CANON Digital Galvano Scanner System

GC-251

KP-1SM30、SM100

Users Manual

Rev. 1.00

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.

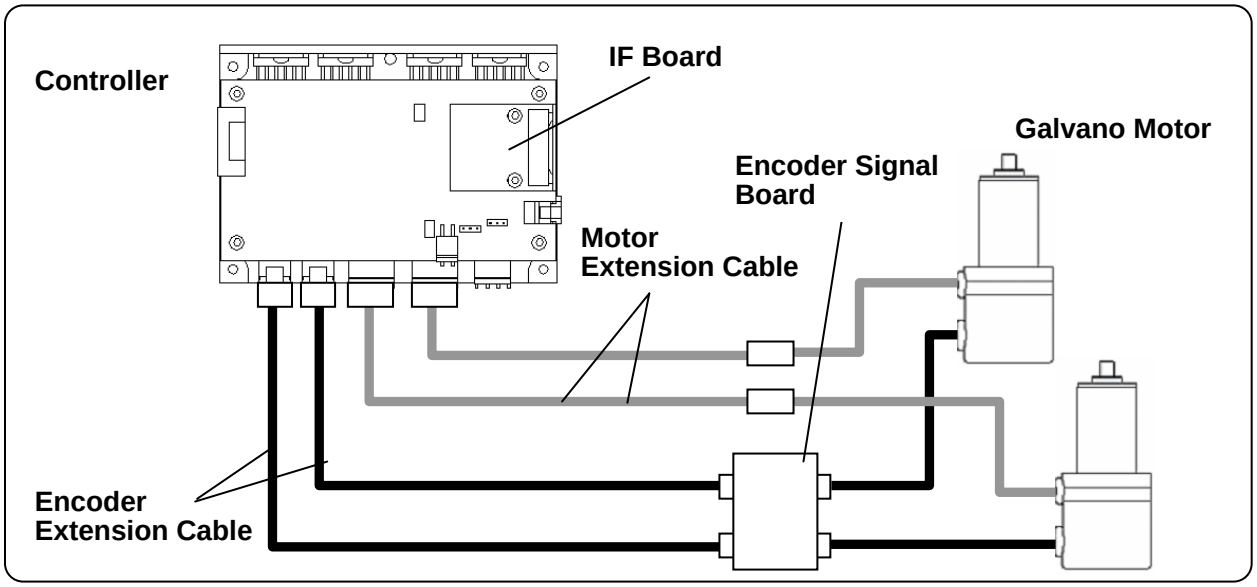
This system has the following features:

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

1.2. Configuration

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

Galvano motor:	Encoder-mounted galvano motor	
KP-1SM30	····	Beam diameter: φ10 to φ20 mm
KP-1SM100	····	Beam diameter: φ20 to φ30 mm
Controller:	Digital servo-controller	
GC-251	····	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-EC	····	Encoder extension cable
GM-MC	····	Motor extension cable



2. Specifications

2.1. Galvano Motor (KP-1SM30, KP-1SM100)

Performance and shape

	KP-1SM30	KP-1SM100
Conforming beam diameter	Φ10 to φ20	Φ20 to φ30
Scan angle	±20 deg	±20 deg
Number of encoder pulses	83328 pulses/rotation	83328 pulses/rotation
Command resolution	0.036 μrad	0.036 μrad
Torque constant	0.041 Nm/A	0.093 Nm/A
Weight	0.95kg	1.65kg

(Reference) Command resolution

The controller of this system divides one encoder cycle into 2048.
KP-1SM30,SM100 is controlled by the following command resolution:

83328 pulses × 2048 divisions = 170655744 pulses/rotation (360°)
360°/ 170655744 = 0.000002109 ° = 0.036urad

Environmental conditions

Operating temperature and humidity	23℃±10℃, 80% RH or less (No condensation)
Storage temperature and humidity	–20 to 60°C, 90% RH or less (No condensation)

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

2.2. Controller (GC-251)

Performance and shape

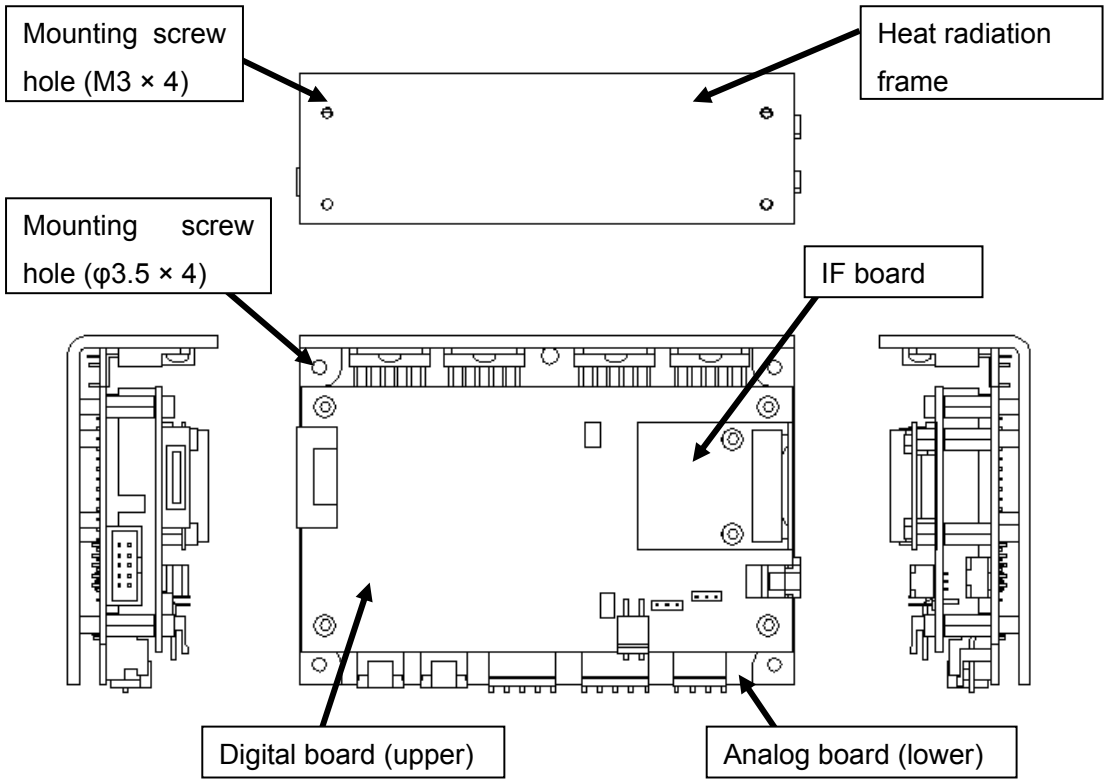
	GC-251
Number of control axes	2
Control sampling	100 kHz
Maximum drive current	10 A (each axis)
Interface	High-speed serial communication for position input (XY2-100) Control RS-232C
Notch filter	Digital notch filter ×2 Digital low-pass filter ×1 Analog notch filter ×3
Weight	500 g

Environmental conditions

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

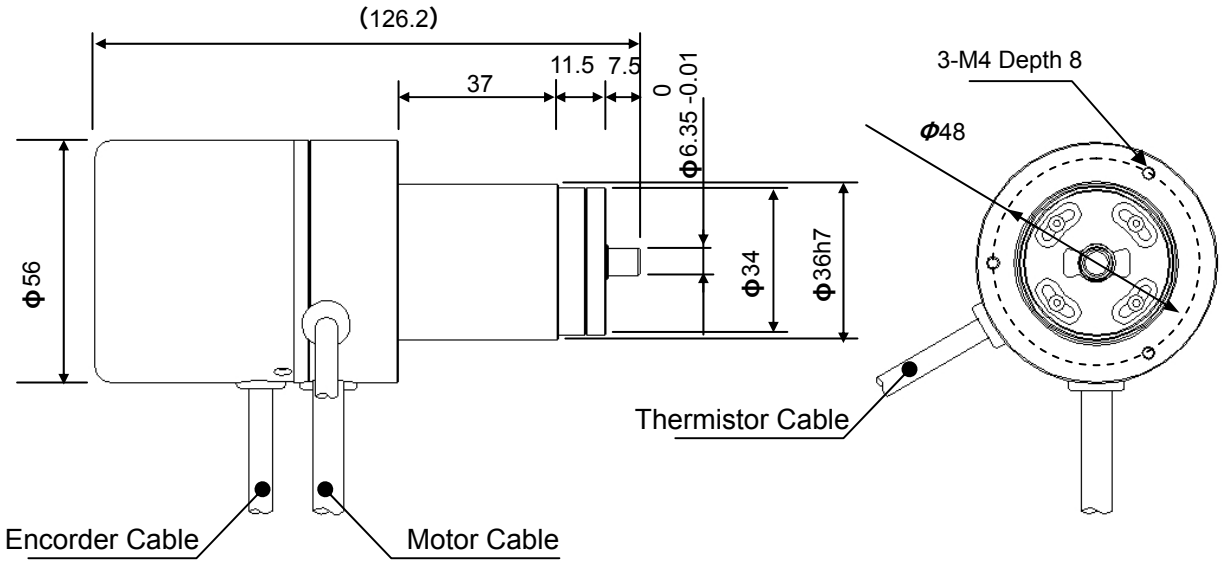
Note: The above operating temperature and humidity conditions depend on the operating and heat radiation conditions.

