High Speed , Superfine positioning

3 Axis SFS Controller

FINE-503

User's Manual

Piezo Actuator

For Your Safety

OptoSigma®

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Contents

For Your Safety

- Before using this product, read this manual and all warnings or cautions in the documentation provided.
- Only Factory Authorized Personnel should be changes and/or adjust the parts ofcontroller.

The Symbols Used in This Manual

⚠ WARNING	⚠ CAUTION
This symbol FINEs warnings that should be read and used to prevent serious injury or death.	This symbol indicates where caution should be used to avoid possible injury to yourself or others, or damage to property.

The above indications are used together with the following symbols to indicate the exact nature of the warning or caution.

Examples of Symbols Accompanying Warnings and Cautions	
	△ Symbols enclosed in a triangle indicate warnings and cautions. The exact nature of the warning or caution is indicated by the symbol inside (the symbol at left indicates risk of electrocution).
	○ Symbols enclosed in a circle FINE indicate prohibitions (actions that must not be performed).The exact nature of the prohibition is indicates by the symbol inside or next to the circle FINE (the symbol at left indicates that the product must not be disassembled).
	● Symbols inside a black circle FINE actions that must be performed to ensure safety. The exact nature of the action that must be performed is indicated by the symbol inside (the symbol at left is used in cases in which the AC adapter must be unplugged to ensure safety).

Symbols on the product

The symbol FINE on the product calls your attention. Please refer to the manual, in the case that you operate the part of the symbol FINE on the product.

	This symbol labeled on following portion calls your attention. Piezo connecters on the rear panel.

Disclaimer of Liability

① SIGMAKOKI CO., LTD. does not accept liability for damages resulting from the use of this product or the inability to use this product.
② SIGMAKOKI CO., LTD. does not accept liability for damages resulting from the use of this product that deviates from that described in the manual.
③ SIGMAKOKI CO., LTD. does not accept liability for damages resulting from the use of this product in extraordinary conditions, including fire, earthquakes, and other acts of God, action by any third party, other accidents, and deliberate or accidental misuse.
④ If the equipment is used in a manner not specified by the SIGMAKOKI CO., LTD., the protection provided by the equipment may be impaired.

⚠ WARNING

- Do not use this product in the presence of flammable gas, explosives, or corrosive substances, in areas exposed to high levels of moisture or humidity, in poorly ventilated areas, or near flammable materials.
- Do not connect or check the product while the power is on.
- Installation and connection should be performed only by a qualified technician.
- Do not bend, pull, damage, or modify the power or connecting cables.
- Do not touch the products internal parts.
- Connect the earth terminal to ground.
- Should the product overheat, or should you notice an unusual smell, heat, or unusual noises coming from the product, turn off the power immediately.
- Do not turn on the power in the event that it has received a strong physical shock as the result of a fall or other accident.
- Do not touch the stage while operation.
- Use dry clothes only for cleaning the equipment.
- USABLE DETACHBLE POWER CORDS

Type	Connecter	Cord	Attachment plug cap
FINE-503 AC120V	Use the detachable power cord set attached to the product only.		
FINE-503 AC230V	IEC C-22 Rated 7A,250V UL,CSA Approved	Type SJT, No16 AWG Min. 3-Conductors (Single phased;2-current carrying &ground)	NEMA6-15P Tandem blade Rated 7A,250V UL, CSA Approved
		UL, CSA Approved	

Cable length of above Power Supply cord shall be shorter than 4.5m.

⚠ CAUTION

- Do not leave the product in an enclosed area or in areas in which it would be exposed to direct sunlight or vibration.
- Do not touch the product when your hands are wet.
- When unplugging the product, pull on the plug rather than the cord.
- Because some electrical change remains after the power has been cut, do not touch the input or output terminals for ten seconds after the product has been turned off.
- When connecting peripherals to the product, adjust the product's initial setting parameter settings to suit the peripheral.
- Turn off the power before connecting the product to other devices. Connection should be performed following the connection diagram.
- Before turning the equipment on or when beginning operations , be sure that you can turn the power off immediately in the event that an abnormality should occur.
- The product can only be repaired, modified, or disassembled by a qualified technician.
- Do not obstruct the product's air vents or other openings.
- For continued protection against risk of fire, replace only with same type and rating fuse.
  Fuse replacement is done by a qualified technician
  Fuse: SOC Corp. Type ET 500mA, Rating 250Vac, 0.5A, T

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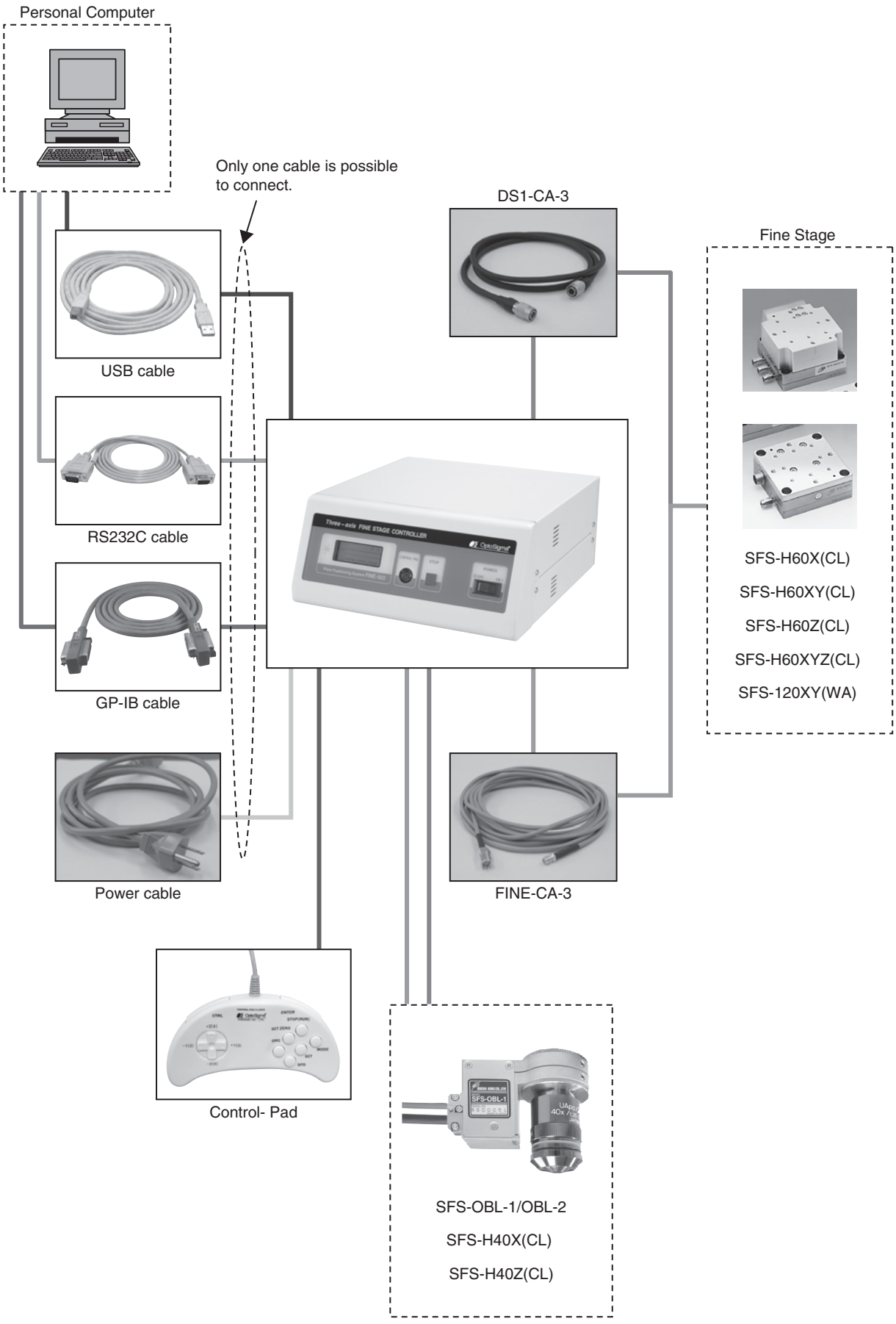
Connection Diagram FINE-503



