CANON Digital Galvano Scanner System

GM-1000 Series

GC-201

Users Manual

Rev. 1.20

Be sure to read this guide before using the product.
Keep this guide carefully for future use.

For Safe and Correct Use

To prevent injury to the user or damage to property, this guide gives information for the safe and correct use of this product.

Before installation, operation, maintenance, or inspection, be sure to read this guide.

Markings

This guide uses the following markings:

⚠ Warning

This indicates the possibility of death or serious injury by a fire or electric shock.

⚠ Caution

This indicates the possibility of injury or damage to property.

⚠ Warning

・Do not use the product in an atmosphere of inflammable or explosive gas or vapor.
・Use the product at the specified voltage.
・Connect the power supply line correctly.
・Do not install, operate, maintain, or inspect the product with wet hands.
・Do not disassemble or alter this product.
・Do not drop or cause impact to the product.

⚠ Caution

・Before installation, operation, maintenance, or inspection, thoroughly check that the device is safe.
・When connecting a connector, check the pin numbers with the power off.
・When connecting oscilloscope probes to the test pins, be careful not to apply tension to them.
・Since this product is a precision device, use it under the specified environmental conditions.
・Do not store or transport this product in a place exposed to direct sunlight, moisture, dust, or temperature of 60ºC or higher.

Contents

1. Product Outline

1.1. Features

The Canon Digital Galvano Scanner System is fully digitally controlled with a high-precision optical encoder on the galvano motor and a high-speed digital signal processor (DSP) on the controller.

This system has the following features:

- High positioning precision
- Low temperature drift
- Fast and stable operation by a unique control system
- Easy tuning with parameter settings

1.2. Configuration

This system supports various applications by the combination of a galvano motor and a controller.

Galvano motor: Encoder-mounted galvano motor

GM-1010 ···· Beam diameter: φ8 to φ10 mm

GM-1015 ···· Beam diameter: φ10 to φ15 mm

GM-1020 ···· Beam diameter: φ15 to φ30 mm

Controller: Digital servo-controller

GC-201 ···· Controller for two-axis control

IF board: IF board for high-speed serial communication

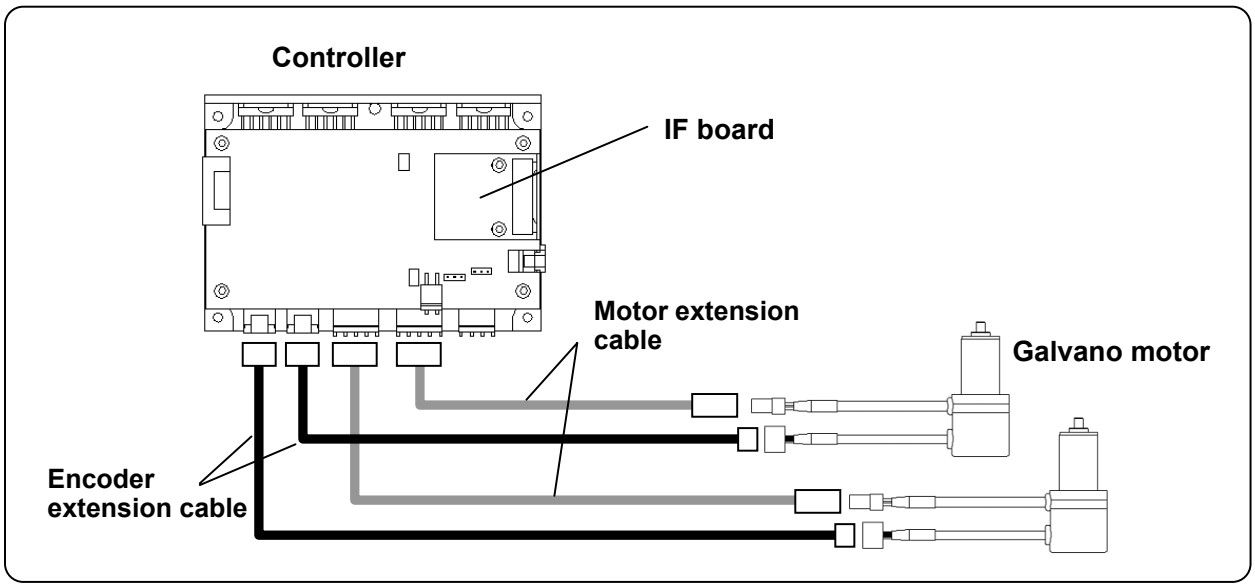
GC-422 ···· IF board for 5V-TTL (RS-422)

GC-LVDS ···· IF board for LVDS level

Extension cable: Extension cable for galvano motor and controller connection

GM-EC10, 20, 30 ···· Encoder extension cable (1, 2, 3 m)

GM-MC10, 20, 30 ···· Motor extension cable (1, 2, 3 m)



2. Specifications

2.1. Galvano Motor (GM-1010, GM-1015, and GM-1020)

Performance and shape

	GM-1010	GM-1015	GM-1020
Conforming beam diameter	Φ8 to φ10	φ10 to φ15	φ15 to φ30
Scan angle	±20 deg	±20 deg	±20 deg
Encoder cycle number	1000 pulses/rotation	1500 pulses/rotation	1500 pulses/rotation
Number of encoder pulses	8,192,000 pulses	12,288,000 pulses	12,288,000 pulses
Command resolution	0.77 µrad	0.51 µrad	0.51 µrad
Torque constant	0.0127 Nm/A	0.0226 Nm/A	0.0415Nm/A
Weight	200 g	300 g	600g

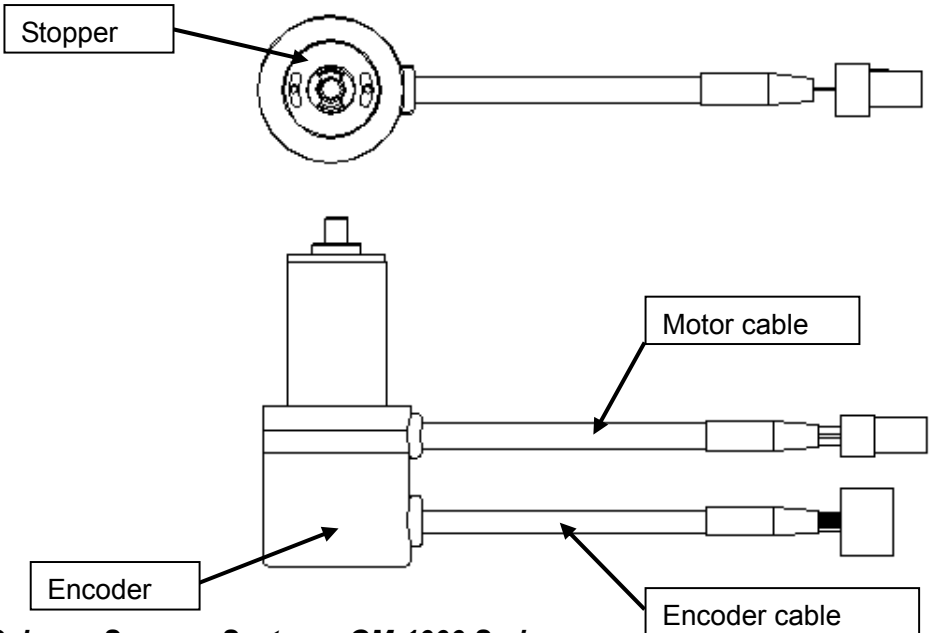
(Reference)
For details about encoder cycle number, number of encoder pulses, and command resolution, see2.8.1. “Number of Encoder Pulses”.

Environmental conditions

Operating temperature and humidity	0 to 50ºC, 90% RH or less (No condensation)
Storage temperature and humidity	–20 to 60ºC, 90% RH or less (No condensation)

Note: The above operating temperature and humidity conditions depend on the operating and heat radiation conditions.

Part names



2.2. Controller (GC-201)

Performance and Dimensions

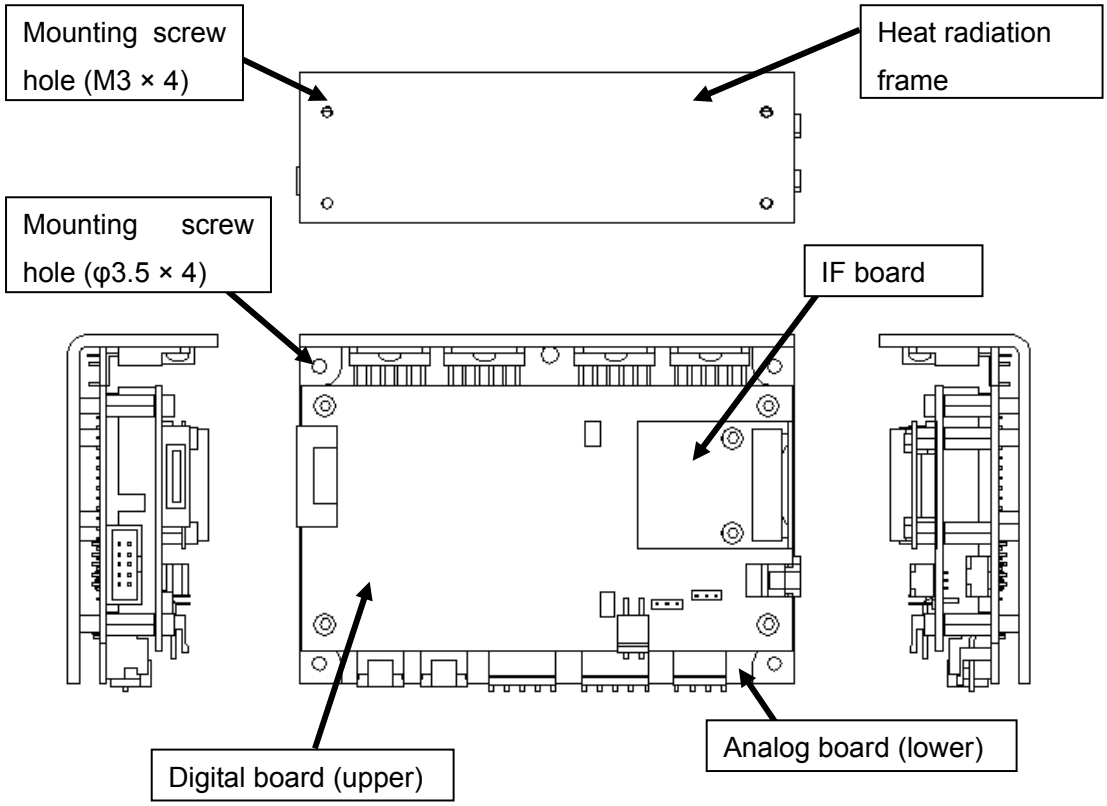
	GC-201
Number of control axes	2
Control sampling	100 kHz
Maximum drive current	Peak 10 A (each axis)
Interface	RS-232C , High-speed serial communication(XY2-100)
Notch filter	Digital notch filter ×2 Digital low-pass filter ×1 Analog notch filter ×2
Weight	350 g

Environmental conditions

Operating temperature and humidity	0 to 50ºC, 90% RH or less (No condensation)
Storage temperature and humidity	-20 to 60ºC, 90% RH or less (No condensation)

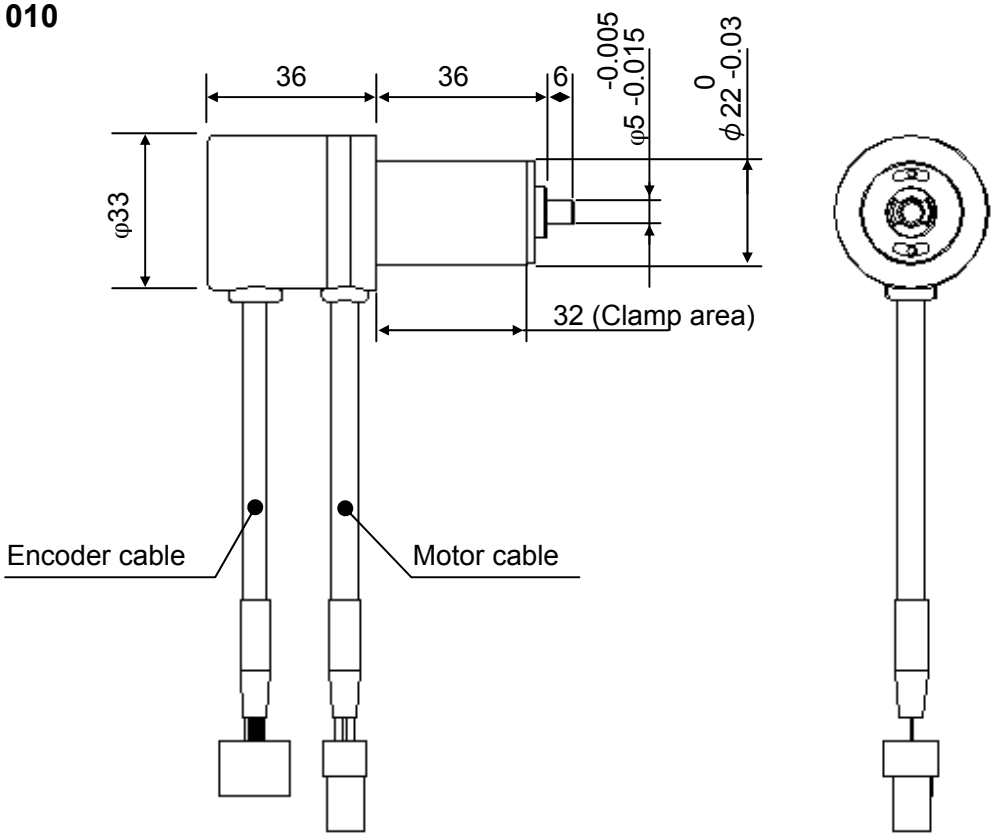
Note: The above operating temperature and humidity conditions depend on the operating and heat radiation conditions.

Section names

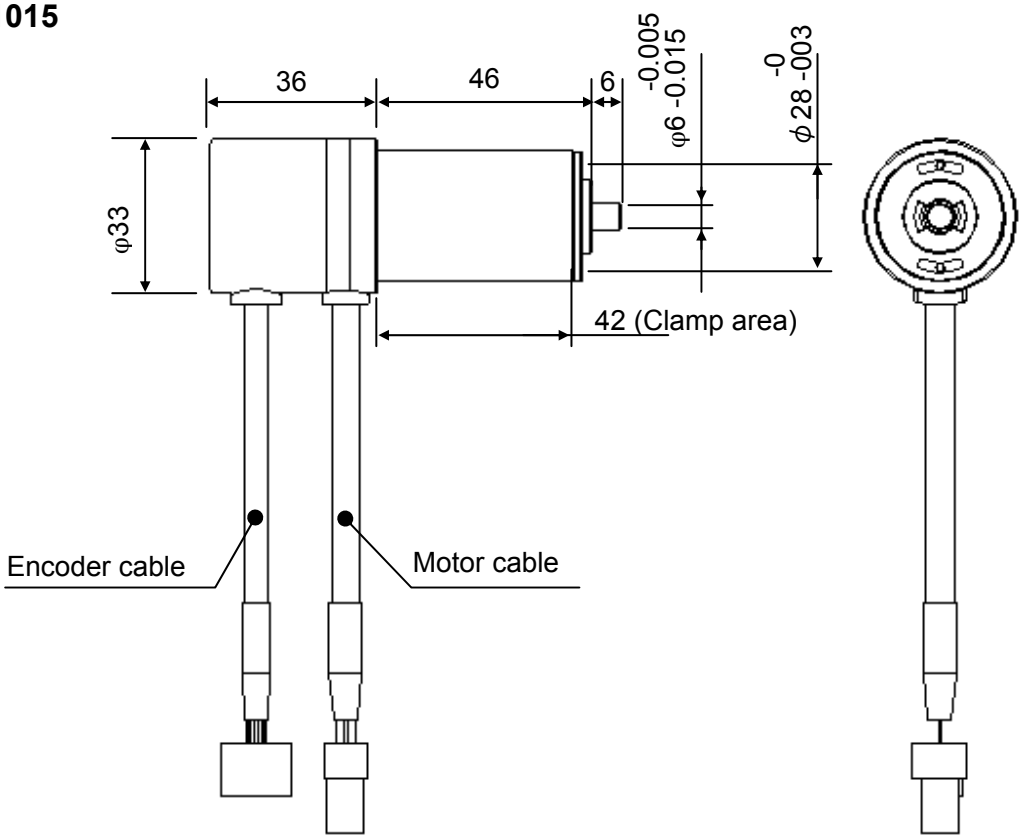


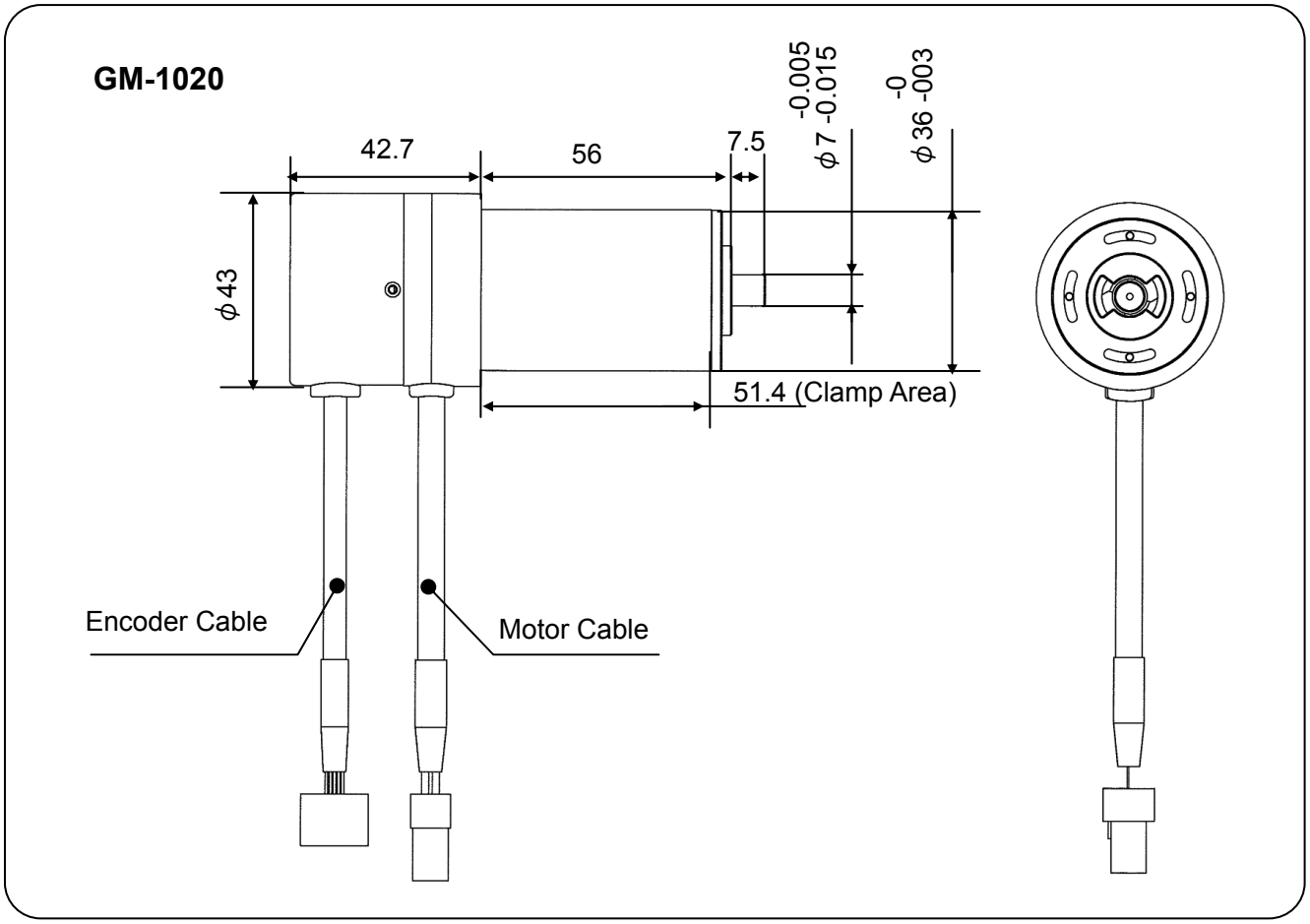
2.3. Dimensions

GM-1010

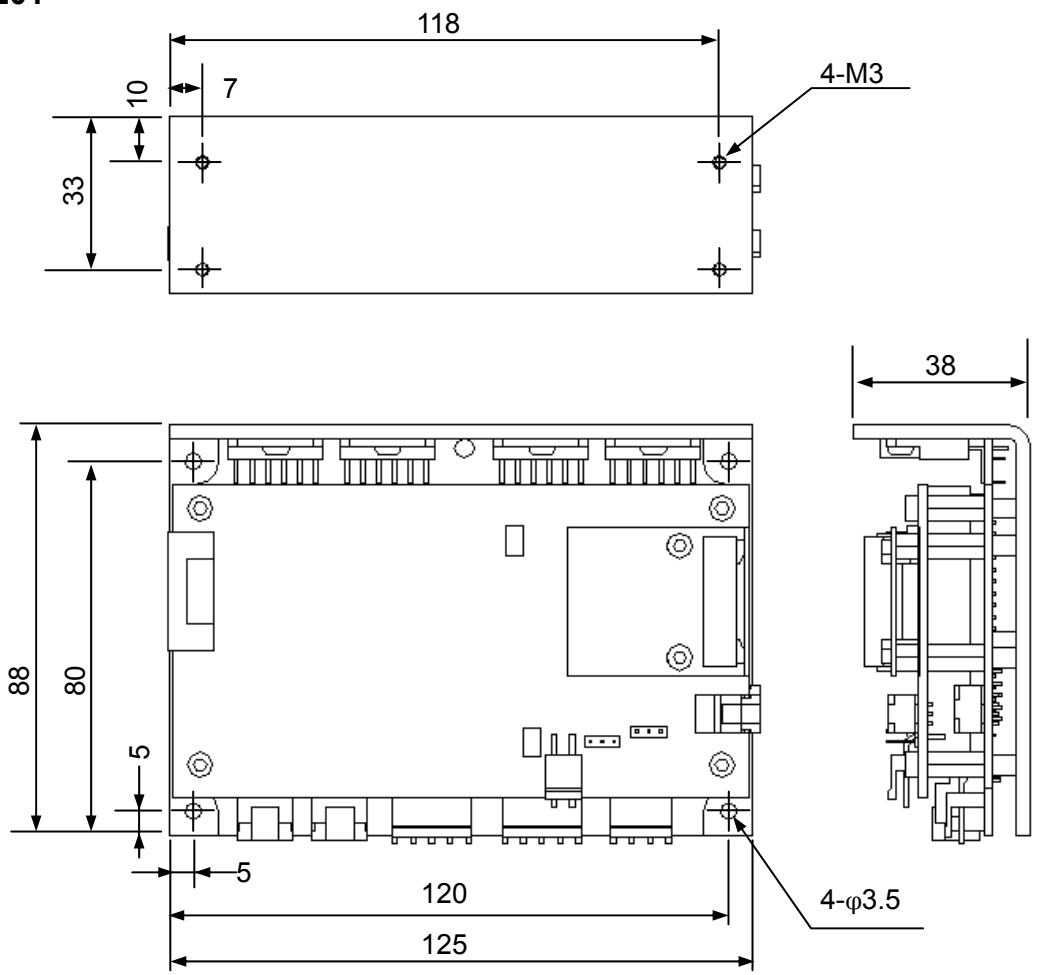


GM-1015





GC-201



2.4. Power Supply

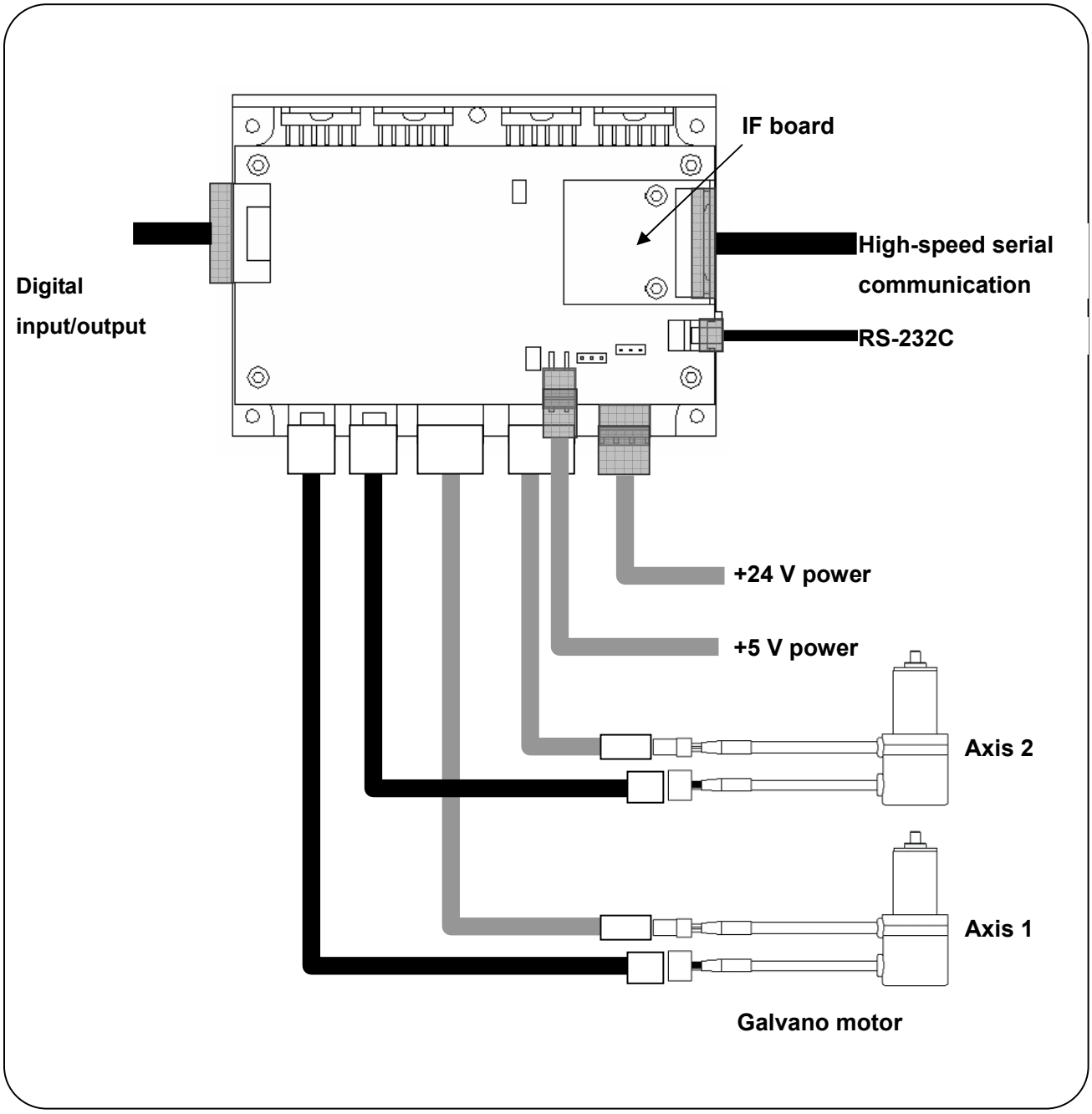
Power supply specifications

+24 V ± 10%	(For motor drive)	Peak 10 A × 2 axes
		RMS 2.5 A × 2 axes

(RMS value differs according to operating conditions, the above conditions GM-1010, Ymirror、±5°, 200Hz)

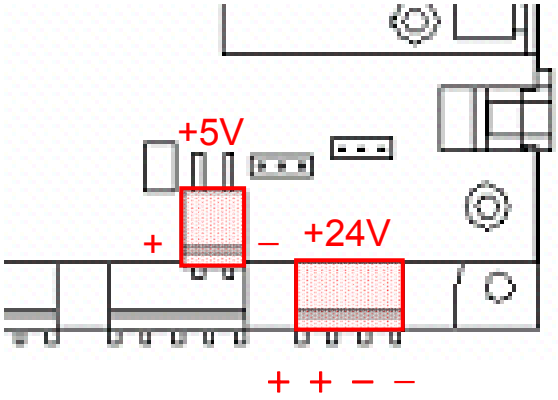
+5 V ± 5%	(For control circuit)	2.8 A

2.5. Connections



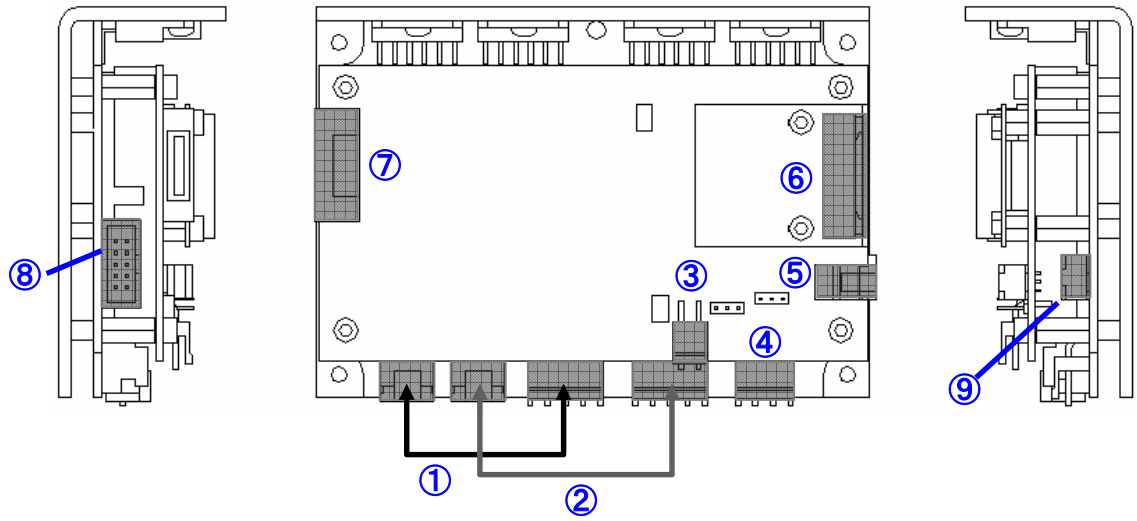
Note:

- Connecting the power +24 V, and GND in reverse will damage the GC-201 controller. Take caution when connecting.
- Connecting the power +5 V, and GND in reverse will damage the GC-201 controller. Take caution when connecting.



2.6. Connector and Pin Assignment

(Connector types)



①	Axis 1 motor encoder connector
②	Axis 2 motor encoder connector
③	+5 V power supply
④	+24 V power supply
⑤	RS-232C
⑥	High-speed serial communication
⑦	Digital input/output
⑧	Analog monitor
⑨	Fan power supply (+24 V)

(Connector model number & pin assignment)

③ +5 V power supply

(Connector model number)

Connector	Model No.	Manufacturer
Board side	S2P-VH	JST
Cable side	VHR-2N	JST

(Connector pin assignment)

Pin No.	Signal Description
1	+5 V
2	GND

④ +24 V power supply

(Connector model number)

Connector	Model No.	Manufacturer
Board side	S4P-VH	JST
Cable side	VHR-4N	JST

(Connector pin assignment)

Pin No.	Signal Description
1	+24 V input for Axis 1
2	+24 V input for Axis 2
3,4	GND

⑤ RS-232C

(Connector model number)

Connector	Model No.	Manufacturer
Board side	S03B-PASK-2	JST
Cable side	PAP-03V-S	JST

(Connector pin assignment)

Pin No.	Signal Description
1	Send data (Signal level complying with RS-232C)
2	Receive data (Signal level complying with RS-232C)
3	GND

⑥ High-speed Serial Communication

(Connector model number)

Connector	Model No.	Manufacturer
Board side	SM12B-PASS-1-TB	JST
Cable side	PAP-12V-S	JST

(Connector pin assignment)

Pin No.	Signal Name	Signal Description
1	CLK-	Clock (-)
2	CLK+	Clock (+)
3	FS-	Frame sync (-)
4	FS+	Frame sync (+)
5	DAT(AXIS 1) -	Axis 1　Target position data (-)
6	DAT(AXIS 1)＋	Axis 1　Target position data (+)
7	DAT(AXIS 2) -	Axis 2　Target position data (-)
8	DAT(AXIS 2)＋	Axis 2　Target position data (+)
9	STS-	Status (-)
10	STS+	Status (+)
11	GND	System GND
12	FG	Frame GND

The signal levels depend on the IF board.

GC-422 - Receiver: AM26LV32C (TI), Driver: SN75179B (TI)

GC-LVDS - Receiver: SN65LVDS32 (TI), Driver: SN65LVDS179 (TI)

⑦ Digital I/O

See 5.1.　“Connector Pin Assignment”

⑧ Analog Monitor

See 5.1.　“Connector Pin Assignment”

⑨ Cooling Fan Power Supply

(Connector model number)

Connector	Model No.	Manufacturer
Board side	S04B-PASK-2	JST
Cable side	PAP-04V-S	JST

(Connector pin arrangement)

Pin No.	Signal Description
1	+24 V Output
2	GND
3	(No connection)
4	(No connection)

2.7. Optional Cables

Optional cables are prepared for power and communications cables.

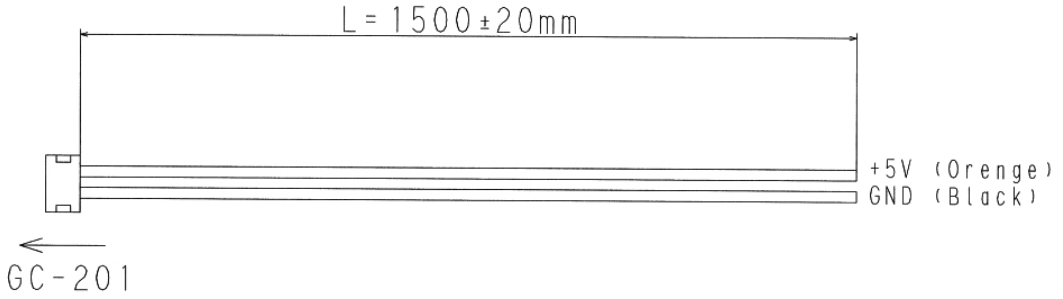
Connector pin assignment for each cable as follows.

Verify details with your sales representative.

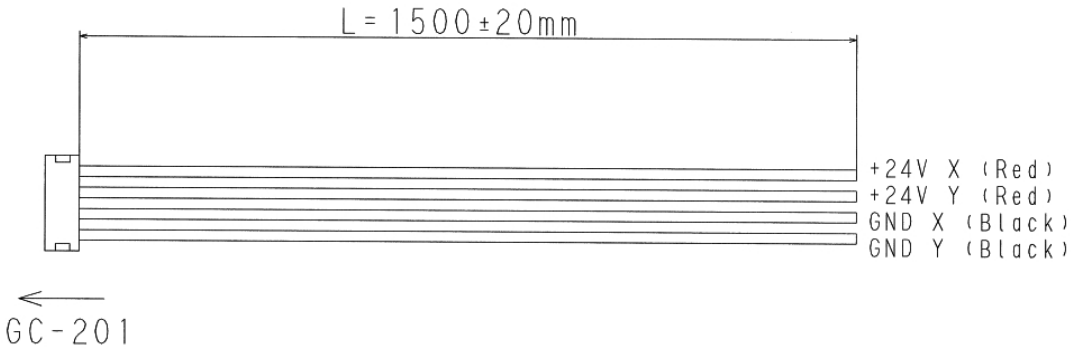
Option cables

①	Power cable (+5 V)
②	Power cable (+24 V)
③	RS-232C cable
④	High-speed serial communication cable

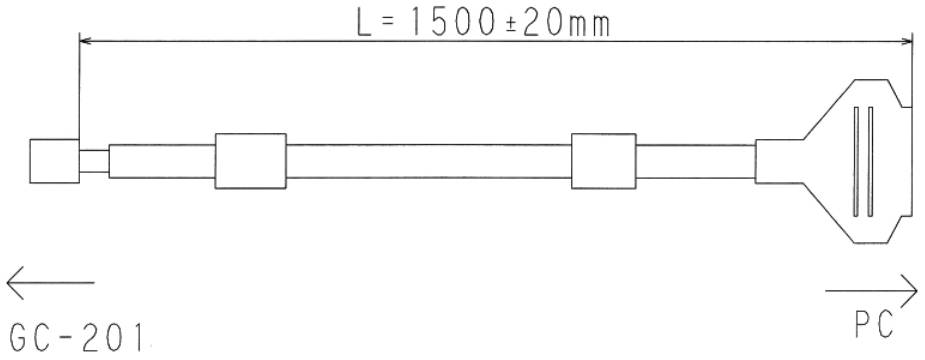
① Power Cable +5 V



② Power Cable +24 V



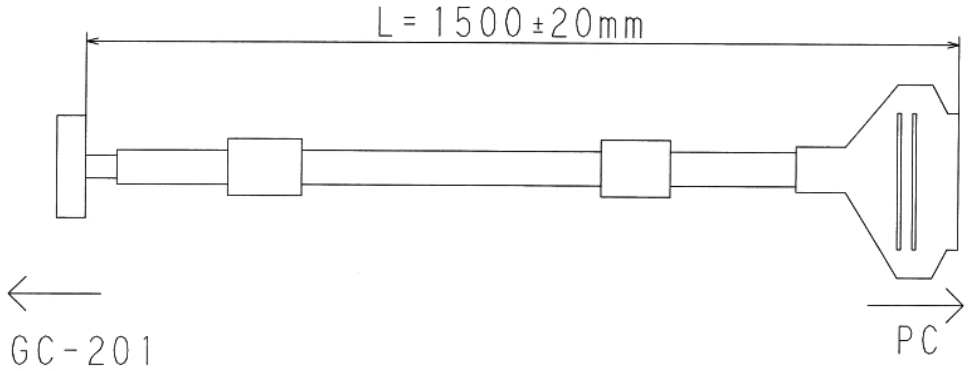
③ RS-232C Cable



PC side (D-sub 9 pin)

Pin	Signal
2	RX
3	TX
5	GND

④ High-Speed Serial Communication Cable



PC side (D-sub 25pin)

Pin	Signal	Pin	Signal
1	Clock -	14	Clock +
2	FS -	15	FS +
3	Data (Axis 1) -	16	Data (Axis 1) +
4	Data (Axis 2) -	17	Data (Axis 2) +
5	Do not connect	18	Do not connect
6	Status -	19	Status +
7	Do not connect	20	Do not connect
8	Do not connect	21	Do not connect
9	Do not connect	22	Do not connect
10	Do not connect	23	GND
11	GND	24	GND
12	Do not connect	25	Do not connect
13	Do not connect		

2.8. Control Specifications

The controller (GC-201) is operated by:

- **RS-232C command input**
- **High-speed serial communication**

	RS-232C communication command input	High-speed serial communication
Features	- Raster scan and step movement etc. can be performed easily. - In order to obtain synchronization with external equipment, operation can be started with an external trigger signal. (Fluctuating delays may occur within the internal control sampling time.)	- Vector scans with control over the desired locations of two axes are possible. This is used in laser marking etc. - Complete synchronization with external equipment can be obtained in order to use high-speed serial communication clock pulses by controlling the controller. - As it can be operated with XY2-100 communication specifications, a controller compliant with XY2-100 can be connected.
Target position command	RS-232C communication command	High-speed serial communication
Operation setting parameter setting	RS-232C communication command	RS-232C communication command
Control clock	Uses the controller GC-201 internal circuit clock pulses	Uses high-speed serial communication clock pulses

- A target position command input by an RS-232C communication command, or a target position command from a high-speed serial communication can be mutually switched with a command. (See 2.8.5. “RS-232C Communication Command Input and High-Speed Communication Switching”)

- With the default settings at shipping, power-on starts up the controller with in RS-232 Communication Command Input mode.

