Special IO Module

RIO3-SMD
User Manual

REVISION HISTORY				
REV	**PAGE**	**REMARKS**	**DATE**	**EDITOR**
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Table of Contents

HITACHI
Inspire the Next

1 Important Notes

Solid state equipment has operational characteristics differing from those of electromechanical equipment.

Safety Guidelines for the Application, Installation and Maintenance of Solid-State Controls describes some important differences between solid state equipment and hard-wired electromechanical devices.

Because of this difference, and 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.

In no event will HITACHI be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any installation, HITACHI cannot assume responsibility or liability for actual use based on the examples and diagrams.

Warning!

- ✓ **If you don't follow the directions, it could cause a personal injury, damage to the equipment or explosion**

- ✓ Do not assemble the products and wire with power applied to the system. Else it may cause an electric arc, which can result into unexpected and potentially dangerous action by field devices. Arching is explosion risk in hazardous locations. Be sure that the area is non-hazardous or remove system power appropriately before assembling or wiring the modules.

- ✓ Do not touch any terminal blocks or IO modules when system is running. Else it may cause the unit to an electric shock or malfunction.

- ✓ Keep away from the strange metallic materials not related to the unit and wiring works should be controlled by the electric expert engineer. Else it may cause the unit to a fire, electric shock or malfunction

Caution!

- ✓ **If you disobey the instructions, there may be possibility of personal injury, damage to equipment or explosion. Please follow below Instructions.**

- ✓ Check the rated voltage and terminal array before wiring. Avoid the circumstances over 50℃ of temperature. Avoid placing it directly in the sunlight.

- ✓ Avoid the place under circumstances over 85% of humidity.

- ✓ Do not place Modules near by the inflammable material. Else it may cause a fire.

- ✓ Do not permit any vibration approaching it directly.

- ✓ Go through module specification carefully, ensure inputs, output connections are made with the specifications. Use standard cables for wiring.

- ✓ Use Product under pollution degree 2 environment.

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1.1 Safety Instruction

1.1.1 Symbols

DANGER ⚠	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, property damage, or economic loss. Attentions help you to identity a hazard, avoid a hazard, and recognize the Consequences.

1.1.2 Safety Notes

DANGER ⚠	The modules are equipped with electronic components that may be destroyed by electrostatic discharge. When handling the modules, ensure that the environment (persons, workplace and packing) is well grounded. Avoid touching conductive components, RBUS Pin.

1.1.3 Certification

UL Listed Industrial Control Equipment, certified for U.S.

See UL File E196687

CE Certificate

EN 61000-6-2; Industrial Immunity

EN 61000-6-4; Industrial Emissions

Reach, RoHS (EU, CHINA), EAC

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2 Specification

2.1 RIO3-SMD

2.1.1 Wiring Diagram
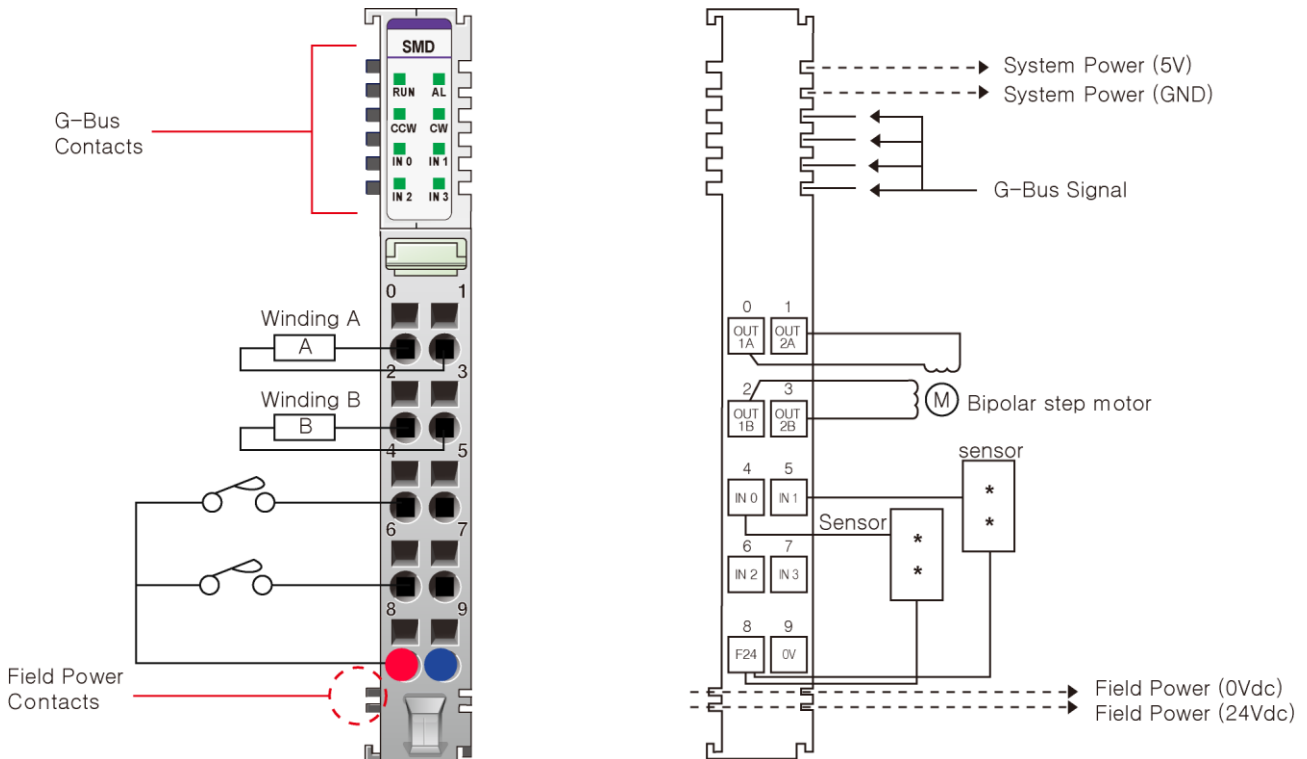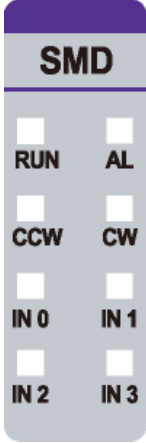
Pin No.	Signal Description		Signal Description		Pin No.
0	Motor Out1_A		Motor Out2_A		1
2	Motor Out1_B		Motor Out2_B		3
4	Input Channel 0		Input Channel 1		5
	Digital Input	Encoder Mode	Digital Input	Encoder Mode	
	DI0	Enc Aph	DI1	Enc Bph	
6	Input Channel 2		Input Channel 3		7
	Digital Input	Encoder Mode	Digital Input	Encoder Mode	
	*Hard Stop		*Hard Stop		
8	Field Power 24V		Field Power 0V		9

Warning: Do not connect or disconnect a motor while the driver is energized.

*Hard Stop: Stop motor when input is detected

2.1.2 LED Indicator

Module Win. Label	LED	Color	Status	Description
SMD	RUN	Green	Off	Module supply not connected.
			Blinking	Motor is at constant speed. Absolute positioning or motion command is under execution.
			On	Motor Normal Operation.
	AL *	Green	On	Alarm occurred.
			Off	No Alarm.
	CCW	Green	On	Motor is rotating counterclockwise.
			Off	Motor is stopped.
	CW	Green	On	Motor is rotating clockwise.
			Off	Motor is stopped.
	IN 0	Green	On	Input 0 is ON.
			Off	Input 0 is OFF.
	IN1	Green	On	Input 1 is ON.
			Off	Input 1 is OFF.
	IN2	Green	On	Input 2 is ON.
			Off	Input 2 is OFF.
	IN3	Green	On	Input 3 is ON.
			Off	Input 3 is OFF.

