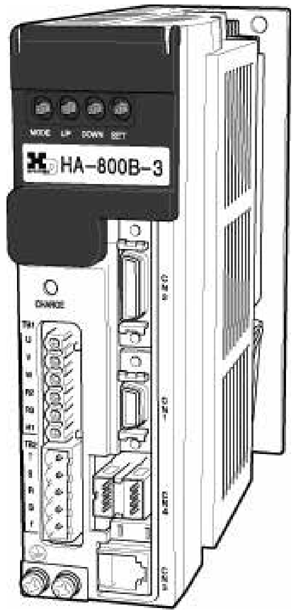
HarmonicDrive®

MECHATROLINK

100V/200V power supply
AC Servo Driver (MECHATROLINK-II type)

HA-800B series manual

(for SHA, FHA-Cmini, FHA-C, RSF/RKF, HMA series)



ISO14001
ISO9001

This operation manual covers the following software versions:

●Ver 3.X

Introduction

Thank you very much for your purchasing our AC Servo Driver HA-800B series for 100V/200V power supply.
Wrong handling or use of this product may result in unexpected accidents or shorter life of the product.
Read this document carefully and use the product correctly so that the product can be used safely for many years.
Product specifications are subject to change without notice for improvement purposes.
Keep this manual in a convenient location and refer to it whenever necessary in operating or maintaining the units.
The end user of the driver should have a copy of this manual.
* When using this product together with a HMA series AC servo motor, replace "actuator" with "motor" when reading this manual. Also, the value of the "reduction ratio" would be "1".

SAFETY GUIDE

To use this driver safely and correctly, be sure to read SAFETY GUIDE and other parts of this document carefully and fully understand the information provided herein before using the driver.

Notation

Important safety information you must note is provided herein. Be sure to observe these instructions.

WARNING	Indicates a potentially hazardous situation, which, if not avoided, could result in death or serious personal injury.
CAUTION	Indicates a potentially hazardous situation, which, if not avoided, may result in minor or moderate personal injury and/or damage to the equipment.
Caution	Indicates what should be performed or avoided to prevent non-operation or malfunction of the product or negative effects on its performance or function.

LIMITATION OF APPLICATIONS

The equipment listed in this document may not be used for the applications listed below:

- Space equipment
- Aircraft, aeronautic equipment
- Nuclear equipment
- Household apparatus
- Vacuum equipment
- Automobile, automotive parts
- Amusement equipment, sport equipment, game machines
- Machine or devices acting directly on the human body
- Instruments or devices to transport or carry people
- Apparatus or devices used in special environments

If the above list includes your intending application for our products, please consult us.

CAUTION

If this product is utilized in any facility in which human life is at stake or that may incur material losses, install safety devices so that accidents will not occur even when the output control is disabled due to damage.

SAFETY NOTE

ITEMS YOU SHOULD NOTE WHEN USING THE ACTUATOR

- **NOTICES ON DESIGN**

CAUTION

Always use them under followings conditions:
The actuator is designed to be used indoors. Observe the following conditions:
- Ambient temperature: 0 to 40℃
- Ambient humidity: 20 to 80%RH (No condensation)
- Vibration: 24.5m/s^2 or less
- No contamination by water, oil
- No corrosive or explosive gas

Follow exactly the instructions in the relating manuals to install the actuator in the equipment.
- Ensure exact alignment of the actuator shaft center and corresponding center as per the manual.
- Failure to observe this caution may lead to vibration, resulting in damage of output elements.

- **OPERATIONAL PRECAUTIONS**

WARNING

Never connect cables directly to a power supply socket.
- Each actuator must be operated with a proper driver.
- Do not directly apply a commercial power supply. Failure to observe this caution may lead to fire or damage to the actuator.

Do not apply impacts and shocks.
- Do not use a hammer during installation.
- Failure to observe this caution could damage the encoder and may cause uncontrollable operation.

Avoid handling of actuators by cables.
- Failure to observe this caution may damage the wiring, causing uncontrollable or faulty operation.

CAUTION

Keep limited torques of the actuator.
- Keep limited torques of the actuator.
- Be aware that, if arms directly attached to the output shaft are hit, the output shaft may become non-controllable.

ITEMS YOU SHOULD NOTE WHEN USING THE DRIVER

● NOTICES ON DESIGN

CAUTION

Always use them under followings conditions:

The driver generates heat. Take extra caution for radiation and use it under the following conditions.

- Mount in a vertical position keeping sufficient distance to other devices to let heat generated by the driver radiate freely.
- 0 to 50℃, 95% RH or below (No condensation)
- No vibration or physical shock
- No metal powder, dust, oil mist, corrosive gas, or explosive gases.

Use sufficient noise suppressing means and safe grounding.

Any noise generated on a signal wire will cause vibration or improper motion. Be sure to observe the following conditions.

- Keep signal and power leads separated.
- Keep leads as short as possible.
- Ground actuator and driver at one single point, minimum ground resistance class: D (less than 100 ohms)
- Do not use a power line filter in the motor circuit.

Pay attention to negative torque by inverse load.

- Inverse load may cause damages of drivers.
  Please consult our sales office, if you intent to make a voltage resistance test.

Use a fast-response type ground-fault detector designed for PWM inverters.

When using a fast-response type ground-fault detector, use one that is designed for PWM inverters. Do not use a time-delay-type ground-fault detector.

Safety measures are essential to prevent accidents resulting in death, injury or damage of the equipment due to malfunction or faulty operation.

● OPERATIONAL PRECAUTIONS

WARNING

Never change wiring while power is active.

Make sure of power non-active before servicing the products. Failure to observe this caution may result in electric shock or uncontrollable operation.

Do not touch terminals or inspect products at least 15 minutes after turning OFF power.

- Even after the power supply is turned OFF, electric charge remains in the driver. In order to prevent electric shock, perform inspections 15 minutes after the power supply is turned OFF and confirming the CHARGE lamp is turned OFF.
- Make installation of products not easy to touch their inner electric components.

CAUTION

Do not make a voltage resistance test.

- Do not perform a megger test or voltage resistance test. Failure to observe this caution may result in damage to the control circuit of the driver. Please consult our sales office, if you intent to make a voltage resistance test.

Do not operate control units by means of power ON/OFF switching.

- Start/stop operation should be performed via input signals.
- Failure to observe this caution may result in deterioration of electronic parts.

DISPOSAL

CAUTION

All products or parts have to be disposed of as industrial waste.

Since the case or the box of drivers have a material indication, classify parts and dispose them separately.

Structure of this document

Chapter 1	**Functions and configuration**	Overviews of driver models, specifications, external dimensions, etc., are explained.
Chapter 2	**Installation/wiring**	Receiving inspection, environment, power wiring, noise suppression and connector wiring are explained.
Chapter 3	**Startup**	Startup procedures to be followed when the driver is used for the first time, from receiving inspection to operation of the actual system, are explained.
Chapter 4	**Encoder system**	The encoder configuration is different depending on the actuator model. Details of each actuator are explained.
Chapter 5	**I/O signals**	Details of I/O signal conditions and signal functions are explained.
Chapter 6	**Panel display and operation**	How to operate the display, operation buttons on the driver's front panel and overview of operation in each mode is explained.
Chapter 7	**Status display mode/ Alarm mode/ Tune mode**	Information displayed in the status display mode and alarm mode, and operations and details of servo loop gains, various judgment criteria and acceleration/deceleration time setting during speed control performed in the tune mode are explained.
Chapter 8	**System parameter mode**	The I/O signal assignment, logic setting method and the details of the electronic gear settings as function expansion are explained.
Chapter 9	**Test mode**	Details of how to check the system operation by auto-tuning via jogging, monitoring of I/O signals and simulated operation of output signals are explained.
Chapter 10	**Communication software (PSF-800)**	How you can use the dedicated personal computer software to check I/O signal statuses, rotation speeds and other servo statuses, perform auto-tuning, set parameters, assign I/O signals and monitor servo operation waveforms are explained in this chapter.
Chapter 11	**Troubleshooting**	Details of how driver alarms and warnings generate are explained.
Chapter 12	**Option**	Options you can purchase as necessary are explained.
Chapter 13	**MECHATROLINK communication function**	The communication specification and setting method of MECHATROLINK are explained.
Appendix		The list of default parameters and regenerative resistors are explained.

Contents

SAFETY GUIDE 1
Notation 1
LIMITATION OF APPLICATIONS....1
SAFETY NOTE....2
Structure of this document....5
Contents 6
Related manual 14
Related actuator/driver standards....15
Compatible standards....16
Conformance to European EC Directives 18

Chapter 1 Functions and configuration

1-1 Overviews of driver 1-1
Overviews of functions.... 1-1
1-2 Function block diagram.... 1-2
1-3 Device configuration diagram 1-3
1-4 Driver model 1-5
Driver model 1-5
Option 1-5
1-5 Actuator and extension cable combinations.... 1-6
1-6 Driver ratings and specifications 1-8
1-7 Function list....1-11
1-8 External drawing 1-12
1-9 Name and function of each part of a display panel 1-14

Chapter 2 Installation/wiring

2-1 Receiving inspection.... 2-1
Check procedure 2-1
2-2 Installation location and installation.... 2-2
Installation environment.... 2-2
Notices on installation.... 2-3
Installation procedure.... 2-4
2-3 Connecting power cables.... 2-6
Allowable cable sizes.... 2-6
Connecting power cables.... 2-7
Protecting power lines 2-9
Connecting a ground wire.... 2-9
Power ON and OFF sequences.... 2-10

2-4 Suppressing noise 2-15
Grounding 2-15
Installing noise filters 2-16
2-5 Wiring the driver and motor 2-18
Connecting the motor 2-18
Connecting the encoder 2-20
2-6 Wiring the host device 2-21
Connecting the host device 2-21
Connecting the MECHATROLINK connector 2-22
Connecting the personal computer (PSF-800) 2-23

Chapter 3 Startup

3-1 Startup procedures 3-1
Startup procedures 3-2
3-2 Turning ON the power for the first time 3-3
Details on control power supply ON 3-4
Troubleshooting upon power ON 3-8
3-3 Operation check with the actuator alone 3-9
Troubleshooting at operation check 3-10
3-4 Operation check with the actual system 3-12
Troubleshooting at actual operation check 3-13
3-5 Manual gain adjustment method 3-14
Position control 3-14
Speed control 3-15
Applied servo gain adjustment function 3-17
3-6 Normal operation 3-21
Notices for normal operations 3-21
Daily maintenance/inspection 3-21
Periodically replaced parts 3-22
Data backup battery (optional) 3-22
How to install/replace the data backup battery 3-23

Chapter 4 Encoder system

4-1 Overview of encoders 4-1
4-2 17-bit absolute encoder 4-4
Features 4-4
Startup 4-5
Origin setting 4-7
Data output 4-8
Remedial actions for errors/warnings 4-10
4-3 13-bit absolute encoder 4-12
Features 4-12
Startup 4-14
Origin setting 4-15
Data output 4-17

Remedial actions for errors/warnings 4-21
4-4 Incremental encoder 4-23
Startup 4-25
Origin setting... 4-26
Data output 4-27
Remedial action for error 4-28

Chapter 5 I/O signals

5-1 I/O signal list 5-1
Pin numbers and names of I/O signals 5-1
Models of I/O signal connector CN2 5-1
Input signal connection circuit... 5-2
Output signal connection circuit 5-3
5-2 Details of input signals 5-5
CN2-1: FWD inhibit (FWD-IH).. 5-5
CN2-2: REV inhibit (REV-IH) 5-5
CN2-3: Latch 1 (LATCH1).. 5-5
CN2-4: Latch 2 (LATCH2).. 5-5
CN2-5: Origin signal (ORG) 5-6
CN2-6: Input signal common (IN-COM).. 5-6
5-3 Details of output signals... 5-7
CN2-7: Operation preparation complete (READY) 5-7
CN2-8: Origin return complete (ORG-END)... 5-7
CN2-9: In-position complete (INPOS)... 5-8
CN2-10: Alarm (ALARM).. 5-8
CN2-11: Output signal common (OUT-COM)... 5-8
CN2-12 to 17: Encoder signal output (A, B, Z)... 5-9
5-4 Monitor output.. 5-10
CN9-1: Speed monitor (SPD-MON) 5-10
CN9-2: Current monitor (CUR-MON)... 5-10
CN9-3: Signal monitor (SIG-MON) 5-11
CN9-4: Monitor Ground (GND) 5-11
5-5 Connection example with default settings.................................... 5-12
4-wire-saving incremental model (FHA-C series) 5-12
13-bit absolute model (FHA-C series).. 5-13
17-bit absolute encoder model (SHA).. 5-14

Chapter 6 Panel display and operation

6-1 Operating display panel 6-1
Summary of modes.. 6-1
Initial panel display 6-2
Panel display hierarchy.. 6-3
Operation overview of status display mode 6-4
Operation outline of alarm mode... 6-5
Operation overview of tune mode 6-6
Operation outline of system parameter mode 6-8
Operation outline of test mode... 6-10

Chapter 7 Status display mode/alarm mode/tune mode

7-1 Status display mode 7-1
Status display mode list 7-1
7-2 Details of status display mode 7-3
d01, 02: Error pulse count display 7-3
d04: Overload rate display 7-4
d05, 06: Feedback pulse display 7-5
d07, 08: Command pulse display 7-5
d13: Applicable actuator code 7-6
d16: Regenerative power (HA-800B-24 only) 7-7
7-3 Alarm mode 7-8
Alarm display 7-8
7-4 Alarm list 7-9
AL: Present alarm/warning display 7-9
AHcLr: Alarm history clear 7-10
7-5 Tune mode 7-11
7-6 Details of tune mode 7-12
AJ00: Position loop gain 7-12
AJ01: Speed loop gain 7-12
AJ02: Speed loop integral compensation 7-13
AJ03: Feed-forward gain 7-13
AJ04: In-position range 7-13
AJ07: Zero speed judgment value 7-14
AJ12: Acceleration time constant 7-14
AJ13: Deceleration time constant 7-14
AJ16: Speed monitor offset 7-15
AJ17: Current monitor offset 7-15
AJ18: FWD torque limit 7-15
AJ19: REV torque limit 7-15
AJ20: Feed-forward filter 7-16
AJ21: Load inertia moment ratio 7-16
AJ22: Torque constant compensation factor 7-17
AJ23: Spring constant compensation factor 7-17
AJ24: Automatic positioning gain 7-17

Chapter 8 System parameter mode

8-1 System parameter mode 8-1
SP40: CN9-CP3 output signal setting 8-3
SP44 to 45: Electronic gear setting 8-3
SP48: Deviation clear upon servo-ON setting 8-4
SP49: Allowable position deviation 8-4
SP50: Command polarity 8-5
SP51: Speed input factor setting 8-6
SP54: Status display setting 8-6
SP55: DB enable/disable setting 8-6
SP59: Angle compensation enable/disable setting 8-6

SP60: Automatic positioning gain setting enable/disable setting 8-7
SP61: Encoder monitor output pulses 8-7
SP62: Input signal logic setting.. 8-7
SP63: Output signal logic setting.. 8-8
SP64: Regenerative resistor selection (HA-800B-24 only) 8-8
SP65: FWD/REV inhibit operation 8-8
SP66: Absolute encoder function setting 8-9
SP69: Feed-forward control function setting... 8-9

Chapter 9 Test mode

9-1 Test mode 9-1
9-2 Details of test mode 9-2
T00: I/O signal monitor 9-2
T01: Output signal operation.. 9-3
T02: JOG speed setting... 9-4
T03: JOG acceleration/deceleration time constant setting........................ 9-5
T04: JOG operation 9-6
T05: Parameter initialization 9-7
T08: Multi revolution clear... 9-8
T09: Auto-tuning 9-9
T10: Auto-tuning travel angle setting 9-11
T11: Auto-tuning level selection 9-12

Chapter 10 Communication software

10-1 Overviews... 10-1
Setup 10-1
Initial screen... 10-4
Status display... 10-7
10-2 Auto-tuning 10-8
10-3 Parameter setting.. 10-10
10-3-1. Editing and initializing internal parameters of the driver 10-10
10-4 Saving, comparing and copying set values 10-12
10-4-1. Saving set values 10-12
10-4-2. Reading saved set value files.. 10-14
10-4-3. Comparing a saved settings file with internal set values of the driver.. 10-15
10-4-4. Writing a saved settings file to the driver 10-17
10-5 Test operation 10-19
10-6 Output signal operation... 10-21
10-7 IO monitor 10-22
10-8 Waveform monitoring.. 10-23
10-9 Alarm 10-26

Chapter 11 Troubleshooting

11-1 Alarms and remedial actions 11-1
Alarm list 11-1
Remedial action for alarm 11-2
11-2 Warnings and remedial actions 11-12
Warning list 11-12
Remedial action for warning 11-13

Chapter 12 Option

12-1 Option 12-1
Extension cable 12-1
Dedicated communication cable 12-2
Connectors 12-3
Servo parameter setting software 12-3
Data backup battery 12-4
Monitor cable 12-4

Chapter 13 MECHATROLINK communication function

13-1 Specifications 13-1
Communication specification 13-1
System configuration 13-1
Communication setting 13-2
13-2 Network parameters 13-3
List of parameters 13-3
101: Final external positioning distance 13-3
102: FWD soft limit 13-3
103: REV soft limit 13-4
104: Origin position range 13-4
105: Originating approach speed 13-4
106: Originating acceleration/deceleration time 13-4
107: Virtual origin 13-4
108: Originating direction 13-5
109: Soft limit enable/disable 13-5
13-3 Main command 13-6
List of main commands 13-6
13-4 Details of main commands 13-7
Disable command (NOP: 00H) 13-7
Parameter read command (PRM_RD: 01H) 13-8
Parameter write command (PRM_WR: 02H) 13-8
ID read command (ID_RD: 03H) 13-9
Device setup request command (CONFIG: 04H) 13-10
Error/warning read command (ALM_RD: 05H) 13-10
Error/warning clear command (ALM_CLR: 06H) 13-11
Synchronization establishment request command (SYNC_SET: 0DH) 13-11
Connection establishment request command (CONNECT: 0EH) 13-12
Connection release request command (DISCONNECT: 0FH) 13-13

Non-volatile parameter read command (PPRM_RD: 1BH) 13-13
Non-volatile parameter write command (PPRM_WR: 1CH).................. 13-14
Coordinate system setting command (POS_SET: 20H)........................ 13-14
Brake actuation request command (BRK_ON: 21H)............................ 13-15
Brake release request command (BRK_OFF: 22H)............................. 13-15
Sensor-ON command (SENS_ON: 23H) 13-16
Sensor-OFF command (SENS_OFF: 24H).. 13-16
Motion stop request command (HOLD: 25H)....................................... 13-17
Status monitor command (SMON: 30H).. 13-18
Servo-ON (SV_ON: 31H)... 13-19
Servo-OFF (SV_OFF: 32H) 13-20
Interpolated feed (INTERPOLATE: 34H) 13-21
Positioning (POSING: 35H) 13-22
Constant-speed feed (FEED: 36H) 13-23
Interpolated feed with position detection function (LATCH: 38H).......... 13-24
Positioning by external input (EX_POSING: 39H) 13-25
Originating (ZRET: 3AH) 13-26
Speed command(VELCTRL: 3CH) 13-27
Torque command (TRQCTRL: 3DH).. 13-28
13-5 Subcommand.. 13-29
Disable command (NOP: 00H) 13-29
Parameter read command (PRM_RD: 01H) 13-30
Parameter write command (PRM_WR: 02H)....................................... 13-30
Error/warning read command (ALM_RD: 05H) 13-31
Non-volatile parameter write command (PPRM_WR: 1CH).................. 13-31
Status monitor command (SMON: 30H).. 13-32
13-6 Command data field.. 13-33
Latch signal selection: LT_SGN... 13-33
Option: OPTION 13-33
Status (STATUS).. 13-34
Monitor selection (SEL_MON1/2/3/4),
monitor information (MONITOR1/2/3/4).. 13-35
IO monitor (IO_MON) 13-36
Substatus (SUBSTATUS)... 13-36
Description of alarm/warning (ALM_DATA)... 13-36
Parameter No. and size (NO/SIZE) 13-38
13-7 Control mode 13-42
Switching the control mode.. 13-42
Notices for switching between control modes...................................... 13-42

Appendix

A-1 Default settings A-1

A-2 Regenerative resistor A-9

Built-in driver regenerative resistor and regenerative power A-9

External regenerative resistor A-13

Allowable load inertia A-16

A-3 List of data retained in the driver A-27

A-4 Driver replacement procedures A-30

Related manual

The table below lists related manual. Check each item as necessary.

Title	Description
AC Servo Actuator SHA series manual	The specifications and characteristics of SHA20A to SHA65A actuators are explained.
AC Servo Actuator FHA-C series manual	The specifications and characteristics of FHA-17C to FHA-40C actuators are explained.
AC Servo Actuator FHA-Cmini series manual	The specifications and characteristics of FHA-8C to FHA-14C actuators are explained.
AC Servo Actuator RSF/RKF series manual	The specifications and characteristics of RSF-17 to RSF-32 and RKF-20 to RKF-32 actuators are explained.
AC Servo Motor HMA series manual	The specifications and characteristics of HMAC08 to HMAA21A motors are explained.

Related actuator/driver standards

	Function	HA-800*-1	HA-800*-3	HA-800*-6	HA-800*-24
	Rated current (A)	1.5	3	6	24
	Maximum current (A)	4.0	9.5	19	55
	General-purpose I/O	HA-800A			
	MECHATROLINK	HA-800B			
	CC-Link	HA-800C			
Overseas standard	UL/cUL	○			
	CE	○			
	TUV	○			

Applicable actuator	Voltage	UL/cUL	CE	Encoder type	HA-800*-1	HA-800*-3	HA-800*-6	HA-800*-24
FHA-8C-xx-E200	200		○	Wire-saving incremental	-1C-200			
FHA-11C-xx-E200	200		○		-1C-200			
FHA-14C-xx-E200	200		○		-1C-200			
FHA-17C-xx-E250	200	○	○			-3C-200		
FHA-25C-xx-E250	200	○	○			-3C-200		
FHA-32C-xx-E250	200	○	○				-6C-200	
FHA-40C-xx-E250	200	○	○				-6C-200	
FHA-8C-xx-12S17b	200			17-bit absolute	-1D/E-200			
FHA-11C-xx-12S17b	200				-1D/E-200			
FHA-14C-xx-12S17b	200				-1D/E-200			
FHA-17C-xx-S248	200	○	○	13-bit absolute		-3A-200		
FHA-25C-xx-S248	200	○	○			-3A-200		
FHA-32C-xx-S248	200	○	○				-6A-200	
FHA-40C-xx-S248	200	○	○				-6A-200	
FHA-8C-xx-E200	100		○	Wire-saving incremental	-1C-100			
FHA-11C-xx-E200	100		○		-1C-100			
FHA-14C-xx-E200	100		○		-1C-100			
FHA-17C-xx-E250	100	○	○			-3C-100		
FHA-25C-xx-E250	100	○	○				-6C-100	
FHA-32C-xx-E250	100	○	○				-6C-100	
FHA-8C-xx-12S17b	100			17-bit absolute	-1D/E-100			
FHA-11C-xx-12S17b	100				-1D/E-100			
FHA-14C-xx-12S17b	100				-1D/E-100			
FHA-17C-xx-S248	100	○	○	13-bit absolute		-3A-100		
FHA-25C-xx-S248	100	○	○				-6A-100	
FHA-32C-xx-S248	100	○	○				-6A-100	

				Function	HA-800*-1	HA-800*-3	HA-800*-6	HA-800*-24
				Rated current (A)	1.5	3	6	24
				Maximum current (A)	4.0	9.5	19	55
				General-purpose I/O	HA-800A			
				MECHATROLINK	HA-800B			
				CC-Link	HA-800C			
		Overseas standard		UL/cUL	○			
				CE	○			
				TUV	○			
Applicable actuator	**Voltage**	**UL/cUL**	**CE**	**Encoder type**				
SHA20Axxxx-C08x200-xxS17bA	200	○	○	17-bit absolute		-3D/E-200		
SHA25Axxxx-B09x200-xxS17bA	200	○	○			-3D/E-200		
SHA32Axxxx-B12x200-xxS17bA	200	○	○				-6D/E-200	
SHA40Axxxx-B15x200-xxS17bA	200	○	○				-6D/E-200	-24D/E-200
SHA45Axxxx-D16x200-xxS17bA	200	○	○					-24D/E-200
SHA58Axxxx-A21x200-xxS17bA	200	○	○					-24D/E-200
SHA65Axxxx-A21x200-xxS17bA	200	○	○					-24D/E-200
SHA25Axxxx-B09x100-xxS17bA	100	○	○				-6D/E-100	
HMAC08x200-10S17bA	200	○	○	17-bit absolute		-3D/E-200		
HMAB09x200-10S17bA	200	○	○			-3D/E-200		
HMAB12x200-10S17bA	200	○	○				-6D/E-200	
HMAB15x200-10S17bA	200	○	○					-24D/E-200
HMAA21Ax200-10S17bA	200	○	○					-24D/E-200
HMAB09x100-10S17bA	100	○	○				-6D/E-100	

Compatible standards

Motor & Actuator

UL 1004-1 (Rotating Electrical Machines - General Requirements)
UL 1004-6 (Servo and Stepper Motors)
CSA-C22.2 No. 100 (Motors and Generators)
(UL File No. E243316)
EN60034-1 (Low Voltage Directive)

* The compatible Motor and Actuator standards vary depending on the model. For details, refer to the individual catalogue.

Driver

<HA-800B-1*, HA-800B-3*, HA-800B-6*, HA-800B-24*>

UL 508C (Power Conversion Equipment)
CSA-C22.2 No.14 (Industrial Control Equipment)
(UL File No. E229163)

EN61800-5-1 (Low Voltage Directive)
EN61800-3 (EMC Directive)

Conformance to European EC Directives

We conduct tests of checking conformity to the Low Voltage Directive and EMC Directives related to CE marking for the HA-800 series drivers at the third party authentication agency in order to ease CE marking by customer's device.

Precautions on conformance to EMC Directives

We fabricated a model that embeds AC Servo Driver and AC Servo Actuator or Motor in a control board for our AC servo system and use the model to comply with standards related to EMC Directives.
Designed for EMC product standard EN61800-3 commercial, light industrial, and industrial environments (class 2 environments); conforms with category C2 limit values.
In your actual use, using conditions, cable length and other conditions related to wiring may be different from the model.
For these reasons, it is necessary that the final equipment or devices incorporating AC Servo Driver and AC Servo Actuator comply with EMC Directives.
We introduce peripheral devices used in our model such as noise filter to make it easy for you to comply with EMC Directives when incorporating and using this product.

Standard related to EMC Directives

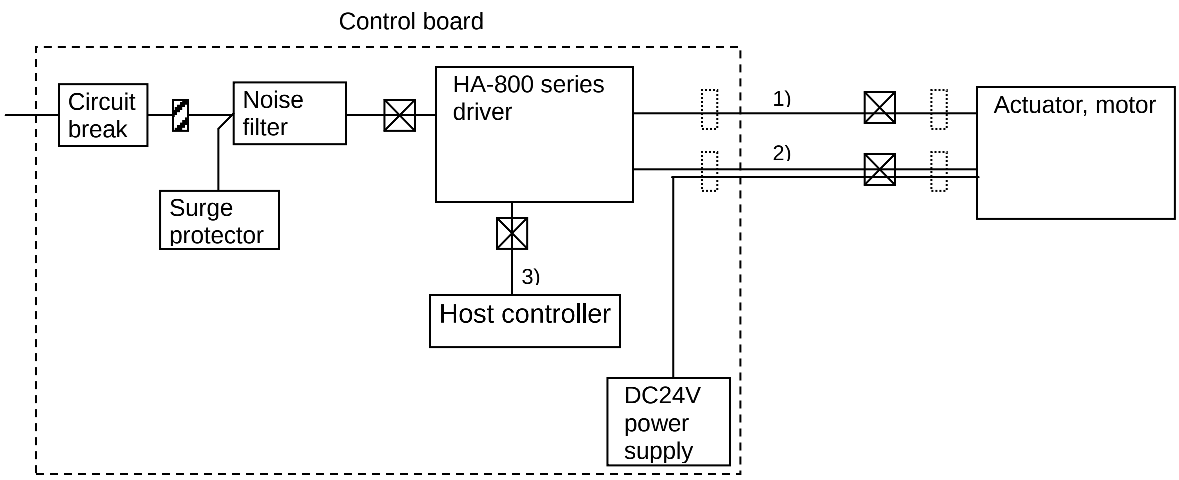
Motor/driver
EN55011: 2016/A11:2020 (Group 1 Class A)
EN61800-3: 2004/A1:2012 (Category C2, 2nd environment)

> **CAUTION**
> This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

Configuration of peripheral devices

Installation environment (conditions): Please observe the following installation environment in order to use this product safely.
1) Overvoltage category: III
2) Pollution degree: 2

Model configuration diagram



: Toroidal core : Ferrite core : Metal clamp

1) Encoder cable 2) Motor cable (motor power and holding brake) 3) Interface cable

(1) Input power supply

200V input type

Main circuit power: 3 phase/single phase, 200 to 230V (+10%, -15%), 50/60Hz

Control power supply: Single phase, 200 to 230V (+10%, -15%), 50/60Hz

100V input type

Main circuit power: Single phase, 100 to 115V (+10%, -15%), 50/60Hz

Control power supply: Single phase, 100 to 115V (+10%, -15%), 50/60Hz

(2) Circuit breaker

Use a circuit breaker complying with IEC standard and UL standard (UL Listed) for the power input area.

(3) Noise filter

Use a noise filter complying with EN55011 Group 1 Class A.
(For details, refer to the next page.)

(4) Toroidal core

Install toroidal core in the power input area.
Depending on the noise filter, 4-turn input to L1, L2, L3, and ground or 1-turn input to L1, L2, and L3, not including ground, may be valid.
(For details, refer to the next page.)

(5) Motor cable, encoder cable

Use shield cables for the motor cable and encoder cable.
Clamp ground the shield of the motor cable and encoder cable near the driver and motor.
If you use FHA-8C/11C/14C or RSF-8B/11B/14B, insert the ferrite core into the motor cable and encoder cable (near the motor).

(6) Interface cable

If you use the HA-800C driver, use ferrite core for the interface cable.

(7) Surge protector

Install the surge absorber in the AC power input area. Remove the surge absorber when you perform voltage resistance test of AC/DC machine/system with built-in surge absorber.
(The surge absorber may be damaged.)

(8) Ground

In order to prevent electric shock, make sure to connect the ground wire of the control board (control cabinet) to the ground terminal ⏚ of the AC Servo Driver.

Moreover, do not tighten the connection to the ground terminal ⏚ of the AC Servo Driver together.

Recommended parts for compliance with EMC

(1) Noise filter

Model	Specifications	Manufacturer	Remarks
RF3020-DLC	Rated voltage: Line-Line 440 to 550 V Rated current: 20A	RASMI ELECTRONICS LTD.	Enable the 4-turn input to L1, L2, L3, and ground for toroidal core.
RF3030-DLC	Rated voltage: Line-Line 440 to 550 V Rated current: 30A	RASMI ELECTRONICS LTD.	
RF3040-DLC	Rated voltage: Line-Line 440 to 550 V Rated current: 40A	RASMI ELECTRONICS LTD.	
HF3010A-UN	Rated voltage: AC250V Rated current: 10A	Soshin Electric Co., Ltd.	Enable 1-turn input to L1, L2, and L3, not including ground for toroidal core.
HF3030A-UN	Rated voltage: AC250V Rated current: 30A	Soshin Electric Co., Ltd.	
HF3040A-UN	Rated voltage: AC250V Rated current: 40A	Soshin Electric Co., Ltd.	
HF3010C-SZC	Rated voltage: AC500V Rated current: 10A	Soshin Electric Co., Ltd.	
HF3020C-SZC	Rated voltage: AC500V Rated current: 20A	Soshin Electric Co., Ltd.	
HF3030C-SZC	Rated voltage: AC500V Rated current: 30A	Soshin Electric Co., Ltd.	
SUP-P5H-EPR	Rated voltage: AC250V Rated current: 5A	Okaya Electric Industries Co., Ltd.	Enable the 4-turn input to L1, L2, L3, and ground for toroidal core. Moreover, install insulation transformer and ferrite core at the power input area. Refer to 4. (3) and (5).
SUP-P10H-EPR	Rated voltage: AC250V Rated current: 10A	Okaya Electric Industries Co., Ltd.	
3SUP-H5H-ER-4	Rated voltage: AC250V Rated current: 5A	Okaya Electric Industries Co., Ltd.	
3SUP-H10-ER-4	Rated voltage: AC250V Rated current: 10A	Okaya Electric Industries Co., Ltd.	

(2) Toroidal core

Model	Outer diameter	Inner diameter	Manufacturer
MA070R-63/38/25A	65 mm	36 mm	JFE Ferrite Corporation
LRF624520MK	66 mm	41 mm	Nippon Chemi-Con Corporation

(3) Ferrite core

Model	Manufacturer
ZCAT3035-1330	TDK Corporation
ZCAT2032-0930	TDK Corporation
ZCAT2132-1130	TDK Corporation

(4) Surge protector

Model	Manufacturer
RAV-781BXZ-4	Okaya Electric Industries Co., Ltd.
RAV-781BWZ-4	Okaya Electric Industries Co., Ltd.
LT-C32G801WS	Soshin Electric Co., Ltd.
LT-C12G801WS	Soshin Electric Co., Ltd.

(5) Insulation transformer

Although the noise resistance of the HA-800 series is sufficient without an insulation transformer, it is recommended that one be used in a noisy environment. Prepare an insulation transformer of the following specification if using one.

Driver model	Number of phase	Power capacity (kVA)	
HA-800B-1*	3	FHA-8,11C	0.15
		FHA-14C	0.25
HA-800B-3*	3	FHA-17C RSF-17	0.4
		SHA20 SHA25 FHA-25C RSF-20,25 RKF-20,25 HMAC08 HMAB09 MAC08 MAB09	0.8
HA-800B-6*	3	SHA25	0.8
		SHA32 FHA-32C RSF-32 RKF-32 HMAB12 MAB12	1.5
		SHA40 FHA-40C MAB15	1.8
HA-800B-24*	3	SHA40 SHA45 HMAB15 MAB15	2.5
		SHA58 SHA65	3.5
		HMAA21A MAA21	5.5

Protection to Ground fault / Ground fault test

In the following condition, the electronic power output short-circuit protection circuitry meets the requirements of IEC 60364-4-41, Clause 411. (Protective measure: automatic disconnection of supply)

TN grounding system: It's protected by product built-in Fuses. That the fault loop impedance is lower than the following table.

TT grounding system: It's possible to protect by installing RCD outside the product. The following table shows the ground fault test conditions.

TI grounding system: Protection to Ground fault isn't being tested.

Table. TN grounding system

Model	Power voltage [V]	Rated current [Arms]	Shut down time [sec]	Shut down current [Arms]	Upper limit of fault loop impedance [Ω]
HA-800B-1*-100	100	3.8	0.8	40	0.5750
HA-800B-3*-100	100	4.5	0.8	40	0.5750
HA-800B-6*-100	100	8.0	0.8	80	0.5750
HA-800B-1*-200	200	2.4	0.4	50	0.5750
HA-800B-3*-200	200	4.0	0.4	50	0.5750
HA-800B-6*-200	200	7.6	0.4	100	0.5750
HA-800B-24*-200	200	26.1	0.4	200	0.5750

Table. TT grounding system

Model	Power voltage [V]	Rated current [Arms]	RCD IΔn [mA]	Shut down time [sec]	Shut down current [Arms]	Upper limit of fault loop impedance [Ω]
HA-800B-1*-100	100	3.8	30	0.3	0.03	666.6
HA-800B-3*-100	100	4.5	30	0.3	0.03	666.6
HA-800B-6*-100	100	8.0	30	0.3	0.03	666.6
HA-800B-1*-200	200	2.4	30	0.2	0.03	1333.3
HA-800B-3*-200	200	4.0	30	0.2	0.03	1333.3
HA-800B-6*-200	200	7.6	30	0.2	0.03	1333.3
HA-800B-24*-200	200	26.1	30	0.2	0.03	1333.3

*1: The upper limit of the fault loop impedance includes the servo system internal impedance of 0.28Ω.

*2: For TT systems, the authorities may specify the rated sensitivity current and maximum permissible fault loop impedance, so follow the authorities' instructions.

*3: For TT systems, a Type B RCD may be required.

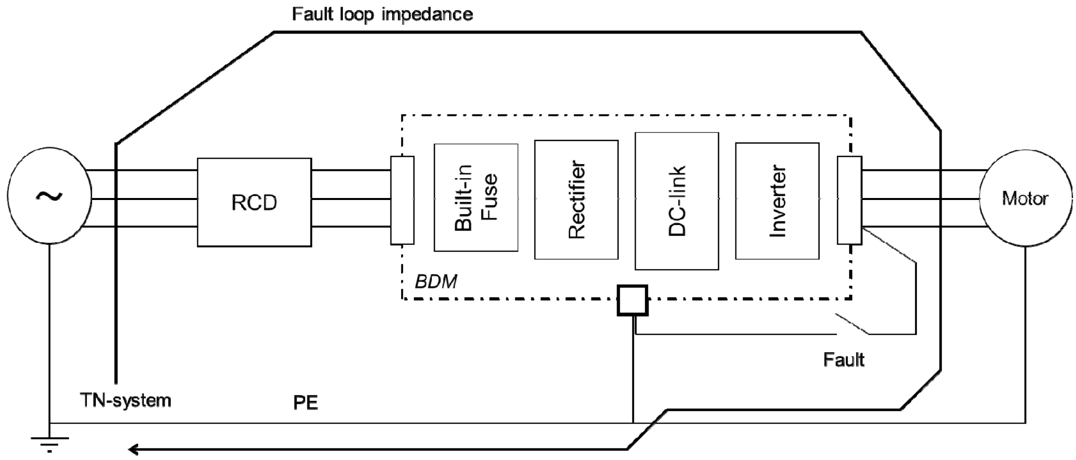


Figure. TN grounding system

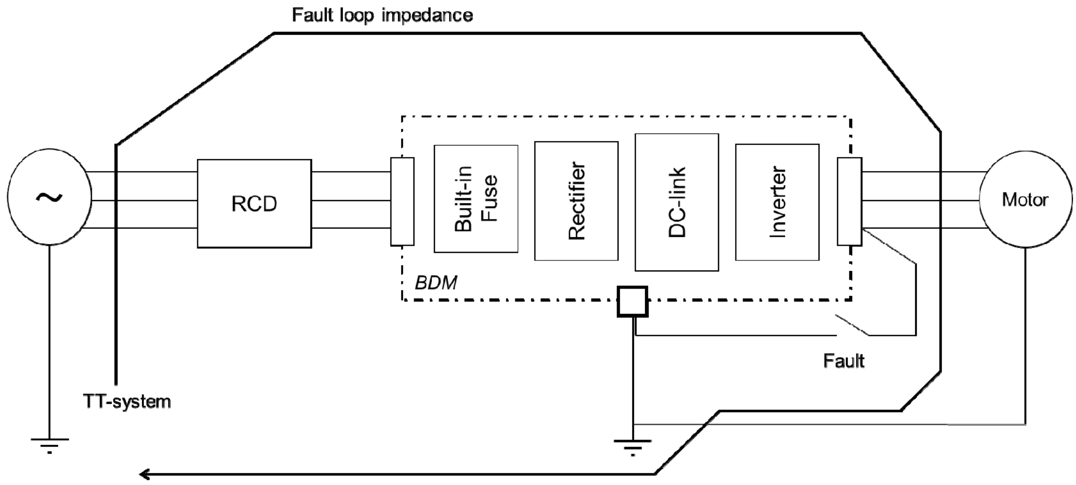


Figure. TT grounding system

Overload protection and Over temperature protection for actuators and motors

Overload protection:
HA-800 series servo driver provide overload protection for actuators and motors. (It is set based on 120% of the rated current (allowable continuous current) of the actuator/motor.)
Its overload protection does not have thermal memory retention. Also, it is not speed sensitive.

Over temperature protection:
HA-800 series servo driver does not have a over temperature protection function for actuators and motors. The over temperature protection for actuators and motors is required at end application.

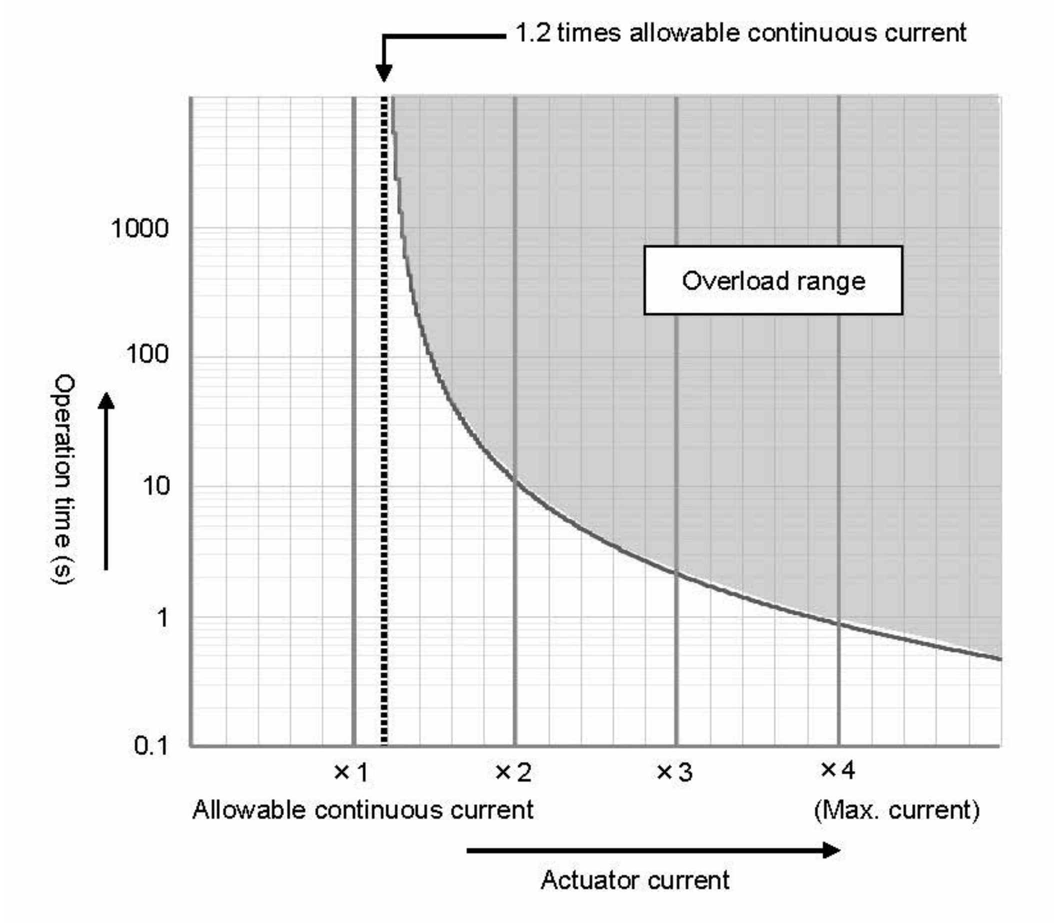


Figure. Overload protection

Chapter 1

Functions and configuration

Outlines of driver models, specifications, external dimensions, etc., are explained in this chapter.

1-1 Overviews of driver 1-1
1-2 Function block diagram 1-2
1-3 Device configuration diagram 1-3
1-4 Driver model 1-5
1-5 Actuator and extension cable combinations 1-6
1-6 Driver ratings and specifications 1-8
1-7 Function list 1-11
1-8 External drawing 1-12
1-9 Name and function of each part of a display panel 1-14

1-1 Overviews of driver

The HA-800B driver series are dedicated servo drivers for SHA series, FHA-C series, RSF series, AC Servo Motor HMA series and other actuators which are ultra-thin and feature a hollow shaft structure. These actuators utilize speed reducer HarmonicDrive® for precision control and AC servo motors.
The HA-800B drivers provide many superior functions to allow various actuators to excel in performance.

Overviews of functions

MECHATROLINK-II type

The driver conforms to MECHATROLINK-II, and can be operated in 17-byte and 32-byte modes.
The host controller is intended to be used in combination with the MP2000 series by YASKAWA Electric Corporation and KV-ML16V controller by Keyence Corporation. (Some functions are limited.)
Check our website for the latest information for more details of the limited functions.

Supporting transmission cycles of 1 to 5 ms

The supported transmission cycle are 1 ms, 1.5 ms, 2 ms, 3 ms, 4 ms and 5 ms.

Half the positioning stabilization time (compared to HA-655) using an original control logic

The amount of positioning stabilization time was cut in half compared to the conventional machine as a result of controlling overshooting and undershooting during positioning using an original control logic.

Auto-tuning function

The auto-tuning function allows the driver to estimate the load and automatically set an optimal servo gain.

Separate main circuit power and control circuit power

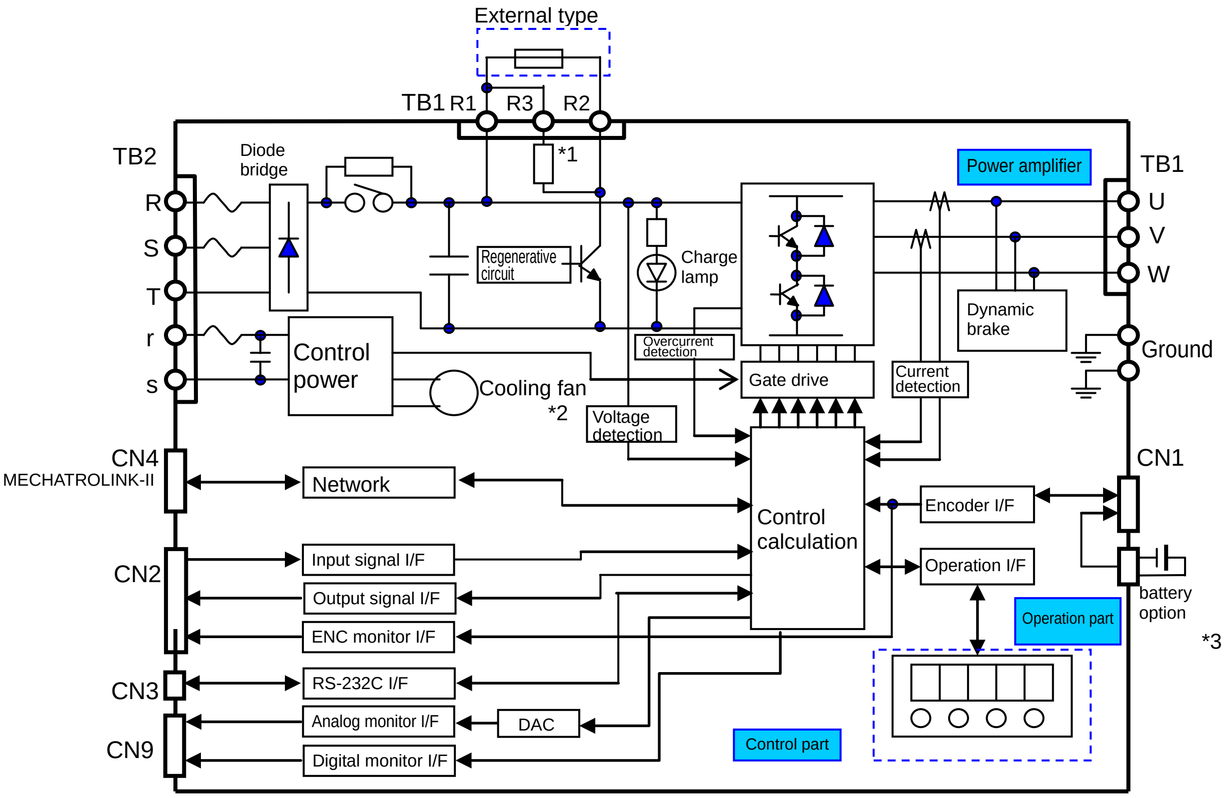
The control circuit power is separate from the main circuit power, which allows for safe diagnosis in the event of an error.

Dedicated comprehensive software

Dedicated software, PSF-800, is now available to be used for changing the HA-800B driver parameters and monitoring the operation status.

1-2 Function block diagram

An internal function block diagram of this driver is shown.

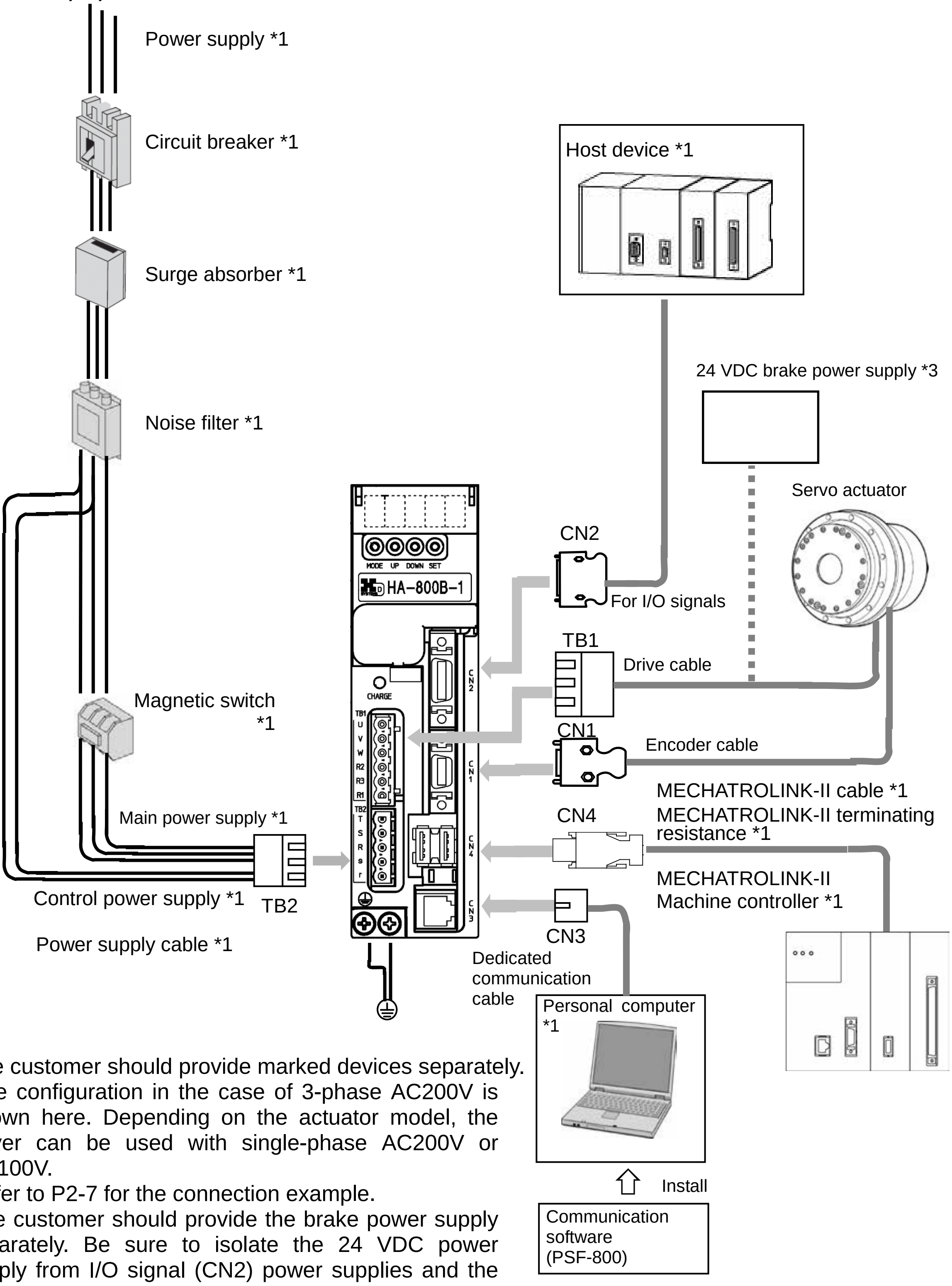


*1: The HA-800-1 has no built-in regenerative resistor.
*2: The HA-800-6 and higher models come with a cooling fan.
*3: A battery is required if an absolute encoder is used.

1-3 Device configuration diagram

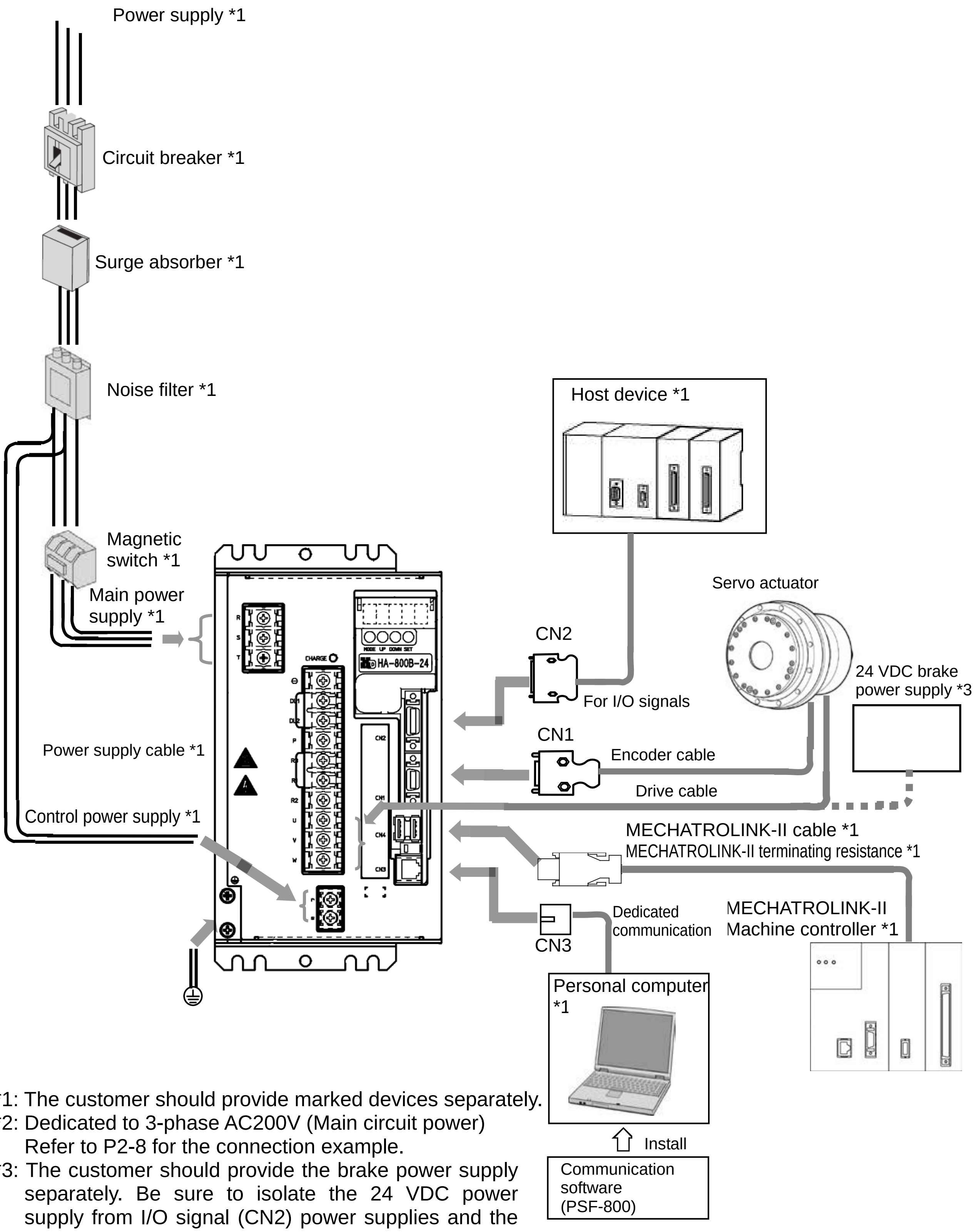
A basic configuration diagram of this driver is shown.

HA-800B-1, 3, 6



*1: The customer should provide marked devices separately.
*2: The configuration in the case of 3-phase AC200V is shown here. Depending on the actuator model, the driver can be used with single-phase AC200V or AC100V.
Refer to P2-7 for the connection example.
*3: The customer should provide the brake power supply separately. Be sure to isolate the 24 VDC power supply from I/O signal (CN2) power supplies and the like. A separate power supply must always be used.

HA-800B-24



*1: The customer should provide marked devices separately.
*2: Dedicated to 3-phase AC200V (Main circuit power)
Refer to P2-8 for the connection example.
*3: The customer should provide the brake power supply separately. Be sure to isolate the 24 VDC power supply from I/O signal (CN2) power supplies and the like. A separate power supply must always be used.

1-4 Driver model

The following explains how to read the driver model name and symbol, as well as options.

Driver model

HA-800B-3A-200-SP

Model: AC Servo Driver HA series

Series: 800 series

800A	I/O command type
800B	MECHATROLINK-II type
800C	CC-Link type

Rated output current:

1	1.5A
3	3A
6	6A
24	24A

Available encoder[*1]:

A[*2]	13-bit absolute encoder
B	14-wire incremental encoder
C	4-wire wire-saving incremental encoder
D[*2]	17-bit absolute encoder
E	17-bit encoding incremental model

Input voltage:

200	AC200V
100	AC100V

Custom specification code:

Blank	Standard product
SP	Special product

*1: For details on the available encoders, see Chapter 4.
*2: When available encoder A or D is selected, a data backup battery (option) must be installed.

Option

Extension cables (optional)

Refer to [Actuator and extension cable combinations] (P1-6).

Connectors (optional)

Model CNK-HA80B-S1/CNK-HA80B-S2/CNK-HA80B-S1-A/CNK-HA80B-S2-A

Data Backup battery for absolute encoder (optional)

Not included with the HA-800 driver.
When using an absolute encoder with the absolute specifications, an optional data backup battery is required.
Model HAB-ER17/33-2

Dedicated communication cables (optional)

Model EWA-RS03

Servo parameter setting software

PSF-800 (Downloadable from our website [https://www.hds.co.jp/])

1-5 Actuator and extension cable combinations

The following explains the combinations of drivers, actuators and extension cables (option).

Actuator series	Model No.	Input voltage (V)	Encoder type	Combined driver HA-800B	Extension cable (option)
SHA series	20	200	17-bit Absolute	HA-800B-3D/E-200	Motor wire EWD-M**-A06-TN3 Encoder wire EWD-S**-A08-3M14
	25	100		HA-800B-6D/E-100	
		200		HA-800B-3D/E-200	
	32	200		HA-800B-6D/E-200	
	40	200		HA-800B-6D/E-200	
	40	200		HA-800B-24D/E-200	Motor wire Model No. 40,45: EWD-MB**-A06-TMC Model No. 58,65: EWD-MB**-D09-TMC Encoder wire Model No. 40,45: EWD-S**-A08-3M14 Model No. 58,65: EWD-S**-D10-3M14
	45	200		HA-800B-24D/E-200	
	58	200		HA-800B-24D/E-200	
	65	200		HA-800B-24D/E-200	
FHA-Cmini series	8	200	4 wires, wire-saving type Incremental	HA-800B-1C-200	Motor wire EWC-M**-A06-TN3 Encoder wire EWC-E**-M06-3M14
	11	200		HA-800B-1C-200	
	14	200		HA-800B-1C-200	
	8	100		HA-800B-1C-100	
	11	100		HA-800B-1C-100	
	14	100		HA-800B-1C-100	
	8	200	17-bit Absolute	HA-800B-1D/E-200	Motor wire EWC-M**-A06-TN3 Encoder wire EWD-S**-A08-3M14
	11	200		HA-800B-1D/E-200	
	14	200		HA-800B-1D/E-200	
	8	100		HA-800B-1D/E-100	
	11	100		HA-800B-1D/E-100	
	14	100		HA-800B-1D/E-100	
FHA-C series	17	200	4 wires, wire-saving type Incremental	HA-800B-3C-200	Motor wire EWC-MB**-M08-TN3 Encoder wire EWC-E**-B04-3M14
	25	200		HA-800B-3C-200	
	32	200		HA-800B-6C-200	
	40	200		HA-800B-6C-200	
	17	200	13-bit Absolute	HA-800B-3A-200	Motor wire EWC-MB**-M08-TN3 Encoder wire EWC-S**-B08-3M14
	25	200		HA-800B-3A-200	
	32	200		HA-800B-6A-200	
	40	200		HA-800B-6A-200	
	17	100	4 wires, wire-saving type Incremental	HA-800B-3C-100	Motor wire EWC-MB**-M08-TN3 Encoder wire EWC-E**-B04-3M14
	25	100		HA-800B-6C-100	
	32	100		HA-800B-6C-100	
	17	100	13-bit Absolute	HA-800B-3A-100	Motor wire EWC-MB**-M08-TN3 Encoder wire EWC-S**-B08-3M14
	25	100		HA-800B-6A-100	
	32	100		HA-800B-6A-100	
RSF series	17	200	14 wires Incremental	HA-800B-3B-200	Motor wire EWA-M**-A04-TN3 Encoder wire EWA-E**-A15-3M14
RSF/RKF series	20	200		HA-800B-3B-200	
	25	200		HA-800B-3B-200	
	32	200		HA-800B-6B-200	

Actuator series	Model No.	Input voltage (V)	Encoder type	Combined driver HA-800B	Extension cables (option)
HMA series	08	200	17-bit Absolute	HA-800B-3D/E-200	Motor wire EWD-MB**-A06-TN3 Encoder wire EWD-S**-A08-3M14
	09	100		HA-800B-6D/E-100	
		200		HA-800B-3D/E-200	
	12	200		HA-800B-6D/E-200	
	15	200		HA-800B-24D/E-200	Motor wire Model No.15:EWD-MB**-A06-TMC Model No.21A:EWD-MB**-D09-TMC Encoder wire Model No.15:EWD-S**-A08-3M14 Model No.21A:EWD-S**-D10-3M14
	21A	200		HA-800B-24D/E-200	

*1: The maximum torque, allowable continuous torque, and operable range depend on the driver combined with the SHA40A actuator. Select the option according to your intended application. Refer to "Operable Range" in the SHA Series Manual.

*2: ** in the extension cable model indicates the cable length. Select a desired length from the following 3 types: 03: 3m, 05: 5m, 10: 10m

1-6 Driver ratings and specifications

The following explains the ratings and specifications of this driver.

Input voltage		Power supply: 200V			Power supply: 100V		
Model		HA-800B-1*	HA-800B-3*	HA-800B-6*	HA-800B-1*	HA-800B-3*	HA-800B-6*
Driver's rated current *1		1.5 A	3.0 A	6 A	1.5 A	3.0 A	6 A
Driver's maximum current *1		4.0 A	9.5 A	19.0 A	4.0 A	9.5 A	19.0 A
Input voltage	Main circuit	AC200 to 230V (single phase *2 *3/3-phase) +10% to -15%			AC100 to 115V (single phase), +10 to -15%		
	Control circuit	AC200 to 230V (single phase), +10 to -15% 30VA			AC100 to 115V (single phase), +10 to -15% 30VA		
Power frequency		50/60Hz					
Allowed revolution (motor shaft)	13-bit absolute	—	-4,096 to 4,095		—	-4,096 to 4,095	
	17-bit absolute	-32,768 to 32,767			-32,768 to 32,767		
Allowed environment		Operating temperature: 0 to 50℃ Storage temperature: -20 to 65℃ Operating/storage humidity: below 95%RH (No condensation) Resistance to vibration: 4.9m/s² (10 to 55Hz, Tested for 2 hours each in the X, Y, and Z directions)/Shock resistance: 98m/s² (Tested once each in the X, Y, and Z directions) Ambience: No metal powder, dust, oil mist, corrosive gas, or explosive gas.					
Structure		Natural air-cooling		Forced air-cooling	Natural air-cooling		Forced air-cooling
Installation method		Base mount (wall installation)					
Command method		MECHATROLINK-II, 17-byte, 32-byte modes					
Input signals		FWD inhibit, REV inhibit, latch 1, latch 2, origin signal					
Output signals		Operation preparation complete, origin return complete, operation completion, alarm					
Monitor terminals		3 channels, motor rotation speed, current command, general-purpose output (parameter selection)					
Digital I/O port		RS-232C Status monitor, various parameters settings (PSF-800)					
Operation panel	Configuration	Display (7-segment LED), 5 digits (red), 4 push-button switches					
	Status display function	Rotation speed (r/min), torque command (%), load rate (%), input signal monitor, output signal monitor, alarm history (8 alarms), etc.					
	Parameter adjustment function	System parameters 3, 4, adjustment parameters 1, 2					
Protective functions	Alarms	Overspeed, overload, IPM error (overcurrent), regenerative resistor overheat, encoder disconnection, encoder receiving error, UVW error, system failure, multi revolution overflow, multi revolution data error, error counter overflow, memory failure, FPGA configuration error, FPGA setting error, MEMORY error, single revolution data error, BUSY error, overheat error, communication error					
	Warnings	Battery voltage low, overload, cooling fan stopped, main circuit input voltage low, FWD inhibit input effective, REV inhibit input effective					
Regenerative processing		Comes with an external regenerative resistor mounting terminal	Regenerative resistor contained Comes with an external regenerative resistor mounting terminal		Comes with an external regenerative resistor mounting terminal	Regenerative resistor contained Comes with an external regenerative resistor mounting terminal	
Regenerative resistor absorption power		—	3W max.	8W max.	—	3W max.	8W max.
Embedded functions		Status display function, self diagnosis, electronic gear, JOG and other operations, dynamic brake, multi revolution data backup (when the optional data backup battery is installed)					
Surge-current prevention function		Incorporated (CPU control based on monitoring of main circuit voltage)					
Operation mode		Status display mode (for usual operations), test mode, tune mode, system parameter configuration mode					
Mass		1kg		1.2kg	1kg		1.2kg

*1: Set according to the specification of the combined actuator.
*2: If the FHA-Cmini (FHA-8C/11C/14C) or FHA-17C is combined, 3-phase 200VAC or single-phase 200VAC

input can be used.
*3: If the SHA series or any of FHA-25C/32C/40C is combined, use of 3-phase 200VAC input is recommended. Single-phase 200VAC input can also be used by derating the output. Derate the rotation speed or output torque based on the continuous motion range of the actuator being 100%.

Actuator reduction ratio	SHA20A 51/81/ 101/121/161	SHA25A 51/81/ 101/121	SHA25A 11/161	SHA32A 51/81/ 101/121	SHA32A 11/161	SHA40A 51/81/101/121/161 (Combined with HA-800B-6)	FHA-25C 50/80/100/ 120/160	FHA-32C 50/80/100/ 120/160	FHA-40C 50/80/100/ 120/160
Derating	100%	40%	70%	60%	80%	30%	60%	80%	40%

Actuator reduction ratio	SHA20A 50/80/ 100/120/160	SHA25A 50/80/ 100/120	SHA25A 160	SHA32A 50/80/ 100	SHA32A 120	SHA32A 160	SHA40A 50/80/100/120/160 (Combined with HA-800B-6)
Derating	100%	40%	70%	60%	80%	100%	30%

Actuator reduction ratio	HMAC08	HMAB09	HMAB12
Derating	80%	40%	60%

Input voltage		Power supply: 200V
Model		**HA-800B-24***
Driver's rated current *1		24 A
Driver's maximum current *1		55 A
Input voltage	Main circuit	AC200 to 230V (3-phase), +10 to -15%
	Control circuit	AC200 to 230V (single phase), +10 to -15% 30VA
Power frequency		50/60Hz
Allowed revolution (motor shaft)	17-bit absolute	-32,768 to 32,767
Allowed environment		Operating temperature: 0 to 50℃ Storage temperature: -20 to 65℃ Operating/storage humidity: below 95%RH (No condensation) Resistance to vibration: 4.9m/s² (10 to 55Hz, Tested for 2 hours each in the X, Y, and Z directions)/Shock resistance: 98m/s² (Tested once each in the X, Y, and Z directions) Ambience: No metal powder, dust, oil mist, corrosive gas, or explosive gas.
Structure		Forced air-cooling type
Installation method		Base mount (wall installation)
Control method		MECHATROLINK-II, 17-byte, 32-byte modes
Input signals		FWD inhibit, REV inhibit, latch 1, latch 2, origin signal
Output signals		Operation preparation complete, origin return complete, operation completion, alarm
Motor terminals		3 channels, motor rotation speed, current command, general-purpose output (parameter selection)
Digital I/O port		RS-232C Status monitor, various parameters settings (PSF-800)
Operation panel	Configuration	Display (7-segment LED), 5 digits (red), 4 push-button switches
	Status display function	Rotation speed (r/min), torque command (%), load rate (%), input signal monitor, output signal monitor, alarm history (8 alarms), etc.
	Parameter adjustment function	System parameters 3, 4, adjustment parameters 1, 2
Protective functions	Alarms	Overspeed, overload, IPM error (overcurrent), regenerative resistor overheat, encoder disconnection, encoder receiving error, UVW error, system failure, multi revolution overflow, multi revolution data error, error counter overflow, memory failure, FPGA configuration error, FPGA setting error, MEMORY error, single revolution data error, BUSY error, overheat error, communication error, 1-phase missing error, main circuit voltage low error, overregeneration error, excessive regenerative power error
	Warnings	Battery voltage low, overload, main circuit input voltage low, FWD inhibit input effective, REV inhibit input effective
Regenerative processing		Regenerative resistor contained Comes with an external regenerative resistor mounting terminal
Regenerative resistor absorption power		90W max.
Embedded functions		Status display function, self diagnosis, electronic gear, JOG and other operations, dynamic brake, multi revolution data backup (when the optional data backup battery is installed)
Surge-current prevention function		Incorporated (CPU control based on monitoring of main circuit voltage)
Operation mode		Status display mode (for usual operations), test mode, tune mode, system parameter configuration mode
Mass		5.8kg

*1: Set according to the specifications of the combined actuator.

1-7 Function list

The following explains a list of functions provided by this driver.

P: Position control　S: Speed control　T: Torque control

Function	Description	Applicable control mode	Reference
Position control mode	The driver functions as a position control servo.	P	Chapter 13-3
Speed control mode	The driver functions as a speed control servo.	S	
Torque control mode	The driver functions as a torque control servo.	T	
Absolute position sensor	Once the absolute position is set, an actuator equipped with an absolute position encoder will recognize the current position after each subsequent reconnection of power.	All	P4-7 P4-15
Shorter positioning time	The HarmonicDrive® characteristics of the actuator are utilized in the control logic to shorten the positioning time.	P	P3-17
Auto-tuning	The driver can estimate the load in the JOG mode and automatically set an appropriate servo gain.	All	P9-9
Regenerative processing	If the regenerated power exceeds the value permitted by the driver, the excess power is used for the external regenerative resistor.	All	P2-18
Alarm history	The descriptions and occurrence times of up to 8 most recent alarms are displayed.	All	P7-8
Alarm history clear	The alarm history is cleared.	All	P7-10
Alarm code output	When an alarm occurs, its description is displayed and an alarm is output.	All	P7-9
Warning output	When a warning occurs, its description is displayed and an alarm is output.	All	
Electronic gear *1	You can change the weight (multiplier) of pulse input by setting desired values for the numerator and denominator of electronic gear. (Incremental encoder only)	All	P8-3
JOG operation	The JOG operation of the actuator is possible, and operation check can be performed to see if the power supply, motor wire and encoder wiring are normal, regardless of the I/O signals received from the host.	All	P9-4
Status display mode	The servo driver status can be displayed, and monitored if requested.	All	P7-1
Test mode	Functions such as I/O signal monitor, output signal operation, JOG operation and auto-tuning are available.	All	Chapter 9
Tune mode	The servo gain, in-position range and various other items relating to the servo system can be set.	All	P7-11
System parameter mode	The various HA-800B functions can be set.	All	Chapter 8
Analog monitor output	The motor speed and motor current can be monitored as voltage levels.	All	P5-10
Status monitor output	The selected servo status can be monitored.	All	P8-3
Absolute encoder function setting *	A 17-bit absolute encoder can be used as an incremental encoder.	All	P4-4

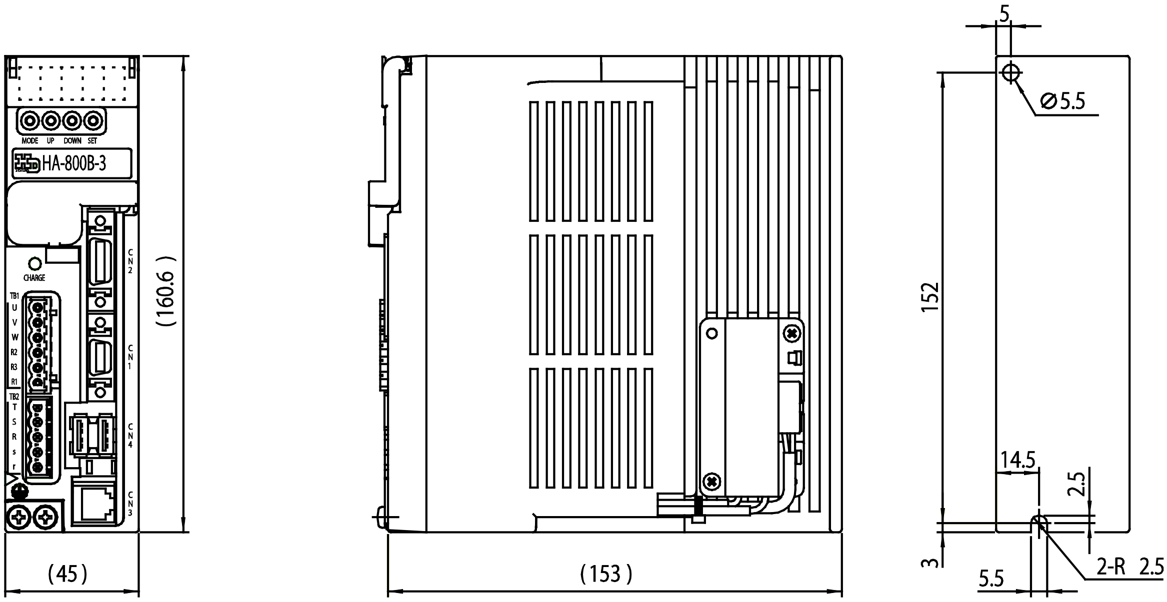
*1: When the host controller is used in combination with the MP2000 series by YASKAWA Electric Corporation or the KV-ML16V controller by Keyence Corporation, do not change the electric gear settings for the HA-800B.

*: This is available for HA-800 software version 3.x or later.

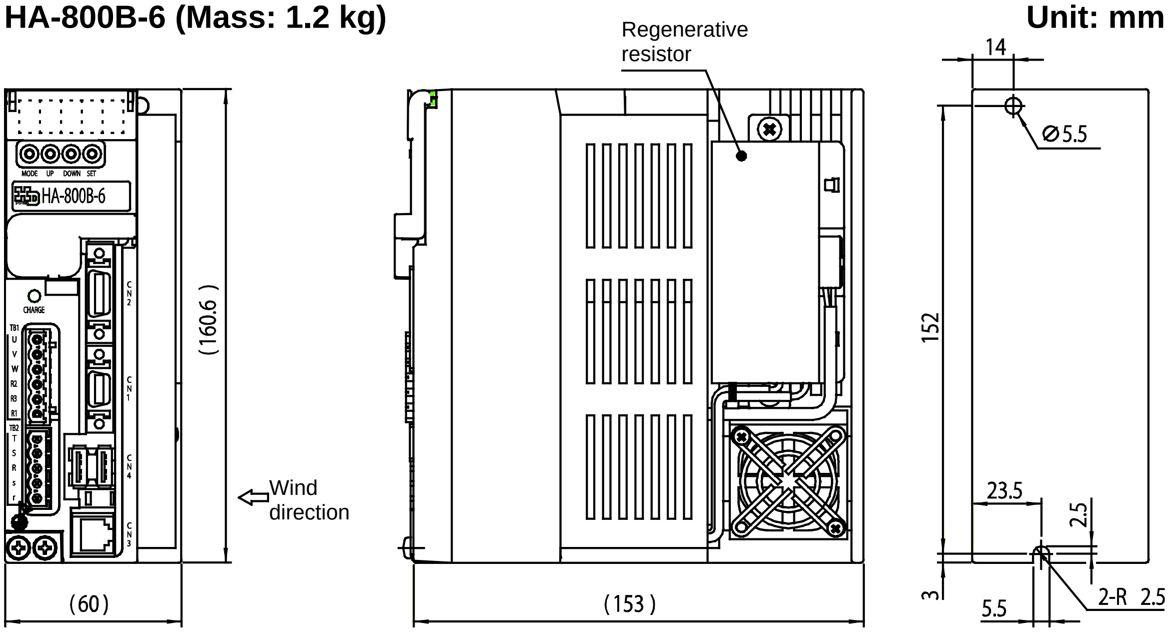
1-8 External drawing

The following shows the external drawing of this driver.

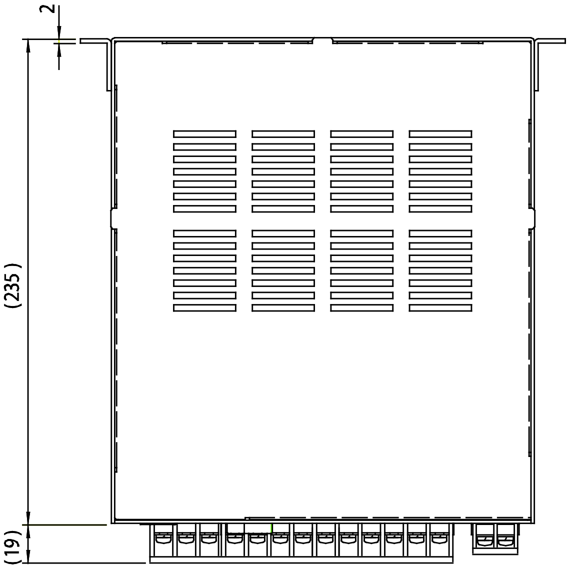
HA-800B-1/3 (Mass: 1 kg) **Unit: mm**

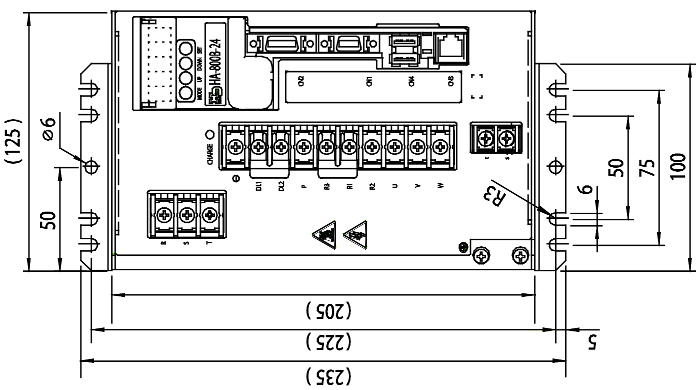


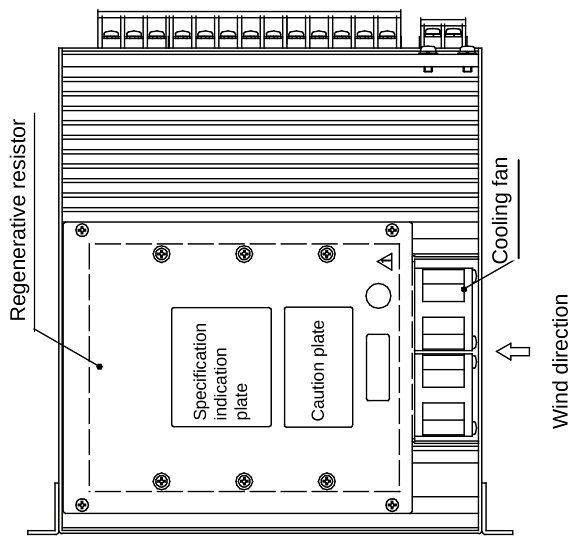
HA-800B-6 (Mass: 1.2 kg) **Unit: mm**

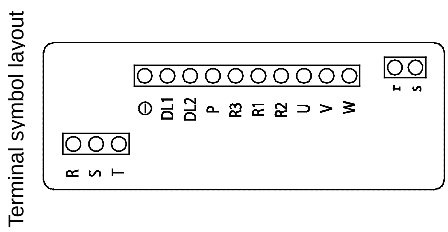


HA-800B-24 (Mass: 5.8 kg) **Unit: mm**





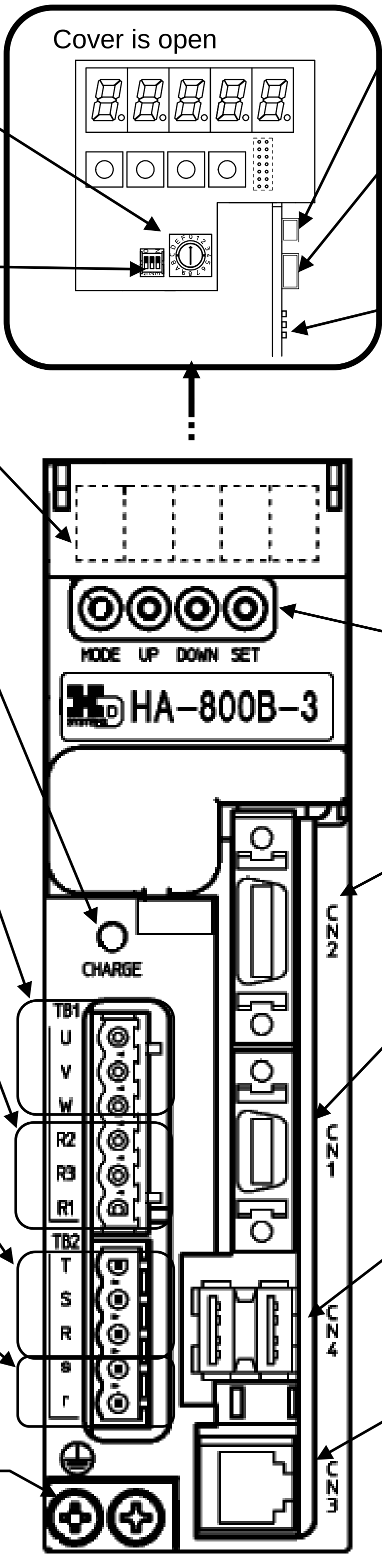




1-9 Name and function of each part of a display panel

The following explains the operation part on the front side of this driver as well as each function provided on the operation part.

HA-800B-1/HA-800B-3/HA-800B-6



Station address setting switch (SW2)

This switch is used to set the MECHATROLINK communication. [Chapter 13 MECHATROLINK communication function]

Station address/transfer bytes setting switch (SW1)

This switch is used to set the MECHATROLINK communication [Chapter 13 MECHATROLINK communication function]

LED display

The driver status display, alarm display, data values, etc., can be checked.

CHARGE lamp

This lamp turns ON when the main circuit power is input.
If this lamp remains ON after the power has been turned OFF, the system is still charged with high voltage. Do not touch the power connector.

Servo motor connection terminals (U, V, W)

Connect the servo motor drive wire. [Wiring the driver and motor] (P2-18)

Regenerative resistor connection terminals (R1, R2,

A terminal for connecting an external regenerative resistor. Connect an external regenerative resistor if the regeneration capacity is not enough. [Wiring the driver and motor] (P2-18)

Main circuit power connection terminals (T, S, R)

A terminal for connecting the main circuit power supply.
[Connecting power cables] (P2-6)

Control circuit power connection terminals (s, r)

A terminal for connecting the control circuit power supply. [Connecting power cables] (P2-6)

Ground terminal

A ground terminal for protection against electric shock. Be sure to connect this terminal.
[Connecting a ground wire] (P2-9)

Maintenance connector

Do not connect.

