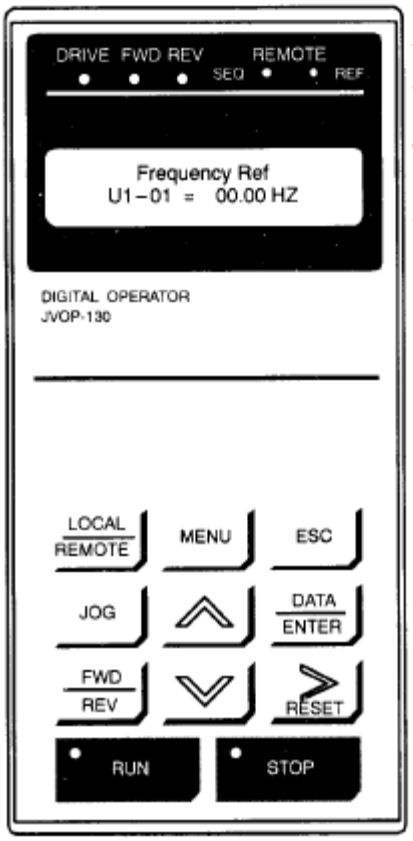
4

Setting User Constants

This chapter describes setting user constants using the Digital Operator.

4.1 Using the Digital Operator

This section describes the component names and functions of the Digital Operator. The component names and functions are shown in *Figure 4.1* and Key functions are described in Table 4.1.



Operation Mode Indicators

DRIVE: Lit when in Operation mode.
FWD: Lit when there is a forward run command input.
REV: Lit when there is a reverse run command input.
SEQ: Lit when the run command from the control circuit terminal is enabled.
REF: Lit when the frequency reference from control circuit Terminals 13 and 14 is enabled.

Data Display

Two-line LCD that displays data for monitoring, user constants and set values with 16 characters per line.

Keys

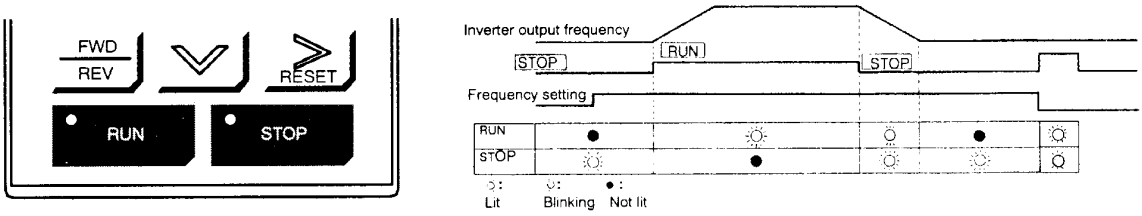
Execute operations such as setting user constants, monitoring, Jog, and Auto-Tuning.

Figure 4.1 Digital Operator Component Names and Functions

Table 4.1 Key Functions

Key	Name	Function
LOCAL / REMOTE	LOCAL/REMOTE Key	Switches between operation (LOCAL) via the Digital Operator and control circuit terminal (REMOTE) operation. This key can be enabled or disabled by setting a user constant (o2-01).
MENU	MENU Key	Displays menus.
ESC	ESC Key	Returns to the status before the DATA/ENTER key was pressed.
JOG	JOG Key	Enables jog operation when the VG5 is being operated from the Digital Operator.
FWD / REV	FWD/REV Key	Selects the rotation direction of the motor when the VG5 is being operated from the Digital Operator.
RESET	RESET Key	Sets the number of digits for user constant settings. Also acts as the reset key when a fault has occurred.
∧	Increment Key	Selects menu items, groups, functions, and user constant names, and increments set values.
∨	Decrement Key	Selects menu items, groups, functions, and user constant names, and decrements set values.
DATA / ENTER	DATA/ENTER Key	Enters menu items, functions, constants, and set values after they are set.
RUN	RUN Key	Starts the VG5 operation when the VG5 is in operation with the Digital Operator.
STOP	STOP Key	Stops VG5 operation. This key can be enabled or disabled by setting a user constant (o2-02) when operating from the control circuit terminal.

NOTE: Except in diagrams, keys are referred to using the key names listed in the above table.



The RUN and STOP indicators light and blink to indicate operating status.

Figure 4.2 RUN and STOP Indicators

4.2 Modes

This section describes the VG5's monitor modes, switching between modes, and accessing/setting user constants.

4.2.1 Inverter Modes

The VG5 Inverter's user constants and monitoring functions have been organized in groups called modes that make it easier to read and set user constants.

The VG5 is equipped with five modes, as shown in the *Table 4.2*.

Table 4.2 Modes

Mode	Primary Function(s)
Operation Mode	The Inverter can be run in this mode. Use this mode when monitoring values such as frequency references or output current, displaying fault information, or displaying the fault history.
Initialize Mode	Use this mode when selecting the language displayed on the Digital Operator, selecting the access level for reading/setting user constants, selecting the control mode, or initializing the user constants.
Programming Mode	Use this mode when reading/setting the user constants required for operation. The Programming mode functions are subdivided into the following groups: • Application: Operation mode selection, DC Control, speed search, etc. • Tuning: Acceleration/deceleration times, S-curve characteristics, carrier frequencies, etc. • Reference: Settings related to frequency control. • Motor: V/f characteristics and motor constants. • Option: Settings for Optional Cards. • Terminal: Settings for sequential I/O and analog I/O. • Protection: Settings for the motor and Inverter protection functions. • Operator: Selects the Digital Operator's display and key functions.
Auto-Tuning Mode	(Usable only within (Vector Control mode.) Use this mode when running a motor with unknown motor constants in the Vector Control mode. The motor constants are calculated and set automatically.
Modified Constants Mode	Use this mode to read/set user constants that have been changed from their factory set values.

4.2.2 Switching Modes

Once the Inverter has been put into Operation mode by pressing the Menu key, the Increment and Decrement keys can be pressed to switch to other modes. Press the DATA/ENTER key to read/set the user constants in each mode.

Press the ESC key to return to the mode display from the user constant display.

Press the DATA/ENTER key twice to write a constant and then press the ESC key to return to the mode display. This is the most Basic operation, so you should remember it.

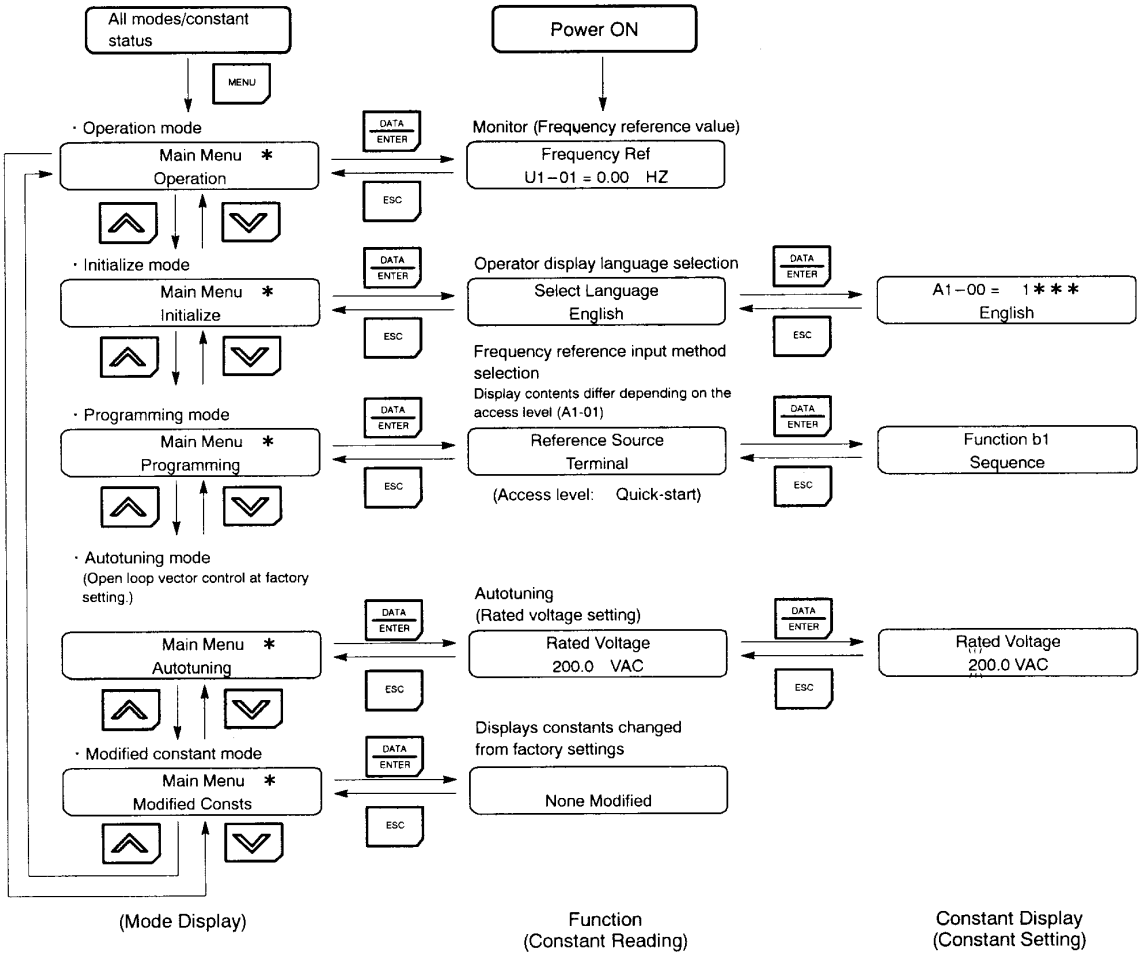


Figure 4.3 Mode Transitions

4.2.3 User Constant Access Levels

The VG5 has three access levels which divide the various user constants based on their applications, as shown below. The access level restricts which user constants can be set or displayed.

Quick-Start	Allows reading/setting of user constants required for simple operation. (factory preset)
Basic	Allows reading/setting of Basic user constants.
Advanced	Allows reading/ setting of all user constants.

Set the access level in Initialize mode with user constant A1-01.

■ Changing the Access Level from Quick-Start to Basic

The Inverter is set at the factory to start in the Quick-Start access level. Use the following procedure to change from the Quick-Start level to the Basic level.

Step	Key Sequence	Digital Operator Display	Remarks
1	MENU	Main Menu ✱ Operation	
2	^	Main Menu ✱ Initialize	
3	DATA ENTER	Select Language English	
4	^	Access Level QUICK-START	
5	DATA ENTER	A1-01 = 2✱✱✱ QUICK-START	
6	^	A1-01 = 3 Basic	
7	DATA ENTER	Entry Accepted	
		Access Level Basic	After approx. 3 seconds, the Operator display is as shown on the left.

As shown above, Quick-Start has changed to Basic.

These seven steps can be illustrated as when in *Figure 4.4*.

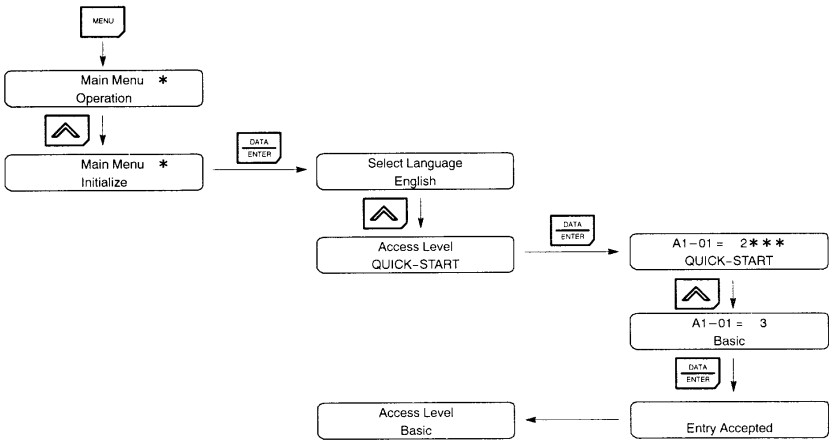


Figure 4.4 Changing Quick-Start to Basic

Setting User Constants in Each Access Level

The displayed access level will change when Programming mode is selected. The display will not change for access levels in Operation mode, Initialize mode, Auto-Tuning mode, and Modified Constants mode.

