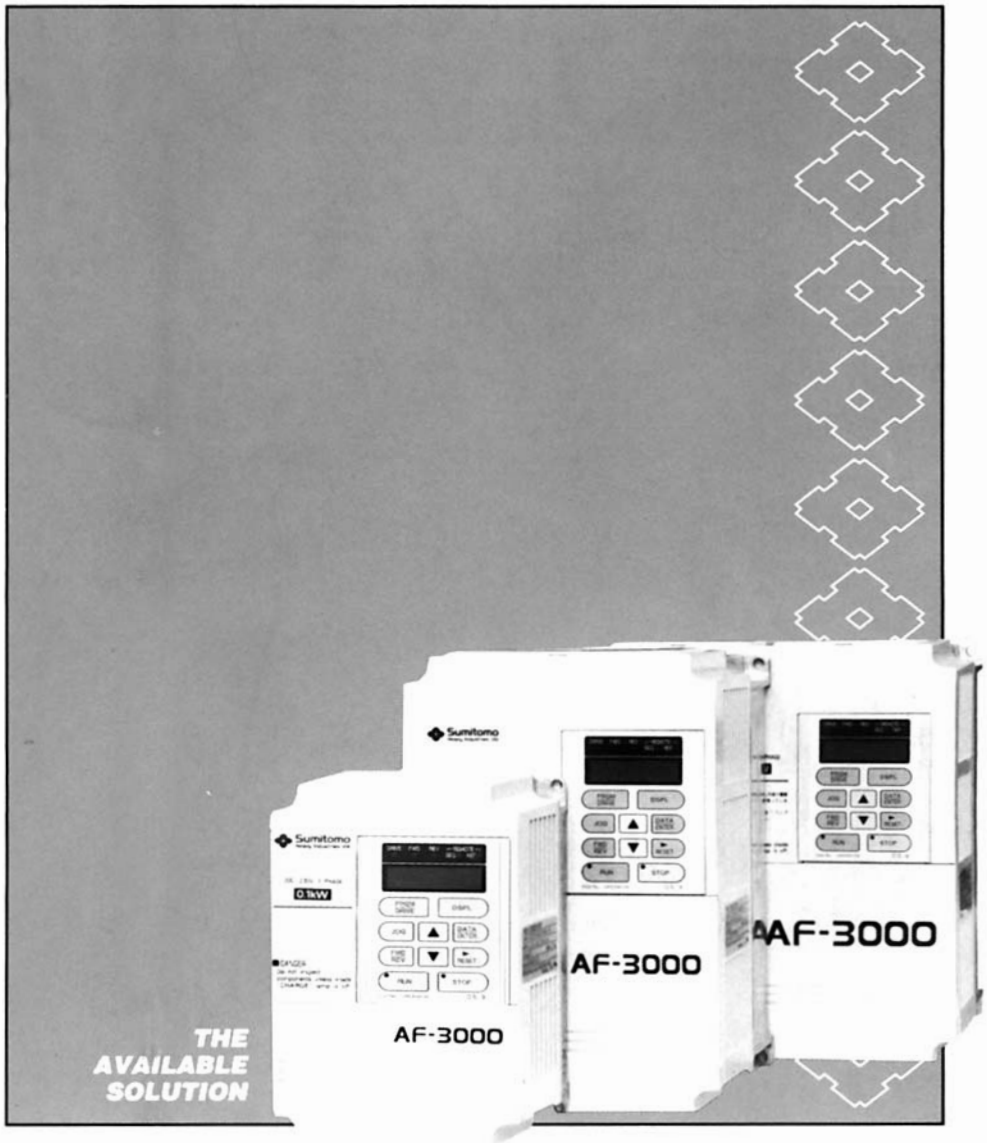
SUMITOMO
MACHINERY CORPORATION OF AMERICA

AF-3000®

Compact AC Inverter
Operating & Maintenance Manual



Catalog 10.091.60.002

DANGER

Voltage is present on capacitors for five minutes after input circuit is open. Risk of electric shock and/or electrical energy-high current levels.

WARNING

Disconnect electrical supply before servicing the electrical system.

Do not change the wiring while power is applied to the circuit.

Do not check signals during operation.

WARNING

Refer to this manual for connection of circuits and the rating of auxiliary circuits.

Be sure to ground AF-3000 using the ground terminal G(E).

Never connect main circuit output terminals T1(U), T2(V), T3(W) to AC main circuit power supply.

CAUTION

Separate motor overcurrent, overload and overheating protection is required to be provided in accordance with CANADIAN ELECTRICAL CODE, PART I and NEC.

This instruction manual is composed of 2 sections: The first section describes handling, wiring, operation, maintenance/inspection, troubleshooting and specifications of the AF-3000 Digital Compact Inverter. The second outlines the digital operator performance, constants, operation, etc.