Section names



2.3. Outline Drawing

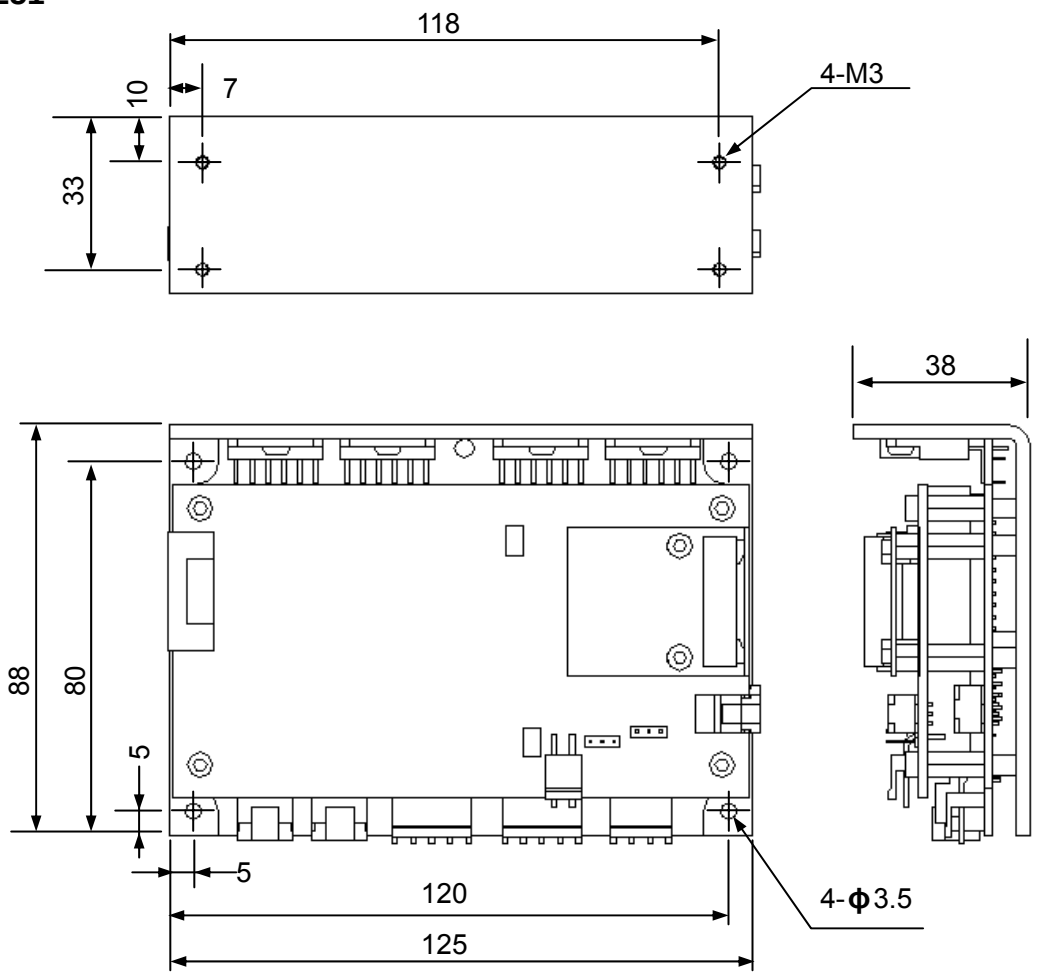
KP-1SM30



KP-1SM100

TBD

GC-251

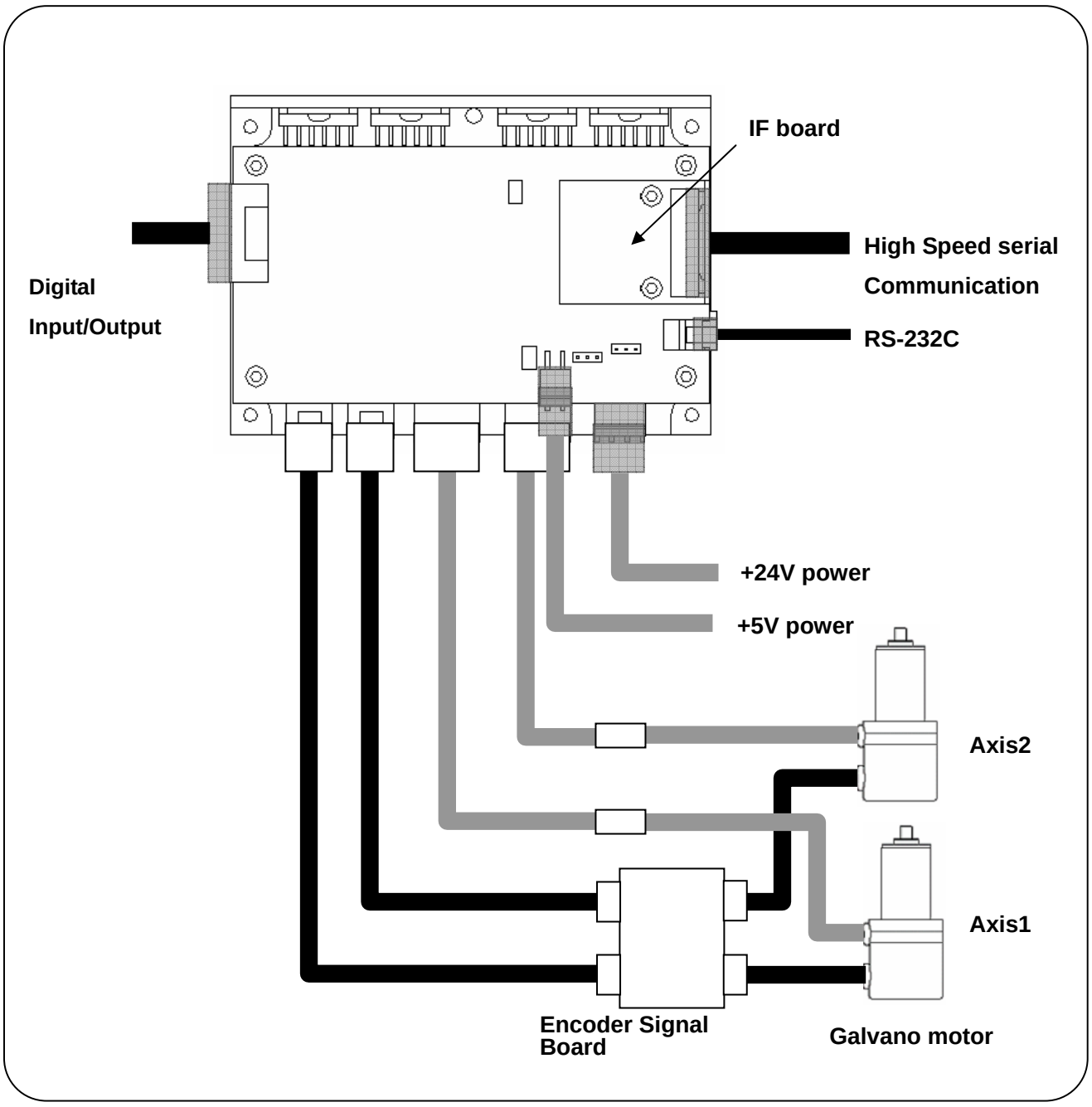


2.4. Power Supply

Power supply specifications

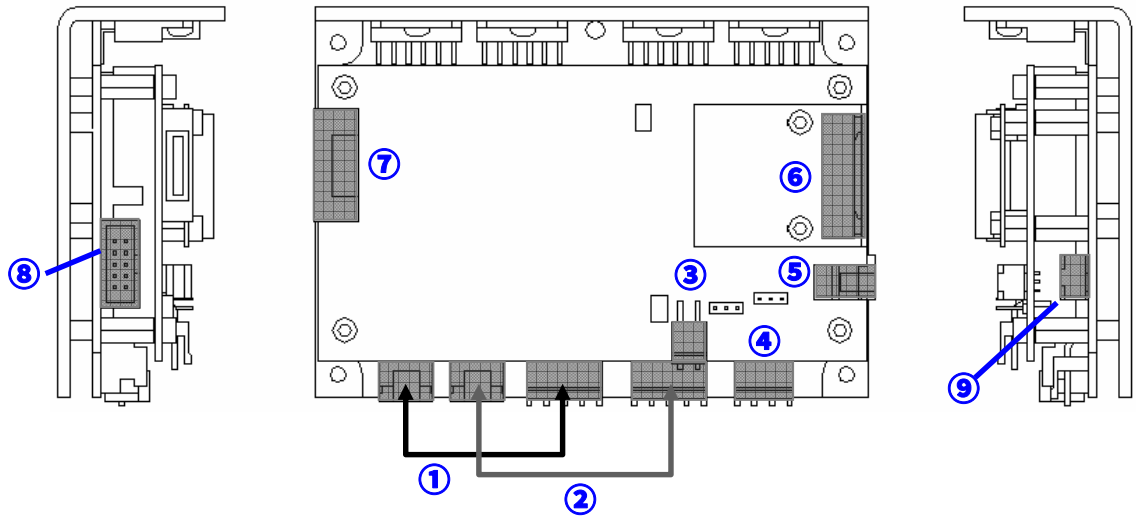
+24 V ± 10%	10 A (max) × 2 axes	(For motor drive)
+5 V ± 5%	2.8 A	(For control circuit)

2.5. Connections



2.6. Connector Pin Arrangement

(Connector types)



①	Axis 1 motor encoder
②	Axis 2 motor encoder
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)

(Pin arrangement)

③ +5 V power supply

Connector model number

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

Connector pin arrangement

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 arrangement

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 arrangement

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 arrangement

Pin No.	Signal Name	Signal Description
1	CLK-	Clock (-)
2	CLK+	Clock (+)
3	FS-	Frame sync (-)
4	FS+	Frame sync (+)
5	XD-	Axis 1 data (-)
6	XD+	Axis 1 data (+)
7	YD-	Axis 2 data (-)
8	YD+	Axis 2 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 Arrangement”

⑧ Analog Monitor

See 5-1 , “Connector Pin Arrangement”

⑨ 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
2	Fan Rotation Error (Open collector Input)
3	(No connection)

2.7. Control Specifications

The controller (GC-201, GC-101) is operated by:

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

In addition, either the internal clock or external clock (high-speed serial communication) can be selected for operation.

	Internal Clock	External Clock (High-speed serial communication)
Clock input	Clock pulses generated by the controller internal circuit	High-speed serial communication clock pulses
Target position command	RS-232C command	High-speed serial communication command (When RS-232C command input mode is set, a high-speed serial communication command is ignored.)
Operation setting parameter setting	RS-232C command	RS-232C command

With the default settings at shipping, power-on activates the controller with the internal clock.

The parameter can be set so that the controller starts with the external clock after power-on.

For activation with the external clock, however, signal input by high-speed serial communication is necessary at power-on.

2.7.1 RS-232C command input

RS-232C command input allows the following:

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

(For details, see 7, “Commands.”)

If position data send by high-speed serial communication is disabled, RS-232C command input is enough for the following:

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

(Communication specifications)

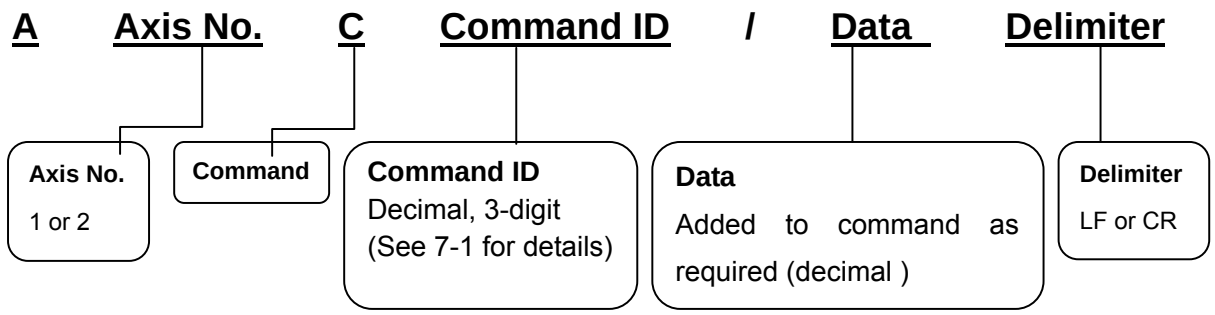
Wiring	Cross wiring
Communication rate	38400 bps
Data length	8 bits
Stop bit	1
Parity	None
Data format	ASCII code
Delimiter code	LF (0x0a) or CR (0x0d)

(Command specifications)

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

The data contents depend on the command. (For details, see 7-2, “Command Details.”)

Command send



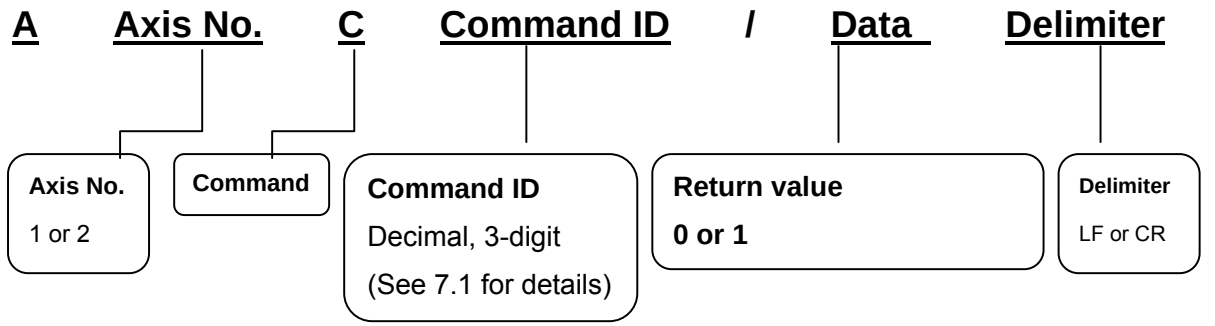
E.g. Servo ON ID = 4 Data = 1

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

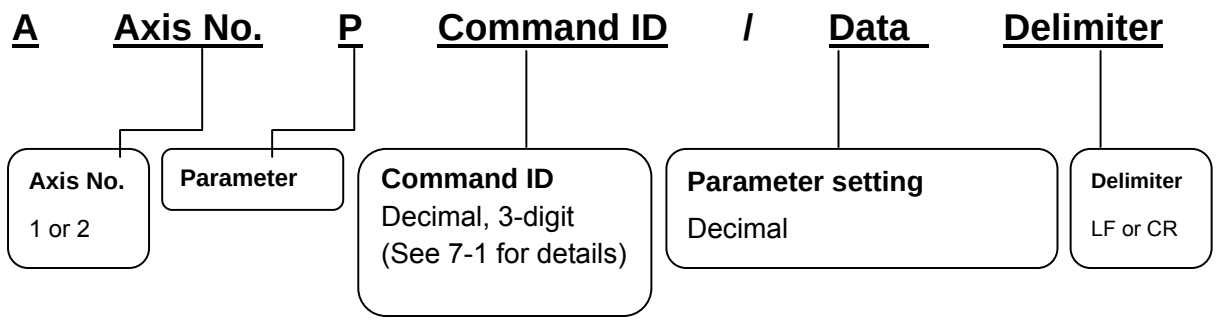
A1C004 / 1 (LF)

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

A 1 C 0 0 4 / 1 (LF)

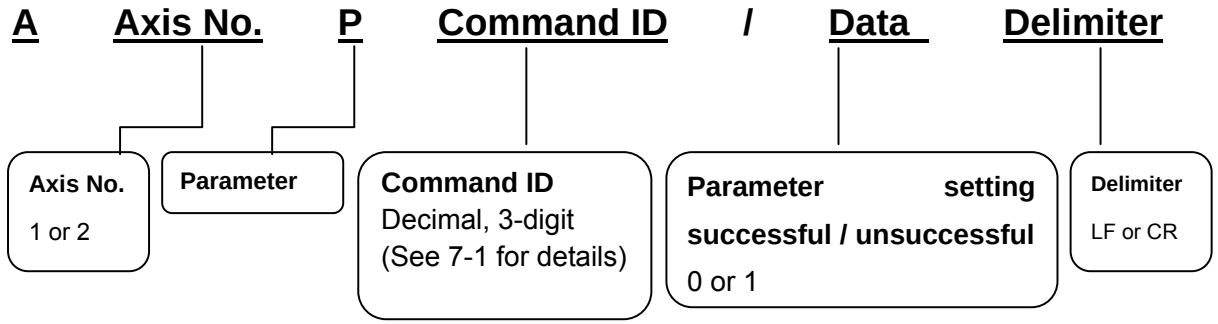
Parameter of controller can be changed by the following sending method to controller.
Also in response to parameter send, the controller always returns a reply with data.
The data contents depend on the command. (For details, see 7-2, “Command Details.”)
When changed a parameter of it, to start it by the same setting in power supply on at the next time; the parameter that changed, it is necessary to write in it at ROM.

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

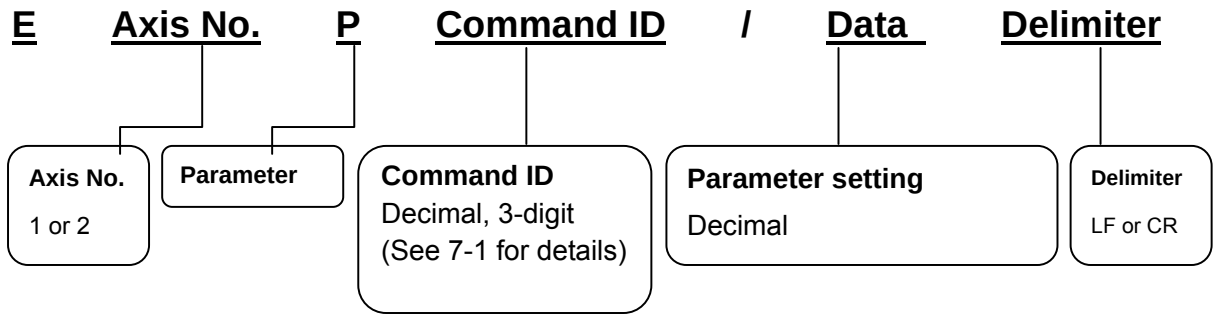


E.g. LQ gain parameter ID = 6 Data = 4500
A1P006 / 4500 (LF)
(ASCII code: 0x41 0x31 0x50 0x30 0x30 0x36 0x2f 0x30 0x0a)
A 1 P 0 0 6 / 0 (LF)

For the ROM Write of the parameter, a reply with data has been sent by all means by a controller. The content of data is different by a parameter. (For details, see 7-3, “Parameter Details.”)

（Note） Please make the ROM write of the parameter after enough confirmation. Depending on value for change, the controller may not start normally.

Parameter ROM Write send



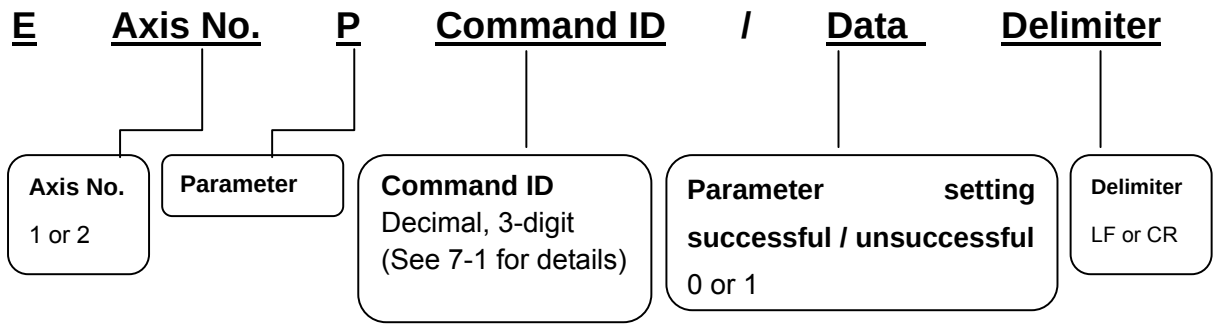
E.g. LQ gain parameter ID = 6 Data = 4500

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)

2.7.2 High-speed serial communication

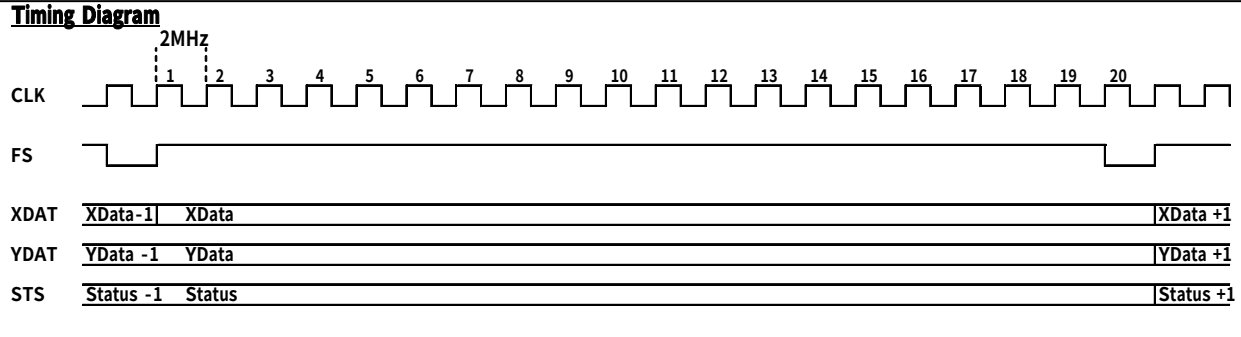
To control the mirror to an arbitrary position by Marking or any other application, target position data updated as required can be given to the controller by using high-speed serial communication.