This section provides the procedure to change the acceleration time to 20.0 seconds in each access level. The acceleration time (C1-01) is a user constant in Programming mode.

If the new user constant setting is not written to the unit by pressing the DATA/ENTER key within one minute after starting the procedure, the display will automatically revert to the original user constant setting. In this case, the procedure must be started again.

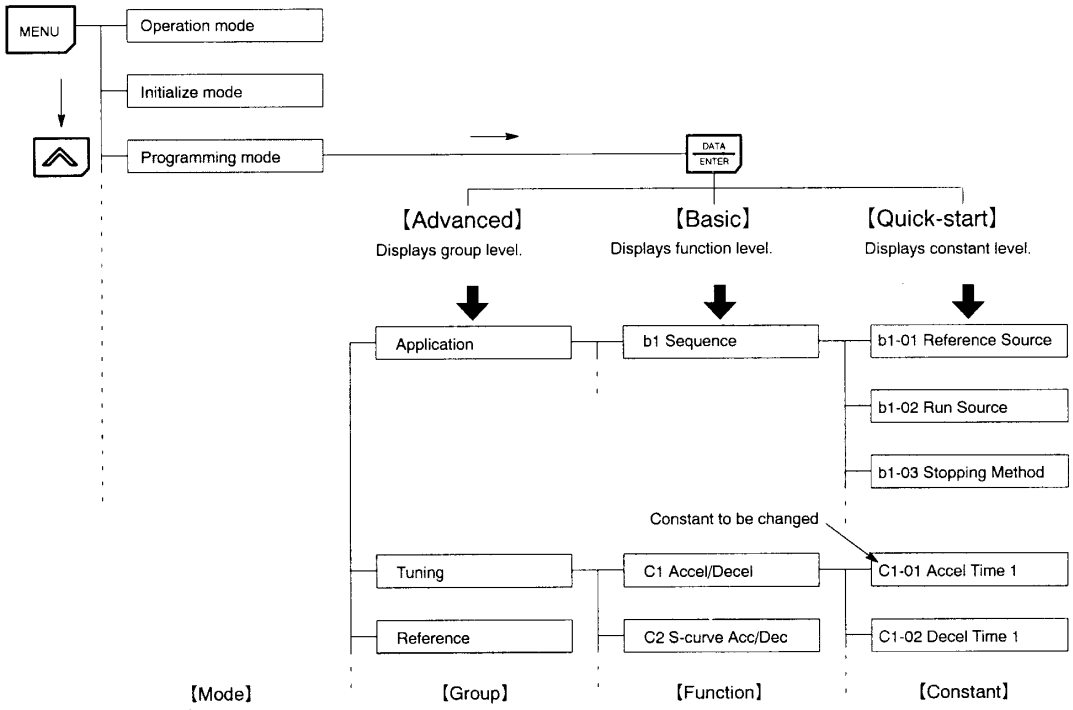


Figure 4.5 Constant Access Levels

‘ EXAMPLE • **Setting a User Constant in the Quick-Start Access Level**

The user constant level will be displayed when the DATA/ENTER key is pressed at the Programming mode display. Use the following display to set the acceleration time to 20.0 seconds.

Step	Key Sequence	Digital Operator Display	Remarks
1	MENU	Main Menu ✱ Operation	
2	^	Main Menu ✱ Programming	
	Press twice.		
3	DATA/ENTER	Reference source Terminals	Changed to constant setting level.
4	^	Run Source Terminals	
5	^	Stopping Method Ramp to Stop	
6	^	Accel Time 1 C1−01 = 10.0 Sec	
7	DATA/ENTER	Accel Time 1 0010.0 Sec	Selects the user constant so that the leading 0 blinks. The digit that is blinking can be changed.
8	RESET	Accel Time 1 0010.0 Sec	Blinking digit moves 2 places to the right.
	Press twice.		
9	^	Accel Time 1 0020.0 Sec	Changes 1 to 2.
10	DATA/ENTER	Entry Accepted	
		Accel Time 1 C1−01 = 20.0 Sec	After approx. 3 seconds, the Operator display is as shown on the left.

The acceleration time has been set to 20.0 seconds.

Returns to Programming mode display.

Step	Key Sequence	Digital Operator Display	Remarks
11	ESC	Main Menu ✱ Programming	

EXAMPLE **Setting a User Constant in the Basic Access Level**

The function level will be displayed when the DATA/ENTER key is pressed at the Programming mode display.

Use the following display to set the acceleration time to 20.0 seconds.

Step	Key Sequence	Digital Operator Display	Remarks
1	MENU	Main Menu ✱ Operation	
2	^ Press twice.	Main Menu ✱ Programming	
3	DATA/ENTER	Function b1 Sequence	Changed to constant reading (function) level.
4	^	Function b2 DC Braking	
5	^	Function C1 Accel/Decel	
6	DATA/ENTER	Accel Time 1 C1−01 = 10.0 Sec	Changed to constant setting level,.
7	DATA/ENTER	Accel Time 1 0010.0 Sec	Selects the user constant so that the leading 0 blinks. The blinking digit can be changed.
8	RESET Press twice.	Accel Time 1 0010.0 Sec	Blinking digit moves 2 places to the right and the "1" blinks.
9	^	Accel Time 1 0020.0 Sec	Changes 1 to 2.
10	DATA/ENTER	Entry Accepted	Writes-in the new setting.
		Accel Time 1 C1−01 = 20.0 Sec	The Operator display is as shown on the left.
11	ESC	Function C1 Accel/Decel	Returns to "Function C1 Accel/Decel" display.

EXAMPLE **Setting a User Constant in the Advanced Access Level**

The group level will be displayed when the DATA/ENTER key is pressed at the Programming mode display.

Use the following display procedure to set a constant.

Step	Key Sequence	Digital Operator Display	Remarks
1	MENU	Main Menu ✱ Operation	
2	^ Press twice.	Main Menu ✱ Programming	
3	DATA ENTER	Group b Application	
4	^	Group C Tuning	
5	DATA ENTER	Function C1 Accel/Decel	Changed to constant reading (function) level.
6	DATA ENTER	Accel Time 1 C1−01 = 10.0 Sec	
7	DATA ENTER	Accel Time 1 0010.0 Sec	Selects the user constant so that the leading 0 blinks. The blinking digit can be changed.
8	> RESET Press twice.	Accel Time 1 0010.0 Sec	Blinking digit moves 2 places to the right and the "1" blinks.
9	^	Accel Time 1 0020.0 Sec	Changes 1 to 2.
10	DATA ENTER	Entry Accepted	Writes-in the new setting, 20.0 s.
		Accel Time 1 C1−01 = 20.0 Sec	After a few seconds, the Operator display is as shown on the left.
11	ESC	Function C1 Accel/Decel	

The constant setting in Advanced level (acceleration time change from 10.0 to 20.0 seconds) has been completed.

4.2.4 Operation Mode

Operation mode is the mode in which the Inverter can be operated.

Many user constants cannot be changed when the Inverter is operating. Refer to *User Constant List* for details.

The following monitor displays are possible in Operation mode: the frequency reference, output frequency, output current, and output voltage, as well as fault information and the fault history.

NOTE: When running the Inverter, press the MENU key first to enter the Operation mode and then press the DATA/ENTER key from the Operation mode display to bring up the monitor display.

Run commands cannot be received from any other display. Once the Inverter is running, it can be switched to other modes.

■ Operations in Operation Mode

Key operations in Operation mode are shown in *Figure 4.6*.

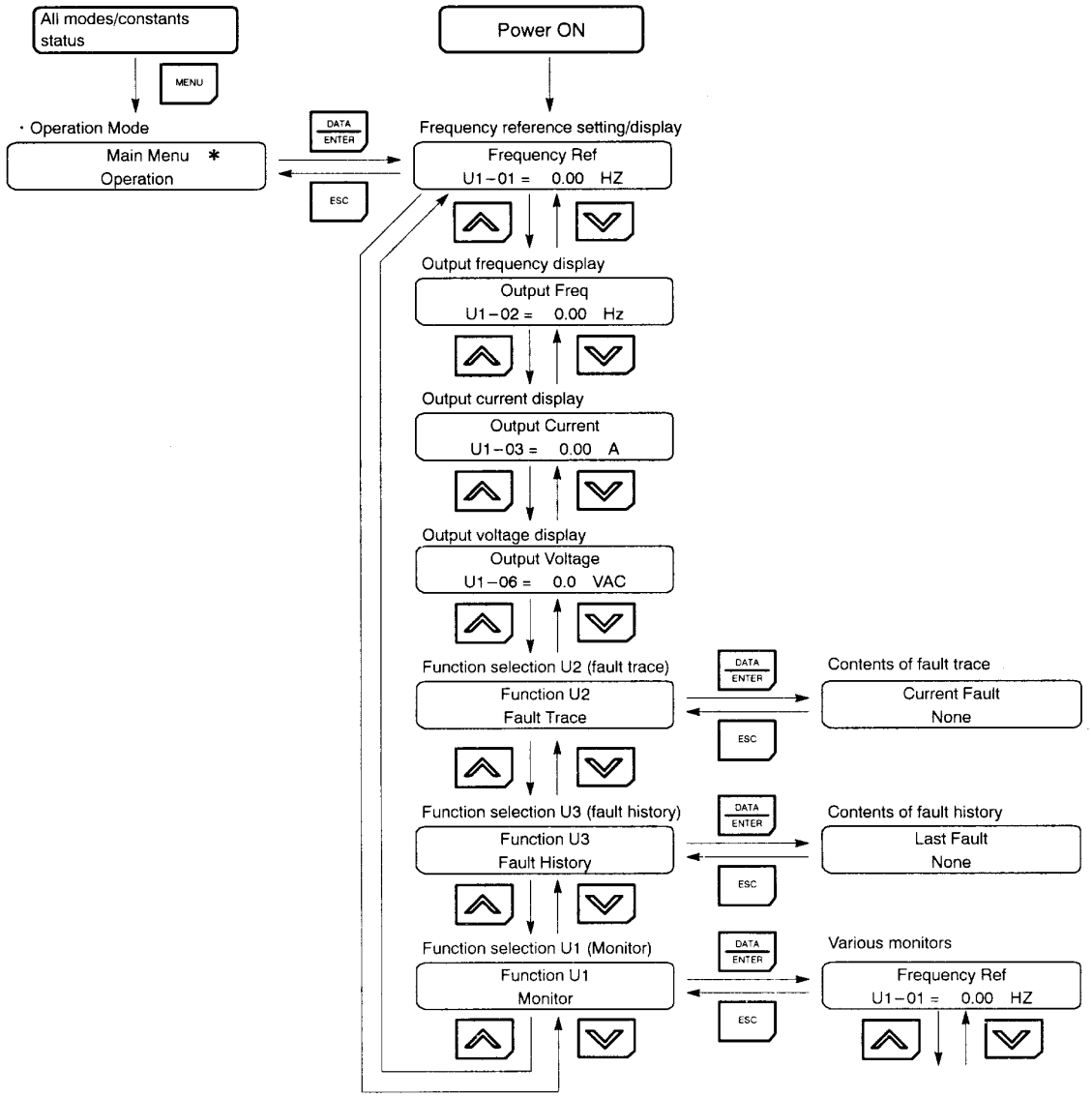


Figure 4.6 Operations in Operation Mode

Conditions for Monitoring

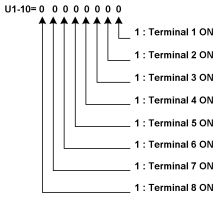
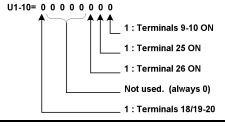
Table 4.3 shows the items that can be monitored in Operation mode.

