KOHZU

operation manual

Rev1.37

MontBlanc stage compliant
Stepping motor controller

KOSMOS series
Model: CRUX/CRUX-A

User's Manual

Read this manual before using this product.
Keep in a convenient place for future reference.

CRUX CRUX-A

Kohzu Precision Co., Ltd.

Introduction

In this document, information and operation method for the stepping motor controller, "CRUX" and "CRUX-A", are explained.

Read this manual carefully and understand the functions thoroughly before using "CRUX" or "CRUX-A".
In addition, keep this document in a convenience place for future reference.

Symbols Identifications

In this document, noted items that should be followed to prevent danger to people and damage to the device are divided as shown next.

Prohibited

This symbol indicates prohibited items. Do not conduct actions specified under this symbol.

Warning (Caution)

This symbol indicates items that require warning (caution). If operation is conducted ignoring noted contents, it may cause injury or physical damage.

Note/Remarks

This symbol indicates items to provide further understanding or useful information.

Safety Precautions

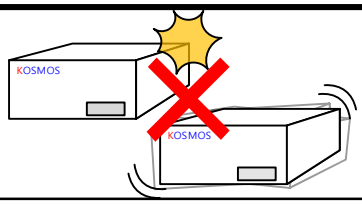
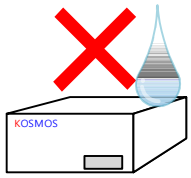
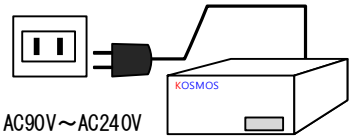
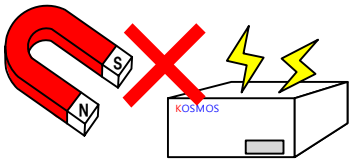
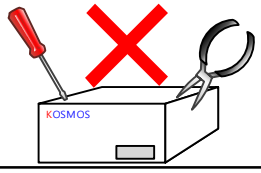
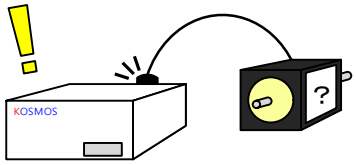
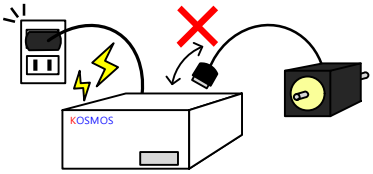
⊘			Do not apply severe shock to the product and avoid using in a place with vibration.
⊘			Liquid or chemical splashes on this device are dangerous and cause failures. Never use this device that these specified above may occur.
⚠			Use 90-240V AC (50/60Hz) as a power supply. *Confirm ratings of the power cable. *Always earth FG (Frame Ground).
⊘			This product is precision electronic equipment. Because malfunction may occur near large motors, high voltage electric devices or device that generates strong magnetism, do not use this product under these environment.
⊘			Do not disassemble or modify the product.
⚠			Pay close attention when connecting the motor driven stage or a motor other than those specified by us.
⚠			When the controller's power supply is turned ON, do not pull out or insert cables.

Table of Contents

1 Product Summary

1-1. Features of this product

Thank you for purchasing our stage controller, “CRUX” / “CRUX-A” .
(Hereinafter, both "CRUX" and "CRUX-A" are referred to as "CRUX").

CRUX consists of the reconfigured conventional small-size stage controller SC-021, and is significant high cost performance equipment actualizing low price while featuring high level functions satisfying needs of customers.

- Completely supports our motor drive precision stage <MontBlanc Series>.
- Micro-step motor driver with 250 divisions at maximum equipped as standard.
- Compact size.

- Lineup of "CRUX" equipped with DC driver and "CRUX-A" equipped with AC driver.

- Supports rectangular and trapezoidal drives.

- Origin return method selectable from 10 kinds (+ORG OFFSET).

- Remote control by USB communication is possible.
- Remote control by RS-232C communication is possible.

- Control is possible through application for stage drive, "Chamonix".
  Please download from our company's HP.

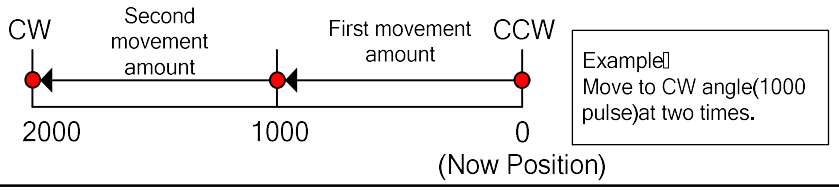
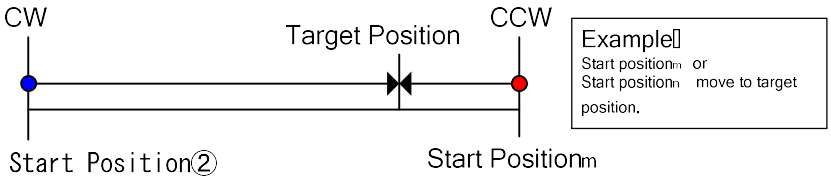
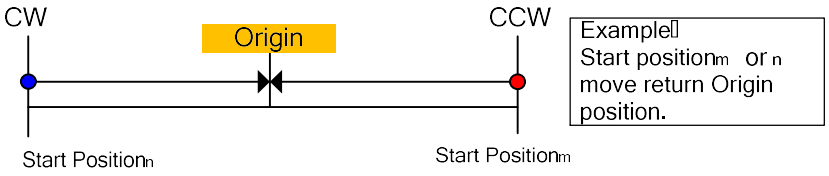
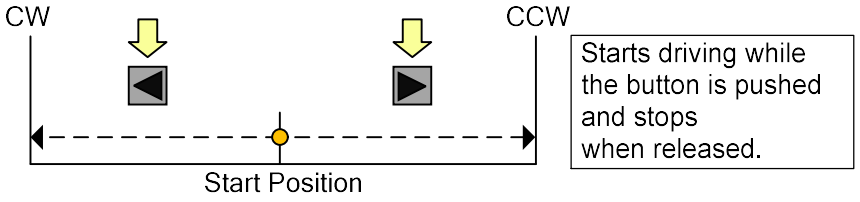
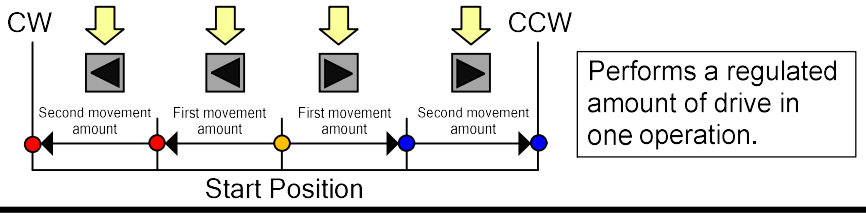
http://www.kohzu.co.jp/

■ Out of product scope

This product does not offer the following items.

・CRUX cannot drive motors besides 5-phase stepping motors.
・Not compatible with motors with an electromagnetic brake.
・No automatic operation possible with CRUX only.
*For automatic operation, connect a computer with CRUX and conduct remote control.
*With the jog box, “INCOM” (Sold separately), a part of functions can be performed.
・Not compatible with remote controls (Sequencer connection, etc.) except for RS-232 and USB communication.

1-2. List of Functions

Relative Position Movement (2 axes simultaneous start possible)	Moves toward the specified direction from the present position by a set moving value. 
Absolute Position Movement (2 axes simultaneous start possible)	Moves to the specified target position. 
Origin Return Movement	Performs origin return with the specified origin return method. 
Continuous Drive Mode (Optional)	Moves continuously with the free drive mode of the easy control jog box "INCOM". 
Relative Position Drive Mode (Optional)	Moves for the specified moving amount with the relative position drive mode of the easy control jog box "INCOM".* *Moving amount is set from PC. 

1-3. Attachments and Options

1-3-1. Attachments

The following items are included to the product. Make sure to check that all items are included. Immediately contact your retainer or our sales department if there are missing or damaged parts.

① Power cable (3P)

Power cable (3P) for AC100 V is included usually.
In addition, a 3P->2P conversion plug comes as an option.
*A power cable for AC200 V must be prepared by customers or contact our sales department.

② Emergency stop short plug

A short plug to connect when not using the emergency stop signal comes as attachment.

1-3-2. Optional products (Required)

A motor cable for KOSMOS series necessary to drive the MontBlanc product, RS-232C (cross) communication cable and USB cable used to control from a computer are not included in the product.

Purchase a motor cable separately.
Also, purchase a communication cable or USB cable available on the market.

Motor cable list for KOSMOS series

Stage side Connector shape	Length	Cable type	
		Fixed cable	Moving cable
Round type connector	3m	CB1503	RCB1503
	5m	CB1505	RCB1505
	10m	CB1510	RCB1510

*Other types of cable (for 10-lead and square connector) can also be manufactured.
For details, see our company's website.

1-3-2. Optional products (Convenient tools)

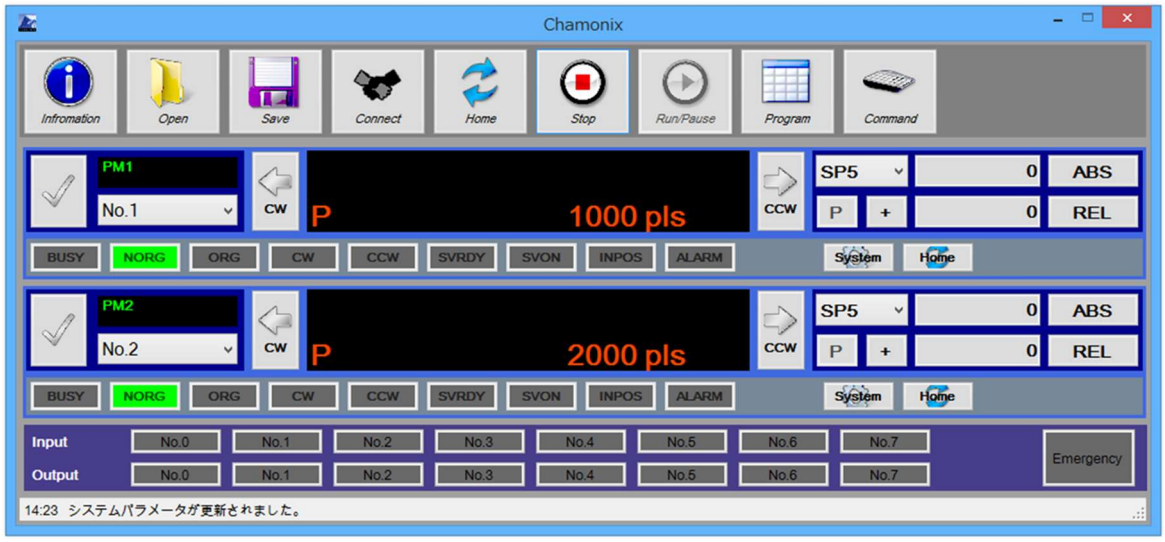
The following optional products are available to make this product easier to use.
Purchase or download as necessary.
For questions about the following products, please contact your retainer or our sales department.

① Jog box "INCOM" for easy control

Easy jog box that can control the basic operation functions of CRUX.
For details, see "4 Easy Control Jog Box" (Page 28).

② Stage control application, "Chamonix"

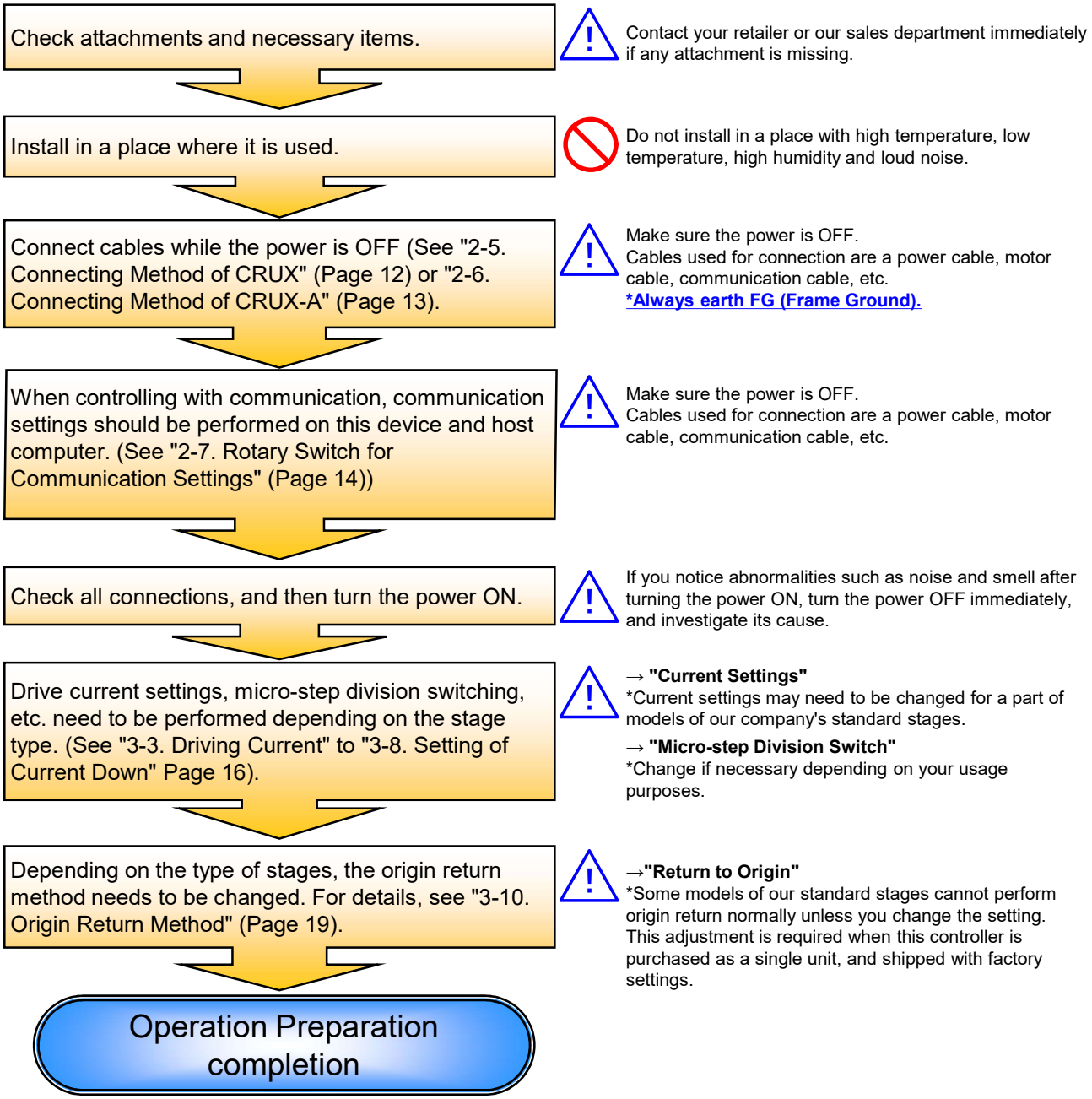
Application that can control all functions of CRUX from PC.
Please download from our company's HP.



2 Installation and Preparation

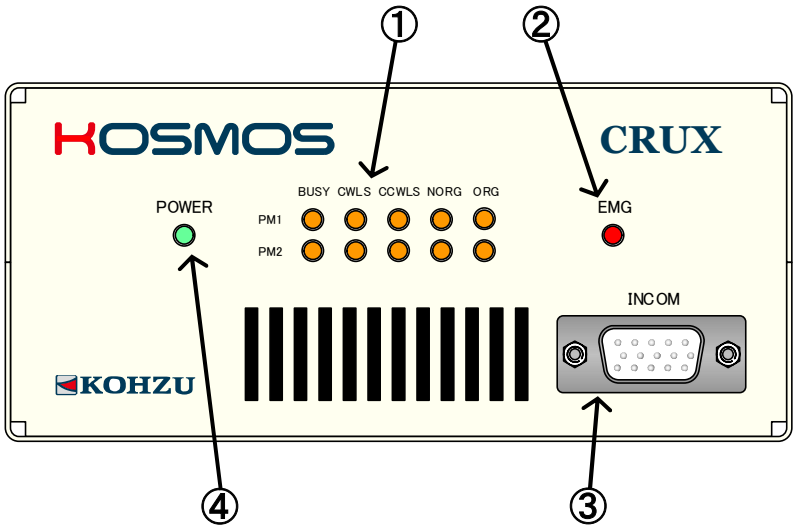
2-1. Proceeding with Installation and Preparation

Always follow the sequence specified next to install the product.



It takes about 3 second for starting to complete, after the power is turned ON.

2-2. Parts Name of CRUX



① Limit and position sensor display LED
Position sensor and driving states are displayed.

BUSY: Turns ON yellow during motor driving.

CWLS: When the CW limit sensor is in the detection state, it turns ON yellow.

CCWLS: When the CCW limit sensor is in the detection state, it turns ON yellow.

