Configuring Drive Parameters

3

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Choosing a Programming Device

Introduction

Hitachi variable frequency drives (inverters) use the latest electronics technology for getting the right AC waveform to the motor at the right time. The benefits are many, including energy savings and higher machine output or productivity. The flexibility required to handle a broad range of applications has required ever more configurable options and parameters—inverters are now a complex industrial automation component. And this can make a product seem difficult to use, but the goal of this chapter is to make this easier for you.

As the powerup test in Chapter 2 demonstrated, you do not have to program very many parameters to run the motor. In fact, most applications would benefit only from programming just a few, specific parameters. This chapter will explain the purpose of each set of parameters, and help you choose the ones that are important to your application.

If you are developing a new application for the inverter and a motor, finding the right parameters to change is mostly an exercise in optimization. Therefore, it is okay to begin running the motor with a loosely tuned system. By making specific, individual changes and observing their effects, you can achieve a finely tuned system. And, the SJ300 Series inverters have a built-in auto-tuning algorithm to set certain motor parameters.

Inverter Programming Keypads

The front panel keypad is the first and best way to get to know the inverter's capabilities. Every function or programmable parameter is accessible from the keypad. All keypads have the same basic layout, but with different features. The OPE–SRE has a potentiometer knob for frequency setting input. The SRW–0EX Read/write Copy Unit has the ability to upload (copy) or download (write) all inverter parameter data to/from memory in the copy unit itself. This unit is useful in transferring one inverter's settings to another.

The following table shows various programming options, the features unique to each device, and the cables required.

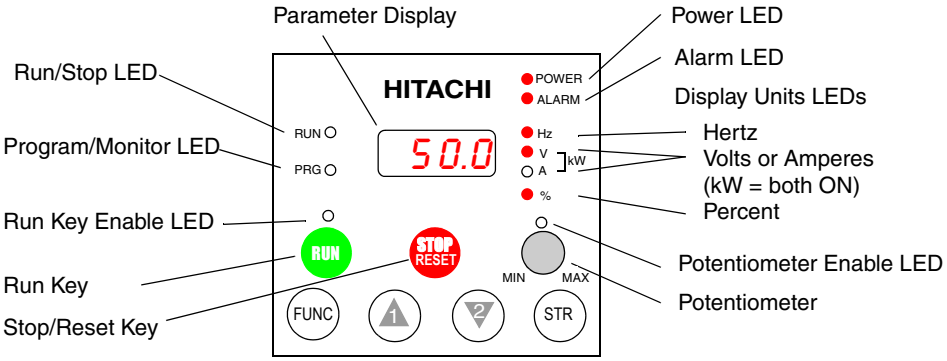
Device	Part Number	Parameter Access	Parameter setting storage	Cables (for optional external mounting)	
				Part number	Length
Inverter keypad, U.S. version	OPE–SRE	Monitor and program	EEPROM in inverter	ICS–1	1 meter
				ICS–3	3 meters
Inverter keypad, European version	OPE–S	Monitor and program	EEPROM in inverter	Use same two cables as above	
Read/write Copy Unit with Keypad	SRW–0EX	Monitor and program; read or write all data	EEPROM in inverter or in copy unit	Use same two cables as above	

TIP: Other special-purpose keypads are available, such as ones to serve the needs of the HVAC market (heating, ventilating & air conditioning). Please contact your Hitachi distributor for details.

Using Keypad Devices

Inverter Front Panel Keypad

The SJ300 Series inverter front keypad contains all the elements for both monitoring and programming parameters. The keypad layout (OPE–SRE) is shown below. All other programming devices for the inverter have a similar key arrangement and function.

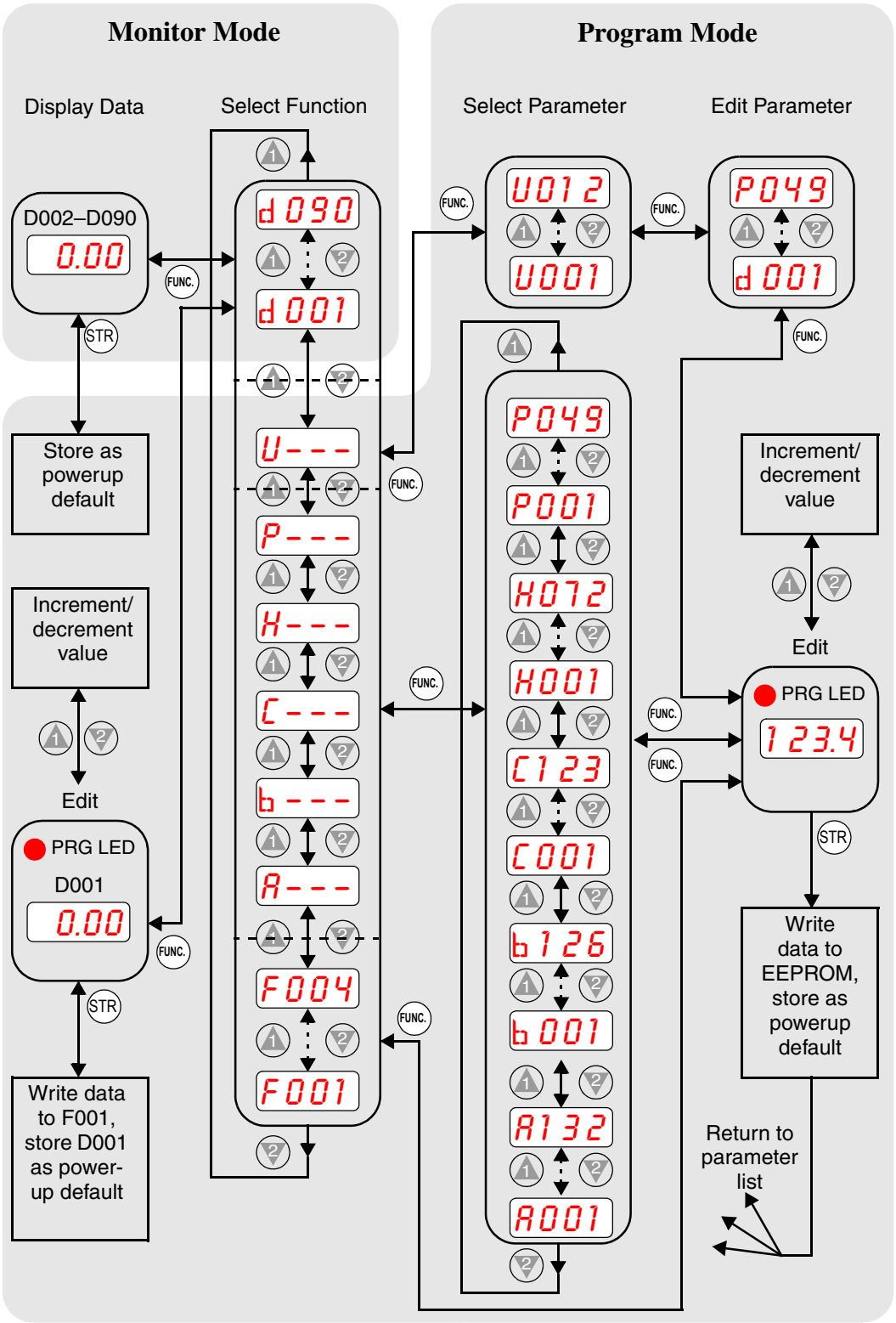


Key and Indicator Legend

- **Run/Stop LED** – ON when the inverter output is ON and the motor is developing torque, and OFF when the inverter output is OFF (Stop Mode).
- **Program/Monitor LED** – This LED is ON when the inverter is ready for parameter editing (Program Mode). It is normally OFF when the parameter display is monitoring data (Monitor Mode). However, the PRG LED will be ON whenever you are monitoring the value of parameter D001. (When the keypad is enabled as the frequency source via A001=02, you can edit the inverter frequency directly from D001 monitor display by using the Up/Down keys.)
- **Run Key** – Press this key to run the motor (the Run Enable LED must be ON first). Parameter F004, Keypad Run Key Routing, determines whether the Run key generates a Run FWD or Run REV command.
- **Run Key Enable LED** – is ON when the inverter is ready to respond to the Run key, OFF when the Run key is disabled.
- **Stop/Reset Key** – Press this key to stop the motor when it is running (uses the programmed deceleration rate). This key will also reset an alarm that has tripped.
- **Potentiometer** (OPE–SRE only) – allows an operator to directly set the motor speed when the potentiometer is enabled for output frequency control
- **Potentiometer Enable LED** – ON when the potentiometer is enabled for value entry (OPE–SRE only).
- **Parameter Display** – a 4-digit, 7-segment display for parameters and function codes.
- **Display Units: Hertz/Volts/Amperes**/kW/% - These LEDs indicate the units associated with the parameter display. When the display is monitoring a parameter, the appropriate LED is ON. In the case of kW units, both Volts and Amperes LEDs will be ON. An easy way to remember this is that kW = (V x A)/1000.
- **Power LED** – This LED is ON when the power input to the inverter is ON.
- **Alarm LED** – This LED is ON when an alarm condition has tripped the inverter. Clearing the alarm will turn this LED OFF again. See Chapter 6 for details on clearing alarms.
- **Function Key** – This key is used to navigate through the lists of parameters and functions for setting and monitoring parameter values.
- **Up/Down (1, 2) Keys** – Use these keys to alternately move up or down the lists of parameter and functions shown in the display, and increment/decrement values.
- **Store (STR) Key** – When the unit is in Program Mode and the operator has edited a parameter value, press the Store key to write the new value to the EEPROM. This parameter is then displayed at powerup by default. If you want to change the powerup default, navigate to a new parameter value and press the Store key.

Keypad Navigational Map

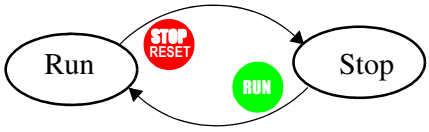
Whether you use the keypad on the inverter or the read-write copy unit, each navigates the same way. The diagram below shows the basic navigational map of parameters and functions.

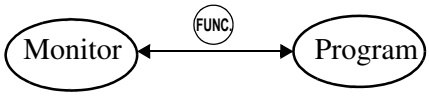


NOTE: The inverter 7-segment display shows lower case “b” and “d”, meaning the same as the upper case letters “B” and “D” used in this manual (for uniformity “A to F”).

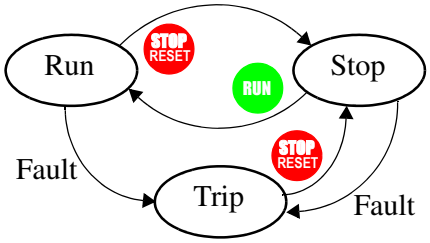
Operational Modes

The RUN and PGM LEDs tell just part of the story; Run Mode and Program Modes are independent modes, not opposite modes. In the state diagram to the right, Run alternates with Stop, and Program Mode alternates with Monitor Mode. This is a very important ability, for it shows that a technician can approach a running machine and change some parameters without shutting down the machine.





The occurrence of a fault during operation will cause the inverter to enter the Trip Mode as shown. An event such as an output overload will cause the inverter to exit the Run Mode and turn OFF its output to the motor. In the Trip Mode, any request to run the motor is ignored. You must clear the error by pressing the Stop/Reset switch. See “Monitoring Trip Events, History, & Conditions” on page 6–5.



Run Mode Edits

The inverter can be in Run Mode (inverter output is controlling motor) and still allow you to edit certain parameters. This is useful in applications that must run continuously, yet need some inverter parameter adjustment.

The parameter tables in this chapter have a column titled “Run Mode Edit.” An Ex mark ✘ means the parameter cannot be edited; a Check mark ✔ means the parameter can be edited. You’ll notice in the table example to the right the two adjacent marks: “✘ ✔”. The two marks (that can also be “✘ ✘” or “✔ ✔”) correspond to these levels of access to editing:

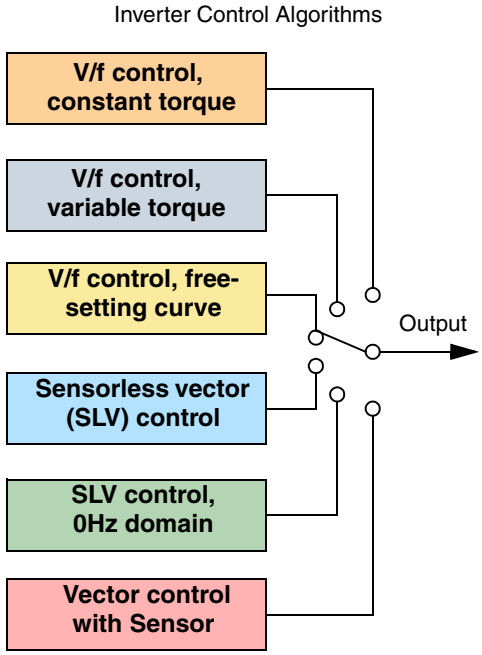
	Run Mode Edit Lo Hi	
	✘ ✔	

- Low-access level to Run Mode edits (indicated by *left-most* mark)
- High-access level to Run Mode edits (indicated by *right-most* mark)

The Software Lock Setting (parameter B031) determines the particular access level that is in effect during Run Mode and access in other conditions, as well. It is the responsibility of the user to choose a useful and safe software lock setting for the inverter operating conditions and personnel. Please refer to “Software Lock Mode” on page 3–36 for more information.

Control Algorithms

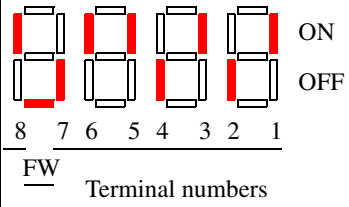
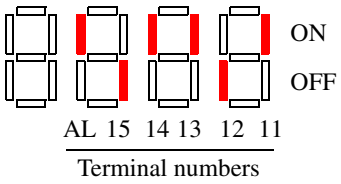
The motor control program in the SJ300 inverter has several sinusoidal PWM switching algorithms. The intent is that you select the best algorithm for the motor characteristics in your application. Each algorithm generates the frequency output in a unique way. Once configured, the algorithm is the basis for other parameter settings as well (see “Torque Control Algorithms” on page 3–14). Therefore, choose the best algorithm early in your application design process.



“D” Group: Monitoring Functions

Parameter Monitoring Functions

You can access important system parameter values with the “D” Group monitoring functions, whether the inverter is in Run Mode or Stop Mode. After selecting the function code number for the parameter you want to monitor, press the Function key once to show the value on the display. In Functions D005 and D006 the intelligent terminals use individual segments of the display to show ON/OFF status.

“D” Function			Run Mode Edit	Range and Units	SRW Display
Func. Code	Name	Description			
D001	Output frequency monitor	Real-time display of output frequency to motor, from 0.0 to 400.0 Hz	—	0.0 to 400.0 Hz	FM 0000.00Hz
D002	Output current monitor	Filtered display of output current to motor (100 mS internal filter time constant)	—	A	Iout 0000.0A
D003	Rotation direction monitor	Three different indications: “F”. Forward “o”. Stop “r” Reverse	—	—	Dir STOP
D004	Process variable (PV), PID feedback monitor	Displays the scaled PID process variable (feedback) value (A75 is scale factor)	—	—	PID-FB 0000.00%
D005	Intelligent input terminal status	Displays the state of the intelligent input terminals:  	—	—	IN-TM LLLLLLLLL
D006	Intelligent output terminal status	Displays the state of the intelligent output terminals:  	—	—	OUT-TM LLLLLL
D007	Scaled output frequency monitor	Displays the output frequency scaled by the constant in B86. Decimal point indicates range: XX.XX 0.00 to 99.99 XXX.X 100.0 to 999.9 XXXX. 1000 to 9999 XXXX 10000 to 99990	—	User-defined	F-CNV 000000.00
D012	Torque monitor	Estimated output torque value, range is -300.0 to +300.0%	—	%	TRQ +000%
D013	Output voltage monitor	Voltage of output to motor, range is 0.0 to 600.0V	—	VAC	Vout 000.0V

"D" Function			Run Mode Edit	Range and Units	SRW Display
Func. Code	Name	Description			
D014	Power monitor	0.0 to 999.9	—	kW	Power 000.0kW
D016	Cumulative operation RUN time monitor	Displays total time the inverter has been in RUN mode in hours. Range is 0 to 9999 / 1000 to 9999/ 100 to 999 (10,000 to 99,900) hrs.	—	hours	RUN 0000000hr
D017	Cumulative power-on time monitor	Displays total time the inverter has had input power (ON) in hours. Range is: 0 to 9999 / 100.0 to 999.9 / 1000 to 9999 / 100 to 999 hrs.	—	hours	ON 0000000hr

Trip Event and Programming Error Monitoring

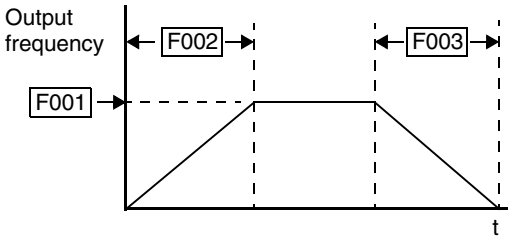
The trip event and history monitoring feature lets you cycle through related information using the keypad. See "Monitoring Trip Events, History, & Conditions" on page 6–5 for more details.

Programming errors generate an error code that begins with the special E character. See "Programming Error Codes" on page 3–68 for more information.

"D" Function			Run Mode Edit Lo Hi	Range and Units	SRW Display
Func. Code	Name	Description			
D080	Trip Counter	Number of trip events	—	—	ERR COUNT 00000
D081 to D086	Trip monitor 1 to 6	Displays trip event information	—	—	(Trip event type)
D090	Programming error monitor	Displays programming error code	—	—	XXXX

"F" Group: Main Profile Parameters

The basic frequency (speed) profile is defined by parameters contained in the "F" Group as shown to the right. The output frequency is set in Hz, but acceleration and deceleration are specified seconds (the time to ramp from zero to maximum frequency, or from maximum frequency to zero). The motor direction parameter determines whether the keypad Run key produces a FW or RV command. This parameter does not affect the [FW] terminal or [RV] intelligent terminal function, which you configure separately.



Acceleration 1 and Deceleration 1 are the standard default accel and decel values for the main profile. Accel and decel values for an alternative profile are specified by using parameters Ax92 through Ax93. The motor direction selection (F004) determines the direction of rotation as commanded only from the keypad. This setting applies to any motor profile (1st, 2nd, or 3rd) in use at a particular time.

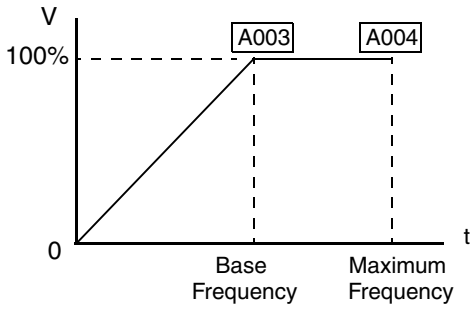
"F" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
F001	Output frequency setting	Standard default target frequency that determines constant motor speed Range is 0 to 360 Hz	✔ ✔	0.00	0.00	0.00	Hz	>F001 SET-Freq. TM 0000.00Hz 2FS 0000.00Hz 3FS 0000.00Hz TM 0000.00Hz JG 0000.00Hz 1S 0000.00Hz 15S 0000.00Hz OP1 0000.00Hz OP2 0000.00Hz RS485 0000.00Hz
F002	Acceleration (1) time setting	Standard default acceleration Range is 0.01 to 3600 sec.	✔ ✔	30.0	30.0	30.0	sec.	>F002 ACCEL TIME1 0030.00s
F202	Acceleration (1) time setting, 2nd motor	Standard default acceleration, 2nd motor Range is 0.01 to 3600 sec.	✔ ✔	30.0	30.0	30.0	sec.	>F202 2ACCEL TIME1 0030.00s
F302	Acceleration (1) time setting, 3rd motor	Standard default acceleration, 3rd motor Range is 0.01 to 3600 sec.	✔ ✔	30.0	30.0	30.0	sec.	>F302 3ACCEL TIME1 0030.00s
F003	Deceleration (1) time setting	Standard default deceleration Range is 0.01 to 3600 sec.	✔ ✔	30.0	30.0	30.0	sec.	>F003 DECEL TIME1 0030.00s
F203	Deceleration (1) time setting, 2nd motor	Standard default deceleration, 2nd motor Range is 0.01 to 3600 sec.	✔ ✔	30.0	30.0	30.0	sec.	>F203 2DECEL TIME1 0030.00s
F303	Deceleration (1) time setting, 3rd motor	Standard default deceleration, 3rd motor Range is 0.01 to 3600 sec.	✔ ✔	30.0	30.0	30.0	sec.	>F303 3DECEL TIME1 0030.00s
F004	Keypad Run key routing	Two options; select codes: 00 Forward 01 Reverse	✘ ✘	00	00	00	—	>F004 DIG-RUN SELECT FW

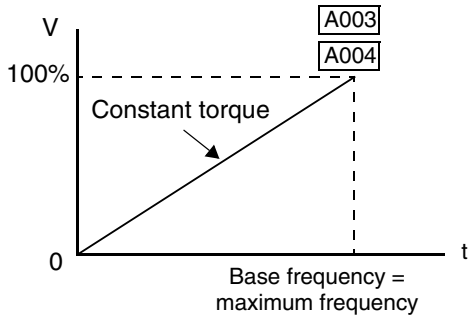
“A” Group: Standard Functions

Basic Parameter Settings

These settings affect the most fundamental behavior of the inverter—the outputs to the motor. The frequency of the inverter’s AC output determines the motor speed. You may select from three different sources for the reference speed. During application development you may prefer using the potentiometer, but you may switch to an external source (control terminal setting) in the finished application, for example.