*Note: At least one of the following conditions occurs:

• Over Voltage, Under Voltage, Over Current detection

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2.1.3 Specification

Items	Specification
Digital input	
Number of channels	4 points, sink type (2 points DI or Encoder Input, 2 point *Hard Stop Input)
Indicators	4 green terminal Input status
On–state voltage	24Vdc nominal 12V ~ 28.8V @ 60℃
On-state current	6.4mA @ 28.8Vdc
Off-state voltage	5Vdc @ 25℃
Input signal delay	OFF to ON: Max. 0.3ms ON to OFF: Max. 0.3ms
Nominal input impedance	5.4 kΩ typical
Encoder mode	Incremental encoder support
General specification	
Power dissipation	Max. 100mA @ 5Vdc
Isolation	I/O to Logic: photocoupler isolation Field power: non-isolation
UL field power	Supply voltage: 24Vdc nominal, Class 2
Field power	Supply voltage: 24Vdc nominal Voltage range: 18 ~ 28.8Vdc, Power dissipation: Max. 35mA @ 24Vdc
Wiring	I/O Cable Max. 2.0mm^2 (AWG 14)
Torque	0.8Nm (7 lb-in)
Weight	60g
Module size	12mm x 99mm x 70mm,
Environment condition	**Refer to 'Environment Specification'**

*Hard Stop: Stop motor when input is detected

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Inspire the Next

Items	Specification
Stepper motor driver power element	
Amount	1 stepper motor
Load Type	2-phase bi-polar motor
Rated Voltage	24Vdc nominal 18Vdc ~ 28.8Vdc
Output Current	Max. 1A @ -40℃ ~ 60℃
Step Resolution	Max. 16 micro stepping - full, half, 1/4, 1/8, 1/16
Operation modes	Instant Command Mode Position Table Mode
Function modes	Position (absolute/relative), Set Point Change, etc.
Protection	Over Current / Over Voltage Reverse voltage protection

2.1.4 Environment Specification

Environmental specification	
Operation Temperature	-40℃ ~ 60℃
UL Temperature	-20℃ ~ 60℃
Storage Temperature	-40℃ ~ 85℃
Relative Humidity	5%~90% Non-condensing
Mounting	DIN Rail
General specification	
Shock Operating	IEC 60068-2-27
Vibration Resistance	Based on IEC 60068-2-6 DNVGL-CG-0039: Vibration Class B, 4g
Industrial Emissions	EN 61000-6-4: 2007 +A1: 2011
Industrial Immunity	EN 61000-6-2: 2005
Installation Position	Vertical and horizontal installation is possible
Product Certifications	CE, UL, EAC

2.1.5 Function Command

```
                        ┌─────────────────┐
                        │  Stepper Module │
                        └─────────────────┘
                                 │
               ┌─────────────────┴──────────────────┐
               ▼                                     ▼
    ┌─────────────────────┐              ┌─────────────────────┐
    │ Instant Command Mode│              │    Position Table   │
    └─────────────────────┘              └─────────────────────┘
               │                                     │
         ┌─────┴──────────┐                    ┌─────┴──────────┐
         ▶  Set Home Position                  ▶     Go To
         ▶  Set Mark Position                  ▶     Go To DP
         ▶     Go To                           ▶      Move
         ▶     Go To DP                        ▶      Stop
         ▶      Move                           ▶  High Impedance
         ▶      Run                            ▶   Input Query
         ▶      Stop                           ▶   Go To Index
         ▶      Clear
         ▶  High Impedance
```
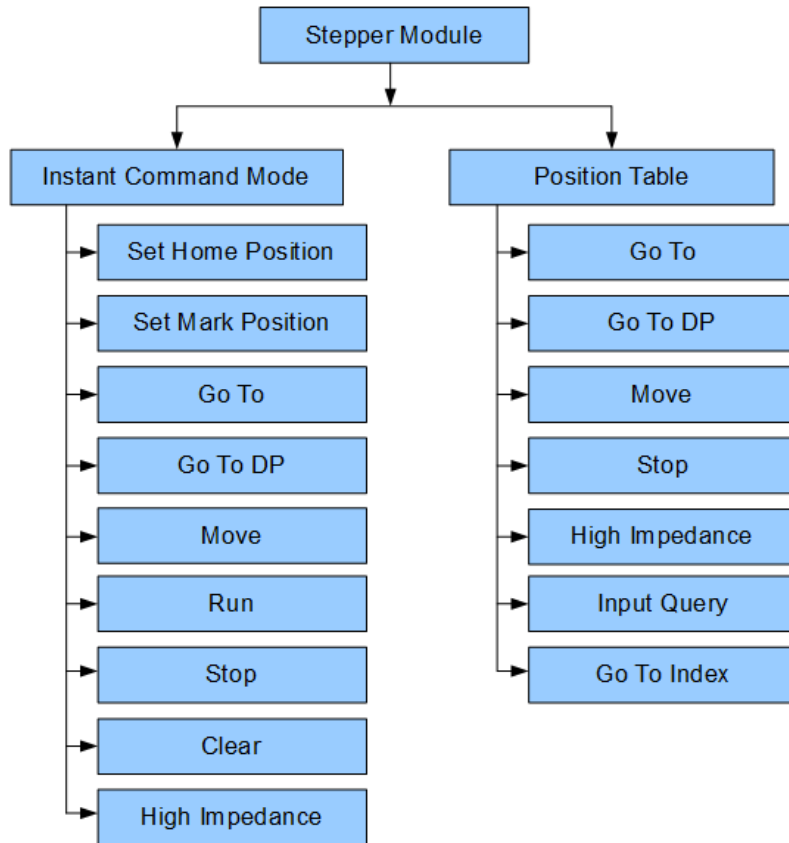
RIO3-SMD provides two main function commands.

After power on, module will be ready and motor is neutral position (not stopped).

Usually, RIO3-SMD is on 'Instant Command mode' which is activate function command from master (❶). If function command (from master) of RIO3-SMD is done (❷), RIO3-SMD is stay last command status and hold on position (❸).

Ex)

① Master ──Move 200 step──▶ GT-5521 — M

② Master ──────────────▶ GT-5521 — M   Move 200 step

③ Master ──────────────▶ GT-5521 — M   After Move 200 step Motor stopped
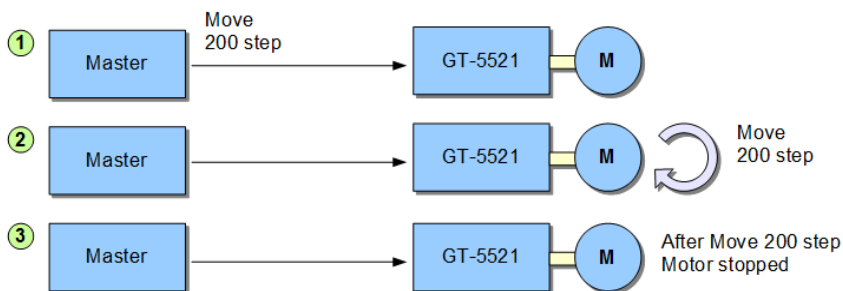
In 'Position Table Mode', module needs some specific commands. In this manual, it will be covered in the 'How to use position table function.' chapter.

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Inspire the Next

2.1.6 Configuration Parameter Data

This section describes the individual parameters that shall be used to configure the RIO3-SMD Stepper module:

No.	Name	Description	Type
1	Acceleration Current (in peak current)	Target phase current generated by controlling the amplitude of motor supply voltage that is assigned to the module. It should be configured with HiZ state. If motor status is not, it will be HiZ State. (7.8*Value)/100 = Setting Current(A)	Byte
2	Deceleration Current (in peak current)	Target phase current generated by controlling the amplitude of motor supply voltage that is assigned to the module. It should be configured with HiZ state. If motor status is not, it will be HiZ State. (7.8*Value)/100 = Setting Current(A)	Byte
3	Holding Current (in peak current)	Target phase current generated by controlling the amplitude of motor supply voltage that is assigned to the module. It should be configured with HiZ state. If motor status is not, it will be HiZ State. (7.8*Value)/100 = Setting Current(A)	Byte
4	Running Current (in peak current)	Target phase current generated by controlling the amplitude of motor supply voltage that is assigned to the module. It should be configured with HiZ state. If motor status is not, it will be HiZ State. (7.8*Value)/100 = Setting Current(A)	Byte
5	Step mode & Encoder/Digital Input selection	This byte contains Step mode select(4~7bit) and Encoder/Digital input selection(0~3bit). Step mode range = Full step ~ 1/16 micro step. Digital Input, Encoder mode(AB mode).	Byte
6	Acceleration Speed	The available range is from 14.55 to 59590 step/s2 with a resolution of 14.55 step/s2. When the value is set to 59590, the device works in infinite acceleration mode.	Float*
7	Deceleration Speed	The available range is from 14.55 to 59590 step/s2 with a resolution of 14.55 step/s2. When the device is working in infinite acceleration mode, this value is ignored.	Float*
8	Maximum Speed	The available range is from 15.25 to 15610 step/s with a resolution of 15.25 step/s.	Float*
9	Minimum Speed	The available range is from 0 to 976.3 step/s with a resolution of 0.238 step/s. Note: If the Minimum Speed is set to '0' then the Module will enable Low Speed Optimization in order to achieve smooth operation at lower speeds.	Float*
10	Full Step Speed	Defines the threshold speed for the step mode to Switch automatically to full step mode. When the motor speed exceeds this threshold value, the full step mode is automatically switched to full-step. The available range is from 7.63 to 15625 step/s with a resolution of 15.25 step/s.	Float*

* Float type:

    ex.) Maximum speed = 2008.16 step/sec

        Configuration parameter of Maximum speed = 200816 → 0x31070

- When changing the parameter data, set the motor operation to high impedance status.