Before using the AF-3000, a thorough understanding of this manual is recommended for daily maintenance, inspection and troubleshooting.

In this manual, "constant (No.□□)" indicates the item number of control constant set by digital operator.

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WARNING

Disconnect electrical supply before servicing the electrical system.

Do not change the wiring while power is applied to the circuit.

Do not check signals during operation.

WARNING

Refer to this manual for connection of circuits and the rating of auxiliary circuits.

Be sure to ground AF-3000 using the ground terminal G.

Connect the motor to output terminals T1, T2, T3. Connect an AC power supply to input terminals L1, L2, L3 (for 240 V single-phase series, connect only to L1 and L2).

CAUTION

Separate motor overcurrent, overload and overheating protection is required to be provided in accordance with CANADIAN ELECTRICAL CODE, PART I and NEC.

CAUTION

All the potentiometers of AF-3000 have been adjusted at the factory. Do not change their settings unnecessarily.

Do not make withstand voltage tests on any part of the AF-3000 unit. It is electronic equipment using semiconductors and vulnerable to high voltage.

Make sure to tighten screws on the main circuit and control circuit terminals. Refer to installation instructions for torque values. See par. 1.5.3 "(5) Wire and terminal screw sizes."

Handle with care so as not to damage the inverter during transportation.

Do not pick up by the front cover or the unit cover (plastic portion). Use the die-cast portion.

ADVERTISSEMENT

Des tensions subsistent aux bornes des condensateurs pendant cinq minutes aprés l'ouverture de circuit d'entrée.

Couper l'alimentation avant d'entreprendre le depannage du système électrique.

ATTENTION

Une protection distincte contre les surintensités, la surcharge et la surchaufee de moteur doit être fournie conformément AU CODE CANADIAN DE L'ÉLECTRICITÉ PREMIER PARTIE et LE NATIONAL DE L' ÉLECTRICITE.

WARNING

Twist wires together before inserting in grounding terminal.

CAUTION

Separate motor overcurrent, overload and overheating protection is required to be provided in accordance with CANADIAN ELECTRICAL CODE, PART I and NEC.

Use 75°C copper wires only.

Low voltage terminals shall be wired with Class I Wiring.

When mounting units in an enclosure, remove the top, bottom and terminal covers.

ADVERTISSEMENT

Enroulex les fils ensemble avant de les introduire dans la borne.

Des tensions subsistent aux bornes des condensateurs pendant cinq minutes aprés l'ouverture de circuit d'entrée.

Couper l'alimentation avant d'entreprendre le depannage du système électrique.

ATTENTION

Une protection distincte contre les surintensités, la surcharge et la surchaufee de moteur doit être fournie conformément AU CODE CANADIAN DE L'ÉLECTRICITÉ PREMIER PARTIE et LE NATIONAL DE L'ÉLECTRICITE.

The AF-3000 is an ultra-compact, all-digital inverter which provides low noise operation.

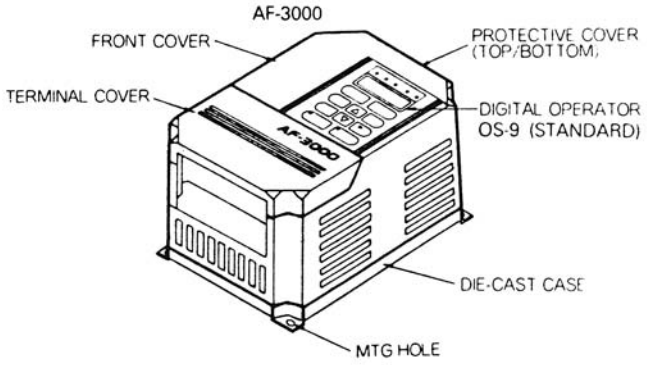
Two types are available : 1) with digital operator or 2) with drive status indicating plate (indicating plate).

The digital operator allows maximum utilization of the drive by providing access to the inverter's program constants and operation variables.

The model with the indicating plate provides status and fault codes while preventing unauthorized access to the programming constants. It is also useful for those applications where the programming operator can be moved from one unit to another.