- The parameter can be set to determine which mode the controller starts after power-on. (See 6.1. “Setting Controller Start Up Mode”)

Note:
For start up when set to the High-Speed Serial Communication mode, in order to use high-speed serial communication clock pulses internally, signal input by high-speed serial communication is necessary at power-on. When there is no signal input, a Clock Lack error occurs. (See 10.2. “Errors”) After an error occurs, and input of a high-speed serial communication signal begins correctly, operation begins automatically from the high-speed serial communication signal.

2.8.1. Number of Encoder Pulses

This section explains the relationship between the galvano scanner motor rotating angle and the number of encoder pulses.
Control commands and some of the parameter angle settings use the number of encoder pulses.

The controller divides one encoder cycle into 8,192, and this is the number of encoder pulses. Depending on the type of encoder included on the motor, caution is necessary as the number of pulses for the same specified angle can differ.

Many commands use pulses as a unit in the RS-232C communication command parameter data used for operations.

In the case of the GM-1010 for example

1 rotation (360°) = 1,000 cycles = 1,000 × 8,192 = 8,192,000 pulses

1° (angle of equipment) = 8,192,000 pulses × 1 / 360 = 22,756 pulses

Resolution = 360° ÷ 8,192,000 pulses = 0.0000429° = 0.77 urad

Each motor is as follows.

Motor type	GM-1010	GM-1015, GM-1020
Included encoder cycles / 1 rotation 360°	1,000 cycles	1,500 cycles
Number of pulses	8,192,000 pulses	12,288,000 pulses
Command resolution (1 pulse)	0.77 urad	0.51 urad

2.8.2. RS-232C command input

RS-232C command input allows the following:

- Operation setting
- Parameter setting
- Error processing
- Status check

(For details, see 8. “Commands”)

In case not using high-speed serial communication, RS-232C communication command input is enough for the following function:

- Step movement
- Raster scan (Continuous oscillation of a certain angle at a fixed frequency)

(Communication specifications)

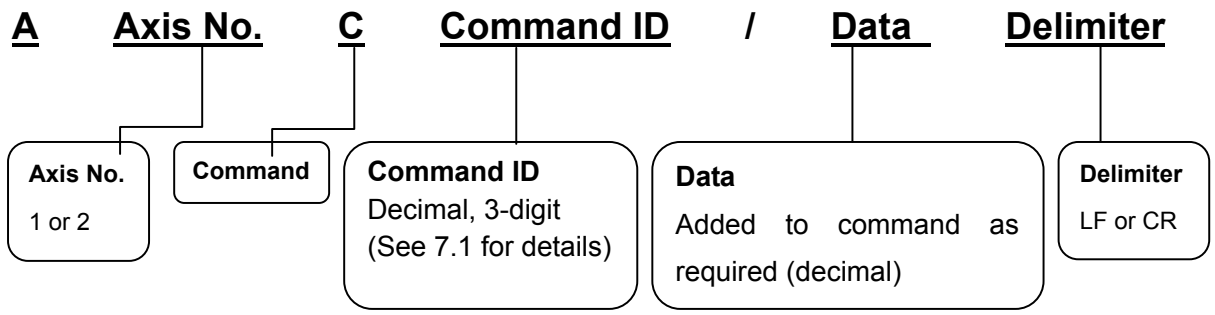
Wiring	Cross wiring
Communication rate	38400 bps
Data length	8 bits
Stop bit	1
Parity	None
Data format	ASCII code
Delimiter code	LF (0x0a) or CR (0x0d)

(Command specifications)

In response to command send, the controller returns a reply with data.

The data contents depend on the command. (For details, see 8.2. “Command Details”)

Command send



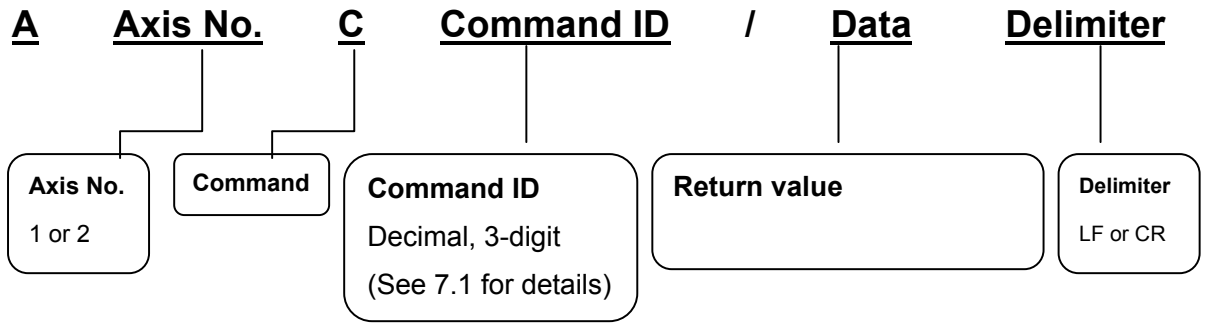
E.g. Servo ON ID = 4 Data = 1

A1C004 / 1 (LF)

(ASCII code: 0x41 0x31 0x43 0x30 0x30 0x34 0x2f 0x31 0x0a)

A 1 C 0 0 4 / 1 (LF)

Command reply



E.g. Servo ON ID = 4 Data = 1

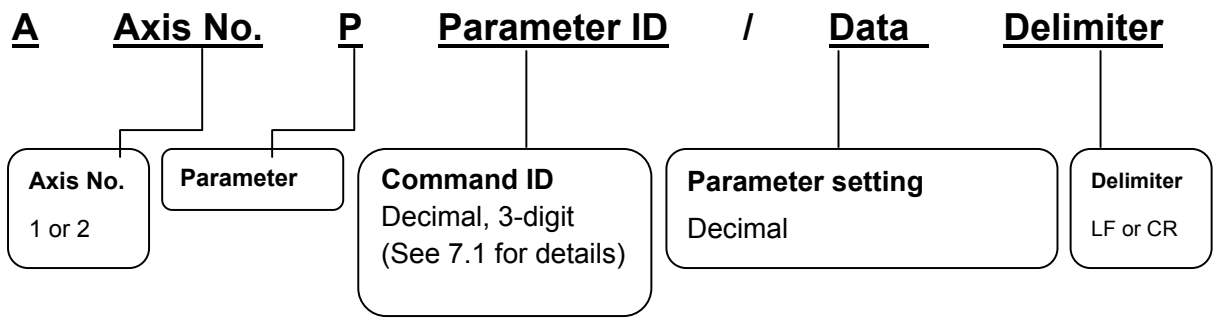
A1C004 / 1 (LF)

(ASCII code: 0x41 0x31 0x43 0x30 0x30 0x34 0x2f 0x31 0x0a)

A 1 C 0 0 4 / 1 (LF)

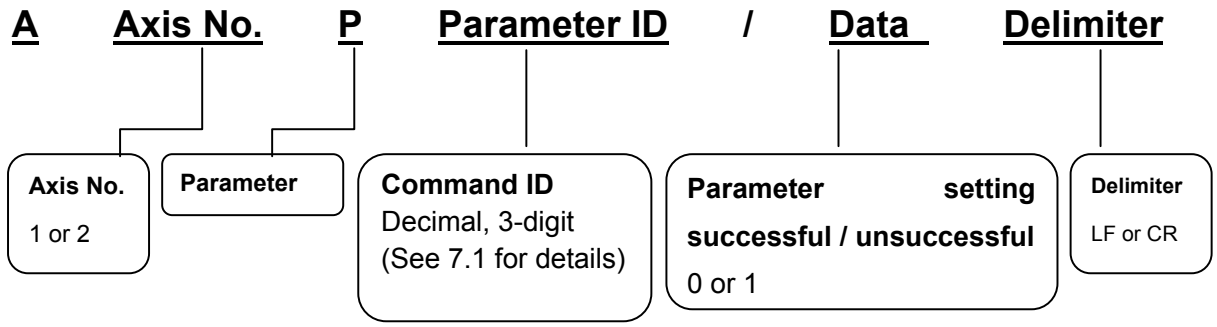
Parameters of the GC-201 can be changed by the following sending method to the controller.
Also in response to parameters sent, the controller always returns a reply with data.
The data contents depend on the command. (For details, see 9.2. “Parameter Details”)
When a parameter is changed, in order to start up with the same setting the next time power is turned on, it is necessary to write the changed parameter to the ROM.
(See 9.4. “Writing Parameters into ROM” for methods of writing to ROM with control software)
(Note: Carry out writing parameters to ROM only after thoroughly verifying the content. Depending on the changed values, the controller may not start normally.)

Parameter send



E.g. LQ gain parameter ID = 6 Data = 4500
A1P006 / 4500 (LF)
(ASCII code: 0x41 0x31 0x50 0x30 0x30 0x36 0x2f 0x34 0x35 0x30 0x30 0x0a)
A 1 P 0 0 6 / 4 5 0 0 (LF)

Parameter reply



E.g. LQ gain parameter ID = 6 Data = 4500
A1P006 / 4500 (LF)
(ASCII code: 0x41 0x31 0x50 0x30 0x30 0x36 0x2f 0x30 0x0a)
A 1 P 0 0 6 / 0 (LF)

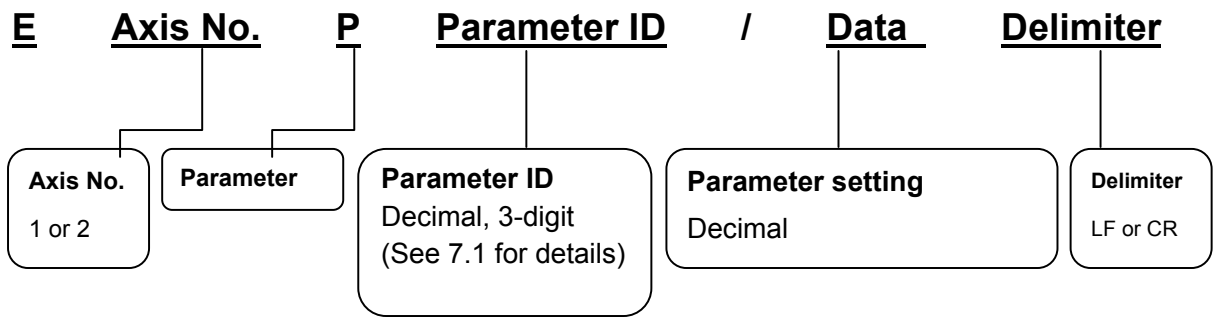
Writing parameters to ROM is also possible with commands via RS-232C.

When writing parameters to ROM, a reply that definitely contains data will be sent by a controller.

The content of data is different by a parameter. (For details, see 9.2. “Parameter Details”)

(Note: Carry out writing parameters to ROM only after thoroughly verifying the content. Depending on the changed values, the controller may not start normally.)

Parameter ROM Write send



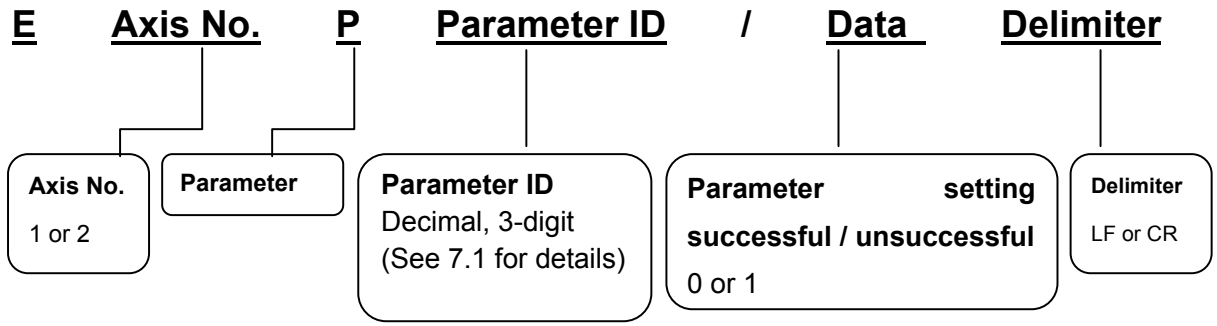
E.g. LQ gain parameter ID = 6 Data = 4500

E1P006 / 4500 (LF)

(ASCII code: 0x45 0x31 0x50 0x30 0x30 0x36 0x2f 0x34 0x35 0x30 0x30 0x0a)

E 1 P 0 0 6 / 4 5 0 0 (LF)

Parameter ROM Write reply



E.g. LQ gain parameter ID = 6 Data = 4500

E1P006 / 4500 (LF)

(ASCII code: 0x45 0x31 0x50 0x30 0x30 0x36 0x2f 0x30 0x0a)

E 1 P 0 0 6 / 0 (LF)

2.8.3. High-speed serial communication

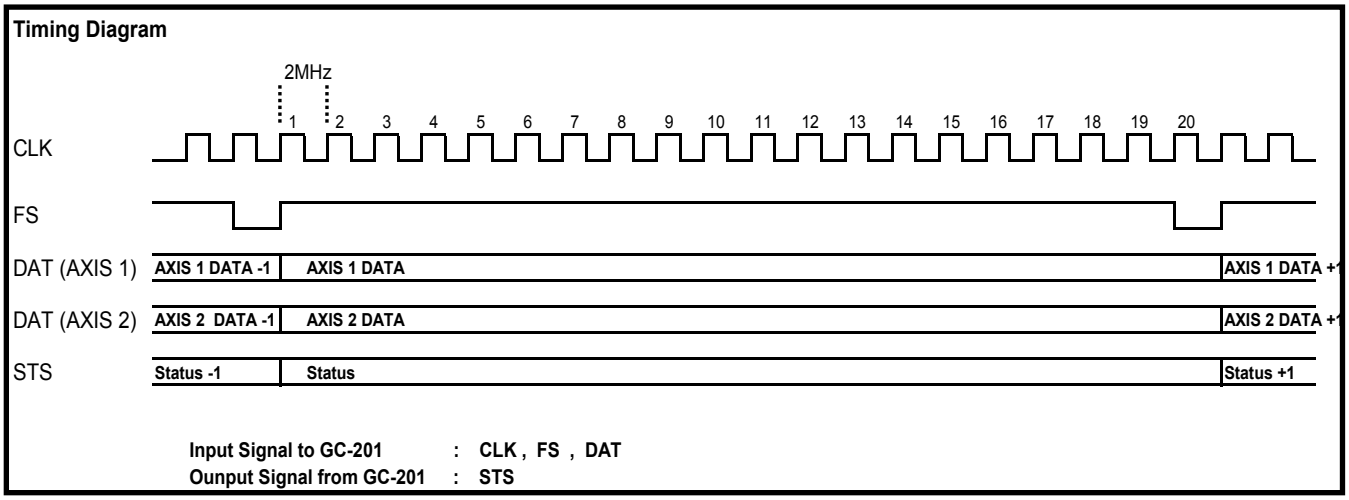
To control the mirror to an arbitrary position by marking or any other application, target position data updated as required can be given to the controller by using high-speed serial communication.

By setting, the controller can be started up in the mode of tracking a target position specified by high-speed serial communication. (For details, see 6.1. “Setting Controller Start Up Mode”)

(Communication specifications)

Base clock (CLK)	2 MHz
Frame sync (FS)	100 kHz
Data (DAT)	20 bits (Position data: 16 bits)
Status (STS)	20 bits
Transmission system	Differential signal
Signal level	5V-TTL, LVDS (Selectable by the optional IF board)

(Timing Diagram)



As indicated in the above timing diagram, it is necessary to always continuously input the CLK, FS, and DAT signals to the GC-201. In the event that the signal is disconnected, or the signal’s timing is incorrect, the GC-201 will output an error signal (Clock Lack). (For details, See 10.2. “Errors”.)

When switching to high-speed serial communication mode, or starting up in high-speed serial communication mode when turning on the controller’s power supply, input of the high-speed serial communication signal (all of CLK, FS, and DAT) beforehand is necessary.

For the support of other communication specifications, contact the Sales Department.

(Target Position Data)　DAT (AXIS1), DAT (AXIS 2)

It is possible to switch the length of data used as target position data from the DAT (AXIS1), DAT (AXIS 2) 20 bit (every 100 kHz) signals. Please set appropriately to match the signal specifications of the scanner controller that outputs a high-speed serial communication signal, and other output equipment.

Note: The length of data input in the GC-201 is always 20 bit (every 100 kHz). The bits of the target position data that get used and sent are switched from within 20 bit data.
When there is a big difference in the target position specified in the high-speed serial communication, and the actual operation position, it is possible this parameter setting is incorrect. Please verify.

The data length of the target position data by the high-speed serial communication can be changed by two following parameters.

(Target position data length)

Can be changed by 16 bit – 20 bit.

Parameter ID	DATA
67	16: 16bit　Data * 17: 17bit　Data 18: 18bit　Data 19: 19bit　Data 20: 20bit　Data

(Data position)

The least significant bit position of the target position data of high-speed serial communication 20bit data can be set by following parameter. The specified number of bits is shifted right, making the target position data.

Parameter ID	DATA
68	0: 0bit　position 1: 1bit　position * 2: 2bit　position 3: 3bit　position 4: 4bit　position

With the default settings at shipping, the setting is * (16 bit position data length, data least significant bit 1 bit position). This communication specification is compatible with XY2-100. When using the scanner controller of XY2-100 specifications, please use this setting.

Examples of the settings are as follows.

(Example 1) Parameter ID = 67 16

Parameter ID = 68 1

XY2-100 specification compatible

Bit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
DATA (AXIS 1)	N	N	N	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	N
DATA (AXIS 2)	N	N	N	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	N

16bit (Parameter **ID = 67)**

1bit (Parameter **ID = 68)**

Note: The above N bit data is not used. It does not matter if it is either 1 or 0.

(Example 2) Parameter ID = 67 16

Parameter ID = 68 3

Bit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
DATA (AXIS 1)	N	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	N	N	N
DATA (AXIS 2)	N	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	N	N	N

16bit (Parameter **ID = 67)**

3bit (Parameter **ID = 68)**

(Example 3) Parameter ID = 67 18

Parameter ID = 68 2

Bit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
DATA (AXIS 1)	D17	D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	N	N
DATA (AXIS 2)	D17	D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	N	N

18bit (Parameter **ID = 67)**

2bit (Parameter **ID = 68)**

(Example 4) Parameter ID = 67 20

Parameter ID = 68 0

Bit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
DATA (AXIS 1)	D19	D18	D17	D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
DATA (AXIS 2)	D19	D18	D17	D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0

20bit (Parameter **ID = 67)**

0bit (Parameter **ID = 68)**

This section explains the motor rotating angle for the high-speed serial communication data.
Default settings have the following relationships.

Data 1 = 1 pulse (factory setting)

See 2.8.1. “Number of Encoder Pulses" for the relationship between the motor rotating angle and the number of pulses.

・ In the case of 16 bit data

(GM-1010)

	High-speed communication Target position data value 16bit	Motor	
		Number of pluses	Motor rotating angle
Maximum position	0xFFFF	－32767 pulses	－1.44 deg
0 pulse position	0x8000	0	0
Minimum position	0x0000	＋32768 pulses	＋1.44 deg

(GM-1015, GM-1020)

	High-speed communication Target position data value 16bit	Motor	
		Number of pluses	Motor rotating angle
Maximum position	0xFFFF	－32767 pulses	－0.96 deg
0 pulse position	0x8000	0	0
Minimum position	0x0000	＋32768 pulses	＋0.96 deg

Note: The motor rotating angle + direction when viewed from the rotation axis appear as clockwise.

When set to the factory default, rotation is only possible up to angles above.
If a greater angle is specified, set a magnification by using the following parameter.

Parameter ID	Data
13 (High-speed serial communication conversion gain parameter)	Magnification ×1000

E.g. For x2 (parameter ID = 13 setting: 2000), the following angle can be specified:

-1.44 × 2 deg ~ 1.44 × 2 deg (GM-1010)

-0.96 × 2 deg ~ 0.96 × 2 deg (GM-1015, 1020)

The command resolution will be two times

- **In the case of 20 bit data**

Usually data 1 = 1 pulse.

(GM-1010)

	High-speed communication Target position data value 20bit	Motor	
		Number of pluses	Motor rotating angle
Maximum position	0xFFFFF	−524287 pulses	−23.04 deg
0 pulse position	0x80000	0	0
Minimum position	0x00000	+524288 pulses	+23.04 deg

(GM-1015, GM-1020)

	High-speed communication Target position data value 20bit	Motor	
		Number of pluses	Motor rotating angle
Maximum position	0xFFFFF	−524287 pulses	−15.36 deg
0 pulse position	0x80000	0	0
Minimum position	0x00000	+524288 pulses	+15.36 deg

However, the maximum rotating angle specification is ±20°.

Maximum movable range of the motor is set with Parameter ID = 0, 1 (CW limit, CCW limit).

The position data of high-speed serial communication can not exceed this range.

2.8.3.1. Origin Offset

It is possible to change the origin position of high-speed serial communications.

Parameter ID	Data
15 High-speed serial communication offset	Unit: pulse

Unit is pulse.

High-speed serial communication offset is not influenced by the parameter ID = 13 high-speed serial communication conversion gain setting.

E.g.

When parameter ID = 15 setting 2276 pulse (=0.1°) is set, regardless of the parameter ID = 13 setting, it will always operate with a 0.1° (CW direction) offset.

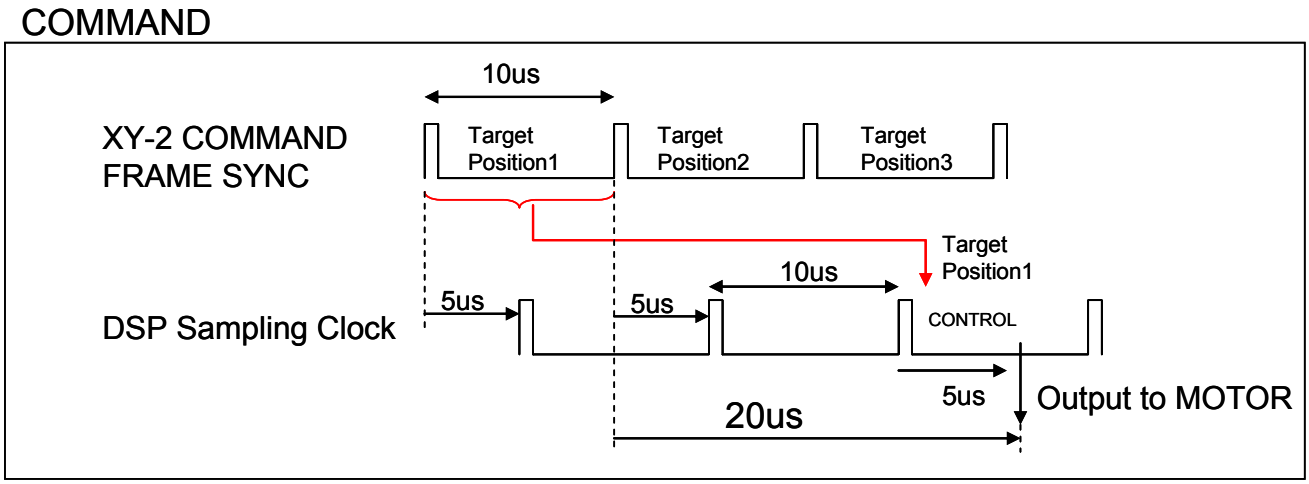
Note) Current position output data of Next heading 2.8.4. is actual motor encoder position data.

Current position output data
= High speed serial communication command position + High speed serial communication offset

So, Current position data is not equal to High speed serial communication command position that you specify.

2.8.3.2. High-speed serial communication motor drive timing

The following diagram indicates actual motor drive signal output timing when the high-speed serial communication position command is received.



2.8.4. Status (High-speed Serial Communication STS)

The controller status is sent by the high-speed serial communication STS line.

The contents of status sent from a controller can be changed by the following parameter.

Note: Status output will only be output when controlled by the high-speed serial communication mode. During operation in a RS-232C communication input mode (internal clock), there will be no status output (raster scan, status transfer etc.).

Parameter ID	Data
66	0: Controller condition 1 1: Controller condition 2 2: Current position (Axis 1) 3: Current position (Axis 2) 4: Current position (Axis1, Axis2)

Each of the status contents are as follows.

	Mode-0	Mode-1	Mode-2	Mode-3	Mode-4
S19	(reserve)	0	Axis1data bit19	Axis2 data bit19	Axis flag
S18	(reserve)	0	Axis1data bit18	Axis2 data bit18	Axis1(2) data bit18
S17	(reserve)	0	Axis1data bit17	Axis2 data bit17	Axis1(2) data bit17
S16	POW OK	0	Axis1data bit16	Axis2 data bit16	Axis1(2) data bit16
S15	TEMP OK	0	Axis1data bit15	Axis2 data bit15	Axis1(2) data bit15
S14	(reserve)	0	Axis1data bit14	Axis2 data bit14	Axis1(2) data bit14
S13	Axis2 INPOS	Axis1 READY	Axis1data bit13	Axis2 data bit13	Axis1(2) data bit13
S12	Axis1 INPOS	Axis1 ALARM	Axis1data bit12	Axis2 data bit12	Axis1(2) data bit12
S11	(reserve)	Axis1 ALARM	Axis1data bit11	Axis2 data bit11	Axis1(2) data bit11
S10	0	Axis1 INPOS	Axis1data bit10	Axis2 data bit10	Axis1(2) data bit10
S09	1	0	Axis1data bit9	Axis2 data bit9	Axis1(2) data bit9
S08	POW OK	0	Axis1data bit8	Axis2 data bit8	Axis1(2) data bit8
S07	TEMP OK	0	Axis1data bit7	Axis2 data bit7	Axis1(2) data bit7
S06	(reserve)	0	Axis1data bit6	Axis2 data bit6	Axis1(2) data bit6
S05	Axis2 INPOS	0	Axis1data bit5	Axis2 data bit5	Axis1(2) data bit5
S04	Axis1 INPOS	0	Axis1data bit4	Axis2 data bit4	Axis1(2) data bit4
S03	(reserve)	Axis2 READY	Axis1data bit3	Axis2 data bit3	Axis1(2) data bit3
S02	0	Axis2 ALARM	Axis1data bit2	Axis2 data bit2	Axis1(2) data bit2
S01	1	Axis2 ALARM	Axis1data bit1	Axis2 data bit1	Axis1(2) data bit1
S00	(reserve)	Axis2 INPOS	Axis1data bit0	Axis2 data bit0	Axis1(2) data bit0

- **Mode-0 : Controller condition 1**

  Outputs the status of the controller.

  POW OK : No problem with the power supply

  TEMP OK : No problem with the internal temperature

  Axis2 INPOS: Axis 2 in-position signal

  Axis1 INPOS: Axis 1 in-position signal

  (When current position moves into the in-position range, this signal will be output.)

- **Mode-1: Controller condition 2**

  Outputs the status of the controller.

  READY : Servo ON and ready to control by high-speed serial communication.

  ALARM 1 : Alarm output (priority high)

  (See 5.3. “Digital Input-Output Function”. Same as Axis 1 Error 1, Axis 2 Error 1)

  ALARM 2 : Alarm output (priority low)

  (See 5.3. “Digital Input-Output Function”. Same as Axis 1 Error 2, Axis 2 Error 2)

  INPOS : In-position signal

  (When it moves into the parameter ID = 3 in-position range, this signal will be output.)

- **Mode-2: Current position data (Axis 1)**

  Outputs the axis 1 encoder position.

  Data length: 20 bits.

	High-speed communication Position data value 20 bits
Maximum position	0xFFFFF
0 pulse position	0x80000
Minimum position	0x0000F

- **Mode-3: Current position data (Axis 2)**

  Outputs the Axis 2 encoder position.

  Data length: 20 bits.

- **Mode-4: Current position data (Axis 1, Axis 2)**

  The encoder position of Axis 1 and Axis 2 is output alternately.

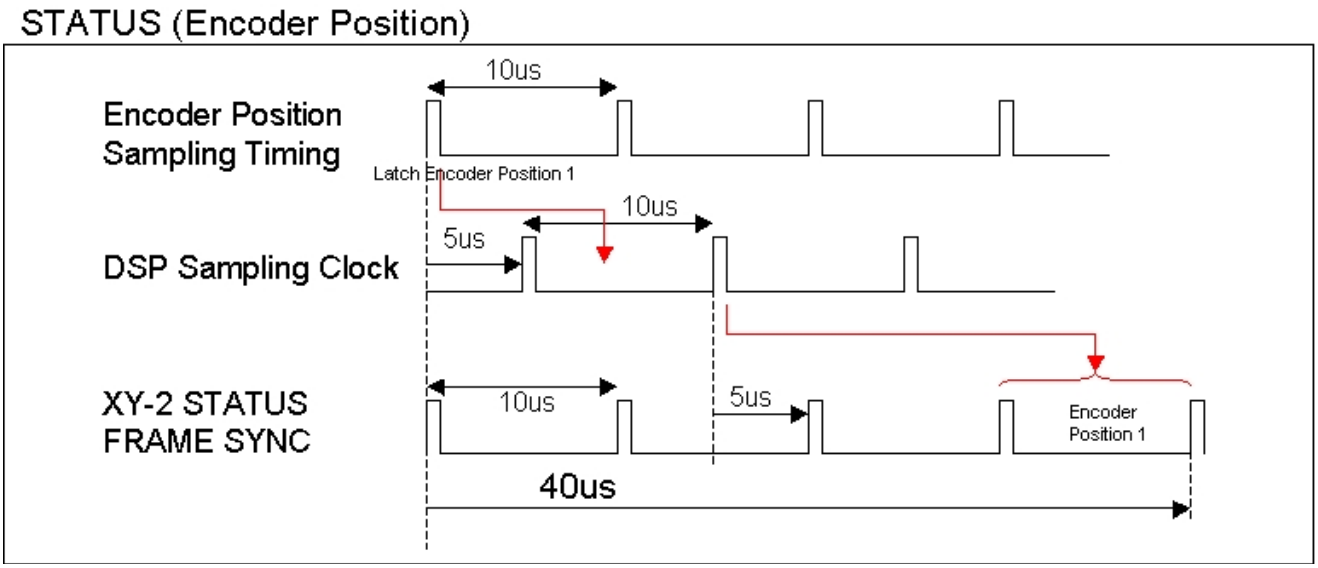
  Data length: 19 bits.

  The first 1 bit indicates the axis (Axis Flag).

  Axis Flag = 0 Axis 1

  Axis Flag = 1 Axis 2

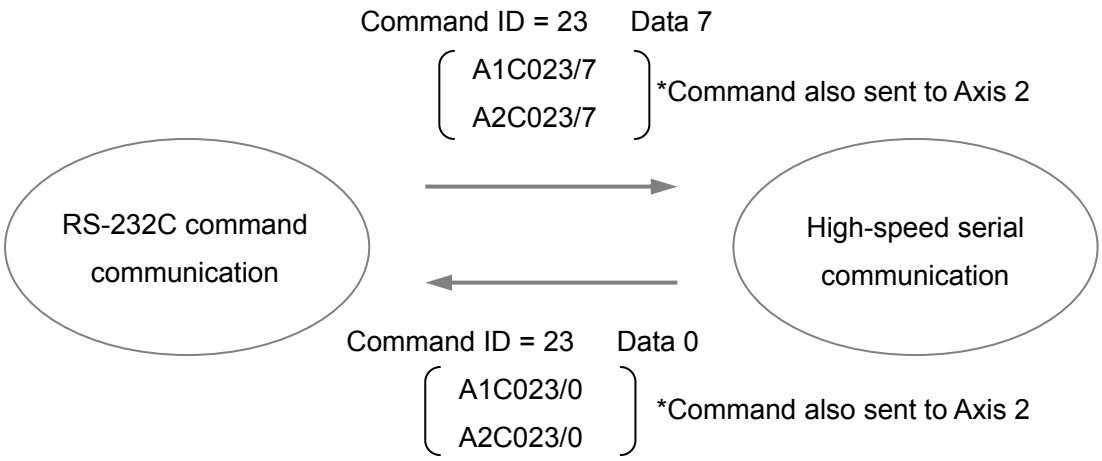
Data information for the current position data of Mode-2, 3, and 4 is output with the timing as follows.



2.8.5. RS-232C Communication Command Input and High-Speed Communication Switching

A position command input can be switched with a RS-232C communication command.

Command ID	Data
23	0: RS-232C command communication 7: High-speed serial communication



Note: In the case of two axis control, it is necessary to execute this command for each axis.

It is possible to receive input of RS-232C communication commands even when switching to high-speed serial communication. However, as position commands give priority to the input of high-speed serial communication, operation commands such as RS-232C communication command step movement, and raster scans will be ignored.

2.9. Heat Radiation and Installation

Since the controller and motor generate heat, their heat radiation should be considered carefully.

Generated heat depends on the operating conditions. Determine a heat radiation method according to the operating conditions.

The controller and motor have a temperature detection sensor (thermistor) in the heat generating section. As a safety function, the thermistor stops control if the detector temperature reaches:

Controller	About 70ºC
Motor	About 70ºC

(For details, see 10.1. “Safety Functions”)

The controller and motor require heat radiation so that their temperatures will not exceed the above values.

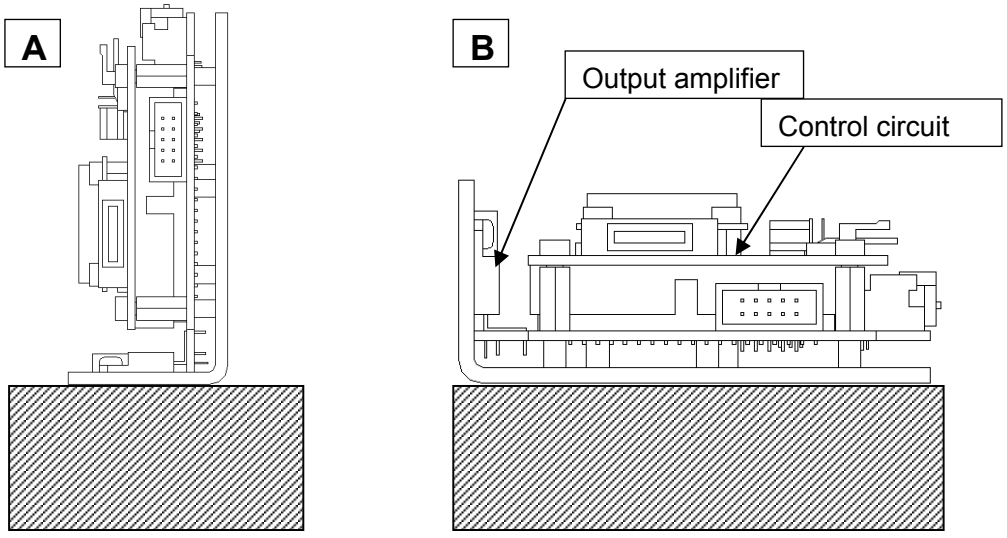
Controller installation methods

The controller can be installed by either method A or B below.