(*) WH: writable only when outputs are in high impedance

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Byte	Input Image Data							
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	Module Status Input Data							
0	HiZ	Busy	*M_DIR	-	-	-	F_POW	Ready (Module_OK)
1	-	-	-	-	*CMD_STATUS		*MOT_STATUS	
2	Pos Tab Read	Command Data						
3	Position Table Index							
	Absolute Position Input Data / Position table Read data							
4	Absolute Position Input 0 byte							
	Position Command Parameter1							
5	Absolute Position Input 1 byte							
	Position Command Parameter2							
6	Absolute Position Input 2 byte							
7	Absolute Position Input 3 byte							
	Actual Speed Input Data / Position table Read data							
8	Actual Speed Input 0							
	Position Command Parameter3							
9	Actual Speed Input 1							
	Position Command Parameter3							
10	Actual Speed Input 2							
	Position Command Parameter3							
11	Actual Speed Input 3							
	Position Command Parameter3							
	Digital Input / Encoder Position Input Data							
12	--							DI 0
	Encoder Position Input 0 byte							
13	--							DI 1
	Encoder Position Input 1 byte							
14	--							DI 2
	Encoder Position Input 2 byte							
15	--							DI 3
	Encoder Position Input 3 byte							

- *M_DIR: Last State in Motor Direction(Reverse[0], Forward[1])

- *CMD_STATUS: Commend Success(0), Commend Error(1), Commend Busy(2)

- *MOT_STATUS: Stop(0), Accelerate(1), Decelerate(2), Constant Speed(3)

- This counter is a cyclic 16-bit counter. The relationship between this counter and the internal position counter depends on the resolution of the encoder and the microsteps defined for the internal position count

- The absolute position value range is -0x001F FFFF to 0xFFE0 0000.

2.1.7 Mapping data into the image table

Input Image Value - 16Byte

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
				Input Image Data				
				Module Status Input Data				
0	HiZ	Busy	*M_DIR	-	-	-	F_POW	Ready (Module_OK)
1	-	-	-	-	*CMD_STATUS		*MOT_STATUS	
2	Pos Tab Read	Command Data						
3	Position Table Index							
				Absolute Position Input Data / Position table Read data				
4	Absolute Position Input 0 byte							
	Position Command Parameter1							
5	Absolute Position Input 1 byte							
	Position Command Parameter2							
6	Absolute Position Input 2 byte							
7	Absolute Position Input 3 byte							
				Actual Speed Input Data / Position table Read data				
8	Actual Speed Input 0							
	Position Command Parameter3							
9	Actual Speed Input 1							
	Position Command Parameter3							
10	Actual Speed Input 2							
	Position Command Parameter3							
11	Actual Speed Input 3							
	Position Command Parameter3							
				Digital Input / Encoder Position Input Data				
12	--							DI 0
	Encoder Position Input 0 byte							
13	--							DI 1
	Encoder Position Input 1 byte							
14	--							DI 2
	Encoder Position Input 2 byte							
15	--							DI 3
	Encoder Position Input 3 byte							

*M_DIR: Last State in Motor Direction(Reverse[0], Forward[1])
*CMD_STATUS: Commend Success(0), Commend Error(1), Commend Busy(2)
*MOT_STATUS: Stop(0), Accelerate(1), Decelerate(2), Constant Speed(3)
This counter is a cyclic 16-bit counter. The relationship between this counter and the internal position counter depends on the resolution of the encoder and the microsteps defined for the internal position count
The absolute position value range is -0x001F FFFF to 0xFFE0 0000.

HITACHI
Inspire the Next

Output Image Value - 10Byte

Byte	Output Image Data							
	Control Word 0							
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	Module Output Mode							
0	--			Pos Tab Read	Pos Tab Run	Pos Tab Save	Pos Tab Write	Instant Command
1	Position Table Index							
	Command Data							
2	NOP				0	0	0	0
	SET_HOME_POSITION				0	0	0	1
	SET_MARK_POSITION				0	0	1	0
	GOTO				0	0	1	1
	GOTO_DP				0	1	0	0
	MOVE				0	1	0	1
	RUN				0	1	1	0
	INPUT_QUERY*				0	1	1	1
	STOP				1	0	0	0
	GOTO_INDEX*				1	0	0	1
	CLEAR				1	0	1	0
	High Impedance				1	0	1	1
	Command Parameter Data							
3	Direction (Reverse : 0 / Forward : 1)							Dir
	State Change (On -> Off : 0 / Off -> On : 1)							Input Query
4	Stop Mode (Soft Stop : 0 / Hard Stop : 1)							Stop
	Position (Home : 0 / Mark : 1 / Absolute : 2)							GOTO
5	SPD & POS Output 0 / *Position Table No.							
6	SPD & POS Output 1 / *Position Table No.							
7	SPD & POS Output 2 / *Position Table No.							
8	SPD & POS Output 3 / *Position Table No.							
	Reserved							
9	Reserved							

* INPUT_QUERY, GOTO_INDEX is only for 'Position Table Function'.

* 'State Change' is only for INPUT_QUERY.

* 'Position Table No.' is only for GOTO_INDEX.

- Since the initial state of the motor is in the high impedance state, it is recommended to change to the STOP operation state before other operations.

- Position Table Index is only for 'Position Table Function'.

HITACHI
Inspire the Next

Application Commands

This section describes the output command modes and individual commands of the stepper module in detail.

RIO3-SMD has two main output mode. 'Instant command mode' and 'Position Table Mode'. It executes only one module output mode at once.

Following table summarizes the list of module output modes:

1. Mode: Instant Command

Description: With this mode, module instantly execute the command, which is received from Network Adapter.

Following table summarizes the list of supported commands:

Command: NOP
Description: No action is taken by the module. If this command use in position table function command, it will be used as wait command.

Command Structure:

Command Value	Parameters (Data Type)	Description
0x00	Byte / Enumeration.	Op-code for NOP Command.
-	Byte / Enumeration.	This parameter is ignored by the module.
-	Byte / Enumeration.	This parameter is ignored by the module.
- Wait Count (only position table)	32-bit Integer	32-bit unsigend integer value. This parameter contains waiting count value.

Example Command Code:

	Output Mode	Cmd	Cmd Parameter Data							Reserved
			Para1	Para2	Para3					
Output Byte	0	1	2	3	4	5	6	7	8	9
Instant Cmd/ Set Home	01	00	01	00	00	00	00	00	00	00

Command: Set Home Position
Description: This command resets the internal position register to zero. The zero position is also defined as HOME position.
With Encoder Interface mode, this command initializes encoder count.

HITACHI
Inspire the Next

Command Structure:

Command Value	Parameters (Data Type)	Description
0x01	Byte / Enumeration.	Op-code for Set Home Position Command.
-	Byte / Enumeration.	This parameter is ignored by the module.
-	Byte / Enumeration.	This parameter is ignored by the module.
-	32-bit Integer	This parameter is ignored by the module.

Example Command Code:

	Output Mode	Cmd	Cmd Parameter Data						Reserved
			Para1	Para2	Para3				
Output Byte	0	1	2	3	4	5	6	7	8	9
Instant Cmd/ Set Home	01	00	01	00	00	00	00	00	00	00

Command: Set Mark Position
Description: This command sets the new value for the mark position.