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Chapter 1 Before Using

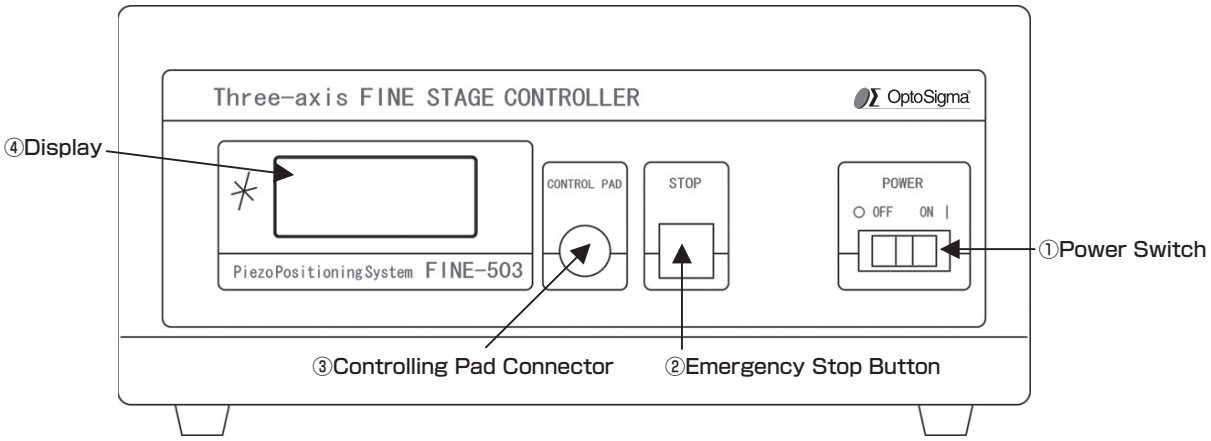
1. General Outline

This unit is a controller containing piezo driver for one axis/two axes/three axes.
Each axis equips a digital sensor input, collects hysteresis curve peculiar to PIEZO and enables to achieve closed loop control.
Fine stage can be controlled by simple command sent from PC connected this controller with RS232C,GP-IB, or USB interface.

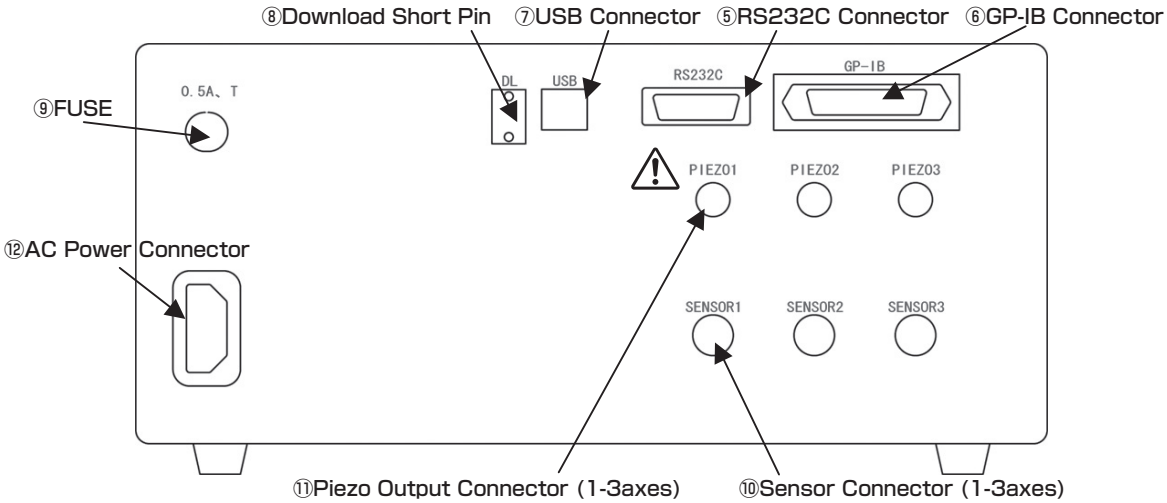
2. Function and the Names of Each Parts

2-1 Name of each parts

FINE-503 Front Panel



FINE-503 Rear Panel



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2-2 Function of each parts

① Power Switch ：Electric power is supplied when it turn "ON." Power is cut when it turn "OFF."

② Emergency Stop Button ：Stop the Fine Stage immediately, then move to the 0V point in case of open loop control or 0nm point in case of closed loop control.

③ Control Pad Connector ：Connect Control Pad（CJ-200A）.

④ Display ：Display operation mode and coordinate of each axis.

⑤ RS232C Connecter ：Connect to PC by RS232C.

⑥ GP-IB Connecter ：Connect to PC by GP-IB.

⑦ USB Connecter ：Connect to PC by USB.

⑧ Download Short Pin ：Used for rewriting the contents of a memory switch, or upgrade.

⑨ FUSE ：SOC Corp. ET 500mA , Rating 250Vac,0.5A ,T

⑩ Sensor Connecter（1-3 axes） ：Connect digital sensor of the Fine Stage used.（Cable:DS1-CA-3）
It can be connected up to maximum of 3 axes.

⑪ Piezo Connecter（1-3 axes） ：Connect to the Fine Stage used.（Cable:FINE-CA-3）
It can be connected up to maximum 3 axes.

⚠ Do not touch the connecter pin. It has high potential（150Vdc）.

⑫ AC Power Connecter ：FINE-503 AC120V; Connect Power supply cable which was attached.
FINE-503 AC230V; Refer to 'WARNIG' in 'For Your Safety'

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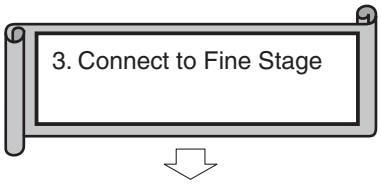
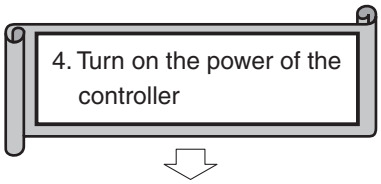
Chapter 2 Basic Operation Methods

In order to understand the functions of this controller, an outline and details of basic operation is described below.



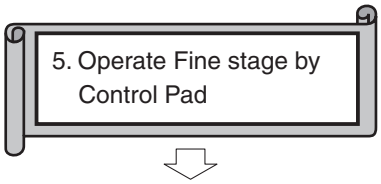
Connect Fine Stage (SFS series) with the exclusive connecting cables.

Reference 3-1 Connect Fine Stage. Page 6
3-2 Connect the power cable and Control Pad. Page 6



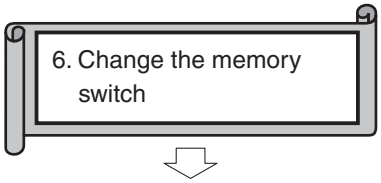
Turn on the power switch on the front panel.
Initial screen is displayed in LCD after the software version information.
Set up the memory switch according to the stage operation.

Reference 4-1 Operation mode at power-on Page 8
4-2 Changing the operation mode at power-on. Page 8
4-3 Check the settings of memory switch. Page 9



Press MODE button on the Control Pad.
Operation mode is changed at forever it is pressed.
HOST (COMPUTER) →MANUAL →EDIT →REMOTE →LOAD →HOST…
Fine Stage can be moved to each direction by cross-shaped button on Control Pad.