The base frequency and maximum frequency settings interact according to the graph below (left). The inverter output operation follows the constant V/f curve until it reaches the full-scale output voltage. This initial straight line is the constant-torque part of the operating characteristic. The horizontal line over to the maximum frequency serves to let the motor run faster, but at a reduced torque. This is the constant-horsepower part of the characteristic. If you want the motor to output constant torque over its entire operating range (limited to the motor nameplate voltage and frequency rating), then set the base frequency and maximum frequency equal as shown (below right).





NOTE: The “2nd motor” and “3rd motor” settings in the tables in this chapter store an alternate set of parameters for additional motors. The inverter can use the 1st, 2nd, or 3rd set of parameters to generate the output frequency to the motor. See “Configuring the Inverter for Multiple Motors” on page 4–72.

“A” Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
A001	Frequency source setting	Six options; select codes: 00 Keypad potentiometer 01 Control terminal 02 Function F001 setting 03 RS485 serial command 04 Expansion board 1 05 Expansion board 2	✘ ✘	01	01	02	—	>A001 F-SET SELECT TRM
A002	Run command source setting	Five options; select codes: 01 Input terminal [FW] or [RV] (assignable) 02 Run key on keypad, or digital operator 03 RS485 serial command 04 Start/Stop, expansion card #1 05 Start/Stop, expansion card #2	✘ ✘	01	01	02	—	>A002 F/R SELECT TRM
A003	Base frequency setting	Settable from 30 Hz to the maximum frequency	✘ ✘	50.	60.	60.	Hz	>A003 F-BASE F 0060Hz

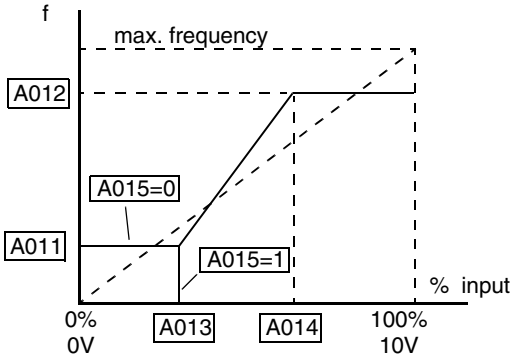
“A” Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
A203	Base frequency setting, 2nd motor	Settable from 30 Hz to the maximum frequency	✘ ✘	50.	60.	60.	Hz	>A203 2F-BASE F 0060Hz
A303	Base frequency setting, 3rd motor	Settable from 30 Hz to the maximum frequency	✘ ✘	50.	60.	60.	Hz	>A303 3F-BASE F 0060Hz
A004	Maximum frequency setting	Settable from 30 Hz to 400 Hz	✘ ✘	50.	60.	60.	Hz	>A004 F-max F 0060Hz
A204	Maximum frequency setting, 2nd motor	Settable from 30 Hz to 400 Hz	✘ ✘	50.	60.	60.	Hz	>A204 2F-max F 0060Hz
A304	Maximum frequency setting, 3rd motor	Settable from 30 Hz to 400 Hz	✘ ✘	50.	60.	60.	Hz	>A304 3F-max F 0060Hz

NOTE: The base frequency must be less than or equal to the maximum frequency (ensure that A003 ≤ A004).

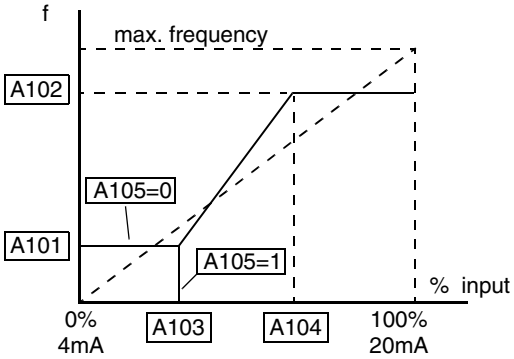
Analog Input Settings

The inverter has the capability to accept external analog inputs that can command the output frequency to the motor. Signals including voltage input (0 to +10V) at terminal [O], bipolar input (-10 to +10V) at terminal [O2], and current input (4 to 20mA) at terminal [OI] are available. Terminal [L] serves as signal ground for the three analog inputs. The analog input settings adjust the curve characteristics between the analog input and the frequency output.

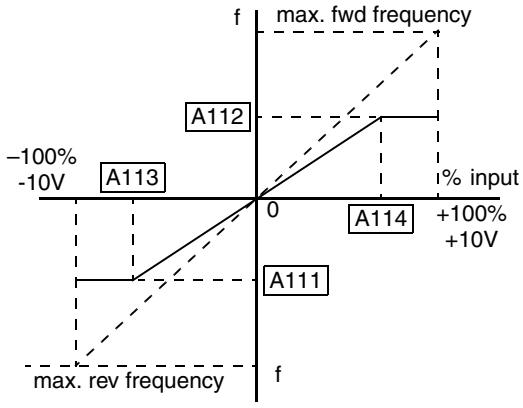
Adjusting [O–L] characteristics – In the graph to the right, A013 and A014 select the active portion of the input voltage range. Parameters A011 and A012 select the start and end frequency of the converted output frequency range, respectively. Together, these four parameters define the major line segment as shown. When the line does not begin at the origin (A011 and A013 > 0), then A015 defines whether the inverter outputs 0Hz or the A011-specified frequency when the analog input value is less than the A013 setting. When the input voltage is greater than the A014 ending value, the inverter outputs the ending frequency specified by A012.



Adjusting [OI–L] characteristics – In the graph to the right, A103 and A104 select the active portion of the input current range. Parameters A101 and A102 select the start and end frequency of the converted output frequency range, respectively. Together, these four parameters define the major line segment as shown. When the line does not begin at the origin (A101 and A103 > 0), then A105 defines whether the inverter outputs 0Hz or the A101-specified frequency when the analog input value is less than the A103 setting. When the input voltage is greater than the A104 ending value, the inverter outputs the ending frequency specified by A102.



Adjusting [O2–L] characteristics – In the graph to the right, A113 and A144 select the active portion of the input voltage range. Parameters A111 and A112 select the start and end frequency of the converted output frequency range, respectively. Together, these four parameters define the major line segment as shown. When the input voltage is less than the A113 input starting value, the inverter outputs the starting frequency specified by A111. When the input voltage is greater than the A114 ending value, the inverter outputs the ending frequency specified by A112.



"A" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
A005	[AT] selection	Two options; select codes: 00 Select between [O] and [OI] at [AT] 01 Select between [O] and [O2] at [AT]	✘ ✘	00	00	00	—	>A005 AT SELECT O/OI
A006	[O2] selection	Three options; select codes: 00 Independent 01 Only positive 02 Both positive and negative	✘ ✘	00	00	00	—	>A006 O2 SELECT O2
A011	[O]–[L] input active range start frequency	The output frequency corresponding to the voltage input range starting point Range is 0.00 to 400.00 Hz	✘ ✔	0.00	0.00	0.00	Hz	>A011 INPUT-O EXS 0000.00Hz
A012	[O]–[L] input active range end frequency	The output frequency corresponding to the voltage input range ending point Range is 0.00 to 400.00 Hz	✘ ✔	0.00	0.00	0.00	Hz	>A012 INPUT-O EXE 0000.00Hz
A013	[O]–[L] input active range start voltage	The starting point for the voltage input range Range is 0 to 100%	✘ ✔	0.	0.	0.	%	>A013 INPUT-O EX%S 000%
A014	[O]–[L] input active range end voltage	The ending point for the voltage input range Range is 0 to 100%	✘ ✔	100.	100.	100.	%	>A014 INPUT-O EX%E 100%
A015	[O]–[L] input start frequency enable	Two options; select codes: 00 Use A011 start value 01 Use 0 Hz	✘ ✔	01	01	01	—	>A015 INPUT-O LEVEL 0Hz
A016	External frequency filter time constant	Range n = 1 to 30, where n = number of samples for avg.	✘ ✔	8.	8.	8.	Samples	>A016 INPUT F-SAMP 08

Multi-speed and Jog Frequency Settings

The SJ300 inverter has the capability to store and output up to 16 preset frequencies to the motor (A020 to A035). As in traditional motion terminology, we call this *multi-speed profile* capability. These preset frequencies are selected by means of digital inputs to the inverter. The inverter applies the current acceleration or deceleration setting to change from the current output frequency to the new one. The first multi-speed setting is duplicated for the second motor settings (the remaining 15 multi-speeds apply only to the first motor).

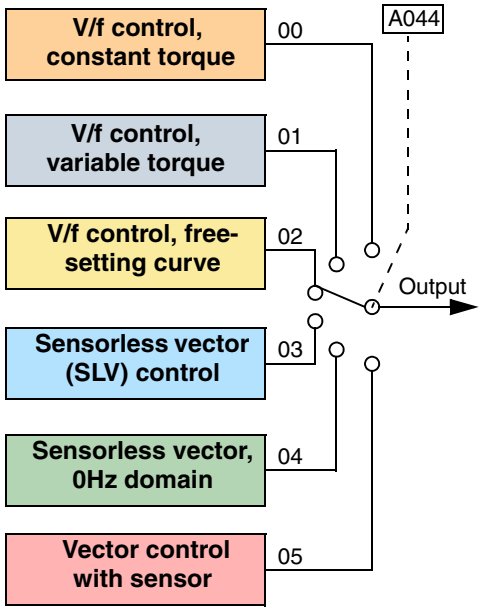
The jog speed setting is used whenever the Jog command is active. The jog speed setting range is arbitrarily limited to 10 Hz to provide safety during manual operation. The acceleration to the jog frequency is instantaneous, but you can choose from six modes for the best method for stopping the jog operation.

"A" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
A019	Multi-speed operation selection	Two options; select codes: 00 Binary; up to 16-stage speed using 4 intelligent terminals 01 Single-bit; up to 8-stage speed using 7 intelligent terminals	✘ ✘	00	00	00	—	>A019 SPEED SELECT BINARY
A020	Multi-speed frequency setting	Defines the first speed of a multi-speed profile, range is 0 to 360 Hz A020 = Speed 1 (1st motor)	✔ ✔	0.00	0.00	0.00	Hz	>A020 SPEED FS 0000.00Hz
A220	Multi-speed frequency setting, 2nd motor	Defines the first speed of a multi-speed profile for 2nd motor, range is 0 to 360 Hz A220 = Speed 1 (2nd motor)	✔ ✔	0.00	0.00	0.00	Hz	>A220 SPEED 2FS 0000.00Hz
A320	Multi-speed frequency setting, 3rd motor	Defines the first speed of a multi-speed profile for 3rd motor, range is 0 to 360 Hz A320 = Speed 1 (3rd motor)	✔ ✔	0.00	0.00	0.00	Hz	>A320 SPEED 3FS 0000.00Hz
A021 to A035	Multi-speed frequency settings (for both motors)	Defines 15 more speeds, range is 0 to 360 Hz. A021 = Speed 2... A035 = Speed 16	✔ ✔	0.00	0.00	0.00	Hz	>A021 SPEED 01S 0000.00Hz
A038	Jog frequency setting	Defines limited speed for jog, range is 0.5 to 9.99 Hz	✔ ✔	1.00	1.00	1.00	Hz	>A038 Jogging F 01.00Hz
A039	Jog stop mode	Define how end of jog stops the motor; six options: 00 Free-run stop, jogging disabled during motor run 01 Controlled deceleration, jogging disabled during motor run 02 DC braking to stop, jogging disabled during motor run 03 Free-run stop, jogging always enabled 04 Controlled deceleration, jogging always enabled 05 DC braking to stop, jogging always enabled	✘ ✔	00	00	00	—	>A039 Jogging Mode FRS

Torque Control Algorithms

The inverter generates the motor output according to the V/f algorithm or the sensorless vector control algorithm. Parameter A044 selects the inverter torque control algorithm for generating the frequency output, as shown in the diagram to the right (A244 and A344 for 2nd and 3rd motors, respectively). The factory default is 00 (constant torque V/f control).

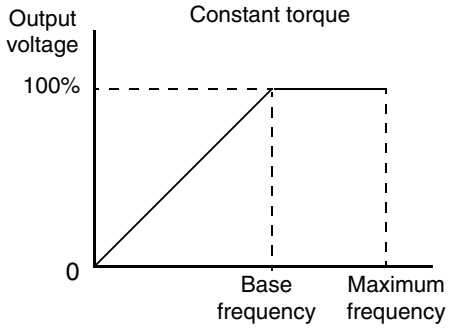
Inverter Torque Control Algorithms

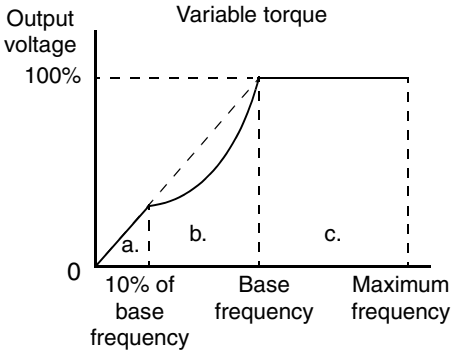


Review the following descriptions to help you choose the best torque control algorithm for your application.

- The built-in V/f curves are oriented toward developing constant torque or variable torque characteristics (see graphs below).
- The free-setting curve provides an even more flexible characteristic, but it requires more parameter settings.
- Sensorless vector control calculates an ideal torque vector based on current motor position, winding currents, and so on. It is a more robust control method than the V/f control methods. However, it is more dependent on actual motor parameters and will require you to set these values carefully or to perform the auto-tuning procedure (see "Auto-tuning of Motor Constants" on page 4–67) to obtain optimum performance.
- Sensorless vector control, 0Hz domain increases the low-speed torque performance (0–2.5Hz) via an advanced Hitachi torque control algorithm. However, you will need to size the inverter for one frame size larger than the motor for proper operation.
- Vector control with sensor requires expansion card SJ–FB encoder feedback board and a motor shaft encoder. Choose this method when precise position/velocity control is required.

Constant and Variable Torque – The graph below (left) shows the constant torque characteristic from 0Hz to the base frequency A003. The voltage remains constant for output frequencies higher than the base frequency.





The graph above (right) shows the general characteristic for variable torque. The curve may be best described in three sections, as follows:

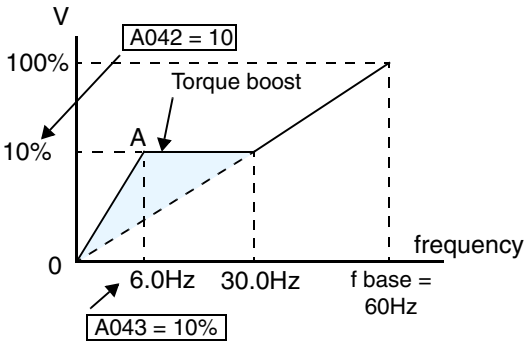
a. The range from 0Hz to 10% of the base frequency is the constant torque characteristic. For example, a base frequency of 60Hz ends the constant torque characteristic segment at 6Hz.

b. The range from 10% of the base frequency to the base frequency is the variable (reduced) torque characteristic. The voltage is output in the curve of frequency to the 1.7 power.

c. After reaching the base frequency, the characteristic maintains a constant output voltage for higher frequencies.

Using parameter A045 you can modify the voltage gain of the inverter. This is specified as a percentage of the full-scale setting AVR (Automatic Voltage Regulation) in parameter A082. The gain can be set from 20% to 100%. It must be adjusted in accordance with the motor specifications.

Torque Boost – The Constant and Variable Torque algorithms feature an adjustable *torque boost* curve. When the motor load has a lot of inertia or starting friction, you may need to increase the low frequency starting torque characteristics by boosting the voltage above the normal V/f ratio (shown at right). The boost is applied from zero to 1/2 the base frequency. You set the breakpoint of the boost (point A on the graph) by using parameters A042 and A043. The manual boost is calculated as an addition to the standard straight V/f line (constant torque curve).



Be aware that running the motor at a low speed for a long time can cause motor overheating. This is particularly true when manual torque boost is ON or if the motor relies on a built-in fan for cooling.

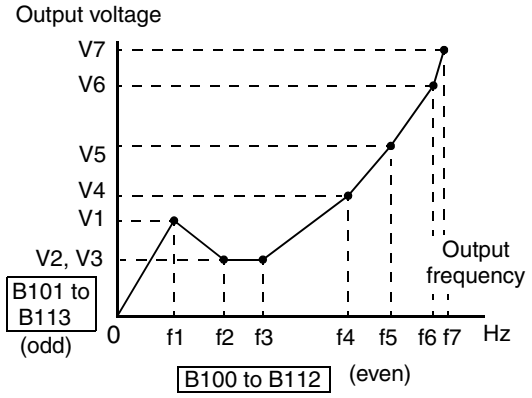
NOTE: Manual torque boost applies only to constant torque (A044=00) and variable torque (A044=01) V/f control.

NOTE: The motor stabilization parameter H006 is effective for constant torque (A044=00) and variable torque (A044=01) V/f control.

V/f Free-setting – The free-setting V/f inverter mode of operation uses voltage and frequency parameter pairs to define seven points on a V/f graph. This provides a way to define a multi-segment V/f curve that best suits your application.

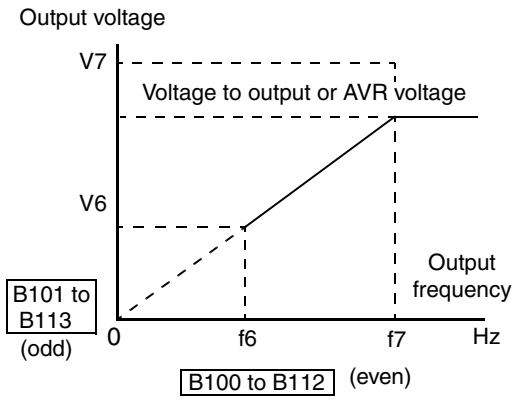
The frequency settings do require that F1 ≤ F2 ≤ F3 ≤ F4 ≤ F5 ≤ F6 ≤ F7; their values must have this ascending order relationship. However, the voltages V1 to V7 may either increase or decrease from one to the next. The example to the right shows the definition of a complex curve by following the setting requirements.

Free-setting f7 (B112) becomes the maximum frequency of the inverter. Therefore, we recommend setting f7 first, since the initial value of all default frequencies f1–f7 is 0Hz.



NOTE: The using of V/f free-setting operation specifies parameters that override (make invalid) certain other parameters. The parameters that become invalid are torque boost (A041/A241), base frequency (A003/A203/A303), and maximum frequency (A004/A204/A304). In this case, we recommend leaving their settings at the factory default values.

The V/f free-setting endpoint f7/V7 parameters must stay within the more basic inverter limits in order for the specified free-setting characteristic curve to be achieved. For example, the inverter cannot output a higher voltage than the input voltage or the AVR setting voltage (Automatic Voltage Regulation), set by parameter A082. The graph to the right shows how the inverter input voltage would clip (limit) the characteristic curve if exceeded.



Sensorless Vector Control and**, Sensorless Vector Control, 0Hz Domain –** These advanced torque control algorithms improve the torque performance at very low speeds:

- Sensorless Vector Control – improved torque control at output frequencies down to 0.5 Hz
- Sensorless Vector Control, 0Hz Domain – improved torque control at output frequencies from 0 to 2.5 Hz.

These low-speed torque control algorithms must be tuned to match the characteristics of the particular motor connected to your inverter. Simply using the default motor parameters in the inverter will not work satisfactorily for these control methods. Chapter 4 discusses motor/inverter size selection and how to set the motor parameters either manually or by using the built-in auto-tuning. Before using the sensorless vector control methods, please refer to "Setting Motor Constants for Vector Control" on page 4–65.

NOTE: When the inverter is in SLV (sensorless vector) mode, use B083 to set the carrier frequency greater than 2.1 kHz for proper operation.

NOTE: You must disable sensorless vector operation when two or more motors are connected (parallel operation) to the inverter.

Vector Control with Encoder Feedback – This method of torque control uses an encoder as a motor shaft position sensor. Accurate position feedback allows the inverter to close the velocity loop and provide very accurate speed control, even with variations in motor loads. To use encoder feedback you will need to add an SJ–FB Encoder Feedback Card in the inverter's expansion bay. Please refer to "Expansion Cards" on page 5–5 in this manual or the SJ–FB manual for details.

The following table shows the methods of torque control selection.