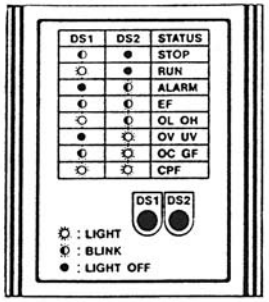
1.1 PARTS NAMES OF AF-3000

· With digital operator

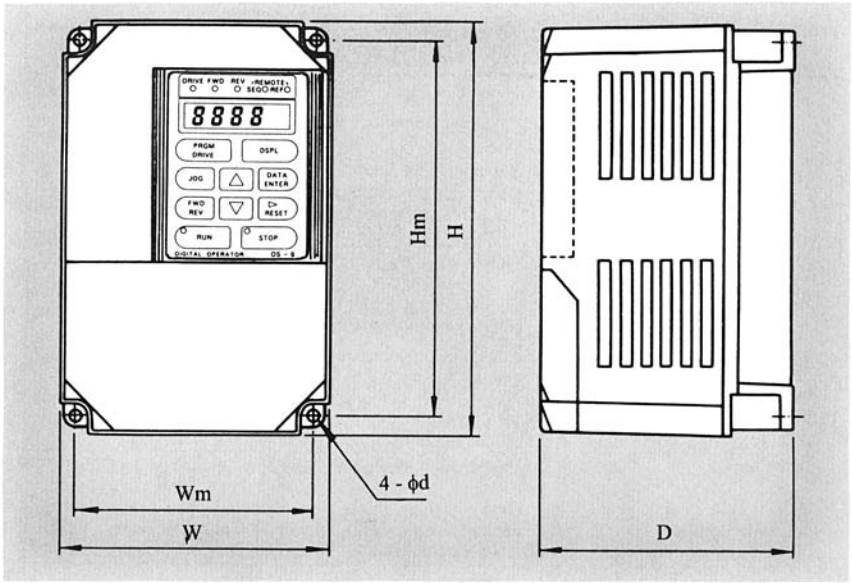


· With indicating cover

The indicating cover shown to the right will be mounted in place of the digital operator which is installed in the unit.



1.8.2 Dimensions in inches (mm)



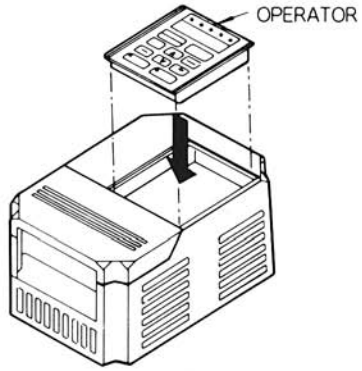
Voltage	Ratings		Dimensions							Weight
	HP	kW		H	Hm	W	Wm	D	d	
200-230 3-Phase Input	1/8-1/2	0.1-0.4	in	5.91	5.43	4.13	3.66	3.94	0.20	2.43 lb
			mm	150	138	105	93	100	5.0	1.1 kg
	1-2	0.75-1.5	in	5.91	5.43	5.51	5.04	5.47	0.20	4.41 lb
			mm	150	138	140	128	139	5.0	2.0 kg
	3-5	2.2-3.7	in	7.87	7.32	5.51	4.96	6.69	0.22	7.28 lb
			mm	200	186	140	126	170	5.5	3.3 kg
200-230 1-Phase Input	1/8-1/2	0.1-0.4	in	5.91	5.43	5.51	5.04	5.47	0.20	4.9 lb
			mm	150	138	140	128	139	5.0	2.2 kg
	1-2	0.75-1.5	in	7.87	7.32	5.51	4.96	6.69	0.22	6.6 lb
			mm	200	186	140	126	170	5.5	3.0 kg
	3-5	2.2-3.7	in	7.87	7.28	7.48	6.89	7.48	0.24	11.0 lb
			mm	200	185	190	175	190	6.0	5.0 kg
380-460 3-Phase	1/8-1/2	0.2-0.4	in	7.87	7.32	5.51	4.96	4.72	0.22	4.41 lb
			mm	200	186	140	126	120	5.5	2.0 kg
	1-2	.75-1.5	in	7.87	7.32	5.51	4.96	6.69	0.22	6.61 lb
			mm	200	186	140	126	170	5.5	3.0 kg
	3-5	2.2-3.7	in	7.87	7.28	7.48	6.89	7.48	0.24	10.14 lb
			mm	200	185	190	175	190	6.0	4.6 kg

2. DIGITAL OPERATOR (OS-9)

The digital operator (OS-9), mounted directly on the inverter, is an AF-3000 exclusive use operation panel which can perform operation, change the control constants and monitor operation status.

2.1 DIGITAL OPERATOR MOUNTING/REMOVING

The digital operator can be mounted and removed in the following procedures. It cannot be mounted or removed during current conduction. Be sure to turn off the inverter power supply and mount/remove it after the charge lamp is extinguished. Unless otherwise, it may cause malfunction.



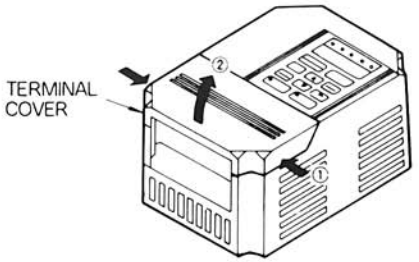
How to mount operator

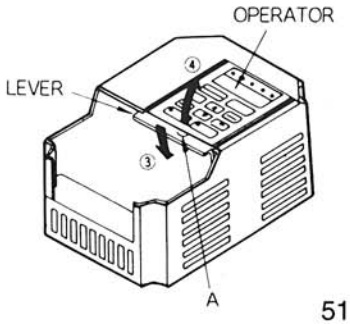
Insert the operator in the direction of the arrow mark until it goes to the end.