Reference 5-1 About Control Pad Page 9
5-2 About each operation mode and button Page 10
5-3 Operate Fine Stage by Control Pad Page 11

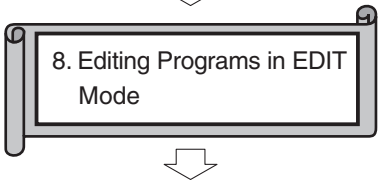


Memory switch memorizes various setting parameter, such as communication settings.
The contents of memory switch can be confirmed and set by Ctrl + SET button on Control Pad.

Reference 6-1 Set up the contents of memory switch Page 11
6-2 Contents list of memory switch Page 12
6-3 Details of memory switch Page 13

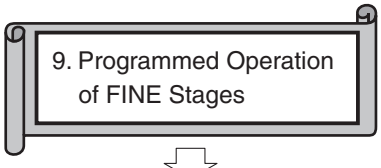
Fine Stage can be operated from PC by sending a simple command.

Reference 7-1 Command list Page 15
7-2 Command format Page 15
7-3 Command details Page 16



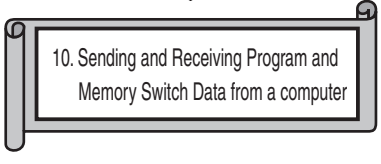
In Edit mode, you can edit and record patterns of operation, coordinates for the first, second and third axes, speed setting, and wait times.

Reference 8-1 Recording Selections and Data input Page 19
8-2 Editing Programs:An Example Page 19
8-3 Explanation of Program Data Page 20



Programs edited in edit mode can be used to operate FINE stages by means of commands received from the PC or by signals from Control Pad.

Reference 9-1 Starting Programmed Operations from a Control Pad Page 21
9-2 Starting Programmed Operations from a Computer Page 21



Upload program or memory switch data to, or download program or memory switch data from the controller.

Reference 10-1 Control Pad Operations Page 22
10-2 Example of Upload and Download Operations Page 22
10-3 Example of Format for Download Data Page 23
10-4 Example of Format for Upload Data Page 23

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3. Connect to Fine Stage

This controller can control SFS series stage by connecting with exclusive cables.

3-1 Connect to Fine Stage

Connect controller to each Fine Stages.
Connect piezo cable (FINE-CA-3) to piezo connector of Fine Stage.
Connect sensor cable (DS1-CA-3) to sensor connector of Fine Stage. (Only in closed loop operation)

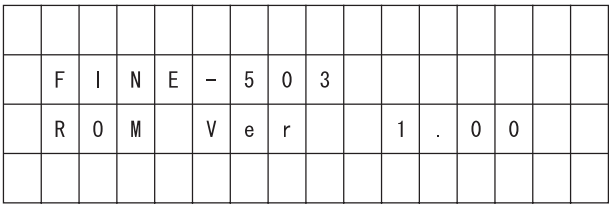
3-2 Connect to the power cable and Control Pad

Connect the power cable to the AC connecter on rear panel and plug to the socket. (Use the ground connecting to earth ground when use.)
When using the Control Pad (CJ-200A) with stage controller, connect to "CONTROL PAD" section in the center of a front panel and make sure the arrow FINE of the connector faces upwards.

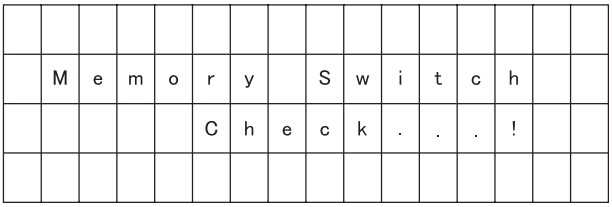
4. Turn on the Power of Controller

When power switch of the controller is turned on, the equipment name and the version information are shown first. Then the present operation mode, step, opening/closing control status, the coordinates position of each axis, and the sensor resolution in case of closed loop control will be displayed.

Ⅰ) Equipment name and current version information



Ⅱ) Checking memory switch data



Ⅲ) Warming up of stage
Turn on the piezo output relay.
It acquires hysteresis curve data in case of closed loop.

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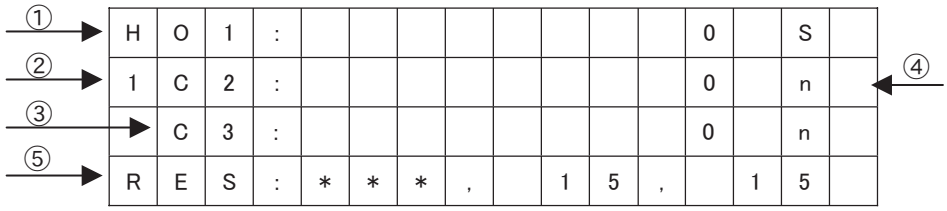
Ⅳ) Coordinate screen



① Operation mode
H：Host
M：Manual
E：Edit
R：Remote
L：Load
② Control Pad sending step amount
③ Control mode
O：Open loop control
C：Closed loop control
④ Coordinate of each axis
⑤ Sensor resolution of each axis
"＊＊＊" will be displayed at open loop

Note) Ⅲ) At the time of the warming-up of a stage, and the acquisition of hysteresis curve data in closed loop, voltage is displace by 1 cycle from - 10 to 150V and the stability of a piezo-electric element and hysteresis curve data are acquired.
Stage moves for this reason.

Note) Ⅳ) Coordinate screen display "⑤ Sensor resolution of each axis" changes by the stage position.
Read the installation document of a stage in detail.

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4-1 Operation mode at power-on

The operation mode at power-on changes according to the setting item "MODE SEL" in memory switch. The initial value is set to "HOST（COMPUTER）".
The operation mode at power-on is chosen from 5 kinds of mode HOST（COMPUTER）, MANUAL, EDIT, REMOTE and LOAD.

4-2 Changing the operation mode at power-on

Follow the below directions in order to change the operation mode at power-on. All of the operation are changed by Control Pad（CJ-200A）.

（example:FINE-503）

① Turn on the power of controller.

② Press the "MODE" button on the Control Pad and change the mode to MANUAL.

③ Press "Ctrl" and "SET" button simultaneously. The memory switch setup screen is shown.

④ Press "-2（4）"（at bottom side）on the cross-shaped button until "MODE SEL"（Memory No.07）comes out as shown in Figure 4-1.

⑤ Press "SET" or "SPD" button according to the mode you want to change.
Display change as in the following order : HOST → MANUAL → EDIT → REMOTE → LOAD → HOST

⑥ Press "MODE" button when you finished setup. Configuration screen appears as shown in Figure 4-2.
（Press "MODE" button to do setup again. Press "SPD" button to cancel settings.）

⑦ Press "SET" button.
Display returns to the initial screen of MANUAL mode.

Memory switch setup screen

0	1		S	P	E	E	D		S	E	L				
													1		

Operation mode select screen (Figure 4-1)

0	7		M	O	D	E		S	E	L					
										H	O	S	T		

Setup configuration screen (Figure 4-2)

O	K	?													
	Y	E	S					→		(	S	E	T	)	
	N	O						→		(	S	P	D	)	
	C	A	N	C	E	L		→		(	M	O	D	E	)

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4-3 Check the settings of memory switch

Setup inner memory settings of controller according to each connected Fine Stages.
Set the memory switch according to the operating environment.
(Setup communication and control mode settings to the using conditions.)
Refer to the detail explanation of clause no. 6 "Change memory switch".

Memory switch setup screen is shown by pressing "Ctrl" and "SET" button simultaneously in MANUAL mode.

Button operation of memory switch to be set by control-pad (CJ-200A)

Button	Function
Up (cross-shaped button)	Change the setting items. (No.2 → 1 → 19 → 18)
Down (cross-shaped button)	Change the setting items. (No.18 → 19 → 1 → 2)
Right (cross-shaped button)	When the contents are numerical values, blinking cursor is moved to right digit to change setting.
Left (cross-shaped button)	When the contents are numerical values, blinking cursor is moved to left digit to change setting.
SET	① Change the setting contents. (Increases in case of digit value indication)
	② After setting is completed, it registers changed data and quits the set up.
SPD	① Change the setting contents. (Decreases in case of digit value indication)
	② After setting is completed, it cancels changed data and quits the set up.
MODE	① Press when setting is completed (Move to confirmation screen)
	② After setting is completed, return to the memory switch screen again.
Ctrl + ORG + ZERO Pressed both three buttons	Reset the memory switch to factory defaults.

