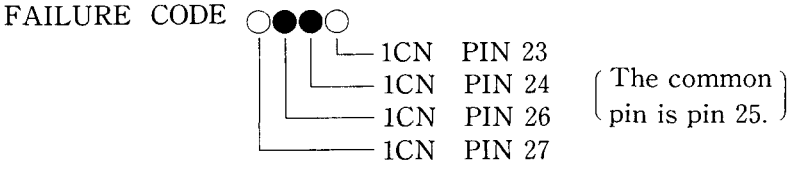


Fig. 13.3 Failure Code Output

Table 13.7 Protective Functions

F Code No.	Protective Function	Explanation	Failure
F−000	Winding Selection Failure	Windings were not selected within set time.	●●●●
F−001	Emergency Stop Failure	Operation was not stopped within 10 seconds after emergency stop was commanded.	●●●●
F−100	Inverter Output Overcurrent	Output current exceeded set overcurrent value.	●●●○
F−200	Inverter Internal MC Operation Failure	The magnetic contactor in the input block is not functioning.	●●○●
F−201	MCCB Trip	The MCCB in the input block tripped.	●●○●
F−300	Inverter Input Overcurrent	Input current exceeded set overcurrent value.	●●○●
F−400	Inverter Overvoltage	Inverter DC bus voltage exceeded set overvoltage value.	●○●●
F−500	Motor Overspeed	Motor speed exceeded 120% of max. set speed.	●○●○
F−600	Power Voltage Error 1	Synchronous power signal is lost (at power-ON).	●○○●
F−601	Power Frequency Error 1	Whether 50 Hz or 60 Hz cannot be determined (at power-ON).	●○○●
F−602	Power Voltage Error 2	Low-voltage (85% or lower), momentary power loss (for 0.02 second or longer), or open phase	●○○●
F−603	Power Frequency Error 2	Excess power frequency deviations (Deviation is 5% of the frequency or greater.)	●○○●
F−604	Power Voltage Error 3	Low-voltage of control power source (175 VAC or lower) or power loss	●○○●
F−700	Inverter Output Overload	Output current of 120% of 30-minute rating flowed for one minute or longer.	●○○○
F−701	Inverter Input Overload	Input current of 120% of 30-minute rating flowed for one minute or longer.	●○○○
F−800	Excess Speed Deviation	Speed rose to 120% of commanded value or greater, or dropped to 50% or lower.	○●●●
F−900	Motor Thermal Error 1	Motor temperature exceeded upper limit. (Minor failure)	●●●●
F−901	Motor Thermal Error 2	Motor Temperature over upper limit continued for four minutes or longer.	○●●○
F−902	Motor Thermal Error 3	Break in wire occurred in the motor temperature detection thermistor. (Detected at −10°C or less)	○●●○
F−903	Heat Sink Thermal Error 1	Heat sink temperature exceeded upper limit. (minor failure)	●●●●
F−904	Heat Sink Thermal Error 2	Heat sink temperature over upper limit continued for one minute or longer.	○●●○
F−905	Heat Sink Thermal Error 3	Break in wire occurred in the heat sink temperature detection themistor. (Detected at −10°C or less)	○●●○
F−906	Control Panel Thermal Error 1	Panel intermal temperature exceeded +55°C (minor failure)	●●●●
F−907	Control Panel Thermal Error 2	Panel internal temperature exceeded +60°C	○●●○

Table 13.7 Protective Functions (Cont'd)

F Code No.	Protective Function	Explanation	Failure Code
F−A00	Initial Charge Failure 1	Charging for the main capacitor did not complete.	○●○●
F−b00	Controller Failure 1	Failure of the speed instruction AD converter	○●○○
F−b01	Controller Failure 2	Failure of the AD converter with CPU	○●○○
F−b02	Controller Failure 3	Failure of the Phase-U current detection AD converter	○●○○
F−b03	Controller Failure 4	Failure of the Phase-W current detection AD converter	○●○○
F−C00	Break in Speed Detection Signal Cable	Break in wire or misconnection of the motor encoder signal cable	○○●●
F−d00	Controller Failure 5	Memory (PROM) failure	○○●○
F−d01	Software Version Mismatch	Controller mismatched software version.	○○●○
F−d11	Position Detector Failure 1	· Phase C was not detected when tuning up. (Encoder method orientation) · Sensor Signal was not detected when tuning up. (Magnetic sensor method orientation)	○○●○
F−d12	Position Detector Failure 2	Phase-C signal exceeded 100 pulses when tuning up.	○○●○
F−d13	Position Detector Failure 3	· Pulses per rotation exceeded 4096 ± 1 when tuning up. (Encoder method orientation) · Detection error of one rotation of shaft exceeded ± 22.5°. (Magnetic sensor method orientation)	○○●○
F−d14	Tune-up Incomplete	Orientation command was input before tuning up.	●●●●
F−d15	INC Signal Error	Incremental signal timing error of INC signal	●●●●
F−d16	Break in Position Detection Signal Cable	Break in wire or misconnection of the position detection encoder signal cable.	○○●○
F−d17	Break in Magnetic Sensor Signal Cable	Break in wire or misconnection of the magnetic sensor signal cable	○○●○
F−d18	Orientation Card Unmatch	Unmatch between orientation selection (C1-39) and orientation card	○○●○
F−E00	Controller Failure 6	Memory (NVRAM) failure	○○○●
F−E01	Controller Failure 7	Memory (NVRAM) failure	○○○●
F−E02	Controller Failure 8	Data in memory (NVRAM) exceeded upper or lower limit.	○○○●
F−E03	Controller Failure 9	Memory (NVRAM) failure	○○○●
F−E04	Motor Code Selection Error	Selected motor code did not match the unit.	○○○●
F−F00	I/O Error 1	Inter-CPU data transfer error	○○○○
F−F03	I/O Error 2	Inter-CPU data transfer error	○○○○
CPF00	CPU Failure 1	Internal memory (RAM) failure or WDT activation	————
CPF01	CPU Failure 2	Excessive time error	————