At installation, put the controller frame in contact with a heat-radiating structure (heat sink or cabinet).

Method A has higher heat radiation efficiency. However, select either method by considering the operating conditions and cable routing. When installing the controller frame, apply thermal grease or attach a thermal conductive sheet to the contact surface.

Under some operating conditions, forced air cooling by a fan is necessary. Cool the heat-radiating structure (heat sink or cabinet) and the controller.



In addition to the output amplifier, the control circuit section (DSP) generates heat.

Allow as much space as possible around the equipment.

Caution

The controller becomes hot during operation.

3. Software

The controller (GC-201) bundles the dedicated control software.

Using the control software makes the following controller operations easy:

- Parameter setting
- Operation setting (Step movement and raster scan)
- Status check
- Servo tuning (Frequency characteristic measurement)

Most of the functions that can be performed by the control software can also be executed by external commands input through RS-232C connection without using the control software. This manual describes operations both by the control software and by RS-232C command input.

Note: The following function can be executed by the control software only, and not by RS-232C command input:

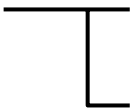
- Frequency characteristic (FFT) measurement
- Auto tuning
- XY matching
- Step response measurement function

3.1. Supported PC Environment

Supported OS	MS-Windows 2000, XP, Vista
Connection port	RS-232C port (with USB-RS-232C conversion cable)

3.2. Installation CD

Installation folder structure of the bundled control software



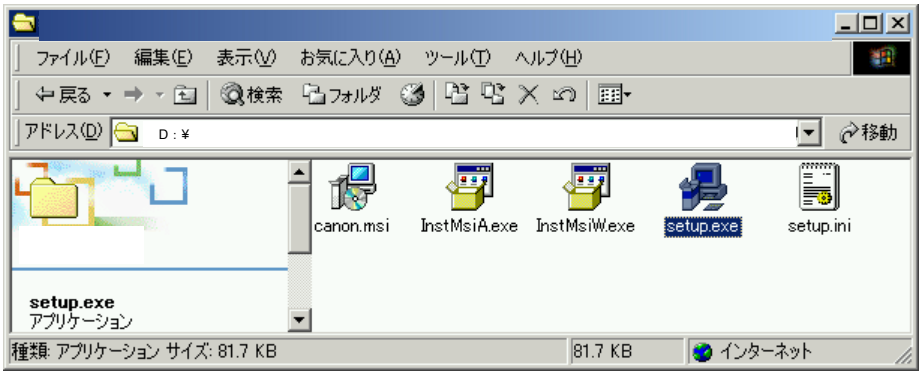
Control Software (Control software installer)

Manual (GC-201, GC-251 manual)

The necessary software is not included in 11.1. “Firmware Update”. Please contact your sales representative.

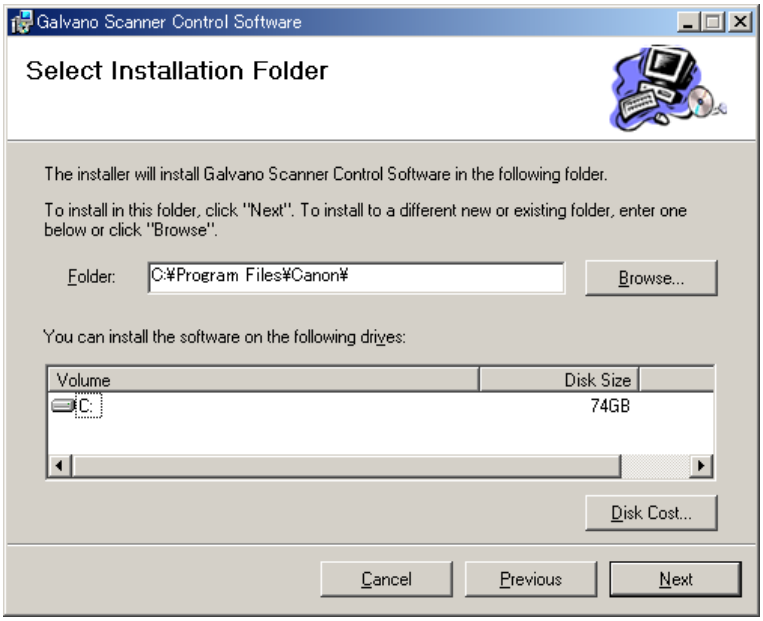
3.3. Control Software Installation

・ Insert the bundled control software installation CD into the CD drive.

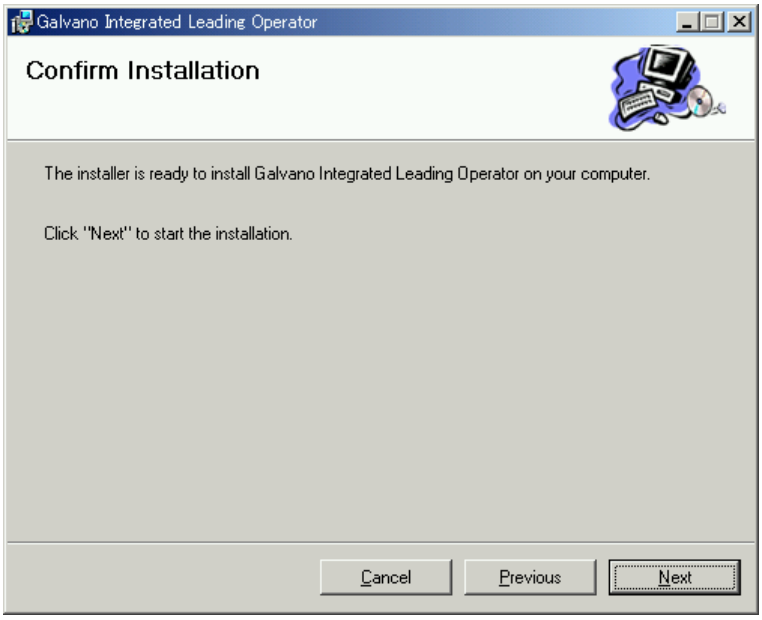


・ Execute Setup.exe in the Control Software folder.

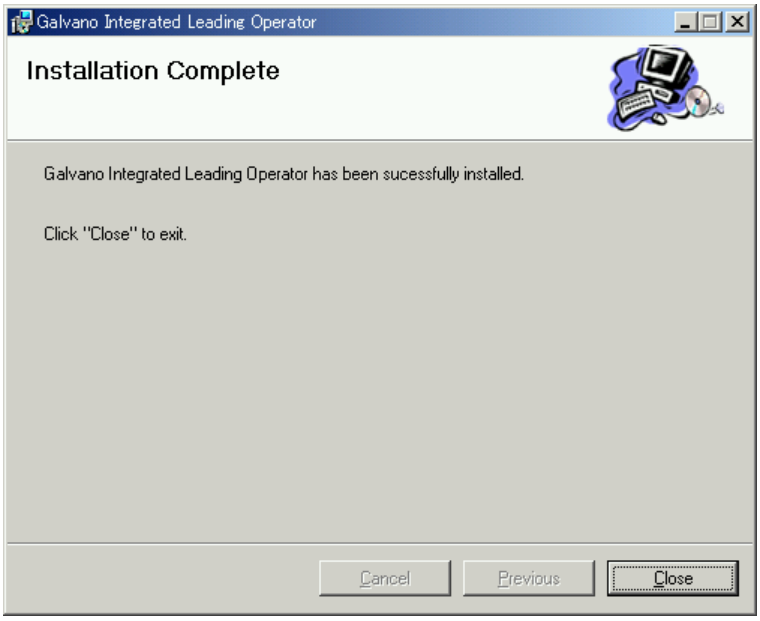
・ Press the Next button.



- Specify an installation folder and press the Next button.
  (Recommendation: Usually this is not changed.)



- Press the Next button.



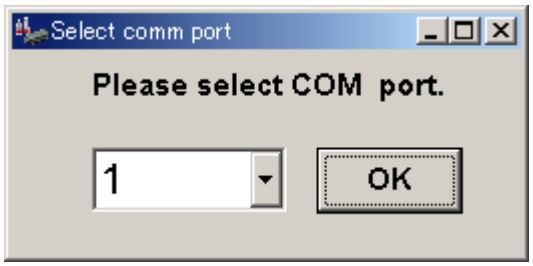
- Press the Close button. This completes installation.

3.4. Software Start Up

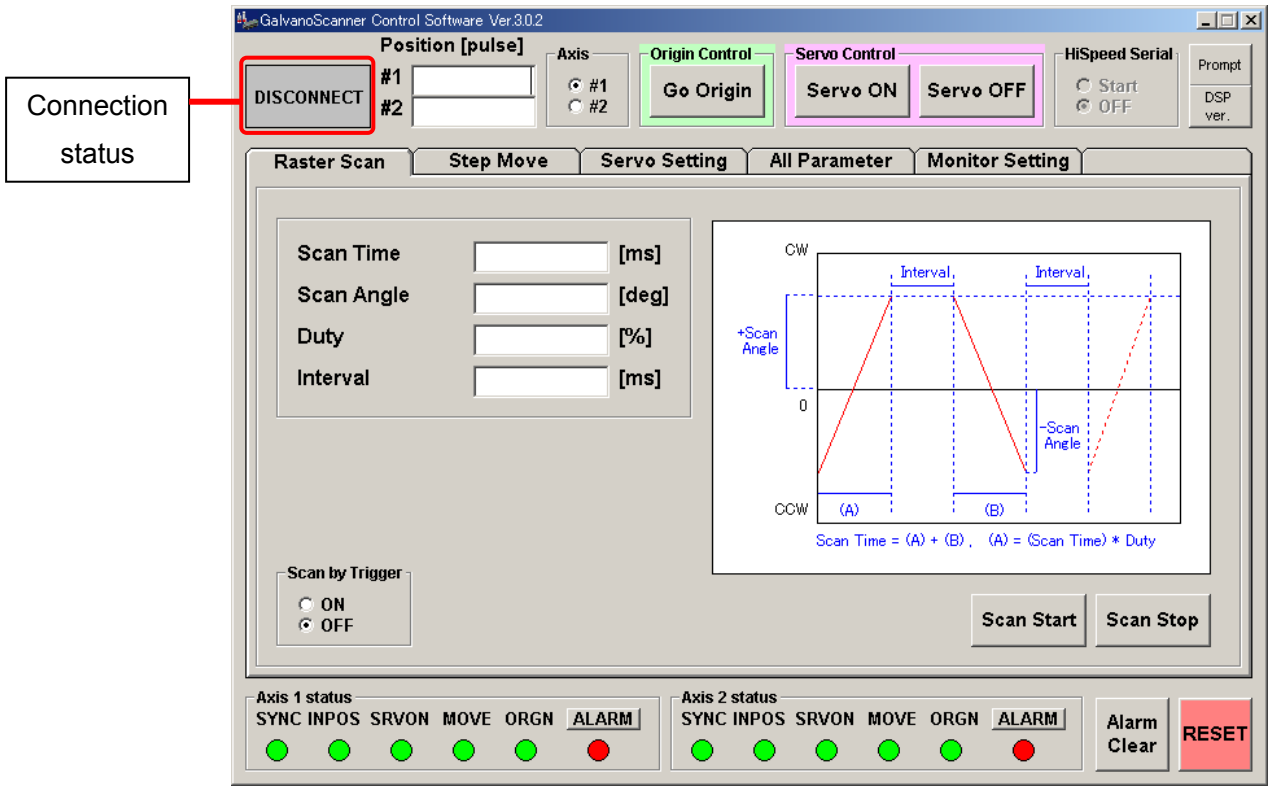
- Connect the controller and the PC with the optional RS-232C cable.

- Select Windows “START” - “Programs” - “Canon Scanner” - “Control Software”.

- Setting the COM port
  Select the connected RS-232C port and press the OK button.

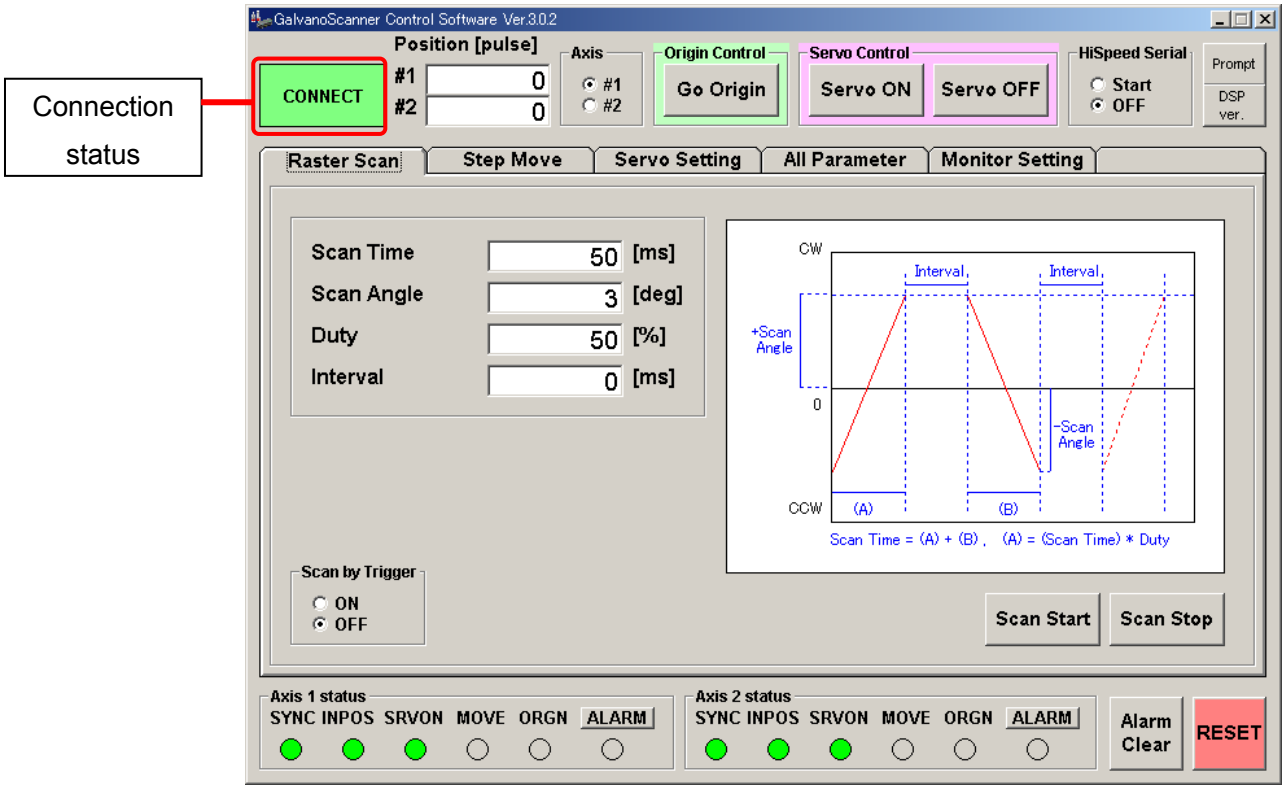


- The control screen is displayed.
  While communication with the controller has not started yet, the screen displays “DISCONNECT” in gray at the upper left as the connection status.



Note: The value of each item on the above screen differs depending on the controller status.

- When the power to the controller is turned on, communication automatically starts.
  When communication starts, the connection status at the upper left changes to “CONNECT” in green.

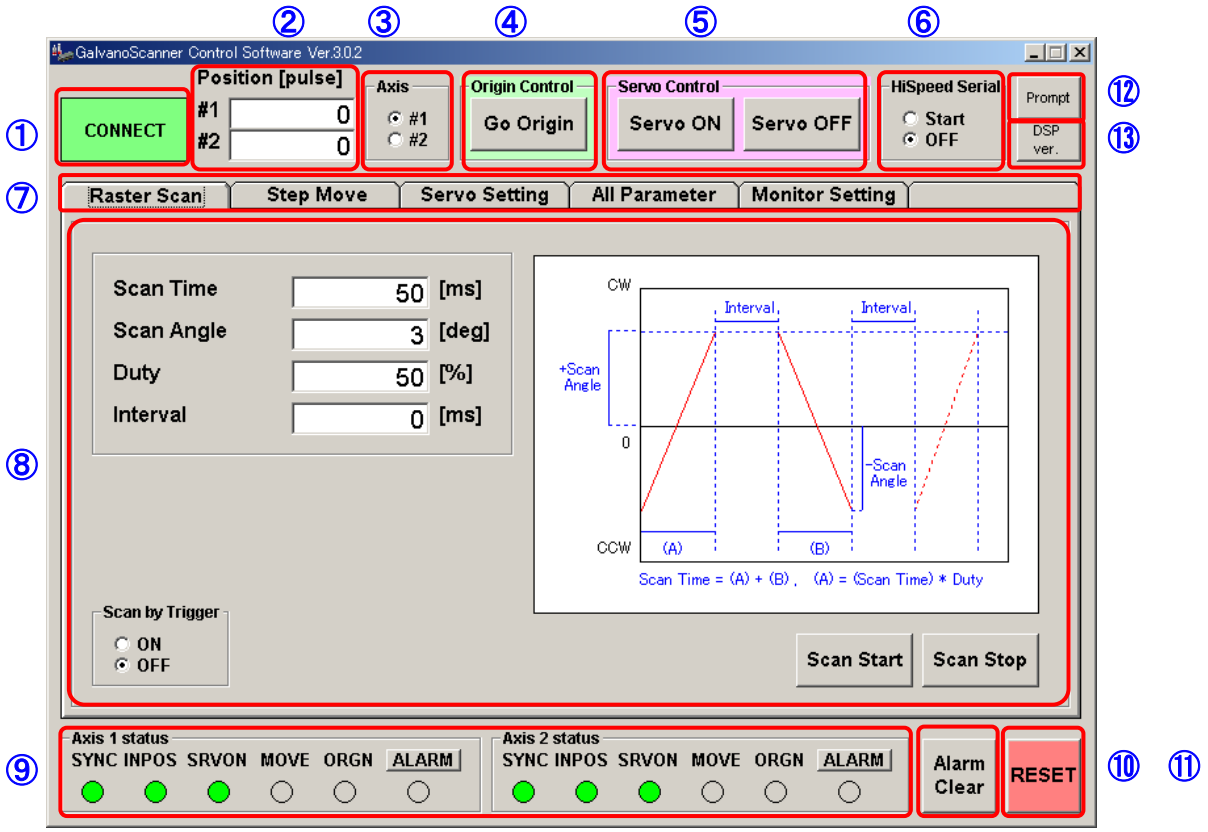


The control software can be started up after power to the controller has been turned on. Communication then starts automatically. (“CONNECT” is displayed.)

Note: The value of each item on the above screen differs depending on the controller status.

3.5. Control Screen

This section explains the buttons and other items on the control screen.



①	Connection display	The status of RS-232 connection to the controller is displayed. Connected: CONNECT (green) Not connected: DISCONNECT (gray)
②	Position display	The encoder position (Mechanical angle) of each axis is displayed. (Unit: pulse) Note: Since the number of encoder pulses per rotation depends on the galvano motor, the relationship between the number of pulses and the angle also differs with the motor type.
③	Axis selection	Select an axis for control and information display. (#1 = Axis 1, #2 = Axis 2) The screen can display the information of only one axis selected here, although the position displayed at ② and the status displayed at ⑨ always show the information of both axes.
④	Origin control (Homing to origin)	Press this button to go to origin or detect the origin. The operation depends on the controller status. (During ordinary servo control) Moving to the origin (where the position display is 0) Invalid during high-speed serial communication (After servo OFF and soft reset) Starting origin detection

⑤	Servo ON/OFF	Start or stop servo control.
⑥	High-speed serial communication selection	Select the high-speed serial communication command or RS232C command input for position specification. (For details, see 4.4. Position Command Input by High-speed Serial Communication) (Start = High-speed serial communication, OFF = RS-232C command)
⑦	Tab selection	The screen of each function can be displayed by tab selection. (A detailed explanation of the screen is shown when each function is displayed.)
⑧	Control display	This area displays the screen of each function selected by a tab at ⑦.
⑨	Status display	The controller status of two axes is displayed. If press the alarm button during alarm light on, windows content the alarm details will come up.
⑩	Alarm clear	Clears the alarm. The alarm lamp turns off.
⑪	Soft reset button	Press this button for soft reset.
⑫	Command input screen	Allows direct command input.
⑬	DSP version display	The version of the controller software is displayed. During troubleshooting, the support staff may ask for the version number.

4. Operating Procedure

This chapter explains how to use the system.

Operations by [Control Software] and by [RS-232C command] are explained together.

4.1. Controller Start Up

When the power (+5 V, +24 V) is turned on, the controller execute the following automatically:

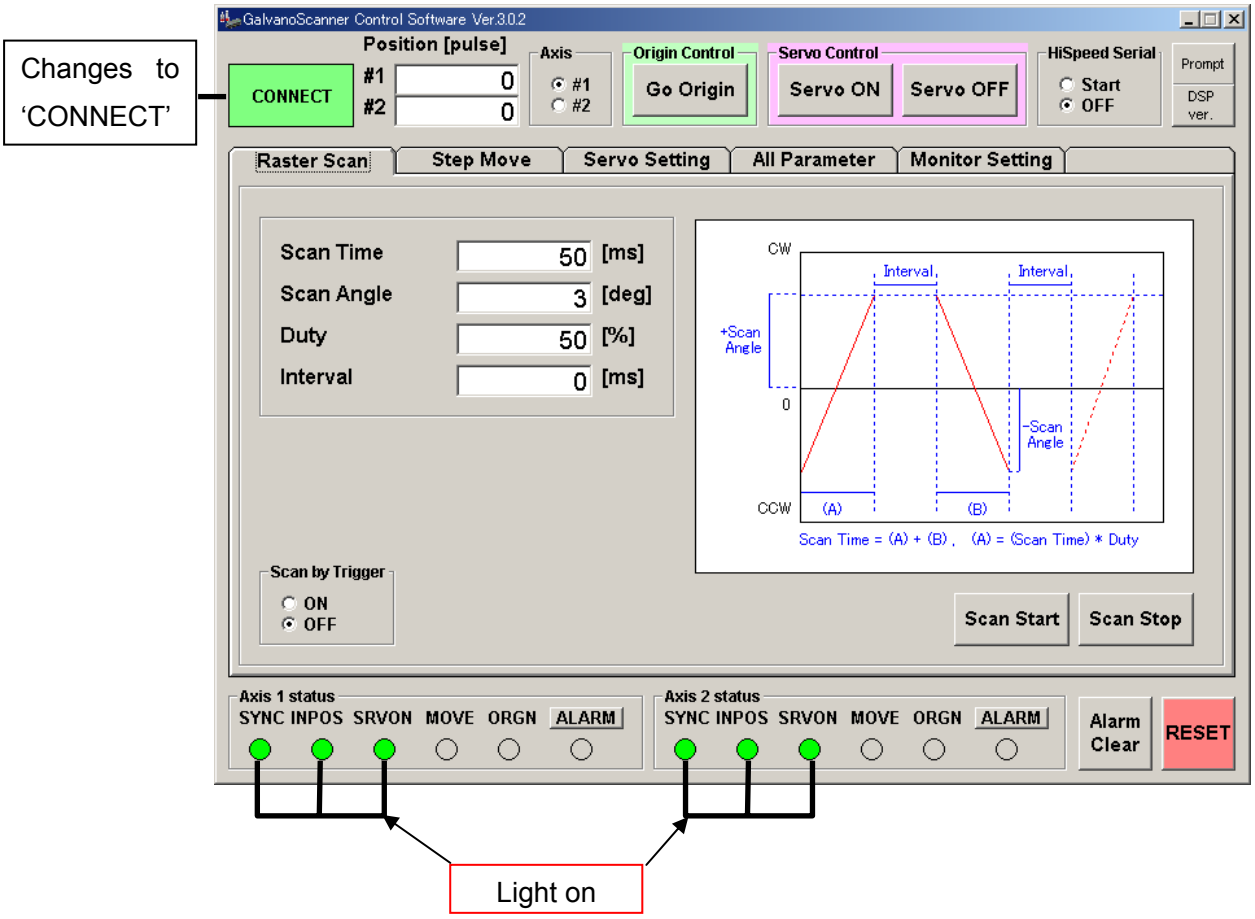
- Read saved parameters from ROM
- Home to the origin
- Correct the encoder (high-speed oscillation of a fixed angle)

It takes about 15 seconds until the controller is started up.

With the default settings at shipping, the controller is started up with RS-232C communication command input (internal clock) mode.

The completion of start up can be confirmed as follows:

Control Software



RS-232C command

Sends RS-232C command ID=14 “Status read” and checks the following status:

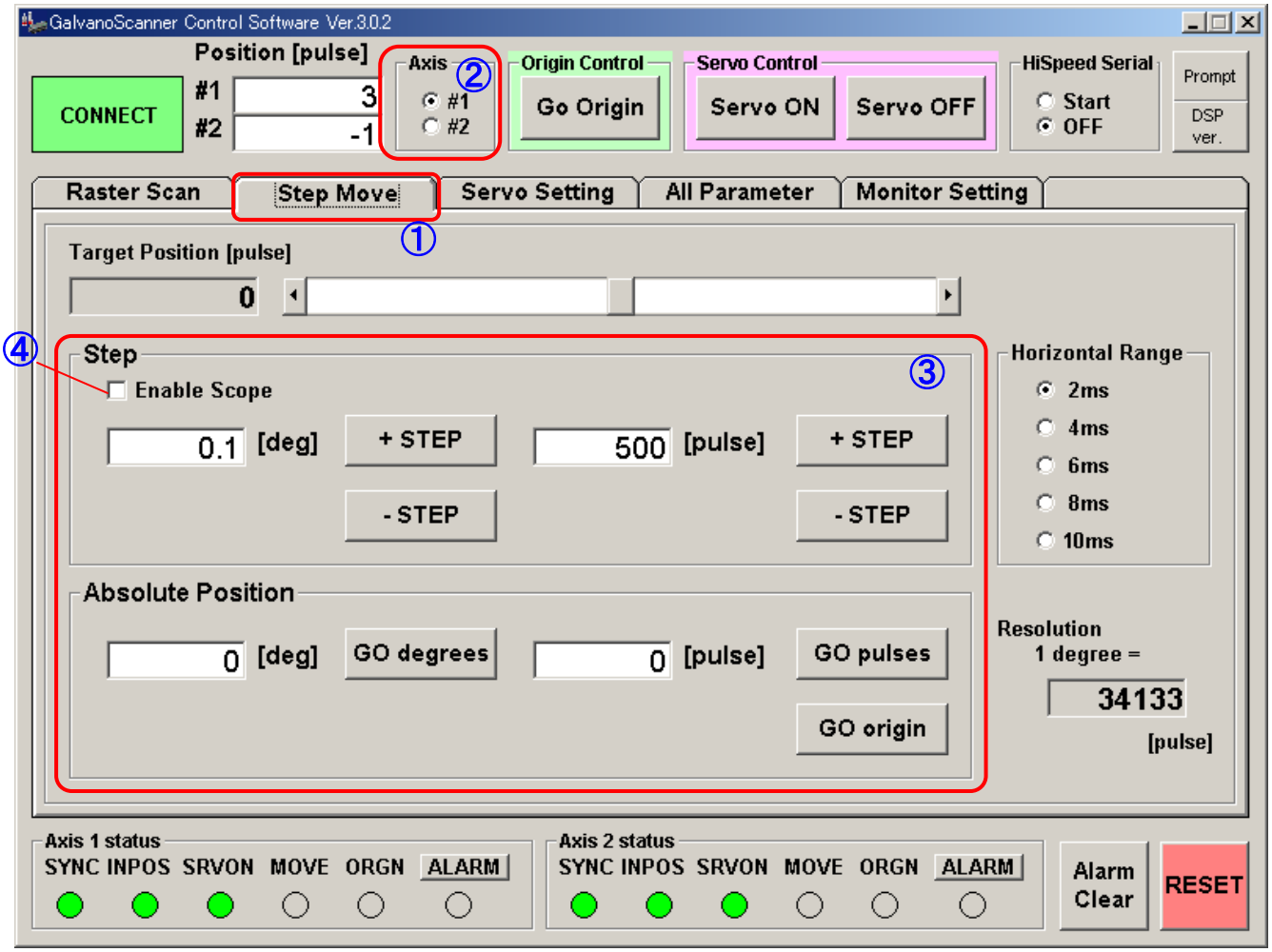
SRVON, SYNC, INPOS = High
ORGN = Low

(For details, see 8.2. “Command Details”)

4.2. Step Movement

Execute step movement for a fixed angle.

Control Software



・Select the Step Move tab. ①

・Select an axis for step movement. ②

・Specify the displacement (angle or pulse count) for relative position (STEP) and absolute position. ③

・Press the STEP button (either positive or negative position direction can be specified) or GO button. ③

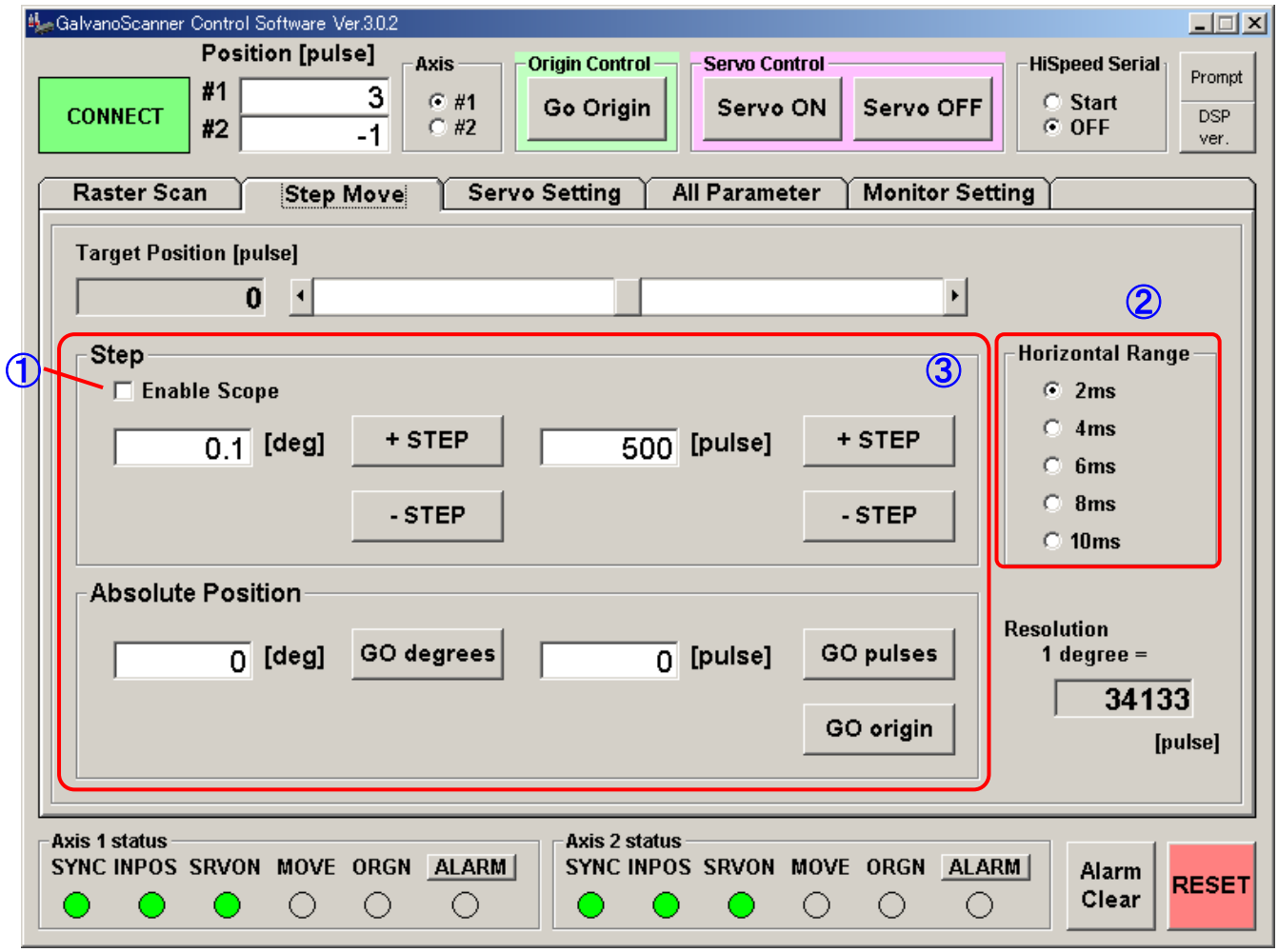
Note: Uncheck the ④ checkbox when moving continuously. If it is checked, the stabilization time measurement function on the next page operates, and as it takes time to display the results, moving continuously is not possible.

RS-232C command

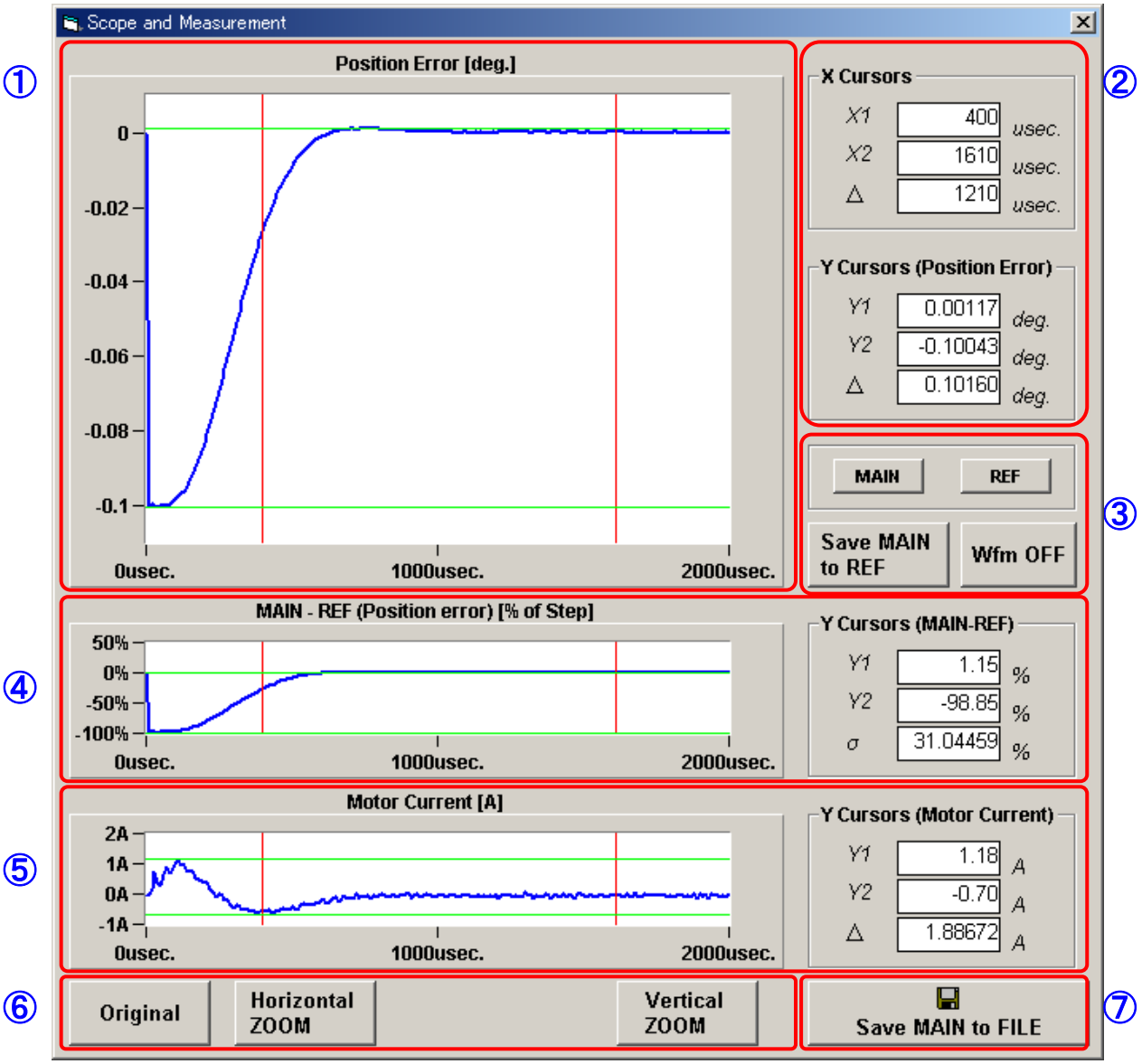
- Target value setting mode (Command ID = 10)
- Target position setting (Command ID = 20)
- Movement start (Command ID = 8)

4.2.1. Step Movement Responce Time Measurement

Control Software has a function that measures the step movement response time. This function is can only be executed by the control software. It cannot be executed by a RS-232C command.



