

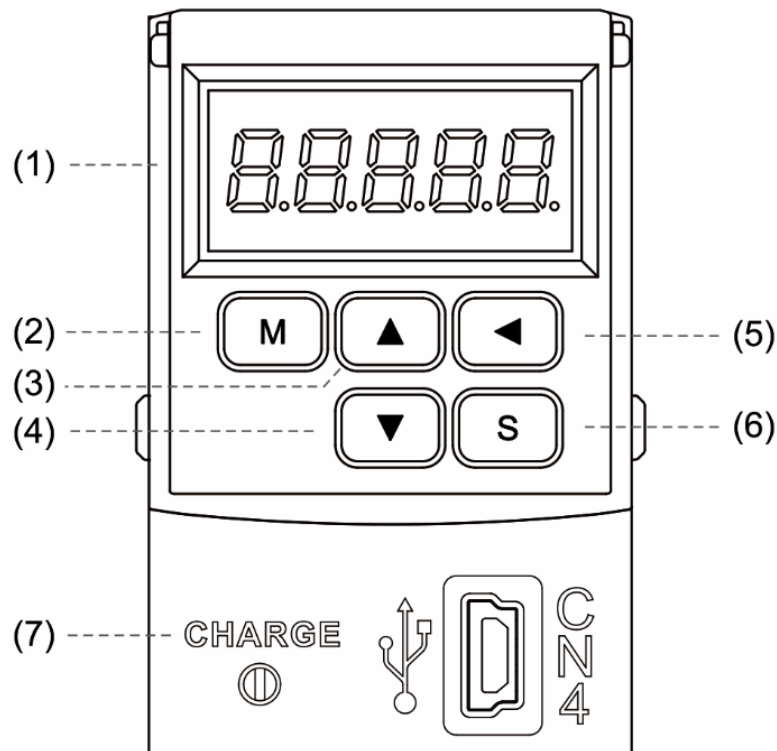
CHAPTER 4: TEST OPERATION AND DRIVE DISPLAY



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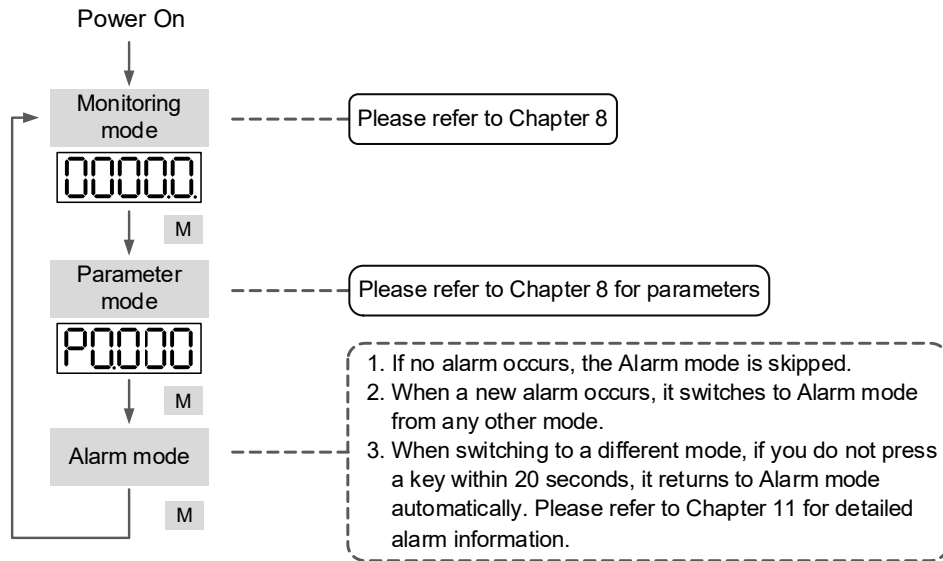
4.1 - DISPLAY DESCRIPTION



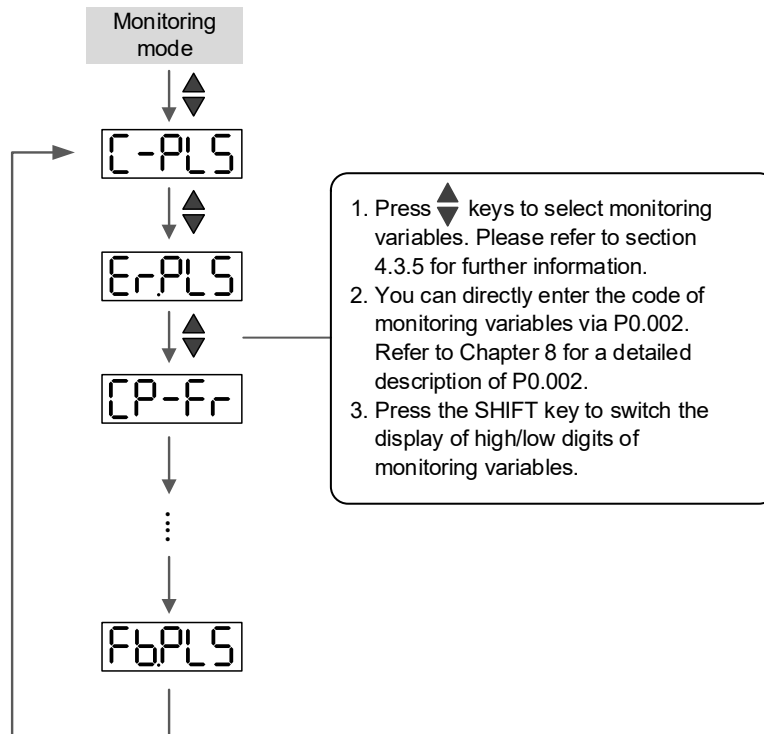
- 1) Display: 5-digit, 7-segment LED displays the monitoring values, parameters, and setting values.
- 2) MODE key: switches the display between Monitoring mode, Parameter mode, and Alarm mode. In Editing mode, press the MODE key to switch to Parameter mode.
- 3) UP key: changes monitoring code, parameter number, and value.
- 4) DOWN key: changes monitoring code, parameter number, and value.
- 5) SHIFT key: in Parameter mode, use this key to change the group number. In Editing mode, moving the flashing (selected) digit to the left lets you adjust the higher setting bit. In Monitor mode, this switches the display from high / low bytes in Monitor mode.
- 6) SET key: displays and stores the parameter value. In Monitor mode, pressing the SET key switches between decimal and hexadecimal display. In Parameter mode, pressing the SET key switches to Editing mode.
- 7) Charge LED: the Charge LED indicator is on when the circuit is powered and when hazardous voltages remain on the drive after power is turned off.