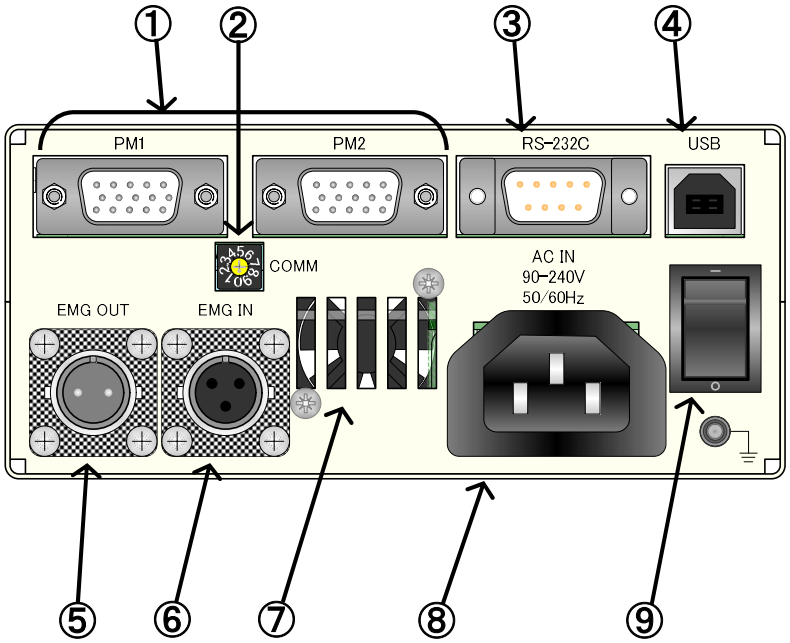
NORG: When the NORG sensor is in the detection state, it turns ON yellow.

ORG: When the ORG sensor is in the detection state, it turns ON yellow.

② Emergency stop LED
When the emergency stop is ON, it turns ON red.

③ Connector for "INCOM" connection

④ Power light
Turns ON green when the power is ON.



① Motor connecting connector
Stage driving output, and sensor input

② Rotary switch for communication mode selection
Selects USB or RS-232C (including baud rate setting), selects Normal/Simple command

③ RS-232C connector
Connector 9-pin for RS-232C communication line

④ USB connector
For USB communication line

⑤ Emergency stop signal output connector

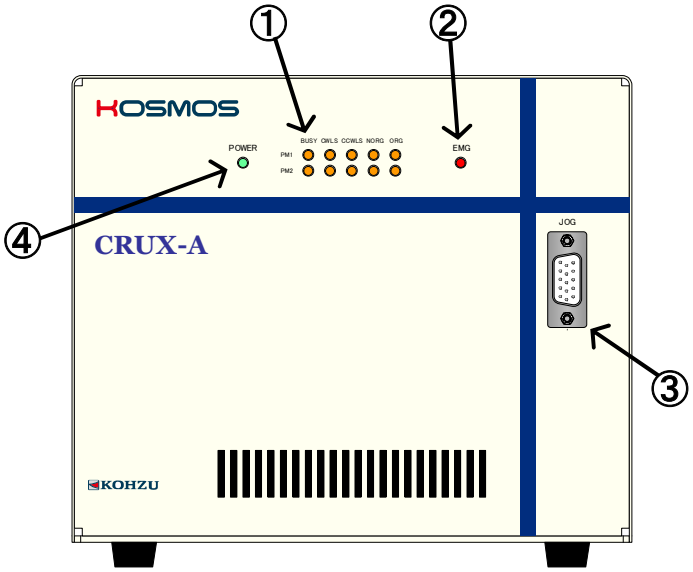
⑥ Emergency stop signal input connector

⑦ Heat discharging fan
Never block exhaust by placing objects behind the fan.

⑧ Power connector

⑨ Power switch
Turns power ON/OFF.

2-3. Parts Name of CRUX-A



① Limit and position sensor display LED
Displays the position sensor state and driving state.

BUSY: Turns ON yellow during motor driving.

CWLS: When the CW limit sensor is in the detection state, it turns ON yellow.

CCWLS: When the CCW limit sensor is in the detection state, it turns ON yellow.

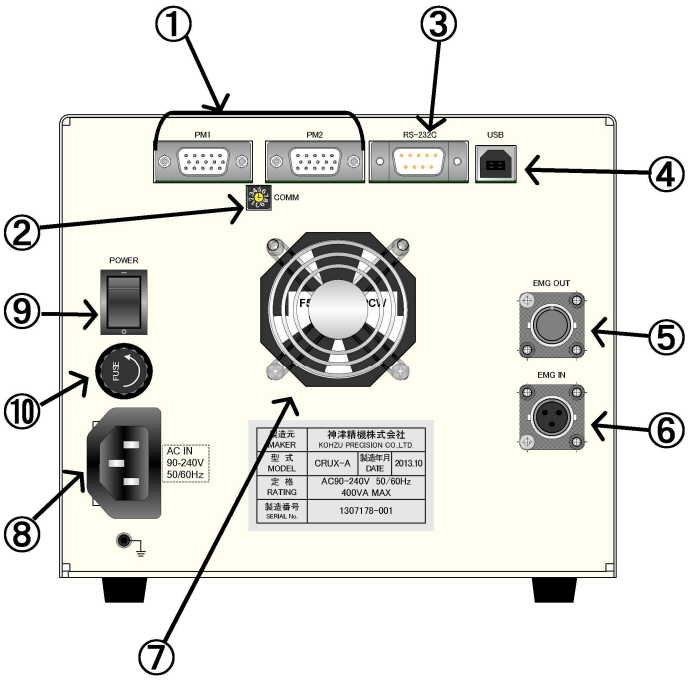
NORG: When the NORG sensor is in the detection state, it turns ON yellow.

ORG: When the ORG sensor is in the detection state, it turns ON yellow.

② Emergency stop LED
When the emergency stop is ON, it turns ON red.

③ Connector for "INCOM" connection

④ Power light
Turns ON green when the power is ON.



① Motor connecting connector
Stage driving output, and sensor input

② Rotary switch for communication mode selection
Selects USB or RS-232C (including baud rate setting)
Selects Normal/Simple command

③ RS-232C connector
Connector 9-pin for RS-232C communication line

④ USB connector
For USB communication line

⑤ Emergency stop signal output connector

⑥ Emergency stop signal input connector

⑦ Heat discharging fan
Never block exhaust by placing objects behind the fan.

⑧ Power connector

⑨ Power switch
Turns power ON/OFF.

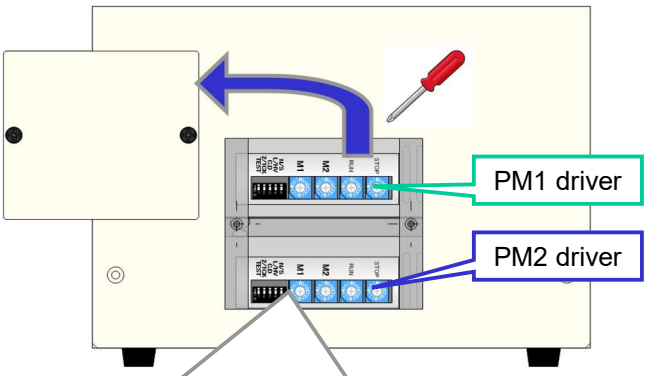
⑩ Fuse
Fuse for CRUX-A circuit protection is included.

2-4. Driver Settings Procedures of CRUX-A

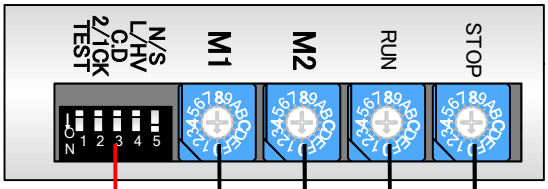
Steps

*Turn the power OFF when performing settings.

① Remove the side panel cover.
② Set a driver per axis.
For details on settings, see "3-5. Micro-step Division Switch" to "3-8. Setting of Current Down" (Page 17).
③ Attach the side panel cover.



Close-up of driver setting part



Setting of Current Down → (see Page 17)
Setting of Drive Current → (see Page 17)
Number of Micro-step Divisions Switch (M2) → (see Page 17)
Number of Micro-step Divisions Switch (M1) → (see Page 17)
*(DO NOT change)

CRUX-A driver settings table

	SW No.	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
M1, M2	Number of divisions	1	2	4	5	8	10	20	40	80	16	25	50	100	125	200	250

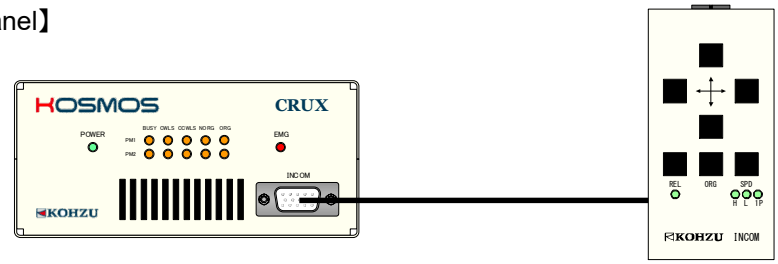
	SW No.	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
RUN	Current value (A)	0.35	0.42	0.50	0.58	0.66	0.75	0.81	0.88	0.96	1.03	1.11	1.18	1.26	1.33	1.40	1.48

	SW No.	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
STOP	%	12	19	23	30	37	44	48	55	57	64	68	75	81	87	92	98

2-5. Connecting Method of CRUX

When pulling out or inserting a connection wire, make sure the power of main body is OFF.
Connection/connecting wires between CRUX and external equipment are explained.

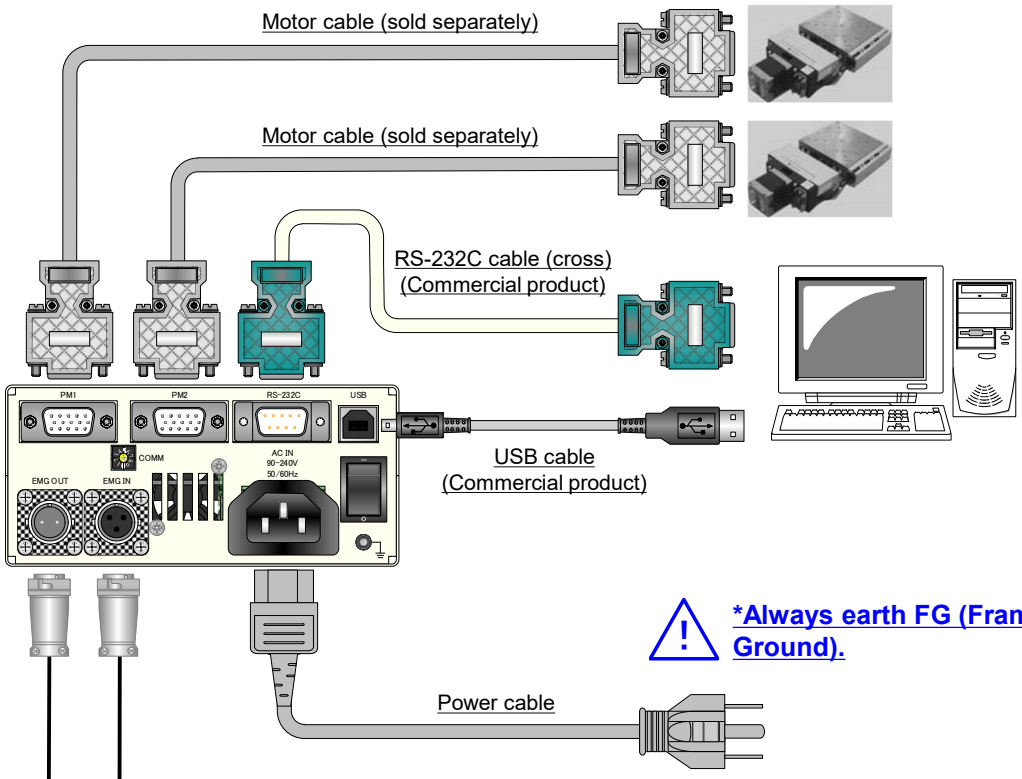
【Front Panel】



INCOM

【Rear Panel】

With 5-phase stepping motor
Precision stage (sold separately)

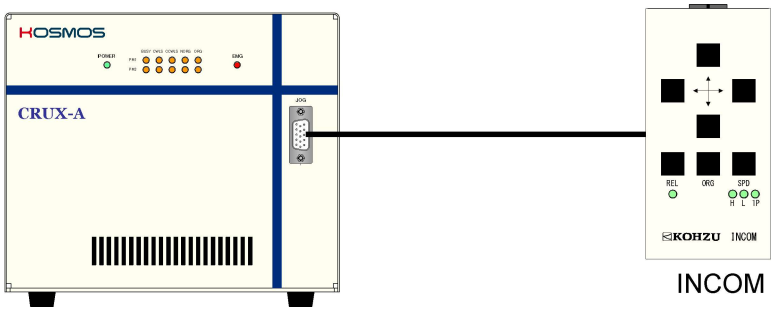


For details, see "3-9. Emergency Stop Function" (Page 18), "6-4. Connector" (Page 68), and "6-5. Circuit Diagram of Emergency Stop and Sensor" (Page 69).

2-6 Connecting Method of CRUX-A

When pulling out or inserting a connection wire, make sure the power of main body is OFF.
Connection/connecting wires between CRUX-A and external equipment are explained.

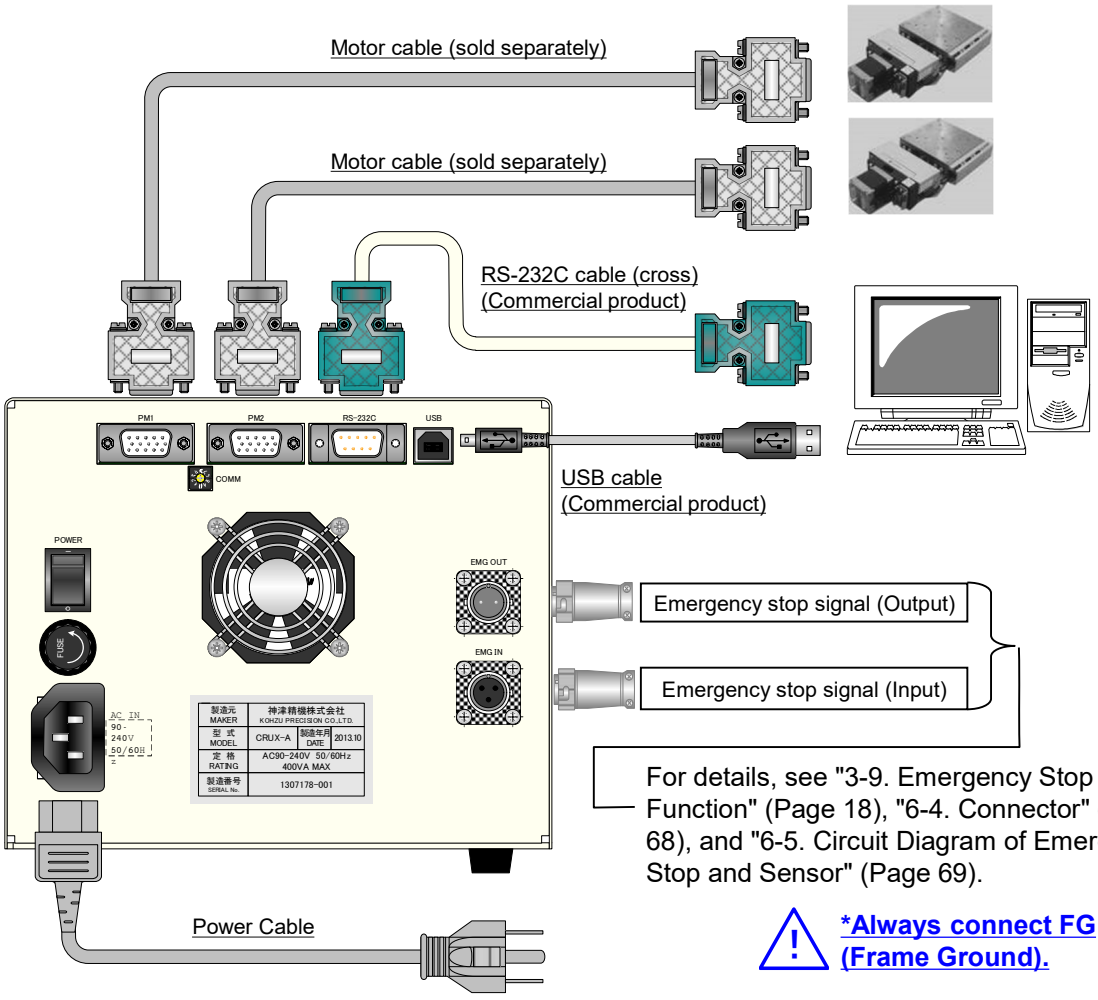
【Front Panel】



INCOM

【Rear Panel】

Precision stage with 5-phase stepping motor (sold separately)



For details, see "3-9. Emergency Stop Function" (Page 18), "6-4. Connector" (Page 68), and "6-5. Circuit Diagram of Emergency Stop and Sensor" (Page 69).

***Always connect FG (Frame Ground).**

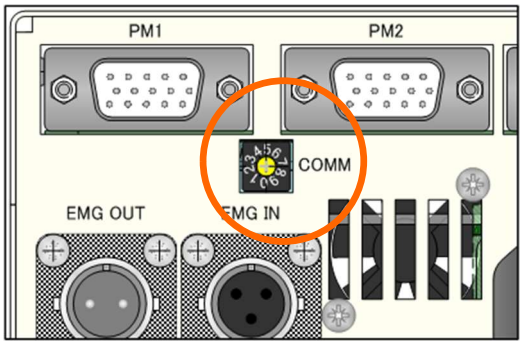
2-7. Rotary Switch for Communication Setting

CRUX can set or change communication conditions with the rotary switch (COMM) in the rear panel.
Default setting is Communication mode 4 (Normal command USB mode).

