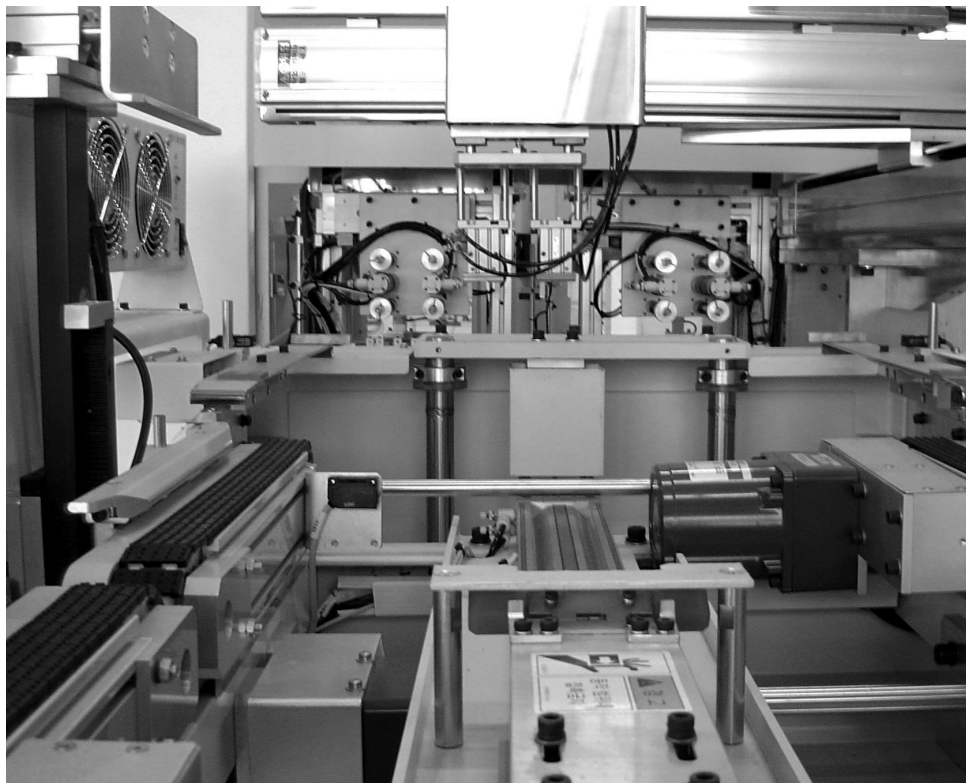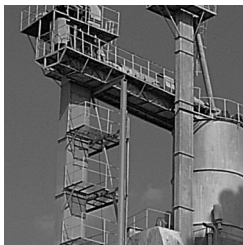**AB** **Allen-Bradley**

OEMax

CSD3 Plus Servo Drive (Indexing)

User Manual

Catalog Number(s) : CSD3-xxBX2 Rev.B

AB Allen-Bradley · Rockwell Software

Rockwell Automation

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

WARNING ⚠	Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.
ATTENTION ⚠	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence
WARNING ⚠	Labels may be located on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
BURN HAZARD	Labels may be located on or inside the equipment, for example, a drive or motor, to alert people that surfaces may be at dangerous temperatures.

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Parameters

Read this preface to familiarize yourself with the rest of the manual.

About This Publication

This manual provides detailed information for the indexing of the CSD3 Plus Servo Drive

Who Should Use this Manual

This manual is intended for engineers or technicians directly involved in the installation and wiring of the CSD3 Plus Servo Drive drive, and programmers directly involved in the operation, field maintenance, and integration of the CSD3 Plus Servo Drive drive.

If you do not have a basic understanding of the CSD3 Plus Servo Drive drive, contact your local Allen-Bradley OEMax sales representative before using this product, for information on available training courses.

Additional Resources

The following documents contain additional information concerning related CSD3P products.

For	Read This Document	Publication Number
Information about the installation of your CSD3 Plus Servo Drive	CSD3 Plus Servo Drive Installation Instructions	CSD3-IN001
Information about the operation of your CSD3 Plus Servo Drive	CSD3P Servo Drive User Manual	CSD3P-UM001
Information about the new features of SmartJog 4.1	SmartJog 4.1 User Manual	SMARTJOG-UM001B

You can view or download publications at http://www.oemax.co.kr or http://www.oemax.com To order paper copies of technical documentation, contact your local Allen-Bradley OEMax distributor or sales representative.

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Overview

Introduction

Use this chapter to briefly understand the idea of indexing of a servo drive. This chapter also describes the elements for indexing, such as position unit and acceleration, etc.

What is indexing

Servo drive is a device to control a servo motor with a pulse train or an analog signal coming from an external controller, which is responsible for the control of physical dimensions such as displacement, speed or torque. It means that a servo drive is an actuator but not a controller, just implementing the control with a command from the external controller.

An external controller determines a position, speed or torque depending on control scheme, usually based on the feedback from a servo drive. However, some applications do not require feedback-based command from the controller , but a servo drive just follows a pre-defined sequence from the controller. Especially, indexing requirement is much simpler in such applications. They just need a movement with an accurate position information regardless of other control inputs.

Now, the CSD3 Plus Servo Drive provides a simple indexing for one axis, not requiring any command from a controller, but providing programmed position control. It is quite simple function. Given an index in a parameter, then the CSD3 Plus Servo Drive starts indexing. Since any other external device is not required, the system configuration would be so simple and implemented very fast.

The CSD3 Plus Servo Drive has a special routine to provide indexing. Indexing starts to work when the control mode is set to Indexing. The CSD3 Plus Servo Drive is able to support 8 indexes with each different speed and provide various travel modes over 8 indexes. The operation can be paused or aborted by I/O signals. Also, the CSD3 Plus Servo Drive provides various homing modes.

Index Elements

In order to make a movement, it is necessary to define four elements: a position (where to move), a velocity (how fast it moves), acceleration time and deceleration time to reach the speed and make a stop. The position is defined as a number of pulses or μm, and either in the incremental or in the absolute coordinate. Up to 8 index data can be programmed. The CSD3 supports only trapezoidal velocity profile.
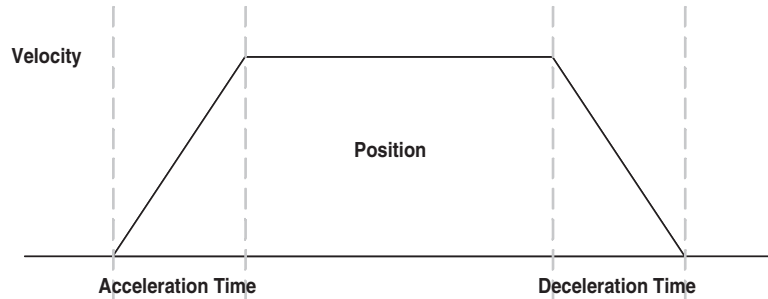
Indexing Types

There are two kinds of coordinate systems to express position. In the absolute coordinate system, all the Indexes are expressed based on one reference location, called as Home or Origin. In the incremental coordinate system, a position is defined with a relative distance from its previous position. For example, 20000 pulses input at the first position can result in different second positions as shown in each figure below depending on indexing type.
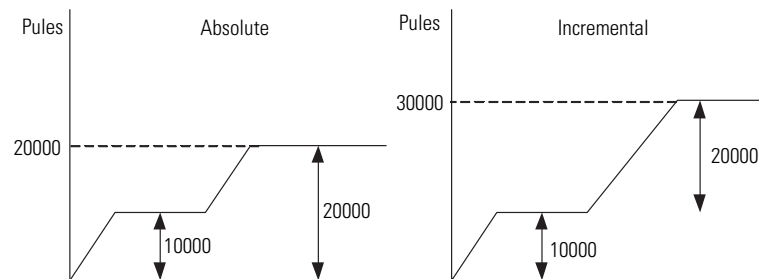
Position Unit

The position information can be entered into the index position parameters in either pulse or user (μm) unit. A user can select either option in the 1st digit of Pr-0.18 (Position Unit & Fault Code). The selected position unit applies to all the position values used in the indexing.

IMPORTANT When a value which is converted from user unit to pulse unit is out of -499,999,999~+499,999,999 pulse range, a fault (Indexing Position Range Overflow) occurs and parameter values reset to zero.

The parameters affected by the position unit are shown below:

- Pr-3.09 ~ Pr-3.24: Index 1~8 position

Parameter	No.	7-Seg. Position	Value	Update timing	Default	Range	Unit
Index 1 Position High	Pr-3.09	N/A	N/A	Immediately	0	-4,999 ~+4,999	pulse, μm
Index 1 Position Low	Pr-3.10	N/A	N/A	Immediately	0	-99,999 ~+99,999	pulse, μm
Index 2 Position High	Pr-3.11	N/A	N/A	Immediately	0	-4,999 ~+4,999	pulse, μm
Index 2 Position Low	Pr-3.12	N/A	N/A	Immediately	0	-99,999 ~+99,999	pulse, μm
Index 3 Position High	Pr-3.13	N/A	N/A	Immediately	0	-4,999 ~+4,999	pulse, μm
Index 3 Position Low	Pr-3.14	N/A	N/A	Immediately	0	-99,999 ~+99,999	pulse, μm
Index 4 Position High	Pr-3.15	N/A	N/A	Immediately	0	-4,999 ~+4,999	pulse, μm
Index 4 Position Low	Pr-3.16	N/A	N/A	Immediately	0	-99,999 ~+99,999	pulse, μm
Index 5 Position High	Pr-3.17	N/A	N/A	Immediately	0	-4,999 ~+4,999	pulse, μm
Index 5 Position Low	Pr-3.18	N/A	N/A	Immediately	0	-99,999 ~+99,999	pulse, μm
Index 6 Position High	Pr-3.19	N/A	N/A	Immediately	0	-4,999 ~+4,999	pulse, μm
Index 6 Position Low	Pr-3.20	N/A	N/A	Immediately	0	-99,999 ~+99,999	pulse, μm
Index 7 Position High	Pr-3.21	N/A	N/A	Immediately	0	-4,999 ~+4,999	pulse, μm

Index 7 Position Low	Pr-3.22	N/A	N/A	Immediately	0	-99,999 ~+99,999	pulse, μm
Index 8 Position High	Pr-3.23	N/A	N/A	Immediately	0	-4,999 ~+4,999	pulse, μm
Index 8 Position Low	Pr-3.24	N/A	N/A	Immediately	0	-99,999 ~+99,999	pulse, μm

• Pr-5.15 ~ Pr-5.22: Moving distance After Home sensor, Homing Offset, S/W Limit(+)/(-)

Parameter	No.	7-Seg. Position	Value	Update timing	Default	Range	Unit
Moving distance After Home Sensor High	Pr-5.15	N/A	N/A	Servo Off	0	-4,999 ~+4,999	pulse, μm
Moving distance After Home Sensor Low	Pr-5.16	N/A	N/A	Servo Off	0	-99,999 ~+99,999	pulse, μm
Homing Offset High	Pr-5.17	N/A	N/A	Servo Off	0	-4,999 ~+4,999	pulse, μm
Homing Offset Low	Pr-5.18	N/A	N/A	Servo Off	0	-99,999 ~+99,999	pulse, μm
Software Negative Limit High	Pr-5.19	N/A	N/A	Servo Off	0	-4,999 ~+4,999	pulse, μm
Software Negative Limit Low	Pr-5.20	N/A	N/A	Servo Off	0	-99,999 ~+99,999	pulse, μm
Software Positive Limit High	Pr-5.21	N/A	N/A	Servo Off	0	-4,999 ~+4,999	pulse, μm
Software Positive Limit Low	Pr-5.22	N/A	N/A	Servo Off	0	-99,999 ~+99,999	pulse, μm

The value within -499,999,999~+499,999,999 range is entered into the Index No. Position High and Low separately as shown below, where No. means a parameter number such as Pr-3.09 (Index 1 Position High) or Pr-3.10 (Index 1 Position Low).

• Index No. Position High : 10^5~10^8 digits of an Index command, -4,999~+4,999

• Index No. Position Low : 10^0~10^4 digits of an Index command, -99,999~+99,999

When a value out of the range -99,999~+99,999 is entered into the index position, the sign of the entered value is set in the Index No. Position High. If the value is within the range, the sign is set in the Index No. Position Low.

• When a user tries to enter a negative value into an Index No. Position Low while Index No. Position High is not equal to zero by using the built-in operator, the parameter value is not changed.

• When a user enters a value other than 0 into Index No. Position High while Index No. Position Low is smaller than zero, the parameter value is not changed.

Example)

Index No. Position	Index No. Position High	Index No. Position Low
-12,345,678	-123	45678
-12,345	0	-12345

Pulse Unit

Set the 1st digit of Pr-0.18 (Position Unit & Fault Code) to '0' and enter the number of pulses into the Index parameter. The example below describes how to use the High and Low parameters of Index No. Position (pulse).

Parameter	No.	7-Seg. Position	Value	Detail	Update timing	Default	Range	Unit
Position Unit& Fault Code	Pr-0.18	1	0	Position Unit(pulse)	Power Off/On	0	0~1	N/A
			1	Position Unit(User Unit : um)				
		2	0	Fault Code		0	0~2	N/A
			1	Index Number				
			2	Fault Code & Index Number				
Pulse reference of User unit input	Pr-0.23			Pulse reference of User unit input	Power Off/On	0	0~ 999,999	pulse
Distance reference of User unit input	Pr-0.24			Distance reference of User unit input	Power Off/On	0	0~ 65,535	μm

EXAMPLE

Example1)

When Index No. Position High is equal to zero,

Index No. Position (pulse) = Index No. Position Low

Example2)

When Index No. Position High is not equal to zero and

Index No. Position High is larger than zero and Index No. Position Low is larger than zero,

Index No. Position (pulse) =
Index No. Position High*10^5+ Index No. Position Low

When Index No. Position High is not equal to zero and

Index No. Position High is smaller than zero and Index No. Position Low is larger than zero,

Index No. Position (pulse) =
Index No. Position High*10^5- Index No. Position Low

User Unit

A servo drive uses a number of pulses to express a moving distance. However, it is not so convenient to check a movement in pulse unit since user unit (μm) is actually used to express a moving distance. The CSD3 Plus Servo Drive supports either a number of pulses or user (μm) to express a moving distance. When a movement is given in a number of pulses, then the servo makes a movement based on the number of pulses directly. However, set the 1st digit of Pr-0.18 (Position Unit & Fault Code) to '1', then the servo needs to convert user (μm) into a number of pulses when a position is given in user (μm). The conversion requires a coefficient to show the correlation between μm and a number of pulses. The Pr- 0.23 (Pulse user reference: 0~999,999 pulses) and Pr-0.24 (Distance user reference: 0~65,535 μm) are the parameters to set the coefficient.

- User reference: A μm = B pulses

- Index No. Position (pulse) =
  Index No. Position (μm) * Pr-0.23 value (pulse) / Pr-0.24 value (μm)

IMPORTANT   When a value which is converted from user unit to pulse unit is out of -499,999,999~+499,999,999 pulse range, a fault (Indexing Position Range Overflow) occurs and parameter values reset to zero.

Example)

User reference: 300 μm = 1,000 pulses

Pr-0.23 value (pulse): 1,000

Pr-0.24 value (μm): 300

Index 1 Position: 7,320 μm

Index 1 Position (pulse) = 7,320 μm * 1,000 pulses / 300 μm

$$= 24{,}400 \text{ pulses}$$

Velocity, Acceleration Time, Deceleration Time Setting

A user can enter total 8 velocities for 8 indexes. However, there are only one Acceleration Time and one Deceleration Time.