By setting, the controller can be activated in the mode of tracking a target position specified by high-speed serial communication. (For details, see 6-1, “Setting Activation 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



16bit Data

(Bit)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
XDAT	C2	C1	C0	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	P
YDAT	C2	C1	C0	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	P
STS	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0

20bit Data

(Bit)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
XDAT	D19	D18	D17	D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
YDAT	D19	D18	D17	D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
STS	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0

CLK	Frequency	:	2MHz	
XDAT, YDAT	(16bit Data)	C2 .. C0	:	Header (un-used)
		D15 .. D0	:	Position Data (Signed Integer data)
		P	:	Parity (un-used)
	(20bit Data)	D19 .. D0	:	Position Data (Signed Integer data)
STS	S19 .. S0	:	(Status Table)	

Input signal from PC : CLK, FS, XDAT, YDAT
Output signal from DRIVE : STS

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

Note: For setting high-speed serial communication mode or controller activation in high-speed serial communication mode at power-on, high-speed serial communication signals are necessary. Enter the CLK, FS, and DAT signals in advance.

For how to set the activation mode, see 6-1, “Setting Activation Mode.”

(Target Position Data) XDAT、YDAT

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

The target position data length can be changed in 16bit – 20bit.

Parameter ID	DATA
6 7	16： 16bit Data ※ 17： 17bit Data 18： 18bit Data 19： 19bit Data 20： 20bit Data

The least significant bit position of the target position data of high-speed serial communication 20bit data can be set by following parameter.
The right shifts this number of bit make the target position data.

Parameter ID	DATA
6 8	0： 0bit position 1： 1bit position ※ 2： 2bit position 3： 3bit position 4： 4bit position

An example of the setting as follows.

16bit Data

(Bit)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
XDAT	C2	C1	C0	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	P
YDAT	C2	C1	C0	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	P

Parameter ID = 67 16

Parameter ID = 68 1

18bit Data

(Bit)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
XDAT	D17	D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	C1	C0
YDAT	D17	D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	C1	C0

Parameter ID = 67 18

Parameter ID = 68 2

20bit Data

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

Parameter ID = 67 20

Parameter ID = 68 0

With the default settings at shipping, the setting is ※ (16bit position data length, data least significant bit 1bit position).

This communication specification has compatibility of XY2-100.

When using the scanner controller of XY2-100 specifications, please use this setting.

Motor rotating angle for the high-speed serial communication data

- **In the case of 16bit position data**

  Data: 1 for one pulse that 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 the High-speed Serial Communication Conversion Gain parameter (Parameter ID = 13)

  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.

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

  Data: 1 for one pulse that can be specified up to the following positions:

  Maximum position: 0xFFFF = 524287 pulses

  0-pulse position: 0x8000 = 0

  Minimum position: 0x0000 = –524287 pulses

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

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

(Status) STS

The status of controller is sent by status line (STS) of high-speed serial communication.

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

Parameter ID	Data
6 6	1： Controller Condition 2： Current position (Axis 1) 3： Current position(Axis 2) 4： Current position(Axis1 , Axis2)

Each status contents are as follows.

Status Table

	Mode-1	Mode-2	Mode-3	Mode-4
S19	0	X Position Data Bit_19	Y Position Data Bit_19	Axis Flag
S18	0	X Position Data Bit_18	Y Position Data Bit_18	X(Y) Position Data Bit_18
S17	0	X Position Data Bit_17	Y Position Data Bit_17	X(Y) Position Data Bit_17
S16	0	X Position Data Bit_16	Y Position Data Bit_16	X(Y) Position Data Bit_16
S15	0	X Position Data Bit_15	Y Position Data Bit_15	X(Y) Position Data Bit_15
S14	0	X Position Data Bit_14	Y Position Data Bit_14	X(Y) Position Data Bit_14
S13	Y_READY	X Position Data Bit_13	Y Position Data Bit_13	X(Y) Position Data Bit_13
S12	Y_ALARM2	X Position Data Bit_12	Y Position Data Bit_12	X(Y) Position Data Bit_12
S11	Y_ALARM1	X Position Data Bit_11	Y Position Data Bit_11	X(Y) Position Data Bit_11
S10	Y_INPOS	X Position Data Bit_10	Y Position Data Bit_10	X(Y) Position Data Bit_10
S9	0	X Position Data Bit_9	Y Position Data Bit_9	X(Y) Position Data Bit_9
S8	0	X Position Data Bit_8	Y Position Data Bit_8	X(Y) Position Data Bit_8
S7	0	X Position Data Bit_7	Y Position Data Bit_7	X(Y) Position Data Bit_7
S6	0	X Position Data Bit_6	Y Position Data Bit_6	X(Y) Position Data Bit_6
S5	0	X Position Data Bit_5	Y Position Data Bit_5	X(Y) Position Data Bit_5
S4	0	X Position Data Bit_4	Y Position Data Bit_4	X(Y) Position Data Bit_4
S3	X_READY	X Position Data Bit_3	Y Position Data Bit_3	X(Y) Position Data Bit_3
S2	X_ALARM2	X Position Data Bit_2	Y Position Data Bit_2	X(Y) Position Data Bit_2
S1	X_ALARM1	X Position Data Bit_1	Y Position Data Bit_1	X(Y) Position Data Bit_1
S0	X_INPOS	X Position Data Bit_0	Y Position Data Bit_0	X(Y) Position Data Bit_0

Axis Flag =0 第1軸
Axis Flag =1 第2軸

1: Controller Condition

Output the status of the controller.

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

ALARM1 : Alarm output (priority high)
(See 5-3 Digital Input-Output Function. Same meaning as 'Axis 1 Error 1 (priority high)' , ' Axis 2 Error 1(priority high)')

ALARM2 : Alarm output (priority low)
(See 5-3 Digital Input-Output Function. Same meaning as 'Axis 1 Error 2 (priority low)' , ' Axis 2 Error 2(priority low)')

INPOS ： In-position signal

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

2: Current position (Axis 1)

Output the Axis 1 encoder position.

Position Data length: 20bit. 。

3: Current position (Axis 2)

Output the Axis 2 encoder position.

Position Data length: 20bit. 。

4: Current position (Axis1, Axis2)

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

Position Data length: 21bit. 。

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

Axis Flag = 0 Axis 1

Axis Flag = 1 Axis 2

Note: After the position of the encoder is actually detected, the encoder position status is output after a delay of 2 servo sampling. (1 servo sampling = 10μsec)

Note: Only when controlling by high-speed serial communications, the status output is output. It is not output when operating with the internal clock (raster scan and movement in the step).

2.8. 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) at 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 9, “Safety Functions.”)

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

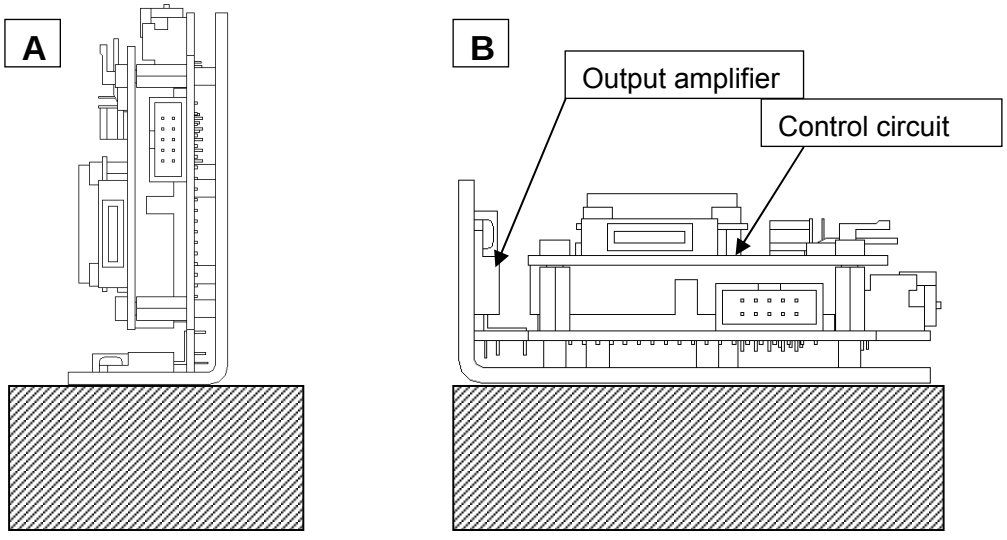
Controller installation methods

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, which is the main source of heat, 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, 101) comes with dedicated control software “GALILEO (Galvano Integrated Leading Operator (GALILEO).”

GALILEO makes the following controller operations easy:

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

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

Note: The following function can be executed by GALILEO only, and not by external command input:

- Frequency characteristic measurement

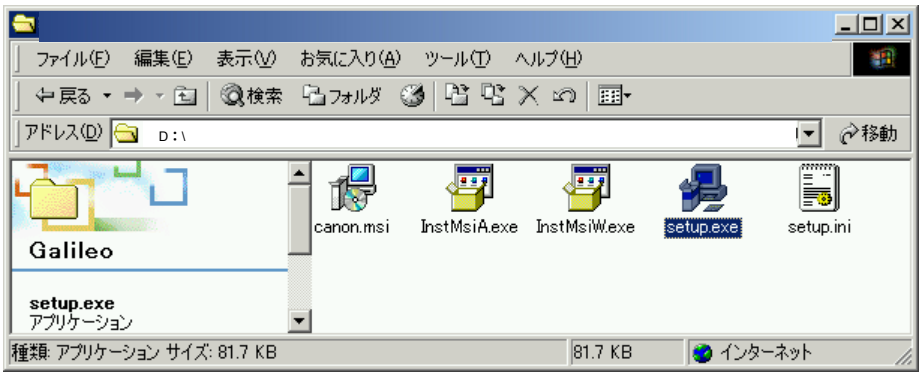
3.1. Supported PC Environment

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

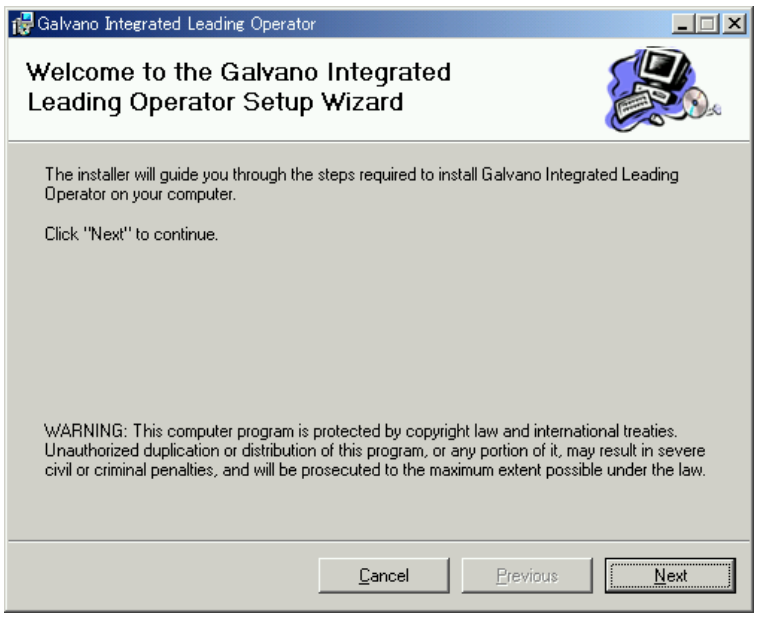
3.2. Installation

- Insert the accessory application CD into the CD drive.

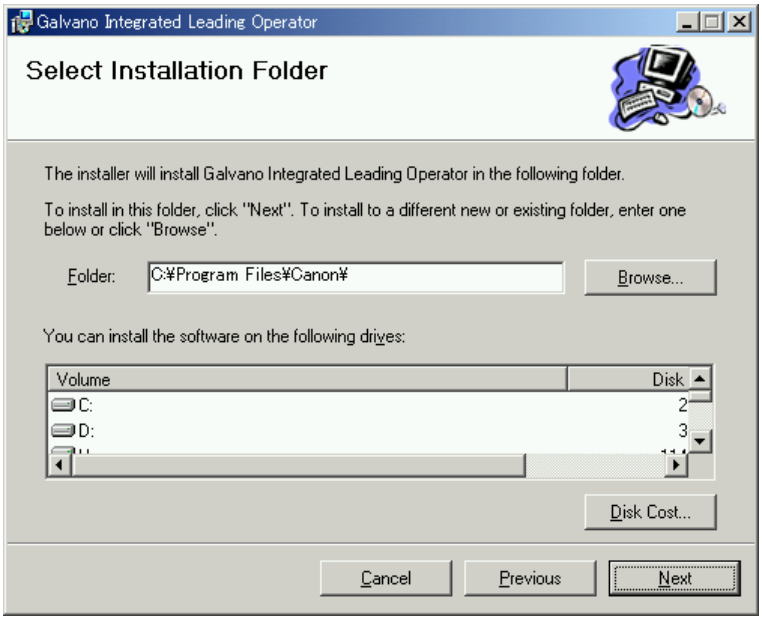
- Execute Setup.exe in the GALILEO folder.



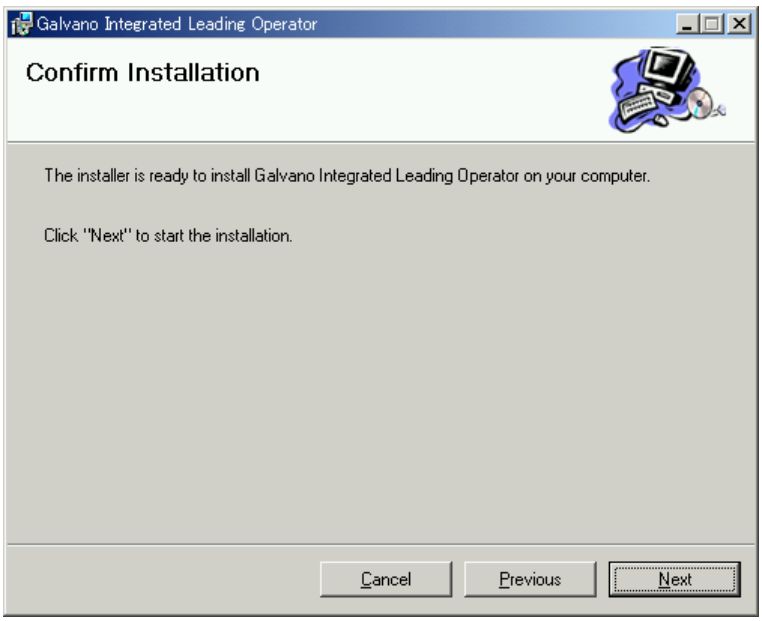
- Press the Next button.



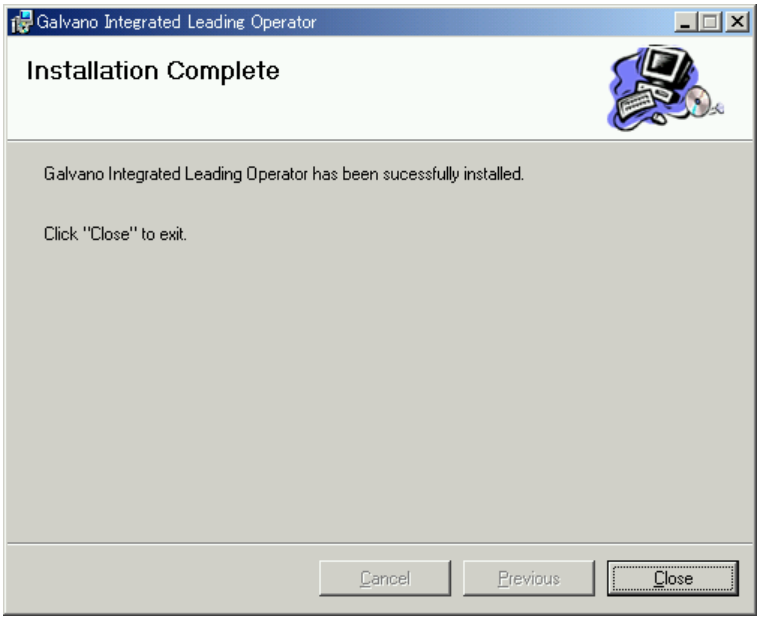
- Specify an installation folder and press the Next button.
  (Recommendation: Do not change usually.)