Note) After you changed memory switch settings, you should return to the coordinate screen and reboot the power. If it is not rebooted, it may not operate correctly depending on the changed item.

5. Operate Fine Stage by Control Pad

Control Pad CJ-200A is a device for smooth operation each mode in FINE-503.
Since it is connected to a stage controller with the cable, it is possible to control by remote.
Therefore, even when the stage controller and the Fine Stage are placed separately, you can check the operation of the Fine Stage near by using the Control Pad.

5-1 About Control Pad

CJ-200A is designed as control Pad for the stage Controller FINE-503.

Note 1) Be sure to turn off the power of the controller when connecting the Control Pad. If the Control Pad is connected while the controller power is on, CJ-200A may not work correctly.

Refer to《5-3》about the function of each button of Control Pad CJ-200A.

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5-2 About each operation mode and button

There are 5 kinds of operation modes（HOST mode, MANUAL mode, EDIT mode, REMOTE mode, LOAD mode）in a controller. It changes by pressing "MODE" and the both "Ctrl"+ "MODE" button of a control pad simultaneously.

《HOST（COMPUTER）Mode》
Fine Stage can be operated from PC.
Either one of RS232C, GP-IB or USB interface is possible to use connecting with PC.

《MANUAL Mode》
Fine Stage can be operated from each button of Control Pad.
Also, settings of the memory switch can be changed.

《EDIT Mode》
In EDIT mode, you can edit program data stored inside the controller.
Two kinds of program are possible to store inside it.（Ex. No.1 and No.2）.

《REMOTE Mode》
Execute the stored program by using Control Pad.

《LOAD Mode》
Program data and memory switch settings can be edited on a computer and downloaded to the controller（FINE-503）, or data can be uploaded to computer and saved to disk.

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5-3 Operate Fine Stage by Control Pad

Fine Stage can be operated from the buttons of Control Pad as shown in bellow.

Function	Button	Performance
(1) Cross-shaped button	Right	Move the first axis to positive side. (+ direction)
	Left	Move the first axis to reverse side. (− direction)
	Up	Move the second axis to positive side. (+ direction)
	Down	Move the second axis to reverse side. (− direction)
	Ctrl + Right	Move the third axis to positive side. (+ direction)
	Ctrl + Left	Move the third axis to reverse side. (− direction)
(2) Speed change button	SPD	Change the JOG sending step amount. (1 → 2 → 3 → 4 → 1)
(3) Coordinates clear button	ZERO	Reset the coordinate value of all axes to 0.
(4) Mechanical origin return button	ORG	Move to the mechanical origin.
(5) Stop button	STOP	Stop the stage and move it to the mechanical origin.
(6) Memory switch setting button	Ctrl + SET	Set up the memory switch.

6. Change the Memory Switch

Setup of memory switch is necessary in order to operate the Fine Stage optimally.

6-1 Set up the contents of memory switch

The memory switch screen is displayed by pressing "Ctrl" + "SET" button simultaneously in MANUAL mode.
The settings of memory switch can be changed by each button on the Control Pad.

*) Please check button operation of memory switch settings in《4-3》"Check the settings of memory switch" in order to use each button.

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6-2 Contents list of memory switch

The contents of memory switch is set to factory defaults when "Ctrl" + "ORG" + "ZERO" button is pressed simultaneously on the memory switch setting screen.

No.	Memory switch contents (Displayed)	Setting Ranges/Options	Initial value
01	SPEED SEL	1 ～ 4	1
02	AXIS	1 ～ 3	1
03	INTERFACE	RS232C/USB/GP-IB	RS232C
04	BAUDRATE	4800/9600/19200/38400	9600
05	DELIMIT	CR/LF/CR+LF/EOI	CR + LF
06	GP-IB ADDR	1 ～ 30	8
07	MODE SEL	HOST/MANUAL/EDIT/REMOTE/LOAD	HOST
08	COMM/ACK	MAIN/SUB	MAIN
09	SENSOR MODE 1	CLOSE/OPEN	OPEN
10	SENSOR MODE 2	CLOSE/OPEN	OPEN
11	SENSOR MODE 3	CLOSE/OPEN	OPEN
12	INPOS1	5 ～ 495	40
13	INPOS2	5 ～ 495	40
14	INPOS3	5 ～ 495	40
15	DISP1	VOLT/OTHER/SENSOR	OTHER
16	DISP2	VOLT/OTHER/SENSOR	OTHER
17	DISP3	VOLT/OTHER/SENSOR	OTHER
18	SAMPLE	100/200/350	100
19	FULLCL	TRAC/LOCK	TRAC

Note) "SENSOR" setting of No15 ～ 17 is available only for Open loop control.

Note) Be sure to return to the coordinate screen and reboot the power after changing the memory switch setup.
It may not operate correctly depending on the setting if the controller was not rebooted.

Reference) No.12 ～ 14 : INPOS settings
For the INPOS settings, set up according to the sensor resolution of the coordinates screen.
Be aware that the stage may not be able to control normally if INPOS setting value was under sensor resolution. Refer below recommendation table with relation between SAMPLE and INPOS.

SAMPLE : Sampling time (μS)	INPOS recommended value (nm)
100	40
200	30
350	15

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6-3 Details of memory switch

The number in front of each row stands for the memory switch number.
(Non-numeric options for memory switch settings data are listed in ascending order according to the values (0,1,2,3,…) used at download and upload. The values used at download and upload are marked with an asterisk as follows.)

1) SPEED SEL：Select the speed number

Specifies the initial-setting speed number at power on.

・Setting range 1 - 4
1：1 step
2：10 steps
3：100 steps
4：1000 steps

2) AXIS：Select number of axes to control

Set the number of stages connected or of axes to control. (2nd and 3rd axis will not operate if set to 1 axis)

・Setting options 1：1 axis 2：2 axes 3：3 axes

3) INTERFACE：Communication Interface Selection

Set the communication system with host (PC).

・Setting options	RS232C：RS232C Interface	(*0)
	USB：USB Interface	(*1)
	GP-IB：GP-IB Interface	(*2)

4) BAUDRATE：Baud rate settings

Set the data communication speed when RS232C is selected.

・Setting options	4800：4800bps	(*0)
	9600：9600bps	(*1)
	19200：19200bps	(*2)
	38400：38400bps	(*3)

5) DELIMIT：Delimiter setting

Set the delimiter of block in a communication data.

・Setting options	CR：CR (Fixed to CR when USB is selected)	(*0)
	LF：LF	(*1)
	CRLF：CR + LF	(*2)
	EOI：EOI	(*3)

6) GP-IB ADDR：Set the GP-IB address.

Set the address GP-IB when it is selected.

・Setting range 1 ～ 30

7) MODE SEL：Set the initial operation mode at power-on.

Select the initial operation mode at power-on.

・Setting options	HOST：Host mode	(*0)
	MANUAL：Manual mode	(*1)
	EDIT：Edit mode	(*2)
	REMOTE：Remote mode	(*3)
	LOAD：Load mode	(*4)

8) COMM/ACK：Set the communication protocol with a PC.

Select whether it replies 'OK/NG' to the command sent from PC at HOST mode or do not.

・Setting options	MAIN：Reply OK/NG	(*0)
	SUB：Do not reply OK/NG	(*1)

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9）SENSOR MODE 1：Set control mode.
10）SENSOR MODE 2：Set control mode.
11）SENSOR MODE 3：Set control mode.

Select the control mode. When it is set OPEN, sensor resolution <RES> will be displayed "＊＊＊".