Velocity

Enter velocity t for each movement into the velocity parameter. The input range is 0~5000 and its unit is rpm. For the Index 1 to the Index 7, use Pr-2.05~Pr-2.11 to enter its velocity. For the Index 8, use Pr-2.18.

Parameter	No.	7-Seg. Position	Value	Update timing	Default	Range	Unit
Contact speed command 1/ Index 1 Velocity	Pr-2.05	N/A	N/A	Immediately	100	-5,000 ~5,000	rpm
Contact speed command 2/ Index 2 Velocity	Pr-2.06	N/A	N/A	Immediately	200	-5,000 ~5,000	rpm
Contact speed command 3/ Index 3 Velocity	Pr-2.07	N/A	N/A	Immediately	300	-5,000 ~5,000	rpm
Contact speed command 4/ Index 4 Velocity	Pr-2.08	N/A	N/A	Immediately	400	-5,000 ~5,000	rpm
Contact speed command 5/ Index 5 Velocity	Pr-2.09	N/A	N/A	Immediately	500	-5,000 ~5,000	rpm
Contact speed command 6/ Index 6 Velocity	Pr-2.10	N/A	N/A	Immediately	600	-5,000 ~5,000	rpm
Contact speed command 7/ Index 7 Velocity	Pr-2.11	N/A	N/A	Immediately	700	-5,000 ~5,000	rpm
Index 8 Velocity	Pr-2.18	N/A	N/A	Immediately	800	0~5,000	rpm

Acceleration

A user can define only one Acceleration time for all the 8 indexes. The range of Index Acceleration Time (Pr-2.19) is 0~20,000 and its unit is msec. The Acceleration slope is calculated by velocity and Acceleration time as shown below.

Index No. Acceleration slope (pulse/sec/sec) =
[Index No. Welocity (revolution/min) / 60 * Motor ppr (pulse/

revolution)] / (Acceleration time (msec) * 0.001)

Parameter	No.	7-Seg. Position	Value	Update timing	Default	Range	Unit
Index Acceleration Time	Pr-2.19	N/A	N/A	Immediately	200	0~20,000	msec

Deceleration

A user can define only one Deceleration time for all the 8 indexes. The range of Index Deceleration Time (Pr-2.20) is 0~20,000 and its unit is msec. The Deceleration slope is calculated by velocity and Deceleration time as shown below.

Index No. Deceleration slope (pulse/sec/sec) =
[Index No. Velocity (revolution/min) / 60 * ppr (pulse/revolution)] /
(Deceleration time(msec) * 0.001)

Parameter	No.	7-Seg. Position	Value	Update timing	Default	Range	Unit
Index Deceleration Time	Pr-2.20	N/A	N/A	Immediately	200	0~20,000	msec

Indexing

Introduction

This chapter describes the operation of the CSD3 Plus Servo Drive.

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For indexing, the CSD3 servo drive uses general servo parameters, position data, travel mode and I/O signals. Since general servo parameters are also used for Indexing, refer to *The CSD3 Servo Drive User Manual (The CSD3P-UM001)* for more information about parameters related to general servo operations.

Firmware Download

When a user uploads the firmware (which is downloaded from, Rockwell Automation Korea Allen-Bradley OEMax product homepage, www.oemax.co.kr) for indexing to the CSD3 Plus Servo Drive, there occur several errors including checksum error or fault.

To solve the problem, a user needs to do power cycling two times.

Control Mode Setting

Indexing mode is added to the CSD3 Plus Servo Drive. The table below shows all the control modes supported in the CSD3 Plus Servo Drive.

	Basic Control Mode		Combinational Control Mode	
	Display	**Description**	**Display**	**Description**
Control Mode	`P`	Position mode	`- - 5P`	Speed + position mode
	`5`	Speed mode	`- t 5 -`	Torque + speed mode
	`t`	Torque mode	`- t - P`	Torque + position mode
	`C`	Multi-step speed mode	`C - - P`	Multi-step speed + position mode
	`I`	Indexing mode	`C - 5 -`	Multi-step speed + speed mode
			`C t - -`	Multi-step speed + torque mode

Parameter	No.	7-Seg. Position	Value	Detail	Update timing	Default	Range	Unit
Control mode	Pr-0.00	1	P	Position mode	Power Off/On	P		N/A
		2	S	Speed mode				
		3	T	Torque mode				
		4	C	Contact Speed mode				
		5	I	Indexing mode				

I/O Signals

I/O Signals are actual control signals for Indexing, i.e. starting a movement and making a stop. Once all index data is set up, I/O signals control indexing.

I/O Signal Configuration

A user can configure I/O signals in the CSD3 servo drive.

Digital Input signals

Type	Description	Mode
</SV-ON> Servo-ON	If input is ON, the power is applied to the servo motor, and if OFF, the power is cut off.	All
</A-RST> Fault Reset	Fault reset Resets the servo fault status.	All
</G-SEL> Gain group conversion	Use 2 group gain where the input is on, and use existing gain where the input is off. Convert 2 types of gain groups.	All
</P-TL> Limit forward torque	If signal is ON, limit forward torque by the setting of [Pr-4.03].	All
</N-TL> Limit reverse torque	If signal is ON, limit reverse torque by the setting of [Pr-4.04].	All
<P-OT> Prohibit forward operation	If load mechanical part reaches the forward limit, this prevents the motor from moving further to that direction.	P S C I[1]
<N-OT> Prohibit reverse operation	If load mechanical part reaches the reverse limit, this prevents the motor from moving further to that direction.	P S C I
</P-CON> P/PI control conversion	Converts the speed controller from PI controller type into P controller type. Used to provide better response performance by prohibiting the overshoot in transient response.	P S C I
</C-SEL> Control mode conversion	Used to convert control mode when used as combinational control mode.	Combinational Control Mode Only
</C-DIR> </C-SP1> </C-SP2> </C-SP3> </C-SP4> Terminal speed command	The rotation direction</C-DIR> and rotation speed </C-SP1 to /C-SP4> of the motor are determined by the above input in terminal speed control mode. Rotation speed of </C-SP1 to /C-SP3> is set in [Pr-2.05 to Pr-2.11]. Rotation speed of </C-SP4> is set by analog speed command voltage. <</C-DIR> is used to change motor rotation direction in speed control mode. (Indexing) The combination of </C-SP1>, </C-SP2> and </C-SP3> selects one of eight position commands.	C, I(/C-DIR, /C-SP4 is not available.)
</Z-CLP> Zero clamp	Disregard the input value if in speed control, analog command value is smaller than the value set at speed zero clamp level [Pr-5.04].	S
</INHIB> Inhibit pulse command	Disregard position command pulse where the signal is ON.	P
</ABS-DT> Absolute Encoder Data Transmission	Transmits absolute encoder data to host controller through EA, EB when the signal is ON.	P I
</PCLR> /ABORT	Clear position command, position feedback, and position error. (Indexing) Abort Indexing	P I

/START	Control motor rotation start or stop by using terminal signal in speed or terminal speed control mode. (Indxing)Start Motion or Indexing	S C I
/GEAR	In position control mode, the 2nd electronic gear parameters [Pr-3.05] and [Pr-3.06] are used when input is ON. The basic electronic gear parameters [Pr-3.01] and [Pr-3.02] are used when input is OFF. Switch between two electronic gear ratios.	P
/HOME	Home Sensor Signal	I
/SHOM	Start Homing	I
/PAUSE	Pause Indexing	I

[1]   P: Position mode, S: Speed mode, C: Contact Speed mode, I: Indexing mode

Digital Output signals

Signal	Description	Mode
</P-COM (+, -)> Positioning Completion detection	It is ON when the position error is within the set value of output width of position completion signal, [Pr-5.00],	P I
</NEAR (+, -)> Position approach detection	It is ON when the position error is within the setting value of output width of position approach signal, [Pr-5.01].	P I
</V-COM (+, -)> Speed coincidence detection	It is ON when error between speed command and motor rotation speed is within the set value of output width of speed coincidence signal, [Pr-5.02].	P S C I
</TG-ON (+, -)> Rotation detection	It is ON when the motor rotates at speeds higher than the set value of rotation detection level, [Pr-5.03].	All
</T-LMT (+, -)> Torque limit detection	It is ON when it reaches the set torque limit.	All
</V-LMT (+, -)> Speed limit detection	It is ON when it reaches the set speed limit.	All
<BK (+, -)> Breaker control	Signal for the control of brake mounted internally or externally on the servo motor.	All
</WARN (+, -)> Warning detection	It is ON if a servo warning is detected,	All
</HOMC (+, -)> Homing Completed	It is ON when the home is defined.	I
</IMO (+, -)> In Motion	It is ON in motion.	I

Fault Code Output

Signal	Description
AL1	In the Indexing mode, the 2nd digit of Pr-0.18 determines what the output is.
	-. 0 : Fault Code
AL2	-. 1 : Index Number
	This is maintained during indexing and also until it starts a new indexing.
AL3	The default is '0'.
	-. 2 : Fault Code & Index Number
Fault-S G	Index Number during indexing
	Fault Code if not under indexing

Parameter	No.	7-Seg. Position	Value	Detail	Update timing	Default	Range	Unit
Position Unit & Fault Code	Pr-0.18	1	0	Position Unit(pulse)	Power Off/On	0	0~1	N/A
			1	Position Unit(User Unit : um)				
		2	0	Fault Code		0	0~2	N/A
			1	Index Number				
			2	Fault Code & Index Number				

	/AL3	/AL2	/AL1
Index 1	OFF	OFF	OFF
Index 2	OFF	OFF	ON
Index 3	OFF	ON	OFF
Index 4	OFF	ON	ON
Index 5	ON	OFF	OFF
Index 6	ON	OFF	ON
Index 7	ON	ON	OFF
Index 8	ON	ON	ON

Factory Defaults

Factory defaults are default settings for general servo functions, which are different from Indexing. These should be configured properly before using Indexing.

Factory Defaults

PIN No	Input		PIN No	Output
3	DI #1 /SV-ON		41-42	DO #1 /P-COM
4	DI #2		43-44	DO #2 /TG-ON
5	DI #3		47-48	DO #3 BK
6	DI #4 P-CON			
7	DI #5 /A-RST			
8	DI #6 /N-TL			
9	DI #7 /P-TL			

The table below shows sample of I/O Configuration when there is no limit switch but Home sensor. And the Indexes are assigned by I/O selection signals.

PIN No	Input		PIN No	Output
3	DI #1 /SV-ON		41-42	DO #1 /P-COM
4	DI #2 /HOME		43-44	DO #2 /HOMC
5	DI #3 /SHOM		47-48	DO #3 /IMO
6	DI #4 /START			
7	DI #5 /C-SP1			
8	DI #6 /C-SP2			
9	DI #7 /C-SP3			

I/O Settings

Input Signal Assignment

Refer to the below tables to allocate sequence input signals.

Set values	8	7	6	5	4	3	2	1	0
Input channel number	Always valid	DI#7	DI#6	DI#5	DI#4	DI#3	DI#2	DI#1	Always invalid
CN1 pin number		9	8	7	6	5	4	3	

As shown on the table below, relevant functions are already assigned to sequence input parameters and the number of digits of the related configuration window; the user enters relevant function by selecting a value in the range of '1-8' , excluding value '0'.

For example, if a certain function is to be applied to Pin 5 of CN1, the parameter pertaining to that signal should be looked up from the table below and the set value entered as '3'.

If the input signal function is not to be used, enter '0'.

If the input signal should be always ON regardless of wiring, enter '8'.

The table below is a summary of parameters for each function and the 7-segment digits displayed on the configuration window. Be sure that the digits on the configuration window match the parameters relevant to each signal.

	7-segment	4th digit	3rd digit	2nd digit	1st digit
	Configuration window of each parameter	0	0	0	0
1	Pr - 0.05	</P-CON> Initial value: 4	<N-OT> Initial value:8	<P-OT> Initial value:8	</SV-ON> Initial value: 1
2	Pr - 0.06	</C-SEL>	</P-TL> Initial value:7	</N-TL> Initial value: 6	</A-RST> Initial value: 5
3	Pr - 0.07	</C-SP3>	</C-SP2>	</C-SP1>	</C-DIR>
4	Pr - 0.08	</PCLR>or </ABORT>	</G-SEL>	</INHIB>	</Z-CLP>
5	Pr - 0.09	</GEAR>	</C-SP4>	</START>	</ABS-DT>
6	Pr.-0.26	N/A	</PAUSE>	</SHOM>	</HOME>

Configuration example

```Pr - 0.05``` ```8.8.78.8.8.```	Value '7' is set at the 4th digit of the configuration window for parameter[Pr-0.05]. This value has been set to use the </P-CON> function; it means that the pin DI#7 of CN1 is to be used as input pin.
Applicable modes	ALL	Other details	Servo-OFF>Configure>Reapply power>Completed
Detailed description	Refer to the Chapter 5-2 of the CSD3 Plus Servo Drive User Manual (CSD3P-UM001).

Output Signal Assignment

Refer to the below tables to allocate sequence output signals.

	7-segment	4th digit	3rd digit	2nd digit	1st digit
	Configuration window of each parameter	⊠0	0	0	0
1	```Pr - 0.10```	</V-COM>	</BK> Initial value 3	</TG-ON> Initial value: 2	</P-COM> Initial value: 1
2	```Pr - 0.11```	</WARN>	</NEAR>	</ V-LMT>	</T-LMT>
3	```Pr - 0.21```	N/A	N/A	</IMO>	</HOMC>

Configuration example

```Pr - 0.11``` ```8.8.38.8.8.```	Value '3' has been set as the 4th digit on the configuration window of parameter [Pr-0.11]. This value is set to output the </NEAR> signal; it means that pin 47 and 48 of CN1 are to be used as output pins.
Applicable modes	ALL	Other details	Servo-OFF > Configuration>Reapply power > Completed
Detailed description	Refer to the Chapter 5-2 of the CSD3 Plus Servo Drive User Manual (CSD3P-UM001).

Description of I/O Signals

START and IMO (In Motion)

The START is an input signal to start indexing and IMO is an output signal to indicate that the indexing is working. When the active going edge of the START signal is detected, the CSD3 Plus Servo Drive starts the indexing and gives IMO output. The START is used to initiate the travel mode or to clear pause.