The "Valid access Levels" column in the table indicates whether an item can be monitored in a particular access level and control method. The codes in this column have the following meanings:

Q	Items that can be monitored in the Quick-Start access level only.
B	Items that can be monitored in the Quick-start and Basic access levels.
A	Items that can be monitored in all access levels. (Quick-start, Basic, and Advanced)
X	Items that cannot be monitored in the control mode shown.

The output signal levels for multi-function analog outputs shown in the table are for a gain of 100.0 and a bias of 0.00.

Table 4.3 Constants Monitored in Operation Mode

Function	Constant No.	Name: Digital Operator Display	Function	Output Signal Levels for Multi-Function Analog Outputs	Min. Unit	Valid Access Levels: V/f	V/f with PG	Open-Loop Vector	Flux Vector
Status Monitor	U1-01	Frequency Ref	Monitor/sets the frequency reference value. The display units can be set with user constant o1-03.	10 V: Maximum frequency (0 to ± 10 V possible)	0.01 Hz	Q	Q	Q	Q
	U1-02	Output Freq	Monitors the output frequency. The display units can be set with user constant o1-03.	10 V: Maximum frequency (0 to ± 10 V possible)	0.01 Hz	Q	Q	Q	Q
	U1-03	Output Current	Monitors the output current.	10 V: Rated current (0 to + 10 V output)	0.1 A	Q	Q	Q	Q
	U1-04	Control Method	Shows which control mode is set.	Cannot be output.	—	Q	Q	Q	Q
	U1-05	Motor Speed	Monitors the motor speed.	10 V: Maximum frequency (0 to ± 10 V possible)	0.01 Hz	X	Q	Q	Q
	U1-06	Output Voltage	Monitors the Inverter's internal output voltage reference value.	10 V: 200 (400) VAC (0 to + 10 V output)	0.1 V	Q	Q	Q	Q
	U1-07	DC Bus Voltage	Monitors the DC voltage of the Inverter's internal main circuit.	10 V: 400 (800) VDC (0 to + 10 V output)	1 V	Q	Q	Q	Q
	U1-08	Output kWatts	Monitors the output power. (This is an internally detected value.)	10 V: Maximum motor capacity (0 to ± 10 V possible)	0.1 kW	Q	Q	Q	Q
	U1-09	Torque Reference	Monitors the internal torque reference value when vector control is used.	10 V: Rated torque 0 to ± 10 V possible)	0.1 %	X	X	Q	Q
	U1-10	Input terminal status. / Input Term Sts	Shows input ON/OFF status. 	Cannot be output.	—	Q	Q	Q	Q
	U1-11	Output terminal status / Output Term Sts	Shows input ON/OFF status. 	Cannot be output.	—	Q	Q	Q	Q

Function	Constant No.	Name: Digital Operator Display	Function	Output Signal Levels for Multi-Function Analog Outputs	Min. Unit	Valid Access Levels: V/f	V/f with PG	Open-Loop Vector	Flux Vector
Status Monitor	U1-12	Operation Status / Int. Ctl Sts 1	Inverter operating status. U1-12 = 00000000 1: Running 1: Zero-speed level 1: Reverse 1: Reset input ON 1: Eref/Eout agree 1: Inverter ready 1: Minor fault detected 1: Major fault detected	Cannot be output.	—	Q	Q	Q	Q
	U1-13	Cumulative operation time / Elapsed Time	Monitors the Inverter's elapsed operating time. The initial value and running/power-on time selection can be set with user constants o2-07 and o2-08.	Cannot be output.	1 hr	Q	Q	Q	Q
	U1-14	Software No. / FLASH ID	Manufacturer's ID number.	Cannot be output.	—	Q	Q	Q	Q
	U1-15	Terminal 13 input voltage level / Term 13 Level	Monitors the input voltage of the frequency reference (voltage). An input of 10 V corresponds to 100%.	10 V: 100% (10 V) (0 to ± 10 V possible)	0.1%	B	B	B	B
	U1-16	Terminal 14 input current level / Term 14 Level	Monitors the input current of the frequency reference (current). An input of 20 mA corresponds to 100%.	20 mA: 100% (20 mA) (0 to + 10 V output)	0.1%	B	B	B	B
	U1-17	Terminal 16 input voltage level / Term 16 Level	Monitors the input voltage of the multi-function analog input. An input of 10 V corresponds to 100%.	10 V: 100% (10 V) (0 to ± 10 V possible)	0.1%	B	B	B	B
	U1-18	Motor secondary current (Iq) / Mot SEC Current	Monitors the calculated value of the motor's secondary current (Iq).	10 V: Rated secondary current. (0 to + 10 V output)	0.1%	B	B	B	B
	U1-19	Motor exciting current (Id) / Mot EXC Current	Monitors the calculated value of the motor's excitation current (Id).	10 V: Rated secondary current. (0 to + 10 V output)	0.1%	X	X	B	B
	U1-20	Output frequency after soft-start / SFS Output	Monitors the output frequency after a soft start. The display shows the frequency without the correction from compensation functions such as slip compensation.	10 V: Maximum frequency (0 to ± 10 V possible)	0.01 Hz	A	A	A	A
	U1-21	ASR input / ASR Input	Monitors the input to the Speed Control loop. The maximum frequency corresponds to 100%.	10 V: Maximum frequency (0 to ± 10 V possible)	0.01 %	X	A	X	A
	U1-22	ASR output / ASR Output	Monitors the output from the Speed Control loop. The motor's rated secondary current corresponds to 100%.	10 V: Rated secondary current (0 to ± 10 V possible)	0.01 %	X	A	X	A
	U1-23	Speed deviation / Speed Deviation	Monitors the speed deviation within the Speed Control loop. The maximum frequency corresponds to 100%.	10 V: Maximum frequency (0 to ± 10 V possible)	0.01 %	X	A	X	A

Function	Constant No.	Name: Digital Operator Display	Function	Output Signal Levels for Multi-Function Analog Outputs	Min. Unit	Valid Access Levels: V/f	V/f with PG	Open-Loop Vector	Flux Vector
Status Monitor	U1-24	PID feedback value / PID Feedback	Monitors the feedback value when PID Control is used. The input for the maximum frequency corresponds to 100%.	10 V: Maximum frequency (0 to ± 10 V possible)	0.01%	A	A	A	A
	U1-25	Dl-16H2 input status / Dl-16 Reference	Monitors reference value from a VG5-D116H2 Digital Reference Card. The value will be displayed in binary or BCD depending on user constant F3-01.	Cannot be output.	—	A	A	A	A
	U1-26	Output voltage reference (Vq) / Voltage Ref (Vq)	Monitors the Inverter's internal voltage reference value for the motor's secondary current control.	10 V: 200 (400) VAC (0 to ± 10 V possible)	0.1 V	X	X	A	A
	U1-27	Output voltage reference (Vd) / Voltage Ref (Vd)	Monitors the Inverter's internal voltage reference value for the motor's excitation current control.	10 V: 200 (400) VAC (0 to ± 10 V possible)	0.1 V	X	X	A	A
	U1-28	Software No. (CPU) / CPU ID	Manufacturer's CPU software ID number.	Cannot be output.	0.1 V	A	A	A	A
	U1-32	ACR output of q axis / ACR (q) Output	Monitors current control output value for motor's secondary current.	10 V: 100%	0.1%	X	X	A	A
	U1-33	ACR output of d axis / ACR (d) Output	Monitors current control output value for motor's excitation current.	10 V: 100%	0.1%	X	X	A	A
	U1-34	OPE fault constant / OPE Detected	Shows the first constant number where an OPE fault is detected.	Cannot be output.	—	A	A	A	A
	U1-35	Zero Servo movement pulses / Zero Servo Pulse	Shows the number of PG pulses for the movement range at the stop point for a Zero Servo times 4.	Cannot be output.	1	X	X	X	A

Function	Constant No.	Name: Digital Operator Display	Function	Output Signal Levels for Multi-Function Analog Outputs	Min. Unit	Valid Access Levels: V/f	V/f with PG	Open-Loop Vector	Flux Vector
Fault trace (See note.)	U2-01	Current fault Current Fault	Information on the current fault.	Cannot be output.	—	Q	Q	Q	Q
	U2-02	Last fault Last Fault	Information on the last fault.		—	Q	Q	Q	Q
	U2-03	Frequency reference at fault Frequency Ref	Frequency reference value when the “last fault” occurred.		0.01 Hz	Q	Q	Q	Q
	U2-04	Output frequency at fault Output Freq	Output frequency when the “last fault” occurred.		0.01 Hz	Q	Q	Q	Q
	U2-05	Output current at fault Output Current	Output current when the “last fault” occurred.		0.1 A	Q	Q	Q	Q
	U2-06	Motor speed at fault Motor Speed	Motor speed when the “last fault” occurred.		0.01 Hz	X	Q	Q	Q
	U2-07	Output voltage reference at fault Output Voltage	Output voltage when the “last fault” occurred.		0.1 V	Q	Q	Q	Q
	U2-08	DC bus voltage at fault DC Bus Voltage	The main circuit DC voltage when the “last fault” occurred.		1 V	Q	Q	Q	Q
	U2-09	Output power at fault Output kWatts	Output power when the “last fault” occurred.		0.1 kW	Q	Q	Q	Q
	U2-10	Torque reference at fault Torque Reference	Torque reference when the “last fault” occurred. (The rated torque = 100%)		0.1%	X	X	Q	Q
	U2-11	Input terminal status at fault Input Term Sts	Input terminal status when the “last fault” occurred.		—	Q	Q	Q	Q
	U2-12	Output terminal status at fault Output Term Sts	Output terminal status when the “last fault” occurred. (Same format as U1-11.)		—	Q	Q	Q	Q
	U2-13	Operation status at fault Inverter Status	Inverter operating status when the “last fault” occurred. (Same format as U1-12.)		—	Q	Q	Q	Q
	U2-14	Cumulative operation time at fault Elapsed Time	Elapsed operating or power-on time when the “last fault” occurred.		1 hr	Q	Q	Q	Q

NOTE: When faults CPF00, 01, 02, 03, UV1 and UV2 occur, a fault trace is not performed.

Function	Constant No.	Name: Digital Operator Display	Function	Output Signal Levels for Multi-Function Analog Outputs	Min. Unit	Valid Access Levels: V/f	V/f with PG	Open-Loop Vector	Flux Vector
Fault history (See note.)	U3-01	Most recent fault Last Fault	Information on the last fault.	Cannot be output.	—	Q	Q	Q	Q
	U3-02	Second most recent fault Fault Message 2	Information on the 2nd to last fault.		—	Q	Q	Q	Q
	U3-03	Third most recent fault Fault Message 3	Information on the 3rd to last fault.		—	Q	Q	Q	Q
	U3-04	Fourth/oldest fault Fault Message 4	Information on the 4th to last fault.		—	Q	Q	Q	Q
	U3-05	Cumulative operation time at fault Elapsed Time 1	Elapsed running or power-on time when the last fault occurred.		1 hr	Q	Q	Q	Q
	U3-06	Accumulated time of second fault Elapsed Time 2	Elapsed running or power-on time when the 2nd to last fault occurred.		1 hr	Q	Q	Q	Q
	U3-07	Accumulated time of third fault Elapsed Time 3	Elapsed running or power-on time when the 3rd to last fault occurred.		1 hr	Q	Q	Q	Q
	U3-08	Accumulated time of fourth/oldest fault Elapsed Time 4	Elapsed running or power-on time when the 4th to last fault occurred.		1 hr	Q	Q	Q	Q

NOTE: Faults CPF00, 01, 02, 03, UV1 and UV2 are not recorded in the fault history.