- Press the Next button.



- Press the Close button. This completes installation.

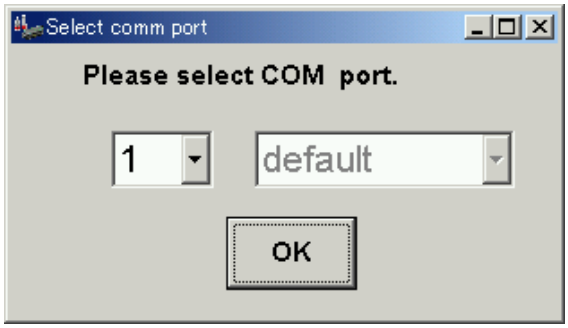


3.3. Activation

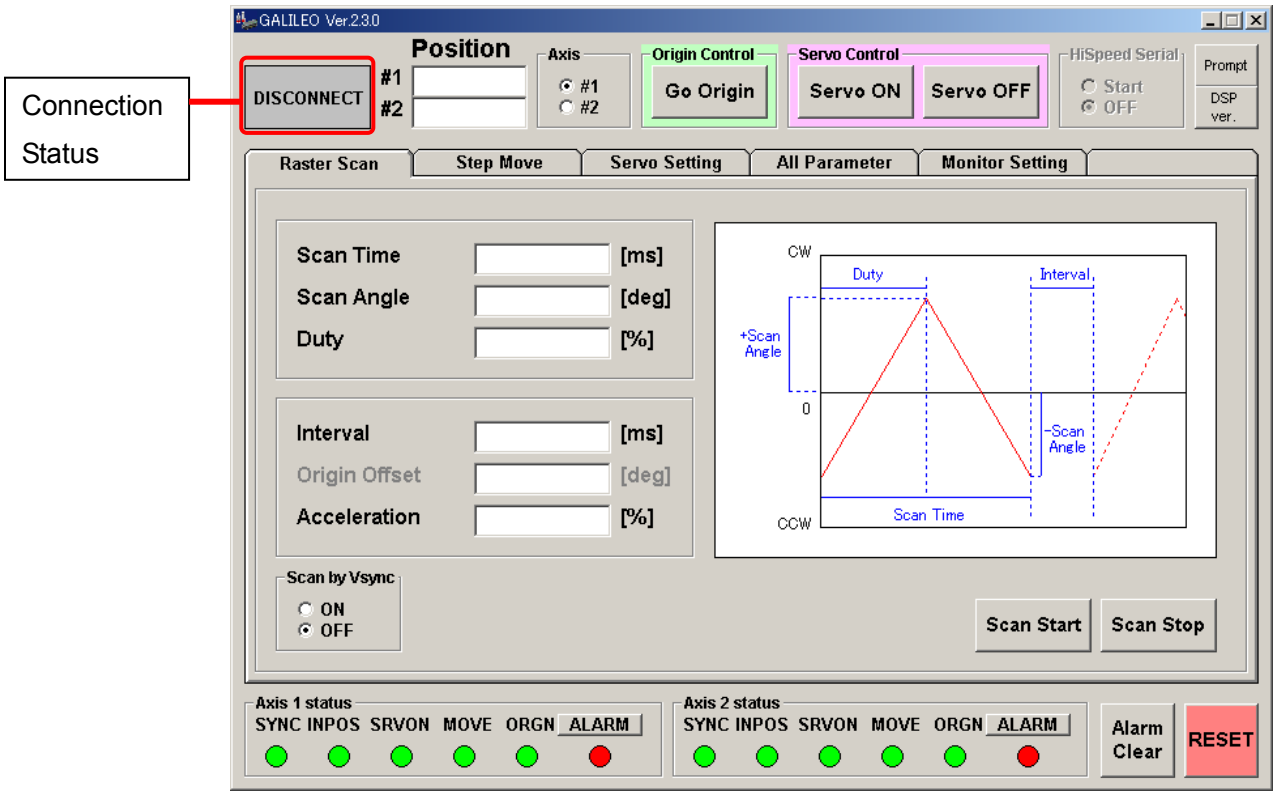
- Connect the controller and the PC with the optional RS-232C cable.

- Click “START” - “Programs” - “Canon Scanner” - “GALILEO”.

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



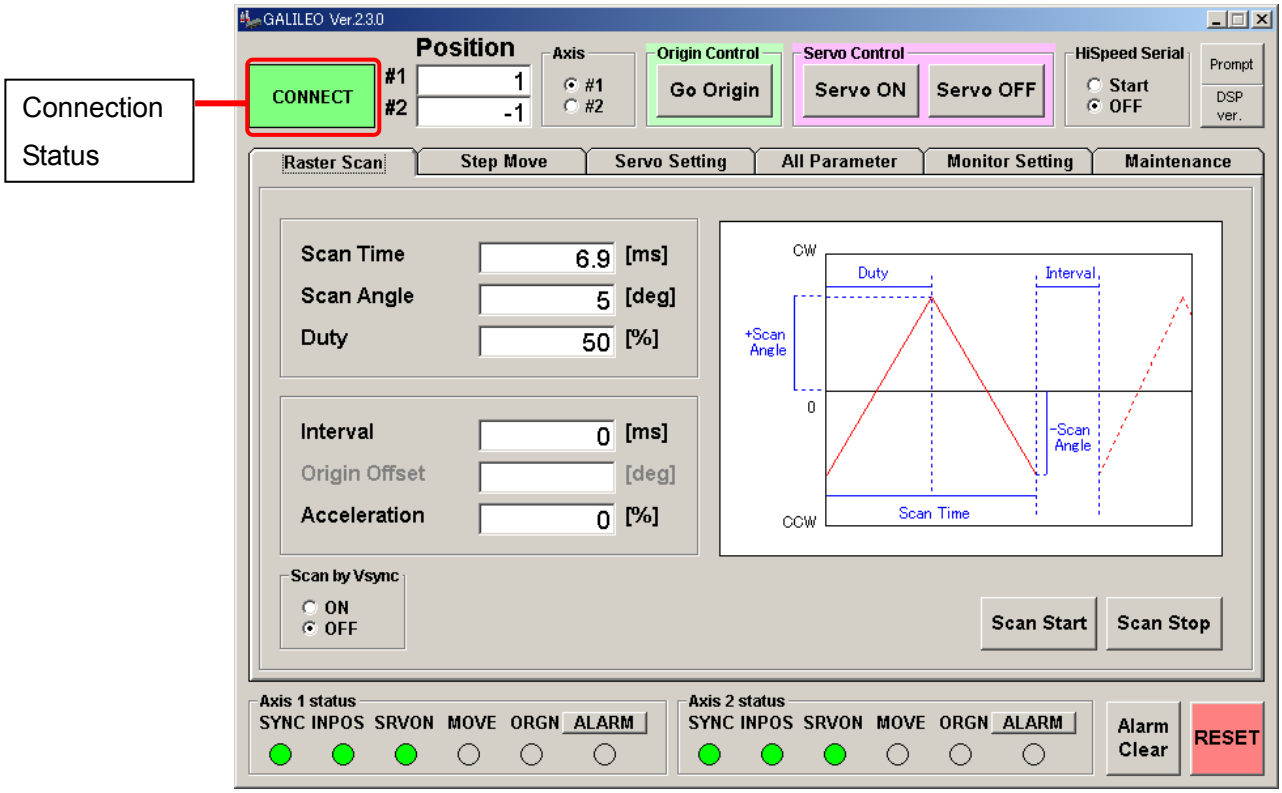
- The control screen is displayed.
  While communication with the controller has not started yet, the screen displays “DISCONNECT” in gray at the upper left as the connection status.



Note: The value of each item on the above screen depends 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.

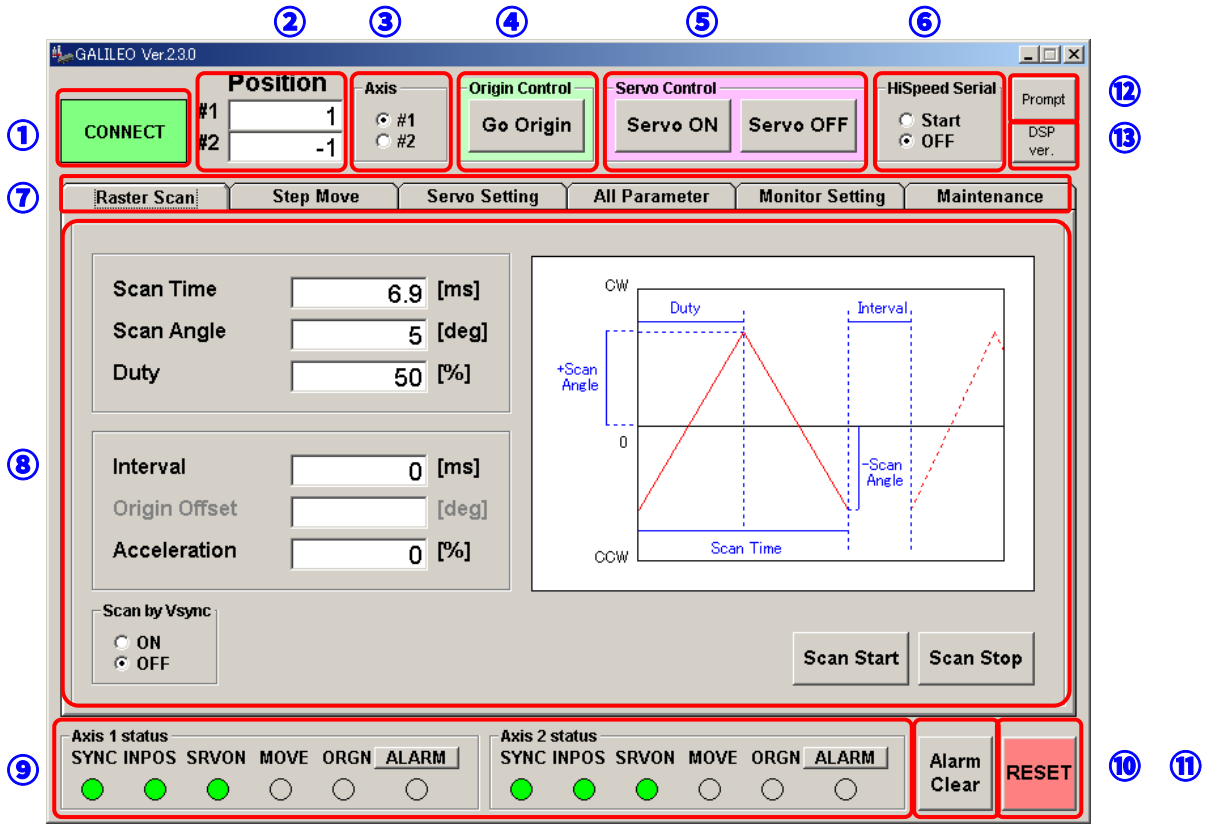


GALILEO can be activated after power to the controller has been turned on. Then communication starts automatically. (“CONNECT” is displayed.)

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

3.4. 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 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 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 internal command for position specification. (For details, see Chapter 4.) (Start = High-speed serial communication, OFF = Internal 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.
⑩	Soft reset	Press this button for soft reset.
⑪	Command input screen	Allows direct command input.
⑫	DSP version	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 [GALILEO] and by [RS-232C command] are explained together.

4.1. Controller Activation

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

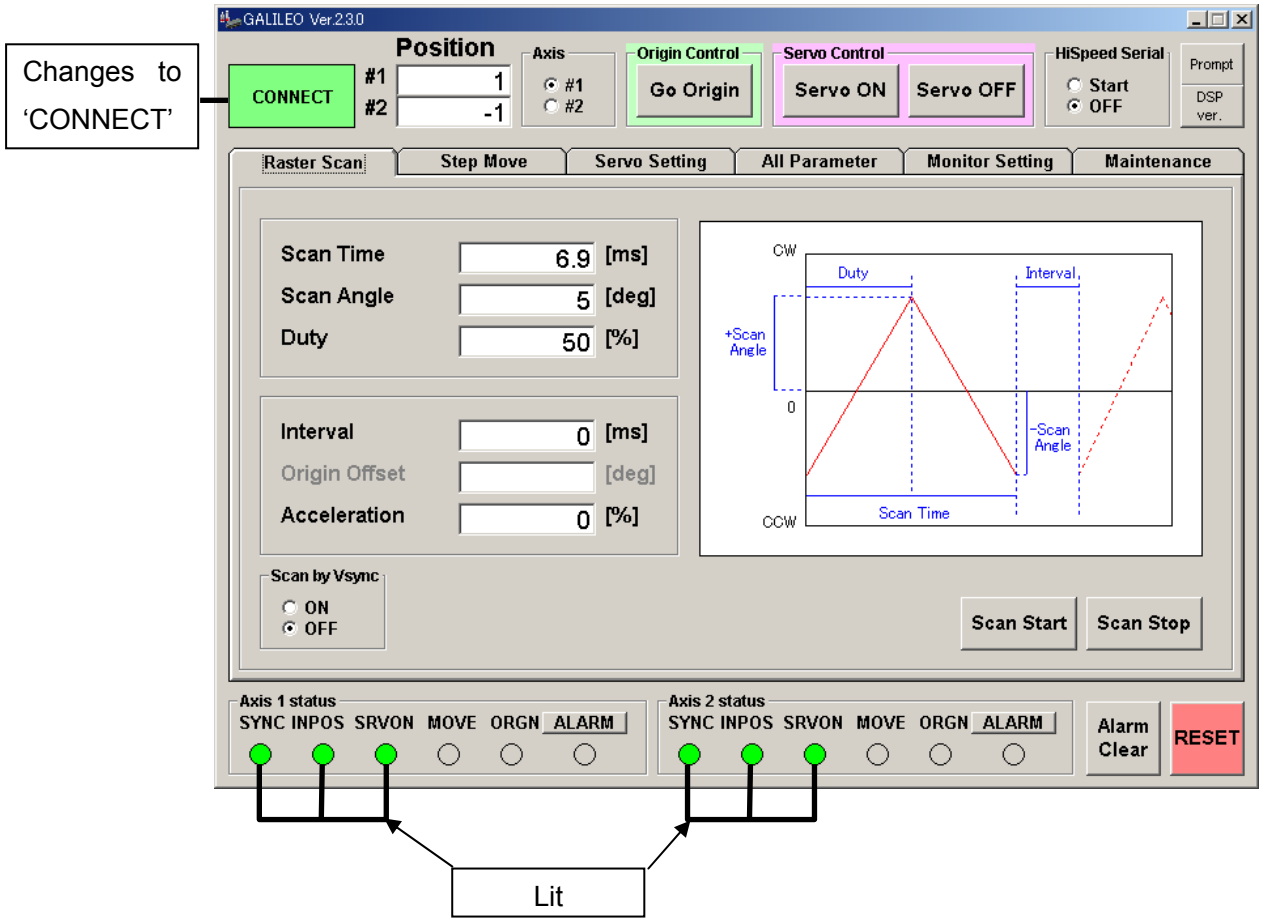
- Reads saved parameters from ROM
- Homes to the origin
- Corrects the encoder (high-speed oscillation of a fixed angle)

It takes about 15 seconds until the controller is activated.

With the default settings at shipping, the controller is activated with the internal clock.

The completion of activation can be confirmed as follows:

GALILEO



Note: At activation, the status temporarily changes to "DISCONNECT" and the ALARM lamp lights (about 5 s). This is not an error. Wait for a while.