Command Structure:

Command Value	Parameters (Data Type)	Description
0x02	Byte / Enumeration.	Op-code for Set Mark Position Command.
-	Byte / Enumeration.	This parameter is ignored by the module.
-	Byte / Enumeration.	This parameter is ignored by the module.
Position	32-bit Integer	32-bit Integer Value. New position to be loaded in the MARK register.

Example Command Code: Set Marked Position 200 step

	Output Mode	Cmd	Cmd Parameter Data						Reserved
			Para1	Para2	Para3				
Output Byte	0	1	2	3	4	5	6	7	8	9
Instant Cmd/ Set Home	01	00	02	00	00	C8	00	00	00	00

Command: GOTO
Description: This command produces a motion to the specified Home / Mark / Absolute position through the shortest path. The Absolute position (output scan) value is always in agreement with the selected step mode; the parameter value unit is equal to the selected step mode (full, half, quarter etc.).
This command keeps the BUSY flag low until the target position is reached. This command can be given only when the previous motion command has been completed (BUSY flag released). Any attempt to perform this command when a previous command is under execution (BUSY low) causes the command to be ignored.

HITACHI
Inspire the Next

Command Structure:

Command Value	Parameters (Data Type)	Description
0x03	Byte / Enumeration.	Op-code for GOTO Command.
-	Byte / Enumeration.	This parameter is ignored by the module.
Home/Mark / Absolute Position	Byte / Enumeration.	The options 'Home position - 0 / Mark position - 1' uses the values from the internal registers. So, the third parameter is only used with 'Absolute Position - 2'.
Position	32-bit Integer	32-bit Integer Value. This parameter is used with the option 'Absolute Position' otherwise it will be ignored by the module

Example Command Code: Goto Home/Go to Set/Go to Abs 51,200 steps

	Output Mode		Cmd		Cmd Parameter Data						Reserved
				Para1	Para2			Para3			
Output Byte	0	1	2	3	4	5	6	7	8		9
Instant Cmd/ GOTO Home	01	00	03	00	00	00	00	00	00		00
Instant Cmd/ GOTO Set	01	00	03	00	01	00	00	00	00		00
Instant Cmd/ GOTO Abs	01	00	03	00	02	00	C8	00	00		00

Command: GOTO_DP
Description: This command produces a motion to the specified absolute position imposing a forward or a reverse direction. The Absolute Position (output scan) value is always in agreement with the selected step mode; the parameter value unit is equal to the selected step mode (full, half, quarter, etc.).
This command keeps the BUSY flag low until the target speed is reached. This command can be given only when the previous motion command has been completed (BUSY flag released). Any attempt to perform this command when a previous command is under execution (BUSY low) causes the command to be ignored.

Command Structure:

Command Value	Parameters (Data Type)	Description
0x04	Byte / Enumeration.	Op-code for GOTO_DP Command.
Direction	Byte / Enumeration.	This parameter specifies the direction of rotation ? either Reverse ? 0 / Forward ? 1 to be used with the command.
-	Byte / Enumeration.	This parameter is ignored by the module.
Position	32-bit Integer	32-bit Integer Value. This parameter contains the absolute position to be used by the command

Example Command Code: Goto DP Forward / Goto DP Reverse

	Output Mode		Cmd		Cmd Parameter Data						Reserved
				Para1	Para2			Para3			
Output Byte	0	1	2	3	4	5	6	7	8		9
Instant Cmd/ GOTO DP FW	01	00	04	01	00	00	00	00	00		00
Instant Cmd/ GOTO DP REV	01	00	04	00	00	00	C8	00	00		00

HITACHI
Inspire the Next
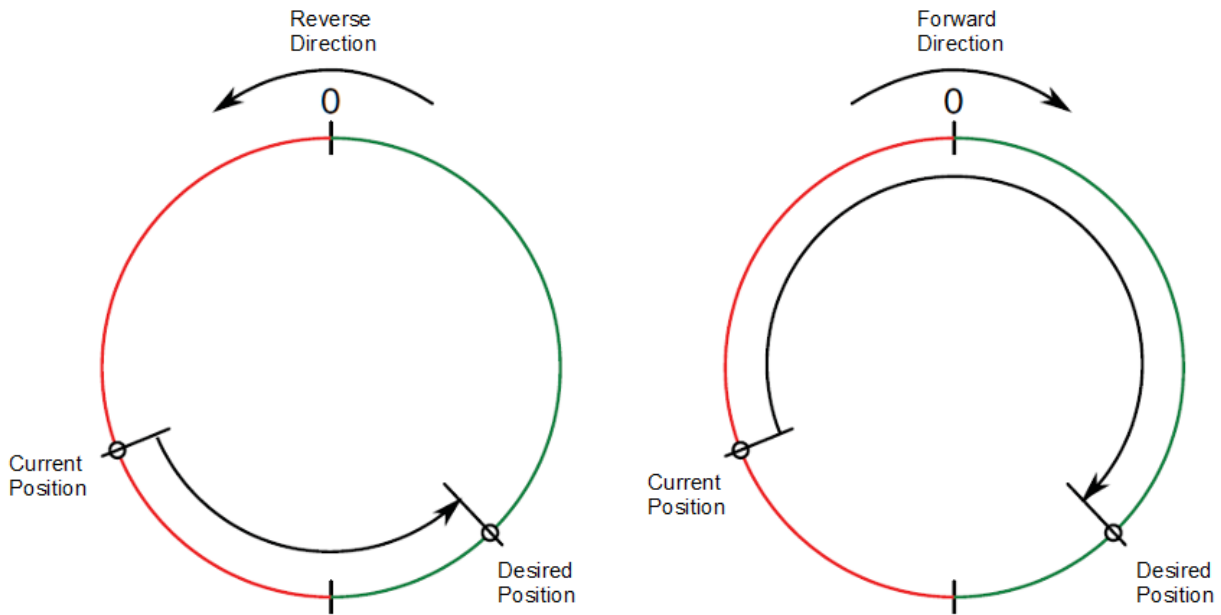
* Caution: GOTO DP command has direction of motor movement. Thus, motor doesn't work the shortest way to desired position (in absolute position).

Command: MOVE
Description: This command produces a motion of 'N' micro steps specified by the third parameter; the direction is specified by the first parameter (forward or reverse). The value of 'N' is always in agreement with the selected step mode (full, half, quarter, etc.).
This command keeps the module BUSY until the target number of steps are performed. This command can only be performed when the motor is stopped. If a motion is in progress, the motor must be stopped and it is then possible to perform a Move command. Any attempt to perform a Move command when the motor is running causes the command to be ignored.

Command Value	Parameters (Data Type)	Description
0x05	Byte / Enumeration.	Op-code for MOVE Command.
Direction	Byte / Enumeration.	This parameter specifies the direction of rotation ? either Reverse ? 0 / Forward ? 1 to be used with the command.
-	Byte / Enumeration.	This parameter is ignored by the module.
N-Micro Steps	32-bit Integer	32-bit Integer Value. This parameter contains the value of micro steps to be used by the command.

Command Structure:

Note:
If the specified speed is lower than the configured Minimum Speed than the motor attains the target speed starting from zero to allow smooth operation of the motor.

HITACHI
Inspire the Next

Example Command Code: Move Forward 51,200 step / Move Reverse 51,200 step

	Output Mode	Cmd	Cmd Parameter Data						Reserved
			Para1	Para2	Para3				
Output Byte	0	1	2	3	4	5	6	7	8	9
Instant Cmd/ GOTO DP FW	01	00	05	01	00	00	C8	00	00	00
Instant Cmd/ GOTO DP REV	01	00	05	00	00	00	C8	00	00	00

Command: RUN

Description: This command produces a motion at the speed specified by the third parameter; the direction is specified by the first parameter (forward or reverse). The value of speed is expressed in steps/sec. The specified speed value should be lower than Maximum Speed and greater than Minimum Speed (provided in module configuration) otherwise the Run command is executed at Maximum Speed or Minimum Speed respectively.
This command keeps the module BUSY until the target speed is reached. This command can be given anytime and is immediately executed.

Note:
If the specified speed is lower than the configured Minimum Speed than the motor attains the target speed starting from zero to allow smooth operation of the motor.