- Put a check in the Enable Scope checkbox ①
- Select the time range for step movement response to be measured ②
  (As the response time depends on the displacement, change when necessary.)
- Specify the displacement (angle and pulse count) for relative position (STEP) and absolute position. ③
- Press the STEP button (either positive or negative position direction can be specified) or GO button. ③
- The Scope and Measurement window appears automatically



Scope and Measurement window

(Scope and Measurement window explanation)

①	Step response waveform	Displays the step response waveform by the deviation from the target position. 0 usec (left edge) position is the movement start time.
②	Cursor location (Step response waveform)	① Displays the cursor location in the step response waveform graph.

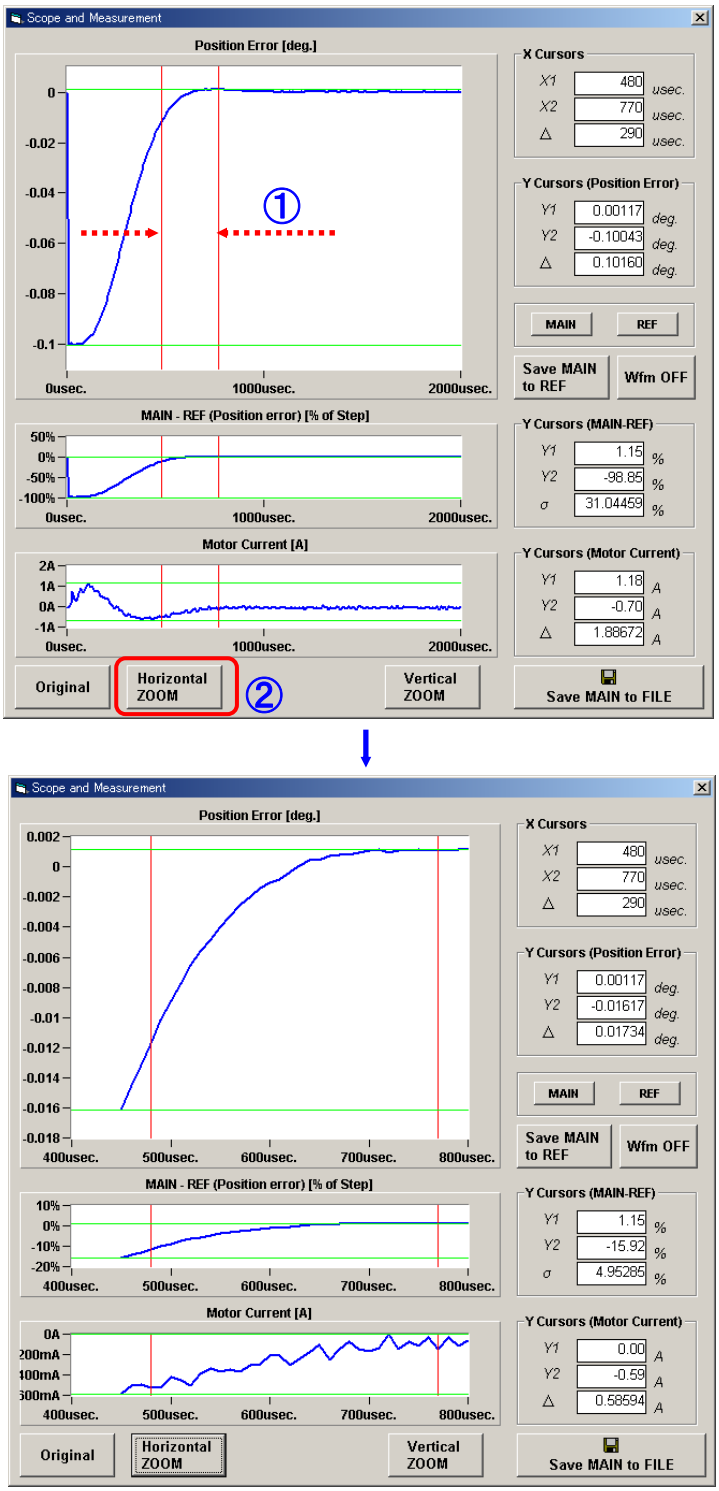
③	Reference data (Save, display, hide)	Measured step response waveforms can be saved temporary as reference data. The next measured data can be overwritten and compared. (See 4.2.1.2 “the Reference Data Comparison Method.”)
④	Displays the difference of MAIN and reference data	This displays the difference between measurement data and reference data.
⑤	Motor drive current	Displays the motor drive current.
⑥	Zoom button	Use the zoom button to zoom in and display detailed data. (See 4.2.1.1 “the Measurement Data Display Zoom Method.”)
⑦	Saving data	This saves measurement data as a text file.

4.2.1.1. Measurement Data Display Zoom Method

A zoomed display is possible in order to confirm measurement data details.

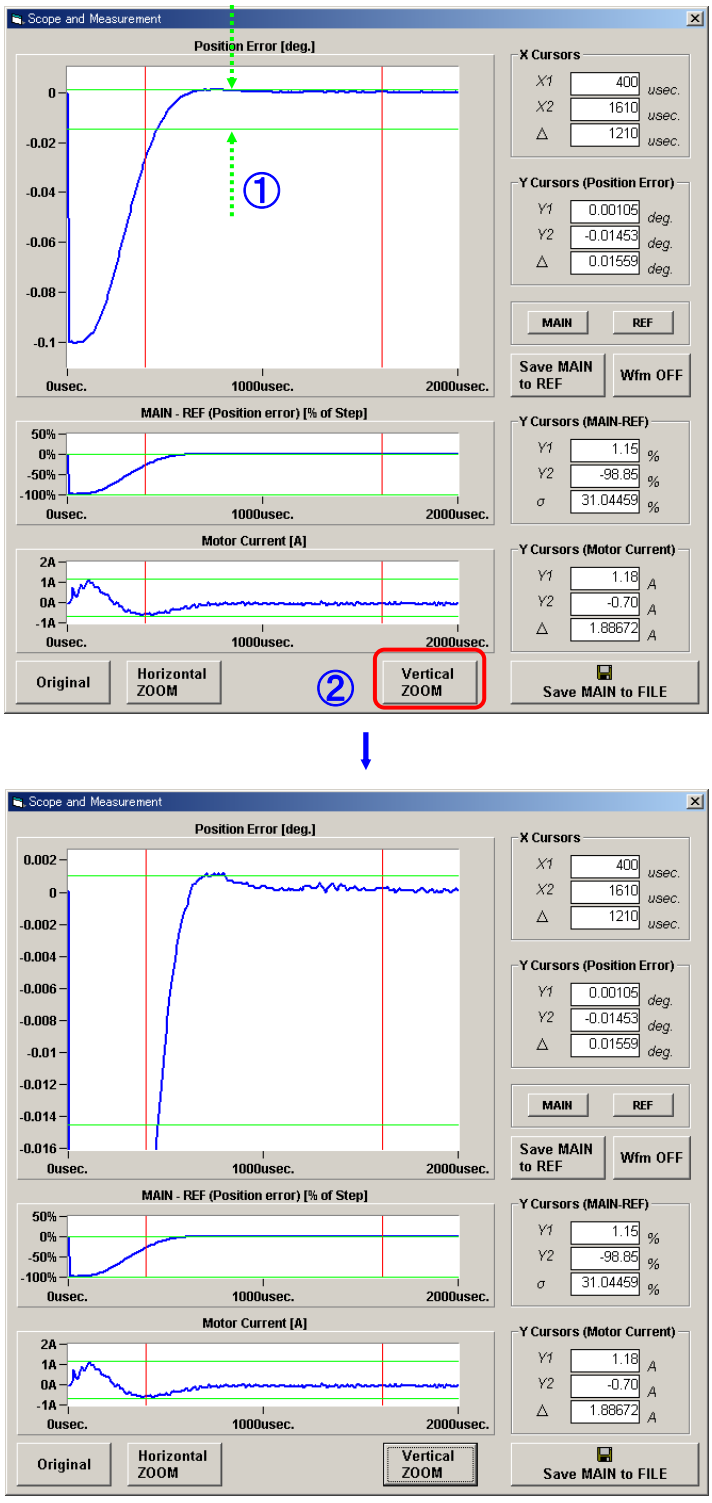
(Specify horizontal (time) zoom)

- Drag the step response display cursor (red) to the width you want to display enlarged ①
  (Adjust while looking at the X Cursors display below)
- Press the Horizontal ZOOM button ②



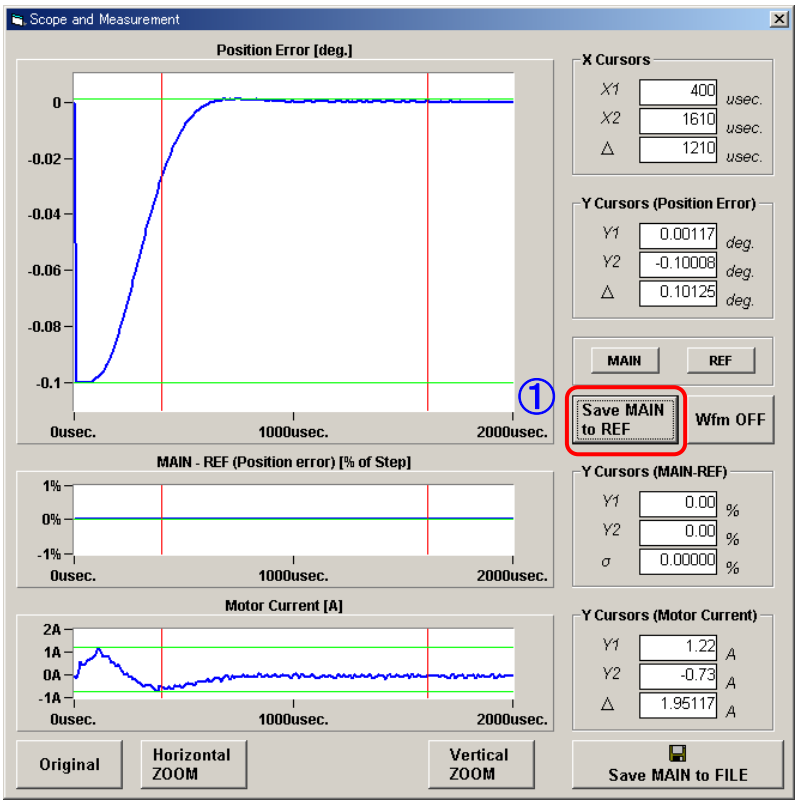
(Specify vertical (angle) zoom)

- Drag the step response display cursor (green) to the width you want to display enlarged ①
  (Adjust while looking at the Y Cursors display below)
- Press the Vertical ZOOM button ②



4.2.1.2. Reference Data Comparison Method

This displays step response waveforms with two different measurement conditions, and makes a comparison possible.

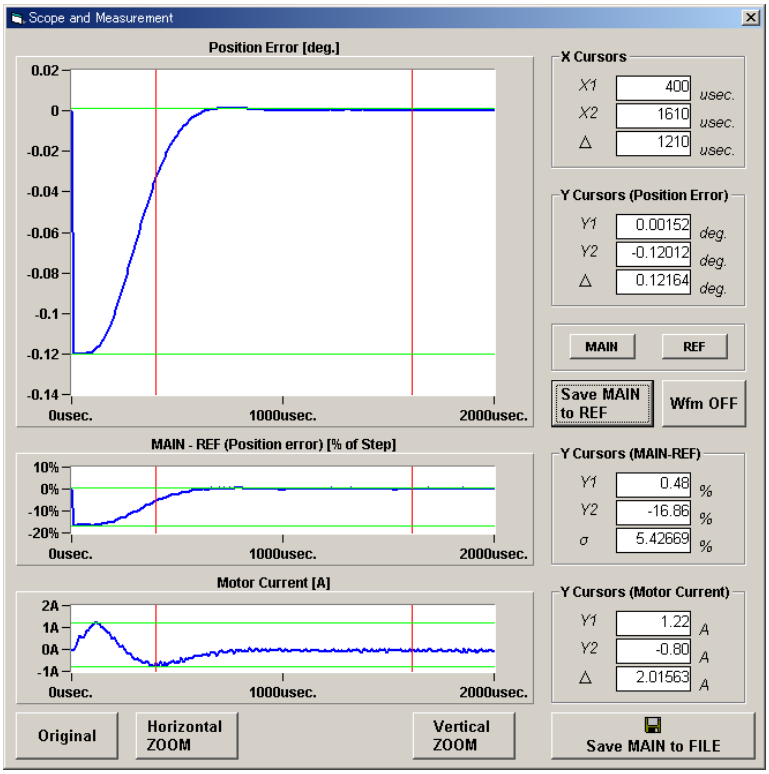


- Display the step response waveform with the first measurement condition, and press the “Save MAIN to REF” button. ①

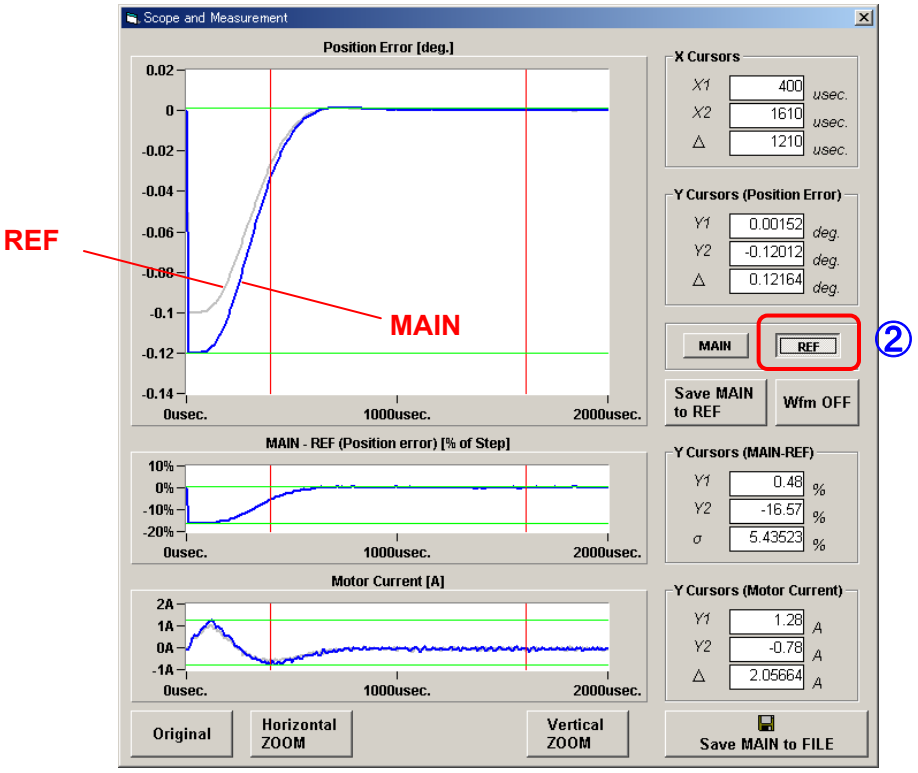
  Measured waveform data (MAIN) is copied to the reference data (REF).

  There is no change to the screen display at this time.

  (The above display is the measurement results for 0.1 deg (Mechanical) step movement.)
- Returns to the control software window without closing the Scope and Measurement window.
- Measuring the step response with different measurement conditions.



- The step response waveform displays (blue).
  (The above display is the measurement results for 0.12 deg (Mechanical) step movement.)
- Press the REF button. ②
- The response waveform (gray) saved in reference data is overwritten.



- Press the following button when you want to delete the waveform display for each of MAIN (blue) and REF (gray).

  MAIN button ③ -> Wfm OFF button ⑤

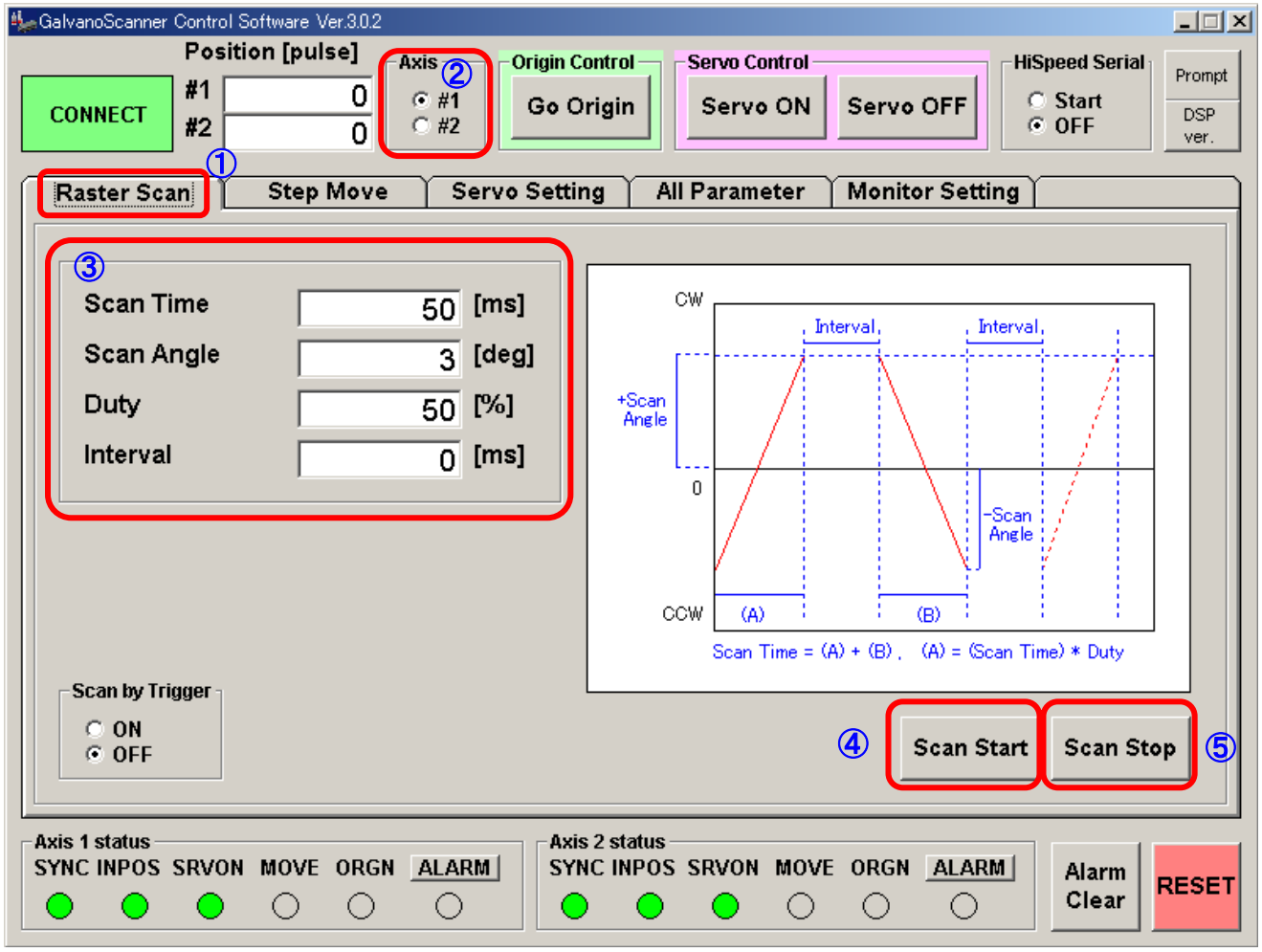
  REF button ④ -> Wfm OFF button ⑤

To display again, press the MAIN, or OFF buttons.

4.3. Raster Scan

Execute oscillation of a fixed angle at a fixed frequency.

Control Software



- Select the Raster Scan tab. ①
- Select an axis for raster scan. ②
- Specify the operation parameters (Scan Time, Scan Angle, Duty, and Interval). ③
- Press the Scan Start button to start operation. ④
- Press the Scan Stop button to stop operation. ⑤

RS-232C command

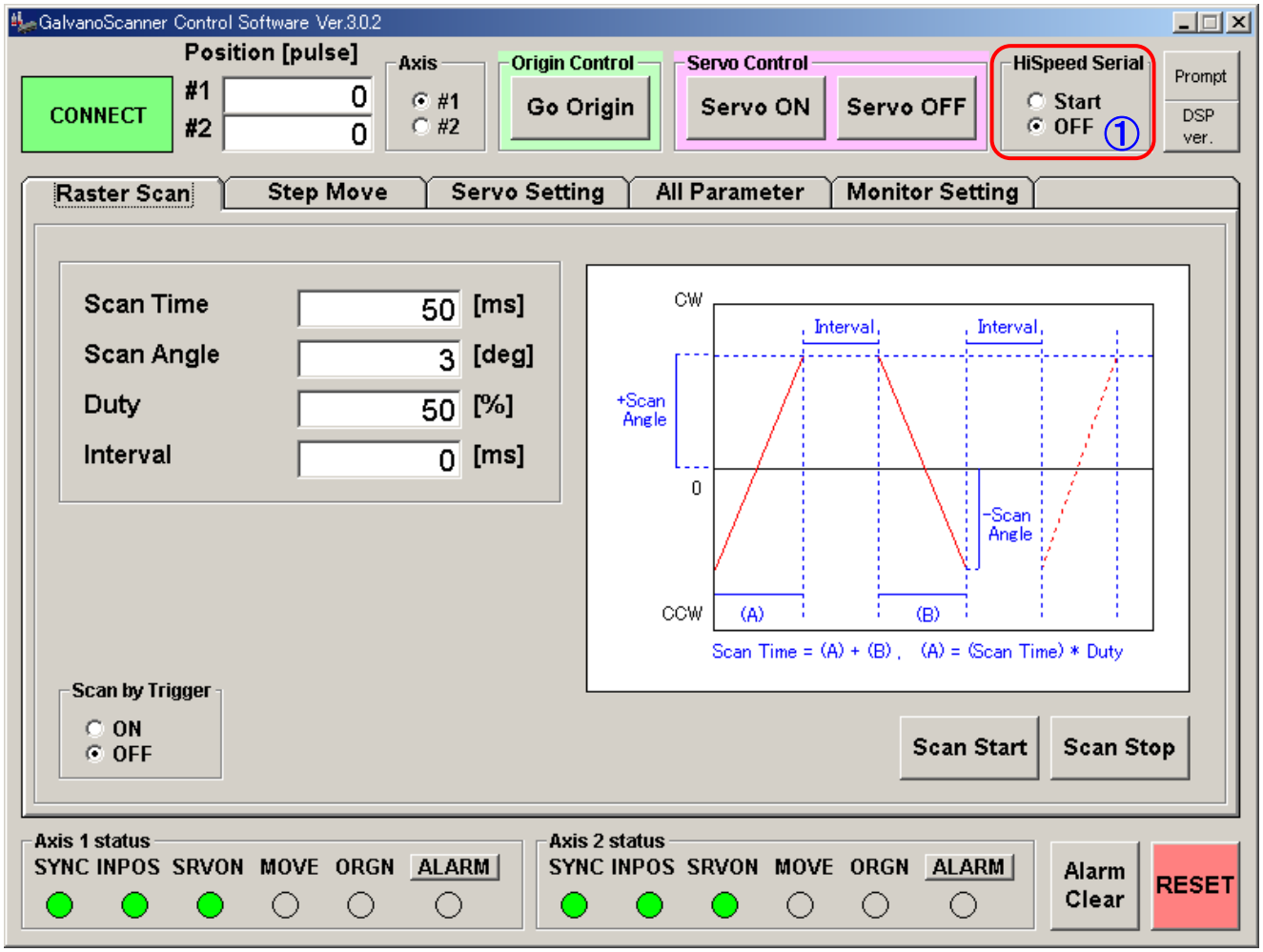
- Raster scan interval setting (Parameter ID = 26)
- Raster scan duty ratio setting (Parameter ID = 27)
- Raster scan oscillation angle setting (Parameter ID = 28)
- Scan start (Command ID = 23 Data = 3)
- Scan stop (Command ID = 23 Data = 0)

4.4. Position Command Input by High-speed Serial Communication

In order to carry out a vector scan, target position data is given to the controller by high-speed serial communication, and the data is updated as required.

It is possible to change the mode of the controller to the mode of receiving target position data by high-speed serial communication. For changing the mode, it is necessary to enter high-speed serial communication signals into the controller in advance.

Control Software



- Switch HiSpeed Serial to Start. ①

  This switching makes the controller follow target position data by high-speed serial communication.

- Switch HiSpeed Serial to OFF. ②

  Input of the MOVE command is awaited.

RS-232C commands

- Switch to high-speed serial communication (Command ID = 23 Data = 7)
- Return to internal clock operation (Command ID = 23 Data = 0)

5. Monitor Output and Digital Input Functions

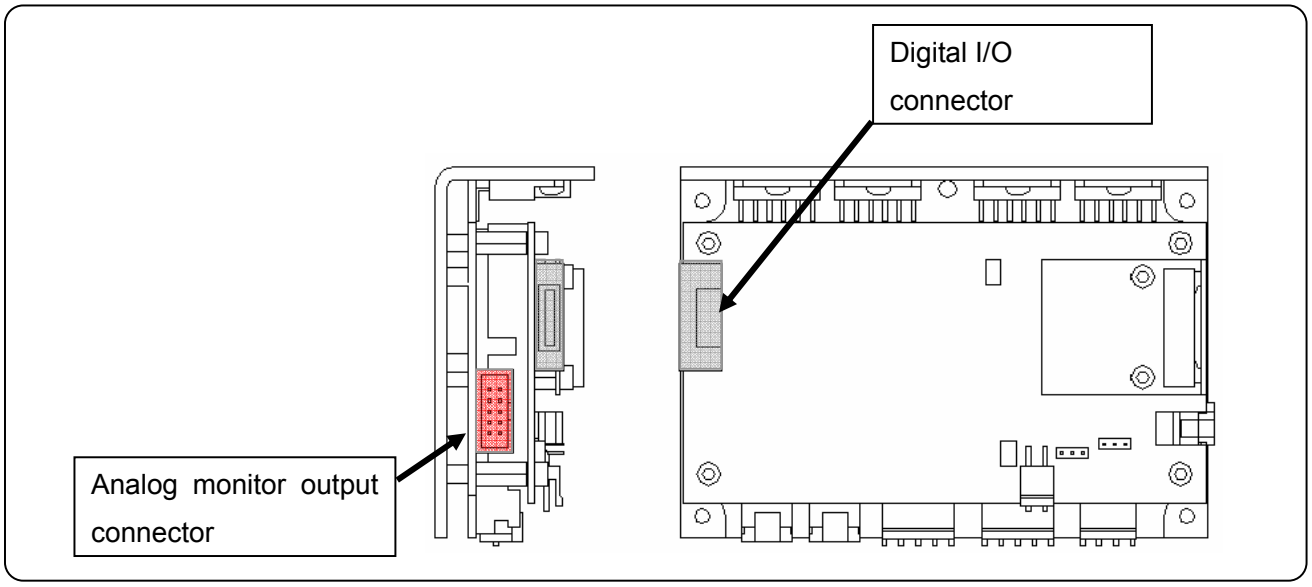
The controller has an analog monitor output connector for monitoring the operation status and a digital I/O connector for external signal input.

5.1. Connector Pin Assignment

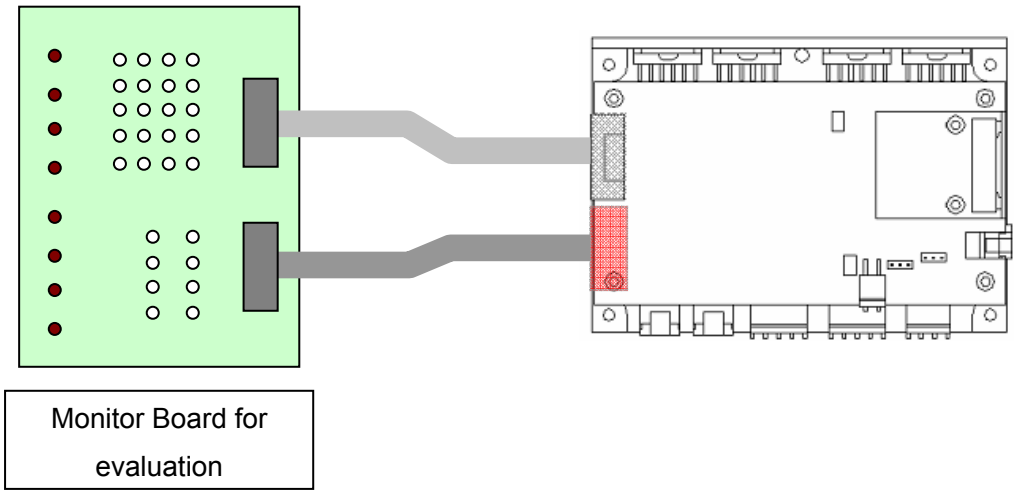
The controller is equipped with the following:

Analog monitor output connector ×1

Digital I/O connector ×1



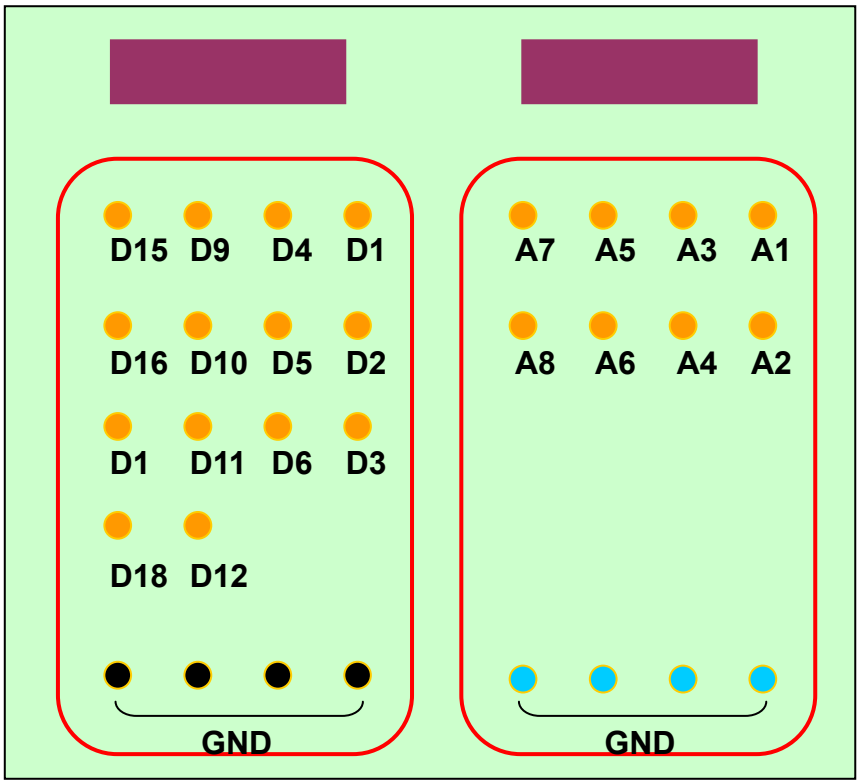
In order to evaluate this galvano scanner, the above output connectors are connected, and a monitor board for evaluation that can confirm analog output signals and the I/O of a digital signal is prepared as an optional product. Please contact the Sales Department for details.



The signal name is displayed on the evaluation monitor board. Please check the signal after referring to the table of the following pin arrangement.

Evaluation Monitor Board Pin Assignment

Pin Assignment of the optional monitor board for evaluation is as follows.



Analog monitor output connector

Connector model number

Connector	Model No.	Manufacturer
Board side	XG4C-1034	OMRON
Cable side	XG4M-1030-T	OMRON

Connector pin assignment

Pin No.	Monitor Board for Evaluation Signal Name	Signal Description
1	A1	Axis 1 current command value
2	A2	Axis 1 analog monitor 1 (Monitor item switching)
3	A3	Axis 1 analog monitor 2 (Monitor item switching)
4	A4	Axis 1 analog monitor 3 (Monitor item switching)
5	A5	Axis 2 current command value
6	A6	Axis 2 analog monitor 1 (Monitor item switching)
7	A7	Axis 2 analog monitor 2 (Monitor item switching)
8	A8	Axis 2 analog monitor 3 (Monitor item switching)
9	A9	Analog GND
10	A10	Analog GND

The controller has three monitor terminals for each of the two axes to check the operation status. The output signal contents can be changed and the output magnification can also be changed. (For details, see 5.2. “Analog Monitor Output Selecting”)

Digital I/O connectors

Connector model number

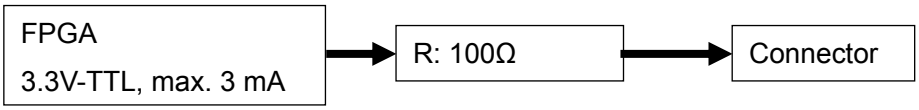
Connector	Model No.	Manufacturer
Board side	8931E-020-178L	KEL
Cable side	8925E-020-179	KEL

Connector pin assignment

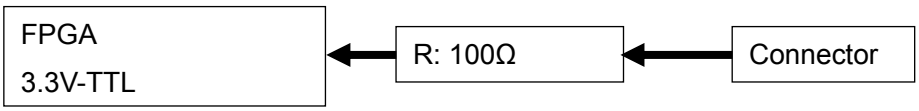
Pin No.	Monitor board for evaluation Signal Name	I/O	Signal Description	Logic	Remarks
A1	D1	Output	Axis 1 error 1 (Priority high)	High : Error	See Circuit 1 below.
B1	D2	Output	Axis 1 error 2 (Priority low)	High : Error	See Circuit 1 below.
A2	D3	Output	Axis 1 servo interrupt period	Edge	See Circuit 1 below.
B2	D4	Output	Axis 2 error 1 (Priority high)	High : Error	See Circuit 1 below.
A3	D5	Output	Axis 2 error 2 (Priority low)	High : Error	See Circuit 1 below.
B3	D6	Output	Axis 2 servo interrupt period	Edge	See Circuit 1 below.
A4	DG1	-	GND		
B4	DG2	-	GND		
A5	D9	Input	External Sampling Signal	↑: INT generation	See Circuit 2 below.
B5	D10	Input	External Trigger Signal	High : ON	See Circuit 2 below.
A6	D11	Input	Start up mode switching		See Circuit 2 below.
B6	D12		No connection		
A7	DG3	-	GND		
B7	DG4	-	GND		
A8	D15		No connection		
B8	D16		No connection		
A9	D17		No connection		
B9	D18		No connection		
A10			No connection		
B10			No connection		

Connection specifications

(Circuit 1)



(Circuit 2)



5.2. Analog Monitor Output Selecting

The analog monitor output can be switched to monitor various operation and signal statuses.

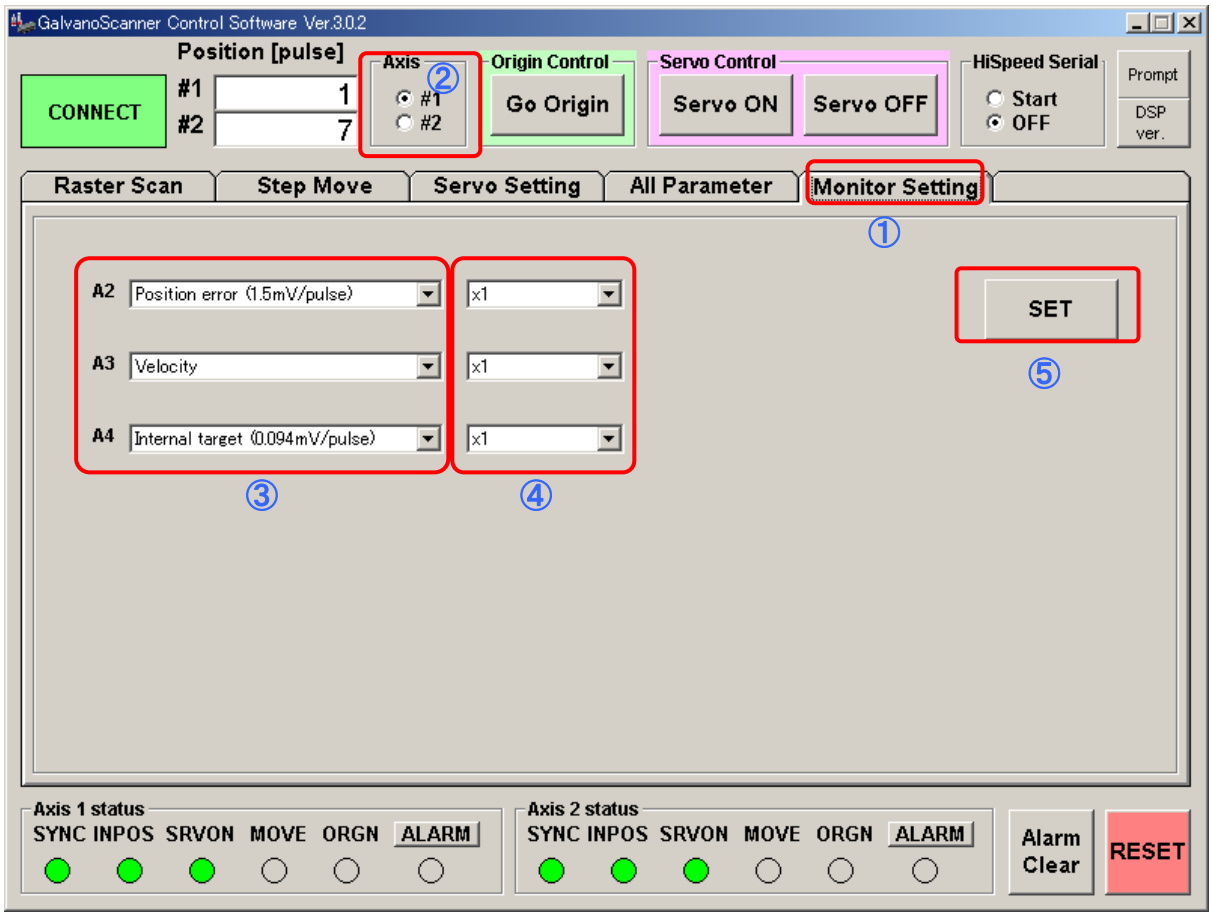
This switching can be executed from **[Control Software]** or **[RS-232C command send]**.