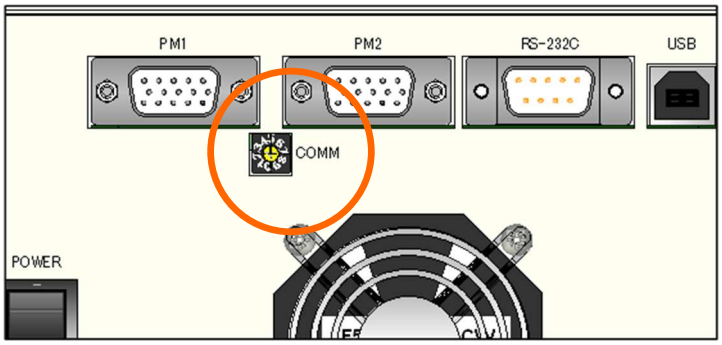
*Settings of RS-232C communication except for speed (baud):
Parity : NON
Word length : 8bit
Stop bit : 1
The settings are fixed.

■ Position of Rotary Switch

Rear panel (CRUX)



Rear panel (CRUX-A)



■ Settings

Settings are as shown in the table below.
(Mode 0 to 4 are General command specification, and 5 to 9 are Simple command specification)

Communication mode	Communications settings		
	RS-232C speed	USB	
0	38400	*	General Command
1	57600	*	
2	19200	*	
3	9600	*	
4	*	USB	

5	38400	*	Simple command
6	57600	*	
7	19200	*	
8	9600	*	
9	*	USB	

*For the USB driver, use "CRUX_USB_DRIVERxx" in the disk that comes with the product.
(For driver installation steps, see "5-7. Installation Procedures of USB Driver" (Page 65)).

3 Functions

3-1. Speed Setting

3-1-1. Speed Table

Speed setting of CRUX is possible in the range of 1 to 500,000 (pulse/second). However, because few cases generally require to define speed change in detail, CRUX adopts a method to select from the **10 patterns speed table**.

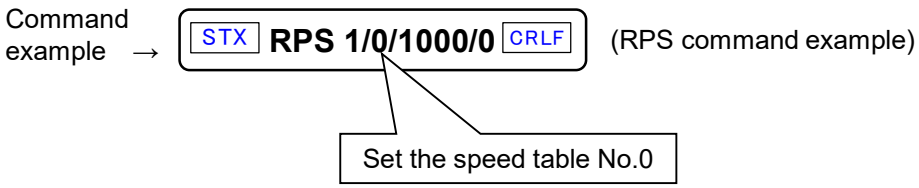
Also, since each speed table can be set freely, necessary drive speed can be set to 10 patterns.

■ Speed table *Setting values in the table below are default values
(Table No.0 is only for rectangular drive)

Speed Table No.	Start speed pps	Maximum speed pps	Accelerating Time x 10 msec	Decelerating time x 10 msec
0	500	500	1	1
1	500	2,000	20	20
2	500	3,000	24	24
3	500	4,000	28	28
4	500	5,000	32	32
5	500	6,000	36	36
6	500	7,000	40	40
7	500	8,000	44	44
8	500	9,000	48	48
9	500	10,000	52	52

3-1-2. Speed Change in Remote Control

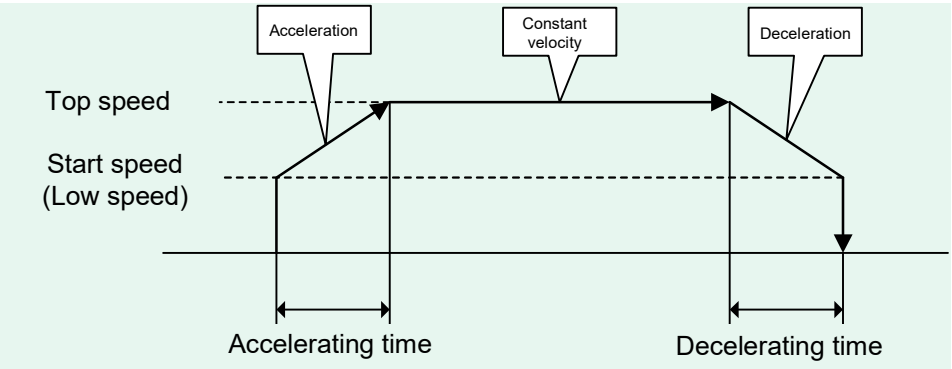
In remote control, specify a speed table No. in each moving command.



For settings on the speed table No.0 to 9, use **RTB WTB** command.
For details, see **RTB** (Page 44) and **WTB** (Page 50) in "5-3. Command Details".

3-2 Trapezoidal Drive

When moving an object, it cannot be moved in high speed abruptly due to inertial force.
In case of the stepping motor also, it normally starts in low speed, and then achieve the maximum speed after gradual acceleration.



By setting the **start speed (Low speed), top speed, and acceleration time (Deceleration time),** CRUX performs internal calculation on the acceleration/deceleration rate and series of acceleration/deceleration operation are conducted automatically.

3-3. Driving Current (CRUX)

CRUX can control 2 types of stepping motors, 0.75A/phase and 0.35A/phase rated current.
According to a target stage, set the applicable phase.
The setting becomes effective by writing to system No.67 with the WSY command (System setting writing). (Standard setting is "0" 0.75A/phase)

Setting No.	0	1
Current	0.75	0.35

3-4. Setting No. of Divisions of Micro-Step (CRUX)

CRUX can select a number of motor step divisions from 16 types.
The setting becomes effective by writing to system No.66 with the WSY command (System setting writing). (Standard setting is "2" Number of divisions 1/2)

Setting No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Resolution	1	2	2.5	4	5	8	10	20	25	40	50	80	100	125	200	250

3-5. Micro-Step Division Switch (CRUX-A)

CRUX-A can remotely switch the micro-step setting 1 (M1) and the micro-step setting 2 (M2).
The setting becomes effective by writing to system No.65 with the WSY command (System setting writing).
(Standard setting is "0" M1)

Setting No.	0	1
MS selection	M1	M2

3-6. Setting No. of Divisions of Micro-Step (CRUX-A) - (See Page 11)

CRUX-A can select a number of motor step divisions from 16 types.
Perform setting by opening the side panel, and using the [M1 or M2] rotary switch.
(Standard setting is M1 = "1" (resolution 1/2), M2 = "6" (No. of divisions 1/20))

Setting No.	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Number of divisions	1	2	4	5	8	10	20	40	80	16	25	50	100	125	200	250

3-7. Setting of Drive Current (CRUX-A) - (See Page 11)

Set the current when the motor is running with the digital switch with RUN display.
Perform setting by opening the side panel, and using the [RUN] rotary switch.
(Standard setting is "5" 0.75A/phase)

Setting No.	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Current value (A)	0.35	0.42	0.5	0.58	0.66	0.75	0.81	0.88	0.96	1.03	1.11	1.18	1.26	1.33	1.4	1.48

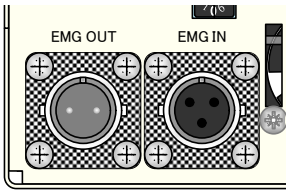
3-8. Setting of Current Down (CRUX-A) - (See Page 11)

When the automatic current is set (C.D switch OFF), current down is executed in set ratio while the motor is stopped.
Perform setting by opening the side panel, and using the [STOP] rotary switch.
(Standard setting is "6", 48%)

Setting No.	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
%	12	19	23	30	37	44	48	55	57	64	68	75	81	87	92	98

3-9. Emergency Stop Function

CRUX can execute an emergency stop during driving when the emergency stop signal becomes active. (Normal close method)



- **EMG IN** (Emergency stop signal input)
  Connect the emergency stop signal (Normal close method) between 2-3 pin on EMG IN.
  At emergency stop operation: Between 2-3 pin OPEN
  At emergency stop release: Between 2-3 pin CLOSE (Short)

*When not using the emergency stop, make sure to connect the short connector that comes with this product.

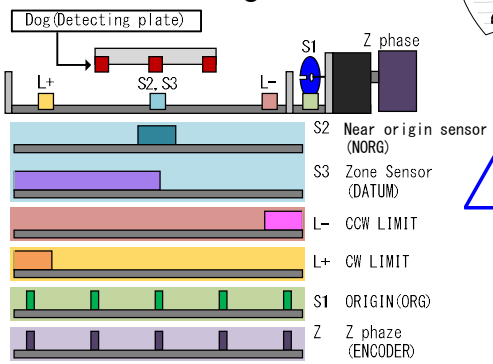
- **EMG OUT** (Emergency stop status signal output)
  Signal output port of open connector method
  At emergency stop operation: Output signal OPEN
  At emergency stop release: Output signal CLOSE (Short)

- **Emergency Stop Release**
  After resolving causes of emergency stop, release the prepared emergency stop switch.
  (Performing origin return is recommended, because pulse shift may happen after an emergency stop is executed).

3-10. Origin Return Method

Origin return method can be selected in CRUX according to the combination of sensor of the positioning device used.

Sensor Configuration



Based on the set origin return method, after moving near the specified sensor at the maximum speed of the specified speed table, it moves to the origin at the same speed with the starting speed of the speed table (Default: 500pps) and stops.

Though our standard stages can support the default setting, Method 4, for most models, it is necessary to change to Method 3 for the models that equip an origin sensor (S1) in a part of motor axis.

Method	Sensor Configuration	Description
1	S1,S3	The zone sensor (DATUM) determines return direction and the edge of initial origin sensor (ORG) becomes the origin position within the zone sensor.
2	S3	The edge of zone sensor (DATUM) is the origin position.
3	S1,S2,L-	The edge of origin sensor (ORG) located in the near origin sensor (NORG) is the origin position.
4	S2,L-	The edge of near origin sensor (NORG) is the origin position. (Our standard method)
5	S1,L+	Origin sensor (ORG) in proximity of CW limit is the origin position.
6	S1,L-	Origin sensor (ORG) in proximity of CCW limit is the origin position.
7	L+	The edge of CW limit is the origin position.
8	L-	The edge of CCW limit is the origin position.
9	S1	The edge of origin sensor (ORG) is the origin position.
10	None	Present position is the origin position. (No driving)

Setting with System No.1 ORG OFFSET

After executing each origin return operation, it moves just as much as the set value in System No.1 "ORG_OFFSET" and the position is set as 0 coordinate value. (For details, see "5-6-2 System Setting Details" (Page 63))

*In Method 10, "ORG OFFSET" is invalid.

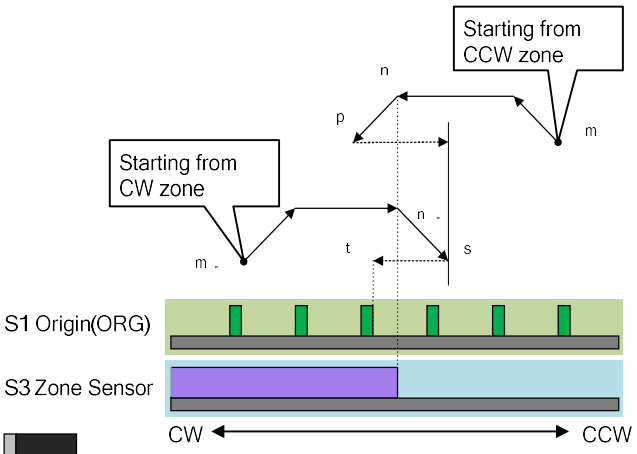
1 The zone sensor (DATUM) determines return direction and the edge of initial origin sensor (ORG) becomes the origin position within the zone sensor.

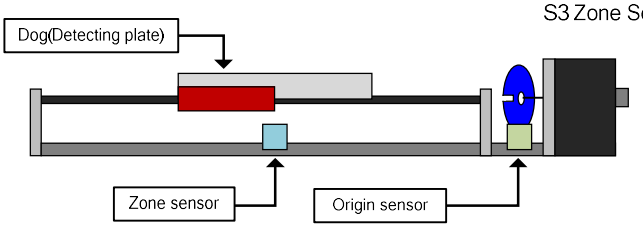
Starting from CCW zone

① Detection starts to CW direction with trapezoidal drive.
② Decelerates and stops when zone sensor is detected.
③ Reverses to CCW direction in low speed movement.
④ Reverses to CW direction after passing the zone sensor.
⑤ Stops at initial origin sensor detection after zone sensor detection.

Starting from CW zone

①' Detection starts to CCW direction with trapezoidal drive.
②' Stops with deceleration after moving through zone sensor.
④ Reverses to CW direction in low speed movement.
⑤ Stops at initial origin sensor detection after zone sensor detection.





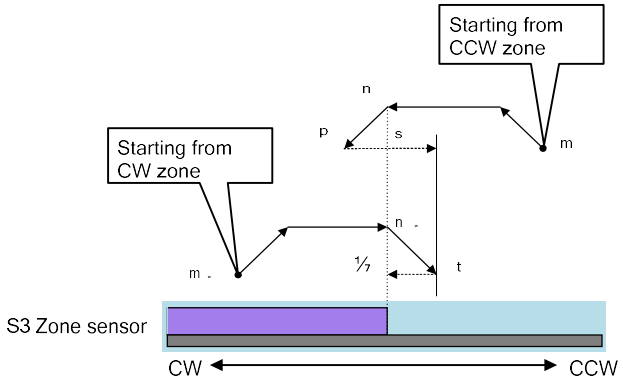
2 The edge of zone sensor (DATUM) is the origin position.

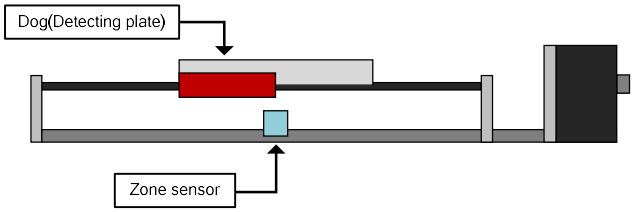
Starting from CCW zone

① Detection starts to CW direction with trapezoidal drive.
② Decelerates and stops when zone sensor is detected.
③ Reverses to CCW direction in low speed movement.
④ Stops with deceleration after passing the zone sensor.
⑤ Reverses to CW direction in low speed movement.
⑥ Stops at the edge detection of zone sensor.

Starting from CW zone

①' Detection starts to CCW direction with trapezoidal drive.
②' Stops with deceleration after passing the zone sensor.
⑤ Reverses to CW direction in low speed movement.
⑥ Stops at the edge detection of zone sensor.





3 The edge of origin sensor (ORG) located in the near origin sensor (NORG) is the origin position.

A stage with the origin senor in its motor shaft requires this method.

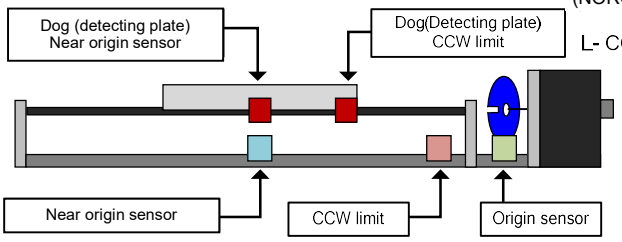
Starting from CW zone

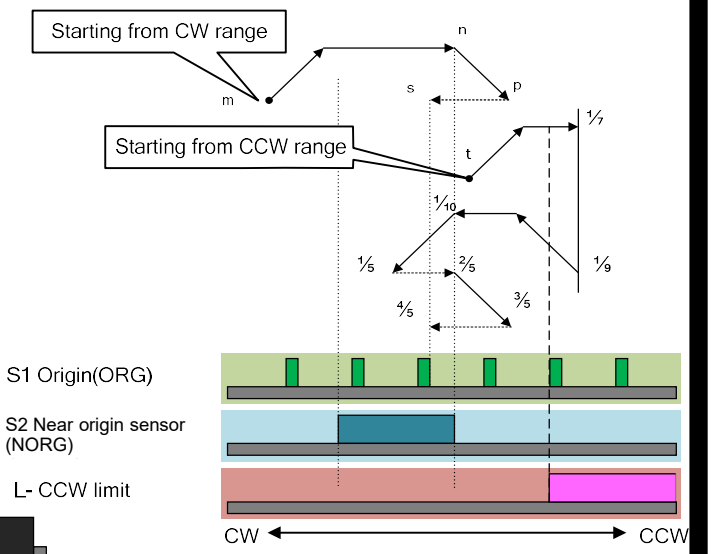
① Detection starts to CCW direction with trapezoidal drive.
② Decelerates and stops after passing the near origin sensor.
③ Reverses to CW direction in low speed movement.
④ After near origin sensor detection, stops at the initial origin detection.

Starting from CCW zone

① Detection starts to CCW direction with trapezoidal drive.
② Stops when CCW limit is detected.
⑦ Reverses to CW direction and starts trapezoidal drive.
⑧ Decelerates and stops after detecting the near origin sensor.
⑨ Reverses to CCW direction in low speed movement.
⑩ Decelerates and stops after passing through the near origin sensor again.
⑪ Reverses to CW direction in low speed movement.
⑫ After near origin sensor detection, stops at the initial origin detection.