RS-232C command

Send Command ID14 “Status read” and check the following:

SRVON, SYNC, INPOS = High

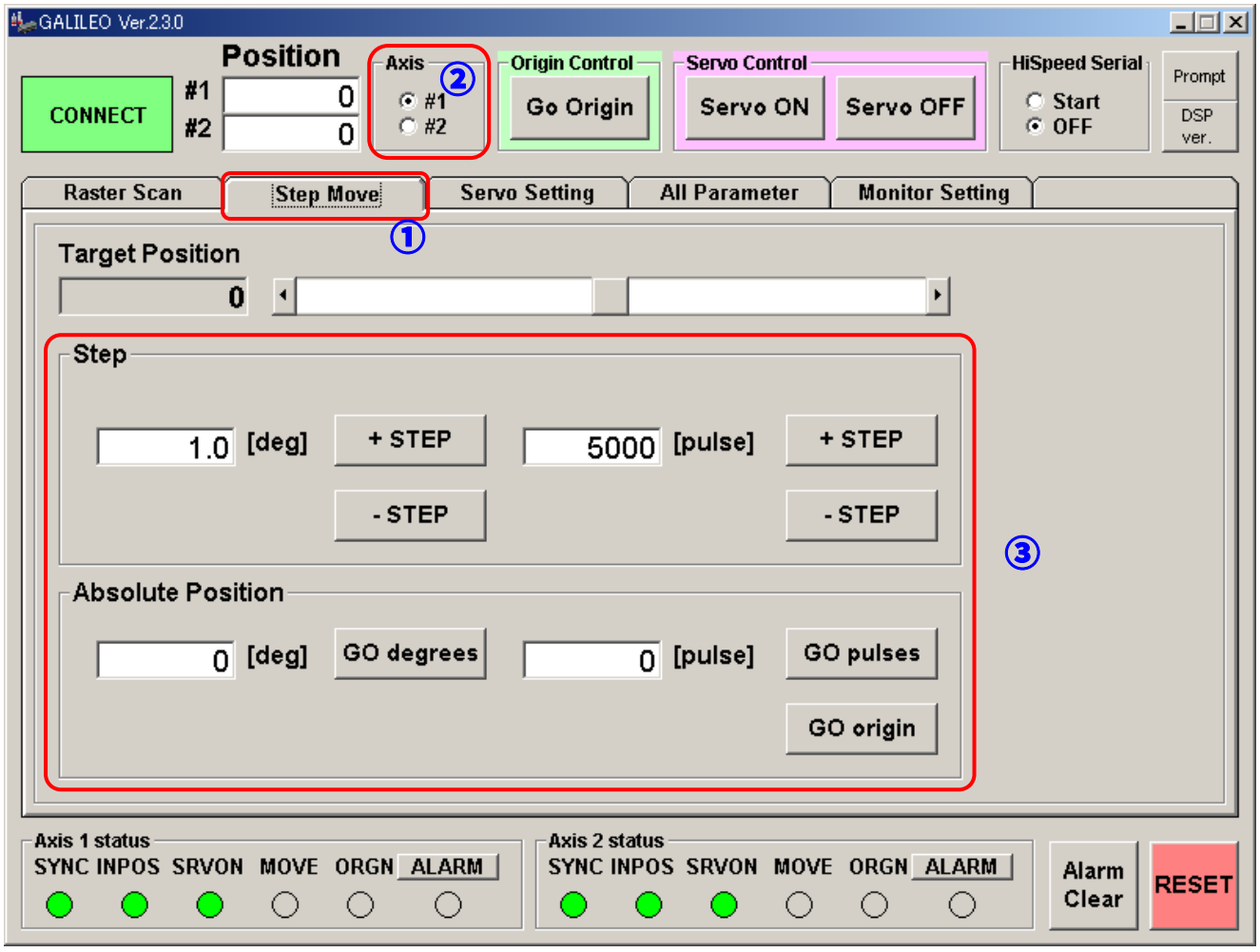
ORGN = Low

(For details, see 7-2, “Command Details.”)

4.2. Step Movement

Execute step movement for a fixed angle.

GALILEO



- Select the Step Move tab. ①
- Select an axis for step movement. ②
- Specify the displacement (angle and pulse count) for relative position (STEP) and absolute position. ③
- Press the MOVE button (either positive or negative position direction can be specified). ③

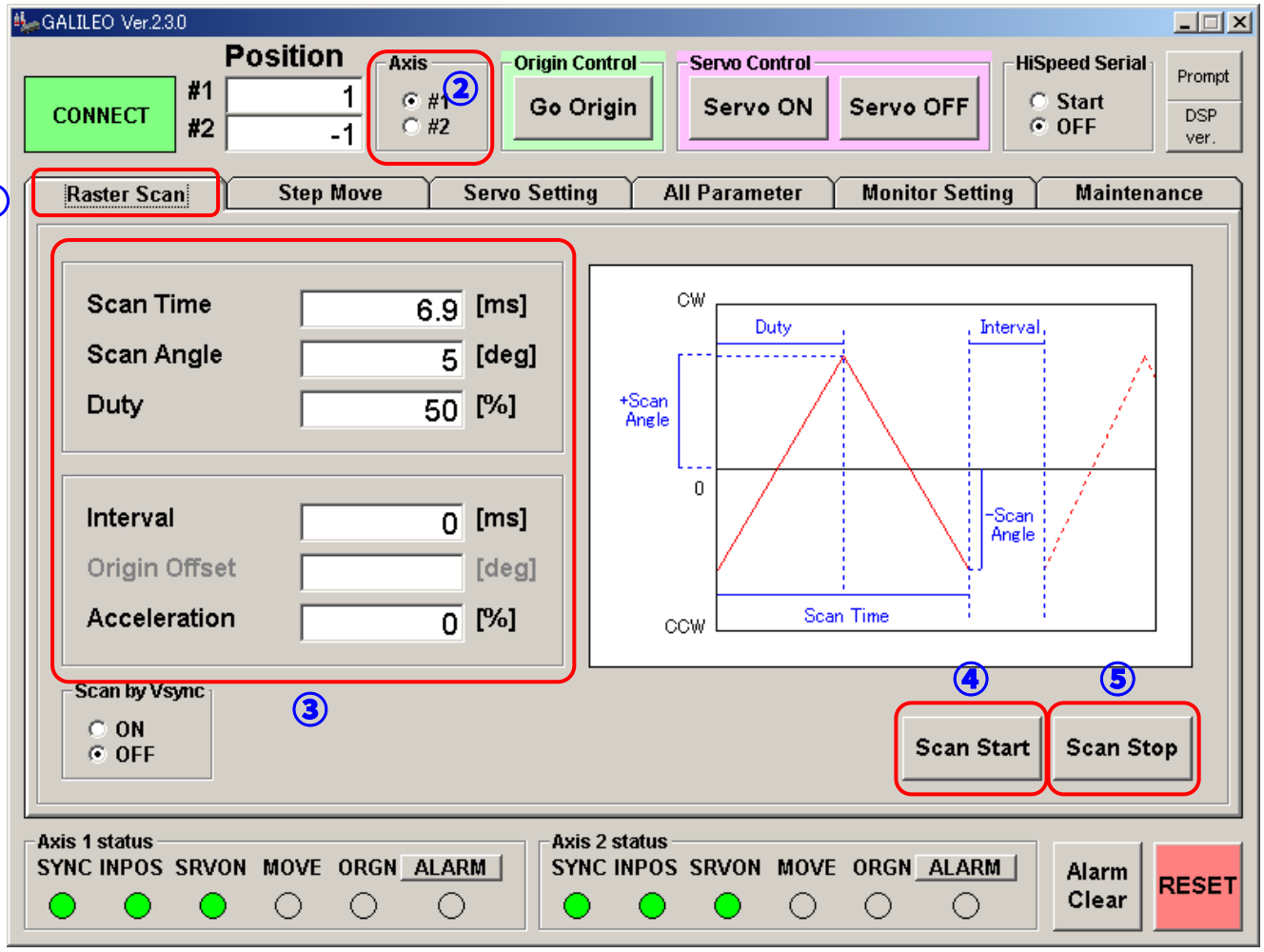
RS-232C command

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

4.3. Raster Scan

Execute oscillation of a fixed angle at a fixed frequency.

GALILEO



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

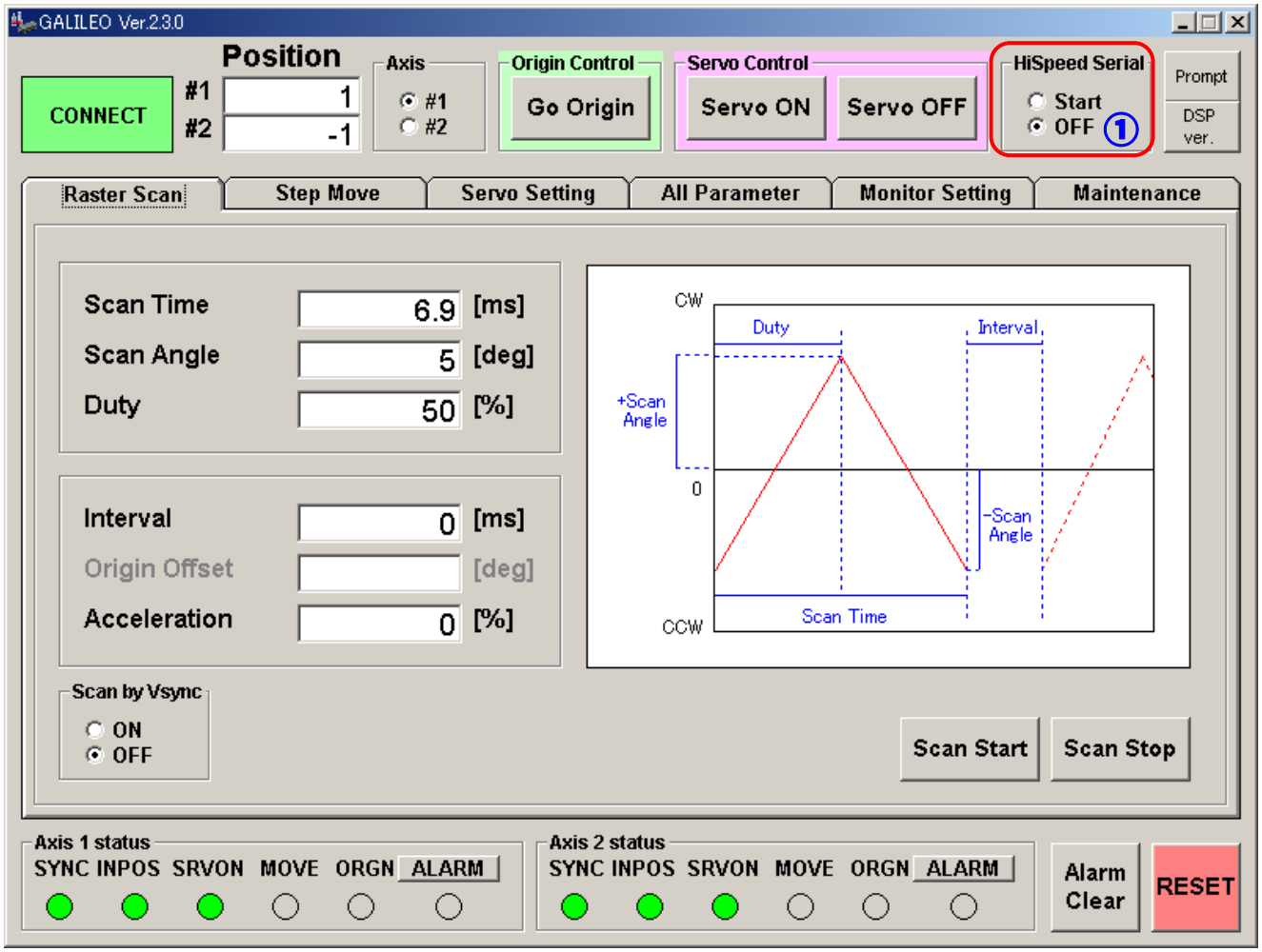
RS-232C command

- 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

For a vector scan, give target position data to the controller by high-speed serial communication, The data is updated as required.

Switch the controller to the status of receiving target position data by high-speed serial communication. For switching, it is necessary to enter high-speed serial communication signals into the controller in advance.



- Select an axis for high-speed serial communication. ①
- Switch HiSpeed Serial to Start. ②

  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

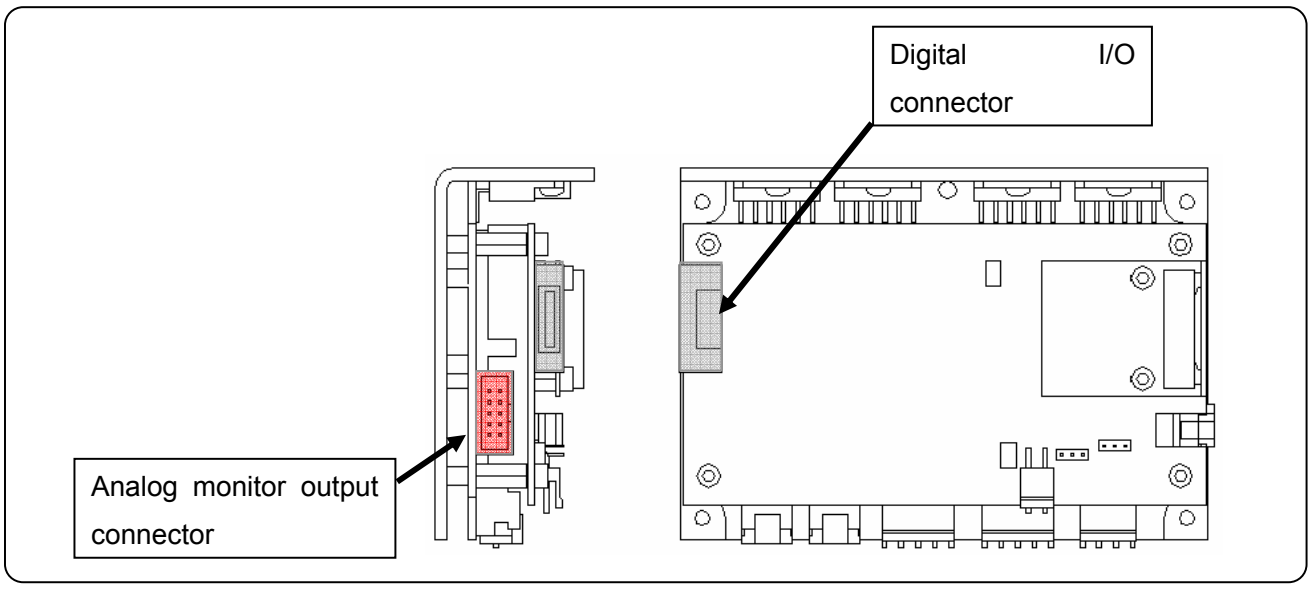
The controller has an analog monitor output connector for monitoring the operation status and a digital I/O connector for external signal input.

