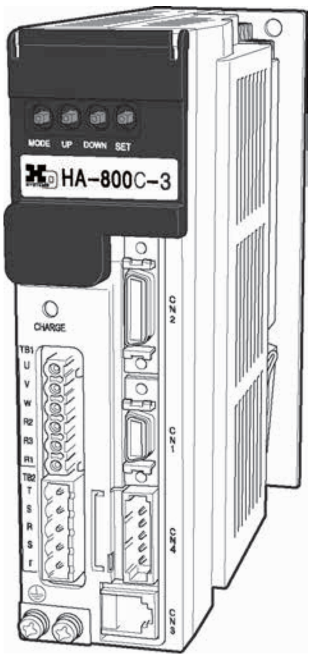
HarmonicDrive®

CC-Link

100V/200V power supply
AC Servo Driver (CC-Link Type)

HA-800C 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 HA-800C series servo driver.
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

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

SAFETY NOTE

- **CAUTIONS FOR ACTUATORS AT APPLICATION DESIGNING**

CAUTION

Always use 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 (Non-condensation)**
- **Vibration: Max 24.5 m/s^2**
- **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 motor shaft center and corresponding center in the application.**
- **Failure to observe this caution may lead to vibration, resulting in damage of output elements.**

- **CAUTION FOR ACTUATORS IN OPERATIONS**

WARNING

Never connect cables directly to a power supply socket.

- **Each actuator must be operated with a proper driver.**
- **Failure to observe this caution may lead to injury, fire or damage of 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 attached to output element hits by accident an solid, the output element may be uncontrollable.**

● CAUTIONS FOR DRIVERS AT APPLICATION DESIGNING

CAUTION

Always use drivers under followings 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 (Non condensation)**
- **No vibration or physical shock**
- **No corrosive, inflammable or explosive gas**

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 apply products for inverse load.**

Use a fast-response type ground-fault detector 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.

● CAUTION FOR DRIVERS IN OPERATIONS

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 personal injury.

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

- **Otherwise residual electric charges may result in electric shock. 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.

- **Failure to observe this caution may result in damage of the control unit.**
- **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 OF AN ACTUATOR, A MOTOR, A CONTROL UNIT AND/OR THEIR PARTS

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**	Explanation of 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.
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.
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	**CC-Link communication function**	Explains the specification, the wiring technique, and the setting method of CC-Link.
Appendix		The list of default parameters and regenerative resistors are explained.

Contents

Chapter 3 Startup

Chapter 4 Encoder system

Chapter 9 Test mode

Chapter 10 Communication software

Appendix

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 SHA-20A to SHA-65A 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**				
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-800C-1*, HA-800C-3*, HA-800C-6*, HA-800C-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 the Low Voltage Directive and EMC Directive conformance check test 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.

<u>Precautions on conformance to EMC Directives</u>

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)

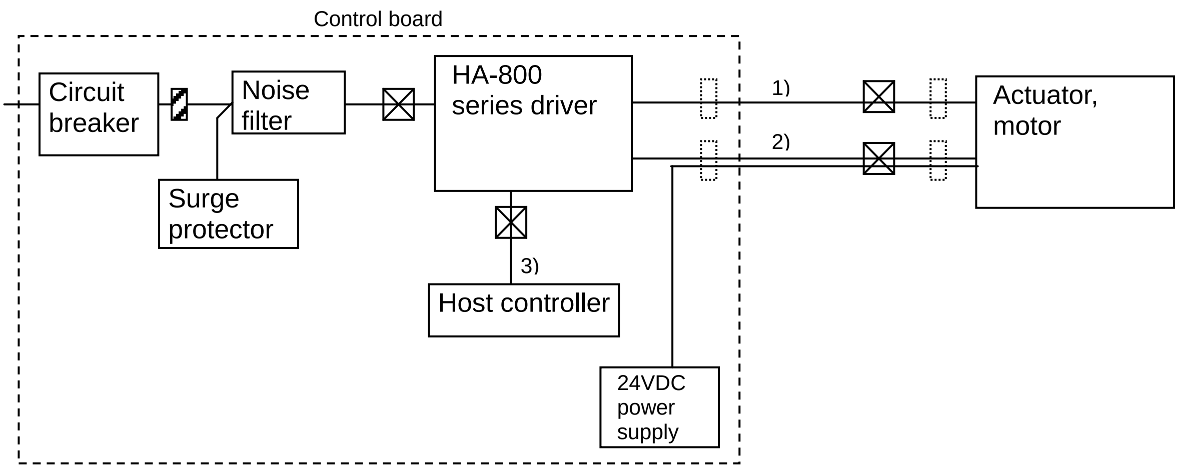
CAUTION

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

<u>Configuration of peripheral devices</u>

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

<u>Model configuration diagram</u>



: 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 550V Rated current: 20 A	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 550V Rated current: 30 A	RASMI ELECTRONICS LTD.	
RF3040-DLC	Rated voltage: Line-Line 440 to 550V Rated current: 40 A	RASMI ELECTRONICS LTD.	
HF3010A-UN	Rated voltage: AC250V Rated current: 10 A	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: 30 A	Soshin Electric Co., Ltd.	
HF3040A-UN	Rated voltage: AC250V Rated current: 40 A	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: 5 A	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 (3) and (5).
SUP-P10H-EPR	Rated voltage: AC250V Rated current: 10 A	Okaya Electric Industries Co., Ltd.	
3SUP-H5H-ER-4	Rated voltage: AC250V Rated current: 5 A	Okaya Electric Industries Co., Ltd.	
3SUP-H10H-ER-4	Rated voltage: AC250V Rated current: 10 A	Okaya Electric Industries Co., Ltd.	

(2) Toroidal core

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

The use of the insulation transformer is recommended in the place thought that the noise environment is severe though HA-800 series have an enough noise tolerance though it doesn't use the insulation transformer.

Driver Model	No. of phase	Power capacity (kVA)	
HA-800C-1∗	3	FHA-8,11C	0.15
		FHA-14C	0.25
HA-800C-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-800C-6∗	3	SHA25	0.8
		SHA32 FHA-32C RSF-32 RKF-32 HMAB12 MAB12	1.5
		SHA40 FHA-40C MAB15	1.8
HA-800C-24∗	3	SHA40 SHA45 HMAB15 MAB15	2.5
		SHA58 SHA65	3.5
		HMAA21A MAA21	5.5

<u>Protection to Ground fault / Ground fault test</u>

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-800C-1*-100	100	3.8	0.8	40	0.5750
HA-800C-3*-100	100	4.5	0.8	40	0.5750
HA-800C-6*-100	100	8.0	0.8	80	0.5750
HA-800C-1*-200	200	2.4	0.4	50	0.5750
HA-800C-3*-200	200	4.0	0.4	50	0.5750
HA-800C-6*-200	200	7.6	0.4	100	0.5750
HA-800C-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-800C-1*-100	100	3.8	30	0.3	0.03	666.6
HA-800C-3*-100	100	4.5	30	0.3	0.03	666.6
HA-800C-6*-100	100	8.0	30	0.3	0.03	666.6
HA-800C-1*-200	200	2.4	30	0.2	0.03	1333.3
HA-800C-3*-200	200	4.0	30	0.2	0.03	1333.3
HA-800C-6*-200	200	7.6	30	0.2	0.03	1333.3
HA-800C-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.

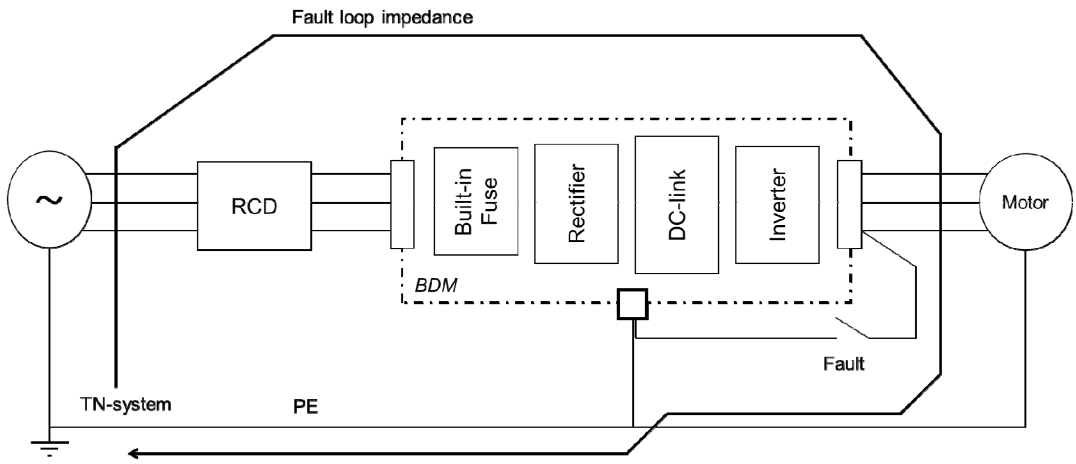


Figure. TN grounding system

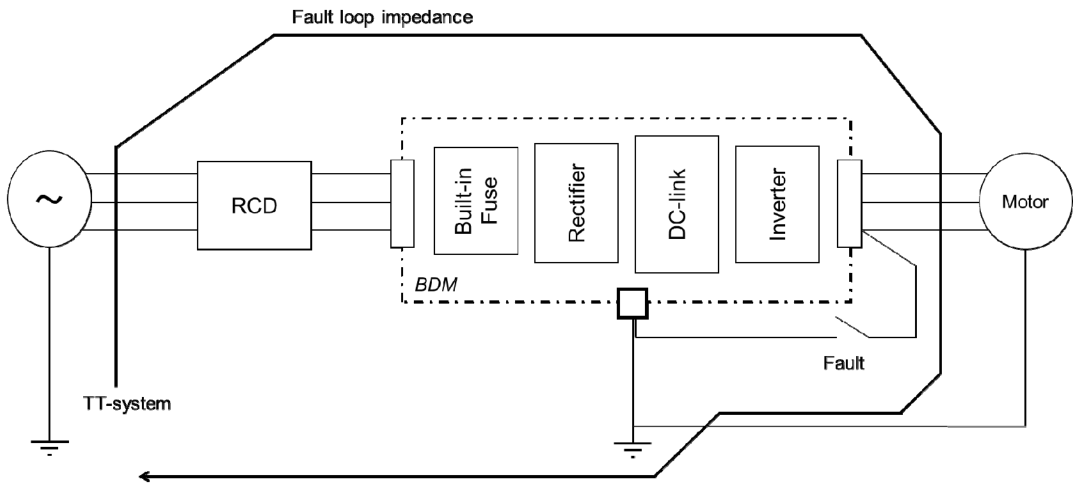


Figure. TT grounding system

<u>Overload protection and Over temperature protection for actuators and motors</u>

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.

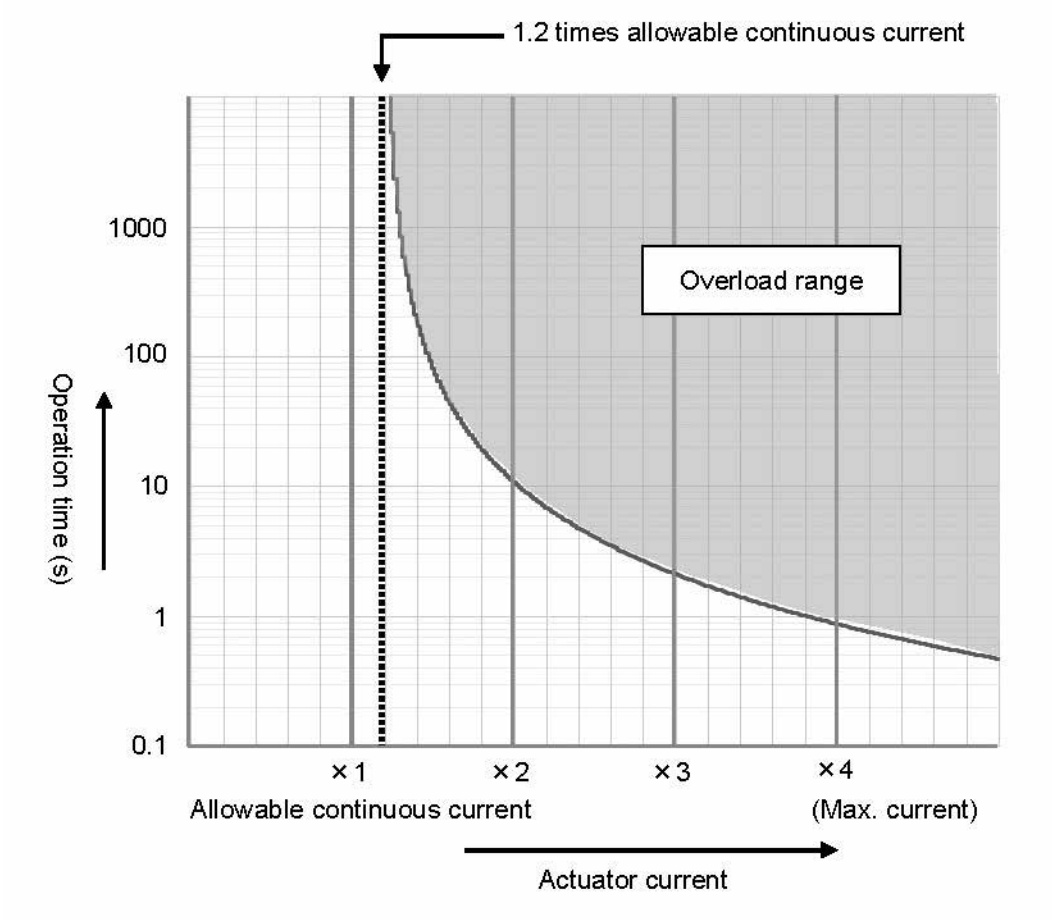


Figure. Overload protection

Chapter 1

Functions and configuration

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

1-1 Overview of drivers

The HA-800C driver is a dedicated driver designed to drive: the ultra-thin/hollow shaft structure actuator SHA series, FHA-C series, RSF/RKF series, AC Servo Motor HMA series, and other actuators combining an ultra-thin speed reducer HarmonicDrive® for precision control and flat AC servo motor.
The HA-800C drivers provide many superior functions to allow various actuators to excel in performance.

Overview of functions

CC-Link Ver. 1.10 type

Since it supports all communication speeds and station numbers stipulated by CC-Link Ver. 1.10, it is possible to combine with other devices supporting CC-Link to easily construct systems.

Possible to control speed and torque as well through 2 exclusive stations

If the driver is used with two exclusive stations, it can also be used to control speed and torque. Moreover, it is possible to switch among all control modes without rebooting the power supply of HA-800C.

Control mode switching

It is possible to switch among position control, speed control, and torque control via settings of CC-Link's RYn* and RWwn*.

Halving positioning settling time by unique control logic (compared to HA-655)

By unique control logic, overshoot and undershoot at positioning are minimized to halve the positioning settling time compared to conventional drivers.

Auto-tuning function

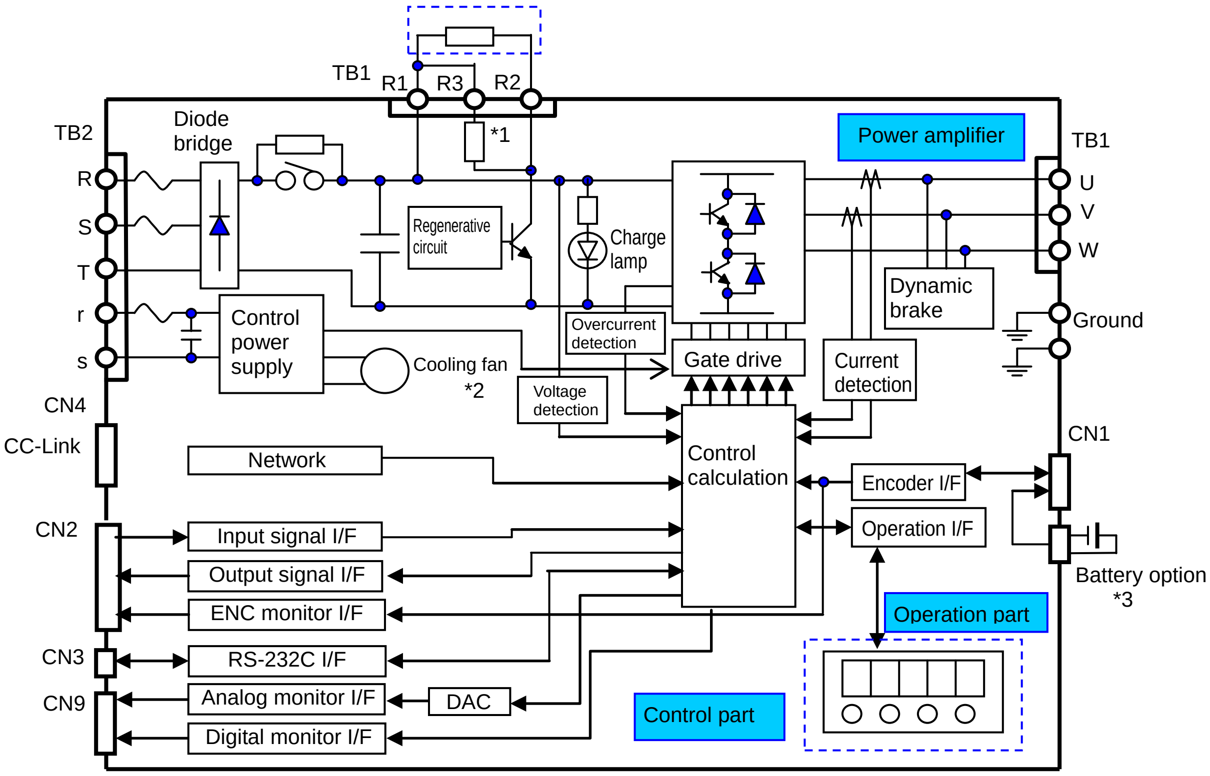
The auto-tuning function allows the driver to estimate the load and automatically set an optimum servo gain .

Full dedicated software

When HA-800C is used for the purpose of position control and the target position is known beforehand, the dedicated software for storing amount of movement in advance, PSF-680CL Ver.2, is provided.
Moreover, PSF-800, the dedicated software for changing parameters of the HA-800C driver and monitoring operation conditions, is also provided.

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.

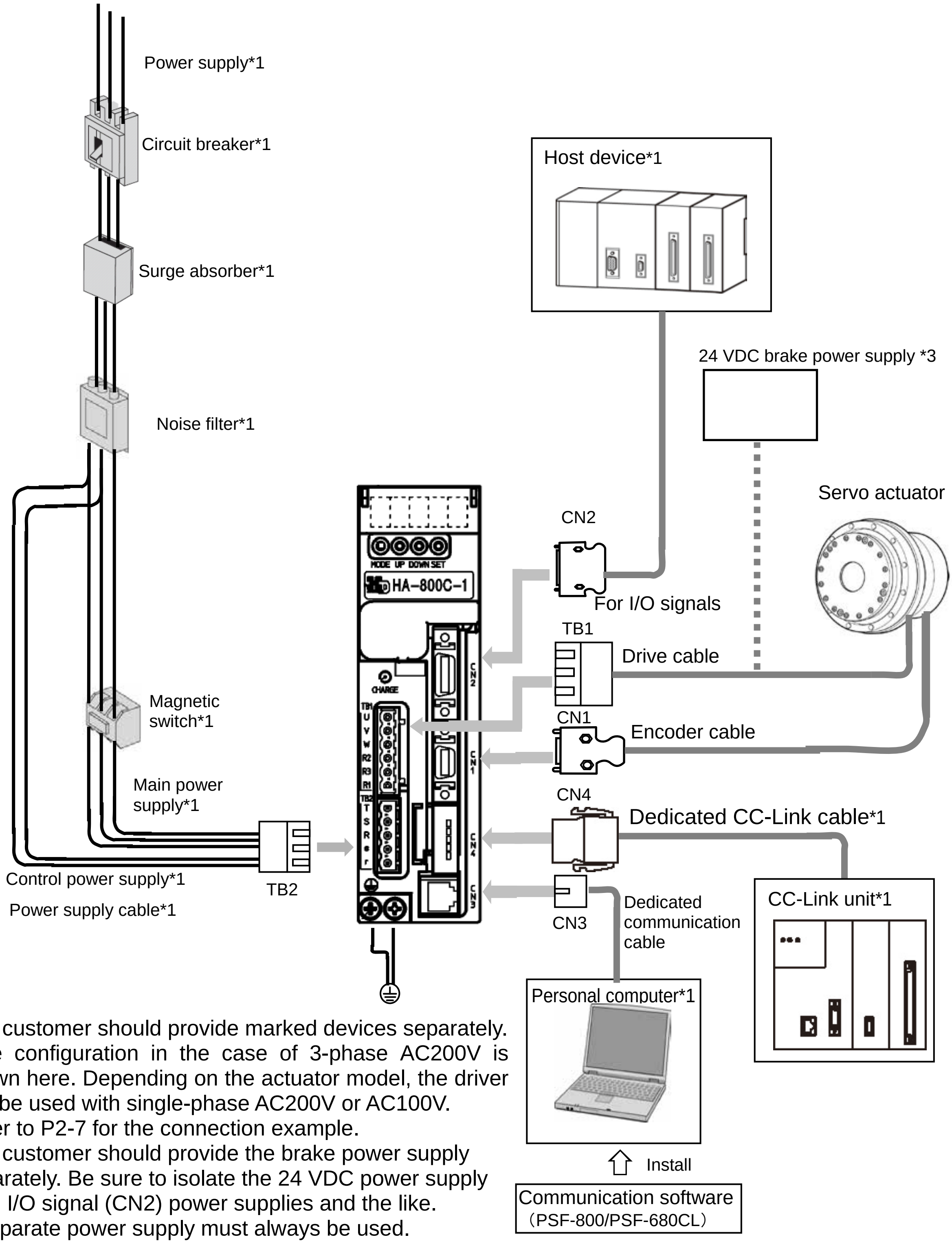
1

Functions and configuration

1-3 Device configuration diagram

A basic configuration diagram of this driver is shown.

HA-800C-1,3,6-200

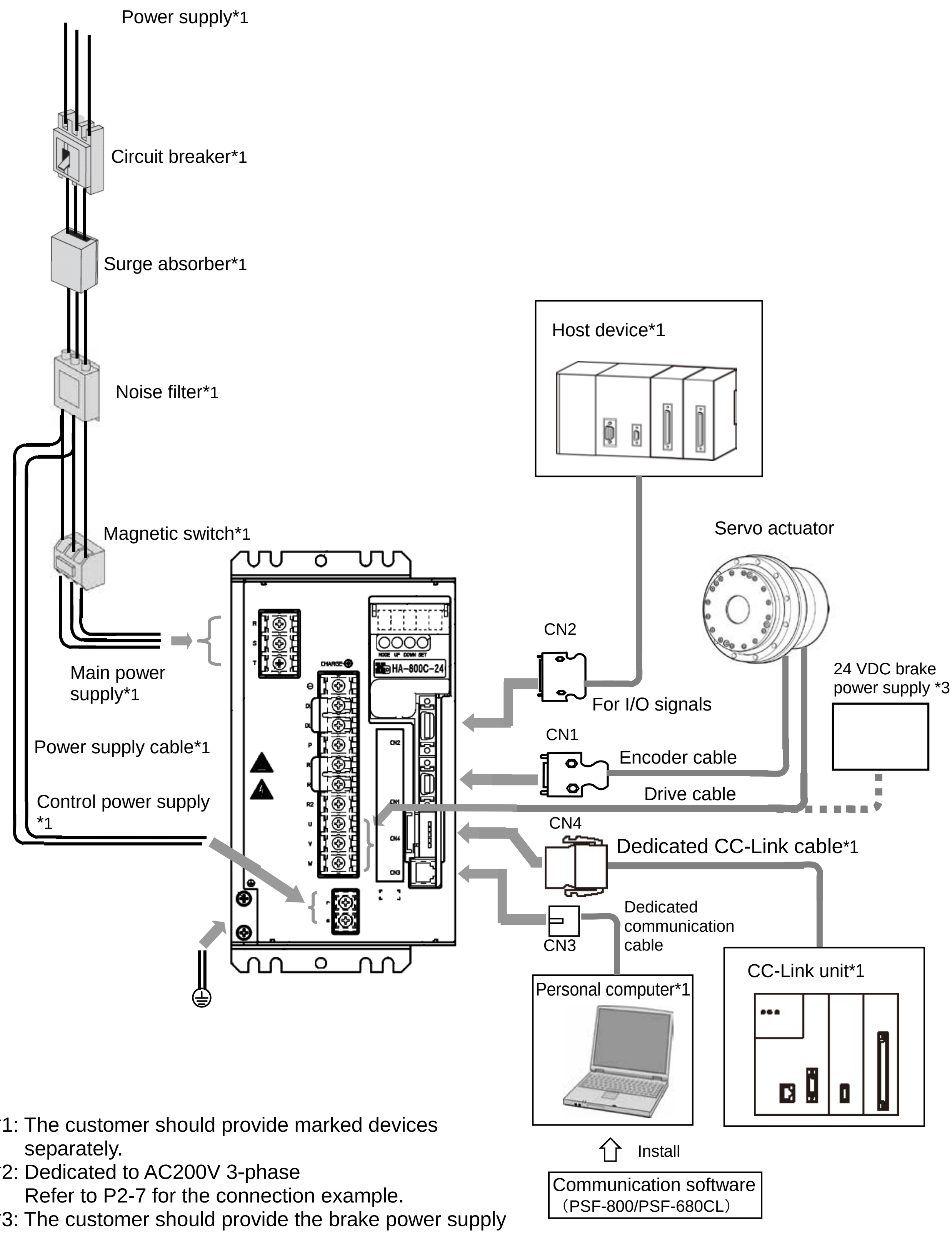


*1: The customer should provide marked devices separately.

*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-800C-24-200



*1: The customer should provide marked devices separately.
*2: Dedicated to AC200V 3-phase
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.

1-4 Driver model

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

Driver model

HA-800C-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	1.5 A
3	3 A
6	6 A
24	24 A

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 [1-5 Actuator and extension cable combinations].

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-800C	Extension cables (option)
SHA series	20	200	17-bit absolute	HA-800C-3D/E-200	Motor wire EWD-MB**-A06-TN3 Encoder wire EWD-S**-A08-3M14
	25	100		HA-800C-6D/E-100	
		200		HA-800C-3D/E-200	
	32	200		HA-800C-6D/E-200	
	40	200		HA-800C-6D/E-200	
	40	200		HA-800C-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-800C-24D/E-200	
	58	200		HA-800C-24D/E-200	
	65	200		HA-800C-24D/E-200	
FHA-Cmini series	8	200	4 wires, wire-saving type incremental	HA-800C-1C-200	Motor wire EWC-M**-A06-TN3 Encoder wire EWC-E**-M06-3M14
	11	200		HA-800C-1C-200	
	14	200		HA-800C-1C-200	
	8	100		HA-800C-1C-100	
	11	100		HA-800C-1C-100	
	14	100		HA-800C-1C-100	
	8	200	17-bit absolute	HA-800C-1D/E-200	Motor wire EWC-M**-A06-TN3 Encoder wire EWD-S**-A08-3M14
	11	200		HA-800C-1D/E-200	
	14	200		HA-800C-1D/E-200	
	8	100		HA-800C-1D/E-100	
	11	100		HA-800C-1D/E-100	
	14	100		HA-800C-1D/E-100	
FHA-C series	17	200	4 wires, wire-saving type incremental	HA-800C-3C-200	Motor wire EWC-MB**-M08-TN3 Encoder wire EWC-E**-B04-3M14
	25	200		HA-800C-3C-200	
	32	200		HA-800C-6C-200	
	40	200		HA-800C-6C-200	
	17	200	13-bit absolute	HA-800C-3A-200	Motor wire EWC-MB**-M08-TN3 Encoder wire EWC-S**-B08-3M14
	25	200		HA-800C-3A-200	
	32	200		HA-800C-6A-200	
	40	200		HA-800C-6A-200	
	17	100	4 wires, wire-saving type incremental	HA-800C-3C-100	Motor wire EWC-MB**-M08-TN3 Encoder wire EWC-E**-B04-3M14
	25	100		HA-800C-6C-100	
	32	100		HA-800C-6C-100	
	17	100	13-bit absolute	HA-800C-3A-100	Motor wire EWC-MB**-M08-TN3 Encoder wire EWC-S**-B08-3M14
	25	100		HA-800C-6A-100	
	32	100		HA-800C-6A-100	
RSF series	17	200	14 wires incremental	HA-800C-3B-200	Motor wire EWA-M**-A04-TN3 Encoder wire EWA-E**-A15-3M14
RSF/RKF series	20	200		HA-800C-3B-200	
	25	200		HA-800C-3B-200	
	32	200		HA-800C-6B-200	

1

Functions and configuration

Actuator series	Model No.	Input voltage (V)	Encoder type	Combined driver HA-800C	Extension cables (option)
HMA series	08	200	17-bit Absolute	HA-800C-3D/E-200	Motor wire EWD-MB**-A06-TN3 Encoder wire EWD-S**-A08-3M14
	09	100		HA-800C-6D/E-100	
		200		HA-800C-3D/E-200	
	12	200		HA-800C-6D/E-200	
	15	200		HA-800C-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-800C-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-800C-1*-200	HA-800C-3*-200	HA-800C-6*-200	HA-800C-1*-100	HA-800C-3*-100	HA-800C-6*-100
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) Vibration resistance: 4.9 m/s^2 (10 to 55Hz, Tested for 2 hours each in the X, Y, and Z directions) Shock resistance: 98 m/s^2 (Tested once each in the X, Y, and Z directions) Ambience: Free from metal powder, powder dust, oil mist and corrosive gases					
Command type		CC-Link Ver. 1.10 1 or 2 exclusive stations					
Structure		Natural air cooling		Forced air-cooling	Natural air cooling		Forced air-cooling
Installation method		Base mount (wall installation)					
Control modes		Position control, speed control, torque control (Speed control and torque control are possible only when 2 exclusive stations are used.)					
Input signals		Emergency stop, alarm clear, deviation clear, origin signal					
Output signals		Ready, alarm, origin recognition complete, Z signal (open collector output)					
Monitor terminals		3 channels, motor rotation speed, current command, general-purpose output (parameter selection)					
Digital I/O port		RS-232C, Status monitor, various parameter setting, (PSF-800) , Creation of operation data, originating/operation related parameter setting (PSF-680CL Ver.2)					
Operation panel	Configuration	Display (7-segment LED), 5 digits (red), 4 push-button switches					
	Status display function	Rotation speed (r/min), torque command (%), over load rate (%), input signal monitor, output signal monitor, alarm history (8 alarms), etc.					
	Parameter adjustment function	System parameters 3, 4, adjustment parameters					
Protective functions	Alarms	Emergency stop, 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		1 kg		1.2 kg	1 kg		1.2 kg

*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 200V or single-phase 200V input can be used.
*3: If the SHA series or any of FHA-25C/32C/40C is combined, use of 3-phase 200V input is recommended. Single-phase 200V 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-800C-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-800C-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-800C-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)		-32,768 to 32,767 (17 bit absolute)
Allowed environment		Operating temperature: 0 to 50℃ Storage temperature: -20 to 65℃ Operating/storage humidity: below 95%RH (No condensation) Vibration resistance: 4.9 m/s^2(10 to 55Hz, Tested for 2 hours each in the X, Y, and Z directions) Shock resistance: 98m/s^2 (Tested once each in the X, Y, and Z directions) Ambience: Free from metal powder, powder dust, oil mist and corrosive gases
Command type		CC-Link Ver. 1.10 1 or 2 exclusive stations
Structure		Forced air-cooling type
Installation method		Base mount (wall installation)
Control modes		Position control, speed control, torque control (Speed control and torque control are possible only when 2 exclusive stations are used.)
Input signals		Emergency stop, alarm clear, deviation clear, origin signal
Output signals		Ready, alarm, origin recognition complete, Z signal (open collector output)
Monitor terminals		3 channels, motor rotation speed, current command, general-purpose output (parameter selection)
Digital I/O port		RS-232C Status monitor, various parameter setting, (PSF-800) Creation of operation data, originating/operation related parameter setting (PSF-680CL Ver.2)
Operation panel	Configuration	Display (7-segment LED), 5 digits (red), 4 push-button switches
	Status display function	Rotation speed (r/min), torque command (%), overload rate (%), input signal monitor, output signal monitor, alarm history (8 alarms), etc.
	Parameter adjustment function	System parameters 3, 4, adjustment parameters
Protective functions	Alarms	Emergency stop, 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		5.8 kg

*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

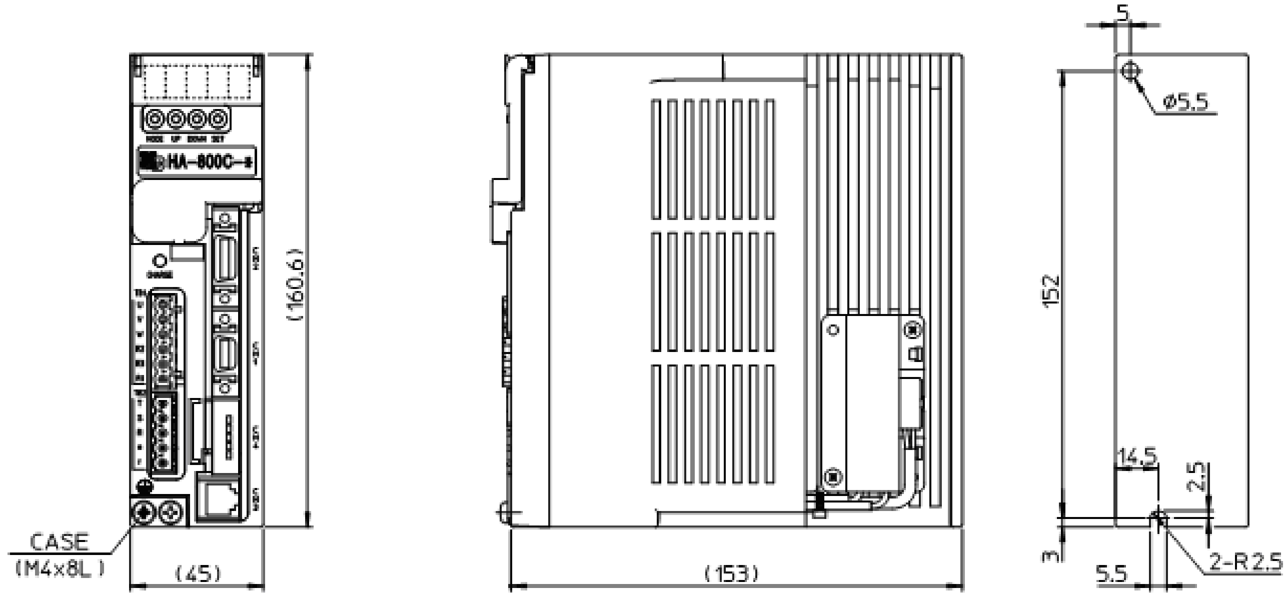
Function	Description	Applicable control mode	Reference
Position control mode	The driver functions as a position control servo.	P	P13-19
Speed control mode	The driver functions as a speed control servo.	S	
Torque control mode	The driver functions as a torque control servo.	T	
Absolute position sensor	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	P4-8 P4-16
Shorter positioning time	The HarmonicDrive® characteristics of the actuator are utilized in the control logic to shorten the positioning time.	P	P3-14
Auto-tuning	The driver can estimate the load in the JOG mode and automatically set an appropriate servo gain.	All	P9-10
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	You can change the weight (multiplier) of pulse input by setting desired values for the numerator and denominator of electronic gear. (Incremental encoder only)	P	P8-2
JOG operation	Operation check can be performed to see if the JOG operation of the actuator is possible, and if the power supply, motor wire and encoder wiring are normal, regardless of the I/O signals received from the host.	All	P9-6
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	Set the servo gain, in-position range and various other items relating to the servo system.	All	Chapter 7
System parameter mode	Various functions of HA-800C are set.	All	Chapter 8
Analog monitor output	The motor speed and motor current can be monitored as voltage levels.	All	P5-8
Status monitor output	The selected servo status can be monitored.	All	P8-2
Output shaft single revolution absolute function * (SHA-CG-S only)	You can control the absolute position information accurately even when rotation continues in just one direction, for example indexing.	All	P8-10 A-6
Output shaft divide function *	You can select a setting of 36,000, 360,000, or 3,600,000 divisions for the output shaft and can set operation commands in angle units.	P	P8-10 A-6
Absolute encoder function setting	A 17-bit absolute encoder can be used as an incremental encoder.	All	P8-9

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

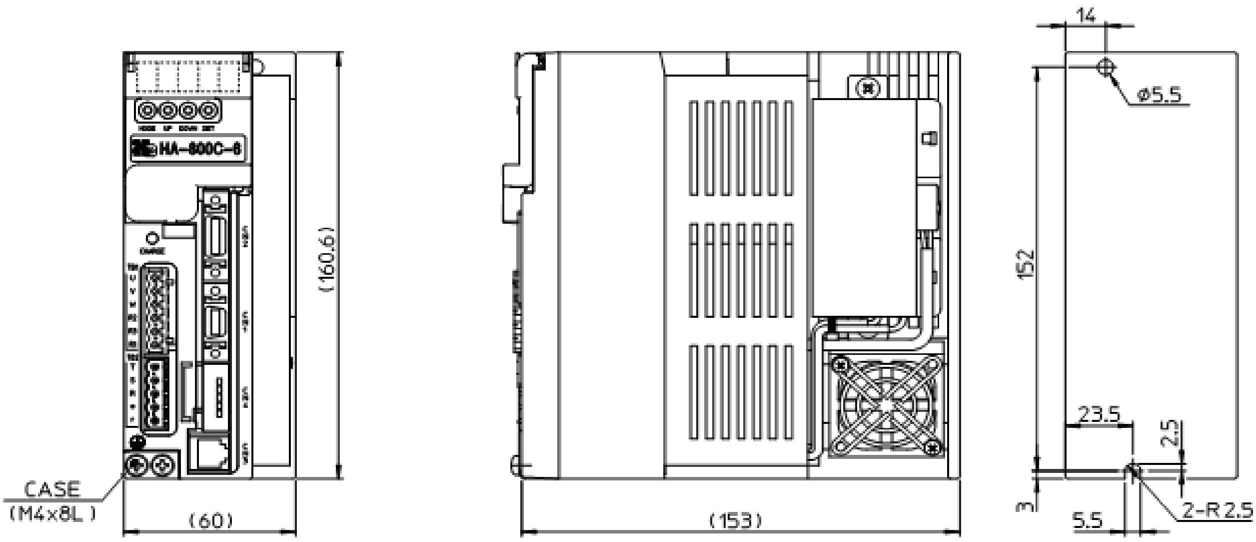
1-8 External drawing

The following shows the external drawing of this driver.