・Setting options　CLOSE：Closed loop control　(＊0)
OPEN：Open loop control　(＊1)

12）INPOS1：Set the in-position of the first axis when closed loop control is selected.
13）INPOS2：Set the in-position of the second axis when closed loop control is selected.
14）INPOS3：Set the in-position of the third axis when closed loop control is selected.

Set the in-position range of each axis when closed loop control is selected.

・Setting range　5 ～ 495 (nm)

(In-position：The error range of actual positioning to the commanded value, in closed loop control.
Example) When in-position is setting 50, positioning is actually completed within 10000± 50 nm to the 10000 nm instruction.)

15）DISP1：Select the display form of first axis.
16）DISP2：Select the display form of second axis.
17）DISP3：Select the display form of third axis.

Select the display form of each axis.

・Setting options　VOLT：Display supplied voltage value.　(＊0)
OTHER：(when CLOSE) Display nm　(＊1)
(when OPEN) Display output steps
SENSOR：Display nm (Only Open loop control)　(＊2)
Value of Digital sensor is displayed only when Digital sensor is connected.

18）SAMPL：Sampling time of digital sensor.

Set the sampling time of digital sensor. Basically, the longer the time is set, the higher the sensor resolution becomes.

・Setting range　100：100μs　(＊0)
200：200 μ s　(＊1)
350：350 μ s　(＊2)

19）FULLCL：Select the control system when closed loop is selected.

・Setting options　TRAC：Always tracking position within the range of in-position to the command value.　(＊0)
LOCK：Once stage position enters within the range of in-position to the command value, the voltage value will be fixed and the gap of a sensor value will not be controlled.　(＊1)

Note) About "9～11) SENSOR MODE"：Do not choose "CLOSE", if the model without sensor (OP type stage) is connected, or the sensor cable is not connected. It does not operate normally.
Note) About "15~17) DISP1~3"："nm" is not displayed, if the model without sensor (OP type stage) is connected, or the sensor cable is not connected.

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7. Operate Fine Stage from PC

RS232C, GP-IB, or USB interface are used to connect to PC.
The controller controls the Fine Stage by sending the command (string) from PC.
The controller is initially set to HOST mode when the power is turned on after purchase.

7-1 Command list

Types of commands are shown as bellow.

Command	Command letter	Meanings
Absolute movement amount setting	A	Specifies absolute coordinate.
Relative movement amount setting	M	Specifies relative coordinate.
Continuous run setting	J	Specifies continuous movement.
Drive command	G	Start the movement of A, M, and J command.
Mechanical origin command	H	Return to the mechanical origin.
Logical origin command	N	Position stage at logical origin "0".
Stop command	L	Stop
Logic mechanical origin setting	R	Reset the coordinate value.
Step amount setting	D	Set the step amount.
Hysteresis curve data acquisition command	@	Get hysteresis curve data
Full closed setting	K	Change tracking mode and lock mode.
Present position information 1	Q	Status request. (Ex. Coordinate value)
Present position information 2	V	Reply a supplied voltage value
Call status 1	!	Reply B (busy) /R (ready)
Call internal information	?	Reply internal information
Execution of internal program (for remote operation)	P	Execute internal programmed operation.

7-2 Command format

The communication protocol used between the controller and the PC depend on memory switch.

1. COMM/ACK：MAIN

A communication protocol forms one response for each command.

Command string・・・・・receive

Reply string・・・・・・・・send

A response string is "O.K." when command is received normally, and "NG" when not.

However, in the cases when a data is returned like a check commands, it returned the data instead of "OK".

Command should only be sent after checking the internal status of the controller.

2. COMM/ACK：SUB

A communication protocol does not respond "OK/NG" to each command.

However, in the case when a data is be returned liked a check command, it returns the data.

Command should only be sent after checking the internal status "ready", except "Q:" or "!:" command.

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7-3 Command details

・A Command：Absolute movement command

It is a command to make an absolute coordinate movement. This command is to specify the axis, direction, and amount of movement. Drive command "G" is needed after this command is executed. The absolute amount of movement is specified in nm unit or the number of steps according to the control method.

Open loop control：Amount of steps　Closed loop control：nm
(Values) Open loop control：-8000 ～ 120000 steps
Closed loop control：±999999nm
(However, it only moves within the range of acquisition data in hysteresis characteristic.)

A：1 ＋ P100　Moves the 1st axis to ＋ 100 steps position
G：
A：2 － P100　Moves the 2nd axis to － 100 steps position
G：
A：3 ＋ P1000　Moves the 3rd axis to ＋ 1000 steps position
G：
A：W ＋ P100 ＋ P100 ＋ P100　Moves the 1st axis to ＋ 100 steps position, the 2nd axis to ＋ 100 steps
G：　position, and the 3rd axis to ＋ 100 steps position

・M Command：Relative movement command

This command is to specify the axis, direction, and relative amount of movement. Drive command "G" is needed after this command is executed. The relative movement amount is specified in nm unit or the number of steps according to the control method.

Open loop control：Amount of steps　Closed loop control：nm
(Values) Open loop control：±128000 steps
Closed loop control：±999999nm
(However, it only moves within the range of acquisition data in hysteresis characteristic)

M：1 ＋ P100　Moves the 1st axis to ＋ 100 steps
G：
M：2 － P100　Moves the 2nd axis to － 100 steps
G：
M：3 ＋ P1000　Moves the 3rd axis to ＋ 1000 steps
G：
M：W ＋ P10 ＋ P10　Moves the 1st axis to ＋ 10 steps, the 2nd axis to ＋ 10 steps
G：
M：W ＋ P100 ＋ P100 ＋ P100　Moves the 1st axis to ＋ 100 steps, the 2nd axis to ＋ 100 steps,
G：　and the 3rd axis to ＋ 100 steps

・J Command：Continuous movement command

This command drives the stage continuously. The amount of driving steps depend on the speed on the speed number selected by the memory switch No.1. Drive command "G" is needed after this command is executed.

J：1 ＋　Moves the 1st axis to ＋ direction
G：
J：2 －　Moves the 2nd axis to － direction
G：
J：3 ＋　Moves the 3rd axis to ＋ direction
G：
J:W ＋＋　Moves the 1st axis to ＋ direction, the 2nd axis to ＋ direction
G：
J:W ＋＋－　Moves the 1st axis to ＋ direction, the 2nd axis to ＋ direction, and the 3rd axis to －
G：　direction

・G Command：Drive command

It is a command to start driving.
This command is used always after A, M, or J command. If there is no A, M, or J command, or the command has been already executed, this command does not operate.

G：　Drive command

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・H Command：Return to the mechanical origin command

It is a command to return the stage to the mechanical origin. It returns to 0 step point（0mV output point）at open loop control, and 0nm point at closed loop control.

H：1　Return 1st axis to the mechanical origin
H：2　Return 2nd axis to the mechanical origin
H：3　Return 3rd axis to the mechanical origin
H：W　Return all axes to the mechanical origin

・N Command：Logical origin command

It is a command to return the stage to the logical origin point.

N：1　Return 1st axis to the logical origin
N：2　Return 2nd axis to the logical origin
N：3　Return 3rd axis to the logical origin
N：W　Return all axes to the logical origin

・L Command：Stop command

It is a command to stop the stage.

L：1　Stop the 1st axis
L：2　Stop the 2nd axis
L：3　Stop the 3rd axis
L：W　Stop all axes
L：E　Stop the stage immediately and return to the mechanical origin as same as emergency stop button

・R Command：Coordinate value clear command

It is a command to clear the coordinate value. The coordinate value is set to 0 step at open loop control, and 0nm at closed loop control.

R：1　Clear the coordinate value of 1st axis
R：2　Clear the coordinate value of 2nd axis
R：3　Clear the coordinate value of 3rd axis
R：W　Clear the coordinate value of all axes

・D Command：Step amount setup command

The speed number of "SPEED SEL" setting in the memory switch is set to initial value at power-on.
This command allows you to change these initial setting.