When the CSD3 Plus Servo Drive is under homing or motion, the START signal is ignored. The IMO signal is ON during the servo drive is in motion, pause or dwell.
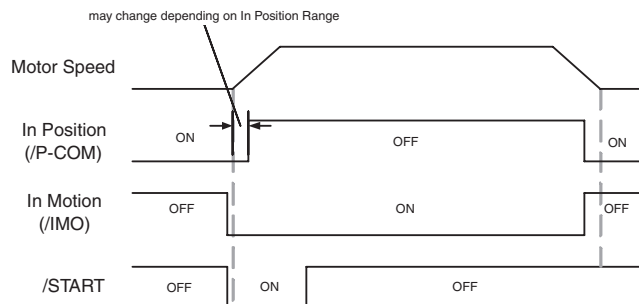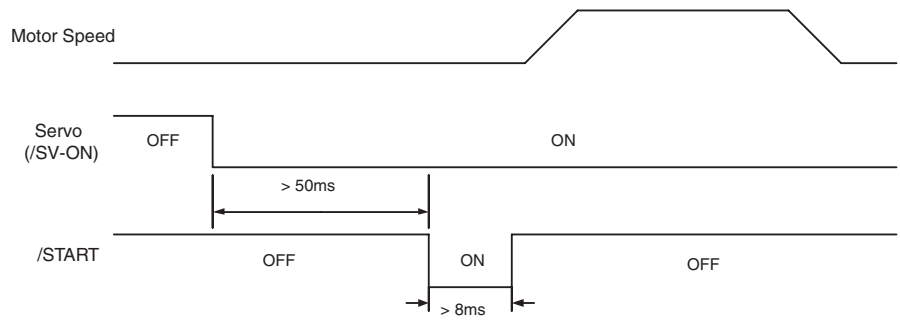
C-SP1, C-SP2 and C-SP3

The C-SP1, C-SP2 and C-SP3 are selection signals to define an index among 8 indexes in the index table. In the selective position travel mode, the CSD3 servo drive determines the index by using the combination of these signals at the active going edge of the START signal. The C-SP1& C-SP2& C-SP3 signals are valid only when the signals maintain their status for at least 4ms before the active going edge of START signal and at least for 8 msec after the active going edge of START signal. If the C-SP1, C-SP2 and C-SP3 signals are detected during motion, they are ignored.
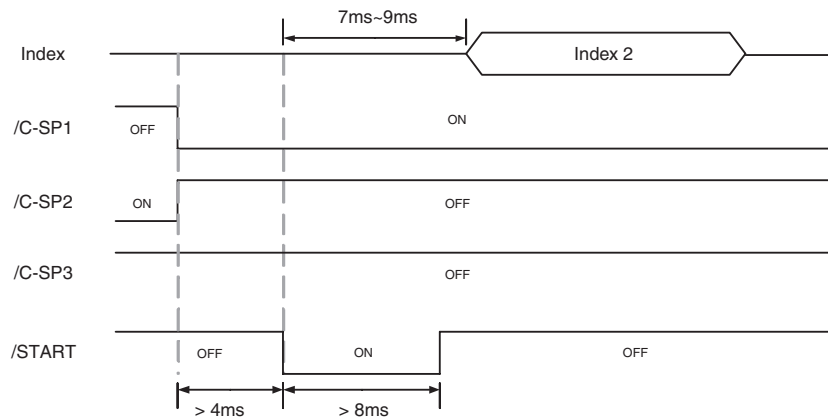
PAUSE

When the system detects the active going edge of a PAUSE signal during indexing, the motor starts to be decelerated to stop in a pre-defined deceleration time while remembering the index. The IMO is still ON because the motion is not completed yet.

When the CSD3 Plus Servo Drive detects the active going edge of START signal during pause, the indexing is enabled again to reach the index position with the motion profiles of acceleration time, velocity and deceleration time.

When the ABORT signal turns ON during pause, the indexing is aborted and the indexing is terminated. The system becomes ready for a new indexing. Please refer to Abort for more information. The pause is enabled at the active going edge of the PAUSE signal, and IMO (In Motion) is still active during pause.
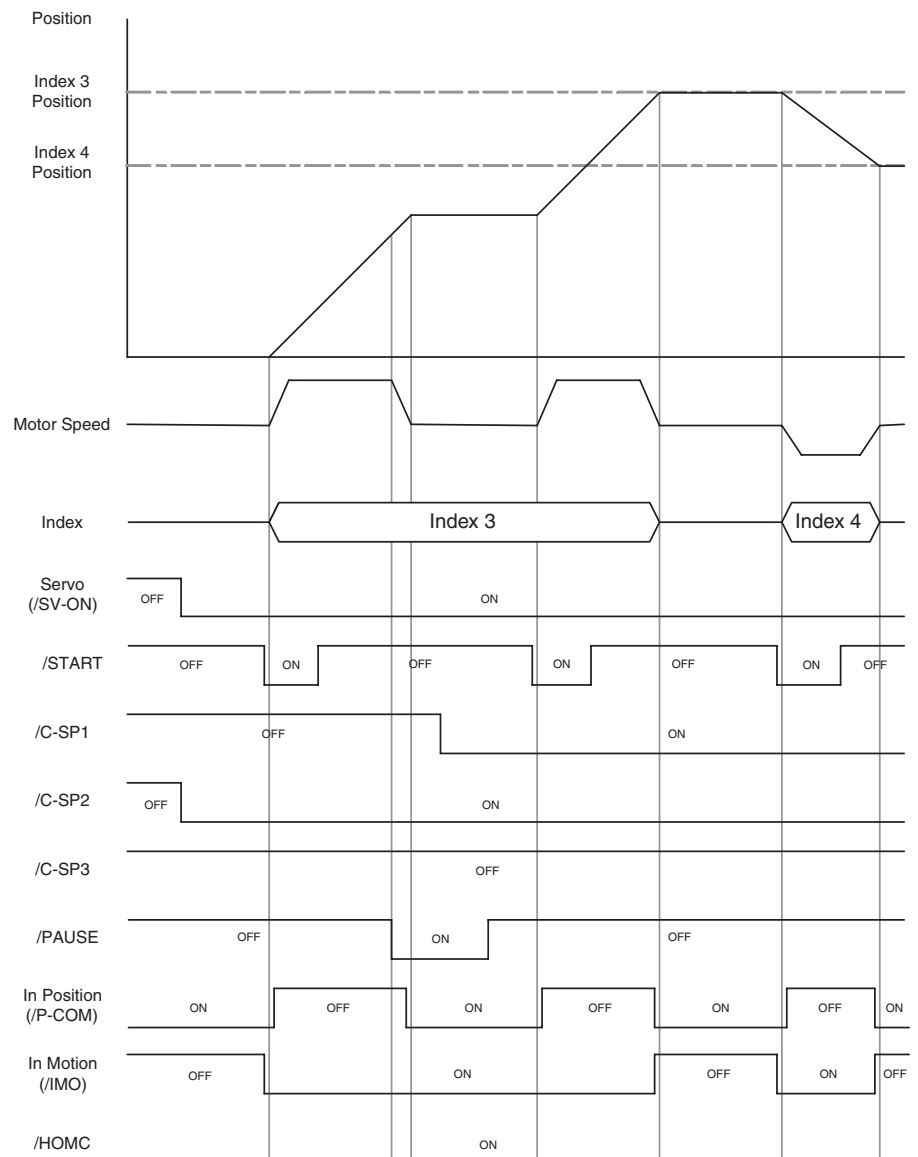
ABORT

The Abort is a signal to cancel indexing. The existing /PCLR signal is used for Abort. When the ABORT signal turns ON during indexing, the motor starts to be decelerated and stops. The indexing is aborted. The IMO signal turns OFF as well. The Abort is enabled at the active going edge of the /ABORT input. The ABORT is only available in the Travel mode, not in the Homing mode. When the ABORT is enabled, IMO (In Motion) signal becomes OFF.
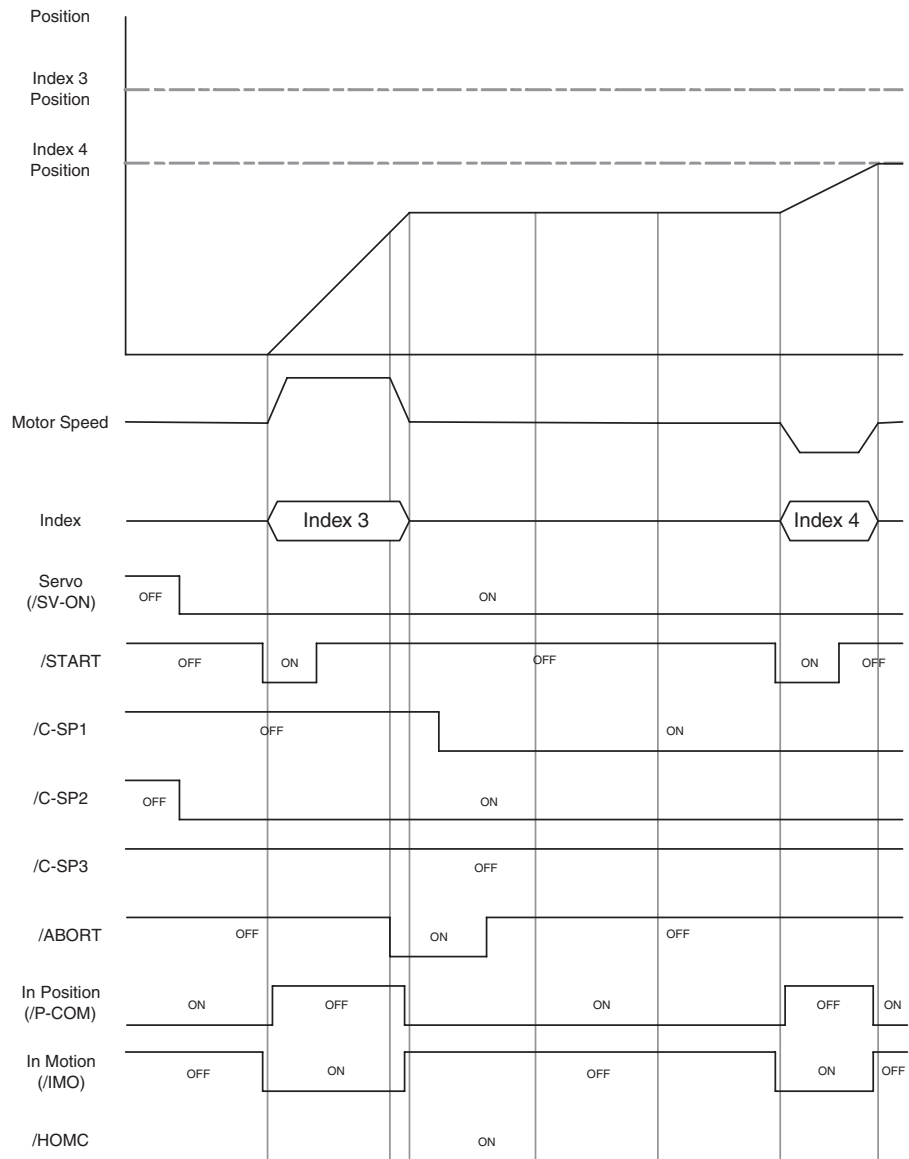
SHOM(Start Homing), HOME(Home Sensor Signal), HOMC(Homing Completed)

Homing is initiated when there is the active going edge of the SHOM signal. Any SHOM signal in the middle of homing process is ignored.

When the second digit of Pr-0.20 is set to '1', the SHOM signal is read in.

The HOME is an input signal from the home sensor.

The HOMC is an output signal indicating that home search is complete. When the system arrives at the origin, the HOMC turns ON.

When there is a fault with the encoder, the HOMC will be OFF since origin information will be lost.

Signal Polarity Settings

Parameter	No.	7-Seg. Position	Value	Detail	Update timing	Default	Range	Unit
Input signal level	Pr-0.25	1	0	P-OT Active Low (Limit(+))	Power Off/On	1	0~1	N/A
			1	P-OT Active High (Limit(+))				
		2	0	N-OT Active Low (Limit(-))		1	0~1	N/A
			1	N-OT Active High (Limit(-))				
		3	0	HOME Active Low		0	0~1	N/A
			1	HOME Active High				

Travel modes

The CSD3 servo drive can store 8 indexes and provide 3 types of travel modes for the 8 indexes. The three types are Automatic Sequential travel, Step Sequential travel, and Selective position travel. Except the Selective position travel, 8 indexes are pre-defined in a memory. The Selective position travel determines 8 indexes by using I/O signals.

Attention

⚠

There occurs a fault when a user tries any indexing without Homing operation completed (i.e. when HOMC (Homing Completed) is not enabled). Refer to *Homing Not Completed* on page 2-27 for more information about the fault.

.

Parameter	No.	7-Seg. Position	Value	Detail	Update timing	Default	Range	Unit
Indexing Mode	Pr-0.17	1	0	Absolute	Power Off/On	0	0~1	N/A
			1	Incremental				
		2	0	Automatic Sequential travel		2	0~2	N/A
			1	Step Sequential Travel				
			2	Selective position travel				

Automatic Sequential travel

In this mode, the motor automatically travels over 8 indexes according to the Index table. When there is a START signal, the motor moves to the index 1 position and stops, and automatically moves to the index 2 position. In the same manner, it repeats until it arrives at the last index. The duration of stop at each index depends on the Dwell time defined in the index data. IMO is active when the movement starts and maintains the state until the last index. If a user wants to use less than 8 indexes, he can enter the number of indexes into the parameter Pr-0.22 (Number of indexes). The default is '8'.
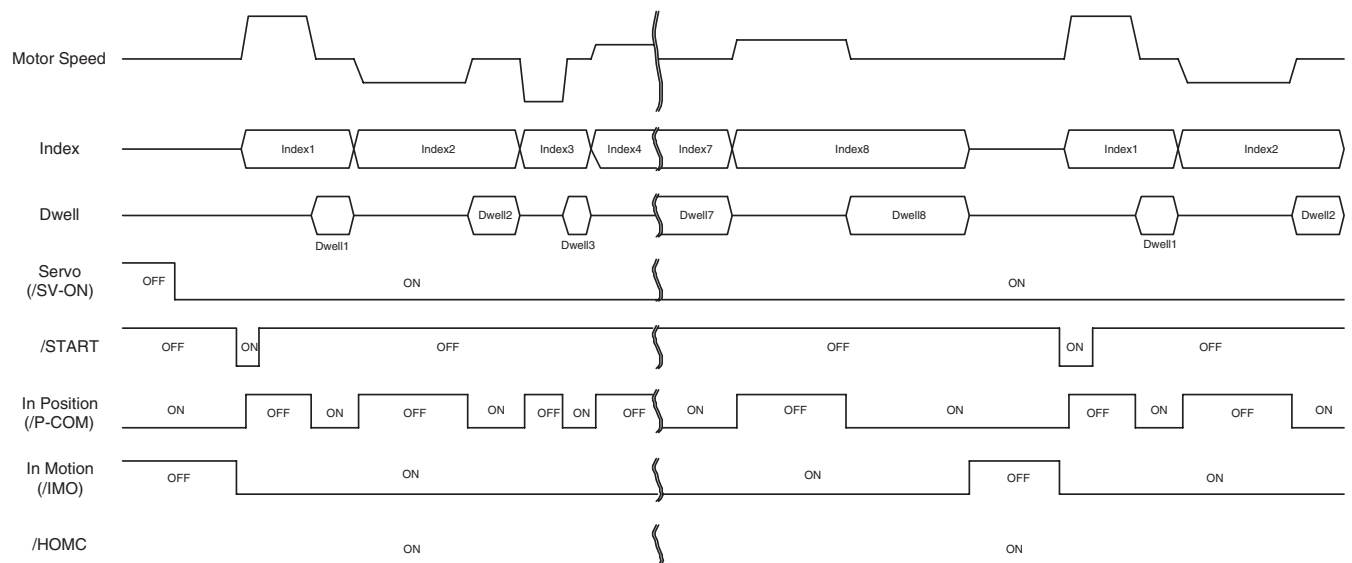
Parameter	No.	7-Seg. Position	Value	Update timing	Default	Range	Unit
Number of Indexes	Pr-0.22			Servo Off	8	1~8	N/A

Step Sequential Travel

In this mode, whenever there is the START signal, it moves to the next index, not like the Automatic Sequential travel where only one START signal is required to move over all the Indexes. Just like the Automatic Sequential travel, the motor travels over 8 indexes according to the Index table, but each START signal is required for each movement.