Waveform monitoring connector (CN9)

The speed, current waveform and status signal can be monitored. [Monitor output] (P5-10)

Communication status monitor LED

LED1: Turns ON while data is being received via MECHATROLINK communication.
LED2: Turns ON while data is being sent via MECHATROLINK communication.
LED3: Turns ON when MECHATROLINK communication is not established.

Push-button switches

4 switches are used to change the display, set various functions and perform JOG operation.
[Chapter 6 Panel display and operation]

I/O signal connector (CN2)

A connector for I/O signals.
[Chapter 5 I/O signals]

Encoder connector (CN1)

A connector between the servo actuator and encoder. Take note that the connection method varies depending on the model.
[Connecting the encoder] (P2-20)

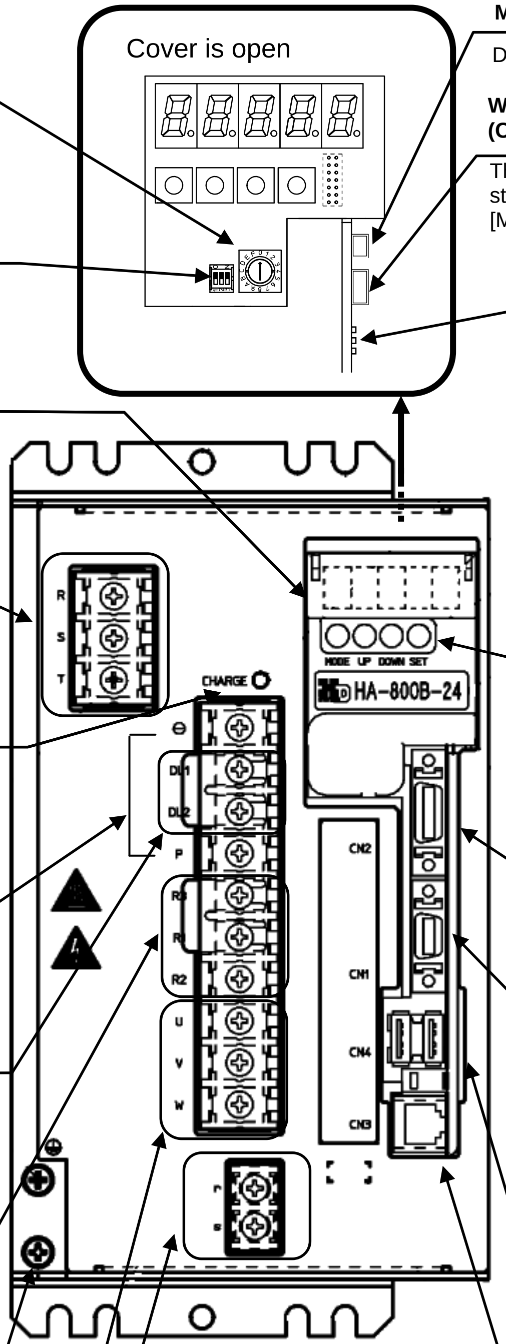
MECHATROLINK connector (CN4)

A connector for MECHATROLINK communication.

PSF-800 communication connector (CN3)

A communication connector for dedicated driver communication software PSF-800.
[Chapter 10 Communication software]

HA-800B-24



Station address setting switch (SW2)

This switch is used to set the MECHATROLINK communication. [Chapter 13 MECHATROLINK communication function]

Station address/transfer bytes setting switch (SW1)

This switch is used to set the MECHATROLINK communication. [Chapter 13 MECHATROLINK communication function]

LED display

The driver status display, alarm display, data values, etc., can be checked.

Main circuit power connection terminals (R, S, T)

A terminal for connecting the main circuit power supply. [Connecting power cables] (P2-6)

CHARGE lamp

This lamp turns ON when the main circuit power is input.
If this lamp remains ON after the power has been turned OFF, the system is still charged with high voltage. Do not touch the power

Maintenance terminal

Do not wire the - and P terminals

DC reactor connection terminals (DL1, DL2)

Terminals between DL1 and DL2 have been short-circuited with a short bar as default. Normally this short bar need not be removed before use.

Regenerative resistor connection terminals (R1, R2, R3)

A terminal for connecting an external regenerative resistor.
Connect an external regenerative resistor if the regeneration capacity is not enough. [Wiring the driver and motor] (P2-18)

Ground terminal

A ground terminal for protection against electric shock. Be sure to connect this terminal.
[Connecting a ground wire] (P2-9)

Control circuit power connection terminals (r, s)

A terminal for connecting the control circuit power supply. [Connecting power cables] (P2-6)

Servo motor connection terminals (U, V, W)

Connect the servo motor drive wire. [Wiring the driver and motor] (P2-18)

Maintenance connector

Do not connect.

Waveform monitoring connector (CN9)

The speed, current waveform and status signal can be monitored. [Monitor output] (P5-10)

Communication status monitor LED

LED1: Turns ON while data is being received via MECHATROLINK communication.
LED2: Turns ON while data is being sent via MECHATROLINK communication.
LED3: Turns ON when MECHATROLINK communication is not established.

Push-button switches

4 switches are used to change the display, set various functions and perform JOG operation. [Chapter 6 Panel display and operation]

I/O signal connector (CN2)

A connector for command signals and I/O signals. [Chapter 5 I/O signals]

Encoder connector (CN1)

A connector between the servo actuator and encoder. Take note that the connection method varies depending on the model. [Connecting the encoder] (P2-20)

MECHATROLINK connector (CN4)

A connector for MECHATROLINK communication.

PSF-800 communication connector (CN3)

A communication connector for dedicated driver communication software PSF-800.
[Chapter 10 Communication software]

Chapter 2

Installation/wiring

Receiving inspection, environment, power wiring, noise suppression and connector wiring are explained in this chapter.

2-1 Receiving inspection 2-1
2-2 Installation location and installation 2-2
2-3 Connecting power cables 2-6
2-4 Suppressing noise 2-15
2-5 Wiring the driver and motor 2-18
2-6 Wiring the host device 2-21

2-1 Receiving inspection

After unpacking, check the items described below.

Check procedure

1 **Check for damage.**

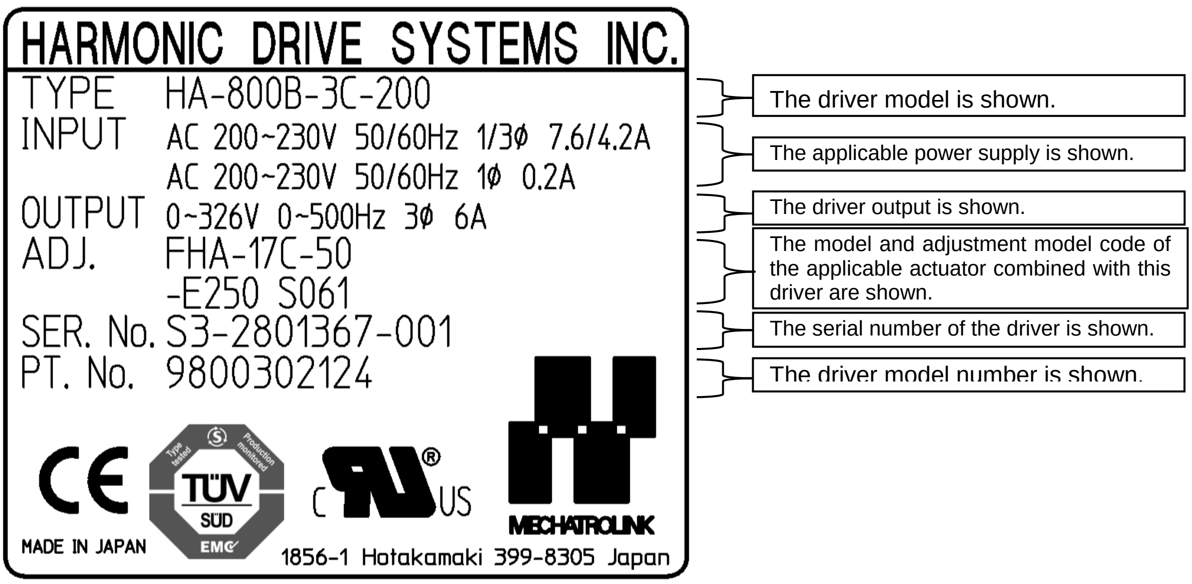
If any damage is found, immediately contact the supplier or store where you purchased your driver.

2 **Check if the driver is what you ordered.**

Check the model code shown below the display panel on the front face of this driver.
For information on how to check the model, refer to [Driver model] (P1-5).

Check the model, input voltage and combined actuator on the nameplate attached on the right side face of the driver.
If the model is wrong, immediately contact the supplier or store where you purchased your driver.

Nameplate



When combining the driver to an actuator with an absolute encoder in order to use it with the absolute specifications, confirm that an optional data backup battery (HAB-ER17/33-2) has been prepared.

WARNING

Do not combine the actuator other than the one specified on the nameplate.
The characteristics of this driver have been adjusted according to the actuator. Wrong combinations of HA-800B drivers and actuators may cause insufficient torque or overcurrent that may lead to actuator burnout, injury or fire.

Do not connect the power supply other than the voltage specified on the nameplate.
Connecting a power supply not matching the input voltage specified on the nameplate may result in damage to the HA-800B driver, injury or fire.

2-2 Installation location and installation

Install this driver in a manner meeting the conditions specified below.

Installation environment

Operating temperature	● 0 to 50℃ Store the driver in a cabinet. The temperature in the cabinet may be higher than the outside air temperature due to power losses of the housed devices, size of the cabinet, etc. Consider an appropriate cabinet size, cooling and layout to make sure the temperature around the driver does not exceed 50℃.
Operating humidity	● Relative humidity of 95% or less, non-condensing Exercise caution if the driver is used in a place subject to significant temperature differences between day and night or in patterns where the driver is started/stopped frequently, because these conditions increase the chances of condensation.
Vibration	● 4.9 m/s^2 (0.5G) (10 to 55Hz) or less (Tested at 10-55 MHz for 2 hours each in the X, Y, and Z directions) If there is a source of vibration nearby, install the driver on a base via a shock absorber to prevent the vibration from transmitting directly to the driver.
Impact	● 98 m/s^2 (10G) or less (Tested once each in the X, Y, and Z directions)
Others	● Free from dust, dirt, condensation, metal powder, corrosive gases, water, water droplets, oil mist, etc. Avoid using the driver in an environment subject to corrosive gases because accidents may occur due to poor contact of contact parts (connectors, etc.). ● Avoid exposure to direct sunlight.

Notices on installation

Install this driver vertically by providing sufficient clearances around it to ensure good ventilation.
When installing the driver, provide a clearance of at least 30mm from a wall or adjacent machine, at least 50mm from the floor, and at least 50mm from the ceiling.

The table below shows the power losses of HA-800B drivers for reference when planning the cooling system.

FHA-C series (200V)

Driver	HA-800B-1			HA-800B-3		HA-800B-6	
Actuator	FHA-8C	FHA-11C	FHA-14C	FHA-17C	FHA-25C	FHA-32C	FHA-40C
Power loss	25W	30W	40W	30W	40W	50W	60W

RSF/RKF series

Driver	HA-800B-1	HA-800B-3		HA-800B-6
Actuator	RSF-17	RSF/RKF-20	RSF/RKF-25	RSF/RKF-32
Power loss	35W	40W	55W	60W

SHA series (200V)

Driver	HA-800B-3		HA-800B-6		HA-800B-24			
Actuator	SHA20	SHA25	SHA32	SHA40	SHA40	SHA45	SHA58	SHA65
Power loss	35W	35W	65W	80W	130W	130W	130W	130W

SHA series (100V)

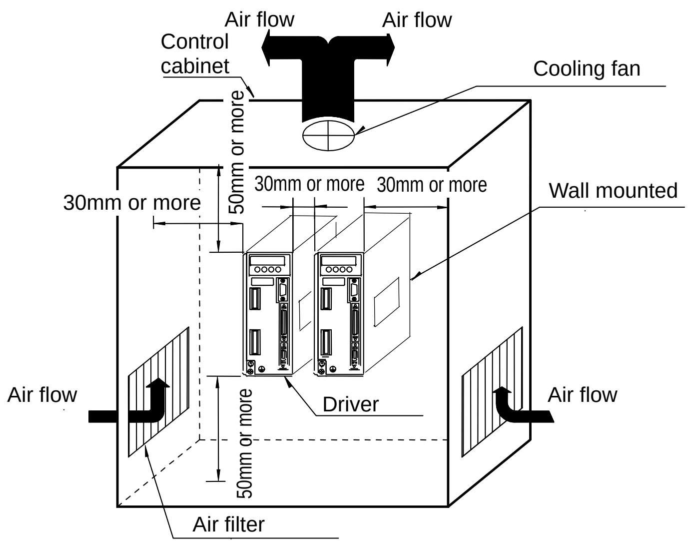
Driver	HA-800B-6
Actuator	SHA25
Power loss	40W

HMA series (200V)

Driver	HA-800B-3		HA-800B-6	HA-800B-24	
Actuator	HMAC08	HMAB09	HMAB12	HMAB15	HMAA21A
Power loss	35W	35W	65W	130W	130W

HMA series (100V)

Driver	HA-800B-6
Actuator	HMAB09
Power loss	40W



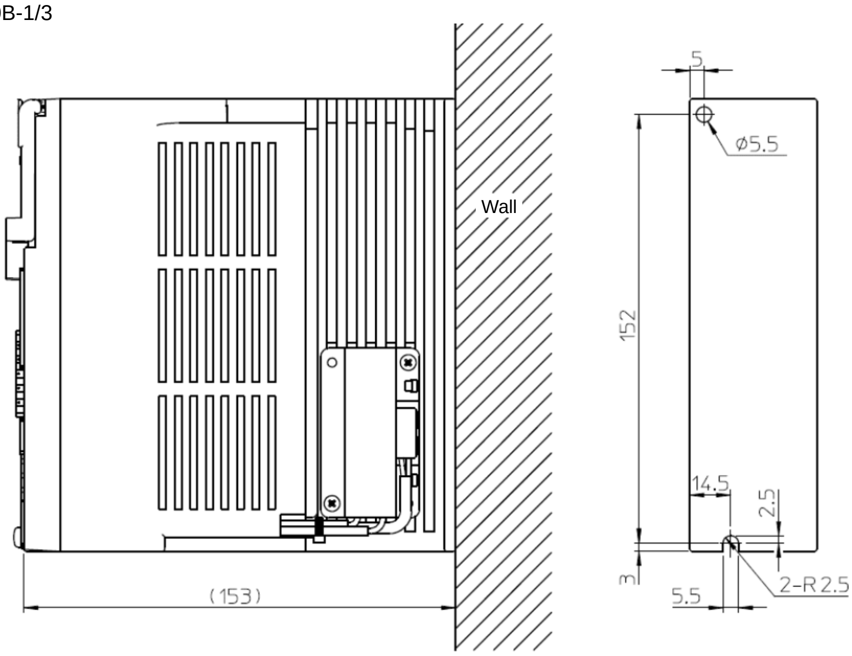
Installation procedure

[HA-800B-1, HA-800B-3, HA-800B-6]

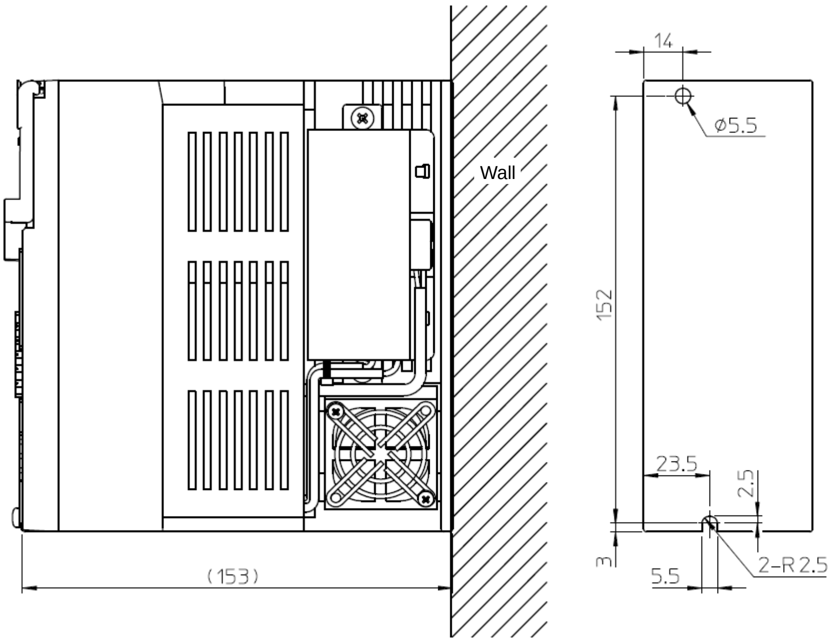
Install the driver using 2 mounting holes provided at the back. The wall on which to install the driver should be made of an iron sheet of 2mm or more in thickness.

1. **Screw a M4 screw into the middle of the tapped hole provided at the bottom of the mounting surface.**
2. **Hook the mounting hole (cut hole) provided at the bottom of the driver onto the M4 screw installed in 1.**
3. **Securely tighten a M4 screw through the mounting hole at the top of the driver and hole in the mounting surface.**
4. **Securely tighten the M4 screw at the bottom.**

HA-800B-1/3



HA-800B-6



2

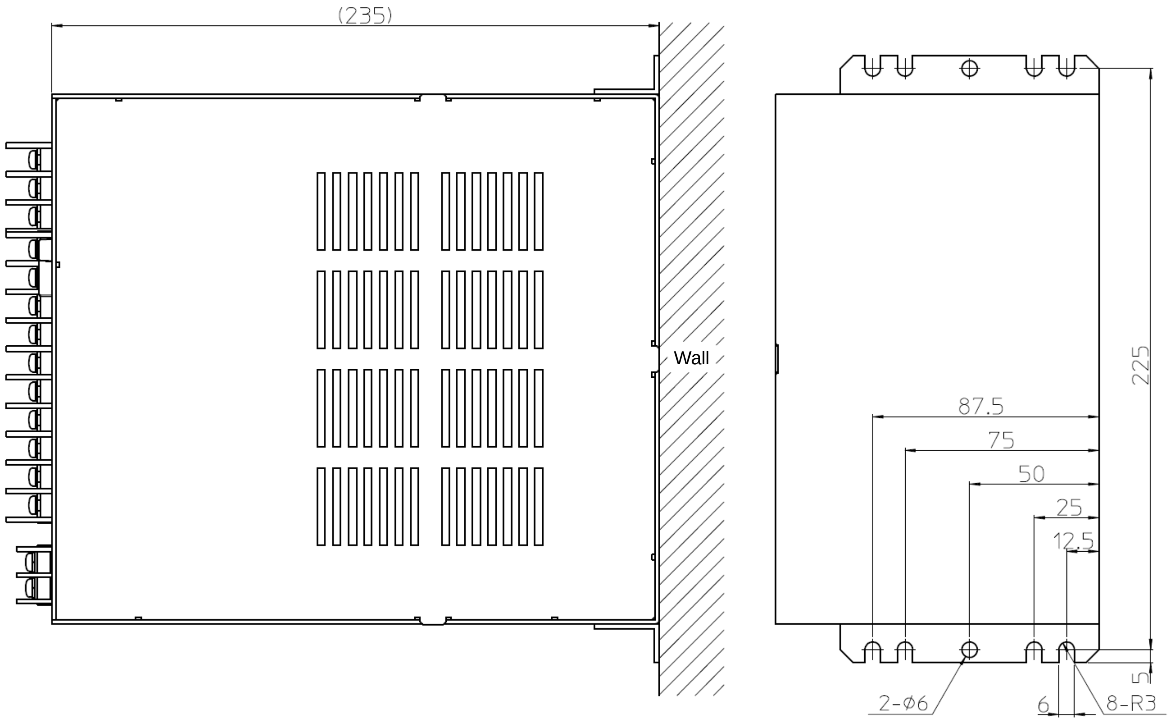
Installation/wiring

[HA-800B-24]

An iron sheet of 5mm or more in thickness is recommended for the wall on which to install the driver.

1. **Screw an M5 screw into the middle of the mounting hole (U-shaped) provided at the bottom of the driver.**
2. **Securely tighten an M5 screw through the mounting hole (U-shaped) at the top of the driver.**
3. **Securely tighten the screw at the bottom of the driver as well.**
   Confirm that all the 8 screws are securely tightened.

HA-800B-24



2-3 Connecting power cables

The following explains how to connect the power supply to this driver.

> **WARNING**
>
> **Before connecting the power cable to the HA-800B driver, completely unplug the power cable from the main power supply. Failure to do so may result in electric shock during the connection work.**

> **CAUTION**
>
> **(1) Connect the power cable to the HA-800B driver after installing the driver on the specified wall.**
> **(2) Ground the HA-800B driver to avoid electric shock, malfunctions caused by external noise, and for the suppression of radio noise emissions.**

Allowable cable sizes

The table below lists the minimum allowable wire sizes of power cables, ground cables and other cables. Using the thickest wires possible is recommended.
When bundling wires or placing them into ducts, rigid plastic conduits or metal pipes, use wires of the next larger size.
It is recommended to use HIV (special heat-resistant vinyl wires).

[3-phase 200V input]

<table>
<tr><th colspan="2"></th><th colspan="9">Min. allowable wire size (mm^2)</th></tr>
<tr><th colspan="2">Driver</th><th colspan="2">HA-800B-1</th><th colspan="2">HA-800B-3</th><th colspan="2">HA-800B-6</th><th colspan="3">HA-800B-24</th></tr>
<tr><th colspan="2">Combined actuator
Combined motor</th><td colspan="2">FHA-8C
FHA-11C
FHA-14C</td><td>FHA-17C
FHA-25C</td><td>SHA20
SHA25
HMAC08
HMAB09
MAC08
MAB09</td><td>FHA-32C
FHA-40C</td><td>SHA32
SHA40
HMAB12
MAB12
MAB15</td><td>SHA40
SHA45
HMAB15
MAB15</td><td>SHA58
SHA65</td><td>HMAA21A
MAA21</td></tr>
<tr><th>For main circuit power supply</th><th>R, S, T</th><td colspan="2">0.75</td><td colspan="2">1.25</td><td>2.0</td><td>2.0</td><td>3.5</td><td>3.5</td><td>5.5</td></tr>
<tr><th>For control circuit power supply</th><th>r, s</th><td colspan="2">0.75</td><td colspan="2">1.25</td><td colspan="2">1.25</td><td colspan="3">1.25</td></tr>
<tr><th>Motor cable *1</th><th>U, V, W, E</th><td>0.5</td><td>0.75</td><td>0.75</td><td>1.25</td><td colspan="2">2.0
(1.25) *2</td><td>2.0
(1.25) *2</td><td colspan="2">5.5
(3.5) *3</td></tr>
<tr><th>Ground wire (FG)</th><th>Ground mark</th><td colspan="2">3.5</td><td colspan="2">3.5</td><td colspan="2">3.5</td><td>3.5</td><td>3.5</td><td>5.5</td></tr>
<tr><th>Regenerative resistor</th><th>R1, R2</th><td colspan="2">1.25</td><td colspan="2">1.25</td><td colspan="2">1.25</td><td colspan="3">3.5</td></tr>
<tr><th>Encoder Cable</th><th>CN1</th><td colspan="9">Twisted pair shield cable of 0.3 mm^2 or thicker *1</td></tr>
<tr><th>Control signal wire</th><th>CN2</th><td colspan="9">Twisted pair wire or twisted pair whole-shield cable (AWG24, 0.2 mm^2)</td></tr>
</table>

*1: We provide extension cables (3m/5m/10m) for motor cables (including brake cables) and encoder cables. For the combinations of HA-800B drivers, actuators and extension cables, refer to [Actuator and extension cable combinations] (P1-6).

*2: 1.25 mm^2 is used in case of 105℃ heat-resistant wires. If you use HIV cables, 2 mm^2 or thicker cables are recommended.

*3: 3.5 mm^2 is used in case of 105℃ heat-resistant wires. If you use HIV cables, 5.5mm^2 or thicker cables are recommended.

[Single phase 100V input]

		Min. allowable wire size (mm^2)				
Driver		HA-800B-1		HA-800B-3	HA-800B-6	
Combined actuator Combined motor		FHA-8C FHA-11C FHA-14C		FHA-17C	FHA-25C FHA-32C	SHA25 HMAB09 MAB09
For main circuit power supply	R, S	0.75		1.25	2.0	2.0
For control circuit power supply	r, s	0.75		1.25	1.25	
Motor cable *1	U, V, W, E	0.5	0.75	0.75	2.0 (1.25) *2	
Ground wire (FG)	Ground mark	3.5		3.5	3.5	
Regenerative resistor	R1, R2	1.25		1.25	1.25	
Encoder cable	CN1	Twisted pair shield cable of 0.3 mm^2 or thicker *1				
Control signal wire	CN2	Twisted pair wire or twisted pair whole-shield cable (AWG24, 0.2 mm^2)				

*1: We provide extension cables (3m/5m/10m) for motor cables (including brake cables) and encoder cables. For the combinations of HA-800B drivers, actuators and extension cables, refer to [Actuator and extension cable combinations] (P1-6).

*2: 1.25 mm^2 is used in case of 105℃ heat-resistant wires. If you use HIV cables, 2 mm^2 or thicker cables are recommended.

Connecting power cables

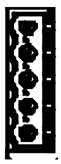
The following terminal block for power connection is provided on the display panel on the front face of this driver. Connect the power source cables to the respective terminals as shown below. If a 3-phase power supply is used, its phases can be arranged in any order.

HA-800B-1/3/6

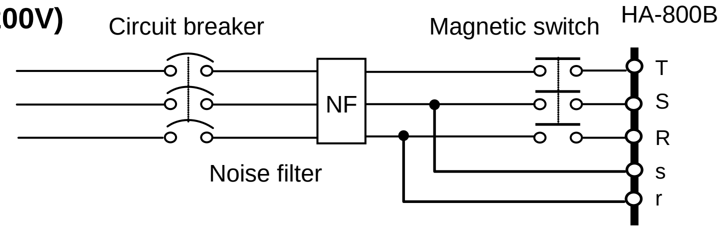
Terminal block for power connection (for TB2)

Manufacturer	Phoenix Contact
Model	FKC2,5/5-ST-5.08

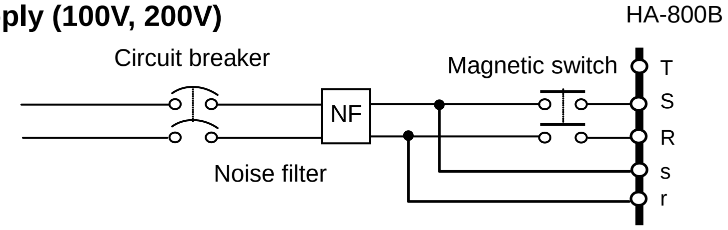
T
S
R
s
r



- **3-phase power supply (200V)**

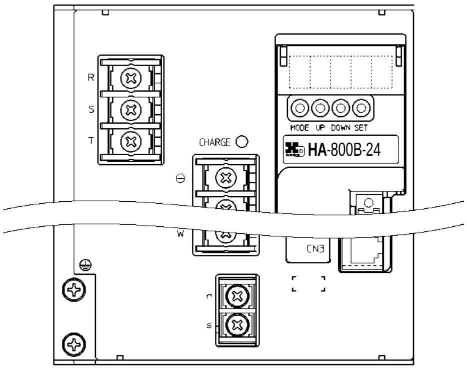


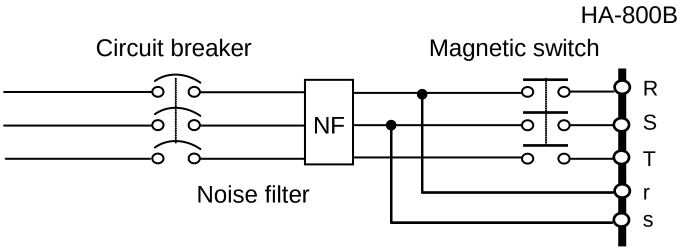
- **Single-phase power supply (100V, 200V)**



HA-800B-24

- **3-phase power supply (200V)**



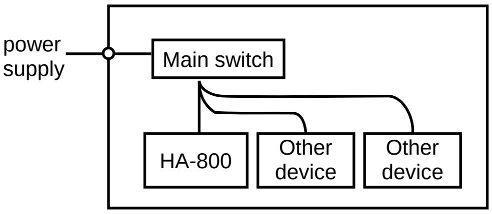


Terminal block for power connection

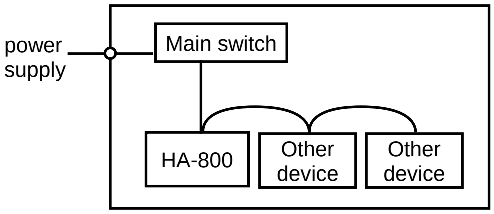
Terminal name	Screw size	Crimp terminal outer diameter	Reference
R, S, T ⏚	M4	ϕ8mm	Round crimp terminal (R-type) 3.5-R4 (J.S.T. Mfg. Co., Ltd.) 5.5-4NS (J.S.T. Mfg. Co., Ltd.)
r, s	M4	ϕ8mm	Round crimp terminal (R-type) R1.25-4 (J.S.T. Mfg. Co., Ltd.)

Caution

- With HA-800B-1/3/6, be sure to use a connector compatible with the terminal block for power connection (for TB2).
- With HA-800B-24, be sure to use a crimp terminal compatible with the terminal block for power connection.
- The power-receiving part of the driver adopts a surge-current-suppress-circuit. Although this circuit prevents extreme voltage drops when the power is input, avoid daisy-chain wiring between the power supply and devices and wire each device separately from the main power supply switch.



Good wiring example



Bad wiring example

2

Installation/wiring

Protecting power lines

Be sure to use a molded case circuit breaker (MCCB) in the power line to protect the power line.
Select an appropriate circuit breaker from the table below.

Input voltage	200V	200V	200V	200V	100V	200V	200V	200V		
Driver model	HA-800B -1-200	HA-800B -1-200	HA-800B -3-200	HA-800B -3-200	HA-800B -6-100	HA-800B -6-200	HA-800B -6-200	HA-800B-24-200		
Actuator motor	FHA-8C FHA-11C	FHA-14C	FHA-17C RSF-17	SHA20 SHA25 FHA-25C RSF-20 RSF-25 RKF-20 RKF-25 HMAC08 HMAB09 MAC08 MAB09	SHA25 HMAB09 MAB09	SHA32 FHA-32C RSF-32 RKF-32 HMAB12 MAB12	SHA40 FHA-40C MAB15	SHA40 SHA45 HMAB15 MAB15	SHA58 SHA65	HMAA21A MAA21
Rated current (A) of circuit breaker (MCCB)	3	5		10	15		20	30		
Required power capacity per driver (kVA) *1	0.15	0.25	0.4	0.8	0.8	1.5	1.8	2.5	3.5	5.5
Surge-current upon main circuit power ON (A) *2	15	15	15	15	8	15	15	15	15	15

*1: The values are for allowable continuous output of the actuator.

*2: The values are quoted at ambient temperature of 25℃.

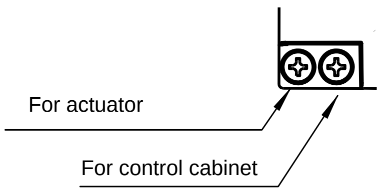
The above values are based on the standard input voltage (AC200V, AC100V).
The circuit breaker rated current is a recommended value for 3-phase AC200V input or single-phase AC100V input.

Connecting a ground wire

Use a ground wire of an appropriate size selected from the table below, or larger.

Cable	Symbol	Min. allowable wire size (mm^2)			
		HA-800B-1	HA-800B-3	HA-800B-6	HA-800B-24
Ground (FG) wire	Ground mark	3.5	3.5	3.5	3.5, 5.5

The HA-800B driver has 2 types of ground terminals, as shown below.
Make sure to use wire sizes in the table above or larger for the ground terminals and connect it using a round crimp terminal.
Make sure to connect a single wire to a single ground terminal.



Power ON and OFF sequences

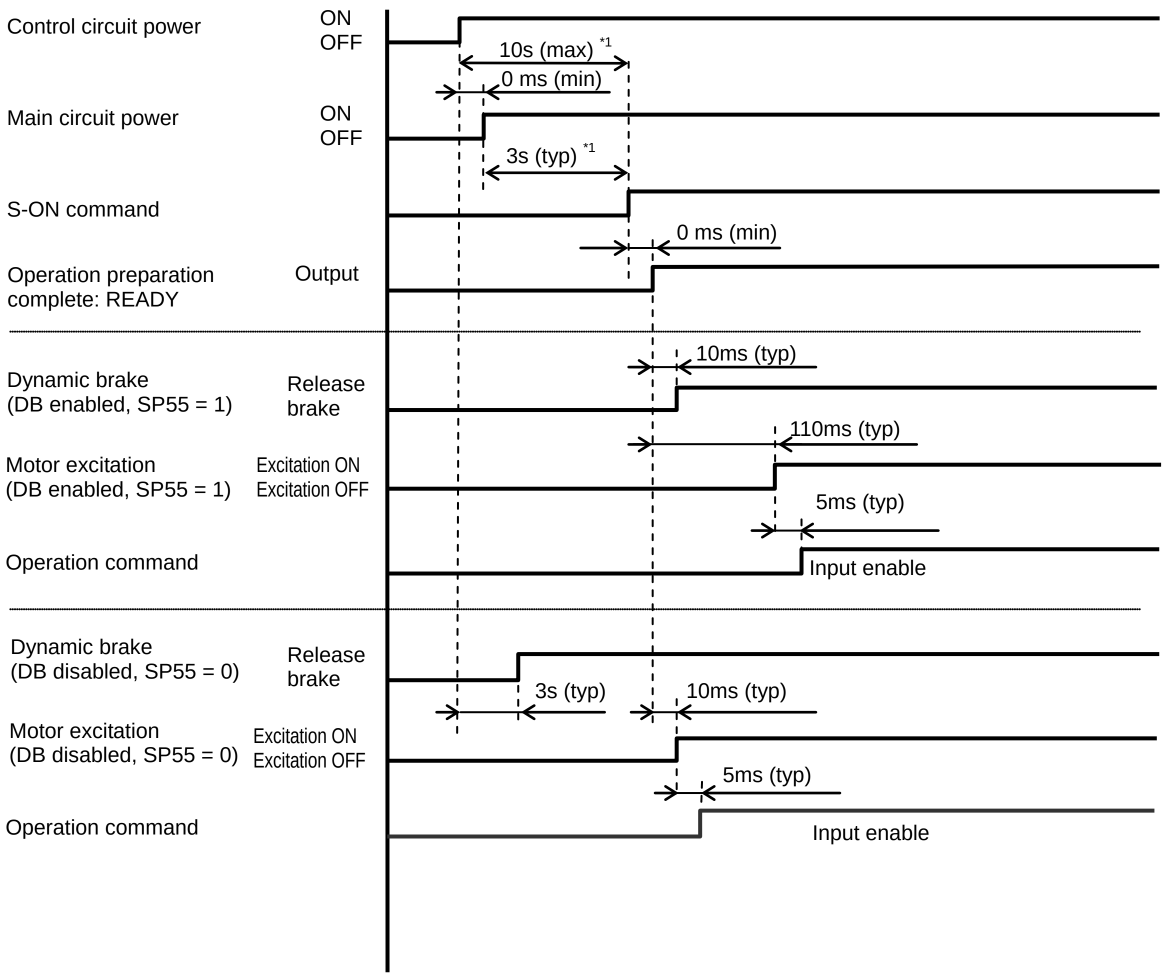
Povide a sequence circuit that cuts off the main circuit power ON/OFF switch in response to an emergency stop signal or the HA-800B driver's [CN2-10 Alarm: ALARM] signal.

Caution

- Turn ON/OFF the power after switching the servo lock of the HA-800B driver to OFF.
- If the power is turned ON/OFF too frequently, the surge-current limiting resistor in the internal circuit may deteriorate.
  The power ON/OFF frequency should not exceed 5 times in an hour and 30 times in a day. Furthermore, the interval between turning OFF and ON the power should keep more than 30 seconds.

Power ON sequence, servo-ON sequence (HA-800B-1, -3, -6)

Create a sequence program for the host device so that the power to this driver will be turned ON at the timings shown below. The chart below shows a power ON sequence based on a 17-bit absolute encoder system. I/O output and monitor output remain indeterminable for approximately 10 seconds after turning the control power supply ON.

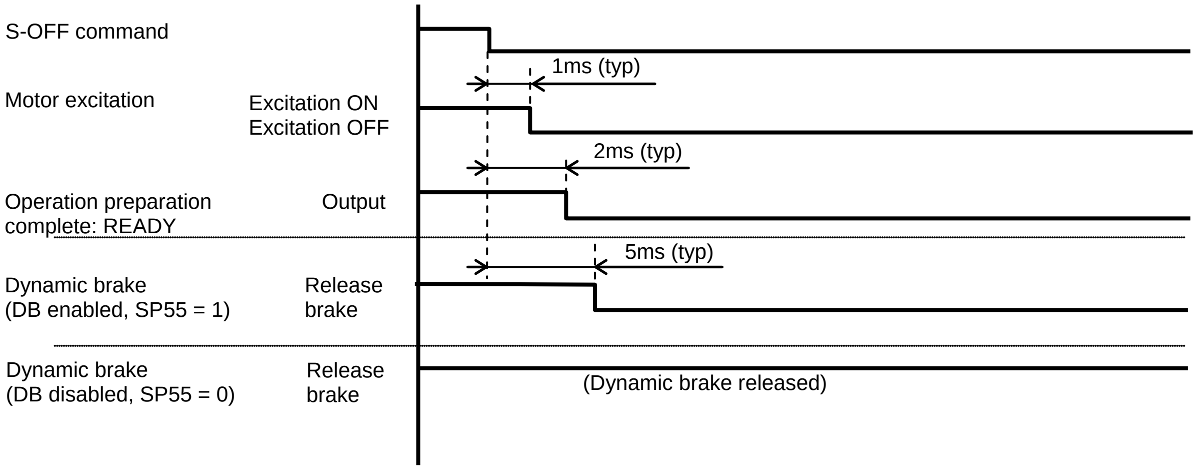


*1: This value is for when the control circuit power and main circuit power are turned ON simultaneously. If the main circuit power is turned ON approx. 7 seconds or more after the control circuit power, the S-ON command will be input after approximately 3 seconds, provided that the capacitor in the main circuit power has been discharged fully.

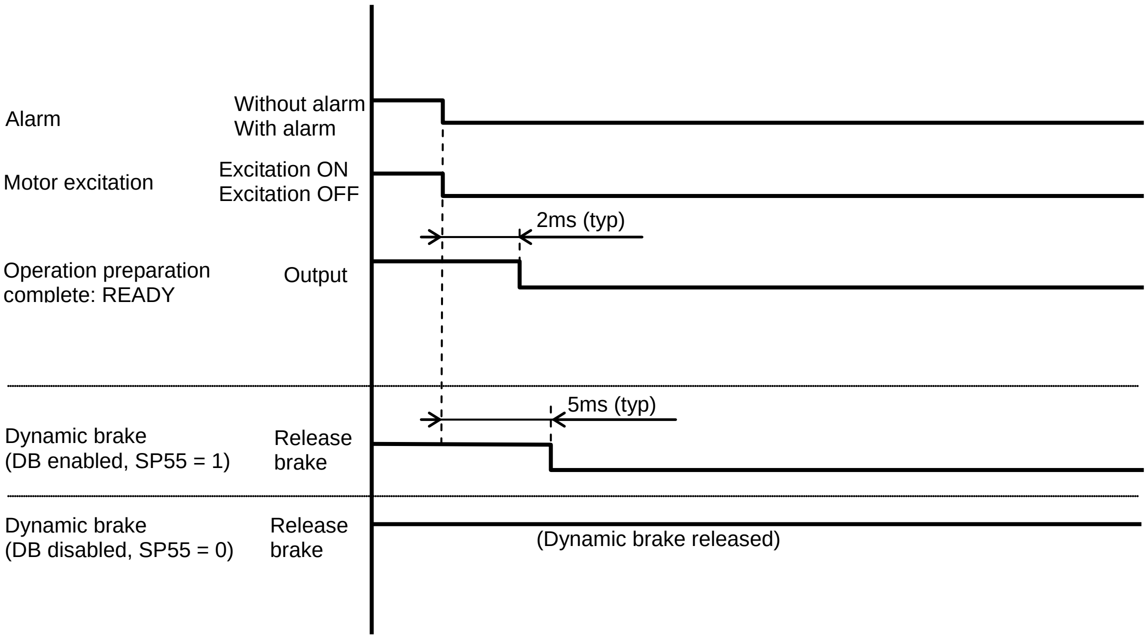
2

Installation/wiring

Servo-OFF sequence (HA-800B-1, -3, -6)

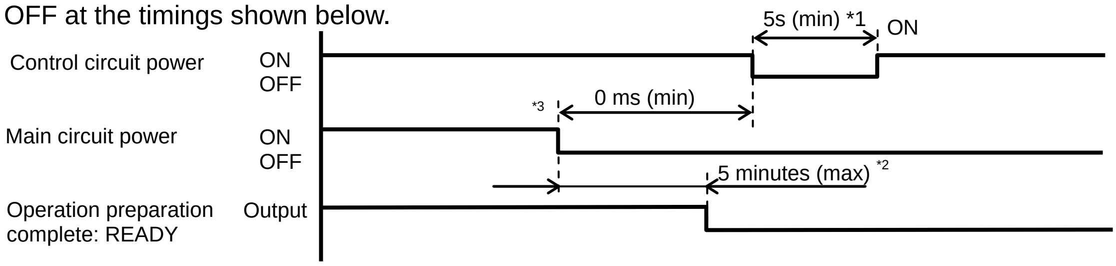


Sequence when an alarm generates (HA-800B-1, -3, -6)



Power OFF sequence (HA-800B-1, -3, -6)

Create a sequence program for the host device so that the power to this driver will be turned OFF at the timings shown below.



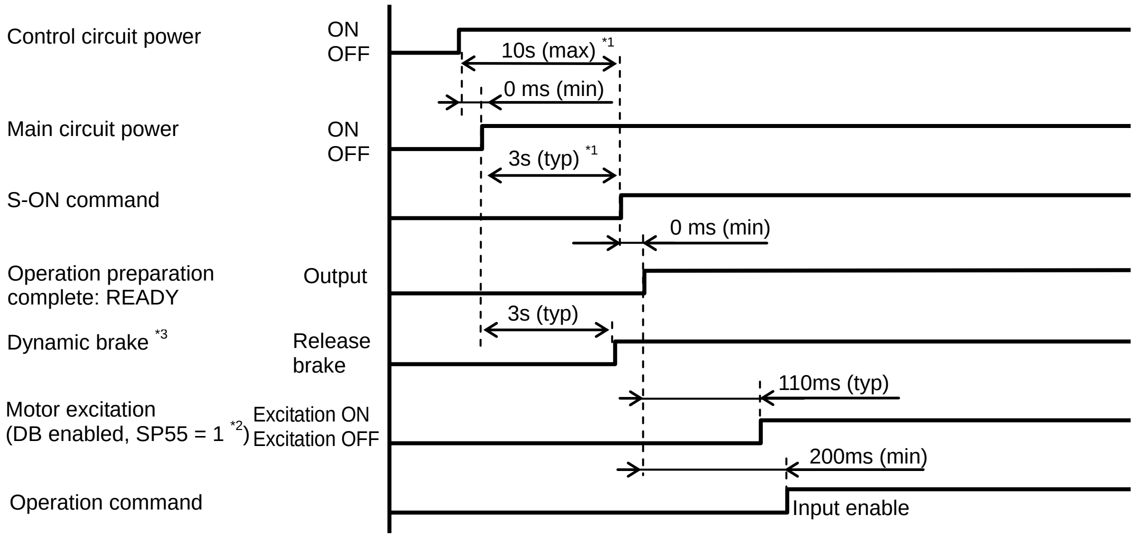
*1: After turning OFF the control circuit power, wait for at least 5 seconds before turning it ON.

*2: If the main circuit power is turned OFF while servo-OFF, it may take up to 5 minutes or so before the operation preparation complete signal (READY) turns OFF (main circuit DC voltage drop).
If the main circuit power is turned OFF while servo-ON, the motor excitation is continued until the operation preparation complete signal (READY) turns OFF (main circuit DC voltage drop). If the main circuit DC voltage does not drop due to regeneration operation, etc., it takes long until the motor excitation turns OFF. Turn the servo OFF first and then turn the main circuit power OFF, except when alarms are being generated.
If the main circuit power and control circuit power are turned OFF simultaneously, the operation preparation complete signal (READY) also turns OFF, but the capacitor for the main circuit power is still charged and therefore, do not touch the power terminals until the main circuit charge monitor LED on the front panel turns OFF (approximately 15 minutes).

*3: Turn the main circuit power OFF when the motor excitation is OFF (when the servo is OFF or an alarm is being generated).

Power ON, servo-ON sequence (HA-800B-24)

Create a sequence program for the host device so that the power to this driver will be turned ON at the timings shown below. The chart below shows a power ON sequence based on a 17-bit absolute encoder system. I/O output and monitor output remain indeterminable for approximately 10 seconds after turning the control power supply ON.

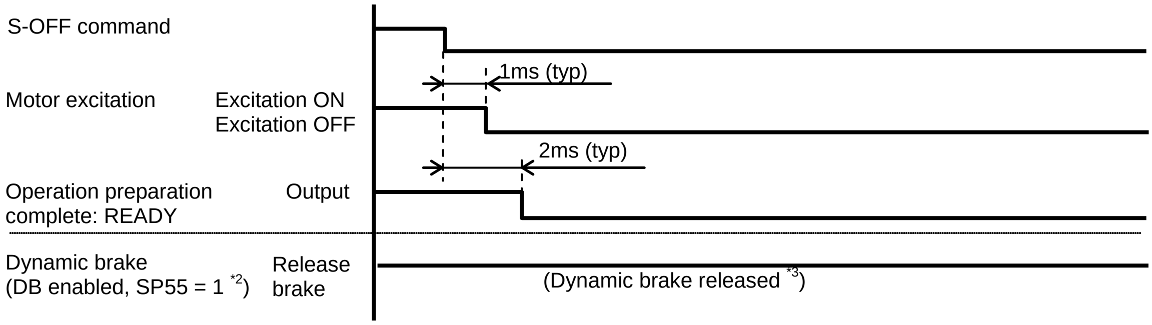


*1: This value is for when the control circuit power and main circuit power are turned ON simultaneously. If the main circuit power is turned ON approx. 7 seconds or more after the control circuit power, the servo ON enable signal will be output after approximately 3 seconds, provided that the capacitor in the main circuit power has been discharged fully.

*2: Make sure to use HA-800B-24 by setting [SP55 DB enable/disable setting] to 1 (default setting).

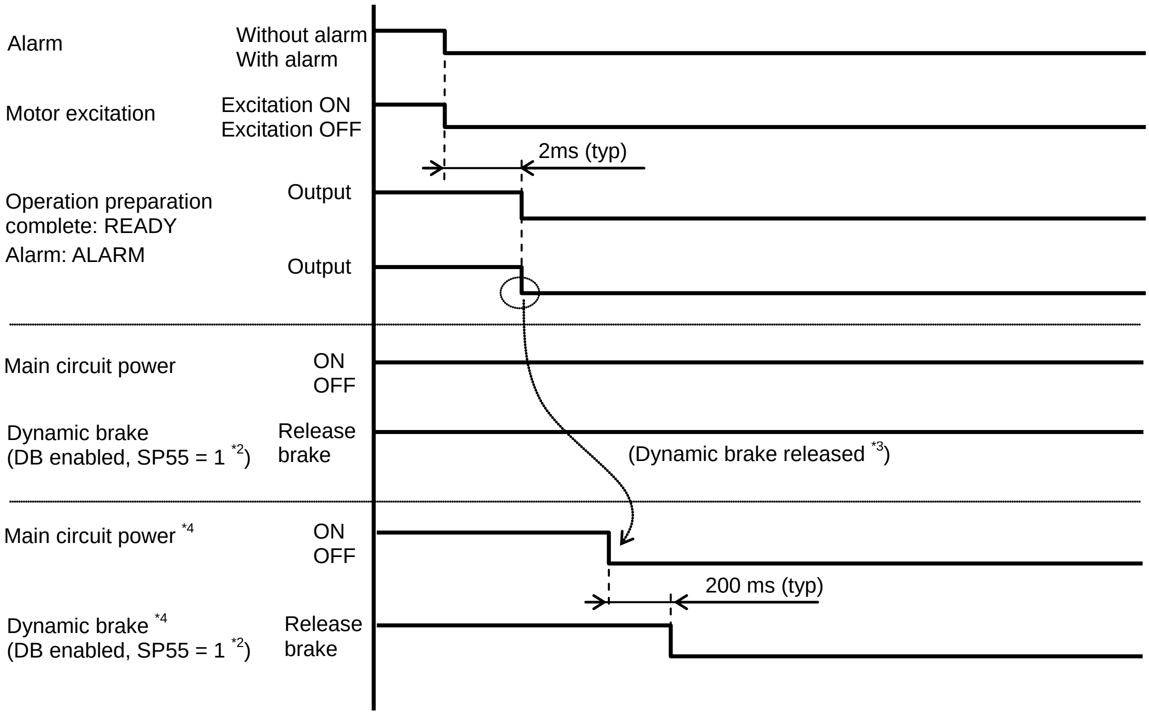
*3: The dynamic brake operates interlinked to the main circuit power.

Servo-OFF sequence (HA-800B-24)



*2: Make sure to use HA-800B-24 by setting [SP55 DB enable/disable setting] to 1 (default setting).
*3: The dynamic brake operates interlinked to the main circuit power.

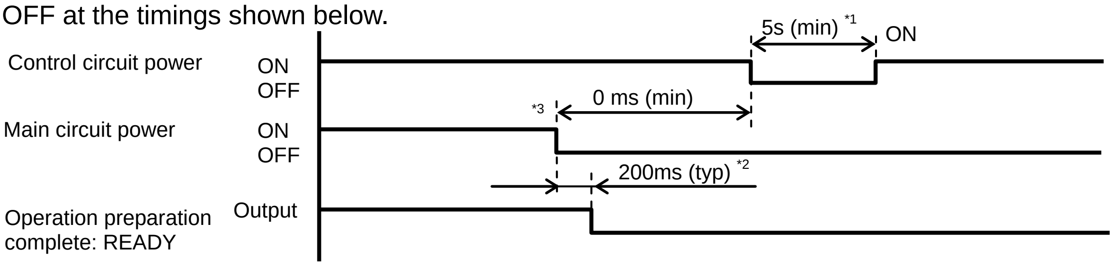
Sequence when an alarm generates (HA-800B-24)



*2: Make sure to use HA-800B-24 by setting [SP55 DB enable/disable setting] to 1 (default setting).
*3: The dynamic brake operates interlinked to the main circuit power.
*4: It is possible to use the dynamic brake by using output signal alarm output to cut off the main circuit power of the driver. By cutting off the driver's main circuit power, the main circuit discharge function is enabled, which lowers the main circuit DC voltage and activates the dynamic brake. However, if regenerative resistances is under high load such as regenerative resistor overheat alarm (AL41) and overregeneration alarm (AL42), the discharge function may not operate and the dynamic brake thus may not be activated.

Power OFF sequence (HA-800B-24)

Create a sequence program for the host device so that the power to this driver will be turned OFF at the timings shown below.



*1: After turning OFF the control circuit power, wait for at least 5 seconds before turning it ON.

*2: If you turn the main circuit power OFF, the operation preparation complete signal (READY) turns OFF in approximately 0.2 second due to the main circuit discharge function. However, if regenerative resistance is under high load such as regenerative resistor overheat alarm (AL41) and overregeneration alarm (AL42), the discharge function may not operate and it takes approximately 10 minutes to discharge.
If the main circuit power is turned OFF while servo-ON (during motor excitation), the motor excitation is continued until the operation preparation complete signal (READY) turns OFF (main circuit DC voltage drop). If the main circuit DC voltage does not drop due to regeneration operation, etc., it takes long until the motor excitation turns OFF. Turn the servo OFF first and then turn the main circuit power OFF, except when alarms are being generated.
If the main circuit power and control circuit power are turned OFF simultaneously, the motor excitation turns OFF in several 10 to 100 ms (the time varies depending on the input voltage). At this point, the operation preparation complete signal (READY) also turns OFF, but the capacitor for the main circuit power is still charged and therefore, do not touch the power terminals until the main circuit charge monitor LED on the front panel turns OFF (approximately 15 minutes).

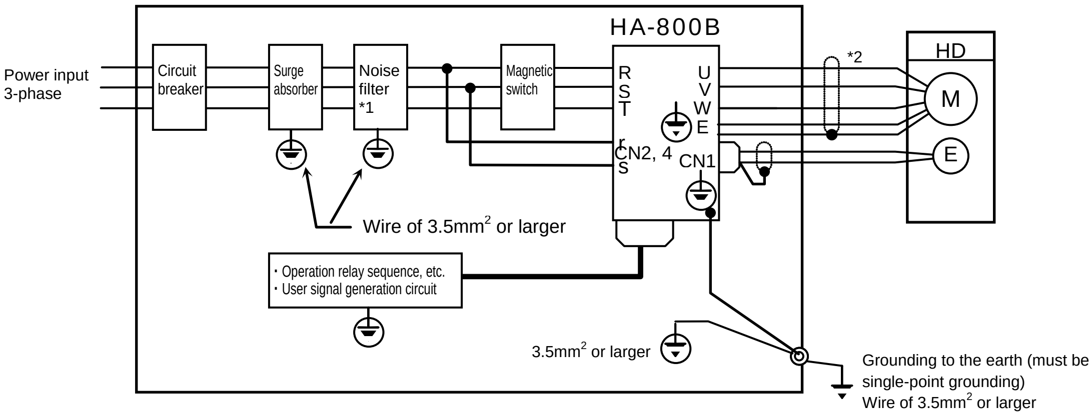
*3: Turn the main circuit power OFF when the motor excitation is OFF (when the servo is OFF or an alarm is being generated).

2-4 Suppressing noise

The main circuit of this driver uses a power element (IPM) based on PWM control. Switching noise generates due to sudden changes in current/voltage that occur when this element is switched. If there is a problem with the wiring and grounding, other external devices may malfunction or radio noise may generate.
This driver also has a CPU and other built-in electronic circuits. Accordingly, provide appropriate wiring and other measures to minimize malfunctions caused by external noise.
To prevent troubles caused by external noise, be sure to provide wiring and grounding as follows.

Grounding

Refer to the figure below when grounding all devices comprising the system.



*1: For information on grounding noise filters, refer to [Installing noise filters] (P2-16).
*2: FHA-17C to 40C actuators come with a shield connected to the body.

Grounding motor frame

When the actuator is grounded on the driven machine side through the frame, current flows through the floating capacity (Cf) of the motor from the power circuit of the driver. To avoid negative influence of the current, always connect the ground terminal (motor frame) of the actuator to the ground terminal of the driver, and connect the ground terminal of the driver directly to ground.

Grounding ducts

When the motor cables are housed in a metal conduit or a metal box, be sure to ground their metal parts.
Always connect the ground at a single point.

2

Installation/wiring

Installing noise filters

Use of noise filters is recommended to prevent malfunctions caused by impulse noise that may enter from the power line and also to prevent noise generating inside the driver from emitting to the power line.
When multiple drivers are used, install noise filters for each driver.
Select bi-directional noise filters that can suppress both external noise and internal noise.
Recommended noise filters are shown below.

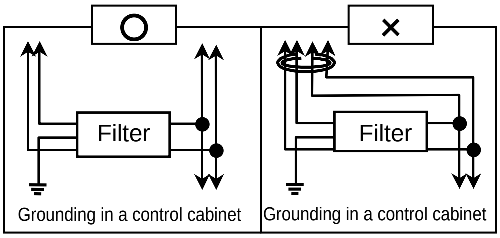
Model	Specifications	Manufacturer
RF3020-DLC	Rated voltage: Line-Line 440 to 550V, rated current: 20A	RASMI ELECTONICS LTD
RF3030-DLC	Rated voltage: Line-Line 440 to 550V, rated current: 30A	
RF3040-DLC	Rated voltage: Line-Line 440 to 550V, rated current: 40A	
HF3010A-UN	Rated voltage: 250VAC, rated current: 10A	Soshin Electric Co., Ltd.
HF3030A-UN	Rated voltage: 250VAC, rated current: 30A	
HF3040A-UN	Rated voltage: 250VAC, rated current: 40A	
SUP-P5H-EPR	Rated voltage: 250VAC, rated current: 5A	Okaya Electric Industries Co., Ltd.
SUP-P10H-EPR	Rated voltage: 250VAC, rated current: 10A	
3SUP-H5H-ER-4	Rated voltage: 250VAC, rated current: 5A	
3SUP-H10H-ER-4	Rated voltage: 250VAC, rated current: 10A	

EMC Directive conformance check tests are conducted by connecting the noise filter and toroidal core in the table above to the driver power input area.
For the measure to comply with EC Directives, refer to P18 in this manual.

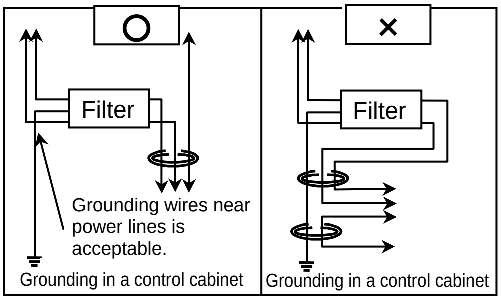
Caution

- Install the noise filters and this driver as close as possible with one another.
- Also install noise filters to the power source cables of electric devices other than this driver in the same manner.
  In particular, always install noise filters to sources of high-frequency, such as electric welders and electrical-discharge processing machines.
- Incorrect use of noise filters can reduce its effectiveness by half. Install noise filters by referring to the cautionary information provided below.

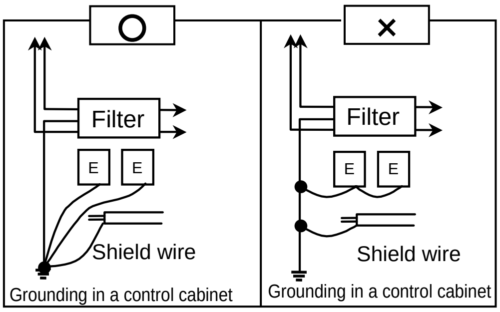
  - Separate the filtered wires and unfiltered wires from each other. Do not place them in the same pipe or duct, or bundle them together.



  - Do not place the ground wire and filtered wires in the same pipe or duct, or bundle them together.



  - Do not daisy-chain ground wires, but connect one ground wire separately to each device or to a single point on the control cabinet or ground plate.



- Be sure to install surge protector devices to coils of magnetic relays, magnetic switches (contactors), solenoids, etc.
- Do not open the end of analog input signal cables such as speed signal cables.
- Since this driver is designed for industrial use, it incorporates no measures to prevent radio interference.
  If the driver is used in the following environments, connect line filters to the input side of the power source cable:
  - Used near houses
  - Where radio interference may present problems

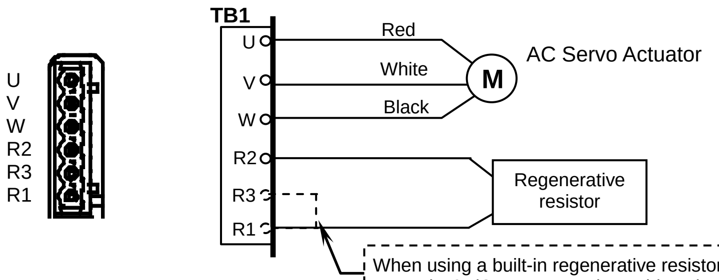
2-5 Wiring the driver and motor

The following explains how to wire this driver and motor.

Connecting the motor

Connect the motor by connecting the U, V and W terminals of the TB1 connector, as shown below.
Refer to the actuator manual to check the phase order of motor cable wires beforehand, and connect each pair of terminals that have the same symbol. Take note that if the phase order is wrong or any of the phases is missing, alarms, etc., will not generate.
The optional yellow and blue motor relay cables are used to connect the power supply (24 DCV, no polarity) for releasing the brake on actuators that have a brake. For actuators without a brake, the cables need not to be connected.

[HA-800B-1/-3/-6]



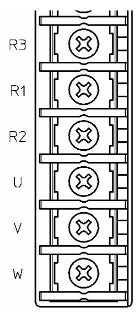
When using a built-in regenerative resistor with the HA-800B-3/6, short-circuit the R1 and R3. (On our extension cables, these terminals are already short-circuited with a short bar.)
When using an external regenerative resistor, keep R1 and R3 open and connect the regenerative resistor between R1 and R2.

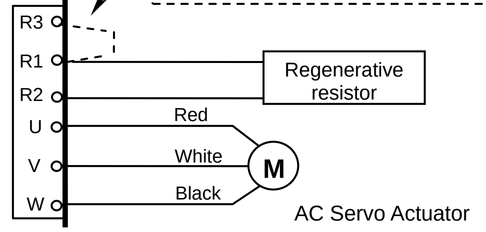
Terminal block for motor connection (for TB1)

Manufacturer	Phoenix Contact
Model	FKIC2.5/6-ST-5.08

[HA-800B-24]

When using a built-in regenerative resistor with the HA-800B-24, short-circuit the R1 and R3. (These terminals are already short-circuited with a short bar as default.)
When using an external regenerative resistor, keep R1 and R3 open and connect the regenerative resistor between R1 and R2. If an external regenerative resistor is not used, do not open the short bar. If the short bar is open, the main circuit discharge function will not operate.





Terminal block for motor connection

Screw size	Crimp terminal outer diameter	Reference
M4	ϕ8mm	Round crimp terminal (R-type) 3.5-R4 (J.S.T. Mfg. Co., Ltd.) 5.5-4NS (J.S.T. Mfg. Co., Ltd.)

WARNING

If the phase order of the motor cable is wrong or any wire is disconnected or connected during operation, an uncontrollable operation may result.

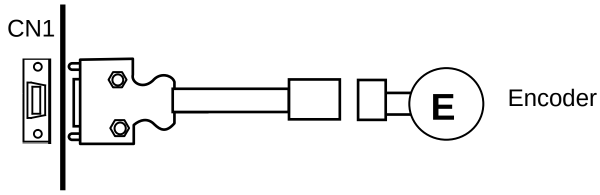
Caution

- With HA-800B-1/3/6, be sure to use a connector compatible with the terminal block for motor connection (for TB1).
- With HA-800B-24, be sure to use a crimp terminal compatible with the terminal block for motor connection.

Connecting the encoder

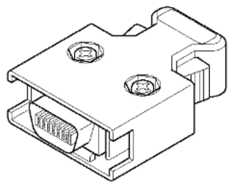
To connect the encoder, connect the CN1 connector, as shown below.
For the encoder signal wire, use a twisted pair shield cable with a wire size of 0.3 mm^2 or larger and having the necessary number of cores.
Shorten the wiring length as much as possible.

If provided by the customer
Wiring length: 10m or less   Wire conductivity: 0.04Ω/m or less
We have optional
cables of 3m/5m/10m long.



Encoder connector (CN1)

	Connector	Cover
Manufacturer	3M	3M
Model	10114-3000PE	10314-52F0-008



Pin layout of encoder connector (CN1)

The pin layout shown below is viewed from the soldered side.

4-wire wire-saving incremental encoder

6	4	2	
NC	NC	NC	
7	5	3	1
$\overline{SD}$	SD	NC	+5V
13	11	9	
NC	NC	NC	
14	12	10	8
NC	NC	NC	0V

13-bit absolute encoder

6	4	2	
CLR	BAT-	BAT+	
7	5	3	1
$\overline{SD}$	SD	NC	+5V
13	11	9	
NC	NC	NC	
14	12	10	8
NC	NC	NC	0V

17-bit absolute encoder

6	4	2	
NC	BAT-	BAT+	
7	5	3	1
$\overline{SD}$	SD	NC	+5V
13	11	9	
NC	NC	NC	
14	12	10	8
NC	NC	NC	0V

14-wire incremental encoder

6	4	2	
$\overline{Z}$	$\overline{B}$	B	
7	5	3	1
$\overline{A}$	A	Z	+5V
13	11	9	
W	V	U	
14	12	10	8
$\overline{W}$	$\overline{V}$	$\overline{U}$	0V

(*: In the 17-bit encoder incremental model, there is no need to connect BAT+/BAT-.)

Caution

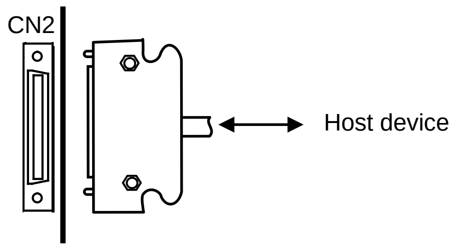
- Do not connect NC terminals. If NC terminals are connected by mistake, malfunctions may result.

2-6 Wiring the host device

The following explains wiring of this driver and host device.

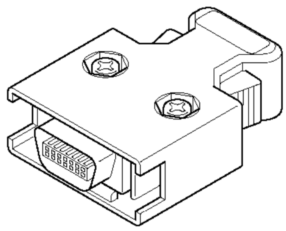
Connecting the host device

To connect the host device, connect the CN2 connector, as shown below.
For the I/O signal cable, use a twisted pair shield cable or twisted pair whole-shield cable with a wire size of 0.2 mm2 (AWG24) and having the necessary number of cores.



I/O signal connector (CN2)

	Connector	Cover
Manufacturer	3M	3M
Model	10120-3000PE	10320-52F0-008



Pin layout of I/O signal connector (CN2)

The pin layout shown below is viewed from the soldered side.

10 ALARM	8 ORG-END	6 IN-COM	4 LATCH 2	2 REV-IH
9 FINISH	7 READY	5 ORG	3 LATCH 1	1 FWD-IH
20 FG	18 MON-GND	16 MON-Z+	14 MON-B+	12 MON-A+
19 --	17 MON-Z-	15 MON-B-	13 MON-A-	11 OUT-COM

Caution

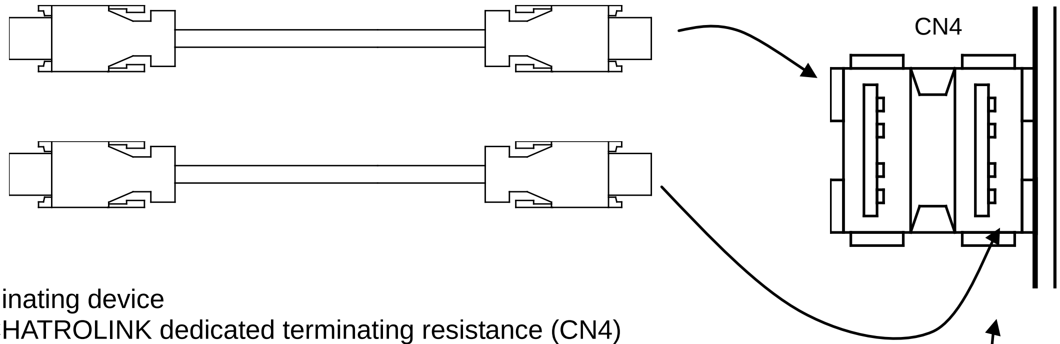
- Keep the I/O signal cable to 3m or shorter.
- Separate power cables (power source cables and motor wires and other circuits subject to strong electric power) and I/O signal cables by more than 30cm. Do not encase them in the same pipe or duct, nor bundle them together.
  Do not open the end of cables for analog input signals, such as speed signals.

Connecting the MECHATROLINK connector

Connect HA-800B using a dedicated communication cable manufactured by YASKAWA Controls Co., Ltd. (JEPMC-W6002-A5-E, etc.). Connect a terminating resistance (JEPMC-W6022) at the end of the device.

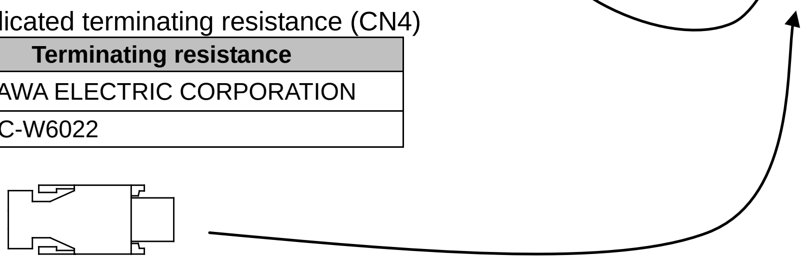
MECHATROLINK dedicated communication cable (CN4)

	Cable
Manufacturer	YASKAWA ELECTRIC CORPORATION
Model	JEPMC-W6002-A5-E, etc.



Terminating device
MECHATROLINK dedicated terminating resistance (CN4)

	Terminating resistance
Manufacturer	YASKAWA ELECTRIC CORPORATION
Model	JEPMC-W6022



Connecting the personal computer (PSF-800)

To connect to the personal computer, use dedicated communication cable or refer to the following pin layout.
Dedicated communication cable: EWA-RS03 (option)
Cable length: 1.6m

PSF-800 communication connector (CN3)

	Connector
Manufacturer	Hirose Electric Co., Ltd.
Model	TM11P-66P (53)

Connector on the personal computer side (D-sub 9-pin female)

	Socket	Hood	Jack screw
Manufacturer	OMRON Corporation	OMRON Corporation	OMRON Corporation
Model	XM2D-0901	XM2S-0913	XM2Z-0073

Pin layout of PSF-800 communication connector (CN3)

Driver side

Symbol	Pin No.
TxD	1
GND	2
NC	3
NC	4
GND	5
RxD	6
-	-
-	-
-	-

Personal computer side

Pin No.	Symbol
1	-
2	TxD
3	RxD
4	-
5	GND
6	-
7	-
8	-
9	-

The PC and HA-800B driver communicate via RS-232C.
Do not wire the NC (3 and 4 pins).

Chapter 3

Startup

Startup procedures to be followed when the driver is used for the first time, from receiving inspection to operation of the actual system, are explained in this chapter.

3-1 Startup procedures ··· 3-1
3-2 Turning ON the power for the first time ··· 3-3
3-3 Operation check with the actuator alone ··· 3-9
3-4 Operation check with the actual system ··· 3-12
3-5 Manual gain adjustment method ··· 3-14
3-6 Normal operation ··· 3-21

3-1 Startup procedures

The following explains the procedures to start up this driver.

WARNING

Shut off the electric power source on the plant side before any wiring works are carried out. Once the electric power on the plant side is supplied to the system, do not perform any wiring works. Electric shock may result.

CAUTION

(1) Check the wirings again and correct the problems, if any, before turning ON the power.
- **Are all wirings correct?**
- **Are there temporarily wired lines?**
- **Are there any loose terminal connections?**
- **Are the wires grounded properly?**

(2) Clean around the devices. In particular, thoroughly inspect the interior of the system for wire chips, tools and other objects remaining inside the system.

(3) When 2 or more persons are working together, they should discuss the details of work before turning ON the power and each person should pay attention to the safety of others.

(4) Do not operate the driver by turning ON/OFF the power.
- **Frequent power ON/OFF operations may cause deterioration of circuit elements inside the driver.**
- **Start/stop the actuator using command signals.**

Startup procedures

Key startup procedures are as follows:

1. Check before turning ON the power for the first time
   ↓
2. Operation check with the actuator alone in the actual control mode
   ↓
3. Operation check with the actual system
   ↓
4. Normal operation

Refer to: [Turning ON the power for the first time] (P3-3)

Refer to: [Operation check with the actuator alone] (P3-9)

Refer to: [Operation check with the actual system] (P3-12)

Refer to: [Normal operation] (P3-21)

3-2 Turning ON the power for the first time

The following explains the startup procedure when turning ON the power for the first time.

CAUTION

(1) Be sure to perform a trial run before commencing the normal operation.
(2) In a trial run, separate the actuator from the machine/system and operate the actuator alone (under no load).

Receiving inspection	Check the nameplate attached on the right side face of the driver to see if the driver and actuator combination is correct. Refer to: [Receiving inspection] (P2-1)
↓ Check the installation location	Check the installation environment of the driver. Refer to: [Installation location and installation] (P2-2)
↓ Check the wirings	Check the wirings of power source cable, motor wire, encoder wire and I/O signal cables. Refer to: [Connecting power cables] (P2-6)
↓ Turn ON the control power supply	Turn ON the control power supply. The sequence of the driver's LED display varies depending on the encoder equipped in the actuator. For the absolute encoder, AL53 and AL81 are generated. Execute [T08: multi revolution clear] and turn the control power OFF then ON to reconnect the power. Refer to: [Details on control power supply ON] (P3-4, 3-5)
↓ Turn ON the main power supply	Turn ON the main power supply.
↓ JOG operation with the actuator alone in the test mode	Perform rotary operations via JOG operation to confirm that the power supply, motor and encoder are wired correctly. Refer to: [Chapter 9 Test mode]

Details on control power supply ON

The driver's internal process sequence to be implemented upon power ON varies depending on the connected actuator.

(1) When a 17-bit absolute encoder (17-bit encoder incremental model) (SHA series, FHA-Cmini series, HMA series) is combined (P3-4)
(2) When a 13-bit absolute encoder (FHA-C series) is combined (P3-5)
(3) When a 4-wire-saving incremental encoder (FHA-Cmini series) is combined (P3-6)
(4) When a 4-wire-saving incremental encoder (FHA-C series) or 14-wire incremental encoder is combined (P3-7)

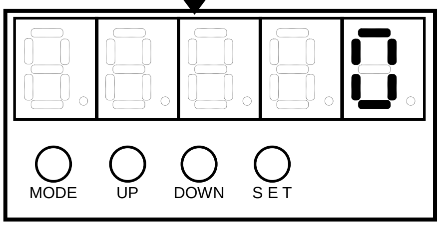
(1) When a 17-bit absolute encoder (SHA series, FHA-Cmini series, HMA series) is combined

1 Turn ON the control circuit power.

Check the driver and actuator combination as well as the input voltage and multi revolution data of the absolute encoder.

Normal

Abnormal



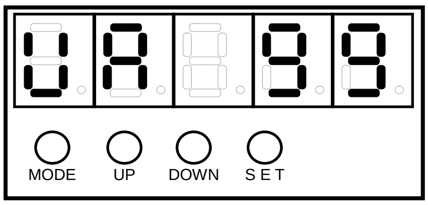
2 The system switches to the status display mode.

The default setting is to display the motor rotation speed.

If multiple alarms or warnings have occurred, the applicable alarms/warnings are displayed one by one.

- **If the actuator combination is wrong**

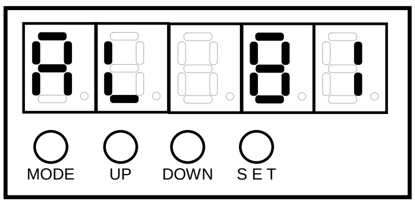
As shown on the right, [UA99: Wrong actuator connected] is displayed.



Action to be taken
The combined actuator is specified on the nameplate attached on the right side face of the driver.
Shut off the control circuit power, and exchange the actuator to the correct one. After connecting the correct actuator, turn ON the power again to confirm that the system starts correctly.

- **Absolute multi revolution data error**

This error occurs when the power is turned ON for the first time or the actuator has been disconnected from the driver for an extended period of time (approximately 30 minutes or more).
As shown to the left, [AL 81: System down] is generated.



Action to be taken
Issue a multi revolution clear command. After the multi revolution clear command, reconnect the driver power.
For the method to clear the multi revolution counter, refer to [T08: Multi revolution clear](P9-8).

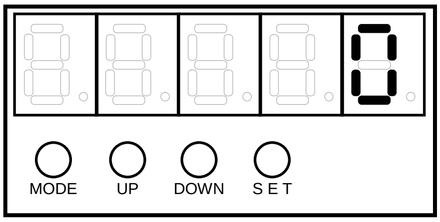
(2) When a 13-bit absolute encoder (FHA-C series) is combined

1 **Turn ON the control circuit power.**

Check the input voltage and multi revolution data of the absolute encoder.

Normal

Abnormal



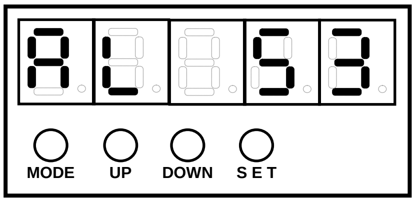
2 **The system switches to the status display mode.**

The default setting is to display the motor rotation speed.

If multiple alarms or warnings have occurred, the applicable alarms/warnings are displayed one by one.

● **Absolute multi revolution data error**

This error occurs when the power is turned ON for the first time or the actuator has been disconnected from the driver for an extended period of time (approximately 30 minutes or more).
As shown to the left, [AL 53: System down] is generated.



Action to be taken

Issue a multi revolution clear command. After the multi revolution clear command, reconnect the driver power.
For the method to clear the multi revolution counter, refer to [T08: Multi revolution clear](P9-8).

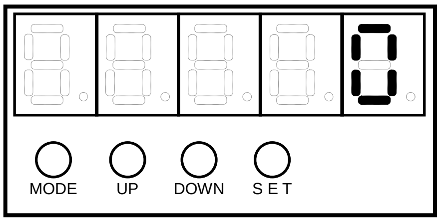
(3) When a 4-wire-saving incremental encoder (FHA-Cmini series) is combined

1 **Turn ON the control circuit power.**

Check the driver and actuator combination.

Normal

Abnormal



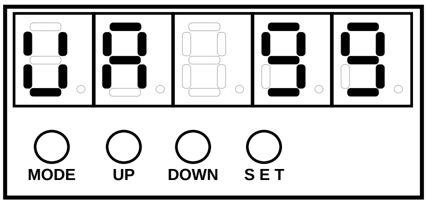
2 **The system switches to the status display mode.**

The default setting is to display the motor rotation speed.

If multiple alarms or warnings have occurred, the applicable alarms/warnings are displayed one by one.

● **If the actuator combination is wrong**

[UA99: Wrong actuator connected] is displayed.



Action to be taken

The combined actuator is specified on the nameplate attached on the right side face of the driver.
Shut off the control circuit power, and exchange the actuator to the correct one. After connecting the correct actuator, turn ON the power again to confirm that the system starts correctly.

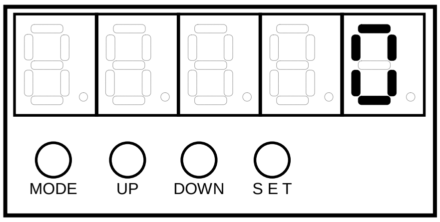
3
Startup

(4) When a 4-wire-saving incremental encoder (FHA-C series) or 14-wire incremental encoder is combined

1 **Turn ON the control circuit power.**

Normal

Abnormal



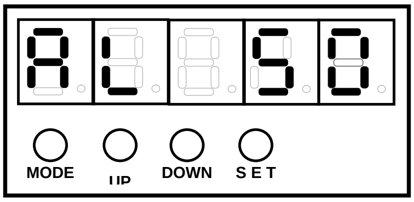
2 **The system switches to the status display mode.**

The default setting is to display the motor rotation speed.

If multiple alarms or warnings have occurred, the applicable alarms/warnings are displayed one by one.

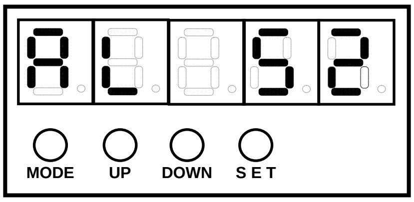
- **Wrong wiring**

If there are any problems in wiring the phase A, B, and Z signals, phase U, V, and W and/or power supply, [AL 50: Encoder disconnection] is generated.



- **Wrong wiring**

If there are any problems in wiring of phase U, V, and W signals and/or power supply of the encoder, [AL 52: UVW error] is generated.



Troubleshooting upon power ON

Description of operation	Description of problem	Check item	Estimated cause	Reference
Power ON	The LED display does not turn ON.	The situation improves when the CN1 connector is unplugged.	● Insufficient input voltage or poor power connection ● Defective driver	P2-6 P2-7
		The situation improves when the CN2 connector is unplugged.	● Insufficient input voltage or poor power connection ● Defective driver	
		The situation does not improve even after unplugging the CN1 and CN2 connectors and wires.	● Insufficient input voltage or poor power connection ● Defective driver	
	An alarm generates.	Refer to [Chapter 11 Troubleshooting].		Chapter 11
	AL53 and AL81 are generated.	Execute the multi revolution clear, then reconnect the power.		P9-8
JOG operation	Does not rotate.	Is the motor wire connected correctly?	● Poor motor wire connection ● Defective driver ● Defective actuator	P2-18
	The rotation direction is reversed.			
	An alarm generates.	Refer to [Chapter 11 Troubleshooting].		Chapter 11

3-3 Operation check with the actuator alone

The following explains the operation check procedure on the motor alone before the motor is assembled into the system.

CAUTION

(1) Be sure to perform a trial run before commencing the normal operation.
(2) In a trial run, separate the actuator from the machine/system and operate the actuator alone (under no load).

Input signal logical setting ↓	Make sure to set the logic specification as needed if you use the input signal. Refer to: [SP62: Input signal logic setting] (P8-7)
Output signal logic setting ↓	Make sure to set the logic specification as needed if you use the output signal. Refer to: [SP63: Output signal logic setting] (P8-8)
Set the function extension mode ↓	As necessary, change the function settings of the driver. Check the settings for parameters that strongly affect operation. Refer to: [Chapter 8 System parameter mode]
Check the I/O wirings and logics in the test mode. ↓	Check the wirings of driver signals input from the host, as well as driver outputs and host signal wirings/logics, in the test mode. Refer to: [Chapter 9 Test mode]
Operate from the host controller	Perform actual operations according to the actual operation commands from the host controller. Refer to: [Chapter 13 MECHATROLINK communication function]

Troubleshooting at operation check

Position control mode

Operation	Description of problem	Check item	Estimated cause	Reference
Servo-ON input	The servo does not lock.	Is the motor wire connected correctly?	Poor motor wire connection	P2-18
		Is warning code [93: Main circuit voltage low] generated?	The main circuit voltage is not input or lower than the warning 93 threshold.	P2-6
	An alarm generates.	Refer to [Chapter 11 Troubleshooting].		Chapter 11
Operation command input	The actuator does not rotate.	Is the motor wire connected correctly?	Wrong motor wire UVW connection	P2-18
		Is the FWD or REV inhibit input enabled?	The inhibit input in non-rotatable direction is enabled.	P5-5
	The rotation direction *1 is reversed.	Check the command program.	Wrong operation program setting	P13-6
		Check the command polarity.	Parameter setting error	P8-5
	An alarm generates.	Refer to [Chapter 11 Troubleshooting].		Chapter 11

*1: The rotation polarity varies depending on the actuator model. Refer to the manual of your actuator.