*When starting from the near origin sensor zone, execute from ⑨.





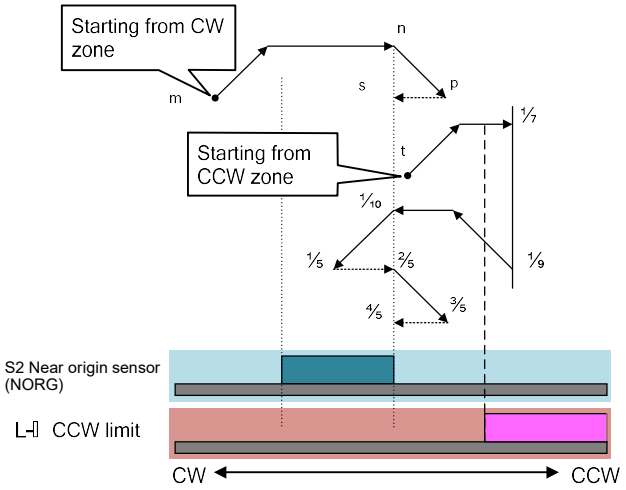
4 The edge of the near origin sensor (NORG) is the origin position. (Our standard method)

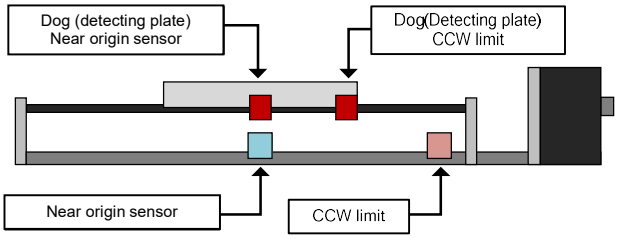
Starting from CW zone

① Detection starts to CCW direction with trapezoidal drive.
② Decelerates and stops when passing the near origin sensor.
③ Reverses to CW direction in low speed movement.
④ Stops when the near origin sensor is detected.

Starting from CCW zone

⑤ Detection starts to CCW direction with trapezoidal drive.
⑥ Stops CCW limit is detected.
⑦ Reverses to CW direction and starts trapezoidal drive.
⑧ Decelerates and stops when the near origin sensor is detected.
⑨ Reverses to CCW direction in low speed movement.
⑩ Decelerates and stops again after moving through the near origin sensor.
⑪ Reverses to CW direction in low speed movement.
⑫ Stops when the near origin sensor is detected.
*When starting from the near origin sensor zone, execute from ⑨.





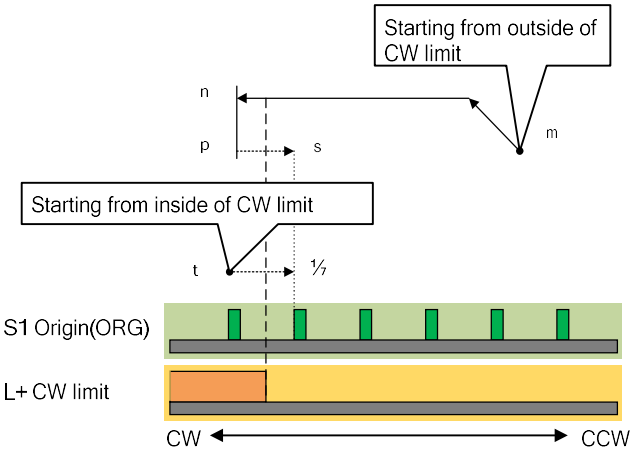
5 Origin sensor (ORG) in proximity of CW limit is the origin position.

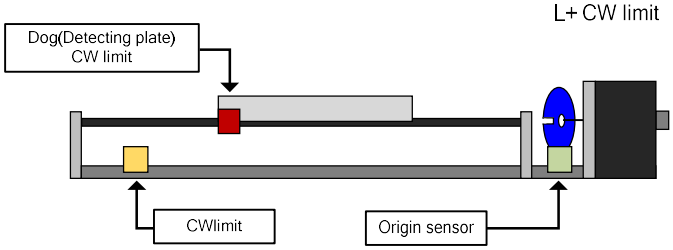
Starting from outside of CW limit

① Detection starts to CW direction with trapezoidal drive.
② Stops when CW limit is detected.
③ Reverses to CCW direction in low speed movement.
④ Stops at the initial origin detection position after passing CW limit.

Starting from inside of CW limit

⑤ Starts low speed movement to CCW direction.
⑥ Stops at the initial origin detection position after passing CW limit.





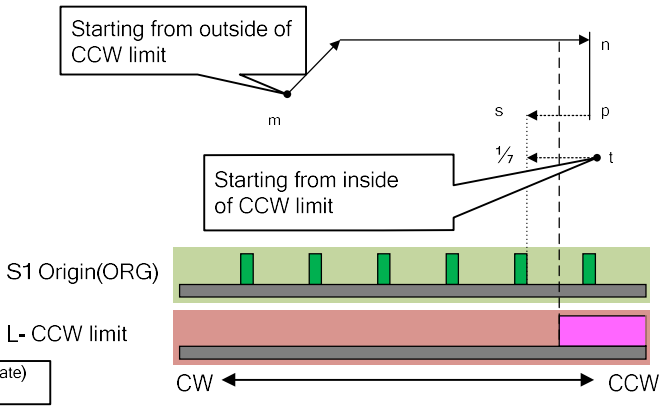
6 Origin sensor (ORG) in proximity of CCW limit is the origin position.

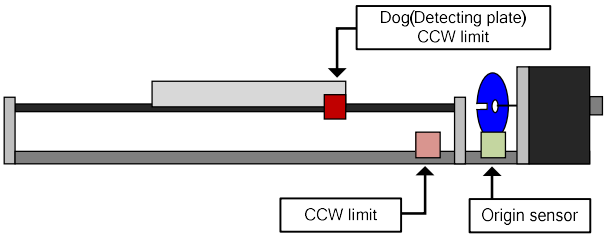
Starting from outside of CCW limit

① Detection starts to CCW direction with trapezoidal drive.
② Stops when CCW limit is detected.
③ Reverses to CW direction in low speed movement.
④ Stops at the initial origin detection position after passing CCW limit.

Starting from inside of CCW limit

⑤ Starts low speed movement to CW direction.
⑥ Stops at the initial origin detection position after passing CCW limit.





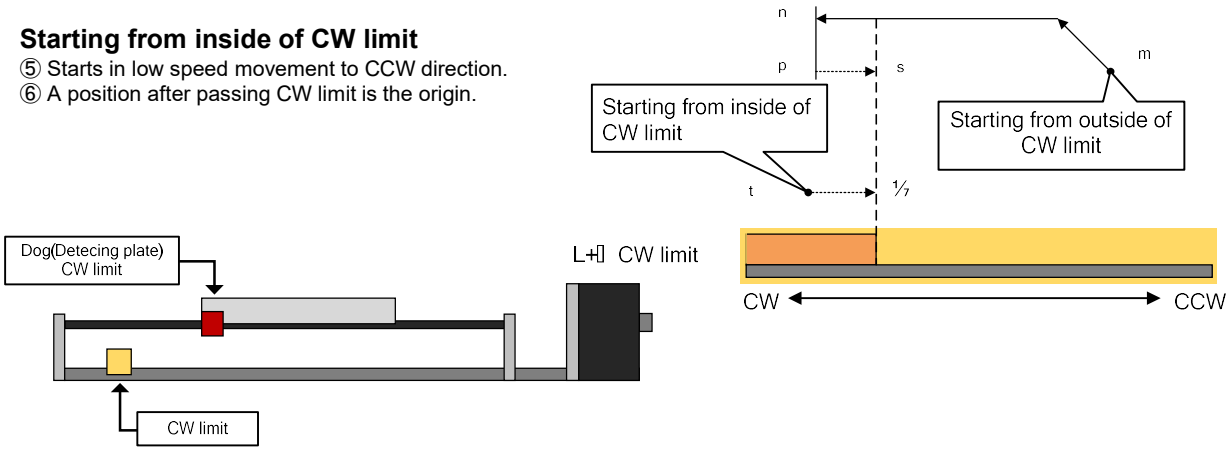
7 The edge of CW limit is the origin position.

Starting from outside of CW limit

① Detection starts to CW direction with trapezoidal drive.
② Stops when CW limit is detected.
③ Reverses to CCW direction and in low speed movement.
④ A position after passing CW limit is the origin.

Starting from inside of CW limit

⑤ Starts in low speed movement to CCW direction.
⑥ A position after passing CW limit is the origin.



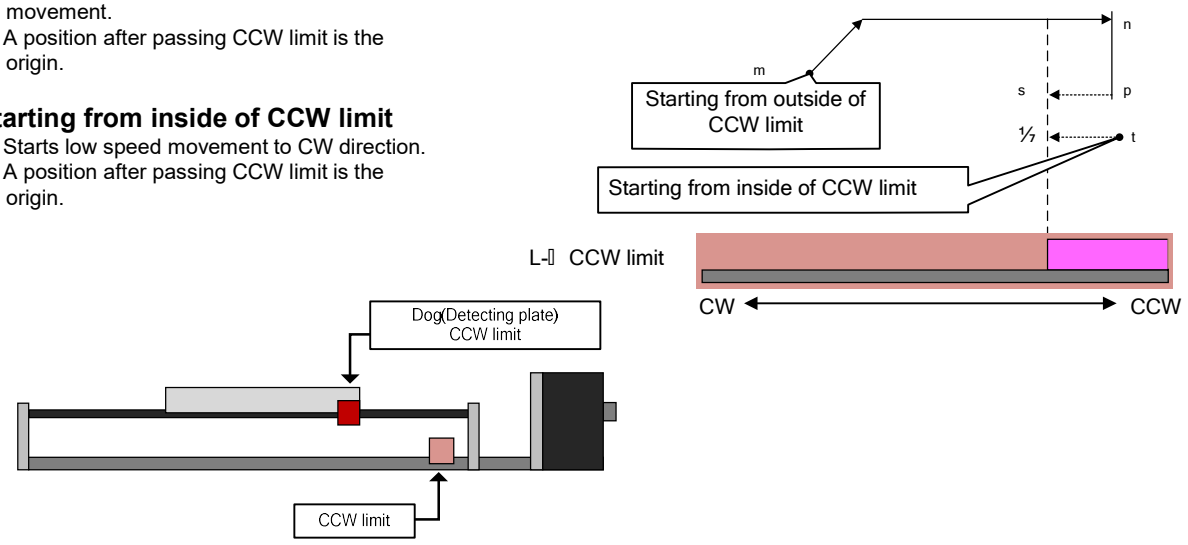
8 The edge of CCW limit is the origin position.

Starting from outside of CCW limit

① Detection starts to CCW direction with trapezoidal drive.
② Stops when CCW limit is detected.
③ Reverses to CW direction in low speed movement.
④ A position after passing CCW limit is the origin.

Starting from inside of CCW limit

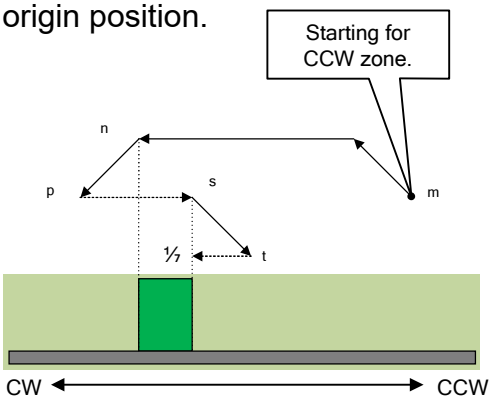
⑤ Starts low speed movement to CW direction.
⑥ A position after passing CCW limit is the origin.

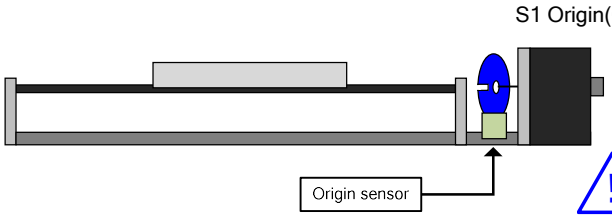


9 The edge of origin sensor (ORG) is the origin position.

Starting from CCW zone

① Detection starts to CW direction with trapezoidal drive.
② Stops with deceleration after passing the ORG sensor.
③ Reverses to CCW direction in low speed movement.
④ Decelerates and stops after passing the ORG sensor again.
⑤ Reverses to CW direction in low speed movement.
⑥ Stops at ORG sensor detection.
*When starting from the ORG zone, execute from ③.





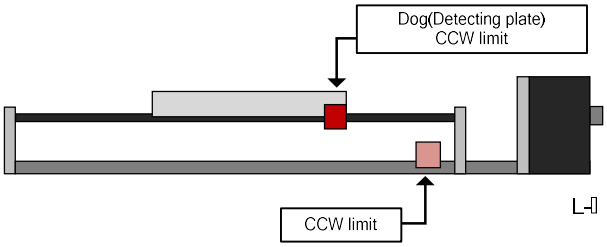
Stops if CW limit signal is detected during origin return.

10 Present position is the origin position. (No driving)

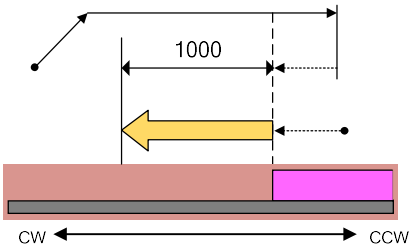
The current position is set as the origin position without driving in this mode and it is regarded as origin return detection is completed.

By entering an offset value in System No.1 (**ORG OFFSET**) setting, a position after moving the set value from each origin detection completion point can be also the origin position.
*In Method 10, "ORG OFFSET" is invalid.

Example After executing origin return with Method 8, moves for the set pulse value (System No.1) from the position which becomes the origin (pulse value "0").
Set "1000" for System No.1 for the diagram below.



L-□ CCW limit



3-11. EEPROM Save Data Error

ROM equipped on CRUX and CRUX-A has an upper limit on the number of overwriting.
If the limit is exceeded or the save parameter is damaged, the system becomes the following condition.

3-11-1. Starting

When ROM data error is verified in starting check, the EMG lamp on the front panel flashes.
Also, all drive modes are in prohibited condition. (Same state with the emergency stop mode)

Example: "INCOM" connected
When the easy control jog box, "INCOM" is connected, "REL", "H", "L", and "1P" lamps are all ON.

Restoration method

When ROM data are damaged, already set data cannot be restored.
By performing the following restoration procedure, data are overwritten to the factory state (Default value), and the system is restored to normal state.

Remote control

① Send the "RST" command (Reset command) from PC.

② Next, send the following commands.

CRUX: WSY1/66/2
WSY2/66/2
WSY1/67/0
WSY2/67/0 Send the four commands above.

CRUX-A: WSY1/65/0
WSY2/65/0 Send the two commands.

When overwriting application is necessary, download the remote controller control application, "Chamonix" from our company's HP.

Using "Chamonix"
① Connect CRUX/CRUX-A and PC with RS232C or USB, and start "Chamonix".
② Push the [Command] button on upper right of the main window to display the manual input screen.
③ Send the commands specified above.

After executing the restoration procedure above, turn the power of CRUX/CRUX-A ON.

*If the EEPROM safe data error mode occurs every time the system starts, the number of overwriting on ROM may be exceeded or ROM hardware damage may be the cause.

3-11-2. Normal starting

When a ROM data error is verified during normal starting, warning is generated with remote control.
However, all modes can be used as usual.

Warning code [W SYS 51]

ROM may be damaged, but there is no time to stop the equipment!!

For an effective measure in such a case, it is recommend to **create a backup file of changed parameters** if system parameters are changed.
(A backup file creation function is available as standard in our company's application program, [Chamonix])

When the EEPROM save data error happens, perform the restoration procedure, and then read from a backup file.

Driving is possible under the same condition when the method above is performed.

3-12. Powering OFF

When turning the power of CRUX/CRUX-A OFF, wait for three seconds or more after quitting the running control application, and then turn the power OFF.

When the power is turned OFF while application is running, ROM data may be damaged.
When data happened to be damaged, follow "3-11-1. EEPROM Save Data Error - Restoration method" (Page 26).

4 Jog Box for Easy Control

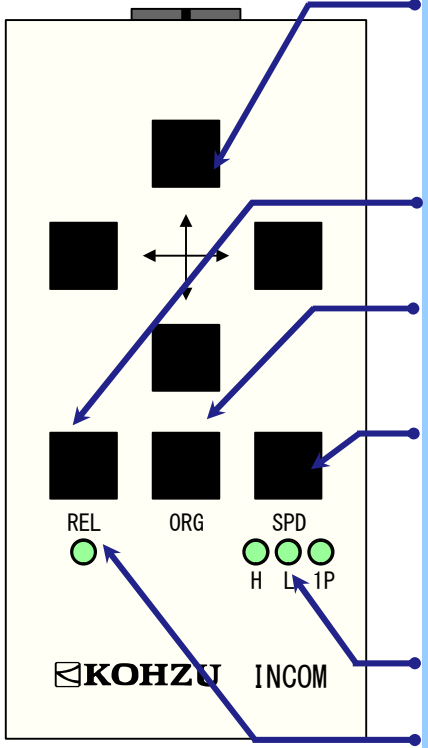
INCOM

4-1.Description for INCOM Operation

Functions

① Switching of 2 drive modes: This switches between continuous [FRP] mode and relative [REL] mode.
② Continuous operation [FRP] mode: While the button is pressed, it continues to move at the selected speed.
③Relative position drive [REL] mode: Relative movement can be done by the amount of relative drive set by PC.
④ Operation stop (deceleration stop): Deceleration and stop can be performed in the acceleration/deceleration time that is set with the speed button.
⑤ Origin return (2 axes simultaneous): Origin return can be done either for 2 axes simultaneously or 1 axis at a time.
⑥ Speed change (H/L/1P): Speed can be changed in 3 stages, i.e. H/L/1P.