Whenever it arrives at each position, the IMO signal is turned OFF.
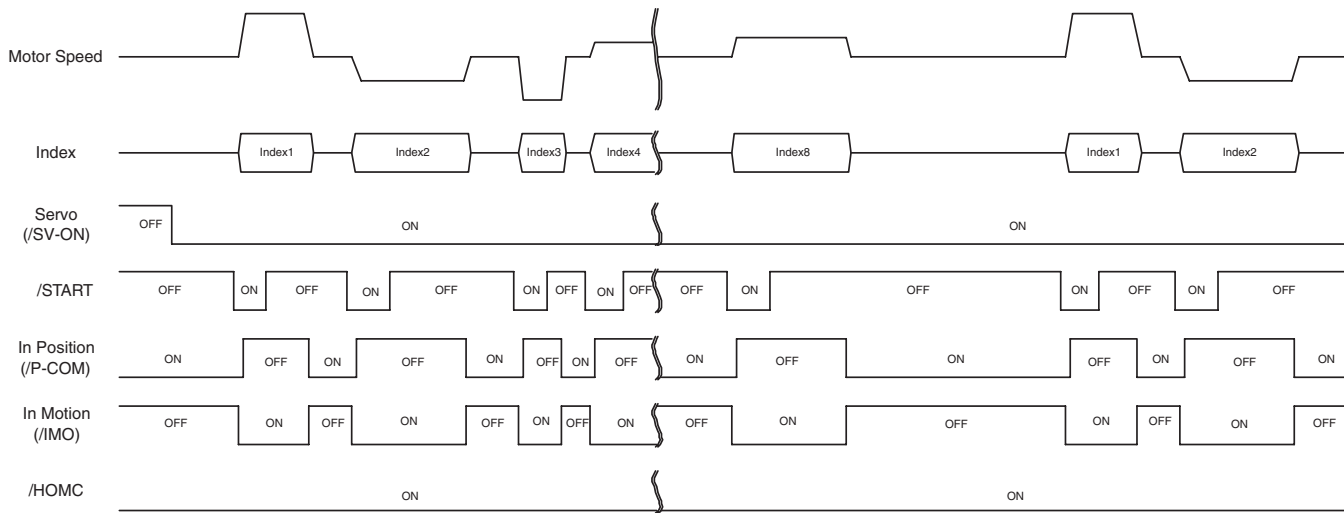
Selective Position Travel

The 8 indexes are determined by the combination of I/O signals, i.e. C-SP0, C-SP1 and C-SP2 when the CSD3 servo drive detects the active going edge of the START signal.

C-SP2	C-SP1	C-SP0	Index
OFF	OFF	OFF	Index 1 Position
OFF	OFF	ON	Index 2 Position
OFF	ON	OFF	Index 3 Position
OFF	ON	ON	Index 4 Position
ON	OFF	OFF	Index 5 Position
ON	OFF	ON	Index 6 Position
ON	ON	OFF	Index 7 Position
ON	ON	ON	Index 8 Position

This is an example to show how the motor travels over Indexes stored in the memory according the combination of selection signals. The motor will move to each index in order.

Index 5 --> Index 7 --> Index 3 --> Index 4 --> Index 1
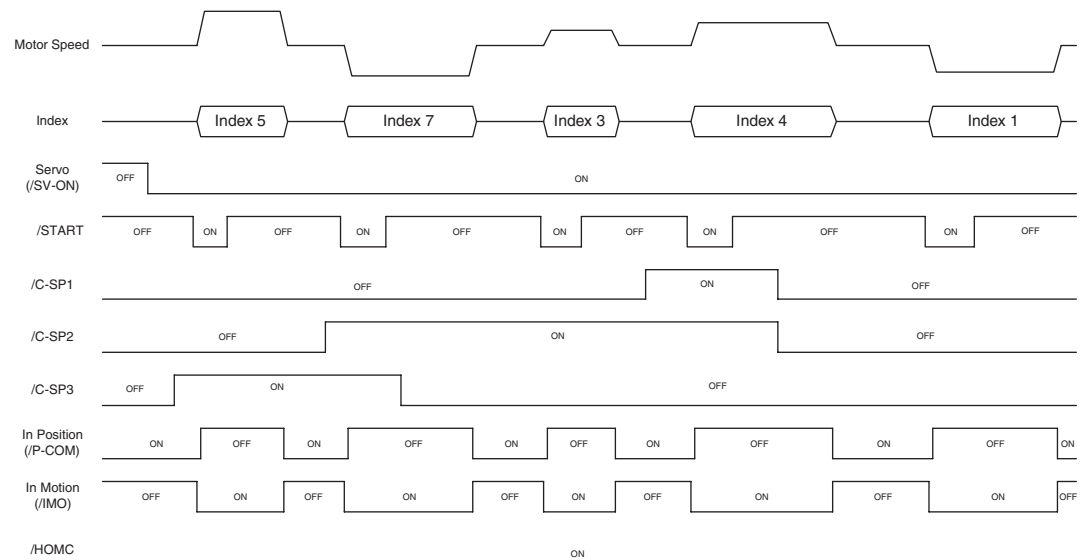
Homing

During indexing, all 8 indexes are defined based on a single position reference which is called 'origin'. Home Search is a movement to find and set the origin. After it finds HOME and defines the origin, the position of the origin is set to "0". There are several ways to find the origin and the CSD3 Plus Servo Drive provides 8 kinds of home search methods.

For an appropriate homing operation, a user must set up the following parameters:

- Homing Mode (Pr-0.19), Homing Direction(Pr-20 7-Seg. 1st Digit)
- Homing Start Option(Pr-20 7-Seg. 2nd Digit)
- 1st Homing Velocity(Pr-2.16)
- 2nd Homing Velocity(Pr-2.17)
- Stopper Torque Threshold(Pr-4.09) - Optional
- Elapsed time after Stopper Torque Threshold(Pr-4.10) - Optional
- Moving distance After Home Sensor(Pr-5.15, Pr-5.16) - Optional
- Home Offset(Pr-5.17, Pr-5.18) - Optional

Parameter	No.	7-Seg. Position	Value	Detail	Update timing	Default	Range	Unit
Homing Mode	Pr-0.19	1	0	Mode 0 : None	Power Off/On	1	0~8	N/A
			1	Mode 1: To Home sensor/ Back to Marker				
			2	Mode 2: To Limit sensor/ Back to Marker				
			3	Mode 3: To Home sensor/ Fwd to Marker				
			4	Mode 4: To Limit sensor/ Fwd to Marker				
			5	Mode 5: Stopper				
			6	Mode 6: To Stopper/Back to Marker				
			7	Mode 7: To Home sensor/ Move/Back to Marker				
			8	Mode 8: Marker				
Homing Option	Pr-0.20	1	0	Homing Direction : (-), CW	Power Off/On	1	0,1	N/A
			1	Homing Direction : (+), CCW				
		2	0	Homing start by Servo ON		1	0,1	N/A
			1	Homing start by SHOM				
Homing Time Limit	Pr-0.21	N/A	N/A	Homing Time Limit		60	0~60,000	sec
1st Homing Velocity	Pr-2.16	N/A	N/A	1st homing Velocity	Servo Off	100	0~5,000	rpm
2nd Homing Velocity	Pr-2.17	N/A	N/A	2nd homing Velocity		15	0~5,000	rpm

With an Incremental motor, the position feedback is set to '0' when homing operation is complete (If offset is '0').

Attention ⚠	There occurs a fault when a user tries any indexing without Homing operation completed (i.e. when HOMC (Homing Completed) is not enabled). Refer to *Homing Not Completed* on page 2-27 for more information about the fault.

Attention ⚠	With an Absolute motor, the position feedback is set to '0' even after homing operation is complete and there is no reset for the multi turn data of the absolute encoder. The multi turn data of Absolute motor is not automatically reset. Instead, it can be reset only by a user.

Attention ⚠	In the homing mode which uses the sensor for homing, if homing is started outside of a sensor, homing can not be successfully completed.

.

N-Limit Sensor   HOME Sensor   P-Limit Sensor
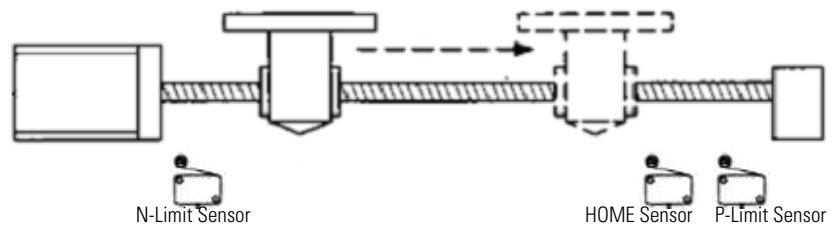
Homing Mode

The CSD3 Indexing supports 8 homing modes by using Home Sensor, Limit(+)/(-) Sensor, Stopper, and Marker, etc.

Homing Mode 0: None

The Homing Mode 0 does not use Home Search. When the homing start option of the Pr-0.20 is set to '0', the CSD3 servo drive defines the position where it is as the origin when a drive is enabled. When the homing start option of the Pr-0.20 is set to '1', the position when there is the SHOM signal is set to the origin.

Homing Mode 1: To Home Sensor / Back to Marker (default)

Homing Mode 1 uses Home Sensor and Marker to define the origin

When Home Search is started, the motor moves toward the Homing Direction (Pr-0.20) at 1st Homing Velocity (Pr-2.16) until it detects the Home Sensor. At that time, the motor is decelerated and stops, and moves toward reverse direction at 2nd Homing Velocity (Pr-2.17). When it loses the signal input from Home sensor and meets the first Marker, it is decelerated and stops, and returns to the positon where it detects the active going edge of the first Marker.
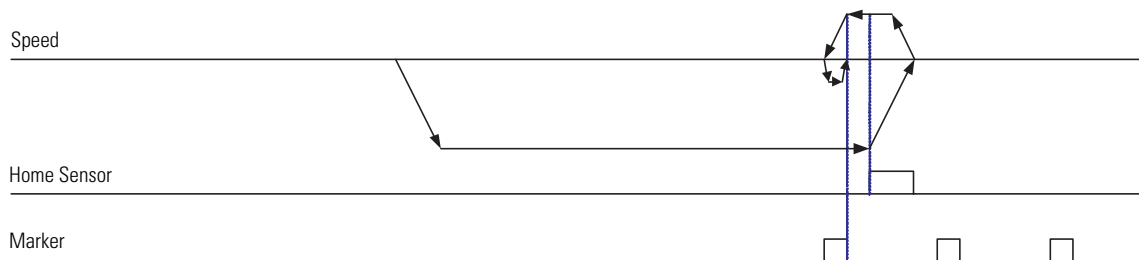
Homing Mode 2: To Limit Sensor / Back to Marker

The Homing Mode 2 uses Limit Sensor (+) or (-) and Marker.

Only the limit sensor installed in the homing direction is used and Hardware limit fault is disabled. The operational principle is the same as the Homing mode 1, only except that the limit sensor is used instead of HOME sensor input.

Homing Mode 3: To Home Sensor / Fwd to Marker

Similar to the Homing mode 1, the Homing Mode 3 also uses Home Sensor and Marker to define the origin. However, its mechanism is different.

When it detects HOME sensor input, the speed is decelerated to 2nd Homing Velocity and it is maintained until it detects the active going edge of Marker, then it

is decelerated and stops and moves backward to the position where it detects the active going edge of Marker.

Speed

Home Sensor
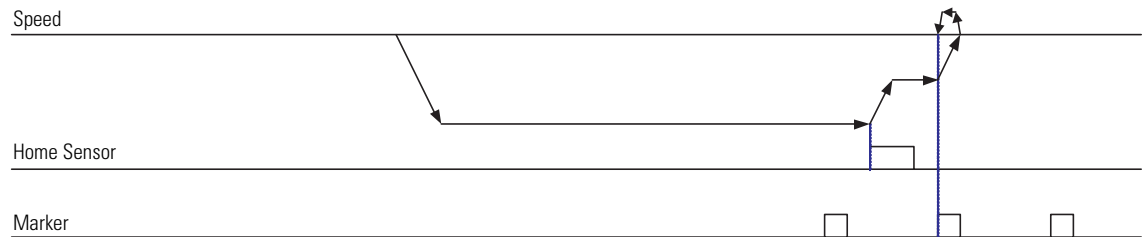
Marker

Homing Mode 4: To Limit Sensor / Fwd to Marker

Similar to the Homing mode 2, the Homing Mode 4 also uses Limit Sensor (+) or (-) and Marker. The limit sensor in the homing direction is used and Hardware limit fault is disabled. However, its operational principle is almost the same as the Homing mode 3, only except that the limit sensor is used instead of HOME sensor input.

Homing Mode 5: Stopper

The Homing Mode 5 uses the Stopper to make mechanical stop.

When Home search starts, it moves toward Homing Direction at the 1st Homing Velocity until it detects a Stopper. When its torque is maintained higher than Stopper Torque Threshold for the Elapsed time after Stopper Torque Threshold, it stops and the origin is defined at the position where it stops. The Stopper Torque Threshold is defined in the parameter Pr-4.09.

Speed
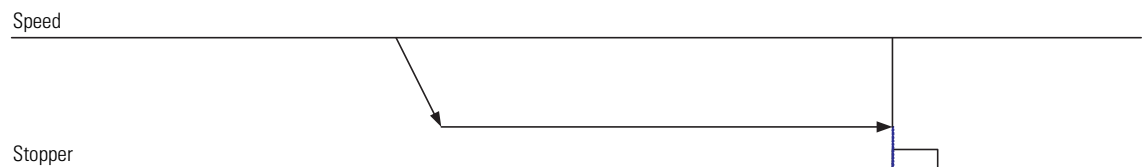
Stopper

Homing Mode 6: To Stopper / Back to Marker

The Homing Mode 6 uses the Stopper and Marker. The operation is similar to the Homing Mode 5, but this mode makes backward movement until it detects the falling edge of Marker when its torque is maintained higher than Stopper Torque Threshold for the Elapsed time after Stopper Torque Threshold. After it detects the active going edge of Marker, it is decelerated and stops, and returns to the the positon where it detects the active going edge of the first Marker.

Speed

Stopper
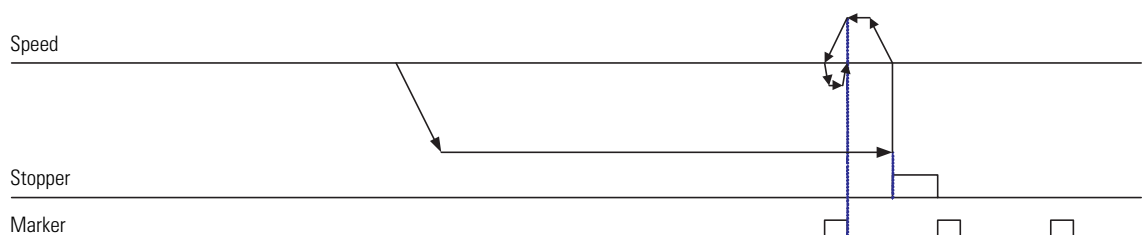
Marker

Homing Mode 7: To Home Sensor / Move / Back to Marker

The Homing Mode 7 uses Home Sensor and Moving distance after home sensor, and Marker, just as the Homing mode 3.