■ Monitoring a Startup

In Operation mode, the frequency reference, output frequency, output current, and output voltage can be monitored immediately if the factory presets are being used. One of these four values, the output voltage, can be changed to a different monitor item. When an item other than the output voltage is to be monitored, set that value in user constant o1-01 (monitor selection). Refer to the example procedure given later in this manual.

When the power is turned ON, the frequency reference will appear in the unit's data display if the factor presets are being used. Any one of the four values monitored at startup (frequency reference, output frequency, output current, or the value set in user constant o1-01) can be selected to appear when the power is turned ON.

The value that appears at startup is determined by user constant o1-02 (monitor selection after power up).

User constants o1-01 and o1-02 can be changed in the Basic or Advanced access levels. These user constants can be changed during operation.

■ Monitor Displays

The following notation is used in this manual when describing user constants.

User Constant Number	Display Name	Change during Operation	Setting Range	Unit	Factory Setting	Valid Access Levels: V/f Control	V/f with PG	Open-Loop Vector	Flux Vector
o1-01	Monitor selection	❍	4 to 28	—	6	B	B	B	B

Use the last two digits from the U1 Monitor list (U1-❑❑) to select a value. For example, the torque reference is U1-09, so input 9 to select the torque reference.

Change During Operation	Indicates whether or not the constant can be changed during operation. ❍ Can be changed during operation. × Cannot be changed during operation.
Setting Range	The setting range for the constant.
Units	The unit used to set the constant ("–" indicates that no unit is used).
Factory Setting	The value preset at the factory. (There are different factory settings for each control method, i.e., if the control method is changed, the factory setting can also change.)

Valid Access Levels	Indicates the control methods and access levels under which the constant can be accessed and set.	
	Q	Accessible/settable under Quick-Start.
	B	Accessible/settable under Quick-Start or Basic.
	A	Accessible/settable under all access levels (Quick-Start, Basic, and Advanced).
	X	Not accessible/settable in the specified control method.

User Constant Number	Name	Change During Operation	Setting Range	Unit	Factory Setting	Valid Access Levels			
						V/f Control	V/f with PG	Open-Loop Vector	Flux Vector
o1-02	Monitor selection after power up	❍	1 to 4	–	1	B	B	B	B

Use constant o1-02 to indicate which value will be displayed when the Inverter is started. Refer to the following table:

Monitor Display Contents at Startup

Setting	Contents
1	Indicates the frequency reference at startup.
2	Indicates the output frequency at startup.
3	Indicates the output current at startup.
4	Indicates the value set in user constant o1-01 at startup.

EXAMPLE **Changing Monitor Display to Output Power at Startup in Basic Access Level**

Change the access level to Basic if it is not already set there. Refer to *Figure 4.4* for the procedure to change from Quick-Start to Basic access level.

Use the following procedure to change the display from the output voltage to the output power.

Step	Key Sequence	Digital Operator Display	Remarks
1	MENU	Main Menu ✱ Operation	
2	^ Press twice.	Main Menu ✱ Programming	
3	DATA ENTER	Function b1 Sequence	Changed to constant reading (function) level.
4	v Press twice.	Function o1 Monitor Select	
5	DATA ENTER	User Monitor Sel Output Voltage	Changed to constant setting level.
6	DATA ENTER	o1–01 = 6✱✱✱ Output Voltage	
7	^ Press twice.	o1–01 = 8 Output kWatts	
8	DATA ENTER	Entry Accepted	Writes-in the new setting.
		User Monitor Sel Output kWatts	After a few seconds, the Operator display is as shown on the left.

Output power has been set in place of output voltage.

‘ EXAMPLE • **Changing Monitor Display to Output Current at Startup in Basic Access Level**

Use the following procedure to change user constant o1-02 so that the output current is displayed at startup. (The procedure continues from the end of the previous example.)

Step	Key Sequence	Digital Operator Display	Remarks
1	—	User Monitor Sel Output kWatts	Check the display.
2	^	Power-On Monitor Frequency Ref	
3	DATA ENTER	o1−02 = 1∗∗∗ Frequency Ref	
4	^ Press twice.	o1−02 = 3 Output Current	
5	DATA ENTER	Entry Accepted	Writes-in the new setting.
		Power-On Monitor Output Current	After a few seconds, the Operator display is as shown on the left.
6	ESC	Function o1 Monitor Select	
7	ESC	Main Menu ∗ Programming	

Output current has been set in monitor selection after power ON.

4.2.5 Initialize Mode

The Initialize mode is used to select the language displayed by the unit, the access level, and the control method; it is also used to initialize the unit’s user constants. The structure of the Initialize mode is shown in *Figure 4.7.*

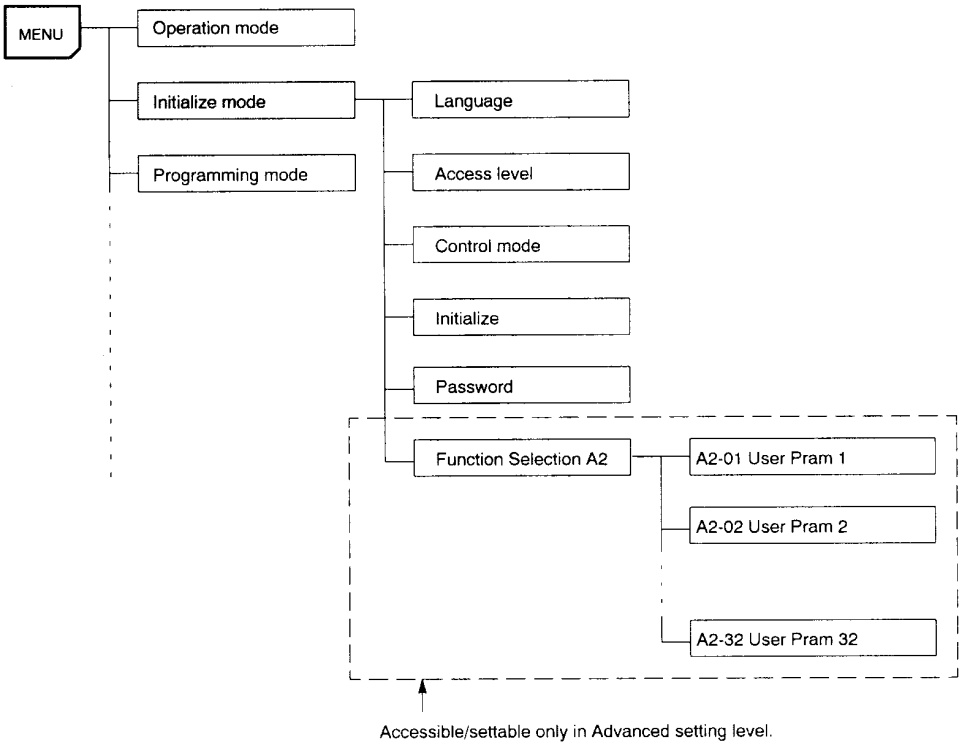


Figure 4.7 Structure of Initialize Mode User Constants

■ Selecting the Display Language: A1-00

- Use constant A1-00 to select the language displayed by the Inverter. A value of 0 sets English and a value of 1 sets Japanese.
- This user constant is not returned to the factory setting when constants are initialized. It must be manually reset to the factory setting.

User Constant Number	Name	Change During Operation	Setting Range	Unit	Factory Setting	Valid Access Levels			
						V/f Control	V/f with PG	Open-Loop Vector	Flux Vector
A1-00	Language selection for Digital Operator display	❍	0 (English), 1 (Japanese)	—	1 (Japanese)	Q	Q	Q	Q

‘EXAMPLE• **Changing the Language to English**

Step	Key Sequence	Digital Operator Display	Remarks
1	MENU	モードセンタク ＊ ドライブモード	
2	^	モードセンタク ＊ カンキョウセッテイ	
3	DATA ENTER	ゲンゴ (Language) ニホンゴ (Japanese)	
4	DATA ENTER	A1-00 = 1＊＊＊ ニホンゴ (Japanese)	Changed to constant setting level.
5	^	A1-00 = 0 English	
6	DATA ENTER	Entry Accepted	Writes-in the new setting.
		Select Language English	After a few seconds, the Operator display is as shown on the left.

Use the following procedure to change the display language from Japanese to English

The display language has been set to English.

■ Setting the Access Level: A1-01

- Use constant A1-01 to select the user constant access level. This level determines which user constants can be changed and displayed.
- The user constants that can be displayed and changed also depend upon the control method being used.

User Constant Number	Name	Change During Operation	Setting Range	Unit	Factory Setting	Valid Access Levels			
						V/f Control	V/f with PG	Open-Loop Vector	Flux Vector
A1-01	Constant access level	❍	0 È 4	—	2 (Q)	Q	Q	Q	Q

- Access Level Settings

Setting	Function	
0	Operation Only	This setting allows the Operation mode and Initialize mode to be changed or displayed. Use this setting to prevent user constant settings from being changed.
1	User Program	This setting allows only the user-selected constants (up to 32) to be changed or displayed. Select the desired user constants in A2-01 through A2-32.
2	Quick-Start	This setting allows the user constants required to start the Inverter (about 25) to be changed or displayed.
3	Basic	This setting allows the commonly used user constants to be changed or displayed.
4	Advanced	This setting allows all user constants to be changed or displayed.

Setting the Control Method: A1-02

- Use constant A1-02 to select one of the four control methods.
- This user constant is not returned to the factory setting when constants are initialized. It must be manually reset to the factory setting.

User Constant Number	Name	Change During Operation	Setting Range	Unit	Factory Setting	Valid Access Levels			
						V/f Control	V/f with PG	Open-Loop Vector	Flux Vector
A1-02	Control method selection	X	0 to 3	—	2 (Open-Loop Vector)	Q	Q	Q	Q

- Control Method Settings

Setting	Function
0	V/f Control without PG (normal V/f Control)
1	V/f Control with PG Feedback (V/f Control using a PG Speed Option Card)
2	Open-Loop Vector Control (Vector Control using the Inverter internal speed information)
3	Flux Vector Control (Vector Control using a PG Speed Option Card)

EXAMPLE **Changing the Control Method to Flux Vector**

Step	Key Sequence	Digital Operator Display	Remarks
1	MENU	Main Menu ✱ Operation	
2	^	Main Menu ✱ Initialize	
3	DATA ENTER	Select language English	
4	^ Press twice.	Control Method Open Loop	
5	DATA ENTER	A1-02 = 2✱✱✱ Open Loop	Changed to constant setting level.
6	^	A1-02 = 3 Flux Vector	
7	DATA ENTER	Entry Accepted	Writes-in the new setting.
		Control Method Flux Vector	After a few seconds, the Operator display is as shown on the left.

Use the following procedure to change the control method to select Flux Vector.

The control method has been changed to Flux Vector.