How to remove operator

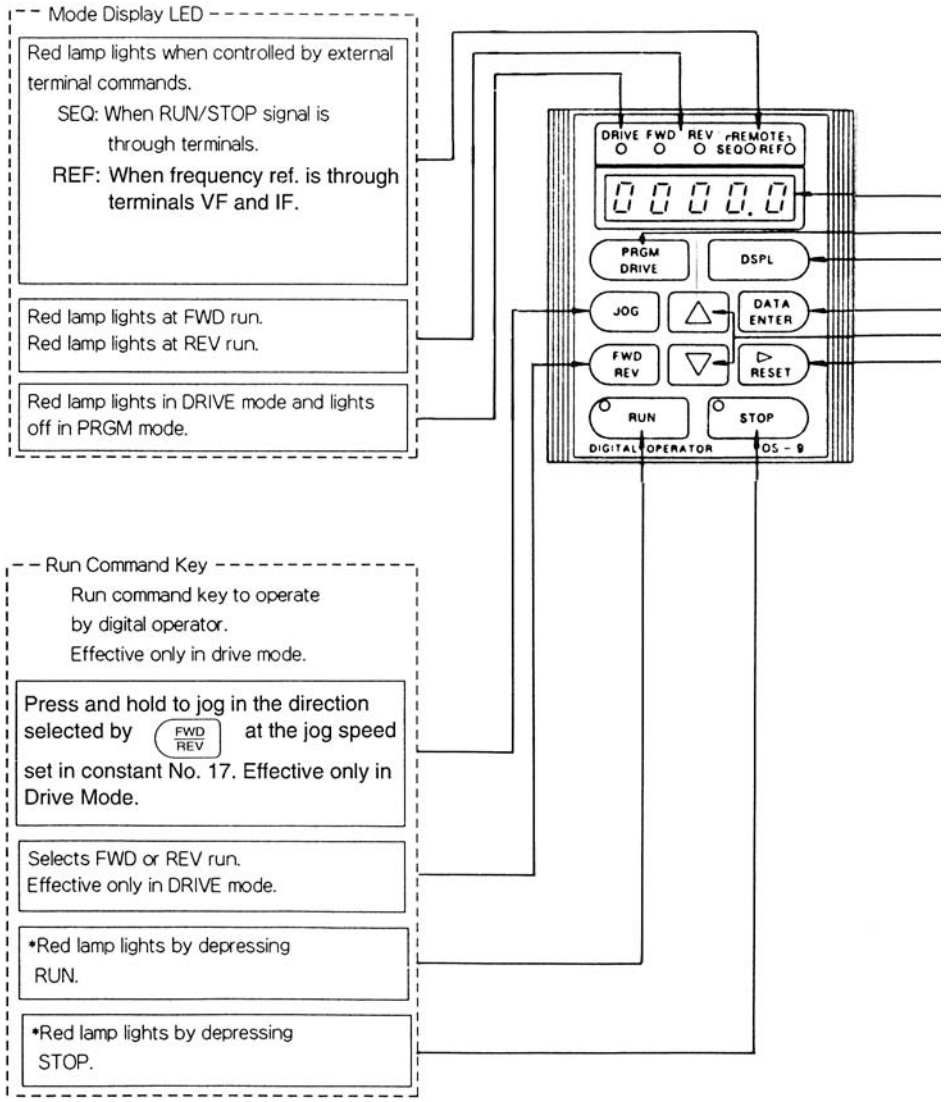
(1) Press in the direction of ① and, at the same time, lift it in the direction of ③ to remove the terminal cover.

(2) Lower the lever in the direction of ③ and insert the minus driver in section A. Then lift the operator in the direction of ④ to remove it.





2.2 DESCRIPTION OF DIGITAL OPERATOR DISPLAY AND OPERATING SECTIONS



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. See next page for explanation.

Read/Write Key

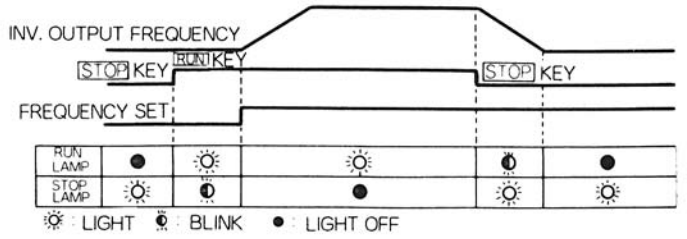
Depressing this key recalls and displays indicated data from memory. Depressing the second time enters displayed data into memory.