Speed control mode

Operation	Description of problem	Check item	Estimated cause	Reference
Servo-ON input	The servo does not lock..	Is the motor wire connected correctly?	Poor motor wire connection	P2-18
		Is warning code [93: Main circuit voltage low] generated?	The main circuit voltage is not input or lower than the warning 93 threshold.	P2-6
	An alarm generates.	Refer to [Chapter 11 Troubleshooting].		Chapter 11
Speed command (VELCTRL: 3CH) input	The actuator does not rotate.	Is the motor wire connected correctly?	Wrong motor wire UVW connection	P2-18
		Monitor the I/O statuses using PSF-800 software.	Incorrect input signal	P5-5
		Is the FWD or REV inhibit input enabled?	The FWD/REV inhibit inputs are enabled.	P5-5
		The speed command value is 0.	Check the speed command set value.	P13-27
	The rotation direction *1 is reversed.	Is the speed command value input correctly?	Check the speed command set value.	P13-27
		Check the command polarity.	Parameter setting error	P8-5
	An alarm generates.	Refer to [Chapter 11 Troubleshooting].		Chapter 11

*1: The rotation polarity varies depending on the actuator model. Refer to the manual of your actuator.

Torque control mode

Operation	Description of problem	Check item	Estimated cause	Reference
Servo-ON input	The motor is not excited.	Is the motor wire connected correctly?	Poor motor wire connection	P2-18
		Is warning code [93: Main circuit voltage low] generated?	The main circuit voltage is not input or lower than the warning 93 threshold.	P2-6
	An alarm generates.	Refer to [Chapter 11 Troubleshooting].		Chapter 11
Torque command (TRQCTRL: 3DH) input	The actuator does not rotate.	Is the motor wire connected correctly?	Wrong motor wire UVW connection	P2-18
		Monitor the I/O statuses using PSF-800 software.	Incorrect input signal	P5-5
		The torque command value is 0.	Check the torque command set value.	P13-28
		Is the FWD or REV inhibit input enabled?	The FWD/REV inhibit inputs are enabled.	P5-5
	The rotation direction *1 is reversed.	The torque command value is not input correctly.	Check the torque command set value.	P13-28
		Check the command polarity.	Parameter setting error	P8-5
	An alarm generates.	Refer to [Chapter 11 Troubleshooting].		Chapter 11

*1: The rotation polarity varies depending on the actuator model. Refer to the manual of your actuator.

3-4 Operation check with the actual system

The following explains the operation checking procedure to be performed using the applicable system assembled with the motor.

WARNING

If this product is applied to any facility that affects life or may trigger material losses, install safety devices so that accidents will not occur even when the output control is disabled due to damage.

Step	Description
Assemble into the actual system	Assemble the system into the ultimate condition to be used.
↓	
Perform auto-tuning in the test mode	Perform auto-tuning in the offline test mode to set an appropriate gain. Refer to: [Chapter 9 Test mode]
↓	
Manually adjust the gain	Issue operation commands from the host controller and check how the machine moves. If the machine movements must be calibrated further, manually adjust the gain. Refer to: [Manual gain adjustment method] (P3-14)
↓	
Set the origin using the absolute encoder	This is necessary only on models equipped with an absolute encoder. Refer to: [Origin setting] (P4-7, 4-15)
↓	
Operate from the host controller	Perform actual operations according to the actual operation commands from the host controller. Refer to: [Chapter 5 I/O signals], [Chapter 13 MECHATROLINK communication function]
↓	
Stop	

3

Startup

Troubleshooting at actual operation check

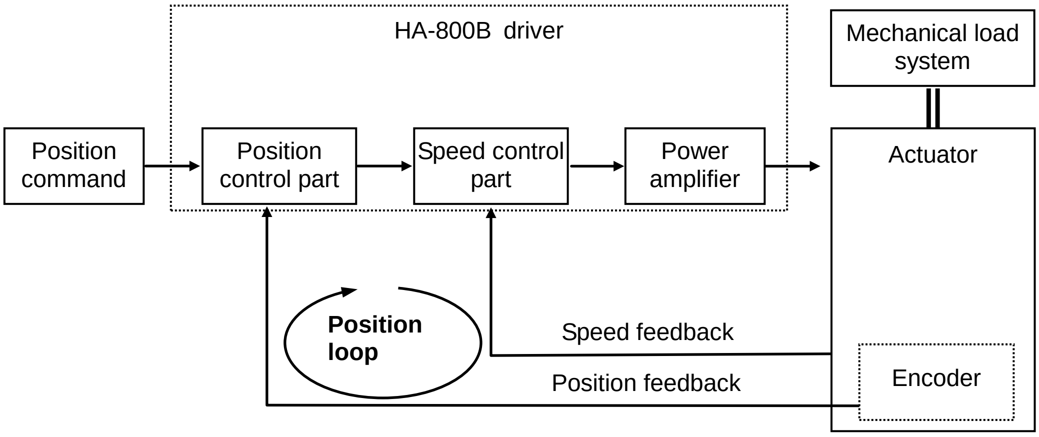
Operation	Description of problem	Check item	Estimated cause	Reference
Auto-tuning	Significant vibration does not decrease even after tuning.	Is the startup or shutdown time too short?	Host controller setting error	P9-9
		Is the load inertia too big?	Actuator selection error	
	An alarm generates.	Refer to [Chapter 11 Troubleshooting].		Chapter 11
Manual gain adjustment	Vibration does not decrease even after adjusting the gain.	Check the servo gain set value.	Servo gain setting error	P3-14
		Is the startup or shutdown time too short?	Host controller setting error	
		Is the load inertia too big?	Actuator selection error	
	An alarm generates.	Refer to [Chapter 11 Troubleshooting].		Chapter 11

3-5 Manual gain adjustment method

If sufficient adjustment could not be achieved by auto-tuning, manual adjustment can be performed using various parameters.
When manually adjusting the servo gain, adjust the gains of individual servos one by one. Check the response characteristics using the HA-800B driver monitor software PSF-800 waveform monitoring. Prepare a measuring instrument to observe monitored output waveforms to CN9.

Position control

A block diagram of position control is shown below.



Parameters

The following parameters are used to adjust the position control gain.

Parameter No.	Description	Default
AJ00	Position loop gain	*1
AJ01	Speed loop gain	*1
AJ02	Speed loop integral compensation	*1

*1: The default varies depending on the applicable actuator. Refer to the values of applicable actuator that are the targets of [Appendix: Default setting] (Apx-1).

Adjustment procedure

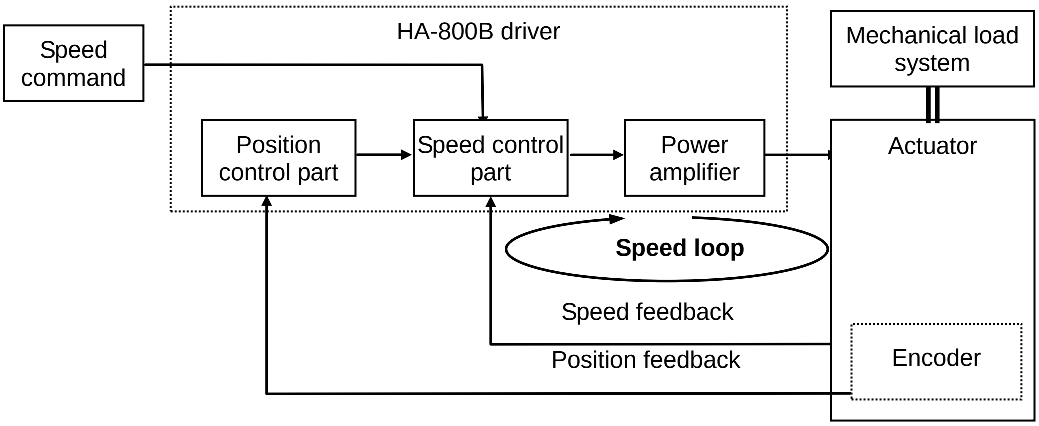
1. **Perform rough adjustment via auto-tuning. Refer to [T09: Auto-tuning] (P9-9).**
2. **Set a smaller position loop gain (AJ00) and larger speed loop integral compensation (AJ02).**
3. **Gradually increase the speed loop gain (AJ01) to the extent that the machine does not vibrate or produce abnormal sound, and once vibration or abnormal sound is detected decrease the gain slightly.**
4. **Gradually decrease the speed loop integral compensation (AJ02) to the extent that the machine does not vibrate or produce abnormal sound, and once vibration or abnormal sound is detected increase the compensation slightly.**
5. **Gradually increase the position loop gain (AJ00), and once vibration is detected decrease the gain slightly.**
6. **Fine-tune the above gains by observing the settling after positioning and condition of machine operation.**

Adjustment details

- **Adjustment details of speed loop gain (AJ01)**
  This parameter is used to determine the response of the speed loop.
  Increasing the set value of this parameter improves the response, but increasing the value excessively causes the mechanical system to vibrate easily. On the other hand, a lower response of the speed loop eliminates vibration but it may cause the response to drop. In addition, setting the response of the speed loop too low can cause a delay in the external position loop, thereby resulting in overshooting or the machine may vibrate as it executes a speed command.
- **Speed loop integral compensation (AJ02)**
  The speed loop can be integrally compensated to reduce the negative effect of speed fluctuation as the load fluctuates. The greater this integral compensation, the slower the response becomes upon load fluctuation. On the other hand, a smaller compensation improves the speed response upon load fluctuation, but too small a setting induces vibration. Accordingly, adjust the integral vibration to an appropriate level.
- **Position loop gain (AJ00)**
  By increasing the position loop gain, you can improve the control response and shorten the positioning time.
  However, an excessively high gain causes overshooting and the machine will reverse at high speed to compensate for the overshoot. These operations will be repeated and vibration will occur.
  If the position loop gain is too low, on the other hand, the control response drops.

Speed control

A block diagram of speed control is shown below.



Parameters

The following parameters are used to adjust the speed control gain.

Parameter No.	Description	Default
AJ01	Speed loop gain	*1
AJ02	Speed loop integral compensation	*1

*1: The default varies depending on the applicable actuator. Refer to the values of applicable actuator that are the targets of [Appendix-1 : Default setting] (Apx-1).

Adjustment procedure

1 **Perform rough adjustment via auto-tuning.Refer to [T09: Auto-tuning] (P9-9).**

2 **Set a larger speed loop integral compensation (AJ02).**

3 **Gradually increase the speed loop gain (AJ01) to the extent that the machine does not vibrate or produce abnormal sound, and once vibration or abnormal sound is detected decrease the gain slightly.**

4 **Gradually decrease the speed loop integral compensation (AJ02) to the extent that the machine does not vibrate or produce abnormal sound, and once vibration or abnormal sound is detected increase the compensation slightly.**

5 **Fine-tune the above gains by observing the condition of machine operation under speed control.**

Adjustment details

- **Adjustment details of speed loop gain (AJ01)**
  This parameter is used to determine the response of the speed loop.
  Increasing the set value of this parameter improves the response, but increasing the value excessively causes the mechanical system to vibrate easily. On the other hand, a lower response of the speed loop eliminates vibration but it may cause the response to drop. In addition, setting the response of the speed loop too low can cause a delay in the external position loop, thereby resulting in overshooting or the machine may vibrate as it executes a speed command.
- **Speed loop integral compensation (AJ02)**
  The speed loop can be integrally compensated to reduce the negative effect of speed fluctuation as the load fluctuates. The greater this integral compensation, the slower the response becomes upon load fluctuation. On the other hand, a smaller compensation improves the speed response upon load fluctuation, but too small a setting induces vibration. Accordingly, adjust the integral vibration to an appropriate level.

3

Startup

Applied servo gain adjustment function

The feed-forward control function can be adjusted with the applied adjustment function. Normally, you should first use the above manual gain adjustment methods in [Position control] (P3-14).Only when these adjustments do not provide satisfactory results you should use the applied adjustment function.
The feed-forward control function calculates the speed command/torque command required for operation from the position command. Compared to feedback control alone, the error pulses can be made smaller to improve the responsiveness.
The feed-forward control function is only effective during position control. It does not operate for speed control or torque control.
[SP69: Feed-forward control function setting] allows you to select feed-forward control and the feed-forward control simple adjustment edition. The feed-forward control simple adjustment edition is a function that can achieve the same degree of control performance with fewer setting parameters (2 relevant parameters) than the previous feed-forward control (5 relevant parameters).

SP69: Feed-forward control function setting

○: Affected by AJxx setting ×: Not affected by AJxx setting

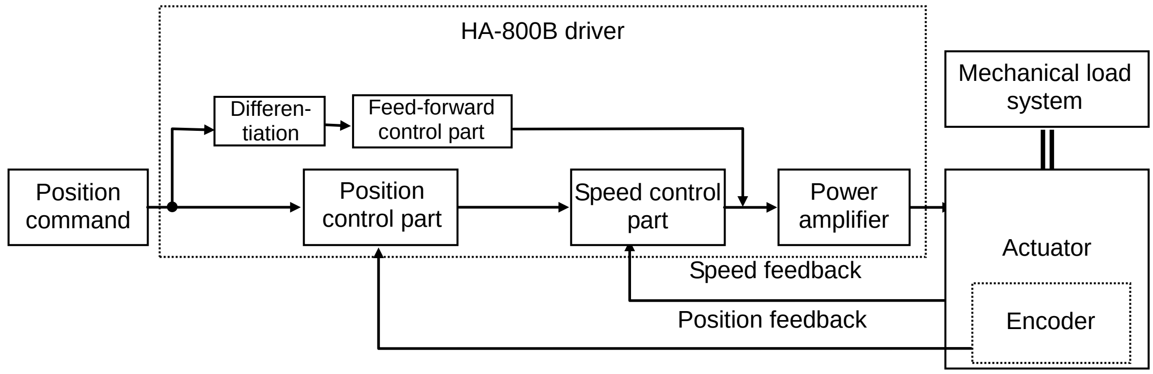
Set value	Function	Relevant parameters				
		AJ03	AJ20	AJ21	AJ22	AJ23
0	Feed-forward control (previous compatible function)	○	○	○	○	○
1	Feed-forward control	○	○	○	○	○
2	Feed-forward control simple adjustment version (stable operation mode)	○	×	○	×	×
3	Feed-forward control simple adjustment version (normal operation mode)	○	×	○	×	×
4	Feed-forward control simple adjustment version (high-speed operation mode)	○	×	○	×	×
5	Feed-forward control simple adjustment version (manual tune mode)	○	○	○	×	×

* [SP69: Feed-forward control function setting] is available for HA-800 software version 3.x or later.
*: Changes to system parameter settings (SP00 to 79) are put into effect by changing the setting, then turning control power supply OFF, then ON again.

Caution

- Do not set [SP69: Feed-forward control function setting] to 0 unless you have been using feed-forward control function with software version 2.08 or earlier, and will use the HA-800B with the same device with software version 3.x or later.
  - The feed-forward control function does not operate after switching from speed control or torque control to position control.
- When using the feed-forward control function, it is necessary to set [AJ21: Load inertia moment ratio] correctly. Set this value correctly using the machine specifications value or the auto-tuning function.
- Changes to [AJ03: Feed-forward gain] take effect when the motor shaft rotation speed drops to [AJ07: Zero speed judgment value] or lower.
- Changes to feed-forward function related parameters (AJ20-23) take effect when the motor stops. Setting values can be changed while the motor is operating.
- The feed-forward control function is only effective during position control. It does not operate for speed control or torque control.

Block diagram of feed-forward control function



Parameters

The following parameters are used for feed-forward control.

Parameter No.	Description	Default
SP69*1	Feed-forward control function setting	*2
AJ03	Feed-forward gain	0
AJ20	Feed-forward filter	1
AJ21	Load inertia moment ratio	100
AJ22	Torque constant compensation factor	100
AJ23	Spring constant compensation factor	100

*1: Changes to system parameter settings (SP00 to 79) are put into effect by changing the setting, then turning control power supply OFF, then ON again.

*2: The default varies depending on the applicable actuator. Refer to [Default settings] (Apx-1) in the appendix.

Adjustment details

● Feed-forward control function setting (SP69)

▪ Setting details

This sets the responsiveness when [SP69: Feed-forward control function setting] is [2, 3, or 4]. The appropriate feed-forward filter frequency is set automatically based on the machine's resonance frequency due to the rigidity of the speed reducer in the actuator and the load inertia moment ([AJ21: Load inertia moment ratio]).

When [SP69: Feed-forward control function setting] is [0, 1, or 5], [AJ20: Feed-forward filter] can be set to any desired value.

▪ Adjustment method

Normally, set [SP69=3: Normal operation mode].From the vibration and responsiveness, set the appropriate operation mode, referencing the table below. The vibration and responsiveness are greatly affected by [AJ03: Feed-forward gain].Also, for a low inertia ratio (when [AJ21: Load inertia moment ratio] is 20 or less), vibration occurs particularly easily.

When the responsiveness is not satisfactory with [SP69=4: High-speed operation mode], you can also adjust the feed-forward filter manually with [SP69=5: Manual tune mode].Only use [SP69=1: Feed-forward control] when [SP69=5: Manual tune mode] cannot produce satisfactory results.

	Vibration	Responsiveness
SP69=2: Stable operation mode	Small	Low speed
SP69=3: Normal operation mode	Medium	Medium speed
SP69=4: High-speed operation mode	Large	High speed

- **Feed-forward gain (AJ03)**

  ▪ **Adjustment method**

  If the feed-forward gain is set too high, the command is achieved more quickly. However, an excessively high gain leads to mechanical shock or vibration (hunting).
  Set [AJ03L Feed-forward gain] in the range [0 to 100].Set the feed-forward gain to around 50 and check the response. Raise and lower the gain about 5 degrees at a time until you have adjusted to a satisfactory response.
  When [AJ03: Feed-forward gain] is 0, the feed-forward control function is disabled.

  ▪ **Effect of electronic gear setting**

  Note that when the electronic gear ratio is high, adequate effects may not be obtained from feed-forward control and vibration may occur.
  For example, setting the numerator larger and denominator smaller for the electronic gear has the same effect as inputting (numerator)/(denominator) pulses per positioning command pulse. In this case, input change increases in discontinuous steps. Since an input change is differentiated under feed-forward control, if this discontinuous input change increases, the derivative value becomes discontinuous, and vibration may occur.
  Also, for a low inertia ratio (when [AJ21: load inertia moment ratio] is 20 or less) and low-speed operation, vibration occurs particularly easily.

- **Feed-forward filter (AJ20)**

  ▪ **Setting details**

  Set the filter frequency to be used in feed-forward control. When [SP69: Feed-forward control function setting] is 0, 1, or 5, the setting has an effect.

  ▪ **Adjustment method**

  A higher set value has faster response but vibration is more likely to occur. In order to make feed-forward control function effectively, it is necessary to set a value larger than the value of [AJ00: Position loop gain].While checking the response, gradually raise the setting value.

- **Load inertia moment ratio (AJ21)**

  ▪ **Setting details**

  Set the ratio of the moment of inertia of load relative to the self-inertia moment.100% means that the load factor is the same as the self-inertia moment. Set the actual load inertia value of the machine. This value can also be set automatically using the auto-tuning function. For details on the auto-tuning function, refer to [Auto-tuning] (P9-11, P10-8).

  ▪ **Effect of setting**

  Increasing the load inertia moment ratio has the effect of increasing the feed-forward amount just like when the feed-forward gain is raised. Lowering the load inertia moment ratio has the same effect as lowering the feed forward gain. Set the actual load inertia value of the machine correctly.

- **Torque constant compensation factor (AJ22)**

  ▪ **Normal use**

  Variation in the actuator torque constant is compensated for.Feed-forward control is performed based on the value set here.Set this factor to 100% in normal use.When [SP69: Feed-forward control function setting] is 0 or 1, the setting has an effect.

  ▪ **Effect of factor**

  The reference value of the torque constant compensation factor is 100%. Setting a higher value increases the actuator torque constant, meaning that the feed-forward control part decreases the feed-forward amount and thereby lowers the feed-forward gain.
  On the other hand, setting a low torque constant compensation factor has the same effect as increasing the feed-forward gain. Torque constants of actuators are subject to slight variation, and this parameter is used to compensate for this variation. Accordingly, set this parameter to 100% in normal use.

- **Spring constant compensation factor (AJ23)**

  ・Normal use

  Variation in the actuator spring constant is compensated for. Feed-forward control is performed based on the value set here. Set this factor to 100% in normal use. When [SP69: Feed-forward control function setting] is 0 or 1, the setting has an effect.

  ・**Effect of factor**

  Although the reference value of the spring constant compensation factor is 100%, set an appropriate compensation factor depending on the variation in the actuator's spring constant.
  Resonance frequencies that cause mechanical resonance may occur depending on the actuator's spring constant compensated for by the spring constant compensation factor and the setting of load inertia moment ratio (AJ21).The feed-forward control part implements controls to lower the feed-forward gain at these resonance frequencies.

3

Startup

3-6 Normal operation

This driver operates according to commands received from the host device. No special procedures are required in normal operations.
The following explains the notices when performing normal operations as well as daily maintenance/inspection.

Notices for normal operations

WARNING

(1) Do not change wirings while the power is supplied.
Disconnecting wires or connectors while the power is supplied may cause electric shock or an uncontrollable operation.
(2) Do not touch the terminals for 15 minutes after the power is turned OFF.
Even after the power is turned OFF, electric charge remains in the driver. Do not touch the terminals for 15 minutes after the power-OFF to avoid electric shock.
(3) Do not operate the driver by turning ON/OFF the power.
Frequent power ON/OFF operation may cause deterioration of circuit elements inside the driver.

Daily maintenance/inspection

Perform maintenance/inspection according to the maintenance/inspection standards for electronic devices specified by the department introducing the driver.

WARNING

(1) Be sure to shut down the power before carrying out maintenance/inspection.
Carrying out maintenance/inspection while the power is supplied may cause electric shock.
(2) Do not touch the terminals for 15 minutes after the power is turned OFF.
Even after the power is turned OFF, electric charge remains in the driver. Do not touch the terminals for 15 minutes after the power-OFF to avoid electric shock.
(3) Do not perform megger test or voltage resistance test.
The control circuits in the driver may be damaged and an uncontrollable operation may occur.

Check point	Interval	Inspection standard	Treatment
Terminal screws	1-year inspection	No loosen screws	Tightening screws
Unit exterior	1-year inspection	No dust or metal chips on the case	Cleaning
Unit interior	1-year inspection	No discoloration, damage or other abnormalities	Contact us.

Periodically replaced parts

A detection circuit is provided for the following replacement parts of this driver so that any part that can no longer operate correctly can be identified. However, it is recommended that each part be replaced at the specified timing listed below. For details, contact our sales office.

Replacement part	Replacement timing	Replacement method
Cooling fan	5 years	Replaced by our office. Ship your HA-800B driver to our sales office. The driver will be returned once the part has been replaced.
Battery	1 year	Purchase a replacement battery (HAB-ER17/33-2_Maintenance). Replace the old battery with the new one after purchase by referring to [How to install/replace the data backup battery].
Electrode capacitor	5 years	When the capacitor is operated in an environment of 40℃ in average temperature throughout the year. It varies depending on the use environment.
Relay	100,000 times (Number of power ON times)	Use the relay at the frequency of turning power ON/OFF of 30 times/day or less.

The life of the cooling fan assumes that this driver is operated 24 hours a day in an environment of 40℃ in average temperature throughout the year.
The life of the battery assumes that the driver remains unpowered in a condition connected to the actuator.

Data backup battery (optional)

The backup battery is used to hold the multi revolution data in the absolute encoder when the power supply is cut off.
The absolute encoder has a built-in capacitor to hold the data even after the backup battery is replaced.
When combining the driver to an actuator with an absolute encoder in order to use it with the absolute specifications, separately install an optional data backup battery (HAB-ER17/33-2).

Backup battery

Model code: HAB-ER17/33-2

Battery type	Lithium thionyl chloride battery
Manufacturer	TOSHIBA BATTERY CO.,LTD.
Manufacturer model	ER17330V (3.6V 1,700 mAh)

Data retention time

Data retention time	Approx. 1 year after the power is cut off
Conditions	Unused power is turned OFF, ambient temperature: 25℃, axis stopped (The actual life varies depending on the condition of use.)

Caution

- A battery purchased separately from the battery manufacturer does not come with connector wires. Prepare them on your own and attach them to the battery before use.

Built-in capacitor of actuator

Data retention time

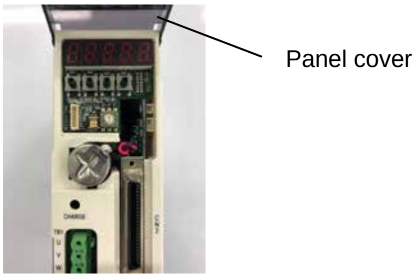
Data retention time	Approx. 30 min. after the power is cut off
Conditions	After 3 h of charging, ambient temperature 25℃, axis stopped

How to install/replace the data backup battery

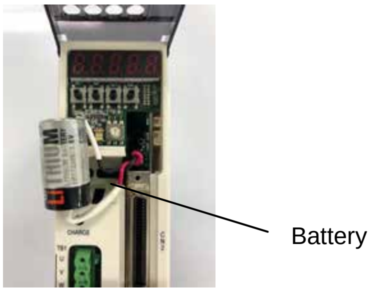
If you have purchased a new absolute encoder model driver or if [UA91: Battery voltage low] is displayed, install or replace the battery by following the procedure below:
(If you have purchased a new driver, follow the procedure in "Installing the battery.)

Removing the battery

1 Open the operation panel cover.

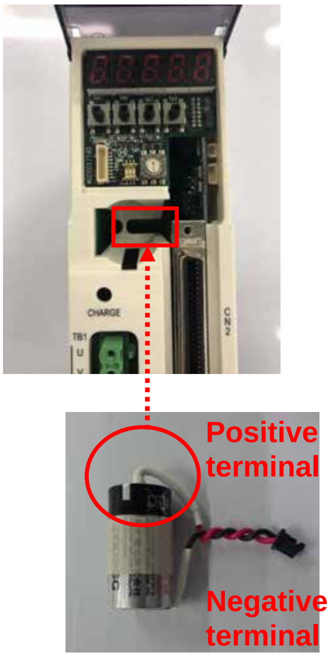


2 Remove the old battery.



Installing the battery

3 Install the new battery by placing it in the battery holder with the positive terminal on the far side (indicated by the red arrow).



Insert the battery so that the lead line from the positive terminal (indicated by the circle) fits in the groove on the far side of the case (indicated by the rectangle), with the lead line from the positive terminal facing to the right horizontally.

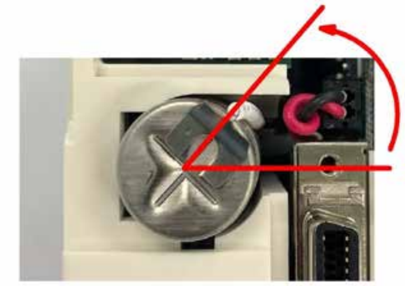
4 **Insert the connector on the battery side into the connector indicated by the circle, and ensure that the connector orientation matches.**

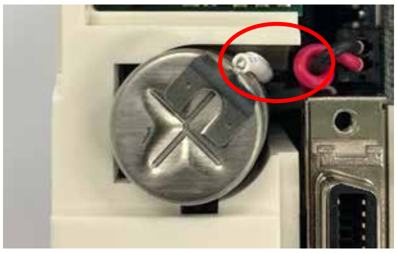
Connect the connector so that the black wire of the battery cable is facing up when looking at the driver from the front.

*Exercise caution, as the space is narrow.

If it is difficult to insert the connector, you can temporarily lift the battery up to insert the connector.

5 **Align the battery and push in any remaining cable.**





After inserting the connector, rotating the orientation of the negative terminal about 45 degrees counterclockwise when looking at the driver from the front will make it easier to close the panel cover.

After inserting the connector, push in any remaining battery cable so that it will not get pinched when the panel cover is closed.

Exercise particular caution with the area indicated by the circle, as it is susceptible to pinching.

6 **Push the battery all the way in and close the panel cover.**

- With a 13-bit absolute encoder or a 17-bit absolute encoder (SHA20, FHA-Cmini series and HMAC08)*, UA91 will be automatically reset after the battery is replaced.

- With a 17-bit absolute encoder (SHA series (excluding SHA20) and HMA series (excluding HMAC08)), UA91 will be reset by resetting the alarm and reconnecting the power after the battery is replaced.

* In Version 2.x and earlier, after the battery is replaced, turning the power back ON releases UA91.

Caution

- Exercise caution to prevent the battery lead line from getting caught when closing the panel cover.
- When replacing the battery because it has expired due to extended use, have only the control power supply ON.

Chapter 4

Encoder system

The encoder configuration is different depending on the actuator model. Details of each actuator are explained in this chapter.

4-1 Overview of encoders 4-1
4-2 17-bit absolute encoder 4-4
4-3 13-bit absolute encoder 4-12
4-4 Incremental encoder 4-23

4-1 Overview of encoders

A different type of encoder is embedded in the actuator according to the actuator model.
Accordingly, wirings, signal exchange with the driver, etc., vary depending on the applicable model.
Details are explained below for each encoder type. Check the section corresponding to your actuator.

Encoder type	Actuator model	Driver model	Details
17-bit absolute encoder 17-bit encoder incremental model	SHA series FHA-Cmini series HMA series	HA-800B∗D/E-100/200	P4-4
13-bit absolute encoder	FHA-C series	HA-800B∗A-100/200	P4-12
4-wire wire-saving incremental encoder	FHA-C series	HA-800B∗C-100/200	P4-23
4-wire wire-saving incremental encoder	FHA-Cmini series	HA-800B∗C-100/200	
14-wire incremental encoder	RSF/RKF series	HA-800B∗B-100/200	

The specifications of encoders that can be connected to the HA-800B driver are shown below. Select an applicable driver model according to the actuator used and the applicable encoder specification.

Item	17-bit absolute encoder *1		13-bit absolute encoder	4 wires, wire-saving type Incremental encoder		14 wires Incremental encoder
Actuator model	**SHA series (excluding SHA20) , HMA series (excluding HMAC08)**	**SHA20, FHA-Cmini series, HMAC08**	**FHA-C series**	**FHA-Cmini series**	**FHA-C series**	**RSF/RKF series**
Details	P4-4	P4-4	P4-12	P4-23	P4-23	P4-23
Applicable driver model	HA-800B-3D/E-100/200 HA-800B-6D/E-100/200 HA-800B-24D/E-200	HA-800B-3D/E-200 HA-800B-1D/E-100/200	HA-800B-3A-100/200 HA-800B-6A-100/200	HA-800B-1C-100/200	HA-800B-3C-100/200 HA-800B-6C-100/200	HA-800B-3B-100/200 HA-800B-6B-100/200
Sensor type	Magnetic sensor	Single revolution: Optical sensor Multi revolution: Magnetic sensor	Optical sensor	Optical sensor	Optical sensor	Optical sensor
Data storage upon power OFF	Battery backup method	Battery backup method	Battery backup method	None	None	None
Resolution per motor shaft rotation	17 bits (131072 pulses)	17 bits (131072 pulses)	13 bits (8,192 pulses)	8,000 pulses *2	10,000 pulses *2	8,000 pulses *2
Maximum motor shaft rotation range	16 bits (-32768 to 32767）	16 bits (-32768 to 32767）	13 bits (-4096 to 4095）	Not limited	Not limited	Not limited
Encoder monitor output pulses	Parameter setting can be changed. Up to 8,192 pulses are output per motor shaft rotation.	Parameter setting can be changed. Up to 8,192 pulses are output per motor shaft rotation.	Fixed	Fixed	Fixed	Fixed
Max. permissible rotational speed upon power failure	6,000 r/min However, 300 r/min when the power is input/encoder is started.	6,000 r/min However, 250 r/min when the power is input/encoder is started.	5,000 r/min (constant speed) 1,400 r/min (accelerating)	—	—	—
Retention time by driver's built-in backup battery	Approx. 1 year (Power not supplied)	Approx. 1 year (Power not supplied)	Approx. 1 year (Power not supplied)	—	—	—
Retention time by actuator's built-in capacitor	Approx. 0.5 h (Fully charged)	Approx. 0.5 h (Fully charged)	Approx. 0.5 h (Fully charged)	—	—	—
Encoder/driver communication method	Line driver receiver method/2.5 Mbps	Line driver receiver method	Line driver receiver method	Line driver receiver method	Line driver receiver method	A, B, Z, U, V and W parallel signals
Encoder/driver connection cable	EWD-S**-A08-3M14 (model No. 25, 32, 40) EWD-S**-D10-3M14 (model No. 58, 65) 2-core twisted wire x 3-pair shield cable	EWD-S**-A08-3M14 2-core twisted wire x 3-pair shield cable	EWC-S**-B08-3M14 2-core twisted wire x 4-pair shield cable	EWC-E**-M06-3M14 2-core twisted wire x 2-pair shield cable	EWC-E**-B04-3M14 2-core twisted wire x 2-pair shield cable	EWA-E**A15-3M14 2-core twisted wire x 7-pair shield cable

Item		17-bit absolute encoder *1		13-bit absolute encoder	4 wires, wire-saving type Incremental encoder		14 wires Incremental encoder
Actuator model		SHA series (excluding SHA20), HMA series (excluding HMAC08)	SHA20, FHA-Cmini series, HMAC08	FHA-C series	FHA-Cmini series	FHA-C series	RSF/RKF series
Alarm	Encoder breakage	○	○	○	○	○	○
	MEMORY error	○	○	×	×	×	×
	System failure	○	○	○	×	×	×
	Single rotation data error	○	○	×	×	×	×
	Multi revolution data error	○	○	×	×	×	×
	BUSY error	○	○	×	×	×	×
	Overheat error	○	○	×	×	×	×
	Communication error	○	○	×	×	×	×
	Encoder counter receiving error	×	×	○	○	○	○
	Multi revolution counter overflow	×	×	○	×	×	×
	Multi revolution data error	×	×	○	×	×	×
Safety/redundancy		Absolute data dual-redundancy matching method	Absolute data dual-redundancy matching method	None	None	None	None

*1: The 17-bit encoder incremental model does not perform multi revolution detection and do not require a data backup battery. Otherwise it is the same as a 17-bit absolute encoder.
*2: Quadruplicated pulses

4-2 17-bit absolute encoder

CAUTION

If [AL81: System failure], [AL82: Single revolution data error] or [AL83: Multi revolution data error] generated due to a loss of absolute position or error, be sure to reset the origin. Failure to do so may result in unexpected operations.

Features

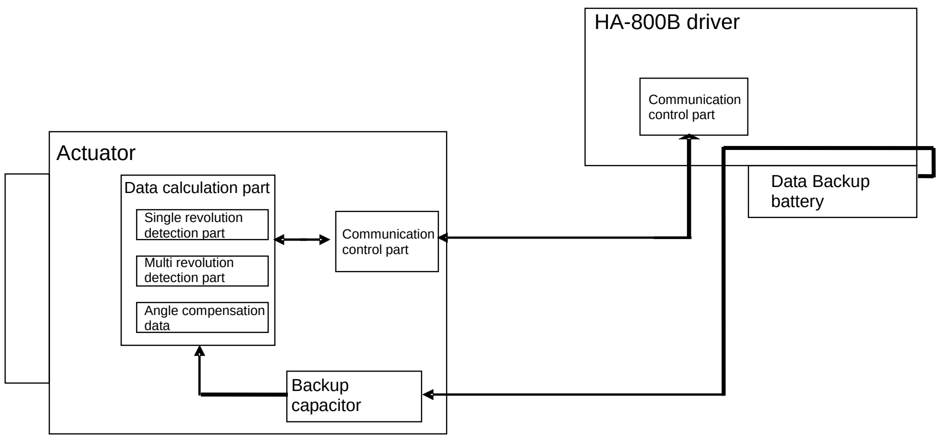
The SHA series (excluding SHA20) and HMA series (excluding HMAC08) are equipped with a multi revolution-type 17-bit magnetic absolute encoder.
The absolute type of the SHA20, FHA-Cmini series and HMAC08 are equipped with a multi revolution-type 17-bit optical absolute encoder. (Multi revolution detection part is magnetic .)
It consists of a detector (17 bits/revolution) for detecting the position after one motor shaft revolution and a cumulative counter (16 bits) for detecting the number of motor revolutions.
This encoder constantly detects the absolute machine position and stores it by means of the backup battery, regardless of whether the power supply for the driver or external controller is turned ON/OFF. (The data backup battery is an option.)
Accordingly, once the origin is detected when the machine is installed, originating is not required after subsequent power ON operations. This facilitates the recovery operation after a power failure or breakdown.

With the 17-bit absolute encoder, the single revolution absolute position detector and the revolution detection/cumulative counter are both made dual-redundant. Two identical data items are constantly compared to ensure highly reliable design permitting self-detection of encoder errors should they occur.

A backup capacitor is also provided in the encoder. (Internal backup. Take note that the retention time is short.)
The 17-bit encoder incremental model does not perform multi revolution detection and do not require a data backup battery. Otherwise it is the same as a 17-bit absolute encoder.

Caution

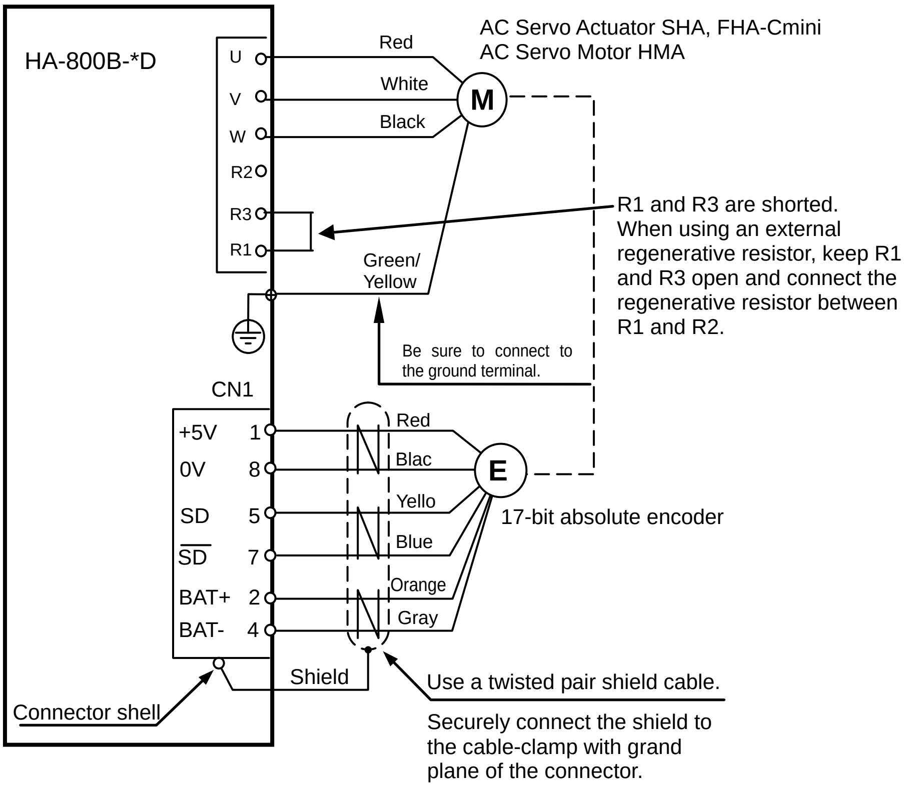
- The backup time is 30 minutes when a new capacitor has been charged for at least 3 hours by supplying power to the actuator. This backup time becomes shorter if the power is supplied for a shorter period or the capacitor deteriorates over time.



Block diagram of actuator/encoder and driver

Standard connection

A connection example of an actuator of 17-bit absolute encoder model with a HA-800B driver is shown.



Startup

Parameters that must be set

Parameters No	Name	Function
SP61	Encoder monitor output pulses	Set the phase A and B pulses to be output to the encoder monitor output terminals (CN2-12 to 18) when the motor shaft of the 17-bit absolute encoder turns one revolution. Setting range: 1 to 8192 If this parameter is set to the maximum value of 8,192, the resolution becomes 32,768 pulses (8,192 x 4). This corresponds to one-fourth the resolution 131,072 of the 17-bit encoder.
SP66	Absolute encoder function setting	A 17-bit absolute encoder can be set to be used as an incremental encoder. Setting range: 0, 1 0: Use as an absolute encoder. (Default value on HA-800B-*D) 1: Use as an incremental encoder. (Default value on HA-800B-*E)

*: If you change the setting, the origin needs to be set again. Be sure to change the value before setting the origin.

Startup procedures

1 Absolute encoder function setting (checking the data backup battery)

Set [SP66: Absolute encoder function setting] according to the method used, then turn the power OFF, then ON again. For details, refer to [SP66: Absolute encoder function setting] (P8-9).

1. When setting [SP66: Absolute encoder function setting] to 0 (default value on HA-800B-*D) and using as an absolute encoder
Open the operation panel cover and install the battery (option: HAB-ER17/33-2).
(Refer to [How to install/replace the data backup battery] (P3-23).

2. When setting [SP66: Absolute encoder function setting] to 1 (default value on HA-800B-*E) and using as an incremental encoder
The backup battery is not required.

2 Initializing the absolute encoder system

1. When setting [SP66: Absolute encoder function setting] to 0 and using as an absolute encoder
When the power supply is turned ON for the first time, [AL81: System failure], [AL82: Single revolution data error], [AL83: Multi revolution data error] and [UA91: Battery voltage low warning] generate. It is necessary to initialize (multi revolution data clear) the errors. For details, refer to [T08: Multi revolution clear] (P9-8).

2. When setting [SP66: Absolute encoder function setting] to 1 and using as an incremental encoder
When using as an incremental encoder, absolute encoder initialization is not required.

* UA91 will not occur on the SHA20, FHA-Cmini series and HMAC08 absolute type if the battery is normal. If UA91 occurs, replace the battery.

3 Setting the parameter

Set [S61: Encoder monitor output pulses *] according to the method used, after which turn the power ON again to make the parameters effective. For details, refer to [SP61: Encoder monitor output pulses] (P8-7) and [Output signal pulses] (P4-8).

*: If you change the value, the origin needs to be set again. Be sure to change the value before setting the origin.

4 Origin setting

Set the origin in order to link the actuator driver and the mechanical origin.

1. When setting [SP66: Absolute encoder function setting] to 0 and using as an absolute encoder
For the origin setting method, refer to [Origin setting] (P4-7).

2. When setting [SP66: Absolute encoder function setting] to 1 and using as an incremental encoder
In order to establish the relationship between the actuator driver and the machine origin, use the return-to-origin function on the host controller to execute a return to origin and manage the coordinates with the host controller.

- When the control power supply is turned ON
- When the driver has been replaced
- When the actuator has been replaced

Origin setting

1. When using the originating function of the host controller *1

Set the coordinate (set the origin) using the host controller based on the following procedure if the HA-800B is intended to be used in combination with the MP2000 series by YASKAWA Electric Corporation or the KV-ML16V controller by Keyence Corporation.
For the notices when using the HA-800B in combination with a host controller, refer to [Notices when connecting the HA-800B with the machine controller (MP2400) manufactured by YASKAWA Electric Corporation] or [Notices when connecting the HA-800B and KV-ML16V controller by Keyence Corporation].

(1) Move the controller to near the mechanical origin via a JOG operation, manually, or using the various host controller functions.
(2) Execute T08 (multi revolution clear) by operating the HA-800B panel near the mechanical origin, and reconnect the HA-800B power supply.
(3) Perform originating using the originating function of the host controller.
*: The current HA-800B position display will not indicate zero at the mechanical origin, but it does not affect the operation. (The current position display of the host controller usually indicates zero.)

2. When not using the originating function of the host controller *1

If not using the originating function of the host controller, perform the following to set the HA-800B coordinate (set the origin).

(1) Set the virtual origin to zero (default), and reconnect the HA-800B power supply.
(2) Move the driver to the target mechanical origin position via a JOG operation or manually.
(3) Execute T08 (multi revolution clear) by operating the HA-800B panel, and reconnect the HA-800B power supply.
(4) Perform any of the following to read the current absolute encoder value.
 (a) Use the HA-800 driver monitor software PSF-800. Check the PSF-800 status display value monitor feedback pulses. For details, refer to [Chapter 10 Communication software].
 (b) Use the status display panel for the HA-800B driver. You can check the current encoder value from the d05 feedback pulse (Low) and d06 feedback pulse (High) shown on the display panel in the status display mode.
 For details, refer to [d05, 06: Feedback pulses display] (P7-5).
 (c) Use the MECHATROLINK communication. For details, refer to [Status monitor command (SMON: 30H)] (P13-18).
(5) Perform either of the following to set the current absolute encoder value that has been read as the virtual origin.
 (a) Use the HA-800 driver monitor software PSF-800. For details, refer to [Parameter setting] (P10-10).
 (b) Use the MECHATROLINK communication. For details, refer to [Non-volatile parameter write command (PPRM_WR: 1CH)] (P13-14).
(6) Reconnect the power supply to the host controller and HA-800B.
(7) The mechanical origin is set to zero in the amount of absolute value displacement operation.
*: The current HA-800B position display will indicate zero at the mechanical origin.

*1: Driver software Ver. 2.x or later is explained.

Caution

- Do not turn the actuator until the Step (3) Multi revolution clear is executed and Step (4) Receiving/reading of the current value is completed. If the actuator moves, the origin may become offset.
- Take note that the current value of the 17-bit absolute encoder (10 digits) cannot be fully displayed (only the last 8 digits are displayed) because only a total of 8 digits are allocated for d05 feedback pulse (Low) and d06 feedback pulse (High) on the display panel of the HA-800B driver.

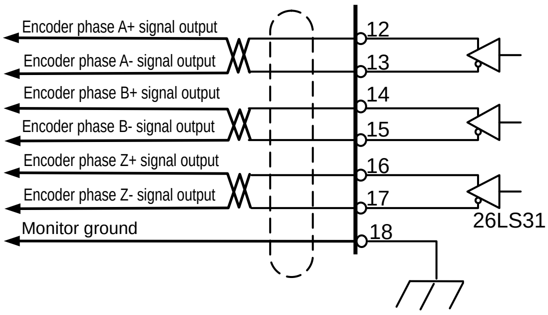
Set the origin in the following situations even if it's not during a start-up.
- The driver has been replaced
- The actuator has been replaced
- [AL81: System failure], [AL82: Single revolution data error] or [AL83: Multi revolution data error] generated due to a loss of absolute position or error.

Data output

Encoder phase A, B and Z signal outputs

When the motor shaft equipped with a 17-bit absolute encoder turns, incremental phase A, B and Z signals are output to the pins CN2-12 to 18. The number of pulses per motor shaft revolution is set by the system parameter SP61.

CN2-12 Phase output-A+ (LD)
CN2-13 Phase output-A- (LD)
CN2-14 Phase output-B+ (LD)
CN2-15 Phase output-B- (LD)
CN2-16 Phase output-Z+ (LD)
CN2-17 Phase output-Z- (LD)
CN2-18 Monitor ground



- **Output signal pulses**

The output pulses per motor shaft revolution are set by the parameter [SP61: Encoder monitor output pulses].

	Output pulses per motor shaft revolution
Phase A signal output	Set value of SP61 ([1] to [8,192])
Phase B signal output	Set value of SP61 ([1] to [8,192])
Phase Z signal output	1

*: If you change the value, the origin needs to be set again. Be sure to change the value before setting the origin.

For example, setting the maximum value 8,192 in SP61 causes 8,192 pulses to be output per motor shaft revolution. Although this corresponds to a resolution of 32,768 pulses, or 4 times 8,192, it is one-fourth the resolution 131,072 of the 17-bit absolute encoder per motor shaft revolution.

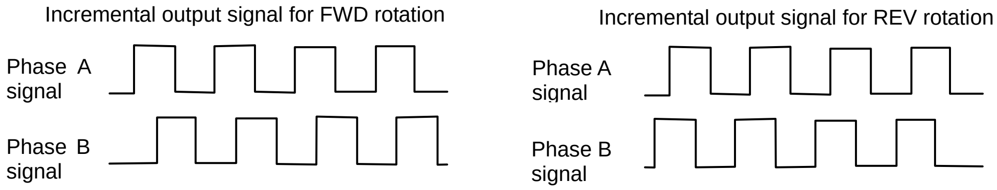
8192 x 4 = 32768 (quadruplicate)

131072÷4＝32768

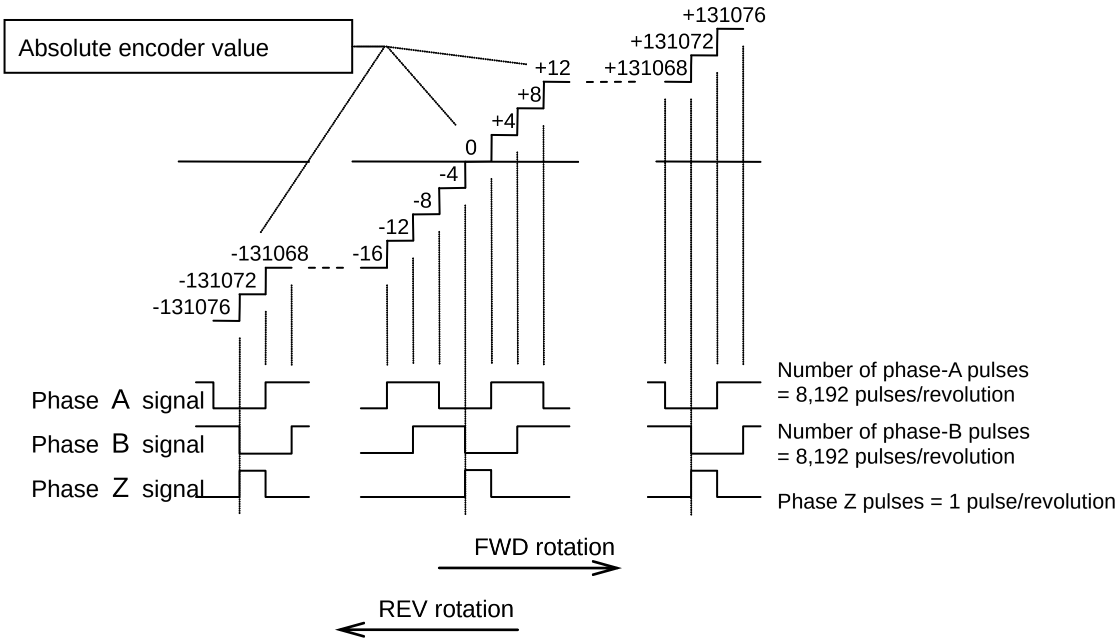
For phase Z, 1 pulse is output per motor shaft revolution.

- **Phase A, B and Z incremental output waveforms**

For FWD rotation, the A signal is output with an advance of 90° relative to the B signal. For REV rotation, the A signal is output with a delay of 90° relative to the B signal.
To obtain the resolution in the quadrupled mode, utilize the leading edges and trailing edges of both phase A and B signals.



When 8,192 is set in SP61, the values of the 17-bit absolute encoder and phase A, B and Z waveforms are as follows. However, the phases of phase A, B, and Z waveforms delay with respect to the value of the absolute encoder for the signal processing time within the driver, due to the rotation speed of the actuator.



- **Signal input method**

Each phase signal is output by a line driver (26LS31). Receive the signals using a line receiver (AM26LS32 or equivalent).

Caution

- Use an EIA-422A compliant line receiver to receive the signals.

Remedial actions for errors/warnings

Remedial action for error

Name	Description	Cause	Action
AL50 Encoder breakage	Encoder signals have been cut off.	(1) Disconnected encoder signal wire (2) Poor contact/connection of encoder signal connector (3) Encoder error (4) HA-800B driver control circuit error	(1) Repair the wire. (2) Connect the connector properly. (3) Replace the actuator. (4) Replace the HA-800B driver.
AL80 MEMORY error	EEPROM memory error in encoder	(1) Encoder error (2) HA-800B driver control circuit error	(1) Replace the actuator. (2) Replace the HA-800B driver.
AL81 System failure	Encoder system shutdown	(1) Turned the power ON for the first time after the purchase. (2) New product without battery installed (3)The HA-800B driver and actuator have been disconnected for an extended period of time (4) SHA series (excluding SHA20) and HMA series (excluding HMAC08): Either the voltage of the backup capacitor in the encoder or HA-800B driver battery, whichever is higher, has become 2.85V or below. SHA20, FHA-Cmini series, and HMAC08: The battery voltage has dropped to 2.85V or below. (5) Encoder failure	(1) Execute T08: Multi revolution clear to reconnect the power. (2) Install the battery (option: HAB-ER17/33-2). (3) Execute test mode T08 with the driver and actuator connected. (4) Replace the HA-800B driver battery with a new one (option: HAB-ER17/33-2_Maintenance). After the battery has been replaced, set the origin. (5) Replace the actuator.
AL82 Single rotation data error	Encoder single revolution data error	(1) Turned the power ON for the first time (2) Malfunction due to external noise (3) Encoder failure	(1) Execute T08: Multi revolution clear to reconnect the power. (2) Provide noise suppression measures to eliminate negative effects of external noise. (3) Replace the actuator.
AL83 Multi revolution data error	Encoder multi revolution data error	(1) Turned the power ON for the first time (2) Malfunction due to external noise (3) Encoder failure	(1) Execute T08: Multi revolution clear to reconnect the power. (2) Provide noise suppression measures to eliminate negative effects of external noise. (3) Replace the actuator.
AL84 BUSY error	When the encoder was started, the motor shaft rotated at a constant speed or above and a position specification problem occurred.	(1) When the power supply was turned ON and encoder was started, the motor shaft rotated at a constant speed or above. SHA series (excluding SHA20) and HMA series (excluding HMAC08): 300 r/min or more SHA20, FHA-Cmini series and HMAC08: 250 r/min or more (2) Encoder failure	(1) When the power supply is turned ON and encoder is started, ensure that the motor shaft rotates at a constant speed or below. (2) Replace the actuator.

Name	Description	Cause	Action
AL85 Overheat error	Heated actuator/encoder	(1) The board temperature in the encoder has reached 95℃ or above. (2) The heat sink temperature of the driver has reached 106℃ or above. (3) Encoder failure	(1) Remove the cause of actuator overheat, such as relaxing the actuator drive conditions or improving the heat radiation conditions for the heat sink. (2) Same as above (3) Replace the actuator.
AL86 Communication error	Data could not be received in at least 4 consecutive communications between the actuator and this driver.	(1) Disconnected encoder signal wire (2) Poor contact/connection of encoder signal connector (3) Malfunction due to external noise	(1) Repair the wire. (2) Connect the connector properly. (3) Provide noise suppression measures to eliminate negative effects of external noise. (4) Check the ground line or other ground.

Remedial action for warning

Name	Description	Cause	Action
UA91 Battery voltage low	The backup battery voltage has dropped to DC3.1V or below.	(1) New product without battery installed (2) Voltage drop due to consumption of backup battery (3) Encoder battery lead line short-circuit and poor connection (4) HA-800B driver control circuit error (5) Encoder failure	(1) Install the battery (option: HAB-ER17/33-2). (2) SHA series (excluding SHA20) and HMA series (excluding HMAC08): Replace the battery with a new one (option: HAB-ER17/33-2_Maintenance), input alarm reset and then reconnect the power supply. SHA20, FHA-Cmini series and HMAC08: * Replace the battery with a new one (option: HAB-ER17/33-2_Maintenance). * In Version 2.x and earlier, after the battery is replaced, turning the power back ON releases UA91. (3) Repair the wire. (4) Replace the HA-800B driver. (5) Replace the actuator.

4-3 13-bit absolute encoder

CAUTION

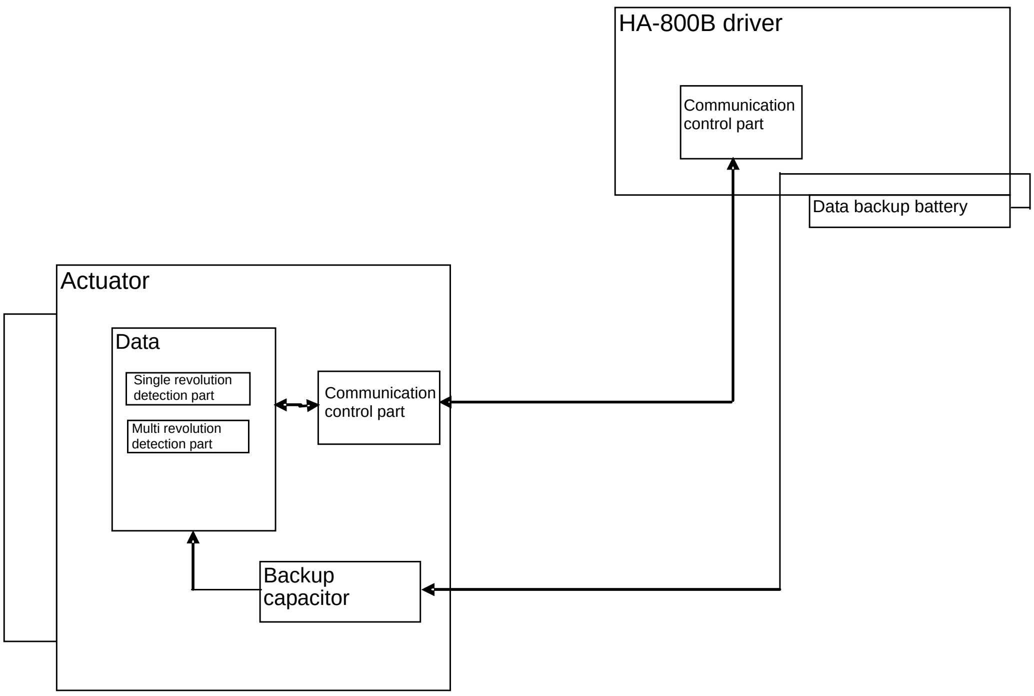
If [AL53: System failure], [AL54: Multi revolution counter overflow] or [AL55: Multi revolution data error] generates due to a loss of absolute position or error, be sure to reset the origin. Failure to do so may result in unexpected operations.

Features

The FHA-C series is equipped with a multi revolution-type 13-bit optical absolute encoder. It consists of a detector (13 bits/revolution) for detecting the position after one motor shaft revolution and a cumulative counter (13 bits) for detecting the number of motor revolutions.
This encoder constantly detects the absolute machine position and stores it by means of the backup battery, regardless of whether the power supply for driver or external controller is turned ON/OFF. Accordingly, once the origin is detected when the machine is installed, originating is not required after subsequent power ON operations. This facilitates the recovery operation after a power failure or breakdown. (The data backup battery is an option.)
A backup capacitor is also provided in the encoder. (Internal backup. Take note that the retention time is short.）

Caution

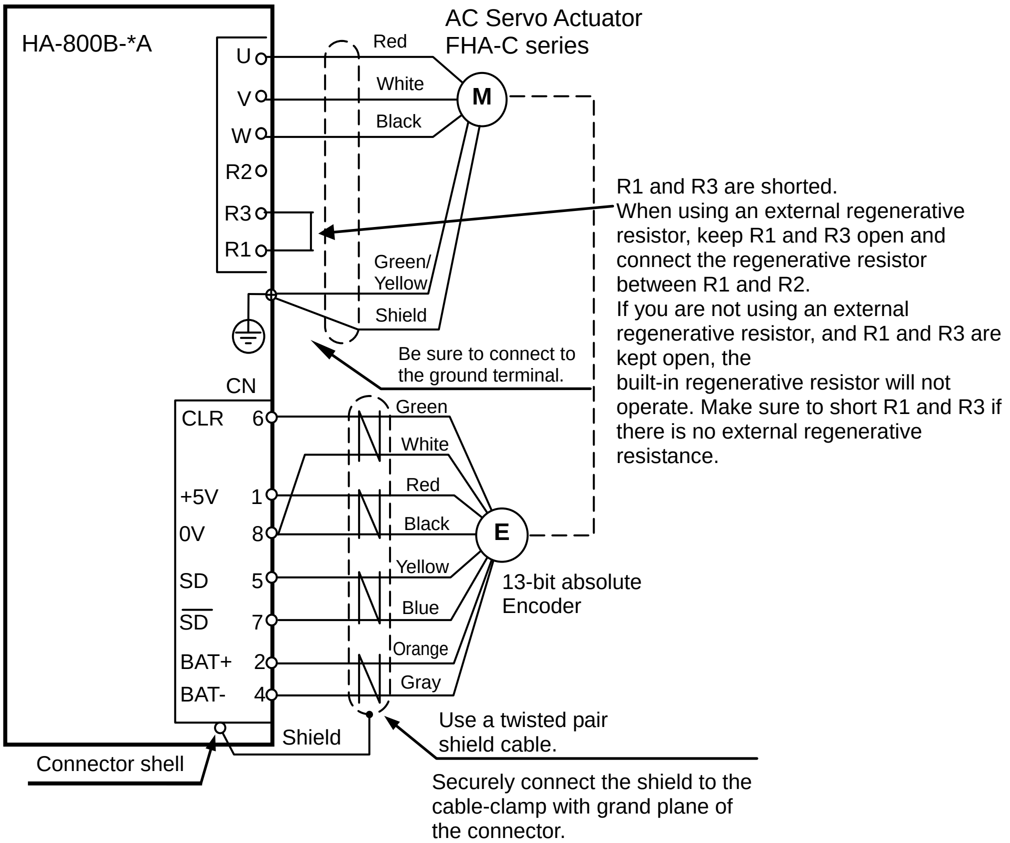
- The backup time is 30 minutes when a new capacitor has been charged for at least 3 hours by supplying power to the actuator. This backup time becomes shorter if the power is supplied for a shorter period or the capacitor deteriorates over time.



Block diagram of actuator/encoder and driver

Standard connection

A connection example of an actuator of 13-bit absolute encoder model with a HA-800B driver is shown.



Startup

Startup procedures

1 Installing the data backup battery

Open the operation panel cover and install the battery (option: HAB-ER17/33-2).
(Refer to [How to install/replace the data backup battery] (P3-23).

2 Initializing the absolute encoder system

When the power supply is turned ON for the first time, [AL53: System failure] generates. It is necessary to initialize (multi revolution data clear) the errors. For details, refer to [T08: Multi revolution clear] (P9-8).

3 Origin setting

Set the origin in order to link the actuator driver and the mechanical origin.
For the origin setting method, refer to [Origin setting] (P4-15).

Origin setting

1. When using the originating function of the host controller *1

Set the coordinate (set the origin) using the host controller based on the following procedure if the HA-800B is intended to be used in combination with the MP2000 series by YASKAWA Electric Corporation or the KV-ML16V controller by Keyence Corporation.
For the notices when using the HA-800B in combination with a host controller, refer to [Notices when connecting the HA-800B with the machine controller (MP2400) manufactured by YASKAWA Electric Corporation] or [Notices when connecting the HA-800B and KV-ML16V controller by Keyence Corporation].

(1) Move the controller to near the mechanical origin via a JOG operation, manually, or using the various host controller functions.
(2) Execute T08 (multi revolution clear) by operating the HA-800B panel near the mechanical origin, and reconnect the HA-800B power supply.
(3) Perform originating using the originating function of the host controller.

*: The current HA-800B position display will not indicate zero at the mechanical origin, but it does not affect the operation. (The current position display of the host controller usually indicates zero.)

2. When not using the originating function of the host controller *1

If not using the originating function of the host controller, perform the following to set the HA-800B coordinate (set the origin).

(1) Set the virtual origin to zero (default), and reconnect the HA-800B power supply.
(2) Move the driver to the target mechanical origin position via a JOG operation or manually.
(3) Execute T08 (multi revolution clear) by operating the HA-800B panel, and reconnect the HA-800B power supply.
(4) Perform any of the following to read the current absolute encoder value.
    (a) Use the HA-800 driver monitor software PSF-800. Check the PSF-800 status display value monitor feedback pulses. For details, refer to [Chapter 10 Communication software].
    (b) Use the status display panel for the HA-800B driver. You can check the current encoder value from the d05 feedback pulse (Low) and d06 feedback pulse (High) shown on the display panel in the status display mode.
    For details, refer to [d05, 06: Feedback pulses display] (P7-5).
    (c) Use the MECHATROLINK communication. For details, refer to [Status monitor command (SMON: 30H)] (P13-18).
    (d) Use [Outputting the current value data from the pins CN2-12 to 18] (HA-655 driver mode). For customers who have been using the HA-655 driver, position data is output from the phase A, B and Z output ports similar to those of the HA-655 driver. Receive and check the data by the host controller. For details, refer to [Outputting the current value data from the pins CN2-12 to 18] (P4-17).
(5) Perform either of the following to set the current absolute encoder value that has been read as the virtual origin.
    (c) Use the HA-800 driver monitor software PSF-800. For details, refer to [Parameter setting] (P10-10).
    (d) Use the MECHATROLINK communication. For details, refer to [Non-volatile parameter write command (PPRM_WR: 1CH)] (P13-14).
(6) Reconnect the power supply to the host controller and HA-800B.
(7) The mechanical origin is set to zero in the amount of absolute value displacement operation.

*: The current HA-800B position display will indicate zero at the mechanical origin.

*1: Driver software Ver. 2.x or later is explained.

Caution

- Do not turn the actuator until the Step (3) Multi revolution clear is executed and Step (4) Receiving/reading of the current value is completed. If the actuator moves, the origin may become offset.

Set the origin in the following situations even if it's not during a start-up.

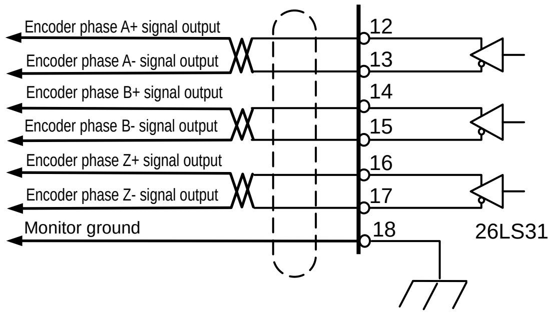
- The driver has been replaced
- The actuator has been replaced
- [AL53: System failure], [AL54: Multi revolution counter overflow] or [AL55: Multi revolution data error] generated due to a loss of absolute position or error.

Data output

Outputting the current value data from the pins CN2-12 to 18

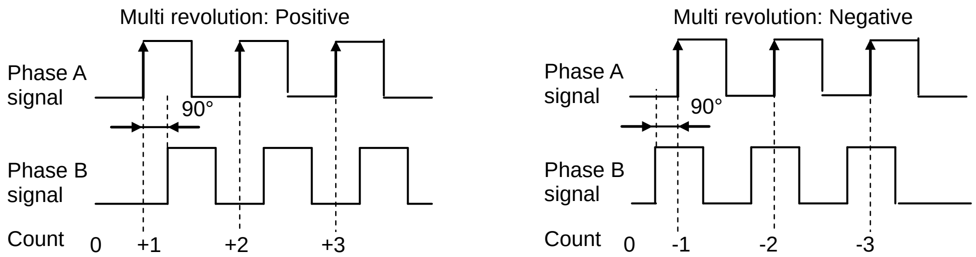
Position data is output from the encoder phase A, B and Z signal output ports.
Following the powering sequence, the output ports of the [CN2-12 phase-A: A+] through [CN2-18 Monitor ground] automatically output multi revolution data and absolute data as the current value data just for once.
In normal operation, pulse train signals are output following the transmission of current value data and implement similar operations to an incremental encoder.

CN2-12 Phase output-A+ (LD)
CN2-13 Phase output-A- (LD)
CN2-14 Phase output-B+ (LD)
CN2-15 Phase output-B- (LD)
CN2-16 Phase output-Z+ (LD)
CN2-17 Phase output-Z- (LD)
CN2-18 Monitor ground



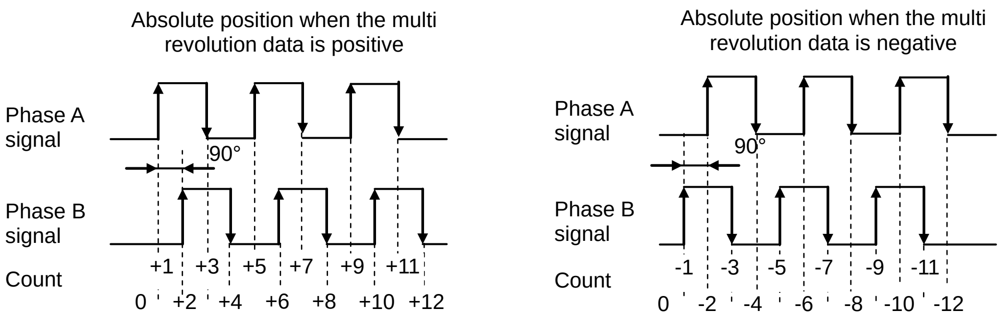
- **Multi revolution data**

Multi revolution data is output by 2 phase signals having a phase difference of 90°. If the multi revolution data of the encoder counter installed on the motor shaft is positive, the multi revolution data has a positive value and the phase A signal is output with an advance of 90° relative to the phase B signal. If the multi revolution data is negative, on the other hand, the multi revolution data has a negative value and the phase A signal is output with a delay of 90° relative to the phase B signal. The pulse frequency is 100kHz. Have the host device discriminate the positive/negative polarities of multi revolution data based on the advance/delay relationships of these 2 phase signals.
For the count, use the leading edge of phase A.



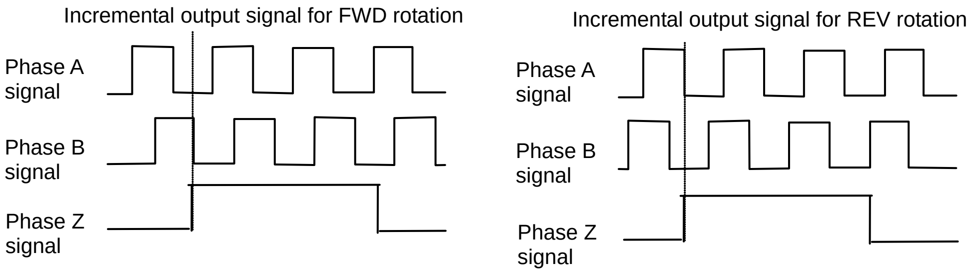
- **Absolute position**

Absolute position is output by 2 phase signals having a phase difference of 90°. If the multi revolution data is positive, the phase A signal is output with an advance of 90° relative to the phase B signal. If the multi revolution data is negative, on the other hand, the phase A signal is output with a delay of 90° relative to the phase B signal. The pulse frequency is 100kHz.
Since pulses are output in the quadrupled mode, count the leading edges and trailing edges of both phase A and B signals. In the example shown below, the absolute position is 12.



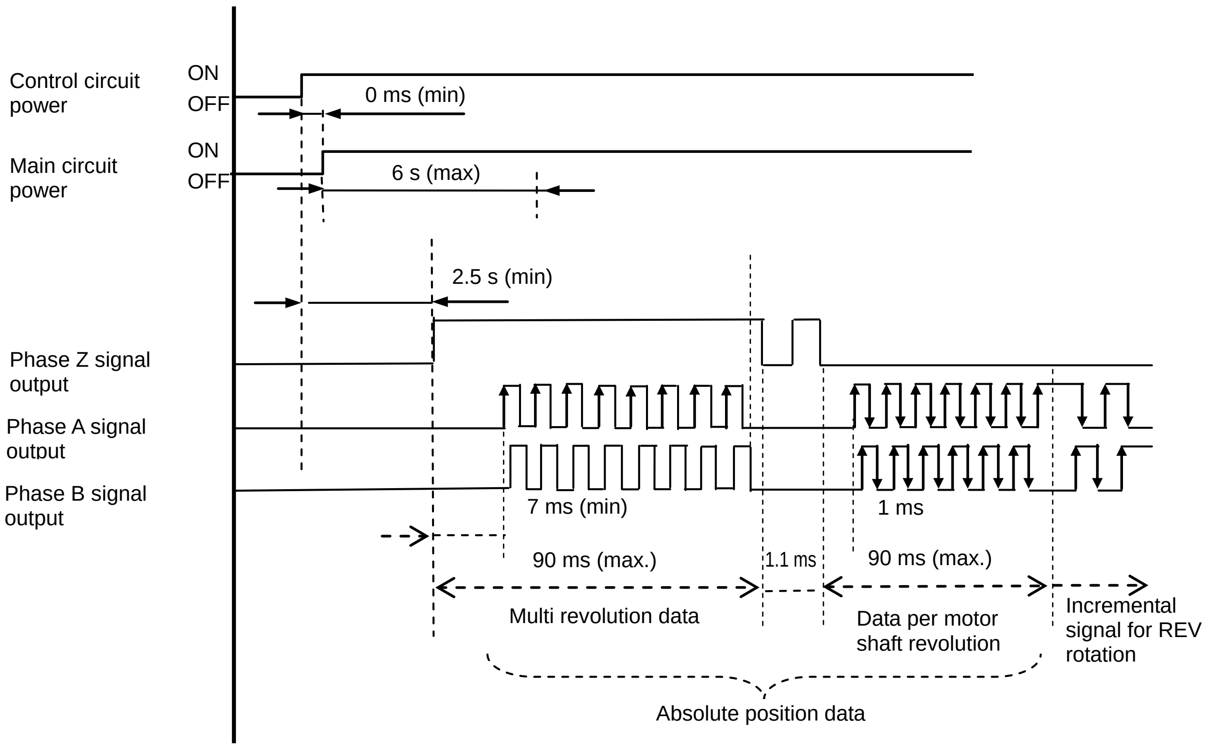
- **Encoder phase A, B and Z incremental signals**

Once multi revolution data and absolute position have been output, 2-phase pulse signals are output in the incremental method. For FWD rotation, the phase A signal is output with an advance of 90° relative to the phase B signal. For REV rotation, the phase A signal is output with a delay of 90° relative to the phase B signal.



- **Output signal sequence**

An example of signal output where the multi revolution data is +8, absolute value is +25, and when REV rotation is started after output of position data, is shown below.



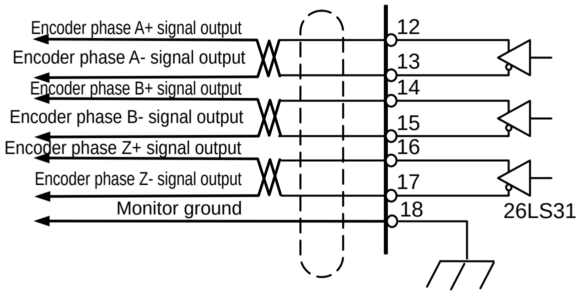
Encoder phase A, B and Z signal outputs

When the motor shaft equipped with a 13-bit absolute encoder turns, incremental phase A, B and Z signals are output to the pins CN2-12 to 18.

- **Number of output pulses**

When the motor shaft turns one revolution, 2,048 pulses are output.
For phase Z, 1 pulse is output per motor shaft revolution. Note that, for phase Z signal, 1 pulse is output per motor shaft revolution, but the width is indeterminable.

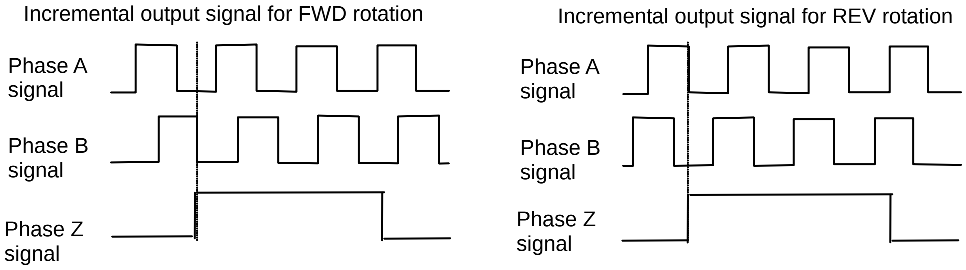
CN2-12 Phase output-A+ (LD)
CN2-13 Phase output-A- (LD)
CN2-14 Phase output-B+ (LD)
CN2-15 Phase output-B- (LD)
CN2-16 Phase output-Z+ (LD)
CN2-17 Phase output-Z- (LD)
CN2-18 Monitor ground



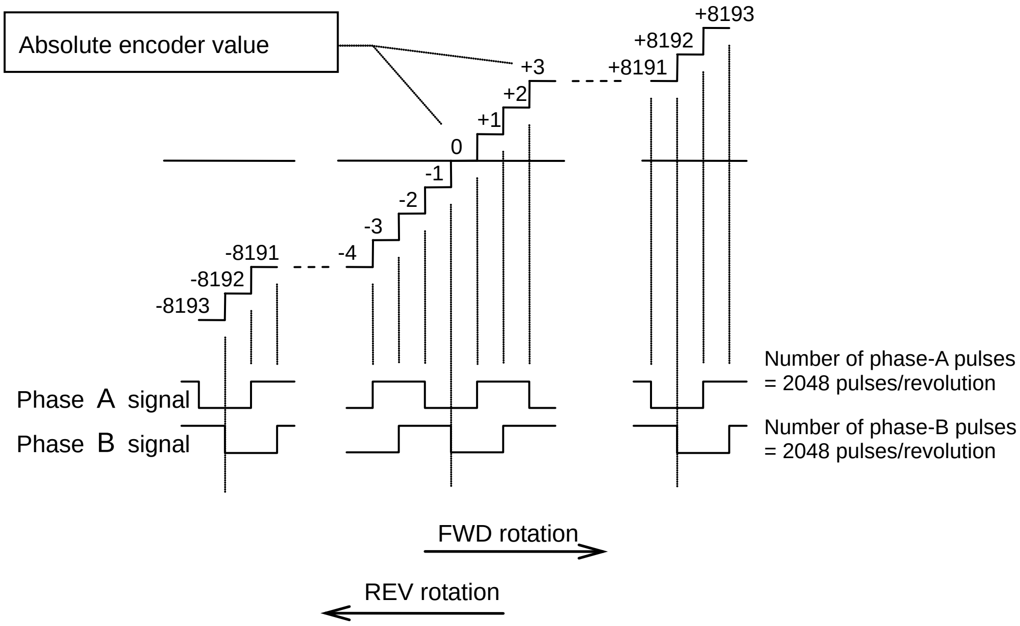
	Output pulses per motor shaft revolution
Phase A	2048
Phase B	2048
Phase Z	1

- **Phase A, B and Z output signal waveforms**

For FWD rotation, the phase A signal is output with an advance of 90° relative to the phase B signal. For REV rotation, the phase A signal is output with a delay of 90° relative to the phase B signal.4To obtain the resolution in the quadrupled mode, utilize the leading edges and trailing edges of both phase A and B signals.



The values of the 13-bit absolute encoder and phase A and B waveforms are shown below.



- **Signal input method**

Each phase signal is output by a line driver (26LS31). Receive the signals using a line receiver (AM26LS32 or equivalent).

Caution

- Use an EIA-422A compliant line receiver to receive the signals.

Checking the absolute position data using the monitor software PSF-800

The HA-800B driver monitor software PSF-800 can be used to display and check the absolute position data of the 17-bit absolute encoder on a personal computer. For details, refer to [Chapter 10 Communication software].

Remedial actions for errors/warnings

Remedial action for error

Name	Description	Cause	Action
AL50 Encoder breakage	Encoder signals have been cut off.	(1) Disconnected encoder signal wire (2) Poor contact/connection of encoder signal connector (3) Encoder malfunction due to rise in actuator temperature (4) Defective encoder (5) HA-800B driver control circuit error	(1) Repair the wire. (2) Connect the connector properly. (3) Review the actuator installation location and cooling system. (4) Replace the actuator. (5) Replace the HA-800B driver.
AL51 Encoder counter receiving error	Encoder serial data could not be received accurately.	(1) Electrical discontinuity of encoder signal wire (2) Non-connection or poor connection of encoder connector CN1 (3) Defective encoder (4) HA-800B driver control circuit error (5) Communication problem due to noise, etc.	(1) Repair the wire. (2) Connect the connector properly. (3) Replace the actuator. (4) Replace the HA-800B driver. (5) Check the ground line or other ground.
AL53 System failure	Encoder multi revolution data has been lost.	(1) The purchased driver was connected and power supply was turned ON for the first time. (2) New product without battery installed (3) The HA-800B driver and actuator have been disconnected for many hours. (4) Either the voltage of the backup capacitor in the encoder or HA-800B driver battery, whichever is higher, has become 2.3V or below. (5) Encoder failure	(1) Execute T08 in the test mode to clear the multi revolution data and then reconnect the power. (2) Install the battery (option: HAB-ER17/33-2). (3) Execute T08 in the test mode to clear the multi revolution data and then reconnect the power. (4) Replace the HA-800B driver battery with a new one (option: HAB-ER17/33-2_Maintenance). After the battery has been replaced, set the origin. (5) Replace the actuator.
AL54 Multi revolution counter overflow	The value in the encoder multi revolution counter has exceeded the range of -4,096 to +4,095 revolutions (motor shaft).	(1) The actuator has turned in one direction in excess of the multi revolution counter range of -4,096 to +4,095 revolutions (motor shaft). (2) Defective encoder (3) HA-800B driver control circuit error	(1) Execute T08 in the test mode to clear the multi revolution data. (2) Replace the actuator. (3) Replace the HA-800B driver.
AL55 Multi revolution data error	The angular acceleration and rotation speed of the motor have exceeded the allowable response range when the encoder power supply was cut off and data was backed up by the battery.	(1) The actuator operated at an acceleration of 5,000 rad/s^2 or more or speed of 1,300 rpm or more, as an equivalent value on the motor shaft, when the driver power supply was cut off. (2) Defective encoder (3) HA-800B driver control circuit error	(1) Execute T08 in the test mode to clear the multi revolution data. (2) Replace the actuator. (3) Replace the HA-800B driver.

Remedial action for warning

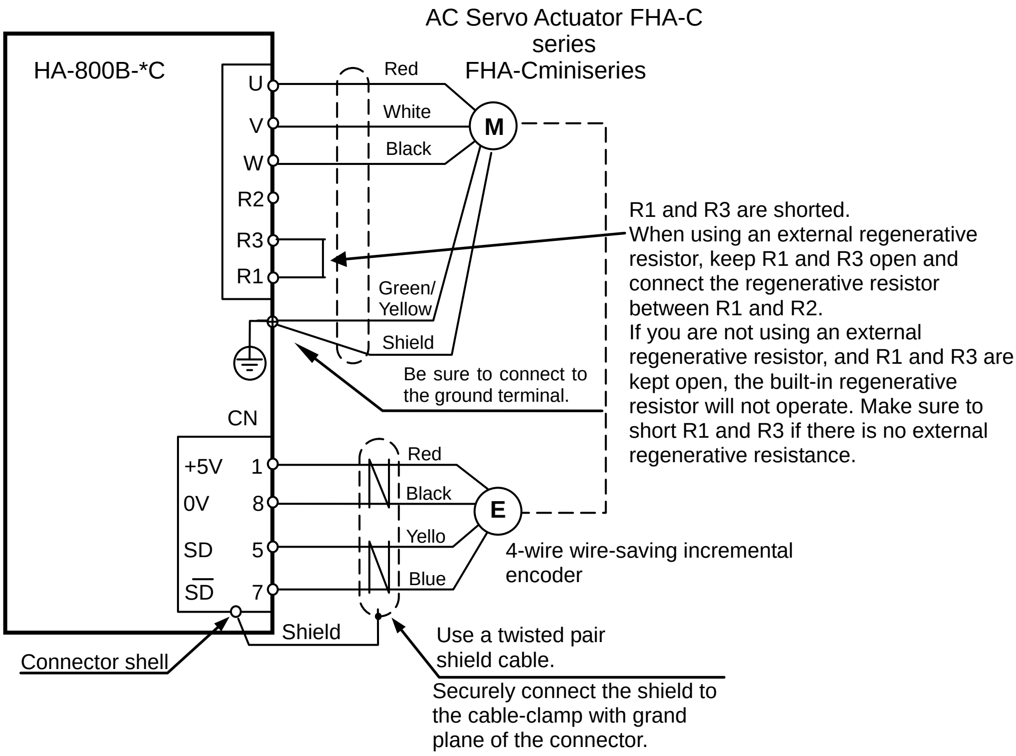
Name	Description	Cause	Action
UA91 Battery voltage low	The backup battery voltage has dropped to DC2.8V or below.	(1) Voltage drop due to consumption of backup battery (2) New product without battery installed (3) Encoder battery lead line short-circuit and poor connection (4) HA-800B driver control circuit error (5) Encoder failure	(1) Replace the battery with a new one (option: HAB-ER17/33-2_Maintenance). (2) Install the battery (option: HAB-ER17/33-2). (3) Repair the wire. (4) Replace the HA-800B driver. (5) Replace the actuator.