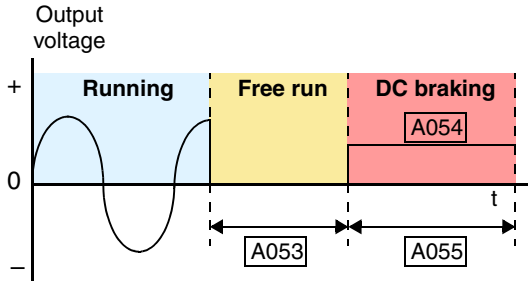
"A" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
A041	Torque boost method selection	Two options: 00 Manual torque boost 01 Automatic torque boost	✘ ✘	00	00	00	—	>A041 V-Boost Mode MANUAL
A241	Torque boost method selection, 2nd motor	Two options (for 2nd motor): 00 Manual torque boost 01 Automatic torque boost	✘ ✘	00	00	00	—	>A241 2V-Boost Mode MANUAL

"A" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
A042	Manual torque boost value	Can boost starting torque between 0 and 20% above normal V/f curve, from 0 to 1/2 base frequency	✔ ✔	1.0	1.0	1.0	—	>A042 V-Boost Code 01.0%
A242	Manual torque boost value, 2nd motor	Can boost starting torque between 0 and 20% above normal V/f curve, from 0 to 1/2 base frequency	✔ ✔	1.0	1.0	1.0	—	>A242 2V-Boost Code 01.0%
A342	Manual torque boost value, 3rd motor	Can boost starting torque between 0 and 20% above normal V/f curve, from 0 to 1/2 base frequency	✔ ✔	1.0	1.0	1.0	—	>A342 3V-Boost Code 01.0%
A043	Manual torque boost frequency adjustment	Sets the frequency of the V/f breakpoint A in graph (top of previous page) for torque boost	✔ ✔	5.0	5.0	5.0	%	>A043 V-Boost F 05.0%
A243	Manual torque boost frequency adjustment, 2nd motor	Sets the frequency of the V/f breakpoint A in graph (top of previous page) for torque boost	✔ ✔	5.0	5.0	5.0	%	>A243 2V-Boost F 05.0%
A343	Manual torque boost frequency adjustment, 3rd motor	Sets the frequency of the V/f breakpoint A in graph (top of previous page) for torque boost	✔ ✔	5.0	5.0	5.0	%	>A343 3V-Boost F 05.0%
A044	V/f characteristic curve selection, 1st motor	Six torque control modes: 00 V/f constant torque 01 V/f variable torque 02 V/f free-setting curve 03 Sensorless vector SLV 04 0Hz domain SLV 05 Vector control with encoder feedback	✘ ✘	00	00	00	—	>A044 Control 1st VC
A244	V/f characteristic curve selection, 2nd motor	Six torque control modes: 00 V/f constant torque 01 V/f variable torque 02 V/f free-setting curve 03 Sensorless vector SLV 04 0Hz domain SLV 05 Vector control with encoder feedback	✘ ✘	00	00	00	—	>A244 2Control 2nd VC
A344	V/f characteristic curve selection, 3rd motor	Six torque control modes: 00 V/f constant torque 01 V/f variable torque 02 V/f free-setting curve 03 Sensorless vector SLV 04 0Hz domain SLV 05 Vector control with encoder feedback	✘ ✘	00	00	00	—	>A344 3Control 3rd VC
A045	V/f gain setting	Sets voltage gain of the inverter from 20 to 100%	✔ ✔	100.	100.	100.	%	>A045 V-Gain Gain 100%

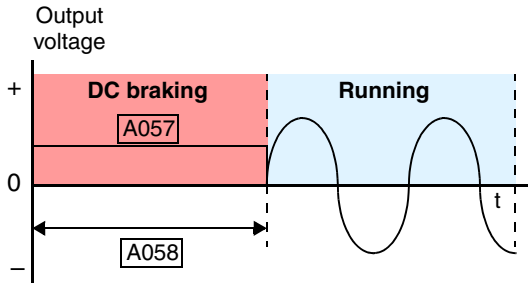
DC Braking Settings

The DC braking feature can provide additional stopping torque when compared to a normal deceleration to a stop. It can also ensure the motor and load are stopped before acceleration.

When decelerating – DC braking is particularly useful at low speeds when normal deceleration torque is minimal. During deceleration, the inverter injects a DC voltage into the motor windings during deceleration below a frequency you can specify (A052). The braking power (A054) and duration (A055) can both be set. You can optionally specify a wait time before DC braking (A053), during which the motor will free run (coast).



When starting – You can also apply DC braking upon the application of a Run command, specifying both the DC braking force level (A057) and the duration (A058). This will serve to stop the rotation of the motor and the load, when the load is capable of driving the motor. This effect, sometimes called "windmilling," is common in fan applications. Often, air moving in duct work will drive the fan in a backward direction. If an inverter is started into such a backward-rotating load, over-current trips can occur. Use DC braking as an "anti-windmilling" technique to stop the motor and load, and allow a normal acceleration from a stop. See also the "Acceleration Pause Function" on page 3–21.



You can configure the inverter to apply DC braking at stopping only, at starting only, or both. DC braking power (0–100%) can be set separately for stopping and starting cases.

You can configure DC braking to initiate in one of two ways:

1. **Internal DC braking** – Set A051=01 to enable internal braking. The inverter automatically applies DC braking as configured (during stopping, starting, or both).
2. **External DC braking** – Configure an input terminal with option code 7 [DB] (see "External Signal for DC Braking" on page 4–17 for more details). Leave A051=00, although this setting is ignored when a [DB] input is configured. The DC braking force settings (A054 and A057) still apply. However, the braking time settings (A055 and A058) do not apply (see level and edge triggered descriptions below). Use A056 to select level or edge detection for the external input.

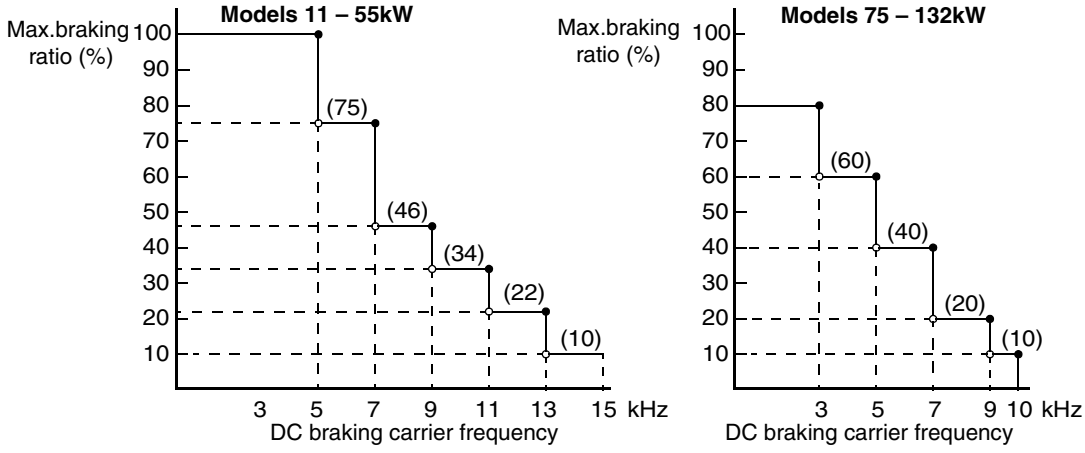
   a. Level triggered – When the [DB] input signal is ON, the inverter immediately applies DC injection braking, whether the inverter is in Run Mode or Stop Mode. You control DC braking time by the duration of the [DB] pulse.

   b. Edge triggered – When the [DB] input transitions OFF-to-ON and the inverter is in Run Mode, it will apply DC braking only until the motor stops... then DC braking is OFF. During Stop Mode, the inverter ignores OFF-to-ON transitions. Therefore, do not use edge triggered operation when you need DC braking before acceleration.

CAUTION: Be careful to avoid specifying a braking time that is long enough to cause motor overheating. If you use DC braking, we recommend using a motor with a built-in thermistor and wiring it to the inverter's thermistor input (see "Thermistor Thermal Protection" on page 4–28). Also refer to the motor manufacturer's specifications for duty-cycle recommendations during DC braking.

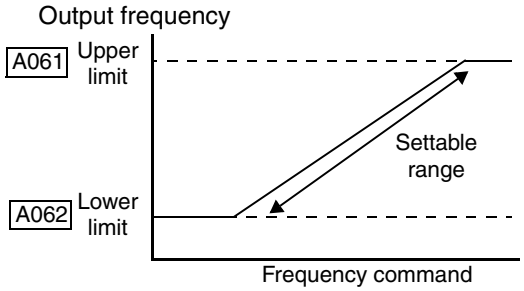
"A" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
A051	DC braking enable	Two options; select codes: 00 Disable 01 Enable	✘ ✔	00	00	00	—	>A051 DCB Mode OFF
A052	DC braking frequency setting	The frequency at which DC braking activates during decel. Range is 0.00 to 60.00 Hz	✘ ✔	0.50	0.50	0.50	Hz	>A052 DCB F 00.50Hz
A053	DC braking wait time	The delay after reaching the DC braking frequency, or [DB] signal, before DC braking begins. Range is 0.0 to 5.0 seconds	✘ ✔	0.0	0.0	0.0	sec.	>A053 DCB WAIT 0.0s
A054	DC braking force during deceleration	Variable DC braking force. Range is from 0% to 100%	✘ ✔	0.	0.	0.	%	>A054 DCB STP-V 000%
A055	DC braking time for deceleration	Sets the duration for DC braking during decel. Range is 0.0 to 60.0 seconds	✘ ✔	0.0	0.0	0.0	sec.	>A055 DCB STP-T 00.0s
A056	DC braking / edge or level detection for [DB] input	Two options; select codes: 00 Edge detection 01 Level detection	✘ ✔	01	01	01	—	>A056 DCB KIND LEVEL
A057	DC braking force for starting	Variable DC braking force. Range is 0 to 100%	✘ ✔	0.	0.	0.	%	>A057 DCB STA-V 000%
A058	DC braking time for starting	Sets the duration for DC braking before accel. Range is 0.0 to 60.0 seconds	✘ ✔	0.0	0.0	0.0	sec.	>A058 DCB STA-T 00.0s
A059	DC braking carrier frequency setting	Range is 0.5 to 15 kHZ for models up to –550xxx, range is 0.5 to 10kHz for 750xxx to 1500xxx models	✘ ✘	3.0	3.0	3.0	kHz	>A059 DCB CARRIER 05.0kHz

Derating of DC Braking – The inverter uses an internal carrier frequency (set by A059) to generate a DC braking voltage (do not confuse with main inverter output carrier frequency set by B083). The maximum DC braking force available to the inverter is more limited with higher DC braking carrier frequency settings for A059 according to the graphs below.



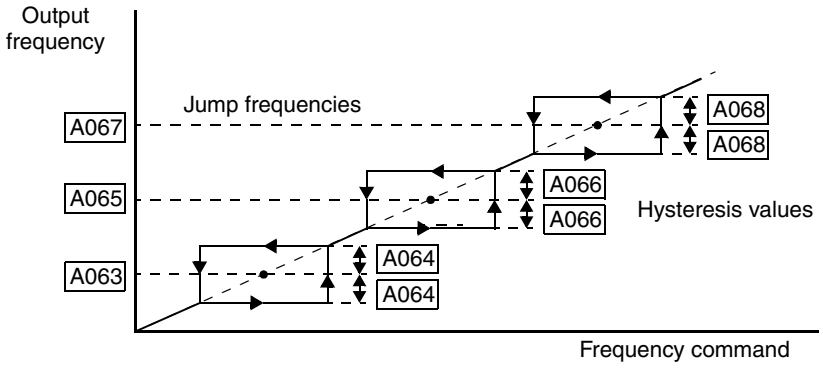
Frequency-related Functions

Frequency Limits – Upper and lower limits can be imposed on the inverter output frequency. These limits will apply regardless of the source of the speed reference. You can configure the lower frequency limit to be greater than zero as shown in the graph to the right. The upper limit must not exceed the rating of the motor or capability of the machinery.



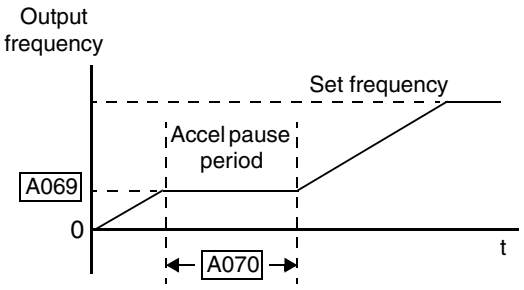
"A" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
A061	Frequency upper limit setting	Sets a limit on output frequency less than the maximum frequency (A004) Range is 0.50 to 400.0 Hz 0.00 setting is disabled >0.10 setting is enabled	✘ ✔	0.00	0.00	0.00	Hz	>A061 LIMIT HIGH 0000.00Hz
A261	Frequency upper limit setting, 2nd motor	Sets a limit on output frequency less than the maximum frequency (A004) Range is 0.50 to 400.0 Hz 0.00 setting is disabled >0.10 setting is enabled	✘ ✔	0.00	0.00	0.00	Hz	>A261 2LIMIT HIGH 0000.00Hz
A062	Frequency lower limit setting	Sets a limit on output frequency greater than zero Range is 0.50 to 400.0 Hz 0.00 setting is disabled >0.1 setting is enabled	✘ ✔	0.00	0.00	0.00	Hz	>A062 LIMIT LOW 0000.00Hz
A262	Frequency lower limit setting, 2nd motor	Sets a limit on output frequency greater than zero Range is 0.50 to 400.0 Hz 0.00 setting is disabled >0.10 setting is enabled	✘ ✔	0.00	0.00	0.00	Hz	>A262 2LIMIT LOW 0000.00Hz

Jump Frequencies – Some motors or machines exhibit resonances at particular speed(s), which can be destructive for prolonged running at those speeds. The inverter has up to three *jump frequencies* as shown in the graph. The hysteresis around the jump frequencies causes the inverter output to skip around the sensitive frequency values.



"A" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
A063 A065 A067	Jump (center) frequency setting	Up to 3 output frequencies can be defined for the output to jump past to avoid motor resonances (center frequency) Range is 0.00 to 400.0 Hz	✘ ✔	0.00	0.00	0.00	Hz	>A063 JUMP F1 0000.00Hz >A065 JUMP F2 0000.00Hz >A067 JUMP F3 0000.00Hz
A064 A066 A068	Jump (hysteresis) frequency width setting	Defines the distance from the center frequency at which the jump occurs Range is 0.0 to 10.0 Hz	✘ ✔	0.50	0.50	0.50	Hz	>A064 JUMP W1 00.50Hz >A066 JUMP W2 00.50Hz >A068 JUMP W3 00.50Hz

Acceleration Pause Function



The acceleration pause function can be used to minimize the occurrence of over-current trips when accelerating high inertia loads. It introduces a dwell or pause in the acceleration ramp. You can control the frequency at which this dwell occurs (A069), and the duration of the pause time (A070). This function can also be used as an anti-windmilling tool, when the load might have a tendency to drive the motor in a reverse direction while the inverter is in a Stop mode. Initiating a normal acceleration in such a situation may result in over-current trips. This function can be used to keep the inverter output frequency and voltage at low levels long enough to bring the load to a stop, and commence turning in the desired direction before the acceleration ramp resumes. See also "DC Braking Settings" on page 3–18.

"A" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
A069	Acceleration pause frequency setting	Range is 0.00 to 400.0Hz	✘ ✔	0.00	0.00	0.00	Hz	>A069 F-STOP F 0000.00H
A070	Acceleration pause time setting	Range is 0.0 to 60.0 sec.	✘ ✔	0.0	0.0	0.0	sec.	>A070 F-STOP T 00.0s

PID Control

When enabled, the built-in PID loop calculates an ideal inverter output value to cause a loop feedback process variable (PV) to move closer in value to the setpoint (SP). The current frequency command serves as the SP. The PID loop algorithm will read the analog input for the process variable (you specify either current or voltage input) and calculate the output.

- A scale factor in A075 lets you multiply the PV by a factor, converting it into engineering units for the process.
- Proportional, integral, and derivative gains are all adjustable.
- Optional – You can assign an intelligent input terminal the option code 23, PID Disable. When active, this input disables PID operation. See "Intelligent Input Terminal Overview" on page 3–49.
- See "PID Loop Operation" on page 4–71 for more information.

"A" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
A071	PID Enable	Enables PID function, two option codes: 00 PID operation OFF 01 PID operation ON	✘ ✔	00	00	00	—	>A071 PID SW OFF
A072	PID proportional gain	Proportional gain has a range of 0.2 to 5.0	✔ ✔	1.0	1.0	1.0	—	>A072 PID P 1.0
A073	PID integral time constant	Integral time constant has a range of 0.0 to 3600 seconds	✔ ✔	1.0	1.0	1.0	sec.	>A073 PID I 0001.0s
A074	PID derivative time constant	Derivative time constant has a range of 0.0 to 100 seconds	✔ ✔	0.0	0.0	0.0	sec.	>A074 PID D 000.00
A075	PV scale conversion	Process Variable (PV) scale factor (multiplier), range of 0.01 to 99.99	✘ ✔	1.00	1.00	1.00	—	>A075 PID CONV 001.00
A076	PV source setting	Selects source of Process Variable (PV), option codes: 00 [OI] terminal (current input) 01 [O] terminal (voltage input)	✘ ✔	00	00	00	—	>A076 PID INPUT OI

NOTE: The setting A073 for the integrator is the integrator's time constant Ti, not the gain. The integrator gain Ki = 1/Ti. When you set A073 = 0, the integrator is disabled.

Automatic Voltage Regulation (AVR) Function

The automatic voltage regulation (AVR) feature keeps the inverter output voltage at a relatively constant amplitude during power input fluctuations. This can be useful if the installation is subject to input voltage disturbances. However, the inverter cannot boost its motor output to a voltage higher than the power input voltage. If you enable this feature, be sure to select the proper voltage class setting for your motor.

"A" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
A081	AVR function select	Automatic (output) voltage regulation, selects from three type of AVR functions, three option codes: 00 AVR enabled 01 AVR disabled 02 AVR enabled except during deceleration	✘ ✘	00	00	00	—	>A081 AVR MODE DOFF
A082	AVR voltage select	200V class inverter settings: 200/215/220/230/240 400V class inverter settings: 380/400/415/440/460/480	✘ ✘	230/400	230/460	200/400	V	>A082 AVR AC 230

Energy Savings Mode / Optimal Accel/Decel

Energy Savings Mode – This function allows the inverter to deliver the minimum power necessary to maintain speed at any given frequency. This works best when driving variable torque characteristic loads such as fans and pumps. Parameter A085=01 enables this function and A086 controls the degree of its effect. A setting of 0.0 yields slow response but high accuracy, while a setting of 100 will yield a fast response with lower accuracy.

"A" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
A085	Operation mode selection	Three options: 00 Normal operation 01 Energy-saver operation 02 Optimal accel/decel operation	✘ ✘	00	00	00	—	>A085 RUN MODE NOR
A086	Energy saving mode tuning	Range is 0.0 to 100 sec.	✔ ✔	50.0	50.0	50.0	sec.	>A086 RUN ECO 0050.0s

Optimal Accel/Decel Operation – This feature uses "fuzzy" logic to optimize acceleration and deceleration curves in real time. It is enabled by A085=02. Optimal accel/decel operation automatically adjusts the acceleration and deceleration times in response to changes in load or inertia to take advantage of the maximum output current capability of the inverter. In general, optimal accel/decel will allow for the shortest accel and decel times based on the actual load conditions. The function continuously monitors output current and DC bus voltage to avoid reaching their respective trip levels.

NOTE: In this mode, the settings of acceleration and deceleration times (F002 and F003) are disregarded.

Optimal Accel/Decel Operation, continued...

The acceleration time is controlled to maintain output current below the level set by the Overload Restriction Function if enabled (Parameters B021/B024, B022/B025, and B023/B026). If Overload Restriction is not enabled, then the current limit used is 150% of the inverter's rated output current.

The deceleration time is controlled so that the output current is maintained below 150% of the inverter's rated current, *and* the DC bus voltage is maintained below the OV Trip level (358V or 770V).

NOTE: DO NOT use Optimal Accel/Decel (A085 = 02) when an application...
- has a requirement for constant acceleration or deceleration
- has a load inertia more than (approx.) 20 times the motor inertia
- uses internal or external regenerative braking
- uses any of the vector control modes (A044 = 03, 04, or 05). This function is ONLY compatible with V/F control.

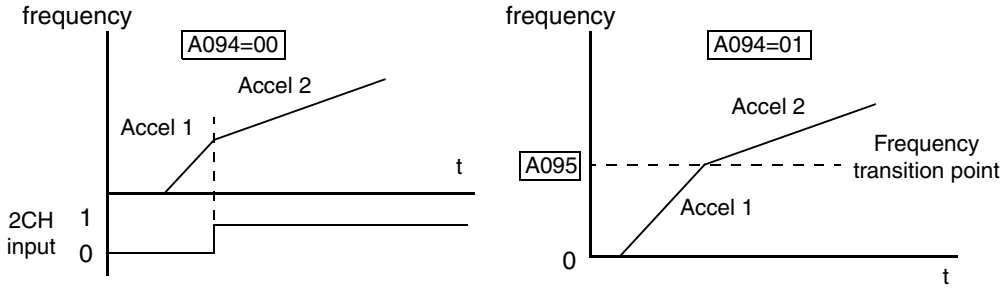
NOTE: If the load exceeds the rating of the inverter, the acceleration time may be increased.

NOTE: If using a motor with a capacity that is one size smaller than the inverter rating, enable the Overload Restriction function (B021/B024) and set the Overload Restriction Level (B022/B025) to 1.5 times the motor nameplate current.

NOTE: Be aware that the acceleration and deceleration times will vary, depending on the actual load conditions during each individual operation of the inverter.