5.1. Connector Pin Arrangement

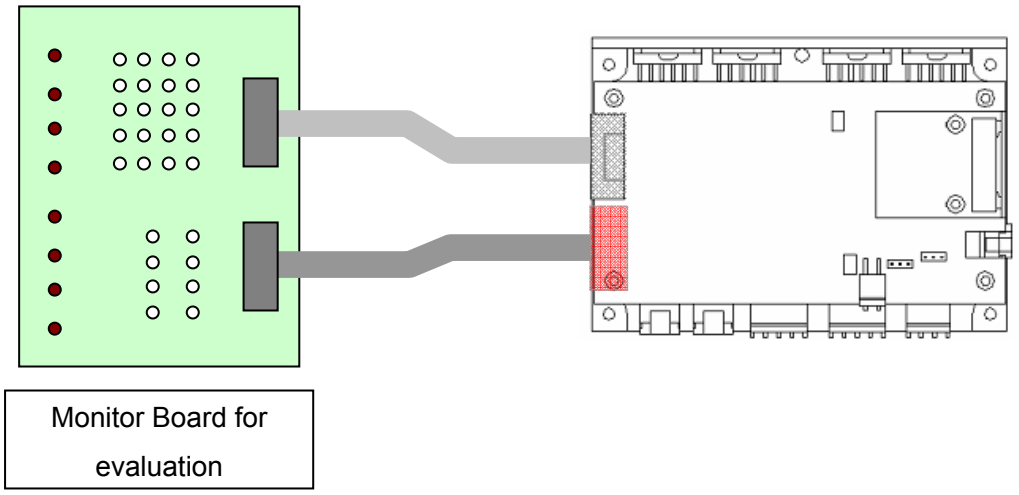
The controller is equipped with the following:

Analog monitor output connector ×1

Digital I/O connector ×1



The monitor board for the evaluation that can do the analog output signal confirmation and the I/O of a digital signal is prepared as an optional product. Please contact the Sales Department.



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

Analog monitor output connector

Connector model number

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

Connector pin arrangement

Pin No.	Monitor Board 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 Switching.”)

Digital I/O connectors

Connector model number

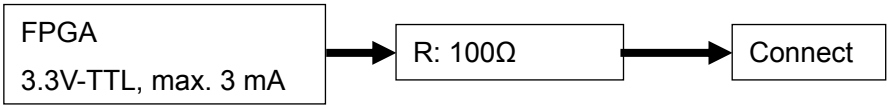
Connector	Model No.	Manufacturer
Board side	8931E-020-178L	KEL
Cable side	8925E-020-179	KEL

Connector pin arrangement

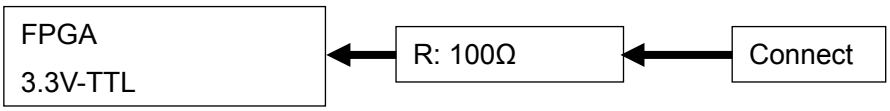
Pin No.	Monitor board Signal Name	I/O	Signal Description	Logic	Remarks
A1	D1	Output	Axis 1 error 1 (Priority high)	High : Error	See Circuit 1 below.
B1	D2	Output	Axis 1 error 2 (Priority low)	High : Error	See Circuit 1 below.
A2	D3	Output	Axis 1 servo interrupt period	Edge	See Circuit 1 below.
B2	D4	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	Activation 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.

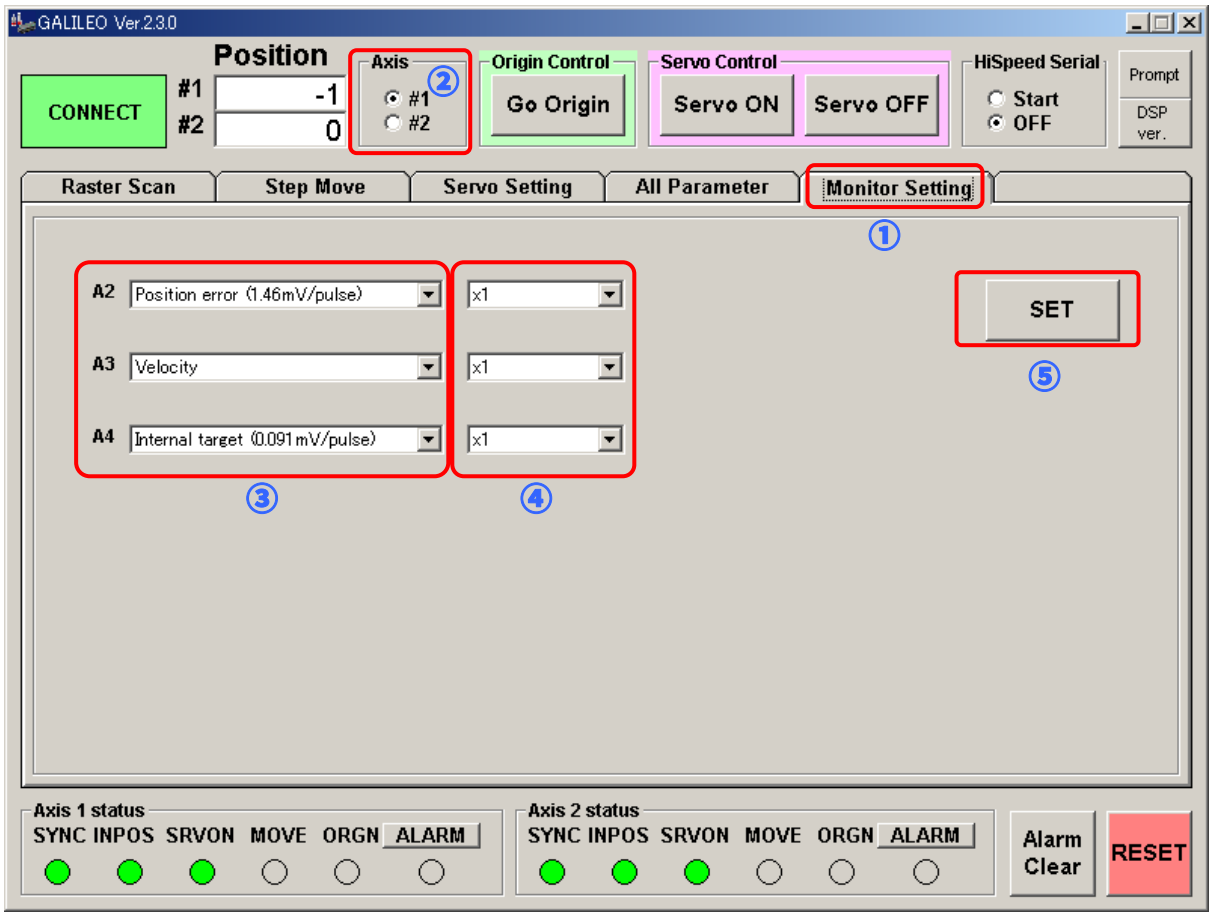
This switching can be executed from **[GALILEO]** or **[RS-232C command send]**.

Output contents

Terminal	Power-on Selection	Signal Description	Signal Level (At Power-on)
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	1.46 mV / pulse
A3 (Axis 1) A7 (Axis 2)		Position	0.091 mV / pulse
	*	Velocity	0.091 mV / pulse / 10 usec
		Coarse angle	
		Fine angle	
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.

GALILEO



- 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 looped by magnification setting if it exceeds this range.

• The relationship between encoder pulse and angle depends on the galvano motor.

KP-1SM30

360° = 83328 pulses × 2048 divisions = 170655744 pulses

0.01° = 170655744 pulses / 360° ×0.01 = 4740 pulses

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

0.01° = 4740 × 0.091 = 431 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)	1: 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)	1: Error	
B2	Output	Axis 2 Error 1 (Priority high)	1: Error	
A3	Output	Axis 2 Error 2 (Priority low)	1: Error	
A2	Output	Axis 1 servo interrupt period	Edge	These are output at a servo interrupt timing in the controller.
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	When external signal is used for servo sampling clock. (Do not use it usually.)
B5	Input	External Trigger Signal	High：ON	See 6-2, “Operation that synchronizes with external trigger Signal input(raster scan)
A6	Input	Activation mode switching		See 6-1, “Setting Controller Activation Mode”

6. Other - Operation Setting

6.1. Setting Controller Activation Mode

Clock selection

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

Parameter ID	Data
64	Bit 1 0: Internal clock 1: High-speed serial communication

P64 = 1: Activation with internal clock

P64 = 3: Activation 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 8-2, “Parameter Details.”)

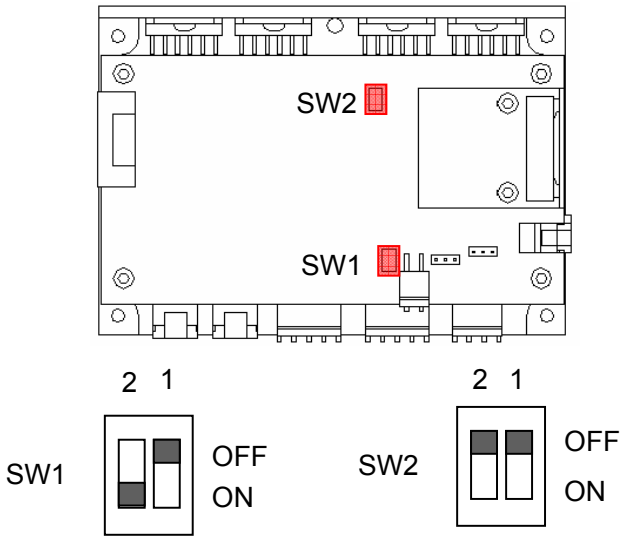
Activation mode

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 power-on activation 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

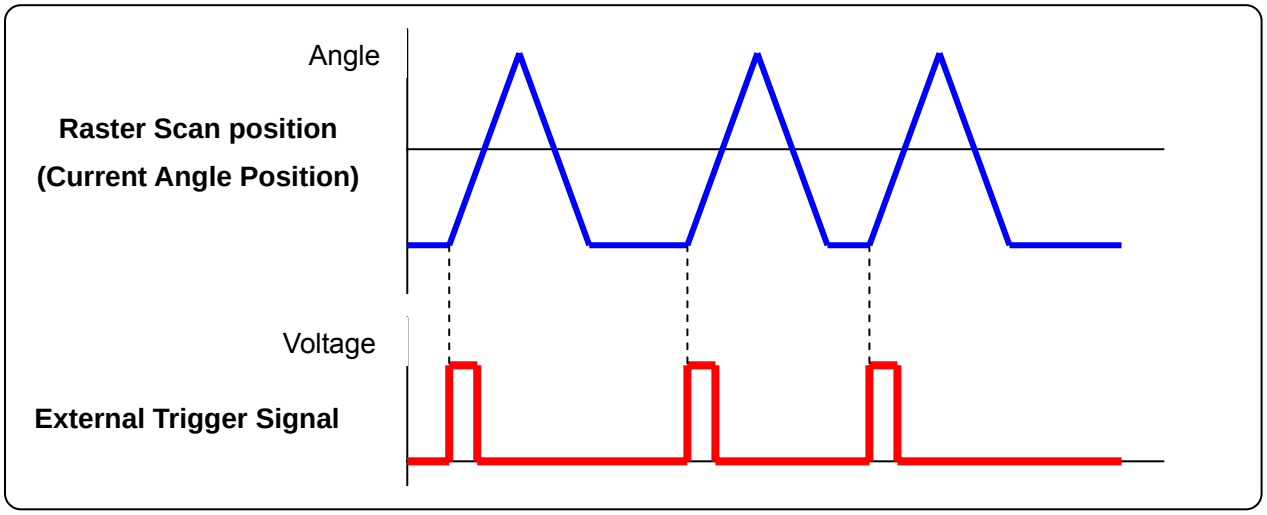
6.2. Operation that synchronizes with external trigger Signal input(Raster Scan)

"4-3. raster scan operation", It can be operated synchronizing with external trigger Signal.

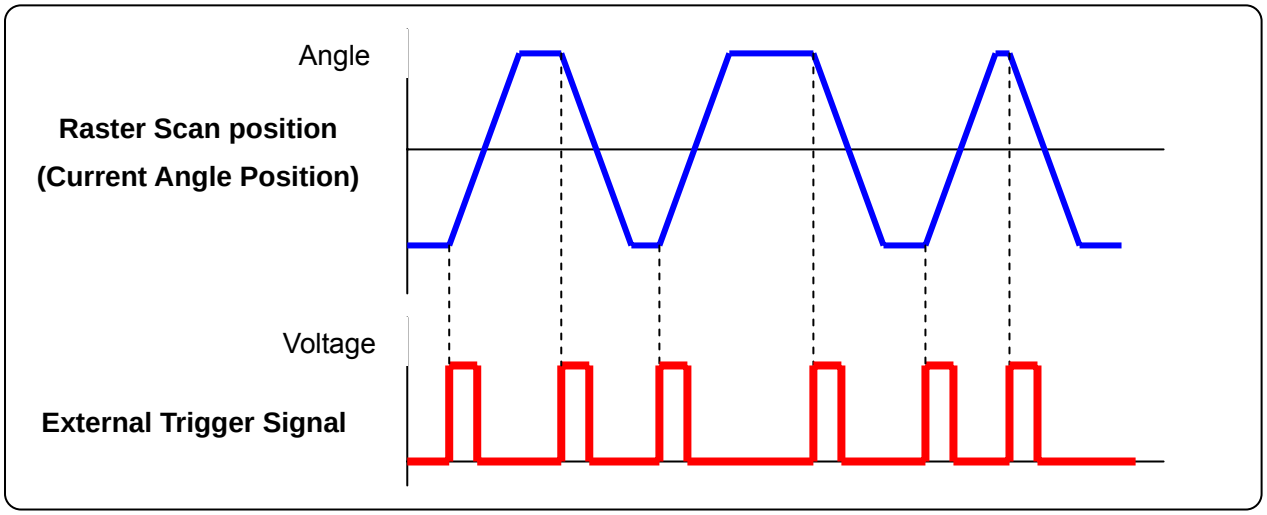
【The Movement Pattern】

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
- Set Parameter ID =27 Raster Scan Duty Ratio
- Set Parameter ID =28 Raster Scan Angle

(Raster Scan Operation)

- Send Command ID=8 Data=6 Movement Start (Movement to the Initial position of raster scan)
- Send Command ID=23 Data=8 (One way scan) } Select either
  Data=9 (One coming and going)
  (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.
- 10usec or less is uneven from the external trigger signal input at time until beginning to
- actually operate.

7. 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.

7.1. 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 move start 6: Initial position of raster scan	
9	Forced Stop			
10	Target position Setting Mode	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 Setting	Yes	See “Command Details.”	
26	Parameter Value Check	Yes	Parameter ID	Parameter value
30	Program Coordinate System	Yes	0: Z phase 1: Program origin	
40	Monitor Output Selection (A2 , A8)	Yes	0: Head1 A phase 1: Head2 A phase 2:Corrected A phase	

			3:Position error	
41	Monitor Output Selection (A3 , A9)	Yes	0: Position 1: Velocity 2:Course Angle 3:Fine Angle	
42	Monitor Output Selection (A4 , A10)	Yes	0: Head1 A phase 1: Head2 A phase 2:Corrected A phase 3:Internal Target	
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 (A2, A8)	Yes	N: Magnification (x 2^N)	
46	Monitor magnification Setting (A2, A8)	Yes	N: Magnification (x 2^N)	
47	Monitor Magnification Setting Check	Yes	0:A2 (A8) Monitor Magnification 1:A3 (A9) Monitor Magnification 2:A4 (A10) Monitor Magnification	
101	Counter Clear Timing	Yes	0: Axis 1 1: Axis 2	0 or 1

7.2. 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 activation. However, the parameter values are retained. If a high-priority error requiring soft reset occurs (see 9-2, “Errors” for details), execute this command after solving 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 9-2, “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.		