4-4 Incremental encoder

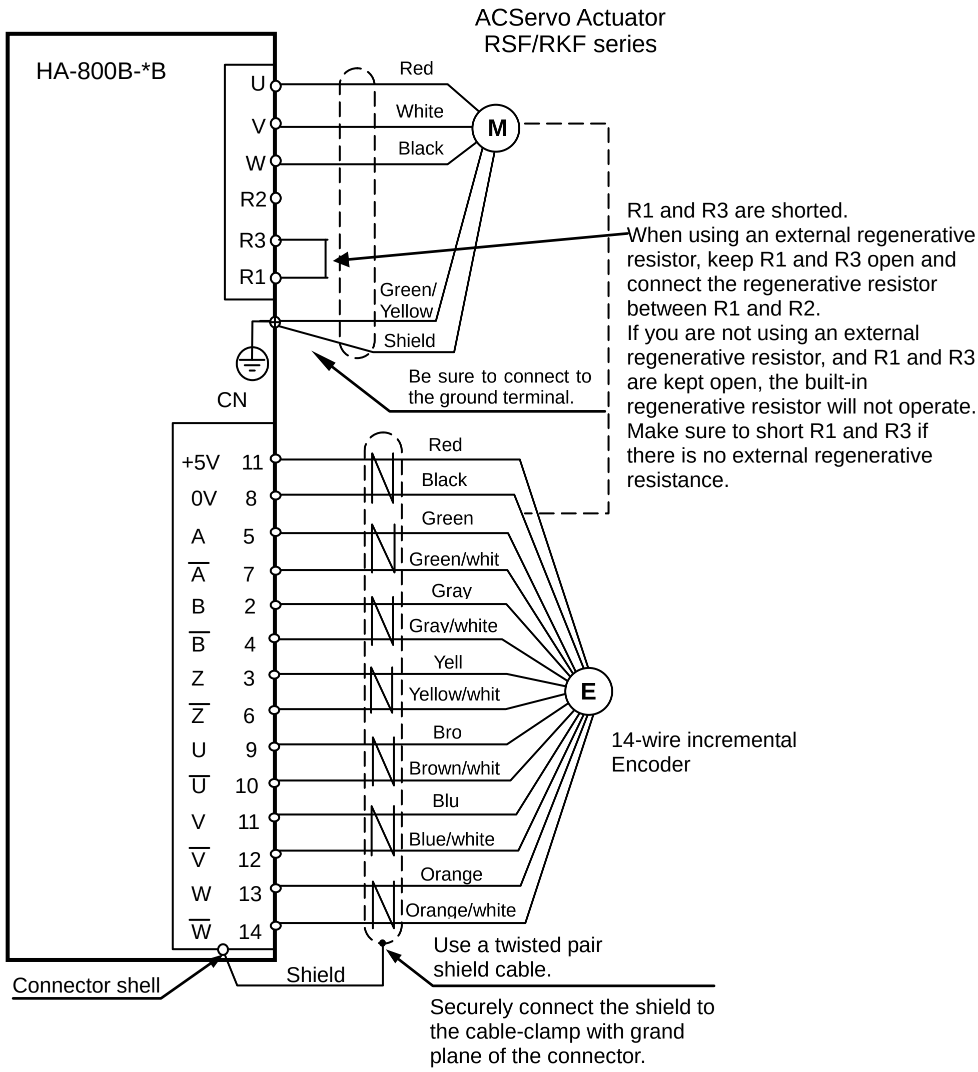
The incremental encoder has a relatively simple structure where pulses are output according to changes in rotation angle. However, it has one drawback of causing loss of current position data when the power supply is cut off, and therefore position control requires originating operation using a separately provided origin sensor.

Standard connection

- **4-wire wire-saving incremental encoder model**



14-wire incremental encoder model



Startup

Parameters that must be set

Nothing in particular.

Startup procedures

1 **Initializing the incremental encoder system**

With incremental encoder systems using FHA-Cmini, FHA-C or RSF/RKF series actuators, driver feedback pulses are reset to 0 (initialized) when the driver power supply is turned ON.

2 **Origin setting**

Set the origin in order to link the actuator driver and the mechanical origin.
For the origin setting method, refer to [Origin setting] (P4-26).

Origin setting

1. When using the originating function of the host controller *1

Set the coordinate (set the origin) using the host controller based on the following procedure if the HA-800B is intended to be used in combination with the MP2000 series by YASKAWA Electric Corporation or the KV-ML16V controller by Keyence Corporation.
For the notices when using the HA-800B in combination with a host controller, refer to [Notices when connecting the HA-800B with the machine controller (MP2400) manufactured by YASKAWA Electric Corporation] or [Notices when connecting the HA-800B and KV-ML16V controller by Keyence Corporation].

(1) Perform originating using the originating function of the host controller.
*: The current HA-800B position display will not indicate zero at the mechanical origin, but it does not affect the operation. (The current position display of the host controller usually indicates zero.)

2. When not using the originating function of the host controller *1

If not using the originating function of the host controller, perform the following to set the HA-800B coordinate (set the origin).

(1) Set the virtual origin to zero (default), and reconnect the HA-800B power supply.
(2) Perform originating to set the origin to be usually used (ZRET: 3AH).
(3) Perform one of the following to confirm that the current incremental encoder value is set to 0.
  (a) Use the HA-800 driver monitor software PSF-800. Check the PSF-800 status display value monitor feedback pulses. For details, refer to [Chapter 10 Communication software].
  (b) Use the status display panel for the HA-800B driver. You can check the current encoder value from the d05 feedback pulse (Low) and d06 feedback pulse (High) shown on the display panel in the status display mode.
  For details, refer to [d05, 06: Feedback pulses display] (P7-5).
  (c) Use the MECHATROLINK communication. For details, refer to [Status monitor command (SMON: 30H)] (P13-18).
(4) By performing the JOG operation etc., move the operation section to the mechanical origin position. Be sure to carry out from the operation in Step (2) without shutting down the power.
(5) With the operating section stopped at the mechanical origin, perform one of the methods in Step (3) to read the current incremental encoder value.
(6) Perform either one of the following to set the current incremental encoder value that has been read as the virtual origin.
  (a) Use the HA-800 driver monitor software PSF-800. For details, refer to [Parameter setting] (P10-10).
  (b) Use the MECHATROLINK communication. For details, refer to [Non-volatile parameter write command (PPRM_WR: 1CH)] (P13-14).
(7) Reconnect the power supply to the host controller and HA-800B.
(8) When an originating operation is executed, the driver will stop at the mechanical origin determined in Step (4) and the current value will be set to 0.
*: The current HA-800B position display will indicate zero at the mechanical origin.

*1: Driver software Ver. 2.x or later is explained.

Set the origin in the following situations even if it's not during a start-up.
- The control power supply has been turned ON
- The driver has been replaced
- The actuator has been replaced

Data output

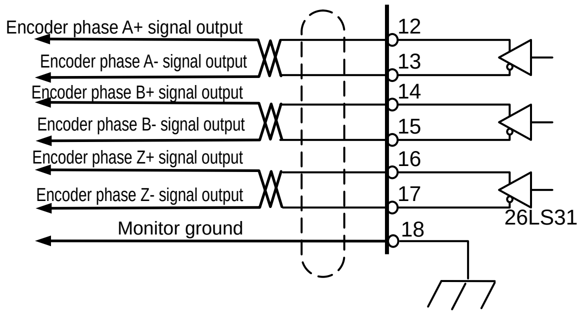
Encoder phase A, B and Z signal outputs

When the motor shaft equipped with an encoder turns, incremental phase A, B and Z signals are output to the pins CN2-12 to 18.

- **Number of output pulses**

  The numbers of phase A and B signal output pulses per motor shaft revolution vary depending on the encoder resolution.
  For phase Z, 1 pulse is output per motor shaft revolution.

  CN2-12 Phase output-A+ (LD)
  CN2-13 Phase output-A- (LD)
  CN2-14 Phase output-B+ (LD)
  CN2-15 Phase output-B- (LD)
  CN2-16 Phase output-Z+ (LD)
  CN2-17 Phase output-Z- (LD)
  CN2-18 Monitor ground



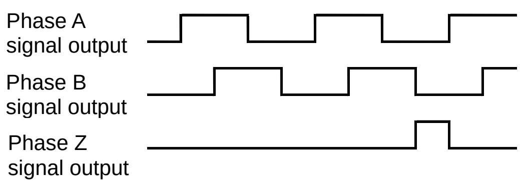
	Output pulses per motor shaft revolution
Phase A	(Encoder resolution) / 4 *1
Phase B	(Encoder resolution) / 4 *1
Phase Z	1

*1: For example, assume that the encoder resolution is 10,000 pulses, 2,500 pulses (10,000 / 4) are output.
* A phase Z for the reduction ratio per shaft revolution of the output shaft is output for an actuator with a speed reducer.

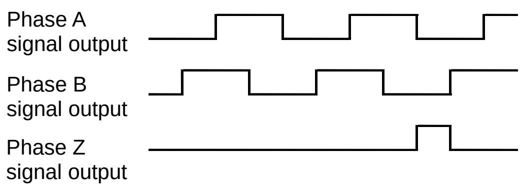
- **Phase A, B and Z output signal waveforms**

  For FWD rotation, the phase A signal is output with an advance of 90° relative to the phase B signal. For REV rotation, the phase A signal is output with a delay of 90° relative to the phase B signal.
  To obtain the resolution in the quadrupled mode, utilize the leading edges and trailing edges of both phase A and B signals.

Incremental output signal for FWD rotation



Incremental output signal for REV rotation



- **Signal input method**

  Each phase signal is output by a line driver (26LS31). Receive the signals using a line receiver (AM26LS32 or equivalent).

Caution

- Use an EIA-422A compliant line receiver to receive the signals.

Remedial action for error

Name	Description	Cause	Action
AL50 Encoder breakage	Encoder signals have been cut off.	(1) Disconnected encoder signal wire (2) Poor contact/connection of encoder signal connector CN1 (3) Encoder malfunction due to rise in actuator temperature (4) Defective encoder (5) HA-800B driver control circuit error	(1) Repair the wire. (2) Connect the connector properly. (3) Review the actuator installation location and cooling system. (4) Replace the actuator. (5) Replace the HA-800B driver.
AL51 Encoder receiving error	Encoder serial data could not be received accurately.	(1) Electrical discontinuity of encoder signal wire (2) Poor contact/connection of encoder signal connector CN1 (3) Defective encoder (4) HA-800B driver control circuit error (5) Communication problem due to noise, etc.	(1) Repair the wire. (2) Connect the connector properly. (3) Replace the actuator. (4) Replace the HA-800B driver. (5) Check the ground line or other ground.
AL52 UVW error	Encoder phase U/V/W signal error	(1) Electrical discontinuity of encoder signal wire (2) Poor contact/connection of encoder signal connector CN1 (3) Defective encoder (4) HA-800B driver control circuit error	(1) Repair the wire. (2) Connect the connector properly. (3) Replace the actuator. (4) Replace the HA-800B driver.

4

Encoder system

Chapter 5

I/O signals

Details of I/O signal conditions and signal functions are explained in this chapter.

5-1 I/O signal list ······ 5-1
5-2 Details of input signals ······ 5-5
5-3 Details of output signals ······ 5-7
5-4 Monitor output ······ 5-10
5-5 Connection example with default settings ······ 5-12

5-1 I/O signal list

This unit communicates with the host device via the CN2 connector (20-pin half-pitch connector). The following explains the I/O signals used in this communication.

Pin numbers and names of I/O signals

The CN2 (20-pin half-pitch connector) pin numbers and corresponding signal names are shown in the table below. Logics can be set to input signals (pins 1 to 5) and output signals (pins 7 to 10) using the system parameter mode.

Pin No.	Signal	Symbol	Input Output
1	FWD inhibit	FWD-IH	Input
2	REV inhibit	REV-IH	Input
3	Latch 1	LATCH1	Input
4	Latch 2	LATCH2	Input
5	Origin signal	ORG	Input
6	Input signal common	IN-COM	Input
7	Operation preparation complete	READY	Output
8	Origin return complete	ORG-END	Output
9	In-position complete	INPOS	Output
10	Alarms	ALARM	Output
11	Output signal common	OUT-COM	Output
12	Encoder monitor (A+)	A+	Output
13	Encoder monitor (A-)	A-	Output
14	Encoder monitor (B+)	B+	Output
15	Encoder monitor (B-)	B-	Output
16	Encoder monitor (Z+)	Z+	Output
17	Encoder monitor (Z-)	Z-	Output
18	Monitor ground	MON-COM	Output
19	—	—	—
20	Frame ground	FG	Output

Do not connect the pins marked "-". These pins are connected to internal circuits, so connecting them may result in failure.

Models of I/O signal connector CN2

The models of CN2 connector are shown below:

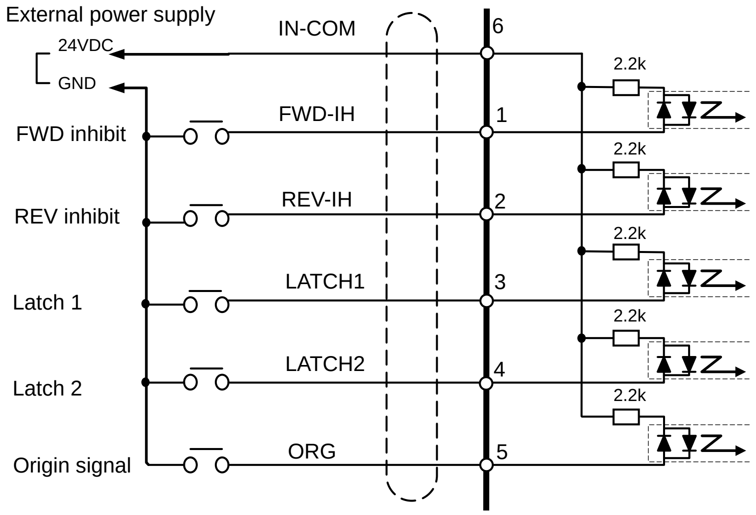
	Connector	Cover
Manufacturer	3M	3M
Model	10120-3000PE	10320-52F0-008

Input signal connection circuit

The following explains how to connect the input signal port to the host device.
This driver has 5 input signal ports as shown below.

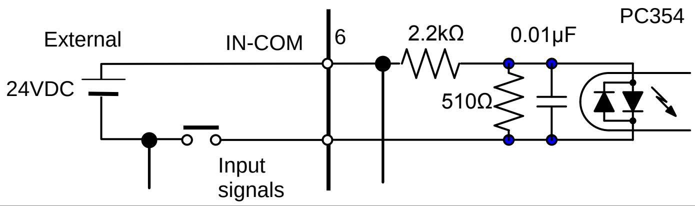
Specifications of input ports

Voltage: 24VDC ± 10%
Current: 20 mA or less (per port)

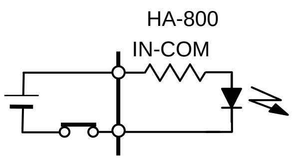
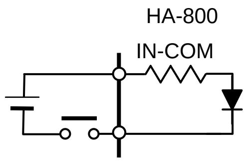


Caution

- The driver has no built-in input signal power supply. Connect 24VDC or GND to [CN2-6: Input signal common] as the common voltage of the external power supply for input signals.



Input signal function (logic)

		Input signal status from host	
		Opt-isolator ON	**Opt-isolator OFF**
Circuit status			
Logic setting	**0: Normally open (contact A) Logic NO**	Enabled	Disabled
	1: Normally closed (contact B) Logic NC	Disabled	Enabled

Enable: The function of the selected signal is enabled.
Disable: The function of the selected signal is disabled.

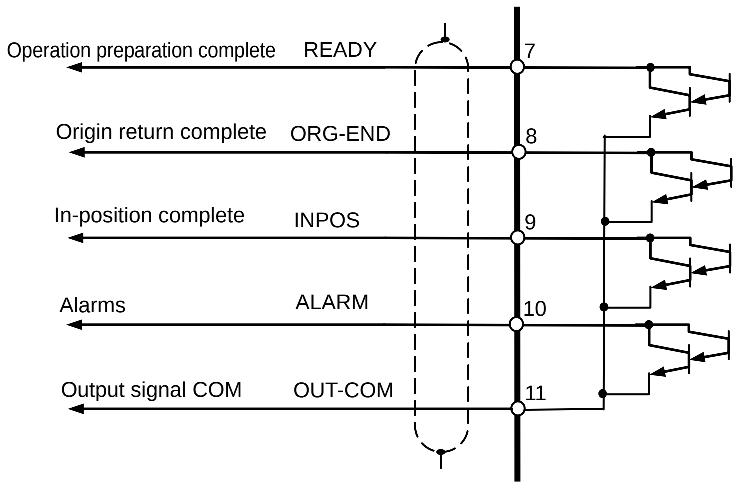
Input signal functions can be changed using system parameters or servo parameter setting software PSF-800. For system parameters, refer to [SP62: Input signal logic setting] (P8-7). For the operation method of the setting software PSF-800, refer to [Chapter 10 Communication software].

Output signal connection circuit

The following explains how to connect the output signal port to the host device.
This driver has 4 output signal ports as shown below.

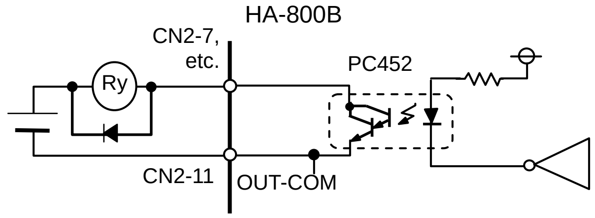
Specifications of output ports

Open-collector output opt-isolator insulation
Voltage: 24VDC or less
Current: 40 mA or less /per port



How to connect

Connect an output signal between each output port and [CN2-11: Output signal common OUT-COM].
Voltage: 24VDC or less
Current: 40 mA or less /per port



Output signal function (logic)

- **Function (logic) definition**

		Transistor output signal status	
		Transistor ON	Transistor OFF
Logic setting	00	Enabled	Disabled
	01	Disabled	Enabled

Enabled: The function of the output signal is enabled.
Disabled: The function of the output signal is disabled.

- **How to change function (logic)**

Output signal functions can be changed using system parameters or servo parameter setting software PSF-800. For system parameters, refer to [SP63: Output signal logic] (P8-7). For the operation method of the setting software PSF-800, refer to [Chapter 10 Communication software].

5-2 Details of input signals

The following explains the details of input signals.
For the signal logic, refer to P5-3.

CN2-1: FWD inhibit (FWD-IH)
CN2-2: REV inhibit (REV-IH)

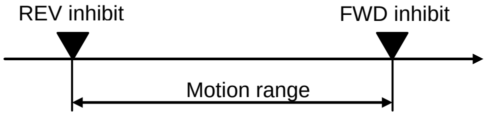
This input is used to limit the motion range using a limit sensor signal set at the operation limit of the drive system.

FWD inhibit: With the default setting, turning ON the input signal does not cause the actuator to generate torque in the forward direction. (The actuator does not generate torque in the reverse direction either, when the deviation is a positive value.)

REV inhibit: With the default setting, turning ON the input signal does not cause the actuator to generate torque in the reverse direction. (The actuator does not generate torque in the forward direction either, when the deviation is a negative value.)

With no normal rotation/ reverse rotation input, the actuator may stop with the position deviation not cleared, and the operation will not start even if a command to operate in the direction to cancel the FWD/REV inhibit input is executed until the position deviation is cleared.
Note also that the actuator may suddenly rotate if the inhibit input is cancelled while the position deviation is not cleared.

With the default setting, the actuator is set (normally open) in a way that turning OFF both input signals does not cause the actuator to generate torque in both the forward and reverse directions. To use these signals, do so upon changing the logic in system parameter, [SP62: Input signal logic setting] (normally closed).
Also, for the position control and speed control, you can change the operation during the inhibit status to lock the servo using [SP65: FWD/REV inhibit operation].



Commands from the host controller are received even in FWD/REV inhibit status. Therefore, the actuator keeps retaining position deviation values if a command continues to be sent in the inhibited direction in FWD/REV inhibit status, and an alarm for excessive position deviation values may occur, in which case the servo driver will turn OFF.

CN2-3: Latch 1 (LATCH1)
CN2-4: Latch 2 (LATCH2)

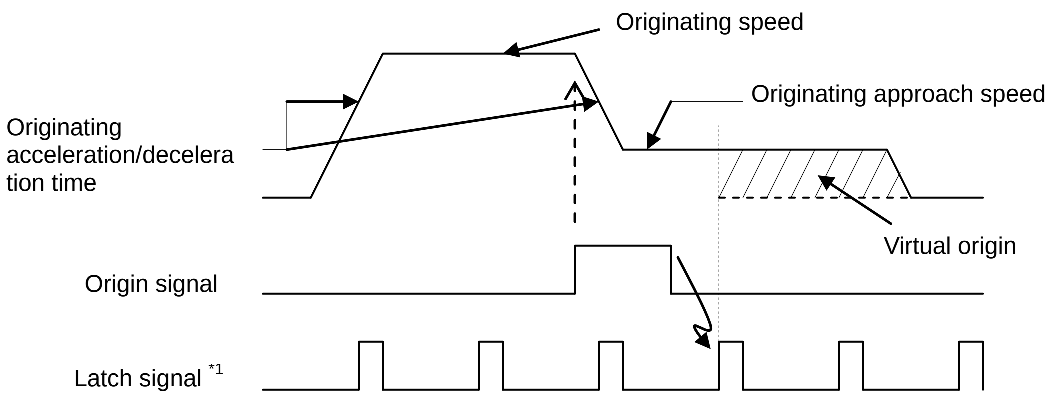
These are input signals to be used for event occurrence condition (selected by LT_SGN) when the following commands are executed.

Name	Command
Interpolated feed with position latch function	LATCH (38H)
Positioning by external input	EX_POSING (39H)
Originating	ZRET (3AH)

The logic can be changed in system parameter, [SP62: Input signal logic setting]. With the default setting, it becomes the latch signal detected status when the input signal turns ON.

CN2-5: Origin signal (ORG)

Connect the input of the sensor installed at the position you want to use as the origin of the system mechanism.
The logic can be changed in system parameter, [SP62: Input signal logic setting]. The logic is set to normally open in the default setting.
When HA-800B performs an originating operation (ZRET: 3AH), this signal is input and an originating is performed by a latch signal.
The parameters required for an originating (originating acceleration/deceleration time, originating approach speed and virtual origin) can be set in PSF-800.
The originating speed is to be set using the host device. For details, refer to [Originating (ZRET: 3AH)] (P13-26).



*1: The latch signal shown in the figure represents the latch signal specified by a MECHATROLINK command.

CN2-6: Input signal common (IN-COM)

This is a common terminal for input signals: CN2-1, 2, 3, 4 and 5. It supplies power to the external power supply for input signals.
Connect the 24VDC or 0V side of the external power supply for input signals.

5
I/O signals

5-3 Details of output signals

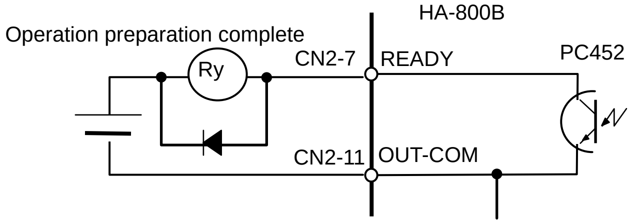
The following explains the details of output signals.
For the signal logic, refer to P5-4.

CN2-7: Operation preparation complete (READY)

With the default setting, this signal turns ON when the servo motor is excited and becomes ready following the [Servo-ON (SV_ON: 31H)] command. It turns OFF if an alarm occurs.
The logic can be changed in system parameter, [SP63: Output signal logic setting]. With the default setting, the output transistor turns ON in the ready state.

Connection method

Voltage: 24VDC or less,
current: 40mA or less (per port)

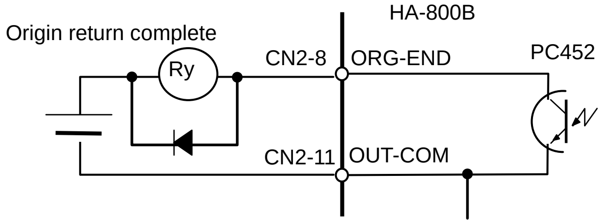


CN2-8: Origin return complete (ORG-END)

With the default setting, the signal turns ON when the originating (ZRET command) is completed. The signal may not turn ON since some host controllers do not use the ZRET command for originating.
When the signal is used in a combination with an absolute encoder, it turns ON once the control circuit power supply is connected to the HA-800B driver and the current encoder value is read.
The logic can be changed in system parameter, [SP63: Output signal logic setting]. With the default setting, the output transistor turns ON when the system is operating normally.

Connection method

Voltage: 24VDC or less,
current: 40 mA or less (per port)



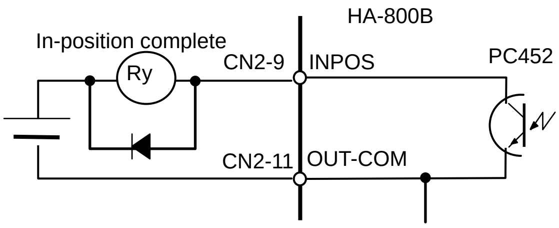
・It turns OFF if an encoder alarm occurs.
・It turns OFF while the originating (ZRET command) is being executed.

CN2-9: In-position complete (INPOS)

With the default setting, this signal turns ON to indicate completion of positioning when the value of the deviation counter changes to or below the value set in [AJ04: In-position range] accessible from [Adjustment parameters]. Use this signal for confirmation of in-position, etc. at the host device. The signal is not valid in speed control or torque control.
The logic can be changed in system parameter, [SP63: Output signal logic setting]. With the default setting, the output transistor turns ON when the accumulated pulses in the deviation counter drop to or below the set value of in-position range.

Connection method

Voltage: 24VDC or less,
current: 40 mA or less (per port)

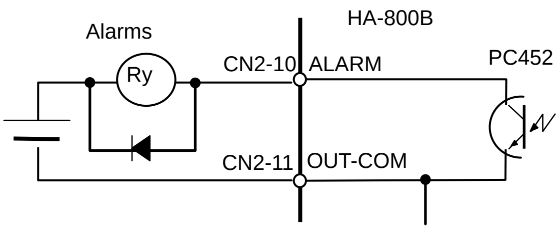


CN2-10: Alarm (ALARM)

With the default setting, this signal turns OFF when an alarm occurs following an error detection by the HA-800B driver. This is a normally closed signal (NC, contact b).
The logic can be changed in system parameter, [SP63: Output signal logic setting]. With the default setting, the output transistor turns ON when the system is operating normally.

Connection method

Voltage: 24VDC or less,
current: 40 mA or less (per port)



CN2-11: Output signal common (OUT-COM)

This is a common terminal for output signals CN2-7, 8, 9 and 10.

CN2-12 to 17: Encoder signal output (A, B, Z)

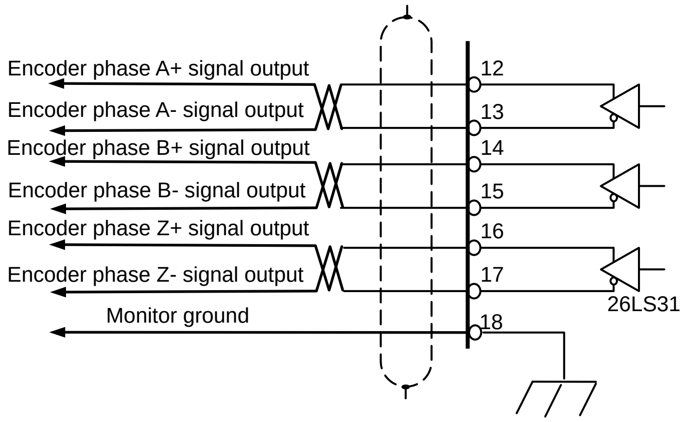
The encoder's phase A, B, and Z signals are output via a line driver (26LS31).

Pin No.	Name	Symbol
12	Encoder monitor (A+)	A+
13	Encoder monitor (A-)	A-
14	Encoder monitor (B+)	B+
15	Encoder monitor (B-)	B-
16	Encoder monitor (Z+)	Z+
17	Encoder monitor (Z-)	Z-

Connection method

Receive the signals using a line receiver (AM26LS32 or equivalent).

*** Use an EIA-422A compliant line receiver.**



5-4 Monitor output

The following explains how to output speed waveforms, current waveforms, and the signal waveforms set in system parameter mode 3, [SP40: CP3 output signal setting], that are output via the CN9 connector.

CN9-1: Speed monitor (SPD-MON)

The port outputs a voltage signal proportional to the motor rotation speed (speed input factor per 10V). The relationship of output voltage and rotation speed is obtained by the value set in system parameter 3 [SP51: Speed input factor]. Note, however, that the output is unstable for 5 seconds after the power is turned ON. (A maximum of approx. ±15V may be output.)

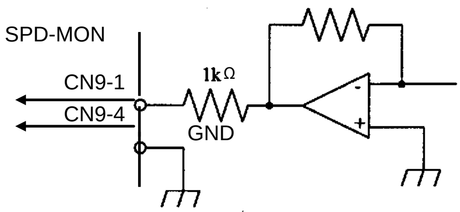
$$\text{Motor rotation speed (r/min)} = \text{Speed monitor output voltage (V)} \times \frac{\text{Speed input factor (r/min)}}{10.0\ \text{(V)}}$$

Output specifications

Output voltage range: -10 to +10V
Output impedance: 1kΩ

Connection method

Plug the supplied connector into CN9 and check the waveform between [CN9-1 speed monitor: SPD-MON] and [CN9-4 monitor ground: GND] using an oscilloscope.



CN9-2: Current monitor (CUR-MON)

The actuator current is output as voltage. The voltage is output based on the maximum actuator current being +10V. Note, however, that the output is unstable for 5 seconds after the power is turned ON. (A maximum of approx. ±15V may be output.)

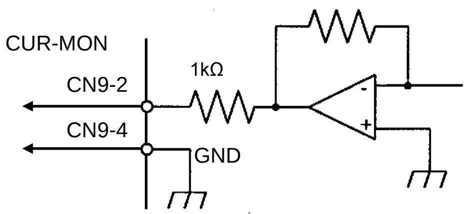
$$\text{Actuator current (A)} = \text{Current monitor output voltage (V)} = \times \frac{\text{Max. current (A)}}{10.0\ \text{(V)}}$$

Output specifications

Output voltage range: -10 to +10V
Output impedance: 1kΩ

Connection method

Plug the supplied connector into CN9 and check the waveform between [CN9-2 current monitor: CUR-MON] and [CN9-4 monitor ground: GND] using an oscilloscope.



CN9-3: Signal monitor (SIG-MON)

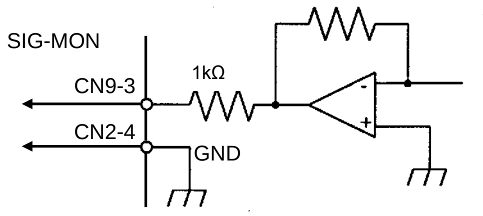
The signal waveform set in signal parameter 3 [SP40: CN9-CP3 output signal setting] is output. The output voltage is 0V for Low and 3.3V for High. Note, however, that the output is unstable for 5 seconds after the power is turned ON. (A maximum of approx. ±15V may be output.)

Output specifications

Output voltage range: 0 or 3.3V
Output impedance: 1kΩ

Connection method

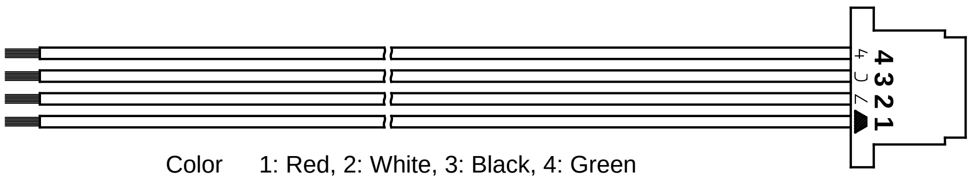
Plug the supplied connector into CN9 and check the waveform between [CN9-3 signal monitor: SIG-MON] and [CN9-4 monitor ground: GND] using an oscilloscope.



CN9-4: Monitor Ground (GND)

This is a common terminal for analog monitors CN9-1, 2 and 3.

* An optional dedicated cable is required to monitor the signal. (EWA-MON01-JST4)

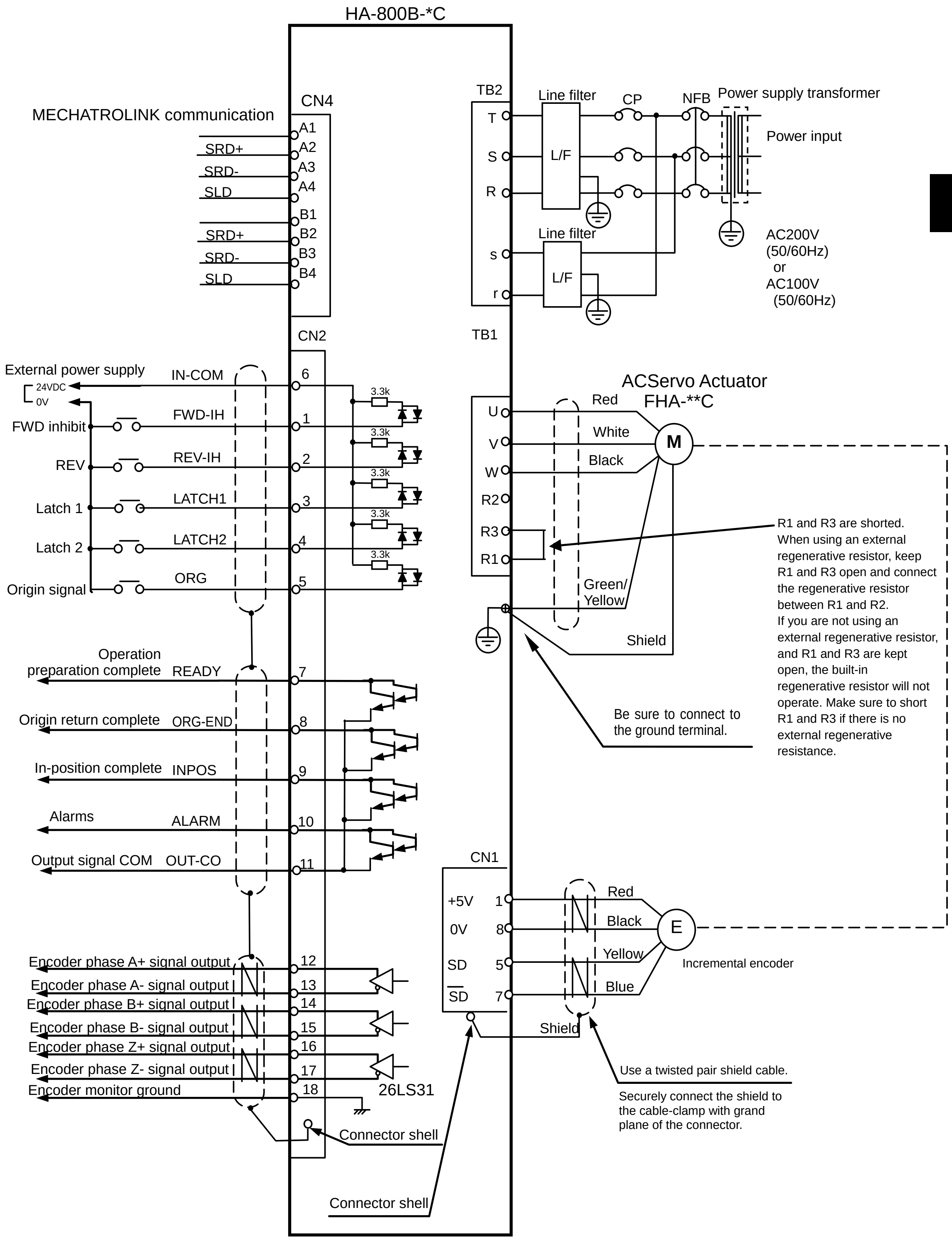


Color   1: Red, 2: White, 3: Black, 4: Green

5 I/O signals

5-5 Connection example with default settings

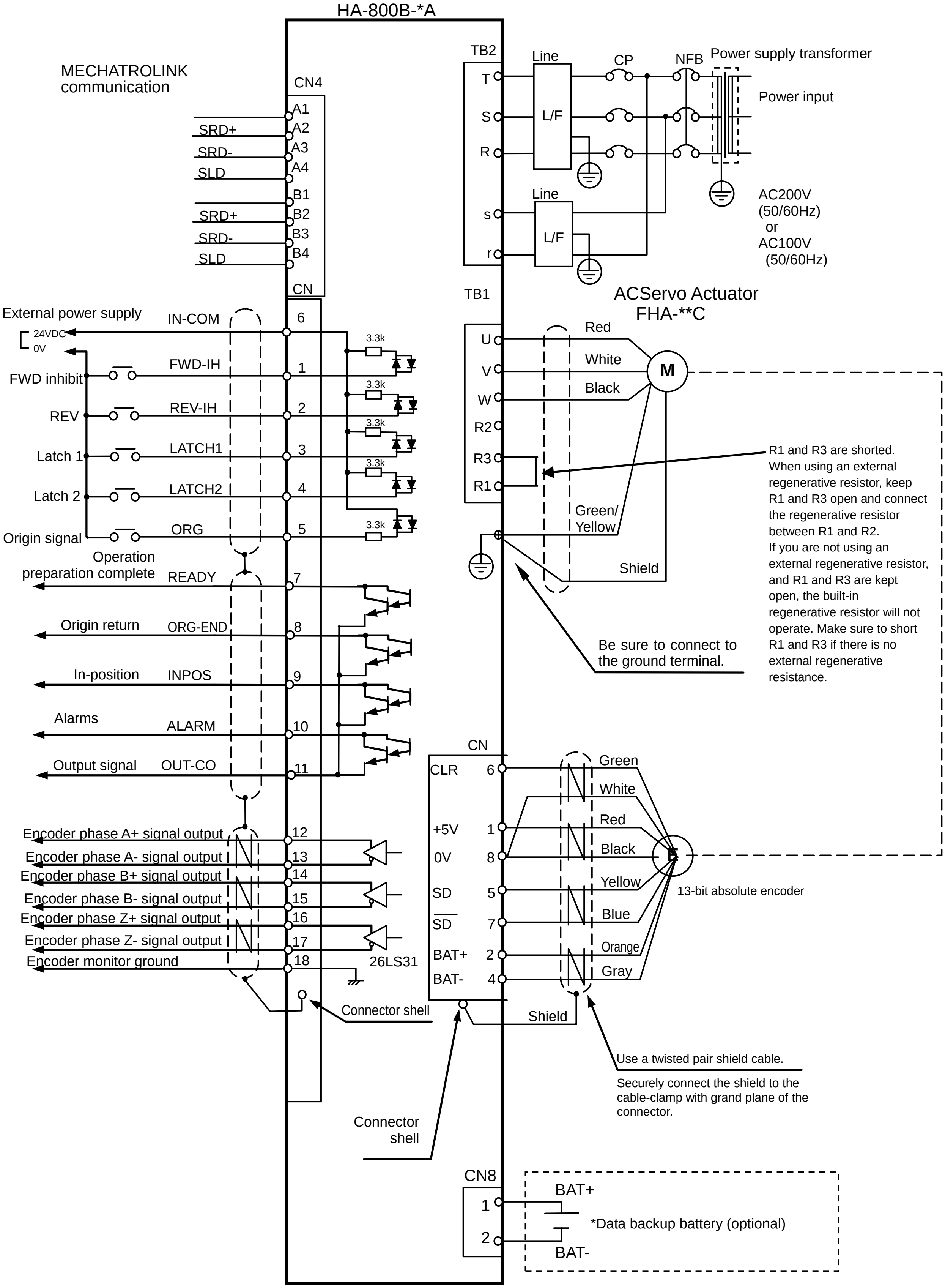
4-wire-saving incremental model (FHA-C series)



5

I/O signals

13-bit absolute model (FHA-C series)

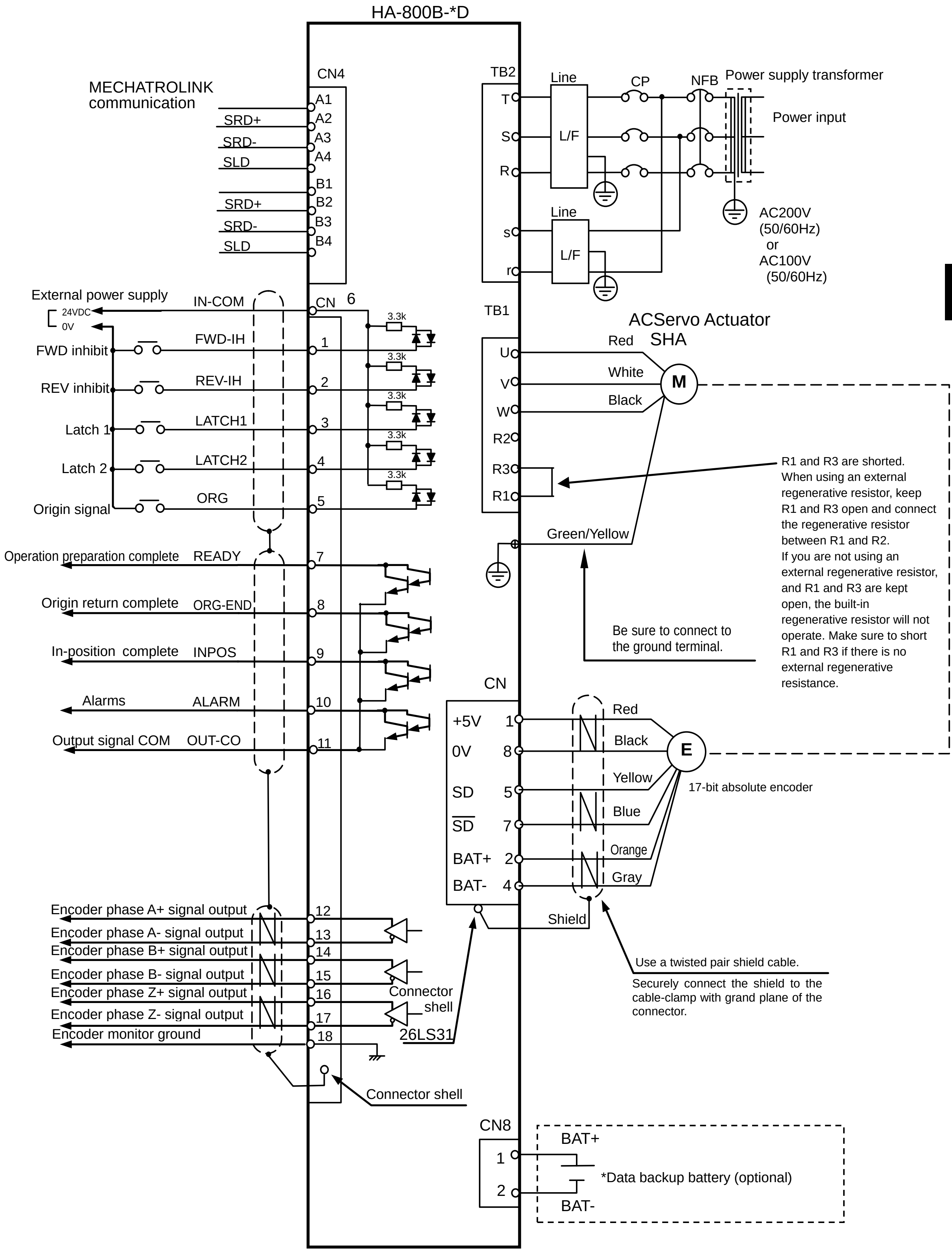


*When combining the driver to an absolute encoder, install an optional data backup battery.

5

I/O signals

17-bit absolute encoder model (SHA)



*When combining the driver to an absolute encoder, install an optional data backup battery.

5

I/O signals

Chapter 6

Panel display and operation

How to operate the display and operation buttons on the driver's front panel and overview of operation in each mode are explained.

6-1 Operating display panel 6-1

6-1 Operating display panel

The front display panel has a 5-digit LED display and 4 operation keys. You can perform display, tuning, setting and other operations other than specifying network-related settings on this display panel.

Summary of modes

The display panel is operated in the 5 modes specified below.

Status display mode (d00 to d16)

The current position information from the motor encoder, condition of cumulative pulses in the deviation counter, I/O signal statuses, load condition, alarm history and code number of the actuator to be combined are shown, among others. For details, refer to [Status display mode] (P7-1).

Alarm mode (AL, A1 to A8, AHcLr)

Present alarms and up to 8 most recent alarm histories are shown. Also, the alarm history can be deleted in the alarm mode. We recommend to clear the alarm history after the system is complete.
When an alarm occurs, the HA-800B driver switches to the alarm mode, regardless of the present mode of the display panel, and shows the present alarm code.
For details, refer to [Alarm mode] (P7-8).

Tune modes 1, 2 and 3 (AJ00 to AJ59)

Parameters, such as a servo gain, can be displayed and changed.
Tune mode parameters can be changed even when the actuator is operating. Changes are reflected in real time.
For details, refer to [Tune mode] (P7-11).

System parameter configuration modes 3 and 4 (SP40 to SP79)

These set the HA-800B driver functions. The set values will become effective when the HA-800B driver power supply is reconnected.
For details, refer to [System parameter mode] (P8-1).

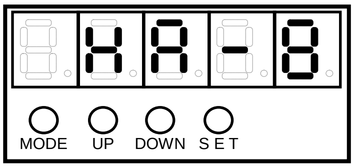
Test modes (T00 to T11)

You can monitor CN2 I/O signals, operate output signals, initialize parameters, and perform multi revolution clear and auto-tuning.
You can also perform a simple JOG operation, and thus, the actuator can be operated simply by connecting the HA-800B driver and the actuator.

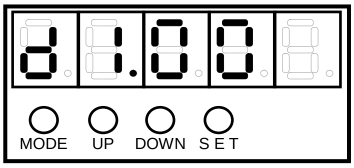
Initial panel display

The following explains the panel display shown when the driver is started normally and while an alarm is present.

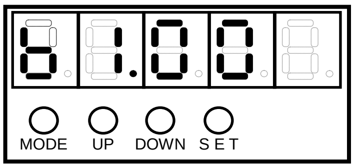
Display upon control power supply ON



When the driver's control power supply is turned ON, the driver model HA-800 is shown at the far right of the panel display.

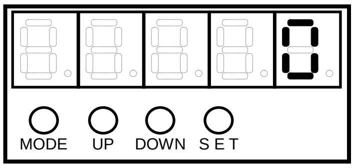


The display software version is shown for approx. 1 second.



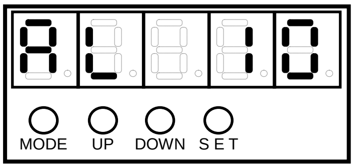
The control software version is shown for approx. 1 second.

Normal

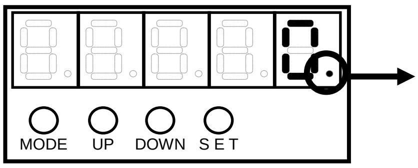


The status data set by system parameter 3 [SP54: Status display setting] is shown.

Alarm



The driver starts in the alarm mode and shows the present alarm.
If multiple alarms or warnings are present, they are shown one by one at an interval of approx. 500 ms.

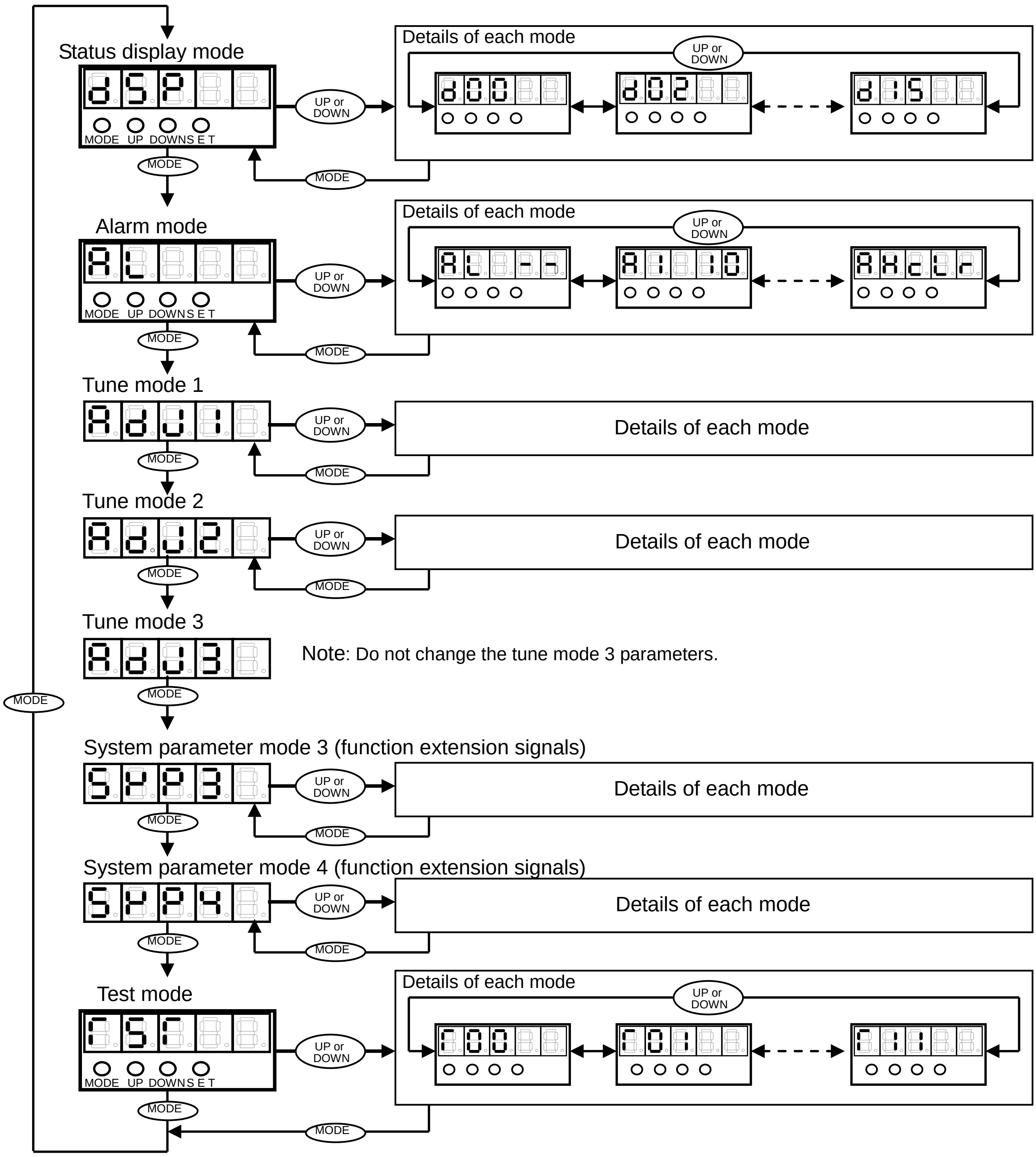


The decimal point in the fifth digit indicates the servo-ON.
Lit: Servo-ON
Unlit: Servo-OFF

6 Panel display and operation

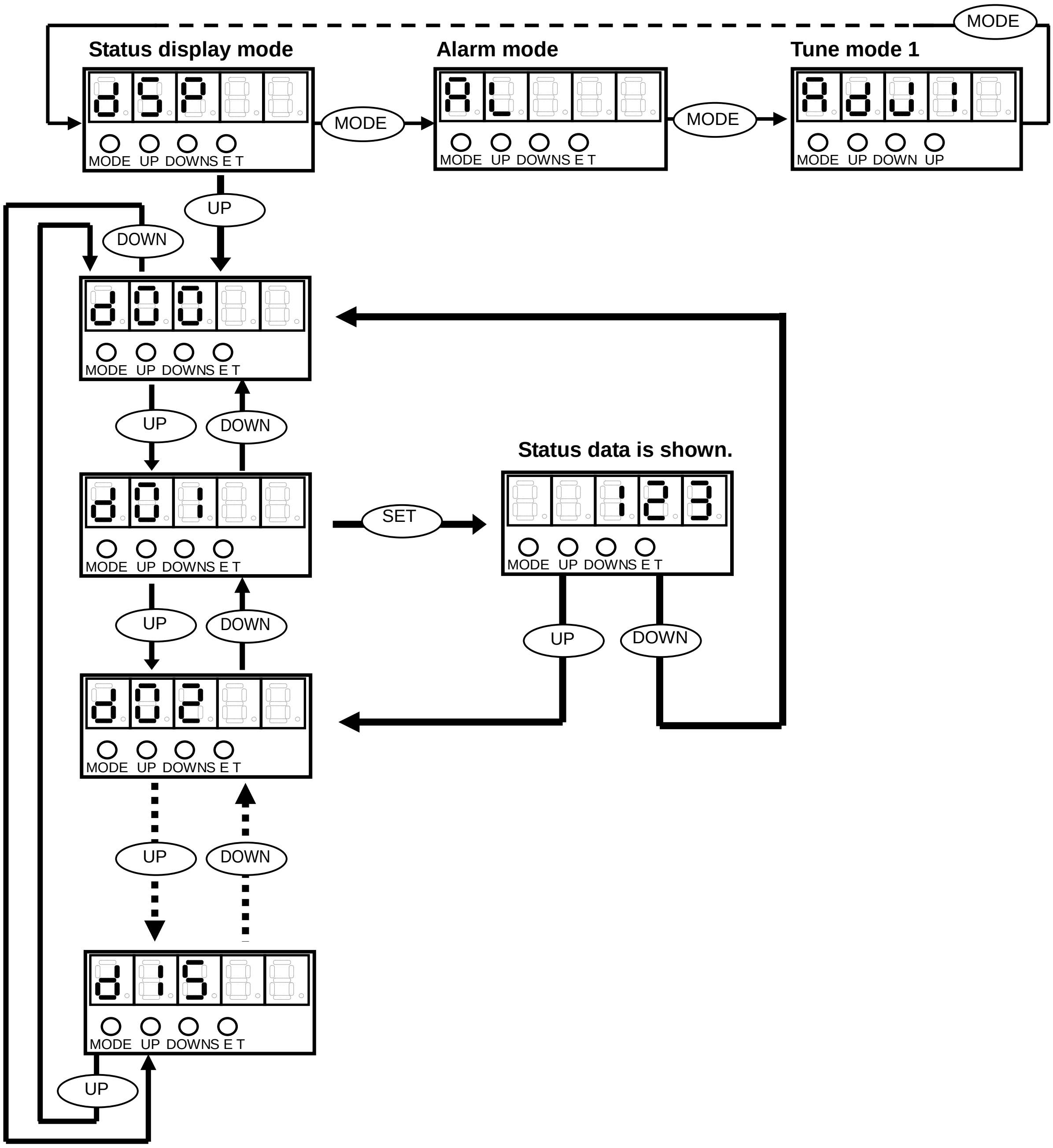
Panel display hierarchy

The display hierarchy of the display panel is shown below.
When an alarm occurs, the display panel switches to the alarm mode, regardless of the present mode, and shows the present alarm code. Even when an alarm is present, you can still switch to other mode and check or change parameters.



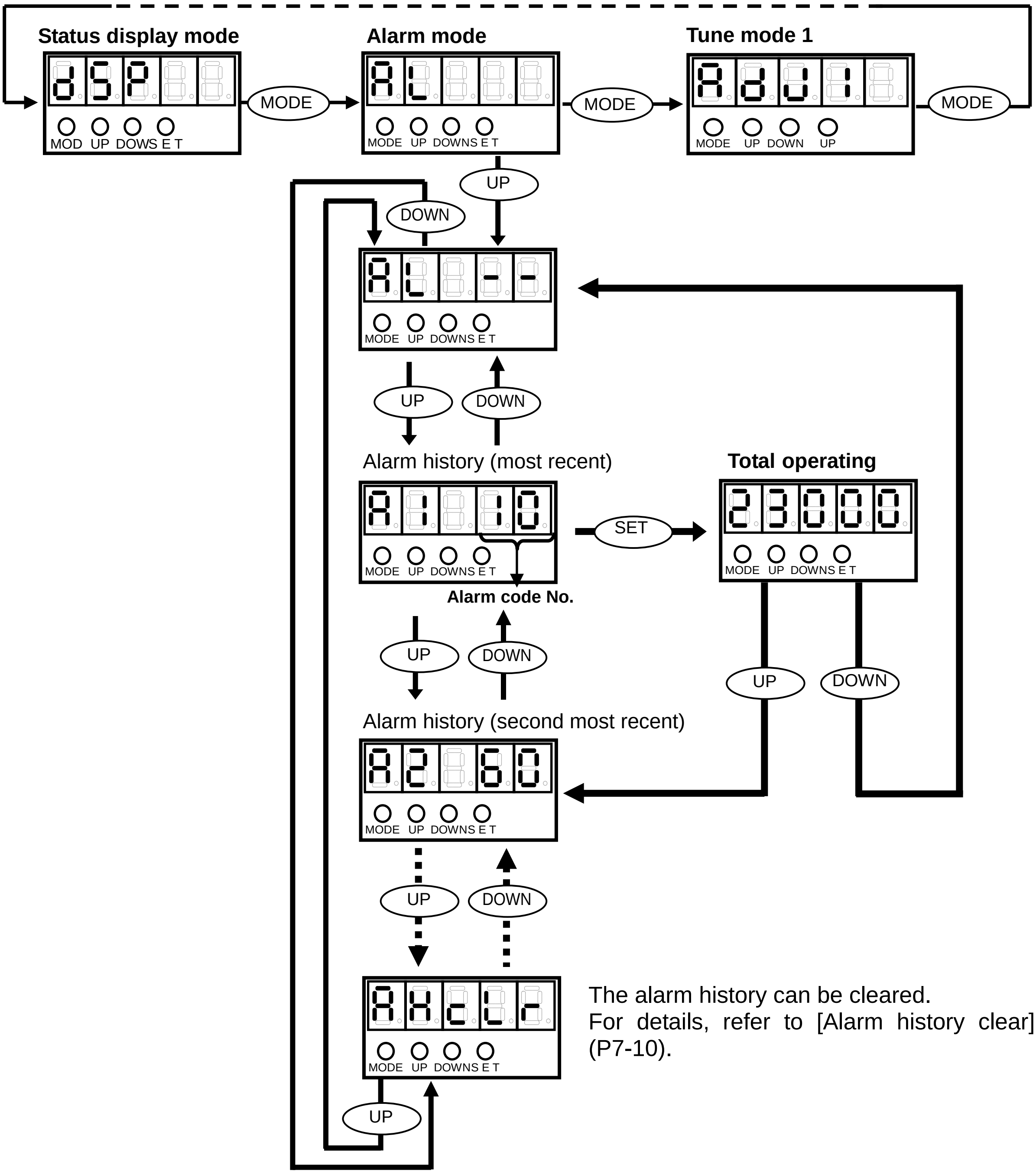
Operation overview of status display mode

An overview of operations in the status display mode is shown below.
To prevent malfunction, a button is recognized as enabled when it has been pressed for at least 0.1 second and 1 second or less.
* For details on data displayed, refer to Chapter 7.



Operation outline of alarm mode

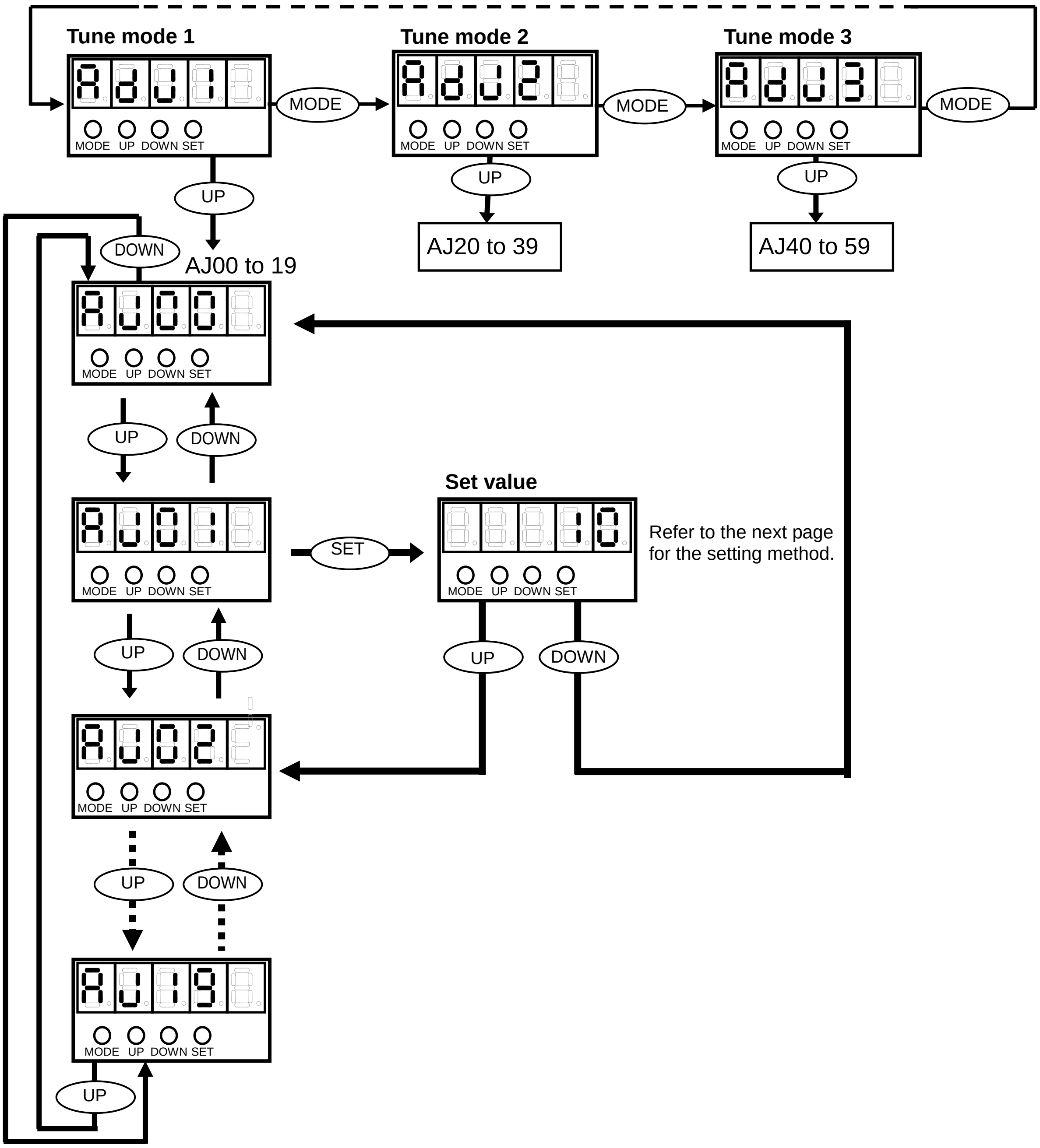
An overview of operations in the alarm mode is shown below.
To prevent malfunction, a button is recognized as enabled when it has been pressed for at least 0.1 second and 1 second or less.
* For the overview on alarms, refer to P7-8.
* For details on alarms, refer to [Chapter 11 Troubleshooting].



The alarm history can be cleared.
For details, refer to [Alarm history clear] (P7-10).

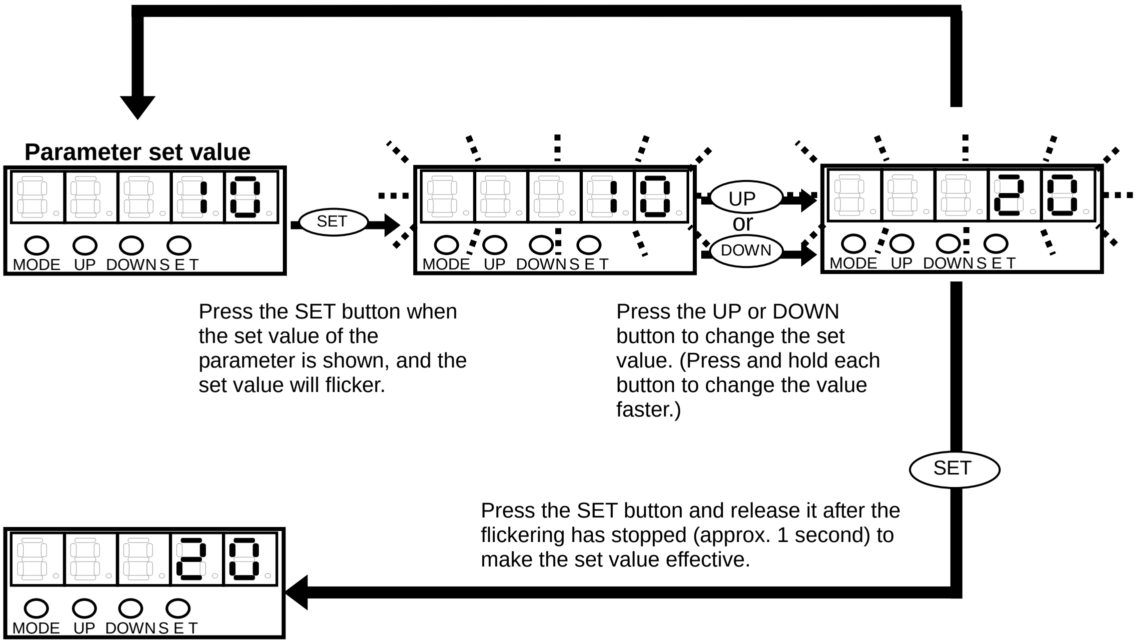
Operation overview of tune mode

An overview of operations in the tune mode is shown below.
To prevent malfunction, a button is recognized as enabled when it has been pressed for at least 0.1 second and 1 second or less.
* For details on the tune mode, refer to [Tune mode] (P7-11).



How to change set value

Press the SET button and release it before the flickering stops (within approx. 1 second), and the change will be cancelled.



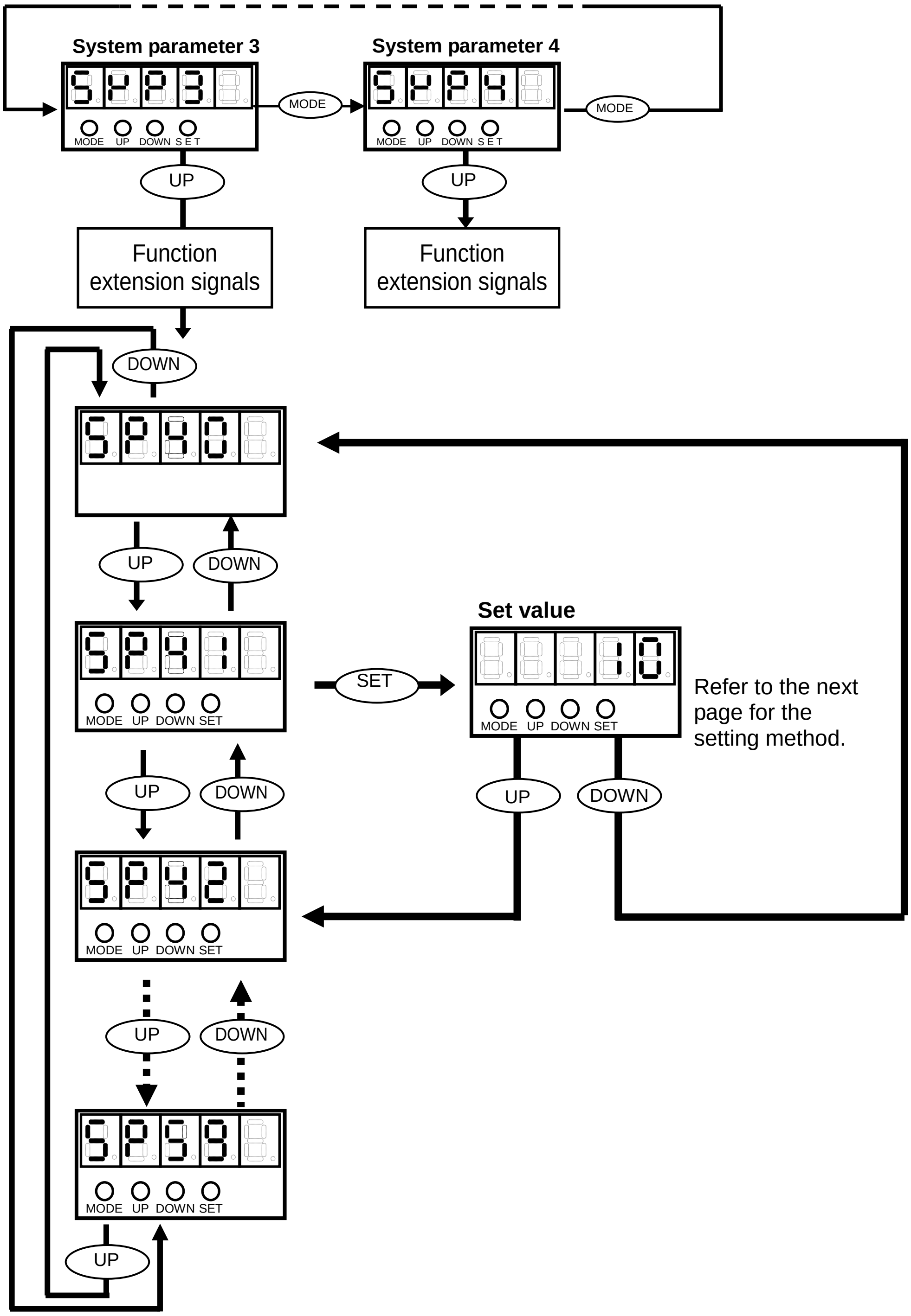
Press the SET button when the set value of the parameter is shown, and the set value will flicker.

Press the UP or DOWN button to change the set value. (Press and hold each button to change the value faster.)

Press the SET button and release it after the flickering has stopped (approx. 1 second) to make the set value effective.

Operation outline of system parameter mode

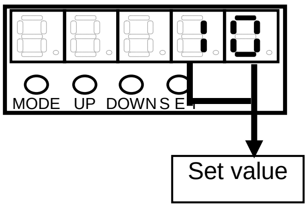
An overview of operations in the system parameter mode is shown below.
To prevent malfunction, a button is recognized as enabled when it has been pressed for at least 0.1 second and 1 second or less.

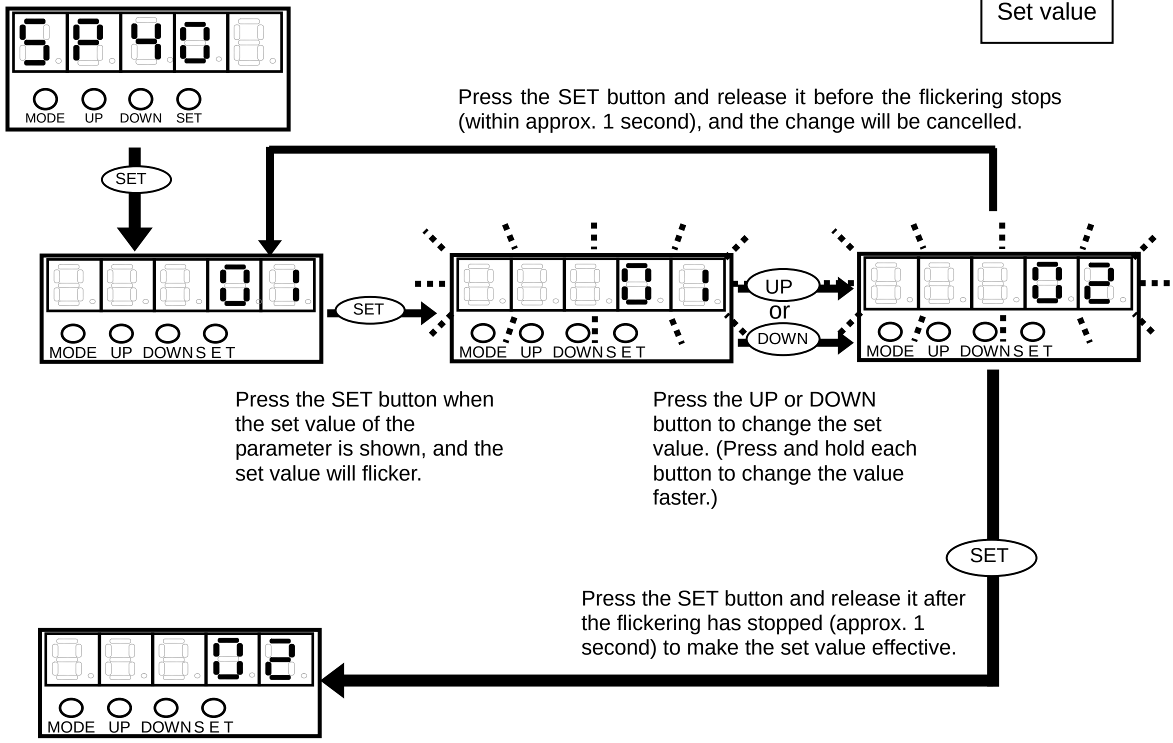


* The setting change of the system parameters (SP40 to 79) is enabled by reconnecting the control power supply after changing the setting.

How to set function extension signals (SPxx)

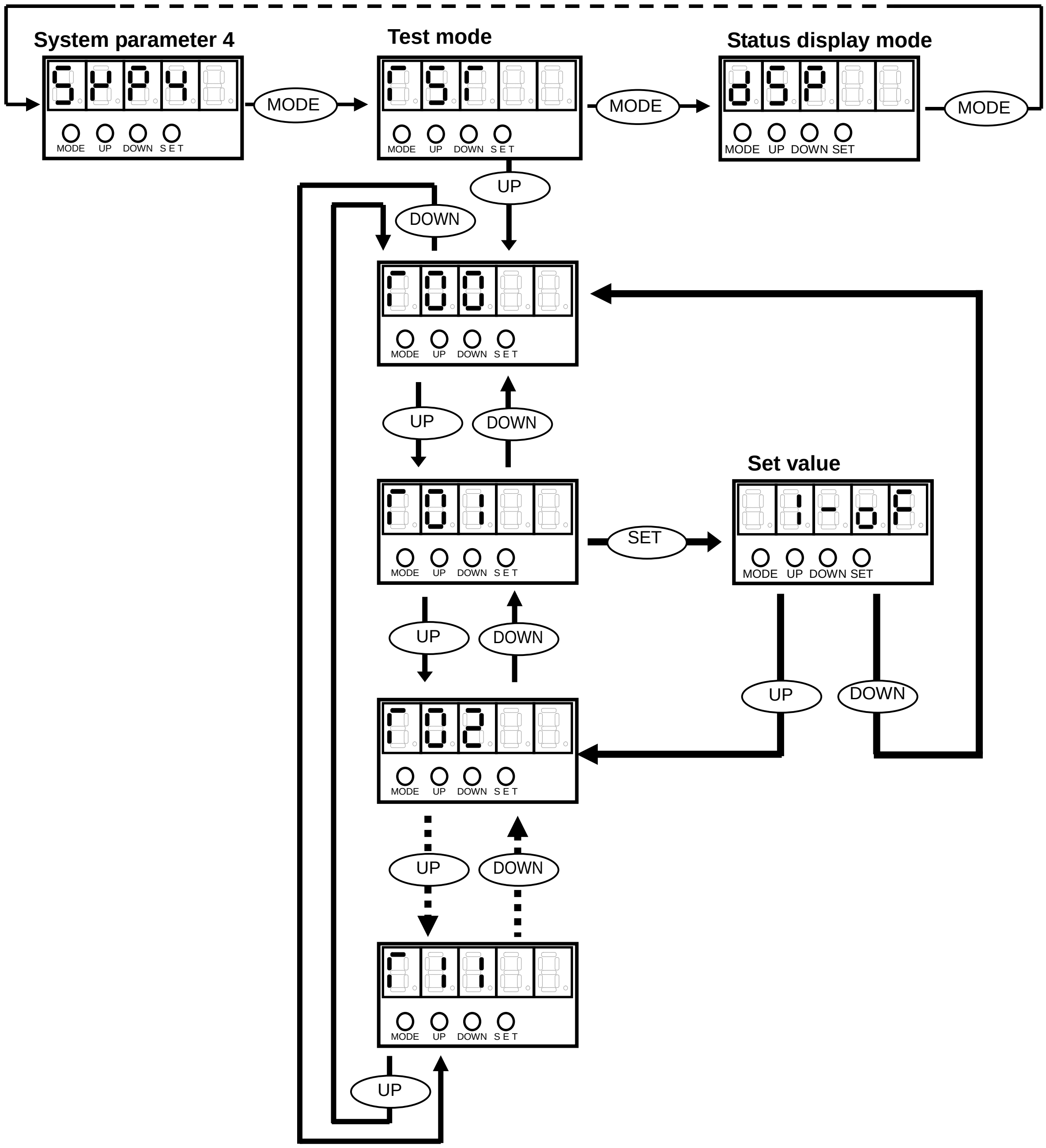
Example) Changing [SP40: CN9-CP3 output signal setting] to 2





Operation outline of test mode

An overview of operations in the test mode is shown below.
To prevent malfunction, a button is recognized as enabled when it has been pressed for at least 0.1 second and 1 second or less.
* For details on test mode, refer to [Chapter 9 Test mode].



Chapter 7

Status display mode/alarm mode/tune mode

This chapter explains information displayed in the status display mode and alarm mode. Operations and details of servo loop gains, various judgment criteria and acceleration/deceleration time setting during speed control performed in the tune mode are explained.

7-1 Status display mode ········· 7-1
7-2 Details of status display mode ········· 7-3
7-3 Alarm mode ········· 7-8
7-4 Alarm list ········· 7-9
7-5 Tune mode ········· 7-11
7-6 Details of tune mode ········· 7-12

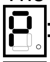
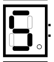
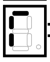
7-1 Status display mode

In the status display mode, position/speed commands to the driver, current position information from the motor/encoder, condition of cumulative pulses in the deviation counter, I/O signal statuses, load condition and code number of the actuator to be combined are shown, among others. These items help diagnose errors and troubles.

Status display mode list

If the driver is normal when the power supply is turned ON, [d00: Motor rotation speed indication] is shown. (Default setting)
To change the displayed items, set desired items by referring to [SP54: Status display setting] (P8-6).

Mode No.	Name	Description	Default	Unit	Details
d00	Motor rotation speed indication	The current rotation speed of the motor shaft is shown. The rotation speed of the actuator's output shaft is obtained by dividing the displayed value by the reduction ratio of the actuator. Rotation direction signal None: FWD -: REV	--	r/min	--
d01	Error pulse count display (Low)	The number of error pulses in position control is shown. Deviation direction symbol None: Deviation in REV rotation -: Deviation in FWD rotation	--	Pulse	P7-3
d02	Error pulse count display (High)				
d03	Output torque monitor	The value of the output torque currently generated by the actuator is shown. 100% indicates the specified maximum output torque of the actuator. Torque direction symbol None: FWD torque -: REV torque	--	%	--
d04	Overload rate display	Current overload status of the actuator is shown.	--	%	--
d05	Feedback pulse display (Low)	The encoder feedback pulses are shown. Absolute encoder: The current encoder value is shown. Incremental encoder: Cumulative feedback pulses since the power ON, multiplied by 4	--	Pulse	P7-5
d06	Feedback pulse display (High)				
d07	Command pulse display (Low)	Command pulses from the driver are shown. Absolute encoder: Current encoder value upon power ON, plus command pulses: Incremental encoder Cumulative command pulses since the power ON corresponding to 0 pulses	--	Pulse	P7-5
d08	Command pulse display (High)				
d09	System reservation	Do not use.	--	--	--
d10	Main circuit power voltage	The rectified main circuit power voltage is shown.	--	V	--
d11	System reservation	Do not use.	--	--	--
d12	System reservation	Do not use.	--	--	--
d13	Applicable actuator code	The actuator code number is shown.	--	--	P7-6

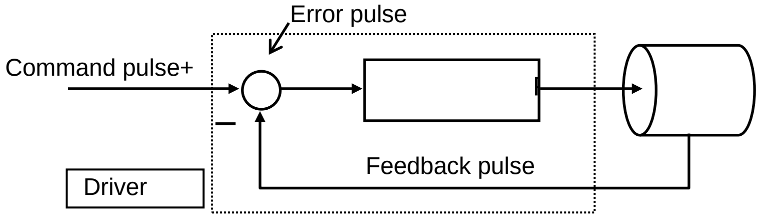
Mode No.	Name	Description	Default	Unit	Details
d14	Control mode	The current control mode is shown. : Position control : Speed control : Torque control	--	--	--
d15	Discharge time	An approximate total power ON time is shown. 0 to 99999	--	h	--
d16	Regenerative power (HA-800B-24 only)	It indicates absorbed power of regenerative resistor as percentage.	--	%	P7-7

7-2 Details of status display mode

The following explains details of the status display mode. (Detailed explanations for simple items are omitted. Refer to the [Status display mode list] (P7-1).)

d01, 02: Error pulse count display

The deviation between command pulses and feedback pulses during position control is shown. d01 indicates the lower 4 digits, while d02 indicates the upper 4 digits.
The driver continues to output a rotation command until there is no longer difference (error pulse) between the feedback pulses fed back from the encoder and command pulses output to the actuator.

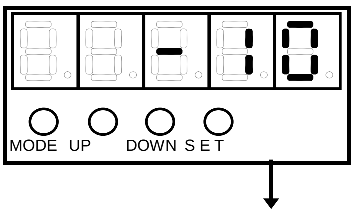


7

Status display mode/alarm mode/tune mode

d01 indicates the lower 4 digits, while d02 indicates the upper 4 digits.