4.2 - PARAMETER SETTING PROCEDURE

4.2.1 - SWITCHING MODES



4.2.2 - MONITORING MODE



Wiring

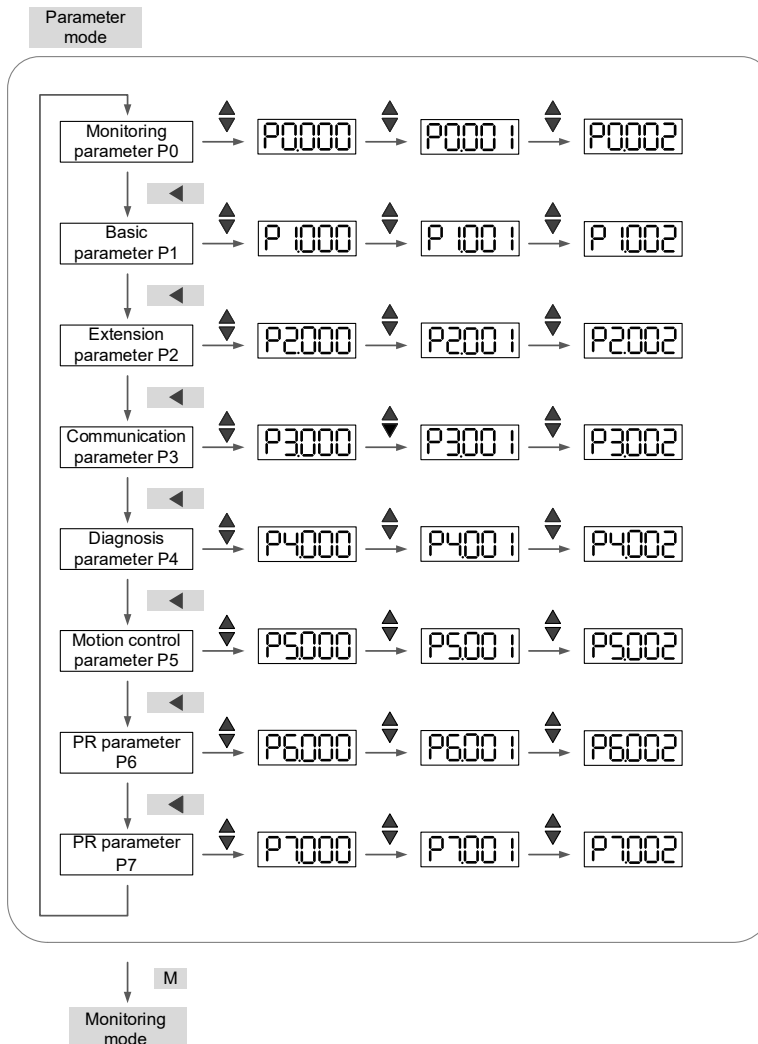
Parameters

DI/DO Codes

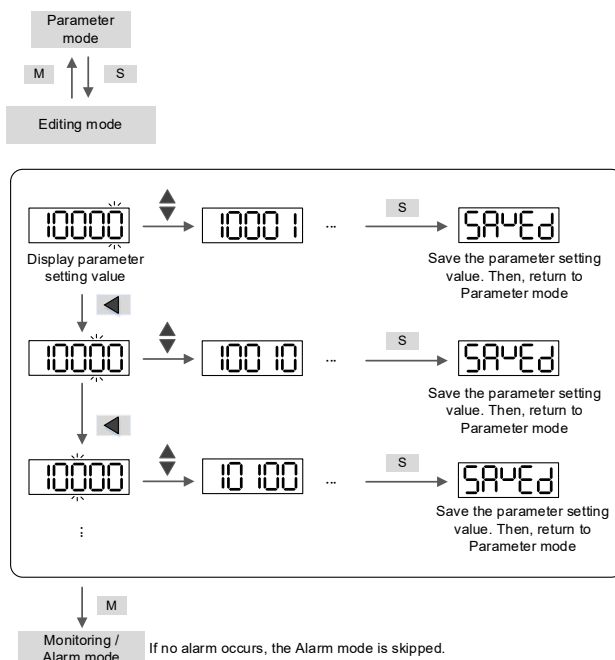
Monitoring

Alarms

4.2.3 - PARAMETER MODE



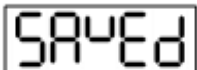
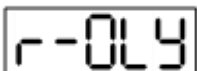
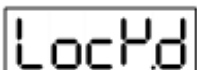
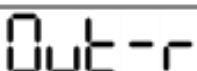
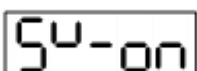
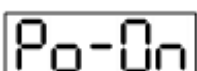
4.2.4 - EDITING MODE



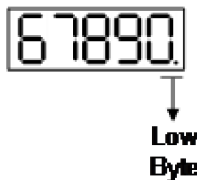
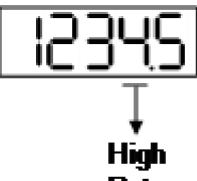
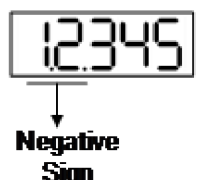
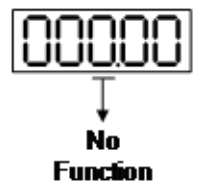
4.3 - STATUS DISPLAY

4.3.1 - SAVE THE SETTING DISPLAY

When you complete the parameter setting, press the SET key to save the parameters. The display shows the status for one second.