Table 4.4 Control Method Characteristics

Characteristic	V/f Control without PG	V/f Control with PG	Open Loop Vector Control	Flux Vector Control
Basic Control Method	Voltage/frequency control (Open Loop)	Voltage/frequency control with speed compensation	Current Vector Control without PG	Current Vector Control with PG
Speed Detector	Not required	Required (pulse generator)	Not required	Required (pulse generator)
Optional Speed Detectors	Not required	Pg-A2 or PG-D2	Not required	PG-B2 or PG-X2
Speed Control Accuracy	1:40	1:40	1:100	1:1000
Starting Torque	150%/3 Hz	150%/3 Hz	150%/1 Hz	150%/0 r/min
Speed Control Range	± 2 to 3%	± 0.03%	± 0.2%	± 0.02%
Torque Limit	Not possible	Not possible	Possible	Possible
Torque Control	Not possible	Not possible	Not Possible	Possible
Example Applications	• Multiple motor drives. • Replacing existing motor for which motor constants are not known. • When Auto-Tuning is not possible.	• Simple speed feedback control. • When a PG is attached to the machine axis.	• Variable speed drive applications.	• Simple servo drives. • Precision Speed Control. • Torque Control.

■ Initializing User Constants: A1-03

- Use constant A1-03 to initialize the user constants.
- When initialized, the user constants will return to their factory-preset values. You should normally record the setting of any constants that are changed from the factory presets.

User Constant Number	Name	Change During Operation	Setting Range	Unit	Factory Setting	Valid Access Levels			
						V/f Control	V/f with PG	Open-Loop Vector	Flux Vector
A1-03	Initialize	X	0, 1110, 2220, 3330	—	0	Q	Q	Q	Q

- Setting to Initialize User Constants

Setting	Function
0	Returns to the Initialize Display without initializing any user constants.
1110	Initializes the user constants to the user settings.
2220	2-wire sequential initialization. (Initializes the user constants to the factory settings.)
3330	3-wire sequential initialization.

Initializing to User Settings

This function initializes the user constants to values that have been recorded as user settings.

To record the user settings, change the user constants to the desired values and then set user constant o2-03 (user constant initial value) to 1. Once user settings are recorded, the o2-03 value will be automatically reset to 0. (The 1110 function will be disabled when user constant o2-03 is set to 0.)

- Example of Wiring for 2-Wire Sequential Operation

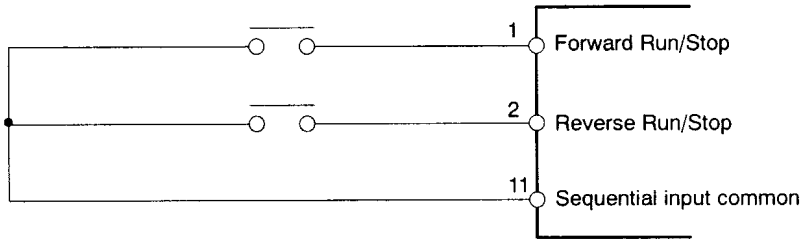


Figure 4.8 Example of Wiring for 2-Wire Sequential Operation

- Example of Wiring for 3-Wire Sequential Operation The default settings of the multi-function inputs are different from the default settings of the 2-wire sequence.

- When setting a 3-wire sequence, the operation can be started and stopped with an automatically resetting pushbutton switch.

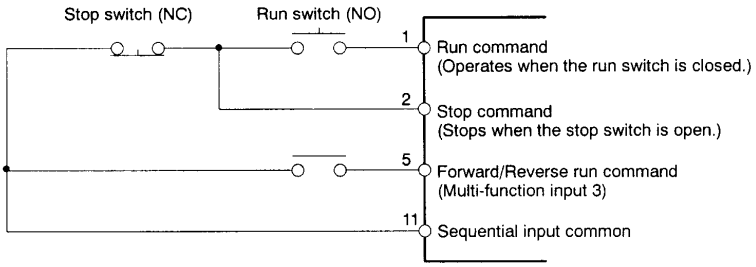


Figure 4.9 Example of Wiring for 3-Wire Sequential Operation

EXAMPLE **Initializing for 2-Wire Sequential Operation**

Use the following procedure to initialize user constants to the factory settings.

Step	Key Sequence	Digital Operator Display	Remarks
1	MENU	Main Menu ✱ Operation	
2	^	Main Menu ✱ Initialize	
3	DATA ENTER	Select Language English	
4	^ Press 3 times.	Init Parameters No Initialize	
5	DATA ENTER	A1-03 = 0✱✱✱ No Initialize	
6	^	A1-03 = 2220 2-wire Initial	
7	DATA ENTER	Entry Accepted	Writes-in the new setting.
		Init Parameters No Initialize	After a few seconds, the Operator display is as shown on the left.

The initialization has been completed for a 2-wire sequence.

■ Passwords: A1-04, A1-05

- Use constants A1-04 and A1-05 to write-protect the initialize-mode user constants.
- User constants A1-01 through A1-03 and A2-01 through A2-32 can be displayed but not changed if the contents of A1-04 and A1-05 are not the same.
- To write-protect the initialize-mode constants, set the password in A1-05 after inputting the desired values in A1-01 through A1-03 and A2-01 through A2-32. User constant A1-05 can be displayed by displaying A1-04 and pressing the Menu key while pressing the Reset key. (A1-05 cannot be displayed with the usual key sequences.)
- It will be possible to change the initialize-mode user constants again when the same password is written to A1-04 and A1-05.

User Constant Number	Name	Change During Operation	Setting Range	Unit	Factory Setting	Valid Access Levels			
						V/f Control	V/f with PG	Open-Loop Vector	Flux Vector
A1-04	Password 1	X	0 to 9999	—	0	Q	Q	Q	Q
A1-05	Password 2	X	0 to 9999	—	0	Q	Q	Q	Q

EXAMPLE **Setting the Password to 1000**

Use the following procedure to set the password to 1000.

Step	Key Sequence	Digital Operator Display	Remarks
1	MENU	Main Menu ✱ Operation	
2	^	Main Menu ✱ Initialize	
3	DATA ENTER	Select Language English	
4	^ Press 4 times.	Enter Password A1-04 = 0	
5	RESET Hold RESET.	Select Password A1-05 = 0	
	MENU And press MENU.		
6	DATA ENTER	Select Password 0000	The first digit will blink. The blinking digit can be changed.
7	^	Select Password 1000	The value of the digit will increment each time the Increment Key is pressed and then stop at 9. Press the Decrement Key to decrease the value.
8	DATA ENTER	Entry Accepted	Writes-in the new setting.
		Select Password A1-05 = 1000	After a few seconds, the Operator display is as shown on the left.
9	ESC	Enter Password A1-04 = 0	

The password has been set to 1000. To enable changing user constants, set the same password in A1-05 = 0.

■ Setting User Constants : A2-01 to A2-32

- User constants A2-01 through A2-32 specify the constants that can be displayed and changed when the access level (A1-01) is set to 1 (user programs).
- User constants A2-01 through A2-32 can be changed only in the Advanced access level and cannot be changed during operation.
- The following restrictions apply to setting/displaying user constants when the access level is set to the user program access level.

Operation	The Quick-Start level user constants can be displayed.
Initialize	The Quick-Start level user constants can be displayed or set.
Programming	Only the user constants specified in A2-01 through A2-32 can be displayed or set.
Auto-Tuning	The user constants cannot be displayed.
Modified constants	The user constants cannot be displayed.

EXAMPLE **Setting C1-08 (Deceleration Time 4) in A2-01 to Define it as a User Constant**

Use the following procedure to set the password to 1000.

Step	Key Sequence	Digital Operator Display	Remarks
1	MENU	Main Menu ∗ Operation	
2	∧	Main Menu ∗ Initialize	
3	DATA/ENTER	Select Language English	
4	∨	Function A2 User Constants	
5	DATA/ENTER	User Param 1 A2-01 = – – – – –	
6	DATA/ENTER	User Param 1 – – – – – – –	The first digit blinks.
7	∧ Press twice.	User Param 1 C1-01	
8	RESET Press twice.	User Param 1 C1-01	Writes-in set value 0000.
9	∧ Press 7 times.	User Param 1 C1-08	
10	DATA/ENTER	Entry Accepted	Writes-in the new setting.
		User Param 1 A2-01 = C1-08	After a few seconds, the Operator display is as shown on the left.
11	ESC	Function A2 User Constants	
12	∧ Press twice.	Access Level Advanced	
13	DATA/ENTER	A1-01 = 4∗∗∗ Advanced	
14	∧ Press twice.	A1-01 = 1 User Program	The user program access level can be set only after one or more constants are set as user constants in A2-01 to A2-32. If no constants are set, the user program access level will not be displayed for A1-01.
15	DATA/ENTER	Entry Accepted	Writes-in the new setting.
		A1-01 = 4∗∗∗ Advanced	If the DATA/ENTER Key is not pressed within one minute, the Operator display will return as shown on the left. In this case, repeat from step 14.

Step	Key Sequence	Digital Operator Display	Remarks
16	ESC	Access Level User Program Main Menu ∗ Initialize	After a few seconds, the Operator display is as shown on the left.

The access level has been set to the user program access level. *Figure 4.10* shows the structure of the user constants.

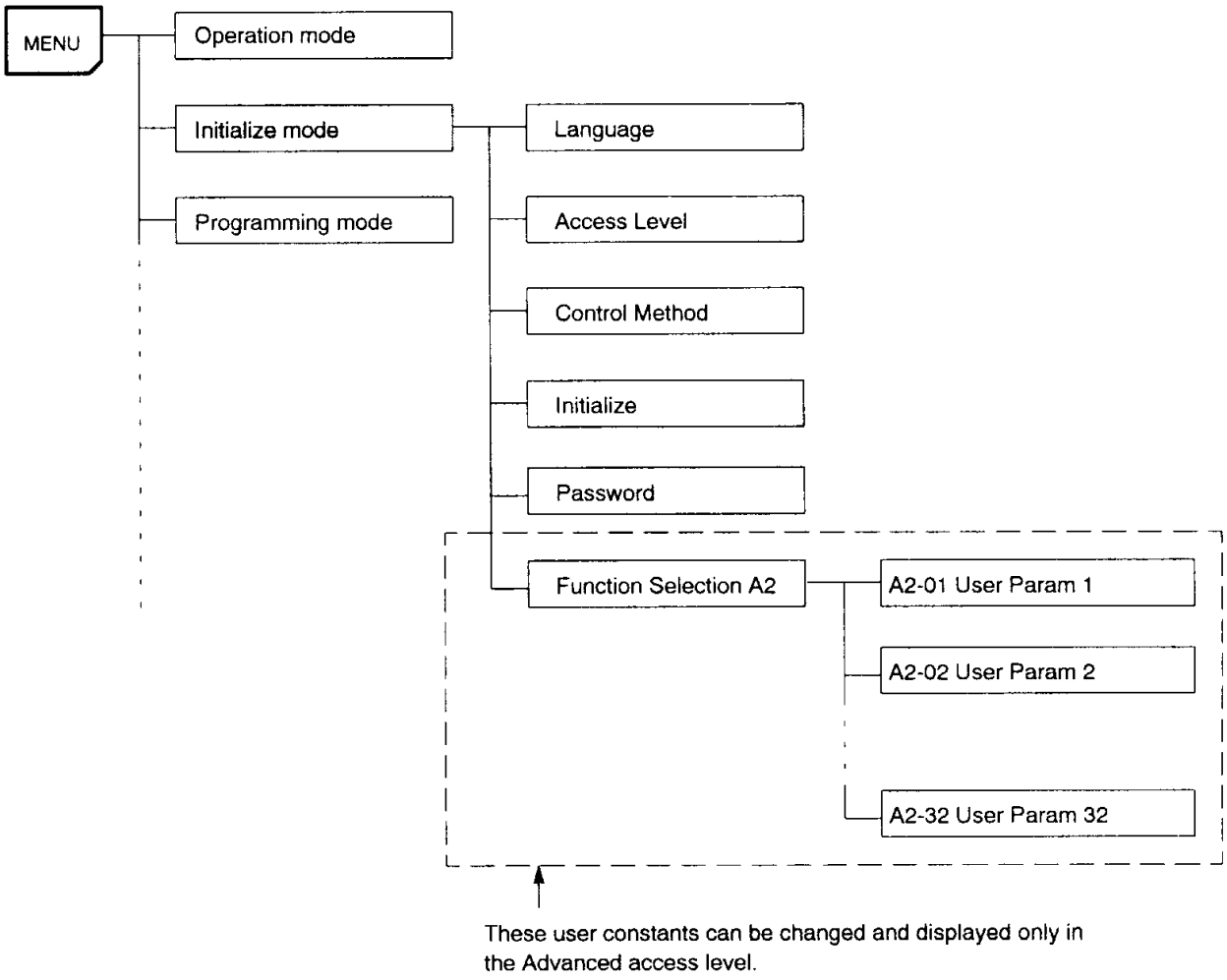


Figure 4.10 Structure of User Constants

4.2.6 Programming Mode

The Inverter user constants can be set in Programming mode. The user constants which can be changed and displayed depend on the access level and control method that are being used. Refer to the following table to determine if a user constant can be changed.