Numeral Change Key

Changes numeral such as set values and constant signals.
△: Increase
▽: Decrease

Digit Selection Key

Selects numerical digits.
This key resets operation at faults.



* RUN or STOP lamp charges in accordance with the operations

2.3 FUNCTION/CONSTANT SETTING

2.3.1 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

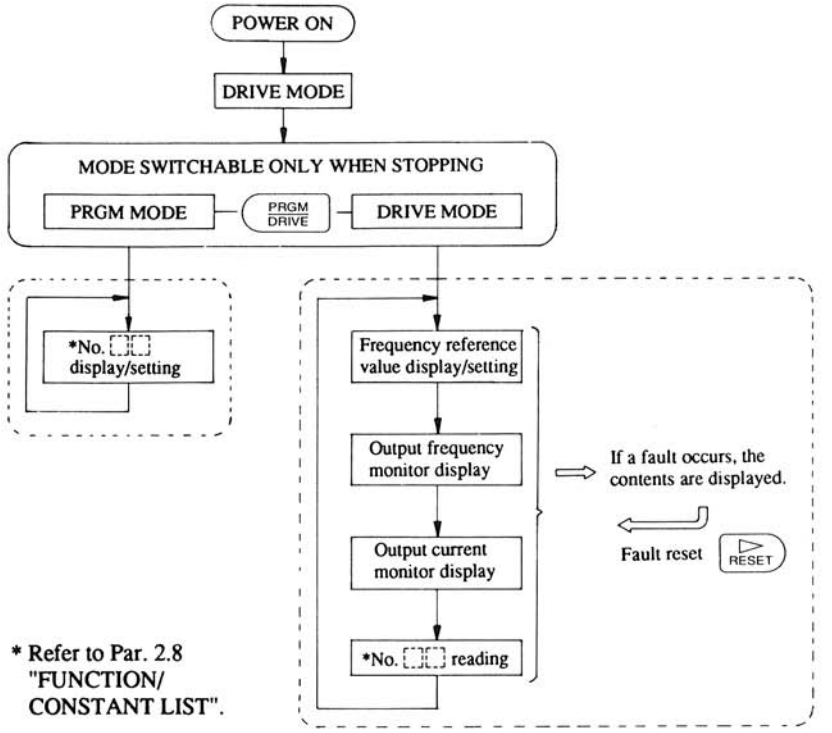
- Operation is enabled.
- An operation can be performed by RUN, STOP, JOG or FWD/REV keys.
- Frequency reference value can be changed during running.

PRGM mode

- Program (function selection, constant setting) can be changed. Operation is not enabled.

Display Contents of DRIVE Mode and PRGM Mode

- Display contents of the digital operator differ according to selected mode (PRGM/DRIVE).
- The constant group to be displayed is changed each time display selection key DSPL is depressed.
- If a fault occurs, the contents are displayed. Additionally, since the contents of the latest fault are stored, maintenance, inspection or troubleshooting can be performed quickly by checking the contents by the digital operator.



* Refer to Par. 2.8 "FUNCTION/ CONSTANT LIST".

2.3.2 Constant Reading and Setting

The AF-3000 has various functions for the optimum operation. The first functions are those basic to drive motors. The second are for basic applications. The third are more advanced application functions. Use it with the set values according to the load conditions or operation conditions of the matching machine. Control constants are read or set by the digital operator. Set constant (No.00) as follows:

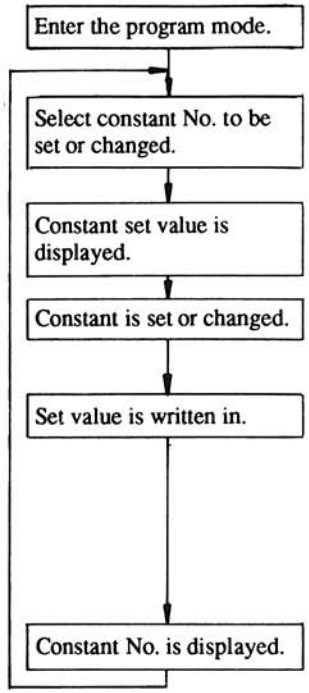
(1) 1st functions (constant Nos.00 to 19) can be set/read :
No.00 = 1 (Factory setting)

(2) 1st and 2nd functions (constant Nos.00 to 29) can be set/read :
No.00 = 2

(3) 1st, 2nd and 3rd functions (constant Nos.00 to 59) can be set/read :
No.00 = 3

<Typical setting>

- The following shows an example where acceleration time (No.09) is changed from 10 seconds to 5 seconds.
- Other constants can be changed in the same operation.