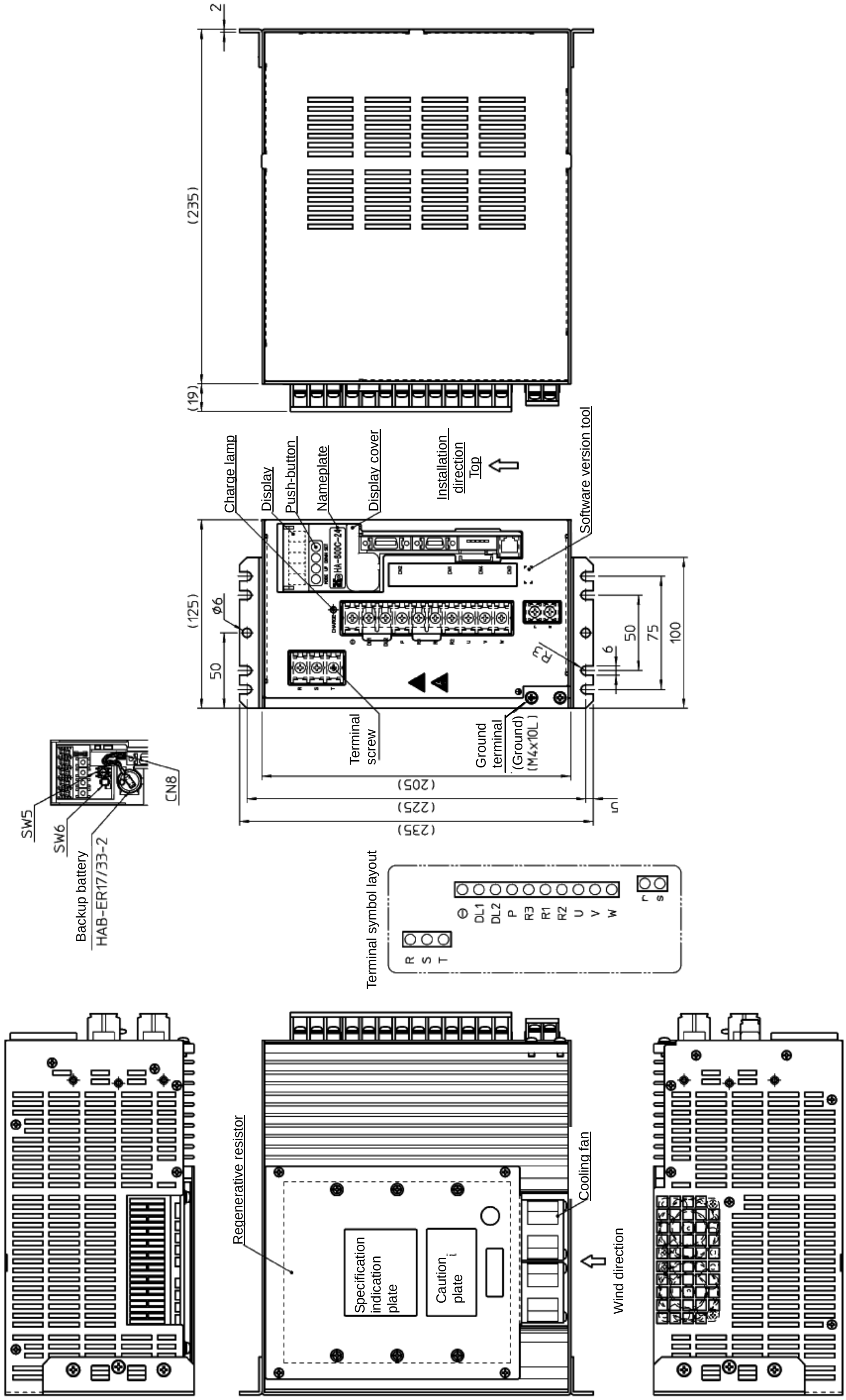
HA-800C-1/3 (Mass: 1 kg) **Unit: mm**



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



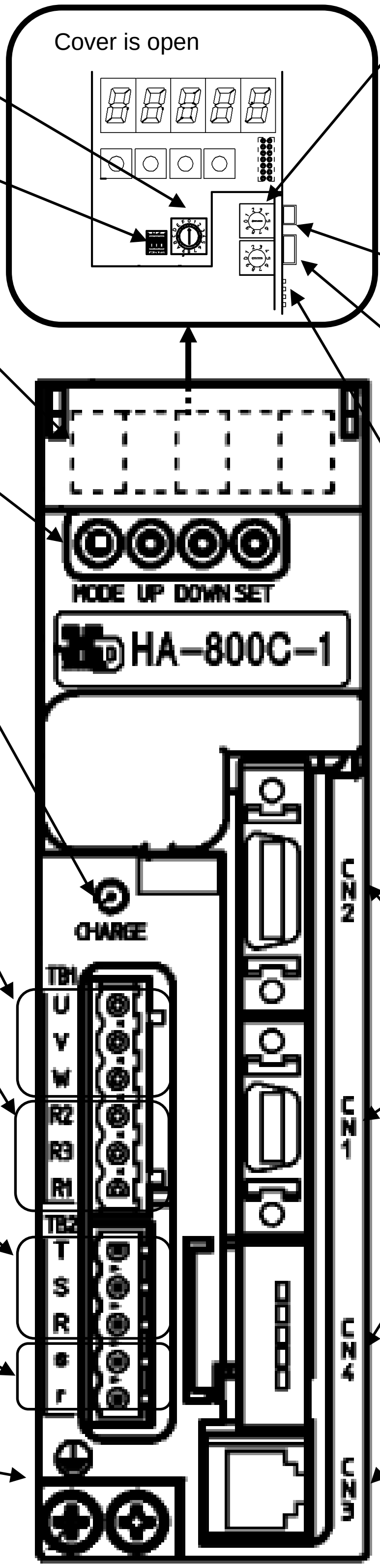
HA-800C-24 (Mass: 5.8 kg) **Unit: mm**



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-800C-1/HA-800C-3/HA-800C-6



Rotary switch (SW3)

Set the communication speed of CC-Link. [Chapter 13 CC-Link communication function]

DIP switch (SW4)

Set the number of exclusive stations of CC-Link.
[Chapter 13 CC-Link communication function]

LED display

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

Push-button switches

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

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 terminal (U, V, W)

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

Regenerative resistor connection terminal (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

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

A terminal for connecting the main circuit power supply.
[Connecting power cables] P2-7

Control circuit power connection terminal (s, r)

A terminal for connecting the control circuit power supply.
[Connecting power cables] P2-7

Ground terminal

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

Rotary switch (SW1 and 2)

Set the station number of CC-Link.
Upper: SW2 tenth place (0 at shipment from our factory)
Lower: SW1 ones place (1 at shipment from our factory)
[Chapter 13 CC-Link communication function]

Maintenance connector

Do not connect.

Waveform monitoring connector

The speed, current waveform and status signal can be monitored.
[Monitor output] (P5-8)

Communications status monitor LED

LRUN: Lit when HA-800C is connected to the CC-Link network.
SD: Lit when HA-800C is sending data to the CC-Link line.
RD: Lit when HA-800C receives data from the CC-Link line.
LERR: Flicker in the following cases:
(1) Settings of station number and communication speed are erroneous. (The LED is lit when 70 is set for the station number in order to connect PSF-680CL.)
(2) The station number setting was changed during operation.
(3) The communication line is unstable due to influence of noise, etc.

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

CC-Link connector (CN4)

This connector is used for CC-Link communication.
[Chapter 13 CC-Link communication function]

PSF-800 communication connector (CN3)

A communication connector for dedicated driver communication software PSF-800/PSF-680CL.
[Chapter 10 Communication software]

HA-800C-24

Rotary switch (SW1 and 2)

Set the station number of CC-Link.
Upper: SW2 tenth place (0 at shipment from our factory)
Lower: SW1 ones place (1 at shipment from our factory)
[Chapter 13 CC-LINK communication function]

Maintenance connector

Do not connect.

Waveform monitoring connector

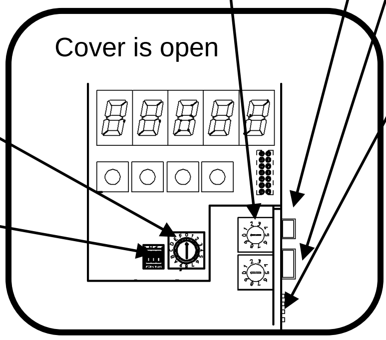
The speed, current waveform and status signal can be monitored.
[Monitor output] (P5-8)

Rotary switch (SW3)

Set the communication speed of CC-Link.
[Chapter 13 CC-LINK communication function]

DIP switch (SW4)

Set the number of exclusive stations of CC-Link.
[Chapter 13 CC-LINK communication function]



Communications status monitor LED

LRUN: Lit when HA-800C is connected to the CC-Link network.
SD: Lit when HA-800C is sending data to the CC-Link line.
RD: Lit when HA-800C receives data from the CC-Link line.
LERR: Flicker in the following cases:
(1) Settings of station number and communication speed are erroneous. (The LED is lit when 70 is set for the station number in order to connect PSF-680CL.)
(2) The station number setting was changed during operation.
(3) The communication line is unstable due to influence of noise, etc.

LED display

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

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

A terminal for connecting the main circuit power supply.
[Connecting power cables] P2-7

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.

Maintenance terminal

Do not wire the - and P terminals.

DC reactor connection terminal (DL1,DL2)

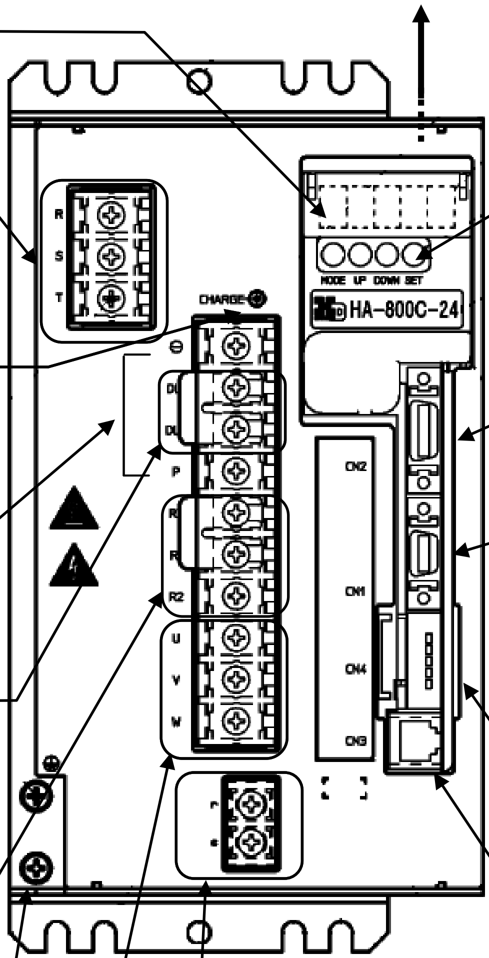
Terminals between DL1 and DL2 have been short-circuited with a short bar as default. Normally this short bar need not be removed before use.

Regenerative resistor connection terminal (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



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

CC-Link connector (CN4)

This connector is used for CC-Link communication.
[Chapter 13 CC-Link communication function]

PSF-800 communication connector (CN3)

This communication connector is used for PSF-800/PSF-680CL (Ver. 2.0 or later). A dedicated communication cable is required separately.

Control circuit power connection terminal (r, s)

A terminal for connecting the control circuit power supply.
[Connecting power cables] P2-7

Servo motor connection terminal (U, V, W)

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

Chapter 2

Installation/wiring

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

2-1 Receiving inspection

After unpacking, check the items described below.

Check procedure

1 Check for damage.

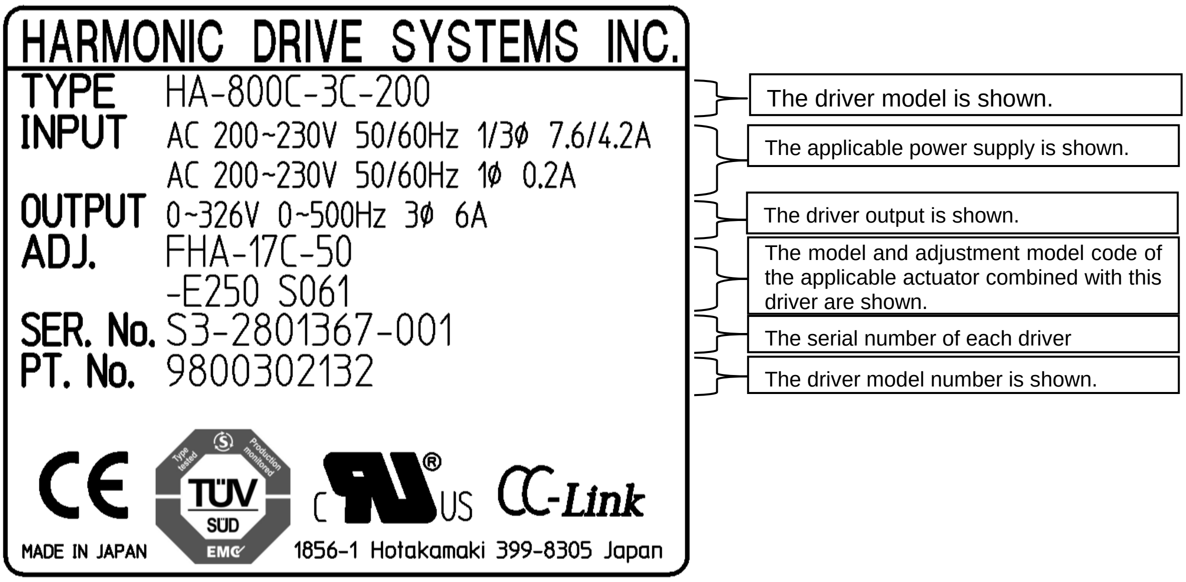
If any damage is found, immediately contact the supplier or store where you purchased your driver.

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-800C 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-800C 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 50mm from a wall or adjacent machine, at least 50mm from the floor, and at least 100mm from the ceiling.

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

FHA-C series (200V)

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

SHA series (200V)

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

SHA series (100V)

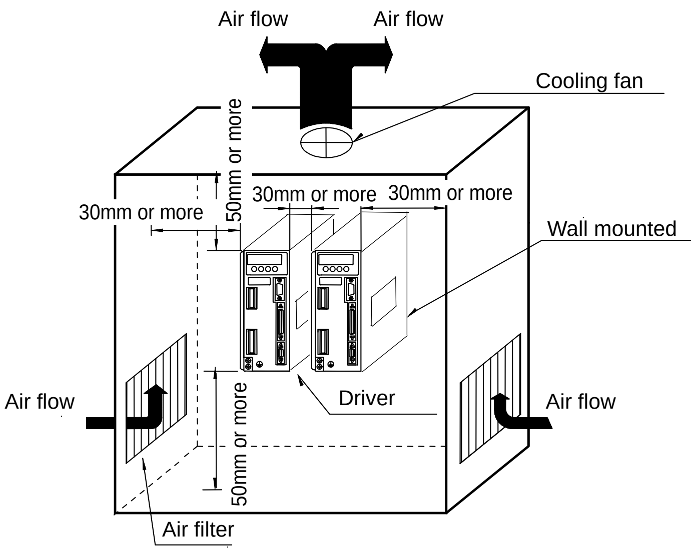
Driver	HA-800C-6
Actuator	SHA25
Power loss	40W

HMA series (200V)

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

HMA series (100V)

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



Installation procedure

[HA-800C-1, HA-800C-3, HA-800C-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.

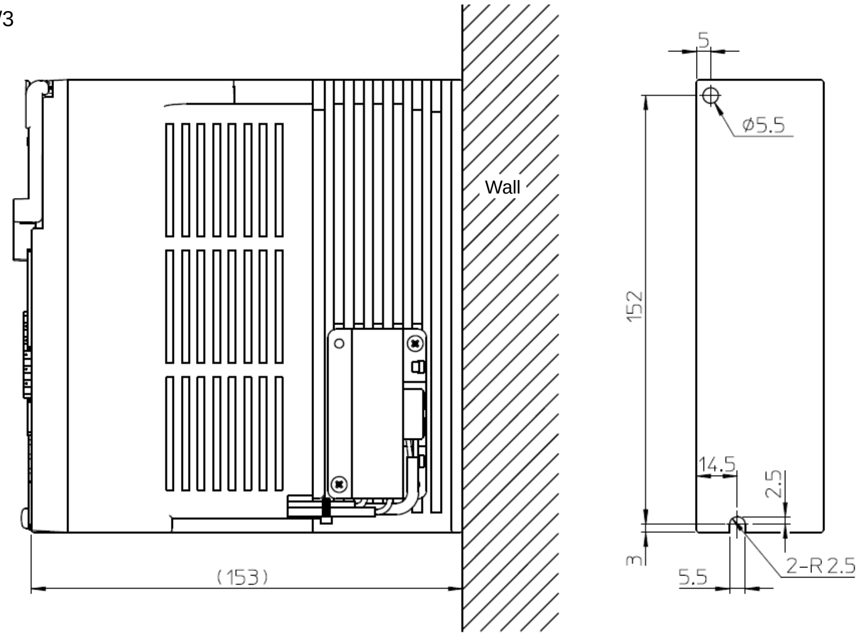
1. **Screw a M4 screw into the middle of the tapped hole provided at the bottom of the mounting surface.**

2. **Hook the mounting hole (cut hole) provided at the bottom of the driver onto the M4 screw installed in 1.**

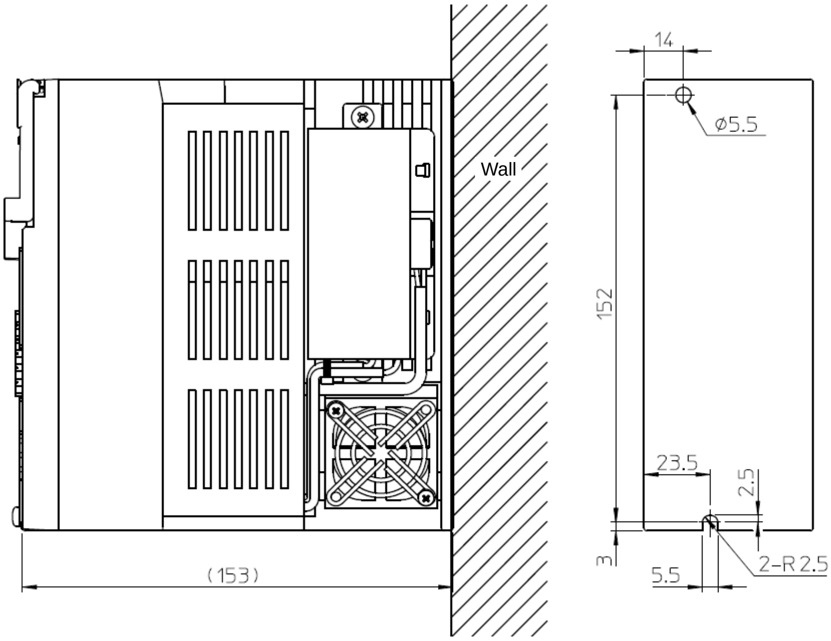
3. **Securely tighten a M4 screw through the mounting hole at the top of the driver and hole in the mounting surface.**

4. **Securely tighten the M4 screw at the bottom.**

HA-800C-1/3



HA-800C-6



[HA-800C-24]

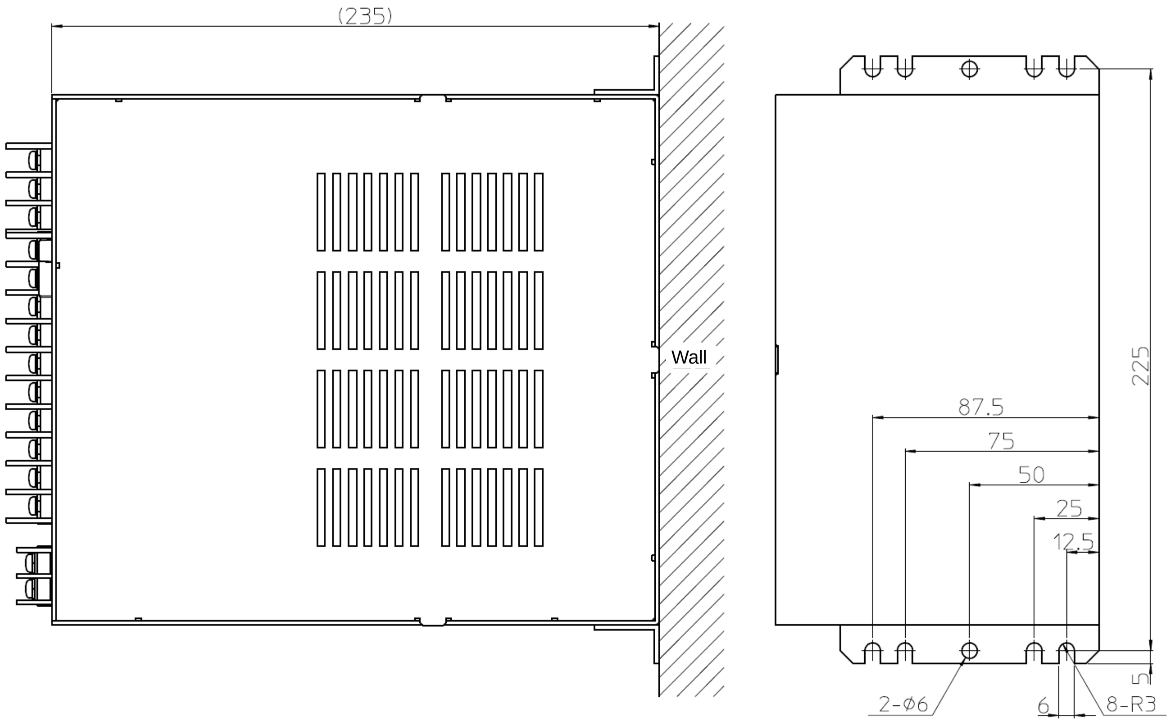
An iron sheet of 5mm or more in thickness is recommended for the wall on which to install the driver.

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-800C-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-800C 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-800C driver after installing the driver on the specified wall.
(2) Ground the HA-800C 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. We recommend the thickest wires possible.
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-800C-1</th><th colspan="2">HA-800C-3</th><th colspan="2">HA-800C-6</th><th colspan="3">HA-800C-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><td>Main circuit power</td><td>R,S,T</td><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><td>Control circuit power</td><td>r, s</td><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><td>Motor cables *1</td><td>U,V,W,E</td><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><td>Ground (FG) wire</td><td>Ground mark</td><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><td>Regenerative resistor</td><td>R1,R2</td><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><td>Encoder cable</td><td>CN1</td><td colspan="9">Twisted pair shield cable of 0.3 mm^2 or larger *1</td></tr>
<tr><td>Control signal wire</td><td>CN2</td><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-800C 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, 5.5 mm^2 or thicker cables are recommended.

[Single-phase 100V input]

		Min. allowable wire size (mm^2)				
Driver		HA-800C-1		HA-800C-3	HA-800C-6	
Combined actuator Combined motor		FHA-8C FHA-11C FHA-14C		FHA-17C	FHA-25C FHA-32C	SHA25 HMAB09 MAB09
Main circuit power	R,S,T	0.75		1.25	2.0	2.0
Control circuit power	r, s	0.75		1.25	1.25	
Motor cables *1	U,V,W,E	0.5	0.75	0.75	2.0 (1.25) *2	
Ground (FG) wire	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 larger *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-800C 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.

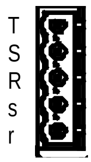
Connecting power cables

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.

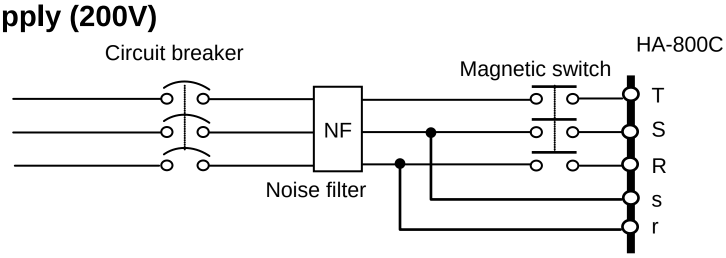
HA-800C-1/3/6

Terminal block for power connection (for TB2)

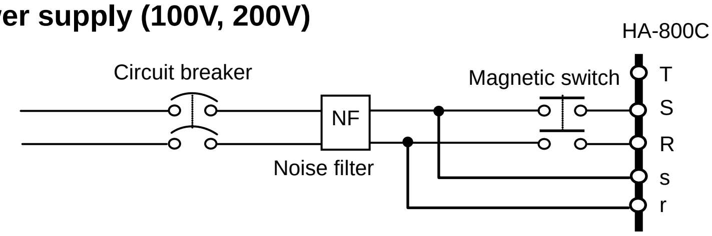
Manufacturer	Phoenix Contact
Model	FKC2,5/5-ST-5.08



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



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

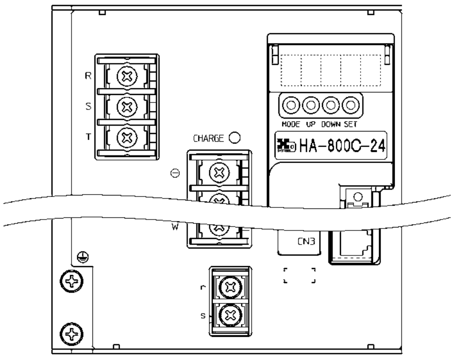


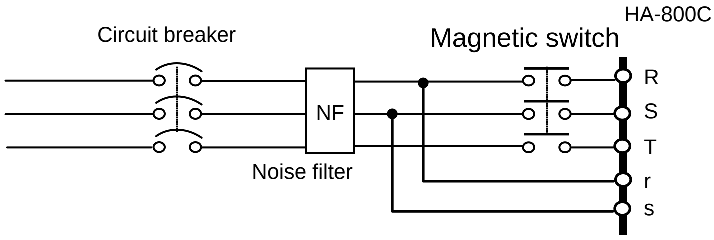
2

Installation/wiring

HA-800C-24

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



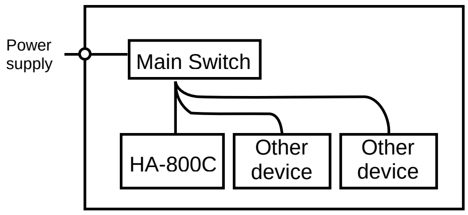


Terminal block for power connection

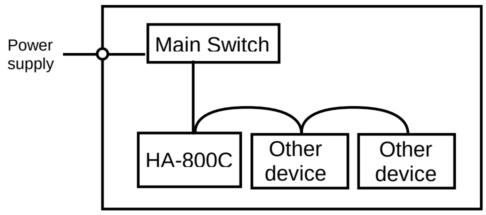
Terminal name	Screw size	Crimp terminal external diameter	Reference
R,S,T ⏚	M4	ϕ8mm	Round crimp terminal (R-type) 3.5-R4 (J.S.T. Mfg. Co., Ltd) 5.5-4NS (J.S.T. Mfg. Co., Ltd)
r,s	M4	ϕ8mm	Round crimp terminal (R-type) R1.25-4 (J.S.T. Mfg. Co., Ltd)

Caution

- With HA-800C-1/3/6, be sure to use a connector compatible with the terminal block for power connection (for TB2).
- With HA-800C-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 capacitor-type 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

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-800C-1-200	HA-800C-1-200	HA-800C-3-200	HA-800C-3-200	HA-800C-6-100	HA-800C-6-200	HA-800C-6-200	HA-800C-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℃.

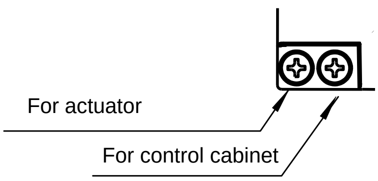
The above values are based on the standard input voltage (AC200V, AC100V).
The circuit breaker rated current is a recommended value for 3-phase AC200V input or single-phase AC100V input.

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-800C-1	HA-800C-3	HA-800C-6	HA-800C-24
Ground (FG) wire	Ground mark	3.5	3.5	3.5	3.5, 5.5

The HA-800C 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

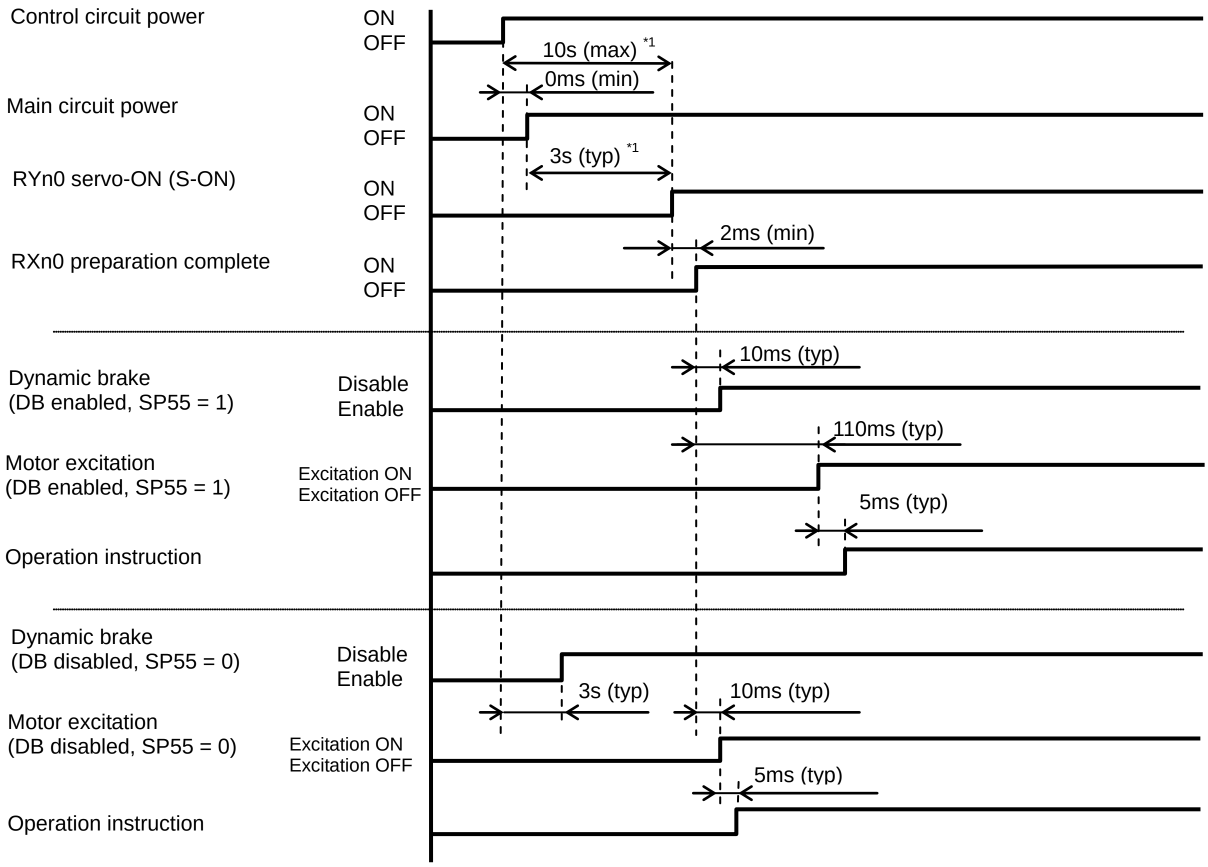
Provide a sequence circuit that cuts off the main circuit power ON/OFF switch in response to an emergency stop signal, etc.