The groups of constants in Programming mode and their functions are shown in *Table 4.5.*

Table 4.5 Programming Mode Constant Groups

Group		Function		Display	Comments	Control Method			
						V/f	V/f w/PG	Open-Loop Vector	Flux Vector
B	Application	b1	Operating Modes	Sequence	Settings such as the reference input method	❍	❍	❍	❍
		b2	DC braking	DC Braking	DC braking function settings	❍	❍	❍	❍
		b3	Speed searching	Speed Search	Speed search function settings	❍	❍	❍	❍
		b4	Timer functions	Delay Timers	Timer function settings	❍	❍	❍	❍
		b5	PID Control	PID Control	PID Control settings	❍	❍	❍	❍
		b6	Dwell functions	Reference Dwell	Accel/decel time dwell function settings	❍	❍	❍	❍
		b7	Droop Control	Droop Control	Droop Control (speed drop) settings	×	×	×	❍
		b8	Energy Saving Control	Energy Saving	Terminal input Energy Saving Control settings	❍	❍	×	×
		b9	Zero Servo	Zero Servo	Stop in the position loop	×	×	×	❍
C	Tuning	C1	Acceleration/deceleration times	Accel/Decel	Acceleration/deceleration time settings	❍	❍	❍	❍
		C2	S-curve acceleration/ deceleration	S-Curve Acc/Dec	S-curve characteristics for accel/decel times	❍	❍	❍	❍
		C3	Slip compensation	Motor-Slip Comp	Slip compensation function settings	❍	❍	❍	❍
		C4	Torque compensation	Torque Comp	Torque compensation function settings	❍	❍	❍	×
		C5	Speed Control	ASR Tuning	Speed Control loop constant settings	×	❍	×	❍
		C6	Carrier frequencies	Carrier Freq	Carrier frequency settings	❍	❍	❍	❍
		C7	Hunting Prevention function	Hunting Prev	Hunting Prevention function for V/f Control	❍	❍	×	×
		C8	Factory tuning constants	Factory Tuning	Adjustments for Open-Loop Vector Control	×	×	❍	×
d	Reference	d1	Frequency references	Preset Reference	Operator frequency reference settings	❍	❍	❍	❍
		d1	Frequency upper/lower limits	Reference Limits	Frequency upper and lower limit settings	❍	❍	❍	❍
		d3	Jump frequencies	Jump Frequencies	Prohibited frequency settings	❍	❍	❍	❍
		d4	Reference frequency hold function	Sequence	Hold for analog frequency reference	❍	❍	❍	❍
		d5	Torque Control	Torque Control	User constant settings for Torque Control	×	×	×	❍
E	Motor	E1	V/f characteristics	V/f Pattern	Sets the motor V/f characteristics	❍	❍	❍	❍
		E2	Motor constants	Motor Setup	Sets the motor constants	❍	❍	❍	❍
		E3	Motor 2 control method	Motor 2 Ctl Meth	Sets the control methods for motor 2	❍	❍	❍	❍
		E4	V/f Characteristics 2	V/F pattern 2	Sets the V/f characteristics for motor 2	❍	❍	❍	❍
		E5	Motor 2 constants	Motor 2 Setup	Sets the motor constants for motor 2	❍	❍	❍	❍

Group		Function		Display	Comments	Control Method			
						V/f	V/f w/PG	Open-Loop Vector	Flux Vector
F	Options	F1	PG Speed Option Card settings	PG Option Setup	User constant settings for a PG Card	×	❍	×	❍
		F2	Analog Reference Card AI	AI-14 Setup	User constant settings for an Analog Reference Card	❍	❍	❍	❍
		F3	Digital Reference Card DI	DI-08, 16 Setup	User constant settings for a Digital Reference Card	❍	❍	❍	❍
		F4	Analog Monitor Card AO	AO-08, 12 Setup	User constant settings for an Analog Monitor Card	❍	❍	❍	❍
		F5	Digital Output Card DO	DO-02C	User constant settings for a Digital Output Card	❍	❍	❍	❍
		F6	Digital Output Card DO	DO-08	User constant settings for a Digital Output Card	❍	❍	❍	❍
		F7	Pulse Monitor Card PO	PO-36F Setup	User constant settings for a Pulse Monitor Card	❍	❍	❍	❍
		F8	SI-F/SI-G Transmission Card	SI-F/G	User constant settings for a Transmission Card	❍	❍	❍	❍
		F9	CP-916B Transmission Card	DDS/SI-B	User constant settings for a Transmission Card	❍	❍	❍	❍
H	Reference	H1	Multi-function inputs	Digital Inputs	Function selection for multi-function inputs	❍	❍	❍	❍
		H2	Multi-function outputs	Digital Outputs	Function selection for multi-function outputs	❍	❍	❍	❍
		H3	Analog inputs	Analog Inputs	Function selection for analog inputs	❍	❍	❍	❍
		H4	Multi-function analog outputs	Analog Outputs	Function selection for analog outputs	❍	❍	❍	❍
		H5	MEMOBUS communications	Serial Com Setup	MEMOBUS communications settings	❍	❍	❍	❍
L	Motor	L1	Motor protection functions	Motor Overload	Overload protection settings and selection	❍	❍	❍	❍
		L2	Momentary power loss ride-through	PwrLoss Ridethru	Selects the power-loss processing method	❍	❍	❍	❍
		L3	Stall Prevention	Stall Prevention	Stall Prevention settings and selection	❍	❍	❍	❍
		L4	Frequency detection	Ref Detection	Frequency detection settings and selection	❍	❍	❍	❍
		L5	Fault restart	Fault Restart	Fault restart function settings	❍	❍	❍	❍
		L6	Overtorque detection	Torque Detection	Overtorque detection settings and selection	❍	❍	❍	❍
		L7	Torque limits	Torque Limit	Torque limit settings (vector control only)	×	×	❍	❍
		L8	Hardware protection	Hdwe Protection	Overheating and phase loss protection settings	❍	❍	❍	❍
o	Operator	o1	Display/Monitor settings	Monitor Select	Selects the display and setting methods	❍	❍	❍	❍
		o2	Function settings	Key Selections	Key function selection and other user constants	❍	❍	❍	❍

Figure 4.11 shows the difference in the display structure for the various access levels.

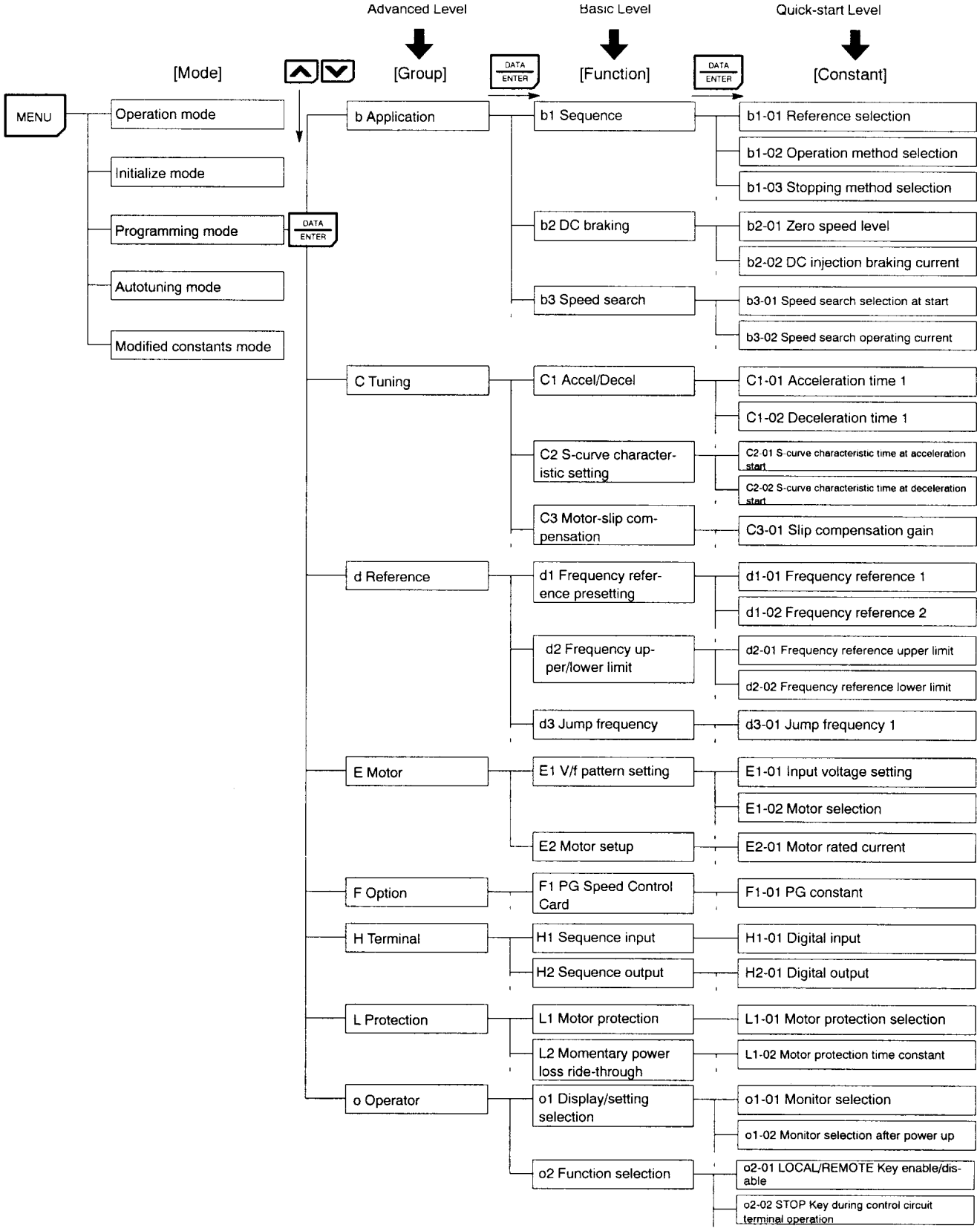


Figure 4.11 Display Structures for Different Access Levels

4.2.7 Auto-Tuning Mode

CAUTION

- Disconnect the load (machine, device) from the motor before Auto-Tuning. The motor may turn, possibly resulting in injury or damage to equipment. Also, motor constants cannot be correctly set with the motor attached to a load.

Auto-Tuning automatically tunes and sets the required motor constants when operating in the Open-Loop or Flux Vector Control modes. Always perform Auto-Tuning before starting operation.

When the rated voltage, rated current, rated frequency, and number of poles listed on the motor nameplate have been input and the RUN key is pressed, the motor constants calculated from these values will be written to E1-04 through E2-09 automatically.