Depress PRGM DRIVE key. — no-01

Change the value with △ or ▽ key. — no-09

Depress DATA ENTER key. — 0.10.0

Change the value with RESET, △ or ▽ key. — 005.0

Depress DATA ENTER key and — End

check that End is displayed.
(End is displayed for 1 second.)
The data are displayed again
after End is displayed. — 005.0

Depress DSPL key — no-09

to display constant No.

Note : Check that End is displayed for each constant setting. Constants cannot be changed simultaneously.

2.3.3 Precautions on Constant Setting

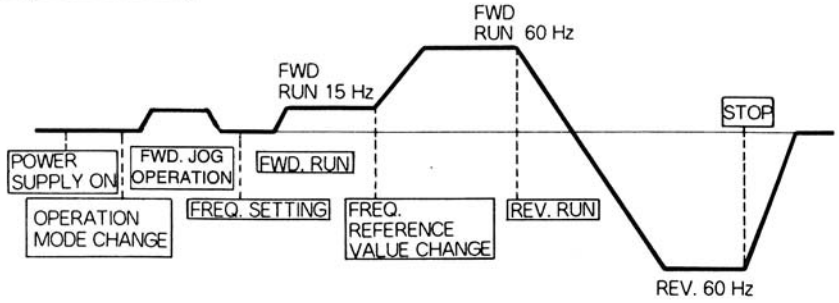
- Perform constant setting securely.
  Improper setting may cause functions not to operate or protective function to operate.
- Record the constants of which setting has been changed.
  Recording the final setting of constants is effective for maintenance or early troubleshooting. Refer to the Par. 2.8 "FUNCTION/CONSTANT LIST" which has a column for entering setting of constants on page 70.
- Change control constants little by little.
  Do not change the motor control constant setting such as V/f maximum output frequency, etc. rapidly. Change it little by little, checking the motor current or load machine status. Changing setting very rapidly may affect the inverter or machine.

- Setting Error
  In the following cases, the set value blinks for 3 seconds and the data before changing are returned.
  - When a value exceeding the setting range is set
  - If the following condition is not satisfied in the multifuncion input selection constant setting :
    Multifunction input selection 1 (No. 32)
    Multifunction input selection 2 (No. 33)
  - If the following conditions are not satisfied in the V/f constant setting :
    Max. output frequency (No. 02)≧Max. voltage frequency (No. 04)＞Intermediate output frequency (No.05)≧Min. output frequency (No. 07)
    For the following setting, intermediate output frequency voltage (No. 06) is disregarded :
    Intermediate output frequency = Min. output frequency.
    For details, refer to "V/f CHARACTERISTIC SETTING" on page 84.
  - If the following condition is not satisfied in the frequency reference constant setting :
    Set frequency reference (Nos. 13 to 17)≦Max. output frequency (No. 02)×Output frequency upper limit value (No. 24)
    For details, refer to "V/f CHARACTERISTIC SETTING" on page 84 and "OUTPUT FREQUENCY LIMIT" on page 91.
  - If the following condition is not satisfied in the frequency reference upper / lower limit value setting :
    Frequency reference lower limit value (No. 25)
    ≦Frequency reference upper limit value (No. 24)

2.4 DIGITAL OPERATOR OPERATION EXAMPLE

The following shows an example of digital operator operation.

Operation Pattern



Operation	[Description]	[Key Operation]	[Digital Operator Display]
Turn ON power supply	· Frequency reference value is displayed.		F 0.0.0
	· Check rotating direction. (FWD is default on power ON.)		LED lamp FWD lights.
Change operation mode.	· PRGM mode is selected.	PRGM/DRIVE	no-01
	· Constant (No.1) data is displayed.	DATA/ENTER	0000
	· Set value is changed.	RESET, △, ▽	0011
	· Set value is written in. (End is displayed for 1 second.)	DATA/ENTER	End
	The data are displayed again after End is displayed.		0011
Frequency Setting	· DRIVE mode is selected.	PRGM/DRIVE	F 0.0.0
15 Hz	· Change reference value.	RESET, △, ▽	F 0 15.0
	· Set value is written in. (Stops blinking for 3 seconds).	DATA/ENTER	F 0 15.0 (Stops blinking for 3 seconds.)
	· Select output frequency monitor display.	DSPL	0.0

(Cont'd)

Operation	[Description]	[Key Operation]	[Digital Operator Display]
			15.0
FWD run	· Running operation.	RUN	LED lamp RUN lights.
Change frequency reference value	· Select frequency reference value display.	DSPL (Depress 3 times.)	F 0 15.0
60 Hz	· Change reference value.	RESET, △, ▽	F 0 60.0
	· Write in set value (stops blinking for 3 seconds).	DATA/ENTER	F 0 60.0
			60.0
	· Select output frequency monitor display.	DSPL	
REV run	· Change to REV run.	FWD/REV	LED lamp REV lights.
REV 60 Hz			-60.0
	· Decelerating to stop	STOP	0.0
Stop			LED lamp STOP lights.
			(RUN blinks while decelerating.)