Caution

- Turn ON/OFF the power supply after switching the [RYn0 servo-ON] signal of the HA-800C 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-800C-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 outputs and monitor output remain indeterminable for approximately 10 seconds after turning the control power supply ON.

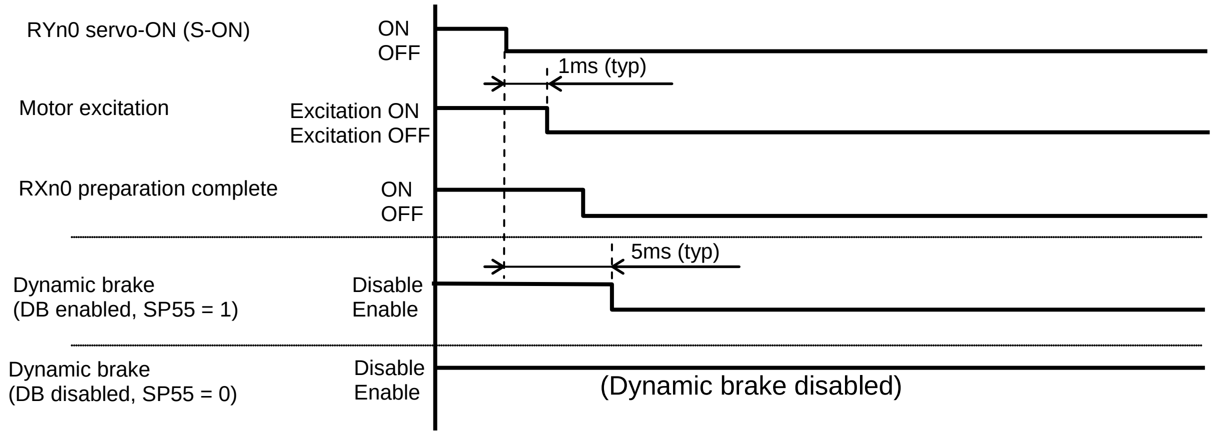


*1: This value is for when the control circuit power and main circuit power are turned ON simultaneously.
If the main circuit power is turned ON 7 seconds or more after the control circuit power, the servo ON signal is enabled after approximately 3 seconds, provided that the capacitor in the main circuit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

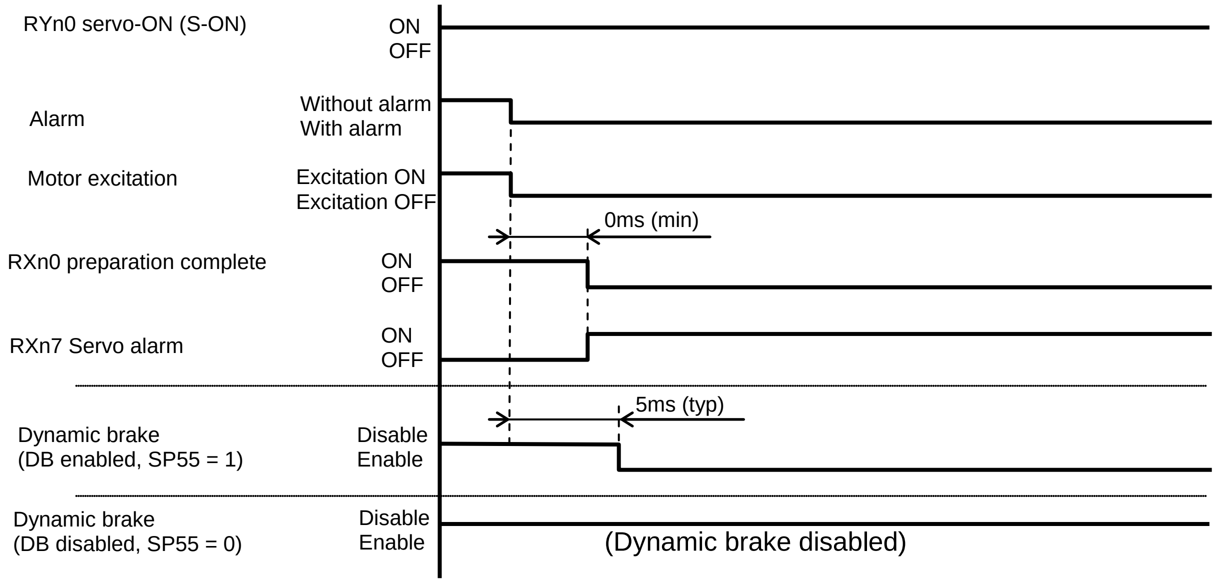
2

Installation/wiring

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

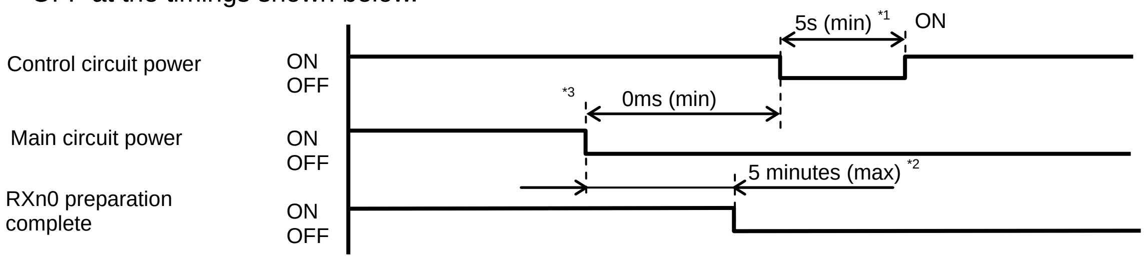


Sequence when an alarm generates (HA-800C-1, -3, -6)



Power OFF sequence (HA-800C-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.



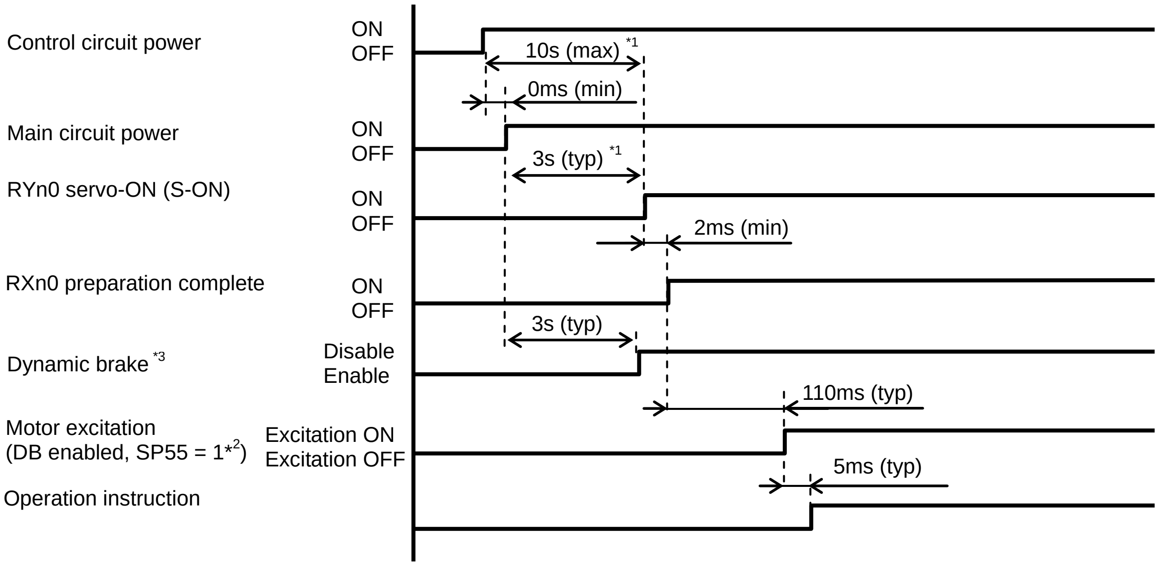
*1: After turning OFF the control circuit power, wait for at least 5 seconds before turning it ON.

*2: If the main circuit power is turned OFF when [RYn0 servo-ON (S-ON)] is turned OFF (servo OFF), it takes up to 5 minutes for [RXn0 preparation complete] is turned OFF (main circuit DC voltage drop).
If the main circuit power is turned OFF while servo-ON (during motor excitation), the motor excitation is continued until [RXn0 preparation complete] is turned 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 cut the main circuit power OFF, except when alarms are being generated.
If the main circuit power and control circuit power are turned OFF simultaneously, [RXn0 preparation complete] also turns OFF, but the capacitor for the main circuit power is still charged and therefore do not touch the driver 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-800C-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 outputs 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 7 seconds or more after the control circuit power, the servo ON signal is enabled after approximately 3 seconds, provided that the capacitor in the main circuit power has been discharged fully.

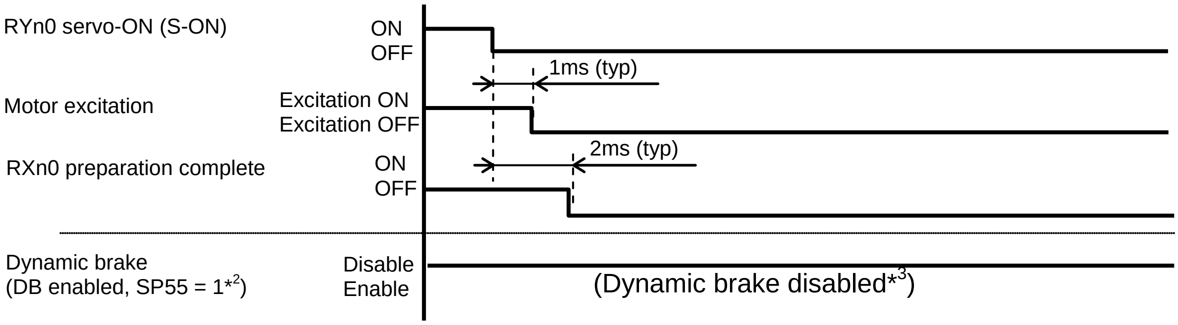
*2: Make sure to use HA-800C-24 by setting [SP55: DB enable/disable setting] to 1 (default setting).

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

2

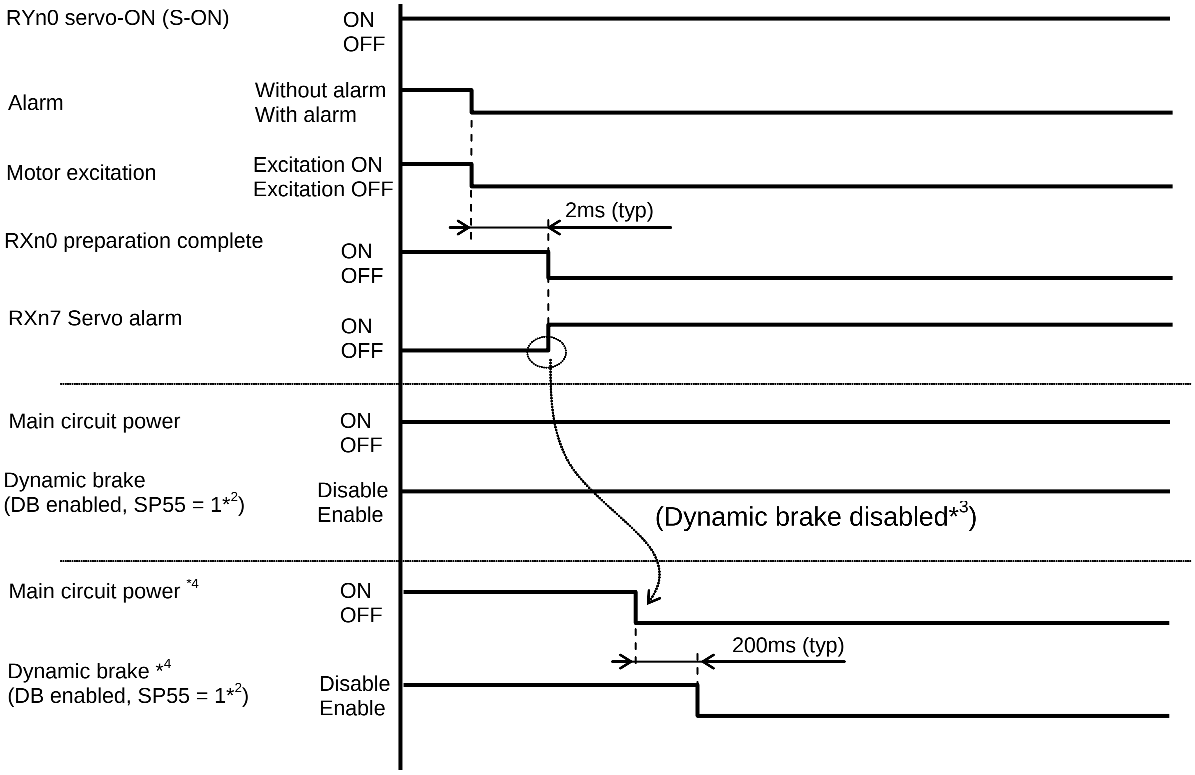
Installation/wiring

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



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

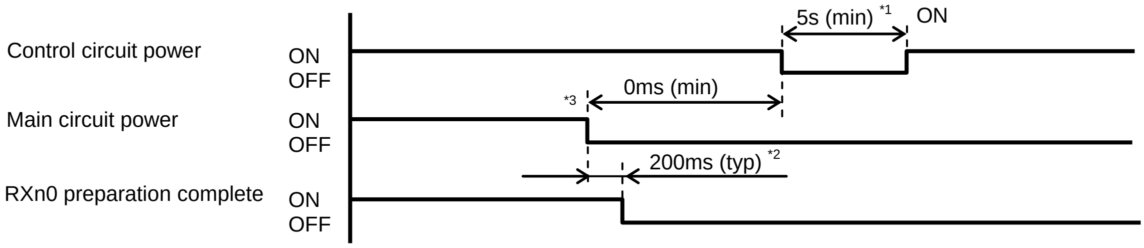
Sequence when an alarm generates (HA-800C-24)



*2: Make sure to use HA-800C-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 such as regenerative overheat alarm (AL41) and overregeneration alarm (AL42) are under high load, or if the R1-R3 short bar is removed, the discharge function will not work and the dynamic brake may not operate.

Power OFF sequence (HA-800C-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 RXn0 setup complete signal turns OFF in approximately 0.2 seconds due to the main circuit discharge function. However, if regenerative resistances such as regenerative resistor overheat alarm (AL41) and overregeneration alarm (AL42) are under high load, or if the R1-R3 short bar is removed, the discharge function will not work and will take 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 RXn0 setup complete signal 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 cut 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 RXn0 setup complete signal also turns OFF, but the capacitor for the main circuit power is still charged and therefore do not touch the driver until the main circuit charge monitor LED on the front panel turns OFF.
* The HA-800C-24 enables the main circuit discharge function. After turning OFF the main circuit power, the main circuit charge monitor LED turns OFF after approximately 0.5 seconds (Max). However, if regenerative resistances such as regenerative resistor overheat alarm (AL41) and overregeneration alarm (AL42) are under high load, or if the R1-R3 short bar is removed, the main circuit charge monitor LED remains lit for approximately 10 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

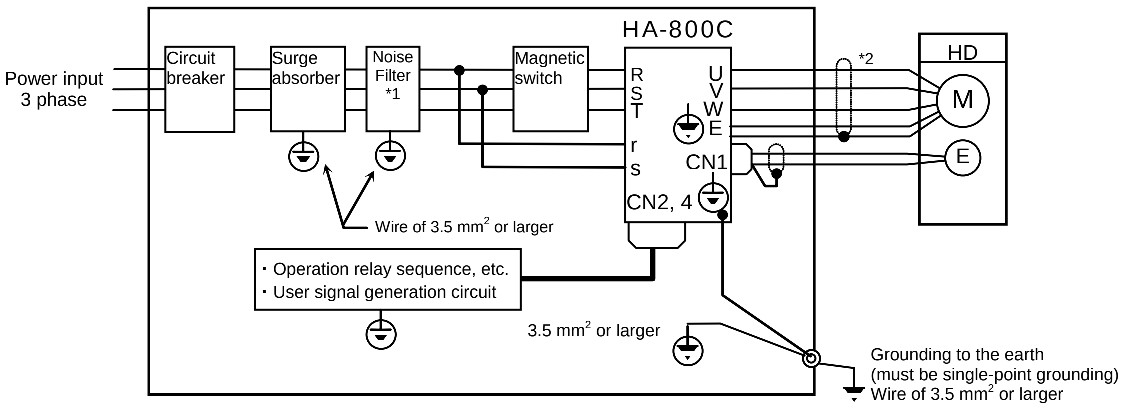
Installation/wiring

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.

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.

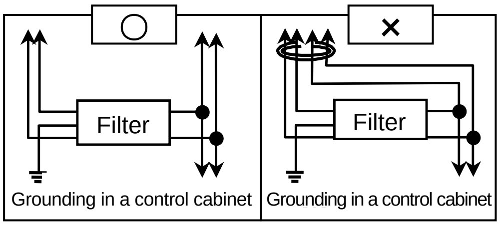
Model	Specifications	Manufacturer
RF3020-DLC	Rated voltage: Line-Line 440 to 550V, rated current: 20A	RASMI ELECTONICS LTD
RF3030-DLC	Rated voltage: Line-Line 440 to 550V, rated current: 30A	
RF3040-DLC	Rated voltage: Line-Line 440 to 550V, rated current: 40A	
HF3010A-UN	Rated voltage: 250VAC, rated 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 P17 in this manual.

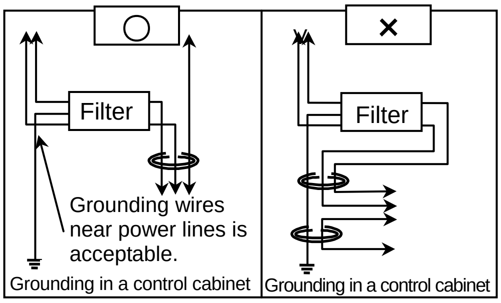
Caution

- 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 seriously reduce its effectiveness. Install noise filters by referring to the cautionary information provided below.

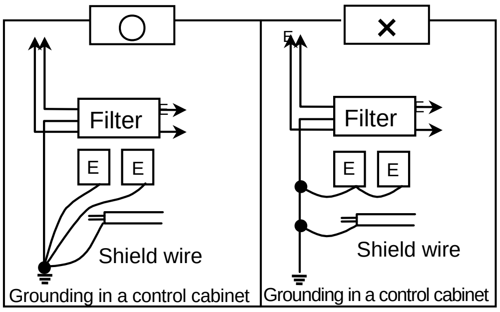
・Separate the filtered wires and unfiltered wires from each other. Do not place them in the same pipe or duct, or bundle them together.



・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

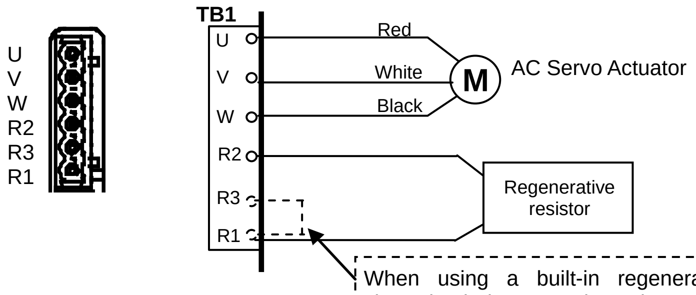
2-5 Wiring the driver and motor

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-800C-1/-3/-6]



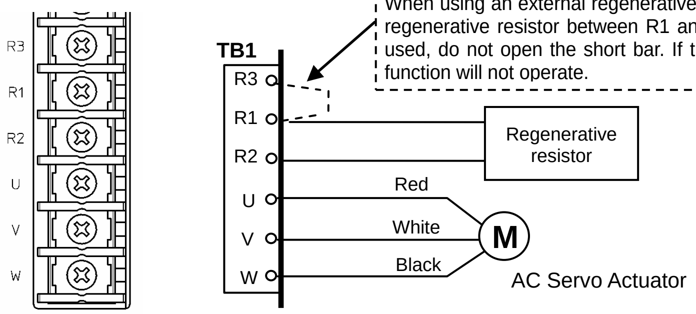
When using a built-in regenerative resistor with the HA-800C-3/6, short-circuit the R1 and R3. (On our extension cables, these terminals are already short-circuited with a short bar.) When using an external regenerative resistor, keep R1 and R3 open and connect the regenerative resistor between R1 and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

Terminal block for motor connection (for TB1)

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

[HA-800C-24]

When using a built-in regenerative resistor with the HA-800C-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.

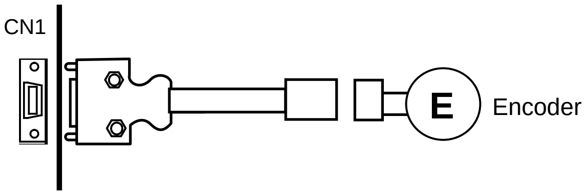
Caution

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

Connecting the encoder

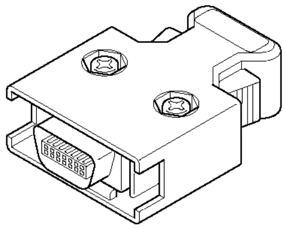
To connect the encoder, connect the CN1 connector, as shown below.
For the encoder signal wire, use a twisted pair shield cable with a wire size of 0.3 mm^2 or larger and having the necessary number of cores.
Shorten the wiring length as much as possible.

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

13-bit absolute encoder

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

17-bit absolute encoder*

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

14-wire incremental encoder

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

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

Caution

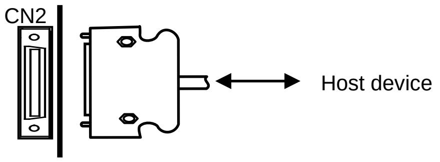
- Do not connect NC terminals. If NC terminals are connected by mistake, malfunctions may result.

2-6 Wiring the host device

The following explains wiring of this driver and host device.

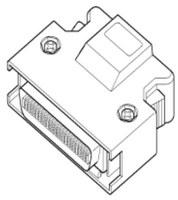
Connecting the host device (I/O signals)

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 mm^2 (AWG24) and having the necessary number of cores.



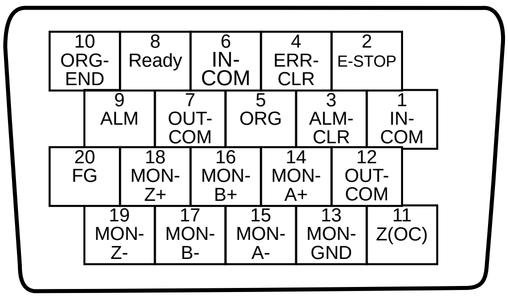
I/O signal connector (CN2)

	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.

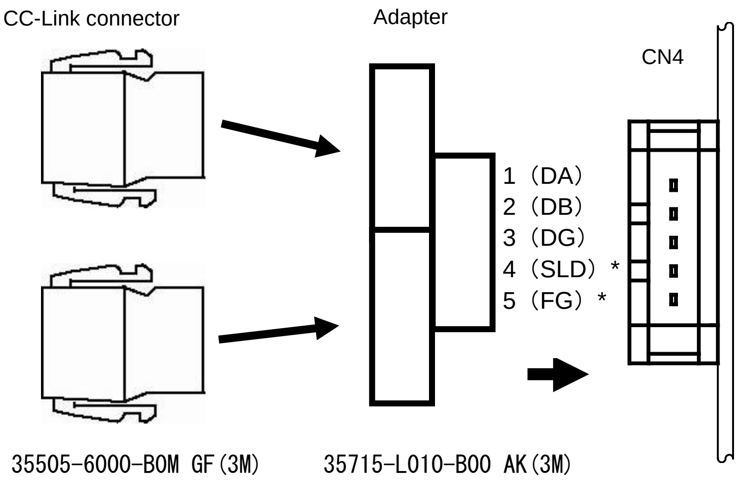


Caution

- 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.

Connection of CC-Link connector

Connect the adapter (35715-L010-B00 AK 3M) for 2-stage replacement of the HA-800C CC-Link connector, and connect the dedicated connector (35505-6000-B0M GF 3M).



* The SLD and FG terminals are the same terminal inside the driver. Normally connect the shield to the 5:FG terminal.

Connecting the personal computer (PSF-800)

Use the dedicated communication cable to connect with a personal computer. If a dedicated cable is not used, assemble a cable setup referring to the following tables.
Dedicated communication cable: EWA-RS03 (option)
Cable length: 1.6m

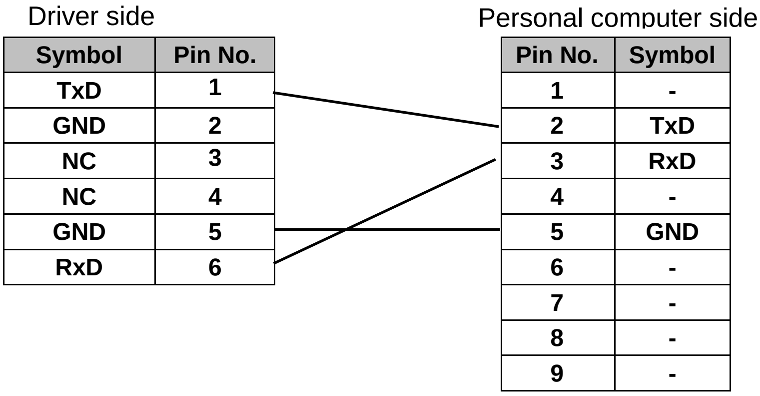
PSF-800 communication connector (CN3)

	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	-

Do not wire the NC (3 and 4 pins).
* Connection with PC must be 1-on-1 only in HA-800C.

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

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:

Check before turning ON the power for the first time	Refer to: [Turning ON the power for the first time] (P3-2)
↓	
Operation check with the actuator alone in the actual control mode	Refer to: [Operation check with the actuator alone] (P3-8)
↓	
Operation check with the actual system	Refer to: [Operation check with the actual system] (P3-12)
↓	
Normal operation	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: [Wiring the driver and motor] (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] (P3-3, 3-4)
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] (It is not possible to enter JOG operation when the actuator servo is turned ON by the input of the RYn0 servo-ON command. Set the RYn0 servo-ON command to 0.) Note: During JOG operation, it is possible to operate the actuator regardless of input signals other than the emergency stop signal. During JOG operation, input signals other than the emergency stop signal are ignored even if operated.

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

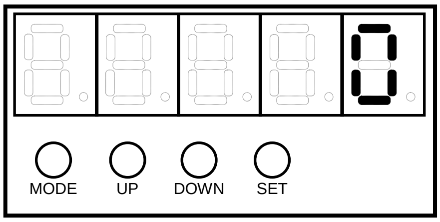
(1) When a 17-bit absolute encoder (SHA series, FHA-Cmini series, HMA series) is combined

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.

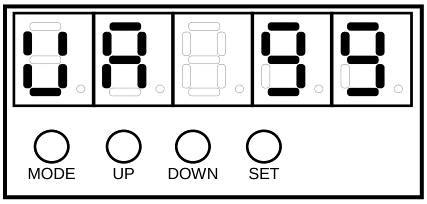
- **If the actuator combination is wrong**

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.



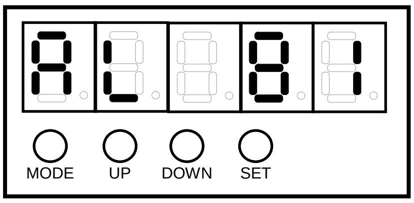
- **Absolute multi revolution data error**

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](P9-9).



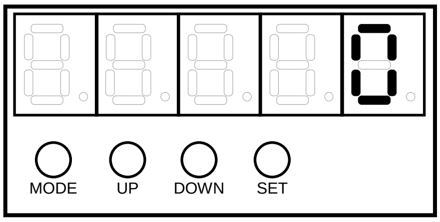
(2) When a 13-bit absolute encoder (FHA-C series) is combined

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.**

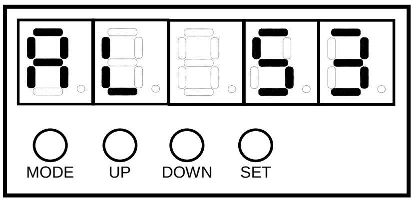
The default setting is to display the motor rotation speed.

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](P9-9).

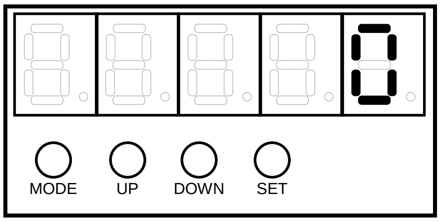
(3) When a 4-wire-saving incremental encoder (FHA-Cmini series) is combined

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.

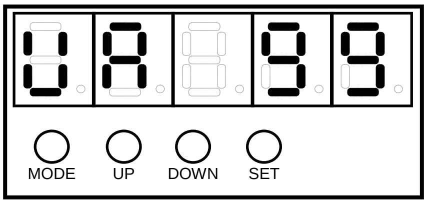
- **If the actuator combination is wrong**

[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.

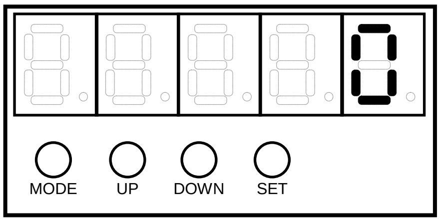


(4) When a 4-wire-saving incremental encoder (FHA-C series) or 14-wire incremental encoder is combined

1 Turn ON the control circuit power.

Normal

Abnormal



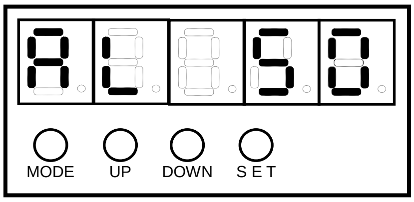
2 The system switches to the status display mode.

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.

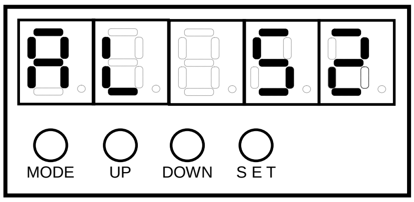
- **Wrong wiring/faulty wiring**

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/faulty 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.



3

Startup

Troubleshooting upon power ON

Description of operation	Description of problem	Check item	Estimated cause	Reference
Power ON	The LEDs do not turn ON.	The situation improves when the CN1 connector is unplugged.	● Insufficient input voltage or poor power connection ● Defective driver	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.		P9-9
JOG operation	Does not rotate.	Is the motor wire connected correctly?	● Poor motor wire connection	P2-18
	The rotation direction is reversed.			
	An alarm generates.	Refer to [Chapter 11 Troubleshooting].		Chapter 11

* : It is not possible to enter JOG operation when the actuator servo is turned ON by the input of the RYn0 servo-ON command. Set the RYn0 servo-ON command to 0.

3-3 Operation check with the actuator alone

The following explains the operation check procedure on the actuator 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. The default is set to normally open. Make sure to change to normally closed if you use the emergency stop input. Refer to: [SP62: Input signal logic setting] (P8-8)
Output signal logical 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 CC-Link communication function]

3

Startup

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 the operation preparation completed?	The RYn0 servo-ON command has not been input.	P13-19
		Is warning 93 generated?	The main circuit voltage is not input or lower than the warning 93 threshold value.	P2-6
	An alarm generates.	Refer to [Chapter 11 Troubleshooting].		Chapter 11
Operation command output (RYn1: Start = 1)	The actuator does not rotate.	Is the motor wire connected correctly?	Wrong motor wire UVW connection	P2-18
		Is RYn4: FWD stroke end or RYn5: REV stroke end 0?	The FWD and REV stroke ends are enabled.	P13-19
		Check the wiring	Wiring error	P2-18
	Rotates only in 1 direction.	Is RYn4: FWD stroke end or RYn5: REV stroke end 0?	The stroke end in non-rotatable direction is enabled.	P13-19
		Check the wiring.	Wiring error	P2-18
	The rotation direction *1 is reversed.	Check the wiring.	Wiring error	P2-18
		Check the command program.	Wrong operation program setting	P13-19
	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 the operation preparation completed?	The RYn0 servo-ON command has not been input.	P13-19
		Is warning 93 generated?	The main circuit voltage is not input or lower than the warning 93 threshold value.	P2-6
	An alarm generates.	Refer to [Chapter 11 Troubleshooting].		Chapter 11
RY (n+2) 3: Speed control switching = 1	The actuator does not rotate.	Is the motor wire connected correctly?	Wrong motor wire UVW connection	P2-18
		Is RYn4: FWD stroke end or RYn5: REV stroke end 0?	The FWD and REV stroke ends are enabled.	P13-19
		The speed command value is 0.	RWwn+4: Check the speed command set value.	
	The rotation direction [*1] is reversed.	Is the speed command value input correctly?	RWwn+4: The speed command set value is negative.	P2-18
	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

Startup

Torque 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 the operation preparation completed?	The RYn0 servo-ON command has not been input.	P13-19
		Is warning 93 generated?	The main circuit voltage is not input or lower than the warning 93 threshold value.	P2-6
	An alarm generates.	Refer to [Chapter 11 Troubleshooting].		Chapter 11
RY (n+2)4: Torque control switching = 1	The actuator does not rotate.	Is the motor wire connected correctly?	Wrong motor wire UVW connection	P2-18
		Are internal torque command value and setting set correctly?	RWwn+5: The torque command set value is smaller than the starting torque of the actuator.	P13-19
		Is RYn4: FWD stroke end and RYn5: REV stroke end 0?	The FWD and REV stroke ends are enabled.	
	The rotation direction *1 is reversed.	Is the torque command value input correctly?	RWwn+5: The polarity of the torque command set value is negative.	P2-18
	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.

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] (P4-8, 4-16)
↓	
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 CC-Link communication function]
↓	
Stop	

Troubleshooting at actual operation check

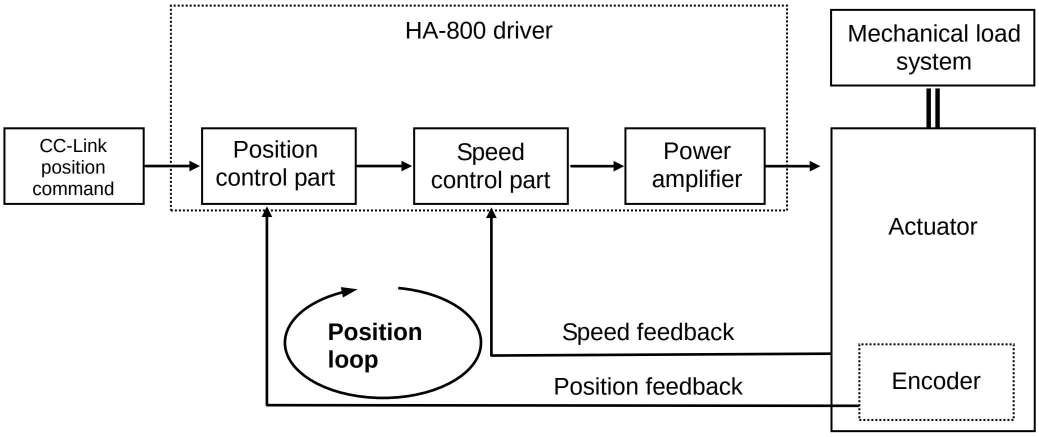
Operation	Description of problem	Check item	Estimated cause	Reference
Auto-tuning	Significant vibration does not decrease even after tuning.	Is the startup or shutdown time too short?	Host controller setting error	P9-10
		Is the load inertia too big?	Actuator selection error	
		Are there load variations?	If the load varies with the rotation position auto-tuning cannot be done properly. Manually adjust the gain.	
	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-800 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.