Displayed Symbol	Description
	Correctly saved the setting value (Saved).
	Read-only and write-protected parameter (Read-only).
	Entered the wrong password or did not enter a password (Locked).
	Entered an incorrect setting value or the reserved setting value (Out of Range).
	You cannot enter a value when in Servo On state (Servo On).
	Changes to the parameter take effect after cycling the power to the servo drive (Power On).

4.3.2 - DISPLAY THE DECIMAL POINT

Displayed Symbol	Description
 Low Byte	High byte / low byte indication: this indicates the current high byte or low byte when the data is displayed in decimal (32 bits). (Note: When in Hex format low byte will indicated by L0000 and high byte by h0000)
 High Byte	
 Negative Sign	Negative sign: the two decimal points on the left represents the negative sign when the data is displayed in decimal format, (16 or 32 bits). In hexadecimal format, it only shows positive values.
 No Function	

Wiring


Parameters

DI/DO Codes



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4.3.3 - ALARM MESSAGES

Displayed Symbol	Description
	When an alarm occurs, the servo drive shows 'AL' as the alarm symbol and 'nnn' as the alarm code. For detailed information, please refer to Chapter 8 P0.001 Parameter Description or Chapter 11 Troubleshooting.

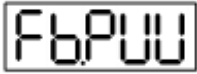
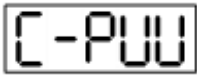
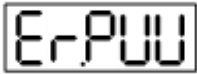
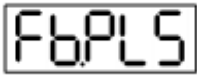
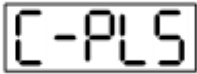
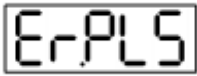

4.3.4 - POSITIVE AND NEGATIVE SIGN SETTING

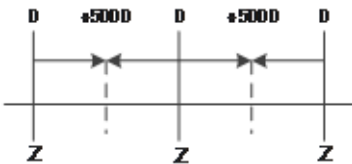
Displayed Symbol	Description
	In Editing mode, press the UP and DOWN keys to change the displayed value. Use the SHIFT key to change the selected value (the selected value is flashing.)
	Press the SHIFT key in editing mode for two seconds to switch between the positive (+) and negative (-) sign. If the parameter value is out of range after switching the positive or negative sign, then the value automatically resets to the original value.

4.3.5 - MONITORING DISPLAY

When you apply power to the drive, the display shows the monitoring symbol for one second, and then enters Monitoring mode. In Monitoring mode, use the UP and DOWN keys to change the monitoring variable. Or you can directly change the setting of P0.002 to specify the monitoring code. When power cycled, the monitoring code is set to the value of P0.002. Scrolling through the codes on the keypad will allow you to monitor codes 0-31. For example, if P0.002 = 85, then on every power cycle the display will monitor the “Ecam Alignment Deviation percentage” but you can quickly scroll through the 1st 31 codes with the keypad. Scrolling through the codes will not change the value of P0.002, so on power cycle the display will revert back to showing the value of 85 (Ecam Alignment Deviation percentage). PUU stands for Pulse User Units and is determined by the E-Gear ratio (P1.044 and P1.045).

See the details in the table below:

Parameter P0.002 setting	Displayed Symbol	Description	Unit
0		Motor feedback pulse number (after the scaling of E-Gear ratio) (user unit)	[user unit]
1		Input the number of pulses command (after the scaling of E-Gear ratio) (user unit)	[user unit]
2		The deviation between control command pulse and feedback pulse number (user unit)	[user unit]
3		Motor feedback pulse number (encoder unit) (1.28 million pulse/rev)	[pulse]
4		Input the number of pulses command (before the scaling of E-Gear ratio) (encoder unit)	[pulse]
5		Error pulse number (after the scaling of E-Gear ratio) (encoder unit)	[pulse]
6		Input frequency of pulse command	[kpps]

Parameter P0.002 setting	Displayed Symbol	Description	Unit
7	SPEED	Motor speed	[rpm]
8	CSPd1	Speed command	[Volt]
9	CSPd2	Speed command	[rpm]
10	C-t91	Torque command	[Volt]
11	C-t92	Torque command	[%]
12	AUG-L	Average torque	[%]
13	PE-L	Peak torque	[%]
14	U bus	Main circuit voltage	[Volt]
15	J-L	Load / Motor inertia ratio (note: if it shows 13.0, it means the actual inertia is 13)	[1 times]
16	IGbt.t	IGBT temperature	[°C]
17	rSnFr	Resonance frequency (low byte is the first resonance and high byte is the second one)	[Hz]
18	d IFF2	<p>The absolute pulse number of encoder Z phase equals the homing value, 0. It is +5000 or -5000 pulses when the motor rotates in the forward or reverse direction.</p> 	-
19*	NNAP1	Mapping parameter #1: shows the content of parameter P0.025 (specify the mapping target by P0.035)	-
20*	NNAP2	Mapping parameter #2: shows the content of parameter P0.026 (specify the mapping target by P0.036)	-
21*	NNAP3	Mapping parameter #3: shows the content of parameter P0.027 (specify the mapping target by P0.037)	-

* - See section 8.4.11 on page 8-258 for special considerations concerning MAP and Monitoring settings.