Sometimes, the distance is very short between HOME sensor and Marker, so it may miss to detect the first Marker. To prevent this, this mode has one more parameter to define a minimum distance to detect Marker. The minimum distance is defined as a time in the parameter Pr-4.10. After it detects Home input, the speed is decelerated to the 2nd Home speed and it is maintained until it detects the active going edge of Marker. The active going edge of Marker is set to the origin.
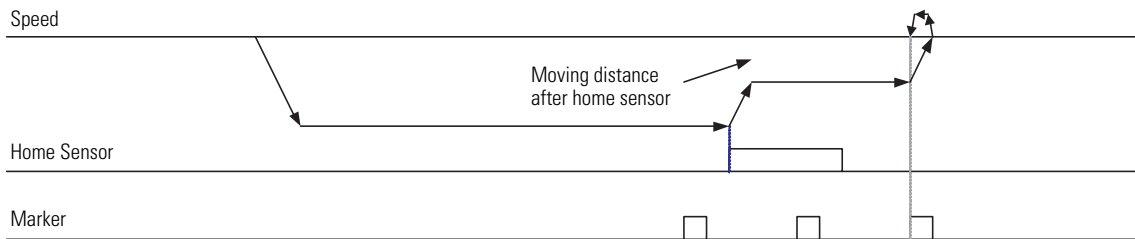
Homing Mode 8: Marker

The Homing Mode 8 uses only Marker. This mode doesn't need any extra sensors, such as HOME sensor or Limit (+) or (-). When Home search starts, it moves toward Homing Direction at the 2nd Homing Velocity. When it detects Marker, it makes stop with deceleration. It moves back to the position where it detects the active going edge of Marker and sets up the position as the origin.
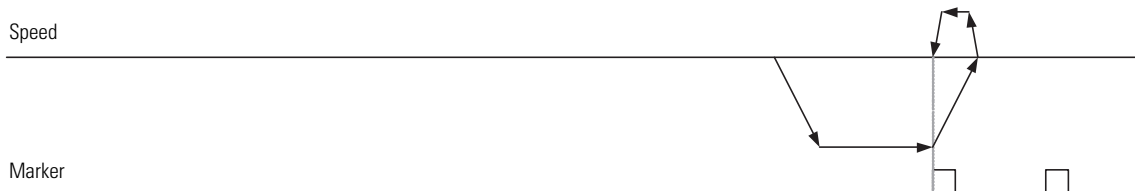
Homing Direction

A user can select the Homing direction, either forward direction (position increase, CCW) or backward direction (position decrease, CW).

Homing direction determines the limit sensor to use in a homing mode.

Homing Direction (Pr-20 7-Seg. 1st Digit : 1) : forward direction (position increase, CCW)→ Limit Sensor used for homing: Limit Sensor (+)

Homing Direction(Pr-20 7-Seg. 1st Digit : 0) : backward direction (position decrease, CW)→ Limit Sensor used for homing: Limit Sensor (-)

Homing Start Option

A user can select how to start homing, either with Start Homing Signal (/SHOM) input or Servo-ON.

When a user selects Start Homing Signal (/SHOM) input option, homing is started when there is the Start Homing Signal (/SHOM) input. However, during Indexing or Homing, the Start Homing Signal (/SHOM) is ignored. Even when Homing Completed Signal(/HOMC) is enabled after previous homing, homing is started again whenever there is the Start Homing Signal (/SHOM) input.

When a user selects Servo-ON as Homing Start Option, homing is started only when the Homing Completed Signal(/HOMC) is disabled. If the Homing Completed Signal(/HOMC) is enabled, homing is not started.

- Homing Start Option (Pr-0.20 7-Seg. 2nd Digit : 0): Homing is started when the servo drive is turned ON

- Homing Start Option (Pr-0.20 7-Seg. 2nd Digit : 1): Homing is started when the active going edge of /SHOM signal is detected

Home Offset

A user can use this option to set up an origin which is different from the origin defined in the homing operation.

If there is a home offset, the final origin is a position which is away (by home offset) from the original origin which is the result of the normal homing operation. The homing offset is not applicable for the 17-bit Absolute Motor.

The Home Offset is set up in the Pr-5.17, and 5-18. Its range is -499,999,999~+499,999,999 and its unit is the same as Position Unit.

Moving distance After Home Sensor

When Homing Mode 7 is selected, markers which appear between the active going edge of the home sensor and the end position of Moving distance After Home Sensor are all ignored. The first marker which appears after Moving distance After Home Sensor is used to define the origin.

Moving distance After Home Sensor is set up in Pr-5.15 and Pr-5.16. Its range is -499,999,999 ~ +499,999,999 and its unit is the same as Position Unit.

Stopper Torque Threshold and Elapsed time after Stopper Torque Threshold

When Homing Mode 5 or 6 is used for Homing, the system judges it actually hits the Stopper if the torque higher than the Stopper Torque Threshold is maintained for the Elapsed time after Stopper Torque Threshold.

The Stopper Torque Threshold is set up in Pr-4.09, about 0~250% of its rated torque.

Elapsed time after Stopper Torque is set up in Pr-4.10. It can be 0~1000 msec. Its default is '0'.

S/W Limit

A user can set up Limit (+) and Limit (-) with arbitrary positions. The operational principle of S/W limit is the same as that of H/W Limit. When the system moves past a S/W Limit, there occurs a warning and the motor stops according to the Over-Travel stop method.

S/W Limit is not working when S/W Limit (+) and S/W Limit (-) are set to the same value. S/W Limit (+) and S/W Limit (-) should be different for the S/W Limit operation. S/W Limit is not working during Homing.

- S/W Limit (+): Pr-5.21, Pr-5.22

- S/W Limit (-): Pr-5.19, Pr-5.20

- Over-Travel stop method : Pr-0.02 7-Seg 2nd Digit

Dwell Time

The Dwell Time is the time from when In Position (P-COM) is enabled and until next indexing starts in the Automatic Sequential travel mode.

Each different Dwell Time can be set up for each index. Pr-5.23 ~ Pr-5.30 are used for the setup. Its range is 0~90,000 and unit is msec.

Parameter	No.	7-Seg. Position	Value	Detail	Update timing	Default	Range	Unit
Index 1 Dwell Time	Pr-5.23	N/A	N/A	Dwell time after 1 step in automatic sequential travel mode	Immediately	1000	0~90,000	msec
Index 2 Dwell Time	Pr-5.24			Dwell time after 2 step in automatic sequential travel mode				
Index 3 Dwell Time	Pr-5.25			Dwell time after 3 step in automatic sequential travel mode				
Index 4 Dwell Time	Pr-5.26			Dwell time after 4 step in automatic sequential travel mode				
Index 5 Dwell Time	Pr-5.27			Dwell time after 5 step in automatic sequential travel mode				
Index 6 Dwell Time	Pr-5.28			Dwell time after 6 step in automatic sequential travel mode				
Index 7 Dwell Time	Pr-5.29			Dwell time after 7 step in automatic sequential travel mode				
Index 8 Dwell Time	Pr-5.30			Dwell time after 8 step in automatic sequential travel mode				

RUN Functions

The CSD3 servo drive supports total 13 Run functions, i.e. Run-00~Run-12.

Run-02 ~ Run-06 are not supported in the Indexing (displayed in gray color below), but Run-00~Run-01 and Run-07~Run-12 provide the same functions in the Indexing.

The Description of each Run function is shown below.

Function	Description	Support in Index Mode
Run-00	JOG operation	Yes
Run-01	Off-line auto tuning	
Run-02	Homing(Move to Marker)	No
Run-03	Auto Adjustment of Speed Command Offset	
Run-04	Auto Adjustment of Torque Command Offset	
Run-05	Manual Adjustment of Speed Command Offset	
Run-06	Manual Adjustment of Torque Command Offset	
Run-07	Adjustment of Current Feedback Offset	Yes
Run-08	Fault Reset	
Run-09	Fault History Clear	
Run-10	Absolute Encoder Reset	
Run-11	2-Group Gain Storing	
Run-12	Parameter Initialization	

Monitoring Modes for Indexing

The monitor modes help a user conveniently check Indexing Position Feedback and Indexing Position Command.

- DIS-24: Indexing Position Feedback
- DIS-25: Indexing Position Command

Index Faults

New Faults have been added for new functions.

Homing Fail

This fault occurs when there is no more movement from a previous step over a certain period of time (Homing Time Limit) during Homing.

- HOMFL

$$E.HoNFL$$

- Fault Code Output

Fault Group	AL1	AL2	AL3
3	1	0	1

- Homing Step

   a. STEP 1 : moving at 1st Homing Velocity - acceleration and constant speed section

   b. STEP 2 : moving at 1st Homing Velocity - decelerating section

   c. STEP 3 : moving at 2nd Homing Velocity - acceleration and constant speed section

   d. STEP 4 : moving at 2nd Homing Velocity - decelerating section

   e. STEP 5 : moving to Marker position

Homing Not Completed

There occurs a fault when a user tries any indexing without Homing operation completed (i.e. when HOMC (Homing Completed) is not enabled).

If a user wants to do indexing without Homing, set Pr-0.19 (homing mode) to '0' and the homing start option of Pr-0.20 (homing option) to '0'(servo-on).

- HOMNC

$$E.HoNnC$$

- Fault Code Output

Fault Group	AL1	AL2	AL3
3	1	0	1

Indexing Position Range Overflow

If the value of a Position Parameter for indexing is out of the range -499,999,999~+499,999,999, there occurs a fault.

If the position unit in pulse, which is converted from the position unit in um, is out of the range, i.e. -499,999,999~+499,999,999, there occurs a fault.

- Position parameter
  – Pr-3.09 ~ Pr-3.24 : Index (1~8) Parameter
  – Pr-5.15 ~ Pr-5.22 : Movement After Home sensor, Homing Offset, S/W Limt(+)/(-)
- INDOV

$E.1ndou$

- Fault Code Output

Fault Group	AL1	AL2	AL3
3	1	0	1

Modbus

Introduction

This chapter describes the Modbus protocol which are added to CSD3 Plus Servo Drive to support for indexing.

Topic	Page
Introduction	3-1
Modbus	3-1
Address Mapping	3-2
Address Rule and Data Conversion	3-9
Exception Code	3-13

Modbus

New Modbus addresses are assigned to the existing parameters and newly added parameters as indexing is added to the CSD3 Plus Servo Drive. The Modbus addresses support parameter Read and Write.

In addition, the addresses to monitor position feedback, Index Number and servo drive error are added for user convenience. These addressees are read only.

Address Mapping

The Modbus Addresses for the CSD3 Plus Servo Drive parameters are shown below.

IMPORTANT	Frequent change of parameters (Group 0 ~ Group 5) may lead to the reduced lifetime of the flash memory.

Modbus Address	Digit	Description	Range	Unit	Default	Update timing	Data type
0000	1	Position control mode	ex) Indexing mode: 16		Position control mode	Power Off/On	Binary
	2	Speed control mode					
	3	Torque control mode					
	4	Selective speed control mode					
	5	Indexing mode					
0001 ~ 0002		Configure motor	-		-	Power Off/On	
0003	1	Select method of DB halt	0~3		0	Servo Off	Hex
	2	Select method of over travel halt	0,1		0		
	3	Select direction of rotation	0,1		0		
	4	Select main power input	0,1		0		
0004	1	Autotuning mode	0,1		1	Servo Off	Hex
	3	Offline tuning speed	2~9		7		
	4	Online tuning coefficient	0~9		0		
0005		Inertia ratio	0.00~60.00		0	Immediately	Decimal
0006	1	/SV-ON	0~8		1	Power Off/On	Hex
	2	P-OT	0~8		8		
	3	N-OT	0~8		8		
	4	/P-CON	0~8		4		
0007	1	/A-RST	0~8		5	Power Off/On	Hex
	2	/N-TL	0~8		6		
	3	/P-TL	0~8		7		
	4	/C-SEL	0~8		0		
0008	1	/C-DIR	0~8		0	Power Off/On	Hex
	2	/C-SP1	0~8		0		
	3	/C-SP2	0~8		0		
	4	/C-SP3	0~8		0		
0009	1	/Z-CLP	0~8		0	Power Off/On	Hex
	2	/INHIB	0~8		0		
	3	/G-SEL	0~8		0		
	4	/PCLR or /ABORT	0~8		0		

Modbus Address	Digit	Description	Range	Unit	Default	Update timing	Data type
0010	1	/ABS-DT	0~8		0	Power Off/ On	Hex
	2	/START	0~8		0		
	3	/C-SP4	0~8		0		
	4	/GEAR	0~8		0		
0011	1	/P-COM	0~3		1	Power Off/ On	Hex
	2	/TG-ON	0~3		2		
	3	/BK	0~3		3		
	4	/V-COM	0~3		0		
0012	1	/T-LMT	0~3		0	Power Off/ On	Hex
	2	/V-LMT	0~3		0		
	3	/NEAR	0~3		0		
	4	/WARN	0~3		0		
0013		Servo ID	1~247		1	Immediately	Decimal
0014		Password	-		-	Immediately	
0015	1	RS-232C communication speed	1~6		6	Immediately	Hex
	2	RS-485 communication speed	1~6		3		
	3	Data format	1~6		1		
	4	Protocol	0,1		0		
0016		Reserved					
0017		Reserved					
0018	1	0: Absolute 1: Incremental	0~1		0	Power Off/ On	Hex
	2	0: Automatic Sequential travel 1: Step Sequential Travel 2: Selective position travel	0~2		2		
0019	1	0: Position Unit (pulse) 1: Position Unit (User Unit : μm)	0~1		0	Power Off/ On	Hex
	2	0: Fault Code 1: Index Number 2: Fault Code & Index Number	0~2		0		
0020	1	Homing mode	0~8		1	Power Off/ On	Hex
0021	1	0: HomHoming Direction : (-), CW 1: Homing Direction : (+), CCW	0,1		1	Power Off/ On	Hex
	2	0: Homing start by Servo ON 1: Homing start by SHOM	0,1		1		
0022		Homing Time Limit	0~60000	sec	60	Servo Off	Decimal
0023		Number of Indexes	1~8		8	Servo Off	Decimal
0024 ~ 0025		Pulse reference of User unit input	0~999.999	pulse	0	Power Off/ On	Decimal
0026		Distance reference of User unit input	0~65535	μm	0	Power Off/ On	Decimal

Modbus Address	Digit	Description	Range	Unit	Default	Update timing	Data type
0027	1	0: P-OT Active Low (Limit+) 1: P-OT Active High (Limit-)	0,1		1	Power Off/ On	Hex
	2	0: N-OT Active Low (Limit-) 1: N-OT Active High (Limit+)	0,1		1		
	3	0: HOME Active Low 1: HOME Active High	0,1		0		
0028	1	HOME	0~8		0	Power Off/ On	Hex
	2	SHOM	0~8		0		
	3	HOLD	0~8		0		
0029	1	HOMC	0~3		0	Power Off/ On	Hex
	2	IMO	0~3		0		
0030 ~ 0099	Reserved						
0100		System gain	0~500	Hz	50	Immediately	Decimal
0101		Speed loop proportional gain	0~10000	Nmsec	60	Immediately	Decimal
0102		Speed loop integral gain	0~60000	Nmsec^2	26	Immediately	Decimal
0103		Position loop proportional gain	0~700	Hz	20	Immediately	Decimal
0104		Torque command filter	0~10000	Hz	300	Immediately	Decimal
0105		Speed command filter	0~10,000	Hz	1000	Immediately	Decimal
0106		Position command filter	0~60000	Hz	0	Immediately	Decimal
0107		Vibration blocking filter	0~10000	Hz	10000	Immediately	Decimal
0108		Position FF gain	0~100	%	0	Immediately	Decimal
0109		Position FF filter	0~2500	Hz	200	Immediately	Decimal
0110		P control transition switch	0~3		3	Servo Off	Decimal
0111		P control transition reference value	0~3000		100	Immediately	Decimal
0112		Speed bias amount	0~450	rpm	0	Immediately	Decimal
0113		Speed bias reference width	0~50000	pulse	1000	Immediately	Decimal
0114		Current Controller Bandwidth	0~2		1	Power Off/ On	Decimal
0115		Velocity Response Level	1~150	%	50	Immediately	Decimal
0116 ~ 0199	Reserved						
0200		External speed command input gain	10.0~2000.0		500.0	Servo Off	Decimal
0201		Jog operation speed	0~5000	rpm	500	Immediately	Decimal
0202		Acceleration time	0~60000	msec	0	Immediately	Decimal
0203		Deceleration time	0~60000	msec	0	Immediately	Decimal
0204		S-operation time	0~5000	msec	0	Immediately	Decimal
0205		Contact speed command 1/Index 1 Velocity	-5000~5000	rpm	100	Immediately	Decimal
0206		Contact speed command 2/Index 2 Velocity	-5000~5000	rpm	200	Immediately	Decimal
0207		Contact speed command 3/Index 3 Velocity	-5000~5000	rpm	300	Immediately	Decimal
0208		Contact speed command 4/Index 4 Velocity	-5000~5000	rpm	400	Immediately	Decimal