Adjustment procedure

1 **Perform rough adjustment via auto-tuning. Refer to [T09: Auto-tuning] (P9-10).**

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.**

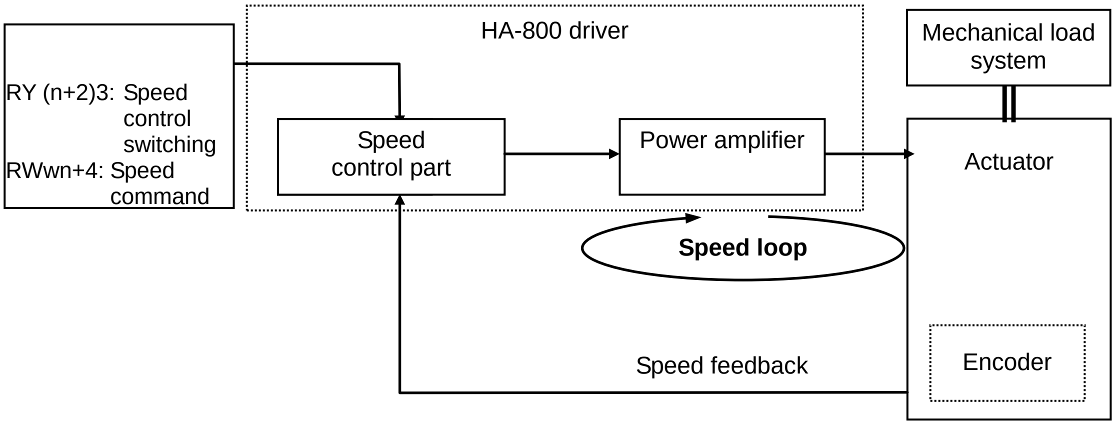
6 **Fine-tune the above gains by observing the settling after positioning and condition of machine operation.**

Adjustment details

- **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.

Adjustment procedure

1 **Perform rough adjustment via auto-tuning. Refer to [T09: Auto-tuning] (P9-10).**

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

- **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)	○	○	○	×	×

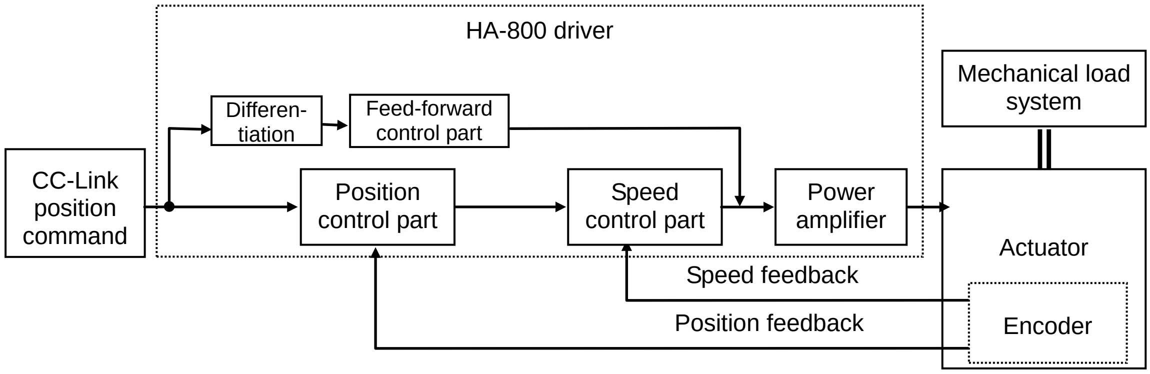
* [SP69: Feed-forward control function setting] is available for HA-800 software version 2.09 or later.

*: 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-800C with the same device with software version 2.09 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.
- With the SHA-CG series, do not set [SP69: Feed-forward control function setting] to 0 or 1.

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-13-6) 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] (P9-10, 10-8).

▪ 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.

3-6 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.

Inspection 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	Consult Harmonic Drive Systems Inc.

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-800C 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, 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 or removal tape. 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 hs 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.

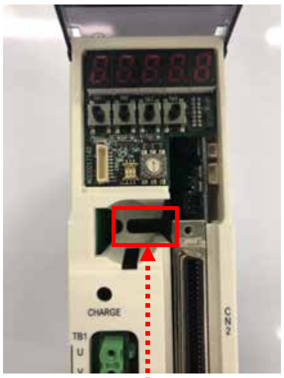
Panel cover

2 Remove the old battery.

Battery holder

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.

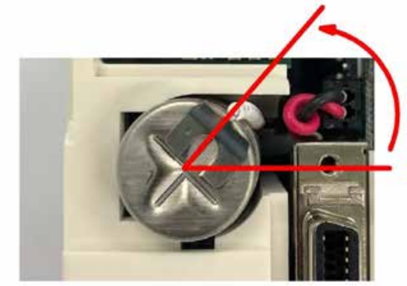
4 **Insert the connector on the battery side into the connector indicated by the circle, and ensure that the connector orientation matches.**

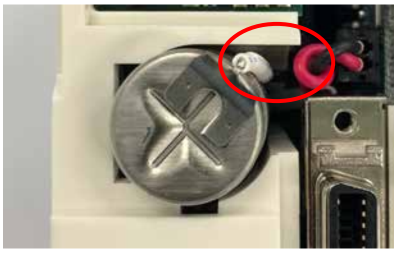
Connect the connector so that the black wire of the battery cable is facing up when looking at the driver from the front.

*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 2.08 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

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-800C-*D/E-100/200	P4-4
13-bit absolute encoder	FHA-C series	HA-800C-*A-100/200	P4-13
4-wire wire-saving incremental encoder	FHA-C series	HA-800C-*C-100/200	P4-23
4-wire wire-saving incremental encoder	FHA-Cmini series	HA-800C-*C-100/200	
14-wire incremental encoder	RSF/RKF series	HA-800C-*B-100/200	

The specifications of encoders that can be connected to the HA-800C 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-wire wire-saving incremental encoder		14-wire 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	P4-13	P4-23	P4-23	P4-23
Applicable driver model	HA-800C-3D/E-100/200 HA-800C-6D/E-100/200 HA-800C-24D/E-200	HA-800C-3D/E-200 HA-800C-1D/E-100/200	HA-800C-3A-100/200 HA-800C-6A-100/200	HA-800C-1C-100/200	HA-800C-3C-100/200 HA-800C-6C-100/200	HA-800C-3B-100/200 HA-800C-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 bit (13,1072 pulses)	17 bit (13,1072 pulses)	13 bits (8,192 pulses)	8,000 pulses*2	10,000 pulses*2	8,000 pulses*2
Maximum motor shaft rotation range	16 bit (-32768 to 32767)	16 bit (-32768 to 32767)	13 bits (-4096 to 4095)	Not limited	Not limited	Not limited
Encoder monitor output pulses (CN2 output)	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 (when power is not supplied)	Approx. 1 year (when power is 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	Line driver receiver method	Line driver receiver method	Line driver receiver method	Line driver receiver method	Line driver receiver method
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

4

Encoder system

Item		17-bit absolute encoder *1		13-bit absolute encoder	4-wire wire-saving incremental encoder		14-wire 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 disconnection	○	○	○	○	○	○
	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 backup battery. Otherwise it is the same as a 17-bit absolute encoder. Also, with the output shaft single revolution absolute model (option code: S), the maximum motor shaft revolution range is up to reduction ratio.

*2: Quadruplicated pulses

4-2 17-bit absolute encoder

CAUTION

If AL81 (system failure), AL821 (single rotation data error) or AL83 (multi revolution data error) occurs 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

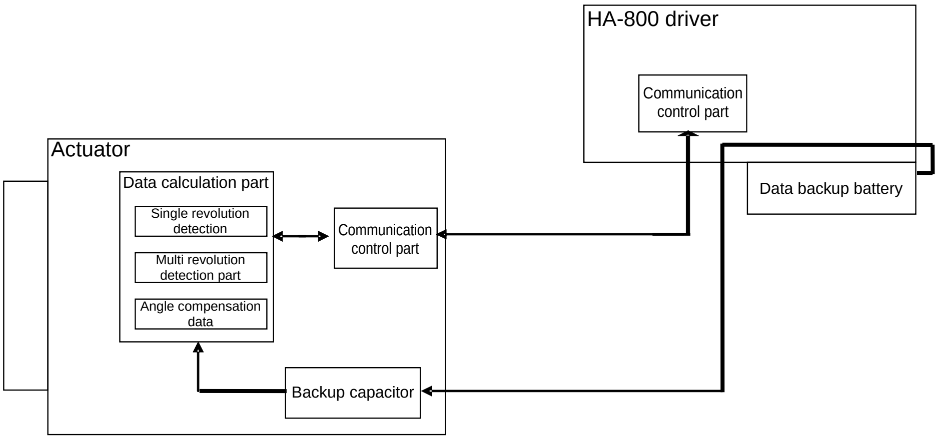
The SHA series (excluding SHA20) and HMA series (excluding HMAC08) are equipped with a multi revolution-type 17-bit magnetic absolute encoder.
The SHA20, FHA-Cmini series and HMAC08 are equipped with a multi revolution-type 17-bit optical absolute encoder. (Multi revolution detection part is magnetic.)
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.
The SHA-CG output shaft single revolution absolute model (SHA-CG-S) assumes a machine that only moves the index table in one direction. When the machine continues to rotate in just one direction, the absolute encoder eventually exceeds the number of revolutions that can be detected with multi revolution detection and it becomes impossible to manage position information accurately.
Therefore, each time the output shaft rotates through single revolution, the cumulative multi revolution counter is cleared to 0 to enable the output shaft single revolution absolute function. This is how position information is accurately managed when the shaft continuously turns in just one direction.

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

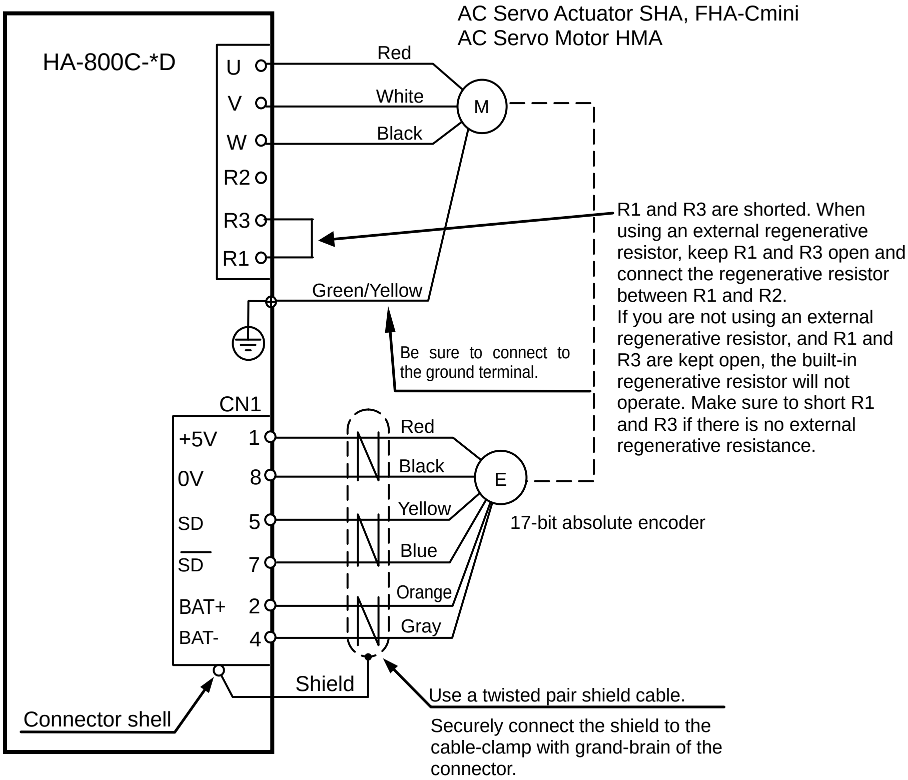
- The backup time is 30 minutes when a new capacitor has been charged for at least 3 hours by supplying power to the actuator. This backup time becomes shorter if the power is supplied for a shorter period or the capacitor deteriorates over time.



Block diagram of actuator/encoder and driver

Standard connection

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



Startup

Parameters that must be set

Parameter No.	Name	Function
SP50	Command Polarity *	Sets whether or not to reverse the actuator rotation direction when an operation command is given by CC-Link etc. as well as the system coordinate directions including forward/reverse inhibit signals and monitoring polarities. Setting range: 0, 1 0: Do not reverse the coordinate direction. 1: Reverse the coordinate direction. For information on the actuator rotation direction, refer to [SP50: Command polarity] (P8-4).
SP61	Encoder monitor output pulses *	Set the phase A and B pulses to be output to the encoder monitor output terminals (CN2-14 to 19) when the motor shaft of the 17-bit absolute encoder turns one revolution. Setting range: 1 to 8,192 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-800C-*D) 1: Use as an incremental encoder. (Default value on HA-800C-*E)
SP67	Output shaft divide function setting *	When using for position control combined with an SHA-CG series unit, you can set the actuator resolution. Setting range: 0 to 3 (default: 0) 0: Division of 131072 per output shaft revolution x reduction ratio 1: Division of single output shaft rotation into 36,000 parts (equivalent to 0.01 degree resolution) 2: Division of single output shaft rotation into 360,000 parts (equivalent to 0.001 degree resolution)) 3: Division of single output shaft revolution into 3,600,000 parts (equivalent to 0.0001 degree resolution).

*: If you change the value, 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-800C-*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-800C-*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] (P9-9).

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 [SP50: Command polarity*], [SP61: Encoder monitor output pulses*], and [SP67: Output shaft divide function setting*] according to the method used, then turn the power OFF, then ON again to put the parameter into effect. For details, refer to [SP50: Command polarity] (P8-4), [SP61: Encoder monitor output pulses] (P8-7), [SP67: Output shaft divide function setting] (P8-10), and [Output signal pulses] (P4-9).

*: 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] (P4-8).

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

Perform the following to set the origin [*1] in order to link the actuator driver and the mechanical origin.

(1) Set the virtual origin to zero (default), and reconnect the HA-800C power supply.
(2) Move the actuator to the target mechanical origin position via a JOG operation, manually, or using the various host controller functions.
(3) Execute T08 (multi revolution clear) by operating the HA-800C panel, and reconnect the HA-800C 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[*2]. 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-800C driver[*2]. 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 CC-Link communication. For details, refer to monitor codes 000Ah and 000Bh (low and high cumulative feedback pulses) (P13-29) or monitor codes 0019h, 001Ah, and 001Bh (low, mid, and high ABS position readouts)
(5) Perform either of the following to set the current absolute encoder value that has been read as the virtual origin[*2].
   (a) Use the HA-800 driver monitor software PSF-800. For details, refer to [Parameter setting] (P10-10).
   (b) Use the CC-Link communication. For details, refer to command codes 920Ch and 920Dh (low and high virtual origins) (P13-35).
(6) Reconnect the power supply to the host controller and HA-800C.
(7) The mechanical origin is set to zero in the amount of absolute value displacement operation.

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

*1: Driver software Ver. 2.x or later is explained.
*2: When [SP50: Command polarity] is set to 1, set the value [Current value read in step (4) (a) (b) x -1] obtained in step (5).

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-800C driver.

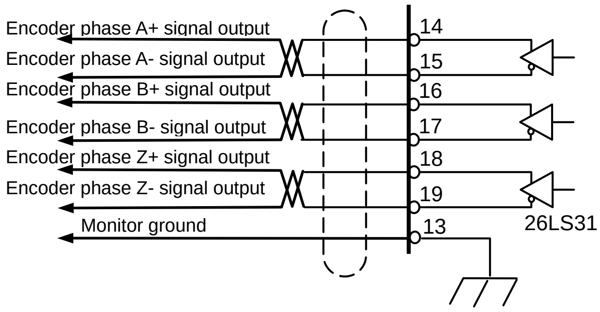
Set the origin in the following situations even if it's not during a start-up.
- The driver has been replaced
- The actuator has been replaced
- [AL81: System failure], [AL82: Single revolution data error] or [AL83: Multi revolution data error] generated due to a loss of absolute position or error.

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 CN2-14 to 19. The number of pulses per motor shaft revolution is set by the system parameter SP61.

CN2-14 Phase output-A+ (LD)
CN2-15 Phase output-A- (LD)
CN2-16 Phase output-B+ (LD)
CN2-17 Phase output-B- (LD)
CN2-18 Phase output-Z+ (LD)
CN2-19 Phase output-Z- (LD)
CN2-13 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 8192)
Phase B signal output	Set value of SP61 (1 to 8192)
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.

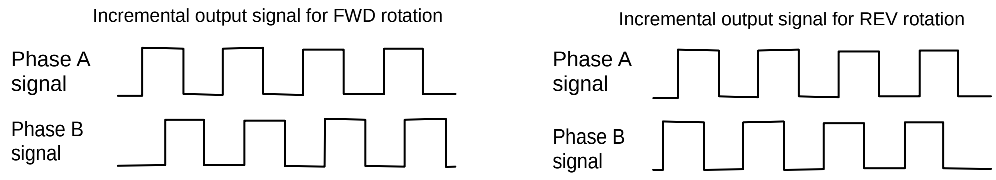
For example, setting the maximum value 8,192 in SP61 causes 8,192 pulses to be output per motor shaft revolution. Although this corresponds to a resolution of 32,768 pulses, or 4 times 8,192, it is one-fourth the resolution 131,072 of the 17-bit absolute encoder per motor shaft revolution.

8,192 × 4 = 32,768 (Quadruplicate)
131,072 ÷ 4 = 32,768

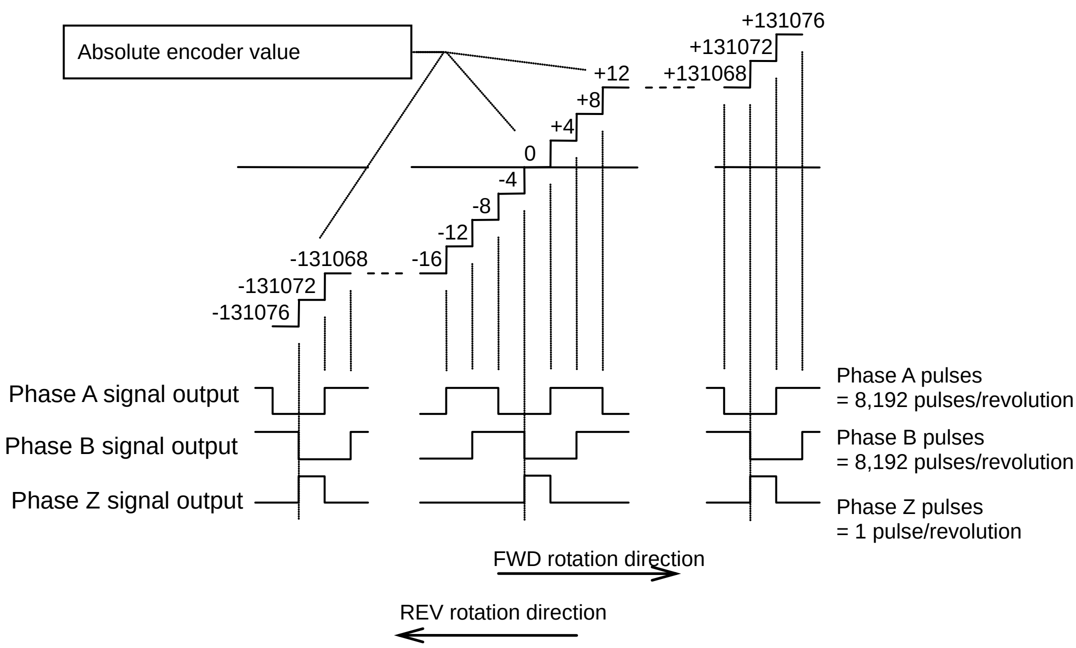
For phase Z, 1 pulse is output per motor shaft revolution.

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



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.

4

Encoder system

Remedial actions for errors/warnings

Remedial action for error

Name	Description	Cause	Action
AL50 Encoder disconnection	Encoder signals have been cut off.	(1) Disconnected encoder signal wire (2) Poor contact/connection of encoder signal connector (3) Encoder error (4) HA-800C driver control circuit error	(1) Repair the wire. (2) Connect the connector properly. (3) Replace the actuator. (4) Replace the HA-800C driver.
AL80 MEMORY error	EEPROM memory error in encoder	(1) Encoder error (2) HA-800C driver control circuit error	(1) Replace the actuator. (2) Replace the HA-800C 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-800C 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-800 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) Perform [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-800C 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) Perform [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) Perform [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.
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-800C 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 2.08 and earlier, after the battery is replaced, turning the power back ON releases UA91. (3) Repair the wire. (4) Replace the HA-800C driver. (5) Replace the actuator.

4-3 13-bit absolute encoder

CAUTION

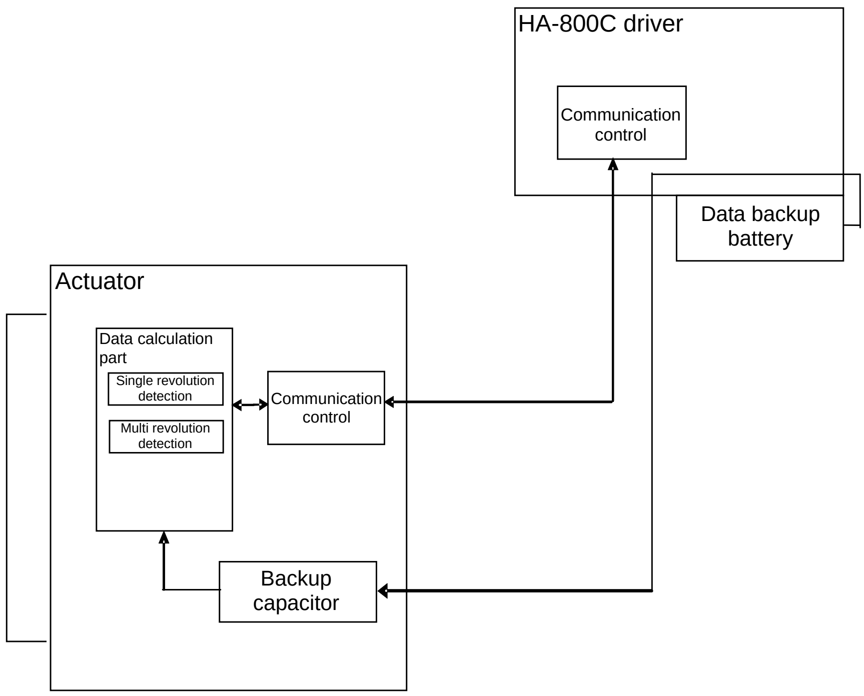
If AL53 (system failure), AL54 (multi revolution counter overflow) or AL55 (multi revolution data error) generates due to a loss of absolute position or error, be sure to reset the origin. Failure to do so may result in unexpected operations.

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

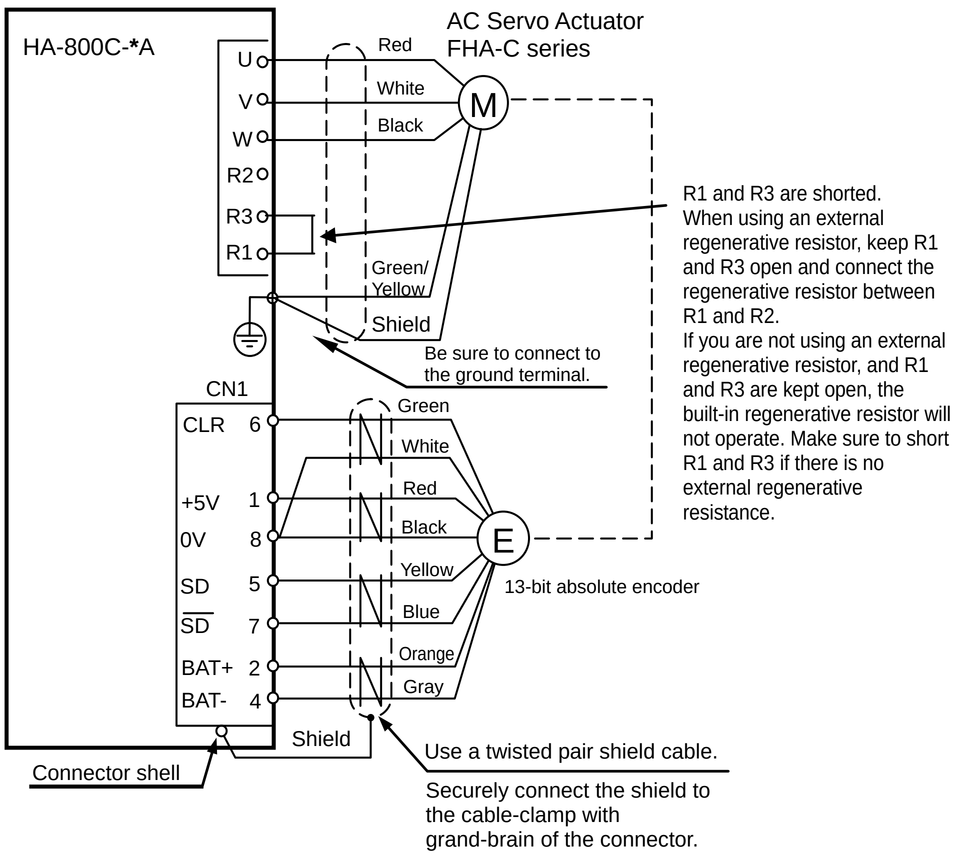
- The backup time is 30 minutes when a new capacitor has been charged for at least 3 hours by supplying power to the actuator. This backup time becomes shorter if the power is supplied for a shorter period or the capacitor deteriorates over time.



Block diagram of actuator/encoder and driver

Standard connection

A connection example of an actuator of 13-bit absolute encoder model with a HA-800C 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] (P9-9).

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] (P4-16).

Origin setting

Perform the following to set the origin *1 in order to link the actuator driver and the mechanical origin.

(1) Set the virtual origin to zero (default), and reconnect the HA-800C power supply.
(2) Move the actuator to the target mechanical origin position via a JOG operation, manually, or using the various host controller functions.
(3) Execute T08 (multi revolution clear) by operating the HA-800C panel, and reconnect the HA-800C 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-800C 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 CC-Link communication. For details, refer to monitor codes 000Ah and 000Bh (low and high cumulative feedback pulses) (P13-29) or monitor codes 0019h, 001Ah, and 001Bh (low, mid, and high ABS position readouts)
    (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.
    (a) Use the HA-800 driver monitor software PSF-800. For details, refer to [Parameter setting] (P10-10).
    (b) Use the CC-Link communication. For details, refer to command codes 920Ch and 920Dh (low and high virtual origins) (P13-35).
(6) Reconnect the power supply to the host controller and HA-800C.
(7) The mechanical origin is set to zero in the amount of absolute value displacement operation.

*: The current HA-800C 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.

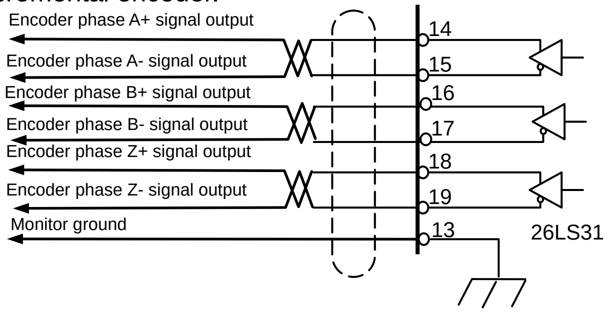
- The driver has been replaced
- The actuator has been replaced
- [AL53: System failure], [AL54: Multi revolution counter overflow] or [AL55: Multi revolution data error] generated due to a loss of absolute position or error.

Data output

Outputting the current value data from the pins CN2-14 to 19

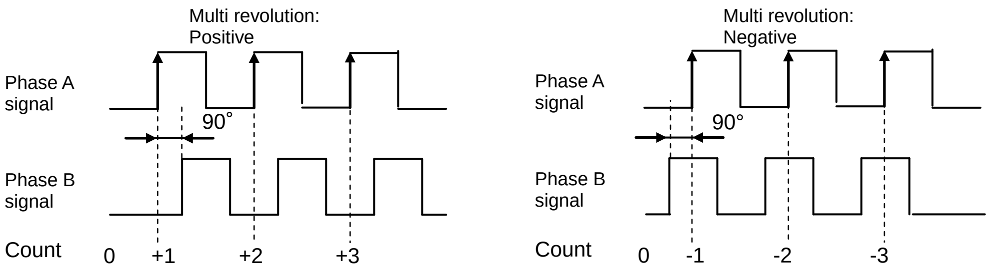
Position data is output from the encoder phase A, B and Z signal output ports.
Following the powering sequence, the ports of the [CN2-14 phase-A output: A+] through [CN2-19 phase-Z output: Z-] automatically output multi revolution data and absolute data as the current value data just for once.
In normal operation, pulse train signals are output following the transmission of position data and implement similar operations to an incremental encoder.

CN2-14 Phase output-A+ (LD)
CN2-15 Phase output-A- (LD)
CN2-16 Phase output-B+ (LD)
CN2-17 Phase output-B- (LD)
CN2-18 Phase output-Z+ (LD)
CN2-19 Phase output-Z- (LD)
CN2-13 Monitor ground



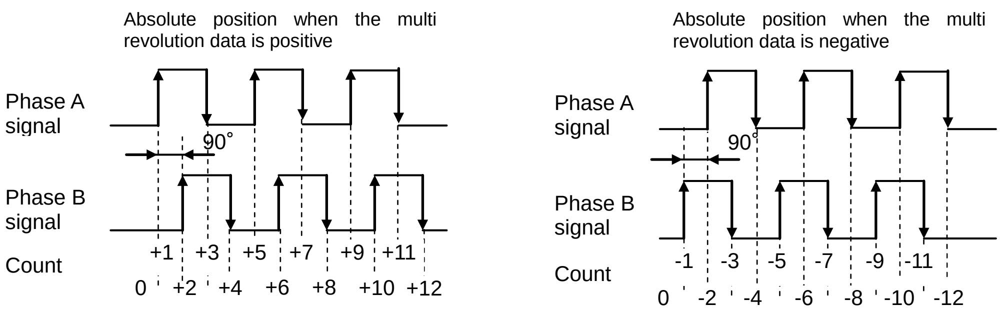
- **Multi revolution data**

"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.



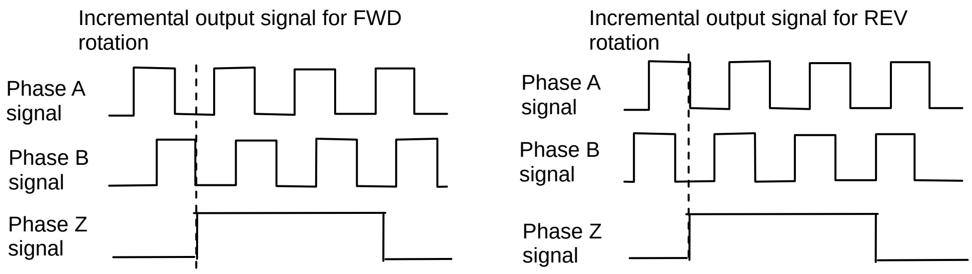
- **Absolute position**

The absolute position is output using 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 form, count the leading edges and trailing edges of both phase A and B signals. In the example shown below, the absolute position is 12.



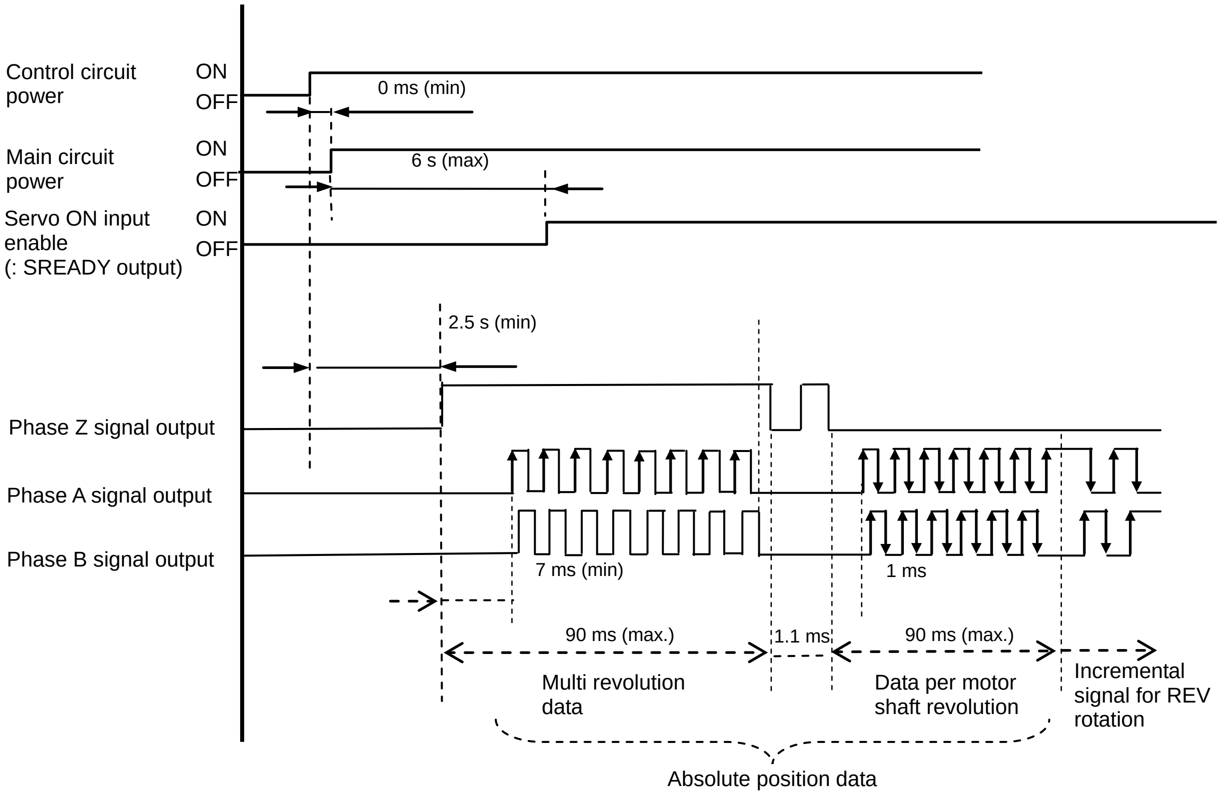
- **Encoder phase A, B and Z incremental signals**

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.