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Parameter P0.002 setting	Displayed Symbol	Description	Unit
22*		Mapping parameter #4: shows the content of parameter P0.028 (specify the mapping target by P0.038)	-
23*		Monitoring variable #1: shows the content of parameter P0.009 (specify the monitoring variable code by P0.017)	-
24*		Monitoring variable #2: shows the content of parameter P0.010 (specify the monitoring variable code by P0.018)	-
25*		Monitoring variable #3: shows the content of parameter P0.011 (specify the monitoring variable code by P0.019)	-
26*		Monitoring variable #4: shows the content of parameter P0.012 (specify the monitoring variable code by P0.020)	-
27-31		Reserved	-

* - See section 8.4.11 on page 8-258 for special considerations concerning MAP and Monitoring settings.

The following table shows the drive display of 16-bit and 32-bit value:

Example	Bits	Description
(Decimal)	16	If the value is 1234, it displays 01234 (in decimal format).
(Hex)		If the value is 0x1234, it displays 1234 (in hexadecimal format; the first digit does not show).
(Dec high)	32	If the value is 1234567890, the display of the high byte is 1234.5 and displays 67890 as the low byte (in decimal format).
(Dec low)		
(Hex high)		If the value is 0x12345678, the display of the high byte is h1234 and displays L5678 as the low byte (in hexadecimal format).
(Hex low)		

The following table shows the drive display for the negative sign:

Example	Description
	If the value is -12345, it displays as 1.2.345 (only in decimal format; there is no positive or negative sign for hexadecimal format display).

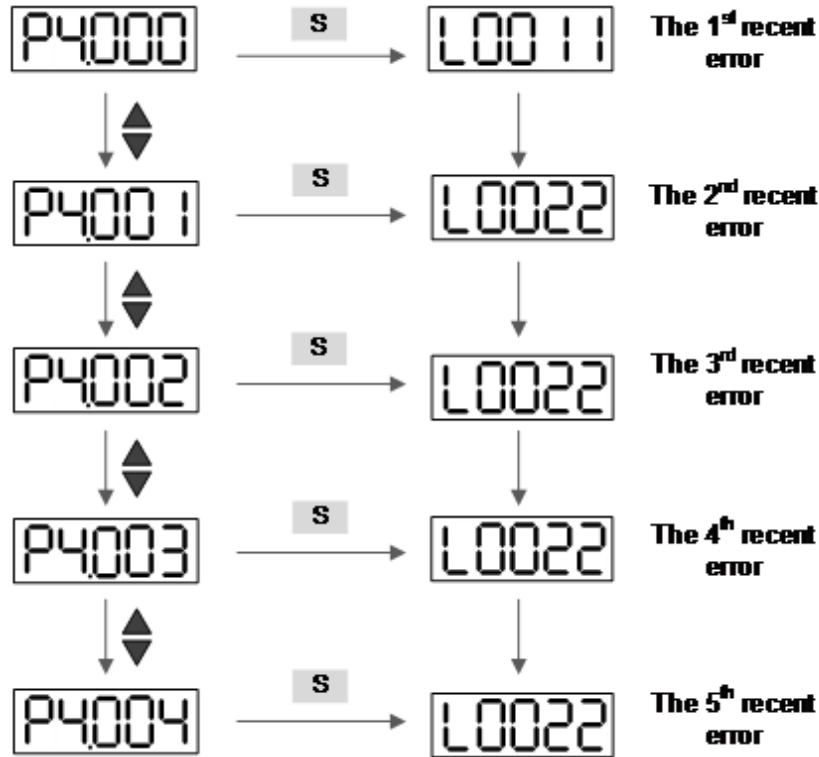
Notes:

- 1) Dec means the value is displayed in decimal format; Hex represents hexadecimal format.
- 2) The display is applicable in both Monitoring mode and Editing mode.
- 3) When all monitoring variables are 32 bits, you can switch the high / low bit and the display (Dec / Hex). As described in Chapter 8, each parameter only supports one display method and cannot be switched.

4.4 - GENERAL FUNCTIONS

4.4.1 - OPERATION OF FAULT RECORD DISPLAY

In Parameter mode, select P4.000 – P4.004 and press the SET key to show the corresponding fault record.



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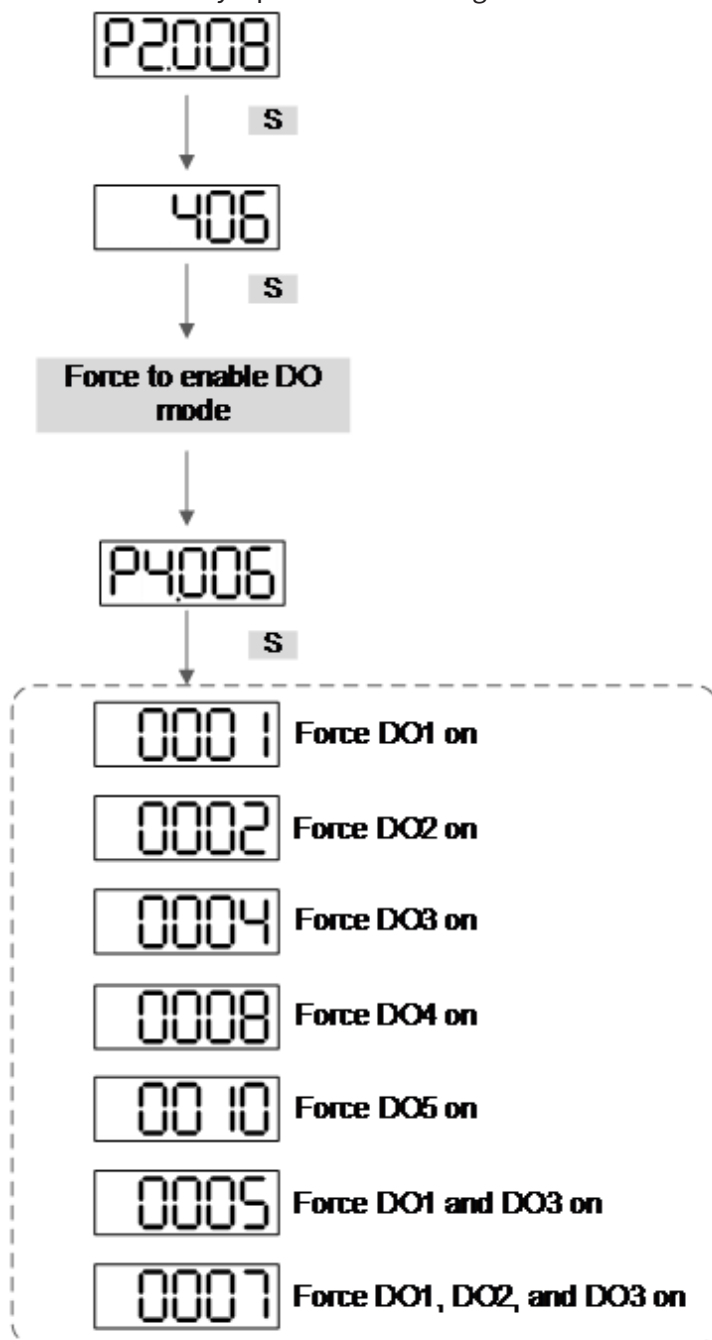
4.4.2 - FORCE DO ON