Descriptions for operation



Drive button:
REL mode: Performs a regulated amount of drive in one operation.
FRP mode: Starts driving while the button is pushed and stops when released.
Operation stop: With respect to the axes that are being driven by INCOM and command operation, drive of the axis that is pressed decelerates and stops.
*For rotating axes/direction, see “4-2. List of Driving Patterns”.

Drive mode change button:
Switches between REL and FRP mode.
*The amount of movement in REL mode is the value that is set in system №68.

Origin return button: (2 axes simultaneous)
Able to execute origin return per axis by pushing each drive button while pushing the ORG button.
*The origin return speed is the speed selected from ‘H/L/1P’.

Speed change button:
Speed is changed each time the button is pressed.
H (high-speed drive) …speed table: No.9
L (low-speed drive)…speed table: No.2
1P (1 pulse drive)… REL mode: 1 pulse drive
FRP mode: Continuous drive at speed of 1pps
*For speed setting, see "3-1. Speed Setting" (Page 15).

SPD_LED (Speed display):
The LED of the selected speed comes on.

REL_LED (Drive mode display):
ON (REL mode)
OFF (FRP mode)

4-2.List of Driving Patterns

		REL_LED	
		ON (REL mode)	OFF (FRP mode)
SPD_LED	H (High-speed drive)	Relative Position Drive	Free Rotation Drive
	L (Low-speed drive)	Relative Position Drive	Free Rotation Drive
	1P	1 pulse drive	1 pps drive

	Drive direction			
	Axis 1		Axis 2	
System No.7	←	→	↑	↓
0: (Normal)	CW	CCW	CCW	CW
1: (Switch)	CCW	CW	CW	CCW

5. Remote Control

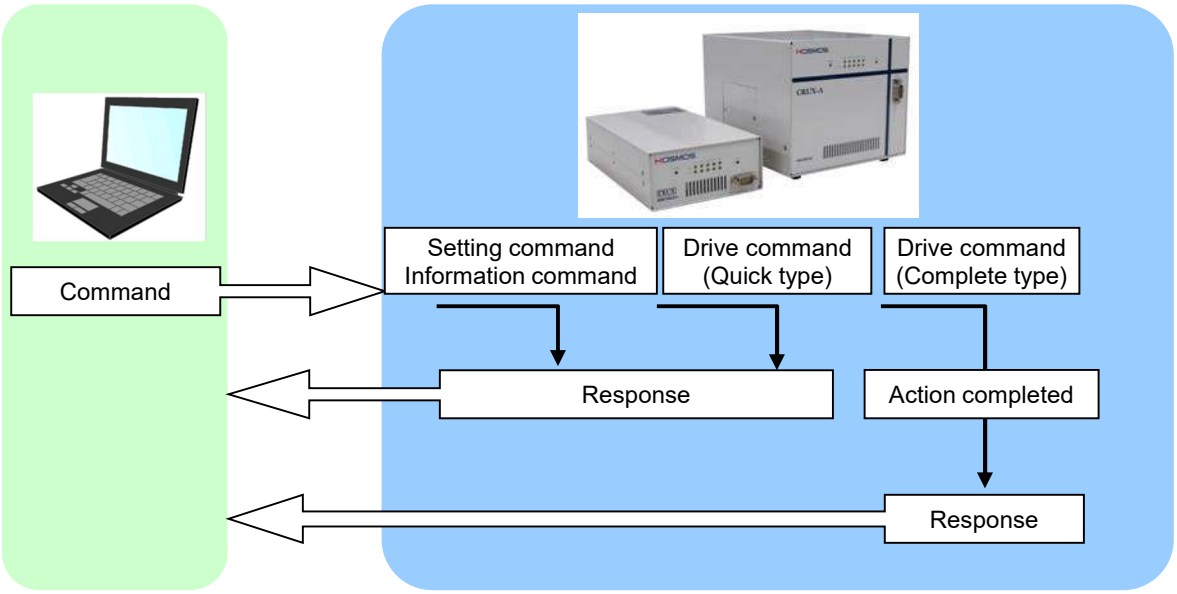
5-1 Proceeding with Installation and Preparation

To control from a computer, this device supports USB and RS-232C communication.
For selecting a communication method, see “2-7. Rotary Switch for Communication Setting” (Page 14).

*For the USB driver, use "CRUX_USB_DRIVERxx" in the disk that comes with the product.
(For driver installation steps, see "5-7. Installation Procedures of USB Driver" (Page 65)).

5-1-1. Transmitting/Receiving

The controller returns one response for one sent command.
The response timing varies according to the type of command or selection of response method.



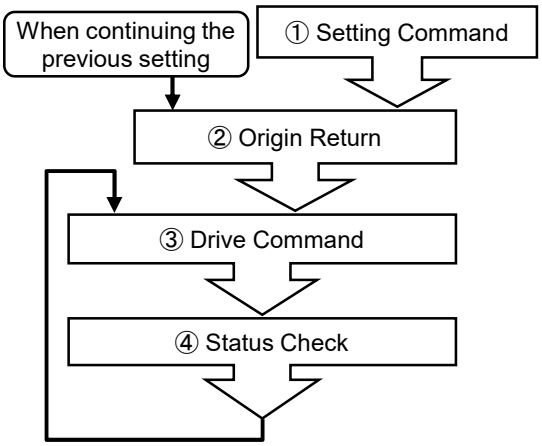
① Setting command The commands as RST and WSY used for setting immediately return a response.

② Drive command For drive-related commands, one of 2 types of response methods can be selected.
1. Returns a response after completion of operation. (Completion type)
2. Returns a response immediately after receipt of the command, and operation completion is checked by the STR (status check) command. (Quick type)

③ Information command Requested information is returned for a command.

5-1-2. Remote Control Procedures

When used for the first time or when the settings are changed, it is necessary to send the setting command first.



RST and WSY commands

ORG command

APS, RPS and MPS commands

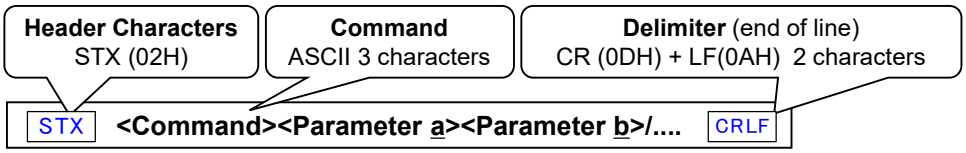
Checking controller performance state

5-1-3. Command Format

A command can be selected from 2 types, general command and simple command.

- General command consists of header characters (STX) and command, parameters and delimiter (CRLF).
- Simple command consists of command, parameters and delimiter (CRLF).

General Command



Sequence	1	2	3	4	5	6	7	8	9	10	11, 12
Command	STX	**W**	**R**	**P**	**2**	**/**	**1**	**0**	**0**	**0**	CRLF
Hexadecimal	02	57	52	50	32	2F	31	30	30	30	0D,0A

Simple command

CH <Parameter a> <Command> <Parameter b> CRLF

*Parameter b is not required for some commands.

Sequence	1	2	3	4	5	6,7
Command	**C**	**H**	**0**	**1**	**R**	CRLF
Hexadecimal	43	48	30	31	52	0D,0A

STX Tab CRLF These are control characters in ASCII code.

Characters which can be used in commands are numerical values (0 to 9), upper case alphabet (A to Z), signs (+, -), and symbols (/, ?).

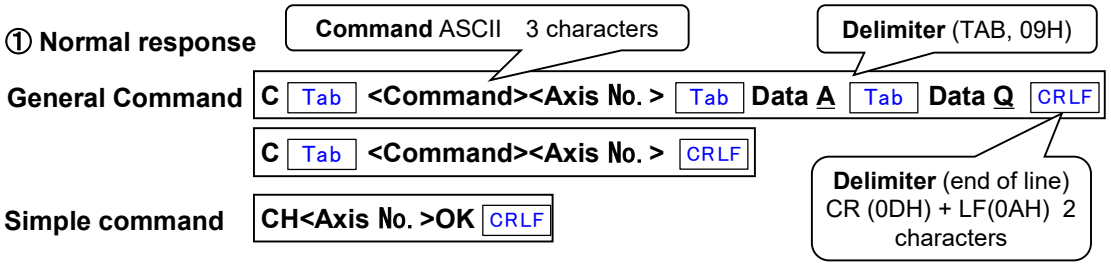
A space (20H) cannot be used in commands.

Parameters are always required. They cannot be omitted.

5-1-4. Response

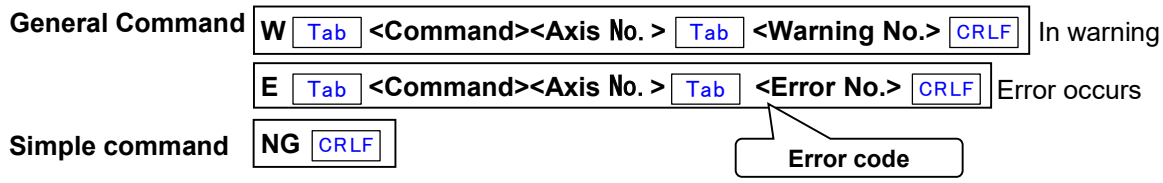
Format for response is as follows. When an error occurs, an error response is returned.
Because responses are different per command, see the details page of each command.

① Normal response



For multiple response data, they are sent with separated by TAB.

② Error response



5-1-5. Characters to Use

Characters shown in the table below can be used for communication.

	0*	1*	2*	3*	4*	5*	6*	7*	8* to F*
*0	x	x	x	**0**	x	**P**	x	x	x
*1	x	x	x	**1**	**A**	**Q**	x	x	x
*2	STX	x	x	**2**	**B**	**R**	x	x	x
*3	x	x	x	**3**	**C**	**S**	x	x	x
*4	x	x	x	**4**	**D**	**T**	x	x	x
*5	x	x	x	**5**	**E**	**U**	x	x	x
*6	x	x	x	**6**	**F**	**V**	x	x	x
*7	x	x	x	**7**	**G**	**W**	x	x	x
*8	x	x	x	**8**	**H**	**X**	x	x	x
*9	Tab	x	x	**9**	**I**	**Y**	x	x	x
*A	**LF**	x	x	x	**J**	**Z**	x	x	x
*B	x	x	**+**	x	**K**	x	x	x	x
*C	x	x	x	x	**L**	x	x	x	x
*D	**CR**	x	**-**	x	**M**	x	x	x	x
*E	x	x	**.**	x	**N**	x	x	x	x
*F	x	x	**/**	**?**	**O**	x	x	x	x

Lower case letters (a to z) cannot be used.

5-2. Command List

The commands that can be used in CRUX are shown in the table below. For details, see the page of each command.

Command			Page
Type	Description	Function	
Setting	**MPI**	Multi-axis Position Initial Setting	37
	RST	System Reset	42
Drive	**APS**	Absolute Position Drive	33
	COF	ON/OFF for Excitation	34
	FRP	Free Rotation Drive	35
	MPS	Multi-axis Position Drive	38
	ORG	Origin Return Drive	39
	RPS	Relative Position Drive	41
	STP	Motor Stop	46
Coordinate	**RDP**	Read Present Position	40
	SAV	Position Data Save	45
	WRP	Write Present Position	48
Information	**IDN**	Version Read	36
	RSY	Read System Setting	43
	STR	Read Status	47
	WSY	Write System Setting	49
Speed Table	**RTB**	Read Speed Table	44
	WTB	Write Speed Table	50
Simple Command	**A**	Absolute Position Drive	51
	C	Read Present Position	52
	D	Motor Stop	53
	H	Origin Return Drive	54
	I	System Reset	55
	P	Relative Position Drive	56
	R	Read Status	57
	S	Speed Setting	58
	W	Write Present Position	59

: Drive command
: Setting command (write)
: Setting command (read)
: Simple command

Caution: Maintaining position information

Unlike former SC controllers, automatic backup of position information is not performed in CRUX.
When position information backup is necessary, execute SAV command before turning the power OFF.

5-3. Command Details

The commands that can be used in CRUX are shown next. (Alphabetical order)

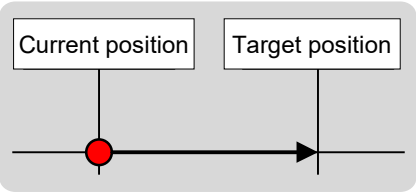
APS

Absolute Position Drive

【Function】Moves to a target position with absolute position management.

【Format】 STX APS a/b/c/d CRLF

No. of parameters = 4



A space cannot be used between characters. No parameter can be omitted.

Command parameters

Function		Setting	Remarks
a	Axis No.	1 to 2	
b	Speed table No.	0 to 9	
c	Movement amount	-8,388,608 to 8,388,607	
d	Response method	0: Completed 1: Quick	

【Response】Returns status information.* *Return timing varies depending on the response method.

Status	Response data
Normal	**C** Tab **APS** <Axis No.> CRLF
Error	**W** Tab **APS** <Axis No.> Tab <Warning No.> CRLF
	E Tab **APS** <Axis No.> Tab <Error No.> CRLF

For <Error No.> and <Warning No.>, see "5-5. Error Code" (Page 60).

【Example】

Moves No.1 axis with speed table No.0 to 1,000 pulses position.

STX **APS1/0/1000/0** CRLF

【Remarks】

A stop during driving is done with STP command.

COF

ON/OFF for Excitation

【Function】Switches ON/OFF for excitation (current output state of a motor).

【Format】 STX COF a/b CRLF No. of parameters = 2

⚠ A space cannot be used between characters. No parameter can be omitted.

Command parameters

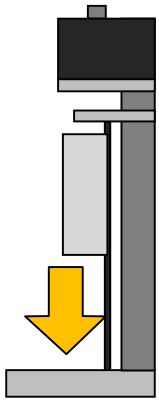
Function		Setting	Remarks
a	Axis No.	1 to 2	
b	ON/OFF for Excitation	0:OFF 1:ON	

【Response】Returns status information. *Returns immediately after receiving the command.

Status	Response data
Normal	C Tab **COF** <Axis No.> CRLF
Error	E Tab **COF** <Axis No.> Tab <Error No.> CRLF

For <Error No.>, see "5-5. Error Code" (Page 60).

【Remarks】



⚠ When using with Z axis, be cautious that Z axis may fall at excitation OFF execution.

⚠ When turning excitation OFF, position shifting may occur because the motor becomes free.
It is recommended to carry out origin return operations again after turning excitation ON.

⚠ When turning OFF the power of the controller in the excitation OFF state and turning ON the power again, it starts in excitation ON state.

FRP

Free Rotation Drive

【Function】Free rotation drive is performed until the stop command (STR) is issued.

【Format】 STX FRP a/b/c CRLF No. of parameters = 3

A space cannot be used between characters. No parameter can be omitted.

Command parameters

Function		Setting	Remarks
a	Axis No.	1 to 2	
b	Speed table No.	0 to 9	
c	Rotating direction	0: CW direction 1: CCW direction	

【Response】Returns status information. *Returns immediately after receiving the command.

Status	Response data
Normal	**C** Tab **FRP** <Axis No.> CRLF
Error	**W** Tab **FRP** <Axis No.> Tab <Warning No.> CRLF
	E Tab **FRP** <Axis No.> Tab <Error No.> CRLF

For <Error No.> and <Warning No.>, see "5-5. Error Code" (Page 60).

【Example】

Performs free rotation drive on No.1 axis to CW direction with speed table No.0.

STX **FRP1/0/0** CRLF

【Remarks】

A stop during driving is done with STP command.

IDN

Version Read

【Function】 Reads the model name of the controller body and returns the version of the program.

【Format】 STX IDN CRLF No. of parameters = 0

【Response】 **C** Tab **IDN** Tab **<Model name>** Tab **<Version>** CRLF

【Response example】 **C** Tab **IDN** Tab **CRUX** Tab **1000** CRLF "CRUX Ver.1.000"

C Tab **IDN** Tab **CRUX-A** Tab **1000** CRLF "CRUX-A Ver.1.000"

MPI

Multi-axis Position Initial setting

【Function】 Sets a drive method and speed necessary for multi-axis simultaneous drive (MPS) command.

【Format】 STX MPI a/b/c CRLF No. of parameters = 3

A space cannot be used between characters. No parameter can be omitted.

Command parameters

Function		Setting	Remarks
a	Axis No.	1 to 2	
b	Driving Type	0: Absolute position drive 1: Relative position drive	
c	Speed Table	0 to 9	

【Response】 Returns status information. *Returns immediately after receiving the command.