Second Acceleration and Deceleration Functions

The SJ300 inverter features two-stage acceleration and deceleration ramps. This gives flexibility in the profile shape. You can specify the frequency transition point, the point at which the standard acceleration (F002) or deceleration (F003) changes to the second acceleration (A092) or deceleration (A093). These profile options are also available for the second motor settings and third motor settings. All acceleration and deceleration times are time to ramp from zero speed to full speed or full speed to zero speed. Select a transition method via A094 as depicted below. Be careful not to confuse the *second acceleration/deceleration settings* with settings for the *second motor*!

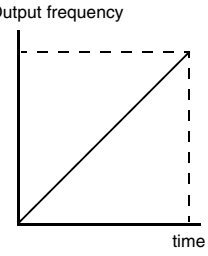
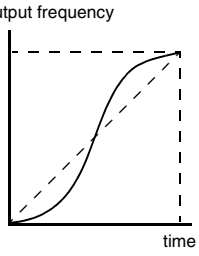
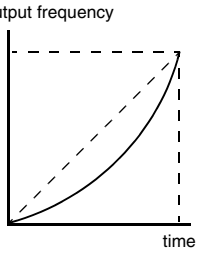
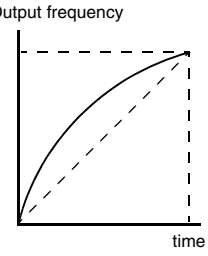
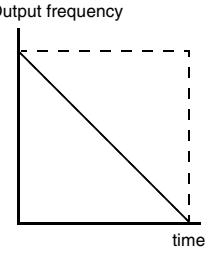
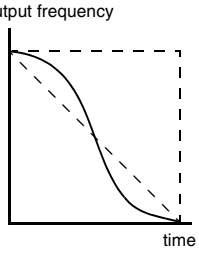
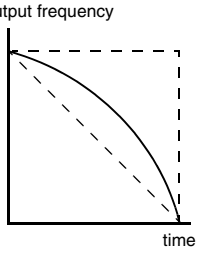
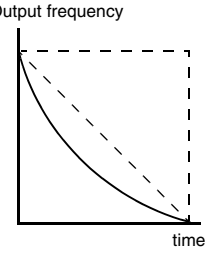


"A" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
A092	Acceleration (2) time setting	Duration of 2nd segment of acceleration, range is: 0.01 to 3600 sec.	✔ ✔	15.0	15.0	15.0	sec.	>A092 ACCEL TIME2 0015.00s
A292	Acceleration (2) time setting, 2nd motor	Duration of 2nd segment of acceleration, 2nd motor, range is: 0.01 to 3600 sec.	✔ ✔	15.0	15.0	15.0	sec.	>A292 2ACCEL TIME2 0015.00s
A392	Acceleration (2) time setting, 3rd motor	Duration of 2nd segment of acceleration, 2nd motor, range is: 0.01 to 3600 sec.	✔ ✔	15.0	15.0	15.0	sec.	>A392 3ACCEL TIME2 0015.00s
A093	Deceleration (2) time setting	Duration of 2nd segment of deceleration, range is: 0.01 to 3600 sec.	✔ ✔	15.0	15.0	15.0	sec.	>A093 DECEL TIME2 0015.00s
A293	Deceleration (2) time setting, 2nd motor	Duration of 2nd segment of deceleration, 2nd motor, range is: 0.01 to 3600 sec.	✔ ✔	15.0	15.0	15.0	sec.	>A293 2DECEL TIME2 0015.00s
A393	Deceleration (2) time setting, 3rd motor	Duration of 2nd segment of deceleration, 2nd motor, range is: 0.01 to 3600 sec.	✔ ✔	15.0	15.0	15.0	sec.	>A393 3DECEL TIME2 0015.00s
A094	Select method to switch to Acc2/Dec2 profile	Two options for switching from1st to 2nd accel/decel: 00 2CH input from terminal 01 transition frequency	✘ ✘	00	00	00	—	>A094 ACCEL CHANGE TM
A294	Select method to switch to Acc2/Dec2 profile, 2nd motor	Two options for switching from1st to 2nd accel/decel: 00 2CH input from terminal 01 transition frequency (2nd motor)	✘ ✘	00	00	00	—	>A294 ACCEL CHANGE TM
A095	Acc1 to Acc2 frequency transition point	Output frequency at which Accel1 switches to Accel2, range is 0.00 to 400.0 Hz	✘ ✘	0.0	0.0	0.0	Hz	>A095 ACCEL CHFr 0000.00Hz
A295	Acc1 to Acc2 frequency transition point, 2nd motor	Output frequency at which Accel1 switches to Accel2, range is 0.00 to 400.0 Hz (2nd motor)	✘ ✘	0.0	0.0	0.0	Hz	>A295 2ACCEL CHFr 0000.00Hz
A096	Dec1 to Dec2 frequency transition point	Output frequency at which Decel1 switches to Decel2, range is 0.00 to 400.0 Hz	✘ ✘	0.0	0.0	0.0	Hz	>A096 DECEL CHFr 0000.00Hz
A296	Dec1 to Dec2 frequency transition point, 2nd motor	Output frequency at which Decel1 switches to Decel2, range is 0.00 to 400.0 Hz (2nd motor)	✘ ✘	0.0	0.0	0.0	Hz	>A296 2DECEL CHFr 0000.00Hz

NOTE: For A095 and A096 (and for 2nd motor settings), if you set a very rapid Acc1 or Dec1 time (less than 1.0 second), the inverter may not be able to change rates to Acc2 or Dec2 before reaching the target frequency. In that case, the inverter decreases the rate of Acc1 or Dec1 in order to achieve the second ramp to the target frequency.

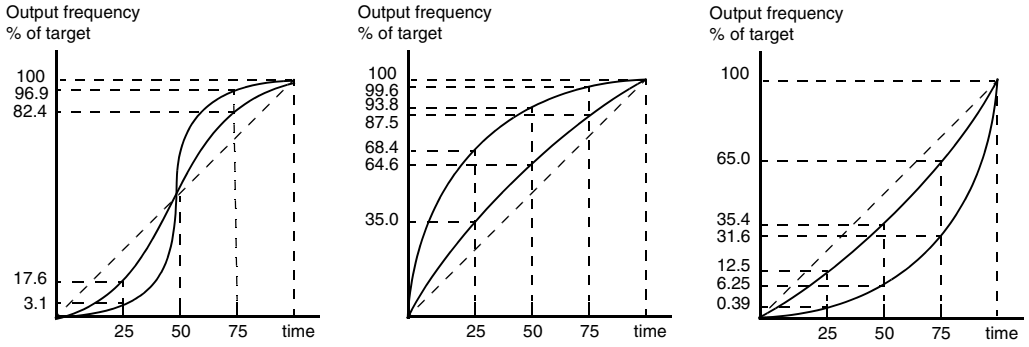
Accel/Decel Characteristics

Standard (default) acceleration and deceleration is linear with time. The inverter CPU can also calculate other curves shown in the graphs below. The sigmoid, U-shape, and reverse U-shape curves are useful for favoring the load characteristics in particular applications. Curve settings for acceleration and deceleration are independently selected via parameters A097 and A098, respectively. You can use the same or different curve types for acceleration and deceleration.

Set value	00	01	02	03
Curve	Linear	Sigmoid	U-shape	Reverse U-shape
Accel A97				
Decel A98				
Typical applications	Linear acceleration and deceleration for general-purpose use	Avoid jerk on start/stop for elevators; use for delicate loads on conveyors	Tension control for winding applications, web presses, roller/accumulators	

"A" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
A097	Acceleration curve selection	Set the characteristic curve of Accel1 and Accel2, four options: 00 Linear 01 S-curve 02 U-shape 03 Reverse U-shape	✘ ✘	00	00	00	—	>A097 ACCEL LINE Linear
A098	Deceleration curve selection	Set the characteristic curve of Decel1 and Decel2, four options: 00 Linear 01 S-curve 02 U-shape 03 Reverse U-shape	✘ ✘	00	00	00	—	>A098 DECEL LINE Linear

The acceleration and deceleration curves can deviate from a straight line to a varying degree. Parameters A131 and A132 control the amount of deviation for the acceleration and deceleration curves respectively. The following graphs show intermediate output frequency points as a percentage of the target frequency, for 25%, 50%, and 75% acceleration time intervals.



"A" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
A131	Acceleration curve constants setting	Sets the curve deviation from straight-line acceleration in ten levels: 01 smallest deviation 10 largest deviation	✘ ✔	02	02	02	—	>A131 ACCEL GAIN 02
A132	Deceleration curve constants setting	Sets the curve deviation from straight-line deceleration in ten levels: 01 smallest deviation 10 largest deviation	✘ ✔	02	02	02	—	>A132 DECEL GAIN 02

Additional Analog Input Settings

The parameters in the following table adjust the input characteristics of the analog inputs. When using the inputs to command the inverter output frequency, these parameters adjust the starting and ending ranges for the voltage or current, as well as the output frequency range. Related characteristic diagrams are located in "Analog Input Settings" on page 3–11.

"A" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
A101	[OI]–[L] input active range start frequency	The output frequency corresponding to the current input range starting point. Range is 0.00 to 400.0 Hz	✘ ✔	00.0	00.0	00.0	Hz	>A101 INPUT-OI EXS 0000.00Hz
A102	[OI]–[L] input active range end frequency	The output frequency corresponding to the current input range ending point. Range is 0.00 to 400.0 Hz	✘ ✔	00.0	00.0	00.0	Hz	>A102 INPUT-OI EXE 0000.00Hz
A103	[OI]–[L] input active range start current	The starting point for the current input range. Range is 0 to 100%	✘ ✔	20.	20.	20.	%	>A103 INPUT-OI EX%S 020%
A104	[OI]–[L] input active range end current	The ending point for the current input range. Range is 0 to 100%	✘ ✔	100.	100.	100.	%	>A104 INPUT-OI EX%E 100%
A105	[OI]–[L] input start frequency enable	Two options: 00 Use A101 start value 01 Use 0Hz	✘ ✔	01	01	01	Hz	>A105 INPUT-OI LEVEL 0Hz
A111	[O2]–[L] input active range start frequency	The output frequency corresponding to the bipolar voltage input range starting point. Range is –400. to 400. Hz	✘ ✔	0.00	0.00	0.00	Hz	>A111 INPUT-O2 EXS +000.00Hz
A112	[O2]–[L] input active range end frequency	The output frequency corresponding to the bipolar voltage input range ending point. Range is –400. to 400. Hz	✘ ✔	0.00	0.00	0.00	Hz	>A112 INPUT-O2 EXE +000.00Hz
A113	[O2]–[L] input active range start voltage	The starting point for the bipolar voltage input range. Range is –100 to 100%	✘ ✔	-100.	-100.	-100.	%	>A113 INPUT-O2 EX%S -100%
A114	[O2]–[L] input active range end voltage	The ending point for the bipolar voltage input range. Range is –100 to 100%	✘ ✔	100.	100.	100.	%	>A114 INPUT-O2 EX%E +100%

“B” Group: Fine-Tuning Functions

The “B” Group of functions and parameters adjust some of the more subtle but useful aspects of motor control and system configuration.

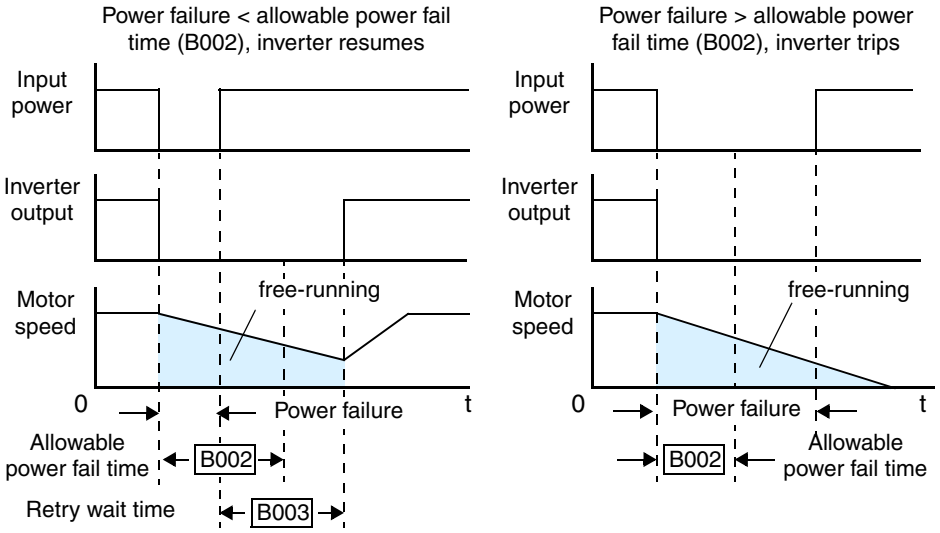
Automatic Restart Mode and Phase Loss

The restart mode determines how the inverter will resume operation after a fault causes a trip event. The four options provide advantages for various situations. Frequency matching allows the inverter to read the motor speed by virtue of its residual magnetic flux and restart the output at the corresponding frequency. The inverter can attempt a restart a certain number of times depending on the particular trip event:

- Over-current trip, restart up to 3 times
- Over-voltage trip, restart up to 3 times
- Under-voltage trip, restart up to 16 times

When the inverter reaches the maximum number of restarts (3 or 16), you must power-cycle the inverter to reset its operation.

Other parameters specify the allowable under-voltage level and the delay time before restarting. The proper settings depend on the typical fault conditions for your application, the necessity of restarting the process in unattended situations, and whether restarting is always safe.



“B” Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
B001	Selection of automatic restart mode	Select inverter restart method, four option codes: 00 Alarm output after trip, automatic restart disabled 01 Restart at 0Hz 02 Resume operation after frequency matching 03 Resume previous freq. after freq. matching, then decelerate to stop and display trip info	✘ ✔	00	00	00	—	>b001 IPS POWER ALM

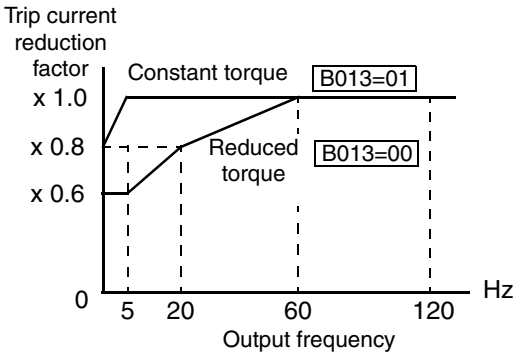
"B" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
B002	Allowable under-voltage power failure time	The amount of time a power input under-voltage can occur without tripping the power failure alarm. If under-voltage exists longer than this time, the inverter trips, even if the restart mode is selected. If it exists less than this time retry will be attempted. Range is 0.3 to 1.0 sec.	✘ ✔	1.0	1.0	1.0	sec.	>b002 IPS TIME 1.0s
B003	Retry wait time before motor restart	Time delay after a trip condition goes away before the inverter restarts the motor. Range is 0.3 to 100 seconds.	✘ ✔	1.0	1.0	1.0	sec.	>b003 IPS WAIT 001.0s
B004	Instantaneous power failure / under-voltage trip alarm enable	Three option codes: 00 Disable 01 Enable 02 Disable during stop and ramp to stop	✘ ✔	00	00	00	—	>b004 IPS TRIP OFF
B005	Number of restarts on power failure / under-voltage trip events	Two option codes: 00 Restart 16 times 01 Always restart	✘ ✔	00	00	00	—	>b005 IPS RETRY 16
B006	Phase loss detection enable	Two option codes: 00 Disable – no trip on phase loss 01 Enable – trip on phase loss	✘ ✔	00	00	00	—	>b006 PH-FAIL SELECT OFF
B007	Restart frequency threshold	When the frequency of the motor is less than this value, the inverter will restart at 0 Hz. Range is 0.00 to 400.0 Hz	✘ ✔	0.00	0.00	0.00	Hz	>b007 IPS F 0000.00Hz

CAUTION: When a loss of phase occurs, increased ripple current will markedly reduce main capacitor life over time. Diode bridge failure can also result. If phase loss occurs under load, the inverter could be damaged. Please pay particular attention to the setting of function B006.

Electronic Thermal Overload Alarm Setting

The thermal overload detection protects the inverter and motor from overheating due to an excessive load. It uses a current/inverse time curve to determine the trip point. The thermal overload alarm [THM] is the resulting intelligent output.

First, use B013 to select the torque characteristic that matches your load. This allows the inverter to utilize the best thermal overload characteristic for your application.

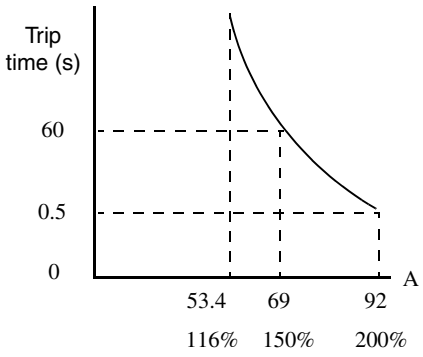


The torque developed in a motor is directly proportional to the current in the windings, which is also proportional to the heat generated (and temperature, over time). Therefore, you must set the thermal overload threshold in terms of current (amperes) with parameter B012. The range is 50% to 120% of the rated current for each inverter model. If the current exceeds the level you specify, the inverter will trip and log an event (error E5) in the history table. The inverter turns the motor output OFF when tripped. Separate settings are available for the second and third motors (if applicable), as shown in the table below.

Function Code	Function/Description	Data or Range
B012 / B212 / B312	Electronic thermal setting (calculated within the inverter from current output)	Range is 0.2 * rated current to 1.2 * rated current

For example, suppose you have inverter model SJ300-110LFE. The rated motor current is 46A. The setting range is (0.2 * 46) to (1.2 *46), or 9.2A to 55.2A. For a setting of B012 = 46A (current at 100%), the figure to the right shows the curve.

The electronic thermal characteristic adjusts the way the inverter calculates thermal heating, based on the type of load connected to the motor, as set by parameter B013.



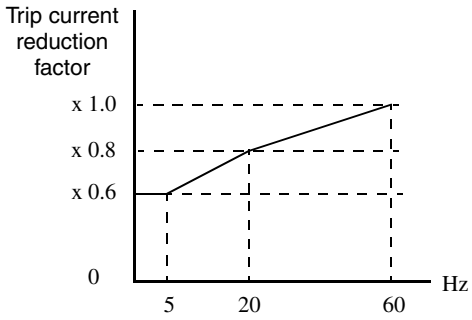
Trip current at 60 Hz

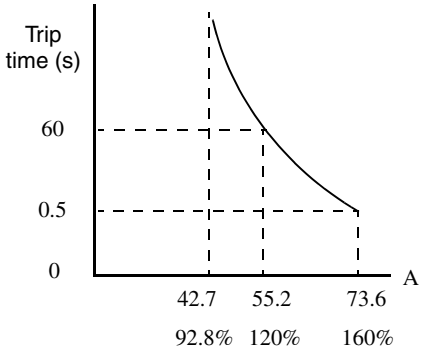
CAUTION: When the motor runs at lower speeds, the cooling effect of the motor's internal fan decreases.

The table below shows the torque profile settings. Use the one that matches your load.

Function Code	Data	Function/Description
B013 / B213 / B313	00	Reduced torque
	01	Constant torque
	02	Free-setting

Reduced Torque Characteristic – The example below shows the effect of the reduced torque characteristic curve (for example motor and current rating). At 20Hz, the output current is reduced by a factor of 0.8 for given trip times.

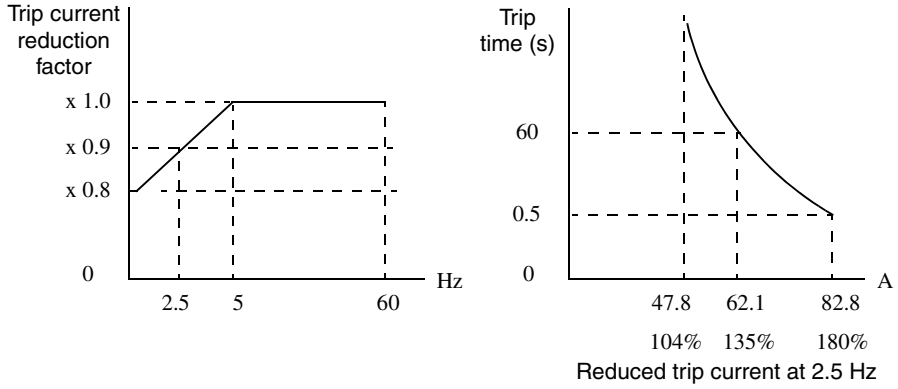




Reduced trip current at 20 Hz

Configuring Drive Parameters

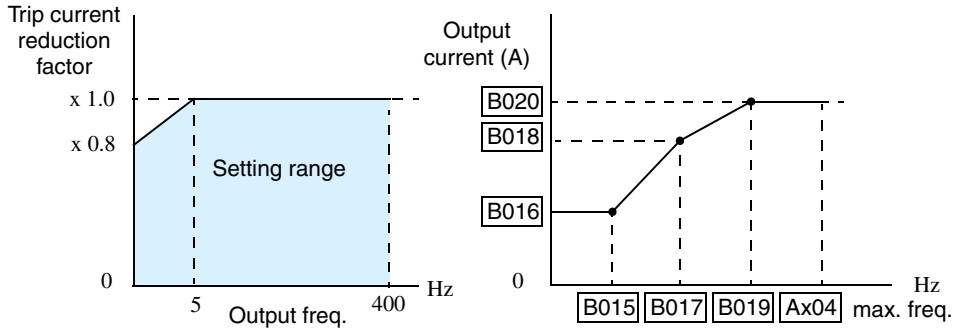
Constant Torque Characteristic – Selecting the constant torque characteristic for the example motor gives the curves below. At 2.5 Hz, the output current is reduced by a factor of 0.9 for given trip times.