You can switch to the Diagnosis mode by the following steps. Set P2.008 to 406 and enable the function to force DO1-DO6 on. Then, set the DO via hexadecimal method with P4.006. When the parameter value is 2, it forces DO2 on. When the value is A (binary 1010), it forces DO2 and DO4 on. No data is retained in this mode. The mode returns to the normal DO mode after cycling the power. You can also set P2.008 to 400 to switch to the normal DO mode. If you want to force one DO but not have to force all to 0, please refer to P4.006. This non-diagnostic method will allow you to trigger an output using communications.



Setting P2.008 to 406 will clear the contents of P4.006 which means turning on DO Force will initially force all digital outputs to low or closed.

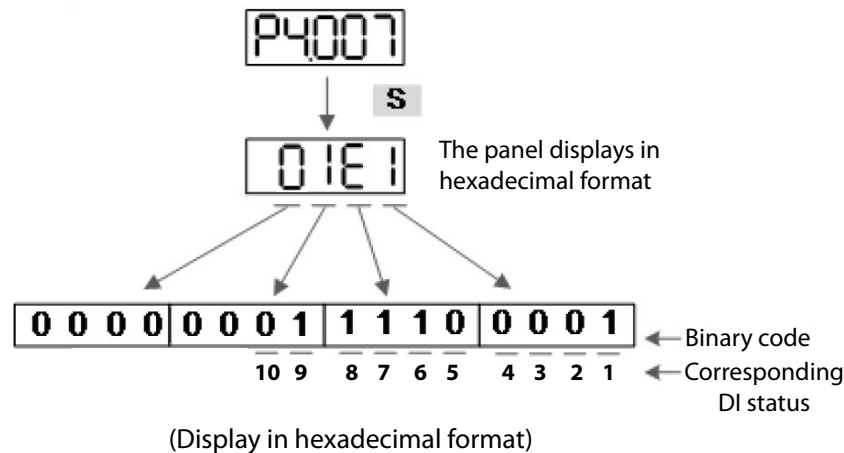
Digital output NO and NC configurations do not remain in effect during DO forces. All DO become a Normally Open contact during the time P2.008 = 406.



4.4.3 - DIGITAL INPUT DIAGNOSTIC MODE

You can switch to the Diagnostic mode by the following steps. P4.007 -> set -> 0000 -> set. This will set the drive display to monitoring mode to DI status (di-St). When DI1 – DI10 are triggered by an external signal, the display shows the corresponding input status displayed in hex. When it shows 9, then DI 1 and DI 4 are on. Entering P4.007 grabs a snapshot of the inputs and will not update in real time after entering into the parameter in edit mode. Pressing the Set key again will then set the display in Monitoring Mode to di-St (Digital Input Status). You can also see the inputs change in real time by setting P000.2 = 39.

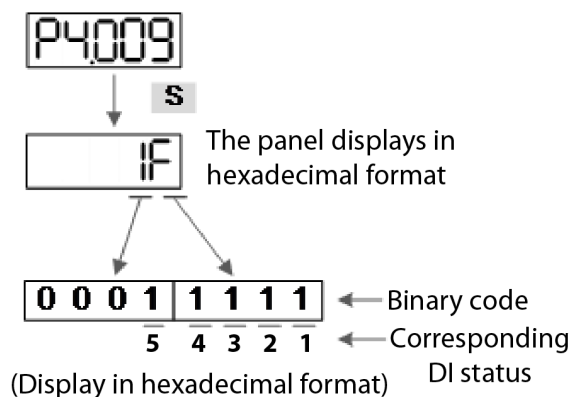
For example, if it shows 01E1, E is in hexadecimal format, and is 1110 in binary format. Then, DI6 – DI8 are ON for the second nibble.



4.4.4 - DIGITAL OUTPUT DIAGNOSTIC MODE

You can switch to the Diagnosis mode by the following steps. Entering P4.009 will only take a snapshot of the digital output status. If you want to see the digital outputs change in real time than you must set P0.002 = 40 to see the output change in monitoring mode. The output signals DO1 – DO6 are triggered and the corresponding signal appears on the display, displayed by bit. When it shows 1, it means the DO is on.

For example, if it shows 1F, F is in hexadecimal format, it is 1111 in binary format. Then, DO1 – DO4 are on.