Command Value	Parameters (Data Type)	Description
0x06	Byte / Enumeration.	Op-code for RUN Command.
Direction	Byte / Enumeration.	This parameter specifies the direction of rotation ?either Reverse ? 0 / Forward ? 1 to be used with the command.
-	Byte / Enumeration.	This parameter is ignored by the module.
Speed	32-bit Integer	32-bit Integer Value. This parameter contains the value of Speed in steps/sec to be used by the command.

Command Structure:

Example Command Code: Run Forward 1,000 step per sec / Run Reverse 1,000 step per sec

	Output Mode	Cmd	Cmd Parameter Data						Reserved
			Para1	Para2	Para3				
Output Byte	0	1	2	3	4	5	6	7	8	9
Instant Cmd/ GOTO DP FW	01	00	05	01	00	00	C8	00	00	00
Instant Cmd/ GOTO DP REV	01	00	05	00	00	00	C8	00	00	00

HITACHI
Inspire the Next

Command: INPUT_QUERY
Description: This Command is not executed in instant command mode, it is only for Position table function command.
'INPUT_QUERY' function is that check the change of input channel status. If input channel's condition is as same as user-defined condition, module proceed next position table function. If it is not, stay until it is satisfying.

Command Structure:

Command Value	Parameters (Data Type)	Description
0x07	Byte / Enumeration.	Op-code for Input_Query Command.
-	Byte / Enumeration.	This parameter is ignored by the module.
Status Change Check Mode	Byte / Enumeration.	This parameter specifies the method of status change check mode (Off -> On ? 1/ On -> Off ? 0) used with this command.
-	32-bit Integer	This parameter is ignored by the module.

Example Command Code:

1. Index 6: Digital Input Ch1 On → Off?

2. Index 4: Digital Input Ch2 Off → On?

	Output Mode		Cmd	Cmd Parameter Data							Reserved
				Para1	Para2	Para3					
Output Byte	0	1	2	3	4	5	6	7	8	9
Pos Write/ Input Query Ch1, Off -> On On Index 6	02	06	07	00	00	01	00	00	00	00
Pos Write/ Input Query Ch2, On -> Off On Index 4	02	04	07	01	00	02	00	00	00	00

Command: STOP
Description: This command causes the motor to stop. The first parameter specifies the stop method to be used with this command and it can be either with infinite deceleration (Hard stop) or immediate deceleration to zero speed and a consequent motor stop (Soft stop)
This command can be given anytime and is immediately executed. This command keeps the module BUSY until the motor is stopped.

Command Structure:

Command Value	Parameters (Data Type)	Description
0x08	Byte / Enumeration.	Op-code for STOP Command.
-	Byte / Enumeration.	This parameter is ignored by the module.
Stop Mode	Byte / Enumeration.	This parameter specifies the method of stop mode (Soft stop ? 0 / Hard stop ? 1) used with this command.
-	32-bit Integer	This parameter is ignored by the module.

Example Command Code:

	Output Mode		Cmd	Cmd Parameter Data						Reserved
				Para1	Para2	Para3				
Output Byte	0	1	2	3	4	5	6	7	8	9
Instant Cmd/ Soft Stop	01	00	08	00	00	00	00	00	00	00
Instant Cmd/ Hard Stop	01	00	08	00	01	00	00	00	00	00

Command: GOTO_INDEX
Description: This Command is not executed in instant command mode. This is able to change of current position table index while position table program is running.

Command Structure:

Command Value	Parameters (Data Type)	Description
0x0A	Byte / Enumeration.	Op-code for GOTO Index Command.
-	Byte / Enumeration.	This parameter is ignored by the module.
-	Byte / Enumeration.	This parameter is ignored by the module.
- Position Table Index No.	32-bit Integer	This parameter specifies the desired index number to change.

Example Command Code:

On Index no. 11: Goto Index no. 7

	Output Mode		Cmd	Cmd Parameter Data						Reserved
				Para1	Para2	Para3				
Output Byte	0	1	2	3	4	5	6	7	8	9
Pos Write/ Goto Index On index 11	02	0B	09	00	00	07	00	00	00	00

Command: CLEAR
Description: This command clears any warnings / alarms flags internally maintained by the module and forces the module to exit from any error state.

Command Structure:

Command Value	Parameters (Data Type)	Description
0x0A	Byte / Enumeration.	Op-code for CLEAR Command.
-	Byte / Enumeration.	This parameter is ignored by the module.
-	Byte / Enumeration.	This parameter is ignored by the module.
-	32-bit Integer	This parameter is ignored by the module.

Example Command Code:

	Output Mode		Cmd	Cmd Parameter Data						Reserved
				Para1	Para2	Para3				
Output Byte	0	1	2	3	4	5	6	7	8	9
Instant Cmd/ Soft Stop	01	00	0A	00	00	00	00	00	00	00

HITACHI Inspire the Next

Command: High Impedance
Description: This command causes the motor to stop and Power bridge will be disabled. The first parameter specifies the stop method to be used with this command and it can be either with infinite deceleration (Hard stop and Impedance) or immediate deceleration to zero speed and a consequent motor stop (Soft stop and Impedance).
This command can be given anytime and is immediately executed. This command keeps the module BUSY until the motor is stopped and power bridge is disabled.

Command Structure:

Command Value	Parameters (Data Type)	Description
0x0B	Byte / Enumeration.	Op-code for High Impedance Command.
-	Byte / Enumeration.	This parameter is ignored by the module.
Impedance Mode	Byte / Enumeration.	This parameter specifies the method of High Impedance mode (Soft HiZ ? 0 / Hard HiZ ? 1) used with this command.
-	32-bit Integer	This parameter is ignored by the module.

Example Command Code:

	Output Mode		Cmd	Cmd Parameter Data							Reserved
				Para1	Para2	Para3					
Output Byte	0	1	2	3	4	5	6	7	8	9	
Instant Cmd/ GOTO DP FW	01	00	05	01	00	00	C8	00	00	00	
Instant Cmd/ GOTO DP REV	01	00	05	00	00	00	C8	00	00	00	

2. Mode: Position Table mode

Position Table mode has several commands. Each command are for position table function.
Position commands are consisting of 'Write', 'Save', 'Run', 'Read'. RIO3-SMD execute only one function command at once.

Position Table Write
Description: This mode is for create 'Position Table' of RIO3-SMD.
With this mode, RIO3-SMD make a Position Table List.
RIO3-SMD provides 250 position table list. Table creation procedure is as following below:

Define maximum index of position table.

Example Command Code: Create position table (Maximum index size 12)

	Output Mode		Cmd	Cmd Parameter Data						Reserved
				Para1	Para2	Para3				
Output Byte	0	1	2	3	4	5	6	7	8	9
Pos Write/ Table Create Index 12	02	FB	00	00	00	0C	00	00	00	00

If you **initialize table list**, set the maximum index to 0xFF.

Example Command Code: Initialize position table (= Maximum index size 0)

	Output Mode		Cmd	Cmd Parameter Data						Reserved
				Para1	Para2	Para3				
Output Byte	0	1	2	3	4	5	6	7	8	9
Pos Write/ Table Initialize	02	FF	00	00	00	00	00	00	00	00

Write command on each position table list.

Example Command Code: Write on position table index 0, reverse 3200 step move

	Output Mode		Cmd	Cmd Parameter Data						Reserved
				Para1	Para2	Para3				
Output Byte	0	1	2	3	4	5	6	7	8	9
Pos Write/ CW 3200 step On Index 0	02	00	05	01	00	80	0C	00	00	00

Position Table Save
Description: This mode is for save 'Position Table' of RIO3-SMD.
When 'Position Table Write' procedure is finished, 'Position Table Save' is necessary.
In addition, it should be executed, before 'Position Table Run'.

Example Command Code: Position Table Save

	Output Mode		Cmd	Cmd Parameter Data						Reserved
				Para1	Para2	Para3				
Output Byte	0	1	2	3	4	5	6	7	8	9
Pos Table Save	04	00	00	00	00	00	00	00	00	00

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Inspire the Next

Position Table Run
Description: Position Table Mode activated by this command.

Example Command Code: Position Table Run

	Output Mode		Cmd	Cmd Parameter Data							Reserved
				Para1	Para2	Para3					
Output Byte	0	1	2	3	4	5	6	7	8		9
Pos Table Run	08	00	00	00	00	00	00	00	00		00

Position Table Read
Description: With this mode, user can observe the Position Table List.
Each specific position table function command on list will be indicated at input data.