2.5 CONSTANT INITIALIZATION AND WRITE-IN PROHIBIT

2.5.1 Constant Initialization (Operation to return to factory setting)

· Write in 8 to constant (No.00).

[Description]	[Key Operation]	[Digital Operator Display]
· Select PRGM mode.	PRGM/DRIVE	no-01
· Select constant (No.00).	▽	no-00
· Constant (No.00) data is displayed.	DATA/ENTER	01 *
· Change the set value.	RESET △ ▽	08
· Write in the set value. (End is displayed for 1 second.) The data are displayed again after End is displayed.	DATA/ENTER	End 01 †

* Differs according to the setting data before changing.
† The display returns to 01 after write-in. This indicates that initialization is executed at writing in the data.

2.5.2 Constant Write-in Prohibit (Only constant reading possible)

· The following shows an example where 0 is written in to constant (No.00) [password (No.00) setting/reading and the first functions (constant Nos. 01 to 19) reading enabled].

[Description]	[Key Operation]	[Digital Operator Display]
· Select PRGM mode.	PRGM/DRIVE	no-01
· Select constant (No.00).	▽	no-00
· Constant (No.00) data is displayed.	DATA/ENTER	01 *
· Change the set value.	RESET △ ▽	00
· Write in the set value. (End is displayed for 1 second.) The data are displayed again after End is displayed.	DATA/ENTER	End 00

* Differs according to the setting data before changing.
For details, refer to "PASSWORD SETTING" on page 79.

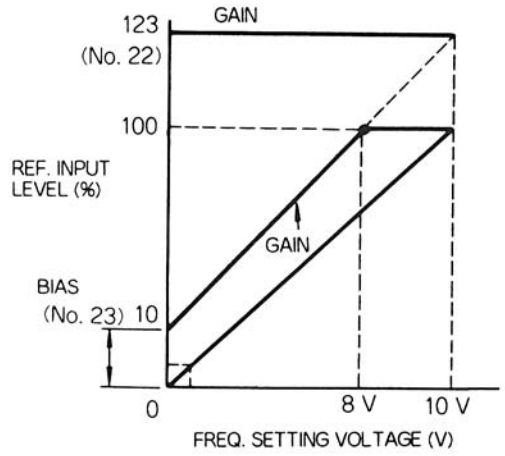
2.6 CORRECTIVE FUNCTION

2.6.1 Adjustment of Frequency Setting Value, Output Frequency Bias (No.23) and Gain (No.22)

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

<Example> Adjust so as to obtain 10% speed (6Hz) at frequency setting voltage 0V and 100% speed (60Hz) at 8V.
[Set constant (No.23)=0.10 and constant (No.22) =1.23.]

[Description]	[Key Operation]	[Digital Operator Display]
· Select PRGM mode.	PRGM/DRIVE	no.-01
<Bias>		
· Select constant (No.23).	△	no-23
· Data (No.23) are displayed.	DATA/ENTER	0.00
· Change the set value.	RESET ▽ △	0.10 (10%=0.1)
· Write in the set value. (End is displayed for 1 second.) The data are displayed again after End is displayed.	DATA/ENTER	End 0.10



<Gain>		
· Select constant (No.22).	DSPL ▽	no-22
· Data (No.22) are displayed.	DATA/ENTER	1.00
· Change the set value.	RESET △ ▽	1.23 *
· Write in the set value. (End is displayed for 1 second.) The data are displayed again after End is displayed.	DATA/ENTER	End 1.23

*How to calculate gain

$$x = \frac{100 - b}{a} \cdots (1) \qquad G = \frac{10x + b}{100} \cdots (2)$$

x can be obtained by equation (1).

$$x = \frac{100 - 10}{8} = 11.25$$

Then by substituting x obtained in equation (1) for equation (2) to obtain G :

$$G = \frac{10 \times 11.25 + 10}{100} = 1.225$$

$$= 1.23$$

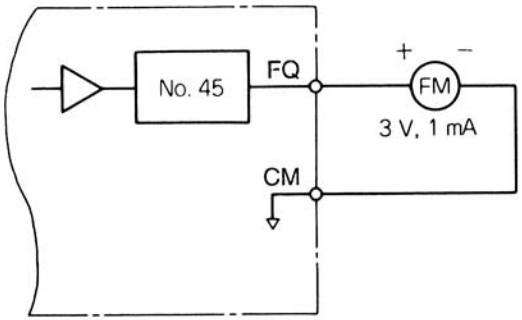
a : Setting voltage at 100% frequency (V)
In this example, since 100% speed (60Hz) is obtained at 8V, a =8.
b : Bias level (%)
In this example, since 10% speed (6Hz) is obtained at frequency setting voltage 0V, b =10.
G : Gain set value
In this example, it is 1.23.