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4.5 - TESTING

This section is divided into two parts. The first part introduces testing without load. And the second part describes testing when running the servo motor with load. To avoid danger, please operate the servo motor without a load first.

4.5.1 - TESTING WITHOUT LOAD

Please remove the load from the servo motor, including coupling on the shaft and accessories, to avoid any damage to servo drive or machine. This prevents the disassembled parts of the motor shaft from falling off and possibly causing personnel injury or equipment damage during operation. Please run the motor without a load first to see if the servo motor can run during normal operation.



Check the following items before operation:

Test before running the servo drive (without power)

- Check for any obvious visible damage.
- The wires at the wiring terminal should be isolated.
- Make sure the wiring is correct to avoid damage or any abnormal operation.
- Check for and remove any electrically conductive objects, including metal (such as screws) or flammable objects inside or near the servo drive.
- Ensure that control switch is in OFF or safe state.
- Do not place the servo drive or external regenerative resistor on flammable objects.
- Ensure the electromagnetic brake works and circuit breakers and disconnects are working normally.
- If there is electronic interference with any peripheral devices, please reduce electromagnetic interference from the devices.
- Please make sure the external voltage level of the servo drive is correct.

Test while running the servo drive (with power)

- The encoder cable should be protected from excessive mechanical tension or stress. When the motor is running, please make sure the cable is not worn or stretched.
- Please contact AutomationDirect if the servo motor vibrates or makes unusual noise during operation. Note that it is normal to hear a little bit of noise in brake motors when the brake is off.
- Make sure the setting for the parameters are correct. Different machinery and applications may require different servo behavior. Please adjust the parameters according to the characteristics of each machine.
- Only change parameters when the servo drive is in the Servo Off status, or you may cause the servo drive to malfunction.
- Check if the power indicator and LED display work properly.

4.5.2 - APPLY POWER TO SURESERVO2 SERVO DRIVE

Please follow the instructions below.

- 1) Make sure the wiring between the motor and servo drive is correct:
 - a) U, V, W, and FG have to connect to the red, white, black, and green wires respectively. If the wiring is incorrect, the motor will not work properly. Please refer to Section 3.1.2 for wiring.
 - b) The encoder cable for the motor is correctly connected to CN2: if you only want to use the JOG function then connecting CN1 and CN3 is not necessary. Please refer to Section 3.6 for the wiring for CN2. Please refer to section 4.5.3 for more information on JOG.



- 2) Connect the power circuit for the servo drive:
Please refer to Section 3.1.3 for power wiring.
- 3) Turn on the power:
Apply power, including to the control circuit (L1c, L2c) and main circuit (R, S, T).

Please see “4.5.4 - Trial run without load (Speed mode)” on page 4–17 for a complete list of parameters that will need to be changed to test run a drive without an IO hooked up.

When the power is on, the display of the servo drive shows AL013 (motor override):

AL013

The default digital inputs (DI6 – DI8) are the signal for reverse inhibit limit or negative limit (NL), forward inhibit limit or positive limit (PL), and motor override (OVRD). If DI6 – DI8 is not used, you must change the values of P2.015 – P2.017, which you can set to 0 (disable the DI function) or some other value for a different function. DI6-DI8 are defaulted to be normally closed which is the best practice for end of travel limits and emergency stops. The onboard STO connector is a safer way to ensure removal of power to the motor in the event of an emergency.

If the servo drive status displays P0.002 setting as the motor speed (07), then the screen display shows:

SPEED
↓
00000

No DISPLAY

When the drive display displays no text, please check if the control circuit power is undervoltage.

OVERVOLTAGE WARNING:

When an overvoltage warning occurs the screen displays AL002:



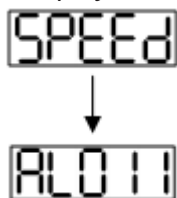
This means the voltage input from the main circuit is higher than the rated range or a power input error has occurred (incorrect power system).

Corrective action:

- 1) Use the voltmeter to measure the input voltage from the main circuit, and ensure it is within the rated range.
- 2) Use the voltmeter to check if the power system complies with the specifications.

ENCODER ERROR WARNING:

When an encoder error occurs the screen displays AL011:



Check that the motor encoder is securely connected, and the wiring is correct.

Corrective action:

- 1) Make sure the wiring is following the instructions in the user manual.
- 2) Check the encoder connector.
- 3) Check for loose wiring.
- 4) Check for damage to the encoder.

MOTOR OVERRIDE WARNING:

In the case of a motor override the screen displays AL013:



Please check if any of the digital inputs DI1 – DI10 are set to motor override (OVRD).

Corrective action:

- 1) If you do not want to set the motor override (OVRD) as one of the digital inputs, make sure no other digital input is set to motor override (OVRD) for DI1 – DI19 (make sure that none of the parameters, P2.010 – P2.017 and P2.036, are set to x21).
- 2) If the motor override (OVRD) function is needed and DI is set as normally closed (function code: 0x0021), please make sure that DI is always normally closed. If not, please set DI as normally open (function code: 0x0121).

NEGATIVE LIMIT ERROR WARNING:

When a negative limit error occurs the screen displays AL014:



Please check if any of the digital inputs are set to negative limit (NL) and that DI is on.

Corrective action:

- 1) If you do not want to set the negative limit (NL) as one of the digital inputs, make sure no other digital input is set to negative limit (NL) for DI1 – DI9 (make sure that none of the parameters, P2.010 – P2.017 and P2.036 are set to 22).
- 2) If the negative limit (NL) function is needed and DI is set as normally closed (function code: 0x0022), please make sure that DI is always normally closed. If not, please set DI as normally open (function code: 0x0122).

POSITIVE LIMIT ERROR WARNING:

When a positive limit error occurs the screen displays AL015:



Please check if any of the digital inputs DI1–DI19 are set to positive limit (PL) and that DI is on.