Example Command Code : Position Table Read (Index no.1 of position table list)

	Output Mode		Cmd	Cmd Parameter Data							Reserved
				Para1	Para2	Para3					
Output Byte	0	1	2	3	4	5	6	7	8		9
Pos Table Read/ Index 1	10	00	00	00	00	01	00	00	00		00

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3 How to use position table function.

This section describes how to use position table function of RIO3-SMD.
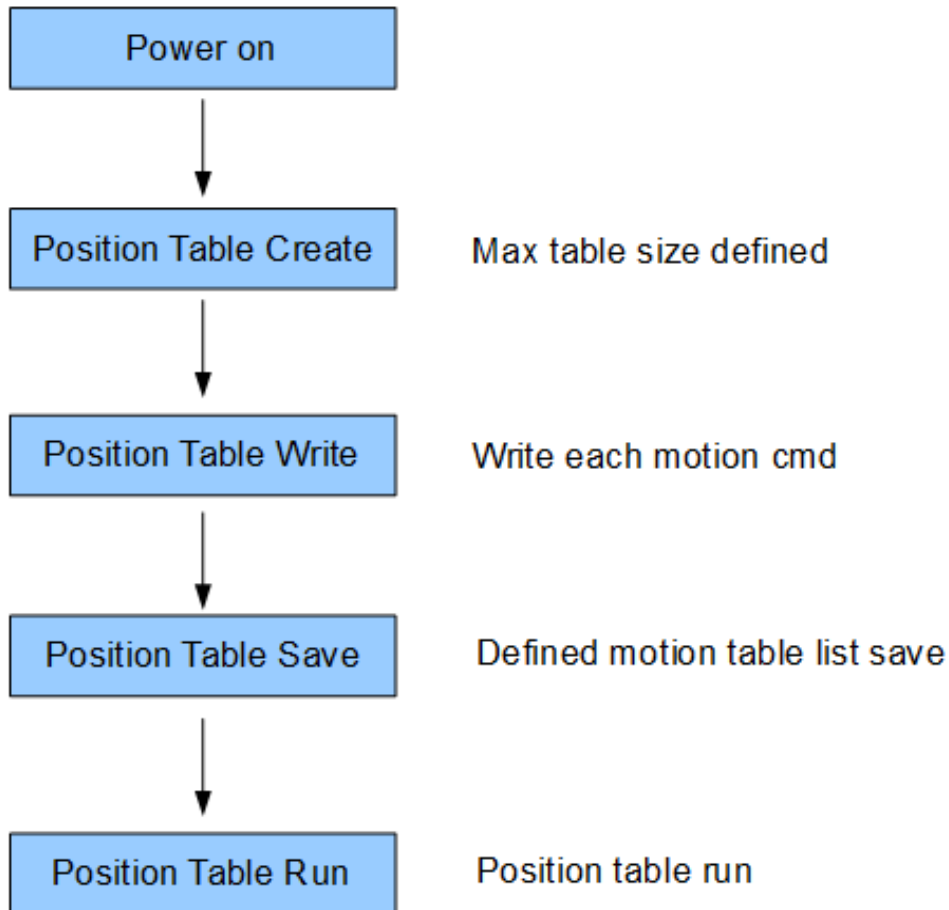
If 'Position Table Write' function is executed, 'Position Table Run' function won't be executed before 'Position Table Save' function is activated. Please activate

The example command is following below:

1) Position Table Create (define maximum table size)

  Example Command Code: Create position table (Maximum index size 12)

	Output Mode		Cmd	Cmd Parameter Data						Reserved
				Para1	Para2	Para3				
Output Byte	0	1	2	3	4	5	6	7	8	9
Pos Write/ Table Create Index 10	02	FB	00	00	00	0A	00	00	00	00

2) RIO3-SMD create position table list as give command.

index no.	Output Mode		Cmd	Cmd Parameter Data						Reserved
				Para1	Para2	Para3				
	0	1	2	3	4	5	6	7	8	9
0										
1										
2										
3										
4										
5										
6										
7										
8										
9										

3) Enter each desired Position table command, until fill the position table list.

  Example Command: Move to 3200 step position on absolute position axis (Index 0)

index no.	Output Mode		Cmd	Cmd Parameter Data						Reserved
				Para1	Para2	Para3				
	0	1	2	3	4	5	6	7	8	9
0	02	00	03	00	02	80	0C	00	00	00
1										
2										
3										
4										
5										
6										
7										
8										
9										

4) If 'Position Table Write' procedure is finished, please command 'Position Table Save'

  Example Command: Position Table Save

Description	Output Mode		Cmd	Cmd Parameter Data						Reserved
				Para1	Para2	Para3				
	0	1	2	3	4	5	6	7	8	9
Pos Table Save	04	00	00	00	00	00	00	00	00	00

5) Run Position table list.

  Example Command: Position Table Run

Description	Output Mode		Cmd	Cmd Parameter Data						Reserved
				Para1	Para2	Para3				
	0	1	2	3	4	5	6	7	8	9
Pos Table Run	08	00	00	00	00	00	00	00	00	00

HITACHI
Inspire the Next

Position Table Run

Once run 'Position Table Run', RIO3-SMD will be performed function command following position table list. If module is performed final function command on position table list, the module goes to perform first function command on the position table list.
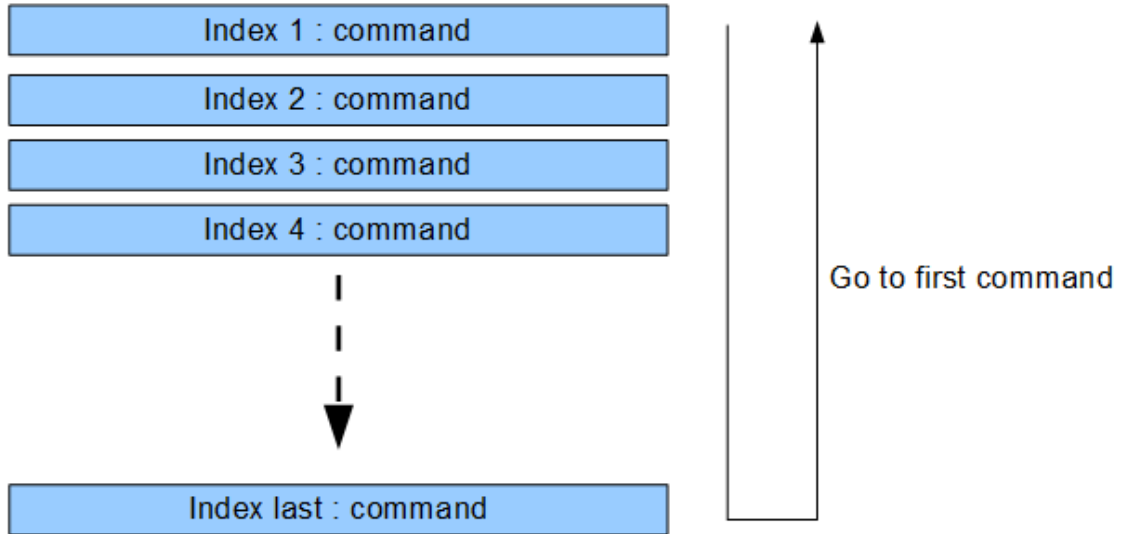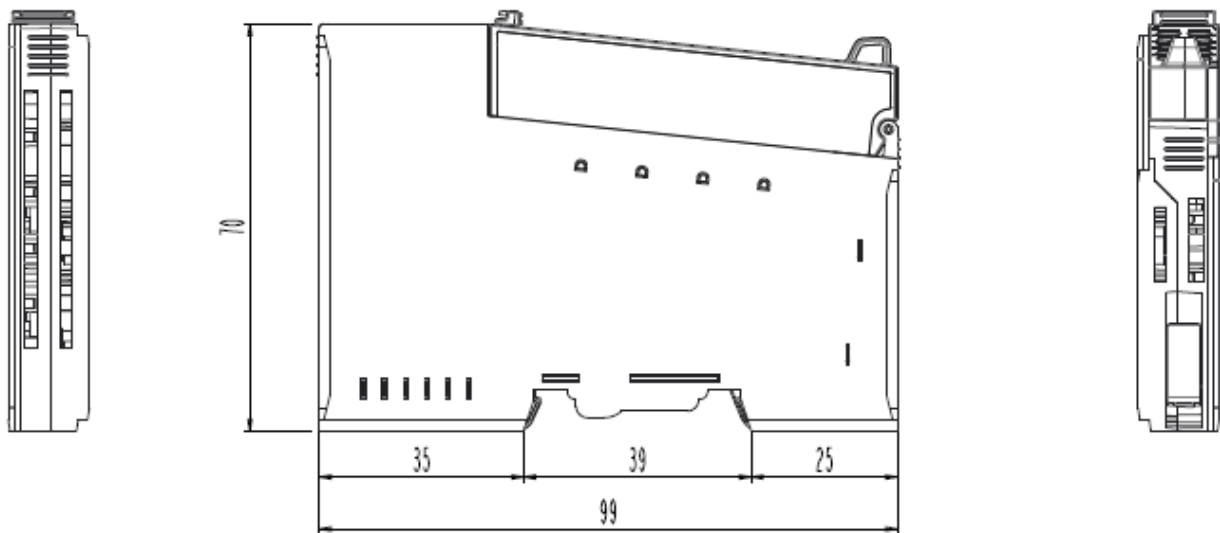