The Auto-Tuning mode will not be displayed if V/f Control has been selected. Refer to *Setting the Control Method: A1-02* under 4.2.5 *Initialize Mode.*

The Inverter's Auto-Tuning function automatically determines the motor constants, while a servo system's Auto-Tuning function determines the size of a load, so these Auto-Tuning functions are fundamentally different.

EXAMPLE **Auto-Tuning Procedure**

Step	Key Sequence	Digital Operator Display	Remarks
1	MENU	Main Menu ✱ Operation	
2	^ press 3 times.	Main Menu ✱ Autotuning	
3	DATA/ENTER	Rated Voltage 200.0 VAC	
4	DATA/ENTER	Rated Voltage 200.0 VAC	The leading digit blinks. When Increment Key is pressed, blinking value increases. When Decrement Key is pressed, blinking value decreases.
5	RESET	Rated Voltage 200.0 VAC	The digit to be set moves to the right and blinks. Follow the above procedures as outlined in step 4.
6	DATA/ENTER	Entry Accepted	After selecting values for steps 4 and 5, press DATA/ENTER Key. The Operator display is as shown on the left. The value is written-in.
		Rated Voltage 200.0 VAC	After a few seconds, the Operator display is as shown on the left.
7	^	Rated Current 1.90 A	
8	DATA/ENTER RESET DATA/ENTER		Press the keys as in steps 4, 5, 6 of rated voltage setting.
9	^	Rated Frequency 60.0 HZ	
10	DATA/ENTER RESET DATA/ENTER		Press the keys as in steps 4, 5, 6 of rated voltage setting.
11	^	Rated Speed 1750 RPM	
12	DATA/ENTER RESET DATA/ENTER		Press the keys as in steps 4, 5, 6 of rated voltage setting.
13	^	Number of Poles 4	
14	DATA/ENTER RESET DATA/ENTER		Press the keys as in steps 4, 5, 6 of rated voltage setting.

Step	Key Sequence	Digital Operator Display	Remarks
15	^	Select Motor 1/2 1	
16	DATA ENTER, RESET, DATA ENTER		Press the keys as in steps 4, 5, 6 of rated voltage setting. Leave the setting at 1 to set the value for motor 1 (the motor contacts normally used.) Select "2" to store the autotuning results for motor 2.
17	^	Tuning Ready? Press RUN Key	
18	RUN	Tune Processing □Hz□□□□A	Autotuning starts and the motor rotates for approx. one minute.
		Tune Successful	Then the motor stops automatically.
19	MENU	Main Menu ✱ Operation	

Returns to the Operation mode display.

NOTE: If a fault occurs during Auto-Tuning, refer to *Table 5.1 Troubleshooting Auto-Tuning Faults.*

4.2.8 Modified Constants Mode

The Modified Constants mode is used to change or display user constants that have been changed from their factory-preset values.

When any user constants have been changed in Programming mode (b1-01) through o2-08), press the DATA/ENTER key in Modified Constants mode to display these user constants. (The Initialize mode user constants will not be displayed.)

EXAMPLE **Changing Frequency Reference 1 to 30.00 in Modified Constants Mode**

In the following example, user constants C1-01 (acceleration time 1) and d1-01 (frequency reference 1) have been changed from their factory settings.

The settings for these two user constants are displayed, and the setting for d1-01 is changed from 60.00 Hz to 30.00 Hz while C1-01 is set to 20.0 seconds.

Step	Key Sequence	Digital Operator Display	Remarks
1	MENU	Main Menu ✱ Operation	
2	∨	Main Menu ✱ Modified Consts	
3	DATA/ENTER	Accel Time 1 C1-01 = 20.0 Sec	
4	∧	Frequency Ref 1 d1-01 = 60.00 HZ	
5	DATA/ENTER	Frequency Ref 1 060.00 HZ	
6	RESET	Frequency Ref 1 060.00 HZ	Blinking digit moves 1 place to the right.
7	∨ press 3 times.	Frequency Ref 1 030.00HZ	
8	DATA/ENTER	Entry Accepted	30.00 Hz is written-in.
		Frequency Ref 1 d1-01 = 30.00 HZ	After a few seconds, the Operator display is as shown on the left.
9	ESC	Main Menu ✱ Modified Consts	Preset reference 1 is changed to 30.00 Hz in the modified constants mode.
10	MENU	Main Menu ✱ Operation	Returns to the Operation mode display.

5

Trial Operation

This chapter describes the preparations and Digital Operator procedures for trial operation of the VG5 and provides an example of trial operation.

WARNING

- Check to be sure that the front cover is attached before turning ON the power supply. Do not remove the front cover during operation. An electric shock may occur.
- Do not come close to the machine when the fault reset function is used. If the alarm is cleared, the machine may start moving suddenly. Also, design the machine so that human safety is ensured even when it is restarted. Injury may occur.
- Provide a separate emergency stop switch; the Digital Operator's STOP key is valid only when its function is set. Injury may occur.
- Reset alarms only after confirming that the RUN signal is OFF. If an alarm is reset with the RUN signal turned ON, the machine may suddenly start. Injury may occur.

CAUTION

- Do not touch the radiation fins (heat sink), braking resistor, or Braking Resistor Unit. These can become very hot. Otherwise, a burn injury may occur.
- Be sure that the motor and machine are within the applicable ranges before starting operation. Otherwise, an injury may occur.
- Provide a separate holding brake if necessary. Otherwise, injury may occur.
- Do not check signals while the Inverter is running. Otherwise, the equipment may be damaged.
- Be careful when changing Inverter settings. The Inverter is factory set to suitable settings. Otherwise, the equipment may be damaged. You must, however, set the power supply voltage jumper for 400 V class Inverters of 18.5 kW or hither. (See *5.2.4 Setting Input Voltage* of this chapter.)

5.1 Procedure

Perform trial operation according to the following operational flow.

Item	Contents	Page
Installation and Mounting	Install the Inverter according to the installation conditions. • Ensure that the installation conditions are met.	9
Wiring and Connection	Connect to the power supply and peripheral devices. • Select peripheral devices which meet the specifications and wire correctly.	19
Power ON	Carrying out the following pre-connection checks before turning ON the power supply. • Always ensure that a power supply of the correct voltage is used and that the power input Terminals L1, L2, and L3 (R, S, and T) are wired correctly. 200 V class: 3-phase 200 to 230 VDC, 50/60 Hz 400 V class: 3-phase 380 to 460 VDC, 50/60 Hz • Make sure that the motor output Terminals T1, T2, and T3 (U, V, and W) and the motor are connected correctly. • Make sure that the control circuit terminals and the control device are wired correctly. Make sure that all control circuit terminals are turned OFF. • When using a PG Speed Option Card, ensure that it is wired correctly. • Set the motor to no-load status (not connected to the mechanical system). Having conducted the above checks, connect the power supply.	88
Check the Display Status *	Check to be sure that there are no faults in the Inverter. • If the display at the time the power is connected is normal, it will read as follows: Data Display: Frequency Reference. • When a fault has occurred, the details of the fault will be displayed. In that case, refer to *Chapter 9 Troubleshooting.*	88
Setting the Input Voltage	Set the Inverter input voltage (E1-01) to the correct voltage.	89
Set the Motor	Set the proper motor protection (E1-02).	90
Auto-Tuning	Execute Auto-Tuning in the Open-Loop Vector Control mode. • When Auto-Tuning is executed, motor constants are set automatically. • When this is not possible using Auto-Tuning, switch to V/f Control mode and set the V/f pattern.	90
No-Load Operation	Start the no-load motor using the Digital Operator. • Set the frequency reference using the Digital Operator and start the motor using key sequences.	93
Actual Load Operation	Connect the mechanical system and operate using the Digital Operator. • When there are no difficulties using the no-load operation, connect the mechanical system to the motor and operate using the Digital Operator.	94
Operation	Basic Operation: Operation based on the basic settings required to start and stop the Inverter. Advanced Operation: Operation which uses PID Control or other functions • For operation within standard constants, select “Basic Operation”. • To use the various applied functions such as, direct current control braking, speed search, timer, S-curve acceleration/deceleration, slip compensation, torque compensation, Droop Control, Zero Servo, and Torque Control, select “Advanced Operation in combination with “Basic Operation”.	95

***** It is sometimes necessary to initialize constants after checking the display status.

Initializing Constants	Initialize the constants • Check the Inverter capacity setting (kVA) in o2-04 before replacing the controller PCB with a spare.	88

5.2 Trial Operation Procedures

5.2.1 Power ON

■ Checkpoints before Turning ON the Power Supply

- Check that the power supply is of the correct voltage.
  200 V class: 3-phase 200 to 230 VAC, 50/60 Hz
  400 V class: 3-phase 380 to 460 VAC, 50/60 Hz
- Make sure that the motor output Terminals T1, T2, and T3 (U, V, and W) and the motor are connected correctly.
- Make sure that the Inverter control circuit terminal and the control device are wired correctly.
- Set all Inverter control circuit terminals to OFF.
- When using a PG Speed Option Card, make sure that it is wired correctly.
- Make sure that the motor is not connected to the mechanical system (no-load status).

5.2.2 Checking the Display Status

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

[Normal] | Frequency Ref
U1-01 = 0.00 Hz | The frequency reference monitor is displayed in the data display section.

When a fault has occurred, the details of the fault will be displayed instead of the above display. In that case, refer to *Chapter 9 Troubleshooting.* The following display is an example of a faulty display.

[Fault] | UV
Under Voltage | The display will differ depending on the type of fault.

5.2.3 Initializing Constants

- When replacing the controller PCB, check the Inverter capacity (kVA) in o2-04 first and then initialize constants to the factory settings. There is no need to initialize constants the first time trial operation is performed after purchasing the Inverter.
- To initialize the constants, set "2220" in A-1-03 (Initialize).
- After the initialization, the access level is set to Quick-Start (a1-01). The following table shows the setting method for Quick-Start.

Use the following procedure to initialize constants.

Step	Key Sequence	Digital Operator Display	Remarks
		Frequency Ref U1-01 = 0.00Hz	
1	MENU	Main Menu ✳ Operation	Displays Operation mode.
2	^	Main Menu ✳ Initialize	Displays Initialize mode.
3	DATA ENTER	Select Language English	Puts the Inverter in Initialize mode.
4	^	Initial Select	Displays the Initialize display.
	Press 3 times.		
5	DATA ENTER	A1-03 = 0 ✳ ✳ ✳ Select	Displays the constant setting for A1-03
6	^	A1-03 = 2220 2-Wire Initial	Initializes for a 2-wire sequence.
7	DATA ENTER	Entry Accepted	Writes the set values. "Entry Accepted" is displayed for approximately 0.5 seconds.
		Initialize Select	Returns to the Initialize display.
8	ESC	Main Menu ✳ Initialize	Returns to the Initialize mode display.

5.2.4 Setting Input Voltage

Set the input voltage of the Inverter (E1-01) according to the power supply voltage

■ Input Voltage: E1-01

Set the input voltage.

User Constant Number	Name	Change During Operation	Setting Range	Unit	Factory Setting	Valid Access Levels			
						V/f Control	V/f with PG	Open-Loop Vector	Flux Vector
E1-01	Input voltage setting	X	155 to 255 (310 to 510)*	VAC	200 (400)*	Q	Q	Q	Q

* Values in parentheses are for 400 V class Inverters.

Use the following procedure to set a 200 V class Inverter to an input voltage of 230 V.