Corrective action:

- 1) If you do not want to set the positive limit (PL) as one of the digital inputs, make sure no other digital input is set to positive limit (PL) for DI1 – DI9 (make sure that none of the parameters, P2.010 – P2.017 and P2.036 are set to 23).
- 2) If the positive limit (PL) function is needed and DI is set as normally closed (function code: 0x0023), please make sure DI is always normally closed. If not, please set DI as normally open (function code: 0x0123).

OVERCURRENT WARNING.

When an overcurrent event occurs the screen displays AL001:

**Corrective action:**

- 1) Check the connection between the motor and servo drive.
- 2) Check if the conducting wire is short circuited. Fix the short circuit and avoid any metal conductors being exposed.

UNDERVOLTAGE WARNING.

When voltage is low but still sufficient to power the display, the screen displays AL003:

AL003

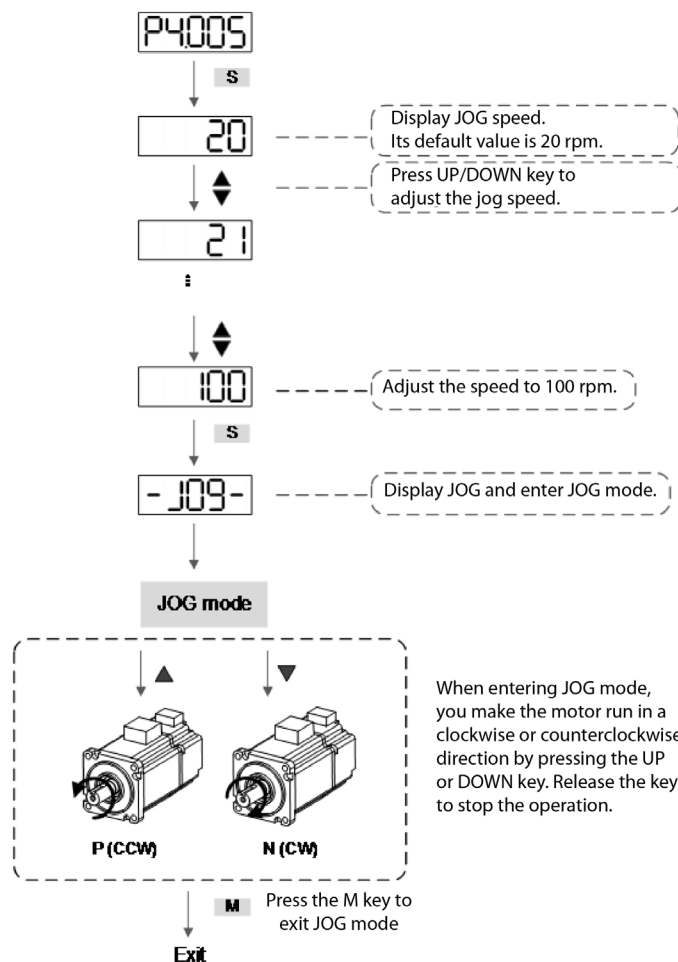
Corrective action:

- 1) Check if the main circuit wiring is correct.
- 2) Use a voltmeter to make sure that the main circuit voltage is normal.
- 3) Use a voltmeter to make sure that the power system complies with the specification.

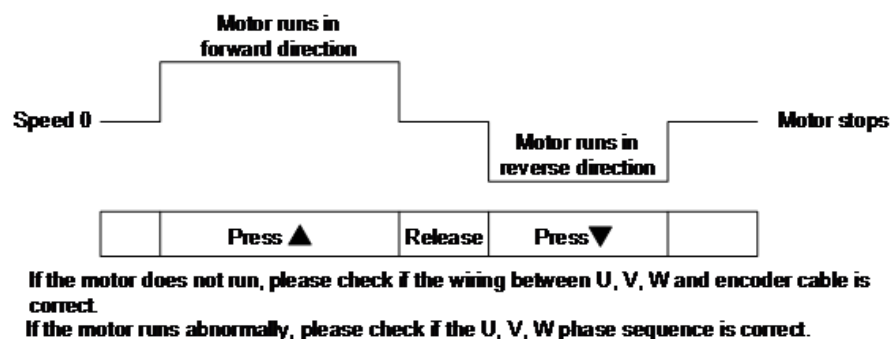
4.5.3 - JOG TRIAL RUN WITHOUT LOAD

It is easy to test the motor and servo drive using a JOG trial run without load since no extra wiring is needed. For safety reasons, it is recommended to set JOG at a low speed. Follow the steps below:

- 1) JOG is available only when the servo drive is in the Servo On state. The drive can be forced into the Servo On state by setting P2.030 to 1 or with the host controller.
- 2) Set P4.005 to JOG speed (unit: rpm). Press the S key to display the JOG speed. The default is 20 rpm. Press the ▲ or ▼ key to adjust the JOG speed.
- 3) Press the ▲ or ▼ key to JOG. In the following example, the speed is set to 100 rpm.
- 4) To exit JOG mode press the M key. Be sure to set P2.030 back to 0 to exit the forced Servo On state.



The following shows the JOG timing diagram:



4.5.4 - TRIAL RUN WITHOUT LOAD (SPEED MODE)

Before starting the trial run without load, firmly secure the motor base to avoid any danger caused by force generated by the motor during speed changes.

Step 1:

Set the control mode of the servo drive to Speed mode. Set P1.001 to 2 for Speed mode. Then cycle the power to the servo drive.