If you want module keep position table run mode, give any command after 'Position Table Run command' or RIO3-SMD will be stopped.
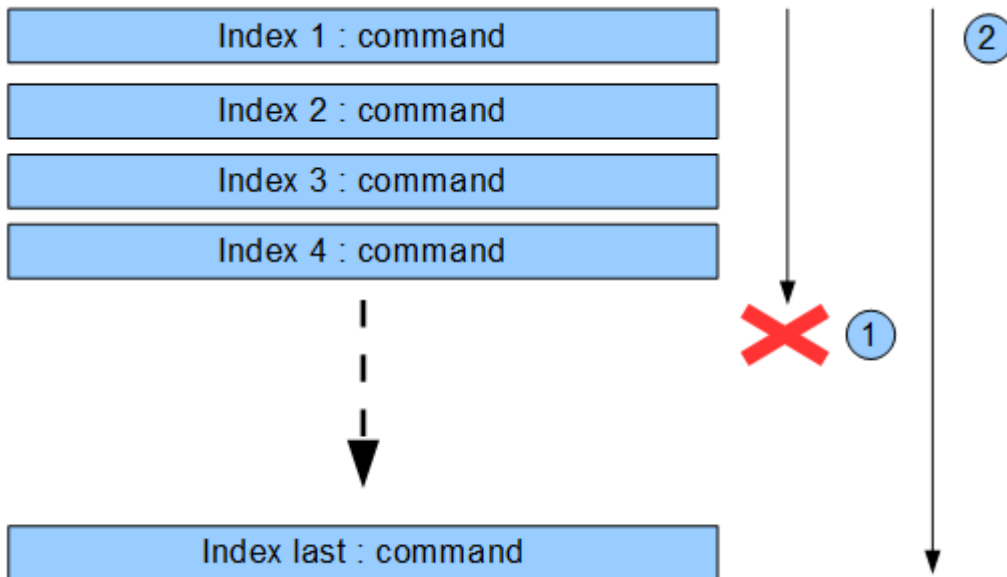
If module is stopped(①) and come back to 'Position Table Run mode', module will be start at first function command on the position table list(②).

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Inspire the Next

4 Dimension

4.1 RIO3-SMD

Dimensions in mm

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Inspire the Next

# 5 Mounting

Caution!

Hot surface!

The surface of the housing can become hot during operation. If the device was operated at high ambient temperatures, allow it to cool off before touching it.

Notice!

Perform work on devices only if they are de-energized!

Working on energized devices can damage them. Therefore, turn off the power supply before working on the devices.
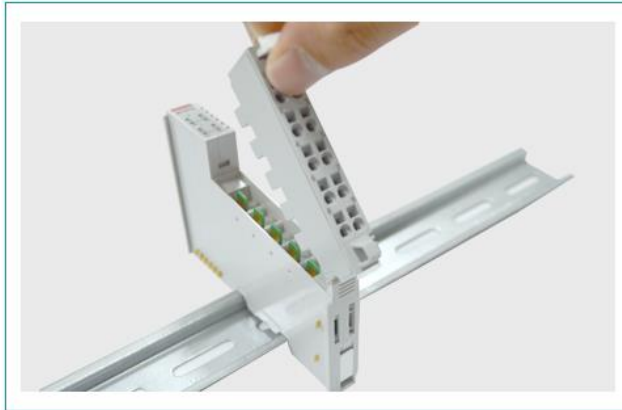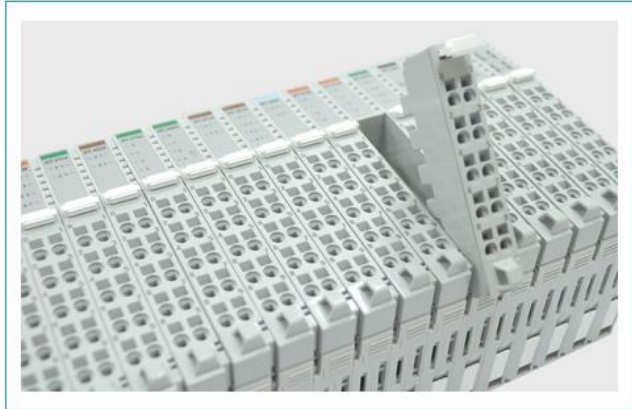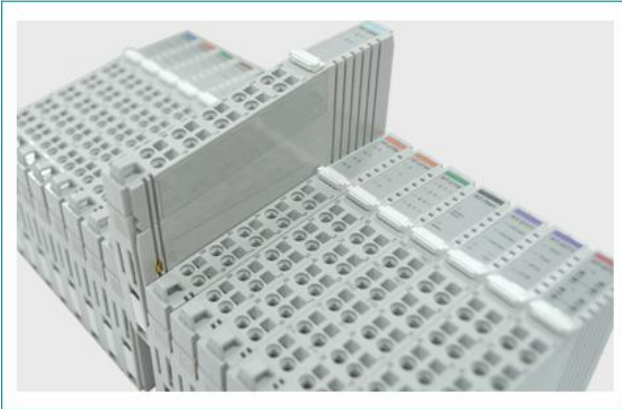
5.1 I/O Inserting and Removing Devices
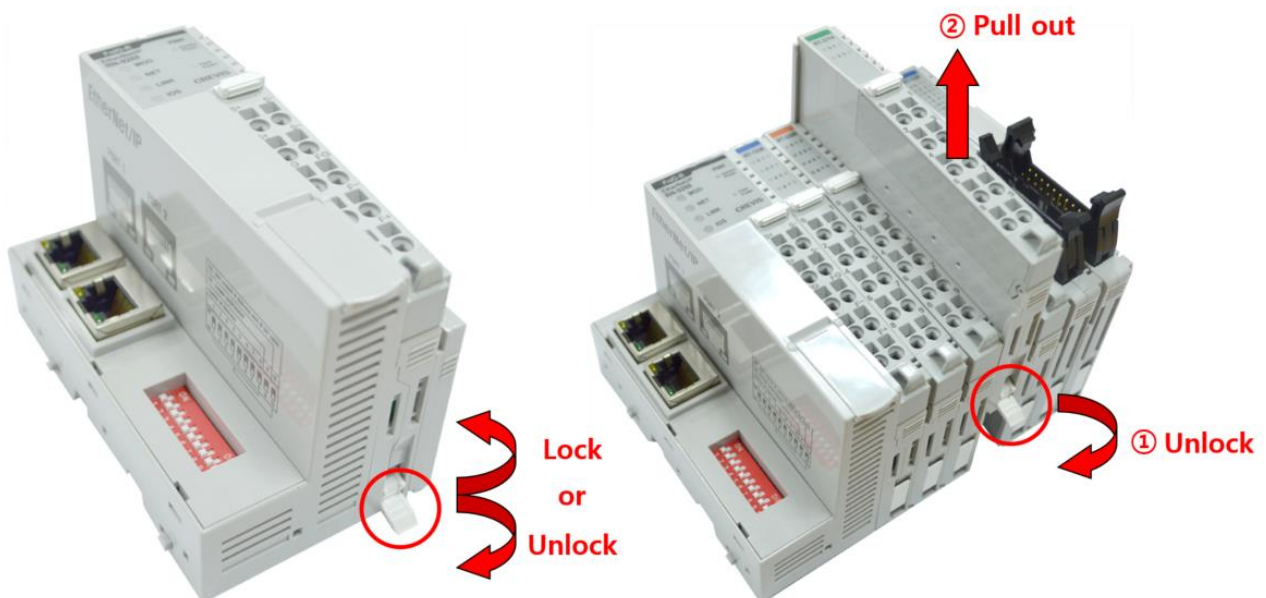
As above figure in order to safeguard the RIO3-Series module from jamming, it should be fixed onto the DIN rail with locking lever. To do so, fold on the upper of the locking lever.