Modbus Address	Digit	Description	Range	Unit	Default	Update timing	Data type
0209		Contact speed command 5/Index 5 Velocity	-5000~5000	rpm	500	Immediately	Decimal
0210		Contact speed command 6/Index 6 Velocity	-5000~5000	rpm	600	Immediately	Decimal
0211		Contact speed command 7/Index 7 Velocity	-5000~5000	rpm	700	Immediately	Decimal
0212		Limit Speed	1~5000	rpm	5000	Servo Off	Decimal
0213		Select Limit Speed	0~3		0	Servo Off	Decimal
0214		Reserved					
0215		Reserved					
0216		1st Homing Velocity	0~5000	rpm	100	Servo Off	Decimal
0217		2nd Homing Velocity	0~5000	rpm	15	Servo Off	Decimal
0218		Index 8 Velocity	0~5000	rpm	800	Immediately	Decimal
0219		Indexing Acceleration time	0~20000	msec	200	Immediately	Decimal
0220		Indexing Deceleration time	0~20000	msec	200	Immediately	Decimal
0221 ~ 0299	Reserved						
0300	1	Position command pulse type	0~6		0	Servo Off	Decimal
	2	Position command pulse type	0,1		0		Decimal
	3	Encoder output pulse direction	0,1		0		Decimal
	4	PCLR input selection	0,1		0		Decimal
0301	-	Electronic gear (numerator)	1~65535	pulse	32,768	Servo Off	Decimal
0302	-	Electronic gear (denominator)	1~65535	pulse	32,768	Servo Off	Decimal
0303	-	Position output pulse adjustment (numerator)	1~32768	pulse	2,048	Servo Off	Decimal
0304	-	Position output pulse adjustment (denominator)	1~32768	pulse	2,048	Servo Off	Decimal
0305	-	2nd Electronic gear (numerator)	1~65535	pulse	32,768	Servo Off	Decimal
0306	-	2nd Electronic gear (denominator)	1~65535	pulse	32,768	Servo Off	Decimal
0307		Reserved					
0308		Reserved					
0309 ~ 0310		Index 1 Position	-499999999 ~ +499999999	pulse, μm	0	Immediately	Decimal
0311 ~ 0312		Index 2 Position	-499999999 ~ +499999999	pulse, μm	0	Immediately	Decimal
0313 ~ 0314		Index 3 Position	-499999999 ~ +499999999	pulse, μm	0	Immediately	Decimal
0315 ~ 0316		Index 4 Position	-499999999 ~ +499999999	pulse, μm	0	Immediately	Decimal

Modbus Address	Digit	Description	Range	Unit	Default	Update timing	Data type
0317 ~ 0318		Index 5 Position	-499999999 ~ +499999999	pulse, μm	0	Immediately	Decimal
0319 ~ 0320		Index 6 Position	-499999999 ~ +499999999	pulse, μm	0	Immediately	Decimal
0321 ~ 0322		Index 7 Position	-499999999 ~ +499999999	pulse, μm	0	Immediately	Decimal
0323 ~ 0324		Index 8 Position	-499999999 ~ +499999999	pulse, μm	0	Immediately	Decimal
0325 ~ 0399	Reserved						
0400		External torque command input gain	0.0~100.0		33.3	Servo Off	Decimal
0401		Forward torque limit	0~300	%	300	Immediately	Decimal
0402		Reverse torque limit	0~300	%	300	Immediately	Decimal
0403		Forward torque external limit	0~300	%	100	Immediately	Decimal
0404		Reverse torque external limit	0~300	%	100	Immediately	Decimal
0405		Rotation inhibit torque limit	0~300	%	300	Immediately	Decimal
0406		Initial torque bias	-100~100	%	0	Immediately	Decimal
0407		Reserved					
0408		Reserved					
0409		Stopper Torque Threshold	0~250	%	15	Servo Off	Decimal
0410		Elapsed time after Stopper Torque Threshold	0~1000	msec	0	Servo Off	Decimal
0411 ~ 0499	Reserved						
500		Position completion determinaion width	0~1000	pulse	10	Immediately	Decimal
501		Position approximation determination width	0~1000	pulse	20	Immediately	Decimal
502		Speed match determination width	0~1000	rpm	10	Immediately	Decimal
0503		Rotation detection level	1~5000	rpm	20	Immediately	Decimal
0504		Speed zero clamp level	0~5000	pulse	0	Immediately	Decimal
0505		Break release wait time	0~1000	10 msec	0	Servo Off	Decimal
0506		Servo Off delay time	0~1000	10 msec	0	Servo Off	Decimal
0507		Break operation wait time	0~1000	10 msec	50	Servo Off	Decimal
0508		Break operation start speed	0~1000	rpm	100	Servo Off	Decimal
0509 ~ 0510		Allowed margin of position error	0~99999	pulse, rpm	20,480	Immediately	Decimal
0511		Instantaneous power failure allow time	20~1000	msec	20	Servo Off	Decimal
0512		Recovery resistor capacity	0~1500		0	Servo Off	Decimal
0513		DA monitor output CH1 configuration	1~62500		0-0500	Immediately	Decimal

Modbus Address	Digit	Description	Range	Unit	Default	Update timing	Data type
0514		DA monitor output CH2 configuration	1~62500		3-0500	Immediately	Decimal
0515	1	Select use of battery when using serial absolute value type encoder	0,1		0	Power Off/ On	Hex
	2	Select use of speed monitor	0,1		0		
	3	Select use of excessive speed error detection function	0,1		0		
	4	Select use of emergency stop input	0,1		0		
0516 ~ 0517		Moving distance After Home Sensor	-499999999 ~ +499999999	pulse, μm	0	Servo Off	Decimal
0518 ~ 0519		Homing Offset	-499999999 ~ +499999999	pulse, μm	0	Servo Off	Decimal
0520 ~ 0521		Software Negative Limit	-499999999 ~ +499999999	pulse, μm	0	Servo Off	Decimal
0522 ~ 0523		Software Positive Limit	-499999999 ~ +499999999	pulse, μm	0	Servo Off	Decimal
0524 ~ 0525		Index 1 Dwell Time	0~90000	msec	1000	Immediately	Decimal
0526 ~ 0527		Index 2 Dwell Time	0~90000	msec	1000	Immediately	Decimal
0528 ~ 0529		Index 3 Dwell Time	0~90000	msec	1000	Immediately	Decimal
0530 ~ 0531		Index 4 Dwell Time	0~90000	msec	1000	Immediately	Decimal
0532 ~ 0533		Index 5 Dwell Time	0~90000	msec	1000	Immediately	Decimal
0534 ~ 0535		Index 6 Dwell Time	0~90000	msec	1000	Immediately	Decimal
0536 ~ 0537		Index 7 Dwell Time	0~90000	msec	1000	Immediately	Decimal
0538 ~ 0539		Index 8 Dwell Time	0~90000	msec	1000	Immediately	Decimal
0540 ~ 0599	Reserved						
1100		Position Feedback(Pulse).Lo	-536870911 ~ +536870911	pulse			Decimal
1101		Position Feedback(Pulse).Hi		pulse			Decimal
1102		Position Feedback(user(μm)).Lo	-2147483648 ~ +2147483648	μm			Decimal
1103		Position Feedback(user(μm)).Hi		μm			Decimal
1104		Index No.			65535		Decimal

The parameters for indexing fit well into the structure of existing parameters. The max. number of parameters for Read/Write is limited by the group. When the data in a parameter is larger than 2-Byte, the parameter has two Modbus Addresses. The portion of the data over 2-Byte is saved into (Hi) area and the data up to 2-Byte is saved into (Lo) area.

1100~1104 are read-only addresses for monitoring and Read is possible through FC03 (However, Write is not possible). These 5 monitoring variables can be read in a group, independently from other Indexing Modbus addresses. In other words, these are continuous and separated from the Indexing Addresses, so it is possible to read these 5 addresses, i.e. from 1100 to 1104, at the same time. For the address other than these 5 addresses, there occurs an error code, i.e. Exception Code 02 (Address Fail).

The position feedback (user(μm)) in 1102~1103 is indexing mode and it is updated only when Pr-0.23 and Pr-0.24 are not '0'. If Pr-0.23 and Pr-0.24 are '0', the value of position feedback (user(μm)) is '0'.

The Index No. in 1104 is '-1' when there has been no indexing. During indexing, it has a corresponding index no. The index no. is maintained until another indexing operation starts.

The below Modbus address has Drive error, so a user can read its value through FC03 when there occurs Drive error.

Modbus Address	Parameter
1150	Drive Error

Address Rule and Data Conversion

Address Rule

Two Modbus addresses are assigned to one Indexing Parameter whose data size is larger than 2-byte. The parameter data whose size is larger than 2-byte are -99,999~99,999, 0~999,999, 0~90,000 and 10~ff15f.

The below table shows the parameters whose size is larger than 2-byte and their corresponding Modbus addresses.

Modbus Address	Parameter Name	Parameter	Data Range
0001(Lo), 0002(Hi)	Configure Motor	Pr-0.01	10 ~ ff15f
0024(Lo), 0025(Hi)	Pulse reference of User unit input	Pr-0.23	0 ~ 999,999
0509(Hi), 0510(Lo)	Allowed margin of position error	Pr-5.09	0 ~ 99,999
0524(Lo), 0525(Hi	Index 1 Dwell Time	Pr-5.23	
0526(Lo), 0527(Hi)	Index 2 Dwell Time	Pr-5.24	
0528(Lo), 0529(Hi)	Index 3 Dwell Time	Pr-5.25	
0530(Lo), 0531(Hi)	Index 4 Dwell Time	Pr-5.26	0 ~ 90,000
0532(Lo), 0533(Hi)	Index 5 Dwell Time	Pr-5.27	
0534(Lo), 0535(Hi)	Index 6 Dwell Time	Pr-5.28	
0536(Lo), 0537(Hi)	Index 7 Dwell Time	Pr-5.29	
0538(Lo), 0539(Hi)	Index 8 Dwell Time	Pr-5.30	

When writing a value to these parameters through the function code FC06, a user can enter (Hi) data and (Lo) data independently. However, a user has to check if the sum of the existing data (either Hi or Lo) and the data (either Lo or Hi) which a user wants to enter is within the allowed range of the parameter.

An example is shown below. In this example, a user wants to replace 65,535dec with 90,000dec as the dwell time after 4th step.

EXAMPLE

Modbus Address	Parameter Name	Parameter	Value
0530(Lo),531(Hi)	Dwell time after 4 step in automatic sequential travel mode	Pr-5.26	0~90,000

<The exisitng data in the parameter>

531(Hi) = 0x0000(0dec), 530(Lo) = 0xFFFF, Actual Value: 0xFFFF (65,535dec)

<The data which a user wants to input>

531(Hi) = 0x0001(1dec), 530(Lo) = 0x5F90 , Actual Value: 0x15F90 (90,000dec)

If a user first enters 0x0001 into the (Hi) address 531, it is added to the 0xFFFF which is in the (Lo) address and the value becomes 0x1FFFF (131,071dec) which is

out of the max. range 90,000. Then, there occurs Range Error. Therefore, it is recommended to enter data into a lower address first for error-free communication.

The same story applies to when writing several values to multiple parameters through the function code FC16.

Data Conversion

As metioned before, the parameter whose size is larger than 2-byte are -99,999~99,999, 0~999,999, 0~90,000 and 10~ff15f. In addition, there are also some data whose size is bigger than 2-byte, i.e. -499,999,999 ~ 499,999,999 which requires 2 parameters or 2 Modbus addresses. These parameters can not be an Index data alone. In other words, one parameter (Pr-[X].[Y]) becomes the lower part of an Index data and the other parameter (Pr-[X].[Y-1]) becomes the higher part of the Indexing data. (X,Y: arbitrary integer)

The below table shows the parameters for an index data.

Modbus Address	Parameter Name	Parameter	Data Range
310(Hi), 309(Lo)	Index 1 Position	Pr-3.09, Pr-3.10	
312(Hi), 311(Lo)	Index 2 Position	Pr-3.11, Pr-3.12	
314(Hi), 313(Lo)	Index 3 Position	Pr-3.13, Pr-3.14	
316(Hi), 315(Lo)	Index 4 Position	Pr-3.15, Pr-3.16	
318(Hi), 317(Lo)	Index 5 Position	Pr-3.17, Pr-3.18	
320(Hi), 319(Lo)	Index 6 Position	Pr-3.19, Pr-3.20	-499,999,999 ~
322(Hi), 321(Lo)	Index 7 Position	Pr-3.21, Pr-3.22	+499,999,999
324(Hi), 323(Lo)	Index 8 Position	Pr-3.23, Pr-3.24	
517(Hi), 516(Lo)	Moving distance after Home Sensor	Pr-5.15, Pr-5.16	
519(Hi), 518(Lo)	Homing Offset	Pr-5.17, Pr-5.18	
521(Hi), 520(Lo)	Software Negative Limit	Pr-5.19, Pr-5.20	
523(Hi), 522(Lo)	Software Positive Limit	Pr-5.21, Pr-5.22	

As shown in the above table, the data range of an index data which uses two parameters is 499,999,999 ~ +499,999,999. When writing this index data into corresponding parameters through FC16, two Modbus addresses are used.

Make sure to understand the order of parameter numbers and the order of Modbus addresses are opposite. In other words, Hi data is written to the Pr-[Group].[Num] and Lo data is written to Pr-[Group][Num+1]. If the Modubus address allocated to Pr-[Group].[Num] is x, the Modbus address allocated to Pr-[Group][Num+1] is x-1.

The below table shows an example. A one index data has two parameters, e.g. Index 1 high (Pr-3.9) and Index 1 low (Pr-3.10).

EXAMPLE

Ex) Index 1 Data (Index 1 high : Pr-3.09, Index 1 low : Pr-3.10)

Modbus Address	Parameter Name	Parameter Number	Data Range
310	Index 1 Position High	Pr-3.09	-499,999,999 ~ +499,999,999
309	Index 1 Position Low	Pr-3.10	

<Data Range>
Max : 499,999,999(0x1DCD64FF), Min : -499,999,999(0xE2329B01)

Input Data = 400,000,000(0x17D78400)

<Procedures for data input>

1. Refer to the Modbus Address Map to locate Modbus addresses allocated to parameters.

2. Convert the input data into Hexadecimal (400,000,000 --> 0x17D78400) .

3. Separate the hexadecimal into Hi and Lo (Hi = 0x17D7, Lo = 0x8400).

4. Enter each hexadecimal into each address (310 = 0x17D7, 309 = 0x8400).

As shown in the above example, a user needs to enter the Hi and Lo of converted hexadecimal into each address.

If both the upper and lower parameters have (+) values, a user can write any values. However, if the upper parameter has (-) value, the lower parameter can not have (-) value, and if the lower parameter has (-) value, the upper parameter can not have any value other than "0".

Exception Code

The below table shows the Exception Code of CSD3 Plus Modbus.