Output contents

Terminal	Monitor Board Signal Name	Power-on Selection	Signal Description	Signal Level (At Power-on)
2 (Axis 1) 6 (Axis 2)	A2 (Axis 1) A6 (Axis 2)		Phase A of Encoder Head 1	
			Phase A of Encoder Head 2	
			Phase A of encoder after synthesis	
		*	Positional deviation signal	1.5 mV / pulse
3 (Axis 1) 7 (Axis 2)	A3 (Axis 1) A7 (Axis 2)		Position	0.091 mV / pulse
		*	Velocity	0.091 mV / pulse / 10
			Coarse angle	
			Fine angle	
4 (Axis 1) 8 (Axis 2)	A4 (Axis 1) A8 (Axis 2)		Phase B of Encoder Head 1	
			Phase B of Encoder Head 2	
			Phase B of encoder after synthesis	
		*	Target position	0.091 mV / pulse

The signal level differs between signals. The output magnification can be switched individually.

Control Software



- Select the Monitor tab. ①
- Select the Monitor tab. ①
- Select an axis for monitor output switching. ②
- Select the monitor item of each output terminal. ③
- Select an output signal magnification. ④
- Press the SET button. ⑤

Note:

・The analog monitor output is from the D/A converter of the controller.

Since the output range of the D/A converter is from -3 to +3 V, output is repeated by the magnification setting if it exceeds this range.

・The relationship between encoder pulse and angle differs depending on the galvano motor.

E.g. GM-1010

360° = 1000 pulses × 8,192 divisions = 8,192,000 pulses

1° = 8,192,000 pulses / 360° = 22,756 pulses

At the monitor output position (0.091 V/pulse), the analog monitor output changes:

1° = 22,756 × 0.091 = 2.071 V

When the magnification is 1x, and there is a position change of 0° → 1°, analog output will change from 0V → 2.071V.

E.g. GM-1015 , GM-1020

360° = 1500 pulses × 8,192 divisions = 12,288,000 pulses

1° = 12,288,000 pulses / 360 = 34,133 pulses

At the monitor output position (0.091 V/pulse), the analog monitor output changes:

1° = 34,133×0.091 = 777 mV

When the magnification is 1x, and there is a position change of 0° → 1°, analog output will change from 0V → 777 mV.

RS-232C Commands

- Monitor Output Selection (A2, A8) Command ID = 40
- Monitor Output Selection (A3, A9) Command ID = 41
- Monitor Output Selection (A4, A10) Command ID = 42
- Monitor Magnification Setting (A2, A8) Command ID = 44
- Monitor Magnification Setting (A3, A9) Command ID = 45
- Monitor Magnification Setting (A4, A10) Command ID = 46

5.3. Digital Input-Output Function

The controller has a digital input-output function for checking the status of the controller.

Pin No.	I/O	Signal Description	Logic	Explanation
A1	Output	Axis 1 Error 1 (Priority high)	High: Error	If an error occurs, the corresponding error signal is output. According to the priority of the error, Error 1 or 2 is output. See 9-2, “Errors.”
B1	Output	Axis 1 Error 2 (Priority low)	High: Error	
B2	Output	Axis 2 Error 1 (Priority high)	High: Error	
A3	Output	Axis 2 Error 2 (Priority low)	High: Error	
A2	Output	Axis 1 servo interrupt period	Edge	Output is timed according to an internal controller servo interrupt..
B3	Output	Axis 2 servo interrupt period	Edge	

In addition, the following digital I/O is prepared as an operation setting of the controller.

Pin No.	I/O	Signal Description	Logic	Explanation
A5	Input	External Sampling Signal	↑: INT generation	Input when an external signal is used for servo sampling clock. (Do not use it usually.)
B5	Input	External Trigger Signal	High: FG_ON	See 6-2, “Operation that synchronizes with external trigger signal input (raster scan)
A6	Input	Start up mode switching		See 6-1, “Setting Controller Start Up Mode”

6. Other - Operation Setting

6.1. Setting Controller Start Up Mode

Clock selection

With the default settings at shipping, a parameter is set to start up the controller in RS-232C communication command input mode (internal clock). When assembling the device, however, the mode can be switched for start up with an external clock (high-speed serial communication). For this switching, the following parameter is set:

Parameter ID	Data
64	Bit 1 0: RS-232C communication command input 1: High-speed serial communication

P64 = 1: Start up with internal clock

P64 = 3: Start up by high-speed serial communication

(Bit 0 of P64 is used to enable or disable encoder correction when homing to the origin; it is usually set to 1. For details, see 9.2. , “Parameter Details”)

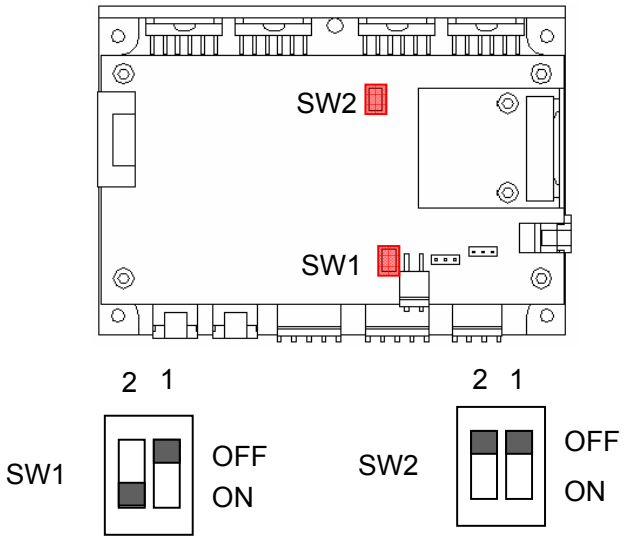
Start up mode

Power-on usually executes the following automatically:

- Reading parameters from EEPROM
- Starting homing and servo control

If there is a problem with the parameters read from EEPROM or if oscillation occurs when homing and servo control are executed automatically, the start up mode can be changed.

For this switching, the switches (SW1 and SW2) on the controller board and the logic of the digital I/O terminal (A6) are combined.



Axis 1

SW1-2	Terminal A6	Auto EEPROM Read	Auto Homing
OFF	0	Disabled	Disabled
OFF	1 or open	Enabled	Disabled
ON	0	Enabled	Disabled
ON	1 or open	Enabled	Enabled

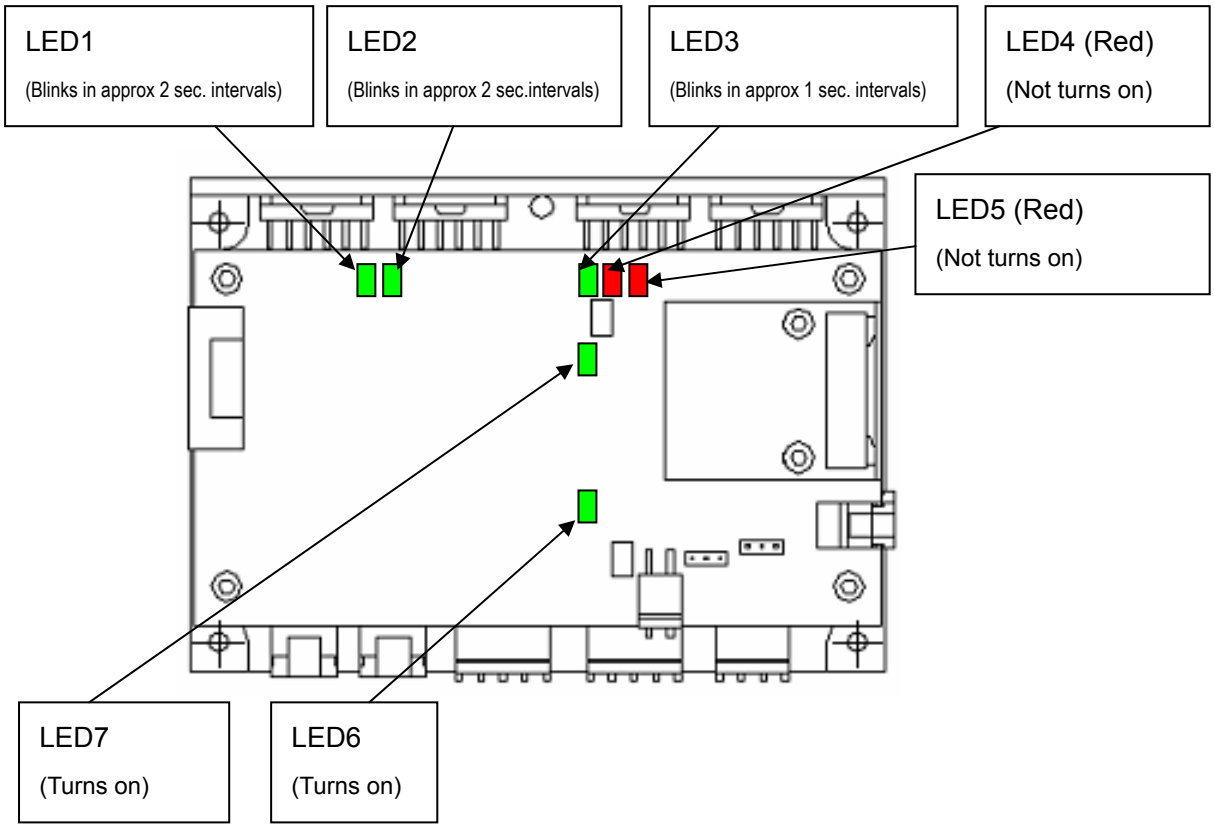
Axis 2

SW2-2	Terminal A6	Auto EEPROM Read	Auto Homing
OFF	0	Disabled	Disabled
OFF	1 or open	Enabled	Disabled
ON	0	Enabled	Disabled
ON	1 or open	Enabled	Enabled

: Setting at shipping

6.2. Controller LED Display

The controller (GC-201) is equipped with an LED that indicates the controller status.
After turning on the power, when the controller starts up normally, the display will be as follows.



Meaning of each LED

LED No.	Meaning	Remarks
LED1	DSP1 operation (for Axis 1)	Always blinks in approximately 2 sec. intervals if DSP1 start up correctly.
LED2	DSP1 operation (for Axis 2)	Always blinks in approximately 2 sec. intervals if DSP1 start up correctly.
LED3	FPGA Start up	Always lit if FPGA start up correctly.
LED4	ALARM display (for Axis 1)	This LED (red) is lit when a malfunction occurs with the controller.

		A response is necessary after confirming the error details with the control software, or RS-232C command ID = 15 error read.
LED5	ALARM display (for Axis 2)	This LED (red) is lit when a malfunction occurs with the controller. A response is necessary after confirming the error details with the control software, or RS-232C command ID = 15 error read.
LED6	DSP2 operation (for Axis 1)	Always lights in approximately 1 sec. intervals if DSP2 start up correctly.
LED7	DSP2 operation (for Axis 2)	Always lights in approximately 1 sec. intervals if DSP2 start up correctly.

Note: When connecting only one axis of the motor and operating the controller (GC-201), an error will always occur for the axis that is not connected. As a result, either LED4 or LED5 will light up, however, as there is no problem with the operation of the connected axis, use it as is.

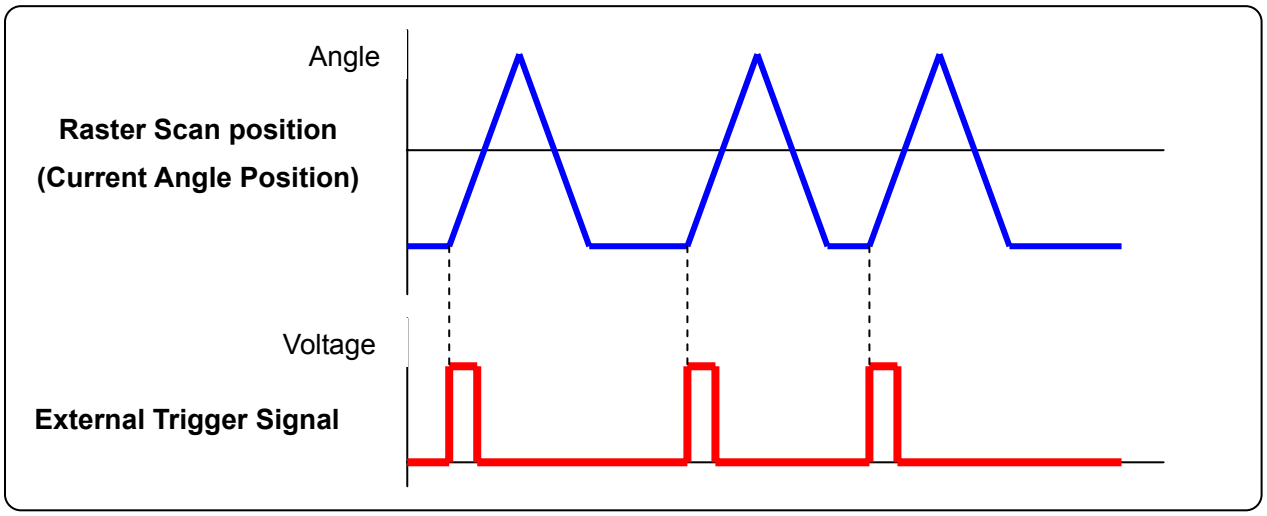
6.3. Operation that Synchronizes with External Trigger Signal input (Raster Scan)

"4.3. Raster Scan" can be operated in synchronization with an external trigger signal.

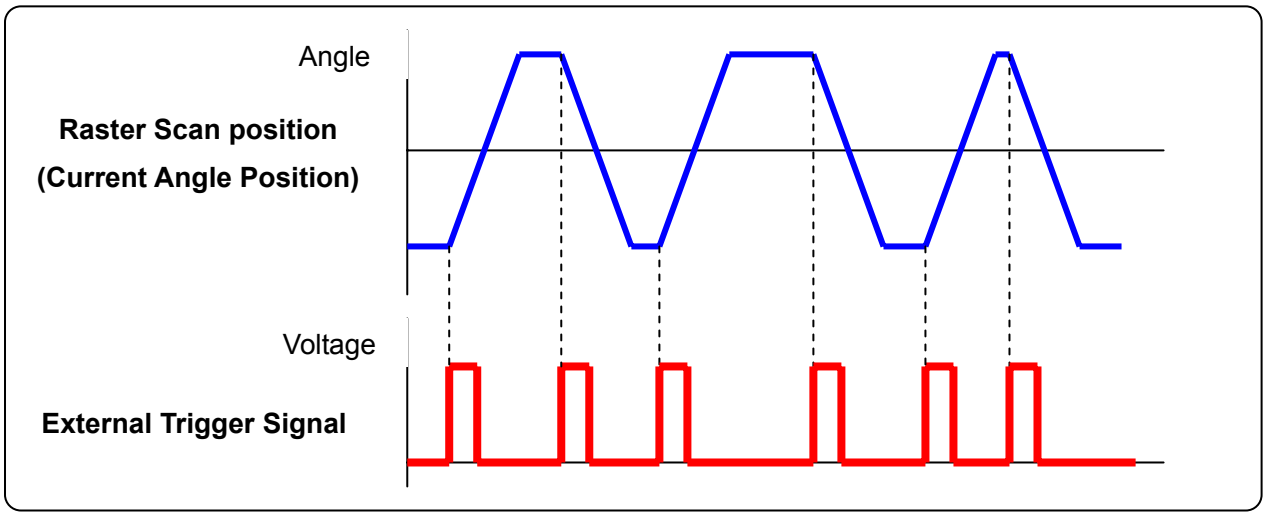
The Movement Pattern

There are two kinds of movement patterns.

① (The raster scan of one coming and going operates whenever the external trigger signal is input.)



② (The raster scan of one way operates whenever the external trigger signal is input.)



① and ② operation pattern can be selected by RS-232C command (Command ID = 23 'Operation Mode setting')

Input the external trigger signal

The external trigger signal is input from the digital I/O connector.

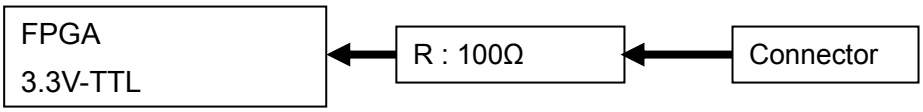
(See 5-1 'Connector Pin Arrangement)

Connector pin arrangement

Pin No.	Monitor Board Signal Name	I/O	Signal Description	Logic	Remarks
B5	D 10	Input	External Trigger Signal	High: ON	See Circuit below.

Connection Specifications

3.3V TTL Input



Operation procedure

(Raster Scan Parameter Settings)

・Set Parameter ID =26 Raster Scan Time Setting

・Set Parameter ID =27 Raster Scan Duty Ratio Setting

・Set Parameter ID =28 Raster Scan Angle Setting

(Raster Scan Operation)

・Send Command ID=8 Data=6 Movement Start (Movement to the initial position of a raster scan)

・Send Command ID=23 Data=8 (One way scan)
Data=9 (One coming and going) } Select either

(Reference: Data = 3 in case of continuous operation)

・Input the external trigger Signal

・Send Command ID=23 Data=0 Scan Stop

Notes

- The external trigger input during raster scan move is ignored.
- From the external trigger signal input, until the time actual operation starts, there can be a fluctuation of up to a maximum of 10 usec.

7. Tuning

7.1. Tuning

At the time of shipping, with the combination of the galvano motor and controller (GC-201), appropriate servo tuning has been completed.

The following tools have been prepared to check malfunctions during use, and handling trouble such as mirror damage.

- **Control software**

  It is possible to check servo tuning related parameters and make changes from the control software's Servo Setting tab.

  Note: Changes are not usually made to the parameters. Settings with inappropriate parameter values can cause abnormal operations such as oscillations.

- **Frequency characteristic (FFT) measurement**

  It is possible to check the servo tuning status.

  (See 7.2 Frequency Characteristic (FFT) Measurement for details)

- **Auto tuning**

  When adjusting servo tuning, in order to exchange a damaged mirror, an easy auto tuning program is required.

  However, use of this function is limited to the mirror shape provided by the setting file (definition file).

  (See 7.3 Easy Auto Tuning for details)

- **X and Y axis matching**

  This function automatically matches the step movement response waveform of Axis 1, and Axis 2.

  (See 7.4 X, Y Matching for details)

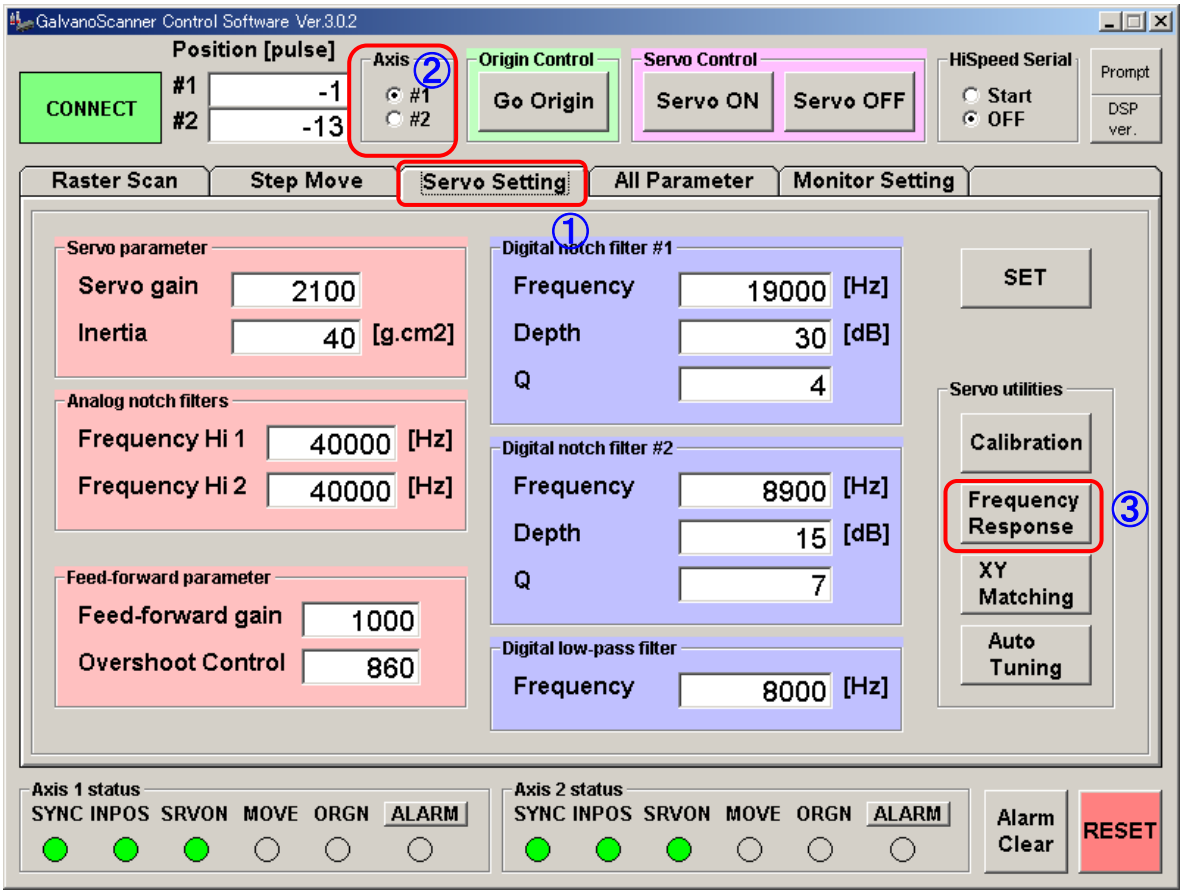
7.2. Frequency response (FFT) Measurement

The control software includes a function to measure the frequency response of the galvano scanner motor.

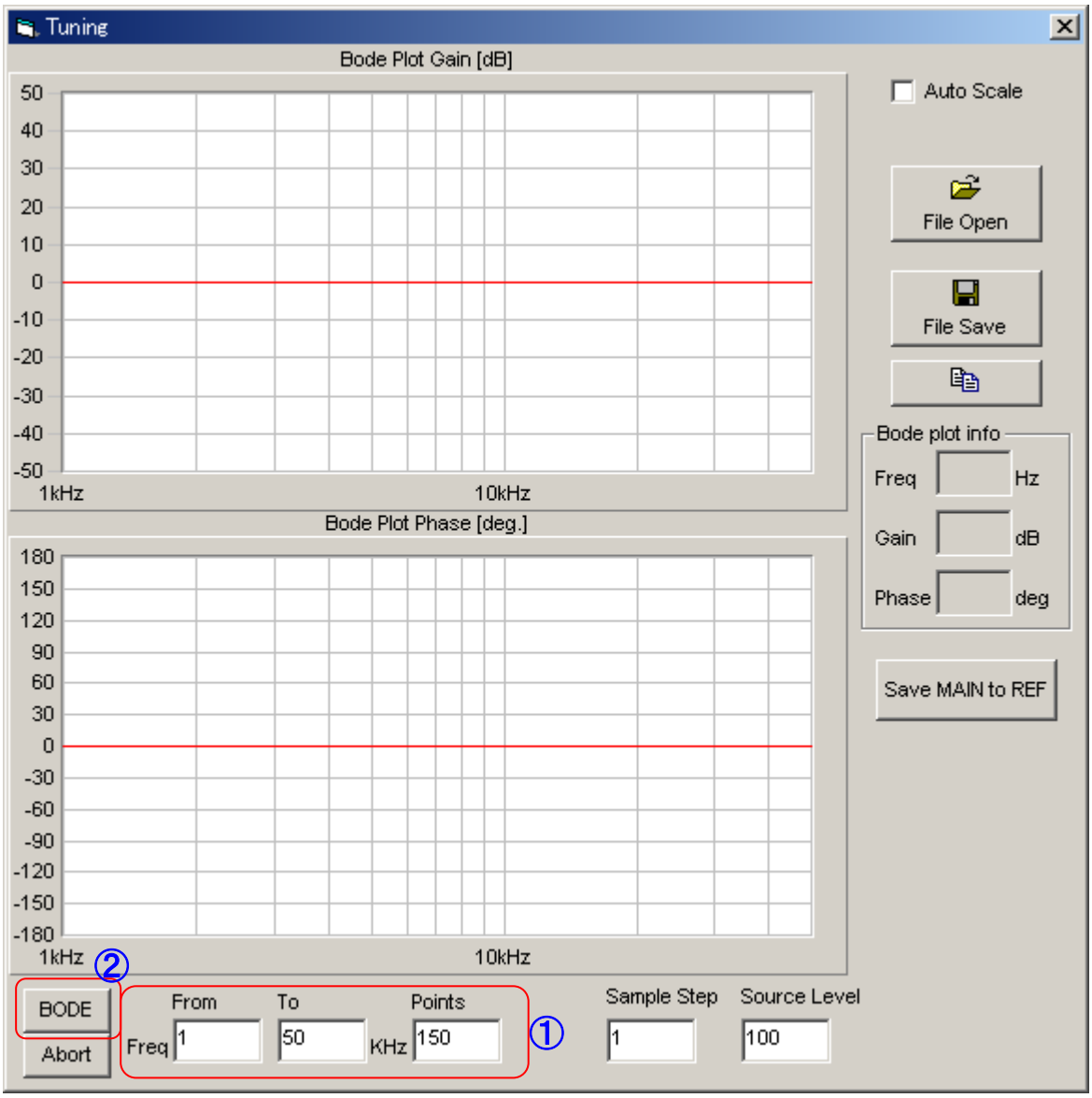
Frequency response measurement is used in the following situations.

Initial frequency responses are saved, and these are compared to confirm changes with frequency response when malfunctions occur. You can determine whether the cause of the malfunction is with the motor or servo settings.

Operations



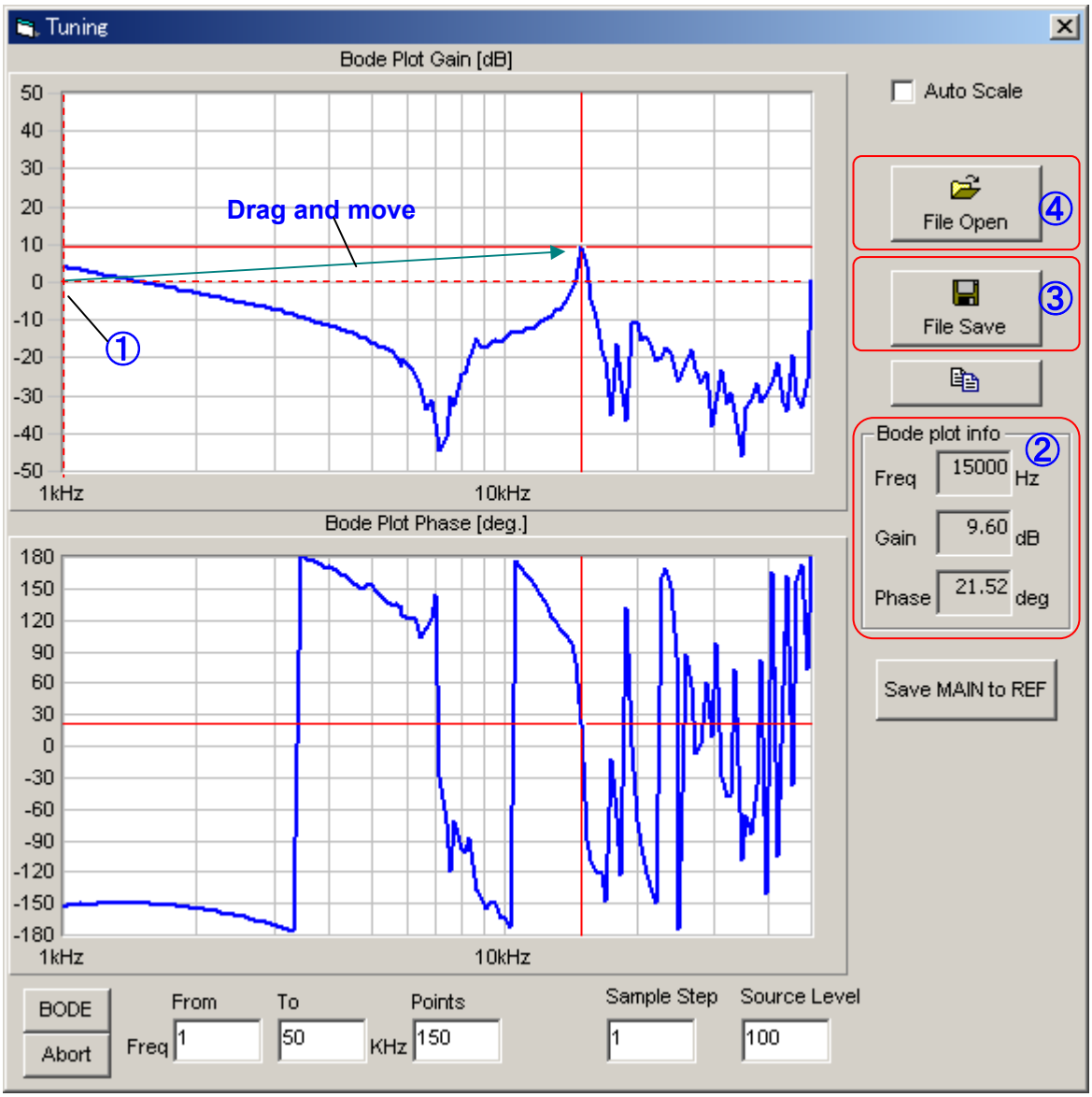
- Confirm the Servo ON status of the axis being measured.
  The status of SYNC, INPOS, and SRVON are all ON (green).
- Select the Servo Setting tab ①
- Select the axis no. to measure (Axis #1 or #2) ②
- Press the Frequency Response button ③



- The frequency characteristic measurement window appears
- Set the frequency range and number of points to measure ①

  (The above is with defaults of 1 kHz ~ 50 kHz and 150 points input)
- Press the BODE button ②

  (Press the Abort button to stop while measuring)

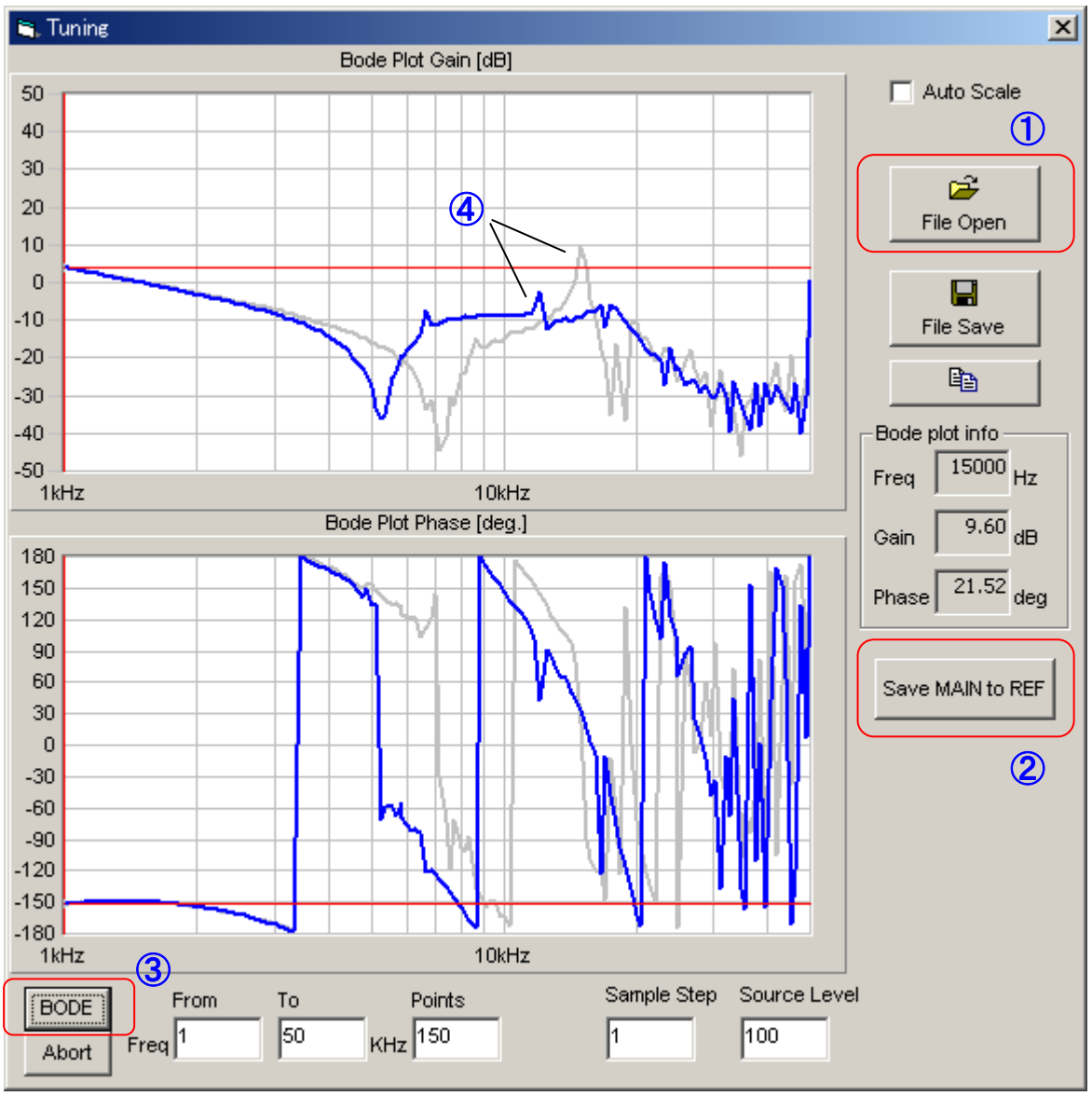


- The frequency characteristic measurement results display.
- By dragging the cursor (point where red lines intersect), specified frequency detailed information (measured frequency points, gain, and phase) will display ②

- Press the File Save button to save measurement results (saves in CSV file format) ③

- It is possible to read and display measurement results that were saved in the past. Press the File Open button to specify the saved CSV saved file ④

Saved data can be compared with the current measurement results in the window.



- Read and display saved data by pressing the File Open button (blue) ①
- Register reference data with the Save MAIN to REF button ②
- Measure with the BODE button ③
- Data (blue) measured with ③ displays overwriting reference data (gray). ④

Note:

When comparing with past measurement data, even when there are no problems, it may not match exactly due to the influence of measurement error.

7.3. Auto Tuning

Servo tuning of galvano scanner motors and controllers are set appropriately by Canon at the time of shipping, however, an auto tuning function is included in the controller software in the following situations for tuning again.

- When you want to replace a damaged mirror

- When oscillation occurs to change of the motor status or load status and you want to carry out appropriate servo tuning

This auto tuning function can only be used when the following conditions have been met.