（Values）1 ～ 3000 steps
D：1100S　Change the step amount of 1st axis to 100 steps
D：2100S　Change the step amount of 2nd axis to 100 steps
D：3100S　Change the step amount of 3rd axis to 100 steps
D：W10S20S　Change the step amount of 1st axis to 10 steps, 2nd axis to 20 steps
D：W100S200S300S　Change the step amount of 1st axis to 100 steps, 2nd axis to 200 steps, and 3rd axis to 300 steps.

・@ Command：Hysteresis curve data acquisition command

This command read the displacement value by digital sensor and acquires hysteresis characteristic. 0mV is displayed at open loop control.

@：　Hysteresis curve data acquisition command

・K Command：Closed loop control command

Change the tracking mode and the lock mode at closed loop control.
Tracking mode：Mode which follows the in-position according to the instructed value.
Lock mode：Mode which does not follow the in-position according to the instructed value.

K：0　Tracking mode
K：1　Lock mode

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・Q command：Status request command

On receipt of this command, the controller returns the coordinate for each axis and the current state of each stage. The controller send the coordinate data of each axis with 10 figures, and then reply the all data length by 16/27/38 figures.

Q：
0, 0, 0, ACK1, ACK2, ACK3
0, 0, 0：Coordinate values are 1st axis : 0 step, 2nd axis : 0 step, and 3rd axis 0 step.

ACK1（Command received status）	K：Command received normally
	X：Command error
ACK2（Stopping Cause）	K：Stopped normally
	W：Stopped by an error
ACK3（Command receptiblity）	R：All commands are receptible
	B：Now busy, command unreceptible

・V command：Supplied voltage check command

It is a command which responds supplied voltage（－ 10000 ～＋ 150000mV）.（Value below 1mV is omitted）

V：1　Responds supplied voltage of the 1st axis
V：2　Responds supplied voltage of the 2nd axis
V：3　Responds supplied voltage of the 3rd axis
V：W　Responds supplied voltage of all 3 axes

Example）V：W
0, 5000, － 10000　1st axis 0V supplied, 2nd axis 5V supplied, and 3rd axis － 10V supplied

・！command：ACK3 configuration command

Replies the status of ACK3.
！：

・？command：Internal information acquisition command

Replies the internal information according to the parameter.
？：[Parameter letter]［AXIS］

［AXIS］is valid only in "D,C"

Parameter letter	Meanings	Reply example
N	Reply model name	FINE-503
V	Reply version number	V1.00
D	Reply speed number	1S
C	Reply control mode	0=CLOSE 1=OPEN

・P command：Execution of internal program command

This command is used to execute the programmed operations according to a controller-internal program.

P：R	Enter remote（execute）mode
P：H	Return to host（computer）mode
P：P［No.］	Set program number（1 or 2）［No.］1, 2
P：S	Start independent programmed operation
P：E	Stop independent programmed operation
P：U0	Temporarily suspend independent programmed operation
P：U1	End temporary pause of independent programmed operation
P：C0	Prevent transmission of "operation complete"（COMP）signal when programmed operation is completed
P：C1	Allow transmission of "operation complete"（COMP）signal when programmed operation is completed

*）The controller will send the data string "COMP" when programmed operation is completed

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8. Editing Programs in EDIT Mode

In EDIT mode, you can edit program data stored inside the controller.
There are two programs, No.1 and No.2. Each line number can be edited up to maximum 1000.

8-1 Recording Selections and Data input

Programs can be edited by using each buttons on the control pad.

1) Record buttons

Cross-shaped, up, and down ：Cycle through program numbers in the order No.1 → 2 → 1 → 2

SET ：① In the EDIT mode start-up screen, press this button to begin editing
② On the confirmation screen, press this button to exit and record changes to settings

SPD ：On the confirmation screen, exit without saving changes to settings

MODE ：① Press to exit EDIT mode (a confirmation screen will be displayed)
② In the confirmation screen displayed at completion of EDIT mode operations, press MODE to return to EDIT mode

2) Data-entry buttons

Cross-shaped, up ：Scroll through program line numbers in descending order (No.5 → 4 → 3 → 2)

Cross-shaped, down ：Scroll through program line numbers in ascending order (No.1 → 2 → 3 → 4)

Cross-shaped, right ：Move the edit cursor to the right

Cross-shaped, left ：Move the edit cursor to the left

SET ：Make changes to the selected item (numerical data increases)

SPD ：Make changes to the selected item (numerical data decreases)

8-2 Editing Programs：An Example

This example illustrates how to edit programs with the FINE-503.

[Operation]

① From the EDIT mode screen, press the "SET" button. The program-number selection screen will appear.

② Select a program number by pressing the top or bottom of the cross-shaped button.
Press the top or bottom of the cross-shaped button to cycle through settings. (No.1 → No.2 → No.1)
In this example, position data will be recorded in Program No.1. Press the "SET" button when "PROGRAM NO.1" is displayed. The screen will change to program data in Edit mode.

③ Data are separating by commas. Move the cursor using by the right and left sides of the Cross-shaped button.

④ After moving the cursor to the item you wish to edit, press the "SET" or "SPD" buttons to change the setting for the item.

Fig.8-1 EDIT Mode Screen

E	0	1	:								0		S	
1	0	2	:								0		S	
	0	3	:								0		S	
R	E	S	:	*	*	*	,	*	*	*	,	*	*	*	

Fig.8-2 Program Number Selection

	E	D	I	T		M	O	D	E					
	P	R	O	G	R	A	M		N	O	.		1		

Fig.8-3 Confirmation Dialog

O	K	?												
	Y	E	S					→		(	S	E	T	)
	N	O						→		(	S	P	D	)
	C	A	N	C	E	L		→		(	M	O	D	E	)

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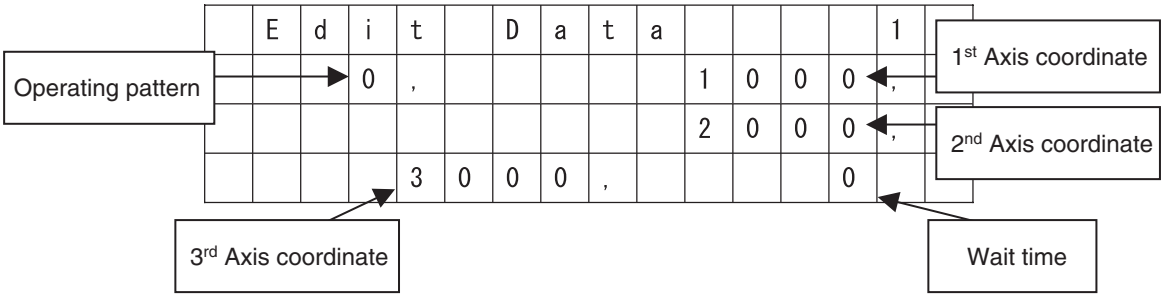
Fig.8-4 Editing Programs



⑤ Press the "MODE" button when entry is complete The confirmation screen shown in Fig. 8-3 will appear display, "(YES:SET) (NO:SPD) (CANCEL:MODE)".
Press the "MODE" button to make further changes to position data.
Press the "SPD" button to exit without saving position data.

⑥ Press the "SET" button.
Position data will be saved and the initial screen for EDIT mode will be displayed.

8-3 Explanation of Program Data

Example of relative positional coordinates entered Program No.1

① Line number	② Operating pattern	③ Specified First-axis coordinate	④ Specified Second-axis coordinate	⑤ Specified third-axis coordinate	⑤ Wait time
1	F	255	—	—	—
2	0	10	10	10	2
3	30	—	—	—	0
4	N	—	—	—	—
5	99	—	—	—	—
1000					

① Line number Programs can consist of from one to one thousand lines.