To pull out the HX-RIO3 module, unfold the locking lever as below figure.

HITACHI
Inspire the Next

5.2 RTB (Removable Terminal Block)
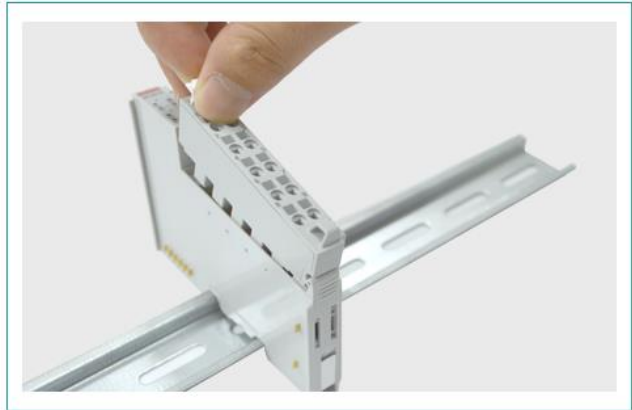
Whole terminal block can be combined and removed for the convenience if its maintenance.
There is a locking switch on the RTB for the easy combination and easy removal.
Easy combination and easy removal for IO modules on the din rail through One Touch Locking Switch.

HITACHI
Inspire the Next

6 G-Bus Pin Description

Communication between the Network Adapter and the expansion module as well as system / field power supply of the bus modules is carried out via the internal bus. It is comprised of 6 data pin and 2 field power pin.

*Please refer to the table below regarding the pin description from P1 to P8.

No.	Description
P1	Field Power (VCC)
P2	Field Power (GND)
P3	GBUS CLK
P4	GBUS MISO
P5	GBUS MOSI
P6	GBUS Token
P7	System Power (GND)
P8	System Power (VCC)

DANGER	
⚠	Do not touch data and field power pins in order to avoid soiling and damage by ESD noise.

HITACHI
Inspire the Next

7 APPENDIX A

7.1 Product List

No.	RIO3-Number	Description	ID (hex)
Digital Input Module			
01	RIO3-XDP8	8 Points, Universal, 24Vdc, 10RTB	1238
02	RIO3-XDP16C	16 Points, Universal, 24Vdc, 20P connector	123F
03	RIO3-XDP16T	16 Points, Universal, 24Vdc, 18RTB	12DF
04	RIO3-XDP32C	32 Points, Universal, 24Vdc, 40P connector	12FA
05	RIO3-XY16T	8 Sink Input / 8 Source Output with Diagnostic, 24Vdc	1428
06	RIO3-XAH4	4 Points, 240Vac, 10RTB	1904
Digital Output Module			
07	RIO3-YTP8	8 Points, Source, 24Vdc/0.5A, 10RTB	2328
08	RIO3-YTP16C	16 Points, Source, 24Vdc/0.3A, 20P connector	222F
09	RIO3-YTP16T	16 Points, Source, 24Vdc/0.3A, 18RTB	226F
10	RIO3-YTP32C	32 Points, Source, 24Vdc/0.3A, 40P connector	22CA
11	RIO3-YS4	4 Points, MOS Relay, 240Vdc/ac, 0.5A, 10RTB	2734
12	RIO3-YS8	8 Points, MOS Relay Output Terminal, 240Vdc, 0.5A	2738
13	RIO3-YR4	4 Points, Relay, 24Vdc/2A, 240Vac/2A, 10RTB	2744
Analog Input Module			
14	RIO3-LDC2	2ch load cell input unit, strain gauge	3002
15	RIO3-AX4I	4 Channels, 0~20, 4~20mA, 12bits, 10RTB	3114
16	RIO3-AXH4I	4 Channels, 0~20, 4~20mA, 16bits, 10RTB	3154
17	RIO3-AX8I	8 Channels, 0~20, 4~20mA, 12bits, 10RTB	3118
18	RIO3-AXH8I	8 Channels, 0~20, 4~20mA, 16bits, 10RTB	3158
19	RIO3-AX16IC	16 Channels, 0~20, 4~20mA, 12bits, 20P connector	311F
20	RIO3-AX16IT	16 Channels, 0~20, 4~20mA, 12bits, 18RTB	317F
21	RIO3-AX4V	4 Channels, 0~10, 0~5, 1~5Vdc, 12bits, 10RTB	3424
22	RIO3-AXH4V	4 Channels, 0~10, 0~5, 1~5Vdc, 16bits, 10RTB	3464
23	RIO3-AX8V	8 Channels, 0~10, 0~5, 1~5Vdc, 12bits, 10RTB	3428
24	RIO3-AXH8V	8 Channels, 0~10, 0~5, 1~5Vdc, 16bits, 10RTB	3468
25	RIO3-AX16VC	16 Channels, 0~10, 0~5, 1~5Vdc, 12bits, 20P connector	342F
26	RIO3-AX16VT	16 Channels, 0~10, 0~5, 1~5Vdc, 12bits, 18RTB	347F
27	RIO3-RTD4T	4 Channels, RTD, 10RTB	3704
28	RIO3-RTD8C	8 Channels, RTD, 20P connector	3708
29	RIO3-TC4T	4 Channels, Thermocouple, 10RTB	3804
30	RIO3-E3AC	AC Measurement	3901
Analog Output Module			
31	RIO3-AY4I	4 Channels, Current Output, 4~20mA, 12bits	4214
32	RIO3-AYH4I	4 Channels, Current Output, 4~20mA, 16bits	4254

HITACHI
Inspire the Next

33	RIO3-AY8I	8 CHANNELS CURRENT OUTPUT, 4~20mA, 12BIT	4218
34	RIO3-AY4V	4CH, 0~10Vdc, 12Bits, 10RTB	4424
35	RIO3-AYH4V	4CH, 0~10Vdc, 16Bits, 10RTB	4464
36	RIO3-AY8V	8CH, 0~10Vdc, 12Bits, 10RTB	4428
37	RIO3-AY16VC	16CH, 0~10Vdc, 12Bits, 20P Connector	442F
38	RIO3-AY16VT	16CH, 0~10Vdc, 12Bits, 18RTB	447F
	Special Module		
39	RIO3-CU24L	High Speed Counter, 2CHs, 24Vdc, Encoder Input, 10RTB	
40	RIO3-RS232	1CH, RS 232, RTS/CTS, Full Duplex Type, 10RTB	5211
41	RIO3-RS485	1CH, RS 485, Half Full Duplex Type, 10RTB	5231
42	RIO3-PWM2	PWM Output, 2CHs, 0.5A/24Vdc, Source, 18RTB	5442
43	RIO3-PO2	Pulse Output, 2CHs, 0.5A/24Vdc, Source, 18RTB	5642
	Power Module		
44	RIO3-SHD	Shield Module	7408
45	RIO3-0VDC	Common for 0Vdc	7508
46	RIO3-PSD	Power Expansion, In 24Vdc, Out 1A/5Vdc	7511
47	RIO3-24VDC	Common for 24Vdc	7518
48	RIO3-VDC	Common for 0Vdc, 24Vdc	7588
49	RIO3-PS	Field Power, 5/24/48 Vdc, 110/220 Vac	7641

7.2 Glossary

System Power: The power for starting up CPU.

Field Power: The power for input and output line.

Terminator Resistor: Resistor for prevention reflected wave.

EDS: Electronic Data Sheet.

Sink: The method of in/output power supply if a device has no power source.

Source: The method of in/output power supply if a device has the power source.

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