Status	Response data
Normal	**C** Tab **MPI** <Axis No.> CRLF
Error	**E** Tab **MPI** <Axis No.> Tab <Error No.> CRLF

For <Error No.>, see "5-5. Error Code" (Page 60).

【Example】

1. Set No.1 axis to move with absolute position drive and speed table No.5.

STX **MPI1/0/5** CRLF

2. Set No.2 axis to move with absolute position drive and speed table No.8.

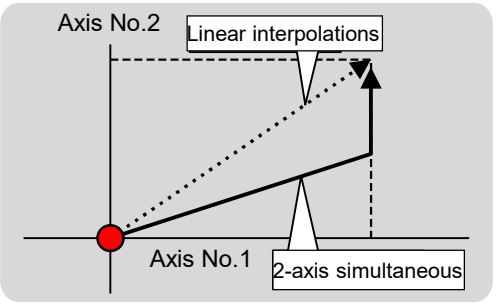
STX **MPI2/0/8** CRLF

MPS

Multi-axis Position Drive

【Function】Performs simultaneous drive of 2 axes.

【Description】In the multi-axis position drive (MPS) command, when moving distance and moving speed differ, time to require moving also differs, and its orbit is folding lines as shown in the right figure.



【Format】 STX MPS a/b/c/d/e CRLF

No. of parameters = 5

Command parameters

Function		Setting	Remarks
a	1st axis No.	1 to 2	
b	1st axis target position	-16,777,215 to 16,777,215	For absolute position drive mode: -8, 388,608 to 8,388,607
c	2nd axis No.	1 to 2	
d	2nd axis target position	-16,777,215 to 16,777,215	For absolute position drive mode: -8, 388,607 to 8,388,607
e	Response method	0: Completed 1: Quick	

【Response】Returns status information. *Return timing varies depending on the response method.

Status	Response data
Normal	**C** Tab **MPS** <1st axis No.> CRLF
Error	**W** Tab **MPS** <1st axis No.> Tab <Warning No.> CRLF
	E Tab **MPS** <1st axis No.> Tab <Error No.> CRLF

For <Error No.> and <Warning No.>, see "5-5. Error Code" (Page 60).

【Example】

Move the 1st axis 1,000 pulses position and 2nd axis 2,000 pulses position with the MPS command.

1. Set the 1st axis to absolute position drive and speed table No.5 with the MPI command.

   STX **MPI1/0/5** CRLF

2. Set the 2nd axis to absolute position drive and speed table No.8 with the MPI command.

   STX **MPI2/0/8** CRLF

3. Set the 1st drive to 1,000 and 2nd drive to 2,000 and start driving with the MPS command.

   STX **MPS1/1000/2/2000/0** CRLF

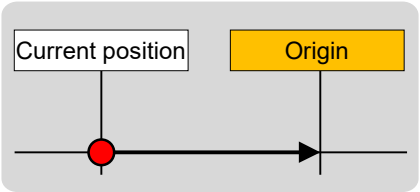
【Remarks】

A stop during driving is done with the STP command.

ORG

Origin Return Drive

【Function】 Performs origin position detection according to a selected method.
Origin return method can be selected from 10 kinds + (System No.1 ORG OFFSET).
Use system settings for origin return method (See Page 62).
For details, see "3-10. Origin Return Method" (Page 19).



【Format】 STX ORG a/b/c CRLF

No. of parameters = 3

A space cannot be used between characters. No parameter can be omitted.

Command parameters

Function		Setting	Remarks
a	Axis No.	1 to 2	
b	Speed table No.	0 to 9	
c	Response method	0: Completed 1: Quick	

【Response】 Returns status information.*
*Return timing varies depending on the response method.

Status	Response data
Normal	**C** Tab **ORG** <Axis No.> CRLF
Error	**W** Tab **ORG** <Axis No.> Tab <Warning No.> CRLF
	E Tab **ORG** <Axis No.> Tab <Error No.> CRLF

For <Error No.> and <Warning No.>, see "5-5. Error Code" (Page 60).

【Example】

Make Axis No.1 return to origin with speed table No.5.

STX **ORG1/5/0** CRLF

【Remarks】

A stop during driving is done with the STP command.

RDP

Read Present Position

【Function】 Reads the present position value (pulse counter value).

【Format】 STX RDP a CRLF No. of parameters = 1

A space cannot be used between characters. No parameter can be omitted.

Command parameters

Function		Setting	Remarks
a	Axis No.	1 to 2	

【Response】 Returns the current position.

【Example】

Reads the current position of No.2 axis.

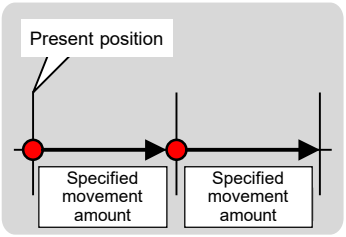
Command: STX **RDP2** CRLF

Response: **C** Tab **RDP2** Tab **123456** CRLF

RPS

Relative Position Drive

【Function】Moves from the present position to a position by set relative movement amount.



【Format】 STX RPS a/b/c/d CRLF

No. of parameters = 4

A space cannot be used between characters. No parameter can be omitted.

Command parameters

Function		Setting	Remarks
a	Axis No.	1 to 2	
b	Speed table No.	0 to 9	
c	Movement amount	-16,777,215 to 16,777,215	
d	Response method	0: Completed 1: Quick	

【Response】Returns status information. *Returns immediately after receiving the command.

Status	Response data
Normal	**C** Tab **RPS** <Axis No.> CRLF
Error	**W** Tab **RPS** <Axis No.> Tab <Warning No.> CRLF
	E Tab **RPS** <Axis No.> Tab <Error No.> CRLF

For <Error No.> and <Warning No.>, see "5-5. Error Code" (Page 60).

【Example】

1. Move No.1 axis in speed table No.0 with 1,000 pulses.

STX **RPS1/0/1000/0** CRLF

【Remarks】

A stop during driving is done with the STP command.

RST

System Reset

【Function】Returns the settings inside controller to default state (default value).

【Format】 STX RST CRLF No. of parameters = 0

A space cannot be used between characters. No parameter can be omitted.

【Response】Returns status information.

Status	Response data
Normal	**C** Tab **RST** CRLF
Error	**E** Tab **RST** Tab <Error No.> CRLF

For <Error No.>, see "5-5. Error Code" (Page 60).

【Remarks】

About 1 sec is required to complete the reset after transmitting the RST command.

CRUX: No. of micro-step divisions switch (System No.66) and drive current (System No.67) are not reset.

CRUX-A: Micro-step switch (System No.65) is not reset.

*Caution

① There is a limit on the number of access for ROM equipped on CRUX.
Do not exceed the range of "Number of writings".

Number of writings: No more than 1,000,000 times

RSY

Read System Setting

【Function】Reads the present set value of the system parameters.

【Format】 STX RSY a/b CRLF No. of parameters = 2

Command parameters

Function		Setting	Remarks
a	Axis No.	1 to 2	
b	System No.	1 to 68	See "5-6-1. System Setting List" (Page 62).

【Response】Returns status information.

Status	Response data
Normal	**C** Tab **RSY** <Axis No.> Tab <System No.> Tab <Setting value> CRLF
Error	**E** Tab **RSY** <Axis No.> Tab <Error No.> CRLF

For <Error No.>, see "5-5. Error Code" (Page 60).

【Example】

1. Check the excitation output status ON/OFF of No. 1 axis.

STX **RSY1/61** CRLF → **C** Tab **RSY1** Tab **61** Tab **1** CRLF …Excitation ON

2. Check the origin return method of No. 2 axis.

STX **RSY2/2** CRLF → **C** Tab **RSY2** Tab **2** Tab **3** CRLF …Setting 3

RTB

Read Speed Table Setting

【Function】 Reads the current setting value of speed table.

【Format】 STX RTB a/b CRLF No. of parameters = 2

Command parameters

Function		Setting	Remarks
a	Axis No.	1 to 2	
b	Speed table No.	0 to 9	

【Response】Returns status information.

Status	Response data
Normal	**C** Tab **RTB** a Tab b Tab c Tab d Tab e Tab f CRLF
Error	**E** Tab **RTB** <Axis No.> Tab <Error No.> CRLF

For <Error No.>, see "5-5. Error Code" (Page 60).

【Response data】

Function		Setting	Remarks
a	Axis No.	1 to 2	
b	Speed table No.	0 to 9	
c	Start speed	0 to 400,000	
d	Top speed	0 to 500,000	
e	Accelerating Time	0 to 85	Setting value x 10 [msec]
f	Acceleration Mode	1: Rectangular drive 2: Trapezoidal drive	

SAV

Position Data Save

【Function】Saves current position information to ROM.

【Format】 STX SAV CRLF No. of parameters = 0

【Response】 Returns the setting value.

Status	Response data
Normal	**C** Tab **SAV** CRLF
Error	**E** Tab **SAV** Tab <Error No.> CRLF

For <Error No.>, see "5-5. Error Code" (Page 60).

*Caution

① There is a limit on the number of access for ROM equipped on CRUX.
Do not exceed the range of "Number of writings".

Number of writings: No more than 1,000,000 times

② Values written with the SAV command become the current position when the power is turned ON next time.

STP

Motor Stop

【Function】 Stops a driving motor.

【Format】 STX STP a/b CRLF No. of parameters = 2

Command parameters

Function		Setting	Remarks
a	Axis No.	0, 1 to 2	“0”: All axes are stopped
b	Selecting stop mode	0: Decelerate and stop 1: Emergency stoop	

【Response】 Returns the setting value.

Status	Response data
Normal	**C** Tab **STP** <Axis No.> CRLF
Error	**E** Tab **STP** <Axis No.> Tab <Error No.> CRLF

For <Error No.>, see "5-5. Error Code" (Page 60).

STR

Read Status

【Function】 Checks the status of each axis.

【Format】 STX STR a CRLF No. of parameters = 1

A space cannot be used between characters. No parameter can be omitted.

Command parameters

Function		Setting	Remarks
a	Axis No.	1 to 2	

【Response】Returns status information.

Status	Response data
Normal	**C** Tab **RTB** a Tab b Tab c Tab d Tab e Tab f CRLF
Error	**E** Tab **STR** <Axis No.> Tab <Error No.> CRLF

For <Error No.>, see "5-5. Error Code" (Page 60).

【Response data】

Function		Setting	Remarks
a	Axis No.	1 to 2	
b	Driving state	0: Stop 1: Operating	
c	ORG signal	0:OFF 1:ON	ON: Detection state
d	NORG signal	0:OFF 1:ON	ON: Detection state
e	CCW limit signal	0:OFF 1:ON	ON: Detection state
f	CW limit signal	0:OFF 1:ON	ON: Detection state

WRP

Write position

【Function】Writes a value of current position (pulse count) of motor pulse.

【Format】 STX WRP a/b CRLF No. of parameters = 2

A space cannot be used between characters. No parameter can be omitted.

Command parameters

Function		Setting	Remarks
a	Axis No.	1 to 2	
b	Set value	-8,388,608 to 8,388,607	

【Response】Returns status information.

Status	Response data
Normal	**C** Tab **WRP** <Axis No.> CRLF
Error	**E** Tab **WRP** <Axis No.> Tab <Error No.> CRLF

For <Error No.>, see "5-5. Error Code" (Page 60).

WSY

Write System Setting

【Function】 Writes the system setting value.

【Format】 STX WSY a/b/c CRLF No. of parameters = 3

A space cannot be used between characters. No parameter can be omitted.

Command parameters

Function		Setting	Remarks
a	Axis No.	1 to 2	
b	System No.	1 to 68	
c	Set value	x x x x	See "5-6-1. System Setting List" (Page 62).

【Response】Returns status information.

Status	Response data
Normal	**C** Tab **WSY** <Axis No.> Tab <System No.> Tab <Setting value> CRLF
Error	**E** Tab **WSY** <Axis No.> Tab <Error No.> CRLF

For <Error No.>, see "5-5. Error Code" (Page 60).

*Caution

① There is a limit on the number of access for ROM equipped on CRUX.
Do not exceed the range of "Number of writings".

Number of writings: No more than 1,000,000 times

WTB

Write speed table

【Function】 Writes the speed table data.

【Format】 STX WTB a/b/c/d/e/f CRLF No. of parameters = 6

A space cannot be used between characters. No parameter can be omitted.

Command parameters

Function		Setting	Remarks
a	Axis No.	1 to 2	
b	Speed table No.	0 to 9	
c	Start speed	1 to 400,000	
d	Top speed	1 to 500,000	
e	Accelerating Time	1 to 85	Setting value x 10 [msec]
f	Acceleration Mode	1: Rectangular drive 2: Trapezoidal drive	

【Response】Returns status information.

Status	Response data
Normal	**C** Tab **WTB** <Axis No.> CRLF
Error	**E** Tab **WTB** <Axis No.> Tab <Error No.> CRLF

For <Error No.>, see "5-5. Error Code" (Page 60).

*Caution

① There is a limit on the number of access for ROM equipped on CRUX.
Do not exceed the range of "Number of writings".

Number of writings: No more than 1,000,000 times

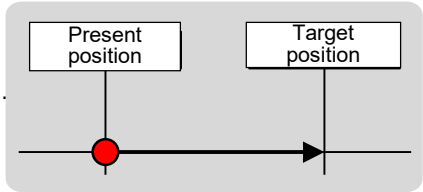
5-4. Simple Command Details

Simple commands that can be used in CRUX are shown next.

A — *Absolute Position Drive*

【Function】Moves from the present position to a position by set relative movement amount.

【Format】 CH 0a A b CRLF No. of parameters = 2



⚠ A space cannot be used between characters.
No parameter can be omitted.

Command parameters

Function		Setting	Remarks
a	Axis No.	1 to 2	
b	Movement amount	-8,388,607 to 8,388,607	

【Response】Returns status information.

Status	Response data
Normal	**CH** <Axis No. > **OK** CRLF
Error	**NG** CRLF

C

Read Position

【Function】Reads the present position value (pulse counter value).

【Format】 CH 0a C CRLF No. of parameters = 1

A space cannot be used between characters. No parameter can be omitted.

Command parameters

Function		Setting	Remarks
a	Axis No.	1 to 2	

【Response】 Returns the current position.

Status	Response data
Normal	**CH** <Axis No. > **C** Tab <Current position> CRLF
Error	**NG** CRLF

【Example】

1. Reads the current position of No.2 axis.

Command: **CH02C** CRLF

Response: **CH02C** Tab **123456** CRLF

D

Motor Stop

【Function】 Stops a driving motor.

【Format】 CH 0a D CRLF No. of parameters = 1

A space cannot be used between characters. No parameter can be omitted.

Command parameters

Function		Setting	Remarks
a	Axis No.	1 to 2	

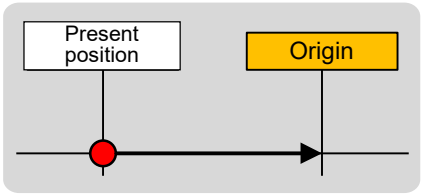
【Response】 Returns the setting value.

Status	Response data
Normal	**CH** <Axis No. > **OK** CRLF
Error	**NG** CRLF

H

Origin Return Drive

【Function】 Performs origin position detection according to a selected method.
Origin return method can be selected from 10 kinds + (System No.1 ORG OFFSET).
See "5-6. System Settings" (Page 62) for origin return method.
For details, see "3-10. Origin Return Method" (Page 19).



【Format】 CH 0a H CRLF No. of parameters = 1

A space cannot be used between characters. No parameter can be omitted.

Command parameters

Function		Setting	Remarks
a	Axis No.	1 to 2	

【Response】Returns status information.

Status	Response data
Normal	**CH** <Axis No. > **OK** CRLF
Error	**NG** CRLF

【Remarks】

A stop during driving is done with the motor stop command, "D".

I

System Reset

【Function】Returns the settings inside controller to default state (default value).

【Format】 CH 01 I CRLF No. of parameters = 0

A space cannot be used between characters. No parameter can be omitted.

【Response】Returns status information.

Status	Response data
Normal	**CH** <Axis No. > **OK** CRLF
Error	**NG** CRLF

【Remarks】

Approx. 1 sec is required to complete the reset after transmitting the I command.

CRUX: No. of micro-step divisions switch (System No.66) and drive current (System No.67) are not reset.

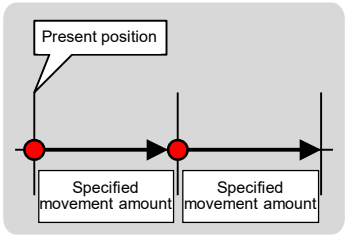
CRUX-A: Micro-step switch (System No.65) is not reset.

P

Relative Position Drive

【Function】Moves from the present position to a position by set relative movement amount.

【Format】 CH 0a P b CRLF No. of parameters = 2



A space cannot be used between characters.
No parameter can be omitted.

Command parameters

Function		Setting	Remarks
a	Axis No.	1 to 2	
b	Movement amount	-16,777,215 to 16,777,215	

【Response】Returns status information.

Status	Response data
Normal	**CH** <Axis No. > **OK** CRLF
Error	**NG** CRLF

R

Read Status

【Function】Checks status of the controller.

【Format】 CH 0a R CRLF No. of parameters = 1

A space cannot be used between characters. No parameter can be omitted.

Command parameters

Function		Setting	Remarks
a	Axis No.	1 to 2	

【Response】Returns status information.