Step	Key Sequence	Digital Operator Display	Remarks
		✳ Main Menu ✳ Initialize	Displays Initialize mode.
1	^	✳ Main Menu ✳ Programming	Displays Programming mode.
2	DATA ENTER	Frequency Ref Terminal	Puts the unit in Programming mode.
3	^	Input Voltage E1-01 = 200 VAC	Displays the input voltage setting display.
	Press 10 times.		
4	DATA ENTER	Input Voltage 200 VAC	The leading digit will blink.
5	RESET	Input Voltage 200 VAC	The second digit will blink.
6	^	Input Voltage 230 VAC	Set to “3”.
	Press 3 times.		
7	DATA ENTER	Entry Accepted	The set value is overwritten. “Entry Accepted” is displayed for approximately 0.5 seconds.
		Input Voltage E1-01 = 230 VAC	Returns to the input voltage display. Check that the data has been updated.
8	ESC	✳ Main Menu ✳ Programming	Returns to the Programming mode display.

■ Setting the Power Supply Voltage Jumper (400 V Class Inverters of 18.5 kW or Higher)

Set the power supply voltage jumper after setting the input voltage constant (E1-01) for 400 V class Inverters of 18.5 kW or higher. Insert the jumper into the voltage connector nearest to the actual power supply voltage.

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

1. Turn OFF the power supply switch and wait for at least one minute (three minutes for models larger than 30 kW) before removing the front panel and setting the jumper.
2. Remove the front cover.
3. Insert the jumper at the position for the voltage supplied to the Inverter (see *Figure 5.1)*.

4. Replace the front cover.

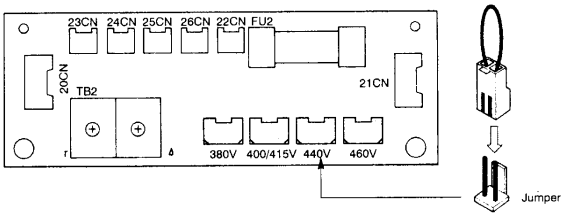


Figure 5.1 Setting the Power Supply Voltage
(Illustration Above is for 400 V Class Inverter between 18.5 kW and 45 kW

■ Motor Selection (Motor Overheating Protection): E1-02

Set the type of motor being used with the motor selection constant (E1-02). This setting is a reference for the motor overheat protection.

User Constant Number	Name	Change During Operation	Setting Range	Unit	Factory Setting	Valid Access Levels			
						V/f Control	V/f with PG	Open-Loop Vector	Flux Vector
E1-02	Motor selection (motor overheating protection)	X	0, 1	—	0	Q	Q	Q	Q

- E1-02 Settings

Setting	Function
0	Standard motor (general-purpose motor)
1	Special motor (Inverter-exclusive motor)

5.2.5 Auto-Tuning

■ Auto-Tuning Operation

Use the following procedure to auto tune the motor constants, i.e., set them automatically.

Step	Key Sequence	Digital Operator Display	Remarks
		Main Menu ✷ Programming	Displays Programming mode.
1	^	Main Menu ✷ Auto-Tuning	Displays Auto-Tuning mode.
2	DATA/ENTER	Rated Voltage 200.0 VAC	Displays the rated voltage.*
3	^	Rated Current 1.90 A	Displays the rated current.*
4	^	Rated Frequency 60.0 Hz	Displays the rated frequency.*
5	^	Rated Speed 1750 RPM	Displays the rated speed.*
6	^	Number of Poles 4	Displays the number of poles.*
7	^	Select Motor ½ 1	Displays the motor selection. (Leave set at "1" for motor 1 (the motor constants normally used).)
8	^	Tuning Ready? Press RUN key	Displays a confirmation prompt for the start of the Auto-Tuning function. (The lower line will blink.)
9	RUN	Tune Proceeding ❑Hz ❑❑❑A	Starts the Auto-Tuning function. (The upper line will blink.)

Step	Key Sequence	Digital Operator Display	Remarks
		Tune Successful	Indicates the completion of Auto-Tuning.
10	MENU	Main Menu ✷ Operation	Returns to the operation mode display.

* When the values displayed and the motor constants differ, set each value separately.

The following example procedure changes the motor rated current to 1.60A.

Step	Key Sequence	Digital Operator Display	Remarks
		Rated Current 1.90 A	Displays the rated current.
1	DATA ENTER	Rated Current 001.90 A	When changing the set values, press the DATA/ENTER key and the digit to change will blink.
2	RESET Press 3 times.	Rated Current 001.90 A	Select the digit to be changed.
3	∨ Press 3 times.	Rated Current 001.60 A	Set to 001.60 A.
4	DATA ENTER	Entry Accepted	Press the DATA/ENTER key to overwrite the set values. "Entry Accepted" will be displayed for approximately 0.5 seconds.
		Rated Current 1.60 A	Returns to the rated current display.

- When Auto-Tuning has been executed correctly, the constants (E1-04 to E2-09) will be automatically written.
- Use the following troubleshooting procedure if a fault occurs during Auto-Tuning.

■ Troubleshooting Auto-Tuning Faults

The display and countermeasures for Auto-Tuning faults are shown below in *Table 5.1*. If one of these faults is detected, it will be displayed on the Operator and the motor will coast to a stop. The fault contact and alarm contact outputs will not function. When a fault occurs, "Tune Aborted" will be displayed and the messages shown in the table will blink.

Table 5.1 Troubleshooting Auto-Tuning Faults

Display Message	Fault	Description	Countermeasure
Data Invalid	Motor data fault	Motor data error for Auto-Tuning.	• Check the input data. • Check the Inverter and motor capacities.
Resistance	Line resistance fault	Auto-Tuning was not completed within a set time.	• Check the input data. • Check the motor wiring.
No-Load Current	No-load current fault		
Saturation – 1	Saturated core coefficient 1 fault		
Saturation – 2	Saturated core coefficient 2 fault		
Rated Slip	Rated slip fault		
Accelerate	Acceleration fault	The motor did not accelerate within a set time.	• Increase the acceleration time (C1-01). • Increase the torque limits (L7-01, -02) if these have been decreased. • Disconnect the motor from the machine if it has been connected.
PG Direction	Motor direction fault	There is a contact fault between the Inverter, PG (Phases-A & B), and motor (Phases-T1, T2, and T3 (U, V, and W)).	• Check the PG wiring. • Check the motor wiring. • Check the PG direction and constant F1-05.

Display Message	Fault	Description	Countermeasure
Motor Speed	Motor speed fault	The torque reference was too large (100%) during Auto-Tuning.	• Disconnect the motor from the machine if it has been connected. • Increase the acceleration time (C1-01). • Check the input data (particularly the number of PG pulses).
ALARM: Over Load (Displayed after completion of Auto-Tuning)	Tuning overload fault	The torque reference was over 20% during Auto-Tuning.	Check the input data (particularly the number of PG pulses) if the motor is being auto tuned separately.
Tune Aborted Minor Fault: ❑❑❑	Minor fault	A minor Inverter fault occurred.	Check the minor fault indicated in the boxes in the display shown at the left.

- Fault displays can be cleared by pressing the MENU key.
- All set constants (motor constants) will be initialized if a fault occurs. Reset the constants from the beginning before starting Auto-Tuning again.

■ Switching to V/f Control When Auto-Tuning Is Not Successful

When Auto-Tuning has not been executed correctly (i.e., when "Tune Aborted" is displayed), switch the control method to "V/f Control" and set the V/f pattern.

1. Change the control method to V/f Control without PG.

Step	Key Sequence	Digital Operator Display	Remarks
1	MENU	Main Menu ✳ Operation	Displays Operation mode.
2	^	✳ Main Menu ✳ Initialize	Displays Initialize mode.
3	DATA ENTER	Select Language English	Puts the unit in Initialize mode. (Select Language display.)
4	^	Control Method Open-Loop Vector	The control method selection is displayed.
	Press 2 times.		
5	DATA ENTER	A1-02 = 2 ✳✳✳ Open-Loop Vector	Control method selection (A1-02) is displayed.
6	v	A1-02 = 0 V/f Control	Selects V/f Control.
	Press 2 times.		
7	DATA ENTER	Entry Accepted	The set values are overwritten.
		Control Method V/f Control	Returns to the control method select display.
8	MENU	Main Menu ✳ Operation	Returns to the Operation mode display.

2. Check the motor nameplate and set the following three items.

User Constant Number	Name	Change During Operation	Setting Range	Unit	Factory Setting	Valid Access Levels			
						V/f Control	V/f with PG	Open-Loop Vector	Flux Vector
E1-05	Maximum voltage	X	0.0 to 255.0 (0.0 to 510.0)	VAC	200.0 (400.0)	Q	Q	Q	Q
E1-06	Base frequency	X	0.0 to 400.0	Hz	60.0	Q	Q	Q	Q
E2-01	Motor rated current	X	10 to 200% (Inverter rated current ratio)	A	*	Q	Q	Q	Q

* The factory setting for rated current differs according to the Inverter capacity.

The setting procedure for these three constants is as follows:

Step	Key Sequence	Digital Operator Display	Remarks
		Main Menu ✷ Operation	Displays Operation mode.
1	 Press 2 times.	Main Menu ✷ Programming	Displays Programming mode.
2		Reference Source Terminal	Puts the unit in Programming mode.
3	 Press 14 times.	Max. Voltage E1-05 = 200.0 VAC	Displays the maximum voltage.
4		Base Frequency E1-06 = 60.0 Hz	Displays the maximum voltage frequency.*
5	 Press 5 times.	Motor Rated FLA E2-01 = 1.90 A	Displays the rated current.*
6		Main Menu ✷ Operation	Returns to the Operation mode display.

* When there are discrepancies between the displayed values and the rating, set each value individually.

5.2.6 No-Load Operation

The section describes trial operation in which the motor is operated from the Digital Operator with the motor in the no-load state (with the motor not connected to the mechanical system).

■ Setting the Frequency Reference

Set the frequency reference on the frequency reference monitor in the Operation mode.

The following is an operation example with the frequency reference set to 10 Hz.

Step	Key Sequence	Digital Operator Display	Remarks
		Main Menu ✷ Operation	Displays Operation mode.
1		Frequency Ref U1-01 = 0.00 Hz	Puts the unit in Operation mode and displays the frequency reference.
2		Frequency Ref U1-01 = 0.00 Hz	Switches operation to the Digital Operator,. (SEQ, REF and LED indicators turn OFF.)
3		Frequency Ref 000.00 Hz	Sets the frequency reference.
4		Frequency Ref 000.00 Hz	The tens digit blinks.
5		Frequency Ref 010.00 Hz	Sets to 010.00 Hz.
6		Entry Accepted	The set values are overwritten.
		Frequency Ref 010.00 Hz	Returns to the frequency reference display.

Operation Using the Digital Operator

- Press the RUN key. The motor will start to rotate (forward rotation).
- Press the FWD/REV key. The motor will rotate in the reverse direction.
- Press the STOP key. The motor will stop. (The RUN key indicator will keep blinking until the motor stops).
- The frequency reference can be changed, even during operation. When this is done, the frequency reference is changed as soon as the DATA/ENTER key is pressed to input the set values.
- If the Jog key is pressed when the Inverter is stopped, it will rotate by the jog frequency (Factory setting: 6.0 Hz) only while the key is being pressed.

■ Checking the Operating Status

- After changing the frequency reference or the rotation direction, check that there is no oscillation or abnormal sound from the motor.
- Check that no faults have occurred in the Inverter during operation.

5.2.7 Loaded Operation

After checking the operation with the motor in no-load status as described in *5.2.6 No-Load Operation* of this chapter, connect the load mechanical system and perform trial operation with an actual load.

■ Connecting the Load System

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

■ Operation Using the Digital Operator

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

■ Checking Operating Status

- Having checked that the operating direction is correct and that the machine is operating smoothly at slow speed, increase the frequency reference.
- After changing the frequency reference or the rotation direction, check that there is no oscillation or abnormal sound from the motor. Check the monitor display to ensure that the U1-03 (output current) is not excessive.