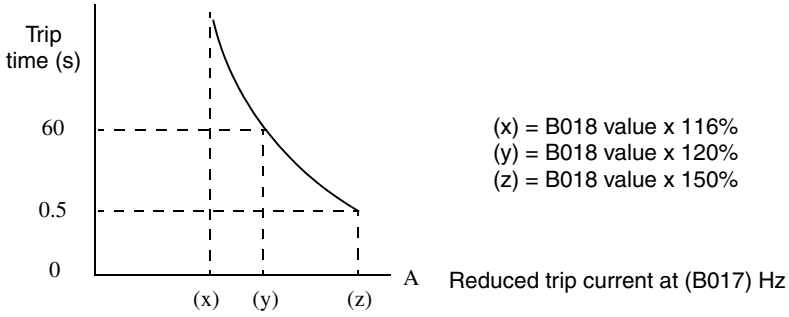
Free Thermal Characteristic - It is possible to set the electronic thermal characteristic using a free-form curve defined by three data points, according to the table below.

Function Code	Name	Description	Range
B015 / B017 / B019	Free-setting electronic thermal frequency 1, 2, 3	Data point coordinates for Hz axis (horizontal) in the free-form curve	0 to 400Hz
B016 / B018 / B020	Free setting electronic thermal current 1, 2, 3	Data point coordinates for Ampere axis (vertical) in the free-form curve	0.0 = (disable) 0.1 to 1000.

The left graph below shows the region for possible free-setting curves. The right graph below shows an example curve defined by three data points specified by B015 – B020.



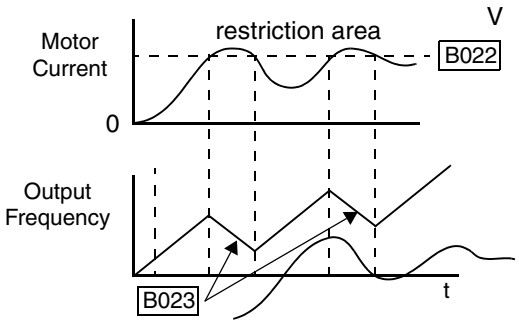
Suppose the electronic thermal setting (B012) is set to 44 Amperes. The left graph below shows the effect of the free setting torque characteristic curve. For example, at (B017) Hz, the output current level to cause overheating in a fixed time period is reduced by a factor of (B018). The right graph below shows the reduced trip current levels in those conditions for given trip times.



Any intelligent output terminal may be programmed to indicate a thermal warning [THM]. Parameter C061 determines the warning threshold. Please see “Thermal Warning Signal” on page 4–55 for more details.

“B” Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
B012	Level of electronic thermal setting	Set a level between 50% and 120% of the inverter rated current	✘ ✔	rated current for each inverter model			%	>b012 E-THM LEVEL 0016.5A
B212	Level of electronic thermal setting, 2nd motor	Set a level between 50% and 120% of the inverter rated current	✘ ✔	rated current for each inverter model			%	>b212 2E-THM LEVEL 0016.5A
B312	Level of electronic thermal setting, 3rd motor	Set a level between 50% and 120% of the inverter rated current	✘ ✔	rated current for each inverter model			%	>b312 3E-THM LEVEL 0016.5A
B013	Electronic thermal characteristic	Select from three curves, option codes: 00 Reduced torque 01 Constant torque 02 V/f free-setting	✘ ✔	01	01	00	—	>b013 E-THM CHAR CRT
B213	Electronic thermal characteristic, 2nd motor	Select from three curves, option codes: 00 Reduced torque 01 Constant torque 02 V/f free-setting	✘ ✔	01	01	00	—	>b213 2E-THM CHAR CRT
B313	Electronic thermal characteristic, 3rd motor	Select from three curves, option codes: 00 Reduced torque 01 Constant torque 02 V/f free-setting	✘ ✔	01	01	00	—	>b313 3E-THM CHAR CRT
B015	Free setting, electronic thermal frequency (1)	Range is 0.0 to 400.0 Hz	✘ ✔	0.	0.	0.	Hz	>b015 E-THM F1 0000Hz
B016	Free setting, electronic thermal current (1)	Range is 0.0 to 1000. A	✘ ✔	0.0	0.0	0.0	A	>b016 E-THM A1 0000.0A
B017	Free setting, electronic thermal frequency (2)	Range is 0.0 to 400.0 Hz	✘ ✔	0.	0.	0.	Hz	>b017 E-THM F2 0000Hz
B018	Free setting, electronic thermal current (2)	Range is 0.0 to 1000. A	✘ ✔	0.0	0.0	0.0	A	>b018 E-THM A2 0000.0A
B019	Free setting, electronic thermal frequency (3)	Range is 0.0 to 400.0 Hz	✘ ✔	0.	0.	0.	Hz	>b019 E-THM F3 0000Hz
B020	Free setting, electronic thermal current (3)	Range is 0.0 to 1000. A	✘ ✔	0.0	0.0	0.0	A	>b020 E-THM A3 0000.0A

Overload Restriction



If the inverter's output current exceeds a preset current level you specify during acceleration or constant speed, the overload restriction feature automatically reduces the output frequency to restrict the overload. This feature does not generate an alarm or trip event. You can instruct the inverter to apply overload restriction only during constant speed, thus allowing higher currents for acceleration. Or, you may use the same threshold for both acceleration and constant speed. In the case of controlled deceleration, the inverter monitors both output current and DC bus voltage. The inverter will increase output frequency to try to avoid a trip due to over-current or over-voltage (due to regeneration).

When the inverter detects an overload, it must decelerate the motor to reduce the current until it is less than the threshold. You can choose the rate of deceleration that the inverter uses to lower the output current.

"B" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
B021	Overload restriction operation mode	Select the operating mode during overload conditions, three options, option codes: 00 Disabled 01 Enabled for acceleration and constant speed 02 Enabled for constant speed only 03 Enabled for accel, decel, and constant speed	✘ ✔	01	01	01	—	>b021 OLOAD 1MODE ON
B022	Overload restriction setting	Sets the level for overload restriction, between 50% and 200% of the rated current of the inverter, setting resolution is 1% of rated current	✘ ✔	rated current times 1.50			A	>b022 OLOAD 1LEVEL 0024.8A
B023	Deceleration rate at overload restriction	Sets the deceleration rate when inverter detects overload, range is 0.1 to 30.0, resolution is 0.1.	✘ ✔	1.00	1.00	1.00	sec.	>b023 OLOAD 1CONST 01.00
B024	Overload restriction operation mode (2)	Select the operating mode motor during overload conditions, three options, option codes: 00 Disabled 01 Enabled for acceleration and constant speed 02 Enabled for constant speed only 03 Enabled for accel, decel, and constant speed	✘ ✔	01	01	01	—	>b024 OLOAD 2MODE ON

"B" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
B025	Overload restriction setting (2)	Sets the level for overload restriction (2), between 50% and 200% of the rated current of the inverter, setting resolution is 1% of rated current	✘ ✔	rated current times 1.50			A	>b025 OLOAD 2LEVEL 0024.8A
B026	Deceleration rate at overload restriction (2)	Sets the deceleration rate (2) when inverter detects overload, range is 0.1 to 30.0, resolution is 0.1.	✘ ✔	1.00	1.00	1.00	sec.	>b026 OLOAD 2CONST 01.00

NOTE: Two sets of overload restriction parameters are available. The set that is in use may be selected by means of an intelligent input terminal (see "Overload Restriction" on page 4–35).

Software Lock Mode

The software lock function keeps personnel from accidentally changing parameters in the inverter memory. Use B031 to select from various protection levels.

The table below lists all combinations of B031 option codes and the ON/OFF state of the [SFT] input. Each Check ✔ or Ex ✘ indicates whether the corresponding parameter(s) can be edited. The Standard Parameters column below lists Low and High level access for some lock modes. These refer to the parameter tables throughout this chapter, each of which includes a column titled *Run Mode Edit* as shown to the right. The two marks (Check ✔ or Ex ✘) under the “Lo Hi” subtitle indicate whether Low-level and/or High-level access applies to each parameter as defined in the table below. In some lock modes, you can edit only F001 and the Multi-speed parameter group that includes A020, A220, A320, A021–A035, and A038 (Jog). However, it does not include A019, Multi-speed operation selection. The editing access to B031 itself is unique, and is specified in the right-most two columns below.

Run Mode Edit Lo Hi	
✘ ✔	

B031 Lock Mode	[SFT] Intelligent Input	Standard Parameters		F001 and Multi-speed	B031	
		Stop	Run	Stop or Run	Stop	Run
00	OFF	✔	Low-level	✔	✔	✘
	ON	✘	✘	✘	✔	✘
01	OFF	✔	Low-level	✔	✔	✘
	ON	✘	✘	✔	✔	✘
02	(ignored)	✘	✘	✘	✔	✘
03	(ignored)	✘	✘	✔	✔	✘
10	(ignored)	✔	High-level	✔	✔	✔

NOTE: Since the software lock function B031 is always accessible when the motor is stopped, this feature is not the same as password protection used in other industrial control devices.

“B” Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–F (Jpn)		
B031	Software lock mode selection	Prevents parameter changes in five options: 00 Low-level access, [SFT] input blocks all edits 01 Low-level access, [SFT] input blocks edits (except F001 and Multi-speed parameters) 02 No access to edits 03 No access to edits except F001 and Multi-speed parameters 10 High-level access, including B031	✘ ✔	01	01	01	—	>b031 S-LOCK Mode MD1

NOTE: To disable parameter editing when using B031 lock modes 00 and 01, assign the [SFT] function to one of the intelligent input terminals. See “Software Lock” on page 4–25.

Miscellaneous Settings

The miscellaneous settings include scaling factors, initialization modes, and others. This section covers some of the most important settings you may need to configure.

"B" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
B034	Run/power-on warning time	Range is 0 to 65,530 hours	✘ ✔	0.	0.	0.	hrs.	>b034 TIME WARN 00000
B035	Rotational direction restriction	Three option codes: 00 Enable for both dir. 01 Enable for forward only 02 Enable for reverse only	✘ ✘	00	00	00	—	>b035 LIMIT F/R FREE
B036	Reduced voltage start selection	Seven option codes: 00 Short 01, 02, 03, 04, 05 (middle) 06 Long	✘ ✔	06	06	06	—	>b036 RVS ADJUST 06

Function Code Display Restriction – The inverter has the (optional) capability to suppress the display and editing of certain parameters. Use B037 to select the display options. The purpose of this feature is to hide particular secondary parameters that become unused or not applicable based on more fundamental parameter settings. For example, setting A001 = 01 configures the inverter to get its frequency command from the front keypad potentiometer. In this case, the inverter will not use the analog inputs nor their adjustment parameters for an external frequency command.

"B" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–F (Jpn)		
B037	Function code display restriction	Three option codes: 00 Display all 01 Display only utilized functions (see table below) 02 Display user-selected functions only (configure with U01 to U12)	✘ ✔	00	00	00	—	>b037 DISP Mode ALL

For example, you can set B037=01 to have the inverter suppress the displaying of all analog input parameters when A001=01, as shown in the first row of the following table.

Function Code	Data	Resulting Non-displayed Functions (when B37 = 01)	Notes
A001	01	A005, A006, A011 – A016, A101 – A114, C081 – C083, C121 – C123	[O], [OI], [O2] terminal functions
A002	01, 03, 04, 05	B087	Stop key function
A019	00	A028 – A035	Multi-speed function
C001 – C008	02, 03, 04, 05		

Function Code	Data	Resulting Non-displayed Functions (when B37 = 01)	Notes
A044, A244	02	B100 – B113	Control methods
A051	01	A052 – A059	DC braking
A071	01	A072 – A076, C044	PID function
A094	01	A095 – A096	2-stage adjustable frequency
A294	01	A0295 – A296	
B013, B213, B313	02	B015 – B020	Electric thermal characteristic
B021	01, 02	B022, B023	Overload restriction
B024	01, 02	B025, B026	Overload restriction 2
B095	01, 02	B090 – B096	Dynamic braking function
C001 – C008	06	A038, A039	Jogging
	08	F202, F203, A203, A204, A220, A241 – A244, A261, A262, A292 – A296, B212, B213, H202 – H206, H220 – H224, H230 – H234, H250 – H252, H260	2nd motor control
	11	B088	Free-run stop
	17	F302, F303, A303, A304, A320, A342 – A344, A392, A393, B312, B313, H306	3rd motor control
	18	C102	Reset
	27, 28, 29	C101	UP/DWN
A044	00, 01	A041 – A043	Torque boost function
	04	H060	0Hz domain SLV limiter
A244	00, 01	A241 – A243	Torque boost function
	04	H260	0Hz SLV limiter
A044	03, 04, 05	B040 – B046, H001, H070 – H072, H002, H005, H020 – H024, H030 – H034, H050 – H052, H060	Vector control
A244	03, 04	B040 – B046, H001, H070 – H072, H202, H205, H220 – H224, H230 – H234, H250 – H252, H260	Vector control
A097	01, 02, 03	A131	Acceleration pattern constant
A098	01, 02, 03	A132	Deceleration pattern constant
B098	01, 02	B099, C085	Thermistor function
B050	01	B051 – B054	Instantaneous power failure
B120	01	B121 – B126	External brake control

Function Code	Data	Resulting Non-displayed Functions (when B37 = 01)	Notes
C021 – C025, C026	02, 06	C042, C043	Frequency arrival signal
	03	C040, C041	Overload advance notice
	07	C055 – C058	Over-torque
	21	C063	Zero-speed detection signal
	24, 25	C045, C046	Frequency arrival signal
	26	C011	Overload advance notice 2
H002	00	H020 – H024	Motor constant
	01, 02	H030 – H034	Motor constant (auto-tuning)
H202	00	H220 – H224	Motor constant
	01, 02	H023 – H0234	Motor constant (auto-tuning)
P010	01	P011 – P023, P025 – P027	Expansion card function

"B" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
B040	Torque limit selection	Five option codes: 00 4-quadrant mode 01 Selected by 2 input terminals (see p. 4–37) 02 From analog [O2] input (0 to 10V = 0 to 200%) 03 From expansion card 1 04 From expansion card 2	✘ ✔	00	00	00	—	>b040 TRQ-LIMIT Mode 4-SET
B041	Torque limit (1) (forward-driving in 4-quadrant mode)	Range is 0 to 200% (torque limit disabled)	✘ ✔	150.	150.	150.	%	>b041 RQ-LIMIT LEVEL1 150%
B042	Torque limit (2) (reverse-regenerating in 4-quadrant mode)	Range is 0 to 200% (torque limit disabled)	✘ ✔	150.	150.	150.	%	>b042 TRQ-LIMIT LEVEL2 150%
B043	Torque limit (3) (reverse-driving in 4-quadrant mode)	Range is 0 to 200% (torque limit disabled)	✘ ✔	150.	150.	150.	%	>b043 TRQ-LIMIT LEVEL3 150%
B044	Torque limit (4) (forward-regenerating in 4-quadrant mode)	Range is 0 to 200% (torque limit disabled)	✘ ✔	150.	150.	150.	%	>b044 TRQ-LIMIT LEVEL4 150%
B045	Torque limit LADSTOP enable	Temporarily stops accel/decel ramps during torque limit. Available for SLV, 0 Hz domain, or vector control with feedback mode. Two option codes: 00 Disable 01 Enable	✘ ✔	00	00	00	—	>b045 TRQ-LIMIT SELECT OFF

"B" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
B046	Reverse Run protection enable	Prohibits reverse motor rotation. Two option codes: 00 Disable 01 Enable	✘ ✔	00	00	00	—	>b046 LIMIT PREV OFF

Controlled Deceleration at Power Loss – When enabled, this feature permits the inverter to control final motor deceleration upon loss of inverter input power. First, you must make a wiring change to the inverter. See "Optional Controlled Decel and Alarm at Power Loss" on page 4–4 for complete instructions including wiring and signal timing diagrams for using the *controlled deceleration at power loss* feature.

After making the wiring change, use function B050 to enable the feature. Use B051 to determine the point at which a decaying DC bus voltage will trigger the controlled deceleration. Use parameter B054 to specify an initial step-wise deceleration at power loss, and B053 to specify the duration of the linear deceleration.

During the controlled deceleration the inverter itself acts as a load to decelerate the motor. With either a high-inertia load or a short deceleration time (or both), it is possible that the inverter impedance will not be low enough to continue linear deceleration and avoid an over-voltage condition on the DC bus. Use parameter B052 to specify a threshold for the over-voltage. In this case, the inverter pauses deceleration (runs at constant speed). When the DC bus decays again below the threshold, linear deceleration resumes. The pause/resume process will repeat as necessary until the DC bus energy is depleted (under-voltage condition occurs).

"B" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
B050	Controlled deceleration and stop on power loss	Allows inverter control using regenerative energy to decelerate after loss of input power (requires jumper change) Two option codes: 00 Disable 01 Enable	✘ ✘	00	00	00	—	>b050 IPS-DECEL Mode OFF
B051	DC bus voltage trigger level during power loss	Sets trigger for controlled deceleration and stop on power loss function. Range is 0.0 to 1000.V	✘ ✘	0.0	0.0	0.0	VDC	>b051 IPS-DECEL V1 0000.0Vdc
B052	Over-voltage threshold during power loss	Sets over-voltage threshold for controlled deceleration function. Range is 0.0 to 1000.V	✘ ✘	0.0	0.0	0.0	VDC	>b052 IPS-DECEL V2 0000.0Vdc
B053	Deceleration time setting during power loss	Range is 0.01 to 99.99 sec. / 100.0 to 999.9 sec. / 1000 to 3600 sec.	✘ ✘	1.00	1.00	1.00	sec.	>b053 IPS-DECEL TIME 0001.00s
B054	Initial output frequency decrease during power loss	Sets the initial decrease in output frequency upon power loss. Range is 0.00 to 10.00 Hz	✘ ✘	0.00	0.00	0.00	Hz	>b054 IPS-DECEL DEC-F 00.00Hz

Miscellaneous functions, continued...

B083: Carrier frequency adjustment – The internal *switching frequency* of the inverter circuitry (also called the *chopper frequency*). It is called the carrier frequency because the lower AC output frequency of the inverter "rides" the carrier. The faint, high-pitched sound you hear when the inverter is in Run Mode is characteristic of switching power supplies in general. The carrier frequency is adjustable from 500 Hz to 15 kHz (the upper limit varies, depending on the inverter rating). The audible sound decreases at the higher frequencies, but RFI noise and leakage current may be increased. Refer to the specification derating curves in Chapter 1 to determine the maximum allowable carrier frequency setting for your particular inverter and environmental conditions.

NOTE: When the inverter is in sensorless vector mode, use B083 to set the carrier frequency greater than 2.1 kHz for proper operation.

NOTE: The carrier frequency setting must stay within specified limits for inverter-motor applications that must comply with particular regulatory agencies. For example, a European CE-approved application requires the inverter carrier to be less than 5 kHz.

B084, B085: Initialization codes – These functions allow you to restore the factory default settings. Please refer to "Restoring Factory Default Settings" on page 6–9.

B086: Frequency display scaling – You can convert the output frequency monitor on D001 to a scaled number (engineering units) monitored at function D007. For example, the motor may run a conveyor that is monitored in feet per minute. Use this formula:

$$\text{Scaled output frequency (D007)} = \text{Output frequency (D001)} \times \text{Factor (B086)}$$

"B" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
B080	[AM] terminal analog meter adjustment	Adjust 8-bit gain to analog meter connected to terminal [AM], range is 0 to 255	✔ ✔	180	180	180	—	>b080 AM-MONITOR ADJUST 180
B081	[FM] terminal analog meter adjustment	Adjust 8-bit gain to analog meter connected to terminal [FM], range is 0 to 255	✔ ✔	60	60	60	—	>b081 FM-MONITOR ADJUST 060
B082	Start frequency adjustment	Sets the starting frequency for the inverter output, range is 0.10 to 9.99 Hz	✘ ✔	0.50	0.50	0.50	Hz	>b082 fmin F 00.50Hz
B083	Carrier frequency setting	Sets the PWM carrier (internal switching frequency) Range is 0.5 to 15.0 kHz, or 0.5 to 10 kHz when derated	✘ ✔	5.0	5.0	5.0	kHz	>b083 CARRIER F 05.0kHz
B084	Initialization mode (parameters or trip history)	Select the type of initialization to occur, two option codes: 00 Trip history clear 01 Parameter initialization 02 Trip history clear and parameter initialization	✘ ✘	00	00	00	—	>b084 INITIAL MODE TRP

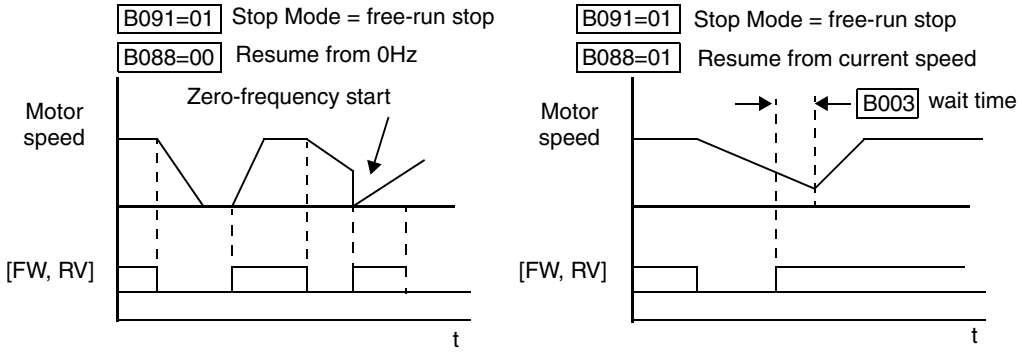
"B" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
B085	Country code for initialization	Select default parameter values for country on initialization, four option codes: 00 Japan version 01 Europe version 02 US version 03 reserved (do not set)	✘ ✘	01	02	00	—	>b085 INITIAL SELECT USA
B86	Frequency scaling conversion factor	Specify a constant to scale D007 to display in engineering units. Range is 0.1 to 99.9	✔ ✔	1.0	1.0	1.0	—	>b086 F-CONV Gain 001.0
B087	STOP key enable	Select whether the STOP key on the keypad is enabled (req. A002=01, 03, 04, or 05). Two option codes: 00 Enable 01 Disable	✘ ✔	00	00	00	—	>b087 STOP-SW SELECT ON

B091/B088: Stop Mode / Restart Mode Configuration – You can configure how the inverter performs a standard stop (each time Run FWD and REV signals turn OFF). Setting B091 determines whether the inverter will control the deceleration, or whether it will perform a free-run stop (coast to a stop). When using the free-run stop selection, it is imperative to also configure how you want the inverter to resume control of motor speed. Setting B088 determines whether the inverter will ensure the motor always resumes at 0 Hz, or whether the motor resumes from its current coasting speed (also called *frequency matching*). The Run command may turn OFF briefly, allowing the motor to coast to a slower speed from which normal operation can resume.