Exception Code(Dec)	Name	Meaning
01	Illegal Function	The function code received in the query is not an allowable action for the slave. If a Poll Program Complete commands was issued, this code indicates that no program function preceded it.
02	Illegal Data Address	The data address received in the query is not an allowable address for the slave.
03	Illegal Data Range	The data length received in the query is not an allowable length for the slave.
07	Illegal CRC Value	The CRC value received in the query is wrong value.
12	Illegal Frame	The bytes length of Frame received in the query is exceeded.
13	Illegal Sequence	The sequence of Address received in the query is wrong.
14	Illegal Data Value	A value contained in the query data field is not an allowable value for the slave.

When writing a value to a paramerter which requires conversion, make sure to use FC16 to write the value into two Modbus addresses simultaneously. If this rule is violated, there occurs the Illegal Sequence, i.e. Exception Code 13.

There occurs the Illegal Frame (Excpetion Code 12) when frame length is out of the min. or max. range of Modbus packet.

There occurs Exception Code 3 when the length of data which a client asks to Server is out of allowed range.

There occurs Exception Code 14 when the data value is out of its min. or max. range.

SmartJog

Introduction

This chapter describes the changes to the SmartJog program to support indexing operation. Refer to the *SmartJog 4.1 User Manual (SMARTJOG-UM001B)* for more information about SmartJog 4.1.

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Indexing	4-2

Indexing

The CSD3 Plus Servo Drive provides position control for one axis without a motion controller. Firmware Version 7.10 is required to use indexing.

Index Table

You can set up the positions, units, and velocity profiles for max. 8 indexes.

No.	Position	Accel(msec)	Velocity(rpm)	Decel(msec)	Dwell(msec)
1	Pr-3.09 Pr-3.10	Pr-2.19	Pr-2.05	Pr-2.20	Pr-5.23
2	Pr-3.11 Pr-3.12	Pr-2.19	Pr-2.06	Pr-2.20	Pr-5.24
3	Pr-3.13 Pr-3.14	Pr-2.19	Pr-2.07	Pr-2.20	Pr-5.25
4	Pr-3.15 Pr-3.16	Pr-2.19	Pr-2.08	Pr-2.20	Pr-5.26
5	Pr-3.17 Pr-3.19	Pr-2.19	Pr-2.09	Pr-2.20	Pr-5.27
6	Pr-3.20 Pr-3.21	Pr-2.19	Pr-2.10	Pr-2.20	Pr-5.28
7	Pr-3.22 Pr-3.23	Pr-2.19	Pr-2.11	Pr-2.20	Pr-5.29
8	Pr-3.24 Pr-3.25	Pr-2.19	Pr-2.18	Pr-2.20	Pr-5.30

Unit

Position Unit. When the 1st digit of Pr-0.18 is '0', the unit is 'pulse'. If it is '1', the unit is 'User Unit'.

User Unit

The reference values which are used for unit conversion between user unit(μm) and 'pulse' are dispalyed.

• User reference: A μm = B pulses

- Pulse

  display the value of Pr-0.23

- um

  display the value of Pr-0.24

Clear All

Displays all the values in the Index Table as '0'. There is no change to the value of each parameter, but only its display is cleared to '0'.

Load Default

Reads the inital values of the parameters in the Index Table. The value of each parameter is not reset to its initial value, but only its display is reset to its initial value.

Read All Parameters

Reads the set values of the parameters in the Index Table. The pulse and μm of the User unit are also displayed.

Write All Parameters

Saves the values in the Index Table into parameters. The pulse and μm of the User unit are also saved into the parameters.

Teaching

A user can set up an arbitrary position, which is located manually or by Jog operation, as an Index Position. When a user changes position, the position is displayed in the Current Position in an appropriate Position Unit. If a user wants to use the position as an Index Position, the user can select the Check Box beside 'POS#?' of the Index Position box. Then the value in the Current Position is displayed in the Position box. The position value which is displayed in the Index Position can be saved by clicking 'Write All Parameter'. '0' is saved to a parameter if there is no value in the correspodning box. Therefore, it is recommended to read the saved position values by clicking 'Read All Parameter' before Teaching.

The teaching window is shown below.

Jog Operation

Speed operation without a motion controller. A user can click Jog On button in Servo-OFF status, then the status is changed to Servo-ON and the operation mode becomes Jog operation. Clicking Forward button causes CCW rotation and clicking Reverse button causes CW rotation.

If a user wants to change velocity, chanage velocity in the Velocity editing box window and click save button. A user can change velocity with Jog Operation Velocity parameter in the Velocity Control Parameter Group 2. This is also applicable to acceleration/deceleration time parameter.

Current Position

Displays current position. This is displayed even during Servo-OFF or Incomplete Homing.

Unit

Displays Position Unit.

Index Position

When a user selects the Check Box beside Index Position POS#1~8, the Current Position value of Jog Operation의 Current Position is displayed in the Index Position. When a user deselects the Check Box, there is no change to the display.

Read All Parameters

Displays Index Position

Write All Parameters

Saves the values of Index Position into the drive

Fault & Limit

Software Limit

Reads or sets up Software Limit

Menu	Description
SW Positive Limit	Reads or sets up Software Limit(+)
SW Negative Limit	Reads or sets up Software Limit(-)
Read	Reads Software Limit
Write	Saves the Software Limit on the screen

Status

Displays the key status of Fault & Limit

Menu	Description
HW-	Displays the status of Hardware Limit (-)
HOME	Displays the status of HOME
HW+	Displays the status of Hardware Limit (+)
SW-	Displays the status of Software Limit(-)
FAUL	Displays the status of Fault
SW+	Displays the status of Software Limit(+)
Fault Reset	Resets Fault

Parameters

Introduction

Additional parameters are required for indexing, besides existing parameters for general servo functions. This chapter describes additional parameters and some modified existing parameters.

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Parameters list	A-1
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Parameters list

The Pr-0.00 has been changed to add the Indexing mode.

The parameters, Pr-2.05 to Pr-2.11, were original speed commands for the multiple speed modes. The Indexing mode uses these parameters to define the velocity for each index.

The right-most column of the below table indicates the followings:

- No change: existing CSD3 parameters, no change
- Changed for Indexing: existing CSD3 parameters, used for indexing
- New for Indexing: new parameters for indexing
- New & Reserved: new reserved parameters for indexing

The parameters which are not changed are shown in gray background.

Parameter Group 0

Parameter Type	Name	LED No.	Set Range	Initial Value	
Pr-0.00	Control mode	-	C,t,S,P,I	---P	Changed for indexing
Pr-0.01	Configure motor	-	-	-	No change
Pr-0.02	Select method of DB halt	1	0~3	0	No change
	Select method of over travel halt	2	0,1	0	No change
	Select direction of rotation	3	0,1	0	No change
	Select main power input	4	0,1	0	No change
Pr-0.03	Autotuning mode	1	0.1	1	No change
	Offline tuning speed	3	2~9	7	No change
	Online tuning coefficient	4	0~9	0	No change
Pr-0.04	Inertia ratio		0.00~60.00	0	No change
Pr-0.05 Input Signal Assignment 1	/SV-ON	1	0~8	1	No change
	P-OT	2	0~8	8	No change
	N-OT	3	0~8	8	No change
	/P-CON	4	0~8	4	No change
Pr-0.06 Input Signal Assignment 2	/A-RST	1	0~8	5	No change
	/N-TL	2	0~8	6	No change
	/P-TL	3	0~8	7	No change
	/C-SEL	4	0~8	0	No change
Pr-0.07 Input Signal Assignment 3	/C-DIR	1	0~8	0	No change
	/C-SP1	2	0~8	0	No change
	/C-SP2	3	0~8	0	No change
	/C-SP3	4	0~8	0	No change
Pr-0.08 Input Signal Assignment 4	/Z-CLP	1	0~8	0	No change
	/INHIB	2	0~8	0	No change
	/G-SEL	3	0~8	0	No change
	/PCLR or /ABORT	4	0~8	0	No change
Pr-0.09 Input Signal Assignment 5	/ABS-DT	1	0~8	0	No change
	/START	2	0~8	0	No change
	/C-SP4	3	0~8	0	No change
	/GEAR	4	0~8	0	No change
Pr-0.10 Output Signal Assignment 1	/P-COM	1	0~3	1	No change
	/TG-ON	2	0~3	2	No change
	/BK	3	0~3	3	No change
	/V-COM	4	0~3	0	No change
Pr-0.11 Output Signal Assignment 2	/T-LMT	1	0~3	0	No change
	/V-LMT	2	0~3	0	No change
	/NEAR	3	0~3	0	No change
	/WARN	4	0~3	0	No change

Parameter Type	Name	LED No.	Set Range	Initial Value	
Pr-0.12	Servo ID	-	1~247	1	No change
Pr-0.13	Password	-	-	-	No change
Pr-0.14	RS-232C communication speed	1	1~6	6	No change
	RS-485 communication speed	2	1~6	3	No change
	Data format	3	1~6	1	No change
	Protocol	4	0,1	0	No change
Pr-0.15	Reserved				New & Reserved
Pr-0.16	Reserved				New & Reserved
Pr-0.17 Indexing Mode	Select type (Incremental, Absolute)	1	0~1	0	New for indexing
	Select travel mode	2	0~2	2	New for indexing
Pr-0.18 Position Unit& Fault Code	Position Unit	1	0~1	0	New for indexing
	Fault Code pin (AL1, AL2, AL3) output option	2	0~2	0	New for indexing
Pr-0.19 Homing Mode	Select Homing mode	1	0~8	1	New for indexing
Pr-0.20 Homing Option	Select Homing direction	1	0,1	1	New for indexing
	Select Homing start option	2	0,1	1	New for indexing
Pr-0.21	Homing Time Limit	-	0~60,000	60	New for indexing
Pr-0.22	Number of Indexes	-	1~8	8	New for indexing
Pr-0.23	Pulse reference of User unit input	-	0~999,999	0	New for indexing
Pr-0.24	Distance reference of User unit input	-	0~65,535	0	New for indexing
Pr-0.25 Input signal level	P-OT signal level	1	0,1	1	New for indexing
	N-OT signal level	2	0,1	1	New for indexing
	Home sensor signal level	3	0,1	0	New for indexing
Pr-0.26 Input Signal Assignment 6	/HOME	1	0~8	0	New for indexing
	/SHOM	2	0~8	0	New for indexing
	/PAUSE	3	0~8	0	New for indexing
Pr-0.27 Output Signal Assignment 3	/HOMC	1	0~3	0	New for indexing
	/IMO	2	0~3	0	New for indexing

Parameter Group 1

Parameter Type	Name	LED No.	Set Range	Initial Value	
Pr-1.00	System gain	-	0~500	50	No change
Pr-1.01	Speed loop proportional gain	-	0~10,000	60	No change
Pr-1.02	Speed loop integral gain	-	0~60,000	26	No change
Pr-1.03	Position loop proportional gain	-	0~700	20	No change
Pr-1.04	Torque command filter	-	0~10,000	300	No change
Pr-1.05	Speed command filter	-	0~10,000	1000	No change
Pr-1.06	Position command filter	-	0~60,000	0	No change
Pr-1.07	Vibration blocking filter	-	0~10,000	10000	No change
Pr-1.08	Position FF gain	-	0~100	0	No change
Pr-1.09	Position FF filter	-	0~2,500	200	No change
Pr-1.10	P control transition switch	-	0~3	3	No change
Pr-1.11	P control transition reference value	-	0~3,000	100	No change
Pr-1.12	Speed bias amount	-	0~450	0	No change
Pr-1.13	Speed bias reference width	-	0~50000	1000	No change
Pr-1.14	Current Controller Bandwidth	-	0~2	1	No change
Pr-1.15	Velocity Response Level	-	0~150	50	No change

Parameter Group 2

Parameter Type	Name	LED No.	Set Range	Initial Value	
Pr-2.00	External speed command input gain	-	10.0~2,000.0	500.0	No change
Pr-2.01	Jog operation speed	-	0~5,000	500	No change
Pr-2.02	Acceleration time	-	0~60,000	0	No change
Pr-2.03	Deceleration time	-	0~60,000	0	No change
Pr-2.04	S-operation time	-	0~5,000	0	No change
Pr-2.05	Contact speed command 1/ Index 1 Velocity	-	-5,000~5,000	100	Changed for indexing
Pr-2.06	Contact speed command 2/ Index 2 Velocity	-	-5,000~5,000	200	Changed for indexing
Pr-2.07	Contact speed command 3/ Index 3 Velocity	-	-5,000~5,000	300	Changed for indexing
Pr-2.08	Contact speed command 4/ Index 4 Velocity	-	-5,000~5,000	400	Changed for indexing
Pr-2.09	Contact speed command 5/ Index 5 Velocity	-	-5,000~5,000	500	Changed for indexing
Pr-2.10	Contact speed command 6/ Index 6 Velocity	-	-5,000~5,000	600	Changed for indexing
Pr-2.11	Contact speed command 7/ Index 7 Velocity	-	-5,000~5,000	700	Changed for indexing
Pr-2.12	Limit speed	-	1~5,000	5000	No change
Pr-2.13	Select limit speed	-	0~3	0	No change
Pr-2.14	Reserved				New & Reserved
Pr-2.15	Reserved				New & Reserved
Pr-2.16	1st Homing Velocity	-	0~5,000	100	New for indexing
Pr-2.17	2nd Homing Velocity	-	0~5,000	15	New for indexing
Pr-2.18	Index 8 Velocity	-	0~5,000	800	New for indexing
Pr-2.19	Index Acceleration time	-	0~20,000	200	New for indexing
Pr-2.20	Index Deceleration time	-	0~20,000	200	New for indexing

Parameter Group 3

Parameter Type	Name	LED No.	Set Range	Initial Value	
Pr-3.00	Position command pulse type	1	0~6	0	No change
	Position command pulse type	2	0,1	0	No change
	Encoder output pulse direction	3	0,1	0	No change
	PCLR input selection	4	0,1	0	No change
Pr-3.01	Electronic gear (numerator)	-	1~65,535	32768	No change
Pr-3.02	Electronic gear (denominator)	-	1~65,535	32768	No change
Pr-3.03	Position output pulse adjustment (numerator)	-	1~32,768	2048	No change
Pr-3.04	Position output pulse adjustment (denominator)	-	1~32,768	2048	No change
Pr-3.05	2nd Electronic gear (numerator)	-	1~65,535	32,768	No change
Pr-3.06	2nd Electronic gear (denominator)	-	1~65,535	32,768	No change
Pr-3.07	Reserved				New & Reserved
Pr-3.08	Reserved				New & Reserved
Pr-3.09	Index 1 Position High	-	-4,999~+4,999	0	New for indexing
Pr-3.10	Index 1 Position Low	-	-99,999~+99,999	0	New for indexing
Pr-3.11	Index 2 Position High	-	-4,999~+4,999	0	New for indexing
Pr-3.12	Index 2 Position Low	-	-99,999~+99,999	0	New for indexing
Pr-3.13	Index 3 Position High	-	-4,999~+4,999	0	New for indexing
Pr-3.14	Index 3 Position Low	-	-99,999~+99,999	0	New for indexing
Pr-3.15	Index 4 Position High	-	-4,999~+4,999	0	New for indexing
Pr-3.16	Index 4 Position Low	-	-99,999~+99,999	0	New for indexing
Pr-3.17	Index 5 Position High	-	-4,999~+4,999	0	New for indexing
Pr-3.18	Index 5 Position Low	-	-99,999~+99,999	0	New for indexing
Pr-3.19	Index 6 Position High	-	-4,999~+4,999	0	New for indexing
Pr-3.20	Index 6 Position Low	-	-99,999~+99,999	0	New for indexing
Pr-3.21	Index 7 Position High	-	-4,999~+4,999	0	New for indexing
Pr-3.22	Index 7 Position Low	-	-99,999~+99,999	0	New for indexing
Pr-3.23	Index 8 Position High	-	-4,999~+4,999	0	New for indexing
Pr-3.24	Index 8 Position Low	-	-99,999~+99,999	0	New for indexing