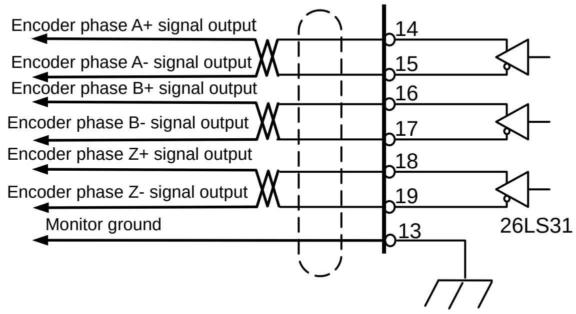
Encoder phase A, B and Z signal outputs

When the motor shaft equipped with a 13-bit absolute encoder turns, incremental phase A, B and Z signals are output to the pins CN2-14 to 19.

- **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 rotation, but the width is indeterminable.

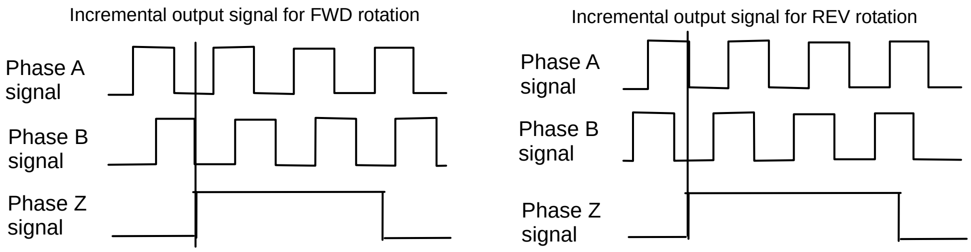
CN2-14 Phase output-A+ (LD)
CN2-15 Phase output-A- (LD)
CN2-16 Phase output-B+ (LD)
CN2-17 Phase output-B- (LD)
CN2-18 Phase output-Z+ (LD)
CN2-19 Phase output-Z- (LD)
CN2-13 Monitor ground



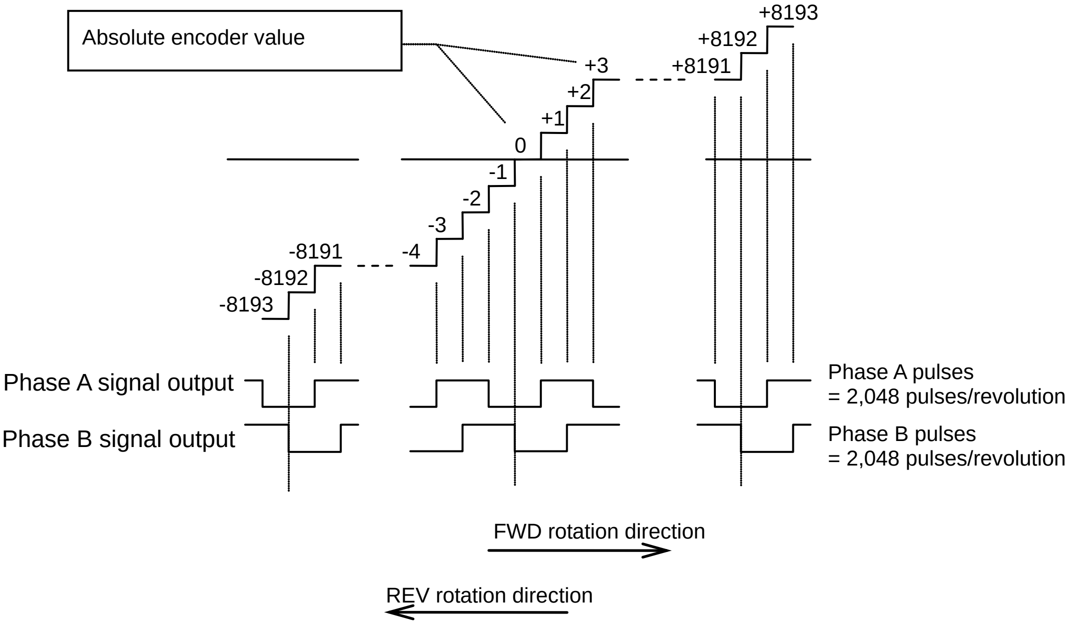
	Output pulses per motor shaft revolution
Phase A	2,048
Phase B	2,048
Phase Z	1

* For an actuator with a speed reducer, a phase Z is output for the reduction ratio per output shaft revolution.

- **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.



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.

4

Encoder system

Remedial actions for errors/warnings

Remedial action for error

Name	Description	Cause	Action
AL50 Encoder disconnection	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-800C 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-800C 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-800C 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-800C 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-800C driver and actuator have been disconnected for many hours. (4) Either the voltage of the backup capacitor in the encoder or HA-800C driver battery, whichever is higher, has become 2.3V or below. (5) Encoder error	(1) Execute test mode T08 to perform multi revolution clear and then reconnect the power. (2) Install the battery (option: HAB-ER17/33-2). (3) Execute test mode T08 to perform multi revolution clear and then reconnect the power. (4) Replace the HA-800C driver battery (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-800C 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-800C 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-800C 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-800C driver.

Remedial action for warning

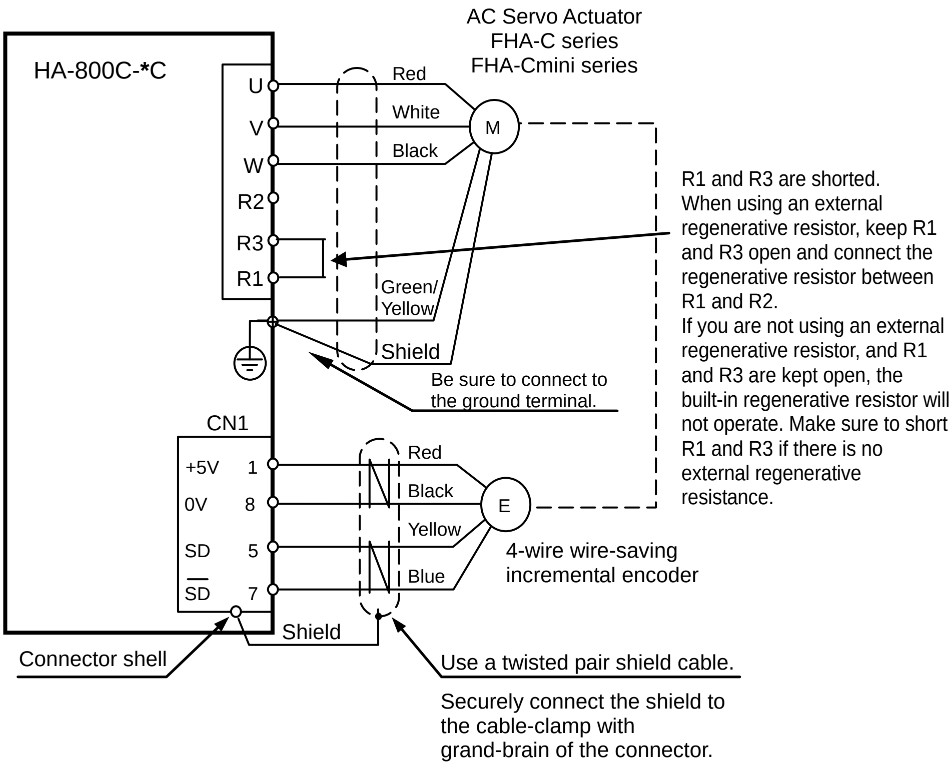
Name	Description	Cause	Action
UA91 Battery voltage low	The backup battery voltage has dropped to DC2.8V or below.	(1) Voltage drop due to consumption of backup battery (2) New product without battery installed (3) Encoder battery lead line short-circuit and poor connection (4) HA-800C driver control 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-800C driver. (5) Replace the actuator.

4-4 Incremental encoder

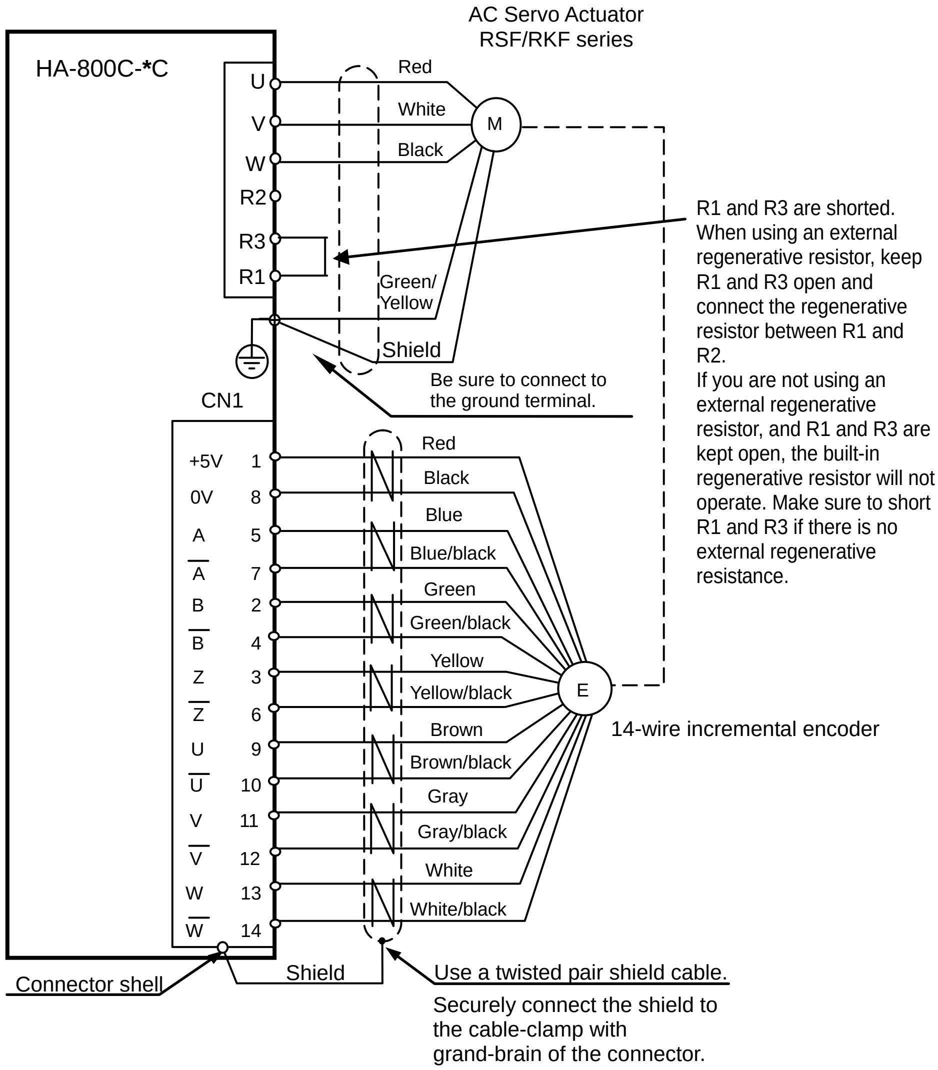
The incremental encoder has a relatively simple structure where pulses are output according to changes in rotation angle. However, it has one drawback of causing loss of current position data when the power supply is cut off, and therefore position control requires originating operation using a separately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

Perform the following to set the origin [*1] in order to link the actuator driver and the mechanical origin.

(1) Set the virtual origin to zero (default), and reconnect the HA-800C power supply.
(2) Perform originating to set the origin to be usually used.
(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-800C 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 CC-Link communication. For details, refer to monitor codes 000Ah and 000Bh (low and high cumulative feedback pulses) (P13-29) or monitor codes 0019h, 001Ah, and 001Bh (low, mid, and high ABS position readouts)
(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 value calculated with the formula, current read value of incremental encoder × $\frac{\text{SP45: electronic gear numerator set value}}{\text{SP44: electronic gear denominator set value}}$
  (a) Use the HA-800 driver monitor software PSF-800. For details, refer to [Parameter setting] (P10-10).
  (b) Use the CC-Link communication. For details, refer to command codes 920Ch and 920Dh (low and high virtual origins) (P13-35).
(7) Reconnect the power supply to the host controller and HA-800C.
(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-800C position display will indicate zero at the mechanical origin.

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

- Use the procedure above to set the origin even if the actuator was replaced.
- If the driver was replaced, also set the value set in step (6) above in the replacement driver.

Data output

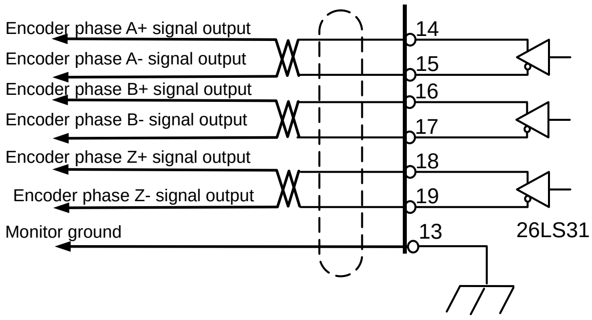
Encoder phase A, B and Z signal outputs

When the motor shaft equipped with an encoder turns, incremental phase A, B and Z signals are output to the pins CN2-14 to 19.

- **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.

CN2-14 Phase output-A+ (LD)
CN2-15 Phase output-A- (LD)
CN2-16 Phase output-B+ (LD)
CN2-17 Phase output-B- (LD)
CN2-18 Phase output-Z+ (LD)
CN2-19 Phase output-Z- (LD)
CN2-13 Monitor ground



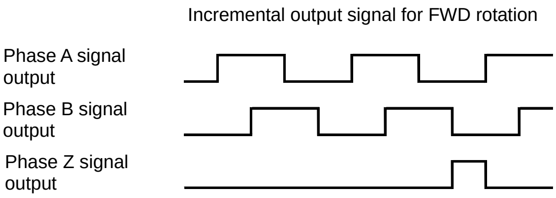
	Output pulses per motor shaft revolution
Phase A	(Encoder resolution) / 4 *1
Phase B	(Encoder resolution) / 4 *1
Phase Z	1

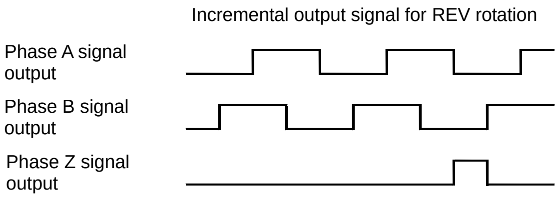
*1: For example, assume that the encoder resolution is 10,000 pulses.
In this case, 2,500 pulses (10,000 / 4) are output.

* For an actuator with a speed reducer, a phase Z is output for the reduction ratio per output shaft revolution.

- **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.





- **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 disconnection	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-800 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-800 driver.
AL51 Encoder counter 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-800 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-800 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-800 driver control circuit error	(1) Repair the wire. (2) Connect the connector properly. (3) Replace the actuator. (4) Replace the HA-800 driver.

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

This unit communicates with the host device via the CN2 connector. The following explains the I/O signals used in this communication.

Pin numbers and names of I/O signals

Pin No.	Signal	Symbol	Input Output
1	Input signal common	IN-COM	Input
2	Emergency stop	E-STOP	Input
3	Alarm clear	ALM-CLR	Input
4	Deviation clear	ERR-CLR	Input
5	Origin signal	ORG	Input
6	Input signal common	IN-COM	Input
7	Output signal common	OUT-COM	Output
8	Operation preparation complete	READY	Output
9	Alarm	ALARM	Output
10	Originating (recognition) complete	ORG-END	Output
11	Encoder Z signal (OC)	Z-OC * 1	Output
12	Output signal common	OUT-COM	Output
13	Monitor common	MON-COM	Output
14	Encoder monitor (A+)	A+	Output
15	Encoder monitor (A-)	A-	Output
16	Encoder monitor (B+)	B+	Output
17	Encoder monitor (B-)	B-	Output
18	Encoder monitor (Z+)	Z+ * 1	Output
19	Encoder monitor (Z-)	Z- * 1	Output
20	Frame ground	FG	

* 1: Pin 11 is an open collector output and pins 18 and 19 are line driver outputs (equivalent to AM26LS31).

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

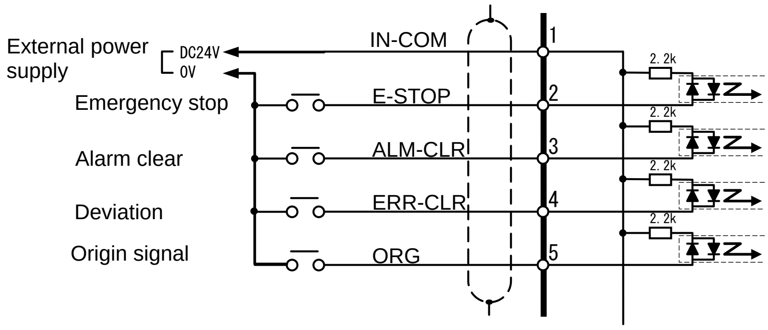
I/O signal connection circuit

The following explains how to connect the I/O signal port to the host device.

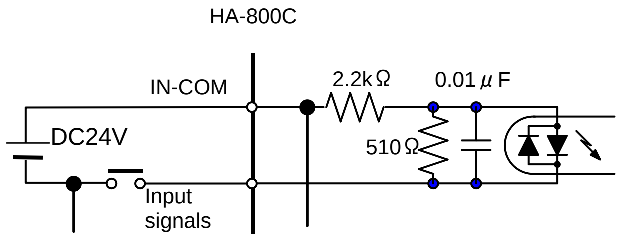
Specifications of input ports

4 input signal ports are provided.

Voltage DC24V ± 10%
Current 20 mA or less (per port)



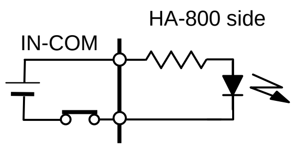
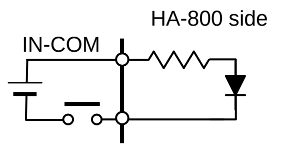
- **How to connect**
  The HA-800C driver has no built-in power supply for input signals. Connect DC24V or GND to [CN2-1: Input signal common] as a common voltage of external power supply for input signals.



(Example of connecting DC24V as common voltage)

Input signal function (logic)

- **Function (logic) definition**

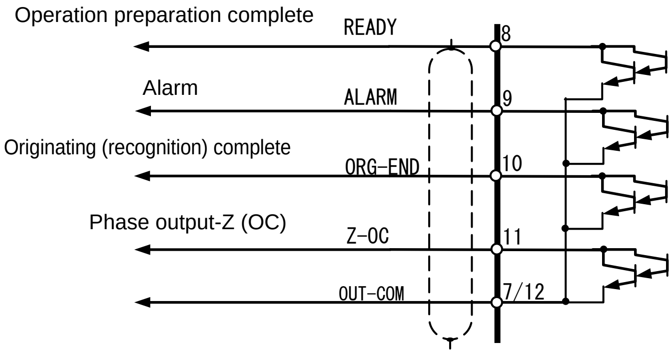
		Input signal status from host	
		Opt-isolator ON	**Opt-isolator OFF**
Circuit status			
Logic setting	**0: Normally open (contact A) Logic NO**	Enable	Disable
	1: Normally closed (contact B) Logic NC	Disable	Enable

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

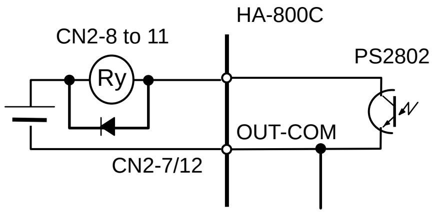
- **How to change function (logic)**
  Input signal logic can be changed using [SP62: Input signal logic setting] (P8-8).
  The input signal default is always set to normally open, but when you use the emergency stop input, make sure to use it after changing to normally closed.
  * The setting change of the system parameters (SP40 to 79) is enabled by reconnecting the control power supply after changing the setting.

Specifications of output ports

4 output signal ports are provided.
Voltage DC24V or less
Current 40 mA or less (per port)
All ports are insulated by an opt-isolator.



- **How to connect**
  Connect an output signal between each output port and [CN2-7/12: Output signal common OUT-COM].



Output signal function (logic)

- **Function (logic) definition**

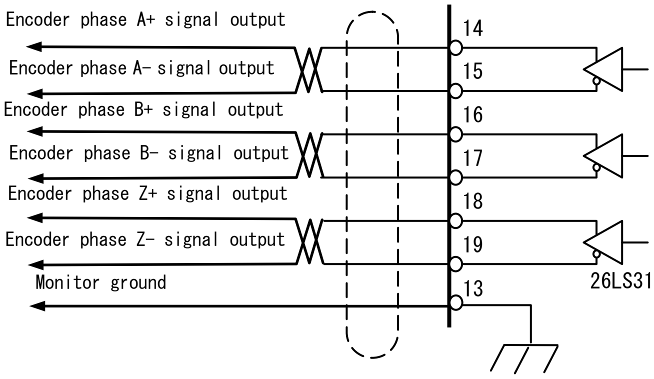
		Transistor output signal status	
		Transistor ON	Transistor OFF
Logic setting	0	Enable	Disable
	1	Disable	Enable

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

- **How to change function (logic)**
  Output signal logic settings can be changed using [SP63: Output logic setting] (P8-8).
  For details, refer to page 8-8.
  * The setting change of the system parameters (SP40 to 79) is enabled by reconnecting the control power supply after changing the setting.

Specification of monitor output signals

6 ports and 3 signals are provided for output signals as shown in the figure to the right to monitor encoder signals.
The encoder's phase-A, B, and Z signals are output via a line driver (26LS31).



- **How to connect**
  Receive the signals using a line receiver (AM26LS32 or equivalent).

5-2 Details of input signals

The following explains the details of input signals.

CN2-1 Input signal common: IN-COM

This is a common terminal for CN2-2, 3, 4 and 5.
Connect DC24V or 0V of the external power supply for input signals.

CN2-2 Emergency stop: E-STOP

If this signal is enabled, the servo is turned OFF and alarm is output. This signal is used to avoid risks such as when normal CC-Link commands cannot be sent due to PLC troubles, etc.
The default of this signal is normally open. If you use a failsafe, which triggers an emergency stop in the event the CN2 cable is disconnected, use it after switching to normally closed.

CN2-3 Alarm clear: ALM-CLR

If a HA-800C driver alarm generates, the alarm status can be deactivated by the edge of this input signal. The default of this signal is normally open. If you use it after changing logic, switch to normally closed before using it.
The alarm clear can also be executed from CC-Link.

CN2-4 Deviation clear: ERR-CLR

If the HA-800C driver is operating in the position control mode, the value of the deviation counter is added to the command counter at the edge of this input signal to clear the deviation counter to 0. The default of this signal is normally open. If you use it after changing logic, switch to normally closed before using it.
Deviations can be cleared from CC-Link as well.

Caution

- With an actuator that has HA-800 software version 2.10 or later and incremental encoder installed, if the number of feedback pulses exceeds -2147483648 to 2147483647 from the origin, do not execute deviation clear.

CN2-5 Origin signal: ORG

This is used as an origin signal for an originating operation. For details, refer to [Originating operation] (P13-9).

5-3 Details of output signals

The following explains the details of output signals.

CN2-8 Operation preparation complete: READY

This is an operation preparation complete signal output of the HA-800C driver. This signal is output when the CC-Link Ryn0: Servo-ON command is 1 and when the servo is turned ON by the actuator. This signal is also output to CC-Link RXn0: Setup complete (Ready). The default of this signal is positive logic (if available, the opt-isolator PS2802 is ON). If you switch logic, switch to negative logic before using it.

CN2-9 Alarm: ALARM

This is an error detection signal of the HA-800C driver. This signal is also output to CC-Link RXn7: Servo alarm. The default of this signal is negative logic (if available, the opt-isolator PS2802 is OFF). You may be able to change the logic of this signal. However, when using this signal, be sure it’s on the default setting to prevent hazard.

CN2-10 Originating (recognition) complete: ORG-END

When an actuator equipped with an incremental encoder is combined, the originating operation is executed and if the reference point is recognized, this signal is available.
When an actuator equipped with an absolute encoder or a 17-bit absolute encoder is combined, if the current value of the encoder is recognized by the HA-800C driver, this signal is available.
This signal is also output to CC-Link RXn2: Origin return complete. The default of this signal is positive logic (if available, the opt-isolator PS2802 is ON). If you use it after changing the logic, use the PSF-800 and then switch to negative logic before using it.

* For details on the originating operation, refer to [Originating Operations] (P13-9).

CN2-11 Phase output-Z (OC): Z

The encoder's phase Z signal is output via an open collector. This signal is output only by 1 pulse per motor revolution. The signal may be used with the origin sensor signal of an automatic mechanism to recognize the accurate origin position, etc.

CN2-7/12 Output signal common: OUT-COM (output signal)

This is a common terminal for output signals CN2-8, 9, 10 and 11.

CN2-14 to 19 Encoder signal output (A, B and Z)

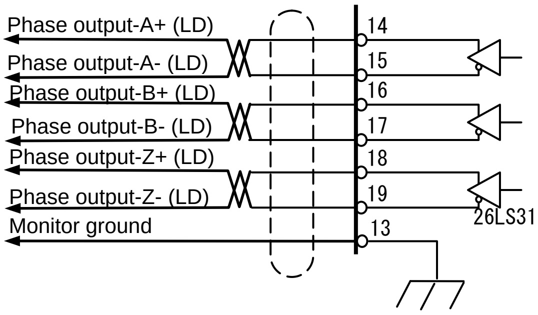
The encoder's phase-A, B, and Z signals are output via a line driver (26LS31).

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

- **How to connect**

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

  Note: Use EIA-422A standard for line receiver.



CN2-20 Ground: FG

Connect cable shield.

5-4 Monitor output

The following explains how to output speeding waveforms output from CN9 connector, current waveforms, and signal waveforms set by system parameter mode 3 [SP40: CN9-CP3 output signal setting].

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 mode 3 [SP51: Speed input factor]. Take note that the output remains unstable after the power is input until the [Operation preparation complete: READY] signal is output. (A maximum of approx. ±15V may be output.)

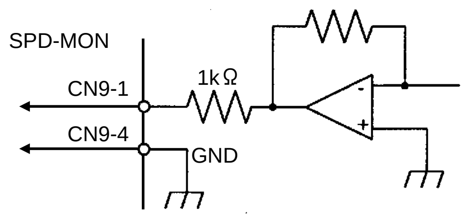
$$\text{Motor rotation speed(r/min)} = \text{Speed monitor output voltage(V)} \times \frac{\text{Speed input factor}}{10.0\text{V}}$$

Output specifications

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

Connection method

Plug the connector for the optional monitor cable (EWA-MON01-JST4) 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 port outputs a voltage proportional to the command current for the actuator (torque input factor per 10V). The relationship of output voltage and current is obtained by the value set in system parameter mode 3 [SP53: Torque input factor].
Take note that the output remains unstable after the power is input until the [Operation preparation complete: READY] signal is output. (A maximum of approx. ±15V may be output.)

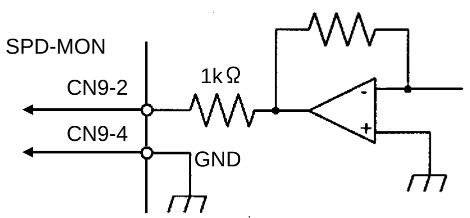
$$\text{Actuator current(A)} = \text{Current monitor output voltage(V)} \times \frac{\text{Torque input factor}}{10.0\text{V}}$$

Output specifications

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

Connection method

Plug the connector for the optional monitor cable (EWA-MON01-JST4) into CN9 and check the waveform between [CN9-2 current monitor: TRQ-MON] and [CN9-4 monitor ground: GND] using an oscilloscope.



CN9-3: Signal monitor (SIG-MON)

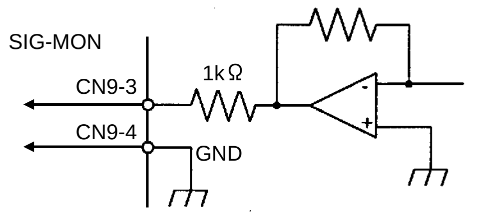
The signal waveform set in system parameter mode 3 [SP40: CN9-CP3 output signal setting] is output. The output voltage is 0V for Low and 3.3V for High. Take note that the output remains unstable after the power is input until the [Operation preparation complete: READY] signal is output.

Output specifications

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

Connection method

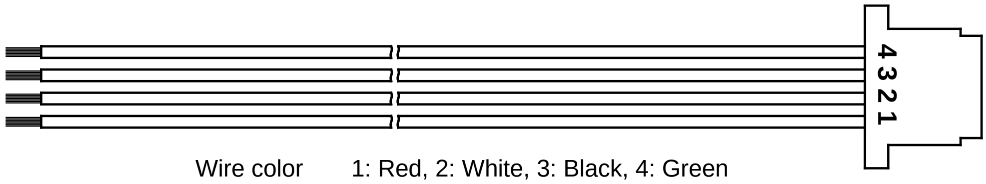
Plug the connector for the optional monitor cable (EWA-MON01-JST4) into CN9 and check the waveform between [CN9-3 signal monitor: SIG-MON] and [CN9-4 monitor ground: GND] using an oscilloscope.



CN9-4: Monitor ground (GND)

It is a common terminal for analog monitor CN9-1, 2 and 3.

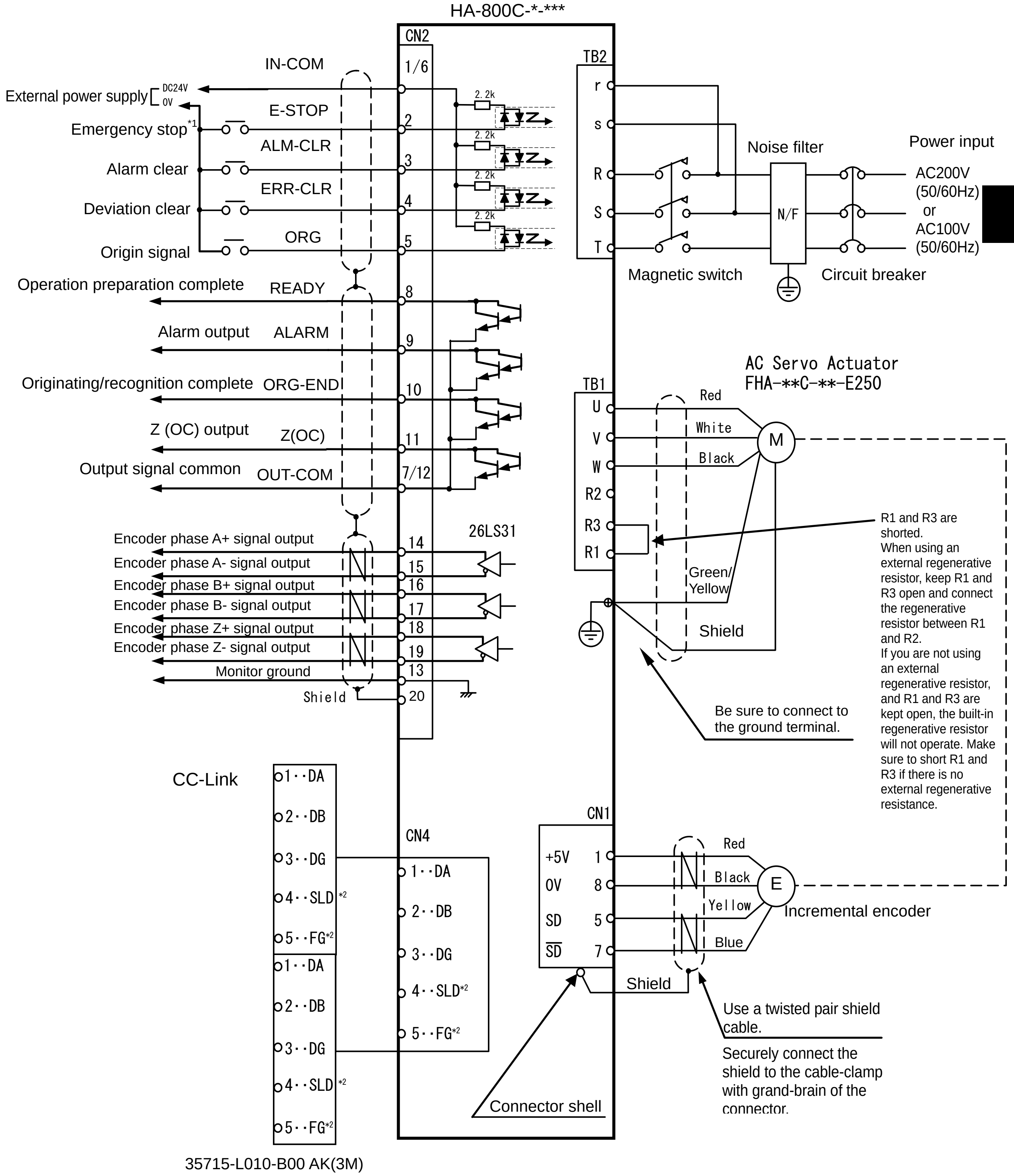
* The optional dedicated cable is required to monitor signals. (EWA-MON01-JST4)



Wire color 1: Red, 2: White, 3: Black, 4: Green

5-5 Connection example with default settings

In case of 4-wire wire-saving incremental specification (FHA-C series)



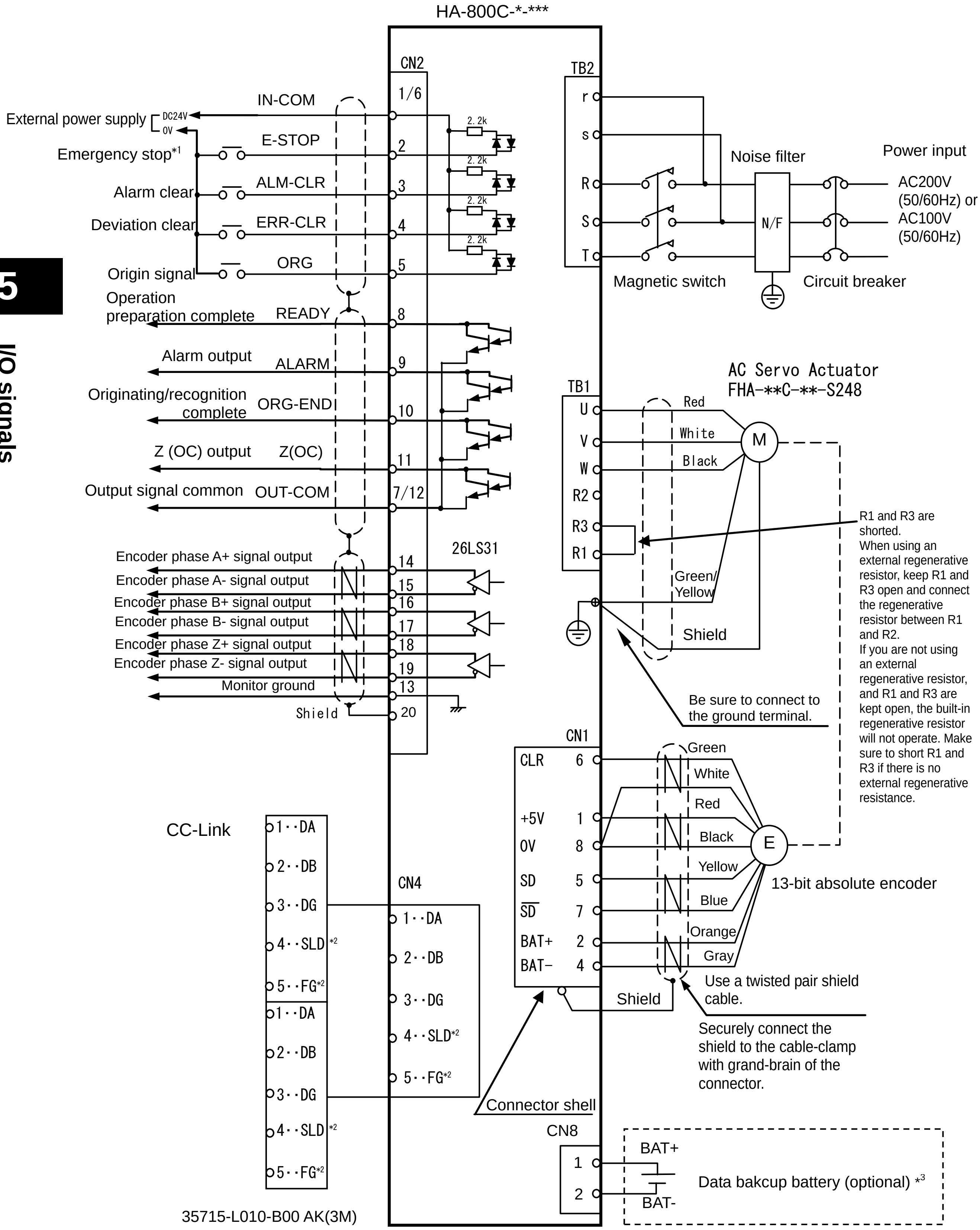
*1 The default settings of the emergency stop input are normally open, but if you use them, make sure to change them to normally closed using the SP62: Input signal logic setting.