In most applications a controlled deceleration is desirable, corresponding to B091=00. However, applications such as HVAC fan control will often use a free-run stop (B091=01). This practice decreases dynamic stress on system components, prolonging system life. In this case, you will typically set B088=01 in order to resume from the current speed after a free-run stop (see diagram below, right). Note that using the default setting, B088=00, can cause trip events when the inverter attempts to force the load quickly to zero speed.

NOTE: Other events can cause (or be configured to cause) a free-run stop, such as power loss (see "Automatic Restart Mode and Phase Loss" on page 3–29), and inverter trip events in general (see "Miscellaneous Functions" on page 3–61). If all free-run stop behavior is important to your application (such as HVAC), be sure to configure each event accordingly.

Some additional parameters further configure all instances of a free-run stop. Parameter B003, Retry Wait Time Before Motor Restart, sets the minimum time the inverter will free-run. For example, if B003 = 4 seconds (and B091=01) and the cause of the free-run stop lasts 10 seconds, the inverter will free-run (coast) for a total of 14 seconds before driving the motor again. Parameter B007, Restart Frequency Threshold, sets the motor frequency at which the inverter will no longer resume and accelerate, instead resuming from 0 Hz (complete stop).



"B" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
B088	Restart mode after FRS	Selects how the inverter resumes operation when the free-run stop (FRS) is cancelled, two option codes: 00 Restart from 0Hz 01 Restart from frequency detected from actual speed of motor	✘ ✔	00	00	00	—	>b088 RUN FRS ZST

"B" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
B090	Dynamic braking usage ratio	Selects the braking duty cycle for the dynamic braking resistor (total brake % ON-time per 100 sec. interval). Range is 0.0 to 100.0% 0% Dynamic braking disabled >0% Enabled, per value	✘ ✔	00	00	00	—	>b090 BRD %ED 000.0%
B091	Stop mode selection	Selects how the inverter stops the motor, two option codes: 00 DEC (decelerate and stop) 01 FRS (free run to stop)	✘ ✘	00	00	00	—	>b091 RUN STOP DEC
B092	Cooling fan control (see note below)	Two option codes: 00 Fan always ON 01 Fan ON during RUN, OFF during STOP	✘ ✘	00	00	00	—	>b092 INITIAL FAN-CTL OFF
B095	Dynamic braking control	Three option codes: 00 Disable 01 Enable during RUN only 02 Enable always	✘ ✔	00	00	00	—	>b095 BRD Mode OFF
B096	Dynamic braking activation level	Range is: 330 to 380V (200V class), 660 to 760V (400V class)	✘ ✔	360/ 720	360/ 720	360/ 720	V	>b096 BRD LEVEL 360Vdc
B098	Thermistor for thermal protection control	Three option codes: 00 Disable 01 Enable-PTC thermistor 02 Enable-NTC thermistor	✘ ✔	00	00	00	—	>b098 THERM SELECT OFF
B099	Thermal protection level setting	Thermistor resistance threshold at which trip occurs. Range is 0.0 to 9999 Ohms	✘ ✔	3000	3000	3000	Ohms	>b099 THERM LEVEL 3000ohm

B090: Dynamic braking usage ratio – This parameter limits the amount of time the inverter can use the dynamic braking accessory device without entering the Trip Mode. Please refer to "Dynamic Braking" on page 5–6 for more information on dynamic braking accessories.

NOTE: When cooling fan control is enabled (B092=01) the inverter always turns the fan ON for 5 minutes immediately after powerup. This will cool the inverter in case the inverter / motor is still warm from prior running before a short power outage.

Free-setting V/f Pattern

The free-setting V/f inverter mode of operation uses voltage and frequency parameter pairs to define seven points on a V/f graph. This provides a way to define a multi-segment V/f curve that best suits your application.

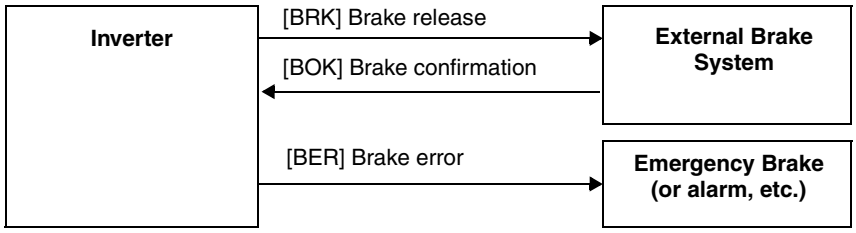
The frequency settings do require that F1 ≤ F2 ≤ F3 ≤ F4 ≤ F5 ≤ F6 ≤ F7; their values must have this ascending order relationship. To satisfy this criterion during initial parameter editing, set F7 (B012) and work backwards when setting these values, since the defaults are all 0 Hz. However, the voltages V1 to V7 may either increase or decrease from one to the next. Therefore, you may set these parameters in any order.

"B" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
B100	Free-setting V/f frequency (1)	V/f point 1, frequency coordinate	✘ ✘	0.	0.	0.	Hz	>b101 FREE-V/F V1 000.0V
B101	Free-setting V/f voltage (1)	V.F point 1, voltage coordinate	✘ ✘	0.0	0.0	0.0	V	>b102 FREE-V/F F1 0000Hz
B102	Free-setting V/f frequency (2)	V/f point 2, frequency coordinate	✘ ✘	0.	0.	0.	Hz	>b103 FREE-V/F V2 000.0V
B103	Free-setting V/f voltage (2)	V.F point 2, voltage coordinate	✘ ✘	0.0	0.0	0.0	V	>b104 FREE-V/F F2 0000Hz
B104	Free-setting V/f frequency (3)	V/f point 3, frequency coordinate	✘ ✘	0.	0.	0.	Hz	>b105 FREE-V/F V3 000.0V
B105	Free-setting V/f voltage (3)	V.F point 3, voltage coordinate	✘ ✘	0.0	0.0	0.0	V	>b106 FREE-V/F F3 0000Hz
B106	Free-setting V/f frequency (4)	V/f point 4, frequency coordinate	✘ ✘	0.	0.	0.	Hz	>b107 FREE-V/F V4 000.0V
B107	Free-setting V/f voltage (4)	V.F point 4, voltage coordinate	✘ ✘	0.0	0.0	0.0	V	>b108 FREE-V/F F4 0000Hz
B108	Free-setting V/f frequency (5)	V/f point 5, frequency coordinate	✘ ✘	0.	0.	0.	Hz	>b109 FREE-V/F V5 000.0V
B109	Free-setting V/f voltage (5)	V.F point 5, voltage coordinate	✘ ✘	0.0	0.0	0.0	V	>b110 FREE-V/F F5 0000Hz
B110	Free-setting V/f frequency (6)	V/f point 6, frequency coordinate	✘ ✘	0.	0.	0.	Hz	>b111 FREE-V/F V6 000.0V
B111	Free-setting V/f voltage (6)	V.F point 6, voltage coordinate	✘ ✘	0.0	0.0	0.0	V	>b112 FREE-V/F F6 0000Hz
B112	Free-setting V/f frequency (7)	V/f point 7, frequency coordinate	✘ ✘	0.	0.	0.	Hz	>b113 FREE-V/F V7 000.0V
B113	Free-setting V/f voltage (7)	V.F point 7, voltage coordinate	✘ ✘	0.0	0.0	0.0	V	>b114 FREE-V/F F7 0000Hz

External Brake Control

The brake control function in the inverter controls external braking used in systems such as elevators. The purpose of this function is to ensure the inverter is powering the motor before releasing external brakes that would permit the load to move or coast. This function requires the configuration and wiring of intelligent input and output terminals. See "External Brake Control Function" on page 4–39 for more information.

"B" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
B120	Brake Control Enable	Two option codes: 00 Enable) 01 Disable	✘ ✔	00	00	00	—	>b120 BRAKE Mode OFF
B121	Brake Wait Time for Release	Sets time delay between arrival at release frequency and the brake release signal. Range is 0.00 to 5.00 sec.	✘ ✔	0.00	0.00	0.00	sec.	>b121 BRAKE STA-WAIT 0.00s
B122	Brake Wait Time for Acceleration	Sets time delay after brake confirmation signal is received until the inverter begins acceleration Range is 0.00 to 5.00 sec.	✘ ✔	0.00	0.00	0.00	sec.	>b122 BRAKE ACC-WAIT 0.00s
B123	Brake Wait Time for Stopping	Sets time delay after brake confirmation signal turns OFF until decelerating the inverter to 0 Hz. Range is 0.00 to 5.00 sec.	✘ ✔	0.00	0.00	0.00	sec.	>b123 BRAKE STP-WAIT 0.00s
B124	Brake Wait Time for Confirmation	Sets the wait time for confirmation after turn ON/OFF of brake release. If confirmation is not received during the specified wait time, the inverter will trip with an external brake error. Range is 0.00 to 5.00 sec.	✘ ✔	0.00	0.00	0.00	sec.	>b124 BRAKE BRK-WAIT 0.00s
B125	Brake Release Frequency Setting	Sets the frequency at which the inverter will output the brake release signal after delay set by B121. Range is 0.00 to 99.99 / 100.0 to 400.0Hz	✘ ✔	0.00	0.00	0.00	Hz	>b125 BRAKE OPEN-F 000.00Hz
B126	Brake Release Current Setting	Sets the minimum inverter current level above which the brake release signal will be permitted. Range is 0% to 200% of rated current	✘ ✔	Rated current for each inverter model			A	>b126 BRAKE OPEN-A 00.16.5A



“C” Group: Intelligent Terminal Functions

The eight input terminals **[1]**, **[2]**, **[3]**, **[4]**, **[5]**, **[6]**, **[7],** and **[8]** can be configured for any of 44 different functions. The next two tables show how to configure the eight terminals. The inputs are logical, in that they are either OFF or ON. We define these states as OFF=0, and ON=1.

The inverter comes with default options for the eight terminals. These default settings are initially unique, each one having its own setting. Note that European and US versions have different default settings. You can use any option on any terminal, and even use the same option twice to create a logical OR (though usually not required).

Input Terminal Configuration

Functions and Options –The *function codes* in the following table let you assign one of 44 options to any of the eight logic inputs for the SJ300 inverters. The functions C001 through C008 configure the terminals [1] through [8] respectively. The “value” of these particular parameters is not a scalar value, but it is a discrete number that selects one option from many available *options*.

For example, if you set function C001=01, you have assigned option 01 (Reverse Run) to terminal [1]. The option codes and the specifics of how each one works are in Chapter 4.

“C” Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
C001	Terminal [1] function	44 programmable functions available for terminals (see next section)	✘ ✔	18 [RS]	18 [RS]	18 [RS]	—	>C001 IN-TM 1 RS
C002	Terminal [2] function		✘ ✔	16 [AT]	16 [AT]	16 [AT]	—	>C002 IN-TM 2 AT
C003	Terminal [3] function		✘ ✔	06 [JG]	06 [JG]	06 [JG]	—	>C003 IN-TM 3 JG
C004	Terminal [4] function		✘ ✔	11 [FRS]	11 [FRS]	11 [FRS]	—	>C004 IN-TM 4 FRS
C005	Terminal [5] function		✘ ✔	09 [2CH]	09 [2CH]	09 [2CH]	—	>C005 IN-TM 5 2CH
C006	Terminal [6] function		✘ ✔	03 [CF2]	13 [USP]	03 [CF2]	—	>C006 IN-TM 6 USP
C007	Terminal [7] function		✘ ✔	02 [CF1]	02 [CF1]	02 [CF1]	—	>C007 IN-TM 7 CF1
C008	Terminal [8] function		✘ ✔	01 [RV]	01 [RV]	01 [RV]	—	>C008 IN-TM 8 RV

The input logic convention is programmable for each of the six inputs. Most inputs default to normally open (active high), but you can select normally closed (active low) in order to invert the sense of the logic.

“C” Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
C011	Terminal [1] active state	Select logic convention, two option codes: 00 normally open N.O. 01 normally closed N.C.	✘ ✔	00	00	00	—	>C011 IN-TM O/C-1 NO
C012	Terminal [2] active state		✘ ✔	00	00	00	—	>C012 IN-TM O/C-2 NO
C013	Terminal [3] active state		✘ ✔	00	00	00	—	>C013 IN-TM O/C-3 NO
C014	Terminal [4] active state		✘ ✔	00	00	00	—	>C014 IN-TM O/C-4 NO
C015	Terminal [5] active state		✘ ✔	00	00	00	—	>C015 IN-TM O/C-5 NO
C016	Terminal [6] active state		✘ ✔	00	01	00	—	>C016 IN-TM O/C-6 NO
C017	Terminal [7] active state		✘ ✔	00	00	00	—	>C017 IN-TM O/C-7 NO
C018	Terminal [8] active state		✘ ✔	00	00	00	—	>C018 IN-TM O/C-8 NO
C019	Terminal [FW] active state		✘ ✔	00	00	00	—	>C019 IN-TM O/C-FW NO

NOTE: An input terminal configured for option code 18 ([RS] Reset command) cannot be configured for normally closed operation.

Intelligent Input Terminal Overview

Each of the eight intelligent terminals may be assigned any of the options in the following table. When you program one of the option codes for terminal assignments C001 to C008, the respective terminal assumes the function role of that option code. The terminal functions have a symbol or abbreviation, which we use to label a terminal using that function. For example the "Reverse Run" command is [RV]. The physical label on the terminal block connector is simply **1**, **2**, **3**, **4**, **5**, **6, 7, or 8**. However, schematic examples in this manual also use the terminal function symbol (such as [RV]) to show the assigned option. The option codes for C011 to C019 determine the active state of the logical input (active high or active low).

Summary Table - This table shows all forty-four intelligent input functions at a glance. Detailed descriptions of these functions, related parameters and settings, and example wiring diagrams are in "Using Intelligent Input Terminals" on page 4–11.

Input Function Summary Table

Option Code	Terminal Symbol	Function Name	Description	
01	RV	Reverse Run/Stop	ON	Inverter is in Run Mode, motor runs reverse
			OFF	Inverter is in Stop Mode, motor stops
02	CF1	Multi-speed select, Bit 0 (LSB)	ON	Binary encoded speed select, Bit 0, logical 1
			OFF	Binary encoded speed select, Bit 0, logical 0
03	CF2	Multi-speed select, Bit 1	ON	Binary encoded speed select, Bit 1, logical 1
			OFF	Binary encoded speed select, Bit 1, logical 0
04	CF3	Multi-speed select, Bit 2	ON	Binary encoded speed select, Bit 2, logical 1
			OFF	Binary encoded speed select, Bit 2, logical 0
05	CF4	Multi-speed select, Bit 3 (MSB)	ON	Binary encoded speed select, Bit 3, logical 1
			OFF	Binary encoded speed select, Bit 3, logical 0
06	JG	Jogging	ON	Inverter is in Run Mode, output to motor runs at jog parameter frequency A038
			OFF	Inverter is in Stop Mode
07	DB	External DC Braking	ON	DC braking will be applied during deceleration
			OFF	DC braking will not be applied
08	SET	Set (select) 2nd Motor Data	ON	The inverter uses 2nd motor parameters for generating frequency output to motor
			OFF	The inverter uses 1st (main) motor parameters for generating frequency output to motor
09	2CH	2-stage Acceleration and Deceleration	ON	Frequency output uses 2nd-stage acceleration and deceleration values
			OFF	Frequency output uses standard acceleration and deceleration values
11	FRS	Free-run Stop	ON	Causes output to turn OFF, allowing motor to free run (coast) to stop
			OFF	Output operates normally, so controlled deceleration stops motor
12	EXT	External Trip	ON	When assigned input transitions OFF to ON, inverter latches trip event and displays E12
			OFF	No trip event for ON to OFF transition; any recorded trip events remain in history until Reset

Input Function Summary Table				
Option Code	**Terminal Symbol**	**Function Name**	**Description**	
13	USP	Unattended Start Protection	ON	On powerup, the inverter will not resume a Run command (mostly used in the US)
			OFF	On powerup, the inverter will resume a RUN command that was active before power loss
14	CS	Commercial Power Source	ON	OFF-to-ON transition signals the inverter that the motor is already running at powerup (via bypass), thus suppressing the inverter's motor output in Run Mode
			OFF	ON-to-OFF transition signals the inverter to apply a time delay (B003), frequency match its output to existing motor speed, and resume normal Run Mode operation
15	SFT	Software Lock	ON	The keypad and remote programming devices are prevented from changing parameters
			OFF	The parameters may be edited and stored
16	AT	Analog Input Voltage/ current Select	ON	Terminal [OI] is enabled for current input (uses terminal [L] for signal return)
			OFF	Terminal [O] is enabled for voltage input (uses terminal [L] for signal return)
17	SET3	Set (select) 3rd motor data	ON	The inverter uses 3rd motor parameters for generating frequency output to motor
			OFF	The inverter uses 1st (main) motor parameters for generating frequency output to motor
18	RS	Reset Inverter	ON	The trip condition is reset, the motor output is turned OFF, and powerup reset is asserted
			OFF	Normal power-on operation
20	STA	START (3-wire interface)	ON	Starts the motor rotation
			OFF	No change to present motor status
21	STP	STOP (3-wire interface)	ON	Stops the motor rotation
			OFF	No change to present motor status
22	F/R	FWD, REV (3-wire interface)	ON	Selects the direction of motor rotation: ON = FWD. While the motor is rotating, a change of F/R will start a deceleration, followed by a change in direction.
			OFF	Selects the direction of motor rotation: OFF =REV. While the motor is rotating, a change of F/R will start a deceleration, followed by a change in direction.
23	PID	PID Disable	ON	Temporarily disables PID loop control. Inverter output turns OFF as long as PID Enable is active (A071=1).
			OFF	Has no effect on PID loop operation, which operates normally if PID Enable is active (A071 = 1).
24	PIDC	PID Reset	ON	Resets the PID loop controller. The main consequence is that the integrator sum is forced to zero.
			OFF	No effect on PID loop controller

Input Function Summary Table				
Option Code	**Terminal Symbol**	**Function Name**	**Description**	
26	CAS	Control gain setting	ON	Selects alternate parameters H070 to H072 for the source of the internal speed loop gain
			OFF	Selects parameters H050 to H052 (or H250 to H252 for 2nd motor) for the source of internal speed loop gain
27	UP	Remote Control UP Function (motorized speed pot.)	ON	Accelerates (increases output frequency) motor from current frequency
			OFF	No change to output frequency
28	DWN	Remote Control DOWN Function (motorized speed pot.)	ON	Decelerates (decreases output frequency) motor from current frequency
			OFF	No change to output frequency
29	UDC	Remote Control Data Clearing	ON	Clears the UP/DWN frequency memory by forcing it to equal the set frequency parameter F001. Setting C101 must be set=00 to enable this function to work.
			OFF	UP/DWN frequency memory is not changed
31	OPE	Operator Control	ON	Forces the source of the output frequency setting (A001) and the source of the RUN command (A002) to be from the digital operator
			OFF	Source of output frequency set by (A001) and source of run command set by (A002) is used
32	SF1	Multispeed bit 1	ON	Logical 1
			OFF	Logical 0
33	SF2	Multispeed bit 2	ON	Logical 1
			OFF	Logical 0
34	SF3	Multispeed bit 3	ON	Logical 1
			OFF	Logical 0
35	SF4	Multispeed bit 4	ON	Logical 1
			OFF	Logical 0
36	SF5	Multispeed bit 5	ON	Logical 1
			OFF	Logical 0
37	SF6	Multispeed bit 6	ON	Logical 1
			OFF	Logical 0
38	SF7	Multispeed bit 7	ON	Logical 1
			OFF	Logical 0
39	OLR	Overload restriction	ON	Selects current overload parameter set 2 (B024, B025, B026)
			OFF	Selects current overload parameter set 1 (B021, B022, B023)

Input Function Summary Table				
Option Code	**Terminal Symbol**	**Function Name**	**Description**	
40	TL	Torque limit enable	ON	Enables torque limit feature
			OFF	Disables all torque limit sources. Defaults to 200% of inverter rated torque output.
41	TRQ1	Torque limit selection, bit 1 (LSB)	ON	Logical 1
			OFF	Logical 0
42	TRQ2	Torque limit selection, bit 2 (MSB)	ON	Logical 1
			OFF	Logical 0
43	PPI	Proportional / Proportional/Integral mode selection	ON	Selects Proportional-Integral control
			OFF	Selects Proportional-only control
44	BOK	Brake confirmation signal	ON	Indicates external brake has released (used only for external brake control function)
			OFF	Indicates the external brake has not yet released
45	ORT	Orientation (home search)	ON	The encoder is in the home (oriented) position
			OFF	The encoder position is not in the home position
46	LAC	LAC: LAD cancel	ON	Disables the Linear Accel / Decel (LAD) mode
			OFF	Normal Linear Accel / Decel mode
47	PCLR	Position deviation reset	ON	Clears the position deviation by setting the actual position equal to the desired position
			OFF	Position count operates normally
48	STAT	Pulse train position command input enable	ON	Enables the pulse train control of motor
			OFF	Disables pulse train control of motor
no	—	Not selected	ON	(input ignored)
			OFF	(input ignored)

Output Terminal Configuration

The inverter provides configuration for logic (discrete) and analog outputs, shown in the table below.