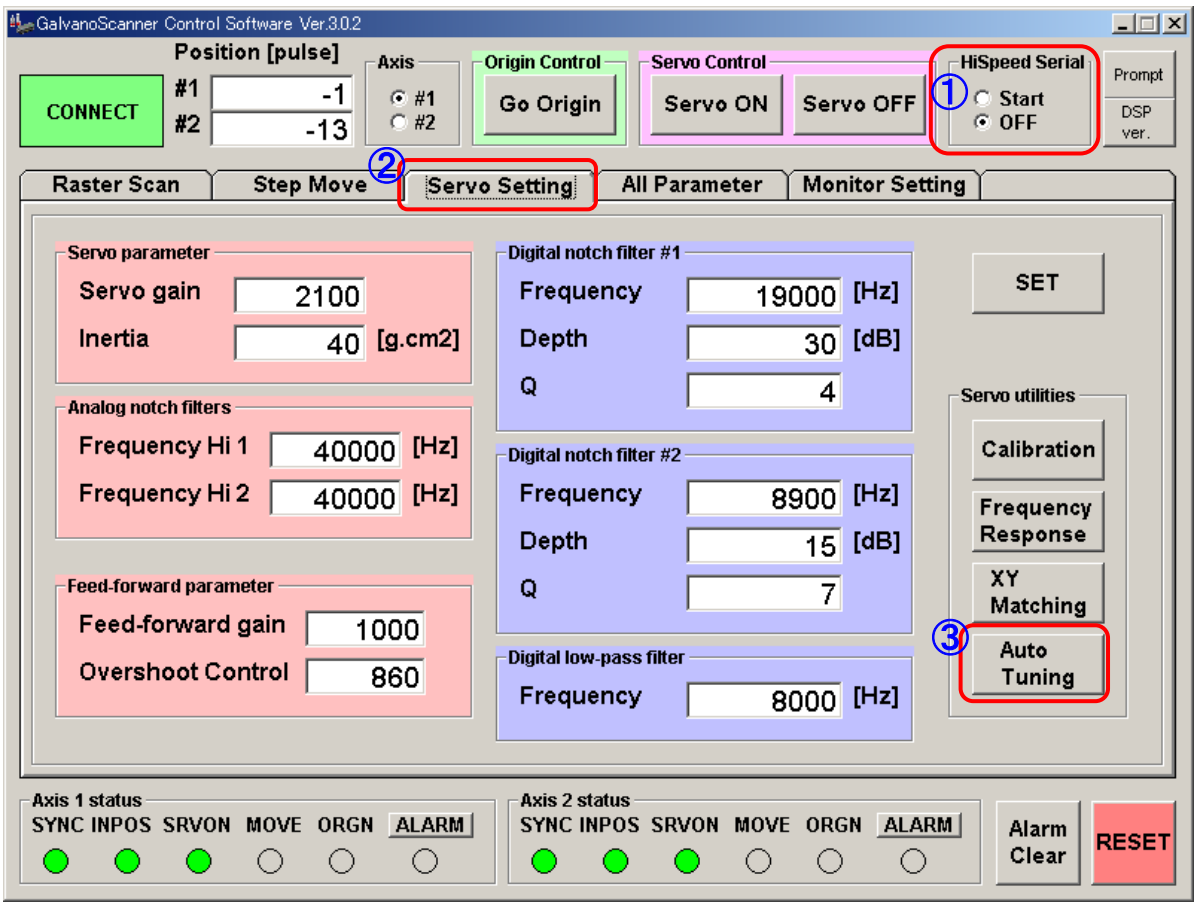
- The load to exchange (mirror, mirror holder) is the same design as the previous one

- The load is servo tuned once at Canon, and an auto tuning dedicated setting file is provided (please contact your sales representative)

- Load attachment conditions for the motor are the same as the previous one
  (The torque tightness of the mirror holder is the same, and torque tightness is listed on the Inspection Sheet at the time of shipping)

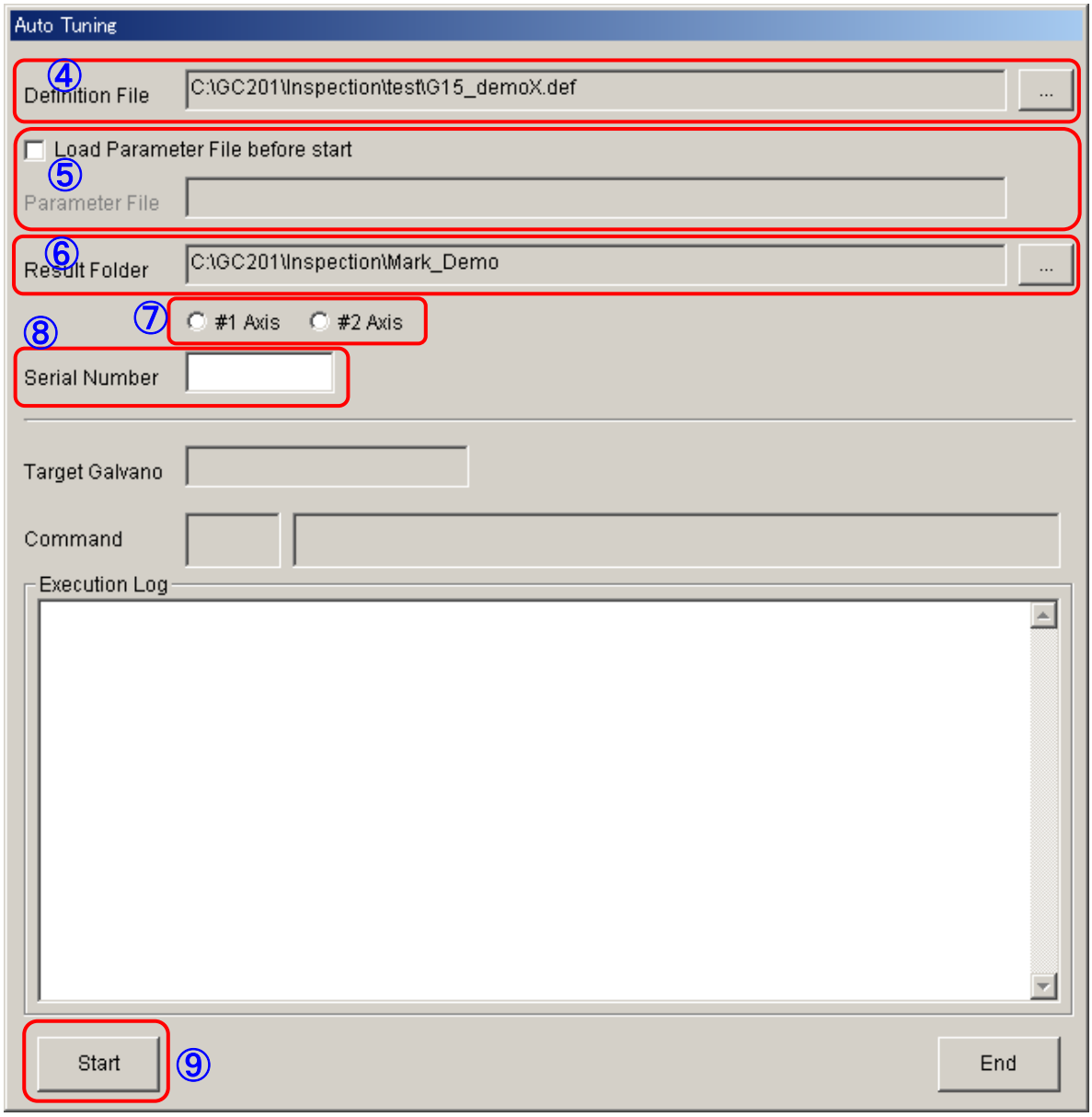
Note:
In order to use this auto tuning function in this case, a dedicated setting file for the load is necessary.
This function is not for fully automatic tuning of an arbitrary (unknown) load.

Operations



- Need to change the mechanical setting so that can operate in a range ±15° (Mechanical Angle) , when excute the auto tuning. Because that auto tuning program operate the motor in a range ± 15° (Mechanical Angle) .
- Turn OFF high-speed serial ①
- Select the Servo Setting tab ②
- Press Auto Tuning ③
- Input the password (canon)

- Display of the Auto Tuning screen



- Select the setting file (Definition File). ④

  Setting files will be provided by Canon.

- When necessary, select parameter files to load in the controller prior to tuning. ⑤

  Check the “Load Parameter File before start” checkbox and specify the parameter file. Use in situations when you want to load a parameter file and then carry out tuning.

  Parameter files to be loaded will be prepared by the user. Refer to 9.5 for the file creation method.

- Select the folder for results (Result Folder). ⑥

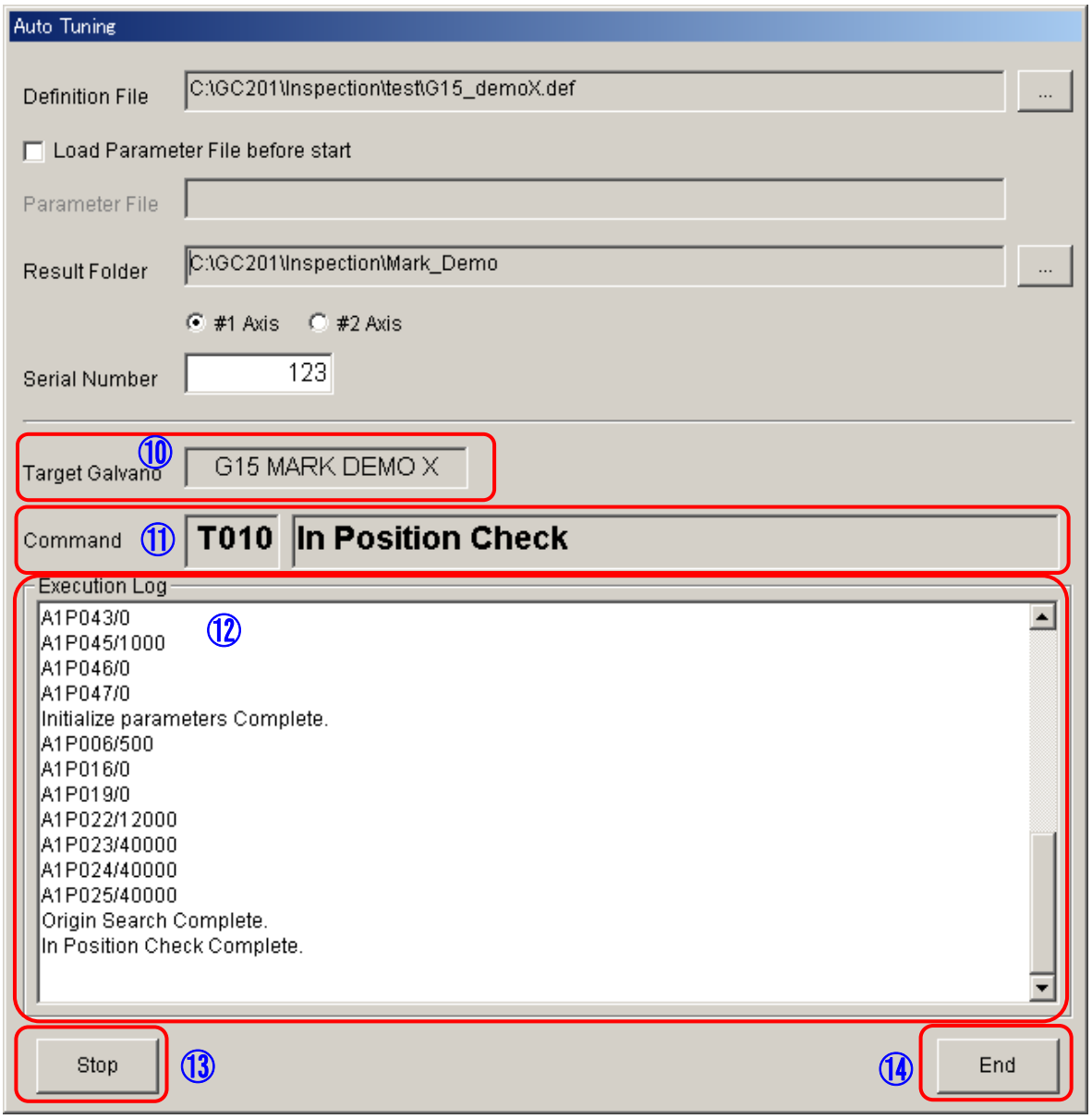
  Tuning results will be saved.

- Select the axis. ⑦

  Select the axis connected to the motor and mirror that corresponds to the Definition File.

- Input the serial number. ⑧

  A folder with the same name as the number input here is generated in the saved results folder, and tuning results are saved. Usually the controller's serial number is input, however, any number that is easy for the user to manage may be input.
- Pressing the Start button. Then starts the tuning. ⑨

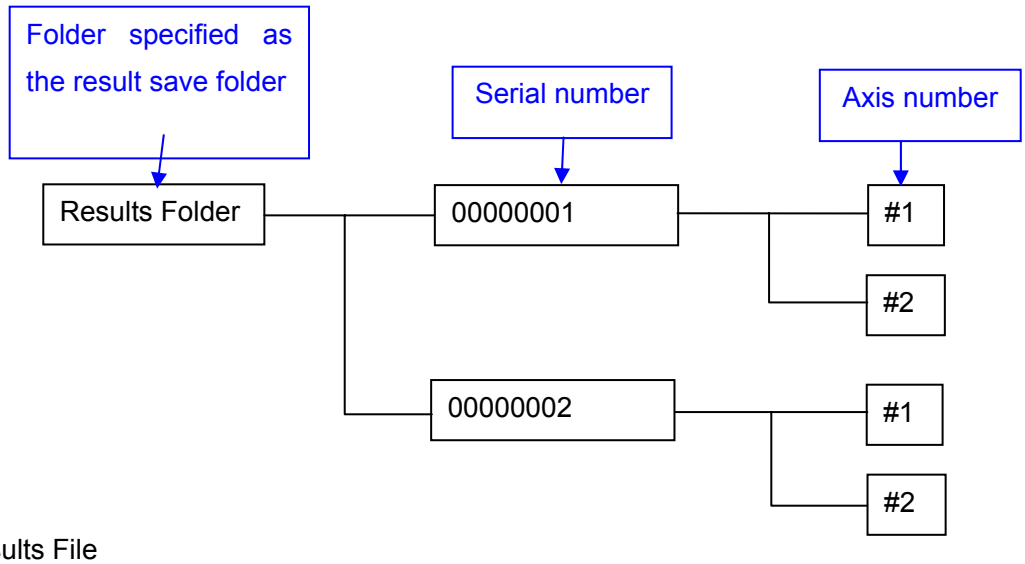


- The name of the motor and mirror to be tuned will display in Target Galvano. ⑩
- Details of the current tuning being carried out display in Command. ⑪
- Detailed tuning operation conditions display in Execution Log. This log is saved as a text file of tuning results in the saved results folder. ⑫
- Press the Stop button to stop while tuning. ⑬
- Press the End button to close the tuning menu. ⑭

- When tuning is completed the following message displays, and tuning results are saved to EEPROM.

Saved Results Folder

The saved results folder is composed as follows.



Results File

The following files are saved in the axis number folders after tuning.

- LOWGAIN.CSV
  Frequency response characteristics with no filter and low gain
- TORQUE.CSV
  Torque correction data
- STEP.CSV
  Step waveform after tuning
- HIGHGAIN.CSV
  Frequency response characteristics after tuning
- Param.TXT
  Parameter file after tuning
- Report.txt
  Log messages currently being executed

Parameters Changed During Auto Tuning

The following parameters are adjusted or changed by the auto tuning.

ID	Meaning
2	Max Velocity
6	LQ Control Gain
7	Torque Constant
8	Total Inertia
9	Current Limit
10	Encoder Periodicity
11	Origin Clear Timing (Head 1)
12	Sampling Time
14	Origin Clear Timing (Head 2)
16	#1 Notch Filter Frequency
17	#1 Notch Filter Q (x 100)
18	#1 Notch Filter Depth
19	#2 Notch Filter Frequency
20	#2 Notch Filter Q (x 100)
21	#2 Notch Filter Depth
22	Low-pass Filter Cutoff Frequency
23	#1 Analog Notch Filter Frequency
24	#2 Analog Notch Filter Frequency
25	#3 Analog Notch Filter Frequency
32	Torque Peak Offset
40	Feed Forward Gain
42	Over-shoot Control
44	PES Limit
45	Loop Gain Fine Adjustment
48	VR Head 1 A/B Offset
49	VR Head 1 A gain
50	VR Head 1 B gain
51	VR Head 2 A/B Offset
52	VR Head 2 A gain
53	VR Head 2 B gain

7.4. X and Y Axis Matching

It is possible to match the step response waveforms of the X axis (Axis #1) and Y axis (Axis #2).

(Summary of Operations)

- Matching the frequency response

  This operation matches the frequency response of both axes at 1 kHz. Gain is adjusted with “loop gain fine adjustment” (parameter ID = 45). Phase is adjusted with “Notch filter Q value” (parameter ID = 17 and 20) of each axis.

- Matching the step response overshoot

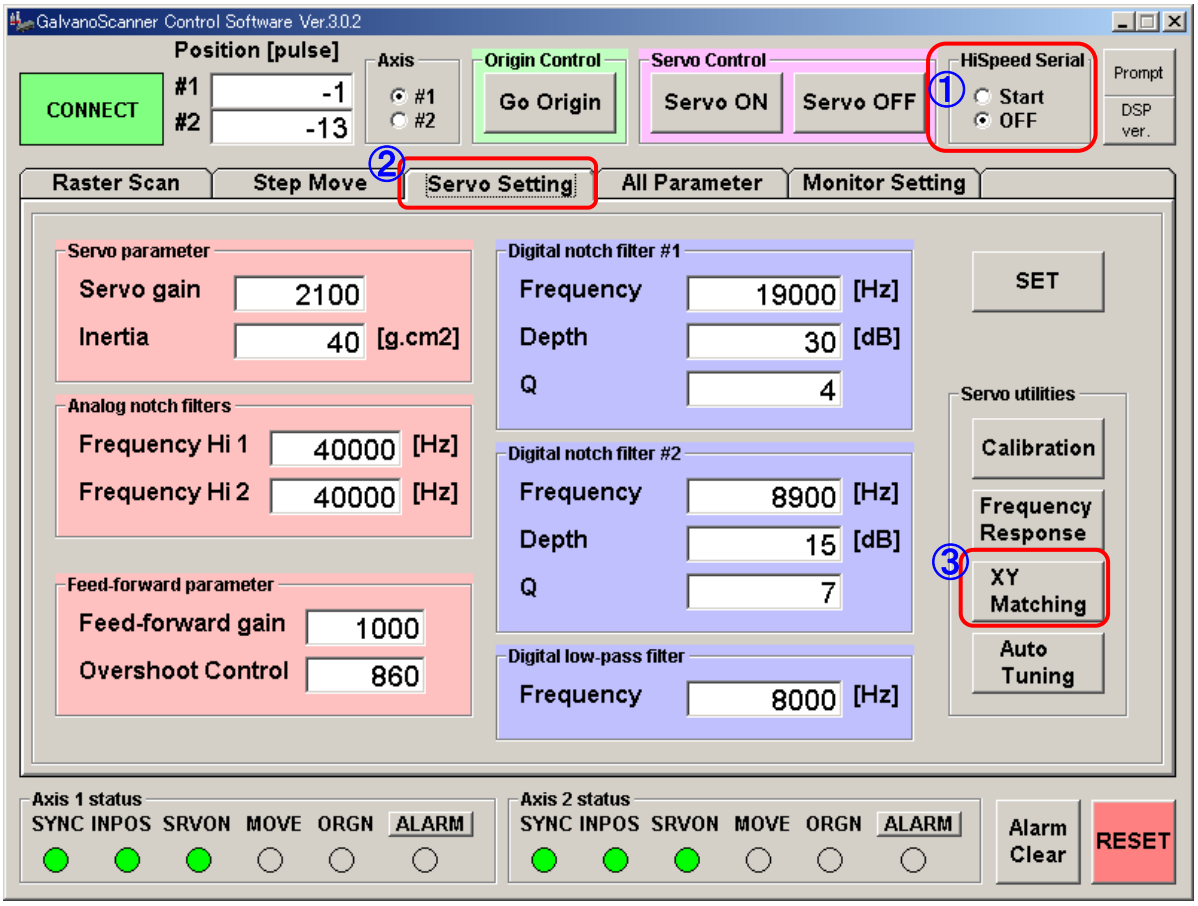
  This operation matches the overshoot of the step response waveforms for each axis. It is carried out after matching the frequency response. Overshoot is adjusted with “Over-shoot Control“(Parameter ID = 42).

(Operating Conditions)

- Both axis motors are connected to controller.
- Both axis use digital notch filter for tuning.

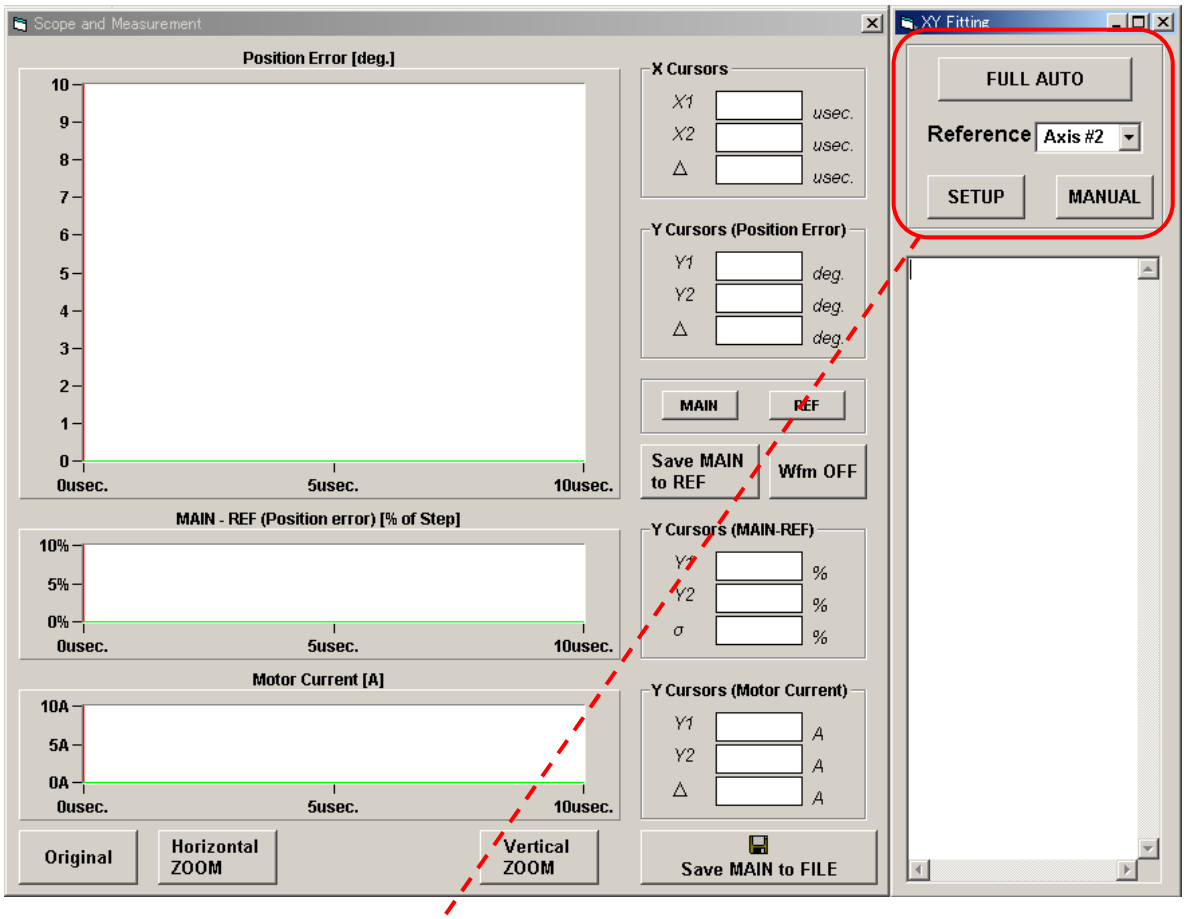
The X and Y match may not function in some situations other than the above conditions. In this case an error will occur during tuning, and it will stop.

Operations

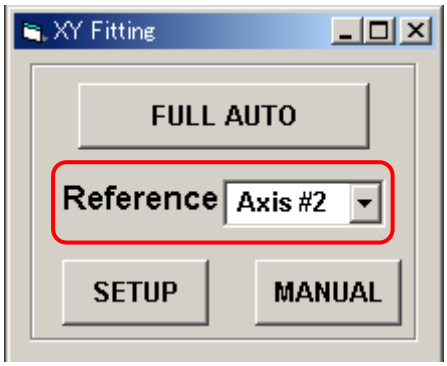


- Turn OFF high-speed serial ①
- Select the Servo Setting tab ②
- Press XY Matching ③

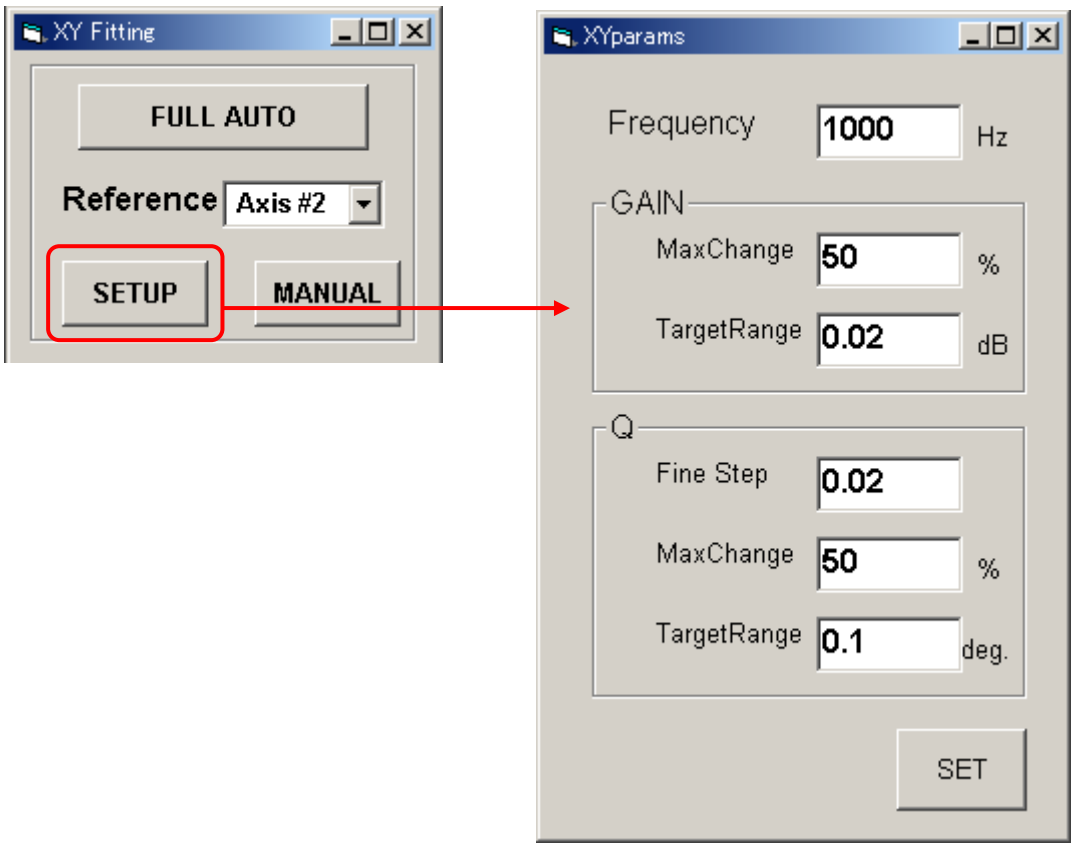
- Display of the X and Y Matching screen



- Select the axis side with no margin for tuning (phase margin, gain margin) as the Reference.
  Usually a large mirror load is attached to the Axis #2 (Y axis) side, Axis #2 will be the Reference.
  With X and Y matching, the frequency response of another Axis will be adjusted to the frequency response of the Reference side.

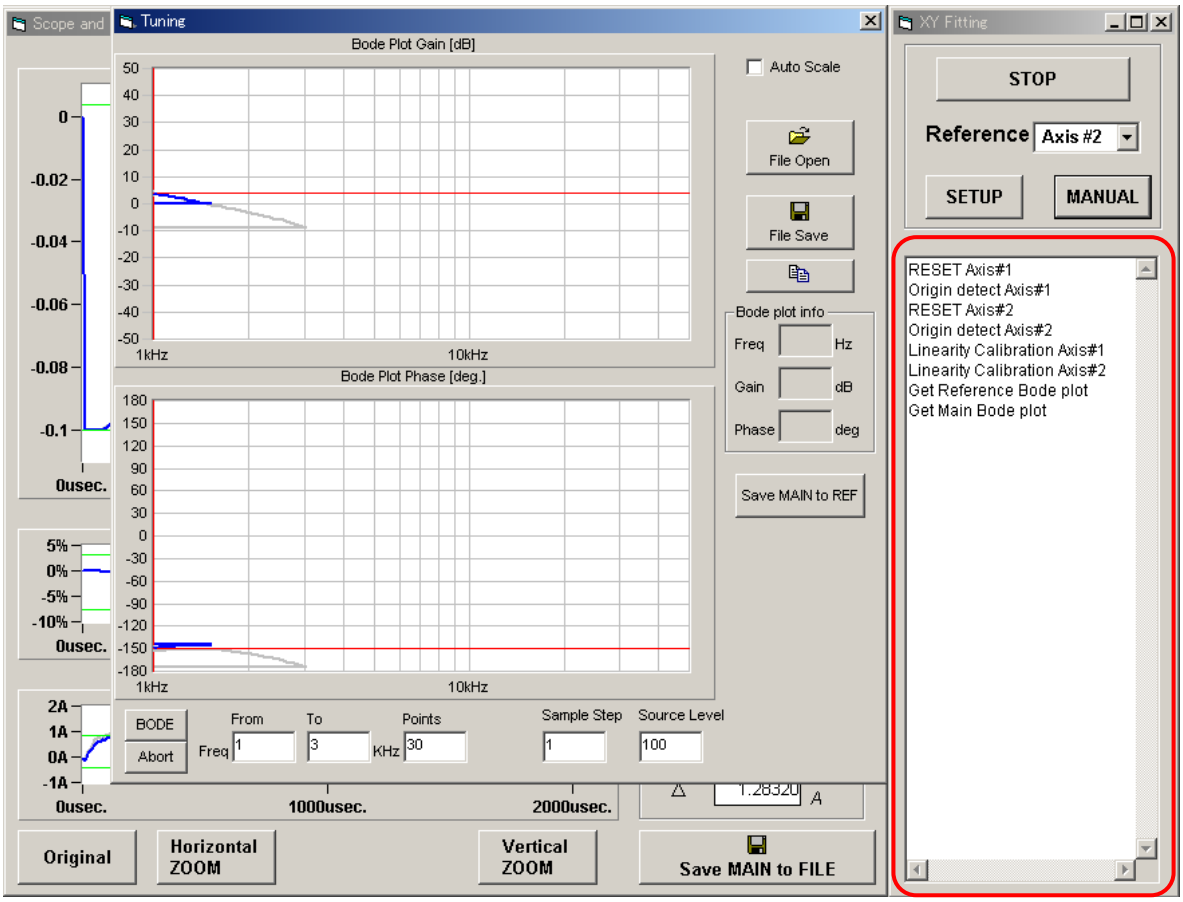


- By pressing the SETUP button, operating conditions during FULL AUTO can be set. Usually default parameter settings will operate correctly.



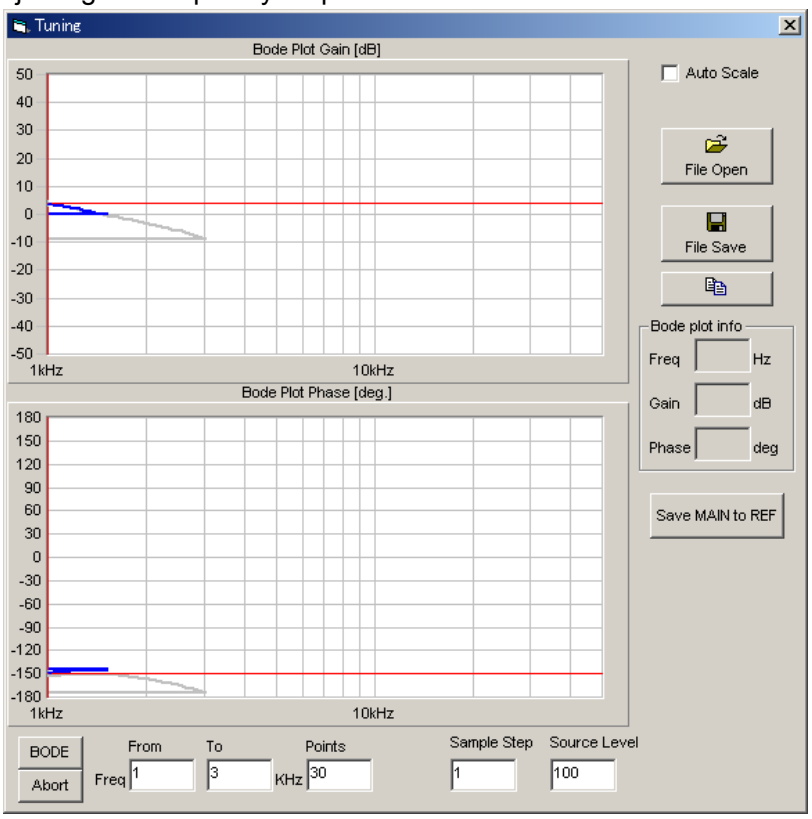
- Frequency — Frequency when measuring the frequency response
- GAIN
  - Max Change — Permissible change rate from the original gain setting value. If this value is exceeded, the operation will be stopped with an error.
  - Target Range — Adjustment takes place so the margin of error between both axis is lower than this value.
- Q
  - Fine Step — Amount of step adjustment for Q
  - Max Change — Permissible change rate from the original Q setting value. If this value is exceeded, the operation will be stopped with an error.
  - Target Range — Adjustment takes place so the margin of error between both axis is lower than this value.

- Press the FULL AUTO and tuning starts.
- Operation details display in the log messages while operating.

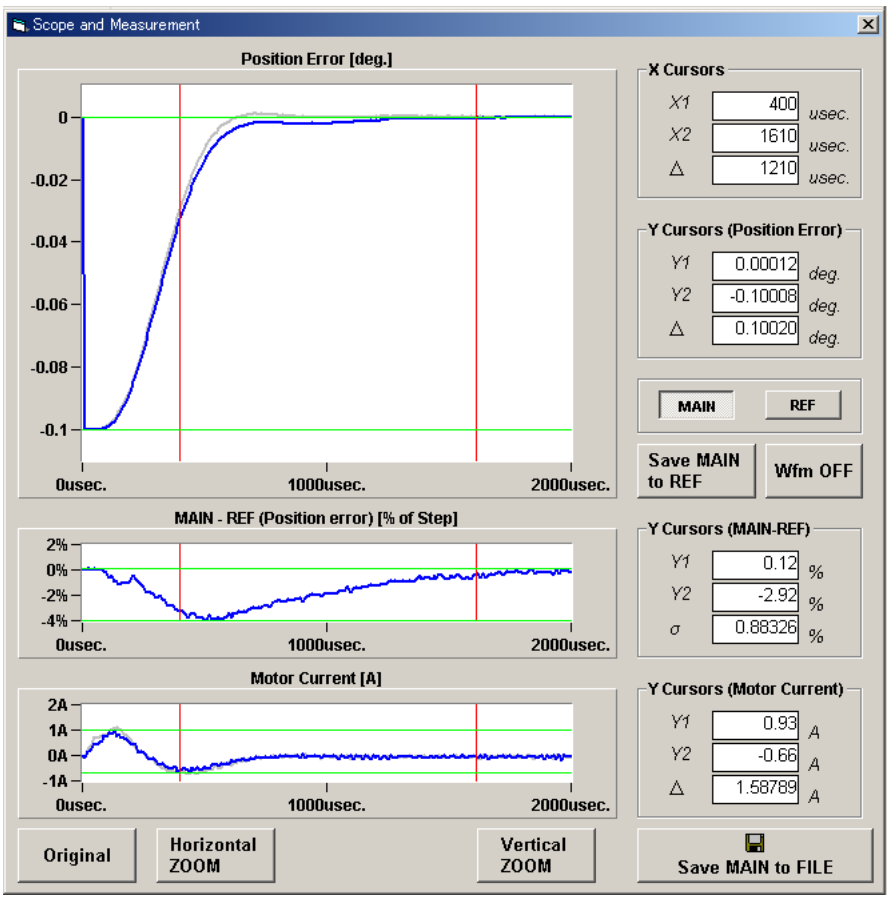


- The gray waveform is the Reference waveform.

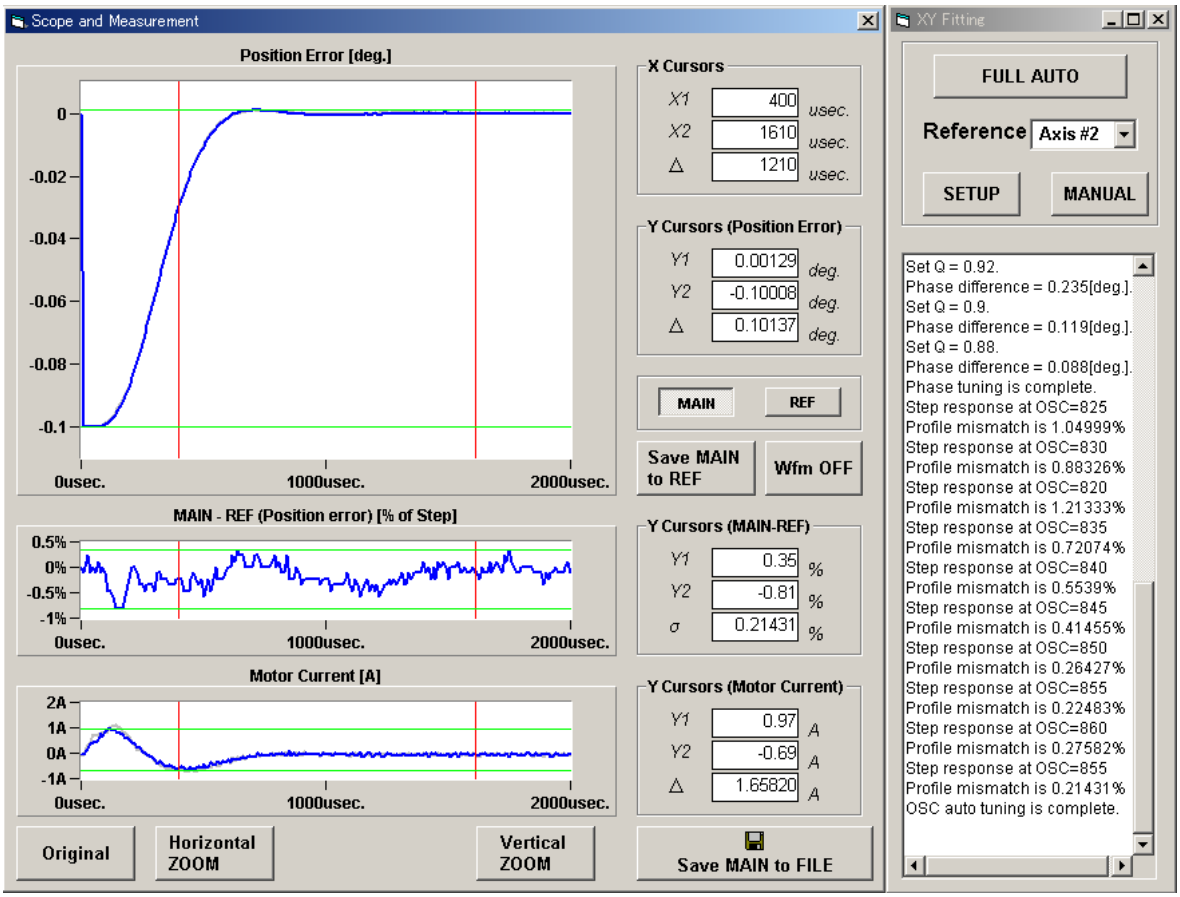
- Adjusting the frequency response.