Status	Response data
Normal	**CH** <Axis No.> **OK** **CH** <Axis No. > **CW_LIMIT** **CH** <Axis No. > **CCW_LIMIT** **CH** <Axis No. > **HOME (Displayed when both NORG and ORG signal are ON)** **CH** <Axis No. > **BUSY (Displayed during driving)**
Error	**NG**

S

Speed Setting

【Function】Determines a drive speed used with A, H, and P commands.
(When the S command is not issued, the speed table No.5 is set)

【Format】 CH 0a S b CRLF No. of parameters = 2

A space cannot be used between characters. No parameter can be omitted.

Command parameters

Function		Setting	Remarks
a	Axis No.	1 to 2	
b	Speed Table	0 to 9	

【Response】Returns status information.

Status	Response data
Normal	**CH** <Axis No.> **OK** CRLF
Error	**NG** CRLF

W

Write position

【Function】Writes a value of current position (pulse counter value) of motor pulse.

【Format】 CH 0a W b CRLF No. of parameters = 2

A space cannot be used between characters. No parameter can be omitted.

Command parameters

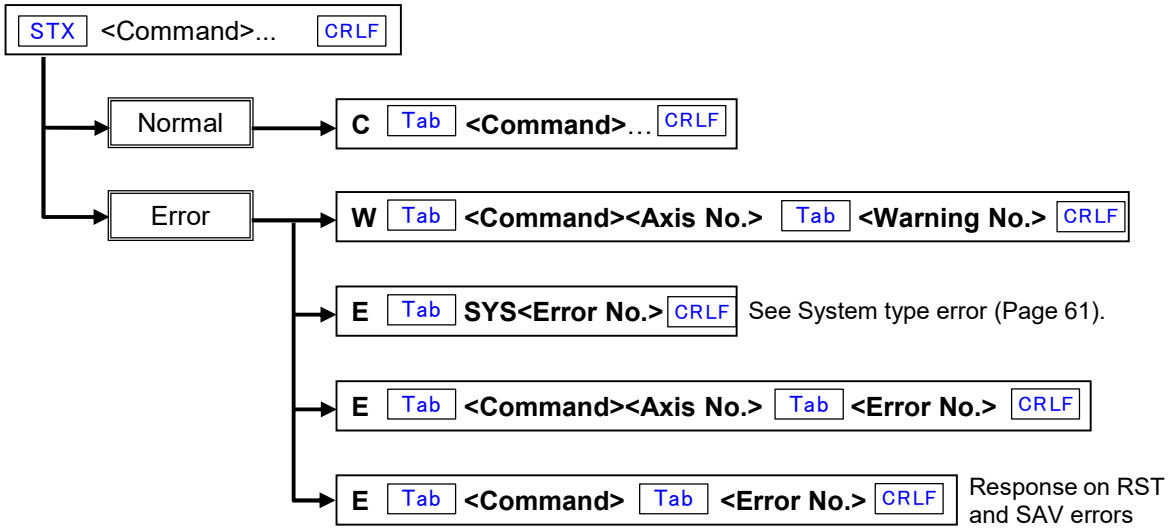
Function		Setting	Remarks
a	Axis No.	1 to 2	
b	Set value	-8,388,607 to 8,388,607	

【Response】Returns status information.

Status	Response data
Normal	**CH** <Axis No.> **OK** Tab <Setting value> CRLF
Error	**NG** CRLF

5-5. Error Code

If an error is confirmed when transmitting a command, the controller returns a response with an error code.



5-5-1. Error Code

When normal, **C** is attached at the first character and when an error happens, **E** or **W** is attached and an error code is returned.

5-5-2. Error Code List

System type error (*Independent from command types)

Error code	Description	Remarks
1	No STX on the head of the command.	
2	Total number of commands is short.	
4	Characters other than specified characters and numbers are included.	
5	No applicable command.	
11	Parameter value to save is out of range.	
12	Damaged save data	

Parameter error

Error No.	Description	Remarks
100	Total number of parameters is incorrect.	
10n	Parameter value on Xth parameter is out of range.	n=1 to 6
120	Specified a value that exceeds a movable value at one time.	

Command type error

Error No.	Description	Remarks
212	ORG OFFSET value is NG to CW direction.	
213	ORG OFFSET value is NG to CCW direction.	

Drive system error

Error No.	Description	Remarks
300	PMG is in use (PMG -> Motor drive IC).	Inside IC related error
301	Speed setting is 0 in rectangular drive.	
302	Tried to operate while axes are driving.	
303	Tried to write the present value of the axis during driving.	
304	Stopped at CW limit during driving.	Case of completion
	Tried to drive in the CW direction in the CW limit detection state.	
305	Stopped at CCW limit during driving.	Case of completion
	Tried to drive in the CCW direction in the CCW limit detection state.	
306	Some MPS driving axes stopped at limit.	
307	Both CW and CCW limiters are included.	
308	Tried to move an axis with its excitation OFF.	

WTB command calculation error

Error No.	Description	Remarks
600	No. of acceleration pulses or accelerating pulse time is large.	

Controller Error

Error No.	Description	Remarks
700	Tried to change an incompatible system setting №.	

Warning

Warning No.	Description	Remarks
51	ROM data error	

5-6. System Settings

5-6-1. System Setting List

It is necessary to perform system setting depending on a model to be used.
Conduct setting with WSY and RSY commands.
*System numbers are same with KOSMOS-ARIES.

System No.	Display	Function	Setting range	Initial value	Remarks
1	ORG OFFESET	Coordinate value after return to origin/Origin offset value	-16,777,215 to +16,777,216	0	See "3-10. Origin Return Method" (Page 19).
2	ORG TYPE	Origin Return Method	1 to 10	4	
6	PM PRESCALE	Returns 0 when pulse value prescale/set value is exceeded.	0 to +8,388,307	0	See "5-6-2 System Setting Details" (Page 63).
7	PM ROTATE CHANGE	Change of motor rotating direction	0: Standard 1: Reverse	0	
8	LIMIT SWAP	Limit signal switch	1: Switch	0	
21	LIMIT LOGIC	Change of limit signal logic	0: NC 1: NO	0	See * below.
22	NORG SIGNAL LOGIC	Change of NORG sensor signal logic	0: NO 1: NC	0	See * below.
23	ORG SIGNAL LOGIC	Change of ORG sensor signal logic	0: NO 1: NC	0	See * below.
61	EXCITATION	Motor excitation ON/OFF	0:OFF 1:ON	1	
65	MICROSTEP SELECT	Micro-step switch	0: M1 1: M2	0	CRUX-A Only
66	MICROSTEP SET	Setting of the number of micro-step divisions	1 to 16	2	CRUX only
67	CURRENT	Motor driver current value	0: 0.75A 1: 0.35A	0	CRUX only
68	Jog Movement amount	Jog box (REL mode) movement amount	+1 to +16,777,215	2000	

*** NC -> Normal close**
NO -> Normal open

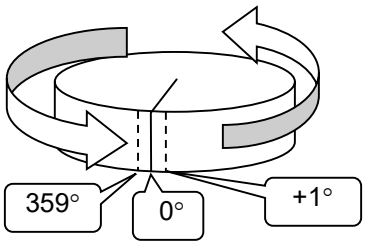
5-6-2. System Setting Details

System No.1 ORG OFFSET (Origin offset)
After completion of origin return drive, driving for set pulse is performed and the stop position is regarded as 0 (Origin).
Initial value 0
Setting range -16,777,215 ～ 16,777,216

System No.2 ORG TYPE (Origin detection method)
An origin detection method is selected. For details, see "3-10. Origin Return Method" (Page 19).
Initial value 4
Setting range 1 to 10

System No.6 PM PRESCALE (Motor pulse value prescale)
When a setting value is exceeded, the motor pulse value is returned to '0'.
Initial value 0
Setting range 0 ～ 8,388,607

Example
When placing an coordinate value 0° after turning 360°using the stage of 360°= 3600 pulses rotation system, set the movement amount corresponding to the movement amount of one round (In this case, 3600 pulses) minus 1. (3600 pulses - 1 pulse = 3599 pulses)
This rewrites the current position information from 360° to 0°.



System No.7 PM ROTATE CHANGE (Change motor rotation direction)
A relationship between pulse command direction and motor rotation direction is changed.
Initial value 0
0: Regular rotation: A motor drives to CW direction with + direction pulse.
1: Reverse rotation: A motor drives to CCW direction with + direction pulse.

System No.8 LIMIT SWAP (Switch limit signal)
CW limit sensor and CCW limit switch are swapped.
Initial value 0
0: Normal
1: Switch

System No.21 LIMIT LOGIC (Change limit signal logic)
CW and CCW limit signal logics are changed.
Initial value 0
0: NC: Normal close
1: NO: Normal open

System No.22 NORG SIGNAL LOGIC (Change NORG sensor signal logic)

NORG signal logic is changed.
Initial value 0
0: NO: Normal open
1: NC: Normal close

System No.23 ORG SIGNAL LOGIC (Change ORG sensor signal logic)

ORG signal logic is changed.
Initial value 0
0: NO: Normal open
1: NC: Normal close

System No.61 EXCITATION (Motor excitation ON/OFF)

Changes the motor excitation state.
Initial value 1 (Excitation ON)
0: Excitation OFF
1: Excitation ON

System No.65 MICROSTEP SELECT (Selection of micro-step M1/M2) CRUX-A only

Built-in driver and micro-step mode can be selected from 2 patterns (M1/M2).
Initial value 0
Selects 0: M1
Selects 1: M2

System No.66 MICROSTEP SELECT (Setting the number of micro-step divisions) CRUX only

Sets the number of micro-step divisions.
Initial value 2
Setting range 1 to 16

Setting No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Resolution	1	2	2.5	4	5	8	10	20	25	40	50	80	100	125	200	250

System No.67 CURRENT (Motor driver current value) CRUX only

Motor application current of the built-in driver can be selected from 2 patterns (0.75A/phase or 0.35A/phase).
Initial value 0
0: Selects 0.75A/phase
1: Selects 0.35A/phase

System No.68 Jog Movement amount (Moving amount of the jog box (REL mode))

Sets movement amount at one time on REL mode (Relative value movement mode) in the jog box, "INCOM".
Initial value 2000
Setting range 1 to 16,777,215

5-7. Installation Procedures of USB Driver

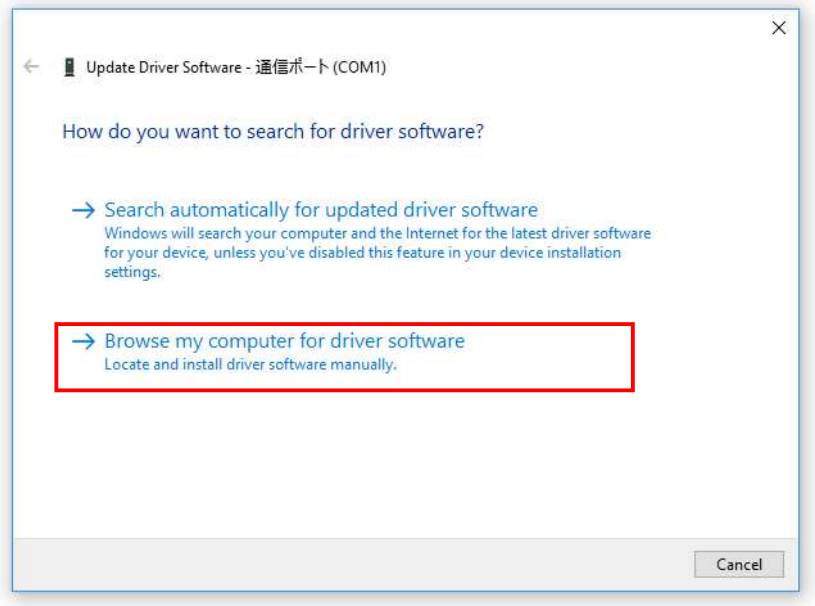
When using USB communication in CRUX, USB driver corresponding to the version of Windows OS needs to be installed.

① Set the communication setting to USB communication mode, and connect CRUX in power ON state to PC.
(See "2-7. Rotary Switch for Communication Setting" (Page 14) regarding communication setting)

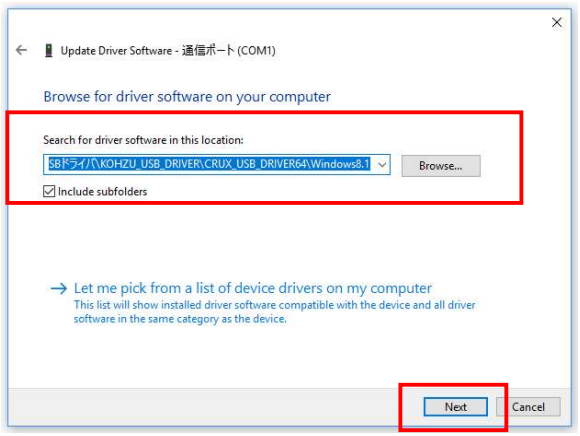
② The driver installer starts.

*When the driver installer does not starts, go to "Control Panel" -> "Hardware and Sound" -> "Device Manager", right click where Unknown device is displayed, and select "Update Driver Software...".

③ Select "Browse my computer for driver software. Locate and install driver software manually."



④ Set a search folder to applicable OS of USB driver folder that comes with the product, and select "Next".



Contents of USB driver folders that come with the product:

- For CRUX USB DRIVER32 (Windows 32bit)
  - Driver file for Windows7
  - Driver file for Windows8
  - Driver file for Windows8.1

- CRUX USB DRIVER64 (For Windows 64bit)
  - Driver file for Windows7
  - Driver file for Windows8
  - Driver file for Windows8.1

*For Windows10, use the driver file for Windows8 or Windows8.1.

⑤ The driver for CRUX is installed and "CRUX USB Serial Port" is displayed.

This is the end of instillation procedures.

6. Specification

6-1. Specification

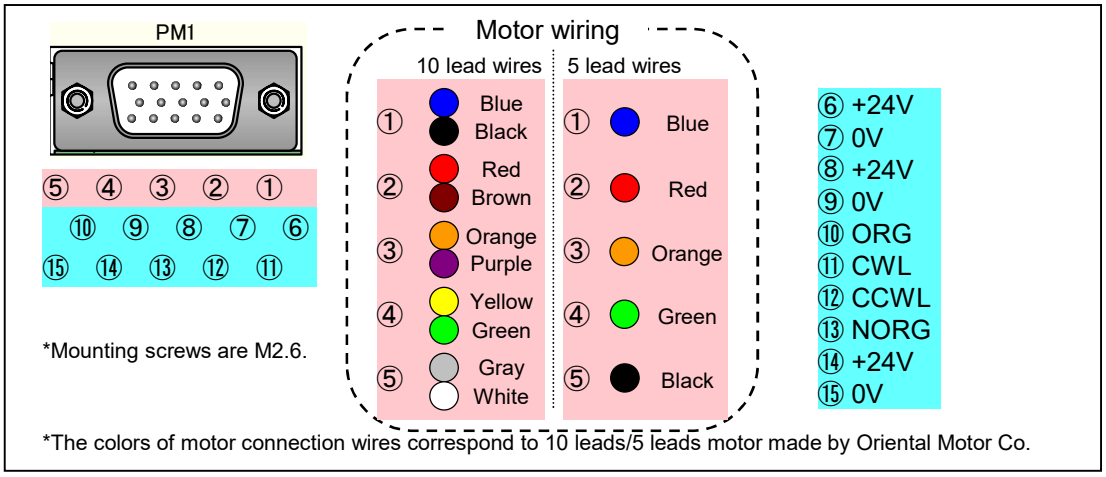
		CRUX	CRUX-A
General Specifications	Product	Stepping motor controller (Built-in DC power driver)	Stepping motor controller (Built-in AC power driver)
	Exterior dimensions (mm)	W128.4 x H58.4 x D220	W180 x H158 x D214
	Number of axes controlled	2	
	Input power	AC 90 to 240 V 50Hz/60Hz	
	Power consumption	60 VA MAX (For AC100 V supply)	430 VA MAX (For AC100 V supply)
	Operating environment	Operating temperature: 0 to 40°C, Operating humidity: 30 to 85 % (Should be no condensation)	
	Weight (kg)	1.4	3.3
Performance Specifications	Driving Function	Absolute position drive, relative position drive, origin return drive, 2 axes simultaneous drive, free rotation drive	
	Speed control	・Drive pulse frequency: 1 to 500 kpps ・Acceleration/deceleration pattern: Rectangular drive and trapezoidal drive (Asymmetry for acceleration/deceleration) ・Others: 10 kinds of speed tables	
	Set Movement Amount	-16,777,215 to 16,777,215 pulses	
	Origin Return Method	10 methods (Combination of ORG, NORG, CW limit, and CCW limit)	
	Output signal	・Motor excitation signal ・Emergency stop signal [Open collector output]	
	Input signal	・Sensor signal (CW limit, CCW limit, NORG "Near origin sensor", ORG "Origin") [12 V pull up photo-coupler input] ・Emergency stop signal [24 V pull up photo coupler input]	
	Display monitor	Sensor status, BUSY state, and emergency stop status LED	
	Communication interface	RS-232C and USB	
	Optional	INCOM (Jog Box for Easy Control)	
Built-in Motor Driver Specifications	Model	DS507F-2 (x 2)	MD-551E (x 2)
	Drive motor	5-phase stepping motor	
	Driving Type	Bipolar constant current pentagon method	
	Driving current	Switch 0.35A/phase and 0.75A/phase (Parameter setting)	Select from 16 types between 0.35A and 1.48A/phase (Rotary switch setting)
	Micro Step Division Number	16 types, Parameter setting 1/2/2.5/4/5/8/10/20/25/40/50/80/100/125/200/250	16 types, Rotary switch setting (Two types, M1 and M2) 1/2/4/5/8/10/16/20/25/40/50/80/100/125/200/250
	Other Functions	Excitation OFF, Stop current adjustment	Excitation OFF, Stop current setting

6-2. Connector

The pin arrangement diagram is from the connector side.