Step 2:

In Speed mode, the following table lists the recommended digital input settings for the trial run:

Digital Input	Parameter value	Symbol	Function Description	CN1 Pin No.
DI1	P2.010 = 101	SON	Servo is activated	DI1- = 9
DI2	P2.011 = 109	TRQLM	Torque limit	DI2- = 10
DI3	P2.012 = 114	SPD0	Speed selection	DI3- = 34
DI4	P2.013 = 115	SPD1	Speed selection	DI4- = 8
DI5	P2.014 = 102	ARST	Alarm reset	DI5- = 33
DI6	P2.015 = 0	-	DI disabled	-
DI7	P2.016 = 0	-	DI disabled	-
DI8	P2.017 = 0	-	DI disabled	-
DI9	P2.036 = 0	-	DI disabled	-
DI10	P2.037 = 0	-	DI disabled	-
VDI11	P2.038 = 0	-	DI disabled	-
VDI12	P2.039 = 0	-	DI disabled	-
VDI13	P2.040 = 0	-	DI disabled	-

This table shows the settings that disable the negative limit (DI6), positive limit (DI7), and motor override (DI8) functions. Thus, parameter P2.015 – P2.017 and P2.036 – P2.040 are set to 0 (disabled). When configuring the digital input for the servo drive, please refer to the DI code descriptions.

The default setting includes the negative limit, positive limit, and motor override functions; therefore, if any alarm occurs after you complete the settings, please cycle the power to the servo drive or set DI5 to ON to clear the error. Please refer to Section 4.5.

The speed command selection is determined by SPD0 and SPD1. See the following table:

Speed Command No.	DI Signal for CN1		Command Source	Content	Range
	SPD1	SPD0			
S0	0	0	External analog command	Voltage difference between V-REF and GND	-10V to +10V
S1	0	1	Internal register (parameters)	P1.009	-60000 – 60000
S2	1	0		P1.010	-60000 – 60000
S3	1	1		P1.011	-60000 – 60000

0: means the switch is open (off).

1: means the switch is closed (on).

The parameter setting range is from -60000 to 60000. Setting speed = Setting range x unit (0.1 rpm). For example: P1.009 = +10000; Setting speed = +10000 x 0.1 rpm = +1000 rpm.

Test Values:

Command setting for the speed register:

Parameter	Setting
P1.009	100
P1.010	25
P1.011	100

Motor's running direction:

Input Command	Rotation Direction
+	CCW (forward direction)
-	CW (reverse direction)

Step 3:

- 1) Switch on DI1 to put the drive in the Servo On state.
- 2) Both speed commands: DI3 (SPD0) and DI4 (SPD1) are off. This means that it executes the S0 command. The motor rotates according to the analog voltage command.
- 3) When DI3 (SPD0) is on, that means it executes the S1 command (1000 rpm). The rotation speed is 3000 rpm.
- 4) When DI4 (SPD1) is on, that means it executes the S2 command (100 rpm). The rotation speed is 100 rpm.
- 5) When both DI3 (SPD0) and DI4 (SPD1) are on, that means it executes the S3 command (-1000 rpm). The rotation speed is -1000 rpm.
- 6) You can repeatedly execute steps 3, 4, and 5.
- 7) If you want to stop the motor, switch off DI1 (Servo Off).

4.5.5 - TRIAL RUN WITHOUT LOAD (POSITION MODE)

Before starting the trial run without load, firmly secure the motor base to avoid any danger caused by the force generated by the motor during speed changes.

Step 1:

Set the control mode of the servo drive to Position mode. Set P1.001 to 1 for Position mode. Then cycle the power to the servo drive.

Step 2:

In Position mode, the following table lists the digital input settings for the trial run:

Digital Input	Parameter value	Symbol	Function Description	CN1 Pin No.
DI1	P2.010 = 101	SON	Servo is activated	DI1- = 9
DI2	P2.011 = 108	CTRG	Command triggered	DI2- = 10
DI3	P2.012 = 111	POS0	Position selection	DI3- = 34
DI4	P2.013 = 112	POS1	Position selection	DI4- = 8
DI5	P2.014 = 102	ARST	Alarm reset	DI5- = 33
DI6	P2.015 = 0	-	DI disabled	-
DI7	P2.016 = 0	-	DI disabled	-
DI8	P2.017 = 0	-	DI disabled	-
DI9	P2.036 = 0	-	DI disabled	-
DI10	P2.037 = 0	-	DI disabled	-
VDI11	P2.038 = 0	-	DI disabled	-
VDI12	P2.039 = 0	-	DI disabled	-
VDI13	P2.040 = 0	-	DI disabled	-

The above table shows the settings that disable the negative limit (DI6), positive limit (DI7), and motor override (DI8) functions. Thus, parameter P2.015 – P2.017 and P2.036 – P2.041 are set to 0 (disabled); you can program the digital input of the servo drive. When programming the digital input, please refer to the DI code descriptions.

The default setting includes the negative limit, positive limit, and motor override functions; therefore, if any alarm occurs after you complete the settings, please cycle the power to the servo drive or set DI5 to ON to clear the alarm. Please refer to Section 4.5.

Refer to Section 3.10.2 for the wiring for Position (PR) control mode. Please see the table below for the 99 sets for PR and the position command (POS0 – POS6):

Position Command	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0	CTRG	Corresponding Parameters
Homing	0	0	0	0	0	0	0	↑	P6.000
									P6.001
PR1	0	0	0	0	0	0	1	↑	P6.002
									P6.003
~									~
PR50	0	1	1	0	0	1	0	↑	P6.098
									P6.099
PR51	0	1	1	0	0	1	1	↑	P7.000
									P7.001
~									~
PR99	1	1	0	0	0	1	0	↑	P7.098
									P7.099

0: means the switch is open (off).

1: means the switch is closed (on).

You can set the 99 sets of PR (P6.000 – P7.099), which you can also set for absolute position commands. Refer to chapter 7 for more detail on using PR mode.

Wiring

Parameters

DI/DO Codes

Monitoring

Alarms

Wiring

Parameters

DI/DO Codes

Monitoring

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