2.6.2 Calibration of Frequency Meter

Calibration of frequency meter or ammeter connected to the inverter can be performed even without providing a calibration resistor.

<Example> When the frequency meter specifications are 3V (1mA) full-scale, 3V full-scale output is used at maximum output frequency [constant (No.02)] operation.

[Set constant (No.45)= 0.30.]



Frequency Meter Calibration

[Description]	[Key Operation]	[Digital Operator Display]
· Select PRGM mode.	PRGM DRIVE	no-01
· Select constant (No.45).	DSPL △ ▽	no-45
· Data are displayed.	DATA ENTER	1.00
· Change the set value.	RESET ▽ △	0.30 10 V× 0.3 = 3.0 V*
· Write in the set value. (End is displayed for 1 second.)	DATA ENTER	End
The data are displayed again after End is displayed.		0.30

* Since analog monitor gain is set to 1.00 prior shipping, 10V is output at maximum output frequency [constant (No.02)] operation.

Note : By data display of constant (No.45) in the program mode, voltage at 100% level according to the constant (No.45) set value is output by the meter calibrating function without any conditions.

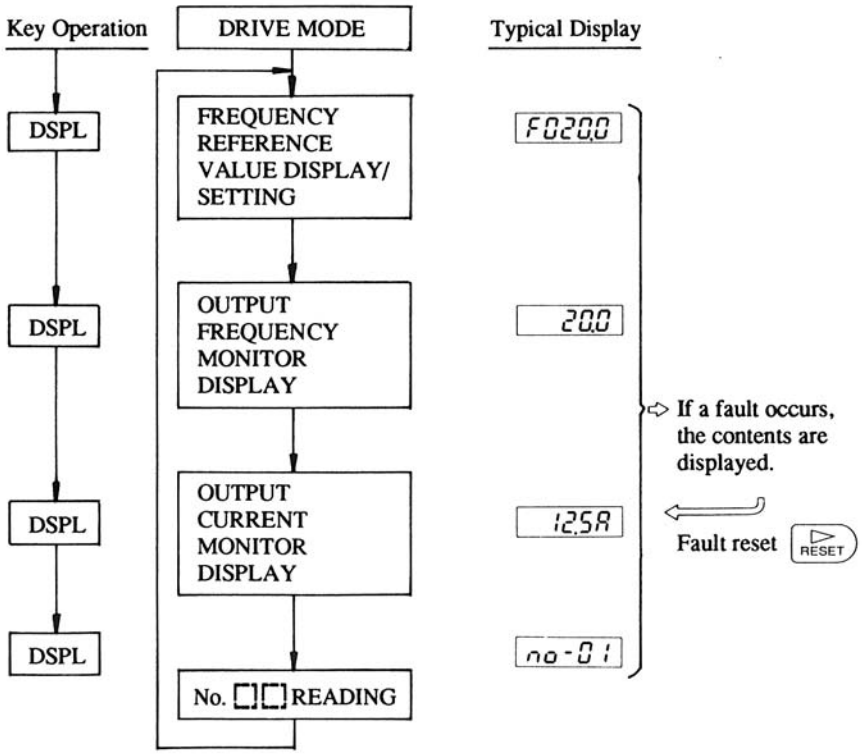
(Example) Assuming constant (No.45) = 0.30 : 10V×0.30 = 3V is output without any conditions.

2.7 MONITOR

Frequency reference value, output frequency, output current and fault contents can be monitored.

2.7.1 Typical Monitor Contents and Display (DRIVE Mode)

The monitor item is changed every time the DSPL key is depressed.



2.7.2 Monitoring of Fault Contents

- If a fault occurs, the fault contents are displayed with priority over other display items.

  Depress the RESET key or turn on the fault reset input signal to reset the fault.
- Since the latest fault content data are stored in the inverter, even if the power supply is turned off, they can be monitored after the power supply is turned on again.

(1) Checking fault contents
The latest data are stored in the constant (No.48). (except UV)

(2) Clearing fault contents
The contents are cleared by setting "6" to the constant (No.00).
Or they are also cleared by constant initialization. [Set constant (No.00) = 8 or 9.]
At this time, other constants are changed to the factory setting values. Therefore, record all of the constant data before initializing constant.

(3) Faults to be stored
OC (overcurrent), OV (overvoltage), OH (cooling fin overheat), OL1 (motor overload), OL2 (inverter overload), OL3 (overtorque detection), EF4, EF5 (external fault), CPF05 (AD converter fault).
For details, refer to Table 1.8 "Fault Display and Contents" on page 35.