② Operating pattern 0：normal operation (move to specified coordinates and then stop)
30：Return to starting origin (specified first axis)
Only specified first axis returns to starting origin.
Specified second axis is still stopping.
31：Return to starting origin (specified second axis)
Only specified second axis returns to starting origin.
Specified first axis is still stopping.
32：Return to starting origin
Specified first and second axes return to starting origin.
33：Return to starting origin
Specified first and second and third axes return to starting origin.
F：Repeat a block of operations a specified number of times
The number of repeats can be input to the coordinates for the first axis (1 to 255).
N：Marks end of block of operations to be repeated
99：End of data
This pattern must be entered in the last line of the program (no operation is performed)

③ Movement distance on specified first axis
Input the relative distance to be moved (±120000 steps：OPEN , ±999999 nm：CLOSE)
*) If the operating pattern is 30/31/32/33/F/N/99, "- " will be input

④ Movement distance on specified second axis
Input the relative distance to be moved (±120000 steps：OPEN , ±999999 nm：CLOSE)

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*) If the operating pattern is 30/31/32/33/F/N/99, "- " will be input

⑤ Wait time

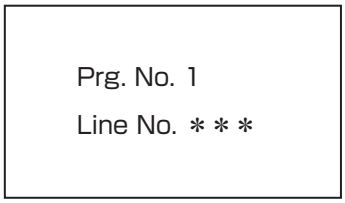
Enter wait time (0 to 2560 in units of 0.1 seconds)

*) If the operating pattern is 30/31/32/33/F/N/99, "- " will be input

9.Programmed Operation of FINE Stages

Programs edited in edit mode can be used to operate FINE stages by means of commands received from the computer or by signals from Control Pad. There are two programs, No.1 and No.2. As end-of-operation signals are output when each operation is completed, programmed operation can be used for easy remote control while confirming the operating condition of each stage. The LCD display during programmed operation shows the program number and the line currently being executed (see below).

LCD Display during program execution



9-1 Starting Programmed Operations from a Control Pad

Pressing the Ctrl and STOP buttons simultaneously when no computer is connected will start programmed operation.

「Operation」

① From the REMOTE mode screen, press the "SET" button.
The selection screen for program number setting will appear.

② Press the "top and bottom of the cross-shaped", "PROGRAM No.1" or "PROGRAM No.2" is displayed.

③ Press the "Ctrl" and "STOP (RUN)" buttons starts programmed operation.。

9-2 Starting Programmed Operations from a Computer

When starting programmed operations from a computer, you can perform motorized operations (positioning) following the instructions in the program by sending remote (execute) commands from host (computer).
The available commands are shown below.

P：R	Enter remote (execute) mode
P：H	Return to host (computer) mode
P：P [No.]	Set program number (1 or 2) [No.] 1, 2
P：S	Start independent programmed operation
P：E	Stop independent programmed operation
P：U0	Temporarily suspend independent programmed operation
P：U1	End temporary pause of independent programmed operation
P：C0	Prevent transmission of "operation complete" (COMP) signal when programmed operation is completed
P：C1	Allow transmission of "operation complete" (COMP) signal when programmed operation is completed

*) The controller will send the data string "COMP" when programmed operation is completed

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10. Sending and Receiving Program and Memory Switch Data from a Computer

Program data and memory switch settings can be edited on a computer and downloaded to the controller, or data can be uploaded to computer and saved to disk.

10-1 Control Pad Operations

Record buttons

Cross-shaped, up, and down : ① Select program number or memory switch
: ② Select UP LOAD or DOWN LOAD

SET : ① In the LOAD mode start-up screen, press this button to upload or download data
: ② Press to choose a program number or memory switch
: ③ Press to upload or download data

MODE : Press to cancel selection or upload/download (the previous screen will be displayed)

10-2 Example of Upload and Download Operations

This example illustrates how to upload Program No.1 using the FINE-503.

[Operations]

① From the LOAD mode screen, press the "SET" button. The selection screen for program number and memory switch settings will appear.

② Press the "top and bottom of the cross-shaped" button until "PROGRAM No.1" is displayed.
After checking the display, press the "SET" button to display the selection screen for upload and download. If you press the "MODE" button at this point, you will return to the previous screen.

③ Press the "top and bottom of the cross-shaped" button until "UP LOAD" is displayed.
After checking the displayed, press the "SET" button. The display, "(YES:SET)" "(CANCEL: MODE)" will appear. If you press the MODE button at this point, you will return to the previous screen. Press the "SET" button to upload the data for Program 1 to the computer.

④ When upload has been completed, the message "Saving・・・・・OK!" will appear, and the upload/download selection screen will be displayed.
When a download has been completed, the message "Receiving・・・・・OK!" will appear, and the upload/download selection screen will be displayed.
Press the "MODE" button twice to return to the Screen displayed at the beginning of LOAD mode.

Figure 10-1 LOAD Mode Screen

```
L 0 1 :             0   S
1 0 2 :             0   S
  0 3 :             0   S
R E S : * * * , * * * , * * *
```

Figure 10-2 Program Number Selections

```
  L O A D   M O D E
  P R O G R A M   N O .   1
```

Figure 10-3 Memory Switch Selections

```
  L O A D   M O D E
  M E M O R Y   S W I T C H
```

Figure 10-4 UP LOAD/DOWN LOAD Selection

```
  L O A D   M O D E       1
          U P   L O A D
```

Figure 10-5 Confirmation Screen

```
  D A T A 1         U P   L O A D
  O K ?
    ( Y E S       : S E T   )
    ( C A N C E L : M O D E )
```


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10-3 Example of Format for Download Data

(1) Program data

Program data are variable length and are recorded as CSV files (comma separation, CR+LF)

[Example] 1,0,1000,1000,1000,3 [CR] [LF]
2,0,100,10000,1000,2 [CR] [LF]
3,99,-,-,-,- [CR] [LF]
[EOF] [EOF] : End of File = 1A (Hex) or Z (ASCII)

(2) Memory switches

Commas are used as separators.

[Example] 1,1,0,1,2,・・・・・,1,0,0 [EOF] [EOF] : End of File = 1A (Hex) or Z (ASCII)

10-4 Example of Format for Uploaded Data

(1) Program data

Program data are variable length and are recorded as CSV files (comma separation, CR+LF)

[Example] 1,0,1000,1000,1000,3 [CR] [LF]
2,0,100,10000,1000,2 [CR] [LF]
3,99,-,-,-,- [CR] [LF]
[EOF] [EOF] : End of File = 1A (Hex)

(2) Memory switches

Commas are used as separators.

[Example] 1,1,0,1,2,・・・・・,1,0,0 [EOF] [EOF] : End of File = 1A (Hex)

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Chapter 3 Specification

11. Specification

(1) General specification

Electrical ratings	
Voltage	FINE-503 AC120V: 120Vac
	FINE-503 AC230V: 230Vac
Voltage fluctuations	±10%
Current	0.5A
Frequency	50/60Hz
Operating temperature	10 to 30℃
Storage temperature	-20 to 60℃
Ambient humidity	Maximum 80%RH for temperature up to 31℃
Altitude	Up to 2000m
Indoor use only	
Installation category	Ⅱ
Pollution degree	2
External degree	270Wx297Dx118H（excluding projections）
Weight	5.3Kg

(2) Performance Specification

Number of axes controlled	3 axes
D/A Converter	18 bit
Maximum output voltage	-10 ～ 150V（-8000 ～ 120000 Steps）1 Step = 1.25mV
Display / Coordinates setting range	
Coordinates display	± 999999 Steps（Open loop control）
	± 999999nm（Closed loop control/Open loop control "Sensor display"）
	－ 10000 ～＋ 150000mV（Open loop control / Closed loop control）
	（value less than 1mV is omitted）
Control mode	O/C（Discernment of an open loop and closed loop）
Resolution	nm（Resolution per count of a sensor）
	Resolution is effective only at closed loop control.
External Interface	RS232C Interface
	Communication Parameter
	・Baud Rate 38400/19200/9600/4800
	・Data Bit 8bit
	・Parity None
	・Stop Bit 1bit
	・Delimiter CR、LF、CR+LF
	GP-IB Interface
	・Configuration address 1 ～ 30
	・Delimiter CR、LF、CR+LF、EOI
	USB1.1 Interface