*2 The SLD and FG terminals are the same terminal inside the driver. Normally connect the shield to the 5:FG terminal.

5

I/O signals

In case of 13-bit absolute encoder specification (FHA-C series)

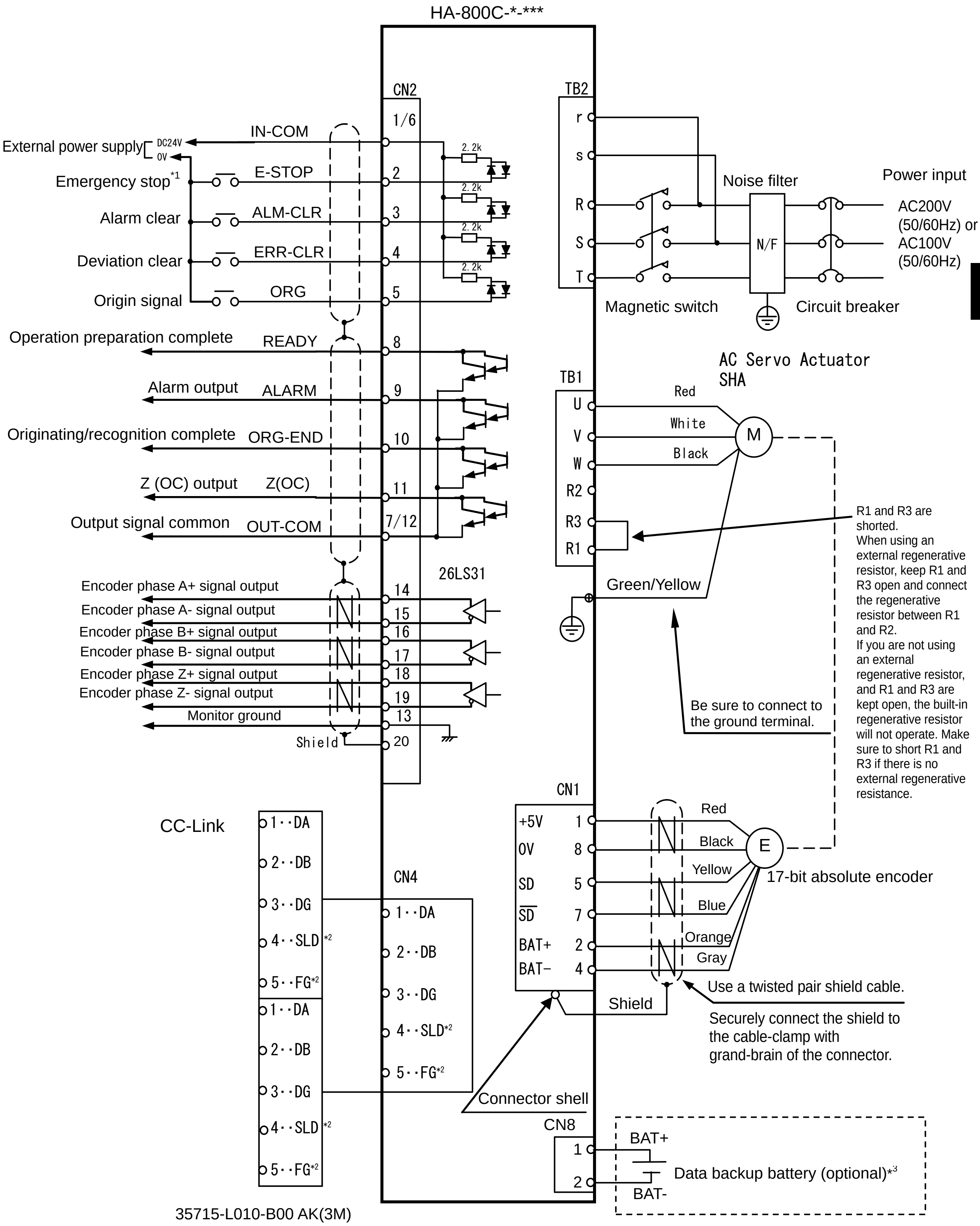


*1 The default settings of the emergency stop input are normally open, but if you use them, make sure to change them to normally closed using the SP62: Input signal logic setting.

*2 The SLD and FG terminals are the same terminal inside the driver. Normally connect the shield to the 5:FG terminal.

*3 When combining the driver to an absolute encoder in order to use it with the absolute specifications, install an optional data backup battery.

In case of 17-bit absolute encoder specification (SHA series)



*1 The default settings of the emergency stop input are normally open, but if you use them, make sure to change them to normally closed using the SP62: Input signal logic setting.

*2 The SLD and FG terminals are the same terminal inside the driver. Normally connect the shield to the 5:FG terminal.

*3 When combining the driver to an absolute encoder in order to use it with the absolute specifications, install an optional data backup battery.

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I/O signals

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 in this chapter.

6-1 Operating display panel

The front display panel has a 5-digit LED display and 4 operation keys. You can perform tuning, setting and other operations 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 in the HA-800C driver, the display panel switches to the alarm mode, regardless of the present mode, and shows the present alarm code.
For details, refer to [Alarm mode] (P7-8).

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

It is possible to display and change servo gain and other parameters.
Tune mode parameters can be changed even when the actuator is operating. Changes are reflected in real time.
For details, refer to [Chapter 7 Status display mode/alarm mode/tune mode].

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

This is used to make settings for the HA-800C driver functions. Although all parameters can be changed even in the servo ON status, the change does not become valid until the power to HA-800C is rebooted.

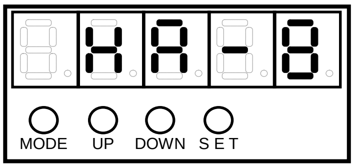
Test mode (T00 to T11)

You can monitor CN2 I/O signals, operate output signals, initialize parameters, and perform multi revolution clear and auto-tuning. Since it is also possible to simply perform JOG operation, it is possible to operate the actuator simply by connecting the HA-800C driver and actuator with cables.

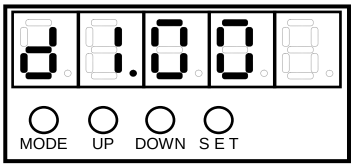
Initial panel display

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

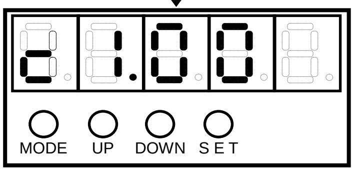
Display upon control power supply ON



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.

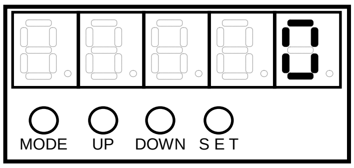


The display software version is shown for approx. 1 second.



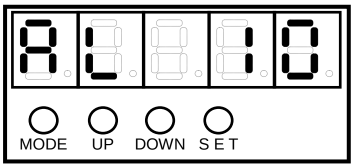
The control software version is shown for approx. 1 second.

Normal

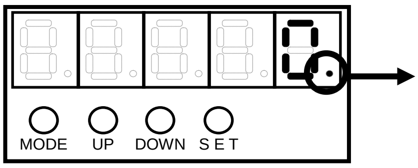


The status data set by [SP54: Status display setting] is shown.

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

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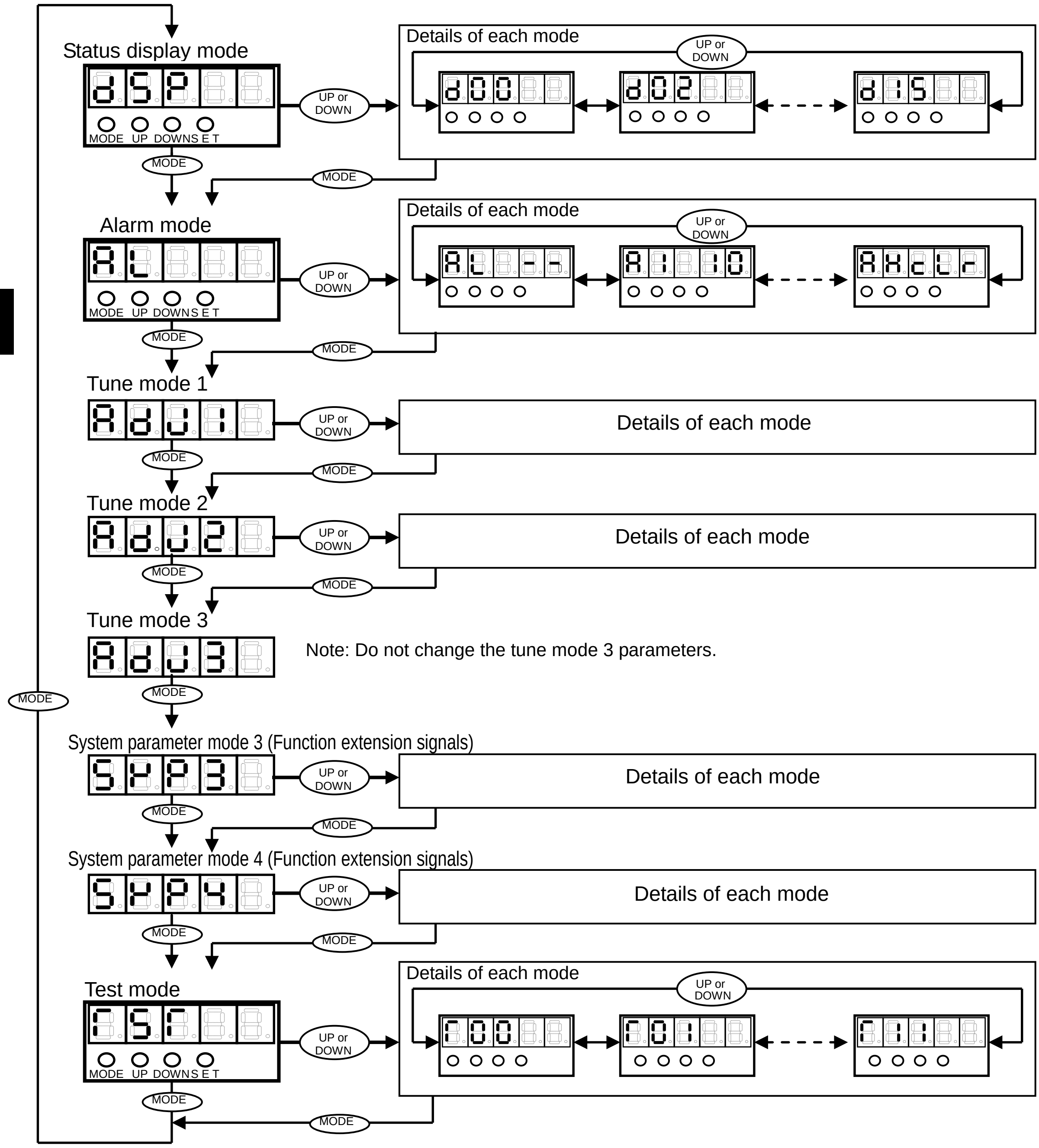
Panel display and operation

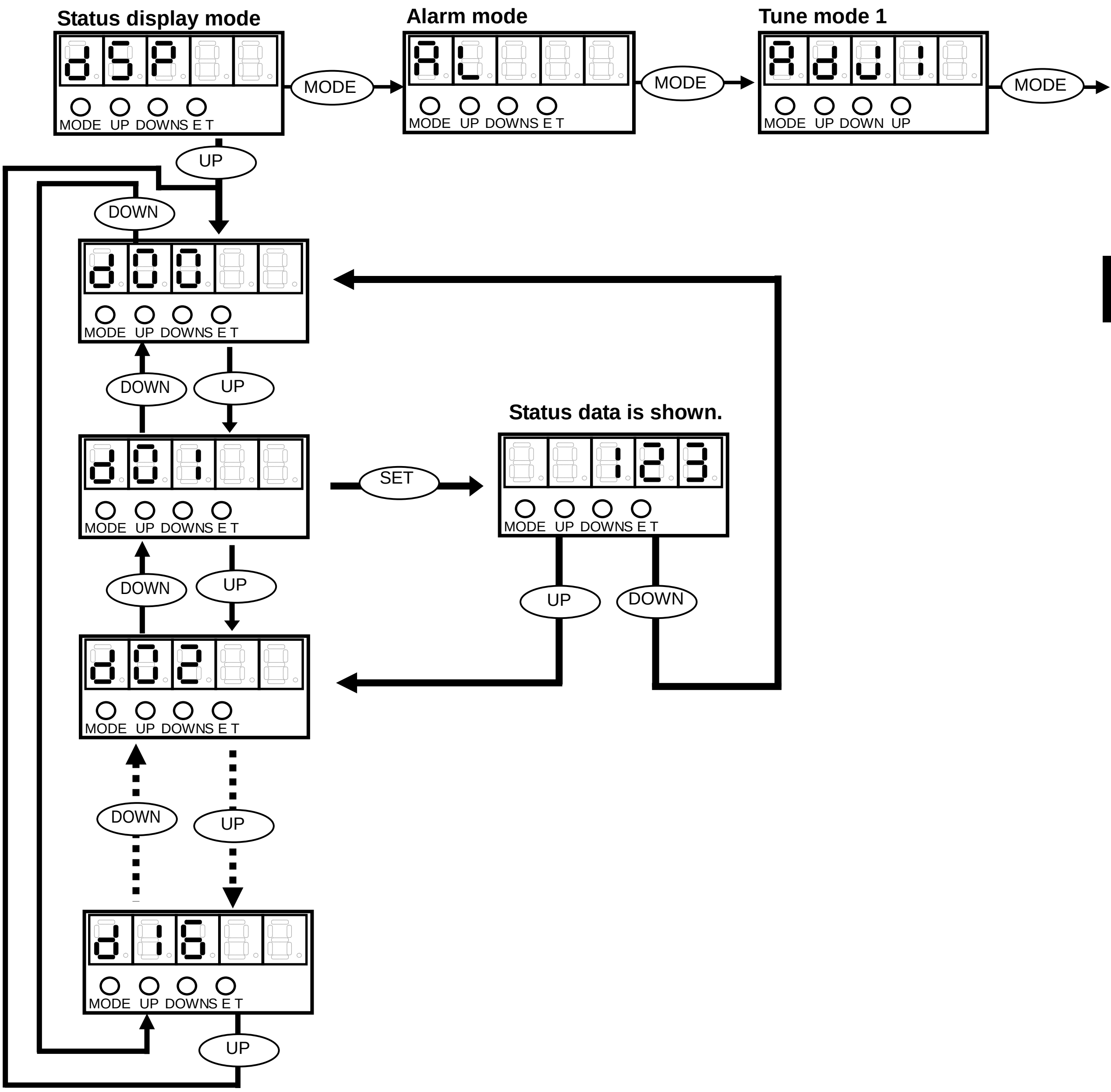
Panel display hierarchy

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.



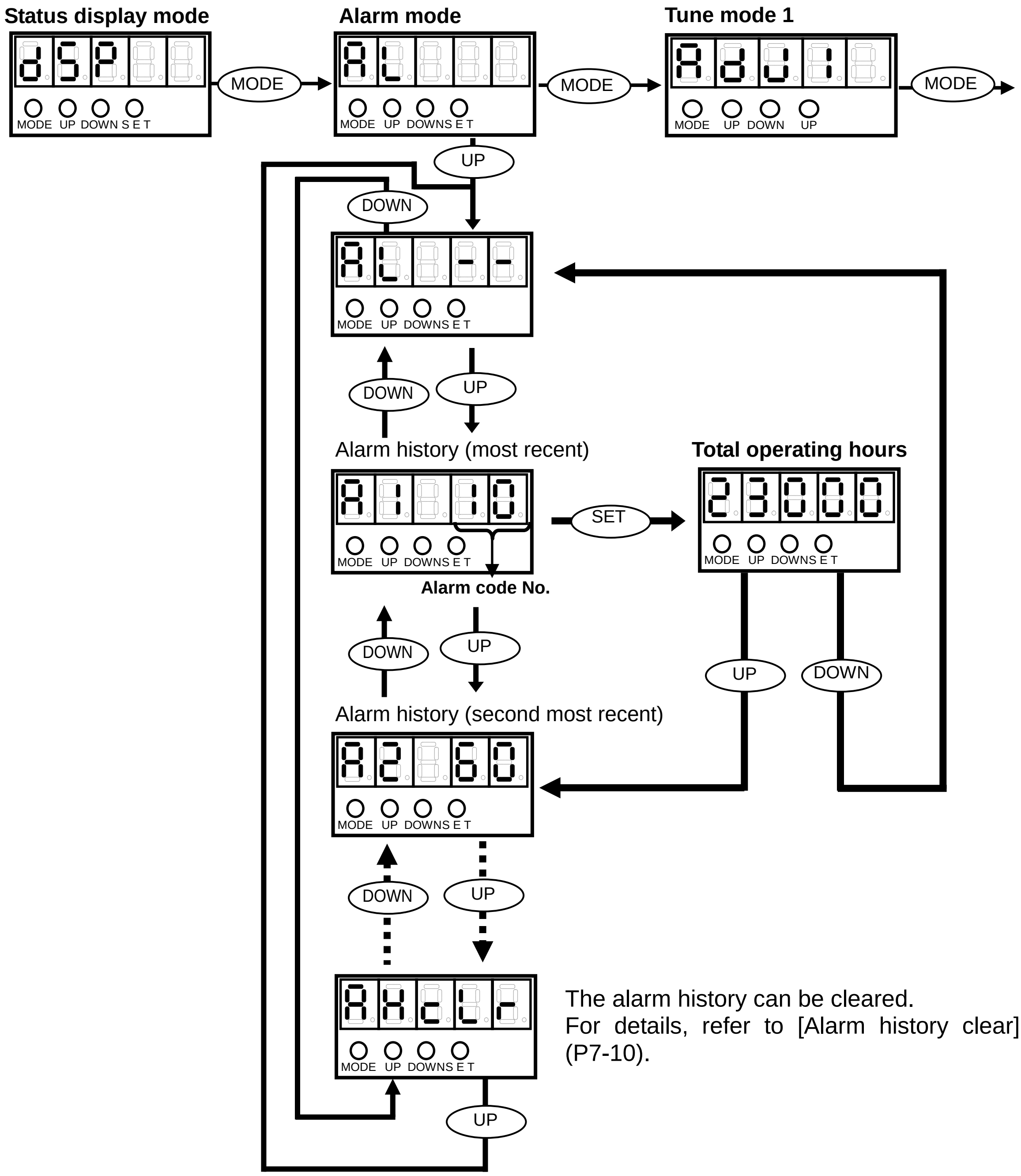
Operation outline of status display mode

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

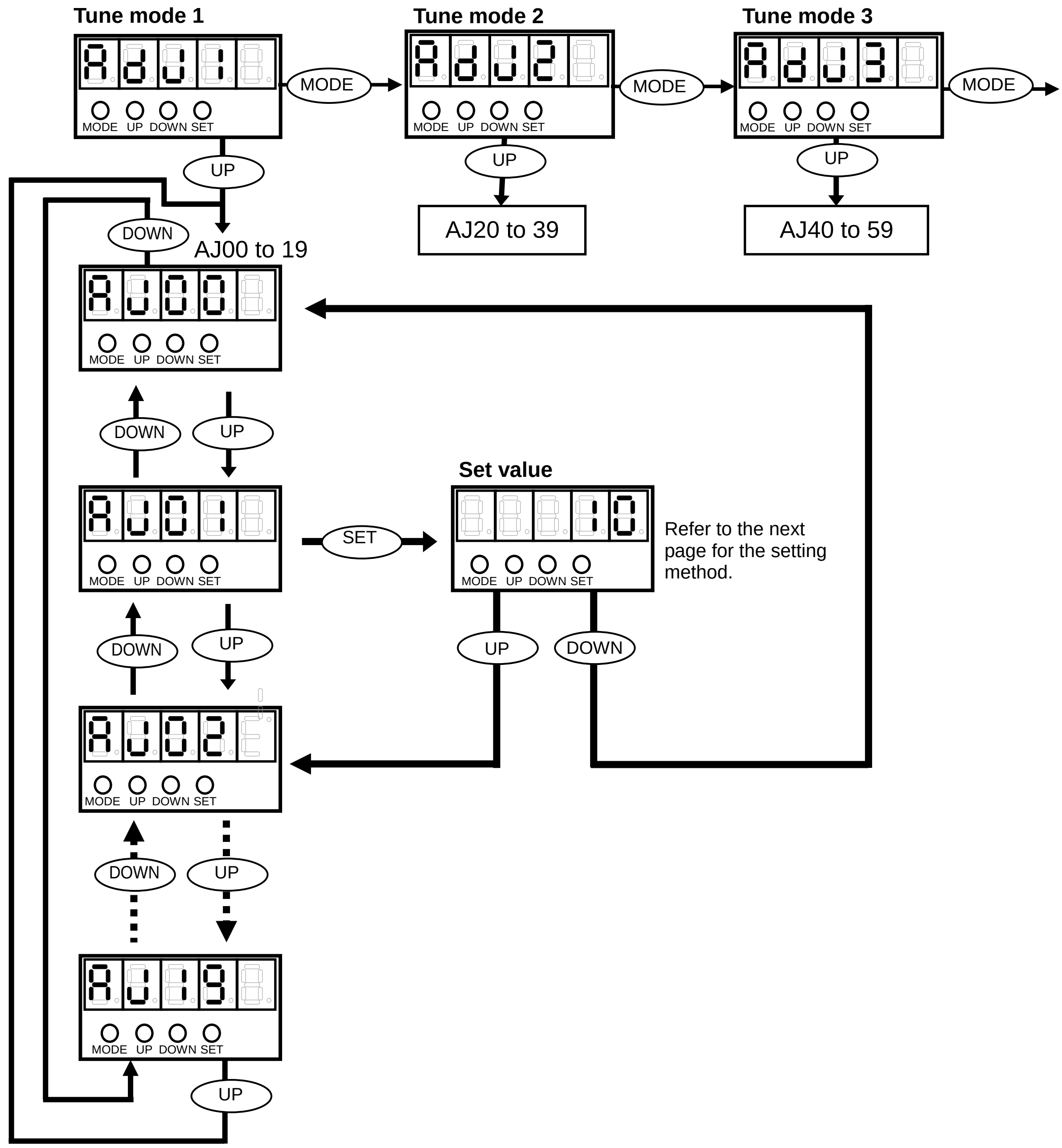
An overview of operations in the alarm mode is shown below.
To prevent malfunction, a button is recognized as enabled when it has been pressed for at least 0.1 second and 1 second or less.
* For the overview on alarms, refer to P7-8.
* For details on alarms, refer to [Chapter 11 Troubleshooting].



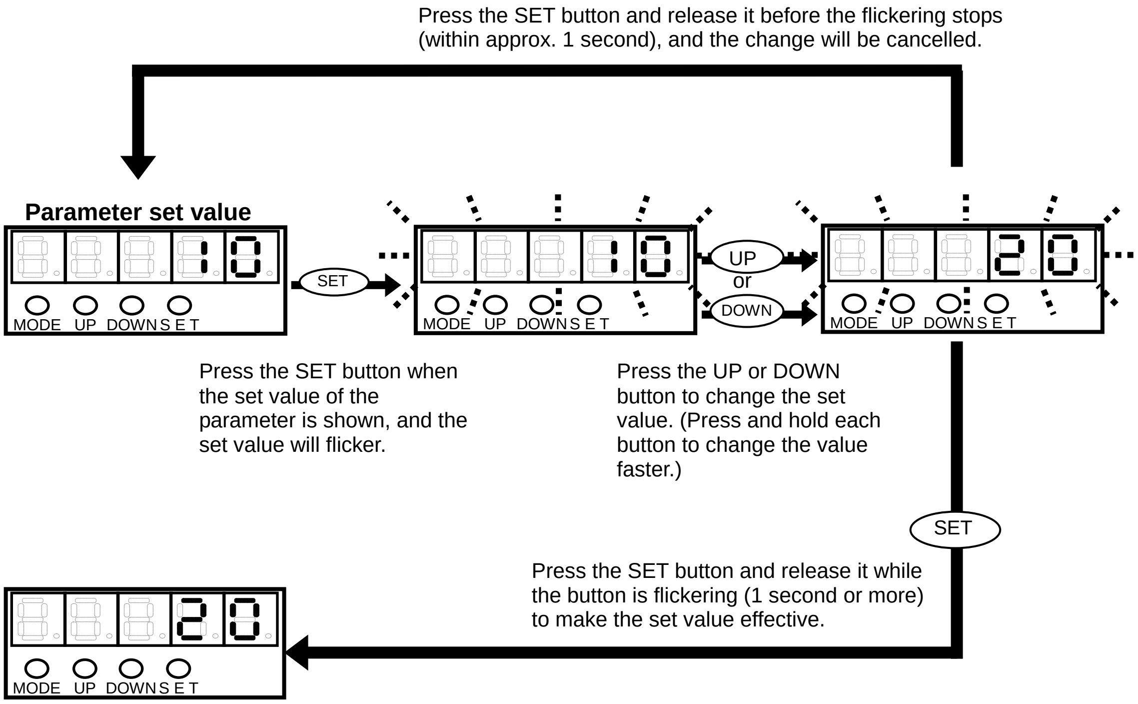
The alarm history can be cleared.
For details, refer to [Alarm history clear] (P7-10).

Operation outline 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).



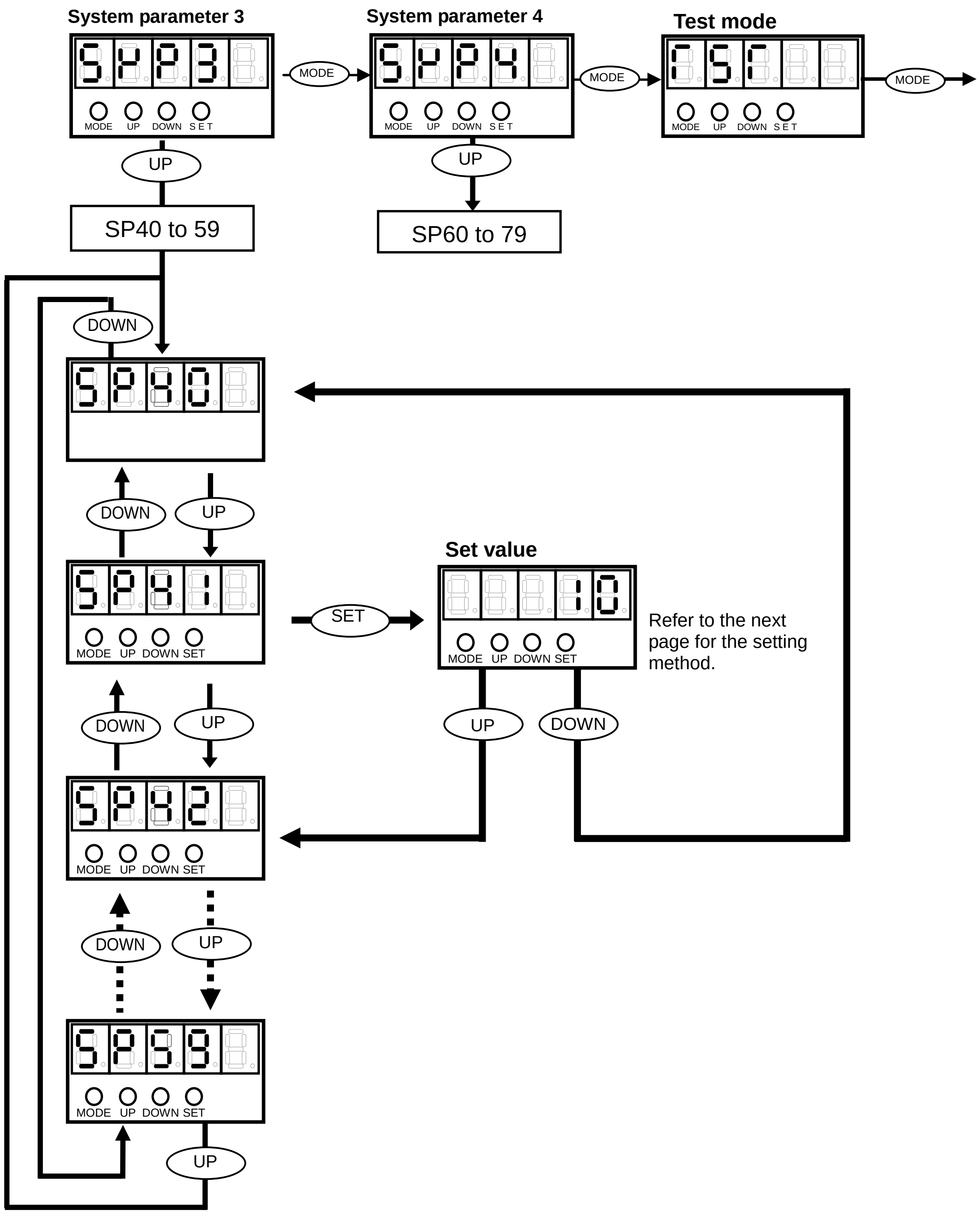
How to change set value



Operation outline of system parameter mode

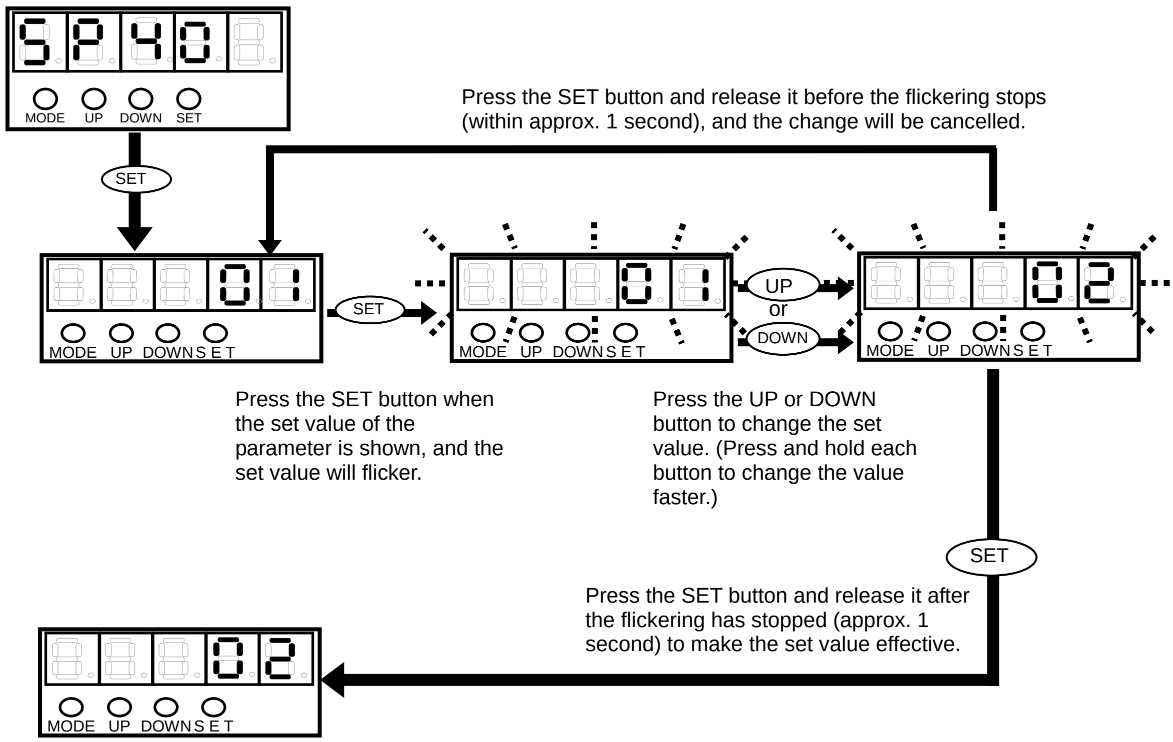
An overview of operations in the system parameter mode is shown below.
To prevent malfunction, a button is recognized as enabled when it has been pressed for at least 0.1 second and 1 second or less.