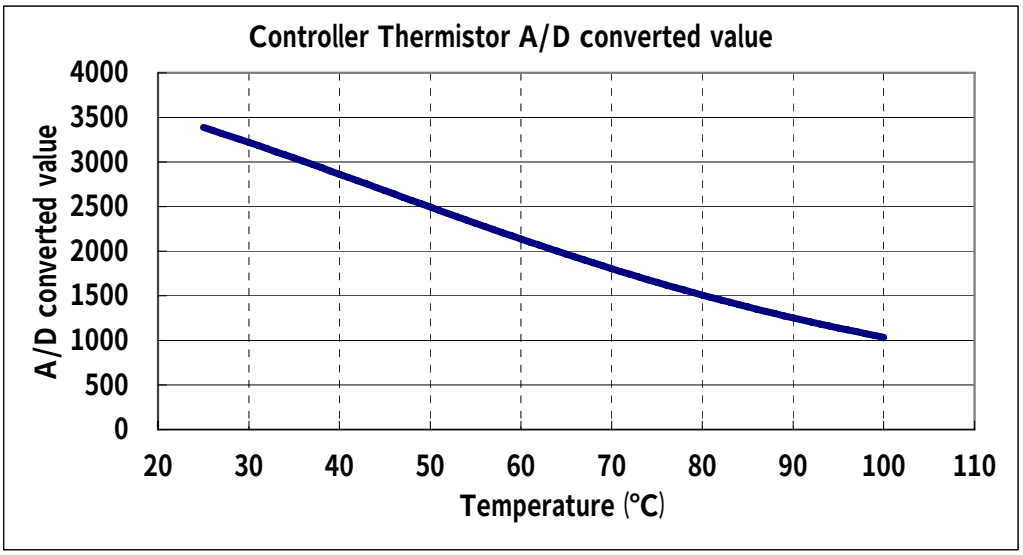
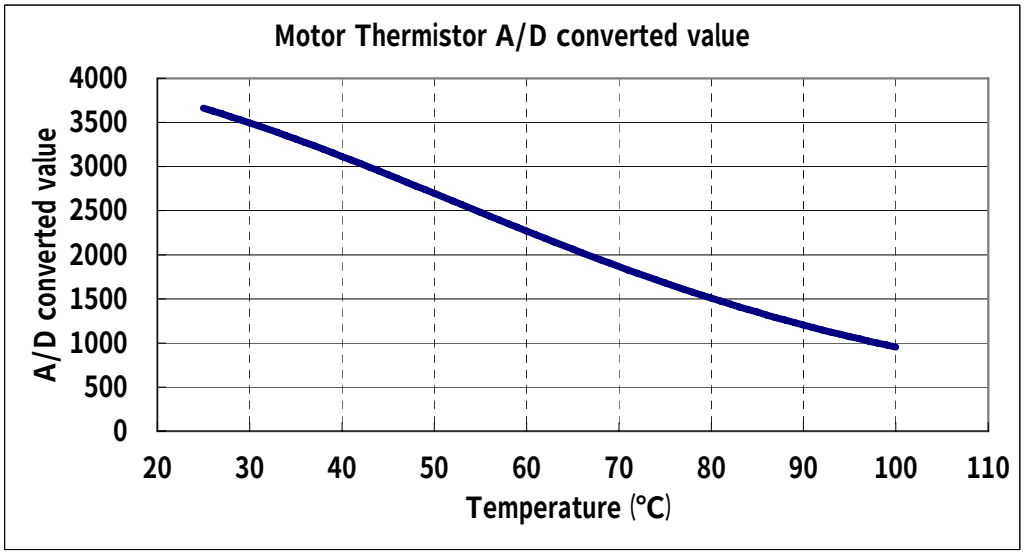
Command ID	4	Command Name	Servo ON
Data	0: OFF 1: ON		
Return Value	0: Command execution successful 1: Command execution unsuccessful		
Explanation	This command starts or stops servo control. Turning servo control off makes the motor axis free. When the controller is operating on the internal clock, 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.		
Related Command			

Command ID	8	Command Name	Movement Start
Data	0: Step move start 6: Movement to the initial position of raster scan		
Return Value	0: Command execution successful 1: Command execution unsuccessful		
Explanation	After a target position is set, this command is executed to start step movement. Raster scan 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 Parameter ID = 27: Raster Scan Duty Ratio Parameter ID = 28: Raster Scan Oscillation Angle Command ID = 8 Data = 6: Movement to the raster scan initial position Command ID = 23 Data = 3: Raster Scan Start 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

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 start by the external trigger signal input (one way scan) 9: Raster scan start 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 6.2, “ Operation that synchronizes with external trigger Signal input”) 9: Raster scan start by the external trigger signal input (Coming and going scan) (For details, see 6.2, “Operation that synchronizes with external trigger Signal input”)		
Related Command	Raster scan movement procedure Parameter ID = 26: Raster Scan Time Parameter ID = 27: Raster Scan Duty Ratio Parameter ID = 28: Raster Scan Angle Command ID = 8: Data = 6: 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 activation. 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: Encoder Head1 A phase 1: Encoder Head2 A phase 2: Corrected A phase 3: Position error		
Return Value	0: Command execution successful 1: Command execution unsuccessful		
Explanation	The output signal of analog monitor output A2 (the Axis1) and A8 (the Axis2) can be selected. When the controller starts, the 3: Position error has been selected. (For details, see 5.2, “Analog Monitor Output Selecting ”)		
Related Command	Command ID = 44: Monitor Magnification Setting (A2, A8)		

Command ID	41	Command Name	Monitor Output Selection (A3, A9)
Data	0: Position 1: Velocity 2: Course Angle 3: Fine Angle		
Return Value	0: Command execution successful 1: Command execution unsuccessful		
Explanation	The output signal of analog monitor output A3 (the Axis1) and A9 (the Axis2) can be selected. When the controller starts, the 1: Velocity has been selected. (For details, see 5.2, “Analog Monitor Output Selecting ”)		
Related Command	Command ID = 45: Monitor Magnification Setting (A3, A9)		

Command ID	42	Command Name	Monitor Output Selection (A4, A10)
Data	0: Encoder Head1 B phase 1: Encoder Head2 B phase 2: Corrected B phase 3: Internal Target		
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, see 5.2, “Analog Monitor Output Selecting ”)		
Related Command	Command ID = 46: Monitor Magnification Setting (A4, A10)		

Command ID	43	Command Name	Monitor Output Select Check
Data	0: A2, A8 monitor 1: A3, A9 monitor 2: A4, A10 monitor		
Return Value	0: Command execution successful 1: Command execution unsuccessful		
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 (Axis1 monitor A2 = Position error)		
Related Command			

Command ID	44	Command Name	Monitor Magnification Setting (A2, A8)
Data	Magnification : N (×2^N)		
Return Value	0: Command execution successful 1: Command execution unsuccessful		
Explanation	Magnification is specified by exponent of 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	45	Command Name	Monitor Magnification Setting (A2, A8)
Data	Magnification : N (×2^N)		
Return Value	0: Command execution successful 1: Command execution unsuccessful		
Explanation	Magnification is specified by exponent of 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	46	Command Name	Monitor Magnification Setting (A2, A8)
Data	Magnification : N (×2^N)		
Return Value	0: Command execution successful 1: Command execution unsuccessful		
Explanation	Magnification is specified by exponent of 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	
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.		
Related Command			

Command ID	101	Command Name	Counter Clear Timing
Data	0: Head 1 1: Head 2		
Return Value	Timing 0 or 1		
Explanation			

8. Parameters

8.1. List of Parameters

ID	Parameter Name
0	CW Limit
1	CCW Limit
2	Max Velocity
3	In-position Width
4	Settling Check Time
5	In-position Overtime
6	LQ Control Gain
7	Torque Constant
8	Total Inertia
9	Current Limit
10	Encoder Periodicity
11	Sampling Time
12	Origin Clearance Timing (Head 1)
13	High-speed Serial Communication Conversion Gain
14	Origin Clearance Timing (Head 2)
15	High-speed Serial Communication Offset
16	First Digital Notch Filter Central Frequency
17	Q Value of First Digital Notch Filter
18	First Digital Notch Filter Depth
19	Second Digital Notch Filter Central Frequency
20	Second Digital Notch Filter Q Value
21	Second Digital Notch Filter Depth
22	Digital Low-pass Filter Cutoff Frequency
23	First Analog Notch Filter Central Frequency
24	Second Analog Notch Filter Central Frequency
25	Third Analog Notch Filter Central Frequency
26	Raster Scan Time
27	Raster Scan Duty Ratio
28	Raster Scan Angle
29	Internal Generation Acceleration Percentage
30	Raster Scan Interval Time
31	Raster Scan Start Position
32	Z-phase Offset
33	Acceleration Time
34	Deceleration Time
36	Out-position Width
40	Feed-forward Gain
42	Overshoot Control

44	Deviation Limit
48	Encoder VR adjustment Head 1 A/B-phase Offset
49	Encoder VR adjustment Head 1 A-phase Amplitude
50	Encoder VR adjustment Head 1 B-phase Amplitude
51	Encoder VR adjustment Head 2 A/B-phase Offset
52	Encoder VR adjustment Head 2 A-phase Amplitude
53	Encoder VR adjustment Head 2 B-phase Amplitude
64	DSP Operation Setting
66	High Speed Serial Status Format
67	High Speed Serial Data Length
68	High Speed Serial Data LSB Position

8.2. 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)		
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. 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 Width
Data	In-position width (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 Width” 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 Width (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	5	Parameter Name	In-position Overtime
Data	In-position overtime (Unit: sec)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	If the position remains beyond the number of pulses set by “Parameter ID = 3: In-position Width” from the target position for a time longer than this setting, an alarm is issued and the servo is turned OFF. When this parameter is set to 0, judgment is disabled.		
Related Command /Parameter	Bit 2 “Moving” becomes 0 in error read (Command ID = 15).		

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	Current Limit
Data	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 5 “Current Saturation” becomes 1 in error read (Command ID = 15).		

Parameter ID	10	Parameter Name	Encoder Periodicity
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. KP-1SM30,KP-1SM100: 83328 pulses Whenever the motor model is changed, the setting of this parameter should be changed.		
Related Command /Parameter			

Parameter ID	11	Parameter Name	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	12	Parameter Name	Origin Clearance Timing (Head 1)
Data	Origin clearance 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 Clearance 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	13	Parameter Name	High-speed Serial Communication Conversion 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 the high-speed serial communication conversion gain (Parameter ID = 13). 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 Clearance Timing (Head 2)
Data	Origin clearance 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 Clearance 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 Communication Offset
Data	High-speed Serial Communication Offset (Unit: pulse)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	Set this parameter, when a 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(16bit) 0x8000 = 100 encoder pulse position.		
Related Command /Parameter			

Parameter ID	16	Parameter Name	First Digital Notch Filter Central 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	First Digital Notch Filter Q Value (Parameter ID = 17) First Digital Notch Filter Depth (Parameter ID = 18)		

Parameter ID	17	Parameter Name	First Digital Notch Filter Q Value
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	First Digital Notch Filter Central Frequency (Parameter ID = 16) First Digital Notch Filter Depth (Parameter ID = 18)		

Parameter ID	18	Parameter Name	First 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	First Digital Notch Filter Central Frequency (Parameter ID = 16) First Digital Notch Filter Q Value (Parameter ID = 17)		

Parameter ID	19	Parameter Name	Second Digital Notch Filter Central 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	Second Digital Notch Filter Q Value (Parameter ID = 17) Second Digital Notch Filter Depth (Parameter ID = 18)		

Parameter ID	20	Parameter Name	Second Digital Notch Filter Q Value
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	Second Digital Notch Filter Central Frequency (Parameter ID = 16) Second Digital Notch Filter Depth (Parameter ID = 18)		

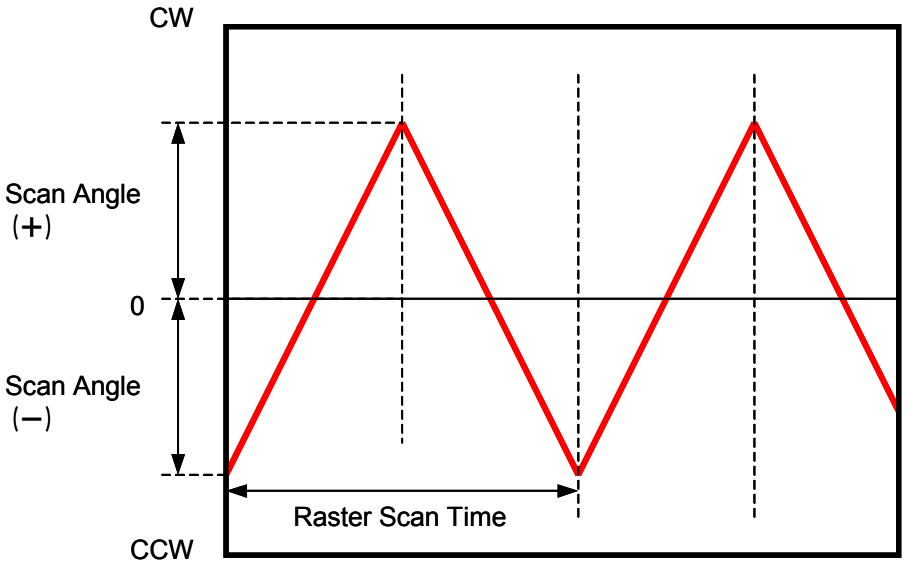
Parameter ID	21	Parameter Name	Second Digital Notch Filter Depth
Data	Depth of the second digital notch filter (Unit: dB)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set the depth of the second digital notch filter.		
Related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

Parameter ID	22	Parameter Name	Digital 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	First Analog Notch Filter Central 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			

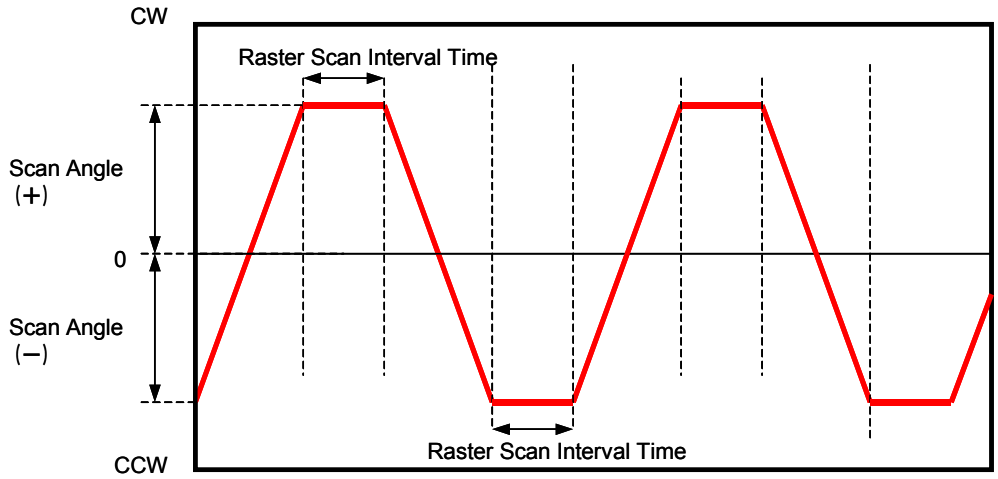
Parameter ID	24	Parameter Name	Second Analog Notch Filter Central Frequency
Data	Central frequency of the second analog notch filter (Unit: Hz)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set the central frequency of the second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

Parameter ID	25	Parameter Name	Third Analog Notch Filter Central 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	Raster Scan Time
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	Raster Scan Duty Ratio (Parameter ID = 27) Raster Scan Angle (Parameter ID = 28) Raster Scan Interval Time (Parameter ID = 30) Raster Scan Start Position (Parameter ID = 31)		

Parameter ID	27	Parameter Name	Raster Scan Duty Ratio
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	Raster Scan Time (Parameter ID = 26) Raster Scan Angle (Parameter ID = 28) Raster Scan Interval Time (Parameter ID = 30) Raster Scan Start Position (Parameter ID = 31)		

Parameter ID	28	Parameter Name	Raster Scan Angle
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	Raster Scan Time (Parameter ID = 26) Raster Scan Duty Ratio (Parameter ID = 27) Raster Scan Interval Time (Parameter ID = 30) Raster Scan Start Position (Parameter ID = 31)		

Parameter ID	30	Parameter Name	Raster Scan Interval Time
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	Raster Scan Time (Parameter ID = 26) Raster Scan Duty Ratio (Parameter ID = 27) Raster Scan Angle (Parameter ID = 28) Raster Scan Start Position (Parameter ID = 31)		

Parameter ID	31	Parameter Name	Raster Scan Start Position
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	Raster Scan Time (Parameter ID = 26) Raster Scan Duty Ratio (Parameter ID = 27) Raster Scan Angle (Parameter ID = 28) Raster Scan Interval Time (Parameter ID = 30)		

Parameter ID	32	Parameter Name	Z-phase Offset
Data	Z-phase (0-point position) offset value (Unit: pulse)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	This parameter is used to set an offset from the actual Z-phase position for determining the 0-pulse position.		
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) Maximum 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	36	Parameter Name	Out-position width
Data	Out-position (Unit: pulse)		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	An error is output if a difference from the target value exceeds the setting of this parameter becoming static. Setting 0 is invalid.		
Related Command /Parameter	Bit 13 “Current Saturation” becomes 1 in error read (Command ID = 15).		