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12. About Connectors

12-1 RS232C Connector

Number	Name	Number	Name
1	—	6	DTR
2	TXD	7	CTS
3	RXD	8	RTS
4	DSR	9	—
5	SG		

model number：XM3B-0922-132（OMRON）female type
SIGMA cable model number：RS232C/STR

12-2 GP-IB Connector

Number	Name	Number	Name
1	DATA1	13	DATA5
2	DATA2	14	DATA6
3	DATA3	15	DATA7
4	DATA4	16	DATA8
5	EOI	17	REN
6	HND(DAV)	18	GND
7	HND(NRFD)	19	GND
8	HND(NDAC)	20	GND
9	IFC	21	GND
10	SRQ	22	GND
11	ATN	23	GND
12	SHIELD	24	GND

model number：57L-20240-7700D35（DDK Ltd.）
SIGMA cable model number：GP-IB

12-3 USB1.1 Connector

Number	Name	Number	Name
1	—	3	+DATA
2	– DATA	4	GND

model number：XM7B-0442（OMRON considerable article）

12-4 PIEZO1/2/3

model number：HRM-305（HIROSE ELECTRIC）
SIGMA cable model number：FINE-CA-3

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12-5 SENSOR1/2/3

Number	Name	Number	Name
1	IN	4	GND
2	VDD	5	SOUT
3	CLK	6	GND

model number：HR10G-7R-6S（HIROSE ELECTRIC product）
SIGMA cable model number：DS1-CA-3

12-6 CONTROL PAD

Number	Name	Number	Name
1	DATA	4	+5V
2	—	5	CLK
3	GND	6	—

model number：TC7668-01-201（HOSHIDEN product）

13. Check Before Reporting Troubles

Please refer to the following items whether it does not operate right or has trouble with communication when using the product.

Please contact us in case if it does not operate correctly even after all of the following items are checked.

① Not turn on the power	・Check whether the power supply cable is connected correctly. ⇒ Refer to《3-2》 ・Check whether the operating voltage range is right.
② Stage does not work correctly	・Check whether the cable is connected correctly. ⇒ Refer to《3-1》 ・Check whether the settings of a memory switch are correct. ⇒ Refer to《6-3》 Check item 2）and 9-11）especially. 2）The number selection of control axes：Set the number of axes to control. It only control except the selected number of axes. 9-11）Control system setup：Set the control system. Select open loop control or closed loop control according to the operating condition. ・In closed loop control, "Sensor Resolution" changes with the memory switch No.18"SAMPLE" and the position of a stage. Make sure the "INPOS" setting（memory switch No.12-14）suitable for "Sensor Resolution." ⇒ Refer to《6-2》
③ Setting of the Memory Switch is not reflected	・Check whether the settings of a memory switch are right. ⇒ Refer to《6-3》 ・Reboot the controller after setting up a memory switch.
④ Control Pad does not work	・Check whether the control pad is connected correctly. ⇒ Refer to《3-2》 ・When you connect a control pad, be sure to connect it while the power is off. If it is connected when the power is on, it may not operate correctly.

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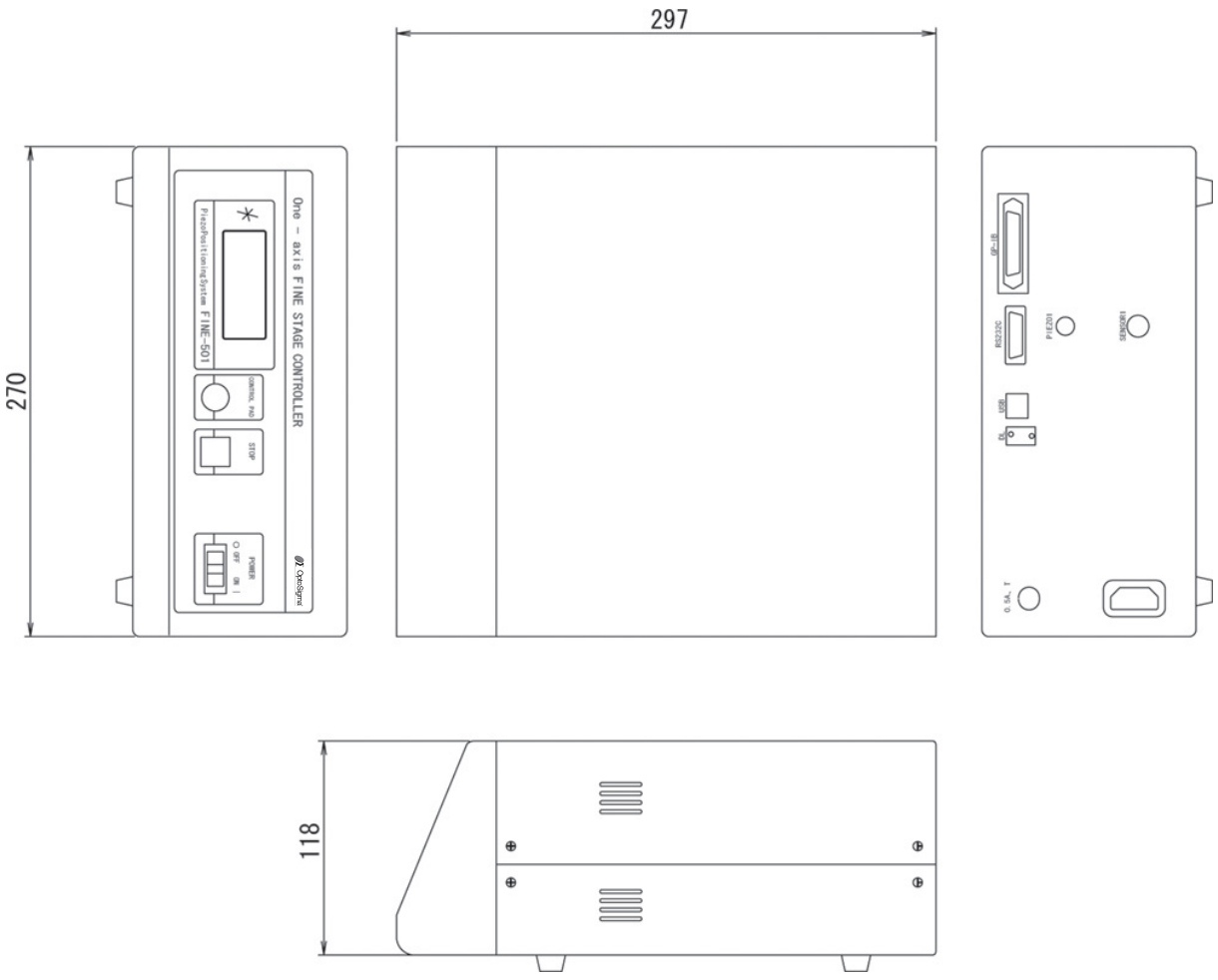
⑤ Can not communicate with PC	・Check whether cables are connected correctly. ・Check whether the settings of a memory switch are correct. ⇒ Refer to《6-3》 Check item 2/3）to 5/6/6）especially. 2/3/3）Communication Interface Selection：Set communication system. Set up according to the using interface. （RS232C, USB, GP-IB） 3/4/4）Baud Rate Setup：Set the data-communications speed when RS232C is used. Set up according to the data-communications speed of the PC. 4/5/5）Delimiter Setup：Set the delimiter FINE of the block used in communicated data. Set up according to the data-communications speed of the PC. Exceptions: It is fixed to CR when USB is selected. Moreover, EOI is usable only when GP-IB is selected. 5/6/6）GP-IB Address Setup：Set the address of GP-IB when it is in use. Set up according to the communication address.

14. Outside Dimension

FINE-503



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MEMO

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2015.12. Third edition