Display example)



The lower 4 digits of the error pulse (multiplied by 4) are shown.
Unit: Pulse (Example) = -10 pulses

Relational items	d05, d06, d07, d08

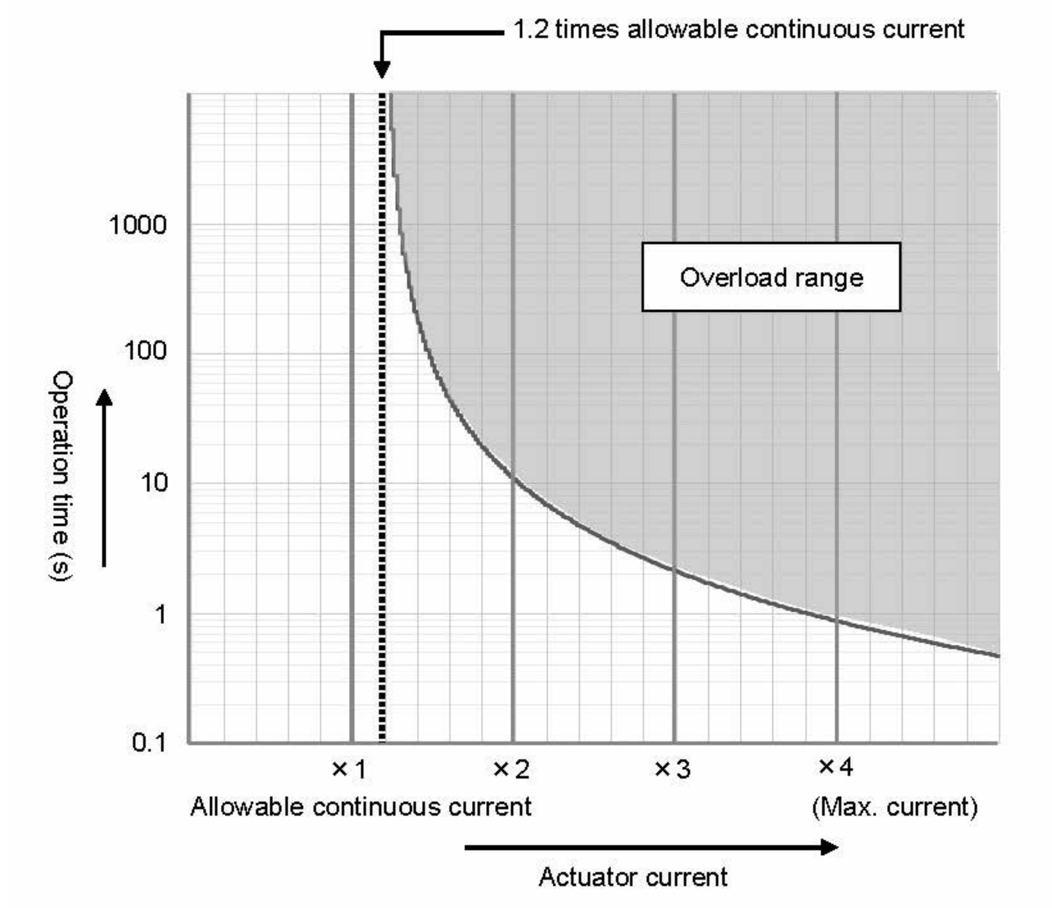
d04: Overload rate display

The current overload status of the actuator (unit: %) is shown.
If the value reaches 100, the overload protective function shuts off the motor current, and simultaneously an alarm [AL20: Overload] is displayed.
When you want to set a higher servo gain to shorten the positioning period, the higher servo gain is permitted if the overload rate remains 0 after the actual operation.
In addition, a system with a greater inertia can also be used as long as the overload rate remains 0.
If the overload rate gradually increases, on the other hand, the servo gain must be decreased or other measures are required.

The driver always monitors the actuator current for the detection of overload rate, and if the current and its discharge time exceed the curve shown below, an overload alarm generates.

Example)

Current at least 1.2 times the allowable continuous current of the actuator has been supplied for an extended period of time.
Current at least 3 times the allowable continuous current of the actuator has been supplied for approx. 2 seconds.



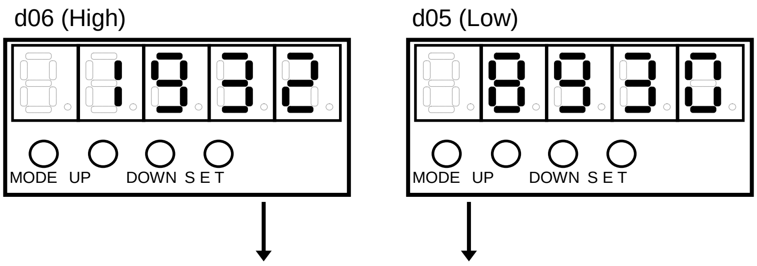
d05, 06: Feedback pulse display

Feedback pulses from the encoder are shown.

- Absolute encoder: The current encoder value is shown.
- Incremental encoder: Cumulative feedback pulses since the power ON, multiplied by 4

d05 indicates the lower 4 digits, while d06 indicates the upper 4 digits.

Display example)



Feedback pulse: [19328930] is shown.

Display range: 0 to ±99999999
When the feedback pulses increase to a 9-digit figure, the highest digit is ignored and only the lower 8 digits are shown.

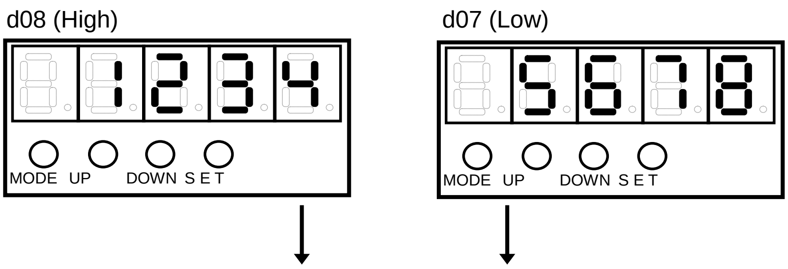
d07, 08: Command pulse display

The command pulse value input to the driver is shown.

- Absolute encoder: Current encoder value at the power ON, plus command pulses
- Incremental encoder: 0 at the power ON, plus command pulses

d07 indicates the lower 4 digits, while d08 indicates the upper 4 digits.

Display example)



Command pulse: [12345678] is shown.

Display range: 0 to ±99999999
When the command pulses increase to a 9-digit figure, the highest digit is ignored and only the lower 8 digits are shown.

Relational items	d01, d02, d05, d06

d13: Applicable actuator code

The actuator applicable to this driver is indicated by a code number.
The relationship of code numbers and actuators is as follows:

Codes of SHA series actuators

Encoder		Absolute					
Voltage specification	Reduction ratio	1/11	1/51	1/81	1/101	1/121	1/161
200 V	SHA20AxxxSG	-	5311	5321	5331	5341	5351
	SHA25AxxxSG/HP	5801	5011	5021	5031	5041	5051
	SHA32AxxxSG/HP	5811	5111	5121	5131	5141	5151
	SHA40AxxxSG	-	5211	5221	5231	5241	5251
	SHA45AxxxSG	-	5821	5831	5841	5851	5861
	SHA58AxxxSG	-	-	5421	5431	5441	5451
	SHA65AxxxSG	-	-	5521	5531	5541	5551
100 V	SHA25AxxxSG	-	5611	5621	5631	5641	5651

Encoder		Absolute				
Voltage specification	Reduction ratio	1/50	1/80	1/100	1/120	1/160
200 V	SHA20AxxxCG	8311	8321	8331	8341	8351
	SHA25AxxxCG	8011	8021	8031	8041	8051
	SHA32AxxxCG	8111	8121	8131	8141	8151
	SHA40AxxxCG	8211	8221	8231	8241	8251
100 V	SHA25AxxxCG	8611	8621	8631	8641	8651

Codes of FHA-Cmini series actuators

Encoder		Incremental			Absolute		
Voltage specification	Reduction ratio	1/30	1/50	1/100	1/30	1/50	1/100
200 V	FHA-8C	6204	6214	6234	6201	6211	6231
	FHA-11C	6404	6414	6434	6401	6411	6431
	FHA-14C	6604	6614	6634	6601	6611	6631
100 V	FHA-8C	6304	6314	6334	6301	6311	6331
	FHA-11C	6504	6514	6534	6501	6511	6531
	FHA-14C	6704	6714	6734	6701	6711	6731

Codes of FHA-C series actuators

Encoder		Incremental					Absolute		
Voltage specification	Reduction ratio	1/50	1/80	1/100	1/120	1/160	1/50	1/100	1/160
200 V	FHA-17C	5217	5227	5237	5257	5247	5218	5238	5248
	FHA-25C	5417	5427	5437	5457	5447	5418	5438	5448
	FHA-32C	5617	5627	5637	5657	5647	5618	5638	5648
	FHA-40C	5717	5727	5737	5757	5747	5718	5738	5748
100 V	FHA-17C	5117	5127	5137	5157	5147	5118	5138	5148
	FHA-25C	5317	5327	5337	5357	5347	5318	5338	5348
	FHA-32C	5517	5527	5537	5557	5547	5518	5538	5548

Codes of FHA-C-PR series actuators

Encoder		Incremental				
Voltage specification	Reduction ratio	1/50	1/80	1/100	1/120	1/160
200 V	FHA-17C-PR	5267	5277	5287	5207	5297
	FHA-25C-PR	5467	5477	5487	5407	5497
	FHA-32C-PR	5667	5677	5687	5607	5697
	FHA-40C-PR	5767	5777	5787	5707	5797
100 V	FHA-17C-PR	5167	5177	5187	5107	5197
	FHA-25C-PR	5367	5377	5387	5307	5397
	FHA-32C-PR	5567	5577	5587	5507	5597

Codes of RSF series actuators

Encoder		Incremental	
Voltage specification	Reduction ratio	1/50	1/100
200 V	RSF-17A	7365	7375
	RSF-20A	7465	7475
	RSF-25A	7575	7575
	RSF-32A	7665	7675

Codes of HMA series actuators

Encoder		Absolute	
Voltage specification	Brake	No brake A	With brake B
200 V	HMAC08x	0011	0021
	HMAB09x	0031	0041
	HMAB12x	0071	0081
	HMAB15x	0091	0101
	HMAA21Ax	0111	0121
100 V	HMAB09x	0051	0061

d16: Regenerative power (HA-800B-24 only)

It indicates absorbed power of regenerative resistor as percentage (unit: %).
The value can be converted to absorbed power of resistor using the following formula.

$$\text{Regenerative resistor absorption power (W)} = 16000\ \text{(W)} \times \frac{\text{Motor display value (\%)}}{100\ \text{(\%)}}$$

* The regenerative power varies depending on input voltage, load conditions, and operation pattern. Take sufficient margin in evaluation tests of your systems.

* This status display function is available only for HA-800B-24. With the HA-800B-1, 3 and 6, the power absorbed by regenerative resistor is unrelated.

7-3 Alarm mode

In the alarm mode, present alarms and warnings as well as up to 8 most recent alarm histories and total operating hours when each alarm occurred are shown. The alarm history can also be cleared in this mode. The following items are shown in the alarm mode. Note, however, that warnings are not stored in the alarm history.

Alarm display

The following items are shown in the alarm mode:

Mode No.	Name	Description	Details
AL	Present alarm/warning display	The present alarm/warning is shown.	P7-9
A1	Alarm history 1 and time of occurrence	Alarm history is shown by a code number. When the SET button on the panel is pressed while the history is displayed, the total operating hours (unit: h) of the driver when the applicable alarm occurred is shown. Note that the total operating hours is approximate.	–
A2	Alarm history 2 and time of occurrence		
A3	Alarm history 3 and time of occurrence		
A4	Alarm history 4 and time of occurrence		
A5	Alarm history 5 and time of occurrence		
A6	Alarm history 6 and time of occurrence		
A7	Alarm history 7 and time of occurrence		
A8	Alarm history 8 and time of occurrence		
AHcLr	Alarm history clear	The history of up to 8 most recent alarms is cleared.	P7-10

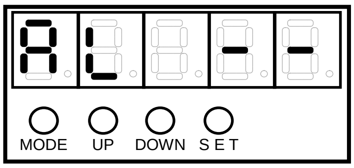
7-4 Alarm list

A list of alarms and warnings is shown.

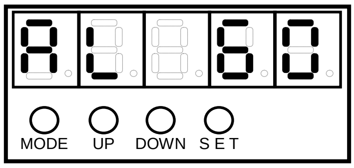
AL: Present alarm/warning display

The driver shows the code number of the present alarm/warning.
If multiple alarms (warnings) are output, all alarm (warning) codes are shown one by one at an interval of approx. 500 ms. If no alarm (warning) is present, [--] is shown.
Even when an alarm (warning) is output, you can still switch to a mode other than the alarm mode and display various parameters and status data.

Display when no alarm is present



Display when an alarm is present



Ex) This indicates that the excessive deviation alarm has occurred.

The relationship of displayed code numbers and alarms/warnings is shown below.
For details, refer to [Chapter 11 Troubleshooting].

Alarms

Code No.	Alarms	Code No.	Alarms	Code No.	Alarms
10	Overspeed	50	Encoder breakage	72	FPGA configuration error
20	Overload	51	Encoder receiving error[*1, *2]	73	FPGA configuration error
30	IPM error (overcurrent)	52	UVW error[*1]	76	Processor error
40	Overvoltage	53	System failure[*2]	80	MEMORY error[*3]
41	Regenerative resistor overheat	54	Multi revolution overflow[*2]	81	System failure[*3]
42	Overregeneration[*4]	55	Multi revolution data error[*2]	82	Single rotation data error[*3]
43	Missing phase[*4]	56	WDT error	83	Multi revolution data error[*3]
44	Control power supply low[*4]	57	Synchronization error	84	BUSY error[*3]
45	Main circuit voltage low[*4]	60	Excessive deviation	85	Overheat error[*3]
46	Overheated dynamic brake[*4]	70	Memory failure (RAM)	86	Communication error[*3]
47	Damaged power circuit	71	Memory failure (EEPROM)		

*1: Displayed only when an incremental encoder is used.
*2: Displayed only when a 13-bit absolute encoder is used.
*3: Displayed only when a 17-bit absolute encoder is used (including 17-bit encoder incremental model)
*4: HA-800B-24 only is displayed

Warning

Code No.	Alarms	Code No.	Alarms	Code No.	Alarms
90	Overload status	94	Command data error	98	REV inhibit input effective
91	Battery voltage low	95	Command error	99	Wrong actuator
92	Cooling fan stopped	96	Communication warning		
93	Main circuit voltage low	97	FWD inhibit input effective		

AHcLr: Alarm history clear

The history of up to 8 most recent alarms stored in the driver is cleared.

1 Press the SET button when [AHcLr] is displayed.

[AHcLr] flickers.

2 Press the SET button again.

The alarm history is cleared and flickering of [AHcLr] stops and becomes lit.
To not clear the alarm history, pressing the UP or DOWN button cancels the alarm history clear, after which the content of A8 or AL is displayed.

7-5 Tune mode

You can read and change parameters relating to actuator operations.
The following items can be changed.

mode	Display	Parameter name	Default	Reference
Tune mode 1	AJ00	Position loop gain	*1	P7-12
	AJ01	Speed loop gain	*1	P7-12
	AJ02	Speed loop integral compensation	*1	P7-13
	AJ03 j03	Feed-forward gain	0	P7-13
	AJ04	In-position range	*1	P7-13
	AJ05	System reservation *3	—	—
	AJ06	System reservation *3	—	—
	AJ07	Zero speed judgment value	10	P7-14
	AJ08	System reservation *3	—	—
	AJ09	System reservation *3	—	—
	AJ10	System reservation *3	—	—
	AJ11	System reservation *3	—	—
	AJ12	Acceleration time constant (position control) Acceleration/deceleration time setting (speed control)	1	P7-14
	AJ13	Deceleration time constant (position control)	1	P7-14
	AJ14	System reservation *3	—	—
	AJ15	System reservation *3	—	—
	AJ16	Speed monitor offset	*2	P7-15
	AJ17	Current monitor offset	*2	P7-15
	AJ18	FWD torque limit	1	P7-15
	AJ19	REV torque limit	1	P7-15
Tune mode 2	AJ20	Feed-forward filter	1	P7-16
	AJ21	Load inertia moment ratio	100	P7-16
	AJ22	Torque constant compensation factor	100	P7-17
	AJ23	Spring constant compensation factor	100	P7-17
	AJ24	Automatic positioning gain	0	P7-17
	AJ25 to 39	System reservation *3	—	—
Tune mode 3	AJ40 to 59	System reservation *3	—	—

*1: It varies depending on the applicable actuator. Refer to the values of applicable actuator that are the targets of [Appendix-1: Default setting] (Apx-1).
*2: It varies depending on the driver.
*3: Do not change parameters in the system reservation area. The default setting of the system reservation may vary depending on the model/version. If the set values change when the parameters are transferred between different models, it does not affect the product functions.
To perform the data comparison with the backed up parameter files or writing the backed up parameter files to the driver using PSF-800 communication software, refer to [10-4-4. Writing a saved settings file to the driver] (P10-17).

7-6 Details of tune mode

The following explains the details of settings in the tune mode.

AJ00: Position loop gain

Adjust the proportional gain of the position feedback loop.
The relation between the set value and actuator operation is as follows:

- Increasing the set value: The position deviation decreases and following accuracy relative to the command increases, but setting too high a value makes the servo system unstable and prone to vibration (hunting).
- Decreasing the set value: Setting too low a value results in poor following accuracy relative to the command.

Set the highest gain within the limits of no vibration (hunting) and minimum overshoot.
Perform a trial operation with a higher servo gain to shorten the positioning period. If the value of [d04: Overload rate display] remains 0 in the status display mode after the actual operation, the higher servo gain can be used.

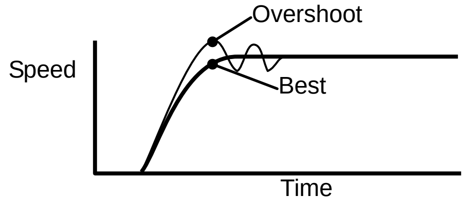
Set value	Function	Unit	Default
10 to 9999	Set the proportional gain of the position feedback loop.	―	*
Relational items	AJ01, AJ02, AJ03, d04		

*: The default varies depending on the applicable actuator. Refer to [Default settings] (Apx-1) in the Appendix.

AJ01: Speed loop gain

Adjust the proportional gain of the speed feedback loop.
The relation between the set value and actuator operation is as follows:

- Increasing the set value: Servo rigidity increases along with response, but setting too high a value makes the servo system unstable and prone to vibration (hunting) and overshoot.
- Decreasing the set value: Setting too low a value leads to poor response and following accuracy.



Set value	Function	Unit	Default
HA-800-1: 0.1 to 999.9 Except HA-800-1: 1 to 9999	Set the proportional gain of the speed feedback loop.	―	*
Relational items	AJ00, AJ02, AJ03		

*: The default varies depending on the applicable actuator. Refer to [Default settings] (Apx-1) in the Appendix-1.

7 Status display mode/alarm mode/tune mode

AJ02: Speed loop integral compensation

Set this parameter to reduce the speed fluctuation due to load fluctuation.
The relation between the set value and actuator operation is as follows:

- Increasing the set value: Vibration (hunting) is eliminated and response becomes slower upon load fluctuation.
- Decreasing the set value: Response upon load fluctuation increases, but setting too low a value causes vibration (hunting).

Set value	Function	Unit	Default
1 to 9999	Set the speed loop integral compensation value.	—	*
Relational items	AJ00, AJ01, AJ03		

*: The default varies depending on the applicable actuator. Refer to [Default settings] (Apx-1) in the Appendix-1.

AJ03: Feed-forward gain

Set this parameter to perform feed-forward control associated to reduce the delay relative to the command. Set 0, if feed-forward control is not performed.
The relation between the set value and actuator operation is as follows:

- Increasing the set value: Tendency of mechanical shock and vibration (hunting) increases.

Set value	Function	Unit	Default
0 to 100	Set the feed-forward gain.	—	0
Relational items	AJ20, AJ21, AJ22, AJ23		

Caution

- When using the feed-forward control function, be sure to reference [Applied servo gain adjustment function] (P3-17) and understand the notices.

AJ04: In-position range

Set the pulse condition for outputting an in-position output signal during position-controlled operation.
An in-position complete signal is output when the error pulse count (command pulses - feedback pulses) is inside the range of +in-position range to -in-position range.
* The setting value of AJ04 is the encoder pulse units.

Set value	Function	Unit	Default
0 to 9999	Set the range in which to output an in-position output signal.	Pulse	*

*: The default varies depending on the applicable actuator. Refer to [Appendix-1: Default settings] (Apx-1).

AJ07: Zero speed judgment value

A zero speed detection signal (ZSPD) of the MECHATROLINK status is output when the actuator's motor shaft rotation speed drops to the zero speed judgment value or below.

Set value	Function	Unit	Default
0 to 100	Set the zero speed judgment value.	r/min	10

Caution

- A zero speed detection (ZSPD) is not performed in the position control mode.

AJ12: Acceleration time constant

Set the time over which the actuator will accelerate from the standstill state to the maximum speed during position control.
Set the time over which the actuator will accelerate from the standstill state to the maximum speed and decelerate from the maximum speed to 0 r/min during speed control.

Set value	Function	Unit	Default
1 to 9999	Set the time over which to accelerate from the standstill state to the maximum speed.	ms	1

Caution

- This is used for position control and speed control.

AJ13: Deceleration time constant

Set the time over which the actuator rotation speed will decelerate from the maximum speed to 0 r/min during position control.

Set value	Function	Unit	Default
1 to 9999	Set the time over which to decelerate to 0 r/min.	ms	1

Caution

- This is used for position control.

AJ16: Speed monitor offset

Adjust the speed monitor output offset currently output to CN9. Though the speed monitor offset has been adjusted at the factory, readjust it if necessary. The adjustment range of -2048 to 2047 corresponds to -10 to +10V.
This offset value is not initialized with parameter initialization and the value is retained.

Set value	Function	Unit	Default
-2048 to 2047	Set the offset value for speed monitor output.	–	*

*: The default value varies depending on the driver.

AJ17: Current monitor offset

Adjust the current monitor output offset currently output to CN9. Though the current monitor offset has been adjusted at the factory, readjust it if necessary. The adjustment range of -2048 to 2047 corresponds to -10 to +10V.
This offset value is not initialized with parameter initialization and the value is retained.

Set value	Function	Unit	Default
-2048 to 2047	Set the offset value for current monitor output.	–	*

*: The default value varies depending on the driver.

AJ18: FWD torque limit

This parameter is used to limit the torque to the specified value when bit 14 (P-CL) of the option field in the MECHATROLINK command packet is set to 1.

Set value	Function	Unit	Default
1 to 100	Specify the torque limit based on the ratio with the maximum current of the actuator set at 100%.	%	1

Torque cannot be limited by this parameter in an operation executed by a torque command.

AJ19: REV torque limit

This parameter is to be used to limit the torque to the specified value when bit 15 (N-CL) of the option field in the MECHATROLINK command packet is set to 1.

Set value	Function	Unit	Default
1 to 100	Specify the torque limit based on the ratio with the maximum current of the actuator set at 100%.	%	1

Torque cannot be limited by this parameter in an operation executed by a torque command.

AJ20: Feed-forward filter

Set the filter frequency to be used in feed-forward control.
Setting a higher value increases the response, but mechanical shock or vibration (hunting) will occur more easily if the value is too high. (Refer to [Applied servo gain adjustment function] (P3-17).)

Set value	Function	Unit	Default
1 to 2000	Set the filter frequency.	Hz	1
Relational items	AJ03, AJ21, AJ22, AJ23, SP69		

Caution

- When using the feed-forward control function, be sure to reference [Applied servo gain adjustment function] (P3-17) and understand the notices.

AJ21: Load inertia moment ratio

Set the load inertia moment ratio relative to self-inertia moment to be used in feed-forward control. Feed-forward control is performed based on the value set here. (Refer to [Applied servo gain adjustment function] (P3-17).)

Set value	Function	Unit	Default
1 to 1000	Sets the load inertia moment ratio.	%	100
Relational items	AJ03, AJ20, AJ22, AJ23, SP69		

Caution

- When using the feed-forward control function, be sure to reference [Applied servo gain adjustment function] (P3-17) and understand the notices.

AJ22: Torque constant compensation factor

Variation in the actuator torque constant used in feed-forward control is compensated for. Feed-forward control is performed based on the value set here. (Refer to [Applied servo gain adjustment function] (P3-17).)

Set value	Function	Unit	Default
1 to 200	Set the torque constant compensation factor for the actuator.	%	100
Relational items	AJ03, AJ20, AJ21, AJ23, SP69		

Caution

- When using the feed-forward control function, be sure to reference [Applied servo gain adjustment function] (P3-17) and understand the notices.

AJ23: Spring constant compensation factor

Variation in the actuator spring constant used in feed-forward control is compensated for. Feed-forward control is performed based on the value set here. (Refer to [Applied servo gain adjustment function] (P3-17).)

Set value	Function	Unit	Default
1 to 200	Set the spring constant compensation factor for the actuator.	%	100
Relational items	AJ03, AJ20, AJ21, AJ22, SP69		

Caution

- When using the feed-forward control function, be sure to reference [Applied servo gain adjustment function] (P3-17) and understand the notices.

AJ24: Automatic positioning gain

This can be used to adjust the gain that is set when [SP60: Automatic positioning gain enable/disable] is enabled.

* This is available with HA-800B software version 2.x or later.

Set value	Function	Unit	Default
-50 to 100	Set the amount of increase/decrease in an automatic positioning gain.	%	0
Relational items	SP60		

Chapter 8

System parameter mode

The following explains the I/O signal logic setting method and the setting details of the electronic gear, etc. as function expansion.

8-1 System parameter mode 8-1

8-1 System parameter mode

The following explains the parameters that can be operated/displayed in each operation mode.
The settable parameters are explained below.
* The setting change of the system parameters (SP40 to 79) is enabled by reconnecting the control power supply after changing the setting.

Parameters No	Name	The reference set value defaults	Reference
SP40	CN9-CP3 output signal setting	00	P8-3
SP41	System reservation *3	—	—
SP42	System reservation *3	—	—
SP43	System reservation *3	—	—
SP44	Electronic gear 1 numerator	1	P8-3
SP45	Electronic gear 1 denominator	1	P8-3
SP46	System reservation *3	—	—
SP47	System reservation *3	—	—
SP48	Deviation clear upon servo-ON setting	1	P8-4
SP49	Allowable position deviation	*1	P8-4
SP50	Command polarity	0	P8-5
SP51	Speed input factor setting	*1	P8-6
SP52	System reservation *3	—	—
SP53	System reservation *3	—	—
SP54	Status display setting	0	P8-6
SP55	DB enable/disable setting	1	P8-6
SP56	System reservation *3	—	—
SP57	System reservation *3	—	—
SP58	System reservation *3	—	—
SP59	Angle compensation enable/disable setting	0	P8-6
SP60	Automatic positioning gain setting enable/disable setting	*1	P8-7
SP61	Encoder monitor output pulses	*1	P8-7
SP62	Input signal logic setting	0	P8-7
SP63	Output signal logic setting	8	P8-8
SP64	Regenerative resistor selection (HA-800B-24 only)	0	P8-8
SP65	FWD/REV inhibit operation	0	P8-8
SP66	Absolute encoder function setting	*4	P8-9
SP67	System reservation *3	—	—
SP68	System reservation *3	—	—
SP69	Feed-forward control function setting	*1	P8-9
SP70 to SP79	System reservation *3	—	—

*1: It varies depending on the applicable actuator. Refer to the values of applicable actuator that are the targets of [Appendix-1: Default setting] (Apx-1).
*2: The system parameters (SP40 to 79) are enabled by reconnecting the control power supply after changing the setting.
*3: Do not change the parameters that are in the system reserved areas. The default setting of the system reservation may vary depending on the model/version. If the set values change when the parameters are transferred between different models, it does not affect the product functions.
To perform the data comparison with the backed up parameter files or writing the backed up parameter

files to the driver using PSF-800 communication software, refer to [10-4 Saving, comparing and copying set values] (P10-12).

*4: HA-800B-*D: SP66=0, HA-800B-*E: SP66=1

SP40: CN9-CP3 output signal setting

Set the monitor output signal to pin 3 of CN9.
* The setting change of the system parameters (SP40 to 79) is enabled by reconnecting the control power supply after changing the setting.

Set value	Description	Default
00	Without output	00
01	Operation preparation complete	
02	Alarm output	
03	In-position output	
04	System reservation	
05	System reservation	
06	Zero speed output	
07	System reservation	

SP44 to 45: Electronic gear setting

It can be set to make the displacement of the driven actuator mechanism per command pulse, an integer. When the host controller is used in combination with the MP2000 series by YASKAWA Electric Corporation or the KV-ML16V controller by Keyence, use this setting for the default value, and use the host controller to specify the settings.
* The setting change of the system parameters (SP40 to 79) is enabled by reconnecting the control power supply after changing the setting.

Caution

- This is a setting function available for the incremental encoder. It cannot be set for the absolute encoder.

Rotary operation

$$\frac{\text{Electronic gear numerator 1 (SP44)}}{\text{Electronic gear denominator 1 (SP45)}} = \frac{\text{Travel angle per command pulse}}{\text{Reduction ratio of load mechanism}} \times \text{Actuator resolution} \times \frac{1}{360}$$

Linear operation

$$\frac{\text{Electronic gear numerator 1 (SP44)}}{\text{Electronic gear denominator 1 (SP45)}} = \frac{\text{Travel distance per command pulse}}{\text{Feed pitch of load mechanism}} \times \text{Actuator resolution} \times 1$$

Set integers for both the denominator and numerator based on this formula:

Combined encoder = Incremental encoder

Parameter No.	Name	Set value	Default
44	Electronic gear numerator	1 to 9999	1
45	Electronic gear denominator	1 to 9999	1

Combined encoder = Absolute encoder

Parameter No.	Name	Set value	Default
44	Electronic gear numerator	1	1
45	Electronic gear denominator	1	1

SP48: Deviation clear upon servo-ON setting

The deviation can be reset to 0 when the servo-ON signal is input.

* The setting change of the system parameters (SP40 to 79) is enabled by reconnecting the control power supply after changing the setting.

Set value	Function	Default
0	When the servo is turned ON while there is a deviation, the actuator will move by the deviation.	1
1	Clear the deviation to zero before turning ON the servo.	

CAUTION

When 0 is set and the control circuit power remains input even while the servo ON input is OFF, position error pulses will generate if the stopped position of the load mechanism moves due to gravity, human force, etc. If the servo-ON input is turned ON in this condition, the actuator will move at the maximum current to make this error pulse count to 0. Accordingly, the facility may be damaged. Exercise caution.

SP49: Allowable position deviation

Set the allowable value of position deviation. If a deviation exceeding this value is generated, [AL60: Excessive deviation] is generated and the servo will be turned OFF.

* The setting value of SP49 is the encoder pulse units.
* The setting change of the system parameters (SP40 to 79) is enabled by reconnecting the control power supply after changing the setting.

Set value	Unit	Unit	Default
1 to 9999	Allowable value of position deviation	x 1,000 pulses	*

*: The default varies depending on the applicable actuator. Refer to [Default settings] (Apx-1) in the Appendix-1.

SP50: Command polarity

Set the actuator rotation direction during positioning.

* The setting change of the system parameters (SP40 to 79) is enabled by reconnecting the control power supply after changing the setting.

Set value	Function	Default
0	CW (clockwise) direction is forward	0
1	CCW (counterclockwise) direction is forward	

*: The rotation directions above indicate the rotation directions viewed from the output shaft.
*: With the SHA-SG/HP series and HMA series, rotation is in the opposite directions from those above.

This parameter affects the commands and monitoring that use MECHATROLINK. It does not affect test operation and other operations performed from PSF-800 or HA-800B panel.

The following shows the affected range of command polarity.

○: SP50 setting is affected, ×: SP50 setting is not affected.

ML communication		Input signals		Display panel	
INTERPOLATE	○	FWD inhibit/REV inhibit	○	JOG operation	×
POSING	○			Auto-tuning	×
FEED	○			Command pulse	×
LATCH	○			Feedback pulse	×
EX_POSING	○	**Output signals**		Error pulse	×
VELCTRL	○	Output signal encoder monitor	×	Speed display	×
TRQCTRL	○	Analog speed monitor	×	Torque display	×
Status_soft limit	○	Analog current monitor	×		
FWF/REV torque limit	○				
FWD/REV soft limit	○				
Monitor information_POS	○				
Monitor information_MPOS	○	**PSF-800**		**Network parameters**	
Monitor information_PERR	○	JOG operation	×	Final external positioning distance	○
Monitor information_APOS	○	Program operation	×	Virtual origin	○
Monitor information_LPOS	○	Auto-tuning	×	Originating direction	○
Monitor information_IPOS	○	Command pulse	×		
Monitor information_TPOS	○	Feedback pulse	×		
Monitor information_FSPD	○	Error pulse	×		
Monitor information_CSPD	○	Speed display	×		
Monitor information_TSPD	○	Torque display	×		
Monitor information_TRQ	○				

SP51: Speed input factor setting

Use this factor to output the voltage of the following formula to [CN9-1: Speed monitor output].

$$\text{Speed monitor output voltage (V)} = \text{Rotation speed (r/min)} \times \frac{10.0\ \text{(V)}}{\text{Speed input factor (r/min)}}$$

* The setting change of the system parameters (SP40 to 79) is enabled by reconnecting the control power supply after changing the setting.

Set value	Function	Unit	Default
1 to maximum motor rotation speed	Set the speed input factor.	r/min	*

*: The default varies depending on the applicable actuator. Refer to [Default settings] (Apx-1) in the Appendix-1.

SP54: Status display setting

Set what will be displayed in the status display mode after the control power supply is turned ON.

* The setting change of the system parameters (SP40 to 79) is enabled by reconnecting the control power supply after changing the setting.

Set value	Function	Default
00 to 16	Status display mode number to be displayed	0

SP55: DB enable/disable setting

Set whether to enable or disable the dynamic brake.
Use this parameter for HA-800B-1, 3, and 6. In HA-800B-24, the dynamic brake operation is interlinked with the main circuit DC voltage. It is not possible to change the operation by the SP55 setting. Use HA-800B-24 by setting SP55 = 1.

* The setting change of the system parameters (SP40 to 79) is enabled by reconnecting the control power supply after changing the setting.

Set value	Function	Default
0	Disabled	1
1	Enabled	

SP59: Angle compensation enable/disable setting

Set the angle compensation to be applied when a FHA-Cmini series (FHA-8C/11C/14C) driver is combined.
This function analyzes the angle transmission error beforehand and compensates for this erroneous difference to improve uni-directional positional accuracy.
The function improves the uni-directional positioning accuracy by approx. 30% than the value without compensation. (30% is not a guaranteed value. The actual improvement rate is different depending on the actuator.)

* The setting change of the system parameters (SP40 to 79) is enabled by reconnecting the control power supply after changing the setting.

Set value	Function	Default
0	Do not compensate	0
1	Compensate	

SP60: Automatic positioning gain setting enable/disable setting

The automatic positioning gain setting function can be used when a FHA-Cmini series (FHA-8C/11C/14C) driver is combined. This function automatically increases the speed loop gain when the error pulse count is small, to shorten the positioning period.
The speed command value of position loop is proportional to the error pulse and thus the positioning speed drops when the error pulse is small. In the case, response can be improved by raising the speed loop gain and increasing the current command value.
If the speed loop gain set in [AJ01: Speed loop gain] is greater than the automatically set value, the value set in AJ01 becomes effective.
* The setting change of the system parameters (SP40 to 79) is enabled by reconnecting the control power supply after changing the setting.

Set value	Function	Unit	Default
0	Do not set	—	*
1	Set		

*: The default varies depending on the applicable actuator. Refer to [Default settings] (Apx-1) in the Appendix-1.

SP61: Encoder monitor output pulses

Set the number of pulses to be output to the encoder monitor output terminal (CN2-12 to 17) per motor revolution when a 17-bit absolute encoder is combined.
Do not change the setting if you use the ZRET command.
* The setting change of the system parameters (SP40 to 79) is enabled by reconnecting the control power supply after changing the setting.

Set value	Function	Unit	Default
1 to 8192	Number of pulses output to the encoder monitor output terminal	Pulse	*

*: The default varies depending on the applicable actuator. Refer to [Default settings] (Apx-1) in the Appendix-1.

SP62: Input signal logic setting

Set the input signal logic.
* The setting change of the system parameters (SP40 to 79) is enabled by reconnecting the control power supply after changing the setting.

Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Origin signal	Latch 2	Latch 1	REV inhibit	FWD inhibit

Set value (bit)	Function	Unit	Default
0	Normally open (contact A) Signal function is enabled when input opt-isolator is turned ON.	—	0
1	Normally closed (contact B) Signal function is enabled when input opt-isolator is turned OFF.		

*: Set a value being the total sum of the values that are raised to the power of 2 for each bit.

SP63: Output signal logic setting

Set the output signal logic.
* The setting change of the system parameters (SP40 to 79) is enabled by reconnecting the control power supply after changing the setting.

Bit 3	Bit 2	Bit 1	Bit 0
Alarms	In-position complete	Origin return complete	Operation preparation complete

Set value (bit)	Function	Unit	Default
0	Normally open (contact A) Transistor turns ON when the output signal is enabled.	—	8
1	Normally closed (contact B) Transistor turns OFF when the output signal is enabled.		

*: Set a value being the total sum of the values that are raised to the power of 2 for each bit.

SP64: Regenerative resistor selection (HA-800B-24 only)

Set this parameter on HA-800B-24 according to the connected regenerative resistor.
At shipment from our factory, the wiring is set such that set value [0: Use a built-in regenerative resistor] as well as built-in regenerative resistors are used.
* Make sure to set the value to [0] if you use built-in regenerative resistors.
* Set the value to [1], if you use an external regenerative resistor because the circuit power is large.
* Do not use the set value [2]. (This setting is for maintenance purpose.)
* The setting change of the system parameters (SP40 to 79) is enabled by reconnecting the control power supply after changing the setting.

Set value	Function	Unit	Default
0	Use built-in regenerative resistor	–	0
1	Use external regenerative resistor		
2	Setting prohibited		

SP65: FWD/REV inhibit operation

Set the operation for when FWD/REV inhibit is input during the position control and speed control.
* The setting change of the system parameters (SP40 to 79) is enabled by reconnecting the control power supply after changing the setting.

Set value	Function	Unit	Default
0	The actuator does not generate torque in the inhibited direction when FWD/REV inhibit input is enabled.	–	0
1	The servo lock is engaged when FWD/REV inhibit input is enabled.		

* This is available for HA-800B software version 2.X or later.

8

System parameter mode

SP66: Absolute encoder function setting

A 17-bit absolute encoder can be used as an incremental encoder. When using as an incremental encoder, the backup battery is not required.
For the actuator for the 17-bit encoder incremental model (combined with driver: HA-800B-*E), connect the backup battery (option: HAB-ER17/33-2_Maintenance) and if SP66=0 is set, the encoder can be used as a 17-bit absolute encoder.

* This is available for HA-800 software version 3.x or later.
* Changes to system parameter settings (SP00 to 79) are put into effect by changing the setting, then turning control power supply OFF, then ON again.

Set value	Function	Unit	Default
0	Use as an absolute encoder.	-	*
1	Use as an incremental encoder.		

*: HA-800B-*D;SP66=0, HA-800B-*E;SP66=1

SP69: Feed-forward control function setting

This configures the feed-forward control function for position control. For details, refer to [Applied servo gain adjustment function] (P3-17).

* This is available for HA-800 software version 3.x or later.
* Changes to system parameter settings (SP00 to 79) are put into effect by changing the setting, then turning control power supply OFF, then ON again.

Set value	Function	Unit	Default
0	Feed-forward control (previous compatible function)	–	*
1	Feed-forward control		
2	Feed-forward control simple adjustment version (stable operation mode)		
3	Feed-forward control simple adjustment version (normal operation mode)		
4	Feed-forward control simple adjustment version (high-speed operation mode)		
5	Feed-forward control simple adjustment version (manual tune mode)		

*: The default varies depending on the applicable actuator.Refer to [Default settings] (Apx-1) in the appendix.

Caution

- When using the feed-forward control function, be sure to reference [Applied servo gain adjustment function] (P3-17) and understand the notices.

8 System parameter mode

Chapter 9

Test mode

Details of how to check the system operation by auto-tuning via jogging, monitoring of I/O signals and simulated operation of output signals are explained in this chapter.

9-1 Test mode 9-1
9-2 Details of test mode 9-2

9-1 Test mode

In the test mode, you can monitor I/O signals and perform JOG operation, auto-tuning, etc.
You can also check the connection with the host controller and operating status without having to drive the actuator.

mode	Display	Description	Details
Test mode	T00	I/O signal monitor	P9-2
	T01	Output signal operation	P9-3
	T02	JOG speed setting	P9-4
	T03	JOG acceleration/deceleration time constant setting	P9-5
	T04	JOG operation	P9-6
	T05	Parameter initialization	P9-7
	T06	System reservation	―
	T07	System reservation	―
	T08	Multi revolution clear	P9-8
	T09	Auto-tuning	P9-9
	T10	Auto-tuning travel angle setting	P9-11
	T11	Auto-tuning level selection	P9-12

Do not set/operate the items that are reserved by the system.

9-2 Details of test mode

The following explains the details of the test mode.

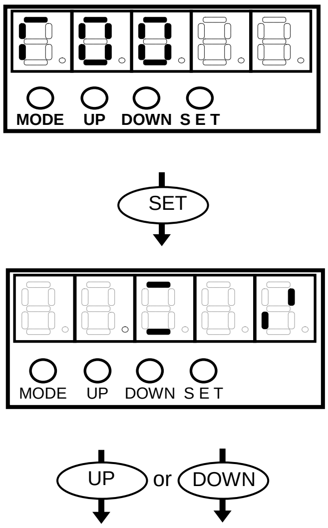
T00: I/O signal monitor

The I/O statuses of assigned pins are reflected and displayed in real time.
The functions of displayed pins are enabled.

1 Press the SET button.

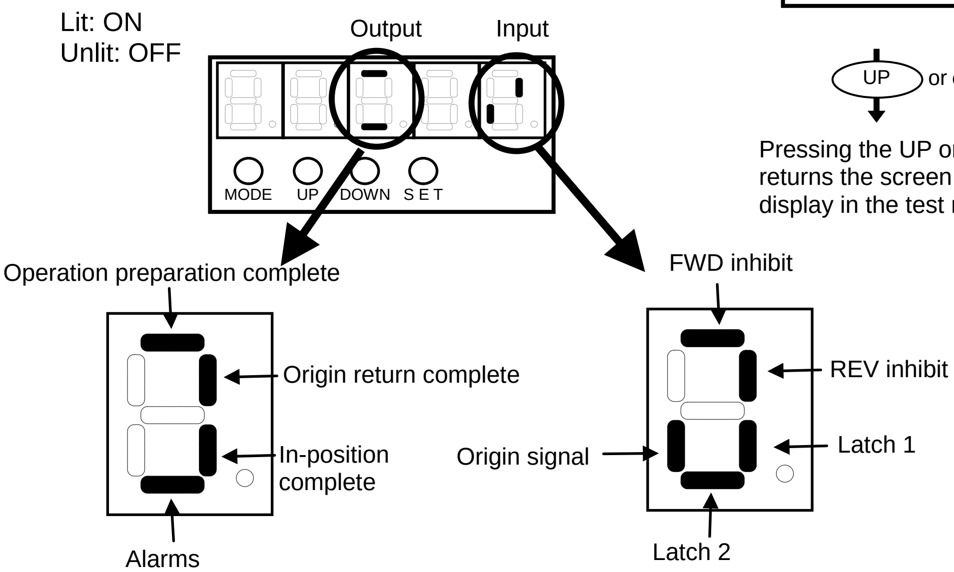
Output signal operation is now permitted.

- The display will not switch if the button is pressed for 1 second or longer.



2 The third digit indicates the output status, while the fifth digit indicates the input status.

Pressing the UP or DOWN button returns the screen to the number display in the test mode.



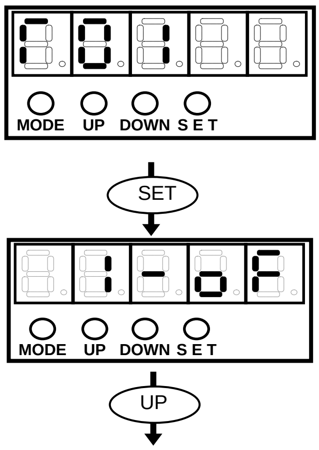
The decimal point in the input monitor indicates the servo-ON. (It does not indicate the input signal status.)
The servo turns ON when the decimal point becomes lit.

T01: Output signal operation

Output signals can be turned ON/OFF as desired.

Caution

- With this operation, the output signal is actually output. Take note that the equipment may operate due to the operation. Also, the operation can be done even when HA-800B is being automatically operated by the command from the host controller. Please keep this in mind during the actual operation.
- This operation cannot be executed at the same time as the output signal operation from PSF-800.



1 **Press the SET button.**

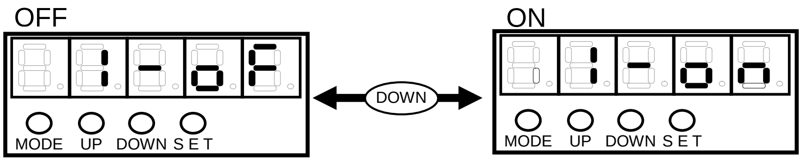
Output signal operation is now permitted.

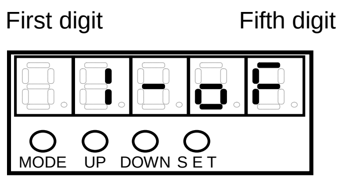
- The display will not switch if the button is pressed for 1 second or longer.

2 **Use the UP button to select the signal to be operated.**

3 **Use the DOWN button to switch the ON/OFF status.**

The output signal shown in the second digit will turn ON/OFF every time the DOWN button is pressed.





- First digit: Nothing is shown.
- Second digit: The number assigned to the output signal to be operated is shown.
  A number between [1] and [7] is shown, where 1, 2, ..., 7 indicate that output 1, 2, ..., 7 can be operated, respectively.
  * [1] to [7] are displayed, but the applicable range for the output signal operation with the HA-800B driver is [1] to [4].
- Third digit: [-] is shown.
- Fourth, fifth digits: The status of the output selected in the second digit is shown.
  on: The signal is ON (output transistor is ON)
  oF: The signal is OFF (output transistor is OFF)

4 **Press the SET button, and the display will return to [T01].**

T02: JOG speed setting

Set the speed of JOG operation.
Although the unit is r/min, this value indicates the actuator's motor rotation speed. The output shaft rotation speed is obtained
by dividing the set value by the gear ratio.
Setting range: 10 to 3000
Unit: r/min

1 Press the SET button.

The JOG speed setting is displayed. (Unit: r/min)

- The display will not switch if the button is pressed for 1 second or longer.

2 To change the set value, press the SET button and release it within 1 second.

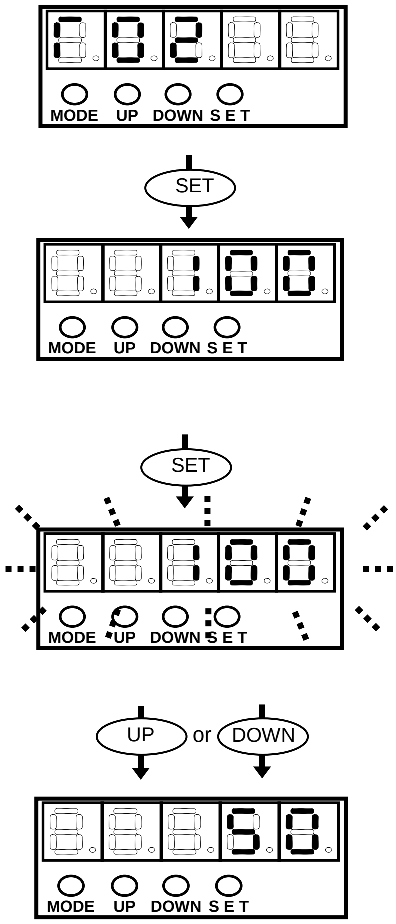
The set value flickers to indicate that it can now be changed.

3 Change the set value.

Pressing the DOWN button decreases the value, while pressing the UP button increases the value.
(Press and hold each button to change the value faster.)

4 To confirm the set value, press and hold the SET button until the set value stops flickering.

To restore the original set value, release the SET button before the set value stops flickering (within approx. 1 second).



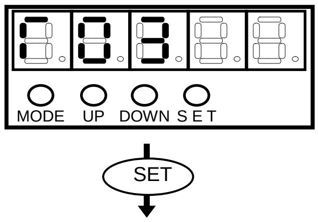
Caution

- The value set here is not stored.
  When the HA-800B driver power is reconnected, it will return to the default value 100.
- Set the speed as low as possible to enable checking.
  Avoid unexpected accidents resulting from high speed.

T03: JOG acceleration/deceleration time constant setting

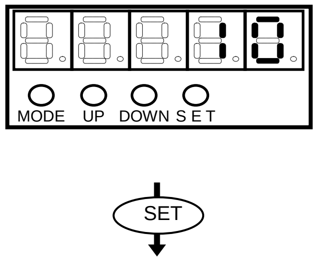
Set the acceleration/deceleration time constant to be applied during JOG operation.
The value set here corresponds to the time over which the actuator accelerates from the standstill state the max. rotational speed of the motor, or time to decelerate from the max. rotational speed of the motor to the standstill state.
Setting range: 1 to 9999
Unit: ms

1 **Press the SET button.**



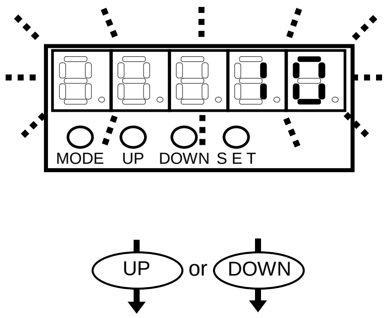
2 **To change the set value, press the SET button and release it within 1 second.**

The set value flickers to indicate that it can now be changed.



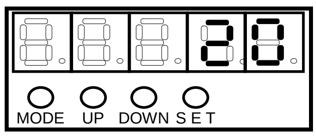
3 **Change the set value.**

Pressing the DOWN button decreases the value, while pressing the UP button increases the value.
(Press and hold each button to change the value faster.)



4 **To confirm the set value, press and hold the SET button until the set value stops flickering.**

To restore the original set value, release the SET button before the set value stops flickering (within approx. 1 second).



Caution

- The value set here is not stored.
  When the HA-800B driver power is reconnected, it will return to the default value 1.

T04: JOG operation

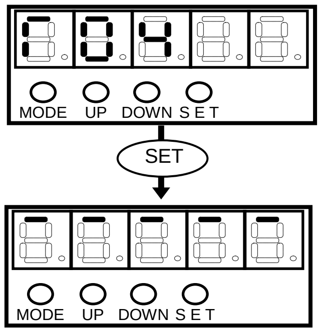
The actuator can be operated regardless of the input signals from the host. Any input signal operation performed during JOG operation is ignored. The data set in [T02: JOG speed setting] and [T03: JOG acceleration/deceleration time constant setting] is used to perform JOG operation of the actuator.

WARNING

- **The actuator operates ignoring even the FWD/REV inhibit input signals during the JOG operation; operate carefully paying attention to the surrounding conditions.**
- **JOG operation is not performed accurately if the host controller and the MECHATROLINK are connected. When performing a JOG operation, disconnect the MECHATROLINK cable and restart the driver first.**
- **Do not perform a test run using the communication software PSF-800 simultaneously. The operation becomes unstable.**
- **The torque limit function is disabled during the JOG operation.**

Caution

- Regardless of the setting of [SP50: Command polarity], the rotation is clockwise for the forward command [UP] and counter-clockwise for the reverse command [DOWN]. With the SHA-SG/HP series and HMA series, rotation is in the opposite directions.
- Note that after jog operation, the current value on the host device and the actual machine position differ.



1 **Press the SET button when the actuator servo is OFF.**

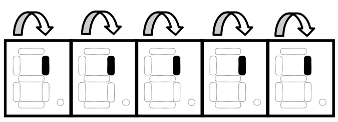
The actuator servo turns ON and JOG operation direction is displayed.

- The display will not switch if the button is pressed for 1 second or longer.

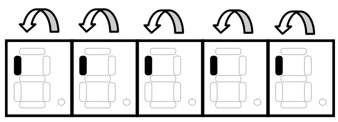
2 **Press the UP or DOWN button to rotate the actuator.**

- The actuator rotates in the CW (clockwise) direction while the UP button is pressed. (The rotation direction is different depending on the actuator.) Release the UP button, and the actuator will stop.
- The actuator rotates in the CCW (counterclockwise) direction while the DOWN button is pressed. (The rotation direction is different depending on the actuator.) Release the DOWN button, and the actuator will stop.
- The rotation speed will reach the speed set in [T02: JOG speed].
- Acceleration and deceleration conform to the data set in [T03: JOG acceleration/deceleration time].

Press the UP button, and the actuator will rotate in the CW direction.



Press the DOWN button, and the actuator will rotate in the CCW direction.



3 **To end the operation, press the SET button.**

The actuator servo turns OFF and the screen returns to the test mode number display.

- The display will not switch if the button is pressed for 1 second or longer.

T05: Parameter initialization

The tune mode parameters (excluding AJ16 and AJ17) and system parameters are reset to their default settings.

Caution

- Perform this operation while the servo is OFF. After the initialization, be sure to reconnect the HA-800B driver power.
- All parameters are initialized (excluding AJ16 and AJ17). Since the logical setting of the I/O signal is also initialized, it is recommended that you write down the necessary parameters or save them using PSF-800 before the initialization.

1 **Press the SET button.**

The HA-800B driver displays the motor code of the applicable actuator currently set.

- The display will not switch if the button is pressed for 1 second or longer.

2 **Press the SET button.**

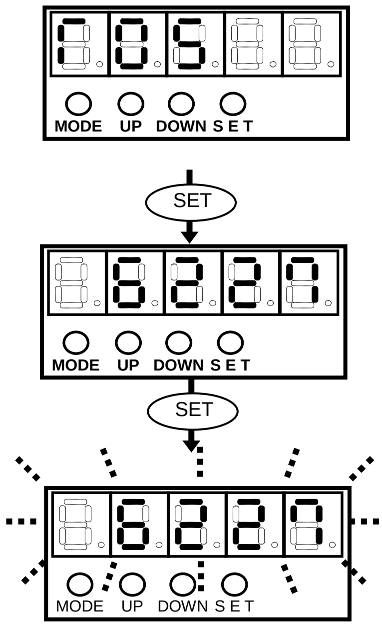
The displayed motor code flickers.

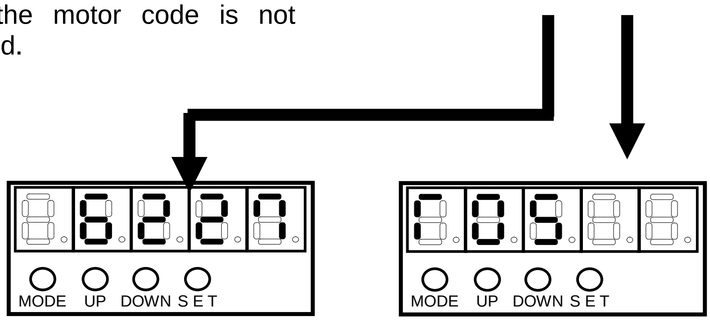
- To cancel the parameter initialization, press the UP or DOWN button. The screen returns to the test mode number display.

3 **Press and hold the SET button until the display stops flickering and becomes lit, and then release the button. (Approx. 1 seconds or more)**

The motor code is initialized and the test mode number is displayed.

- If the SET button is released before the display stops flickering and becomes lit, the motor code is not initialized and remains displayed.





If the button is released before the flickering stops and becomes lit, the motor code remains displayed and parameters are not initialized.

When the button is released after the flickering has stopped and become lit, the screen changes to the test mode number display, at which point the parameter initialization is already complete.

9

Test mode

T08: Multi revolution clear

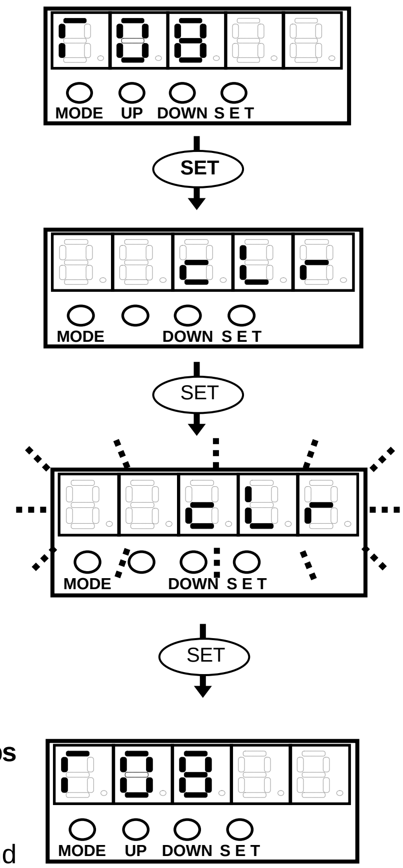
Encoder multi revolution data can be cleared when an actuator equipped with a 13-bit absolute encoder or 17-bit absolute encoder is combined.
This parameter is also used when setting the origin. With the SHA series, FHA-C absolute system, FHA-Cmini absolute system, and HMA series, the multi revolution counter value must be set to zero at the origin.

Caution

- A multi revolution clear command cannot be executed while the actuator servo is ON.
- After the multi revolution clear command, reconnect the HA-800B driver power.
  If the power is not reconnected, the servo cannot be turned ON and thus commands cannot be accepted.

1 **Move the actuator to its origin via manual JOG operation.**
(Only when setting the origin)

2 **Display [T08: Multi revolution clear] in the test mode.**



3 **Press and hold the SET button for at least 0.1 second.**

[cLr] is shown.

4 **Press the SET button.**

Displayed [cLr] flickers.

- If you don't want to clear the multi revolution data, press the UP or DOWN button. The screen returns to the test mode number display.

5 **Continue to hold the SET button until the flickering stops and becomes lit.**
(Approx. 5 seconds or more)

- The multi revolution clear command is executed and the screen changes to the test mode number display.
- If the SET button is released before the flickering stops and becomes lit (within approx. 5 seconds), the multi revolution clear command is not executed and [cLr] remains displayed.

T09: Auto-tuning

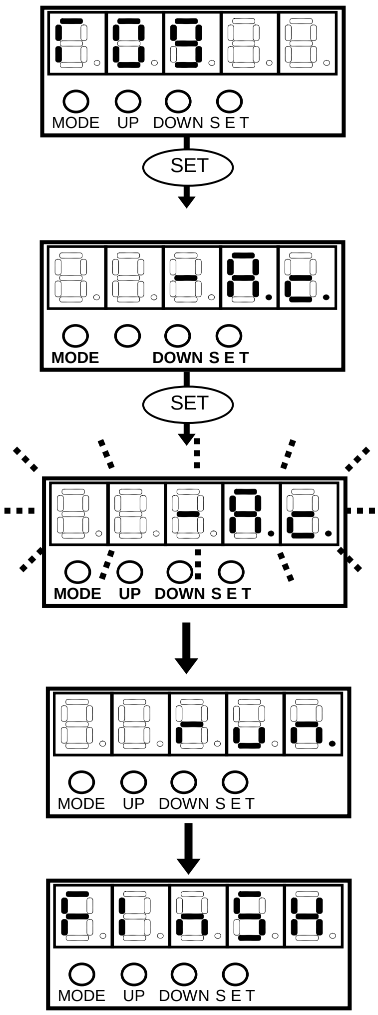
The load is estimated and auto-tuning is performed to set an optimal servo gain.

WARNING

Since the actuator moves to estimate the load, perform auto-tuning after thoroughly confirming safety.
By default, the motor shaft moves 6,000 degrees in the CW direction and then 6,000 degrees in the CCW direction. The corresponding rotation angle of the actuator output shaft is obtained by 1/reduction ratio. In certain situations such as when the displacement of the system is limited, change the displacement by [T10: Auto-tuning travel angle setting].
Do not perform any operation as it may be unstable during a MECHATROLINK communication.

Caution

- To perform an auto-tuning, disconnect the MECHATROLINK communication cable to disable communication and restart HA-800B. Performing an auto-tuning during a MECHATROLINK communication may result in an unexpected behavior.
- Do not execute the PSF-800 waveform monitoring during auto-tuning.
- Note that after auto-tuning, the current value on the host device and the actual machine position differ.



1 While [T09] is displayed, press the SET button.

[-A.c.] is shown.

- The display will not switch if the button is pressed for 1 second or longer.

2 Press the SET button.

Displayed [-A.c.] flickers.

3 Press and hold the SET button for at least 0.1 second.

[-A.c.] changes to [run] and the actuator is excited, after which it moves in the forward direction by the displacement set in [T10: Auto-tuning travel angle setting]. Thereafter, the actuator moves in the CCW direction by the displacement set in [T10: Auto-tuning travel angle setting].
If the main circuit power has not been turned ON or actuator does not move (= a servo alarm is output), [-A.c.] does not change to [run.].

- To cancel the auto-tuning, press the UP or DOWN button. The screen returns to the test mode number display.
- The actuator moves in forward/reverse directions for a while to estimate the load. When the load has been estimated, [run.] changes to [FInSH] to indicate that the auto-tuning is complete.
  Pressing the UP or DOWN button on this display returns the screen to the test mode number display.

Caution

- Depending on the rotation position, a large load variation does not allow the load to be estimated properly which makes auto-tuning impossible. Adjust using the manual.

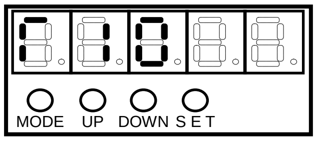
T10: Auto-tuning travel angle setting

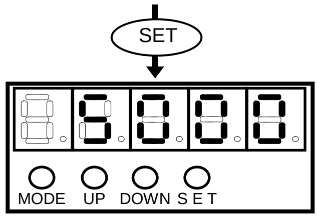
Set the displacement of the motor during auto-tuning.
Setting range: 1500 to 6000 ˚
Unit angle: (˚)

1 While [T10] is displayed, press the SET button.

The auto-tuning displacement is displayed.

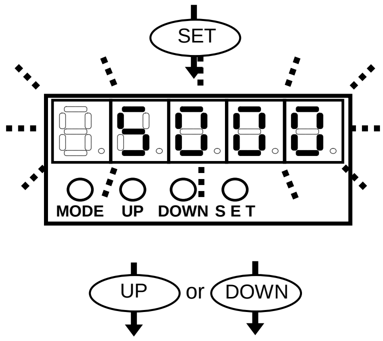
- The display will not switch if the button is pressed for 1 second or longer.





2 Press the SET button.

The auto-tuning displacement flickers.



3 Press the UP or DOWN button to change the auto-tuning displacement.

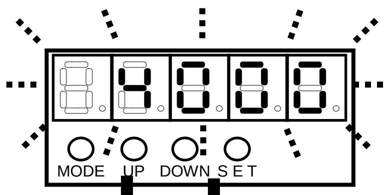
The value is set in angle (˚) and the setting range is 1500 to 6000°(motor shaft).

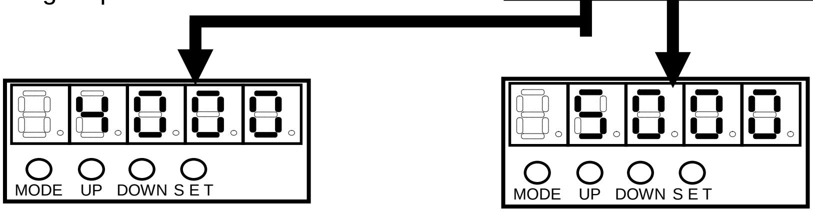
- The load estimated by auto-tuning is subject to a maximum erroneous difference of approx. ±15%. To minimize the erroneous difference, set the auto-tuning displacement as long as possible.

4 Hold the SET button until the auto-tuning displacement stops flickering and becomes lit.

The set value becomes effective.

- If you don't want to apply the set value, release the SET button before the flickering stops and becomes lit.





Hold the SET button until the flickering stops and becomes lit and then release the button to make the set value effective.

If the SET button is released before the flickering stops and becomes lit, the set value is not applied.

Caution

- The set value of auto-tuning displacement is not saved. When the HA-800B driver is restarted, the set value returns to the default (6000 ˚).

9

Test mode

T11: Auto-tuning level selection

Select the level of auto-tuning. Increasing the value set here improves the response, but vibration may also increase depending on the system.

1 **While [T11] is displayed, press the SET button.**

The auto-tuning level selection is displayed.

- The display will not switch if the button is pressed for 1 second or longer.

2 **Press the SET button.**

The auto-tuning level selection flickers.

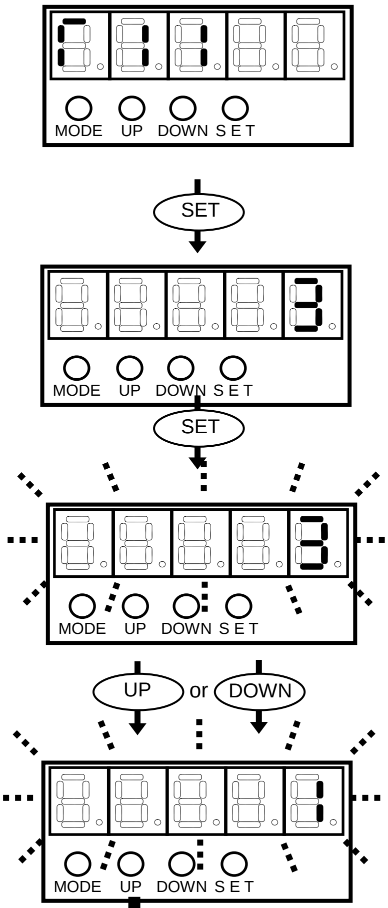
3 **Press the UP or DOWN button to change the auto-tuning level.**

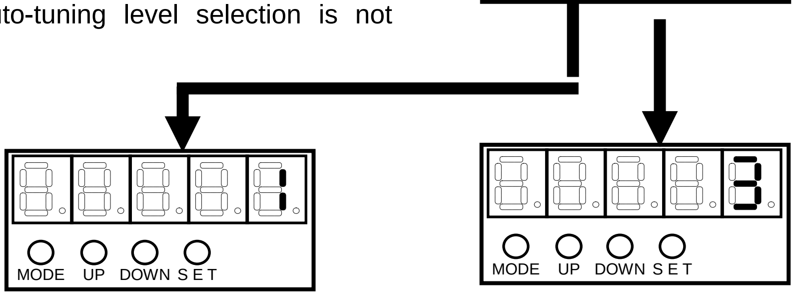
The setting range is 1 to 5.

4 **Hold the SET button until the auto-tuning level selection stops flickering and becomes lit.**

The set value becomes effective.

- If you don't want to apply the set value, release the SET button before the flickering stops and becomes lit. The set value of auto-tuning level selection is not saved.





Hold the SET button until the flickering stops and becomes lit and then release the button to make the set value effective.

If the SET button is released before the flickering stops and becomes lit, the set value is not applied.

Caution

- The set value of auto-tuning level is not saved. When the HA-800B driver is restarted, the set value returns to the default (3).

Chapter 10

Communication software

How you can use the dedicated personal computer software to check I/O signal statuses, rotation speeds and other servo statuses, perform auto-tuning, set parameters, and monitor servo operation waveforms are explained in this chapter.

10-1 Overviews 10-1
10-2 Auto-tuning 10-8
10-3 Parameter setting 10-10
10-4 Saving, comparing and copying set values 10-12
10-5 Test operation 10-19
10-6 Output signal operation 10-21
10-7 IO monitor 10-22
10-8 Waveform monitoring 10-23
10-9 Alarm 10-26

10-1 Overviews

PSF-800 is a communication software program that lets you change driver parameters and monitor operation waveforms, etc., from a personal computer.

Operating environment

PSF-800needs the following environment to operate correctly.
Be sure to use PSF-800 in the following environment to prevent malfunction.

Item	Environment
Computer	Personal computer running Windows® Xp, Windows Vista®*1, or Windows® 7*1, having a built-in RS-232C communication port
OS	Windows® Xp, Windows Vista®*1, Windows® 7*1
Memory	Memory size required by each OS or more
Hard disk	Free disk space of 3 MB or more (Additional free disk space is needed if created data will be saved.)
Display	256 colors or more
Others	・Microsoft® Mouse, Microsoft® IntelliMouse® or other compatible pointing device ・Printer operating on the specified OS, if created data will be printed

*1: Successful operation has been verified on Windows Vista®, and Windows 7®, but it is not guaranteed.

* Microsoft Windows and IntelliMouse are registered trademarks and trademarks of Microsoft Corporation in the United States for use in the United States, Japan and other countries.
* Microsoft Windows Operating System is the full name of Windows.

Caution

- Download the latest version of PSF-800 from our web site.

10

Communication software

Setup

1 Download PSF-800.

Download the software from our website (http://www.hds.co.jp).

2 Install PSF-800.

Extract the files from the downloaded folder and run SETUP.EXE to set up the software according to the on-screen instructions.

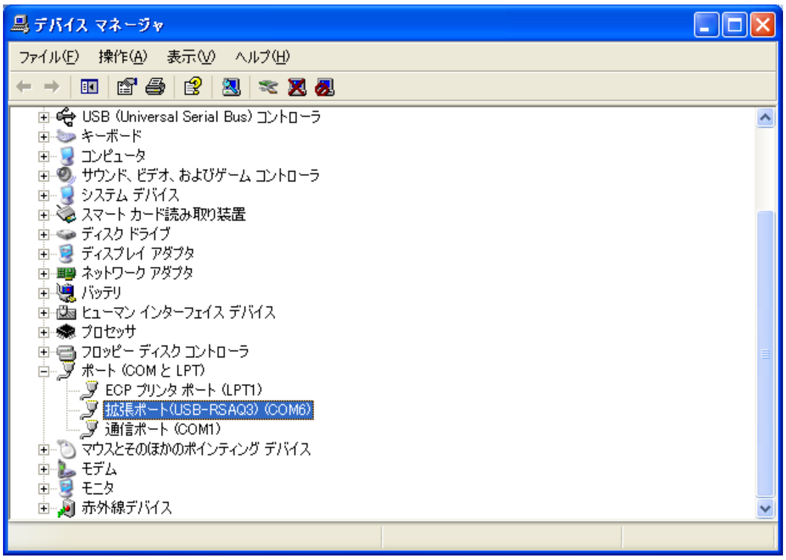
- **Using a USB port**

If a USB port is used, you need an adapter to convert the USB port to a RS-232C port. (USB-RSAQ5 IO Data, etc.)
The built-in RS-232C port of the personal computer is normally assigned to COM1. However, this assignment changes if a USB conversion adapter is used. Perform the following setting procedure:

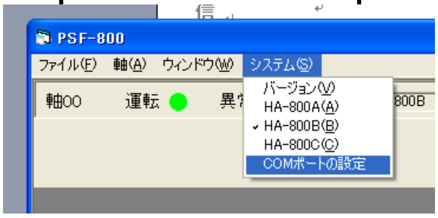
(1) Go to Control Panel, open System, and display Device Manger.

(2) Check the port assignments (COM and LPT1).

(In the following example, COM6 is assigned.)



(3) Choose “System (S)” from the menu, and then scroll down to “Select COM port” to open the “Select COM port” window.



Set the verified port number from (2), and then click the OK button.Next, start the PSF-800 to make the COM port number (1 to 16) set earlier effective.

(4) A VB6 runtime library is needed to run PSF-800.

If this VB6 runtime library is not yet installed, the following message is shown on the personal computer. Take note that the files you have downloaded from our website do not include the VB6 runtime library.

If the VB6 runtime library is not yet installed, you can download it from the following URL:
http://www.vector.co.jp/soft/win95/util/se188840.html

3 Confirm the installation.

When the installation is complete, use a dedicated communication cable* to connect the personal computer and HA-800B. Start and then shut down PSF-800 to confirm that the software has been installed correctly.

Start PSF-800 after turning on the control circuit power of the HA-800.

If the connection is unstable, use toroidal core for the communication cable.

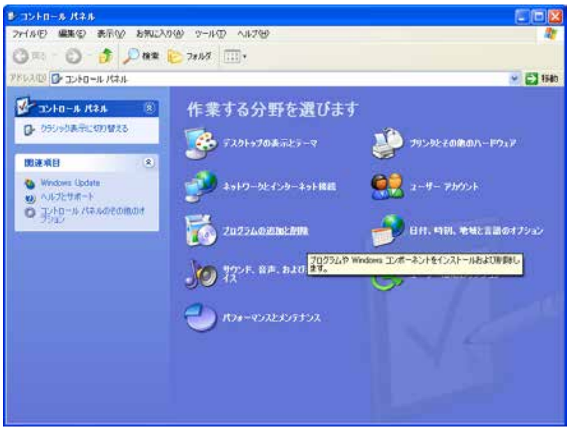
*: Dedicated communication cable

RS-232C communication cable: EWA-RS03

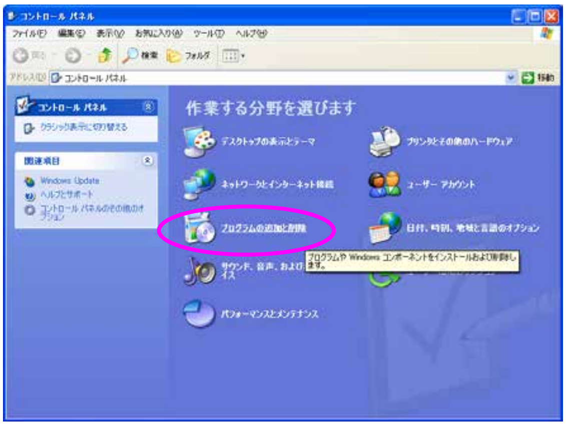
Uninstalling the software

To uninstall PSF-800 from the hard disk, follow the procedure below. Once uninstalled, PSF-800 can no longer be started on that personal computer. To use PSF-800 again, reinstall it according to the installation procedure.

1 **Open Control Panel.**

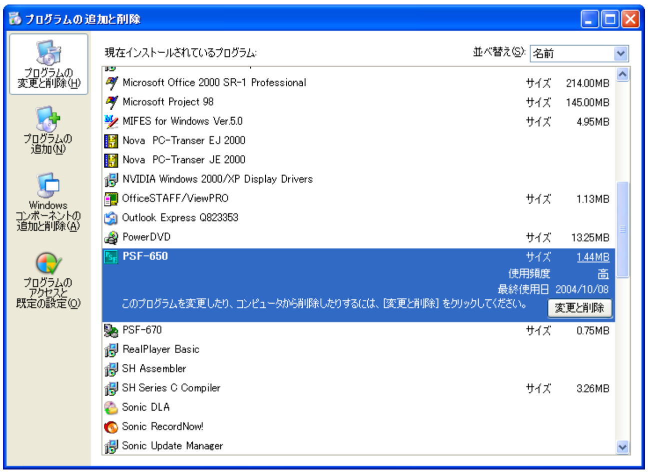


2 **Click Add/Remove Programs.**



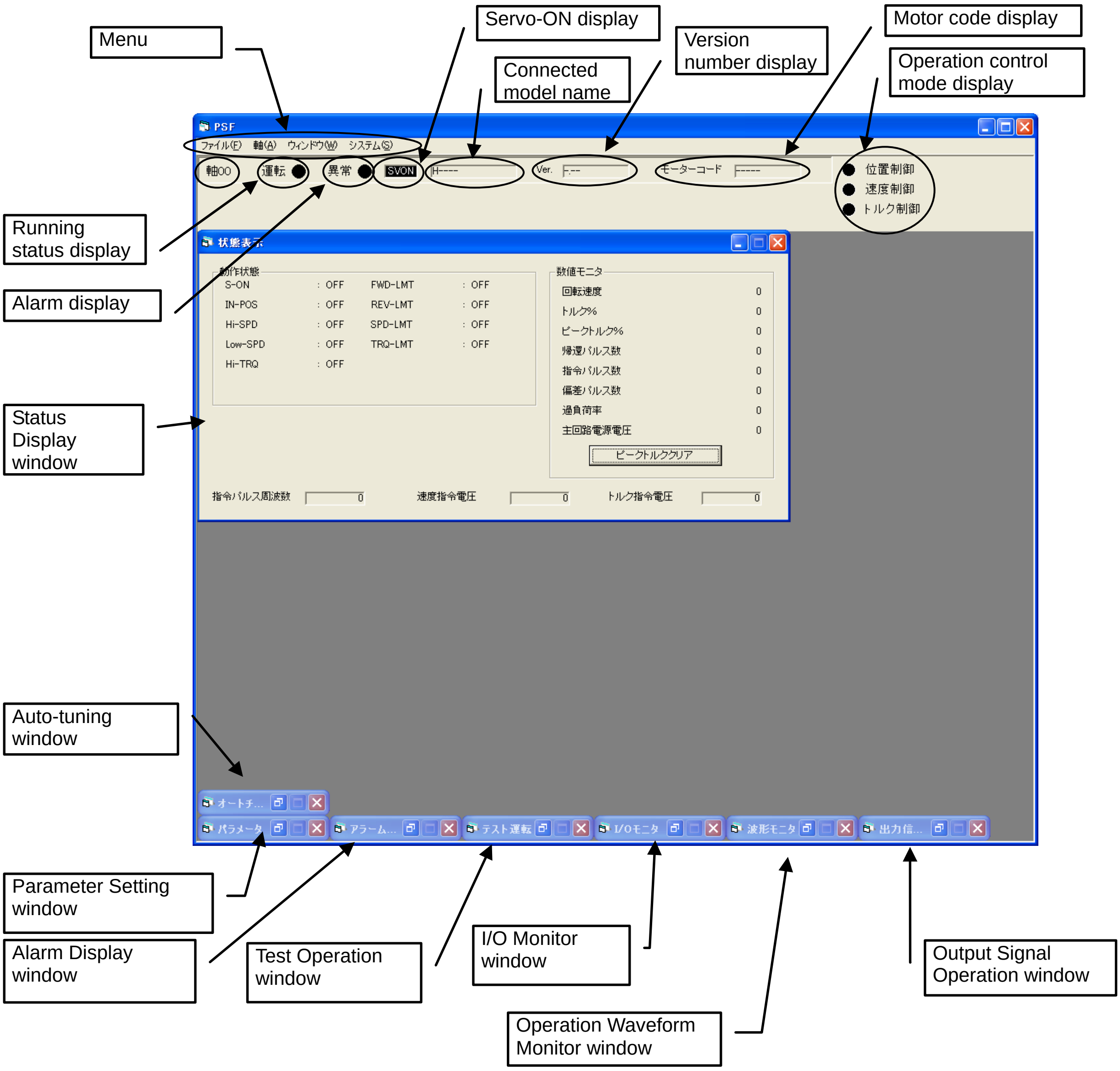
3 **Select and remove the PSF-800 program.**

Select PSF-800 and then click the **Change/Remove** button, and PSF-800 will be uninstalled from the hard disk.



Initial screen

The initial screen of PSF-800 is shown below.



Menu

- **File**

Open ･･･Read the parameter set value, test operation patterns, and waveform monitoring data from the file via the parameter setting, test operation and waveform monitoring operation, respectively.

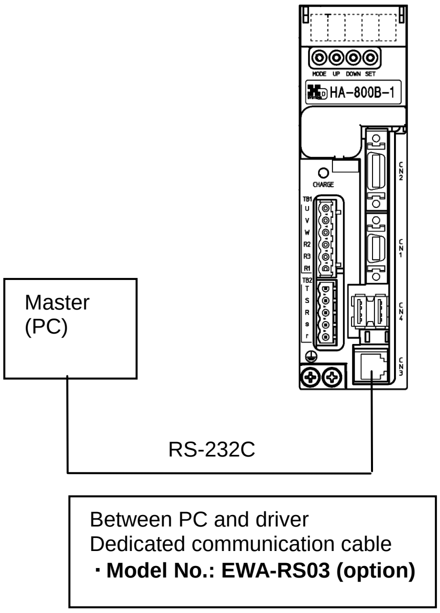
Save As ･･･Save the parameter set value, test operation patterns and waveform monitoring data in the file from the parameter setting, test operation, and waveform monitoring operation, respectively.

Exit --- Exit the program.

- **Axis**

When PSF-800 is connected with HA-800B, 1 driver can be operated.

Connection example of PSF-800 and HA-800B



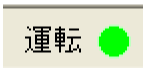
- **Window**

Although the status display screen opens when the software is started, you can change the initial screen in the Window menu.

Detailed display area

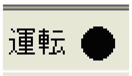
- **Axis number display**
  When HA-800B and PSF-800 are connected, the axis number is fixed to Axis 00.

- **Running status display**
  A steady green light comes on when the HA-800 is connected to PSF-800 and its power supply is turned ON.



(Green)

HA-800 power supply ON



(Unlit)

HA-800 power supply OFF
Or PSF-800 is offline.

- **Alarm display**
  A red light flickers when the HA-800 is generating an alarm.

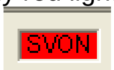
(Red)

Alarm is generating

(Unlit)

No alarm

- **Servo-ON display**
  A steady red light comes on when the actuator servo is ON.



(Red)

Servo ON

(Unlit)

Servo OFF

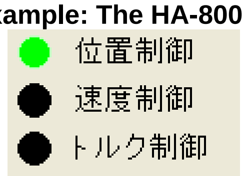
- **Connected model name display**
  The model name of the connected HA-800 is shown.

(Example: General-purpose (position command, speed command, torque command) specification)
HA-800B: MECHATROLINK communication specification
HA-800C: CC-Link specification

- **Version number display**
  The software version of the connected HA-800 is shown.

- **Motor code display**
  The code number of the applicable actuator set in the HA-800 is shown.

- **Operation control mode display**
  The operation mode of the HA-800 is shown. The steady green light indicates the mode in which the HA-800 is currently operating.
  Example: The HA-800 is operating in the position control mode



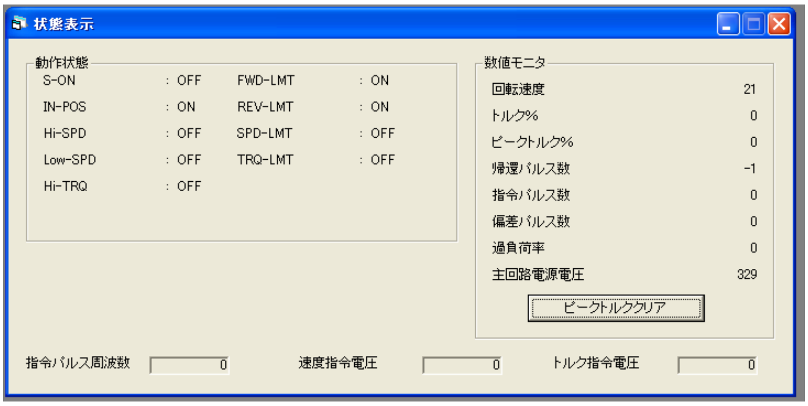
(Green)
(Unlit)
(Unlit)

10

Communication software

Status display

In the Status Display window, you can monitor the operating status and values.



Operating status display

Name	Explanation
S-ON	ON is shown if the actuator servo is ON.
IN-POS	ON is shown during position control if the deviation counter value is within the in-position range set by an adjustment parameter.
Hi-SPD	ON is shown if the motor rpm reaches 2,000 r/min or higher.
Low-SPD	ON is shown if the motor rotation speed drops to or below the zero speed judgment value set by an adjustment parameter.
Hi-TRQ	ON is shown if the motor output torque reaches 50% or more of the maximum torque.
FWD-LMT	ON is shown if the FWD inhibit signal is enabled.
REV-LMT	ON is shown if the REV inhibit signal is enabled.
SPD-LMT	With the HA-800B, this display is OFF.
TRQ-LMT	If the driver's output torque is set to torque limiting, ON is shown.