- Adjusting the amount of overshoot.

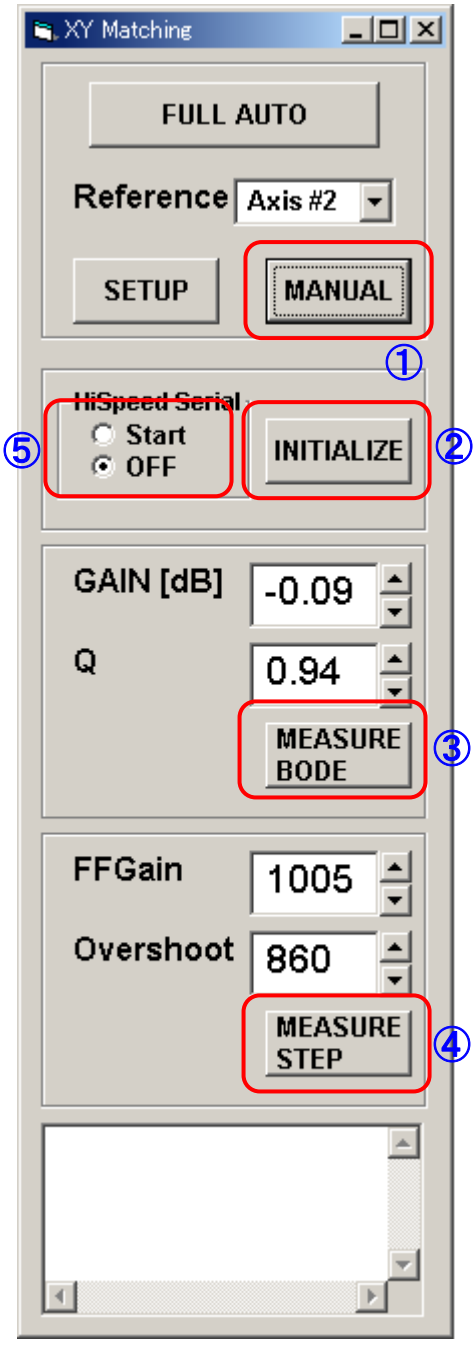


- When the overshoot amount adjustment is completed, the waveforms match.



- Save the tuning results to EEPROM. Refer to 9.4. Writing Parameters into ROM.

Individual parameters can be adjusted by the user.



- Press the MANUAL button. ①
- It will display like the diagram to the right.
- Press INITIALIZE first. ②

③

- Pressing MEASURE BODE carries out the frequency response measurement, and displays the waveforms.
- By changing the GAIN [dB] value and measuring the frequency response, the Gain waveform will move up and down according to the GAIN value.
- By changing the Q value and measuring the frequency response, the Phase waveform will move up and down according to the Q value.
- Adjust so that the gray waveform and black waveform overlap.

④

- Pressing MEASURE STEP carries out the step response measurement, and displays the step waveforms.
- Change the FFGain and Overshoot values, measure the step response, and adjust so that the gray waveform and black waveform overlap.

⑤

- Starting with HiSpeed Serial makes it possible to adjust individual parameters while operating high-speed serial communications.

- Save the tuning results to EEPROM. Refer to 9.4. Writing Parameters into ROM.

8. Commands

The controller has a monitor output (analog output) terminal for monitoring the RS-232C command operation status and an external signal input terminal for controller operation.

8.1. List of Commands

ID	Command Name	Data	Data	Return Value
0	Soft Reset	Yes	0: Auto homing 1: Reset only	
1	Error Clear			
2	Homing Start			
4	Servo ON	Yes	0: OFF 1: ON	
7	Control Mode Specification	Yes	0: PI 1: LQ	
8	Movement Start	Yes	0: Step movement start 6: Initial position of raster scan	
9	Forced Stop			
10	Target Position Setting	Yes	0: Absolute 1: Relative	
11	Thermistor Temperature Read	Yes	0: Controller temperature 1: Motor temperature	A/D converted value of thermistor voltage
12	Current Position Read	Yes	0: Current position 1: Current target value (Program origin) 2: Current target value (Absolute position)	Position (Pulse)
13	Version Read	Yes	0: Main DSP Ver 1: Sub DSP Ver	Ver. No
14	Status Read			Status(16bit)
15	Error Read			Error (16bit)
18	Acceleration Control	Yes	0: OFF 1: ON	
20	Target Position Setting	Yes	Target position (pulse)	
22	Target Velocity Setting	Yes	Target velocity (pulse/second)	
23	Operation Mode Selection	Yes	See “Command Details.”	
26	Parameter Value Check	Yes	Parameter ID	Parameter value
30	Program Coordinate System	Yes	0: Z phase 1: Program origin	

ID	Command Name	Data	Data	Return Value
40	Monitor Output Selection A2 (A8)	Yes	0: Head1 A phase signal 1: Head2 A phase signal 2: Corrected A phase signal 3: Deviation signal	
41	Monitor Output Selection A3 (A9)	Yes	0: Current position signal 1: Velocity signal 2: Corrected encoder count 3: Encoder interpolation data	
42	Monitor Output Selection A4 (A10)	Yes	0: Head1 B phase signal 1: Head2 B phase signal 2: Corrected B phase signal 3: Target position signal	
43	Monitor Output Select Check	Yes	0: A2 (A8) Monitor 1: A3 (A9) Monitor 2: A4 (A10) Monitor	
44	Monitor Magnification Setting A2 (A8)	Yes	N: Magnification (x 2^N)	
45	Monitor Magnification Setting A3 (A9)	Yes	N: Magnification (x 2^N)	
46	Monitor Magnification Setting A4 (A10)	Yes	N: Magnification (x 2^N)	
47	Monitor Magnification Check	Yes	0: A2 (A8) Monitor Magnification 1: A3 (A9) Monitor Magnification 2: A4 (A10) Monitor Magnification	
161	Counter Clear Timing	Yes	0: Axis 1 1: Axis 2	**0 or 1**

8.2. Command Details

Command ID	0	**Command Name**	Soft Reset
Data	0: Reset + Automatic homing 1: Reset only		
Return Value	0: Command execution successful 1: Command execution unsuccessful		
Explanation	This command resets the system to the initial status after start up. However, the parameter values are retained. If a high-priority error requiring soft reset occurs (see 10.2. , “Errors” for details), execute this command after resolving the cause.		
Related Command	Command ID = 2: Homing Start If only reset is executed, homing is necessary for a return.		

Command ID	1	**Command Name**	Error Clear
Data	-		
Return Value	0: Command execution successful 1: Command execution unsuccessful		
Explanation	If a low-priority error occurs (see 10.2. , “Errors” for details), execute this command for a return. If this command is not executed, other commands cannot be accepted. The parameters and other set values are retained.		

Command ID	2	**Command Name**	Homing Start
Data	-		
Return Value	0: Command execution successful 1: Command execution unsuccessful		
Explanation	This command detects the origin. If the status is already SYNC after origin detection, this command executes homing to the origin only.		
Related Command	Command ID = 0: Soft Reset If only soft reset is executed, origin detection is necessary.		

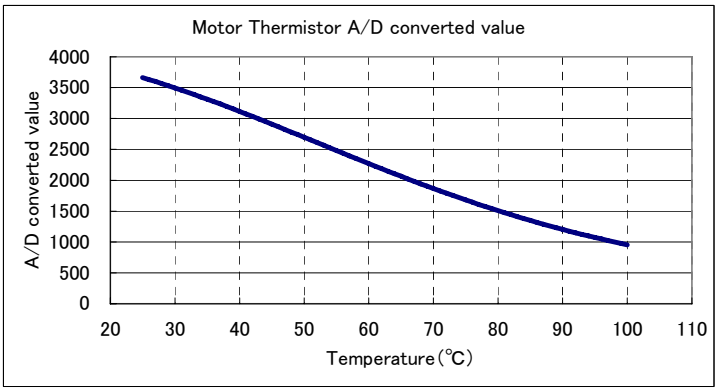
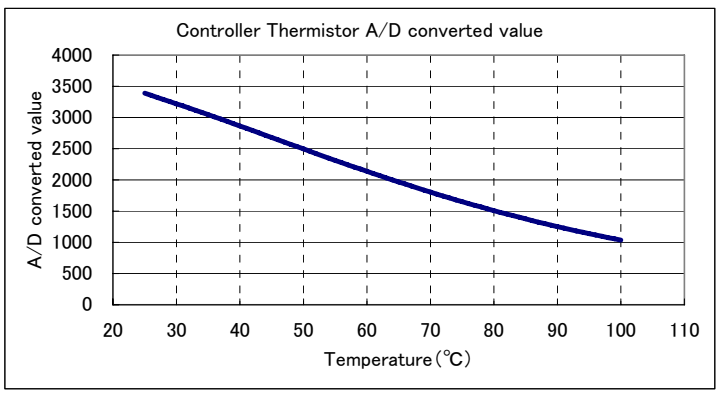
Command ID	4	**Command Name**	Servo ON
Data	0: OFF 1: ON		
Return Value	0: Command execution successful 1: Command execution unsuccessful		
Explanation	This command starts or stops servo control. Turning servo control off makes the motor axis free. When the controller is operating on the internal clock, servo control starts at the servo ON position. When the controller is operating on high-speed serial communication and a target position is entered, the scanner moves to the target position after the start of servo control.		

Command ID	7	Command Name	Control Mode Specification
Data	0: PI control 1: LQ control		
Return Value	0: Command execution successful 1: Command execution unsuccessful		
Explanation	LQ control is usually used.		

Command ID	8	Command Name	Movement Start
Data	0: Step movement start 6: Movement to the initial position of raster scan		
Return Value	0: Command execution successful 1: Command execution unsuccessful		
Explanation	Usual movement: After a target position is set, this command is executed to start step movement. Movement to the raster scan's start position: After setting the raster scan condition settings, this command is executed to move to the start position.		
Related Command	Step movement procedure Command ID = 10: Target Value Setting Mode Command ID = 20: Target Position Setting Command ID = 8: Data = 0: Step Movement Start Raster scan movement procedure Parameter ID = 26: Raster Scan Interval Setting Parameter ID = 27: Raster Scan Duty Ratio Setting Parameter ID = 28: Raster Scan Oscillation Angle Setting Command ID = 8 Data = 6: Movement to the raster scan initial position Command ID = 23 Data = 3: Raster Scan Start (Continuous) Command ID = 23 Data = 0: Raster Scan Stop		

Command ID	9	Command Name	Forced Stop
Data	-		
Return Value	0: Command execution successful 1: Command execution unsuccessful		
Explanation	This command is used for a stop before the target position during movement by Command ID = 8.		
Related Command	Command ID = 8 Data = 0: Movement Start		

Command ID	10	Command Name	Target Value Setting Mode
Data	0: Absolute position 1: Relative position		
Return Value	0: Command execution successful 1: Command execution unsuccessful		
Explanation	This command is used to specify a position coordinate system for setting by “Command ID = 20: Target Position Setting.” Before setting a target position, this command should be executed. Absolute position: Position with the origin as 0 Relative position: Distance from the current position This command should be executed each time a target position is set because its setting is not retained after the start of movement.		
Related Command	Step movement procedure Command ID = 10: Target Value Setting Mode Command ID = 20: Target Position Setting Command ID = 8 Data = 0: Movement Start		

Command ID	11	Command Name	Thermistor Temperature Read
Data	0: Controller temperature 1: Motor temperature		
Return Value	Thermistor voltage A/D converted value		
Explanation	  		

Command ID	12	Command Name	Current Position Read
Data	0: Current position 1: Current target value (Program origin) 2: Current target value (Absolute position)		
Return Value	Position (Pulse)		
Explanation	Command ID = 30: Program Coordinate System		

Command ID	13	Command Name	Version Read
Data	0: Main DSP 1: Sub DSP		
Return Value	Ver. No.		
Explanation			

Command ID	14	Command Name	Status Read
Data	-		
Return Value	Status (16 bits)		

Explanation

Each status can be checked by each bit after conversion into 16-bit display.

Bit	Abbreviation	Meaning	Hex Format
0	SRVON	Servo ON	0x0001
1	SYNC	Counter 0-position confirmed	0x0002
2	INPOS	Settlement in in-position range	0x0004
3	ALARM	Error	0x0008
4	ORGN	Homing to origin	0x0010
5	PROG	Program coordinate setting	0x0020
6			
7			
8	MOVE	Moving (including scan)	0x0100
9	CMODE	Control mode 0 : PI 1 : LQ	0x0200
10	WARN	Encoder signal warning	0x0400
11			
12	TARGET	Target position 0: Absolute position 1: Relative position	0x1000
13	ACC	Acceleration control 0 : OFF 1 : ON	0x2000
14	SETPOS	Target position set	0x4000
15			

Note: Return value of the command is a decimal number.

Command ID	15	Command Name	Error Read

Data	-
Return Value	Error (16 bits)
Explanation	Each status can be checked by each bit after conversion into 16-bit display. For details about errors, see 9.2, “Errors.”

Bit	Abbreviation	Meaning	Hex Format
0	STRK	Stroke over	0x0001
1	CNT	Counter over	0x0002
2	INP	In-position overtime	0x0004
3	SRV	No clock	0x0008
4	CUR	Driver overheat	0x0010
5	HOT	Motor overheat	0x0020
6	FOM	Format error	0x0040
7	COM	Command data error	0x0080
8	PAR	Parameter error	0x0100
9	STA	Status error	0x0200
10	TRN	Communication error	0x0400
11	ORG	Homing error	0x0800
12	ENC	Encoder signal error	0x1000
13	OTP	Out-position error	0x2000
14	CMPER	Servo OFF by hardware	0x4000
15	ETC	Current saturation	0x8000

Note: Return value of the command is a decimal number.

Command ID	18	Command Name	Acceleration Control

Data	0: OFF 1: ON
Return Value	0: Command execution successful 1: Command execution unsuccessful
Explanation	(This command cannot be used now.)

Command ID	20	Command Name	Target Position Setting
Data	Target position (Pulse)		
Return Value	0: Command execution successful 1: Command execution unsuccessful		
Explanation	This command is used to set a target position by step movement.		
Related Command	Step movement procedure Command ID = 10: Target Value Setting Mode Command ID = 20: Target Position Setting Command ID = 8 Data = 0: Step Movement Start		

Command ID	22	Command Name	Target Velocity Setting
Data	Target velocity (Unit: pulse/s)		
Return Value	0: Command execution successful 1: Command execution unsuccessful		
Explanation	This command is used to set the maximum velocity of step movement. The velocity cannot be higher than “Parameter ID = 2: Maximum velocity.” If this command is not set, the velocity specified by “Parameter ID = 2: Maximum velocity” is used.		
Related Command	Step movement procedure Command ID = 22 Target Velocity Setting Command ID = 10: Target Value Setting Mode Command ID = 20: Target Position Setting Command ID = 8 Data = 0: Movement Start		

Command ID	23	Command Name	Operation Mode Selection
Data	0: Raster scan stop or Internal Clock mode 3: Raster scan start 7: High-speed serial communication mode 8: Raster scan started by the external trigger signal input (one way scan) 9: Raster scan started by the external trigger signal input (Coming and going scan)		
Return Value	0: Command execution successful 1: Command execution unsuccessful		
Explanation	0: Raster scan stop or Internal clock mode If this command is sent during a raster scan, the scanner stops after moving to the scan start position. This command is also used for a return from high-speed serial communication mode to internal clock mode. In the case of two axis control, it is necessary to execute this command for each axis. 3: Raster scan start (Continuous scan) Raster scan starts after step movement to the scan initial position. 7: High-speed serial communication mode This command switches the mode to high-speed serial communication from internal clock mode. However, high-speed serial communication signals should be input in advance. In the case of two axis control, it is necessary to execute this command for each axis. 8: Raster scan start by the external trigger signal input (one way scan) (For details, see 6.3. , “Operation that Synchronizes with External Trigger Signal input (Raster Scan)”) 9: Raster scan start by the external trigger signal input (Coming and going scan) (For details, see 6.3. , “Operation that Synchronizes with External Trigger Signal input (Raster Scan)”)		
Related Command	Raster scan movement procedure Parameter ID = 26: Raster Scan Time Setting Parameter ID = 27: Raster Scan Duty Ratio Setting Parameter ID = 28: Raster Scan Angle Setting Command ID = 8: Data = 6: Movement Start Step Movement of the raster scan initial position Command ID = 23: Data = 3: Raster Scan Start Command ID = 23: Data = 0: Raster Scan Stop		

Command ID	26	Command Name	Parameter Value Check
Data	Parameter ID		
Return Value	0: Command execution successful 1: Command execution unsuccessful		
Explanation	This command returns the parameter setting of Parameter ID.		

Command ID	30	Command Name	Program Coordinate System
Data	0: Z phase 1: Program Origin		
Return Value	0: Command execution successful 1: Command execution unsuccessful		
Explanation	For a raster scan, the center of the oscillation angle can be changed. 0: Z phase Set the Z-phase position as the center. This setting is in the default after start up. 1: Program Origin Set the current position as the center. When setting the program origin, move once to the desired center and then specify the position by this command.		

Command ID	40	Command Name	Monitor Output Selection A2 (A8)
Data	0: Head1 A phase signal 1: Head2 A phase signal 2: Corrected A phase signal 3: Deviation signal		
Return Value	0: Command execution successful 1: Command execution unsuccessful		
Explanation	The output signal of analog monitor output A2 (Axis 1) and A8 (Axis 2) can be selected. When the controller starts, the 3: Position error has been selected. (For details, see5.2. , “Analog Monitor Output Selecting ”)		

Command ID	41	Command Name	Monitor Output Selection A3 (A9)
Data	0: Current position signal 1: Velocity signal 2: Corrected encoder count 3: Encoder interpolation data		
Return Value	0: Command execution successful 1: Command execution unsuccessful		
Explanation	The output signal of analog monitor output A3 (Axis 1) and A9 (Axis 2) can be selected. When the controller starts, the 1: Velocity has been selected. (For details, see 5.2. , “Analog Monitor Output Selecting ”)		

Command ID	42	Command Name	Monitor Output Selection A4 (A10)
Data	0: Head1 B phase signal 1: Head2 B phase signal 2: Corrected B phase signal 3: Target position signal		
Return Value	0: Command execution successful 1: Command execution unsuccessful		
Explanation	The output signal of analog monitor output A4 (the Axis1) and A10 (the Axis2) can be selected. When the controller starts, the 3: Internal Target has been selected. (For details, see5.2. , “Analog Monitor Output Selecting ”)		

Command ID	43	Command Name	Monitor Output Select Check
Data	0: A2 (A8) monitor 1: A3 (A9) monitor 2: A4 (A10) monitor		
Return Value	Selected monitor number		
Explanation	The number of the monitor signal that has been selected by command ID=40, 41, and 42 can be confirmed. E.g. A1C040/0 Return Value = 3 (Monitor A2 when the deviation signal is selected.)		

Command ID	44	Command Name	Monitor Magnification Setting A2 (A8)
Data	Magnification : N ($\times 2^N$)		
Return Value	0: Command execution successful 1: Command execution unsuccessful		
Explanation	Magnification is specified by an exponent of the power-of-two. E.g. Data = -2 2^{-2} = 0.25 times Data = -1 2^{-1} = 0.5 times Data = 0 2^{0} = 1 times Data = 1 2^{1} = 2 times Data = 2 2^{2} = 4 times (See 5.2. , “Analog Monitor Output Selecting”)		

Command ID	46	Command Name	Monitor Magnification Setting A3 (A9)
Data	Magnification : N (×2^N)		
Return Value	0: Command execution successful 1: Command execution unsuccessful		
Explanation	Magnification is specified by an exponent of the power-of-two. E.g. Data = -2 2^{-2} = 0.25 times Data = -1 2^{-1} = 0.5 times Data = 0 2^{0} = 1 times Data = 1 2^{1} = 2 times Data = 2 2^{2} = 4 times (See 5.2. , “Analog Monitor Output Selecting”)		
Related Command			

Command ID	47	Command Name	Monitor Magnification Setting A4 (A10)
Data	Magnification : N (×2^N)		
Return Value	0: Command execution successful 1: Command execution unsuccessful		
Explanation	Magnification is specified by an exponent of the power-of-two. E.g. Data = -2 2^{-2} = 0.25 times Data = -1 2^{-1} = 0.5 times Data = 0 2^{0} = 1 times Data = 1 2^{1} = 2 times Data = 2 2^{2} = 4 times (See 5.2. , “Analog Monitor Output Selecting”)		
Related Command			

Command ID	48	Command Name	Monitor Magnification Check
Data	0: A2, A8 monitor magnification 1: A3, A9 monitor magnification 2: A4, A10 monitor magnification		
Return Value	Magnification : N (×2^N)		
Explanation	The exponent of power-of-two. (See 5.2. , “Analog Monitor Output Selecting”)		

Command ID	161	Command Name	Counter Clear Timing
Data	0: Head 1 1: Head 2		
Return Value	Timing 0 or 1		
Explanation	It is necessary to set the return value as follows. Head 1 Parameter ID = 11 Head 2 Parameter ID = 14 These values have the standalone motor unique values, and the controller motor set with servo tuning at Canon has been explained. When changing the motor or controller, after checking this command Head 1 and Head 2, it is necessary to make settings. E.g.: A1C101/0 with a return value of 0, set with parameter A1P011/0. A1C101/1 with a return value of 1, set with parameter A1P014/1. A2C101/0 with a return value of 1, set with parameter A2P011/1. A2C101/1 with a return value of 0, set with parameter A2P014/0.		

9. Parameters

9.1. List of Parameters

ID	Parameter Name
0	CW Limit
1	CCW Limit
2	Max Velocity
3	In-position Range
4	Settling Check Time
5	In-position Overtime
6	LQ Control Gain
7	Torque Constant
8	Total Inertia
9	Motor Current Limit
10	Encoder Wave per Rotation
11	Origin Clear Timing (Head 1)
12	Servo Sampling Time
13	High Speed Serial Data to angle gain
14	Origin Clear Timing (Head 2)
15	High Speed Serial Data Offset
16	#1 Digital Notch Filter Frequency
17	#1 Digital Notch Filter Q
18	#1 Digital Notch Filter Depth
19	#2 Digital Notch Filter Frequency
20	#2 Digital Notch Filter Q
21	#2 Digital Notch Filter Depth
22	Low-pass Filter Cutoff Frequency
23	#1 Analog Notch Filter Frequency
24	#2 Analog Notch Filter Frequency
25	#3 Analog Notch Filter Frequency
26	Cycle Time of Raster Scan
27	Duty of Raster Scan
28	Scan Angle of Raster Scan
30	Interval Time of Raster Scan
31	Start Position of Raster Scan
32	Torque Peak Offset
33	Acceleration Time
34	Deceleration Time
40	Feed-forward Gain
42	Overshoot Control
44	PES Limit
45	Loop Gain Fine Adjustment

48	VR head1 AB offset
49	VR head1 A gain
50	VR head1 B gain
51	VR head2 A gain
52	VR head2 A gain
53	VR head2 B gain
64	DSP Operation Setting
66	High Speed Serial Status Format
67	High Speed Serial Data Length
68	High Speed Serial Data LSB Position

9.2. Parameter Details

Parameter ID	0	Parameter Name	CW Limit
Data	Movable range (Unit: pulse)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	Specify the limit of the clockwise movable range viewed from the axial direction of the motor. In case of input or movement beyond the movable range of angle, an error is output. Note: The relationship between the number of pulses and the angle depends on the motor.		
Related Command /Parameter			

Parameter ID	1	Parameter Name	CCW Limit
Data	Movable range (Unit: pulse) "-" mark is necessary		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	Specify the limit of the counterclockwise movable range viewed from the axial direction of the motor. In case of input or movement beyond the movable range of angle, an error is output. In the movement range parameter value, a "-" mark is necessary. Note: The relationship between the number of pulses and the angle depends on the motor.		
Related Command /Parameter			

Parameter ID	2	Parameter Name	Max Velocity
Data	Maximum velocity (Unit: pulse/s)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to specify step movement by command execution. This maximum velocity applies if "Command ID = 22: Target Velocity Setting" is not set. Note: The relationship between the number of pulses and the angle depends on the motor.		
Related Command /Parameter			

Parameter ID	3	Parameter Name	In-position Range
Data	In-position range (Unit: pulse)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	The end of movement is judged when a difference from the target value (number of pulses) enters this range. Note: The relationship between the number of pulses and the angle depends on the motor.		
Related Command /Parameter	Bit 2 “Settlement in In-position Range” becomes 1 in status read (Command ID = 14).		

Parameter ID	4	Parameter Name	Settling Check Time
Data	Settling check time (Unit: 10 μs)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	The completion of movement is judged if the position remains within the In-position Range (Parameter ID = 3) for the set time after movement. Note: The unit is 10 us. For 1 ms, set 100.		
Related Command /Parameter	Bit 8 “Moving” becomes 0 in status read (Command ID = 14).		

Parameter ID	6	Parameter Name	LQ Control Gain
Data	LQ control gain (Unit: none)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set the LQ control gain.		
Related Command /Parameter	LQ control related parameters: Total Inertia (Parameter ID = 8) Torque Constant (Parameter ID = 7)		

Parameter ID	7	Parameter Name	Torque Constant
Data	Torque constant (Unit: gf・cm / A)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set the torque constant of the motor. Note: Do not change this parameter. A unique value is available depending on the motor model. This is set at shipping.		
Related Command /Parameter	LQ control related parameters LQ Control Gain (Parameter ID = 6) Total Inertia (Parameter ID = 8)		

Parameter ID	8	Parameter Name	Total Inertia
Data	Total inertia (Unit: 0.01 gf・cm^2)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set the inertia due to the motor rotation shaft and the mirror. Note: Be careful about the unit. Set a value of gf・cm^2 multiplied by 100.		
Related Command /Parameter	LQ control related parameters: LQ Control Gain (Parameter ID = 6) Torque Constant (Parameter ID = 8)		

Parameter ID	9	Parameter Name	Motor Current Limit
Data	Motor Current limit (Unit: %)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set the upper limit of a current command value. (Setting for each axis as a ratio to 10A) E.g.: 90% (10A × 0.9 = 9A) If the current remains over the upper limit for a specified time, a current saturation error occurs.		
Related Command /Parameter	Bit 15 “Current Saturation” becomes 1 in error read (Command ID = 15).		

Parameter ID	10	Parameter Name	Encoder Wave per Rotation
Data	Encoder periodicity (Unit: pulse)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set the number of pulses per rotation of the motor encoder. GM-1010: 1000 pulses GM-1015: 1500 pulses Whenever the motor model is changed, the setting of this parameter should be changed.		
Related Command /Parameter			

Parameter ID	11	Parameter Name	Origin Clear Timing (Head 1)
Data	Origin clear timing (0 or 1)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is related to origin detection. The value checked by “Command ID = 101: Counter Clear Timing” is set. Each motor has a unique value. Note: An appropriate value is set at shipping. When only the motor is replaced, the value should be checked and set by a command. The Origin Clear Timing (Head 2) parameter should be set at the same time.		
Related Command /Parameter	Counter Clear Timing (Command ID = 101) A1C101/ 0 (Axis 1 Head 1) Set the value checked above.		

Parameter ID	12	Parameter Name	Servo Sampling Time
Data	Sampling period (Unit: ns)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set the sampling interval of the controller. The usual value is 10000 for 10 µs. Note: This parameter usually requires no change.		
Related Command /Parameter			

Parameter ID	13	Parameter Name	High Speed Serial Data to angle gain
Data	High-speed serial communication conversion gain (Unit: Multiple × 1000)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	High-speed serial communication data is specified by 16 bits. Ordinary data is 1 for one pulse and can be specified up to the following positions: Maximum position: 0xFFFF = 32767 pulses = About 5.76 deg (GM-1010) 0-pulse position: 0x8000 = 0 Minimum position: 0x0000 = –32768 pulses = About –5.76 deg (GM-1010) If a greater angle is specified, set a magnification by using this parameter. E.g. For x2 (Setting: 2000), the following angle can be specified: –5.76×2 deg to –5.76×2 deg The command resolution will be two times.		
Related Command /Parameter			

Parameter ID	14	Parameter Name	Origin Clear Timing (Head 2)
Data	Origin clear timing (0 or 1)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is related to origin detection. The value checked by “Command ID = 101: Counter Clear Timing” is set. Each motor has a unique value (0 or 1). Note: An appropriate value is set at shipping. When only the motor is replaced, the value should be checked and set by a command. The Origin Clear Timing (Head 1) parameter should be set at the same time.		
Related Command /Parameter	Counter Clear Timing (Command ID = 101) A1C101/ 1 (Axis 1 Head 2) Set the value checked above.		

Parameter ID	15	Parameter Name	High Speed Serial Data Offset
Data	High-speed Serial Communication Offset (Unit: pulse)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	Set this parameter, when the center position of the high-speed serial communications data is offset. This is effective, when operating by high-speed serial communications. 0 is set usually. E.g. Data = 100 High-speed serial communication data (16 bit) 0x8000 = 100 encoder pulse position.		
Related Command /Parameter			

Parameter ID	16	Parameter Name	#1 Digital Notch Filter Frequency
Data	Central frequency of the first digital notch filter (Unit: Hz)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set the central frequency of the first digital notch filter.		
Related Command /Parameter	#1 Notch Filter Q Value (Parameter ID = 17) #1 Notch Filter Depth (Parameter ID = 18)		

Parameter ID	17	Parameter Name	#1 Digital Notch Filter Q
Data	Q value of the first digital notch filter (Unit: ×100)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set the Q value of the first digital notch filter. Set a value multiplied by 100.		
Related Command /Parameter	#1 Notch Filter Frequency (Parameter ID = 16) #1 Notch Filter Depth (Parameter ID = 18)		

Parameter ID	18	Parameter Name	#1 Digital Notch Filter Depth
Data	Depth of the first digital notch filter (Unit: dB)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set the depth of the first digital notch filter.		
Related Command /Parameter	#1 Notch Filter Frequency (Parameter ID = 16) #1 Notch Filter Q (Parameter ID = 17)		

Parameter ID	19	Parameter Name	#2 Digital Notch Filter Frequency
Data	Central frequency of the second digital notch filter (Unit: Hz)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set the central frequency of the second digital notch filter.		
Related Command /Parameter	#2 Notch Filter Q (Parameter ID = 17) #2 Notch Filter Depth (Parameter ID = 18)		

Parameter ID	20	Parameter Name	#2 Digital Notch Filter Q
Data	Second digital notch filter Q value (Unit: ×100)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set the Q value of the second digital notch filter. Set a value multiplied by 100.		
Related Command /Parameter	#2 Notch Filter Frequency (Parameter ID = 16) #2 Notch Filter Depth (Parameter ID = 18)		

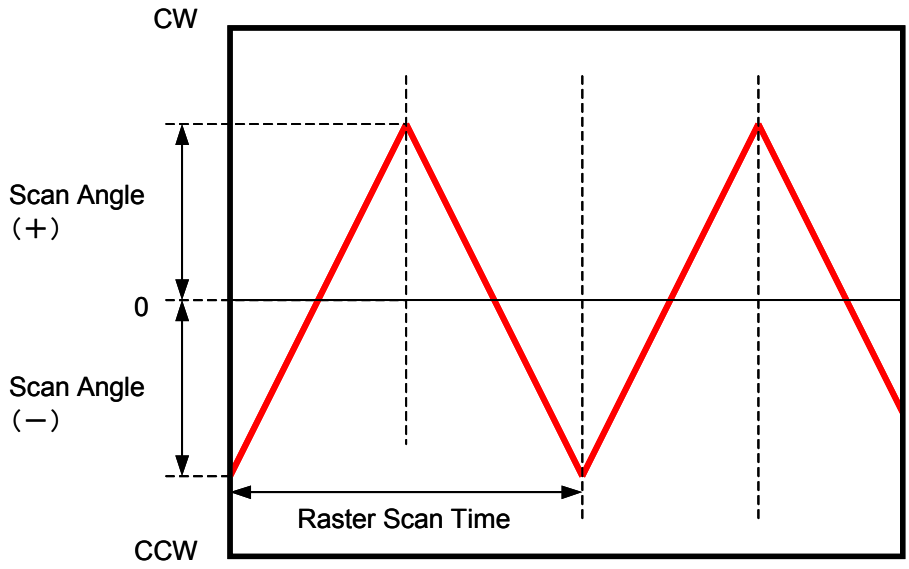
Parameter ID	21	Parameter Name	#2 Digital Notch Filter Depth
Data	Depth of the second digital notch filter (Unit: dB)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set the depth of the second digital notch filter.		
Related Command /Parameter	#2 Notch Filter Frequency (Parameter ID = 16) #2 Notch Filter Q Value (Parameter ID = 17)		

Parameter ID	22	Parameter Name	Low-pass Filter Cutoff Frequency
Data	Cutoff frequency of the digital low-pass filter (Unit: Hz)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set the cutoff frequency of the digital low-pass filter.		
Related Command /Parameter			

Parameter ID	23	Parameter Name	#1 Analog Notch Filter Frequency
Data	Central frequency of the first analog notch filter (Unit: Hz)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set the central frequency of the first analog notch filter. The setting range is from 9750 to 42820 Hz.		
Related Command /Parameter			

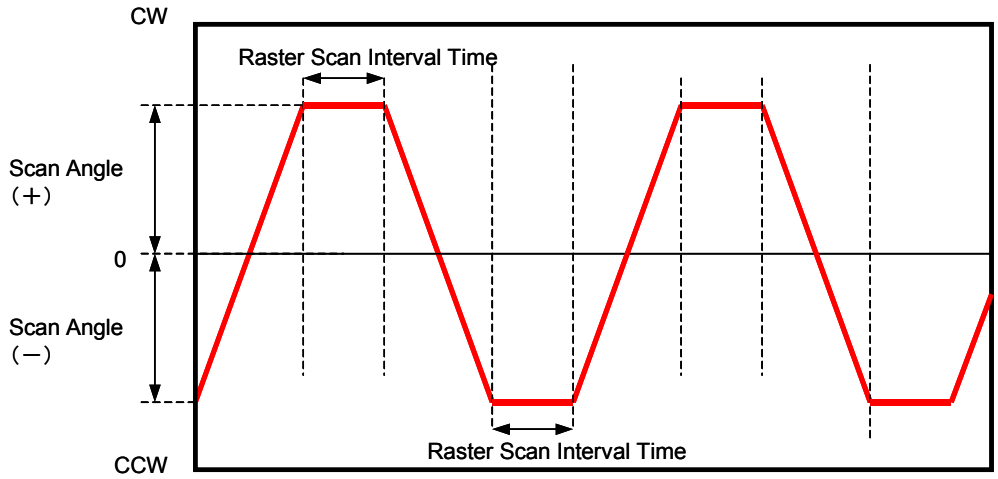
Parameter ID	24	Parameter Name	#2 Analog Notch Filter Frequency
Data	Central frequency of the second analog notch filter (Unit: Hz)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set the central frequency of the second analog notch filter. The setting range is from 9750 to 42820 Hz.		
Related Command /Parameter			

Parameter ID	25	Parameter Name	#3 Analog Notch Filter Frequency
Data	Central frequency of the third analog notch filter (Unit: Hz)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set the central frequency of the third analog notch filter. The setting range is from 9750 to 42820 Hz.		
Related Command /Parameter			

Parameter ID	26	Parameter Name	Cycle Time of Raster Scan
Data	Scan Time (Unit: See Explanation.)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This command is used to set the raster scan time (operation by command). The scan time is the set value × 10 μs. E.g. For the interval of 100 ms, set 10000 (10000 × 10 μs = 100 ms).  		
Related Command /Parameter	Duty of Raster Scan (Parameter ID = 27) Scan Angle of Raster Scan (Parameter ID = 28) Interval Time of Raster Scan (Parameter ID = 30) Start Position of Raster Scan (Parameter ID = 31)		

Parameter ID	27	Parameter Name	Duty of Raster Scan
Data	Raster scan duty ratio (Unit: %)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set the duty ratio of raster scan (operation by command). (See Explanation of Parameter ID = 26.)		
Related Command /Parameter	Cycle Time of Raster Scan (Parameter ID = 26) Scan Angle of Raster Scan (Parameter ID = 28) Interval Time of Raster Scan (Parameter ID = 30) Start Position of Raster Scan (Parameter ID = 31)		

Parameter ID	28	Parameter Name	Scan Angle of Raster Scan
Data	Raster scan angle (Unit: degree × 10000)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set the angle of raster scan (operation by command). (See Explanation of Parameter ID = 26.) Set the scan angle × 10000. For ±5°, set 50000 (5 × 10000).		
Related Command /Parameter	Cycle Time of Raster Scan (Parameter ID = 26) Duty of Raster Scan (Parameter ID = 27) Interval Time of Raster Scan (Parameter ID = 30) Start Position of Raster Scan (Parameter ID = 31)		

Parameter ID	30	Parameter Name	Interval Time of Raster Scan
Data	Raster scan Interval time (Unit: second × 100)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set the Interval time of raster scan (operation by command). (See Explanation of Parameter ID = 26.) Set the wait time (sec) × 100. For 0.1 sec, set 10 (0.1 × 100).  		
Related Command /Parameter	Cycle Time of Raster Scan (Parameter ID = 26) Duty of Raster Scan (Parameter ID = 27) Scan Angle of Raster Scan (Parameter ID = 28) Start Position of Raster Scan (Parameter ID = 31)		

Parameter ID	31	Parameter Name	Start Position of Raster Scan
Data	Raster scan start position (Unit: 0 or 1)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set the start of raster scan (operation by command) from the negative or positive side. 0: Scan start from the negative side 1: Scan start from the positive side		
Related Command /Parameter	Cycle Time of Raster Scan (Parameter ID = 26) Duty of Raster Scan (Parameter ID = 27) Scan Angle of Raster Scan (Parameter ID = 28) Interval Time of Raster Scan (Parameter ID = 30)		

Parameter ID	32	Parameter Name	Torque Peak Offset
Data	Torque central position (Unit: pulse)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set the torque position. Settings match the motor's characteristics when shipped. There is usually no need for changes. When changing the motor, setting again is necessary. Note: An appropriate value is set at shipping.		
Related Command /Parameter			

Parameter ID	33	Parameter Name	Acceleration Time
Data	Acceleration time (Unit: ms)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is valid when "Command ID = 18: Acceleration Control" is ON. Set the time until the velocity reaches the value set by "Parameter ID = 2: Max Velocity" in step movement (movement by command). If 0 is set, the target command of the maximum velocity is followed from the start of movement.		
Related Command /Parameter	Acceleration control (Command ID = 18) Max Velocity (Parameter ID = 2) Movement start (Command ID = 8)		

Parameter ID	34	Parameter Name	Deceleration Time
Data	Deceleration time (Unit: ms)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set the deceleration time for a stop by “Command ID = 9: Forced Stop.”		
Related Command /Parameter	Forced Stop (Command ID = 9)		

Parameter ID	40	Parameter Name	Feed-forward Gain
Data	Feed-forward gain (Unit: none)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set the feed-forward gain. This is usually set at shipping. Setting 0 disables feed-forward.		
Related Command /Parameter			

Parameter ID	42	Parameter Name	Overshoot Control
Data	Overshoot Control (Unit: none)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set overshoot control. This is usually set at shipping. Setting 1000 disables overshoot control.		
Related Command /Parameter			

Parameter ID	44	Parameter Name	PES Limit
Data	Deviation limit (Unit: pulse)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	If a deviation from the target value is great, an excess current usually flows, causing a current saturation error. Make adjustments so that the controller will not deviate beyond this setting. Note: This is usually set appropriately at shipping.		