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



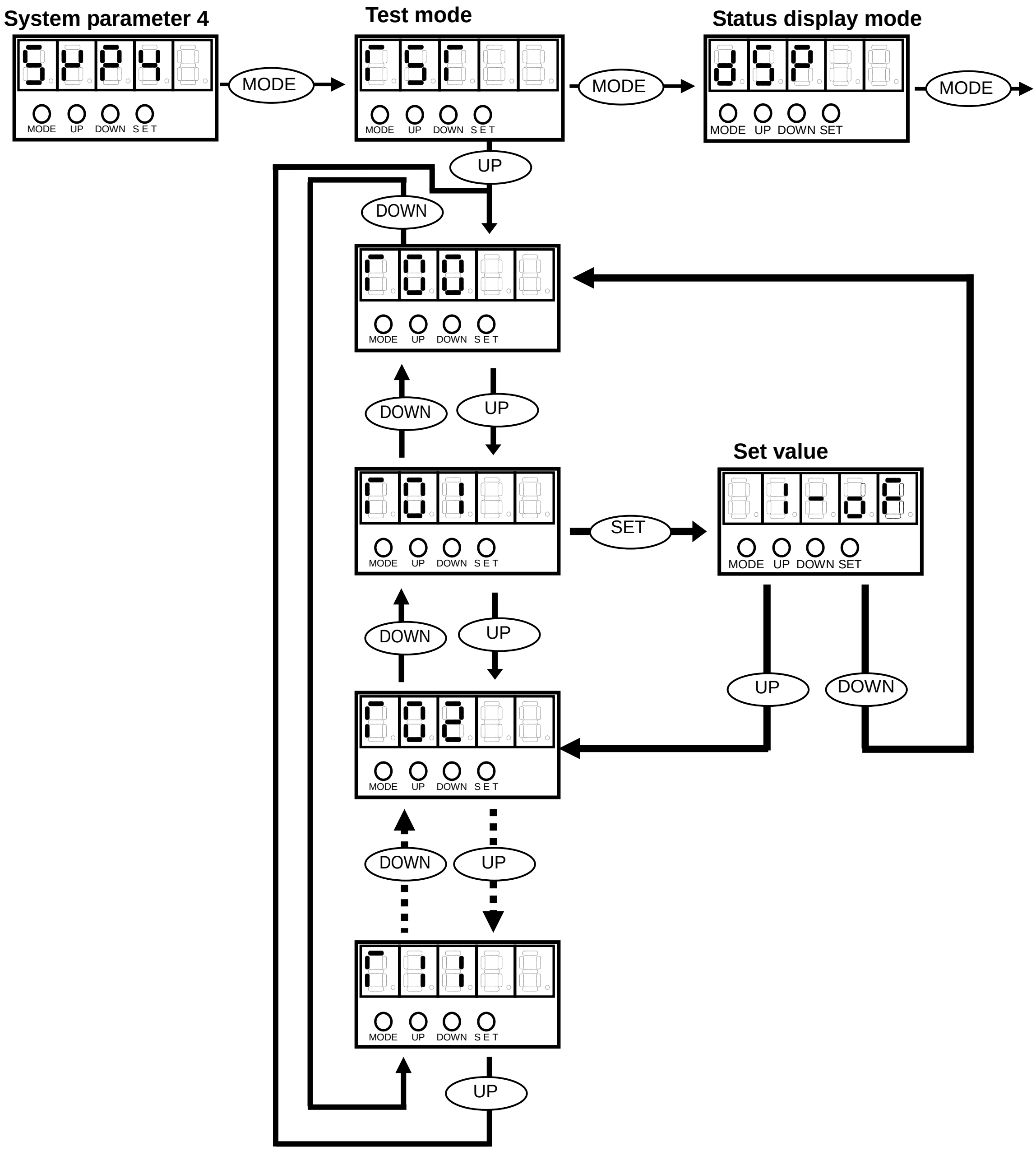
How to set function extension signals (SP**)

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.

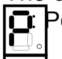
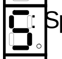
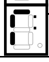
7-1 Status display mode

In the status display mode, position 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] (P8-5).

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.	--	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 (torque to FWD rotation direction) - : REV torque (torque to REV rotation direction)	--	%	--
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 or origin return complete, multiplied by 4	--	pulse	P7-5
d06	Feedback pulse display (High)				
d07	Command pulse display (Low)	Command pulses to the driver are shown. Absolute encoder: Current encoder value upon power ON, plus command pulses: Incremental encoder Cumulative command pulses since the power ON or origin return complete corresponding to 0 pulses	--	pulse	P7-5
d08	Command pulse display (High)				
d09	System reservation	--	--	--	--
d10	Main circuit power voltage	The rectified main circuit power voltage is shown.	--	V	--
d11	System reservation	--	--	--	--
d12	System reservation	--	--	--	--
d13	Applicable actuator code	The actuator code number is shown.	--	--	P7-6

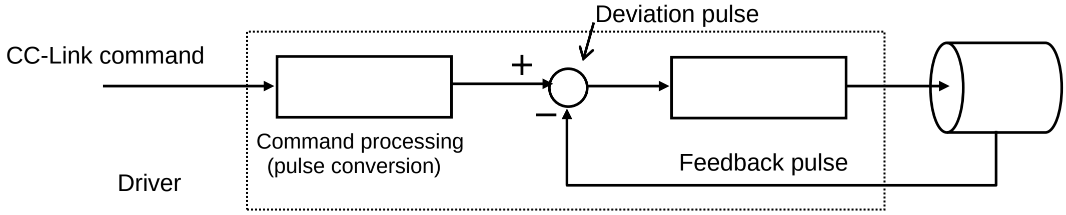
d14	Control mode	The current control mode is shown. : Position control : Speed control : Torque control	--	--	--
d15	Discharge time	An approximate total power ON time is shown. 0 to 99,999	--	h	--
d16	Regenerative power (HA-800-24 only)	It indicates absorbed power of regenerative resistor as percentage.	--	%	P7-7

7-2 Details of status display mode

The following explains details of the status display mode.

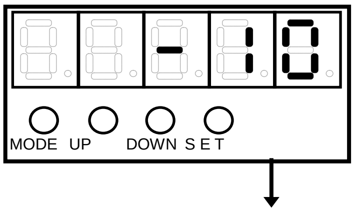
d01, 02: Error pulse count display

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. During speed control or torque control, 0 is shown.



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

Display example)



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

Relational items	d05, d06, d07, d08

d04: Overload rate display

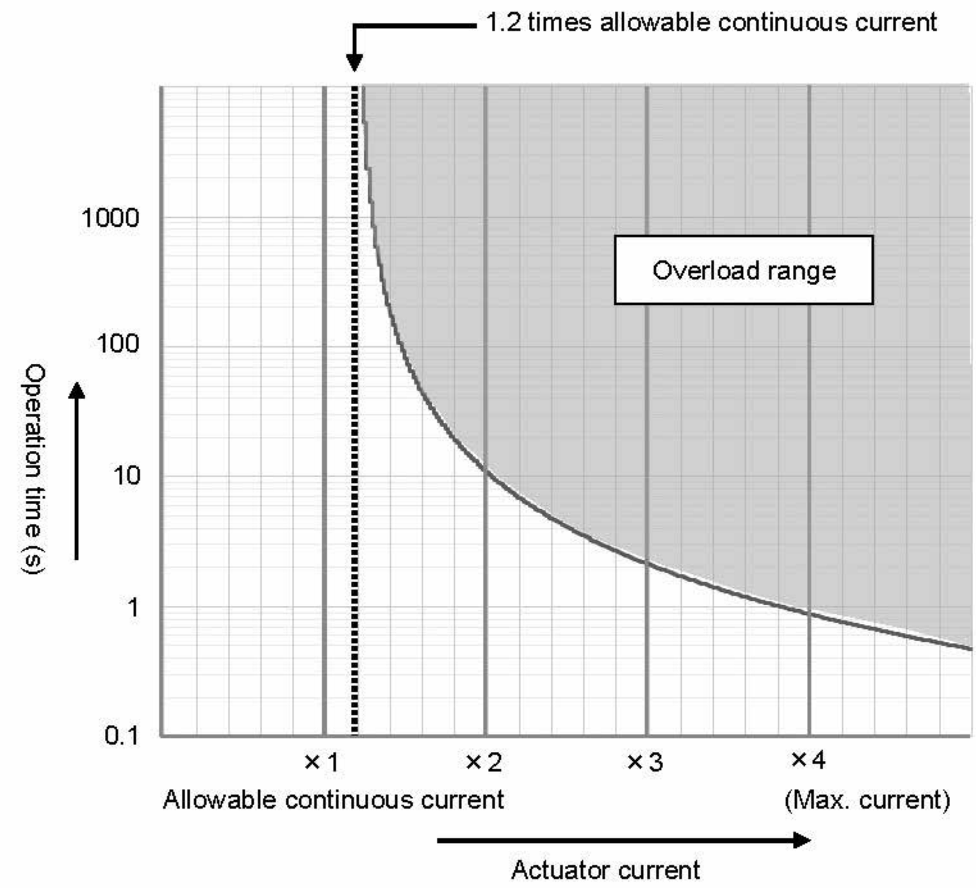
The current overload status of the actuator (unit: %) is shown.
If the value reaches 50, a warning UA90 that displays the operations in the overload status is output. If the value reaches 100, the overload protective function shuts off the motor current, and simultaneously [AL20: Overload] is displayed.
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.



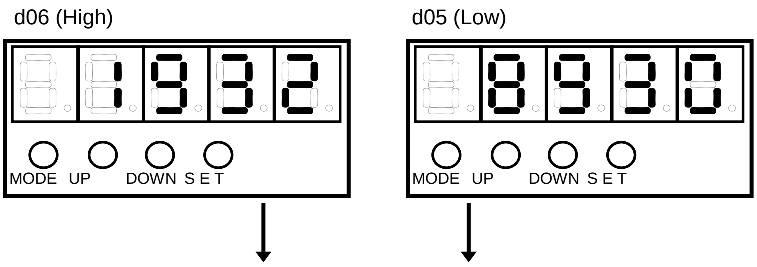
d05, 06: Feedback pulse display

Feedback pulses from the encoder are shown.

- Absolute encoder: The current encoder value is shown.
  Incremental encoder: Cumulative feedback pulses since the power ON or origin return complete, 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.

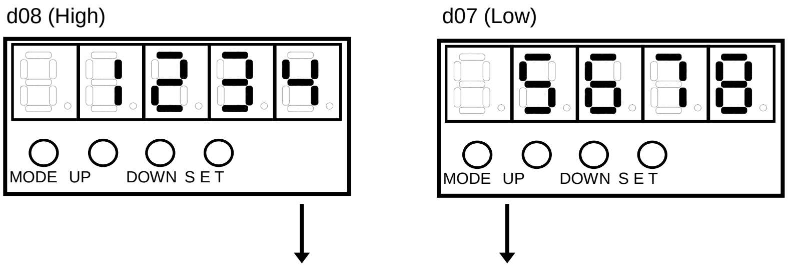
d07, 08: Command pulse display

Command pulse values specified from CC-Link and generated inside the driver are shown.

- Absolute encoder: Current encoder value at the power ON, plus command pulses
  Incremental encoder: Cumulative command pulses since the power ON or origin return complete corresponding to 0 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

Encoder		Output shaft single revolution absolute model				
Voltage specification	Reduction ratio	1/50	1/80	1/100	1/120	1/160
200 V	SHA25AxxxCG-S	8012	8022	8032	8042	8052
	SHA32AxxxCG-S	8112	8122	8132	8142	8152
	SHA40AxxxCG-S	8212	8222	8232	8242	8252
100 V	SHA25AxxxCG-S	8612	8622	8632	8642	8652

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-800-24 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.

$$\text{Regenerative resistor absorption power [W]} = 16{,}000\ \text{[W]} \times \frac{\text{Motor display value [\%]}}{100\text{[\%]}}$$

* 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-800C-24. With the HA-800C-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.	--
A 2	Alarm history 2 and time of occurrence		
A 3	Alarm history 3 and time of occurrence		
A 4	Alarm history 4 and time of occurrence		
A 5	Alarm history 5 and time of occurrence		
A 6	Alarm history 6 and time of occurrence		
A 7	Alarm history 7 and time of occurrence		
A 8	Alarm history 8 and time of occurrence		
AHcLr	Alarm history clear	The history of up to 8 most recent alarms is cleared.	P7-10

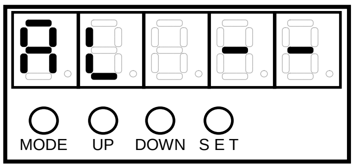
7-4 Alarm list

A list of alarms and warnings is shown.

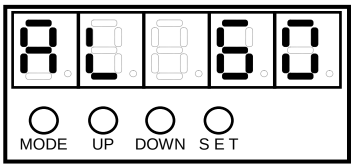
AL: Present alarm/warning display

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



Example) An error counter overflow alarm is present.

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
01	Emergency stop	47	Damaged power circuit	73	FPGA setting error
10	Overspeed	50	Encoder disconnection	76	Processor error
20	Overload	51	Encoder receiving error[*1, *2]	80	MEMORY error[*3]
30	IPM error (overcurrent)	52	UVW error[*1]	81	System failure[*3]
40	Overvoltage	53	System failure[*2]	82	Single rotation data error[*3]
41	Regenerative resistor overheat	54	Multi revolution overflow[*2]	83	Multi revolution data error[*3]
42	Overregeneration[*4]	55	Multi revolution data error[*2]	84	BUSY error[*3]
43	Missing phase[*4]	60	Error counter overflow	85	Overheat error [*3]
44	Control power supply low[*4]	70	Memory failure (RAM)	86	Communication error[*3]
45	Main circuit voltage low[*4]	71	Memory failure (EEPROM)		
46	Overheated dynamic brake[*4]	72	FPGA configuration error		

*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: Displayed HA-800C-24 only.

Warning

Code No.	Alarms	Code No.	Alarms	Code No.	Alarms
90	Overload status	93	Main circuit voltage low	99	Wrong actuator
91	Battery voltage low	97	FWD inhibit input effective		
92	Cooling fan stopped	98	REV 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	Code	Parameters	Default	Details
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	Feed-forward gain	0	P7-13
	AJ04	In-position range	10	P7-13
	AJ05	Attained speed judgment value	2000	P7-14
	AJ06	Attained torque judgment value	50	P7-14
	AJ07	Zero speed judgment value	10	P7-14
	AJ08	System reservation *3	--	--
	AJ09	System reservation *3	--	--
	AJ10	System reservation *3	--	--
	AJ11	Torque limit	100	P7-14
	AJ12	Acceleration/deceleration time constant	1	P7-15
	AJ13	System reservation *3	--	--
	AJ14	System reservation *3	--	--
	AJ15	System reservation *3	--	--
	AJ16	Speed monitor offset	*2	P7-15
	AJ17	Current monitor offset	*2	P7-16
	AJ18	System reservation *3	--	--
	AJ19	System reservation *3	--	--
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	Positioning Automatic 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: Default settings] (PA-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. Saving, comparing, and copying set values].

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.

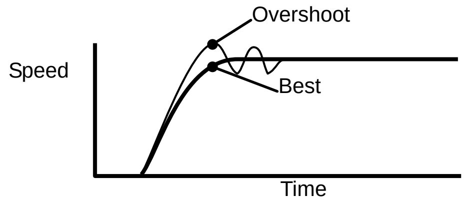
Set value	Function	Unit	Default
10 to 9999	Set the proportional gain of the position feedback loop.	-	*
Relational items	AJ01, AJ02, AJ03, d04		

*: The default varies depending on the applicable actuator. Refer to [Appendix: Default settings] (PA-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-800C-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 [Appendix: Default settings] (PA-1) in the appendix.

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 [Appendix: Default settings] (PA-1) in the appendix.

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, SP69		

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 conditions under which the [RXn1: Operation completion] becomes 1 during operation with position control.
The [RXn1: Operation completion] becomes 1 after command output is completed within HA-800C when the deviation pulse (command - feedback pulse) is in the range from +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 [Default settings] (Apx-1) in the appendix.

AJ05: Attained speed judgment value

An attained speed judgment value RX (n+2)6 is 1 when the actuator's motor shaft rotation speed rises to the set value or above. (The attained speed judgment value RX (n+2)6 is only available with 2-station occupancy)

Set value	Function	Unit	Default
1～9999	Set the attained speed judgment value.	r/min	2000

AJ06: Attained torque judgment value

An attained torque judgment value RX (n+2)7 is 1 when the actuator's output torque rises to the set value or above. (The attained torque judgment value RX (n+2)7 is only available with 2-station occupancy)

Set value	Function	Unit	Default
1～100	Set the attained torque judgment value.	%	50

AJ07: Zero speed judgment value

The [RX(n+2)5: Zero speed output] bit becomes 1 when the actuator's motor shaft rotation speed drops to the zero speed judgment value or below. ([RX(n+2)5: Zero speed output] is enabled only when 2 exclusive stations are used.)

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

Caution

- Switching from the position control mode to other control mode, or from other control mode to the position control mode, is prohibited unless a zero speed output signal is output.

AJ11: Torque limit

During position control or speed control, the torque is limited to the value set by torque limit when [RYn3: Torque limit] is set to 1.

Set value	Function	Unit	Default
1 to 100	Set the torque limit.	%	100

Caution

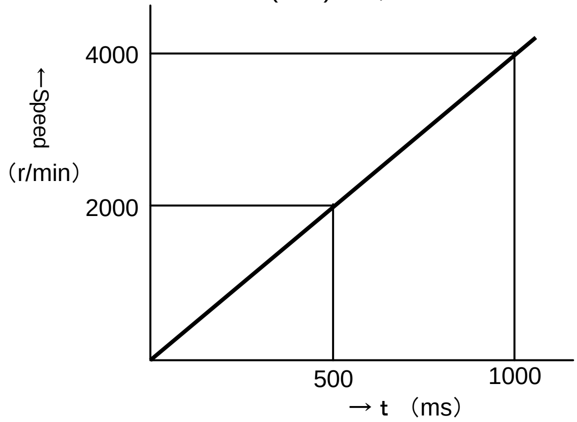
- If torque is limited during position control, depending on the set torque limit the error pulses may increase and the actuator behavior may become unstable the moment the torque limit input is cancelled. Carefully set the torque limit to be applied during position control.

AJ12: Acceleration/deceleration time constant

Set the time it takes for the motor rotation speed to accelerate from [0 r/min] to the maximum rotation speed of the applied actuator and the time it takes for the motor rotation speed to decelerate from the maximum rotation speed of the applied actuator to [0 r/min] for acceleration/deceleration time constant.
Set the target speed in the RWwn+4: Speed command. If you switch the RY(n+2)3: Speed control to 1, the acceleration is started according to this setting.
With the RY (n+2)3: Speed control switched to 1 and the actuator rotating at the speed set in the RWwn+4: Speed command, if you change the RWwn+4: Speed command to 0, the motor decelerates to stop according to this setting.

Set value	Function	Unit	Default
1 to 9999	Set the acceleration/deceleration time.	ms	1

(Ex) Set AJ12=1000 with a motor operating at maximum rotational speed of 4,000 r/min. If RWwn+4=2000 is set to RY (n+2)3=1, its maximum rotational speed will be 2,000 r/min at 500 ms.



Caution

- [AJ12: Acceleration/deceleration time constant] can only be used in speed 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.

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.

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.

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.
In general, changing this parameter is not required to keep the default of 100. If you want to set the setting time more precisely, change the default to around ±10.

Set value	Function	Unit	Default
1 to 200	Correct the variation of the actuator torque constant.	%	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.
In general, changing this parameter is not required to keep the default of 100. If you want to set the setting time more precisely, change the default to around ±10.

Set value	Function	Unit	Default
1 to 200	Set the torque 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: Positioning Automatic Gain

Can adjust set gain when "SP60: Positioning Automatic Gain Setting Enabled/Disabled" is enabled.
* Can be used with HA-800 software version 2.04 or later.

Set value	Function	Unit	Default
-50 to 100	Allows setting of positioning automatic gain increase/decrease.	%	0
Relational item	SP60		

Chapter 8

System parameter mode

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

8-1 System parameter mode

The following explains the parameters that can be operated/displayed in each operation mode. The parameters that can be set are explained below.

Mode	Display	Parameter	The reference set value defaults
System parameter 3 (Function extension)	SP40	CP3 output signal setting	00
	SP41	System reservation *3	—
	SP42	System reservation *3	—
	SP43	System reservation *3	—
	SP44	Electronic gear numerator	1
	SP45	Electronic gear denominator	1
	SP46	System reservation *3	—
	SP47	System reservation *3	—
	SP48	Deviation clear upon servo-ON setting	1
	SP49	Allowable position deviation	*1
	SP50	Command polarity	0
	SP51	Speed input factor setting	*1
	SP52	System reservation *3	—
	SP53	Torque input factor setting	100
	SP54	Status display setting	d00
	SP55	DB enable/disable setting	1
	SP56	System reservation *3	—
	SP57	System reservation *3	—
	SP58	System reservation *3	—
	SP59	Angle compensation enable/disable setting	0
System parameter 4 (Function extension)	SP60	Automatic positioning gain setting enable/disable setting	*1
	SP61	Encoder monitor output pulses	*1
	SP62	Input signal logic setting	0
	SP63	Output signal logic setting	2
	SP64	Regenerative resistor selection (HA-800-24 only)	0
	SP65	FWD/REV inhibit operation	0
	SP66	Absolute encoder function setting	*4
	SP67	Output shaft divide function setting	0
	SP68	Electronic gear function setting	0
	SP69	Feed-forward control function setting	*1
	SP70	System reservation *3	—
	SP71	System reservation *3	—
	SP72 to 79	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].

*2: System parameters (SP40 to 79) become effective by rebooting the control power supply after changing the settings.

*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. Saving, comparing, and copying set values].

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

SP40: CN9-3 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
01	Operation preparation complete	00
02	Alarm output	
03	RXn1: Operation completion output	
04	Attained speed output	
05	Attained torque output	
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.
* 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.
- When the electronic gear is changed, CC-Link communication JOG operation (RY(n+2)5) multiplies the electronic gear ratio (SP44/SP45), also the acceleration/deceleration time for point table operation, CC-Link communication JOG operation, and originating operation is 1/electronic gear ratio.

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

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	1～9999	1
45	Electronic gear denominator	1～9999	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 amount on the command counter can be calculated from when the RYn0: Servo-ON command is 1, and the servo can be turned ON with the deviation at 0.

* 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 RYn0: Servo-ON command is 0, 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 to make this error pulse count to 0. Accordingly, when the error pulse is large, the equipment may sustain damage due to sudden shifts by the actuator. 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 [Appendix: Default settings] (PA-1) in the appendix.

SP50: Command polarity

Sets whether or not to reverse the actuator rotation direction when an operation command is given by CC-Link etc as well as the system coordinate directions including forward/reverse inhibit signals and monitoring polarities.
This parameter affects the point table operation, originating operation and the monitor. It does not affect test operation and other operations performed from the PSF-800 or HA-800C panel.

* This is available for HA-800 software versions 3.01 or later.
* Changes to system parameter settings (SP40 to 79) are put into effect by changing the setting, then turning control power supply OFF, then ON again.

Set value	Function	Default
0	Do not reverse the coordinate direction.	0
1	Reverse the coordinate direction.	

*: 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.

The following shows the range affected by command polarity.

○: Affected by SP50 setting, ×: Not affected by SP50 setting

CC-Link communication		Display panel		PSF-800	
Displacement of operation data	○	T04: JOG operation	×	JOG operation	×
RXn4: During FWD stroke end	○	T09: Auto-tuning	○	Program operation	×
RXn5: During REV stroke end	○	d00: Motor rpm	×	Auto-tuning	○
RYn4: FWD stroke end	○	d01,02: Error pulse	×	Status display Motor rotation speed	×
RYn5: REV stroke end	○	d03: Torque display	×	Status display Torque	×
RY(n+2)6: JOG rotation direction	○	d05,06: Feedback pulse	×	Status display Feedback pulse	×
RWwn+4: Speed command	○	d07,08: Command pulse	×	Status display Command pulse	×
RWwn+5: Torque command	○			Status display Error pulse	×
Monitor code: Cumulative command pulses	○	Parameters		Waveform monitoring Feedback speed	×
Monitor code: Cumulative feedback pulses	○	Originating direction	○	Waveform monitoring Command speed	×
Monitor code: Deviation pulse	○	Virtual origin	○	Waveform monitoring Error pulse	×
Monitor code: Actuator Command within a single revolution	○	Backlash offset	○	Point table edit/operation	○
Monitor code: Output torque monitor	○				
Monitor code: motor speed	○	Input signals		PSF-680CL	
Monitor code: ABS position readout	○	–	–	Displacement of operation data	○
Monitor code: Actuator Position within a single revolution	○			Fine adjustment button CW	○
Monitor code: Cumulative feedback pulses (command pulse units)	○	Output signals		Fine adjustment button CCW	○
		Encoder monitor	×	Originating direction	○
		Analog speed monitor	×	Virtual origin	○
		Analog current monitor	×	Backlash offset	○

SP51: Speed input factor setting

The voltage obtained by the following formula is output for [CN9-1 Speed monitor output] using this value:

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

* 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 [Appendix: Default settings] (PA-1) in the appendix.

SP53: Torque input factor setting

The voltage obtained by the following formula is output for [CN9-2 Current monitor] using this value:

$$\text{Actuator current (A)} = \text{Current monitor output voltage (V)} \times \frac{\text{Torque input factor}}{10.0\text{V}}$$

Output current 100% = maximum current.

* 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 100	Set the torque input factor.	%	100

SP54: Status display setting

Set what will be displayed in the status display mode on the display panel 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
d00 to d16 (0 to 16)	Status display mode number to be displayed	d00 (0)

* The set values in the parenthesis are for when using PSF-800.

SP55: DB enable/disable setting

Set whether to enable or disable the dynamic brake.
In HA-800C-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-800C-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	Disable	1
1	Enable	

SP59: Angle compensation enable/disable setting

Set the angle compensation to be applied when a FHA mini series (FHA-8C/11C/14C) driver is combined with the actuator.
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 positional accuracy by 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 gain setting function can be used during positioning when a FHA mini 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 [Appendix: Default settings] (PA-1) in the appendix.

SP61: Number of encoder monitor output pulses

Set the number of pulses (no multiplication) to be output to the encoder monitor output terminal (CN2-13 to 19) per motor revolution when a 17-bit absolute encoder is combined.
Do not change if you use the originating function.

* 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 [Appendix: Default settings] (PA-1) in the appendix.

SP62: Input signal logic setting

Set the input signal logic.
Each bit of system parameter SP62 corresponds to 4 inputs, respectively.

* Although the setting range is from 0 to 31, the most significant bit is ignored.
* 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
Origin signal	Deviation clear	Alarm clear	Emergency stop

Set value (bit)	Function	Unit	Default
0	Normally open (contact A) The signal function is enabled when input opt-isolator is ON.	-	0
1	Normally closed (contact B) The signal function is enabled when input opt-isolator is 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.
Each bit of the system parameter SP63 corresponds to 3 outputs individually.

* Although the setting range is from 0 to 15, the most significant bit is ignored.
* The setting change of the system parameters (SP40 to 79) is enabled by reconnecting the control power supply after changing the setting.

Bit 2	Bit 1	Bit 0
Originating (recognition) complete	Alarm output	Operation preparation complete

Set value (bit)	Function	Unit	Default
0	Normally open (contact A) The transistor is ON when the output signal is enabled.	-	2
1	Normally closed (contact B) The transistor is 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-800-24 only)

Set this parameter on HA-800C-24 according to the connected regenerative resistor.
At our factory default, 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 regenerative 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.

* This is available for HA-800 software version 2.03 or later.
* 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	Does not generate the torque in the inhibited direction.	-	0
1	Stopped by locking the servo.		

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-800C-*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 2.09 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-800C-*D;SP66=0, HA-800C-*E;SP66=1

8 System parameter mode

SP67: Output shaft divide function setting

When using for position control combined with an SHA-CG series unit, you can set the actuator resolution.
The corresponding electronic gear value is set automatically from the output shaft divide function setting and the applicable actuator.
For the operation commands and monitor signals affected by the output shaft divide function setting, see the table on the next page.

Also, if you change the setting, the origin needs to be set again. Be sure to change the value before setting the origin. For details on the origin setting, refer to [Origin setting] (P4-8).

* This is available for HA-800 software versions 3.01 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	According to [NP00: Actuator resolution]	-	0
1	Division of single output shaft rotation into 36,000 parts (equivalent to 0.01 degree resolution)		
2	Division of single output shaft rotation into 360,000 parts (equivalent to 0.001 degree resolution)		
3	Division of single output shaft rotation into 3,600,000 parts (equivalent to 0.0001 degree resolution)		

Caution

- [SP67: Output shaft divide function setting] is the function that sets the operation command resolution. It does not guarantee the precision of positioning on the output shaft. For details on the output shaft positioning precision, refer to [AC Servo Actuator SHA Series Manual].
- After setting the operation sequence on the host device, when [SP67: Output shaft divide function setting] is changed, the displacement, speed, and acceleration/deceleration time change a great deal from operations before the change, so always check and revise the operation data setting before operating.
- [SP67: Output shaft divide function setting] also functions during originating operation. Be careful when setting the originating speed and originating acceleration/deceleration time.

○: Affected by SP67 setting, ×: Not affected by SP67 setting

CC-Link communication		Display panel		PSF-800	
Displacement/speed of operation data	○	T04: JOG operation	×	JOG operation	×
RXn4: During FWD stroke end	×	T09: Auto-tuning	×	Program operation	×
RXn5: During REV stroke end	×	d00: Motor rpm	×	Auto-tuning	×
RYn4: FWD stroke end	×	d01,02: Error pulse	×	Status display Motor rotation speed	×
RYn5: REV stroke end	×	d03: Torque display	×	Status display Torque	×
RY(n+2)6: JOG rotation direction	×	d05,06: Feedback pulse	×	Status display Feedback pulse	×
RWwn+4: Speed command	×	d07,08: Command pulse	×	Status display Command pulse	×
RWwn+5: Torque command	×			Status display Error pulse	×
Monitor code: Cumulative command pulses	○	Parameters		Waveform monitoring Feedback speed	×
Monitor code: Cumulative feedback pulses	○	Originating direction	×	Waveform monitoring Command speed	×
Monitor code: Deviation pulse	○	Virtual origin	×	Waveform monitoring Error pulse	×
Monitor code: Actuator Command within a single revolution*1	○	Backlash offset*2	×	Point table edit/operation	○
Monitor code: Output torque monitor	×				
Monitor code: motor speed	×	Input signals			
Monitor code: ABS position readout	×	–	–	PSF-680CL*3	
Monitor code: Actuator Position within a single revolution*1	○			Displacement of operation data	○
Monitor code: Cumulative feedback pulses (command pulse units)	○	Output signals		Fine adjustment button CW	×
		Encoder monitor	×	Fine adjustment button CCW	×
		13bit ABS Current value data output	×	Originating direction	×
		Analog speed monitor	×	Virtual origin	×
		Analog current monitor	×	Backlash offset	×

*1: The monitor output range is different because the resolution equivalent to [1 revolution] changes according to the output shaft divide function setting. For details, refer to [A-6 Notices for using SHA-CG(-S)].

*2: When the output shaft divide function is enabled (other than when SP67=0 on the SHA-CG series), backlash offset does not function.

*3: When the output shaft divide function is enabled (other than when SP67=0 on the SHA-CG series), the fine adjustment function of the PSF-680CL cannot be used.

Electronic gear value for when output shaft divide function is set

	SP67=1 36,000 divisions			**SP67=2 360,000 divisions**			**SP67=3 3,600,000 divisions**		
Reduction ratio	Numerator	Denominator	Numerator/denominator	Numerator	Denominator	Numerator/denominator	Numerator	Denominator	Numerator/denominator
50	8192	45	182.0	4096	225	18.2	2048	1125	1.82
80	65536	225	291.3	32768	1125	29.1	16384	5625	2.91
100	16384	45	364.1	8192	225	36.4	4096	1125	3.64
120	32768	75	436.9	16384	375	43.7	8192	1875	4.37
160	131072	225	582.5	65536	1125	58.3	32768	5625	5.83

SP68: Electronic gear function setting

This sets the affecting range of the electronic gear settings for the speed of JOG operations by CC-Link communication and acceleration/deceleration time constants. This is not a function that disables the electronic gear function itself. This setting has an effect only when the incremental encoder is connected.

- Effect on JOG operation speed (RWwn+6)
  RWwn+6=1000
  When [S68=0]
    When the electronic gear = 1/1, operates at 1000r/min.
    When the electronic gear = 4/1, operates at 4000r/min.
  When [S68=1]
    When the electronic gear = 1/1, operates at 1000r/min.
    When the electronic gear = 4/1, operates at 1000r/min.

- Effect on point table acceleration/deceleration time constant (8304h, 8F01h to 8F7Fh)
  Originating acceleration/deceleration constant (9205h)
  JOG operation acceleration/deceleration time constant (RWwn+7)

  When the max. rotational speed = 6000 r/min, acceleration/deceleration time constant = 1000 ms:
  When [S68=0]
    When the electronic gear = 1/1, accelerates at 1000 ms up to 6000r/min.
    When the electronic gear = 4/1, accelerates at 250 ms up to 6000r/min.
  When [S68=1]
    When the electronic gear = 1/1, accelerates at 1000 ms up to 6000r/min.
    When the electronic gear = 4/1, accelerates at 1000 ms up to 6000r/min.

* This is available for HA-800 software versions 3.01 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	Operations are affected by the electronic gear setting	-	0
1	Operations are not affected by the electronic gear setting		

8 System parameter mode

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 2.09 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-13-6) 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.

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

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	Code	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	P9-8
	T06	System reservation	--
	T07	System reservation	--
	T08	Multi revolution clear	P9-9
	T09	Auto-tuning	P9-10
	T10	Auto-tuning displacement	P9-11
	T11	Auto-tuning level selection	P9-12

9-2 Details of test mode

The following explains the details of the test mode.

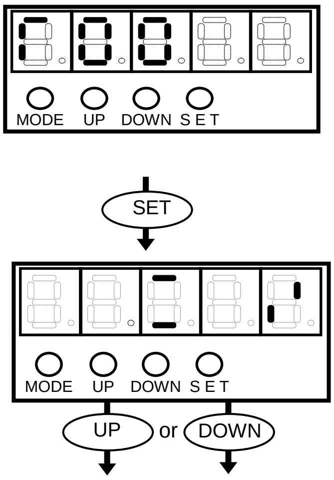
T00: I/O signal monitor

The I/O statuses of assigned pins are reflected and displayed in real time.
The functions of displayed pins are enabled.

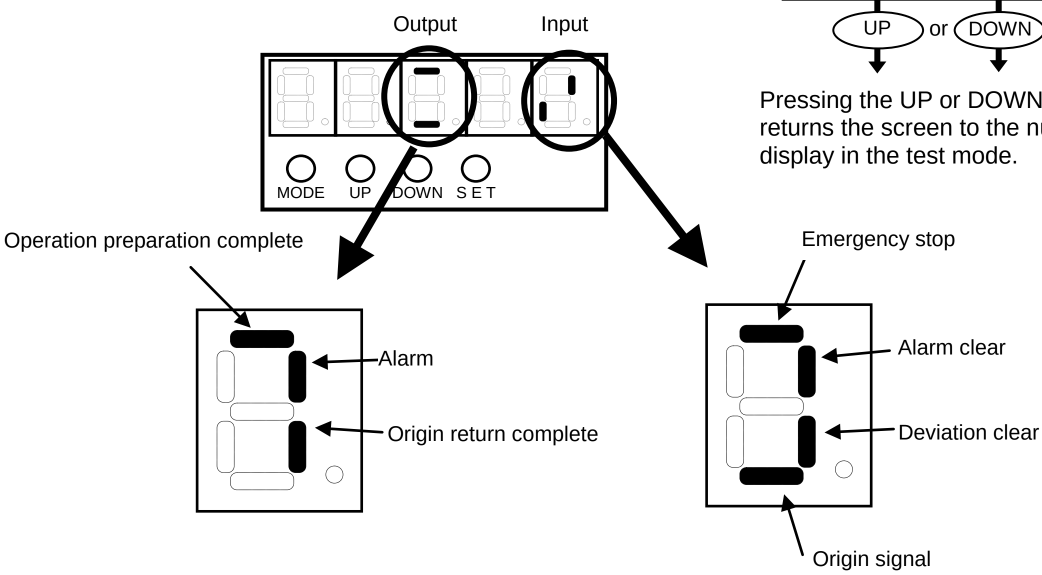
1 **The third digit indicates the output status, while the fifth digit indicates the input status.**

Lit: ON
Unlit: OFF

- The display will not switch if the button is pressed for 1 second or longer.



Pressing the UP or DOWN button returns the screen to the number display in the test mode.