"C" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
C021	Terminal [11] function *	22 programmable functions available for logic (discrete) outputs (see next section)	✘ ✔	01 [FA1]	01 [FA1]	01 [FA1]	—	>C021 OUT-TM 11 FA1
C022	Terminal [12] function *		✘ ✔	00 [RUN]	00 [RUN]	00 [RUN]	—	>C022 OUT-TM 12 RUN
C023	Terminal [13] function *		✘ ✔	03 [OL]	03 [OL]	03 [OL]	—	>C023 OUT-TM 13 OL
C024	Terminal [14] function *		✘ ✔	07 [OTQ]	07 [OTQ]	07 [OTQ]	—	>C024 OUT-TM 14 OTQ
C025	Terminal [15] function		✘ ✔	08 [IP]	08 [IP]	08 [IP]	—	>C025 OUT-TM 15 IP
C026	Alarm relay terminal function		✘ ✔	05 [AL]	05 [AL]	05 [AL]	—	>C026 OUT-TM AL AL
C027	[FM] signal selection	8 programmable functions available for analog outputs (see after next section)	✘ ✔	00 output freq.	00 output freq.	00 output freq.	—	>C027 FM-MONITOR KIND A-F
C028	[AM] signal selection		✘ ✔	00 output freq.	00 output freq.	00 output freq.	—	>C028 AM-MONITOR KIND A-F
C029	[AMI] signal selection		✘ ✔	00 output freq.	00 output freq.	00 output freq.	—	>C029 AMI-MON KIND A-F

NOTE: *Terminals [11] – [13] or [11] – [14] are automatically configured as AC0 – AC2 or AC0 – AC3 when C62 is configured to enable alarm code output.

The output logic convention is programmable for terminals [11] – [15], and the alarm relay terminals. The open-collector output terminals [11] – [15] default to normally open (active low), but you can select normally closed (active high) for the terminals in order to invert the sense of the logic. You can invert the logical sense of the alarm relay output as well.

"C" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
C031	Terminal [11] active state	Select logic convention, two option codes: 00 normally open N.O. 01 normally closed N.C.	✘ ✔	00	00	00	—	>C031 OUT-TM O/C-11 NO
C032	Terminal [12] active state		✘ ✔	00	00	00	—	>C032 OUT-TM O/C-12 NO
C033	Terminal [13] active state		✘ ✔	00	00	00	—	>C033 OUT-TM O/C-13 NO
C034	Terminal [14] active state		✘ ✔	00	00	00	—	>C034 OUT-TM O/C-14 NO
C035	Terminal [15] active state		✘ ✔	00	00	00	—	>C035 OUT-TM O/C-15 NO
C036	Alarm relay terminal active state		✘ ✔	01	01	01	—	>C036 OUT-TM O/C-AL NC

Output Summary Table - This table shows all twenty-two functions for the logic output terminals [11] – [15] at a glance. Detailed function descriptions, related parameters, settings, and example wiring diagrams are in "Using Intelligent Output Terminals" on page 4–42.

Output Function Summary Table				
Option Code	Terminal Symbol	Function Name	Description	
00	RUN	Run signal	ON	Inverter is in Run Mode, motor running
			OFF	Inverter is in Stop Mode, motor stopped
01	FA1	Frequency arrival type 1 – constant speed	ON	when output to motor is at the standard set frequency F001
			OFF	when output to motor is not at the set frequency F001
02	FA2	Frequency arrival type 2 – over-frequency	ON	when output to motor is at or above the FA threshold 1(C042) during accel
			OFF	when the output to motor is below the FA threshold 1 (C043) during decel
03	OL	Overload advance notice signal (1)	ON	when output current is more than the set threshold for the overload signal (set with C041)
			OFF	when output current is less than the set threshold for the overload signal
04	OD	Output deviation for PID control	ON	when PID error is more than the set threshold for the deviation signal
			OFF	when PID error is less than the set threshold for the deviation signal
05	AL	Alarm signal	ON	when the alarm condition has been met and not reset
			OFF	when the alarm had not tripped since the previous power cycle or since the previous keypad reset

Output Function Summary Table				
Option Code	**Terminal Symbol**	**Function Name**	**Description**	
06	FA3	Frequency arrival type 3 – at frequency	ON	when output to motor is at the FA threshold 1 (C042) during accel, or at C043 during decel
			OFF	when the output to motor is not at either the FA threshold 1 (C042) during accel or at C043 during decel
07	OTQ	Over-torque signal	ON	when the over-torque feature is enabled and the motor is generating excess torque
			OFF	when the over-torque feature is disabled or the motor is not generating excess torque
08	IP	Instantaneous power failure signal	ON	when the inverter input power has decreased below the acceptable input voltage level
			OFF	when the inverter input power is within rated range
09	UV	Under-voltage signal	ON	when the inverter input power has decreased below the acceptable input voltage level
			OFF	when the inverter input power is within rated range
10	TRQ	In torque limit	ON	when the output torque exceeds level set for the particular torque/frequency quadrant in effect during operation
			OFF	when the output torque is less than the level set for the operating quadrant
11	RNT	Operation time over	ON	when the inverter Run time exceeds the limit set by Run/power-on warning time (B034)
			OFF	when the inverter Run time is less than the limit set by Run/power-on warning time (B034)
12	ONT	Plug-in time over	ON	when the inverter plug-in time exceeds the set limit
			OFF	when the inverter plug-in time is less than the limit
13	THM	Thermal alarm signal	ON	when the thermal limit for the motor is exceeded
			OFF	when the thermal limit is not exceeded
19	BRK	Brake release signal	ON	when the inverter signals the external braking system to release (open) its brake
			OFF	when the inverter is not driving the motor, and needs the external brake engaged
20	BER	Brake error signal	ON	when the output current is less than the set releasing current
			OFF	when the braking function is not in use, or when the output current to the motor is correct and it is safe to release the brake
21	ZS	Zero speed detect	ON	when the encoder pulses of the motor has stopped
			OFF	when motor rotation causes encoder pulses
22	DSE	Speed deviation maximum	ON	when the velocity error exceeds the error threshold defined for the encoder input
			OFF	when the velocity error is less than the error threshold defined for the encoder input

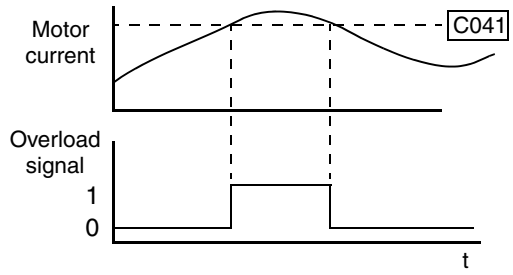
Output Function Summary Table				
Option Code	**Terminal Symbol**	**Function Name**	**Description**	
23	POK	Positioning completion	ON	when the load position is at the target
			OFF	when the load position is not yet at the target
24	FA4	Frequency arrival type 4 – over-frequency (2)	ON	when output to motor is at or above the FA threshold 2 (C045) during accel
			OFF	when the output to motor is below the FA threshold 2 (C046) during decel
25	FA5	Frequency arrival type 5 – at frequency (2)	ON	when output to motor is at the FA threshold 2 (C045) during accel, or at C046 during decel
			OFF	when the output to motor is not at either the FA threshold 2 (C045) during accel or at C046 during decel
26	OL2	Overload notice advance signal (2)	ON	when output current is more than the set threshold for the overload signal
			OFF	when output current is less than the set threshold for the overload signal

Analog Summary Table - The following table shows all eight functions available for assignment to the three analog output terminals [FM], [AM], [AMI] at a glance. Detailed descriptions, related parameters and settings, and example wiring diagrams are in "Analog Output Operation" on page 4–62.

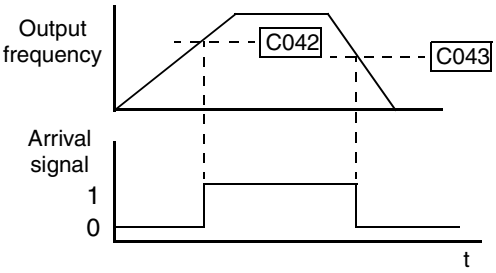
Analog Output Function Summary Table			
Option Code	**Function Name**	**Description**	**Corresponding Signal Range**
00	Output frequency	Actual motor speed, represented by PWM signal	0 to max. frequency in Hz
01	Output current	Motor current (% of maximum rated output current), represented by PWM signal	0 to 200%
02	Output torque	Rated output torque	0 to 200%
03	Digital output frequency	Output frequency (available only at FM output)	0 to max. frequency in Hz
04	Output voltage	Rated output voltage to motor	0 to 100%
05	Input power	Rated input power	0 to 200%
06	Electronic thermal overload	Percentage of electronic overload attained	0 to 100%
07	LAD frequency	Internal ramp generator frequency	0 to max. frequency in Hz

Output Function Adjustment Parameters

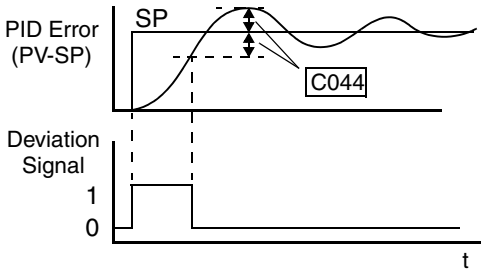
The following parameters work in conjunction with the intelligent output function, when configured. The overload level parameter (C041) sets the motor current level at which the overload signal [OL] turns ON. The range of settings is from 0% to 200% of the rated current for the inverter. This function is for generating an early warning logic output, without causing either a trip event or a restriction of the motor current (those effects are available on other functions).



The frequency arrival signal, [FA1] to [FA5], is intended to indicate when the inverter output has reached (arrived at) the target frequency. You can adjust the timing of the leading and trailing edges of the signal via two parameters specific to acceleration and deceleration ramps, C042 and C043.



The Error for the PID loop is the magnitude (absolute value) of the difference between the Setpoint (desired value) and Process Variable (actual value). The PID output deviation signal [OD] (output terminal function option code 04) indicates when the error magnitude has exceeded a magnitude you define.



"C" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
C040	Overload signal output mode	Choose when the overload signal is enabled; two option codes: 00 During accel/decel 01 During constant speed	✘ ✔	01	01	01	—	>C040 OL Mode CRT
C041	Overload level setting	Range is 0.00 * rated current to 2.00 * rated current	✘ ✔	Rated current for each inverter			A	>C041 OL LEVEL 0016.5A
C042	Frequency arrival setting for acceleration	Sets the frequency arrival setting threshold for the output frequency during acceleration	✘ ✔	0.00	0.00	0.00	Hz	>C042 ARV ACC 0000.00Hz
C043	Arrival frequency setting for deceleration	Sets the frequency arrival setting threshold for the output frequency during deceleration	✘ ✔	0.00	0.00	0.00	Hz	>C043 ARV DEC 0000.00Hz

"C" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
C044	PID deviation level setting	Sets the PID loop error threshold |SP - PV| (absolute value) to trigger intelligent output [OD]. Range is 0.0 to 100%, resolution is 0.1%	✘ ✔	3.0	3.0	3.0	%	>C044 PID LEVEL 003.0%
C045	Frequency arrival setting for acceleration (2)	Range is 0.0 to 99.99 / 100.0 to 400.0 Hz	✘ ✔	0.00	0.00	0.00	Hz	>C045 ARV ACC2 0000.00Hz
C046	Frequency arrival setting for deceleration (2)	Range is 0.0 to 99.99 / 100.0 to 400.0 Hz	✘ ✔	0.00	0.00	0.00	Hz	>C046 ARV DEC2 0000.00Hz
C055	Over-torque (forward-driving) level setting	Threshold for intelligent output terminal [OTQ], quadrant I. Range is: 0 to 200%, up to –550xxx; 0 to 180%, –750 to 1500xxx	✘ ✔	100.	100.	100.	%	>C055 OV-TRQ FW-V 100%
C056	Over-torque (reverse regenerating) level setting	Threshold for intelligent output terminal [OTQ], quadrant II. Range is: 0 to 200%, up to –550xxx; 0 to 180%, –750 to 1500xxx	✘ ✔	100.	100.	100.	%	>C056 OV-TRQ RV-R 100%
C057	Over-torque (reverse driving) level setting	Threshold for intelligent output terminal [OTQ], quadrant III. Range is: 0 to 200%, up to –550xxx; 0 to 180%, –750 to 1500xxx	✘ ✔	100.	100.	100.	%	>C057 OV-TRQ RV-V 100%
C058	Over-torque (forward regenerating) level setting	Threshold for intelligent output terminal [OTQ], quadrant IV. Range is: 0 to 200%, up to –550xxx; 0 to 180%, –750 to 1500xxx	✘ ✔	100.	100.	100.	%	>C058 OV-TRQ FW-R 100%
C061	Electronic thermal warning level setting	Sets the threshold for intelligent output [THM]. Range is 0 to 100%	✘ ✔	80.	80.	80.	%	>C061 E-THM WARN 080%
C062	Alarm code output	Allows binary alarm codes to be output to intelligent terminals. Three option codes: 00 Disable 01 Enable – 3-bit code 02 Enable – 4-bit code	✘ ✔	00	00	00	—	>C062 AL-CODE SELECT OFF
C063	Zero speed detection level	Range is 0.00 to 99.99 / 100.0 Hz	✘ ✔	0.00	0.00	0.00	Hz	>C063 ZS LEVEL 000.00Hz

Serial Communications

The following table configures the communications port of the SJ300 inverter. You can have up to thirty-two devices on the serial communications network. The inverters are slaves and the computer or digital operator is the master. Thus, all inverters on the serial connection must use the same baud rate, data length, parity, and stop bits. However, each device on the serial network must have a unique node address. Please see Appendix B for more information.

"C" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
C070	Data command method	Four option codes: 02 Digital operator 03 RS485 04 Expansion card #1 05 Expansion card #2	✘ ✘	02	02	02	—	>C070 PARAM SELECT REM
C071	Communication speed selection	Five option codes: 02 (Test) 03 2400bps 04 4800bps 05 9600bps 06 19200bps	✘ ✔	04	04	04	bps	>C071 RS485 BAU 4800bps
C072	Node allocation	Set the address of the inverter on the network. Range is 1 to 32.	✘ ✔	1.	1.	1.	—	>C072 RS485 ADDRESS 01
C073	Communication data length selection	Two option codes: 07 7-bit data 08 8-bit data	✘ ✔	7	7	7	—	>C073 RS485 BIT 7BIT
C074	Communication parity selection	Three option codes: 00 No parity 01 Even parity 02 Odd parity	✘ ✔	00	00	00	—	>C074 RS485 PARITY NO
C075	Communication stop bit selection	Two option codes: 01 1 stop bit 02 2 stop bits	✘ ✔	1	1	1	—	>C075 RS485 STOPBIT 1BIT
C078	Communication wait time	Time the inverter waits after receiving a message before it transmits. Range is 0.0 to 1000 ms	✘ ✔	0.	0.	0.	—	>C078 RS485 WAIT 0000ms

Analog Signal Calibration Settings

The functions in the following table configure the signals for the analog output terminals. Note that these settings do not change the current/voltage or sink/source characteristics – only the zero and span (scaling) of the signals.

"C" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
C081	[O] input span calibration	Range is 0 to 65530	✔ ✔	Factory-calibrated			—	>C081 O-ADJUST TOP 02119
C082	[OI] input span calibration	Range is 0 to 65530	✔ ✔	Factory-calibrated			—	>C082 OI-ADJUST TOP 02512
C083	[O2] input span calibration	Range is 0 to 65530	✔ ✔	Factory-calibrated			—	>C083 O2-ADJUST TOP 02818
C085	Thermistor input tuning	Range is 0.0 to 1000	✔ ✔	105.0	105.0	105.0	—	>C085 THERM ADJUST 0105.0
C086	[AM] terminal offset tuning	Range is 0.0 to 10.0V	✔ ✔	0.0	0.0	0.0	V	>C086 AM-MONITOR OFFSET 00.0V
C087	[AMI] terminal meter tuning	Range is 0.0 to 250%	✔ ✔	80.	80.	80.	%	>C087 AMI-MON ADJUST 080
C088	[AMI] terminal offset tuning	Range is 0 to 20mA	✔ ✔	Factory-calibrated			mA	>C088 AMI-MON OFFSET 04.0mA
C121	[O] input zero calibration	Range is 0 to 6553 (65530)	✔ ✔	Factory-calibrated			—	>C121 O-ADJUST ZERO 00000
C122	[OI] input zero calibration	Range is 0 to 6553 (65530)	✔ ✔	Factory-calibrated			—	>C122 OI-ADJUST ZERO 00000
C123	[O2] input zero calibration	Range is 0 to 6553 (65530)	✔ ✔	Factory-calibrated			—	>C123 O2-ADJUST ZERO 03622

NOTE: Settings C081, C082, C083, C121, C122, C123 are factory-calibrated for each inverter. Do not change these settings unless absolutely necessary. Note that if you restore factory defaults for all parameters, these settings will not change.

Miscellaneous Functions

The following table contains miscellaneous functions not in other function groups.

"C" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
C091	Debug mode enable	Two option codes: 00 Display 01 No display	✘ ✔	00	00	00	—	>C091 INITIAL DEBG OFF
C101	Up/Down memory mode selection	Controls speed setpoint for the inverter after power cycle. Two option codes: 00 Clear last frequency (return to default frequency F001) 01 Keep last frequency adjusted by UP/DWN	✘ ✔	00	00	00	—	>C101 UP/DWN DATA NO-STR

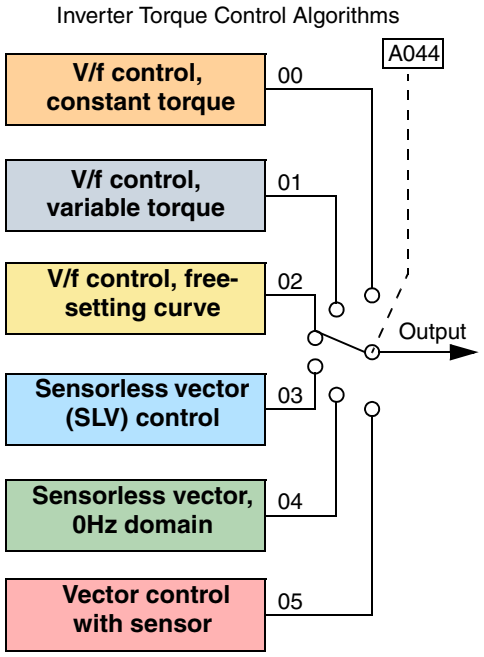
C102/C103: Reset Mode / Restart Mode – The reset mode selection, set via parameter C102, determines how the inverter responds to the [RS] intelligent input signal or keypad Stop/Reset key in a trip condition. The options allow you to cancel the trip on either the OFF-to-ON or ON-to-OFF transition of [RS], and if desired, stop the inverter if it is in Run Mode. A trip event causes the inverter output to the motor to turn OFF immediately. If in Run Mode when the trip occurred, the inverter and motor will enter free-run stop (coasting) operation. In some applications, the motor and load will still be coasting when the inverter returns to normal Run Mode operation. For that situation, you can configure the inverter output (C103=00) to resume operation from 0 Hz and accelerate normally. Or, you can configure the inverter (C103=01) to resume operation from the current speed of the motor (*frequency matching*)—often used in applications such as HVAC.