Parameter ID	45	Parameter Name	Loop Gain Fine Adjustment
Data	Loop Gain Fine Adjustment (Unit: Multiple × 1000)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter makes fine adjustments to the servo's loop gain (inertia of the motor and mirror, and the torque constant of the motor are related). Note: This is usually set appropriately at shipping.		
Related Command /Parameter			

Parameter ID	48	Parameter Name	VR head1 AB offset
Data	A/B-phase offset of encoder VR adjustment head 1 (Unit: none)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to adjust the offset of encoder signal. Note: This is usually set appropriately at shipping.		
Related Command /Parameter			

Parameter ID	49	Parameter Name	VR head1 A gain
Data	A-phase amplitude of encoder VR adjustment head 1 (Unit: none)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to adjust the A-phase amplitude of the encoder signal. Note: This is usually set appropriately at shipping.		
Related Command /Parameter			

Parameter ID	50	Parameter Name	VR head1 B gain
Data	B-phase amplitude of encoder VR adjustment head 1 (Unit: none)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to adjust the B-phase amplitude of the encoder signal. Note: This is usually set appropriately at shipping.		
Related Command /Parameter			

Parameter ID	51	Parameter Name	VR head2 AB offset
Data	A/B-phase offset of encoder VR adjustment head 2 (Unit: none)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to adjust the offset of the encoder signal. Note: This is usually set appropriately at shipping.		
Related Command /Parameter			

Parameter ID	52	Parameter Name	VR head2 A gain
Data	A-phase amplitude of encoder VR adjustment head 2 (Unit: none)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to adjust the A-phase amplitude of the encoder signal. Note: This is usually set appropriately at shipping.		
Related Command /Parameter			

Parameter ID	53	Parameter Name	VR head2 B gain
Data	B-phase amplitude of encoder VR adjustment head 2 (Unit: none)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to adjust the B-phase amplitude of the encoder signal. Note: This is usually set appropriately at shipping.		
Related Command /Parameter			

Parameter ID	64	Parameter Name	DSP Operation Setting
Data	DSP operation setting (Unit: none)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set the start up mode. Each bit has a meaning. Bit 0 0: No automatic encoder correction at homing to the origin 1: Automatic encoder correction at homing to the origin Bit 1 0: Start up in internal clock mode 1: Start up in high-speed serial communication (external clock) mode Bit 2 0: High-speed serial communication specification (XY2-100) (Usually 0) Note: The setting is decimal.		
Related Command /Parameter			

Parameter ID	66	Parameter Name	High Speed Serial Status Format
Data	High Speed Serial Status Format (Unit: none)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	The content of status output to the status line of high-speed serial communications can be selected. 0 : Controller Condition 1 1 : Controller Condition 2 2 : Current position (Axis 1) 3 : Current position (Axis 2) 4 : Current position (Axis 1 , Axis 2) (For details, see 2.8.4. , “Status (High-speed Serial Communication STS)”)		
Related Command /Parameter			

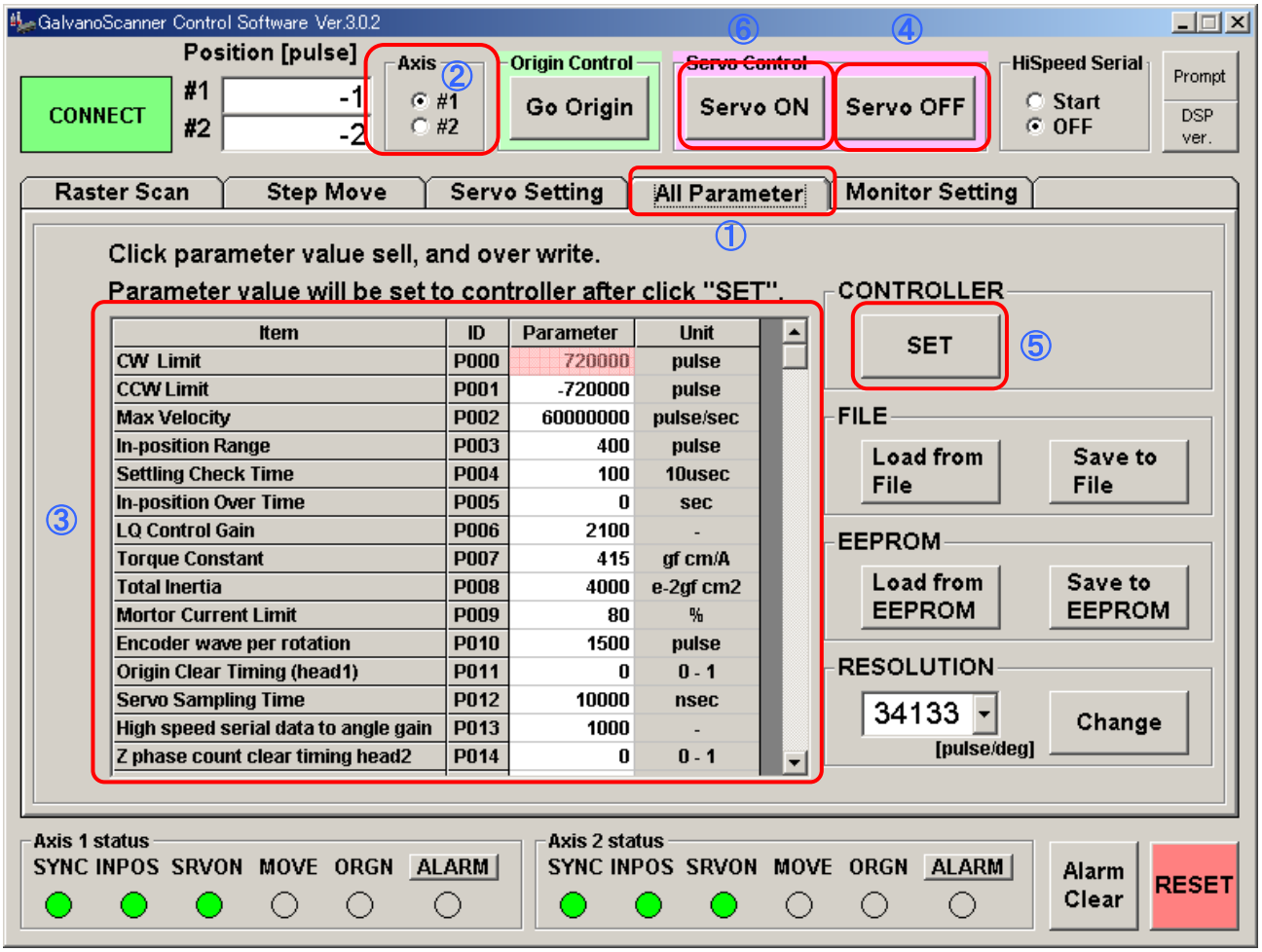
Parameter ID	67	Parameter Name	High Speed Serial Data Length
Data	High Speed Serial Data Length (Unit: bit) Range = 16 ~ 20		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	Position Data length of High-speed serial communication can be specified. Range = 16 bit ~ 20 bit (For details, see 2.8.3. , “High-speed serial communication”)		
Related Command /Parameter			

Parameter ID	68	Parameter Name	High Speed Serial Data LSB Position
Data	High Speed Serial Data LSB Position (Unit: bit) Range = 0 ~ 4		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	The least significant bit position of the target position data of high-speed serial communication 20 bit data can be specified. Range = 0 bit ~ 4 bit (For details, see 2.8.3. , “High-speed serial communication”)		
Related Command /Parameter			

9.3. Modifying Parameters

This section explains how to modify parameters.

Control Software



- Select the All Parameter tab. ①
- Select an axis for parameter settings. ②
- The current parameter values are displayed. ③
- Modify the parameter values as required. When a parameter value is modified, its cell turns red. ③
- Turn the servo OFF (necessary for modifying parameters). ④
- Press the SET button to reflect modified parameters in the controller settings. ⑤
- Turn the servo ON. ⑥

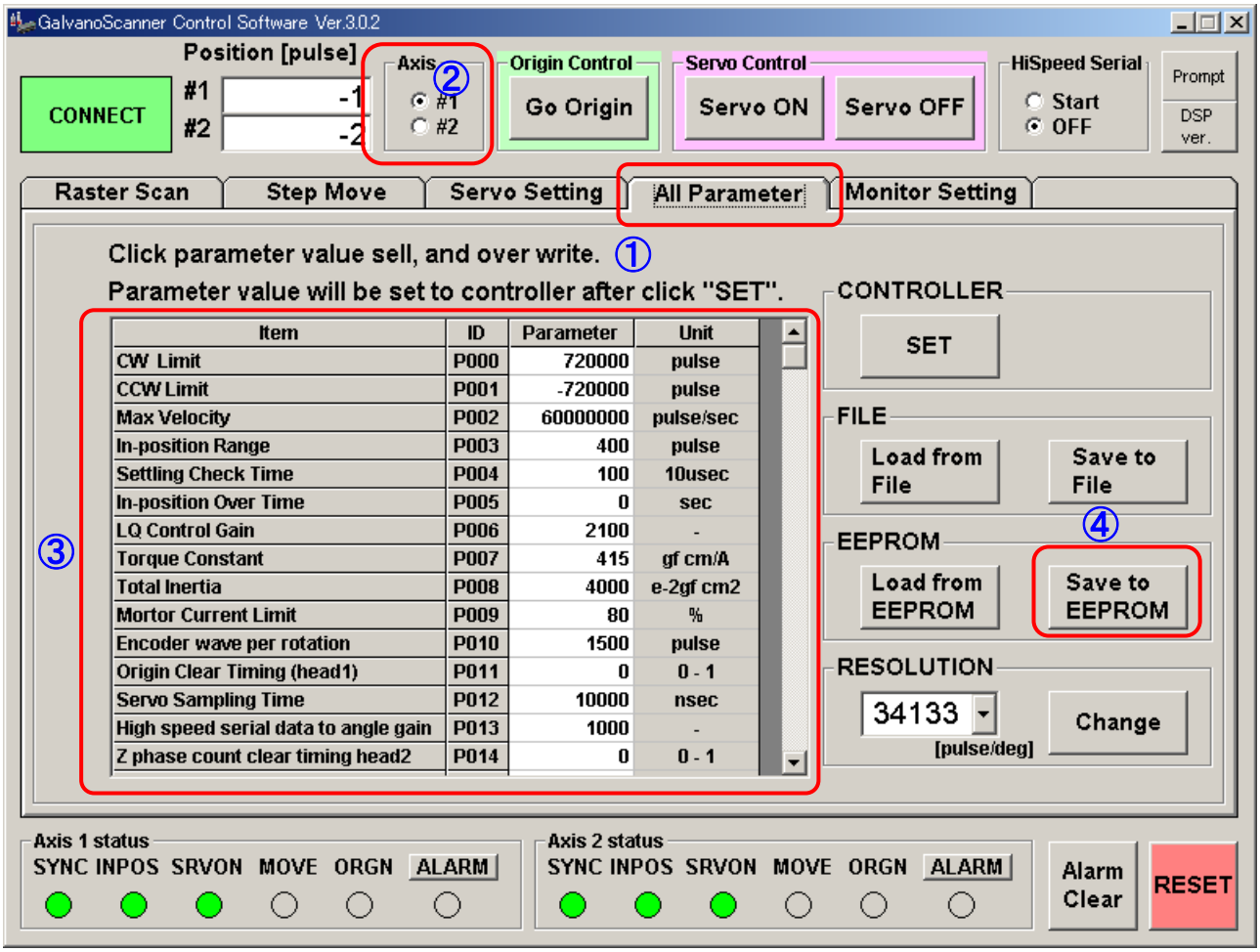
Note: Pressing the SET button reflects modified parameters in the controller settings but does not write them into the controller ROM. When the power is turned off and on again, the controller starts with the old parameters read from ROM. See 9.4 for writing modified parameters into ROM.

9.4. Writing Parameters into ROM

All parameters are written in the controller ROM. At Start up, the parameters are automatically read and set in the controller.

If parameters are modified, they should be written into ROM for start up with the same settings at the next power-on. Write modified parameters into ROM as follows:

Control Software



- Select the All Parameter tab. ①
- Select an axis for parameter settings. ②
- The current parameter values are displayed. ③
- Press the Save to EEPROM button. ④

  Input password “Canon”
- “Saving to EEPROM” is displayed. ⑤

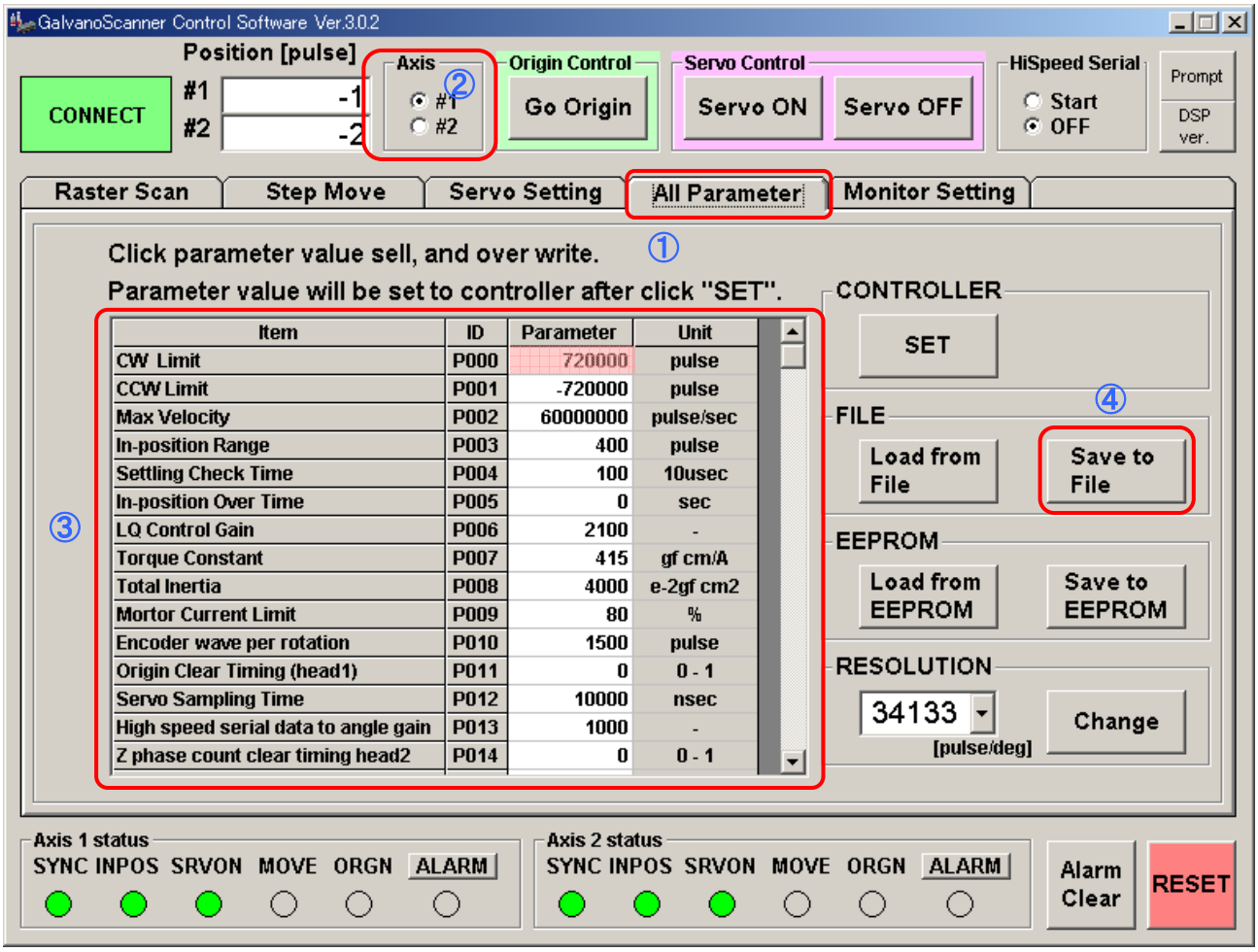
Note: Some parameter settings may disable normal start up next time.

If this problem occurs, change the start up mode for no automatic homing to the origin and check the set values. (See 6.1, “Setting Controller Start Up Mode.”)

9.5. Saving a Parameter File

All parameters can be saved into a PC file.

Save a parameter file as follows:



- Select the All Parameter tab. ①
- Select an axis for parameter settings. ②
- The current parameter values are displayed. ③
- Press the Save to File button. Specify a location and save the file. ④

10. Safety Functions

This system has various safety functions to ensure safe use.

10.1. Safety Functions

The safety functions can be classified into hardware monitoring and software monitoring.

Hardware monitoring

- Power supply fuse +24 V line (each axis)
  +5 V line
- Output amplifier overheat Temperature monitoring by thermistor (abut 80ºC)
- Motor overheat Temperature monitoring by thermistor (abut 75ºC)

(If output amplifier or motor overheat is detected, the amplifier output is shut down.)

- Output amplifier IC Shutdown function

Software monitoring

The controller status is always monitored by software and error notification is made if an abnormality occurs.

Depending on the error type (priority), digital monitor I/O (2 bits) is used for this notification.

The details of an error can be checked by an RS-232C command.

See 10.2, “Errors” for the error details.

Note: The post-error system status and recovery method depend on the priority of the error. See 10.2, “Errors.”

Note: Temperature settings of the above hardware temperature monitoring and software temperature monitoring differ. Usually, temperature monitoring of software operates first, and it is set to carry out error input and servo off operations.

10.2. Errors

Priority: High

Error	Hex	Monitor Item	Error Condition	Setting Change Possible /Impossible (Parameter)	System status after error	Digital Output	Recovery Method
Stroke over	0x0001	Encoder pulse count	The encoder count is outside the range set by parameters P00 (CW Limit) and P01 (CCW Limit).	Possible (P00, P01)	Error Output Servo OFF	(Axis1) Connector A1 Monitor Board D1 (Axis2) Connector B2 Monitor Board D4	Soft reset (C00) + Homing (C02) or Power-off/on
Counter over	0x0002	Velocity (calculated from encoder pulses)	The velocity exceeds the setting by P02 (Maximum Velocity).	Possible (P02)			
In-position overtime	0x0004	Encoder pulse count	The accumulated time based on the setting of P03 (In-position Range) exceeds the setting of P05 (In-position Overtime).	Possible (P03, P05)			
Driver overheat	0x0010	A/D value of thermistor at controller output amplifier	The driver temperature exceeds the A/D value corresponding to 70ºC. (Software monitoring)	Impossible			
Motor overheat	0x0020	A/D value of thermistor at motor coil	The motor temperature exceeds the A/D value corresponding to 70ºC. (Software monitoring)	Impossible			
Origin detection error	0x0800	Homing to the origin	Homing is not completed normally.	Impossible			
Encoder signal error	0x1000	Encoder signal level at homing to origin	An encoder signal is abnormal.	Impossible			
Servo off by hardware	0x4000	Output amplifier shutdown function Thermistor (controller and motor)	The output amplifier is shut down.	Impossible			
Current saturation	0x8000	Output current command	Current saturation (10A×P09 (Current limit)) continues for a specified time or longer.	Possible (P09)			

Priority: Low

Error	Hex	Monitor Item	Error Condition	Setting Change Possible /Impossible (Parameter)	System status after error	Digital Output	Recovery Method
Clock lack	0x0008	High-speed serial communications clock	The clock is no longer input	Impossible			Input the clock normally. If input normally it will return.
Format error	0x0040	Command format	An undefined command or parameter is sent.	Impossible	Error output only	(Axis1) Connector B1 Monitor Board D2 (Axis 2) Connector A3 Monitor Board D5	Error clearance (C01)
Command data error	0x0080	Command data	Command data is illegal. No data is given to a command requiring data. Data is given to a command requiring no data. Data outside the setting range is set.	Impossible			
Parameter error	0x0100	Parameter value	A parameter value is beyond the setting range.	Impossible			
Status error	0x0200	Command description	A command not valid for the current status is sent.	Impossible			
Communication error	0x0400	Communication flag	Communication flag time-out occurs.	Impossible			
Out-position error	0x2000	Encoder pulse count	The setting of P24 (Out-position Width) is exceeded.	Possible (P24)			

11. Appendix

11.1. Firmware Update

The GC-201 controller is equipped with two DSP's (Digital Signal Processor) for Axis 1 and for Axis 2, and the same firmware is written in each DSP.
When firmware is upgraded for the addition of functions and fixing problems, it is possible to connect a RS-232C cable and update the firmware with dedicated write software.

A dedicated firmware update CD will be provided when there is a necessity to update the firmware. Please contact your sales representative about the firmware update CD.

【Firmware Update CD】
The CD contains the following files.

GCFlash.exe (Dedicated write software)
F2812SerialFlash.out
2812.m00
2812.m01
6727.hex

Note:
As part of the firmware update operation, it will be necessary to operate DIP switches and jumper switches on the GC-201 controller. Please carry out static electricity counter-measures such as using an earth band during operation to avoid electrostatic discharge failure.

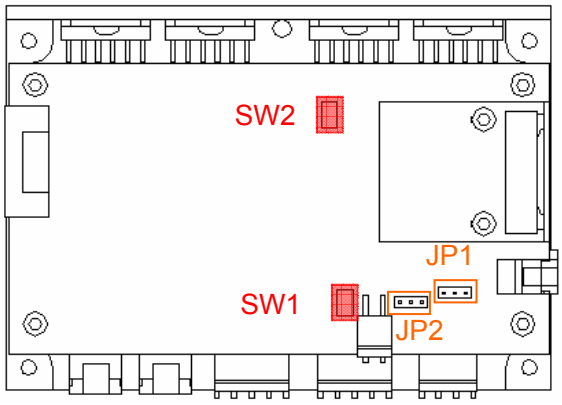
11.1.1. Writing Procedure

Carry out operations according to the following procedure.

It will be necessary to operate DIP switches and jumper switches on the controller.

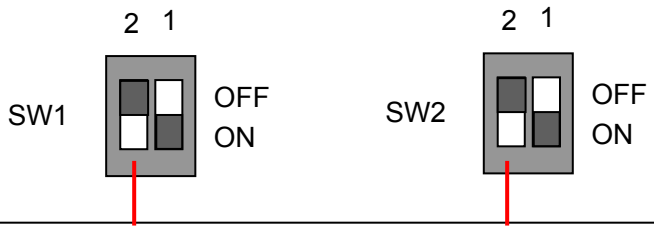
Please follow this procedure.

1. Preparation
   - Turn off power to the GC-201 controller
   - Connect a RS-232C cable to the computer



DIP switch and jumper switch default state

SW1	:	1-OFF
SW2	:	1-OFF
JP1	:	1-2 short
JP2	:	1-2 short

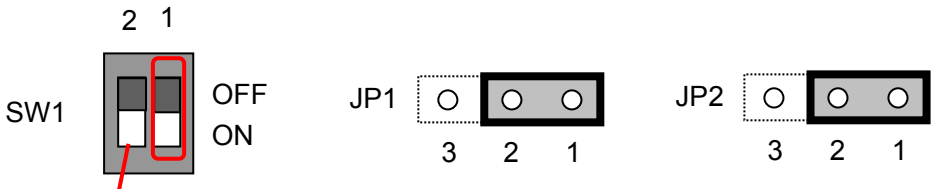


According to the controller settings, the default state of "2" of SW1 or SW2 will differ.
This is regardless of a firmware update. Do not change from the default state.

2. Updating the DSP of Axis 1

With the GC-201 controller's power turned off, set the jumper switches and DIP switches as follows.

SW1 : 1-ON
JP1 : 1-2 short
JP2 : 1-2 short

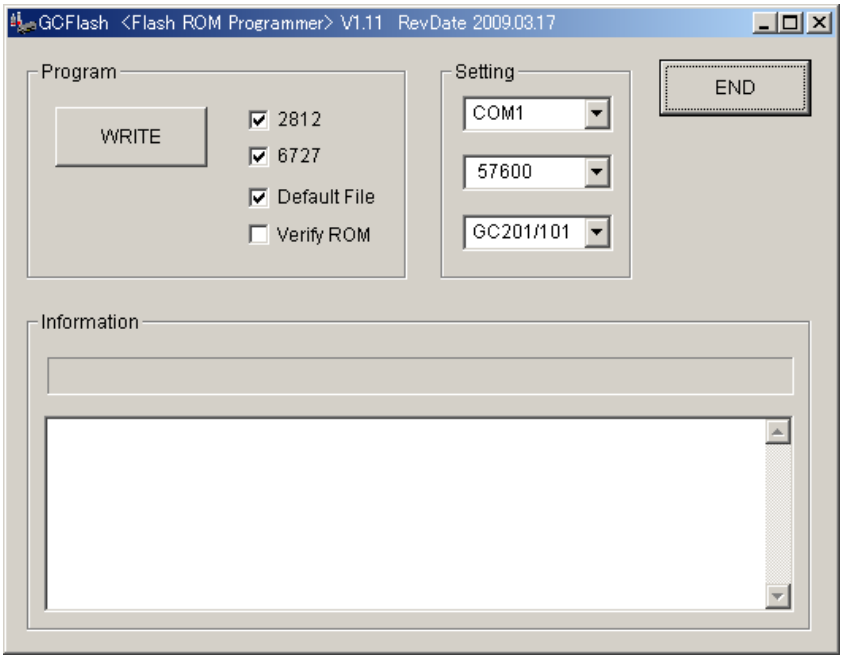


According to the controller settings, the default state of "2" of SW1 will differ. This is regardless of a firmware update. Do not change from the default state.

3. Turn on the power.

4. Start-up GCFlash.exe on the firmware update CD.

5. The GCFlash window will display.



Press the WRITE button. Writing will start.

Usually, settings in the window do not need to be changed, however, need to change when the connected COM port differs. When writing fails frequently, change the baud rate (default value of 57600) to a smaller value and try again.

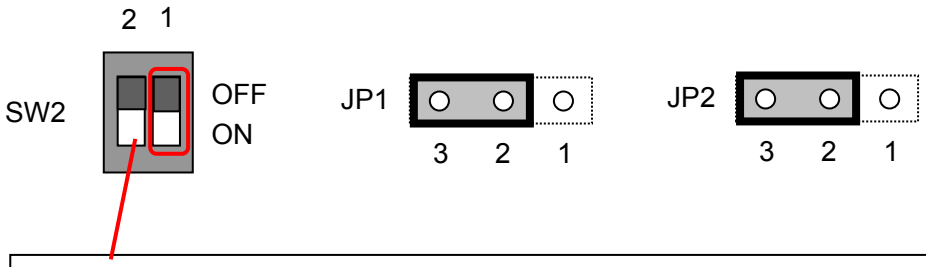
6. When Write Complete displays in the log display area, it is finished.

7. Shut down GCFlash. (It is necessary to completely shut down once.)

8. Turn off the GC-201 controller's power.

9. Updating the DSP of Axis 2
   With the GC-201 controller's power turned off, set the jumper switches and DIP switches as follows.

   SW2 : 1-ON
   JP1 : 2-3 Short
   JP2 : 2-3 Short



According to the controller settings, the default state of "2" of SW2 will differ. This is regardless of a firmware update. Do not change from the default state.

10. Follow instructions 3 to 6.
11. Shut down GCFlash and turn off the GC-201 controller's power.

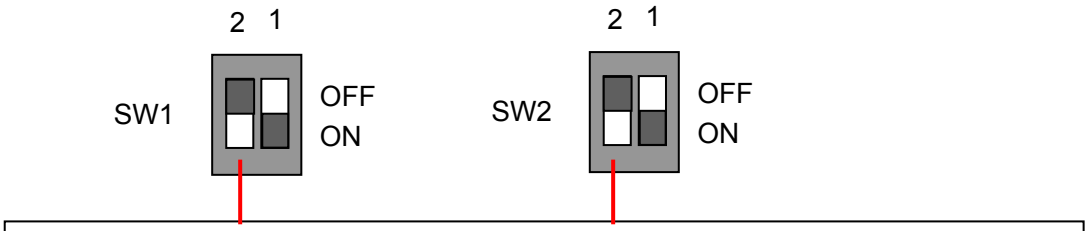
12. With the GC-201 controller's power turned off, return settings to the jumper switches and DIP switches as follows.

SW1 : 1-OFF

SW2 : 1-OFF

JP1 : 1-2 Short

JP2 : 1-2 Short



According to the controller settings, the default state of "2" of SW1 or SW2 will differ.
This is regardless of a firmware update. Do not change from the default state.

11.2. Parameter Changes from the Number of Encoder Divisions

As explained in 2.8.1 Number of Encoder Pulses, the scanner motor encoder signal is divided into 8,192 divisions generating encoder pulses within the GC-201 controller.
Firmware versions prior to DSP Ver. XXXXXXXX were set with 2,048 divisions.

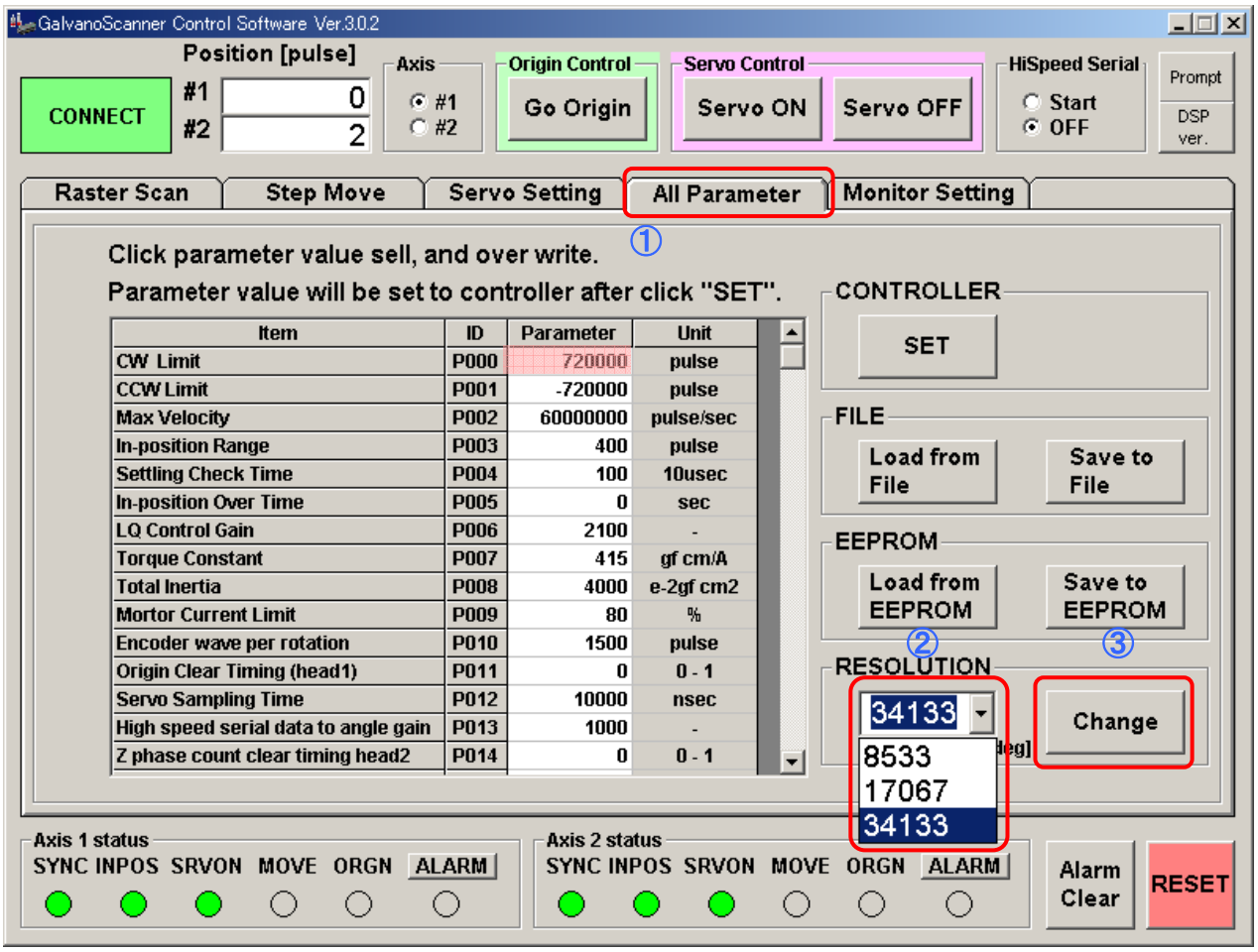
When currently using firmware with 2,048 divisions, with the following procedure, usage with 8,192 divisions is possible.

Procedure for changing the number of encoder divisions

- This will update the firmware to the latest version. See 11.1 Firmware Update for instructions on updating the firmware.
  Please contact your sales representative about the latest firmware update CD.

- Turn on the GC-201 controller.

- Open the All Parameter tab in the control software. ①



Select the following values from the list box in the RESOLUTION area. ②

GM-1010	22,756 (pulse / degree)
GM-1015,1020	34,133 (pulse / degree)

Press the Change button. ③

Parameter changes necessary for using with 8,192 divisions will be carried out.

It is also possible to return to 2,048 divisions.

GM-1010	5,689 (pulse / degree)
GM-1015,1020	8,533 (pulse / degree)

It is possible to use with the latest firmware as is.

NOTE

Canon Inc.
Canon Marketing Japan Inc.
2-16-2, Konan, Minato-ku, Tokyo 108-8011

CB Sales Department **Tel. 03-3740-3336**

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• If you find any question, error, or omission in this document, please contact Canon.

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