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 pole rearrangement. This is usually set at shipping. Setting 100 disables pole rearrangement.		
Related Command /Parameter			

Parameter ID	44	Parameter Name	Deviation 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.		
Related Command /Parameter			

Parameter ID	48	Parameter Name	Encoder VR Adjustment Head 1 A/B-phase 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	Encoder VR Adjustment Head 1 A-phase Amplitude
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	Encoder VR Adjustment Head 1 B-phase Amplitude
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	Encoder VR Adjustment Head 2 A/B-phase 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 encoder signal. Note: This is usually set appropriately at shipping.		
Related Command /Parameter			

Parameter ID	52	Parameter Name	Encoder VR Adjustment Head 2 A-phase Amplitude
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	Encoder VR Adjustment Head 2 B-phase Amplitude
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 activation 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: Activation in internal clock mode 1: Activation 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. 1： Controller Condition 2： Current position (Axis 1) 3： Current position(Axis 2) 4： Current position(Axis1 , Axis2) (For details, see 2.7.2, “High Speed Serial Communications”)		
Related Command /Parameter			

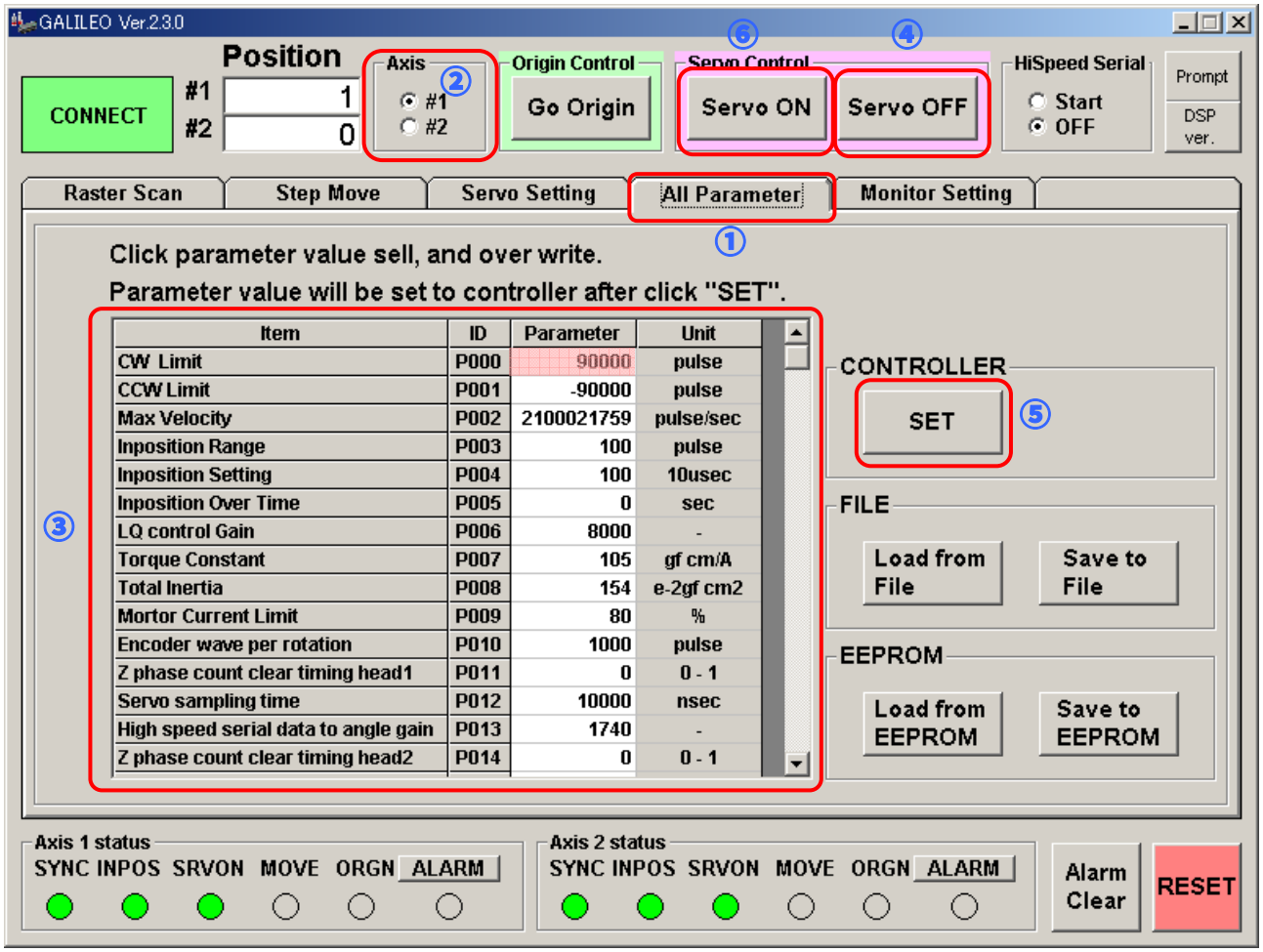
Parameter ID	67	Parameter Name	High Speed Serial Data Length
Data	High Speed Serial Data Length (Unit: bit) Range = 16～20		
Return Value	0: Parameter setting successful 1: Parameter setting unsuccessful		
Explanation	Position Data length of High speed serial communication can be specified. Range = 16bit ～ 20bit (For details, see 2.7.2, “High Speed Serial Communications”)		
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 20bit data can be specified. Range = 0bit ～ 4bit (For details, see 2.7.2, “High-speed Serial Communications”)		
Related Command /Parameter			

8.3. Modifying Parameters

This section explains how to modify parameters.

GALILEO



- 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

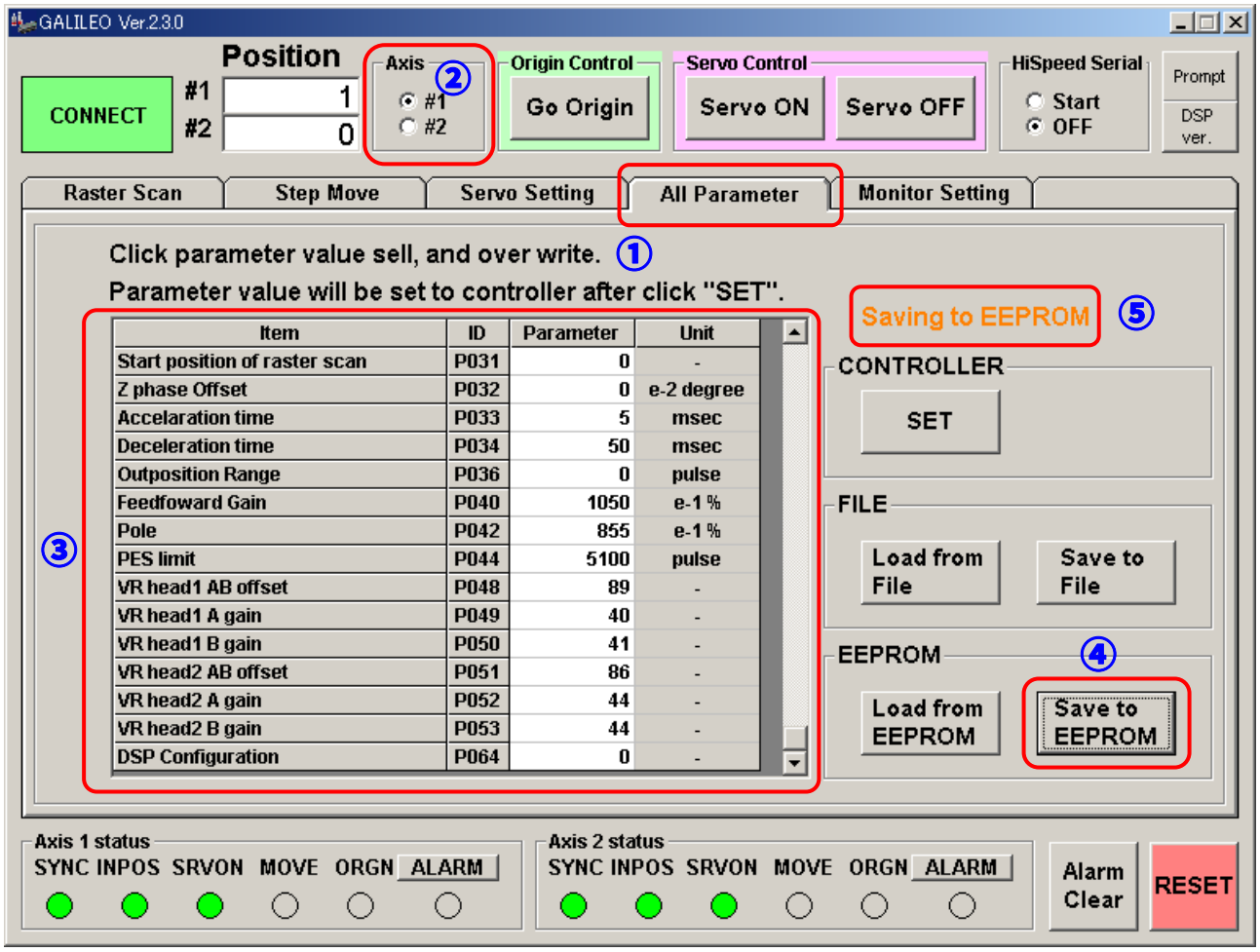
Note: Pressing the SET button reflects modified parameters in the controller settings but does not write them into the controller ROM. When the power is turned off and on again, the controller starts with the old parameters read from ROM. See 8-4 for writing modified parameters into ROM.

8.4. Writing Parameters into ROM

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

If parameters are modified, they should be written into ROM for activation with the same settings at the next power-on.

Write modified parameters into ROM 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 EEPROM button. ④
- “Saving to EEPROM” is displayed. ⑤

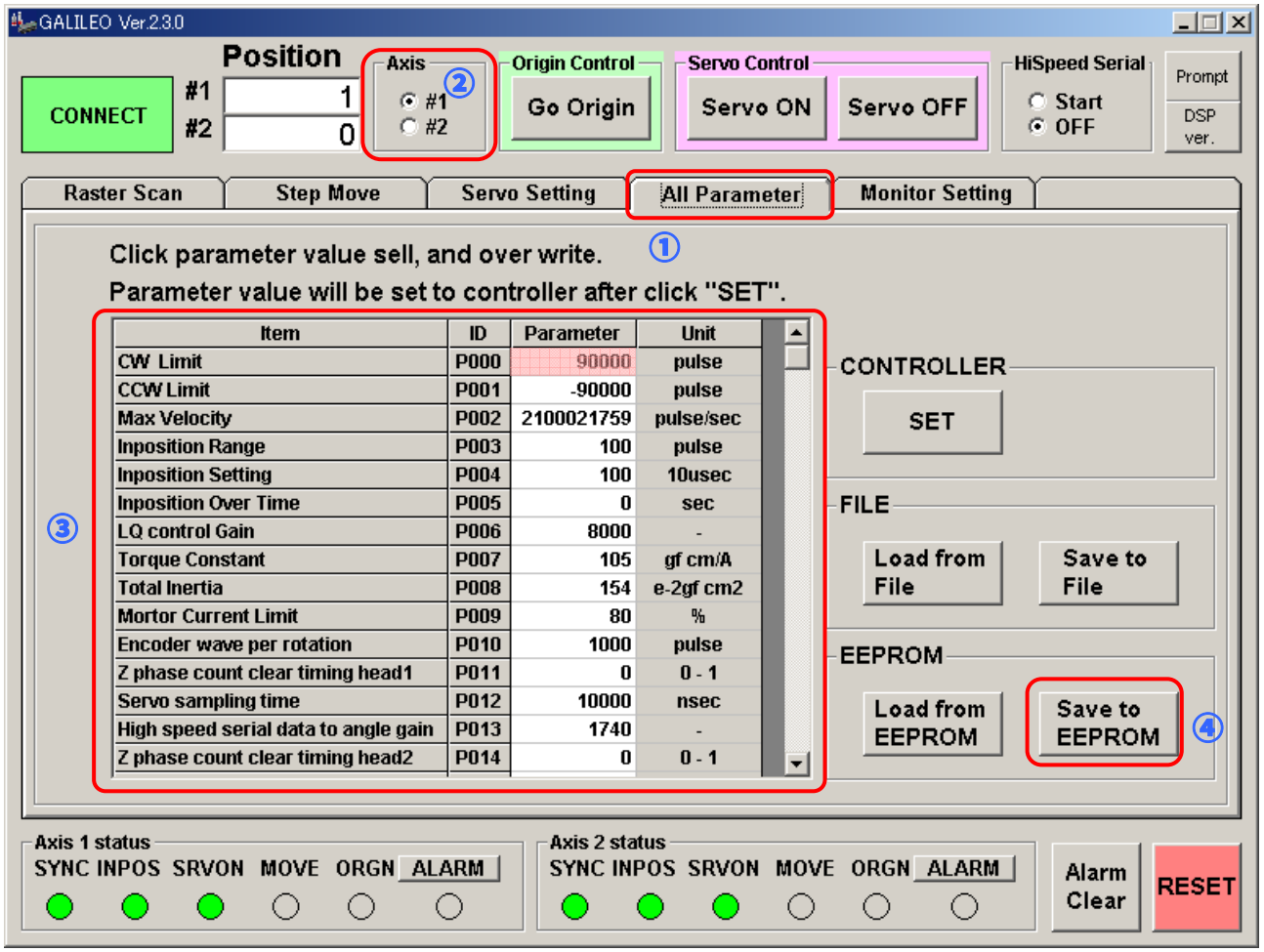
Note: Some parameter settings may disable normal activation next time.

If this problem occurs, change the activation mode for no automatic homing to the origin and check the set values. (See 6-1, “Setting Controller Activation Mode.”)

8.5. 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

9. Safety Functions

This system has various safety functions to ensure safe use.

9.1. 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 9-2 for the error contents.

Note: The post-error system status and recovery method depend on the priority of the error.
See 9-2, “Errors.”

9.2. 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 Width) exceeds the setting of P05 (In-position Overtime).	Possible (P03, P05)			
No clock	0x0008	Clock	Clock pulses are not input.	Impossible			
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			
Homing 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			
Hardware servo OFF	0x4000	Output amplifier shutdown function Thermistor (controller and motor)	The output amplifier is shut down. The thermistor-detected temperature exceeds the setting. (Hardware monitoring). Error notification by software is usually made first.	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
Format error	0x0040	Command format	An undefined command or parameter is sent.	Impossible	Error output only	(Axis1) Connector B1 Monitor Board D2 (Axis2) 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)			

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

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

・The contents of this document are subject to change without notice.
・If you find any question, error, or omission in this document, please contact Canon.

CUD-L007-E01

PRINTED IN JAPAN