Parameter Group 4

Parameter Type	Name	LED No.	Set Range	Initial Value	
Pr-4.00	External torque command input gain	-	0.0~100.0	33.3	No change
Pr-4.01	Forward torque limit	-	0~300	300	No change
Pr-4.02	Reverse torque limit	-	0~300	300	No change
Pr-4.03	Forward torque external limit	-	0~300	100	No change
Pr-4.04	Reverse torque external limit	-	0~300	100	No change
Pr-4.05	Rotation inhibit torque limit	-	0~300	300	No change
Pr-4.06	Initial torque bias	-	-100~100	0	No change
Pr-4.07	Reserved				New & Reserved
Pr-4.08	Reserved				New & Reserved
Pr-4.09	Stopper Torque Threshold	-	0~250	15	New for indexing
Pr-4.10	Elapsed time after Stopper Torque Threshold	-	0~1,000	0	New for indexing

Parameter Group 5

Parameter Type	Name	LED No.	Set Range	Initial Value	
Pr-5.00	Position completion determinaion width	-	0~1000	10	No change
Pr-5.01	Position approximation determination width	-	0~1000	20	No change
Pr-5.02	Speed match determination width	-	0~1,000	10	No change
Pr-5.03	Rotation detection level	-	1~5,000	20	No change
Pr-5.04	Speed zero clamp level	-	0~5,000	0	No change
Pr-5.05	Break release wait time	-	0~1,000	0	No change
Pr-5.06	Servo Off delay time	-	0~1,000	0	No change
Pr-5.07	Break operation wait time	-	0~1,000	50	No change
Pr-5.08	Break operation start speed	-	0~1,000	100	No change
Pr-5.09	Allowed margin of position error	-	0~99,999	20,480	No change
Pr-5.10	Instantaneous power failure allow time	-	20~1,000	20	No change
Pr-5.11	Recovery resistor capacity	-	0~1,500	0	No change
Pr-5.12	DA monitor output CH1 configuration	-	1~62,500	0-0500	No change
Pr-5.13	DA monitor output CH2 configuration	-	1~62,500	3-0500	No change
Pr-5.14	Select use of battery when using serial absolute value type encoder	1	0,1	0	No change
	Select use of speed monitor	2	0,1	0	No change
	Select use of excessive speed error detection function	3	0,1	0	No change
	Select use of emergency stop input	4	0,1	0	No change
Pr-5.15	Moving distance After Home Sensor High	-	-4,999~+4,999	0	New for indexing
Pr-5.16	Moving distance After Home Sensor Low	-	-99,999~+99,999	0	New for indexing
Pr-5.17	Homing Offset High	-	-4,999~+4,999	0	New for indexing
Pr-5.18	Homing Offset Low	-	-99,999~+99,999	0	New for indexing
Pr-5.19	Software Negative Limit High	-	-4,999~+4,999	0	New for indexing
Pr-5.20	Software Negative Limit Low	-	-99,999~+99,999	0	New for indexing
Pr-5.21	Software Positive Limit High	-	-4,999~+4,999	0	New for indexing
Pr-5.22	Software Positive Limit Low	-	-99,999~+99,999	0	New for indexing
Pr-5.23	Index 1 Dwell Time	-	0~90,000	1,000	New for indexing
Pr-5.24	Index 2 Dwell Time	-	0~90,000	1,000	New for indexing
Pr-5.25	Index 3 Dwell Time	-	0~90,000	1,000	New for indexing

Parameter Type	Name	LED No.	Set Range	Initial Value	
Pr-5.26	Index 4 Dwell Time	-	0~90,000	1,000	New for indexing
Pr-5.27	Index 5 Dwell Time	-	0~90,000	1,000	New for indexing
Pr-5.28	Index 6 Dwell Time	-	0~90,000	1,000	New for indexing
Pr-5.29	Index 7 Dwell Time	-	0~90,000	1,000	New for indexing
Pr-5.30	Index 8 Dwell Time	-	0~90,000	1,000	New for indexing

Indexing Parameters

The detail information about the parameters for indexing is listed below.

Parameter	No.	7-Seg. Position	Value	Detail	Update timing	Default	Range	Unit
Control mode	Pr-0.00	1	P	Position Control	Power Off/On	P		N/A
		2	S	Speed Control				
		3	T	Torque Control				
		4	C	Contact Speed Control				
		5	I	Indexing				
Indexing Mode	Pr-0.17	1	0	Absolute	Power Off/On	0	0~1	N/A
			1	Incremental				
		2	0	Automatic Sequential travel		2	0~2	N/A
			1	Step Sequential Travel				
			2	Selective position travel				
Position Unit& Fault Code	Pr-0.18	1	0	Position Unit(pulse)	Power Off/On	0	0~1	N/A
			1	Position Unit(User Unit : μm)				
		2	0	Fault Code		0	0~2	N/A
			1	Index No.				
			2	Fault Code & Index No.				
Homing Mode	Pr-0.19	1	0	Mode 0 : None	Power Off/On	1	0~8	N/A
			1	Mode 1: To Home sensor/Back to Marker				
			2	Mode 2: To Limit sensor/Back to Marker				
			3	Mode 3: To Home sensor/Fwd to Marker				
			4	Mode 4: To Limit sensor/Fwd to Marker				
			5	Mode 5: Stopper				
			6	Mode 6: To Stopper/Back to Marker				
			7	Mode 7: To Home sensor/Move/Back to Marker				
			8	Mode 8: Marker				
Homing Option	Pr-0.20	1	0	Homing Direction : (-), CW	Power Off/On	1	0,1	N/A
			1	Homing Direction : (+), CCW				
		2	0	Homing start by Servo ON		1	0,1	N/A
			1	Homing start by SHOM				
Homing Time Limit	Pr-0.21			Homing Time Limit	Servo Off	60	0~60,000	sec
Number of Indexes	Pr-0.22			Number of Indexes	Servo Off	8	1~8	N/A
Pulse reference of User unit input	Pr-0.23			Pulse reference of User unit input	Power Off/On	0	0~999,999	pulse
Distance reference of User unit input	Pr-0.24			Distance reference of User unit input	Power Off/On	0	0~65,535	μm

Parameter	No.	7-Seg. Position	Value	Detail	Update timing	Default	Range	Unit
Input signal level	Pr-0.25	1	0	P-OT Active Low (Limit(+))	Power Off/On	1	0~1	N/A
			1	P-OT Active High (Limit(+))				
		2	0	N-OT Active Low (Limit(-))		1	0~1	N/A
			1	N-OT Active High (Limit(-))				
		3	0	HOME Active Low		0	0~1	N/A
			1	HOME Active High				
Input Signal Assignment 6	Pr-0.26	1	0	/HOME: unassign	Power Off/On	0	0~8	N/A
			1	/HOME: DI#1				
			2	/HOME: DI#2				
			3	/HOME: DI#3				
			4	/HOME: DI#4				
			5	/HOME: DI#5				
			6	/HOME: DI#6				
			7	/HOME: DI#7				
			8	/HOME: ON				
		2	0	/SHOM: unassign		0	0~8	N/A
			1	/SHOM: DI#1				
			2	/SHOM: DI#2				
			3	/SHOM: DI#3				
			4	/SHOM: DI#4				
			5	/SHOM: DI#5				
			6	/SHOM: DI#6				
			7	/SHOM: DI#7				
			8	/SHOM: ON				
		3	0	/PAUSE: unassign		0	0~8	N/A
			1	/PAUSE: DI#1				
			2	/PAUSE: DI#2				
			3	/PAUSE: DI#3				
			4	/PAUSE: DI#4				
			5	/PAUSE: DI#5				
			6	/PAUSE: DI#6				
			7	/PAUSE: DI#7				
			8	/PAUSE: ON				

Parameter	No.	7-Seg. Position	Value	Detail	Update timing	Default	Range	Unit
Output Signal Assignment 3	Pr-0.27	1	0	/HOMC: unassign	Power Off/On	0	0~3	N/A
			1	/HOMC: DO#1				
			2	/HOMC: DO#2				
			3	/HOMC: DO#3				
		2	0	/IMO: unassign		0	0~3	N/A
			1	/IMO: DO#1				
			2	/IMO: DO#2				
			3	/IMO: DO#3				
Contact speed command 1/ Index 1 Velocity	Pr-2.05	N/A	N/A		Immediately	100	-5,000 ~5,000	rpm
Contact speed command 2/ Index 2 Velocity	Pr-2.06	N/A	N/A		Immediately	200	-5,000 ~5,000	rpm
Contact speed command 3/ Index 3 Velocity	Pr-2.07	N/A	N/A		Immediately	300	-5,000 ~5,000	rpm
Contact speed command 4/ Index 4 Velocity	Pr-2.08	N/A	N/A		Immediately	400	-5,000 ~5,000	rpm
Contact speed command 5/ Index 5 Velocity	Pr-2.09	N/A	N/A		Immediately	500	-5,000 ~5,000	rpm
Contact speed command 6/ Index 6 Velocity	Pr-2.10	N/A	N/A		Immediately	600	-5,000 ~5,000	rpm
Contact speed command 7/ Index 7 Velocity	Pr-2.11	N/A	N/A		Immediately	700	-5,000 ~5,000	rpm
1st Homing Velocity	Pr-2.16	N/A	N/A		Servo Off	100	0~5,000	rpm
2nd Homing Velocity	Pr-2.17	N/A	N/A		Servo Off	15	0~5,000	rpm
Index 8 Velocity	Pr-2.18	N/A	N/A		Immediately	800	0~5,000	rpm
Indexing Acceleration time	Pr-2.19	N/A	N/A		Immediately	200	0~20,000	msec
Indexing Deceleration time	Pr-2.20	N/A	N/A		Immediately	200	0~20,000	msec
Index 1 Position High	Pr-3.09	N/A	N/A		Immediately	0	-4,999 ~+4,999	pulse, μm
Index 1 Position Low	Pr-3.10	N/A	N/A		Immediately	0	-99,999 ~+99,999	pulse, μm
Index 2 Position High	Pr-3.11	N/A	N/A		Immediately	0	-4,999 ~+4,999	pulse, μm

Parameter	No.	7-Seg. Position	Value	Detail	Update timing	Default	Range	Unit
Index 2 Position Low	Pr-3.12	N/A	N/A		Immediately	0	-99,999 ~+99,999	pulse, μm
Index 3 Position High	Pr-3.13	N/A	N/A		Immediately	0	-4,999 ~+4,999	pulse, μm
Index 3 Position Low	Pr-3.14	N/A	N/A		Immediately	0	-99,999 ~+99,999	pulse, μm
Index 4 Position High	Pr-3.15	N/A	N/A		Immediately	0	-4,999 ~+4,999	pulse, μm
Index 4 Position Low	Pr-3.16	N/A	N/A		Immediately	0	-99,999 ~+99,999	pulse, μm
Index 5 Position High	Pr-3.17	N/A	N/A		Immediately	0	-4,999 ~+4,999	pulse, μm
Index 5 Position Low	Pr-3.18	N/A	N/A		Immediately	0	-99,999 ~+99,999	pulse, μm
Index 6 Position High	Pr-3.19	N/A	N/A		Immediately	0	-4,999 ~+4,999	pulse, μm
Index 6 Position Low	Pr-3.20	N/A	N/A		Immediately	0	-99,999 ~+99,999	pulse, μm
Index 7 Position High	Pr-3.21	N/A	N/A		Immediately	0	-4,999 ~+4,999	pulse, μm
Index 7 Position Low	Pr-3.22	N/A	N/A		Immediately	0	-99,999 ~+99,999	pulse, μm
Index 8 Position High	Pr-3.23	N/A	N/A		Immediately	0	-4,999 ~+4,999	pulse, μm
Index 8 Position Low	Pr-3.24	N/A	N/A		Immediately	0	-99,999 ~+99,999	pulse, μm
Stopper Torque Threshold	Pr-4.09	N/A	N/A	Percentage of torque threshold for Stopper-based homing compared to the rated torque	Servo Off	15	0~250	%
Elapsed time after Stopper Torque Threshold	Pr-4.10	N/A	N/A	Time elapsed after Stopper Torque Threshold is exceeded	Servo Off	0	0~1,000	msec
Moving distance After Home Sensor High	Pr-5.15	N/A	N/A	Moving distance after Home sensor signal is detected (High)	Servo Off	0	-4,999 ~+4,999	pulse, μm
Moving distance After Home Sensor Low	Pr-5.16	N/A	N/A	Moving distance after Home sensor signal is detected (Low)	Servo Off	0	-99,999 ~+99,999	pulse, μm
Homing Offset High	Pr-5.17	N/A	N/A	Homing offset (High)	Servo Off	0	-4,999 ~+4,999	pulse, μm
Homing Offset Low	Pr-5.18	N/A	N/A	Homing offset (Low)	Servo Off	0	-99,999 ~+99,999	pulse, μm

Parameter	No.	7-Seg. Position	Value	Detail	Update timing	Default	Range	Unit
Software Negative Limit High	Pr-5.19	N/A	N/A		Servo Off	0	-4,999 ~+4,999	pulse, μm
Software Negative Limit Low	Pr-5.20	N/A	N/A		Servo Off	0	-99,999 ~+99,999	pulse, μm
Software Positive Limit High	Pr-5.21	N/A	N/A		Servo Off	0	-4,999 ~+4,999	pulse, μm
Software Positive Limit Low	Pr-5.22	N/A	N/A		Servo Off	0	-99,999 ~+99,999	pulse, μm
Index 1 Dwell Time	Pr-5.23	N/A	N/A	Dwell time after 1 step in automatic sequential travel mode	Immediately	1000	0~90,000	msec
Index 2 Dwell Time	Pr-5.24	N/A	N/A	Dwell time after 2 step in automatic sequential travel mode	Immediately	1000	0~90,000	msec
Index 3 Dwell Time	Pr-5.25	N/A	N/A	Dwell time after 3 step in automatic sequential travel mode	Immediately	1000	0~90,000	msec
Index 4 Dwell Time	Pr-5.26	N/A	N/A	Dwell time after 4 step in automatic sequential travel mode	Immediately	1000	0~90,000	msec
Index 5 Dwell Time	Pr-5.27	N/A	N/A	Dwell time after 5 step in automatic sequential travel mode	Immediately	1000	0~90,000	msec
Index 6 Dwell Time	Pr-5.28	N/A	N/A	Dwell time after 6 step in automatic sequential travel mode	Immediately	1000	0~90,000	msec
Index 7 Dwell Time	Pr-5.29	N/A	N/A	Dwell time after 7 step in automatic sequential travel mode	Immediately	1000	0~90,000	msec
Index 8 Dwell Time	Pr-5.30	N/A	N/A	Dwell time after 8 step in automatic sequential travel mode	Immediately	1000	0~90,000	msec

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 52304-2496 USA, Tel: (1) 414.382.200, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation, Vorstlaan/Boulevard du Souverain 36, 1170 Brussels, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Allen-Bradley OEMax Product Information and Service   **www.oemax.co.kr**

Korea: 447-6, Gongse-dong, Giheung-gu, Yongin-city, Gyeonggi-do, Korea. Zip Code: 446-902 Tel: (82) 31 280 4700 Fax: (82) 31 280 4900