"C" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
C102	Reset mode selection	Determines response to Reset input [RST]. Three option codes: 00 Cancel trip state at input signal ON transition, Stops inverter if in Run Mode 01 Cancel trip state at signal OFF transition, Stops inverter if in Run Mode 02 Cancel trip state at input signal ON transition, no effect if in Run Mode.	✔ ✔	00	00	00	—	>C102 RESET SELECT ON
C103	Restart mode after reset	Two option codes: 00 Restart at 0 Hz 01 Resume operation after frequency matching	✘ ✔	00	00	00	—	>C103 RESET f-Mode ZST
C111	Overload setting (2)	Range is 0.00 times rated current to 2.00 times rated current	✘ ✔	Rated current for each inverter model			A	>C111 OL LEVEL2 0016.5A

"H" Group: Motor Constants Functions

Introduction

The "H" Group parameters configure the inverter for the motor characteristics. You must manually set H003 and H004 values to match the motor. Most of the remaining parameters are related to vector control, and are in use only when function A044 is set for one of the vector control modes as shown in the diagram. The procedure in "Auto-tuning of Motor Constants" on page 4–67 automatically sets all the parameters related to vector control. If you configure the inverter to use vector control, we highly recommend letting the auto-tuning procedure derive the values for you. If you want to reset the parameters to the factory default settings, use the procedure in "Restoring Factory Default Settings" on page 6–9.



NOTE: The auto-tuning procedure and related warning messages are in "Auto-tuning of Motor Constants" on page 4–67. Please read these before trying to auto-tune the motor parameters.

"H" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
H001	Auto-tuning Setting	Three states for auto-tuning function, option codes: 00 Auto-tuning OFF 01 Auto-tune (measure motor resistance and inductance, without rotating) 02 Auto-tune (rotate motor)	✘ ✘	00	00	00	—	>H001 AUX AUTO NOR
H002	Motor data selection, 1st motor	Select one of three motor parameter sets, 3 options: 00 Standard motor data 01 Auto-tuning data 02 Adaptive tuning data	✘ ✘	00	00	00	—	>H002 AUX DATA NOR
H202	Motor data selection, 2nd motor	Select one of three motor parameter sets, 3 options: 00 Standard motor data 01 Auto-tuning data 02 Adaptive tuning data	✘ ✘	00	00	00	—	>H202 2AUX DATA NOR
H003	Motor capacity, 1st motor	Select 0.2 to 75.0kW for models up to –550xxx, 0.2 to 160.0kW for models –750xxx to –1500xxx	✘ ✘	Factory set			kW	>H003 AUX K 003.70kW

"H" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
H203	Motor capacity, 2nd setting	Select 0.2 to 75.0kW for models up to –550xxx, 0.2 to 160.0kW for models –750xxx to –1500xxx	✘ ✘	Factory set			kW	>H203 2AUX K 003.70kW
H004	Motor poles setting, 1st motor	Four selections: 2 / 4 / 6 / 8	✘ ✘	4	4	4	Poles	>H004 AUX P 4P
H204	Motor poles setting, 2nd motor	Four selections: 2 / 4 / 6 / 8	✘ ✘	4	4	4	Poles	>H204 2AUX P 4P
H005	Motor speed constant, 1st motor	Motor proportional gain constant (factory set), range is 0.01 to 99	✔ ✔	1.590	1.590	1.590	—	>H005 AUX KP 1.590
H205	Motor speed constant, 2nd motor	Motor proportional gain constant (factory set) range is 0 to 99	✔ ✔	1.590	1.590	1.590	—	>H205 2AUX KP 1.590
H006	Motor stabilization constant, 1st motor	Motor constant (factory set), range is 0 to 255	✔ ✔	100.	100.	100.	—	>H006 AUX KCD 00100
H206	Motor stabilization constant, 2nd motor	Motor constant (factory set), range is 0 to 255	✔ ✔	100.	100.	100.	—	>H206 2AUX KCD 00100
H306	Motor stabilization constant, 3rd motor	Motor constant (factory set), range is 0 to 255	✔ ✔	100.	100.	100.	—	>H306 3AUX KCD 00100
H020	Motor constant R1, 1st motor	Range is 0.000 to 65.53, 0.000 to 9.999 10.00 to 65.53	✘ ✘	According to inverter rating			Ohm	>H020 AUX R1 00.489ohm
H220	Motor constant R1, 2nd motor	Range is 0.000 to 65.53, 0.000 to 9.999 10.00 to 65.53	✘ ✘	According to inverter rating			Ohm	>H220 2AUX R1 00.000ohm
H021	Motor constant R2, 1st motor	Range is 0.000 to 65.53, 0.000 to 9.999 10.00 to 65.53	✘ ✘	According to inverter rating			Ohm	>H021 AUX R2 00.355ohm
H221	Motor constant R2, 2nd motor	Range is 0.000 to 65.53, 0.000 to 9.999 10.00 to 65.53	✘ ✘	According to inverter rating			Ohm	>H221 2AUX R2 00.355ohm
H022	Motor constant L, 1st motor	Range is 0.00 - 655.3 mH, 0.00 to 99.99 100.0 - 655.3	✘ ✘	According to inverter rating			mH	>H022 AUX L 005.12mH
H222	Motor constant L, 2nd motor	Range is 0.00 - 655.3 mH, 0.00 to 99.99 100.0 - 655.3	✘ ✘	According to inverter rating			mH	>H222 2AUX L 005.12mH
H023	Motor constant I_0, 1st motor	Range is 0.00 to 655.3 A 0.00 to 99.99 100.0 - 655.3	✘ ✘	According to inverter rating			A	>H023 AUX I0 008.02A
H223	Motor constant I_0, 2nd motor	Range is 0.00 to 655.3 A, 0.00 to 99.99 100.0 - 655.3	✘ ✘	According to inverter rating			A	>H223 2AUX I0 008.02A
H024	Motor Constant J, 1st motor	Ratio (unit-less), range is 1.0 to 1000	✘ ✘	According to inverter rating			—	>H024 AUX J 000.055

"H" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
H224	Motor constant J, 2nd motor	Ratio (unit-less), range is 1.0 to 1000	✘ ✘	According to inverter rating			—	>H224 2AUX J 000.055
H030	Auto-tuned motor constant R1, 1st motor	Auto-tuning data	✘ ✘	According to inverter rating			Ohm	>H030 AUX A-R1 00.489ohm
H230	Auto-tuned motor constant R1, 2nd motor	Auto-tuning data	✘ ✘	According to inverter rating			Ohm	>H230 2AUX A-R1 00.489ohm
H031	Auto-tuned motor constant R2, 1st motor	Auto-tuning data	✘ ✘	According to inverter rating			Ohm	>H031 AUX A-R2 00.355ohm
H231	Auto-tuned motor constant R2, 2nd motor	Auto-tuning data	✘ ✘	According to inverter rating			Ohm	>H231 2AUX A-R2 00.355ohm
H032	Auto-tuned motor constant L, 1st motor	Auto-tuning data	✘ ✘	According to inverter rating			mH	>H032 AUX A-L 005.12mH
H232	Auto-tuned motor constant L, 2nd motor	Auto-tuning data	✘ ✘	According to inverter rating			mH	>H232 2AUX A-L 005.12mH
H033	Auto-tuned motor constant I_0, 1st motor	Auto-tuning data	✘ ✘	According to inverter rating			A	>H033 AUX A-I0 008.02A
H233	Auto-tuned motor constant I_0, 2nd motor	Auto-tuning data	✘ ✘	According to inverter rating			A	>H233 2AUX A-I0 008.02A
H034	Auto-tuned motor constant J, 1st motor	Auto-tuning data	✘ ✘	According to inverter rating			—	>H034 AUX A-J 0000.055
H234	Auto constant J, 2nd motor	Auto-tuning data	✘ ✘	According to inverter rating			—	>H234 2AUX A-J 0000.055
H050	PI proportional gain for 1st motor	Range is 0.0 to 99.9 / 100.0 to 999.9 / 1000%	✔ ✔	100	100	100	%	>H050 AUX KSP 0100.0%
H250	PI proportional gain for 2nd motor	Range is 0.0 to 99.9 / 100.0 to 999.9 / 1000%	✔ ✔	100	100	100	%	>H250 2AUX KSP 0100.0%
H051	PI integral gain for 1st motor	Range is 0.0 to 99.9 / 100.0 to 999.9 / 1000%	✔ ✔	100	100	100	%	>H051 AUX KSI 0100.0%
H251	PI integral gain for 2nd motor	Range is 0.0 to 99.9 / 100.0 to 999.9 / 1000%	✔ ✔	100	100	100	%	>H251 2AUX KSI 0100.0%
H052	P proportional gain setting for 1st motor	Range is 0.00 to 10.00	✔ ✔	1.00	1.00	1.00	—	>H052 AUX KSPP 001.00
H252	P proportional gain setting for 2nd motor	Range is 0.00 to 10.00	✔ ✔	1.00	1.00	1.00	—	>H252 2AUX KSPP 001.00
H060	0Hz SLV limit for 1st motor	Range is 0.0 to 100.0%	✔ ✔	100.	100.	100.	%	>H060 AUX 0SLV-LMT 100.0%
H260	0Hz SLV limit for 2nd motor	Range is 0 to 100.0%	✔ ✔	100.	100.	100.	%	>H260 2AUX 0SLV-LMT 100.0%
H070	Terminal selection PI proportional gain setting	Range is 0 to 99.9 / 100.0 to 999.9 / 1000%	✔ ✔	100.0	100.0	100.0	%	>H070 AUX CH-KSP 0100.0%
H071	Terminal selection PI integral gain setting	Range is 0 to 99.9 / 100.0 to 999.9 / 1000%	✔ ✔	100.0	100.0	100.0	%	>H071 AUX CH-KSI 0100.0%
H072	Terminal selection P proportional gain setting	Range is 0.00 to 10.00	✔ ✔	1.00	1.00	1.00	—	>H072 AUX CH-KSPP 001.00

"P" Group: Expansion Card Functions

The two (optional) expansion cards for the SJ300 have associated configuration data. The following table defines the functions and their value ranges. Please refer to the expansion card manual for more details.

"P" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
P001	Operation mode on expansion card 1 error	Two option codes: 00 Trip (stop motor) 01 Continuous operation	✘ ✔	00	00	00	—	>P001 OPTION1 SELECT TRP
P002	Operation mode on expansion card 2 error	Two option codes: 00 Trip (stop motor) 01 Continuous operation	✘ ✔	00	00	00	—	>P002 OPTION2 SELECT TRP
P010	Feedback option enable	Two option codes: 00 Disable 01 Enable	✘ ✘	00	00	00	—	>P010 FEEDBACK SELECT OFF
P011	Encoder pulse-per-revolution (PPR) setting	Range is 128 to 65000 pulses per revolution	✘ ✘	1024	1024	1024	pulse	>P011 FEEDBACK ENC-P 01024Pls
P012	Control pulse setting	Selects between automatic speed regulation (ASR) and automatic position regulation (APR) modes. Two option codes: 00 ASR mode 01 APR mode	✘ ✘	00	00	00	—	>P012 FEEDBACK CONTROL ASR
P013	Pulse input mode setting	Pulse input mode setting. Three option codes: 00 quadrature 01 count and direction 02 separate forward and reverse pulse trains	✘ ✘	00	00	00	—	>P013 FEEDBACK PULSE MD0
P014	Home search stop position setting	Range is 0 to 4095 pulses	✘ ✔	0.	0.	0.	—	>P014 FEEDBACK POS 0000Pls
P015	Home search speed setting	Range is 0.00 to 99.99 / 100.0 to 120.0Hz	✘ ✔	5.00	5.00	5.00	Hz	>P015 FEEDBACK FC 005.00Hz
P016	Home search direction setting	Two option codes: 00 Forward 01 Reverse	✘ ✘	00	00	00	—	>P016 FEEDBACK TURN FW
P017	Home search completion range setting	Range is 0 to 10,000 pulses	✘ ✔	5	5	5	pulse	>P017 FEEDBACK L 00005Pls
P018	Home search completion delay time setting	Range is 0.00 to 9.99 seconds	✘ ✔	0.00	0.00	0.00	sec.	>P018 FEEDBACK TW 000.00s
P019	Electronic gear set position selection	Two option codes: 00 Position feedback side 01 Position command side	✘ ✔	00	00	00	—	>P019 FEEDBACK EGRP FB
P020	Electronic gear ratio numerator setting	Range is 1 to 9999	✘ ✔	1.	1.	1.	—	>P020 FEEDBACK EGR-N 00001
P021	Electronic gear ratio denominator setting	Range is 1 to 9999	✘ ✔	1.	1.	1.	—	>P021 FEEDBACK EGR-D 00001

"P" Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
P022	Feed-forward gain setting	Range is 0.00 top 99.99 / 100.0	✘ ✔	0.00	0.00	0.00	—	>P022 FEEDBACK FFWG 000.00
P023	Position loop gain setting	Range is 0.00 to 99.99 / 100.0	✘ ✔	0.50	0.50	0.50	—	>P023 FEEDBACK G 000.50
P025	Temperature compensation thermistor enable	Allows for motor-mounted thermistor to calibrate output to motor temperature Two option codes: 00 Disable 01 Enable	✘ ✔	00	00	00	—	>P025 FEEDBACK R2-ADJ OFF
P026	Over-speed error detection level setting	Range is 0.0 to 150.0%	✘ ✔	135.0	135.0	135.0	%	>P026 FEEDBACK 0SPD 135.0%
P027	Speed deviation error detection level setting	Range is 0.00 to 99.99 / 120Hz	✘ ✔	7.50	7.50	7.50	—	>P027 FEEDBACK NER 007.50Hz
P031	Accel/decel time input selection	Three options: 00 Inverter 01 Expansion card 1 02 Expansion card 2	✘ ✘	00	00	00	—	>P031 ACC/DEC SELECT REM
P032	Positioning command input selection	Three options: 00 Inverter 01 Expansion card 1 02 Expansion card 2	✘ ✔	00	00	00	—	>P032 P-SET SELECT REM
P044	DeviceNet comm watchdog timer	Range is 0.00 99.99 seconds	✘ ✘	1.00	1.00	1.00	—	>P044 DEVICENET TIMER 01.00s
P045	Inverter action on DeviceNet comm error	Five options: 00 Trip 01 Decelerate and trip 02 Hold last speed 03 Free run stop 04 Decelerate and stop	✘ ✘	01	01	01	—	>P045 DEVICENET T-OUT FTP
P046	DeviceNet polled I/O: Output instance number	Three settings: 20, 21, 100	✘ ✘	21	21	21	—	>P046 DEVICENET O-AS-INS 021
P047	DeviceNet polled I/O: Input instance number	Three settings: 70, 71, 101	✘ ✘	71	71	71	—	>P047 DEVICENET O-AS-INS 071
P048	Inverter action on DeviceNet idle mode	Five options: 00 Trip 01 Decelerate and trip 02 Hold last speed 03 Free run stop 04 Decelerate and stop	✘ ✘	01	01	01	—	>P048 DEVICENET IDLE FTP
P049	DeviceNet motor poles setting for RPM	Range is 00 to 38 (even numbers only)	✘ ✘	0	0	0	poles	>P049 DEVICENET P 00P

NOTE: Parameters P044 to P049 are available only in inverters with manufacturing code x8K xxxxxx xxxxx or later. The manufacturing code is printed on the product specifications labels, located on the front and side of the inverter housing.

“U” Group: User-selectable Menu Functions

The user-selectable menu functions allow you to configure (select) any twelve of the other functions in the inverter and place them together in a convenient list. This feature provides quick access for the most-used functions needed for your application. Each U Group function can serve as a pointer to any of the other parameters. You do *not* have to use the Store key to retain each association; just scroll to the desired standard parameter for each U Group function and leave it. The setting can point to a monitor-only parameter (such as D001), or point to editable parameters (such as A001). In the case of pointing to an editable functions, you use the Up/Down keys to change the value and the Store key to accept the change into memory—the same procedure as a normal parameter edit.

“U” Function			Run Mode Edit Lo Hi	Defaults			Units	SRW Display
Func. Code	Name	Description		–FE (CE)	–FU (UL)	–FR (Jpn)		
U001	User-selected function	“no” (disabled), or any of the functions D001 to P049	✘ ✔	no	no	no	—	>U001 USER 1 no
U002			✘ ✔	no	no	no	—	>U002 USER 2 no
U003			✘ ✔	no	no	no	—	>U003 USER 3 no
U004			✘ ✔	no	no	no	—	>U004 USER 4 no
U005			✘ ✔	no	no	no	—	>U005 USER 5 no
U006			✘ ✔	no	no	no	—	>U006 USER 6 no
U007			✘ ✔	no	no	no	—	>U007 USER 7 no
U008			✘ ✔	no	no	no	—	>U008 USER 8 no
U009			✘ ✔	no	no	no	—	>U009 USER 9 no
U010			✘ ✔	no	no	no	—	>U010 USER 10 no
U011			✘ ✔	no	no	no	—	>U011 USER 11 no
U012			✘ ✔	no	no	no	—	>U012 USER 12 no

TIP: Function B037 selects which parameter groups are displayed. If you want to limit the displayed parameters to *only* the U Group functions, set B037=02.

Programming Error Codes

The SJ300 inverter operator keypad displays a special code (begins with the E character) to indicate a programming error. Programming errors exist when one parameter conflicts with the meaningful range permitted by related parameter(s). Note that particular real-time frequency (speed) input levels can cause a conflict in some situations. After a conflict exists, the error code will appear on the display, or you can view it later with D090 in Monitor Mode. Also, the PGM LED on the display will flash ON/OFF when programming. These indications are automatically cleared when the parameter is corrected to the allowed range.

Programming Error Code	Parameter out of bounds		Boundary defined by...		
	Code	Description	<, >	Code	Description
E001 E201	A061 / A261	Frequency upper limit setting; 1st, 2nd motor	>	A004 / A204 / A304	Maximum frequency; 1st, 2nd, 3rd motor
E002 E202	A062 / A262	Frequency lower limit setting; 1st, 2nd motor	>		
E004 E204 E304	A003 / A203 / A303	Base frequency setting; 1st, 2nd, 3rd motor	>		
E005 E205 E305	F001, A020 / A220 / A320	Output frequency setting, Multi-speed freq. setting; 1st, 2nd, 3rd motor	>		
E006 E206 E306	A021 to A035	Multi-speed freq. settings	>		
E012 E212	A062 / A262	Frequency lower limit setting; 1st, 2nd motor	>	A061 / A261	Frequency upper limit setting; 1st, 2nd motor
E015 E215	F001, A020 / A220	Output frequency setting, Multi-speed freq. setting; 1st, 2nd motor	>		
E016 E216	A021 to A035	Multi-speed freq. settings	>		
E021 E221	A061 / A261	Frequency upper limit setting; 1st, 2nd motor	<	A062 / A262	Frequency lower limit setting; 1st, 2nd motor
E025 E225	F001, A020 / A220	Output frequency setting, Multi-speed freq. setting; 1st, 2nd motor	<		
E031 E231	A061 / A261	Frequency upper limit setting; 1st, 2nd motor	<	B082	Start frequency adjustment
E032 E232	A062 / A262	Frequency lower limit setting; 1st, 2nd motor	<		
E035 E235 E335	F001, A020 / A220 / A320	Output frequency setting, Multi-speed freq. setting; 1st, 2nd, 3rd motor	<		
E036	A021 to A035	Multi-speed freq. settings	<		
E037	A038	Jog frequency setting	<		
E085 E285 E385	F001, A020 / A220 / A320	Output frequency setting, Multi-speed freq. setting; 1st, 2nd, 3rd motor	>f-x, <f+x	A063 ± A064 A065 ± A066 A067 ± A068	Jump (center) frequency ± jump (hysteresis) frequency width setting (See note after table)
E086	A021 to A035	Multi-speed freq. settings	>f-x, <f+x		

Programming Error Code	Parameter out of bounds		Boundary defined by...		
	Code	Description	<, >	Code	Description
E091 E291	A061 / A261	Frequency upper limit setting; 1st, 2nd motor	>	B112	Free-setting V/f frequency (7)
E092 E292	A062 / A262	Frequency lower limit setting; 1st, 2nd motor	>		
E095 E295	F001, A020 / A220	Output frequency setting, Multi-speed freq. setting; 1st, 2nd motor	>		
E096	A021 to A035	Multi-speed freq. settings	>		
E110	B100, B102, B104, B106, B108, B110	Free V/f frequency	>		
	B102, B104, B106, B108, B110	Free V/f frequency	>	B100	Free-setting V/f frequency (1)
	B100	Free V/f frequency	<	B102	Free-setting V/f frequency (2)
	B104, B106, B108, B110	Free V/f frequency	>		
	B100, B102	Free V/f frequency	<	B104	Free-setting V/f frequency (3)
	B106, B108, B110	Free V/f frequency	>		
	B100, B102, B104	Free V/f frequency	<	B106	Free-setting V/f frequency (4)
	B108, B110	Free V/f frequency	>		
	B100, B102, B104, B106	Free V/f frequency	<	B108	Free-setting V/f frequency (5)
	B110	Free V/f frequency	>		
	B100, B102, B104, B106, B108	Free V/f frequency	<	B110	Free-setting V/f frequency (6)
E120	B017, B019	Free-setting electronic thermal frequency	<	B015	Free-setting, electronic thermal frequency (1)
	B015	Free-setting electronic thermal frequency	>	B017	Free-setting, electronic thermal frequency (2)
	B019	Free-setting electronic thermal frequency	<		
	B015, B017	Free-setting electronic thermal frequency	>	B019	Free-setting, electronic thermal frequency (3)

NOTE: Set frequency (speed) values are not permitted to be inside the jump frequency ranges, if defined. When a frequency reference value from a real-time source (such as keypad potentiometer or analog input) are inside a jump frequency range, the actual speed is automatically forced to equal the lowest point of the jump range.