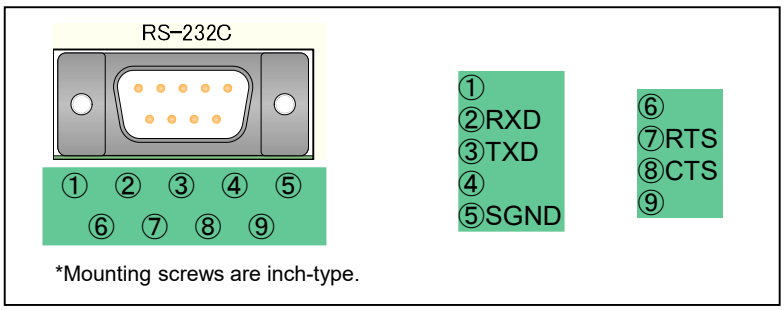
6-2-1. Motor connecting connector

Connector type: D02-M15SAG-13L9E(JAE)



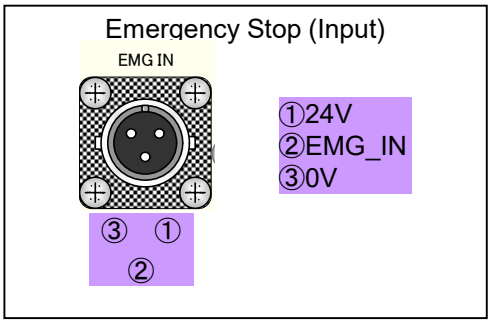
6-2-2. RS-232C Connector

Connector type: CD6109PA1G0(Cvilux): D-sub9 pin male

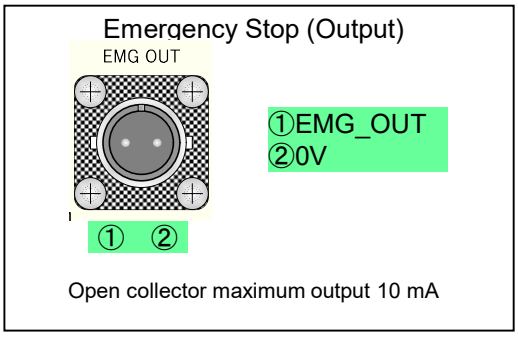


6-2-3. Emergency Stop Signal (Input/Output) Connector

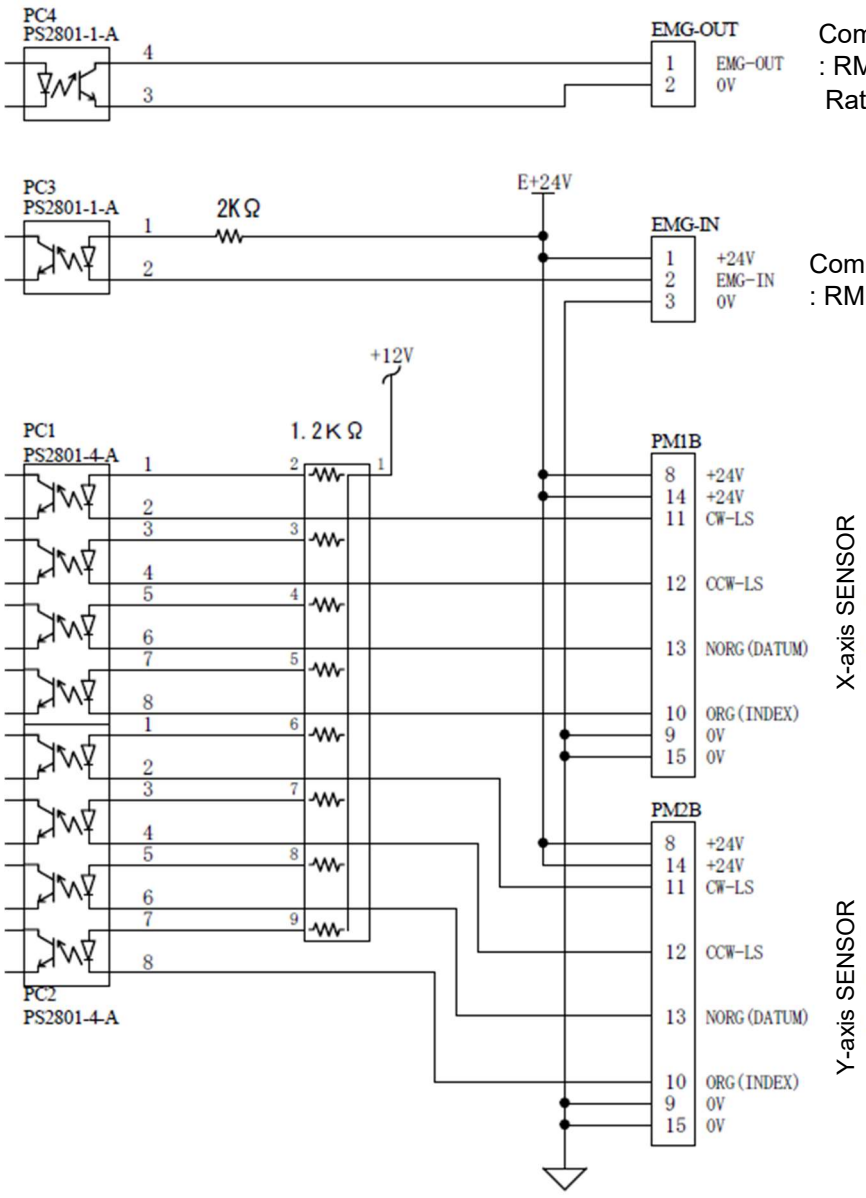
Connector type: RM12BRB-3S _(Hirose)
Compatible connector:
RM12BPE-3PH(71) _(Hirose)



Connector type: RM12BRB-2PH _(Hirose)
Compatible connector:
RM12BPE-2S(71) _(Hirose)

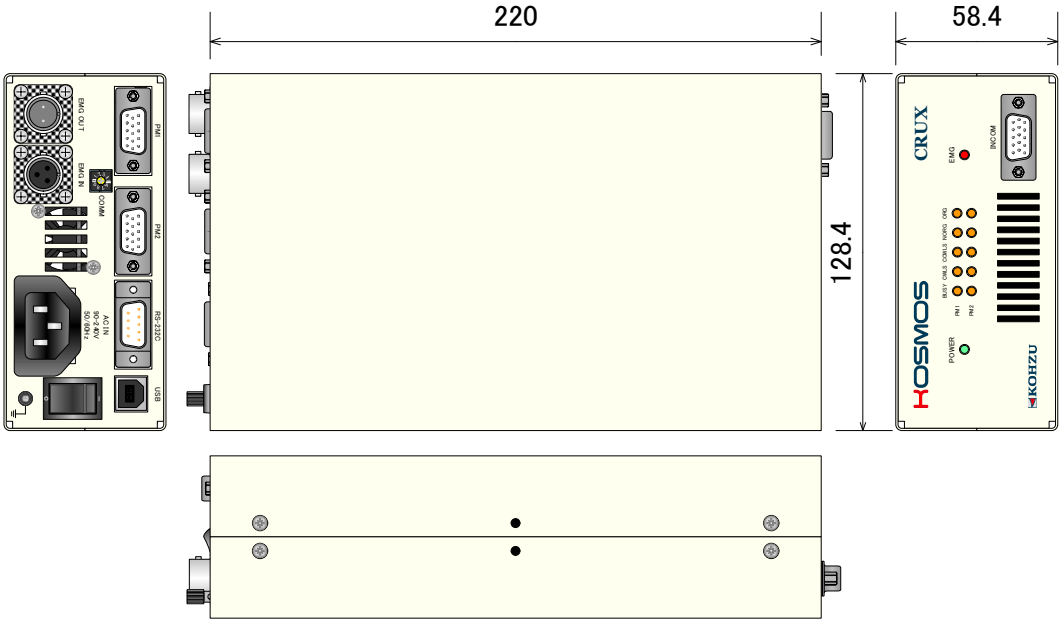


6-3. Circuit Diagram of Emergency Stop and Sensor

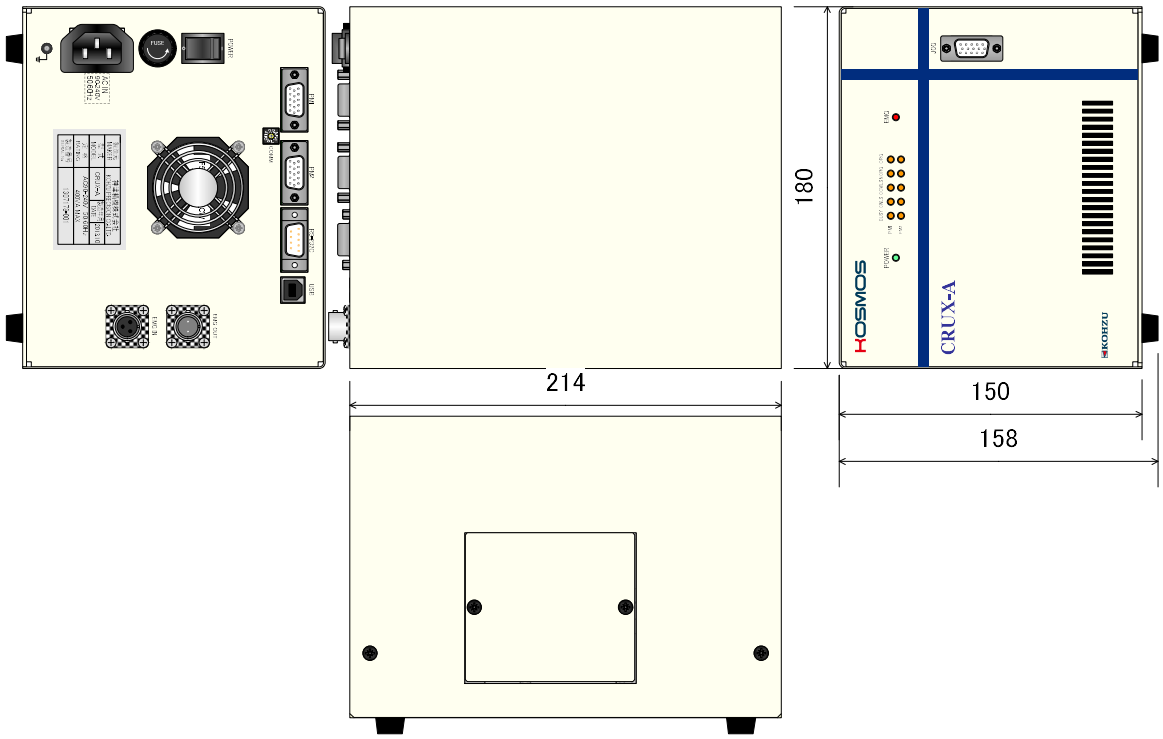


Concerning emergency stop signal, see
"3-9. Emergency Stop Function" (Page 18).

6-4. Dimensions of CRUX



6-5. Dimensions of CRUX-A



7. Maintenance and Service

7-1. Troubleshooting

■ **Power cannot be turned ON.**
◇ Is the power cord pulled out or loosened?
-> Plug the power cord into the main body securely.
◇ Is power conducted to the outlet?
-> Plug the power cord of other electric appliance into the outlet to check if it works.
-> Check electrification with a voltmeter such as a tester.
◇ Is the power cord broken en route?
-> Check conductivity between both ends of the cord if you have a tester.
◇ LED in the front panel does not become ON, though the heat release fan is rotating.
-> After turning OFF the power, turn the power ON again. If the same phenomenon persists, internal error can be considered.

■ The stage does not move.
◇ Do you hear rotation sound? Do you hear abnormal sound?
-> An out of adjustment may be considered. Change the speed or adjust the output current of driver.
◇ (When you hear rotating sound) Is the motor rotating?
-> If the device has been used for a long period of time, it is rare but the coupling of the motor shaft may be loose.
◇ (When you don't hear rotating sound) Is the limit display ON?
-> It is stopped by the limit switch. Move in the reverse direction and move through the limit zone.
◇ (When you don't hear rotating sound) Is the motor cable pulled out or loose?
-> Securely plug the cable connector into the main body connector.
◇ (For multi-axis specification) Are all axes not moving?
-> If some axes move and the others do not, exchange the connection connector of each axis (Motor) to judge if the problem is on the main body side or motor side.

■ **Origin return operation cannot be performed.**
◇ Doesn't the motor operate completely?
-> Check if it operates with other driving methods.
◇ (Stops at non-origin position) Check the origin return method is correct.
-> See "3-10. Origin Return Method" (Page 19) and set to match the stage's sensor configuration. For a part of standard stage, it is necessary to set the origin return method to 3 in the system setting.
◇ (Stops at non-origin position) Is the origin sensor installed properly?
-> Adjust the origin sensor.
-> When a movement range is narrow, the limit sensor range and origin sensor range may overlap. In this case, it does not operate normally. Adjust for the origin sensor range to be out of the limit range.
-> When using the origin proximity sensor and origin sensor, consider each positional relationship. If the origin is out of the origin proximity sensor range, origin return cannot be performed correctly. Make an adjustment of the origin position.
◇ (Stops at a non-origin position) Is the logic of origin sensor set properly?
-> Switch the input logic for the sensor (Normal open and normal close).

■ **Positional deviation happens.**

◇ Are the settings like movement volume correct?
-> Check each setting according to the Operation Manual.
◇ Is the motor properly operating? Do you hear abnormal sound?
-> An out of adjustment may be considered. Change the speed or adjust the output current of driver.
◇ Is the load exceeding the rating applied?
-> Check the load. Also, try to lower the speed.
◇ Is the axis in the limit range?
-> Stopping position and counter value cannot be guaranteed when it is within the limit range.
Use it out of the limit range.
◇ Does the assembly between the motor and driving part show problems?
-> If the device has been used for a long period of time, the coupling of the motor axis may become loose.

■ **Remote control (Communication) does not operate correctly.**

◇ Is the communications cable pulled out or loose?
-> Plug the connector of the communications cable into the connector of the main body properly.
◇ Are communication parameter settings done correctly?
-> See and check “2-7. Rotary Switch for Communication Setting” (Page14).
(Turn the power of CRUX OFF and conduct dip switch setting).
◇ Is correct communication cable used?
-> Check the arrangement of the connector pins on the communication cable.
◇ During communication, is error code sent?
-> Take measures for the error on the host computer.
◇ Are there any errors in the control program on the host computer?
-> Check the program. Please note that errors such as distinction between upper and lower case letters and setting of the delimiter code frequently occur.
-> Are commands transmitted and received properly? Make sure to receive data for commands which return response (For example, status read, etc.).
◇ Check with the stage control application, "Chamonix".
We have application available that can be operated easily.
-> If proper operation can be performed by application, software on the user ‘s side may not be written correctly.
◇ Is communication forcedly interrupted in mid-stream?
-> Turn the power ON again.

■ **EMG lamp flashes (EEPROM data may be damaged)**

◇ Data inside EEPROM are damaged.
-> See the restoration method in “3-11. EEPROM Save Data Error” (Page 26 and 27), and initialize the data.

7-2. Maintenance

■ **Maintenance of Controller**

・When used in a dusty room, perform internal cleaning periodically.
・When not using or storing for a long period of time, always remove the power cable from outlet and other cables.

・Maintenance service shall be carried out only by our company.
For details, please contact our sales department.

7-3. Warranty and Service

If the product fails within the warranty period, we provide a free repair according to the regulations of our company.

Warranty period	One year from the date of shipment

■ Request for a repair within warranty period

Please contact the sales agent, commercial firm and our sales department from which you purchased our product.

■ Request a repair after warranty period has expired

"Even if the warranty period has elapsed Repairs shall be carried out depending on failure at cost.

■ Maintenance for repair parts

We will carry out maintenance of most parts for repair within a period specified by us after discontinuing production.
Please understand that repair requiring parts for which the warranty period has elapsed may be rejected.
Also, this condition may not be met due to some reasons of parts distribution manufacturers.

7-4. Contacts

If you have questions about our products, please contact our sales department via phone or email.

Revision History

Date	Version
2014/04/01	1.10
2015/04/01	1.15 (FG earth added)
2015/06/17	1.20 (ROM check added)
2015/08/20	1.30 (Document edited)
2016/09/22	1.36 (Data error restoration method added)
2020/04/23	1.37（Corrected the description of accessories) (Correction of errors）

Recording Column

Purchased Date Year Month Date

Purchased from

Person in charge TEL

Production No.

Special note

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▪ ▪	

CRUX CRUX-A

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