Value monitor

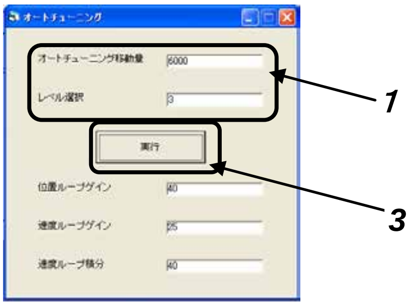
Name	Explanation
Motor rpm	The rotation speed [r/min] of the motor is shown.
Torque	It displays the current torque value %, setting the maximum output torque of the actuator to be 100%.
Peak torque	It displays the output torque peak value %, by setting the maximum output torque of the actuator as 100%. Clicking the Clear Peak Torque button clears this field.
Feedback pulses	The value of the encoder feedback pulse counter is shown.
Command pulses	The value of the driver command pulse counter is shown.
Error pulses	The value calculated by subtracting the feedback pulse counter value from the command pulse counter value (deviation) is shown.
Overload rate	The overload rate is shown. If this value is not 0, the actuator is overloaded.
Main circuit power voltage	The rectified AC voltage [V] of the main circuit is shown.
Regenerative power	It indicates absorbed power of regenerative resistor as percentage (unit: 0.01%). The value can be converted to absorbed power of resistor using the following formula. $\text{Regenerative resistor absorption power (W)} = 16{,}000 \times \dfrac{\text{Display value [0.01\%]}}{10000\ [0.01\%]}$ Ex) When display value = 10, absorption power = 16 [W] * This value monitor is available only for HA-800B-24. With the HA-800B-1, 3 and 6, the power absorbed by regenerative resistor is unrelated.

10-2 Auto-tuning

Auto-tuning is a function that allows the driver to estimate the load and automatically adjust the servo gain to an appropriate value. The auto-tuning method is explained below.

> **WARNING**
>
> **Since the actuator moves to estimate the load, perform auto-tuning after thoroughly confirming safety.**
> **By default, the motor shaft moves 6,000 degrees in the CW direction and then 6,000 degrees in the CCW direction. The corresponding rotation angle of the actuator output shaft is obtained by 1/reduction ratio. In certain situations such as when the displacement of the system is limited, change the displacement.**
> **Auto-tuning is not performed if the MECHATROLINK cable is connected. Disconnect the cable and restart the driver first.**

1 Set the auto-tuning displacement and level in the Auto-tuning window.



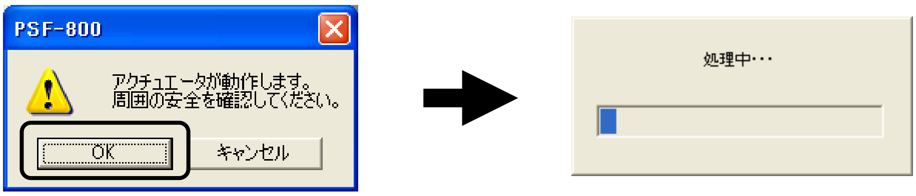
Set value	Explanation
Auto-tuning displacement	Set the travel angle by which the motor shaft turns when estimating the load. The displacement of the actuator's output shaft is calculated by 1/reduction ratio. A desired value of 1,500 to 6,000 degrees can be set. Set as large a value as possible to improve the accuracy of load estimation.
Level selection	Select the level of auto-tuning. A desired value between 1 and 5 can be set. The higher the level, the higher the servo rigidity becomes after tuning.

2 Disconnect the MECHATROLINK cable and turn ON the driver power.

3 Click the Execute button.

4 When an alert message is displayed, click the OK button if no problem is found.

Auto-tuning is performed and the motor rotates. A progress screen is displayed during auto-tuning. Perform auto-tuning after thoroughly checking the condition of equipment and surrounding areas.



10
Communication software

5 When the auto-tuning is completed, the servo gain is displayed.

After the auto-tuning, the Position Loop Gain, Speed Loop Gain, Speed Loop Integration and Load Inertia Moment Ratio are changed to values appropriate for the estimated load.

Caution

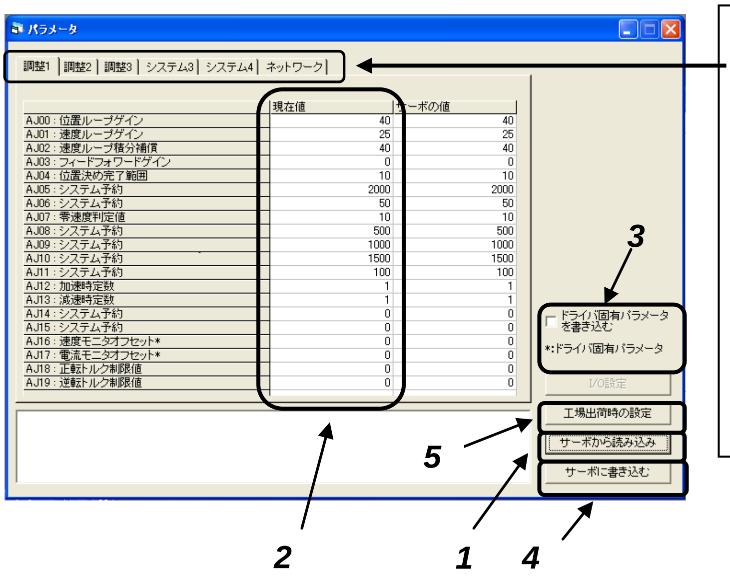
- Depending on the rotation position, a large load variation, does not allow the load to be estimated properly which makes auto-tuning impossible. Adjust using the manual.
- Do not execute the PSF-800 waveform monitoring during auto-tuning.
- Note that after auto-tuning, the current value on the host device and the actual machine position differ.

10-3 Parameter setting

In the Parameter Setting window, you can check and change the values set in tune mode parameters and system parameters.

10-3-1. Editing and initializing internal parameters of the driver

The following explains how to edit the set values for internal parameters of the driver during communication.



Adjustment 1: The set values for tune mode parameters AJ00 to AJ19 can be checked and changed.
Adjustment 2: The set values for tune mode parameters AJ20 to AJ39 can be checked and changed.
Adjustment 3: This is reserved for the system.
System 3: The set values for system parameters SP40 to SP59 can be checked and changed.
System 4: The set values for system parameters SP60 to SP79 can be checked and changed.
Network: Parameter related to the operations executed via MECHATROLINK. The advance settings for the operations, such as originating, can be set.

1 **Open the Parameter Setting window.**
In the Parameter Setting window, click the Load from Servo button.

The currently set values are loaded from the driver and displayed in the [Servo Value] and [Current Value].

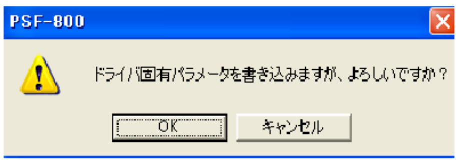
2 **Click the Current Value field of the parameter you want to change, and enter the desired value.**

The parameter you have changed illuminates in red.

3 **Select the [Write driver-specific parameters] check box if you want to write the driver-specific parameters (AJ16: Speed monitor offset, AJ17: Current monitor offset).**

4 **Click the Write to Servo button.**

The new value (the contents of the [Current Value]) is transferred to the driver.
When the [Write driver-specific parameters] check box is selected, a verification screen appears.
Click the OK button if you want to write the parameters. Click the Cancel button if you don't want to write the parameters.



*The [Servo Value] display will not be updated after [Write to Servo] is executed.
Executing [Load from Servo] updates the [Servo Value] and the latest set values after the writing for internal parameters of the driver are displayed.

10 Communication software

Caution

- If the writing cannot be executed correctly due to the communication errors etc., a warning message is displayed. Execute [Write to Servo] again.

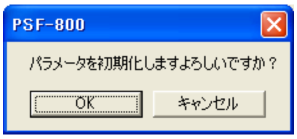
Procedure to reset parameters to their defaults (factory-set values)

Caution

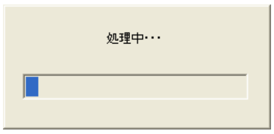
- Perform this operation while the servo is OFF. After the initialization, be sure to reconnect the HA-800B driver power.
- All parameters are initialized except for AJ16 and AJ17. Save the set values prior to the initialization of the required parameters. The parameters can be saved or read for the set values on a PC in accordance with [10-4 Saving, comparing and copying set values] (P10-12).
  By this operation, [Adjustment parameters], [System parameters], and [Network parameters] are initialized.

5 **Click the Default Settings button.**

Verification screen is shown. Click the OK button to initialize. Click the Cancel button to stop initialization.



6 **A progress screen is displayed. Wait for a while, and the values will return to their defaults.**



10

Communication software

10-4 Saving, comparing and copying set values

The following explains how to back up the set values to a personal computer
Save parameter set value, test operation patterns, and waveform monitor data in files from the parameter setting, test operation, and waveform monitoring windows, respectively. Execute saving and reading set values for each Window with the each Window open. The following explains procedures within the parameter window.

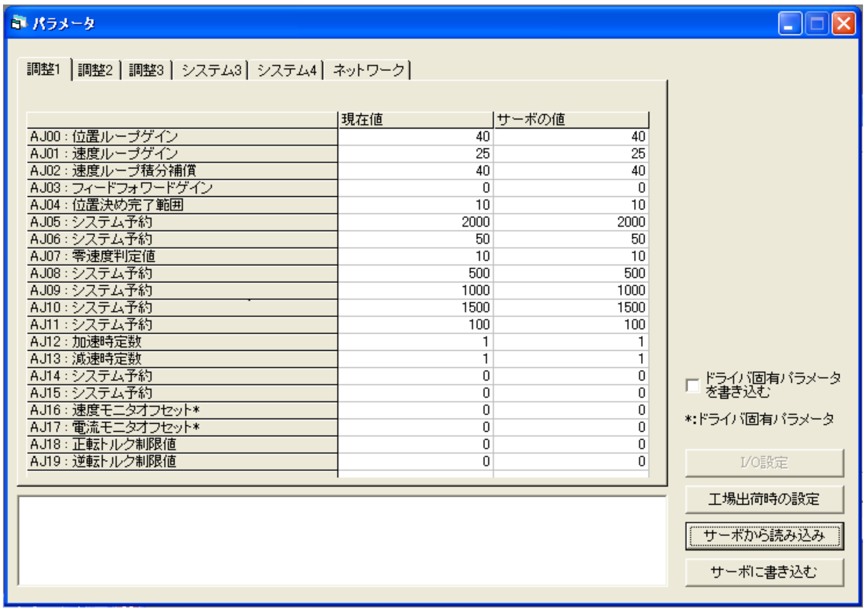
10-4-1. Saving set values

The following explains how to back up the set values for internal parameters of the driver to a personal computer.

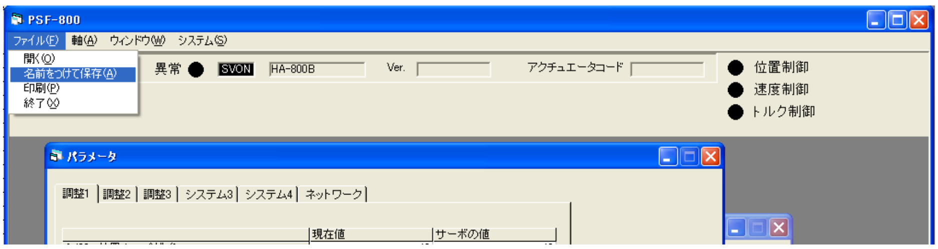
Saving procedure

1 Open the Parameter Setting window. (Same as step 1 in 10-3-1)
In the Parameter Setting window, click the Load from Servo button.

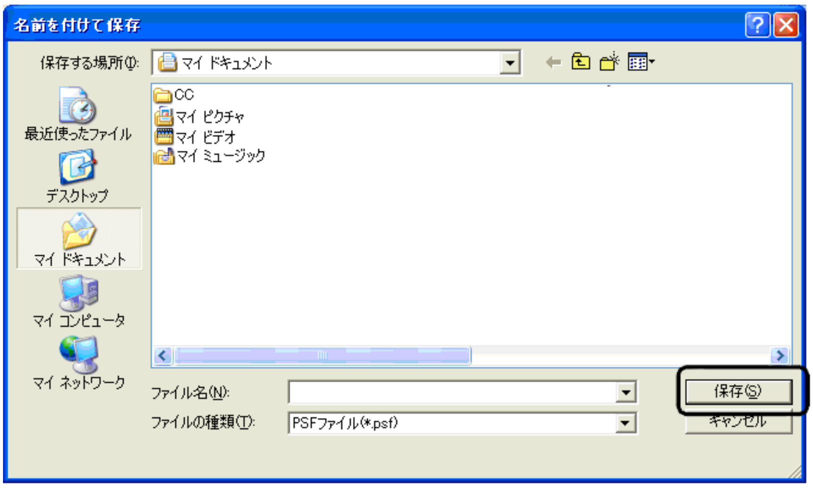
The currently set values are loaded from the driver and displayed in the [Servo Value] and [Current Value].



2 Select Save As from the File menu.



3 **Set a desired folder and file name, and click the Save button.**



Caution

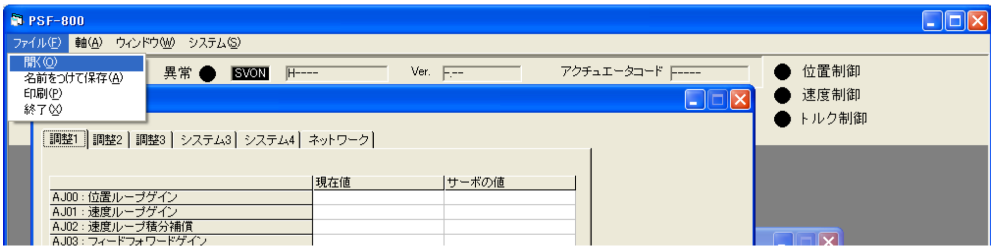
- Be sure to perform Load from Servo before performing Save As.
- The parameters saved by this operation are
  [Adjustment 1], [Adjustment 2], [Adjustment 3], [System 3], [System 4] and [Network].

10-4-2. Reading saved set value files

The following explains how to read a file with parameter set values backed up on a personal computer. The set values can be compared or copied while connected to the driver, or saved set values can be checked offline while disconnected from the driver.

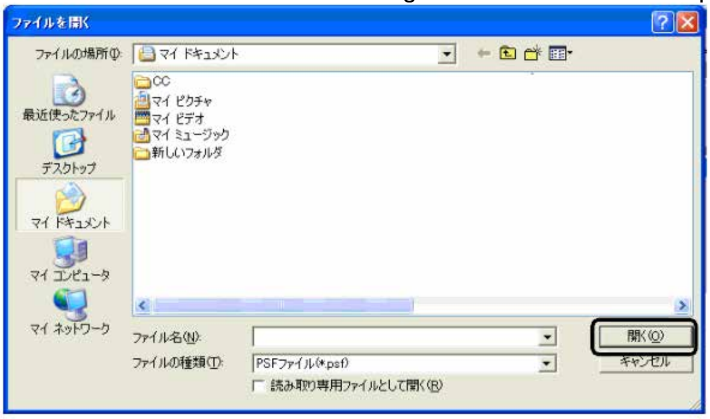
Loading procedure

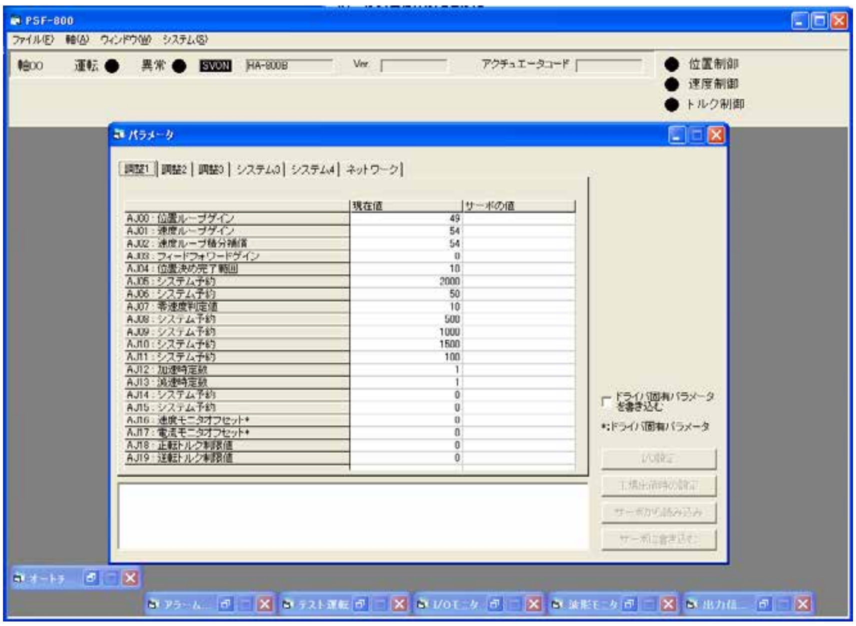
1 **Open the Parameter Setting window.**
Select Open from the File menu.



2 **Set a desired file name, and click the Open button.**

The set values for the saved settings file are loaded and displayed in the [Current Value].





10-4-3. Comparing a saved settings file with internal set values of the driver.

The following explains how to compare the parameter set values backed up on a personal computer with internal parameters of the driver during communication.

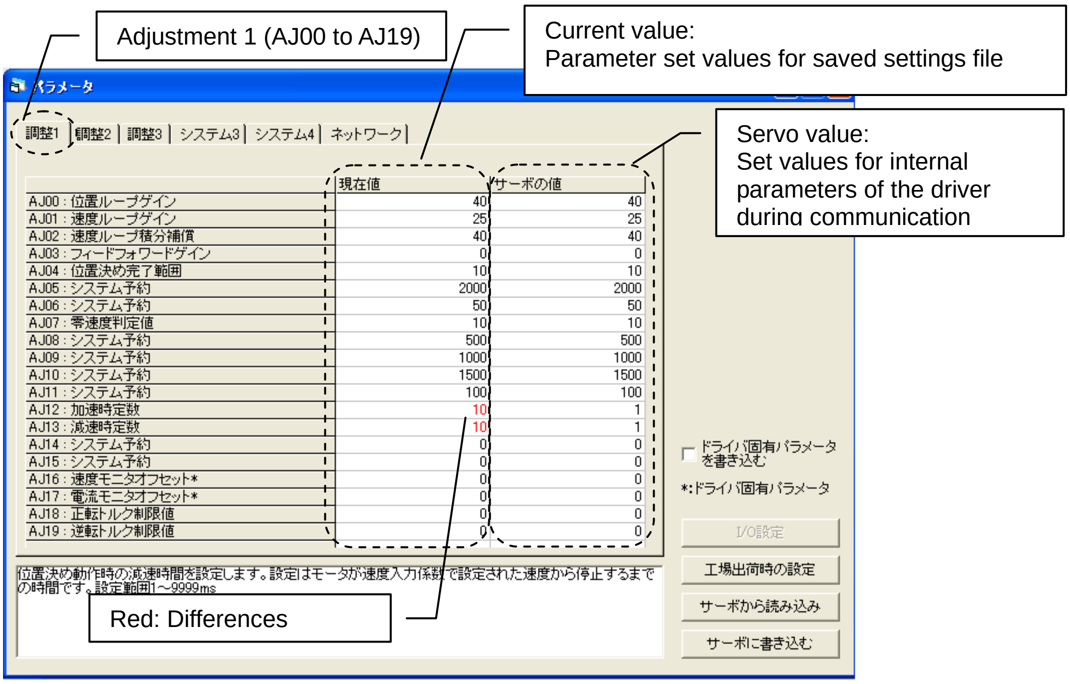
Comparison procedures

1 **Read the internal parameters of the driver during communication. (Same as step 1 in 10-3-1)**
Open the Parameter Setting window.
In the Parameter Setting window, click the Load from Servo button.

The currently set values are loaded from the driver (internal parameters of the driver during communication) and displayed in the Servo Value and Current Value.

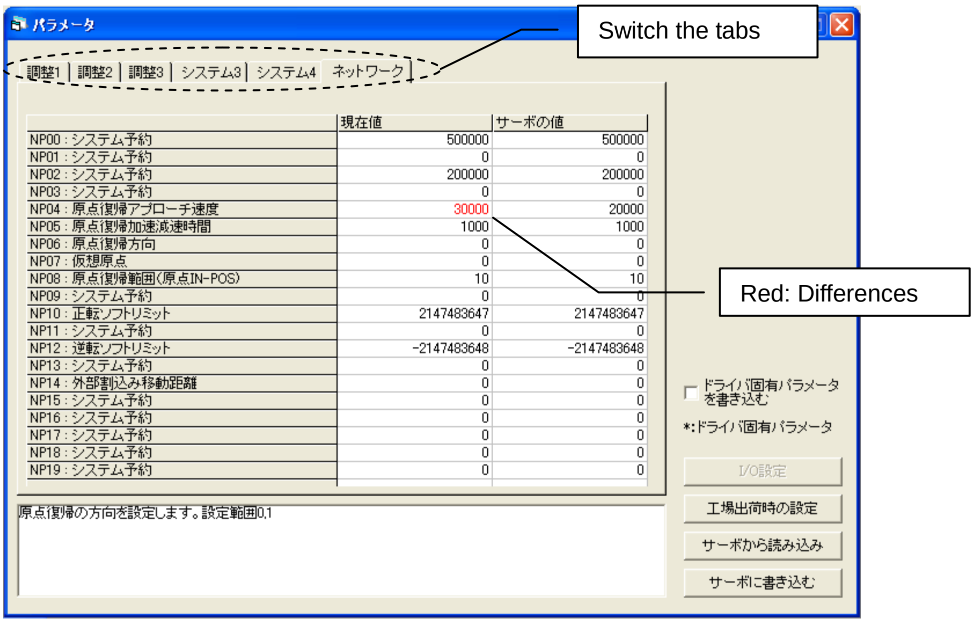
2 **Read the saved settings file.　(Same as steps 1 to 2 in 10-4-2)**
Select Open from the File menu.
Set a desired file name, and click the Open button.

The set values for the saved settings file are loaded and displayed in the [Current Value].
The differences between the set values for the saved settings file and the set values for the internal parameters of the driver during communication are displayed in red.



10
Communication software

3 **Switch the tabs to check all the comparison results.**
Switch the tabs to check the comparison results for all the following parameters: [Adjustment 1], [Adjustment 2], [Adjustment 3], [System 3], [System 4], [Network].



Caution

- The default setting of the system reservation may vary depending on the model/version. Therefore, the differences in the system reservation can be seen in the comparison results, but this is not a problem (It does not affect the product functions).

10-4-4. Writing a saved settings file to the driver

The following explains how to write (copy) the parameter set values backed up on a personal computer to the internal parameters of the driver during communication.

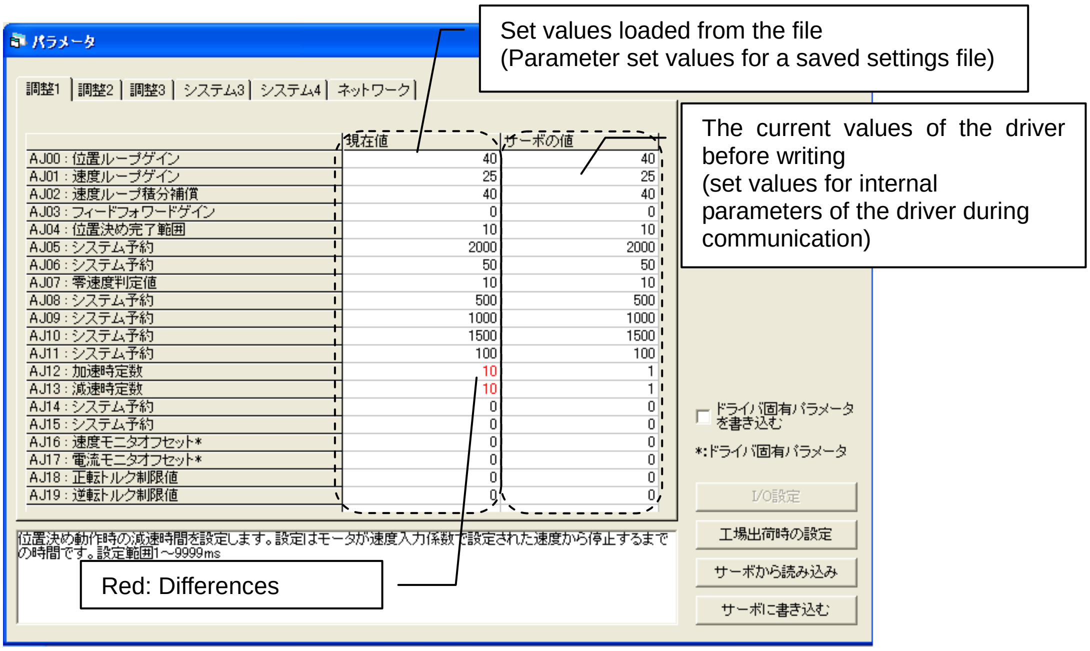
Comparison procedures

1 Read the internal parameters of the driver during communication. (Same as step 1 in 10-3-1)
Open the Parameter Setting window.
In the Parameter Setting window, click the Load from Servo button.

The currently set values are loaded from the driver (internal parameters of the driver during communication) and displayed in the Servo Value and Current Value.

2 Read the saved settings file. (Same as steps 1 to 2 in 10-4-2)
Select Open from the File menu.
Set a desired file name, and click the Open button.

The set values for the saved settings file are loaded and displayed in the [Current Value].
The differences between the set values for the saved settings file and the set values for the internal parameters of the driver during communication are displayed in red.



3 Click the Write to Servo button. (Same as step 3 in 10-3-1)

The set values for the saved settings file displayed in the [Set Value] is written to the driver during communication.
* The [Servo Value] display will not be updated after [Write to Servo] is executed.
Executing [Load from Servo] updates the [Servo Value] and the latest set values after the writing for internal parameters of the driver are displayed.

10 Communication software

Caution

- If the writing cannot be executed correctly due to the communication errors etc., a warning message is displayed. Execute [Write to Servo] again.
- If the warning message is displayed repeatedly, perform the parameter comparison and identify the parameters that cannot be copied.
  As a result of comparison, if the parameter displayed as different (the parameter that cannot be written (copied)) is the system reservation only, it does not affect the product functions.

Caution

- The parameters written (copied) by this operation are
  [Adjustment 1], [Adjustment 2], [Adjustment 3], [System 3] and [System 4], [Network].

10-5 Test operation

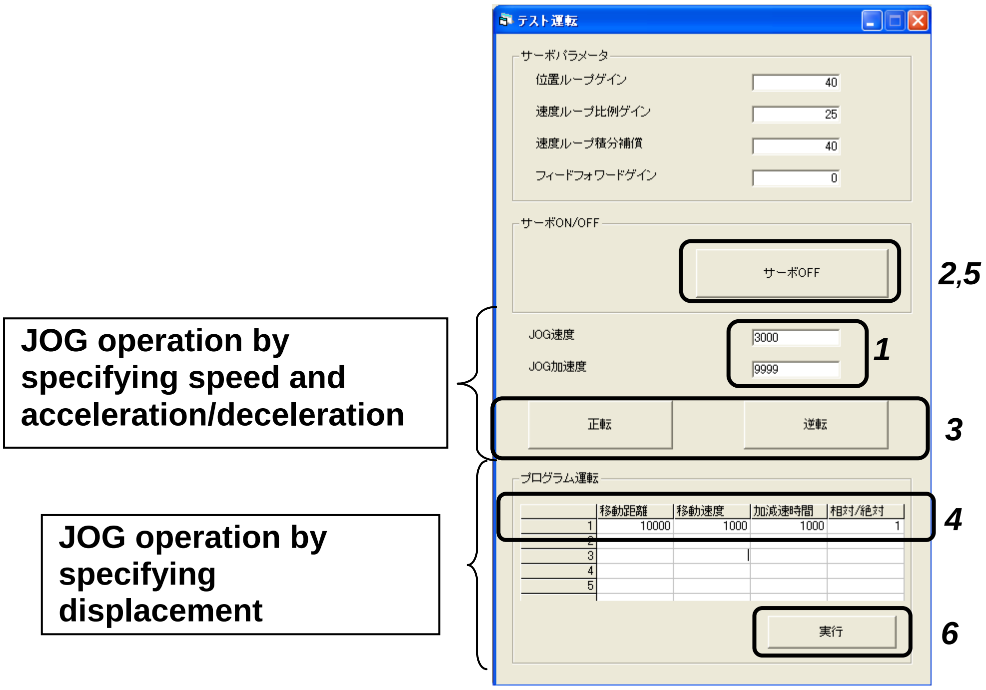
You can specify a speed to perform simple JOG operation, or perform JOG operation by specifying a displacement.

WARNING

- **The actuator operates ignoring even the FWD/REV inhibit input signals during the JOG operation; operate carefully paying attention to the surrounding conditions.**
- **JOG operation is not performed accurately if the host controller and the MECHATROLINK are connected. When performing a JOG operation, disconnect the MECHATROLINK cable and restart the driver first.**
- **Do not perform T04 JOG operation by pressing the driver push-button simultaneously. The operation becomes unstable.**
- **The torque limit function is disabled during the JOG operation.**

Caution

- In test operation, as seen from the output shaft side and regardless of [SP50: Command polarity]
  During jog operation: When forward, displacement set: Rotates in the clockwise direction for positive travel distance setting
  During jog operation: When reverse, displacement set: Rotates in the counter-clockwise direction for negative travel distance setting
  With the SHA-SG/HP series and HMA series, rotation is in the opposite directions.
- Note that after test operation, the current value on the host device and the actual machine position differ.



JOG operation by specifying speed and acceleration/deceleration

1 **Set the JOG speed (r/min) and JOG acceleration/deceleration time (ms)[*1].**

2 **Click the Servo-ON button to activate the servo-ON of the actuator.**

The button text changes to Servo OFF.

3 **Bring the mouse cursor to the FWD button. The actuator moves in the forward direction while the FWD button is held down with the mouse.**

To move the actuator in the reverse direction, click the REV button.

JOG operation by specifying displacement

4 **Set the JOG speed (r/min), JOG acceleration/deceleration time (ms)[*1], travel distance (pulse), travel speed (r/min), acceleration/deceleration time (ms)[*1] and travel distance mode (relative value/absolute value).**

The electronic gear settings do not apply in a JOG operation. Set the desired travel distance (pulse) based on the actuator resolution.

5 **Click the Servo-ON button to activate the servo-ON of the actuator.**

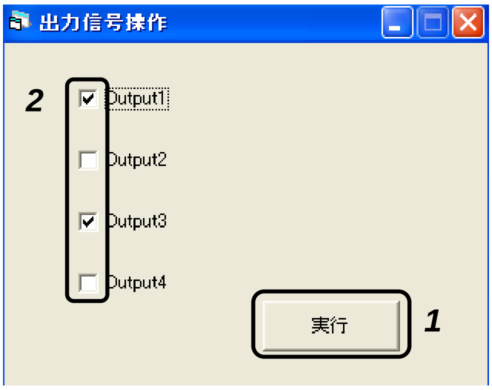
The button text changes to Servo OFF.

6 **Click the desired number (1 to 5), then click the "Execute" button to start program operation. The actuator will stop after moving the specified travel distance.**

*1: Set the acceleration/deceleration time for the time over which the actuator reaches its maximum speed from standstill.

10-6 Output signal operation

The signals corresponding to outputs 1 to 4 can be turned ON/OFF as desired.



1 Click the Execute button.

2 Select the signal you want to output.

The selected signal turns ON.
It can be used for verification with the host device.

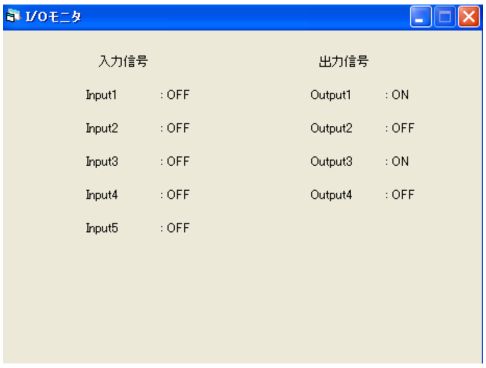
If you click Execute button again, the output signal operation is ended and each output signal automatically returns to the pre-operation status.

Caution

- This cannot be used at the same time as the [T01: Output signal operation] performed by operating the driver panel.
- Take note that, in this operation, the actual output signals are output and the device may be activated by the operation. Also, the operation can be done even when HA-800B is being automatically operated by the command from the host controller. Please keep this in mind during the actual operation.
- This operation cannot be executed at the same time as the output signal operation from test mode.

10-7 IO monitor

The statuses of pins to which input signals and output signals are assigned are monitored.



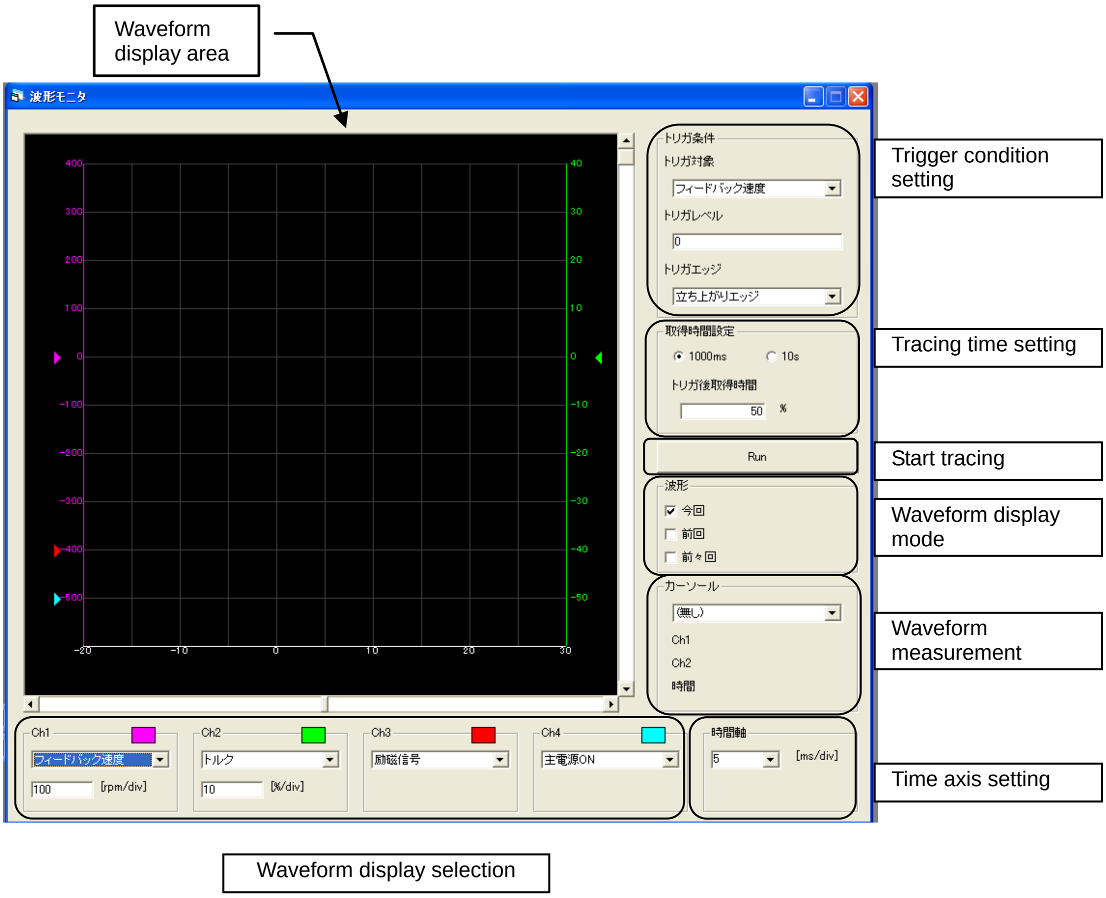
The statuses of input and output signal pins are displayed.
The following statuses are available:

Input signals
ON: Input received
OFF: No input

Output signals
ON: Outputting
OFF: Output OFF

10-8 Waveform monitoring

In addition to speed and torque, waveforms of various status signals can be displayed.



How to obtain waveform

1 **Select the desired waveform using the waveform display selection.**

Different speeds and torques can be selected for Ch1 and Ch2. After selecting the torque and speed, also set the 1 division display.

2 **Set the trigger condition.**

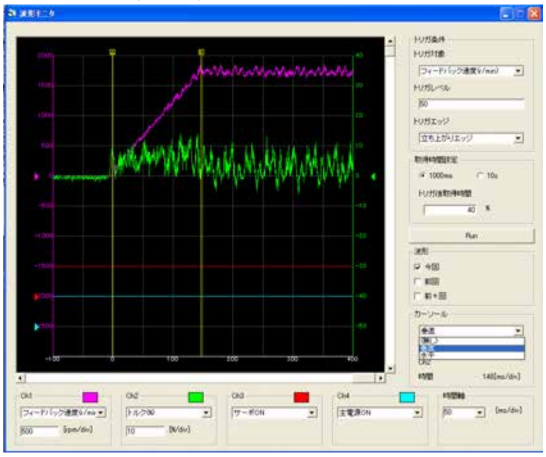
3 **Set the tracing time.**

If 1,000 ms is selected, you can set a desired value between 5 and 100 ms/div as the time axis range to be displayed. If 10s is selected, a desired value between 100 and 1,000 ms/div can be selected. Select the time axis setting from the pull-down menu.

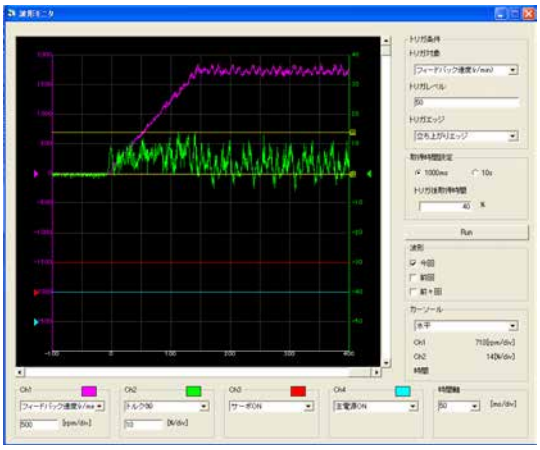
4 **Click the Run button.**

If the Run button shows Stop, the trigger is waited. When the set trigger level is reached, the system acquires waveform and displays it in the waveform display area. It takes some time to acquire waveforms.

- You can select an appropriate waveform display mode to display the current waveform together with the last waveform or waveform acquired before the last.
- In the waveform measurement area, you can perform time axis measurement and speed/torque measurement.
  It takes some time to acquire waveforms.
- You can also use the waveform display selection to change the waveform displayed after acquiring the waveform.



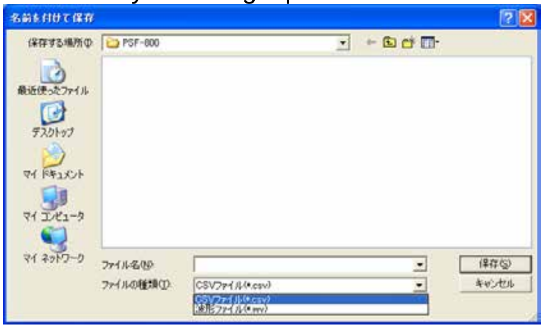
Time axis measurement
(measurement of rise time)



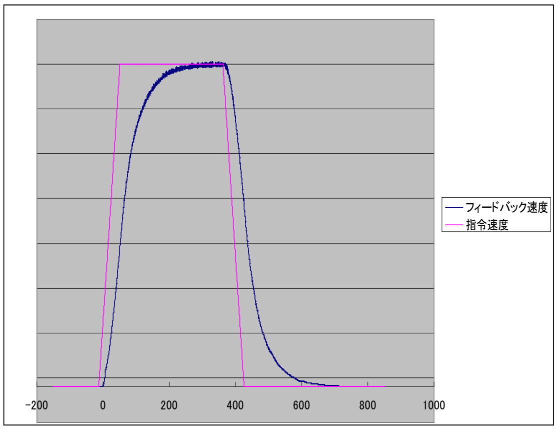
Speed/torque
measurement

5 **You can select Save As from the File menu to save the waveform data.**

You can assign the CSV format and wv format of the waveform data. If saving waveform data in the CSV format, you can read it using Excel. However, with the PSF-800, it is not possible to show the waveform data by opening it from the File menu. If saving waveform data in the wv format, you cannot read it using Excel, etc. However, you can display the waveform data with the PSF-800 by selecting Open in the File menu.

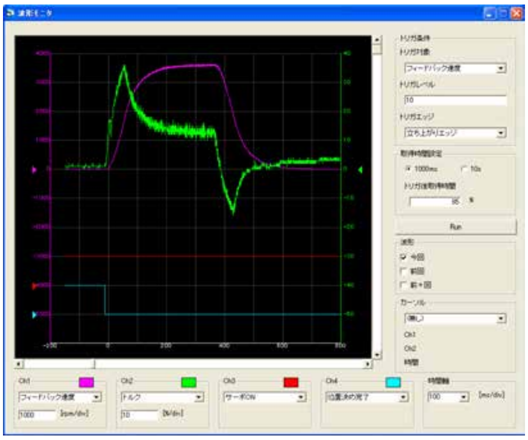


・**CSV format**



Excel display available.

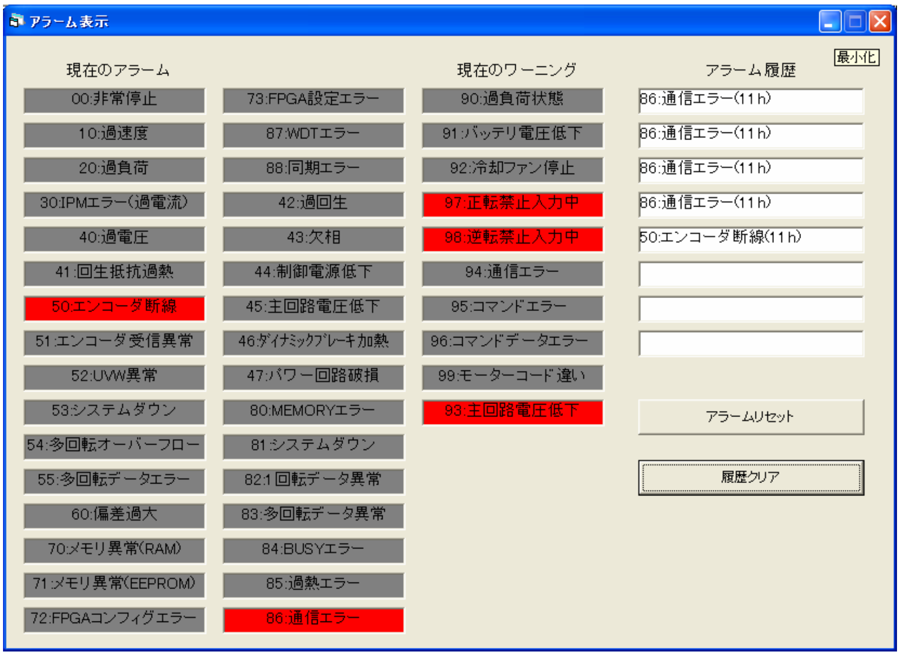
・**wv format**



Able to read the waveform on the PSF-800 again.

10-9 Alarm

If the HA-800B driver is generating an alarm or warning, you can check the content of the alarm/warning. A present alarm or warning is shown in the red border, as illustrated below.
You can also display and check the history of up to 8 most recent alarms.



Alarm reset

An alarm can be reset if the one that can be reset has occurred and its cause has already been eliminated.

Clear history

You can clear the history of up to 8 most recent alarms using the Clear History button.

Chapter 11

Troubleshooting

Details of how driver alarms and warnings generate are explained in this chapter.

11-1 Alarms and remedial actions ···· 11-1
11-2 Warnings and remedial actions ···· 11-12

11-1 Alarms and remedial actions

The driver has built-in functions to display alarms and warnings that generate during actuator operation and protect against abnormal events.

Alarm: If the actuator or driver enters an abnormal state, the driver generates an alarm and outputs an alarm signal, while turning OFF the servo loop at the same time.

Warning: A warning is displayed before the actuator or driver generates an alarm. The servo loop remains ON. Remove the cause of the warning as soon as possible.

If the actuator's or driver's protective function is actuated, the actuator stops moving (servo-OFF of the motor) and the applicable 2-digit alarm code appears on the display. [CN2-10: Alarm signal] will then be available. In addition, up to 8 most recent alarms and total operating hours (unit: h) of the driver when each alarm occurred are also displayed. For the alarm history, refer to [Alarm mode] (P7-8).

Alarm list

The following alarms are displayed.

Alarm code	Alarm name	Alarm clear
AL10	Overspeed	Not permitted
AL20	Overload	Permitted
AL30	IPM error (overcurrent)	Not permitted
AL40	Overvoltage	Not permitted
AL41	Regenerative resistor overheat	Not permitted
AL42	Overregeneration*4	Not permitted
AL43	Missing phase*4	Not permitted
AL44	Control power voltage low*4*5	Not permitted
AL45	Main circuit voltage low*4	Not permitted
AL46	Overheated dynamic brake*5	Not permitted
AL47	Damaged power circuit	Not permitted (Permitted) *7
AL50	Encoder breakage	Not permitted
AL51	Encoder receiving error*1	Not permitted
AL52	UVW error*1	Not permitted
AL53	System failure*2	Not permitted
AL54	Multi revolution overflow*2	Not permitted
AL55	Multi revolution data error*2	Not permitted
AL56	WDT error	Permitted
AL57	Synchronization error	Permitted
AL60	Excessive deviation	Permitted
AL70	Memory failure (RAM)	Not permitted
AL71	Memory failure (EEPROM)	Not permitted
AL72	FPGA configuration error	Not permitted
AL73	FPGA configuration error	Not permitted
AL76	Processor error*5*6	Not permitted
AL80	MEMORY error*3	Not permitted
AL81	System failure*3	Not permitted
AL82	Single rotation data error*3	Not permitted
AL83	Multi revolution data error*3	Not permitted
AL84	BUSY error*3	Not permitted
AL85	Overheat error*3	Not permitted
AL86	Communication error*3	Not permitted

*1: These alarms may generate when an incremental encoder is combined.
*2: These alarms may generate when a 13-bit absolute encoder is combined.
*3: These alarms may be generated when combining with a 17-bit absolute encoder (including the 17-bit encoder incremental model).
*4: These alarms may generate in HA-800B-24.
*5: These alarms are not stored in the alarm history.
*6: The alarm code in the MECHATROLINK communication may be indeterminable depending on the occurrence condition of alarm.
*7: With HA-800B-24, the alarm cannot be cleared. With HA-800B-1/3/6, the alarm can be cleared.

Remedial action for alarm

Remedial actions are explained for respective alarms.

Alarm code	Alarm name	Description	Condition at occurrence	Action
AL10	Overspeed	The motor rotation speed exceeded the maximum rotation speed of the motor.	The alarm occurs when the control circuit power is turned ON:	● Control circuit error → Contact our sales office.
			The alarm occurs due to high-speed actuator rotation when a rotation command is input:	● Overshoot due to inappropriate gain adjustment → Adjust [AJ00: Position loop gain], [AJ01: Speed loop gain] and [AJ02: Speed loop integral compensation] in the tune mode to match the load condition. ● Inappropriate electronic gear setting → Set SP44, 45: Electronic gear settings] again properly. ● Excessive value set for Torque command (TRQCTRL) → Lower the set value.
AL20	Overload	The allowable continuous current was exceeded. (Refer to P7-4.)	The alarm occurs when only the actuator is operated (no load):	● Wrong motor or encoder connection → Connect the motor/encoder correctly by referring to [Chapter 2 Installation/wiring]. ● Large friction torque → Confirm that holding brake is released.
			The alarm occurs when the control circuit power is turned ON:	● Control circuit error → Contact our sales office.
			The alarm occurs during operation:	● Current 1.2 times the allowable continuous current or more was supplied for an extended period of time. ● Current 3 times the allowable continuous current was supplied for approx. 2 seconds. → Review the effective load rate of the actuator, and then reconnect the power supply to resume the operation. ● Large friction torque and load torque → Confirm that holding brake is released. → Confirm that the actuator output torque is sufficient to handle load torque.
			The alarm occurs after the actuator exhibits hunting:	● Hunting due to inappropriate gain adjustment → Adjust [AJ00: Position loop gain], [AJ01: Speed loop gain] and [AJ02: Speed loop integral compensation] in the tune mode to match the load condition.

Alarm code	Alarm name	Description	Condition at occurrence	Action
AL30	IPM error (overcurrent)	The servo current control element detected an overcurrent.	The alarm occurs when the control circuit power is turned ON:	● Control circuit error → Contact our sales office.
			The alarm occurs when the servo-ON command (SV_ON) is input:	● Control circuit error → Contact our sales office.
			The alarm occurs when the servo-ON command (SV-ON) is input, but a normal condition is restored once the motor cable (U, V, W) is disconnected:	● Short-circuit the motor cable → Inspect/reconnect or replace/repair the connection points of the motor cable. ● Short-circuit the motor coil → Contact our sales office. (Replace the actuator.)
			The alarm occurs during acceleration or deceleration:	● The load inertia moment is excessive or acceleration/deceleration time is too short. → Lower the load inertia moment. → For the speed control, increase the time set in [AJ12: Acceleration time constant] or [AJ13: Deceleration time constant] in the tune mode. ● The gain is too high or too low. → Adjust [AJ00: Position loop gain], [AJ01: Speed loop gain] and [AJ02: Speed loop integral compensation] in the tune mode to match the load condition. ● Faulty wiring of regenerative resistor (HA-800B-24) → Resistance of an external regenerative resistor is low. Or it is short-circuited. It is connected in parallel with a built-in regenerative resistor.
			The alarm occurs during operation (when operation can be resumed after 4 to 5 minutes):	● Overload → Review the effective load factor of the actuator and lower the load factor. ● The ambient temperature of the driver is 50℃ or above. → Review the installation location and cooling system of the driver.
			The alarm occurs when cutting the main circuit power OFF:	● Faulty wiring of regenerative resistor (HA-800B-24) → Resistance of an external regenerative resistor is low. Or it is short-circuited. It is connected in parallel with a built-in regenerative resistor.

11

Troubleshooting

Alarm code	Alarm name	Description	Condition at occurrence	Action
AL40	Overvoltage	The main circuit voltage exceeded approx. 400 VDC.	The alarm occurs during operation:	● Excessive load inertia moment → The built-in regenerative resistor does not function. Connect short bar to R1 and R3 terminals. (HA-800B-3, -6, -24) → Connect an external regenerative resistor to the R1 and R2 terminals. → Increase the deceleration time. → Lower the maximum speed. → Lower the load inertia moment. ● Overvoltage detection circuit error → Contact our sales office.
AL41	Regenerative resistor overheat	The thermal switch installed on the regenerative resistor actuated.	The alarm occurs during deceleration:	● Insufficient regenerative resistor capacity → Install an external regenerative resistor to raise the regenerative absorption capacity. → When using an external regenerative resistor in HA-800B-24, set [SP64: Regenerative resistor selection] to [1: Use external regenerative resistor]. ● Regenerative energy processing circuit error → Contact our sales office.
			The alarm occurs after turning the main circuit power ON: (HA-800B-24)	● The regenerative resistor is not properly wired or not connected. → Connect the regenerative resistor correctly.
			When an external regenerative resistor is used: (HA-800B-24)	● The regenerative resistor is not properly wired or not connected. → Connect the regenerative resistor correctly. ● The parameter setting of [S64: Regenerative resistor selection] is wrong. → Change the setting of system parameter SP64 and select an external regenerative resistor.

Alarm code	Alarm name	Description	Condition at occurrence	Action
AL42	Overregeneration (HA-800B-24)	A regenerative resistor absorbed significantly excessive regenerative energy.	The alarm occurs during deceleration:	● Insufficient regenerative resistor capacity → Install an external regenerative resistor to raise the regenerative absorption capacity and change the setting of system parameter SP64. ● Regenerative energy processing circuit error → Contact our sales office. (Replace the HA-800B driver.) ● Load inertia moment exceeds the adaptive range. → Review the configuration and use the resistor with load inertia moment within the adaptive range. → Suppress the rotation low to reduce regenerative energy.
			The alarm occurs after turning the main circuit power ON:	● The regenerative resistor is not properly wired or not connected. → Connect the regenerative resistor correctly. → Connect a short bar correctly when using a built-in regenerative resistor.
			When an external regenerative resistor is used:	● The regenerative resistor is not properly wired or not connected. → Connect the regenerative resistor correctly. ● The parameter setting of [S64: Regenerative resistor selection] is wrong. → Change the setting of system parameter SP64 and select an external regenerative resistor.
AL43	Missing phase (HA-800B-24)	Single-phase power supply was supplied to the main circuit power input (R, S, T) areas.	The alarm occurs after turning the main circuit power ON:	● Wrong wiring → One phase of 3-phase power supply is not correctly connected. ● Low input voltage → Correct input voltage to a value within the specification range. ● Disconnection of 1 main circuit fuse built into the driver → One of the 2 built-in fuses for 3-phase power supply is disconnected. Ground-fault or faulty wiring of Motor output, Ground-fault or faulty wiring of regenerative connection terminal → Check the wiring conditions and replace the driver. (The alarm may occur again if you replace the driver without removing the cause.) If the protective fuse gets disconnected, it must be repaired.
AL44	Control power voltage low (HA-800B-24)	The voltage of the control power supply input (r, s) areas dropped.	The alarm occurs during operation:	● Low input voltage → Correct input voltage to a value within the specification range. ● Momentary power failure occurred. → Review the wiring and power supply environment to prevent power failure.

11

Troubleshooting

Alarm code	Alarm name	Description	Condition at occurrence	Action
AL45	Main circuit voltage low (HA-800B-24)	Although the main circuit power (R, S, T) is supplied, the main circuit DC voltage dropped.	The alarm occurs when turning the main circuit power ON:	● It occurs in case of faulty wiring (not wired) of short bar, faulty wiring of DC reactor, and/or open-circuit between DL1 and DL2. → Connect a short bar or DC reactor correctly between driver terminal blocks DL1 and DL2. ● The alarm occurs when a fuse built into the driver (2 built-in fuses for 3-phase power supply) is disconnected due to driver damage, faulty wiring, etc. → Check the wiring conditions and replace the driver. (The alarm may occur again if you replace the driver without removing the cause.) If the protective fuse gets disconnected, it must be repaired.
AL46	Overheated dynamic brake (HA-800B-24)	The dynamic brake circuit generated abnormal heat.	The alarm occurs after stopping the dynamic brake:	● The dynamic brake stopped under the conditions where load inertia moment was excessive or an excessive negative load was connected. → Review the load.
			The alarm occurs when the control power supply is turned ON:	● Driver damage The driver was damaged when the dynamic brake stopped previously. → Review the load. If the protective fuse gets disconnected, it must be repaired.
AL47	Damaged power circuit	An error was detected by the self-checking circuit when the servo was turned ON.	The alarm occurs when the servo is turned ON.	● Servo ON sequence error → The alarm may occur when chattering occurs with servo-ON command. Check the controller sequence. → The alarm may occur when the servo is turned ON while the motor is rotating due to external force or inertia.
		The alarm occurs due to errors in the driver power circuit.	The alarm occurs when the control power supply is turned ON: or The alarm occurs when the servo is ON:	● HA-800B driver power circuit error → If the error occurs each time the control power supply is turned ON, the circuit may be damaged. → If the error occurs each time the servo is turned ON, the circuit may be damaged. Contact our sales office. (Replace the HA-800B driver.)
AL50	Encoder disconnection	Encoder signals have been cut off.	The alarm occurs when the control circuit power is turned ON:	● Non-connection or poor connection of the encoder connector (CN1) or broken encoder wire → Securely connect the encoder connector again. Or, replace the cable. ● Control circuit error ● Internal encoder damage → Contact our sales office.
			The alarm occurs during operation (a normal condition is restored when the actuator cools down):	● Encoder malfunction due to rise in actuator temperature → Review the installation location and cooling system of the actuator.

Alarm code	Alarm name	Description	Condition at occurrence	Action
AL51	Encoder receiving error[*1]	Encoder serial data cannot be received accurately.	The alarm occurs when the control circuit power is turned ON:	● Non-connection or poor connection of the encoder connector (CN1) or broken encoder wire → Securely connect the encoder connector again. Or, replace the cable. ● Control circuit error ● Internal encoder damage → Contact our sales office.
			The alarm sometimes occurs during operation:	● Malfunction due to external noise → Suppress noise according to [Suppressing noise] (P2-15).
AL52	UVW error	Encoder phase UVW signal error	The alarm occurs when the control circuit power is turned ON:	● Non-connection or poor connection of the encoder connector (CN1) or broken encoder wire → Securely connect the encoder connector again. Or, replace the cable. ● Control circuit error ● Internal encoder damage → Contact our sales office.
			The alarm sometimes occurs during operation:	● Malfunction due to external noise → Suppress noise according to [Suppressing noise] (P2-15).
AL53	System failure[*1]	Encoder multi revolution data has been lost.	The alarm occurs when the power supply is turned ON for the first time after the purchase:	● The encoder holds no multi revolution data. → After installing the battery (option: HAB-ER17/33-2), clear the multi revolution data using [T08: Multi revolution clear] in the test mode.
			The control power supply is cut off while the buttery voltage low warning is occurring:	● Replace the battery (option: HAB-ER17/33-2_Maintenance). → Clear the multi revolution data using [T08: Multi revolution clear] in the test mode. Reconnect the power and perform origin return.
			The power supply was turned ON after the encoder and driver had been left disconnected for an extended period of time:	● Non-connection or poor connection of the encoder connector (CN1) ● Non-connection or poor connection of the battery connector → Connect the encoder connector and battery connector properly. ● Driver control circuit error ● Internal encoder damage → Contact our sales office.
AL54	Multi revolution overflow[*1]	The multi revolution counter value of the absolute encoder exceeded a range of -4096 to +4,095 revolutions (motor shaft).	The alarm occurs when the control circuit power is turned ON:	● Driver control circuit error ● Internal encoder damage → Contact our sales office.
			The alarm occurs during operation:	● The actuator turned in one direction and the multi revolution counter value exceeded a range of -4096 to +4,095 revolutions (motor shaft). → Clear the multi revolution data using [T08: Multi revolution clear] in the test mode.

11

Troubleshooting

Alarm code	Alarm name	Description	Condition at occurrence	Action
AL55	Multi revolution data error[*1]	The rotation angular acceleration and rotation speed of the motor exceeded the allowable response range. (The actuator moved at a speed exceeding the encoder's allowable range while the driver power supply is turned OFF.)	The alarm occurs when the control circuit power is turned ON:	● The actuator moved at a speed that exceeds the allowable speed when the driver power was not supplied. → Clear the multi revolution data using [T08: Multi revolution clear] in the test mode. ● Driver control circuit error ● Internal encoder damage → Contact our sales office.
AL56	WDT error	The counter information is not updated by an increment of 1 during the MECHATROLINK communication.	–	● Poor connection of communication connector → Check if the MECHATROLINK connector is securely inserted. → Replace the MECHATROLINK connector. * The positioning may become offset if it is continued to be used. ● Malfunction due to noise → Check if the FG processing is properly performed. → Make sure that the MECHATROLINK cable is not bundled together with other cables.
AL57	Synchronization error	The MECHATROLINK communication command is off the frequency. Commands are not being sent.	–	● Poor connection of communication connector → Check if the MECHATROLINK connector is securely inserted. → Replace the MECHATROLINK connector. ● Malfunction due to noise → Check if the FG processing is properly performed. → Make sure that the MECHATROLINK cable is not bundled together with other cables. ● Host device error → Make sure that the load on the PC due to other applications is not too great if the communication is to be established using the PC board, etc. → Contact the manufacturer of the host device.

Alarm code	Alarm name	Description	Condition at occurrence	Action
AL60	Excessive deviation	The deviation counter value exceeded the pulse count set in [SP49: Allowable position deviation].	The alarm occurs while the control power supply is being turned ON:	● The actuator moved due to external force and resulted in excessive deviation. → Stop the actuator and reconnect the power supply. → Stop the actuator and execute the alarm clear. The position deviation is cleared at the same time. ● Driver control circuit error → Contact our sales office.
			The alarm occurs during acceleration or deceleration:	● Low gain → Adjust [AJ00: Position loop gain], [AJ01: Speed loop gain] and [AJ02: Speed loop integral compensation] in the tune mode to match the load condition. ● The command speed in the positioning command is too high. → Lower the command speed on the host device. ● Excessive load inertia moment → Lower the load inertia moment.
			The speed does not rise with the command, and the alarm occurs sometime after that:	Cause: The input signal FWD inhibit or REV inhibit is enabled. → Check [SP62: Input signal logic setting]. ● The [CN2-1: FWD inhibit] input or the [CN2-2: REV inhibit] input is turned ON. → Turn OFF the [FWD inhibit] or the [REV inhibit] input. ● Large friction torque and load torque → Confirm that holding brake is released. → Confirm that the actuator output torque is sufficient to handle load torque.
			The actuator does not rotate and the alarm occurs:	● Poor motor cable connection or wrong phase order → Connect the motor cable wires and terminals securely. → Connect the motor wires and terminals in the correct phase order. ● Poor connection of the encoder connector (CN1) → Securely connect the encoder connector again. ● Large friction torque and load torque → Confirm that holding brake is released. → Confirm that the actuator output torque is sufficient to handle load torque.
AL70	Memory failure (RAM)	An error occurred in the driver's RAM memory.	The alarm occurs when the control circuit power is turned ON: The alarm occurs during operation:	● Driver control circuit error → Contact our sales office.
AL71	Memory failure (EEPROM)	An error occurred in the driver's EEPROM memory.	The alarm occurs when the control circuit power is turned ON: The alarm occurs during operation:	● Driver control circuit error → Contact our sales office.

Alarm code	Alarm name	Description	Condition at occurrence	Action
AL72	FPGA Configuration error	The FPGA initialization was not successful when the driver was started.	The alarm occurs when the control circuit power is turned ON:	● Driver control circuit error → Contact our sales office.
AL73	FPGA setting error	The FPGA did not start properly when the driver was started.	The alarm occurs when the control circuit power is turned ON:	● Driver control circuit error → Contact our sales office.
AL76	Processor error	Processor error	—	● Reconnect the driver's control power supply. → If the processor error is not restored even after the control power supply is reconnected, contact our sales office. ● The alarm code in the MECHATROLINK communication may be indeterminable depending on the occurrence condition of alarm.
AL80	MEMORY error*2	An EEPROM memory failure occurred in the 17-bit absolute encoder.	The alarm occurs when the control circuit power is turned ON:	● Driver control circuit error or encoder error → Contact our sales office.
AL81	System failure*2	● SHA series (excluding SHA20) and HMA series (excluding HMAC08): The voltage of the backup power supply in the absolute encoder or external battery voltage, whichever was higher, dropped to 2.85V or below. ● SHA20, FHA-Cmini series and HMAC08: The voltage of the backup battery dropped to 2.85V or below. Stored multi revolution data is lost.	—	Execute [T08: Multi revolution data clear] in the test mode, then reconnect the power. ● Battery not installed ● Low battery voltage → Install or replace the battery by referring to [Normal operation] (P3-21). ● 17-bit absolute encoder error → Contact our sales office. (Replace the actuator.) ● This alarm may occur if CN1 is pulled off while the driver control power supply is active.
AL82	Single rotation data error*2	Inconsistency occurred between the single revolution data managed by the 17-bit absolute encoder at 2 locations.	The alarm occurs after actuator operation:	Execute [T08: Multi revolution data clear] in the test mode, then reconnect the power. ● 17-bit absolute encoder error → Contact our sales office. (Replace the actuator.)
AL83	Multi revolution data error*2	Inconsistency occurred between the multi revolution data managed by the 17-bit absolute encoder at 2 locations.	The alarm occurs during operation:	● Malfunction due to external noise → Suppress noise according to [Suppressing noise] (P2-15).

11

Troubleshooting

Alarm code	Alarm name	Description	Condition at occurrence	Action
AL84	BUSY error*2	The position could not be specified when the 17-bit absolute encoder was started because the actuator was operating at a constant speed or above.	–	● The actuator is operating at a constant speed or above when the encoder is started. → Start the encoder when the actuator is operating at a constant speed or below (ideally the actuator should be stopped). SHA series (excluding SHA20) and HMA series (excluding HMAC08): 300 r/min or less SHA20, FHA-Cmini series and HMAC08: 250 r/min or less ● 17-bit absolute encoder error → Contact our sales office. (Replace the actuator.)
AL85	Overheat error*2	The board temperature in the 17-bit absolute encoder reached or exceeded 95℃.	–	● The board temperature in the 17-bit absolute encoder reached or exceeded 95℃. → Remove possible causes of actuator overheat, such as eliminating sudden starts and improving the heat radiation condition. ● 17-bit absolute encoder error → Contact our sales office. (Replace the actuator.)
		The driver's heat sink temperature reached or exceeded 106℃.	–	● The driver's heat sink temperature reached or exceeded 106℃. → Remove possible causes of actuator overheat, such as eliminating sudden starts and improving the heat radiation condition.
AL86	Communication error*2	Data could not be received in the driver at least 4 consecutive times.	–	● Defective encoder connector (CN1) → Confirm that the encoder connector is inserted securely. → Confirm that the encoder lead lines are soldered properly. → Check the encoder extension connector for poor contact. ● Malfunction due to noise, etc. → Confirm that the ground wire is connected properly. → Confirm that the encoder cable is shielded properly. → Confirm that the encoder and motor wires are not bundled together.
Not lit		LED display is not turned ON even when the control power supply is turned ON.	The alarm occurs when the control circuit power is turned ON:	● The overload protective function in the driver internal power supply circuit was activated due to a short period of power failure, etc. → Cut off the control power supply, wait for about one minute, and reconnect the power. ● Fuse disconnection in the driver → Contact our sales office.

*1: This alarm does not occur when an actuator equipped with a 17-bit absolute encoder is combined.

*2: AL80 to AL86: These alarms may occur when an actuator equipped with a 17-bit absolute encoder is combined. With the 17-bit encoder incremental model, if AL80-AL86 is generated, then after the power is turned OFF then ON again, if AL80-AL86 is generated again, an abnormality in the 17-bit encoder is conceivable. Contact our sales office.

11-2 Warnings and remedial actions

This driver has warning functions to output various conditions before the corresponding protective functions are actuated. If a warning generates, the warning number appears on the display and a warning is output to MECHATROLINK line.
Although the actuator can be controlled while warnings are present, remove the cause of each warning as soon as possible. (If [UA93: Main circuit voltage low] or [UA99: Wrong actuator] occurs, the actuator cannot be controlled.)

Warning list

A list of warnings that may be displayed is shown below.

Warning code	Warning name
90	Overload status
91	Battery voltage low
92	Cooling fan stopped (HA-800B-6 only)*1
93	Main circuit voltage low
94	Command data error
95	Command error
96	Communication warning
97	FWD inhibit input effective*2
98	REV inhibit input effective*2
99	Wrong actuator

*1: HA-800B-24 is not supported.
*2: A warning is not output to the MECHATROLINK line even when a warning has occurred.

Remedial action for warning

Details of each warning are explained.

Warning code	Warning name	Description
UA90	Overload status	The driver is overloaded. If the warning is ignored and actuator operation is continued, an overload error (AL20) will occur. Take an appropriate action by referring to the section of overload alarm.
UA91	Battery voltage low	The data backup battery voltage of the absolute encoder dropped to the voltage specified below, or the battery is not installed. Although the actuator operates, leaving the problem uncertified will cause the battery voltage to drop further, resulting in encoder data to be unable to be retained. Replace the battery with a new one as soon as possible. For the SHA series, if the backup capacitor in the encoder is fully charged when power is being supplied to the driver, the backup battery does not detect a drop in voltage. The backup capacitor in the encoder is discharged when the driver's power is turned OFF, and the backup battery does not detect a drop in voltage until the voltage is low. ● 13-bit absolute encoder DC2.8V or below (The warning will be reset automatically when the battery is replaced with a new one.) ● 17-bit absolute encoder (SHA20, FHA-Cmini series and HMAC08) DC3.1V or less (The warning will be reset automatically when the battery is replaced with a new one.) * In Version 2.x and earlier, after the battery is replaced, turning the power back ON releases UA91. ● 17-bit absolute encoder (SHA series (excluding SHA20) and HMA series (excluding HMAC08)) DC3.1V or less (Replace with a new battery and execute an alarm reset, and then reconnect the power supply.) (1) At time of purchase: If the battery is not installed, install it (option: HAB-ER17/33-2). (2) After extended use: Replace the battery with a new battery (option: HAB-ER17/33-2_Maintenance). (3) Input driver alarm reset. (4) The warning is canceled after reconnecting the power supply.
UA92	Cooling fan stopped (HA-800B-6 only)	The cooling fan installed in the driver stopped operating for some reason. If the actuator is operated at the rated torque, internal elements of the driver may heat to the junction temperature. Remove the cause of the problem as soon as possible. It is also recommended that the cooling fan be replaced after approx. 5 years of continuous operation.
UA93	Main circuit voltage low	The internal DC voltage of the main circuit power dropped to the voltage specified below: ● AC200V actuator DC190V or below (DC220V or less for Ver. 2.02 or older) ● AC100V actuator DC70V or below (DC100V or less for Ver. 2.02 or older) The wiring may be wrong. Refer to [Connecting power cables] (P2-6) and wire appropriately. The input voltage may not be within the specification range. Confirm the main circuit power voltage from the d10 main circuit power voltage status display or the PSF-800 status display, and correct the input voltage to a value within the specification range. If this warning generates, the servo turns OFF. Although the warning will be reset automatically when the main circuit voltage recovers, the servo-ON command must be sent again to turn ON the servo.

Warning code	Warning name	Description
UA94	Command data error	It is output when the data in the command received from the host device is outside of the setting range. If this warning is displayed, check the motion program or the settings of the host device.
UA95	Command error	A command not supported by the HA-800B driver was sent. Or, A command was sent in the communication phase in which commands cannot be received. Check the motion program or the settings of the host device.
UA96	Communication warning	This is output when an error occurs in the MECHATROLINK communication.
UA97	FWD inhibit input effective	This warning occurs when the CN2-1: FWD inhibit input is turned ON. Note that a warning is not output to the MECHATROLINK line even when a warning has occurred.
UA98	REV inhibit input effective	This warning occurs when the CN2-2: REV inhibit input is turned ON. Note that a warning is not output to the MECHATROLINK line even when a warning has occurred.
UA99	Wrong actuator	The connected actuator is different from the applicable actuator set for the driver. Connect the correct actuator and then reconnect the power. The function is available for the following actuators: 17-bit absolute encoder (SHA series, FHA-Cmini series and HMA series) and 4-wire incremental encoder (FHA-Cmini series).

Chapter 12

Option

Options you can purchase as necessary are explained in this chapter.

12-1 Option 12-1

12-1 Option

Options you can purchase as necessary are explained.

Extension cable

HA-800B drivers are available in various models having different rated output current and supporting different types of encoders. Combinations of drivers, actuators and extension cables (option) are shown below.

Actuator series	Model No.	Input voltage (V)	Encoder type	Combined driver			Extension cable (option)
				HA-800B-1	HA-800B-3	HA-800B-6	
SHA series	20	200	17-bit Absolute	—	HA-800B-3D/E-200	—	Motor wire EWD-MB**-A06-TN3 Encoder wire EWD-S**-A08-3M14
	25	100		—	—	HA-800B-6D/E-100	
		200			HA-800B-3D/E-200	—	
	32	200		—	—	HA-800B-6D/E-200	
	40	200		—	—	HA-800B-6D/E-200	
	25	100		—	—	HA-800B-6D/E-100	
FHA-Cmini series	8	200	4 wires, wire-saving type Incremental	HA-800B-1C-200	—	—	Motor wire EWC-M**-A06-TN3 Encoder wire EWC-E**-M06-3M14
	11	200		HA-800B-1C-200	—	—	
	14	200		HA-800B-1C-200	—	—	
	8	100		HA-800B-1C-100	—	—	
	11	100		HA-800B-1C-100	—	—	
	14	100		HA-800B-1C-100	—	—	
	8	200	17-bit Absolute	HA-800B-1D/E-200	—	—	Motor wire EWC-M**-A06-TN3 Encoder wire EWD-S**-A08-3M14
	11	200		HA-800B-1D/E-200	—	—	
	14	200		HA-800B-1D/E-200	—	—	
	8	100		HA-800B-1D/E-100	—	—	
	11	100		HA-800B-1D/E-100	—	—	
	14	100		HA-800B-1D/E-100	—	—	
FHA-C series	17	200	4 wires, wire-saving type Incremental	—	HA-800B-3C-200	—	Motor wire EWC-MB**-M08-TN3 Encoder wire EWC-E**-B04-3M14
	25	200		—	HA-800B-3C-200	—	
	32	200		—	—	HA-800B-6C-200	
	40	200		—	—	HA-800B-6C-200	
	17	200	13-bit Absolute	—	HA-800B-3A-200	—	Motor wire EWC-MB**-M08-TN3 Encoder wire EWC-S**-B08-3M14
	25	200		—	HA-800B-3A-200	—	
	32	200		—	—	HA-800B-6A-200	
	40	200		—	—	HA-800B-6A-200	
	17	100	4 wires, wire-saving type Incremental	—	HA-800B-3C-100	—	Motor wire EWC-MB**-M08-TN3 Encoder wire EWC-E**-B04-3M14
	25	100		—	—	HA-800B-6C-100	
	32	100		—	—	HA-800B-6C-100	
	17	100	13-bit Absolute	—	HA-800B-3A-100	—	Motor wire EWC-MB**-M08-TN3 Encoder wire EWC-S**-B08-3M14
	25	100		—	—	HA-800B-6A-100	
	32	100		—	—	HA-800B-6A-100	

Actuator series	Model No.	Input voltage (V)	Encoder type	Combined driver			Extension cable (option)
				HA-800B-1	HA-800B-3	HA-800B-6	
RSF series	17	200	14 wires Incremental	—	HA-800B-3B-200	—	Motor wire EWA-M**-A04-TN3 Encoder wire EWA-E**-A15-3M14
RSF/RKF series	20	200		—	HA-800B-3B-200	—	
	25	200		—	HA-800B-3B-200	—	
	32	200		—	—	HA-800B-6B-200	

Actuator series	Model No.	Encoder type	Combined driver	Extension cable (option)
			HA-800B-24	
SHA series	40	17-bit Absolute	HA-800B-24D/E	Motor wire EWD-MB**-A06-TMC Encoder wire EWD-S**-A08-3M14
	45		HA-800B-24D/E	
	58		HA-800B-24D/E	Motor wire EWD-MB**-D09-TMC Encoder wire EWD-S**-D10-3M14
	65		HA-800B-24D/E	

Actuator series	Model No.	Input voltage (V)	Encoder type	Combined driver	Extension cables (option)
HMA series	08	200	17-bit Absolute	HA-800B-3D/E-200	Motor wire EWD-MB**-A06-TN3 Encoder wire EWD-S**-A08-3M14
	09	100		HA-800B-6D/E-100	
		200		HA-800B-3D/E-200	
	12	200		HA-800B-6D/E-200	
	15	200		HA-800B-24D/E-200	Motor wire Model No.15:EWD-MB**-A06-TMC Model No.21A:EWD-MB**-D09-TMC Encoder wire Model No.15:EWD-S**-A08-3M14 Model No.21A:EWD-S**-D10-3M14
	21A	200		HA-800B-24D/E-200	

** in the extension cable model indicates the cable length.
Select a desired length from the following 3 types:
03: 3m, 05: 5m, 10: 10m

Dedicated communication cable

Use a dedicated communication cable to connect this driver to a personal computer.

Dedicated communication cable

Model	EWA-RS03
Specifications	D-sub 9-pin (female) 1.6m

Connectors

The CN1, CN2, motor-wire and power-supply connectors of this driver are shown below.

Connector model

CNK-HA80B-S1	: CN1 type/CN2 type/motor-wire type/power-supply connector	--- 4 types
CNK-HA80B-S2	: CN2 type/power-supply connector	--- 2 types
CNK-HA80B-S1-A	: CN1 type/CN2 type	--- 2 types
CNK-HA80B-S2-A	: CN2 type	--- 1 type

	CN1 type	CN2 type	Motor-wire type	For power-supply connector
Manufacturer	3M	3M	Phoenix Contact	Phoenix Contact
Model	Connector: 10114-3000PE Cover: 10314-52F0-008	Connector: 10120-3000PE Cover: 10320-52F0-008	FKIC2,5/6-ST-5.08	FKC2,5/5-ST-5.08

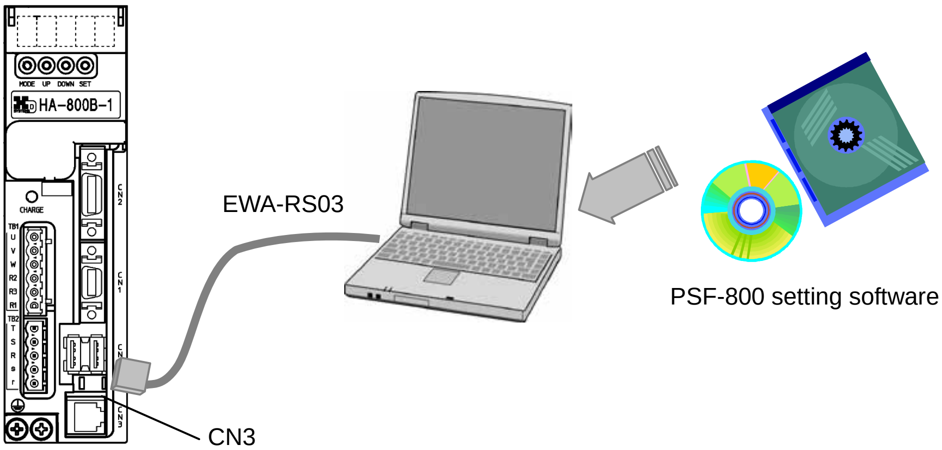
Servo parameter setting software

This software lets you set various servo parameters of your HA-800B driver from a personal computer. Use an EIA-232C cable to connect the CN3 connector on the HA-800B driver to a personal computer in which the servo parameter setting software PSF-800 is installed, and you can change various servo parameters in the driver.
For details on software, refer to [Chapter 10 Communication software].
You can download this servo parameter setting software from our website (http://www.hds.co.jp/).

Model	PSF-800
Supported operating systems	Windows® Xp, Windows Vista®*1, Windows® 7*1
What you need	Dedicated communication cable (EWA-RS03)

*1: Successful operation has been verified on Windows Vista®, and Windows 7®, but it is not guaranteed.

* Microsoft Windows and IntelliMouse are registered trademarks and trademarks of Microsoft Corporation in the United States for use in the United States, Japan and other countries.
* Microsoft Windows Operating System is the full name of Windows.



Data backup battery

This battery is used to retain multi revolution data of the absolute encoder in the event that the power supply is cut off. Required when combining the driver to an actuator with an absolute encoder in order to use it with the absolute specifications. (option)

Model code
When a new driver is purchased: HAB-ER17/33-2
When replacing the battery after extended use: HAB-ER17/33-2_Maintenance

Battery type	Lithium thionyl chloride battery
Manufacturer	TOSHIBA BATTERY CO.,LTD.
Manufacturer model	ER17330V (3.6V 1,700 mAh)

Data retention time

Data retention time	Approx. 1 year after the power is cut off
Conditions	Unused power is turned OFF, ambient temperature: 25°C, axis stopped, continuous use (The actual life varies depending on the condition of use.)

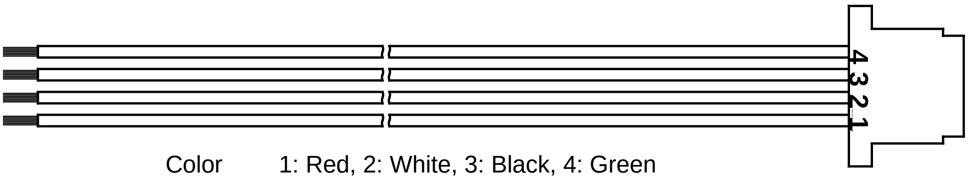
Caution

- A battery purchased separately from the battery manufacturer does not come with connector wires. Prepare them on your own and attach them to the battery before use.

Monitor cable

Use this signal cable to measure speed, current and other signals using an oscilloscope.

Model	EWA-MON01-JST4



Color 1: Red, 2: White, 3: Black, 4: Green

Chapter 13

MECHATROLINK communication function

The communication function of MECHATROLINK is explained in this chapter.

13-1 Specifications 13-1
13-2 Network parameters 13-3
13-3 Main command 13-6
13-4 Details of main commands 13-7
13-5 Subcommand 13-29
13-6 Command data field 13-33
13-7 Control mode 13-42

13-1 Specifications

The communication specification of MECHATROLINK is explained.

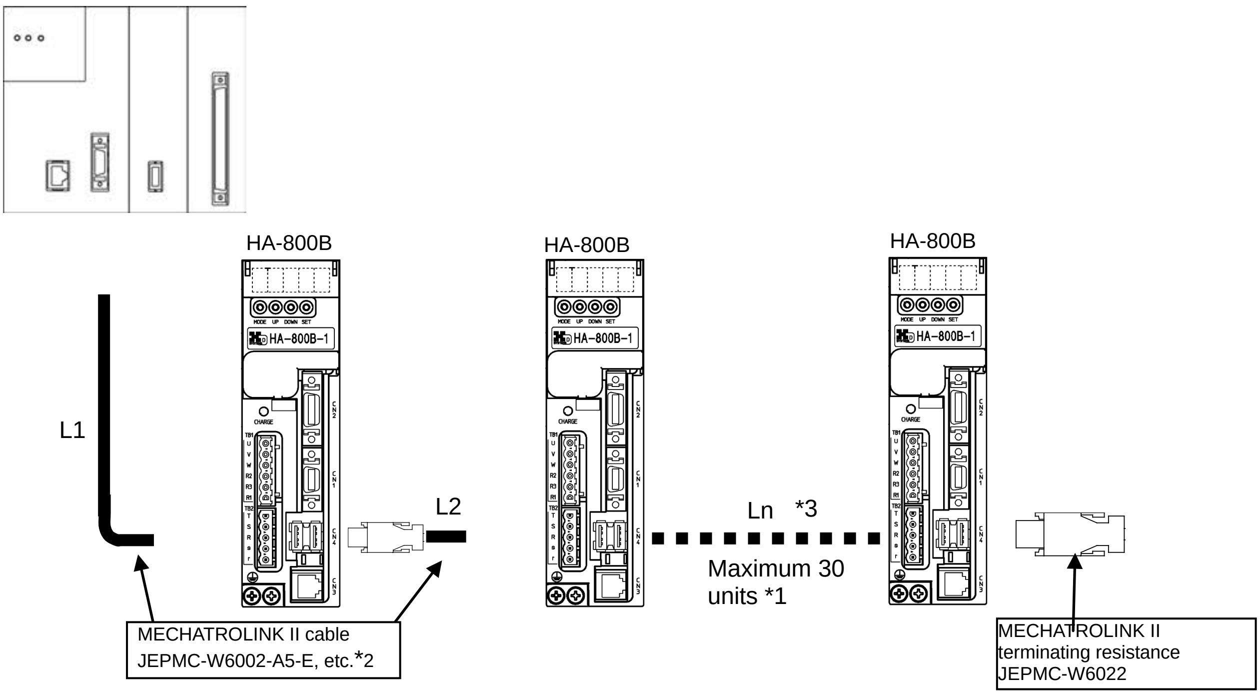
Communication specification

MECHATROLINK version	MECHATROLINK-II
Transmission rate	10Mbps
Maximum transmission distance	50m
Minimum inter-station distance	0.5m
Transmission medium	2-core twisted pair cable with shield
Number of mobile units connected	Maximum 30 slave stations
Topology	Bus
Communication cycle	1 ms, 1.5 ms, 2 ms, 3 ms, 4 ms, 5 ms
Communication method	Fully synchronized master/slave communication
Coding	Manchester encoding
Data length	17 bytes or 32 bytes, selectable

Use the MP2000 series by YASKAWA Electric Corporation for the host controller, or use it in combination with the KV-ML16V controller by Keyence Corporation. (Some functions are limited.)
Check our website for the latest information for more details of the limited functions.

System configuration

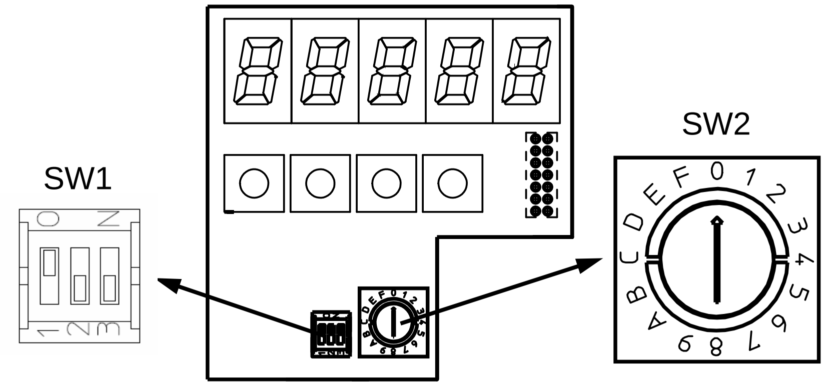
MECHATROLINK-II machine controller (by YASKAWA Electric Corporation and Keyence Corporation)



*1: When 17 or more units communicate with one another or 16 units are connected over the total extension distance of 30m or more, repeaters are required.
The maximum connectable number of units is limited by the communication cycle, retry count and other settings.
For details, refer to the MECHATROLINK Members Association's web site (http://www.mechatrolink.org/jp/index_jp.html).
*2: Be sure to use the dedicated cable. (0.5m to 50m) Don't use any commercial USB cable.
*3: L1+L2+ --- Use these so that Ln equals to or is less than (≦) 50m.

Communication setting

Specify the communication settings for HA-800B using the DIP switch and rotary switch on the front of the main unit.
The new settings will become effective the next time the control power supply for HA-800B is turned ON.



1 Setting the transfer bytes

Set the value by turning ON/OFF the second bit of SW1.

SW1 (Second bit)	Transfer bytes
OFF	Byte 17
ON	Byte 32

2 Setting the station address

For the HA-800B, the station address can be set in a range of 41H to 5FH. The upper digit of the station address is set by the first bit of SW1, while the lower digit is set by SW2.

SW1 (bit 1)	SW2	Station address
OFF	0	Disabled
OFF	1	41H
OFF	2	42H
OFF	3	43H
OFF	4	44H
OFF	5	45H
OFF	6	46H
OFF	7	47H
OFF	8	48H
OFF	9	49H
OFF	A	4AH
OFF	B	4BH
OFF	C	4CH
OFF	D	4DH
OFF	E	4EH
OFF	F	4FH

SW1 (bit 1)	SW2	Station address
ON	0	50H
ON	1	51H
ON	2	52H
ON	3	53H
ON	4	54H
ON	5	55H
ON	6	56H
ON	7	57H
ON	8	58H
ON	9	59H
ON	A	5AH
ON	B	5BH
ON	C	5CH
ON	D	5DH
ON	E	5EH
ON	F	5FH

13-2 Network parameters

Following parameters are set and displayed using the dedicated communication software PSF-800 or MECHATROLINK communication. This chapter explains the parameters. When using PSF-800 to perform these operations, refer to [Chapter 10 Communication software].

List of parameters

NO[*1]	Parameter name	Default	PSF-800 Parameter No.
101	Final external positioning distance	0	NP14
102	FWD soft limit	2147483637	NP10
103	REV soft limit	-2147483638	NP12
104	Origin position range	10	NP08
105	Originating approach speed	20000	NP04
106	Originating acceleration/deceleration time	1000	NP05
107	Virtual origin[*2]	0	NP07
108	Originating direction	0	NP06
109	Soft limit enable/disable	0	NP16

*1: For details on NO, refer to P13-38.
*2: Parameter 107: Virtual origin is applied after the power is reconnected.

101: Final external positioning distance

The actuator moves to the position specified by this parameter based on the position where the latch signal is input upon occurrence of the latch factor specified in the LT_SGN field while the [External positioning input (EX_POSING: 39H)] command is being executed.

Unit	Lower limit value	Upper limit value	Default value
Pulse	-2147483648	2147483647	0

Specify a value in the ± 2,100,000,000 range if the rotation direction changes as a result of a latch signal input.
Failure to do so may result in unexpected operations.

102: FWD soft limit

When the parameter No. 109: Soft limit enable/disable is set to 1 and the REFE bit in PS_SUBCMD is set to 1 for the [Coordinate system setting (POS_SET: 20H)] command, the soft limits are monitored and if the position command exceeds the value set here, the FWD commands are ignored and the P-SOT bit in the STATUS field becomes 1.
Although the setting range is from -2147483647 to 2147483647, set an appropriate value that satisfies the conditions [FWD soft limit > REV soft limit] and [Forward limit ≧ Current value].
The soft limit is effective only during position control.

Unit	Lower limit value	Upper limit value	Default value
Pulse	-2147483647	2147483647	2147483647

103: REV soft limit

When the parameter No. 109: Soft limit enable/disable is set to 1 and the REFE bit in PS_SUBCMD is set to 1 for the [Coordinate system setting (POS_SET: 20H)] command, the soft limits are monitored and if the position command becomes smaller than the value set here, the REV commands are ignored and the P-SOT bit in the STATUS field becomes 1.
Although the setting range is from -2147483648 to 2147483646, set an appropriate value that satisfies the conditions [FWD soft limit > REV soft limit] and [Reverse/forward limit ≦ Current value].
The soft limit is effective only during position control.

Unit	Lower limit value	Upper limit value	Default value
Pulse	-2147483648	2147483646	-2147483648

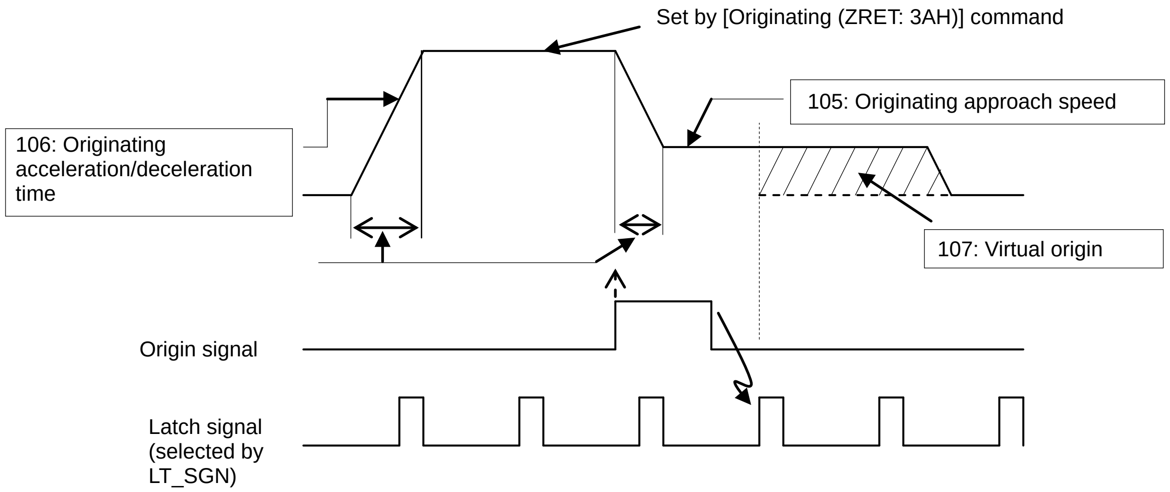
104: Origin position range

Upon completion of the originating triggered by the [Originating (ZRET: 3AH)] command, the ZPOINT bit in the STATUS field becomes 1 if the difference between the origin position and feedback pulse counter is within the range set by this parameter.

Unit	Lower limit value	Upper limit value	Default value
Pulse	0	32767	10

105: Originating approach speed
106: Originating acceleration/deceleration time
107: Virtual origin

When the [Originating (ZRET: 3AH)] command is executed, originating operation is performed as follows.
These parameters set each aspect of originating.



Originating approach speed

Unit	Lower limit value	Upper limit value	Default value
pls/s	125	32767	20000

Originating acceleration/deceleration time

Unit	Lower limit value	Upper limit value	Default value
ms	1	9999	1000

*: The set time corresponds to the time over which the actuator accelerate/decelerates between the standstill and the maximum speed.

Virtual origin

Unit	Lower limit value	Upper limit value	Default value
Pulse	-262144	262143	0

*: On the absolute encoder, the virtual origin portion is applied for the command position and the feedback position.
To change the setting, the power must be reconnected. Note, however, that it does not need to be changed as it is usually set by the host controller.

108: Originating direction

Set the originating direction to be applied when the [Originating (ZRET: 3AH)] command is executed. The set value is 0 or 1. If 0 is set, originating is performed in forward direction. If 1 is set, originating is performed in reverse direction.

Lower limit value	Upper limit value	Default value
0	1	0

109: Soft limit enable/disable

Specify whether or not to use the soft limit. Soft limit is enabled when this parameter is set to 1 and the REFE setting in PS_SUBCMD for the coordinate system setting command (POS_SET: 20H) is set to 1.

Lower limit value	Upper limit value	Default value
0	1	0

13-3 Main command

Main commands of the HA-800B are explained.
Bytes 1 to 29 of command/response data are used. Byte 0 of the command is set to 03H, and 01H is returned in byte 0 of the response.

List of main commands

Name	Command	Description
NOP	00H	Disable command: Processing is not performed.
PRM_RD	01H	Read user parameters.
PRM_WR	02H	Write user parameters (change the setting in the RAM).
ID_RD	03H	Read the ID and control software version of the HA-800B.
CONFIG	04H	Enable the parameter written by the device setup command PRM_WR.
ALM_RD	05H	Read the present alarms or warnings, or up to 8 most recent alarms.
ALM_CLR	06H	Clear the present alarms or alarm history.
SYNC_SET	0DH	Change the communication phase (2 → 3).
CONNECT	0EH	Establish a MECHATROLINK connection.
DISCONNECT	0FH	Open a MECHATROLINK connection.
PPRM_RD	1BH	Execute a non-volatile parameter read (This command is not yet installed.)
PPRM_WR	1CH	Write the parameters to RAM and EEPROM.
POS_SET	20H	Set the current value and enable/disable of soft limit monitoring function.
BRK_ON	21H	Request the brake actuation. (This command is not yet installed.)
BRK_OFF	22H	Request the brake release. (This command is not yet installed.)
SENS_ON	23H	Sensor-ON command
SENS_OFF	24H	Sensor OFF command
HOLD	25H	Motion stop. Stop the actuator currently operating.
SMON	30H	Monitor the servo status.
SV_ON	31H	Turn ON the servo.
SV_OFF	32H	Turn OFF the servo.
INTERPOLATE	34H	Perform interpolated feed. (Receive the displacement by every transmission cycle.)
POSING	35H	Move to the specified target value.
FEED	36H	Perform continuous operations at the specified speed.
LATCH	38H	Latch the position via an external input during interpolated feed.
EX_POSING	39H	Perform positioning where the displacement can be changed via an external input.
ZRET	3AH	Perform originating.
VELCTRL	3CH	Execute the speed command.
TRQCTRL	3DH	Execute the torque command.

13-4 Details of main commands

The following explains the details of each main command.

Disable command (NOP: 00H)

Byte	Command	Response	Explanation
1	NOP (00H)	NOP (00H)	
2		ALARM	
3		STATUS	
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16	WDT	RWDT	
17	Bytes 17 to 29 conform to a subcommand.	Bytes 17 to 29 conform to a subcommand.	
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			

Processing category	Network command
Synchronization category	Asynchronous command
Subcommand	Permitted
Processing time	Within communication cycle
Usable phase	All OK

Parameter read command (PRM_RD: 01H)

Byte	Command	Response
1	PRM_RD (01H)	PRM_RD (01H)
2		ALARM
3		STATUS
4		
5	No.	No.
6		
7	SIZE	SIZE
8		PARAMETER
9		
10		
11		
12		
13		
14		
15		
16	WDT	RWDT

Explanation

Processing category	Data communication command
Synchronization category	Asynchronous command
Subcommand	Not permitted
Processing time	Within communication cycle
Usable phase	2,3

- Read the enabled parameters. For the contents of parameters of the set value of No., refer to [Parameter No. and size (NO/SIZE)] (P13-38).
- In the following conditions, a warning occurs and the command is ignored. In this case, PARAMETER in the response becomes indeterminable:
  - The command is sent in a phase other than 2 or 3 Code 95
  - An out-of-range number is set in No. Code 94
  - The SIZE does not match. Code 94

Parameter write command (PRM_WR: 02H)

Byte	Command	Response
1	PRM_WR (02H)	PRM_WR (02H)
2		ALARM
3		STATUS
4		
5	No.	No.
6		
7	SIZE	SIZE
8	PARAMETER	PARAMETER
9		
10		
11		
12		
13		
14		
15		
16	WDT	RWDT

Explanation

Processing category	Data communication command
Synchronization category	Asynchronous command
Subcommand	Not permitted
Processing time	Within communication cycle
Usable phase	2,3

- Tentatively write a user parameter (the EEPROM is not written). For the contents of parameters of the set value of No., refer to [Parameter No. and size (NO/SIZE)] (P13-38).
- Refer to the [PPRM_WR] command if you want to write the parameters to EEPROM.
- In the following conditions, a warning occurs and the command is ignored.
  - The command is sent in a phase other than phase 2 or 3 Code 95
  - A number outside of the range is set Code 94
  - The parameter is outside the range Code 94
  - The parameter of a size other than the specified size is sent Code 94

Since the HA-800B is recognized as a wildcard servo within the MECHATROLINK system, parameter read/write commands are not issued from the MP2300. To change parameters, use the PC monitor software PSF-800.

Note that if your system is used in the servo-driver transparent command mode, parameter read/write commands can be used.

ID read command (ID_RD: 03H)

Byte	Command	Response
1	ID_RD (03H)	ID_RD (03H)
2		ALARM
3		STATUS
4		
5	DEVICE_CODE	DEVICE_CODE
6	OFFSET	OFFSET
7	SIZE	SIZE
8		ID
9		
10		
11		
12		
13		
14		
15		
16	WDT	RWDT

Explanation

Processing category	Data communication command
Synchronization category	Asynchronous command
Subcommand	Not permitted
Processing time	Within communication cycle
Usable phase	2, 3

- Read IDs. For details on ID, refer to the explanation below.
- In the following conditions, a warning occurs and the command is ignored.
  - The command is sent in a phase other than 2 or 3 Code 95
  - DEVICE_CODE is out of range Code 94
  - OFFSET is out of range Code 94
  - Wrong SIZE (a value other than 1 to 8 is set) Code 94

Type/name		OFFSET / DEVICE_CODE	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Driver	Model	00	H	A	-	8	0	0	M	L	0	0	0	0	0	0	0	0
	Firmware ver.	02	01h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Type/name		OFFSET / DEVICE_CODE	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F
Driver	Model	00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Firmware ver.	02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

*1: The model is indicated by ASCII code.
*2: The firmware version is indicated in HEX.

Device setup request command (CONFIG: 04H)

Byte	Command	Response	Explanation
1	CONFIG (04H)	CONFIG (04H)	
2		ALARM	
3		STATUS	
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16	WDT	RWDT	

Processing category	Control command
Synchronization category	Asynchronous command
Subcommand	Not permitted
Processing time	Max. 4 s
Usable phase	2, 3

- Perform the following.
  - Turn the servo OFF if it is turned ON.
  - Read the parameter again from EEPROM. Parameters not written to EEPROM are replaced by the data in EEPROM.
  - Initialize the current encoder position. If this command is received when the servo is ON, the servo turns OFF.
- In the following conditions, a warning occurs and the command is ignored.
  - The command is sent in a phase other than 2 or 3 Code 95

*: The CMDRDY bit of STATUS remains 0 while the CONFIG command is being executed, and turns 1 upon completion of the CONFIG.

Error/warning read command (ALM_RD: 05H)

Byte	Command	Response	Explanation
1	ALM_RD (05H)	ALM_RD (05H)	
2		ALARM	
3		STATUS	
4			
5	ALM_RD_MOD	ALM_RD_MOD	
6		ALM_DATA	
7			
8			
9			
10			
11			
12			
13			
14			
15			
16	WDT	RWDT	

Processing category	Control command
Synchronization category	Asynchronous command
Subcommand	Not permitted
Processing time	Max. 2 s
Usable phase	2,3

- Read the list of present errors/warnings and error history.
  ALM_RD_MOD 0: Present warnings, errors: The processing time is within the communication cycle.
  ALM_RD_MOD 1: Error history* Up to 8 errors: The processing time is within 2 seconds.
  (0 is written for the 8th and subsequent errors and in the empty fields of history data.)
  * Warning history is not kept.
- In the following conditions, a warning occurs and the command is ignored.
  - Wrong ALM_RD_MOD setting Code 94
  - The command is sent in a phase other than 2 or 3 Code 95

13

Communication function

Error/warning clear command (ALM_CLR: 06H)

Byte	Command	Response	Explanation
1	ALM_CLR (06H)	ALM_CLR (06H)	
2		ALARM	
3		STATUS	
4			
5	ALM_CLR_MOD	ALM_CLR_MOD	
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16	WDT	RWDT	

Processing category	Control command
Synchronization category	Asynchronous command
Subcommand	Not permitted
Processing time	Max. 4 s
Usable phase	2,3

- Clear the present errors/warnings and error history.
  ALM_CLR_MOD 0: Clear the present warnings, errors and position deviation.
  ALM_CLR_MOD 1: Clear the error history.

- In the following conditions, a warning occurs and the command is ignored.
  - Wrong ALM_CLR_MOD setting: Data setting warning Code 94
  - The command is sent in a phase other than 2 or 3 Code 95

* All present warnings can be cleared, but alarms that cannot be cleared with the clear command remain uncleared. To clear alarms that cannot be cleared with the clear command, you must reconnect the driver power.

Synchronization establishment request command (SYNC_SET: 0DH)

Byte	Command	Response	Explanation
1	SYNC_SET (0DH)	SYNC_SET (0DH)	
2		ALARM	
3		STATUS	
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16	WDT	RWDT	

Processing category	Network command
Synchronization category	Asynchronous command
Subcommand	Not permitted
Processing time	Within communication cycle
Usable phase	2

- Synchronous communication is started. (Move from phase 2 to phase 3.)
- The processing is complete upon change of the WDT edge.
- If this command is received in the following conditions, the applicable operations take place:
- ･This command is received in phase 1: Command warning Code 95
- ･This command is received in phase 3: Ignored (No warning)
- ･This command is received in phase 2 while the servo is turned ON: Servo OFF

- If any of the following alarms occurs, synchronous communication is resumed by this command:
  - MECHATROLINK synchronization error
  - MECHATROLINK communication error

Connection establishment request command (CONNECT: 0EH)

Byte	Command	Response	Explanation
1	CONNECT (0EH)	CONNECT (0EH)	
2		ALARM	
3		STATUS	
4			
5	VER	VER	
6	COM_MODE	COM_MODE	
7	COM_TIM	COM_TIM	
8			
9			
10			
11			
12			
13			
14			
15			
16	WDT	RWDT	

Explanation:

Processing category	Network command
Synchronization category	Asynchronous command
Subcommand	Not permitted
Processing time	Within communication cycle
Usable phase	All OK

- Establish a MECHATROLINK connection.
  Set the communication mode via COM_MODE.
  (Refer to the details of CMD_MODE.)
- VER: Set the version: 21H.
- COM_TIM: Fixed to 1.
- In the following conditions, a warning occurs and the command is ignored.
  - COM_MODE is outside the setting range Code 94
  - COM_TIM is outside the setting range Code 94
  - VER is not 21H Code 94

COM_MODE details

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
SUBCMD	0	0	0	DTMOD		SYNCMOD	0

Bit	Name	Description	Value	Status
Bit 1	SYNCMOD	Setting of switching phase	0	Switch from phase 1 to phase 2 (asynchronous mode).
			1	Switch from phase 1 to phase 3 (synchronous mode).
Bit 2/3	DTMOD	Data transfer method	0	Single send mode
			Other than above	Reserved (Do not set.)
Bit 7	SUBCMD	Subcommand: Command used	0	Subcommand: Command not yet used
			1	Subcommand: Command used

Connection release request command (DISCONNECT: 0FH)

Byte	Command	Response	Explanation
1	DISCONNECT (0FH)	DISCONNECT (0FH)	
2		ALARM	
3		STATUS	
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16	WDT	RWDT	

Explanation:

Processing category	Network command
Synchronization category	Asynchronous command
Subcommand	Not permitted
Processing time	Within communication cycle
Usable phase	All OK

- Open the connection.
- When this command is executed, the following operations take place:
  - Switch to phase 1.
  - Turn OFF the servo.
  - Disable the reference point setting.
  - Clear deviation and alarm.

Non-volatile parameter read command (PPRM_RD: 1BH)

Byte	Command	Response	Explanation
1	PPRM_RD (1BH)	PPRM_RD (1BH)	
2		ALARM	
3		STATUS	
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16	WDT	RWDT	

Explanation:

Processing category	—
Synchronization category	—
Subcommand	—
Processing time	—
Usable phase	—

- This command is not yet supported.
  If this command is sent, warning code 95 occurs.

13
Communication function

Non-volatile parameter write command (PPRM_WR: 1CH)

Byte	Command	Response
1	PPRM_WR (1CH)	PPRM_WR (1CH)
2		ALARM
3		STATUS
4		
5	No.	No.
6		
7	SIZE	SIZE
8	PARAMETER	PARAMETER
9		
10		
11		
12		
13		
14		
15		
16	WDT	RWDT

Explanation

Processing category	Data communication command
Synchronization category	Asynchronous command
Subcommand	Not permitted
Processing time	Max. 4 s
Usable phase	2, 3

- Write the user parameters to EEPROM and RAM. For the contents of parameters of the set value of No., refer to [Parameter No. and size (NO/SIZE)] (P13-38).
- In the following conditions, a warning occurs and the command is ignored. In this case, PARAMETER in the response becomes indeterminable:
  - The command is sent in a phase other than 2 or 3 Code 95
  - An out-of-range number is set in No. Code 94
  - The SIZE does not match. Code 94
- CMDRDY = 0 of STATUS applies while the parameter is being written.
  Do not turn off the HA-800B during this period.

Coordinate system setting command (POS_SET: 20H)

Byte	Command	Response
1	POS_SET (20H)	POS_SET (20H)
2		ALARM
3		STATUS
4		
5	PS_SUBCMD	PS_SUBCMD
6	POS_DATA	POS_DATA
7		
8		
9		
10		
11		
12		
13		
14		
15		
16	WDT	RWDT

Explanation

Processing category	Data communication command
Synchronization category	Asynchronous command
Subcommand	Not permitted
Processing time	Within communication cycle
Usable phase	2, 3

- Set the coordinate system. When REFE of PS_SUBCMD is set to 1 and parameter No. 109: Soft limit enable/disable is set to 1, the soft limits are enabled.
- In the following conditions, a warning occurs and the command is ignored.
  - The command is sent in phase 1 Code 95
  - A value other than 3 is set in POS_SEL Code 94
  - This command is sent while the motor is operating Code 94
  - POS_DATA does not meet the condition of [FWD soft limit > POS_DATA > REV soft limit] Code 94
  - An attempt is made to change REFE of PS_SUBCMD to 1 when the condition of [FWD soft limit > POS_DATA > REV soft limit] is not met Code 94

Only 03H (feedback position) can be set in the lower 4 bits of PS_SUBCMD.

PS_SUBCMD details

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
REFE	0	0	0	POS_SEL			

- **REFE**
  0: Disable the soft limits.
  1: Enable the soft limits. (The soft limit is effective only during position control.)
  * This bit is referenced only when parameter [109: Soft limit enable/disable] is set to 1.
- **POS_SEL**
  Specify 3H. If a value other than 3H is specified, a warning (94) occurs.

Brake actuation request command (BRK_ON: 21H)

Byte	Command	Response	Explanation
1	BRK_ON (21H)	BRK_ON (21H)	
2		ALARM	
3		STATUS	
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16	WDT	RWDT	

Processing category	Control command
Synchronization category	Asynchronous command
Subcommand	Not permitted
Processing time	Within communication cycle
Usable phase	2, 3

- This command is not yet supported.
  If this command is sent, a warning (code 95) occurs.

Brake release request command (BRK_OFF: 22H)

Byte	Command	Response	Explanation
1	BRK_OFF (22H)	BRK_OFF (22H)	
2		ALARM	
3		STATUS	
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16	WDT	RWDT	

Processing category	Control command
Synchronization category	Asynchronous command
Subcommand	Not permitted
Processing time	Within communication cycle
Usable phase	2, 3

- This command is not yet supported.
  If this command is sent, a warning (code 95) occurs.

Sensor-ON command (SENS_ON: 23H)

Byte	Command	Response	Explanation
1	SENS_ON (23H)	SENS_ON (23H)	
2		ALARM	
3		STATUS	
4			
5		MONITOR1	
6			
7			
8			
9		MONITOR2	
10			
11			
12			
13	SEL_MON1/2	SEL_MON1/2	
14		IO_MON	
15			
16	WDT	RWDT	

Processing category	Control command
Synchronization category	Asynchronous command
Subcommand	Not permitted
Processing time	Within communication cycle
Usable phase	2, 3

- This command is not yet supported, but even if it is received, the operation is not affected and only a response is returned.

Sensor-OFF command (SENS_OFF: 24H)

Byte	Command	Response	Explanation
1	SENS_OFF (24H)	SENS_OFF (24H)	
2		ALARM	
3		STATUS	
4			
5		MONITOR1	
6			
7			
8			
9		MONITOR2	
10			
11			
12			
13	SEL_MON1/2	SEL_MON1/2	
14		IO_MON	
15			
16	WDT	RWDT	

Processing category	Control command
Synchronization category	Asynchronous command
Subcommand	Not permitted
Processing time	Within communication cycle
Usable phase	2, 3

- This command is not yet supported, but even if it is received, the operation is not affected and only a response is returned.

Motion stop request command (HOLD: 25H)

<table>
<tr><th>Byte</th><th>Command</th><th>Response</th><th>Explanation</th></tr>
<tr><td>1</td><td>HOLD (25H)</td><td>HOLD (25H)</td><td rowspan="29">
<table>
<tr><th>Processing category</th><td>Motion command</td></tr>
<tr><th>Synchronization category</th><td>Asynchronous command</td></tr>
<tr><th>Subcommand</th><td>Permitted</td></tr>
<tr><th>Processing time</th><td>Within communication cycle</td></tr>
<tr><th>Usable phase</th><td>2, 3</td></tr>
</table>

The actuator comes to a stop from a motion status (operating status).
In the following conditions, a warning occurs and the command is ignored:
- Issued in phase 1: Command warning Code 95

</td></tr>
<tr><td>2</td><td></td><td>ALARM</td></tr>
<tr><td>3</td><td rowspan="2">OPTION
(Refer to the section on common commands.)</td><td rowspan="2">STATUS</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td><td>HOLD_MODE</td><td rowspan="4">MONITOR1</td></tr>
<tr><td>6</td><td rowspan="7"></td></tr>
<tr><td>7</td></tr>
<tr><td>8</td></tr>
<tr><td>9</td><td rowspan="4">MONITOR1</td></tr>
<tr><td>10</td></tr>
<tr><td>11</td></tr>
<tr><td>12</td></tr>
<tr><td>13</td><td>SEL_MON1/2</td><td>SEL_MON1/2</td></tr>
<tr><td>14</td><td rowspan="2"></td><td rowspan="2">IO_MON</td></tr>
<tr><td>15</td></tr>
<tr><td>16</td><td>WDT</td><td>RWDT</td></tr>
<tr><td>17</td><td rowspan="13">Bytes 17 to 29 conform to a subcommand.</td><td rowspan="13">Bytes 17 to 29 conform to a subcommand.</td></tr>
<tr><td>18</td></tr>
<tr><td>19</td></tr>
<tr><td>20</td></tr>
<tr><td>21</td></tr>
<tr><td>22</td></tr>
<tr><td>23</td></tr>
<tr><td>24</td></tr>
<tr><td>25</td></tr>
<tr><td>26</td></tr>
<tr><td>27</td></tr>
<tr><td>28</td></tr>
<tr><td>29</td></tr>
</table>

HOLD_MODE details

Movement commands	HOLD_MODE set value		Remarks
	0 (Decelerates to stop)	1 (Rapid stop)	
INTERPOLATE	×	○	Stop suddenly when this is set to Decelerates to stop.
POSING (positioning)	○	○	Stop according to parameter No. 14 (AJ13) when this is set to Decelerates to stop.
FEED (constant-speed feed)	○	○	Stop according to parameter No. 14 (AJ13) when this is set to Decelerates to stop.

Movement commands	HOLD_MODE set value		Remarks
	0 (Decelerates to stop)	1 (Rapid stop)	
LATCH (latch)	×	○	Stop suddenly when this is set to Decelerates to stop.
EX_POSING (external positioning)	○	○	Stop according to parameter No. 14 (AJ13) when this is set to Decelerates to stop.
ZRET (originating)	○	○	Stop according to parameter No. 106 when this is set to Decelerates to stop.
VELCTRL (speed command)	○	×	Stop according to parameter No. 13 (AJ12) when this is set to Decelerates to stop. Decelerate to stop when this is set to Rapid stop.
TRQCTRL (torque command)	×	×	Stop torque free regardless of the setting.

Status monitor command (SMON: 30H)

Byte	Command	Response
1	SMON (30H)	SMON (30H)
2		ALARM
3		STATUS
4		
5		MONITOR1
6		
7		
8		
9		MONITOR2
10		
11		
12		
13	SEL_MON1/2	SEL_MON1/2
14		IO_MON
15		
16	WDT	RWDT
17–29	Bytes 17 to 29 conform to a subcommand.	Bytes 17 to 29 conform to a subcommand.

Explanation:

Processing category	Data communication command
Synchronization category	Asynchronous command
Subcommand	Permitted
Processing time	Within communication cycle
Usable phase	2, 3

- The servo status is monitored.
- If this command is sent in phase 1, a command warning (95) is issued and the command is ignored.

13 Communication function

Servo-ON (SV_ON: 31H)

Byte	Command	Response
1	SV_ON (31H)	SV_ON (31H)
2		ALARM
3	OPTION (Refer to the section on common commands.)	STATUS
4		
5		MONITOR1
6		
7		
8		
9		MONITOR2
10		
11		
12		
13	SEL_MON1/2	SEL_MON1/2
14		IO_MON
15		
16	WDT	RWDT
17	Bytes 17 to 29 conform to a subcommand.	Bytes 17 to 29 conform to a subcommand.
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		

Explanation

Processing category	Control command
Synchronization category	Asynchronous command
Subcommand	Permitted
Processing time	Within 50 ms
Usable phase	2, 3

- The actuator servo turns ON.
- In the following conditions, a warning occurs and the command is ignored.

- The command is sent in phase 1: Command warning Code 95
- The command is sent while an alarm is present: Only the STATUS warning bit turns 1. (The ALARM display shows the present alarm.)

13 Communication function

Servo-OFF (SV_OFF: 32H)

Byte	Command	Response	Explanation
1	SV_OFF (32H)	SV_OFF (32H)	(see below)
2		ALARM	
3		STATUS	
4			
5		MONITOR1	
6			
7			
8			
9		MONITOR2	
10			
11			
12			
13	SEL_MON1/2	SEL_MON1/2	
14		IO_MON	
15			
16	WDT	RWDT	
17–29	Bytes 17 to 29 conform to a subcommand.	Bytes 17 to 29 conform to a subcommand.	

Explanation:

Processing category	Control command
Synchronization category	Asynchronous command
Subcommand	Permitted
Processing time	Within 50 ms
Usable phase	2, 3

- The actuator servo turns OFF.
- In the following conditions, a warning occurs and the command is ignored.
  - The command is sent in phase 1: Command warning Code 95

13 Communication function

Interpolated feed (INTERPOLATE: 34H)

<table>
<tr><th>Byte</th><th>Command</th><th>Response</th><th>Explanation</th></tr>
<tr><td>1</td><td>INTERPOLATE (34H)</td><td>INTERPOLATE (34H)</td><td rowspan="29">
<table>
<tr><th>Processing category</th><td>Motion command</td></tr>
<tr><th>Synchronization category</th><td>Synchronous command</td></tr>
<tr><th>Subcommand</th><td>Permitted</td></tr>
<tr><th>Processing time</th><td>Within communication cycle</td></tr>
<tr><th>Usable phase</th><td>3</td></tr>
</table>

Interpolated feed is performed.
This is a position control command, and thus, it is not received during an operation executed by the speed control command (VELCTRL: 3CH) or the torque control command (TRQCTRL: 3DH).
During a speed control or torque control operation, be sure to set VREF or TQREF to 0 and stop the motor (STATUS 8bit ZSPD = 1) before issuing this command.
In the following conditions, a warning occurs and the command is ignored.
- The command is sent in phase other than 3:
Command warning
Code 95
- The command is sent in servo-OFF:
Command warning
Code 95
- This command is sent during an operation by the speed command (VELCTRL: 3CH) (STATUS 8bit ZSPD = 0). Code 95
- This command is sent during an operation by the torque command (TRQCTRL: 3DH) (STATUS 8bit ZSPD = 0). Code 95
Use DEN of STATUS to check if the position command output has completed.

VFF (speed feed-forward gain) may be sent from the host controller, but it is ignored by the HA-800B.

</td></tr>
<tr><td>2</td><td></td><td>ALARM</td></tr>
<tr><td>3</td><td rowspan="2">OPTION
(Refer to the section on common commands.)</td><td rowspan="2">STATUS</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td><td rowspan="4">TPOS
(Interpolated position)</td><td rowspan="4">MONITOR1</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td></tr>
<tr><td>8</td></tr>
<tr><td>9</td><td rowspan="4">VFF
(Speed feed forward)</td><td rowspan="4">MONITOR2</td></tr>
<tr><td>10</td></tr>
<tr><td>11</td></tr>
<tr><td>12</td></tr>
<tr><td>13</td><td>SEL_MON1/2</td><td>SEL_MON1/2</td></tr>
<tr><td>14</td><td rowspan="2"></td><td rowspan="2">IO_MON</td></tr>
<tr><td>15</td></tr>
<tr><td>16</td><td>WDT</td><td>RWDT</td></tr>
<tr><td>17</td><td rowspan="13">Bytes 17 to 29 conform to a subcommand.</td><td rowspan="13">Bytes 17 to 29 conform to a subcommand.</td></tr>
<tr><td>18</td></tr>
<tr><td>19</td></tr>
<tr><td>20</td></tr>
<tr><td>21</td></tr>
<tr><td>22</td></tr>
<tr><td>23</td></tr>
<tr><td>24</td></tr>
<tr><td>25</td></tr>
<tr><td>26</td></tr>
<tr><td>27</td></tr>
<tr><td>28</td></tr>
<tr><td>29</td></tr>
</table>

Positioning (POSING: 35H)

Byte	Command	Response
1	POSING (35H)	POSING (35H)
2		ALARM
3	OPTION (Refer to the section on common commands.)	STATUS
4		
5	TPOS (Positioning target position)	MONITOR1
6		
7		
8		
9	TSPD (Positioning speed)	MONITOR2
10		
11		
12		
13	SEL_MON1/2	SEL_MON1/2
14		IO_MON
15		
16	WDT	RWDT
17	Bytes 17 to 29 conform to a subcommand.	Bytes 17 to 29 conform to a subcommand.
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		

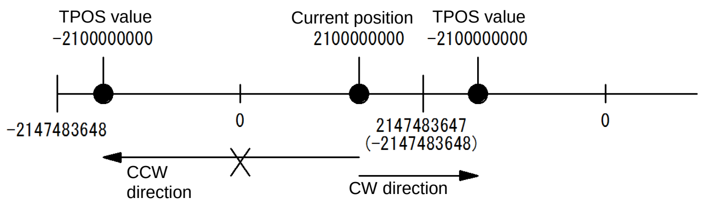
Explanation

Processing category	Motion command
Synchronization category	Asynchronous command
Subcommand	Permitted
Processing time	Within communication cycle
Usable phase	2, 3

- Perform positioning to the position specified by TPOS (unit: pls) at the speed set by TSPD (unit: pls/s). For the acceleration/deceleration time, the time set by parameter No. 13 (AJ12) [Acceleration time constant] or No. 14 (AJ13) [Deceleration time constant] is applied.
  This is a position control command, and thus, it is not received during an operation executed by the speed control command (VELCTRL: 3CH) or the torque control command (TRQCTRL: 3DH).
  During a speed control or torque control operation, be sure to set VREF or TQREF to 0 and stop the motor (STATUS 8bit ZSPD = 1) before issuing this command.

- In the following conditions, a warning occurs and the command is ignored.
  - In phase 1: Command warning Code 95
  - During servo OFF: Command warning Code 95
  - When TSPD reached a value between 1 and 124 or exceeds the maximum speed:
    Data setting warning Code 94
  - When TPOS exceeds the limit:
    Data setting warning Code 94
  - This command is sent during an operation by the speed command (VELCTRL: 3CH) (STATUS 8bit ZSPD = 0). Code 95
  - This command is sent during an operation by the torque command (TRQCTRL: 3DH) (STATUS 8bit ZSPD = 0). Code 95

- TPOS is a signed 4-byte command. (based on absolute position. The setting unit is [pls].)
- TSPD is an unsigned 4-byte command. The setting unit is [pls/s].
- The target position and target speed can be changed during movement.
- Use DEN of STATUS to check if the position command output has completed.
- The maximum permitted positioning distance is 2147483646 (7FFFFFFEH).
- The minimum permitted positioning distance is -2147483646 (80000002H).



TPOS is recognized as an absolute value, but if the value is close to the position that has overflown from the current position as shown in the figure to the left, HA-800B operates in the same positional direction (CW direction) after the encoder overflow. (It does not operate in the CCW direction.)

Constant-speed feed (FEED: 36H)

Byte	Command	Response
1	FEED (36H)	FEED (36H)
2		ALARM
3	OPTION (Refer to the section on common commands.)	STATUS
4		
5		MONITOR1
6		
7		
8		
9	TSPD (Feed speed)	MONITOR2
10		
11		
12		
13	SEL_MON1/2	SEL_MON1/2
14		IO_MON
15		
16	WDT	RWDT
17	Bytes 17 to 29 conform to a subcommand.	Bytes 17 to 29 conform to a subcommand.
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		

Explanation

Processing category	Motion command
Synchronization category	Asynchronous command
Subcommand	Permitted
Processing time	Within communication cycle
Usable phase	2, 3

- TSPD constant-speed feed is performed at the speed set by TSPD (unit: pls/s). To stop, use HOLD (25H). For the acceleration/deceleration time, the time set by parameter No. 13 (AJ12) [Acceleration time constant] or No. 14 (AJ13) [Deceleration time constant] is applied.
  This is a position control command, and thus, it is not received during an operation executed by the speed control command (VELCTRL: 3CH) or the torque control command (TRQCTRL: 3DH).
  During a speed control or torque control operation, be sure to set VREF or TQREF to 0 and stop the motor (STATUS 8bit ZSPD = 1) before issuing this command.

- In the following conditions, a warning occurs and the command is ignored.
  - During phase 1: Command warning Code 95
  - When the servo is OFF: Command warning Code 95
  - When TSPD reaches a value between 1 and 124 or exceeds the maximum value:
    Data setting warning Code 94
  - This command is sent during an operation by the speed command (VELCTRL: 3CH) (STATUS 8bit ZSPD = 0). Code 95
  - This command is sent during an operation by the torque command (TRQCTRL: 3DH) (STATUS 8bit ZSPD = 0). Code 95

・TSPD is an unsigned 4-byte command. The setting unit is [pls/s].
・The target speed can be changed during movement.
・Use DEN of STATUS to check if the command output has completed.

13
Communication function

Interpolated feed with position detection function (LATCH: 38H)

Byte	Command	Response
1	LATCH (38H)	LATCH (38H)
2	LT_SGN	ALARM
3	OPTION (Refer to the section on common commands.)	STATUS
4		
5	TPOS (Interpolated position)	MONITOR1
6		
7		
8		
9	VFF	MONITOR2
10		
11		
12		
13	SEL_MON1/2	SEL_MON1/2
14		IO_MON
15		
16	WDT	RWDT
17	Bytes 17 to 29 conform to a subcommand.	Bytes 17 to 29 conform to a subcommand.
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		

Explanation

Processing category	Motion command
Synchronization category	Synchronous command
Subcommand	Permitted
Processing time	Within communication cycle
Usable phase	3

- Interpolated feed is performed. If the signal selected by LT_SGN is input during operation, the input position is stored in the latch counter (LPOS). Also, the value of LPOS is forcibly output to MONITOR2 during one communication cycle. The set value of VFF is ignored.
  This is a position control command, and thus, it is not received during an operation executed by the speed control command (VELCTRL: 3CH) or the torque control command (TRQCTRL: 3DH).
  During a speed control or torque control operation, be sure to set VREF or TQREF to 0 and stop the motor (STATUS 8bit ZSPD = 1) before issuing this command.

- In the following conditions, a warning occurs and the command is ignored.
  - Other than phase 3: Command warning Code 95
  - When the servo is OFF: Command warning Code 95
  - This command is sent during an operation by the speed command (VELCTRL: 3CH). Code 95
  - This command is sent during an operation by the torque command (TRQCTRL: 3DH). Code 95

・Use DEN of STATUS to check if the position command output has completed.

- LT_SGN: Latch signal selection
  0: Encoder phase Z
  1: CN2-3 Latch 1
  2: CN2-4 Latch 2

Positioning by external input (EX_POSING: 39H)

Byte	Command	Response
1	EX_POSING (39H)	EX_POSING (39H)
2	LT_SGN	ALARM
3	OPTION (Refer to the section on common commands.)	STATUS
4		
5	TPOS (Positioning target position)	MONITOR1
6		
7		
8		
9	TSPD (Positioning speed)	MONITOR2
10		
11		
12		
13	SEL_MON1/2	SEL_MON1/2
14		IO_MON
15		
16	WDT	RWDT
17	Bytes 17 to 29 conform to a subcommand.	Bytes 17 to 29 conform to a subcommand.
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		

Explanation

Processing category	Motion command
Synchronization category	Asynchronous command
Subcommand	Permitted
Processing time	Within communication cycle
Usable phase	2, 3

- The actuator moves at TSPD toward TPOS, and if a latch signal (selected by LT-SGN) is input in the middle, the actuator positions to the position set by parameter No. 101 [Final external positioning distance] based on the position where the latch signal is input. If a latch signal is not input, the actuator positions to the position set by TPOS. For the acceleration/deceleration time, the time set by parameter No. 13 (AJ12) [Acceleration time constant] or No. 14 (AJ13) [Deceleration time constant] is applied.
  This is a position control command, and thus, it is not received during an operation executed by the speed control command (VELCTRL: 3CH) or the torque control command (TRQCTRL: 3DH).
  During a speed control or torque control operation, be sure to set VREF or TQREF to 0 and stop the motor (STATUS 8bit ZSPD = 1) before issuing this command.
- In the following conditions, a warning occurs and the command is ignored.
  - During phase 1: Command warning Code 95
  - During Servo OFF: Command warning Code 95
  - When TSPD reaches a value between 1 and 124 or exceeds the maximum value:
    Data setting warning Code 94
  - When TPOS exceeds the limit:
    Data setting warning Code 94
  - This command is sent during an operation by the speed command (VELCTRL: 3CH). Code 95
  - This command is sent during an operation by the torque command (TRQCTRL: 3DH). Code 95

・TPOS is a signed 4-byte command. (based on absolute position. The setting unit is [pls].)

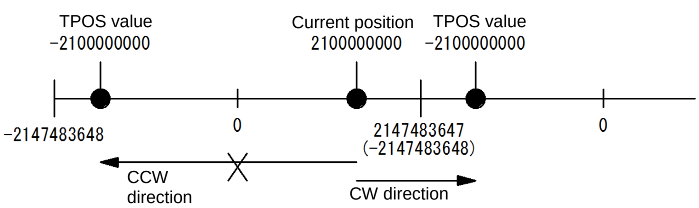
・TSPD is an unsigned 4-byte command. The setting unit is [pls/s].

・Use DEN of STATUS to check if the position command output has completed.

- LT_SGN: Latch signal selection
  0: Encoder phase Z
  1: CN2-3 Latch 1
  2: CN2-4 Latch 2

・The maximum permitted positioning distance is 2147483646 (7FFFFFFEH).

・The minimum permitted positioning distance is -2147483646 (80000002H).



TPOS is recognized as an absolute value, but if the value is close to the position that has overflown from the current position as shown in the figure to the left, HA-800B operates in the same positional direction (CW direction) after the encoder overflow. (It does not operate in the CCW direction.)

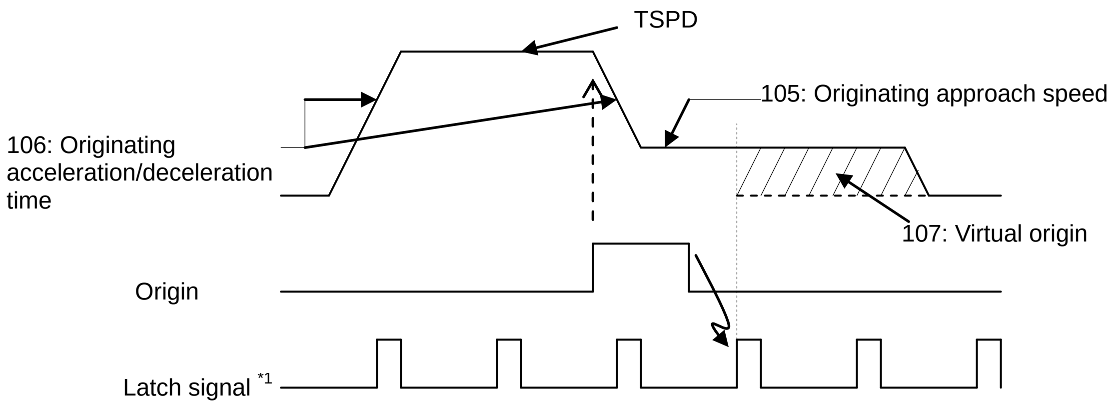
Originating (ZRET: 3AH)

Byte	Command	Response	Explanation
1	ZRET (3AH)	ZRET (3AH)	
2	LT_SGN	ALARM	
3	OPTION (Refer to the section on common	STATUS	
4			
5		MONITOR1	
6			
7			
8			
9	TSPD (Feed speed)	MONITOR2	
10			
11			
12			
13	SEL_MON1/2	SEL_MON1/2	
14		IO_MON	
15			
16	WDT	RWDT	
17	Bytes 17 to 29 conform to a subcommand.	Bytes 17 to 29 conform to a subcommand.	
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			

Processing category	Motion command
Synchronization category	Asynchronous command
Subcommand	Permitted
Processing time	Within communication cycle
Usable phase	2, 3

- Originating is performed according to the [CN2-5: ORG] signal and [CN2-3, 4: LATCH 1, 2] or encoder phase-Z signal. The position is recorded to the latch counter (LPOS) when a latch signal is input after the origin signal changes from ON to OFF during originating, and the LPOS value is forcibly output to Monitor 2 during the communication cycle.
  This is a position control command, and thus, it is not received during an operation executed by the speed control command (VELCTRL: 3CH) or the torque control command (TRQCTRL: 3DH).
  During a speed control or torque control operation, be sure to set VREF or TQREF to 0 and stop the motor (STATUS 8bit ZSPD = 1) before issuing this command.
- In the following conditions, a warning occurs and the command is ignored.
  - During phase 1: Command warning Code 95
  - When the servo is OFF: Command warning Code 95
  - When TSPD reaches a value between 1 and 124 or exceeds the maximum value: Data setting warning Code 94
  - During originating: Command warning Code 95
  - This command is sent during an operation by the speed command (VELCTRL: 3CH) (STATUS 8bit ZSPD = 0). Code 95
  - This command is sent during an operation by the torque command (TRQCTRL: 3DH) (STATUS 8bit ZSPD = 0). Code 95

・TSPD is an unsigned 4-byte command. The setting unit is [pls/s].
- LT_SGN: Latch signal selection
  0: Encoder phase Z
  1: CN2-3 Latch 1
  2: CN2-4 Latch 2



*1: The latch signal shown in the figure represents the signal specified by LT_SGN.

(1) The actuator accelerates in the direction set by parameter [108: Originating direction] to the speed set by TSPD in the amount of acceleration time set by parameter [106: Originating acceleration/deceleration time], and then operates at the originating speed.
(2) The actuator decelerates to the speed set by parameter [105: Originating approach speed] at origin signal ON.
(3) When the latch signal specified by the first LT_SGN is input after the origin signal is turned OFF, the actuator moves only for the amount set by parameter [107: Virtual origin] and then stops. The current value at that point will be set to 0.

Speed command(VELCTRL: 3CH)

<table>
<tr><th>Byte</th><th>Command</th><th>Response</th><th>Explanation</th></tr>
<tr><td>1</td><td>VELCTRL (3CH)</td><td>VELCTRL (3CH)</td><td rowspan="29">
<table>
<tr><th>Processing category</th><td>Motion command</td></tr>
<tr><th>Synchronization category</th><td>Asynchronous command</td></tr>
<tr><th>Subcommand</th><td>Permitted</td></tr>
<tr><th>Processing time</th><td>Within communication cycle</td></tr>
<tr><th>Usable phase</th><td>2, 3</td></tr>
</table>

Execute the speed control.
A command is issued directly to the speed loop when this command is issued. Warning code 95 is issued, however, if this command is issued when Bit 7: PSET is set to 0 in the response STATUS during a position control operation (INTERPOLATE: 34H, POSING: 35H, FEED: 36H, LATCH: 38H, EX_POSING: 39H, ZRET: 3AH).
For the acceleration/deceleration time, the time set by parameter No. 13 (AJ12) [Acceleration time constant] is applied. Parameter No. 14 (AJ13): [Deceleration time constant] is not applied.
In the following conditions, a warning occurs and the command is ignored.
- During phase 1: Command warning Code 95
- This command is issued during a positioning operation (INTERPOLATE: 34H, POSING: 35H, FEED: 36H, LATCH: 38H, EX_POSING: 39H, ZRET: 3AH) : Warning code 95
VREF is a signed 4-byte speed command and is set in [pls/s].
The VREF set value is the maximum speed/40000000H of the applicable actuator motor shaft.
Therefore, the maximum speed is when VREF is set to 40000000H. The rotation direction is determined by the sign.
When the actuator is combined with a controller by YASKAWA Electric Corporation, the speed specified by VREF may be different from the actual speed.

</td></tr>
<tr><td>2</td><td></td><td>ALARM</td></tr>
<tr><td>3</td><td rowspan="2">OPTION
(Refer to the section on common commands.)</td><td rowspan="2">STATUS</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td><td rowspan="4"></td><td rowspan="4">MONITOR1</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td></tr>
<tr><td>8</td></tr>
<tr><td>9</td><td rowspan="4">VREF
(speed command)</td><td rowspan="4">MONITOR2</td></tr>
<tr><td>10</td></tr>
<tr><td>11</td></tr>
<tr><td>12</td></tr>
<tr><td>13</td><td>SEL_MON1/2</td><td>SEL_MON1/2</td></tr>
<tr><td>14</td><td rowspan="2"></td><td rowspan="2">IO_MON</td></tr>
<tr><td>15</td></tr>
<tr><td>16</td><td>WDT</td><td>RWDT</td></tr>
<tr><td>17</td><td rowspan="13">Bytes 17 to 29 conform to a subcommand.</td><td rowspan="13">Bytes 17 to 29 conform to a subcommand.</td></tr>
<tr><td>18</td></tr>
<tr><td>19</td></tr>
<tr><td>20</td></tr>
<tr><td>21</td></tr>
<tr><td>22</td></tr>
<tr><td>23</td></tr>
<tr><td>24</td></tr>
<tr><td>25</td></tr>
<tr><td>26</td></tr>
<tr><td>27</td></tr>
<tr><td>28</td></tr>
<tr><td>29</td></tr>
</table>

Torque command (TRQCTRL: 3DH)

Byte	Command	Response
1	TRQCTRL (3DH)	TRQCTRL (3DH)
2		ALARM
3	OPTION (Refer to the section on common commands.)	STATUS
4		
5		MONITOR1
6		
7		
8		
9	TQREF (torque command)	MONITOR2
10		
11		
12		
13	SEL_MON1/2	SEL_MON1/2
14		IO_MON
15		
16	WDT	RWDT
17	Bytes 17 to 29 conform to a subcommand.	Bytes 17 to 29 conform to a subcommand.
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		

Explanation

Processing category	Motion command
Synchronization category	Asynchronous command
Subcommand	Permitted
Processing time	Within communication cycle
Usable phase	2, 3

- Execute the torque control.
  A command is issued directly to the torque loop when this command is issued. Warning code 95 is issued, however, if this command is issued when Bit 7: PSET is set to 0 in the response STATUS during a position control operation (INTERPOLATE: 34H, POSING: 35H, FEED: 36H, LATCH: 38H, EX_POSING: 39H, ZRET: 3AH).
- In the following conditions, a warning occurs and the command is ignored.
  - During phase 1: Command warning Code 95
  - This command is issued during a positioning operation (INTERPOLATE: 34H, POSING: 35H, FEED: 36H, LATCH: 38H, EX_POSING: 39H, ZRET: 3AH): Warning code 95
- TQREF is a signed 4-byte torque command and is set in [%].
  The TQREF setting is the maximum torque/40000000H of the applicable actuator motor shaft.
  Therefore, the maximum torque is when TQREF is set to 40000000H. The direction is determined by the sign.
- The speed limit is not enabled during a torque command operation.

13-5 Subcommand

The following is a list of HA-800B subcommands.

Name	Command	Description
NOP	00H	Disable command: Processing is not performed.
PRM_RD	01H	Read user parameters.
PRM_WR	02H	Write user parameters (change the setting in the RAM).
ALM_RD	05H	Read the present alarms or warnings, or up to 8 most recent alarms.
PPRM_WR	1CH	Write multiple parameters to the EEPROM at once.
SMON	30H	Monitor the servo status.

Details of subcommands

Disable command (NOP: 00H)

Byte	Command	Response	Explanation
17	NOP (00H)	NOP (00H)	
18		SUBSTATUS	
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			

By function	Network command
Processing time	Within the normal processing time

Parameter read command (PRM_RD: 01H)

Byte	Command	Response	Explanation
17	PRM_RD (01H)	PRM_RD (01H)	**By function**: Data communication command **Processing time**: Within 6 ms ● Read the enabled parameters. For the contents of parameters of the set value of No., refer to P13-38. ● In the following conditions, a warning occurs and the command is ignored. In this case, PARAMETER in the response becomes indeterminable: - An out-of-range number is set in No. Code 94 - The SIZE does not match. Code 94
18		SUBSTATUS	
19	No.	No.	
20			
21	SIZE	SIZE	
22		PARAMETER	
23			
24			
25			
26			
27			
28			
29			

Parameter write command (PRM_WR: 02H)

Byte	Command	Response	Explanation
17	PRM_WR (02H)	PRM_WR (02H)	**By function**: Data communication command **Processing time**: Within 6 ms ● Tentatively write a user parameter (the EEPROM is not written). After setting, offline user parameters will become enabled when a CONFIG command: 04H is executed. ● In the following conditions, a warning occurs and the command is ignored. - An out-of-range number is set in No. Code 94 - The SIZE does not match. Code 94 - The parameter is out of range Code 94 For the parameter No. and size, refer to P13-38.
18		SUBSTATUS	
19	No.	No.	
20			
21	SIZE	SIZE	
22		PARAMETER	
23			
24			
25			
26			
27			
28			
29			

13

Communication function

Error/warning read command (ALM_RD: 05H)

<table>
<tr><th>Byte</th><th>Command</th><th>Response</th><th>Explanation</th></tr>
<tr><td>17</td><td>ALM_RD (05H)</td><td>ALM_RD (05H)</td><td rowspan="13">
<table>
<tr><th>By function</th><td>Data communication command</td></tr>
<tr><th>Processing time</th><td>Max. 2 s</td></tr>
</table>
● Read the list of present errors/warnings and error history.
ALM_RD_MOD 0: Present warnings, errors:
The processing time is within the communication cycle.
ALM_RD_MOD 1: Error history* Up to 8 errors:
The processing time is within 2 seconds.
(0 is written for the 8th and subsequent errors and in the empty fields of history data.)

● In the following conditions, a warning occurs and the command is ignored.
- Wrong ALM_RD_MOD setting Code 94
* Warning history is not kept.
</td></tr>
<tr><td>18</td><td></td><td>SUBSTATUS</td></tr>
<tr><td>19</td><td>ALM_RD_MOD</td><td>ALM_RD_MOD</td></tr>
<tr><td>20</td><td rowspan="10"></td><td rowspan="10">ALM_DATA</td></tr>
<tr><td>21</td></tr>
<tr><td>22</td></tr>
<tr><td>23</td></tr>
<tr><td>24</td></tr>
<tr><td>25</td></tr>
<tr><td>26</td></tr>
<tr><td>27</td></tr>
<tr><td>28</td></tr>
<tr><td>29</td></tr>
</table>

Non-volatile parameter write command (PPRM_WR: 1CH)

<table>
<tr><th>Byte</th><th>Command</th><th>Response</th><th>Explanation</th></tr>
<tr><td>17</td><td>PPRM_WR (1CH)</td><td>PPRM_WR (1CH)</td><td rowspan="13">
<table>
<tr><th>By function</th><td>Data communication command</td></tr>
<tr><th>Processing time</th><td>Max. 4 s</td></tr>
</table>
● Change the contents of the RAM and EEPROM areas where the parameter specified by No. is saved, to the value specified by PARAMETER.

● In the following conditions, a warning occurs and the command is ignored.
- An out-of-range number is set in No. Code 94
- The SIZE does not match. Code 94
- The parameter is out of range Code 94

CMDRDY = 0 of (SUB) STATUS applies while the parameter is being written.
Do not turn off the HA-800B during this period.
</td></tr>
<tr><td>18</td><td></td><td>SUBSTATUS</td></tr>
<tr><td>19</td><td rowspan="2">No.</td><td rowspan="2">No.</td></tr>
<tr><td>20</td></tr>
<tr><td>21</td><td>SIZE</td><td>SIZE</td></tr>
<tr><td>22</td><td rowspan="8">PARAMETER</td><td rowspan="8">PARAMETER</td></tr>
<tr><td>23</td></tr>
<tr><td>24</td></tr>
<tr><td>25</td></tr>
<tr><td>26</td></tr>
<tr><td>27</td></tr>
<tr><td>28</td></tr>
<tr><td>29</td></tr>
</table>

Status monitor command (SMON: 30H)

Byte	Command	Response	Explanation
17	SMON (30H)	SMON (30H)	
18		SUBSTATUS	
19	SEL_MON3/4	SEL_MON3/4	
20		MONITOR3	
21			
22			
23			
24		MONITOR4	
25			
26			
27			
28			
29			

By function	Data communication command
Processing time	Within communication cycle

- The servo status is monitored.
- If this command is sent in phase 1, a command warning (95) is issued and the command is ignored.

13-6 Command data field

Data set in main commands and subcommands are explained.

Latch signal selection: LT_SGN

Select the latch signal (event signal) to be used with the [Interpolated feed with position detection function (LATCH)], [Positioning by external input (EX_POSING)] and [Originating (ZRET)] commands. The bit assignments are as follows.

LT_SGN details

Bit 1	Bit 0	Latch signal
0	0	Encoder phase Z
0	1	CN2-3: Latch 1
1	0	CN2-4: Latch 2

Option: OPTION

OPTION can be used with the following commands:
Servo-ON (SV_ON), Motion stop request (HOLD), Interpolated feed (INTERPOLATE), Positioning (POSING), Constant-speed feed (FEED), Interpolated feed with position detection function (LATCH), Positioning by external input (EX_POSING),
Originating (ZRET), Speed command (VELCTRL), Torque command (TRQCTRL)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	0	0	0

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
N-CL	P-CL	0	0	0	0	0	0

P-CL FWD torque limit
N-CL REV torque limit
- 0: Torque not limited
- 1: Torque limited

Status (STATUS)

In the status field, the servo status is monitored using the reserved areas for bytes 3 and 4 of the main command. The bit assignments are as follows.

Details of byte 3							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
PSET V-CMP	ZPOINT		PON	SVON	CMDRDY	WARNG	ALARM

Details of byte 4							
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
		N-SOT	P-SOT	NEAR	L_CMP	T_LMT	DEN ZSPD

Bit	Name	Description	Value	Status
0	ALARM	Occurrence of an alarm	0	None
			1	Occurrence of an alarm
1	WARING	Occurrence of a warning	0	None
			1	Occurrence of a warning
2	CMDRDY	Command ready	0	Command cannot be accepted (busy)
			1	Command can be accepted (ready)
3	SVON	Servo-ON	0	Servo-OFF
			1	Servo-ON
4	PON	Main circuit power ON	0	OFF
			1	ON
5				Always 0
6	ZPOINT	Origin position*2	0	Out of origin position range (Parameter No. 104: Origin position range)
			1	Within origin position range (Parameter No. 104: Origin position range)
7	PSET	In-position complete Deviation after command output completion (DEN = 1) (during position control)	0	Out of in-position range (Parameter No. 5: In-position range)
			1	Within in-position range (Parameter No. 5: In-position range)
	V-CMP	Attained speed (during speed control)	0	The actuator does not reach the speed specified by the speed command (VELCTRL).
			1	The actuator reached the speed specified by the speed command (VELCTRL).
8	DEN	Position command execution complete (during position control)	0	Execution in progress
			1	Execution complete
	ZSPD	Zero speed detection (during speed control)	0	At or above the speed set by [Parameter No. 8: Zero speed judgment value]
			1	At or below the speed specified by [Parameter No. 8: Zero speed judgment value]
9	T_LMT	Torque limit	0	Torque not limiting
			1	Torque limiting
10	L_CMP	Latch complete	0	Latch not yet complete
			1	Latch complete (When a latch command is executed, this signal turns 1 upon latching of the feedback position with the latch signal input.)
11	NEAR	Positioning near	0	Deviation outside [parameter No. 5: In-position range]
			1	Deviation inside [parameter No. 5: In-position range]

13

Communication function

Bit	Name	Description	Value	Status
12	P-SOT[*1]	FWD soft limit	0	Not exceeding the soft limit in forward direction
			1	Feedback position exceeded the soft limit in forward direction
13	N-SOT[*1]	REV soft limit	0	Not exceeding the soft limit in reverse direction
			1	Feedback position exceeded the soft limit in reverse direction

*1: Enable only when PS_SUBCMD REFE of POS_SET (20H) is 1.
*2: The signal may not turn ON since some host controllers do not use the ZRET command for originating.

Monitor selection (SEL_MON1/2/3/4), monitor information (MONITOR1/2/3/4)

The monitor selection and monitor information signals can be used with the following commands:
Servo-ON (SV_ON), Servo-OFF (SV_OFF), Interpolated feed (INTERPOLATE), Positioning (POSING), Constant-speed feed (FEED), Interpolated feed with position detection function (LATCH), Positioning by external input (EX_POSING),
Originating (ZRET), Sensor-ON (SENS_ON), Sensor-OFF (SENS_OFF), Speed command (VELCTRL), Torque command (TRQCTRL)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
SEL_MON2				SEL_MON1			

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
SEL_MON4				SEL_MON3			

Code	Symbol	Description	Unit
0	POS	Return data equivalent to MPOS	
1	MPOS	Command position (Command Counter)	pls
2	PERR	Position deviation (Error Counter)	pls
3	APOS	Feedback position (Feedback Counter)	pls
4	LPOS	Feedback latch position (latch signal input position)	pls
5	IPOS	Return data equivalent to MPOS	
6	TPOS	Target position (command-specified target position)	pls
7			
8	FSPD	Feedback speed	Position/torque control: pls/s Speed control: Max. rotational speed/40000000h
9	CSPD	Command speed	Position/torque control: pls/s Speed control: Max. rotational speed/40000000h
A	TSPD	Target speed	Position/torque control: pls/s Speed control: Max. rotational speed/40000000h
B	TRQ	Torque command	Position/speed control: % Torque control: Max. torque/40000000h
C			
D			
E			
F			

IO monitor (IO_MON)

The I/O statuses of the HA-800B (CN2 (I/O)) are monitored.
This signal can be used with the following commands:

Status monitor (SMON)	Positioning (POSING)
Servo-ON (SV_ON)	Interpolated feed with position detection function (LATCH)
Servo-OFF (SV_OFF)	Positioning by external input (EX_POSING)
Motion stop request (HOLD)	Originating (ZRET)
Interpolated feed (INTERPOLATE	Sensor ON (SENS_ON)
Constant-speed feed (FEED)	Sensor OFF (SENS_OFF)
Speed command (VELCTRL)	Torque command (TRQCTRL)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
LATCH2	LATCH1	0	0	0	ORG	REV-IH	FWD-IH

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
0	READY	ALARM	NEAR	0	0	0	0

0: OFF, 1: ON

Substatus (SUBSTATUS)

In the substatus, the status of a subcommand is monitored using the reserved area for byte 18 of the subcommand.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
—	—	—	—	—	SBCMDRDY	SBWARNG	SBALM

Bit	Name	Description	Value	Status
0	SBALM	Subcommand alarm occurred	0	None
			1	Occurrence of an alarm
1	SBWARING	Subcommand warning occurred	0	None
			1	Occurrence of a warning
2	SBCMDRDY	Subcommand: Command ready	0	Subcommand: Command cannot be accepted (busy)
			1	Subcommand: Command can be accepted (ready)

Description of alarm/warning (ALM_DATA)

The description of an alarm/warning is displayed by the error/warning read command (ALM_RD).

Alarm list

Alarm code	Alarm name	Alarm clear
10	Overspeed	Not permitted
20	Overload	Permitted
30	IPM error (overcurrent)	Not permitted
40	Overvoltage	Not permitted
41	Regenerative resistor overheat	Not permitted
42	Overregeneration	Not permitted
43	Missing phase	Not permitted
44	Control power voltage low	Not permitted

Alarm code	Alarm name	Alarm clear
45	Main circuit voltage low	Not permitted
46	Overheated dynamic brake	Not permitted
47	Damaged power circuit	Not permitted (Permitted)
50	Encoder breakage	Not permitted
51	Encoder receiving error	Not permitted
52	UVW error	Not permitted
53	System failure	Not permitted
54	Multi revolution overflow	Not permitted
55	Multi revolution data error	Not permitted
56	WDT error	Not permitted
57	Synchronization error	Not permitted
60	Excessive deviation	Permitted
70	Memory failure (RAM)	Not permitted
71	Memory failure (EEPROM)	Not permitted
72	FPGA configuration error	Not permitted
73	FPGA setting error	Not permitted
76	Processor error	Not permitted
80	MEMORY error	Not permitted
81	System failure	Not permitted
82	Single rotation data error	Not permitted
83	Multi revolution data error	Not permitted
84	BUSY error	Not permitted
85	Overheat error	Not permitted
86	Communication error	Not permitted

Warning list

Warning code	Warning name
90	Overload status
91	Battery voltage low
92	Cooling fan stopped
93	Main circuit voltage low
94	Command data error
95	Command error
96	Communication warning
97	FWD inhibit input effective*1
98	REV inhibit input effective*1
99	Incorrect actuator used

*1: Warning is not output to the MECHATROLINK line even when a warning has occurred.

Parameter No. and size (NO/SIZE)

Select the parameter to be read/written.
This signal can be used with the following commands:
Parameter read command (PRM_RD), parameter write command (PRM_WR), and non-volatile parameter write command (PPRM_WR)

Parameter No. and size

Adjustment parameter

No.	Parameter name	Data size	PSF-800 Parameter No.	When data becomes available
1	Position loop gain	4 bytes	AJ00	While data is being written
2	Speed loop gain	4 bytes	AJ01	While data is being written
3	Speed loop integral compensation	4 bytes	AJ02	While data is being written
4	Feed-forward gain	4 bytes	AJ03	While data is being written
5	In-position range	4 bytes	AJ04	While data is being written
6	System reservation	4 bytes	AJ05	─
7	System reservation	4 bytes	AJ06	─
8	Zero speed judgment value	4 bytes	AJ07	While data is being written
9	System reservation	4 bytes	AJ08	─
10	System reservation	4 bytes	AJ09	─
11	System reservation	4 bytes	AJ10	─
12	System reservation	4 bytes	AJ11	─
13	Acceleration time constant	4 bytes	AJ12	While data is being written
14	Deceleration time constant	4 bytes	AJ13	While data is being written
15	System reservation	4 bytes	AJ14	─
16	System reservation	4 bytes	AJ15	While data is being written
17	Speed monitor offset	4 bytes	AJ16	While data is being written
18	Current monitor offset	4 bytes	AJ17	While data is being written
19	FWD torque limit	4 bytes	AJ18	While data is being written
20	REV torque limit	4 bytes	AJ19	While data is being written
21	Feed-forward filter	4 bytes	AJ20	While data is being written
22	Load inertia moment ratio	4 bytes	AJ21	While data is being written
23	Torque constant compensation factor	4 bytes	AJ22	While data is being written
24	Spring constant compensation factor	4 bytes	AJ23	While data is being written
25	Automatic positioning gain	4 bytes	AJ24	While data is being written
26	System reservation	4 bytes	AJ25	─
27	System reservation	4 bytes	AJ26	─
28	System reservation	4 bytes	AJ27	─
29	System reservation	4 bytes	AJ28	─
30	System reservation	4 bytes	AJ29	─
31	System reservation	4 bytes	AJ30	─
32	System reservation	4 bytes	AJ31	─
33	System reservation	4 bytes	AJ32	─
34	System reservation	4 bytes	AJ33	─
35	System reservation	4 bytes	AJ34	─
36	System reservation	4 bytes	AJ35	─
37	System reservation	4 bytes	AJ36	─
38	System reservation	4 bytes	AJ37	─

No.	Parameter name	Data size	PSF-800 Parameter No.	When data becomes available
39	System reservation	4 bytes	AJ38	—
40	System reservation	4 bytes	AJ39	—
41	System reservation	4 bytes	AJ40	—
42	System reservation	4 bytes	AJ41	—
43	System reservation	4 bytes	AJ42	—
44	System reservation	4 bytes	AJ43	—
45	System reservation	4 bytes	AJ44	—
46	System reservation	4 bytes	AJ45	—
47	System reservation	4 bytes	AJ46	—
48	System reservation	4 bytes	AJ47	—
49	System reservation	4 bytes	AJ48	—
50	System reservation	4 bytes	AJ49	—
51	System reservation	4 bytes	AJ50	—
52	System reservation	4 bytes	AJ51	—
53	System reservation	4 bytes	AJ52	—
54	System reservation	4 bytes	AJ53	—
55	System reservation	4 bytes	AJ54	—
56	System reservation	4 bytes	AJ55	—
57	System reservation	4 bytes	AJ56	—
58	System reservation	4 bytes	AJ57	—
59	System reservation	4 bytes	AJ58	—
60	System reservation	4 bytes	AJ59	—

*: For details on parameters, refer to [7-5 Tune mode] and [8-1 System parameter mode].

System parameters

No.	Parameter name	Data size	PSF-800 Parameter No.	When data becomes available
61	CN9-CP3 output signal setting	4 bytes	SP40	When reconnecting the power
62	System reservation	4 bytes	SP41	—
63	System reservation	4 bytes	SP42	—
64	System reservation	4 bytes	SP43	—
65	Electronic gear 1 numerator	4 bytes	SP44	When reconnecting the power
66	Electronic gear 1 denominator	4 bytes	SP45	When reconnecting the power
67	System reservation	4 bytes	SP46	—
68	System reservation	4 bytes	SP47	—
69	Deviation clear upon servo-ON	4 bytes	SP48	When reconnecting the power
70	Allowable position deviation	4 bytes	SP49	When reconnecting the power
71	Command polarity	4 bytes	SP50	When reconnecting the power
72	Speed input factor	4 bytes	SP51	When reconnecting the power
73	System reservation	4 bytes	SP52	—
74	System reservation	4 bytes	SP53	—
75	Status display setting	4 bytes	SP54	When reconnecting the power
76	DB enable/disable setting	4 bytes	SP55	When reconnecting the power
77	System reservation	4 bytes	SP56	—
78	System reservation	4 bytes	SP57	—
79	System reservation	4 bytes	SP58	—
80	Angle compensation enable/disable setting	4 bytes	SP59	When reconnecting the power
81	Automatic positioning gain setting enable/disable	4 bytes	SP60	When reconnecting the power
82	Encoder pulse output pulses	4 bytes	SP61	When reconnecting the power
83	Input signal logic	4 bytes	SP62	When reconnecting the power
84	Output signal logic	4 bytes	SP63	When reconnecting the power
85	Regenerative resistor selection	4 bytes	SP64	When reconnecting the power
86	FWD/REV inhibit operation	4 bytes	SP65	When reconnecting the power
87	Absolute encoder function setting	4 bytes	SP66	When reconnecting the power
88	System reservation	4 bytes	SP67	—
89	System reservation	4 bytes	SP68	—
90	Feed-forward control function setting	4 bytes	SP69	When reconnecting the power
91	System reservation	4 bytes	SP70	—
92	System reservation	4 bytes	SP71	—
93	System reservation	4 bytes	SP72	—
94	System reservation	4 bytes	SP73	—
95	System reservation	4 bytes	SP74	—
96	System reservation	4 bytes	SP75	—
97	System reservation	4 bytes	SP76	—
98	System reservation	4 bytes	SP77	—
99	System reservation	4 bytes	SP78	—
100	System reservation	4 bytes	SP79	—
101	Final external positioning distance	4 bytes	NP14	While data is being written
102	FWD soft limit	4 bytes	NP10	While data is being written
103	REV soft limit	4 bytes	NP12	While data is being written
104	Origin position range	4 bytes	NP08	While data is being written
105	Originating approach speed	4 bytes	NP04	While data is being written

No.	Parameter name	Data size	PSF-800 Parameter No.	When data becomes available
106	Originating acceleration/deceleration time	4 bytes	NP05	While data is being written
107	Virtual origin	4 bytes	NP07	When reconnecting the power
108	Originating direction	4 bytes	NP06	While data is being written
109	Soft limit enable/disable	4 bytes	NP16	While data is being written
110	System reservation	4 bytes	—	While data is being written

*: For details on parameters, refer to [7-5 Tune mode] and [8-1 System parameter mode].

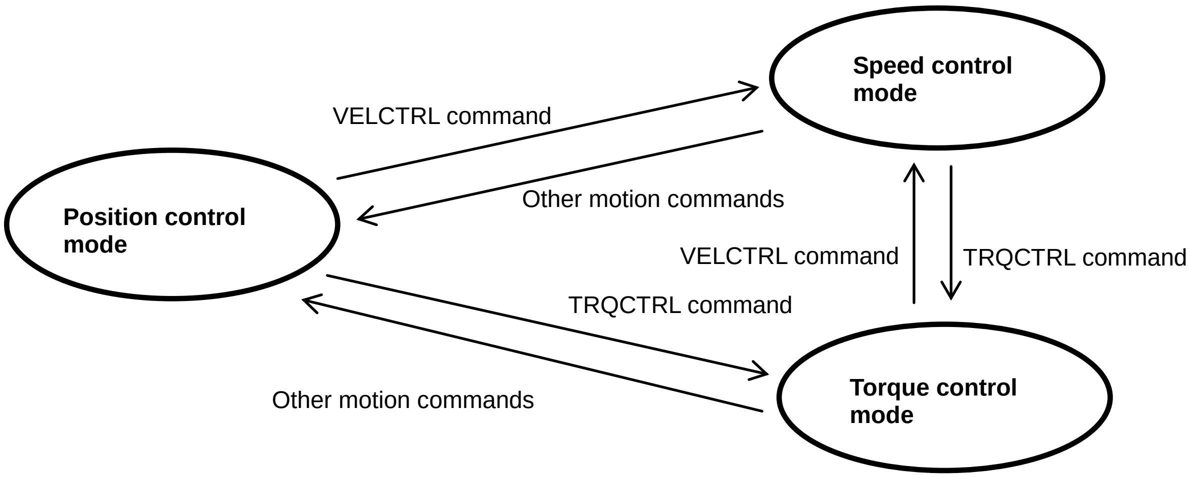
*: The parameters that require the power to be reconnected need to be written to EEPROM. Use non-volatile parameter write command (PPRM_WR). Parameter write command (PRM_WR) cannot be used.

13-7 Control mode

The control mode of the HA-800B is explained.

Switching the control mode

The following commands are used to switch between the 3 types of control mode for HA-800B.



Caution

- A speed limit cannot be applied during torque control.
- In torque control, the sett values in AJ18: FWD torque limit/AJ19: REV torque limit are disabled.

Notices for switching between control modes

UA95: Command error occurs if the control mode is switched between position control and speed control, or between position control and torque control, while the motor is rotating. The motor in this status cannot be stopped. Return the control mode to the mode before UA95 occurred and stop the motor, or stop it by turning the servo OFF.
Switch the control mode after making sure that the current speed is at or below the speed specified by parameter [AJ07: Zero speed judgment value]. (Be sure to check the current speed since zero speed detection is not output in the position control mode.)

Appendix

This chapter explains the default settings, etc.

A-1 Default settings A-1
A-2 Regenerative resistor A-9
A-3 List of data retained in the driver A-27
A-4 Driver replacement procedures A-30

A -1 Default settings

The standards parameter values set as a default for each applicable actuator are shown below.

SHA series (voltage: 200V)

	Actuator model No.	SHA20-SG					SHA25-SG/HP					
	Actuator reduction ratio	51	81	101	121	161	11	51	81	101	121	161
	Combined driver	HA-800B-3D/E-200					HA-800B-3D/E-200					
d13	Applicable actuator Code	5311	5321	5331	5341	5351	5801	5011	5021	5031	5041	5051
AJ00	Position loop gain (default)	40	40	40	40	40	40	40	40	40	40	40
AJ01	Speed loop gain (default)	20	20	20	20	20	25	25	25	25	25	25
AJ02	Speed loop integral compensation (default)	20	20	20	20	20	20	20	20	20	20	20
AJ04	In-position range (default)	150	150	150	150	150	150	150	150	150	150	150
SP49	Allowable position deviation (default)	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
SP51	Speed input factor (default)	6000	6000	6000	6000	6000	5600	5600	5600	5600	5600	5600
SP60	Automatic gain (default)	0	0	0	0	0	0	0	0	0	0	0
SP61	Encoder monitor Output pulses (default)	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192
SP69	Feed-forward control function setting	0	0	0	0	0	0	0	0	0	0	0

	Actuator model No.	SHA32-SG/HP					
	Actuator reduction ratio	11	51	81	101	121	161
	Combined driver	HA-800B-6D/E-200					
d13	Applicable actuator Code	5811	5111	5121	5131	5141	5151
AJ00	Position loop gain (default)	40	40	40	40	40	40
AJ01	Speed loop gain (default)	56	56	56	56	56	56
AJ02	Speed loop integral compensation (default)	70	70	70	70	70	70
AJ04	In-position range (default)	150	150	150	150	150	150
SP49	Allowable position deviation (default)	1500	1500	1500	1500	1500	1500
SP51	Speed input factor (default)	4800	4800	4800	4800	4800	4800
SP60	Automatic gain (default)	0	0	0	0	0	0
SP61	Encoder monitor Output pulses (default)	8192	8192	8192	8192	8192	8192
SP69	Feed-forward control function setting	0	0	0	0	0	0

	Actuator model No.	SHA40-SG					SHA40-SG				
	Actuator reduction ratio	51	81	101	121	161	51	81	101	121	161
	Combined driver	HA-800B-6D/E-200					HA-800B-24D/E-200				
d13	Applicable actuator Code	5211	5221	5231	5241	5251	5211	5221	5231	5241	5251
AJ00	Position loop gain (default)	40	40	40	40	40	40	40	40	40	40
AJ01	Speed loop gain (default)	80	80	80	80	80	8	8	8	8	8
AJ02	Speed loop integral compensation (default)	60	60	60	60	60	60	60	60	60	60
AJ04	In-position range (default)	150	150	150	150	150	150	150	150	150	150
SP49	Allowable position deviation (default)	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
SP51	Speed input factor (default)	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
SP60	Automatic gain (default)	0	0	0	0	0	0	0	0	0	0
SP61	Encoder monitor Output pulses (default)	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192
SP69	Feed-forward control function setting	0	0	0	0	0	0	0	0	0	0

	Actuator model No.	SHA45-SG					SHA58-SG				SHA65-SG			
	Actuator reduction ratio	51	81	101	121	161	81	101	121	161	81	101	121	161
	Combined driver	HA-800B-24D/E-200					HA-800B-24D/E-200				HA-800B-24D/E-200			
d13	Applicable actuator Code	5821	5831	5841	5851	5861	5421	5431	5441	5451	5521	5531	5541	5551
AJ00	Position loop gain (default)	40	40	40	40	40	40	40	40	40	40	40	40	40
AJ01	Speed loop gain (default)	9	9	9	9	9	26	26	26	26	30	30	30	30
AJ02	Speed loop integral compensation (default)	60	60	60	60	60	60	60	60	60	60	60	60	60
AJ04	In-position range (default)	150	150	150	150	150	150	150	150	150	150	150	150	150
SP49	Allowable position deviation (default)	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
SP51	Speed input factor (default)	3800	3800	3800	3800	3800	3000	3000	3000	3000	2800	2800	2800	2800
SP60	Automatic gain (default)	0	0	0	0	0	0	0	0	0	0	0	0	0
SP61	Encoder monitor Output pulses (default)	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192
SP69	Feed-forward control function setting	3	3	3	3	3	0	0	0	0	0	0	0	0

	Actuator model No.	SHA20-CG					SHA25-CG					SHA32-CG				
	Actuator reduction ratio	50	80	100	120	160	50	80	100	120	160	50	80	100	120	160
	Combined driver	HA-800B-3D/E-200					HA-800B-3D/E-200					HA-800B-6D/E-200				
d13	Applicable actuator Code	8311	8321	8331	8341	8351	8011	8021	8031	8041	8051	8111	8121	8131	8141	8151
AJ00	Position loop gain (default)	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
AJ01	Speed loop gain (default)	20	20	20	20	20	25	25	25	25	25	56	56	56	56	56
AJ02	Speed loop integral compensation (default)	20	20	20	20	20	20	20	20	20	20	70	70	70	70	70
AJ04	In-position range (default)	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
SP49	Allowable position deviation (default)	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
SP51	Speed input factor (default)	6000	6000	6000	6000	6000	5600	5600	5600	5600	5600	4800	4800	4800	4800	4800
SP60	Automatic gain (default)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SP61	Encoder monitor Output pulses (default)	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192
SP69	Feed-forward control function setting	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

	Actuator model No.	SHA40-CG					SHA40-CG				
	Actuator reduction ratio	50	80	100	120	160	50	80	100	120	160
	Combined driver	HA-800B-6D/E-200					HA-800B-24D/E-200				
d13	Applicable actuator Code	8211	8221	8231	8241	8251	8211	8221	8231	8241	8251
AJ00	Position loop gain (default)	40	40	40	40	40	40	40	40	40	40
AJ01	Speed loop gain (default)	80	80	80	80	80	8	8	8	8	8
AJ02	Speed loop integral compensation (default)	60	60	60	60	60	60	60	60	60	60
AJ04	In-position range (default)	150	150	150	150	150	150	150	150	150	150
SP49	Allowable position deviation (default)	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
SP51	Speed input factor (default)	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
SP60	Automatic gain (default)	0	0	0	0	0	0	0	0	0	0
SP61	Encoder monitor Output pulses (default)	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192
SP69	Feed-forward control function setting	3	3	3	3	3	3	3	3	3	3

SHA series (voltage: 100V)

	Actuator model No.	SHA25-SG					SHA25-CG				
	Actuator reduction ratio	51	81	101	121	161	50	80	100	120	160
	Combined driver	HA-800B-6D/E-100					HA-800**B**-6D/E-100				
d13	Applicable actuator Code	5611	5621	5631	5641	5651	8611	8621	8631	8641	8651
AJ00	Position loop gain (default)	40	40	40	40	40	40	40	40	40	40
AJ01	Speed loop gain (default)	25	25	25	25	25	25	25	25	25	25
AJ02	Speed loop integral compensation (default)	20	20	20	20	20	20	20	20	20	20
AJ04	In-position range (default)	150	150	150	150	150	150	150	150	150	150
SP49	Allowable position deviation (default)	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
SP51	Speed input factor (default)	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800
SP60	Automatic gain (default)	0	0	0	0	0	0	0	0	0	0
SP61	Encoder monitor Output pulses (default)	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192
SP69	Feed-forward control function setting	0	0	0	0	0	3	3	3	3	3

FHA-Cmini 4-wire, wire saving incremental series (voltage: 200V)

	Actuator model No.	FHA-8C			FHA-11C			FHA-14C		
	Actuator reduction ratio	30	50	100	30	50	100	30	50	100
	Combined driver	HA-800B-1C-200			HA-800B-1C-200			HA-800B-1C-200		
d13	Applicable actuator Code	6204	6214	6234	6404	6414	6434	6604	6614	6634
AJ00	Position loop gain (default)	40	40	40	40	40	40	40	40	40
AJ01	Speed loop gain (default)	35	35	35	45	45	45	80	80	80
AJ02	Speed loop integral compensation (default)	20	20	20	20	20	20	20	20	20
AJ04	In-position range (default)	10	10	10	10	10	10	10	10	10
SP49	Allowable position deviation (default)	100	100	100	100	100	100	100	100	100
SP51	Speed input factor (default)	6000	6000	6000	6000	6000	6000	6000	6000	6000
SP60	Automatic gain (default)	1	1	1	1	1	1	1	1	1
SP61	Encoder monitor Output pulses (default)	1	1	1	1	1	1	1	1	1
SP69	Feed-forward control function setting	0	0	0	0	0	0	0	0	0

FHA-Cmini 4-wire, wire saving incremental series (voltage: 100V)

	Actuator model No.	FHA-8C			FHA-11C			FHA-14C		
	Actuator reduction ratio	30	50	100	30	50	100	30	50	100
	Combined driver	HA-800B-1C-100			HA-800B-1C-100			HA-800B-1C-100		
d13	Applicable actuator Code	6304	6314	6334	6504	6514	6534	6704	6714	6734
AJ00	Position loop gain (default)	40	40	40	40	40	40	40	40	40
AJ01	Speed loop gain (default)	35	35	35	45	45	45	80	80	80
AJ02	Speed loop integral compensation (default)	20	20	20	20	20	20	20	20	20
AJ04	In-position range (default)	10	10	10	10	10	10	10	10	10
SP49	Allowable position deviation (default)	100	100	100	100	100	100	100	100	100
SP51	Speed input factor (default)	6000	6000	6000	6000	6000	6000	6000	6000	6000
SP60	Automatic gain (default)	1	1	1	1	1	1	1	1	1
SP61	Encoder monitor Output pulses (default)	1	1	1	1	1	1	1	1	1
SP69	Feed-forward control function setting	0	0	0	0	0	0	0	0	0

FHA-Cmini absolute series (voltage: 200V)

	Actuator model No.	FHA-8C			FHA-11C			FHA-14C		
	Actuator reduction ratio	30	50	100	30	50	100	30	50	100
	Combined driver	HA-800B-1D-200			HA-800B-1D-200			HA-800B-1D-200		
d13	Applicable actuator Code	6201	6211	6231	6401	6411	6431	6601	6611	6631
AJ00	Position loop gain (default)	40	40	40	40	40	40	40	40	40
AJ01	Speed loop gain (default)	21	21	21	27	27	27	48	48	48
AJ02	Speed loop integral compensation (default)	20	20	20	20	20	20	20	20	20
AJ04	In-position range (default)	150	150	150	150	150	150	150	150	150
SP49	Allowable position deviation (default)	1500	1500	1500	1500	1500	1500	1500	1500	1500
SP51	Speed input factor (default)	6000	6000	6000	6000	6000	6000	6000	6000	6000
SP60	Automatic gain (default)	1	1	1	1	1	1	1	1	1
SP61	Encoder monitor Output pulses (default)	8192	8192	8192	8192	8192	8192	8192	8192	8192
SP69	Feed-forward control function setting	0	0	0	0	0	0	0	0	0

FHA-Cmini absolute series (voltage: 100V)

	Actuator model No.	FHA-8C			FHA-11C			FHA-14C		
	Actuator reduction ratio	30	50	100	30	50	100	30	50	100
	Combined driver	HA-800B-1D-100			HA-800B-1D-100			HA-800B-1D-100		
d13	Applicable actuator Code	6301	6311	6331	6501	6511	6531	6701	6711	6731
AJ00	Position loop gain (default)	40	40	40	40	40	40	40	40	40
AJ01	Speed loop gain (default)	21	21	21	27	27	27	48	48	48
AJ02	Speed loop integral compensation (default)	20	20	20	20	20	20	20	20	20
AJ04	In-position range (default)	150	150	150	150	150	150	150	150	150
SP49	Allowable position deviation (default)	1500	1500	1500	1500	1500	1500	1500	1500	1500
SP51	Speed input factor (default)	6000	6000	6000	6000	6000	6000	6000	6000	6000
SP60	Automatic gain (default)	1	1	1	1	1	1	1	1	1
SP61	Encoder monitor Output pulses (default)	8192	8192	8192	8192	8192	8192	8192	8192	8192
SP69	Feed-forward control function setting	0	0	0	0	0	0	0	0	0

FHA-C 4-wire, wire-saving incremental series (voltage: 200V)

	Actuator model No.	FHA-17C					FHA-25C				
	Actuator reduction ratio	50	80	100	120	160	50	80	100	120	160
	Combined driver	HA-800B-3C-200					HA-800B-3C-200				
d13	Applicable actuator Code	5217	5227	5237	5257	5247	5417	5427	5437	5457	5447
AJ00	Position loop gain (default)	40	40	40	40	40	40	40	40	40	40
AJ01	Speed loop gain (default)	25	25	25	25	25	50	50	50	50	50
AJ02	Speed loop integral compensation (default)	40	40	40	40	40	40	40	40	40	40
AJ04	In-position range (default)	10	10	10	10	10	10	10	10	10	10
SP49	Allowable position deviation (default)	100	100	100	100	100	100	100	100	100	100
SP51	Speed input factor (default)	4800	4800	4800	4800	4800	4500	4500	4500	4500	4500
SP60	Automatic gain (default)	0	0	0	0	0	0	0	0	0	0
SP61	Encoder monitor Output pulses (default)	1	1	1	1	1	1	1	1	1	1
SP69	Feed-forward control function setting	0	3	0	3	0	0	3	0	3	0

FHA-C 4-wire, wire-saving incremental series (voltage: 200V)

	Actuator model No.	FHA-32C					FHA-40C				
	Actuator reduction ratio	50	80	100	120	160	50	80	100	120	160
	Combined driver	HA-800B-6C-200					HA-800B-6C-200				
d13	Applicable actuator Code	5617	5627	5637	5657	5647	5717	5727	5737	5757	5747
AJ00	Position loop gain (default)	40	40	40	40	40	40	40	40	40	40
AJ01	Speed loop gain (default)	80	80	80	80	80	120	120	120	120	120
AJ02	Speed loop integral compensation (default)	40	40	40	40	40	40	40	40	40	40
AJ04	In-position range (default)	10	10	10	10	10	10	10	10	10	10
SP49	Allowable position deviation (default)	100	100	100	100	100	100	100	100	100	100
SP51	Speed input factor (default)	4000	4000	4000	4000	4000	3500	3500	3500	3500	3500
SP60	Automatic gain (default)	0	0	0	0	0	0	0	0	0	0
SP61	Encoder monitor Output pulses (default)	1	1	1	1	1	1	1	1	1	1
SP69	Feed-forward control function setting	0	3	0	3	0	0	3	0	3	0

FHA-C 4-wire, wire-saving incremental series (voltage: 100V)

	Actuator model No.	FHA-17C					FHA-25C					FHA-32C				
	Actuator reduction ratio	50	80	100	120	160	50	80	100	120	160	50	80	100	120	160
	Combined driver	HA-800B-3C-100					HA-800B-6C-100					HA-800B-6C-100				
d13	Applicable actuator Code	5117	5127	5137	5157	5147	5317	5327	5337	5357	5347	5517	5527	5537	5557	5547
AJ00	Position loop gain (default)	40	40	40	40	40	37	37	37	37	37	50	50	50	50	50
AJ01	Speed loop gain (default)	50	50	50	50	50	50	50	50	50	50	120	120	120	120	120
AJ02	Speed loop integral compensation (default)	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
AJ04	In-position range (default)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
SP49	Allowable position deviation (default)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
SP51	Speed input factor (default)	4800	4800	4800	4800	4800	4500	4500	4500	4500	4500	3200	3200	3200	3200	3200
SP60	Automatic gain (default)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SP61	Encoder monitor Output pulses (default)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SP69	Feed-forward control function setting	0	3	0	3	0	0	3	0	3	0	0	3	0	3	0

FHA-C-PR 4-wire, wire-saving incremental series (voltage: 200V)

	Actuator model No.	FHA-17C-PR					FHA-25C-PR				
	Actuator reduction ratio	50	80	100	120	160	50	80	100	120	160
	Combined driver	HA-800B-3C-200					HA-800B-3C-200				
d13	Applicable actuator Code	5267	5277	5287	5207	5297	5467	5477	5487	5407	5497
AJ00	Position loop gain (default)	40	40	40	40	40	40	40	40	40	40
AJ01	Speed loop gain (default)	25	25	25	25	25	50	50	50	50	50
AJ02	Speed loop integral compensation (default)	40	40	40	40	40	40	40	40	40	40
AJ04	In-position range (default)	10	10	10	10	10	10	10	10	10	10
SP49	Allowable position deviation (default)	100	100	100	100	100	100	100	100	100	100
SP51	Speed input factor (default)	4800	4800	4800	4800	4800	4500	4500	4500	4500	4500
SP60	Automatic gain (default)	0	0	0	0	0	0	0	0	0	0
SP61	Encoder monitor Output pulses (default)	1	1	1	1	1	1	1	1	1	1
SP69	Feed-forward control function setting	3	3	3	3	3	3	3	3	3	3

	Actuator model No.	FHA-32C-PR					FHA-40C-PR				
	Actuator reduction ratio	50	80	100	120	160	50	80	100	120	160
	Combined driver	HA-800B-6C-200					HA-800B-6C-200				
d13	Applicable actuator Code	5667	5677	5687	5607	5697	5767	5777	5787	5707	5797
AJ00	Position loop gain (default)	40	40	40	40	40	40	40	40	40	40
AJ01	Speed loop gain (default)	80	80	80	80	80	120	120	120	120	120
AJ02	Speed loop integral compensation (default)	40	40	40	40	40	40	40	40	40	40
AJ04	In-position range (default)	10	10	10	10	10	10	10	10	10	10
SP49	Allowable position deviation (default)	100	100	100	100	100	100	100	100	100	100
SP51	Speed input factor (default)	4000	4000	4000	4000	4000	3500	3500	3500	3500	3500
SP60	Automatic gain (default)	0	0	0	0	0	0	0	0	0	0
SP61	Encoder monitor Output pulses (default)	1	1	1	1	1	1	1	1	1	1
SP69	Feed-forward control function setting	3	3	3	3	3	3	3	3	3	3

FHA-C-PR 4-wire, wire-saving incremental series (voltage: 100V)

	Actuator model No.	FHA-17C-PR					FHA-25C-PR				
	Actuator reduction ratio	50	80	100	120	160	50	80	100	120	160
	Combined driver	HA-800B-3C-100					HA-800B-6C-100				
d13	Applicable actuator Code	5167	5177	5187	5107	5197	5367	5377	5387	5307	5397
AJ00	Position loop gain (default)	40	40	40	40	40	37	37	37	37	37
AJ01	Speed loop gain (default)	50	50	50	50	50	50	50	50	50	50
AJ02	Speed loop integral compensation (default)	40	40	40	40	40	40	40	40	40	40
AJ04	In-position range (default)	10	10	10	10	10	10	10	10	10	10
SP49	Allowable position deviation (default)	100	100	100	100	100	100	100	100	100	100
SP51	Speed input factor (default)	4800	4800	4800	4800	4800	4500	4500	4500	4500	4500
SP60	Automatic gain (default)	0	0	0	0	0	0	0	0	0	0
SP61	Encoder monitor Output pulses (default)	1	1	1	1	1	1	1	1	1	1
SP6	Feed-forward control function setting	3	3	3	3	3	3	3	3	3	3

FHA-C-PR 4-wire, wire-saving incremental series (voltage: 100V)

	Actuator model No.	FHA-32C-PR				
	Actuator reduction ratio	50	80	100	120	160
	Combined driver	HA-800B-6C-100				
d13	Applicable actuator Code	5567	5577	5587	5507	5597
AJ00	Position loop gain (default)	50	50	50	50	50
AJ01	Speed loop gain (default)	120	120	120	120	120
AJ02	Speed loop integral compensation (default)	40	40	40	40	40
AJ04	In-position range (default)	10	10	10	10	10
SP49	Allowable position deviation (default)	100	100	100	100	100
SP51	Speed input factor (default)	3200	3200	3200	3200	3200
SP60	Automatic gain (default)	0	0	0	0	0
SP61	Encoder monitor Output pulses (default)	1	1	1	1	1
SP6	Feed-forward control function setting	3	3	3	3	3

FHA-C absolute series (voltage: 200V)

	Actuator model No.	FHA-17C			FHA-25C			FHA-32C			FHA-40C		
	Actuator reduction ratio	50	100	160	50	100	160	50	100	160	50	100	160
	Combined driver	HA-800B-3A-200			HA-800B-3A-200			HA-800B-6A-200			HA-800B-6A-200		
d13	Applicable actuator Code	5218	5238	5248	5418	5438	5448	5618	5638	5648	5718	5738	5748
AJ00	Position loop gain (default)	40	40	40	40	40	40	40	40	40	40	40	40
AJ01	Speed loop gain (default)	25	25	25	50	50	50	80	80	80	120	120	120
AJ02	Speed loop integral compensation (default)	40	40	40	50	50	50	40	40	40	70	70	70
AJ04	In-position range (default)	10	10	10	10	10	10	10	10	10	10	10	10
SP49	Allowable position deviation (default)	100	100	100	100	100	100	100	100	100	100	100	100
SP51	Speed input factor (default)	4800	4800	4800	4500	4500	4500	4000	4000	4000	3500	3500	3500
SP60	Automatic gain (default)	0	0	0	0	0	0	0	0	0	0	0	0
SP61	Encoder monitor Output pulses (default)	1	1	1	1	1	1	1	1	1	1	1	1
SP69	Feed-forward control function setting	0	0	0	0	0	0	0	0	0	0	0	0

FHA-C absolute series (voltage: 100V)

	Actuator model No.	FHA-17C			FHA-25C			FHA-32C		
	Actuator reduction ratio	50	100	160	50	100	160	50	100	160
	Combined driver	HA-800B-3A-100			HA-800B-6A-100			HA-800B-6A-100		
d13	Applicable actuator Code	5118	5138	5148	5318	5338	5348	5518	5538	5548
AJ00	Position loop gain (default)	40	40	40	37	37	37	50	50	50
AJ01	Speed loop gain (default)	50	50	50	50	50	50	120	120	120
AJ02	Speed loop integral compensation (default)	40	40	40	50	50	50	40	40	40
AJ04	In-position range (default)	10	10	10	10	10	10	10	10	10
SP49	Allowable position deviation (default)	100	100	100	100	100	100	100	100	100
SP51	Speed input factor (default)	4800	4800	4800	4500	4500	4500	3200	3200	3200
SP60	Automatic gain (default)	0	0	0	0	0	0	0	0	0
SP61	Encoder monitor Output pulses (default)	1	1	1	1	1	1	1	1	1
SP69	Feed-forward control function setting	0	0	0	0	0	0	0	0	0

RSF 14-wire incremental series (voltage: 200V)

	Actuator model No.	RSF-17A		RSF-20A		RSF-25A		RSF-32A		
	Actuator reduction ratio	50	100	50	100	50	100	50	100	160
	Combined driver	HA-800B-3B-200		HA-800B-3B-200		HA-800B-3B-200		HA-800B-6B-200		
d13	Applicable actuator Code	7365	7375	7465	7475	7565	7575	7665	7675	7685
AJ00	Position loop gain (default)	50	50	30	30	50	50	50	50	50
AJ01	Speed loop gain (default)	30	30	35	35	40	40	50	50	50
AJ02	Speed loop integral compensation (default)	50	50	30	30	50	50	50	50	50
AJ04	In-position range (default)	10	10	10	10	10	10	10	10	10
SP49	Allowable position deviation (default)	100	100	100	100	100	100	100	100	100
SP51	Speed input factor (default)	3000	3000	3000	3000	3000	3000	3000	3000	3000
SP60	Automatic gain (default)	0	0	0	0	0	0	0	0	0
SP61	Encoder monitor Output pulses (default)	1	1	1	1	1	1	1	1	1
SP69	Feed-forward control function setting	0	0	0	0	0	0	0	0	0

HMA series (voltage: 200V/100V)

	Motor model No.	HMAC08x	HMAB09x	HMAB12x	HMAB15	HMAA21A	HMAB09x
	Combined driver	HA-800B-3D/E-200		HA-800B-6D/ E-200	HA-800B-24D/E-200		HA-800B-6D/ E-100
d13	Applicable actuator Code	0011 0021	0031 0041	0071 0081	0091 0101	0111 0121	0051 0061
AJ00	Position loop gain (default)	40	40	40	40	40	40
AJ01	Speed loop gain (default)	20	25	56	8	26	25
AJ02	Speed loop integral compensation (default)	20	20	70	60	60	20
AJ04	In-position range (default)	150	150	150	150	150	150
SP49	Allowable position deviation (default)	1500	1500	1500	1500	1500	1500
SP51	Speed input factor (default)	6000	5600	4800	4000	3000	4800
SP60	Automatic gain (default)	0	0	0	0	0	0
SP61	Encoder monitor Output pulses (default)	8192	8192	8192	8192	8192	8192
SP69	Feed-forward control function setting	3	3	3	3	3	3

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Appendix

A -2 Regenerative resistor

The following explains the built-in regenerative resistor and external regenerative resistance of the driver.

Built-in driver regenerative resistor and regenerative power

Putting a brake on the machine's movement causes the rotational energy of the machine (including the actuator) to be returned to the driver. This electric energy is called regeneration capacity. The energy returned is called regenerative energy and regenerative energy per unit time is called regenerative power.
Regenerative energy is absorbed as electric energy by the power smoothing capacitor in the driver. If the regenerative energy produced by braking increases and exceeds the energy absorbable to the capacitor, the excess regenerative energy is absorbed (consumed) by a regenerative resistor.
Different HA-800B drivers come with or without a built-in regenerative resistor, as shown in the table below. You can connect an external regenerative resistor to handle the excess regenerative power or regenerative energy that cannot be absorbed (consumed) by the regenerative resistor in the driver.

<table>
<tr><th>Input voltage</th><th colspan="3">200V specification/100V specification</th><th>Power supply: 200V</th></tr>
<tr><th>Model</th><th>HA-800B-1</th><th>HA-800B-3</th><th>HA-800B-6</th><th>HA-800B-24</th></tr>
<tr><td>Driver’s rated current</td><td>1.5 A</td><td>3.0 A</td><td>6 A</td><td>24A</td></tr>
<tr><td>Regenerative processing</td><td>Terminal for mounting external regenerative resistance provided</td><td colspan="3">Regenerative resistor contained
Terminal for mounting external regenerative resistance provided</td></tr>
<tr><td>Power absorbed by built-in regenerative resistor</td><td>–</td><td>3W max.</td><td>8W max.</td><td>90W max.</td></tr>
<tr><td>Allowable absorption energy per regenerative operation (holding) when a built-in regenerative resistor is used
(repeat cycle)</td><td rowspan="2">30J (Power supply: 200V)
53J (Power supply: 100V)
*1, *2</td><td>90J (Power supply: 200V)
110J (Power supply: 100V)
*2</td><td>220J (Power supply: 200V)
260J (Power supply: 100V)
*2</td><td>1600J
*2</td></tr>
<tr><td>Allowable absorption energy per regenerative operation (holding) when a built-in regenerative resistor is used
(non-repeating cycle)</td><td>150J</td><td>420J</td><td>2,400J</td></tr>
<tr><td>Explanation</td><td>There is no built-in regenerative resistor. Normally you don't need any external regenerative resistor. Connect an external regenerative resistor if the smoothing capacitor in the driver cannot absorb the regenerative energy fully.</td><td colspan="3">Connect an external regenerative resistor if the regenerative power is greater than the power absorbed by the built-in regenerative resistor.</td></tr>
</table>

*1: Standard value of power absorbed by an electrode capacitor
*2: 200V specification is the standard value for when the input voltage is AC200V. 100V specification is the standard value for when the input voltage is AC100V.

Examination of regenerative energy

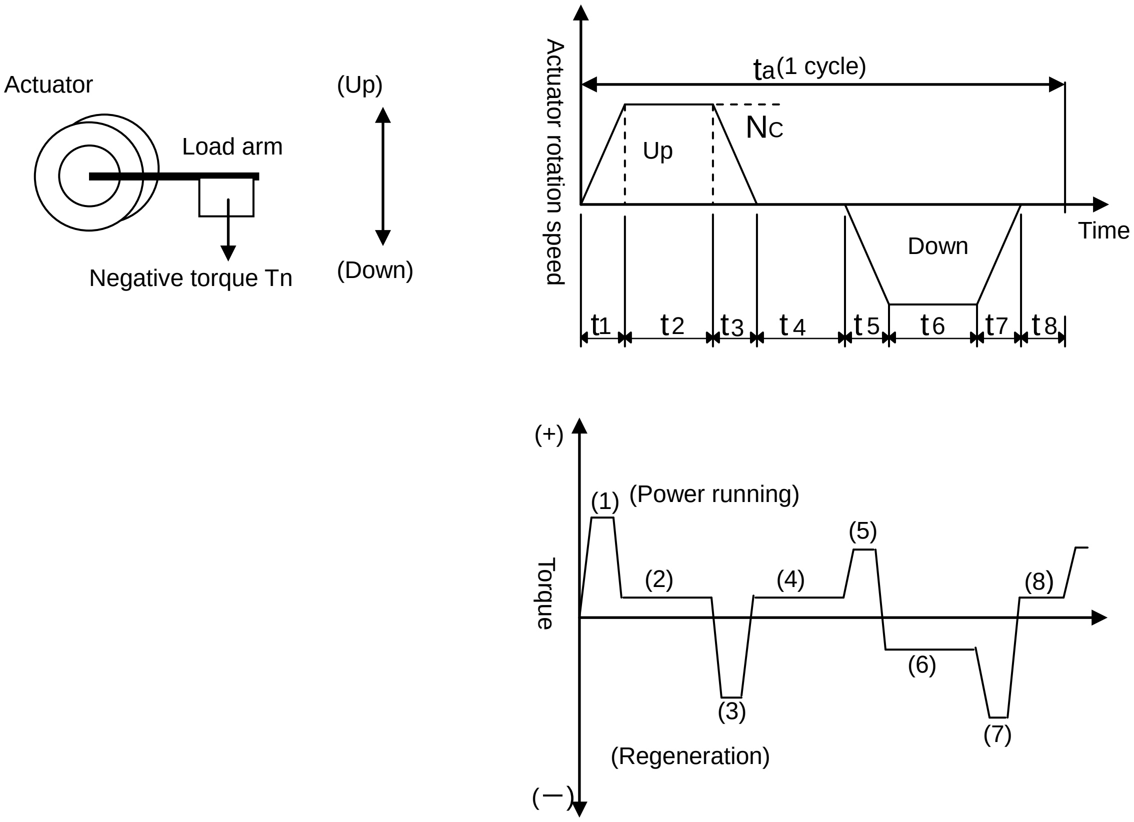
Examine installing a regenerative resistor in the following conditions:

- Drive with high inertia moment and load
- The system is stopped frequently.
- Continuous regeneration occurs such as when the load moves up and down

In these cases, calculate the regenerative energy and check the power that can be absorbed by the built-in regenerative resistor of the driver. If the regenerative energy is greater, install an external regenerative resistor.

Calculation of regenerative energy

Calculate the regenerative energy by assuming that the machine operates as shown below.



Tn: Negative torque of load   Tf: Friction torque of drive-train
Ja: Inertia moment of actuator
Jm: Inertia moment of load
Nc: Max. rotation speed during actuator operation (r/min)

Step	Actuator output torque	Actuator output energy
(1)	T1 = (Ja + Jm) × (2π × Nc) / 60 × (1 / t1) + Tn + Tf	E1 = 1/2 × (2π × Nc) / 60 × T1 × t1
(2)	T2 = Tn + Tf	E2 = (2π × Nc) / 60 x T2 x t2
(3)	T3 = - (Ja + Jm) × (2π × Nc) / 60 × (1 / t3) + Tn + Tf	E3 = 1/2 × (2π × Nc) / 60 × T3 × t3
(4), (8)	T4 = Tn	0 (Regenerative energy is 0, because the actuator is stopped.)
(5)	T5 = (Ja + Jm) × (2π × Nc) / 60 × (1 / t5) - Tn + Tf	E5 = 1/2 × (2π × Nc) / 60 × T5 × t5
(6)	T6 = -Tn + Tf	E6 = (2π × Nc) / 60 x T6 x t6
(7)	T7 = - (Ja + Jm) × (2π × Nc) / 60 × (1 / t7) - Tn + Tf	E5 = 1/2 × (2π × Nc) / 60 × T7 × t7

Of energies E1 to E8, negative energies are added up and the absolute value of this total sum gives the regenerative energy <Es>.
If E3, E6 and E7 are negative in the above example, the total regenerative energy is calculated as follows:

Es = |E3 + E6 + E7|

Energy absorbed by external regenerative resistor

The table below lists the regenerative energies that can be absorbed by the power smoothing capacitor of the HA-800B driver and capacities of the driver's built-in regenerative resistor R.

Driver model	Energy absorbed by built-in capacitor Ec (J) *1	Built-in regenerative resistor specification		Min. allowable external resistance (Ω)
		Absorption capacity Wi (W) *2	Resistance (Ω)	
HA-800B-1	30	−	−	33Ω - 5%
HA-800B-3	30	3W max.	50Ω ± 5%	33Ω - 5%
HA-800B-6	52	8W max.	33Ω ± 5%	33Ω - 5%
HA-800B-24	78	90W max.	10Ω±5%	10Ω−5%

*1: The value of capacitor-absorbed energy Ec represents the standard absorption level of the capacitor at the driver's main service input voltage AC200V. Energy absorbed by built-in capacitor significantly varies depending on input voltage and drive pattern. It also varies over time. Derate the rated capacity to 50% of the standard absorption level as a guideline and perform the calculation.

*2: Absorption capacity refers to the size of regenerative power that can be absorbed by the resistor when its rated capacity is derated.

Calculate the regenerative energy that must be absorbed by the regenerative resistor using each of the values above. Divide the regenerative energy by the operation cycle time to calculate the regenerative power that needs to be absorbed by the regenerative resistor <We>.

We [W] = (Es - Ec) / ta

If <We> is less than the power absorbed by a built-in regenerative resistor <Wi>, no external regenerative resistor is required. If <We> exceeds <Wi>, select an appropriate external regenerative resistor according to the capacity of <We>. Select a resistance equal to or greater than the applicable minimum allowable resistance shown in the table.
When you use an external regenerative resistor, remove the short bar to separate the built-in regenerative resistor from the circuit. The built-in regenerative resistor stops absorbing regenerative energy and thus stops generating heat. This allows connecting a large external regenerative resistor.
* HA-800B-24 allows monitoring regenerative power.

External regenerative resistor

An external regenerative resistor must be provided by the customer. Select an appropriate regenerative resistor by referring to the example below.

Examples of recommended products

Driver model	resistor	Remarks
HA-800B-1	RH220B33ΩJ Iwaki Musen Kenkyusho Co., Ltd.	Allowable absorption power: Approximately 20 to 30W (depends on the cooling conditions) Allowable absorption energy per regenerative operation: 2200J
HA-800B-3		
HA-800B-6		
HA-800B-24	RH500 20ΩJ (Parallel connection of 2 resistors) Iwaki Musen Kenkyusho Co., Ltd.	Allowable absorption power: Approximately 150W (depends on the cooling conditions) Allowable absorption energy per regenerative operation: 13000J Connect 2 resistors in parallel. (Refer to the connection example below.)
	RH500 10ΩJ (Parallel connection in series of 4 resistors) Iwaki Musen Kenkyusho Co., Ltd.	Allowable absorption power: Approximately 300W (Varies depending on the cooling conditions) Allowable absorption energy per regenerative operation: 36,000J Connect four resistors in series and parallel. (Refer to the connection example below.)

Derating the external regenerative resistor

Rise in regenerative resistor temperature

Power resistors used as regenerative resistors consume a large amount of power and become very hot. Be sure to derate the rated capacity of your resistor. Without proper derating, the resistor may present problems such as becoming heated to several hundred degrees or failing prematurely.

Derating

Check the load characteristics of your resistor with its manufacturer. Basically the derating ratio should be 20% or less if the driver is used in a condition of natural convection cooling. Follow the internal standard of your company.

Layout and wiring of external regenerative resistor, and parameter setting

Layout

Regenerative resistors may be heated to 100℃ or more above the ambient temperature. Carefully determine the position of the radiation, installation position, wiring path, etc.

Wiring

Use flame-resistant wires to wire the resistor by avoiding contact between the wires and resistor body. Be sure to use twisted pair wires when connecting to the servo amplifier, and keep the wiring distance to no longer than 5m.

Parameter

When using an external regenerative resistor in HA-800B-24, set [SP64: Regenerative resistor selection] to [1]. For details, refer to [SP64: Regenerative resistor selection] (P8-8).

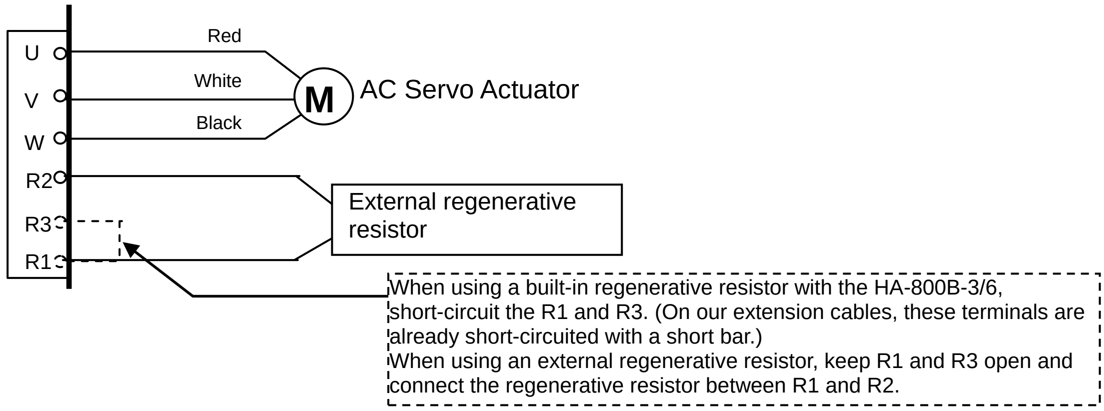
CAUTION

Regenerative resistors become very hot. Determine the position of the radiation, installation position, wiring path, etc. by giving thorough consideration to safety.

Connecting to the driver

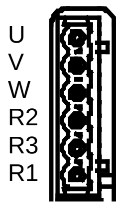
Connect the external regenerative resistor between the R1 and R2 terminals of the HA-800B driver.

HA-800B-1, -3 and -6

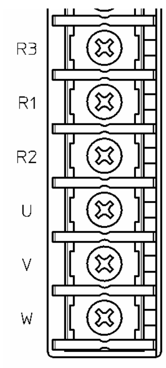


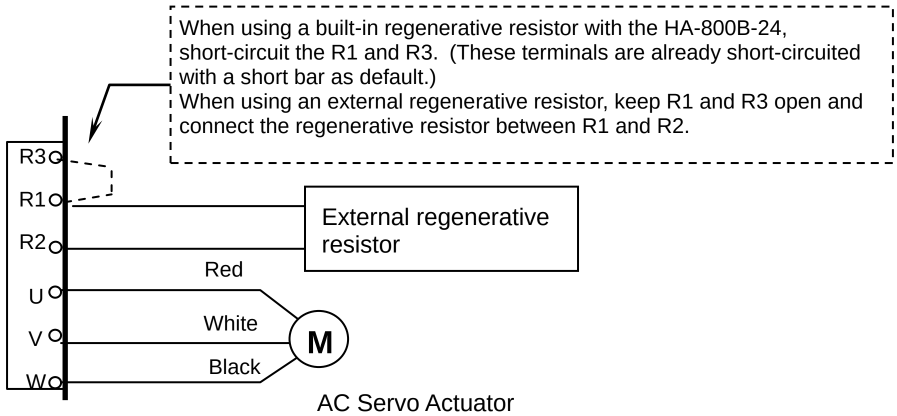
Terminal block for motor connection (for TB1)

Manufacturer	Phoenix Contact
Model	FKIC2.5/6-ST-5.08



HA-800B-24





Terminal block for motor connection

Screw size	Crimp terminal outer diameter	Reference
M4	φ8mm	Round crimp terminal (R-type) 3.5-R4 (J.S.T. Mfg. Co., Ltd.) 5.5-4NS (J.S.T. Mfg. Co., Ltd.)

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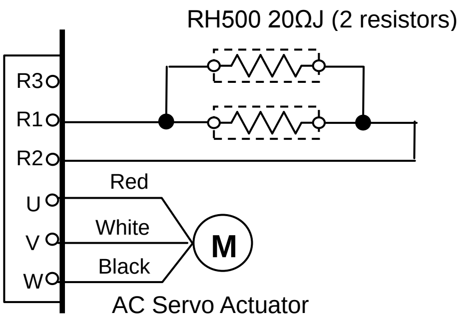
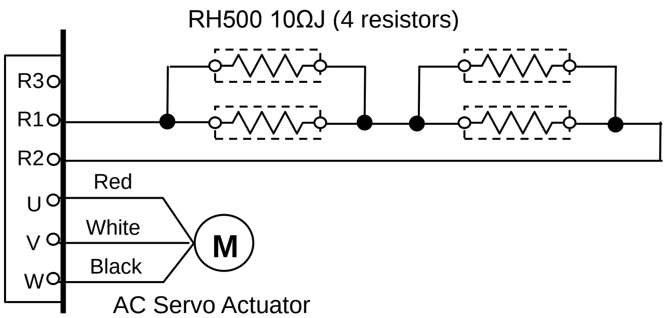
Appendix

Connection example of the external regenerative resistor

Regenerative power: 150W



Regenerative power: 300W



Allowable load inertia

The following is a list of recommended allowable inertia in a horizontal drive at the max. rotational speed (The input voltages are AC200V for 200V specifications, AC100V for 100V specifications). (The allowable load inertia varies depending on the motor speed, operation pattern, and input voltage etc. during an actual operation.)
When a regenerative resistor (built-in or external) is used, it should be utilized within its allowable absorption power or allowable absorption energy.
The parentheses in the "Allowable load inertia moment when an external regenerative resistor is used" field is the same as the allowable load inertia moment when a built-in regenerative resistor is used (repeating cycle / non-repeating cycle). In this case, use is possible up to the allowable load inertia moment with a built-in regenerative resistor.

SHA series (voltage: 200V)

Actuator model No.		SHA20A-SG				
Actuator reduction ratio		51	81	101	121	161
Combined driver		HA-800B-3D/E-200				
Max. rotational speed	r/min	117.6	74.1	59.4	49.6	37.3
Actuator inertia moment (Without brake)	kg·m^2	0.23	0.58	0.91	1.30	2.3
	kgf·cm·s^2	2.4	6.0	9.3	13	24
Actuator Inertia moment (With brake)	kg·m^2	0.26	0.65	1.00	1.4	2.6
	kgf·cm·s^2	2.6	6.6	10	15	26.0
Allowable load inertia moment when a built-in regenerative resistor is used (repeat cycle)	kg·m^2	0.93	2.3	3.6	5.1	7.7
	kgf·cm·s^2	9.5	23	37	52	78
Allowable load inertia moment when a built-in regenerative resistor is used (non-repeating cycle)	kg·m^2	1.7	3.8	4.8	5.8	7.7
	kgf·cm·s^2	17.3	39	49	59	78
Allowable load inertia moment when an external regenerative resistor is used	kg·m^2	2.4	3.8	4.8	5.8	(7.7)
	kgf·cm·s^2	25	39	49	59	(78)
	External regenerative resistor	RH220B33ΩJ				

Actuator model No.		SHA25A-SG/HP					
Actuator reduction ratio		11	51	81	101	121	161
Combined driver		HA-800B-3D/E-200					
Max. rotational speed	r/min	509.1	109.8	69.1	55.4	46.3	34.8
Actuator inertia moment (Without brake)	kg·m^2	0.029	0.56	1.4	2.2	3.2	5.6
	kgf·cm·s^2	0.30	5.7	14	22	32	57
Actuator Inertia moment (With brake)	kg·m^2	0.034	0.66	1.7	2.6	3.7	6.6
	kgf·cm·s^2	0.35	6.7	17	26	38	67
Allowable load inertia moment when a built-in regenerative resistor is used (repeat cycle)	kg·m^2	0.034	0.79	2.0	3.1	4.4	7.9
	kgf·cm·s^2	0.347	8.1	20.4	31.6	44.9	80.6
Allowable load inertia moment when a built-in regenerative resistor is used (non-repeating cycle)	kg·m^2	0.071	1.3	3.4	5.4	7.7	13.8
	kgf·cm·s^2	0.724	13.2	34.7	55.1	78.5	140
Allowable load inertia moment when an external regenerative resistor is used	kg·m^2	0.32	5.6	8.8	11	14	20
	kgf·cm·s^2	3.3	57	90	112	144	201
	External regenerative resistor	RH220B33ΩJ					

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Appendix

Actuator model No.		SHA32A-SG/HP					
Actuator reduction ratio		11	51	81	101	121	161
Combined driver		HA-800B-6D/E-200					
Max. rotational speed	r/min	436.4	94.1	59.3	47.5	39.7	29.8
Actuator inertia moment (Without brake)	kg·m^2	0.091	2.0	5.1	8.0	11	20
	kgf·cm·s^2	0.93	21	52	81	117	207
Actuator Inertia moment (With brake)	kg·m^2	0.11	2.3	5.9	9.2	13	23
	kgf·cm·s^2	1.1	24	60	94	135	238
Allowable load inertia moment when a built-in regenerative resistor is used (repeat cycle)	kg·m^2	0.11	2.3	5.9	9.2	13	23
	kgf·cm·s^2	1.1	24	60	94	135	238
Allowable load inertia moment when a built-in regenerative resistor is used (non-repeating cycle)	kg·m^2	0.28	6.0	15.3	24	33	60
	kgf·cm·s^2	2.8	61.2	156	244	336	612
Allowable load inertia moment when an external regenerative resistor is used	kg·m^2	0.99	20	32	40	50	70
	kgf·cm·s^2	10	200	320	400	510	710
	External regenerative resistor	RH220B33ΩJ					

Actuator model No.		SHA40A-SG									
Actuator reduction ratio		51	81	101	121	161	51	81	101	121	161
Combined driver		HA-800B-6D/E-200					HA-800B-24D/E-200				
Max. rotational speed	r/min	78.4	49.4	39.6	33.1	24.8	78.4	49.4	39.6	33.1	24.8
Actuator inertia moment (Without brake)	kg·m^2	5.0	13	20	28	50	5.0	13	20	28	50
	kgf·cm·s^2	51	130	202	290	513	51	130	202	290	513
Actuator Inertia moment (With brake)	kg·m^2	6.1	15	24	34	61	6.1	15	24	34	61
	kgf·cm·s^2	62	157	244	350	619	62	157	244	350	619
Allowable load inertia moment when a built-in regenerative resistor is used (repeat cycle)	kg·m^2	1.2	3	4.8	6.8	12.2	40	92	114	137	182
	kgf·cm·s^2	12.2	30.6	49	69	124	408	930	1170	1400	1860
Allowable load inertia moment when a built-in regenerative resistor is used (non-repeating cycle)	kg·m^2	6.1	15	24	34	61	58	92	114	137	182
	kgf·cm·s^2	62.2	153	244	346	622	590	930	1170	1400	1860
Allowable load inertia moment when an external regenerative resistor is used	kg·m^2	58	92	114	137	182	58	(92)	(114)	(137)	(182)
	kgf·cm·s^2	590	930	1170	1400	1860	590	(930)	(1170)	(1400)	(1860)
	External regenerative resistor	RH220B33ΩJ					Connect two RH500_20ΩJ in parallel, or connect four RH500_10ΩJ in parallel.				

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Appendix

Actuator model No.		SHA45A-SG					SHA58A-SG			
Actuator reduction ratio		51	81	101	121	161	81	101	121	161
Combined driver		HA-800B-24D/E-200					HA-800B-24D/E-200			
Max. rotational speed	r/min	74.5	46.9	37.6	31.4	23.6	37.0	29.7	24.8	18.6
Actuator inertia moment (Without brake)	kg·m^2	6.8	17	27	38	68	96	149	214	379
	kgf·cm·s^2	69	175	272	390	690	980	1520	2180	3870
Actuator Inertia moment (With brake)	kg·m^2	7.9	20	31	45	79	106	165	237	420
	kgf·cm·s^2	81	204	316	454	804	1090	1690	2420	4290
Allowable load inertia moment when a built-in regenerative resistor is used (repeat cycle)	kg·m^2	43.5	110	148	178	236	111	173	249	441
	kgf·cm·s^2	444	1122	1514	1814	2413	1133	1765	2541	4500
Allowable load inertia moment when a built-in regenerative resistor is used (non-repeating cycle)	kg·m^2	70	119	148	178	236	212	330	474	840
	kgf·cm·s^2	714	1215	1514	1814	2413	2160	3360	4830	8570
Allowable load inertia moment when an external regenerative resistor is used	kg·m^2	75	119	(148)	(178)	(236)	290	450	640	1140
	kgf·cm·s^2	766	1215	(1514)	(1814)	(2413)	2900	4600	6500	11600
	External regenerative resistor	Connect two RH500_20ΩJ in parallel, or connect four RH500_10ΩJ in parallel.					Connect two RH500_20ΩJ in parallel, or connect four RH500_10ΩJ in parallel.			

Actuator model No.		SHA65A-SG			
Actuator reduction ratio		81	101	121	161
Combined driver		HA-800B-24D/E-200			
Max. rotational speed	r/min	34.6	27.7	23.1	17.4
Actuator inertia moment (Without brake)	kg·m^2	110	171	245	433
	kgf·cm·s^2	1120	1740	2500	4420
Actuator Inertia moment (With brake)	kg·m^2	120	187	268	475
	kgf·cm·s^2	1230	1910	2740	4850
Allowable load inertia moment when a built-in regenerative resistor is used (repeat cycle)	kg·m^2	128	200	288	508
	kgf·cm·s^2	1306	2041	2939	5184
Allowable load inertia moment when a built-in regenerative resistor is used (non-repeating cycle)	kg·m^2	240	374	536	950
	kgf·cm·s^2	2440	3810	5460	9690
Allowable load inertia moment when an external regenerative resistor is used	kg·m^2	360	560	810	1420
	kgf·cm·s^2	3700	5700	8200	14500
	External regenerative resistor	Connect two RH500_20ΩJ in parallel, or connect four RH500_10ΩJ in parallel.			

Actuator model No.		SHA20A-CG					SHA25A-CG				
Actuator reduction ratio		50	80	100	120	160	50	80	100	120	160
Combined driver		HA-800B-3D/E-200					HA-800B-3D/E-200				
Max. rotational speed	r/min	120	75	60	50	37.5	112	70	56	46.7	35
Actuator inertia moment (Without brake)	kg·m^2	0.21	0.53	0.82	1.2	2.1	0.50	1.3	2.0	2.9	5.1
	kgf·cm·s^2	2.1	5.4	8.0	12	22	5.1	13.0	20	29	52
Actuator Inertia moment (With brake)	kg·m^2	0.23	0.60	0.94	1.3	2.4	0.60	1.5	2.4	3.4	6.1
	kgf·cm·s^2	2.4	6.1	9.6	14	24	6.1	16	24	35	62
Allowable load inertia moment when a built-in regenerative resistor is used (repeat cycle)	kg·m^2	0.93	2.3	3.6	5.1	7.7	0.72	1.8	2.9	4.1	7.3
	kgf·cm·s^2	9.5	23	37	52	78	7.3	18	30	42	74
Allowable load inertia moment when a built-in regenerative resistor is used (non-repeating cycle)	kg·m^2	1.6	3.8	4.8	5.8	7.7	1.6	3.9	6.2	8.8	16
	kgf·cm·s^2	16.3	39	49	59	78	16.3	40	63	90	163
Allowable load inertia moment when an external regenerative resistor is used	kg·m^2	2.4	3.8	4.8	5.8	(7.7)	5.6	8.8	11	14	20
	kgf·cm·s^2	25	39	49	59	(78)	57	90	112	144	201
	External regenerative resistor	RH220B33ΩJ					RH220B33ΩJ				

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Appendix

Actuator model No.		SHA32A-CG				
Actuator reduction ratio		50	80	100	120	160
Combined driver		HA-800B-6D/E-200				
Max. rotational speed	r/min	96	60	48	40	30
Actuator inertia moment (Without brake)	kg·m^2	1.7	4.3	6.7	9.7	17
	kgf·cm·s^2	17	44	68	99	175
Actuator Inertia moment (With brake)	kg·m^2	2.0	5.1	7.9	11	20
	kgf·cm·s^2	20	52	81	116	207
Allowable load inertia moment when a built-in regenerative resistor is used (repeat cycle)	kg·m^2	2.4	6.1	9.5	13	24
	kgf·cm·s^2	24	62	97	133	245
Allowable load inertia moment when a built-in regenerative resistor is used (non-repeating cycle)	kg·m^2	6	15	24	34	61
	kgf·cm·s^2	61	153	245	347	622
Allowable load inertia moment when an external regenerative resistor is used	kg·m^2	20	32	40	50	70
	kgf·cm·s^2	200	320	400	510	710
	External regenerative resistor	RH220B33ΩJ				

Actuator model No.		SHA40A-CG									
Actuator reduction ratio		50	80	100	120	160	50	80	100	120	160
Combined driver		HA-800B-6D/E-200					HA-800B-24D/E-200				
Max. rotational speed	r/min	80	50	40	33.3	25	80	50	40	33.3	25
Actuator inertia moment (Without brake)	kg·m^2	4.8	12	19	27	49	4.8	12	19	27	49
	kgf·cm·s^2	49	124	194	280	497	49	124	194	280	497
Actuator Inertia moment (With brake)	kg·m^2	5.8	15	23	33	59	5.8	15	23	33	59
	kgf·cm·s^2	59	150	235	338	601	59	150	235	338	601
Allowable load inertia moment when a built-in regenerative resistor is used (repeat cycle)	kg·m^2	1.04	2.7	4.1	5.9	11	40	92	114	137	182
	kgf·cm·s^2	11	28	42	60	112	408	930	1170	1400	1860
Allowable load inertia moment when a built-in regenerative resistor is used (non-repeating cycle)	kg·m^2	5.8	15	23	33	59	58	92	114	137	182
	kgf·cm·s^2	59	153	235	337	602	590	930	1170	1400	1860
Allowable load inertia moment when an external regenerative resistor is used	kg·m^2	58	92	114	137	182	58	(92)	(114)	(137)	(182)
	kgf·cm·s^2	590	930	1170	1400	1860	590	(930)	(1170)	(1400)	(1860)
	External regenerative resistor	RH220B33ΩJ					Connect two RH500_20ΩJ in parallel, or connect four RH500_10ΩJ in parallel.				

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Appendix

SHA series (voltage: 100V)

Actuator model No.		SHA25A-SG					SHA25A-CG				
Actuator reduction ratio		51	81	101	121	161	50	80	100	120	160
Combined driver		HA-800B-6D/E-100					HA-800B-6D/E-100				
Max. rotational speed	r/min	94.1	59.2	47.5	39.6	29.8	96	60	48	40	30
Actuator inertia moment (Without brake)	$kg \cdot m^2$	0.56	1.42	2.2	3.2	5.6	0.50	1.3	2.0	2.9	5.1
	$kgf \cdot cm \cdot s^2$	5.7	14.4	22	32	57	5.1	13.0	20	29	52
Actuator Inertia moment (With brake)	$kg \cdot m^2$	0.66	1.66	2.6	3.7	6.6	0.60	1.5	2.4	3.4	6.1
	$kgf \cdot cm \cdot s^2$	6.7	17	26	38	67	6.1	16	24	35	62
Allowable load inertia moment when a built-in regenerative resistor is used (repeat cycle)	$kg \cdot m^2$	3.3	8.0	11	14	20	3.7	8.8	11	14	20
	$kgf \cdot cm \cdot s^2$	33.7	82	112	144	201	38	90	112	144	201
Allowable load inertia moment when a built-in regenerative resistor is used (non-repeating cycle)	$kg \cdot m^2$	5.6	8.8	11	14	20	5.6	8.8	11	14	20
	$kgf \cdot cm \cdot s^2$	57	90	112	144	201	57	90	112	144	201
Allowable load inertia moment when an external regenerative resistor is used	$kg \cdot m^2$	5.6	8.8	(11)	(14)	(20)	5.6	(8.8)	(11)	(14)	(20)
	$kgf \cdot cm \cdot s^2$	57	90	(112)	(144)	(201)	57	(90)	(112)	(144)	(201)
	External regenerative resistor	RH220B33ΩJ					RH220B33ΩJ				

FHA-Cmini series (voltage: 100V/200V)

Actuator model No.		FHA-8C			FHA-11C			FHA-14C		
Actuator reduction ratio		30	50	100	30	50	100	30	50	100
Combined driver		HA-800B-1*-100 HA-800B-1*-200			HA-800B-1*-100 HA-800B-1*-200			HA-800B-1*-100 HA-800B-1*-200		
Max. rotational speed	r/min	200	120	60	200	120	60	200	120	60
Actuator inertia moment	$kg \cdot m^2$	0.0026	0.0074	0.029	0.0060	0.017	0.067	0.018	0.050	0.20
	$kgf \cdot cm \cdot s^2$	0.027	0.075	0.30	0.061	0.17	0.68	0.18	0.51	2.0
Allowable load inertia moment when a regenerative resistor is disconnected (repeat cycle)	$kg \cdot m^2$	0.0078	0.022	0.087	0.018	0.051	0.20	0.054	0.15	0.60
	$kgf \cdot cm \cdot s^2$	0.081	0.23	0.90	0.18	0.51	2.0	0.54	1.5	6.0
Allowable load inertia moment when a regenerative resistor is disconnected (non-repeating cycle)	$kg \cdot m^2$	0.0078	0.022	0.087	0.018	0.051	0.20	0.054	0.15	0.60
	$kgf \cdot cm \cdot s^2$	0.081	0.23	0.90	0.18	0.51	2.0	0.54	1.5	6.0
Allowable load inertia moment when an external regenerative resistor is used	$kg \cdot m^2$	(0.0078)	(0.022)	(0.087)	(0.018)	(0.051)	(0.20)	(0.054)	(0.15)	(0.60)
	$kgf \cdot cm \cdot s^2$	(0.081)	(0.23)	(0.90)	(0.18)	(0.51)	(2.0)	(0.54)	(1.5)	(6.0)
	External regenerative resistor	RH220B33ΩJ			RH220B33ΩJ			RH220B33ΩJ		

FHA-C series (voltage: 200V)

Actuator model No.		FHA-17C					FHA-25C				
Actuator reduction ratio		50	80	100	120	160	50	80	100	120	160
Combined driver		HA-800B-3*-200					HA-800B-3*-200				
Max. rotational speed	r/min	96	60	48	40	30	90	56	45	37	28
Actuator inertia moment	kg·m^2	0.17	0.43	0.67	0.97	1.7	0.81	2.1	3.2	4.7	8.3
	kgf·cm·s^2	1.7	4.4	6.9	10	17	8.3	21	33	48	85
Allowable load inertia moment when a built-in regenerative resistor is used (repeat cycle)	kg·m^2	0.54	1.3	2.1	2.9	5.1	1.26	3.2	5.1	7.1	12.9
	kgf·cm·s^2	5.4	13	21	30	52	12.9	33	52	72	132
Allowable load inertia moment when a built-in regenerative resistor is used (non-repeating cycle)	kg·m^2	0.54	1.3	2.1	2.9	5.1	2.4	6.3	10	14	25
	kgf·cm·s^2	5.4	13	21	30	52	24	64	100	144	260
Allowable load inertia moment when an external regenerative resistor is used	kg·m^2	(0.54)	(1.3)	(2.1)	(2.9)	(5.1)	2.4	6.3	10	14	25
	kgf·cm·s^2	(5.4)	(13)	(21)	(30)	(52)	24	64	100	144	260
	External regenerative resistor	RH220B33ΩJ					RH220B33ΩJ				

Actuator model No.		FHA-32C					FHA-40C				
Actuator reduction ratio		50	80	100	120	160	50	80	100	120	160
Combined driver		HA-800B-6*-200					HA-800B-6*-200				
Max. rotational speed	r/min	80	50	40	33	25	70	43	35	29	22
Actuator inertia moment	kg·m^2	1.8	4.5	7.1	10.2	18.1	4.9	12.5	19.5	28.1	50
	kgf·cm·s^2	18	46	72	104	185	50	128	200	287	510
Allowable load inertia moment when a built-in regenerative resistor is used (repeat cycle)	kg·m^2	4.7	12	18	30	48	3.5	9.3	14	20	36
	kgf·cm·s^2	48	122	184	306	490	36	95	143	204	378
Allowable load inertia moment when a built-in regenerative resistor is used (non-repeating cycle)	kg·m^2	5.4	13	21	30	54	9.8	25	39	56	100
	kgf·cm·s^2	55	133	210	306	550	100	255	398	571	1020
Allowable load inertia moment when an external regenerative resistor is used	kg·m^2	5.4	13	21	(30)	54	15	37	60	84	150
	kgf·cm·s^2	55	133	210	(306)	550	150	378	610	860	1500
	External regenerative resistor	RH220B33ΩJ					RH220B33ΩJ				

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Appendix

FHA-C series (voltage: 100V)

Actuator model No.		FHA-17C					FHA-25C				
Actuator reduction ratio		50	80	100	120	160	50	80	100	120	160
Combined driver		HA-800B-3*-100					HA-800B-6*-100				
Max. rotational speed	r/min	96	60	48	40	30	90	56	45	37	28
Actuator inertia moment	kg·m^2	0.17	0.43	0.67	0.97	1.7	0.81	2.1	3.2	4.7	8.3
	kgf·cm·s^2	1.7	4.4	6.9	10	17	8.3	21	33	48	85
Allowable load inertia moment when a built-in regenerative resistor is used (repeat cycle)	kg·m^2	0.54	1.3	2.1	2.9	5.1	2.4	6.3	10	14	25
	kgf·cm·s^2	5.4	13	21	30	52	24	64	100	144	260
Allowable load inertia moment when a built-in regenerative resistor is used (non-repeating cycle)	kg·m^2	0.54	1.3	2.1	2.9	5.1	2.4	6.3	10	14	25
	kgf·cm·s^2	5.4	13	21	30	52	24	64	100	144	260
Allowable load inertia moment when an external regenerative resistor is used	kg·m^2	(0.54)	(1.3)	(2.1)	(2.9)	(5.1)	(2.4)	(6.3)	(10)	(14)	(25)
	kgf·cm·s^2	(5.4)	(13)	(21)	(30)	(52)	(24)	(64)	(100)	(144)	(260)
	External regenerative resistor	RH220B33ΩJ					RH220B33ΩJ				

Actuator model No.		FHA-32C				
Actuator reduction ratio		50	80	100	120	160
Combined driver		HA-800B-6*-100				
Max. rotational speed	r/min	64	40	32	26	20
Actuator inertia moment	kg·m^2	1.8	4.5	7.1	10.2	18.1
	kgf·cm·s^2	18	46	72	104	185
Allowable load inertia moment when a built-in regenerative resistor is used (repeat cycle)	kg·m^2	5.4	13	21	30	54
	kgf·cm·s^2	55	133	210	306	550
Allowable load inertia moment when a built-in regenerative resistor is used (non-repeating cycle)	kg·m^2	5.4	13	21	30	54
	kgf·cm·s^2	55	133	210	306	550
Allowable load inertia moment when an external regenerative resistor is used	kg·m^2	(5.4)	(13)	(21)	(30)	(54)
	kgf·cm·s^2	(55)	(133)	(210)	(306)	(550)
	External regenerative resistor	RH220B33ΩJ				

FHA-C-PR series (voltage: 200V)

Actuator model No.		FHA-17C-PR					FHA-25C-PR				
Actuator reduction ratio		50	80	100	120	160	50	80	100	120	160
Combined driver		HA-800B-3*-200					HA-800B-3*-200				
Max. rotational speed	r/min	96	60	48	40	30	90	56	45	37	28
Actuator inertia moment	$kg \cdot m^2$	0.21	0.53	0.83	1.2	2.1	0.9	2.3	3.5	5.2	9.2
	$kgf \cdot cm \cdot s^2$	2.1	5.4	8.5	12	21	9	23	37	53	94
Allowable load inertia moment when a built-in regenerative resistor is used (repeat cycle)	$kg \cdot m^2$	0.63	1.6	2.5	3.5	6.3	1.1	2.9	4.6	6.5	11.5
	$kgf \cdot cm \cdot s^2$	6.4	16.2	25.4	37	64	11.2	30	47	66	117
Allowable load inertia moment when a built-in regenerative resistor is used (non-repeating cycle)	$kg \cdot m^2$	0.63	1.6	2.5	3.5	6.3	2.5	6.3	10	14.2	25.5
	$kgf \cdot cm \cdot s^2$	6.4	16.2	25.4	37	64	28	70	107	159	281
Allowable load inertia moment when an external regenerative resistor is used	$kg \cdot m^2$	(0.63)	(1.6)	(2.5)	(3.5)	(6.3)	2.7	6.9	10.5	15.5	27.6
	$kgf \cdot cm \cdot s^2$	(6.4)	(16.2)	(25.4)	(37)	(64)	28	70	107	159	281
	External regenerative resistor	RH220B33ΩJ					RH220B33ΩJ				

Actuator model No.		FHA-32C-PR					FHA-40C-PR				
Actuator reduction ratio		50	80	100	120	160	50	80	100	120	160
Combined driver		HA-800B-6*-200					HA-800B-6*-200				
Max. rotational speed	r/min	80	50	40	33	25	70	43	35	29	22
Actuator inertia moment	$kg \cdot m^2$	2.1	5.3	8.2	12	21	5.5	14	22	32	56
	$kgf \cdot cm \cdot s^2$	21	54	84	121	215	56	143	223	321	569
Allowable load inertia moment when a built-in regenerative resistor is used (repeat cycle)	$kg \cdot m^2$	4.2	10.7	17	24	43	2.7	7	11	15	28
	$kgf \cdot cm \cdot s^2$	43	109	173	245	439	27.5	71	112	153	286
Allowable load inertia moment when a built-in regenerative resistor is used (non-repeating cycle)	$kg \cdot m^2$	6.3	15.8	24.6	35.4	63	10	26	40.5	58	104
	$kgf \cdot cm \cdot s^2$	64	161	251	367	642	102	265	413	592	1061
Allowable load inertia moment when an external regenerative resistor is used	$kg \cdot m^2$	6.3	15.8	24.6	35.4	63	16.5	42	66	95	168
	$kgf \cdot cm \cdot s^2$	64	161	251	367	642	168	428	673	979	1713
	External regenerative resistor	RH220B33ΩJ					RH220B33ΩJ				

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Appendix

FHA-C-PR series (voltage: 100V)

Actuator model No.		FHA-17C-PR					FHA-25C-PR				
Actuator reduction ratio		50	80	100	120	160	50	80	100	120	160
Combined driver		HA-800B-3*-100					HA-800B-6*-100				
Max. rotational speed	r/min	96	60	48	40	30	90	56	45	37	28
Actuator inertia moment	kg·m^2	0.21	0.53	0.83	1.2	2.1	0.9	2.3	3.5	5.2	9.2
	kgf·cm·s^2	2.1	5.4	8.5	12	21	9	23	37	53	94
Allowable load inertia moment when a built-in regenerative resistor is used (repeat cycle)	kg·m^2	0.63	1.6	2.5	3.5	6.3	2.7	6.9	10.5	15.5	27.6
	kgf·cm·s^2	6.4	16.2	25.4	37	64	28	40	107	159	281
Allowable load inertia moment when a built-in regenerative resistor is used (non-repeating cycle)	kg·m^2	0.63	1.6	2.5	3.5	6.3	2.7	6.9	10.5	15.5	27.6
	kgf·cm·s^2	6.4	16.2	25.4	37	64	28	40	107	159	281
Allowable load inertia moment when an external regenerative resistor is used	kg·m^2	(0.63)	(1.6)	(2.5)	(3.5)	(6.3)	(2.7)	(6.9)	(10.5)	(15.5)	(27.6)
	kgf·cm·s^2	(6.4)	(16.2)	(25.4)	(37)	(64)	(28)	(40)	(107)	(159)	(281)
	External regenerative resistor	RH220B33ΩJ					RH220B33ΩJ				

Actuator model No.		FHA-32C-PR				
Actuator reduction ratio		50	80	100	120	160
Combined driver		HA-800B-6*-100				
Max. rotational speed	r/min	64	40	32	26	20
Actuator inertia moment	kg·m^2	2.1	5.3	8.2	12	21
	kgf·cm·s^2	21	54	84	121	215
Allowable load inertia moment when a built-in regenerative resistor is used (repeat cycle)	kg·m^2	6.3	15.8	24.6	35.4	63
	kgf·cm·s^2	64	161	251	367	642
Allowable load inertia moment when a built-in regenerative resistor is used (non-repeating cycle)	kg·m^2	6.3	15.8	24.6	35.4	63
	kgf·cm·s^2	64	161	251	367	642
Allowable load inertia moment when an external regenerative resistor is used	kg·m^2	(6.3)	(15.8)	(24.6)	(35.4)	(63)
	kgf·cm·s^2	(64)	(161)	(251)	(367)	(642)
	External regenerative resistor	RH220B33ΩJ				

HMA series (voltage: 200V/100V)

Motor model No.		HMAC08	HMAB09	HMAB09	MAB12	HMAB15	HMAA21A
Combined driver		HA-800B-3D/E-200		HA-800B-6D/E-100	HA-800B-6D/E-200	HA-800B-24D/E-200	
Max. rotational speed	r/min	6000	5600	4800	4800	4000	3000
Actuator inertia moment (no brake)	$\times 10^{-4}$ kg·m^2	0.734	1.78	1.78	6.45	15.8	125
	$\times 10^{-4}$ kgf·cm·s^2	7.49	18.2	18.2	65.8	161	1280
Actuator inertia moment (with brake)	$\times 10^{-4}$ kg·m^2	0.828	2.16	2.16	6.83	19.8	141
	$\times 10^{-4}$ kgf·cm·s^2	8.45	22.1	22.1	69.7	202	1444
Allowable load inertia moment when a built-in regenerative resistor is used (repeat cycle)	$\times 10^{-4}$ kg·m^2	2.48	3.00	6.48	10.3	59.4	183
	$\times 10^{-4}$ kgf·cm·s^2	25.4	30.6	66.3	105	606	1867
Allowable load inertia moment when a built-in regenerative resistor is used (non-repeat cycle)	$\times 10^{-4}$ kg·m^2	2.48	6.48	6.48	20.5	59.4	338
	$\times 10^{-4}$ kgf·cm·s^2	25.4	66.3	66.3	209	606	3448
Allowable load inertia moment when an external regenerative resistor is used	$\times 10^{-4}$ kg·m^2	(2.48)	6.48	(6.48)	20.5	(59.4)	423
	$\times 10^{-4}$ kgf·cm·s^2	(25.4)	66.3	(66.3)	209	(606)	4332
	External regenerative resistor	RH220B33ΩJ				Connect two RH500_20ΩJ in parallel, or connect four RH500_10ΩJ in series and parallel.	

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Appendix

A -3 List of data retained in the driver

This is a list of data retained in the internal non-volatile memory (EEPROM) of the driver and a list of operations of the set values.
There are three types of data that are retained in the non-volatile memory. They are adjustment parameters, system parameters, network parameters.

Adjustment parameters AJxx

<table>
<tr><th rowspan="2">Symbol</th><th rowspan="2">Name</th><th colspan="3">Display, Edit, Save</th></tr>
<tr><th>Main unit display panel</th><th>Servo parameter setting Software PSF-800 *2</th><th>MECHATROLINK communication *3</th></tr>
<tr><td>AJ00</td><td>Position loop gain</td><td rowspan="20">Displaying set values
Editing set values</td><td rowspan="20">Displaying set values
Editing set values
Saving a file
(psf extension)</td><td rowspan="20">Displaying set values
Parameter read command
(PRM_RD:01H)
Editing set values
Parameter write command
(PRM_WR:02H)
Non-volatile parameter write command
(PPRM_WR:1Ch)

* Parameter No. 1 to 20</td></tr>
<tr><td>AJ01</td><td>Speed loop gain</td></tr>
<tr><td>AJ02</td><td>Speed loop integral compensation</td></tr>
<tr><td>AJ03</td><td>Feed-forward gain</td></tr>
<tr><td>AJ04</td><td>In-position range</td></tr>
<tr><td>AJ05</td><td>System reservation *1</td></tr>
<tr><td>AJ06</td><td>System reservation *1</td></tr>
<tr><td>AJ07</td><td>Zero speed judgment value</td></tr>
<tr><td>AJ08</td><td>System reservation *1</td></tr>
<tr><td>AJ09</td><td>System reservation *1</td></tr>
<tr><td>AJ10</td><td>System reservation *1</td></tr>
<tr><td>AJ11</td><td>System reservation *1</td></tr>
<tr><td>AJ12</td><td>Acceleration time constant (position control)
Acceleration/deceleration time constant (speed control)</td></tr>
<tr><td>AJ13</td><td>Deceleration time constant (position control)</td></tr>
<tr><td>AJ14</td><td>System reservation *1</td></tr>
<tr><td>AJ15</td><td>System reservation *1</td></tr>
<tr><td>AJ16</td><td>Speed monitor offset</td></tr>
<tr><td>AJ17</td><td>Current monitor offset</td></tr>
<tr><td>AJ18</td><td>FWD torque limit</td></tr>
<tr><td>AJ19</td><td>REV torque limit</td></tr>
<tr><td>AJ20</td><td>Feed-forward filter</td><td rowspan="20">Displaying set values
Editing set values</td><td rowspan="20">Displaying set values
Editing set values
Saving a file
(psf extension)</td><td rowspan="20">Displaying set values
Parameter read command
(PRM_RD:01H)
Editing set values
Parameter write command
(PRM_WR:02H)
Non-volatile parameter write command
(PPRM_WR:1Ch)

* Parameter No. 21 to 40</td></tr>
<tr><td>AJ21</td><td>Load inertia moment ratio</td></tr>
<tr><td>AJ22</td><td>Torque constant compensation factor</td></tr>
<tr><td>AJ23</td><td>Spring constant compensation factor</td></tr>
<tr><td>AJ24</td><td>Automatic positioning gain</td></tr>
<tr><td>AJ25</td><td>System reservation *1</td></tr>
<tr><td>AJ26</td><td>System reservation *1</td></tr>
<tr><td>AJ27</td><td>System reservation *1</td></tr>
<tr><td>AJ28</td><td>System reservation *1</td></tr>
<tr><td>AJ29</td><td>System reservation *1</td></tr>
<tr><td>AJ30</td><td>System reservation *1</td></tr>
<tr><td>AJ31</td><td>System reservation *1</td></tr>
<tr><td>AJ32</td><td>System reservation *1</td></tr>
<tr><td>AJ33</td><td>System reservation *1</td></tr>
<tr><td>AJ34</td><td>System reservation *1</td></tr>
<tr><td>AJ35</td><td>System reservation *1</td></tr>
<tr><td>AJ36</td><td>System reservation *1</td></tr>
<tr><td>AJ37</td><td>System reservation *1</td></tr>
<tr><td>AJ38</td><td>System reservation *1</td></tr>
<tr><td>AJ39</td><td>System reservation *1</td></tr>
<tr><td>AJ40 to AJ59</td><td>System reservation *1</td><td>Displaying set values</td><td>Displaying set values
Saving a file
(psf extension)</td><td>Displaying set values
Parameter read command
(PRM_RD:01H)

* Parameter No. 41 to 60</td></tr>
</table>

*1: Do not change the parameters that are in the system reserved areas. The default setting of the system reservation may vary

depending on the model/version.
*2: If the set values change when the parameters are transferred between different models using PSF-800, it does not affect the product functions.
*3: When editing adjustment parameters using MECHATROLINK communication function, do not execute the parameter write command or non-volatile parameter write command for system reservation.

System parameter SPxx

* The setting change of the system parameters (SP40 to 79) is enabled by reconnecting the control power supply after changing the setting.

Symbol	Name	Display, Edit, Save		
		Main unit display panel	Servo parameter setting Software PSF-800 *2	MECHATROLINK communication *3
SP40	CN9-CP3 output signal setting	Displaying set values Editing set values	Displaying set values Editing set values Saving a file (psf extension)	Displaying set values Parameter read command (PRM_RD:01H) Editing set values Parameter write command (PRM_WR:02H) Non-volatile parameter write command (PPRM_WR:1Ch) * Parameter No. 61 to 80
SP41	System reservation *1			
SP42	System reservation *1			
SP43	System reservation *1			
SP44	Electronic gear 1 numerator			
SP45	Electronic gear 1 denominator			
SP46	System reservation *1			
SP47	System reservation *1			
SP48	Deviation clear upon servo-ON			
SP49	Allowable position deviation			
SP50	Command polarity			
SP51	Speed input factor			
SP52	System reservation *1			
SP53	System reservation *1			
SP54	Status display setting			
SP55	DB enable/disable setting			
SP56	System reservation *1			
SP57	System reservation *1			
SP58	System reservation *1			
SP59	Angle compensation enable/disable setting			
SP60	Automatic positioning gain Setting enable/disable setting	Displaying set values Editing set values	Displaying set values Editing set values Saving a file (psf extension)	Displaying set values Parameter read command (PRM_RD:01H) Editing set values Parameter write command (PRM_WR:02H) Non-volatile parameter write command (PPRM_WR:1Ch) * Parameter No. 81 to 100
SP61	Encoder monitor output pulses			
SP62	Input signal logic setting			
SP63	Output signal logic setting			
SP64	Regenerative resistor selection			
SP65	FWD/REV inhibit operation			
SP66	Absolute encoder function setting			
SP67	System reservation *1			
SP68	System reservation *1			
SP69	Feed-forward control function setting			
SP70	System reservation *1			
SP71	System reservation *1			
SP72	System reservation *1			
SP73	System reservation *1			
SP74	System reservation *1			
SP75	System reservation *1			
SP76	System reservation *1			
SP77	System reservation *1			
SP78	System reservation *1			
SP79	System reservation *1			

*1: Do not change the parameters that are in the system reserved areas. The default setting of the system reservation may vary depending on the model/version.
*2: If the set values change when the parameters are transferred between different models using PSF-800, it does not affect the product functions.
*3: When editing adjustment parameters using MECHATROLINK communication function, do not execute the parameter write command or non-volatile parameter write command for system reservation.

Network parameters

Symbol	Name	Display, Edit, Save		
		Main unit display panel	Servo parameter setting Software PSF-800 *2	MECHATROLINK communication *3
NP 00	System reservation *1	(Cannot be operated)	Displaying set values Editing set values Saving a file (psf extension)	Displaying set values Parameter read command (PRM_RD：01H) Editing set values Parameter write command (PRM_WR：02H) Non-volatile parameter write command (PPRM_WR：1Ch) * Parameter No. 101 to 110
NP 01	System reservation *1			
NP 02	System reservation *1			
NP 03	System reservation *1			
NP 04	Originating approach speed			
NP 05	Originating acceleration/deceleration time			
NP 06	Originating direction			
NP 07	Virtual origin *4			
NP 08	Origin position range			
NP 09	System reservation *1			
NP 10	FWD soft limit			
NP 11	System reservation *1			
NP 12	REV soft limit			
NP 13	System reservation *1			
NP 14	Final external positioning distance			
NP 15	System reservation *1			
NP 16	Soft limit enable/disable			
NP 17	System reservation *1			
NP 18	System reservation *1			
NP 19	System reservation *1			

*1: Do not change the parameters that are in the system reserved areas. The default setting of the system reservation may vary depending on the model/version.
*2: If the set values change when the parameters are transferred between different models using PSF-800, it does not affect the product functions.
*3: When editing adjustment parameters using MECHATROLINK communication function, do not execute the parameter write command or non-volatile parameter write command for system reservation.
*4: The setting change of the virtual origin is enabled by reconnecting the control power supply after changing the setting.

Apx
Appendix

A -4 Driver replacement procedures

The following explains the procedures to replace the HA-800B driver for maintenance.

Procedures	Description		Places to check/Manual
1	Checking the items (items to be replaced)	Check the nameplate of the driver currently used before the replacement. Check the type and combined actuator (ADJ.). ・TYPE: ____________________ ・Combined actuator (ADJ.): ____________________	Nameplate on the side of the driver main unit 2-1 Checking items
2	Checking the items (new items)	Check the nameplate of the new driver. Check that the type and combined actuator (ADJ.) are the same as the ones currently used. * If the type and combined actuator are different, it cannot be replaced.	
3	Checking the switch settings	Check the switch settings of the driver currently used before the replacement. ・Rotary switch (SW1 bit 2) transfer bytes: ________ ・Rotary switch (SW1 bit 1, SW2) station address: ________	Front side of the driver main unit, inside of the LED display cover 1-9 Name and function of each part of a display panel
4	Saving parameters *1	Save the parameters set in the driver currently used (retained in EEPROM) before the replacement. [Adjustment parameters] [System parameters] [Network parameters] ・Name of the file to save (psf extension): ____________	PSF-800 Communication software 10-4-1 Saving set values
5	Replacing items	(1) Disconnect the power to the driver. After confirming that the CHARGE lamp is turned OFF (or wait until the lamp is turned OFF), disconnect **all the wiring** from the driver to be replaced. (2) Remove the driver to be replaced from the control board. (3) Install the new driver to the control board. (4) **Connect the power wiring (TB2 or r, s, R, S, T)** and **ground wire** to the new driver. (5) Connect the **personal computer communication cable (CN3)** to the new driver. *(4)(5) By not connecting the actuator wiring, unexpected actuator operation can be avoided if an incorrect operation command is input during the replacement work.	

*1: If the parameter settings have not been changed and the default settings are used, and the new driver has the default parameter settings, it is not necessary to save/write the parameters.
If you do not know the using condition, save/write the parameters.

Procedures	Description		Places to check/Manual
6	Turn ON the control power supply	Connect the control power (r, s) to the new driver. Check that the driver starts and LED display section (7 segment LED) lights up. * At this time, an alarm may be displayed due to incomplete wiring or parameters not set. It does not affect the replacement work, so proceed to the next step of the procedure. * By connecting the control power (r, s) only, the driver main power supply is not charged. The time waiting for the CHARGE lamp to turn OFF (discharged) can be shortened during wiring work in step 10. * If the main power supply (R, S, T) cannot be connected separately, it is not a problem to connect both control power (r, s) and main power supply (R, S, T) simultaneously. In this case, perform the wiring work in step 8 after the CHARGE lamp is turned OFF (discharged) to prevent electrical shock.	
7	Writing parameters	Write the parameters saved in "4. Saving parameters" to the new driver. [Adjustment parameters] [System parameters] [Network parameters]	PSF-800 Communication software 10-4-4. Writing a saved settings file to the driver.
8	Wire connection Disconnect the power to the new driver.	After confirming that the CHARGE lamp is turned OFF (or wait until the lamp is turned OFF), **connect all the wiring**.	
9	Switch settings	Set the switch status noted in "3. Checking the switch settings" to the new driver. ・Rotary switch (SW1 bit 2) transfer bytes ・Rotary switch (SW1 bit 1, SW2) station address	Front side of the driver main unit, inside of the LED display cover 1-9 Display panel
		This completes the driver replacement work.	

CAUTION

This work requires wiring changes. Exercise caution to prevent accidents such as electric shock.

Index

A

Absolute encoder function setting........................ 8-9
Acceleration time constant................................ 7-14
Alarm 10-26
Alarm history clear 7-10
Alarm mode 7-8
Allowable position deviation................................ 8-4
Angle compensation enable/disable setting 8-6
Applicable actuator code 7-6
Automatic positioning gain................................ 7-17
Automatic positioning gain setting enable/disable setting 8-7
Auto-tuning 9-9, 10-8
Auto-tuning travel angle setting 9-11
Auto-tuning level selection................................ 9-12

B

Battery 3-22
Battery installment/replacement method............ 3-23
Battery voltage low 11-13
BUSY error 11-11

C

Cable size.. 2-6
CN9-CP3 output signal setting 8-3
Command data error 11-14
Command polarity 8-5
Command pulse display 7-5
Command error 11-14
Command data field 13-33
Communication error 11-11
Communication warning 11-14
Configuration diagram 1-3
Control mode 7-2, 13-42
Control power voltage low 11-5
Cooling fan stopped.. 11-13
Current monitor offset....................................... 7-15

D

Damaged power circuit..................................... 11-6
DB enable/disable setting................................... 8-6
Deceleration time constant 7-14
Default settings..A-1
Deviation clear upon servo-ON setting 8-4
Discharge time... 7-2
Display panel 1-14
Driver model 1-5
Driver specification 1-8
Driver replacement procedures A-30

E

Electronic gear setting 8-3
Encoder breakage 11-6
Encoder combination.. 4-2
Encoder monitor output pulses 8-7
Encoder receiving error 11-7
Environment 2-2, 10-1
Error pulse count display 7-3
Excessive deviation 11-9
Extension cable combinations 1-6
External drawing.. 1-12

F

Feedback pulse display 7-5
Feed-forward filter 7-16
Feed-forward gain 7-13
Feed-forward control function setting 8-9
FPGA configuration error.................................11-10
FPGA setting error..11-10
FWD inhibit input effective 11-14
FWD torque limit.. 7-15
FWD/REV inhibit operation................................. 8-8

G

Gain adjustment 3-14
Ground 2-9

I

I/O signal monitor 9-2
In-position range.. 7-13
Input signal logic setting 8-7
Internal function block diagram........................... 1-2
IO monitor.. 10-22
IPM error 11-3

J

JOG acceleration/deceleration time constant setting 9-5
JOG speed setting.. 9-4
JOG operation 9-6

L

List of data retained in the driver A-27
Load inertia moment ratio................................. 7-16

M

Main circuit power voltage 7-1
Main circuit voltage low 11-6
Main circuit voltage low 11-13
Main command.. 13-6
Memory failure..11-9
MEMORY error...11-10
Missing phase 11-5
Motor code 9-7
Motor rotation speed indication 7-1
Multi revolution clear 9-8
Multi revolution overflow....................................11-7
Multi revolution data error..................................11-8
Multi revolution data error................................11-10

N

Noise 2-15

O

Option.. 1-5, 12-1
Origin setting 4-7, 4-15, 4-26
Output signal logic setting 8-8
Output torque monitor... 7-1
Output signal operation 9-3
Output signal operation 10-21

Overheat error 11-11
Overheated dynamic brake 11-6
Overload 11-2
Overload rate display....................................7-1, 7-4
Overload status 11-13
Overregeneration.. 11-5
Overspeed 11-2
Overvoltage 11-4

P

Panel display 6-3
Parameter initialization 9-7
Parameter setting 10-10
Periodically replaced part 3-22
Position loop gain 3-14, 7-12
Present alarm/warning display............................ 7-9
Processor error... 11-10
PSF-800 10-1

R

Rating 1-8
Regenerative power 7-7
regenerative resistance 2-18
Regenerative resistor selection 8-8
Regenerative resistor overheat.......................... 11-4
Regenerative resistor A-9
REV inhibit input effective............................... 11-14
REV torque limit.. 7-15

S

Saving, comparing and copying set values...... 10-12
Single rotation data error 11-10
Specification (MECHATROLINK communication)
.... 13-1
Speed input factor setting 8-6
Speed loop gain.. 7-12
Speed loop integral compensation 7-13
Speed monitor offset... 7-15
Spring constant compensation factor................. 7-17
Status display 7-1
Status display setting... 8-6
Subcommand 13-29
Synchronization error 11-8
System failure..11-7, 11-10

T

Test operation... 10-19
Torque constant compensation factor................ 7-17
Tune mode 7-11

U

UVW error 11-7

W

Waveform monitoring 10-23
WDT error..11-8
Wrong actuator..11-14

Z

Zero speed judgment value 7-14

Warranty Period

The warranty period of the HA-800B series and warranty terms are explained below.

■ Warranty period

Under the condition that it is used properly according to each item specified in the manuals and operation manuals, this product is warranted for the period of 1 year after delivery or 2,000 hours of operation (this product), whichever ends first.

■ Warranty terms

If the product fails due to any defect in workmanship or material during the warranty period specified above, the defective product will be repaired or replaced free of charge.
This limited warranty does not apply to any product that has been subject to:
(1) improper handling or use by the customer;
(2) modification or repair carried out other than by Harmonic Drive Systems, Inc.;
(3) failure not attributable to this product; or
(4) natural disaster or any other event beyond the control of Harmonic Drive Systems, Inc.
The warranty covers only the above-named product purchased from Harmonic Drive Systems, Inc.
Harmonic Drive Systems, Inc. shall not be liable for any consequential damages of other equipment caused by the defective product, or expenses and labor costs for removing and installing the defective product from/to your system.

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