T01: Output signal operation

Output signals can be turned ON/OFF as desired.

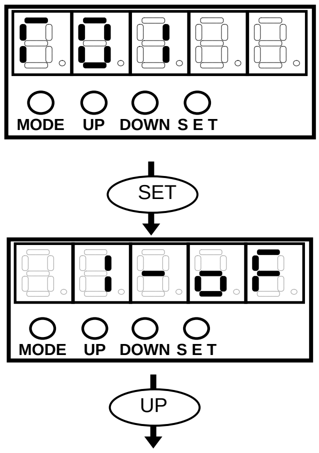
Caution

- 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-800C 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.

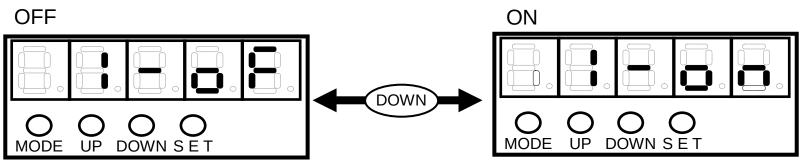
- The display will not switch if the button is pressed for 1 second or longer.



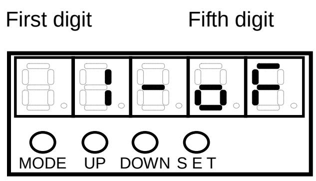
2 Use the UP button to select the signal to be operated.

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 indicates the operation preparation complete, 2 indicates an alarm, and 3 indicates the origin return complete that can be operated, respectively. There are no operation items for 4 to 7.
- 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].

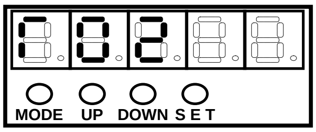
T02: JOG speed setting

T04: 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.

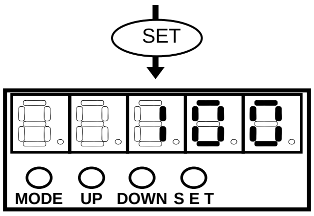
The set value of JOG speed is shown. (Unit: r/min)

- The display will not switch if the button is pressed for 1 second or longer.



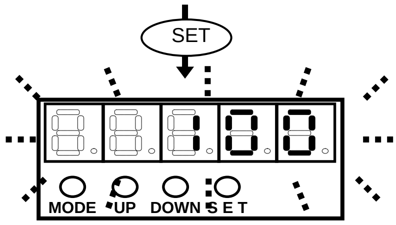
2 To change the set value, press the SET button and release it within 1 second.

The set value flickers to indicate that it can now be changed.



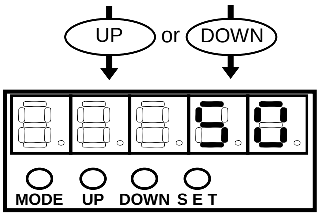
3 Change the set value.

Pressing the DOWN button decreases the value, while pressing the UP button increases the value.



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).



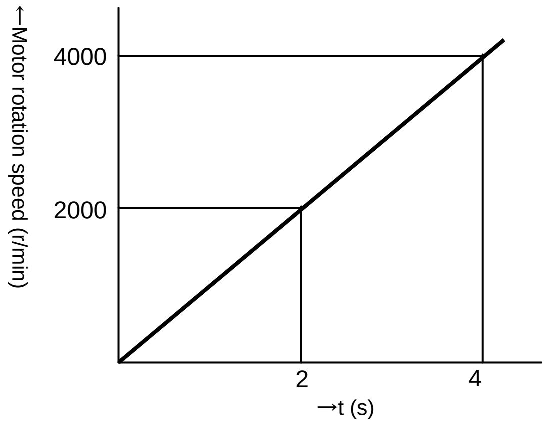
Caution

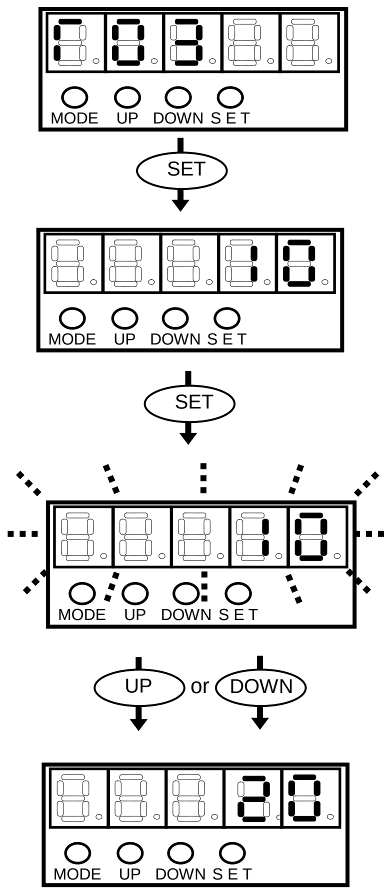
- The value set here is not stored.
  When the HA-800C driver power is reconnected, it will return to the default value 100.
- Set the speed as low as possible to enable checking.
  Avoid unexpected accidents resulting from high speed.

T03: JOG acceleration/deceleration time constant setting

T04: Set the acceleration/deceleration time constant of JOG operation.
The value set here corresponds to the time over which the actuator accelerates from the standstill state to the speed (max. speed) of the applicable actuator converted at the motor shaft or the time over which it decelerates from the speed (max. speed) of the applicable actuator converted at the motor shaft to the standstill state.
Setting range: 1 to 9999
Unit: ms

(Ex) Set T02 = 2000 and T03 = 4000 in a motor operating at maximum rotational speed of 4,000 r/min. When performing the JOG operation, accelerate for 1 second till reaching the speed at T02, and then stop for 1 second after the speed at T02 is reached.





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.

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-800C driver power is reconnected, it will return to the default value 1.
- If high speed is set for [T02: JOG speed setting], it is recommended to set as large a value as possible for this value.

T04: JOG operation

The actuator operates regardless of the input signals except for emergency stop signals from the host. Any input signal operation performed during JOG operation is ignored. The data set in [T02: JOG speed] and [T03: JOG acceleration/deceleration time] is used to perform JOG operation of the actuator.

WARNING

- **Any input signal operations except for emergency stops are ignored during JOG operation. Also, the actuator operates ignoring even the RYn4: FWD stroke end and RYn5: REV stroke end. Operate the actuator while carefully paying attention to the surrounding conditions.**
- **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.**

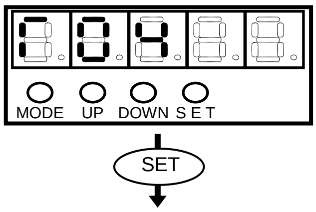
Caution

- RYn0: The "JOG operation" cannot be started when the servo is turned ON by the Servo-ON command input. RYn0: Set the Servo-ON command to 0.
- 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.

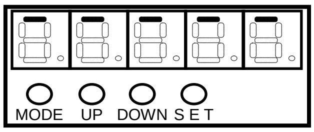
1 Press the SET button when the actuator servo is OFF.

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.

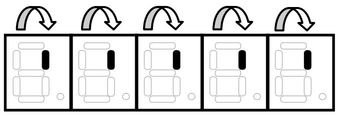


2 Press the UP or DOWN button to rotate the actuator.

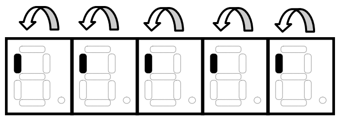


- The actuator rotates in the CW (clockwise) direction while the UP button is pressed. (The rotation direction is different depending on the actuator.) Release the UP button, and the actuator will stop.
- The actuator rotates in the CCW (counterclockwise) direction while the DOWN button is pressed. (The 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.
- Here, the actuator servo is OFF. To turn ON the servo, set the [RYn0 servo-ON command] to 1.

T05: Parameter initialization

The tune mode parameters (excluding AJ16 and AJ17), system parameters and network 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-800C 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 "Saving the set values".
  By this operation, [Adjustment parameters], [System parameters], and [Network parameters] are initialized. Operation data (point data) is not initialized.

1 Press the SET button.

The HA-800C driver displays the applicable actuator code currently set.

- The display will not switch if the button is pressed for 1 second or longer.

2 Press the SET button.

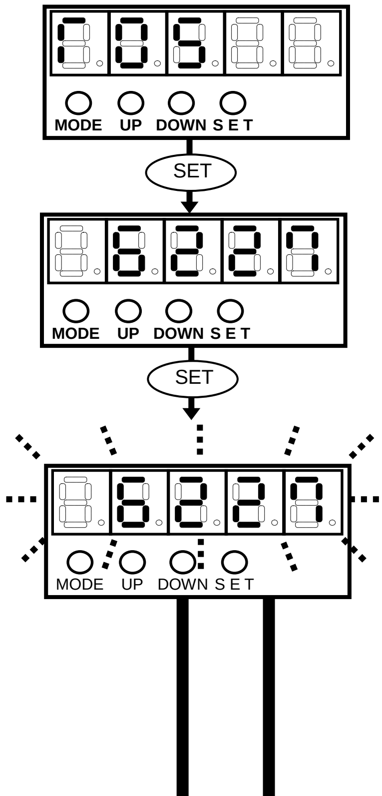
The displayed applicable actuator code flickers.

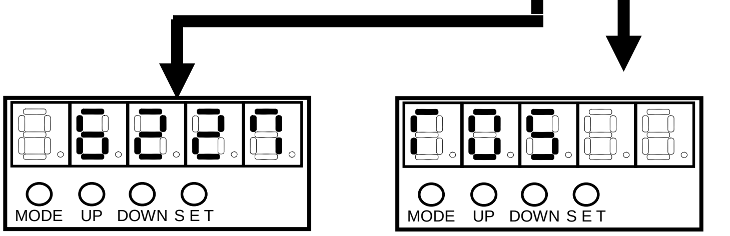
- To cancel the parameter initialization, press the UP or DOWN button. The screen returns to the test mode number display.

3 Press and hold the SET button until the display stops flickering and becomes lit, and then release the button. (Approx. 1 second or more)

The parameter is initialized and the screen returns to the test mode number display.

- If the SET button is released before the display stops flickering and becomes lit, the parameter is not initialized and the applicable actuator code is displayed.
- To turn the power OFF to the HA-800C after initialization is complete, wait for 2 to 3 seconds and then turn OFF.





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.

T08: Multi revolution clear

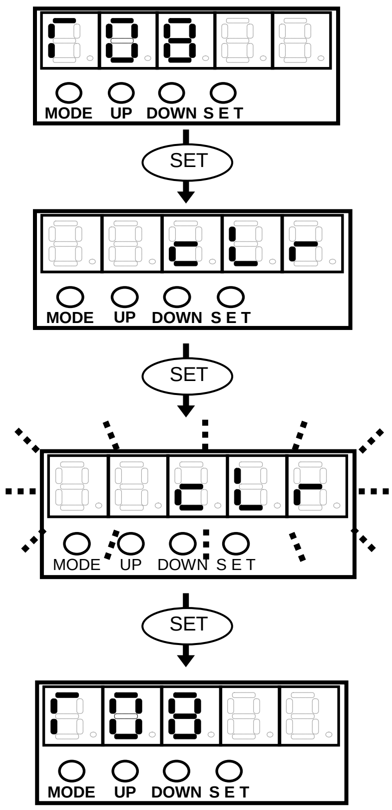
Encoder multi revolution data can be cleared when an actuator equipped with a 13-bit absolute encoder or 17-bit absolute encoder is combined.
This parameter is also used when setting the origin. With the SHA series, FHA-C absolute system, FHA-Cmini absolute system, and HMA series, the multi revolution 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-800C 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 press and hold, and 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 displacement].

Caution

- Auto-tuning is not performed until the actuator servo is turned ON.
- Perform auto-tuning after canceling FWD and REV stroke ends.(Operations from RYn0, 4, 5 are necessary for servo-ON and stroke end.)
- 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 Set RYn0 to 1.

This turns ON the servo. If there are no FWD and REV stroke ends, set RYn4 and RYn5 to 1 as well.

2 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.

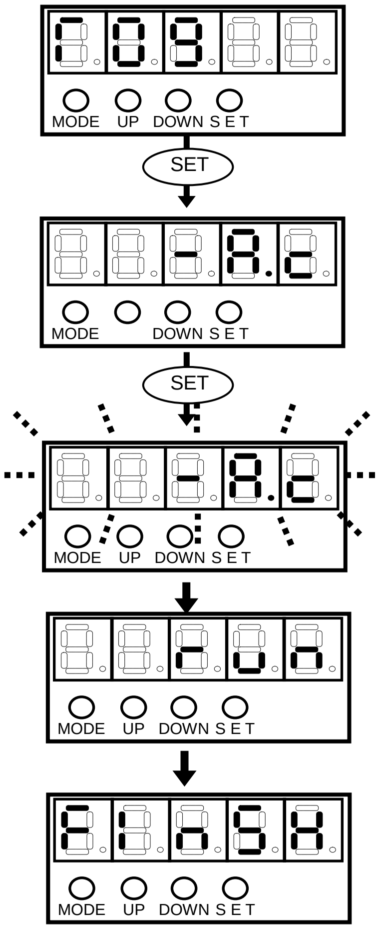
3 Press the SET button.

Displayed [-A.c] flickers.

4 Press and hold the SET button for at least 0.1 second.

[-A.c] changes to [run], after which it moves in the CW direction by the displacement set in [T10: Auto-tuning displacement]. Thereafter, the actuator moves in the CCW direction by the displacement set in [T10: Auto-tuning displacement].
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].

- The actuator moves in forward/reverse directions 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 displacement

Set the displacement of the motor during auto-tuning.
Setting range: 1500 to 6000° (The displacement of the actuator is calculated by set value/reduction ratio.)
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.

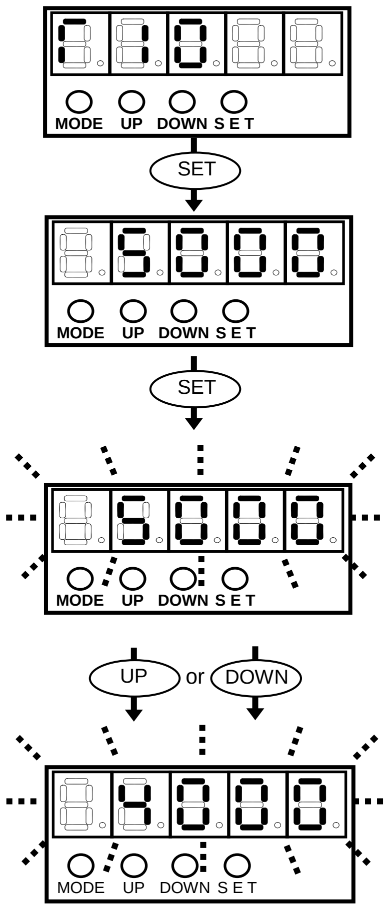
The value is set in angle (°) and the setting range is 1500 to 6000° (motor shaft).

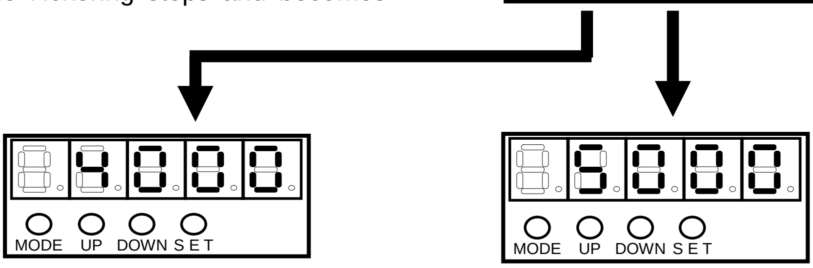
- The load estimated by auto-tuning is subject to a maximum erroneous difference of approx. ±15%. To minimize the erroneous difference, set the auto-tuning displacement as long as possible.

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.





The display changes from flickering to lit: the driver status display, alarm display, data values, etc., can be checked.

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-800C driver is restarted, the set value returns to the default (6000°).

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.

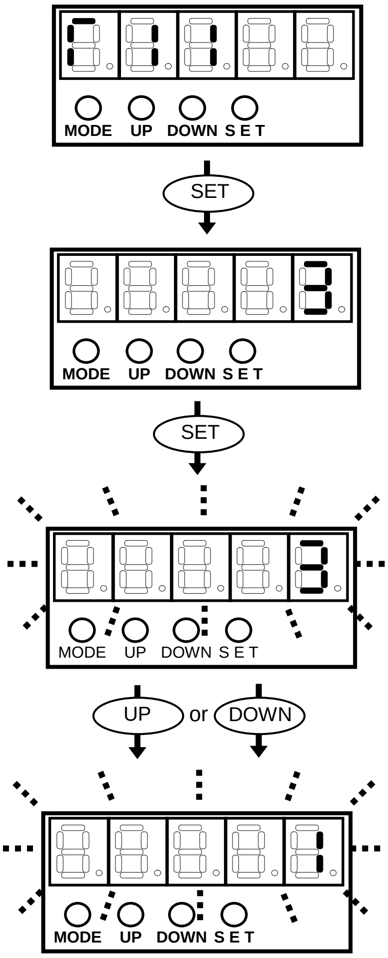
3 Press the UP or DOWN button to change the auto-tuning level.

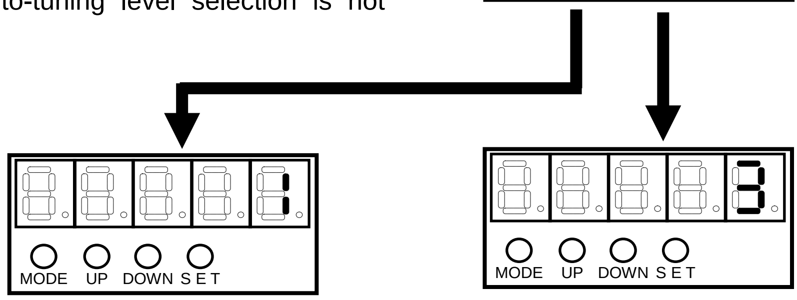
The setting range is 1 to 5.

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 become
s lit, the set value is not applied.

Caution

- The set value of auto-tuning level is not saved.
  When the HA-800C 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 Overview

PSF-800 is a communication software program that lets you change driver parameters and monitor operation waveforms, etc., from a PC.

Operating environment

PSF-800 needs 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.

Setup

1 Download PSF-800.

Download the software from our website (http://www.hds.co.jp).

2 Install PSF-800.

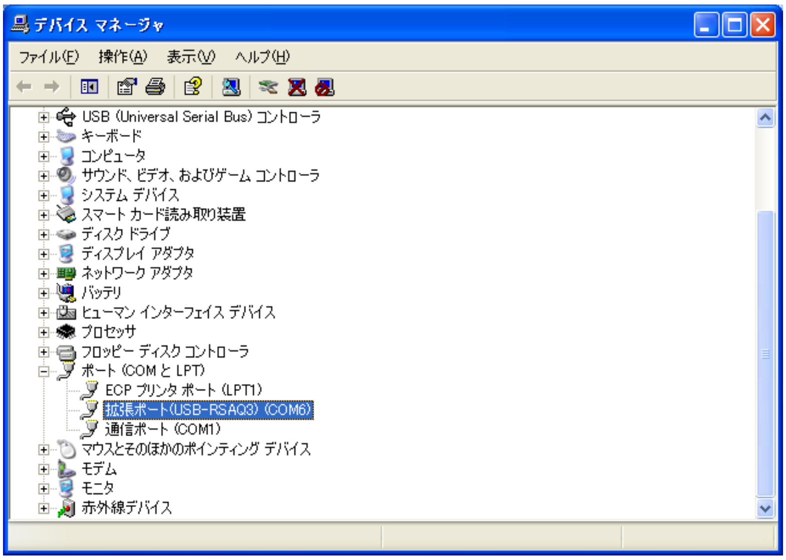
Extract the files from the downloaded folder and run SETUP.EXE to set up the software according to the on-screen instructions.

- **Using a USB port**

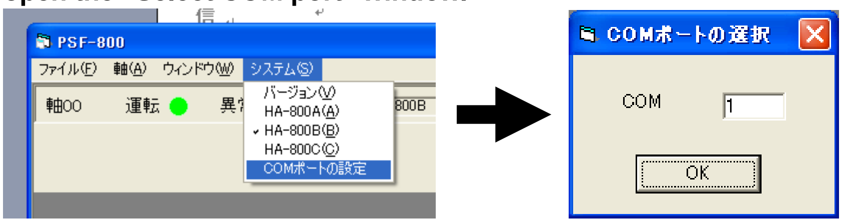
If a USB port is used, you need an adapter to convert the USB port to a RS-232C port. (USB-RSAQ5 IO Data, etc.)
The built-in RS-232C port of the personal computer is normally assigned to COM1. However, this assignment changes if a USB conversion adapter is used. Perform the following setting procedure:

(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-800. 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.

*: Dedicated communication cable
RS-232C communication cable: EWA-RS03

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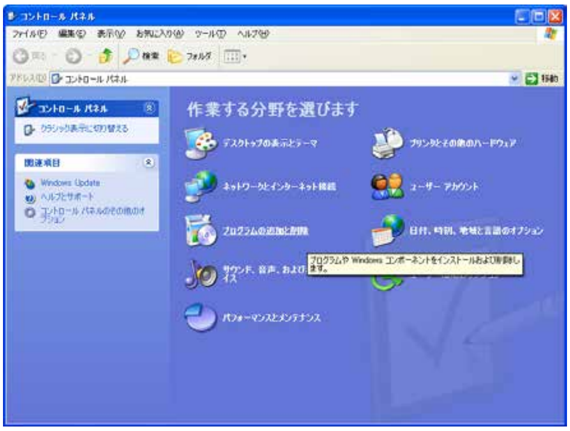
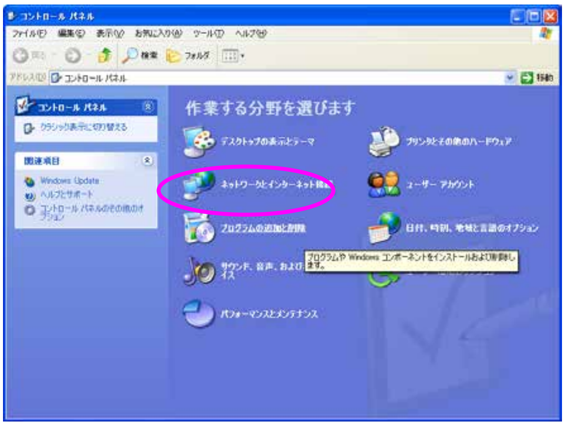
Uninstalling the software

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".

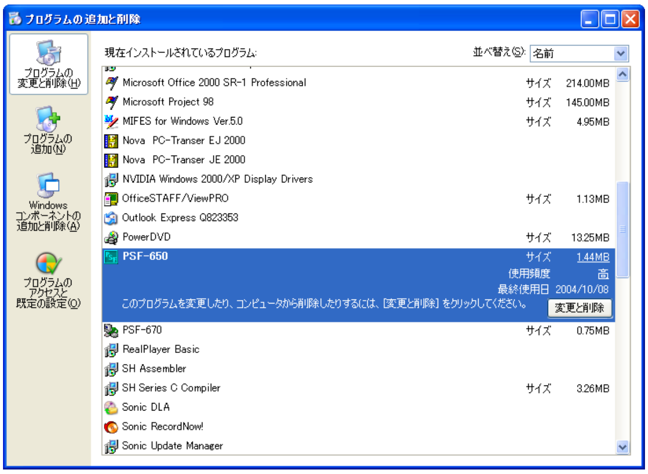


2 Click "Add/Remove Programs".



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.

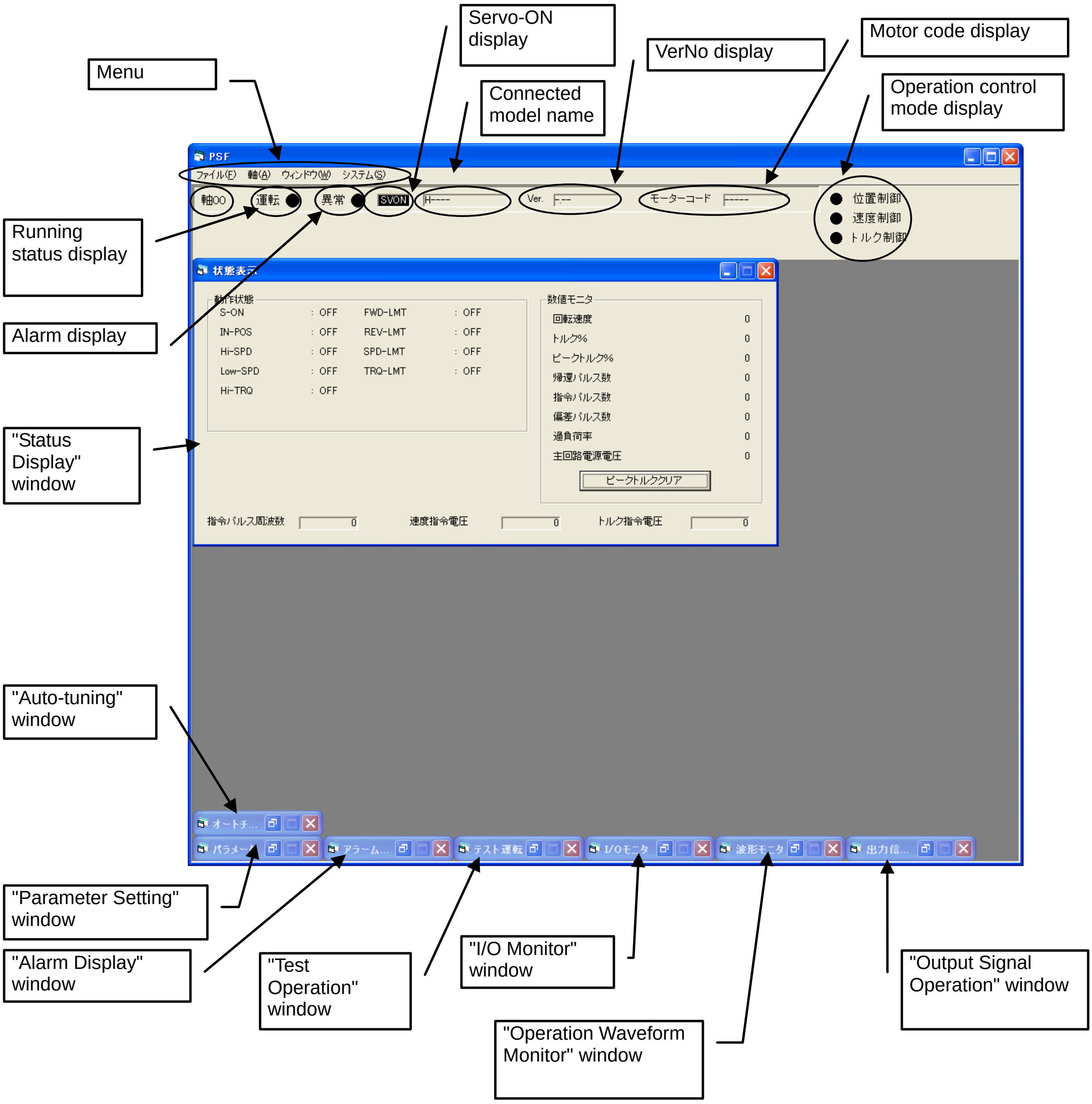


10

Communication software

Initial screen

The initial screen of PSF-800 is shown below.



Menu

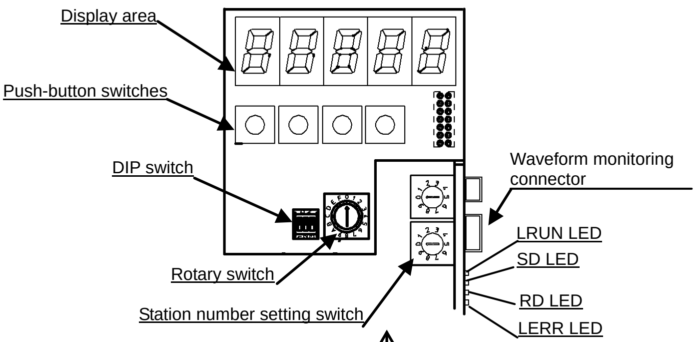
- **"File"**

"Open"········· Read parameter set value, test operation patterns or waveform monitoring data from files by setting parameters, performing test operations or operating the waveform monitoring function.
"Save As"····· Save parameter set value, test operation patterns or waveform monitoring data to files after setting parameters, performing test operations or operating the waveform monitoring function.
"Exit"··········· Exit the program.

- **"Axis"**

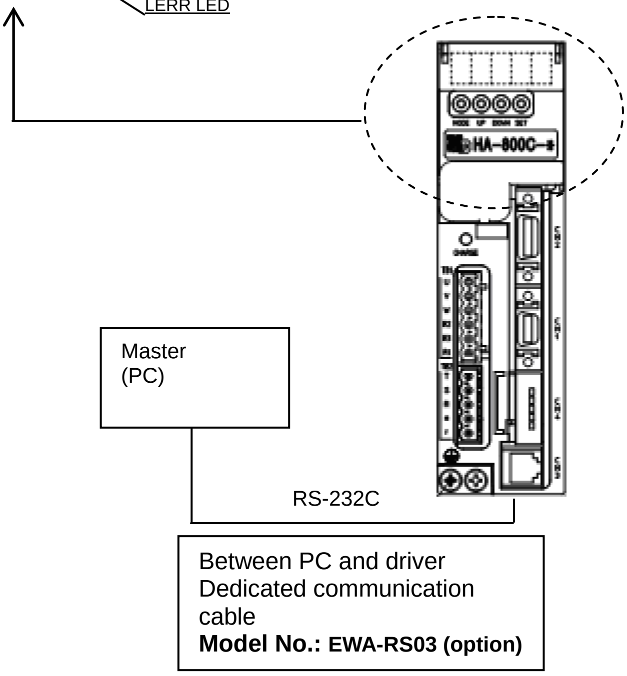
When PSF-800 and HA-800C are connected, PC and HA-800C are connected in 1-to-1 relationship.
When communicating with the PSF-800, set the station number to other than 70 and 90.
(Set the station number setting switch to 70 to connect with PSF-680CL.)

Connection example of PSF-800 and HA-800C



Station number setting switch

Setting details	Mode
1 to 64	Perform CC-Link communication.
70	Perform communication with PSF-680CL.
90	Clears the operation data (point table).



- **"Window"**

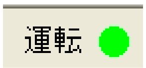
Although the status display screen opens when the software is started, you can change the initial screen in the Window menu.

10 Communication software

Detailed display area

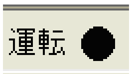
- **Axis number display**
  When HA-800C and PSF-800 are connected, communication cannot be performed if a shaft other than 00 is selected. Use with the default setting.

- **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)

The HA-800 power supply is OFF or PSF-800 is offline.

- **Alarm display**
  A red light flickers when the HA-800 is generating an alarm.

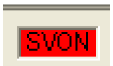
(Red)

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

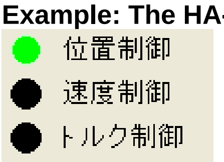
- **Connected model name display**
  The model name of the connected HA-800 is shown.

(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.

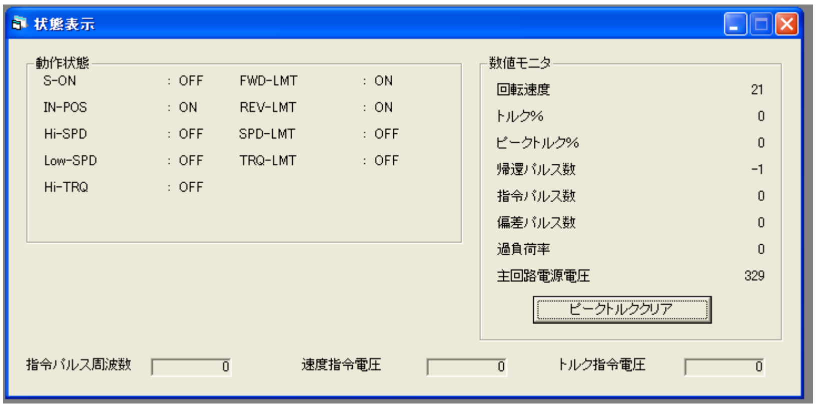
- **Operation control mode display**
  The operation mode of the HA-800 is shown. The steady green light indicates the mode in which the HA-800 is currently operating.
  Example: The HA-800 is operating in the position control mode



(Green)
(Unlit)
(Unlit)

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 speed drops to or above the attained speed value set by an adjustment parameter.
Low-SPD	ON is shown if the motor speed drops to or below the zero speed judgment value set by an adjustment parameter.
Hi-TRQ	ON is shown during torque control if the motor's output torque rises to or above the attained torque value set by an adjustment parameter.
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-800C, this display is OFF.
TRQ-LMT	ON is shown if the driver's output torque is set to torque limiting.

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. $\text{Regenerative resistor absorption power [W]} = 16{,}000\ \text{[W]} \times \dfrac{\text{Display value [0.01\%]}}{10000\ \text{[0.01\%]}}$ Ex) When display value = 10, absorption power = 16 [W] * This value monitor is available only for HA-800C-24. With the HA-800C-1, 3 and 6, the power absorbed by regenerative resistor is unrelated.

10-2 Auto-tuning

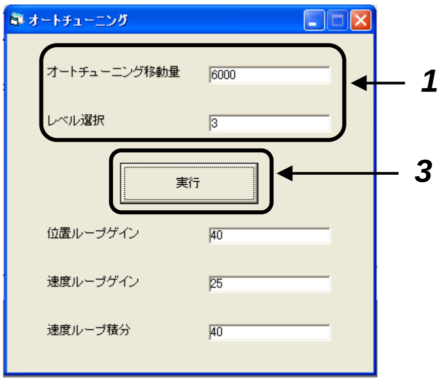
Auto-tuning is a function that allows the driver to estimate the load and automatically adjust the servo gain to an appropriate value. The auto-tuning method is explained below.

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 displacement].

Caution

- 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 **Set the auto-tuning displacement and level in the "Auto-tuning" window.**



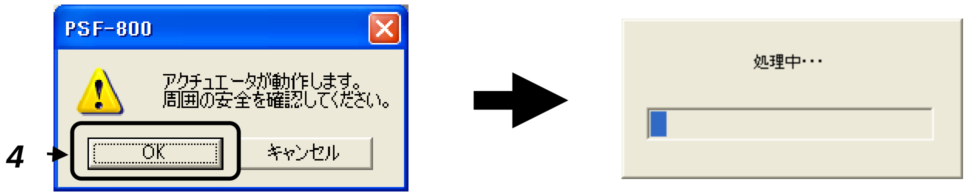
Set value	Explanation
Auto-tuning displacement	Set the travel angle by which the motor shaft turns when estimating the load. The displacement of the actuator's output shaft is calculated by 1/reduction ratio. A desired value of 1,500 to 6,000 degrees can be set. Set as large a value as possible to improve 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 **Set RYn0, 4 and 5 to 1. Turn the servo ON after canceling FWD inhibit or REV inhibit.**

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.



5 When the auto-tuning is completed, the servo gain is displayed.

After the auto-tuning, the "Position Loop Gain", "Speed Loop Gain" and "Speed Loop Integration" are changed to values appropriate for the estimated load.

Caution

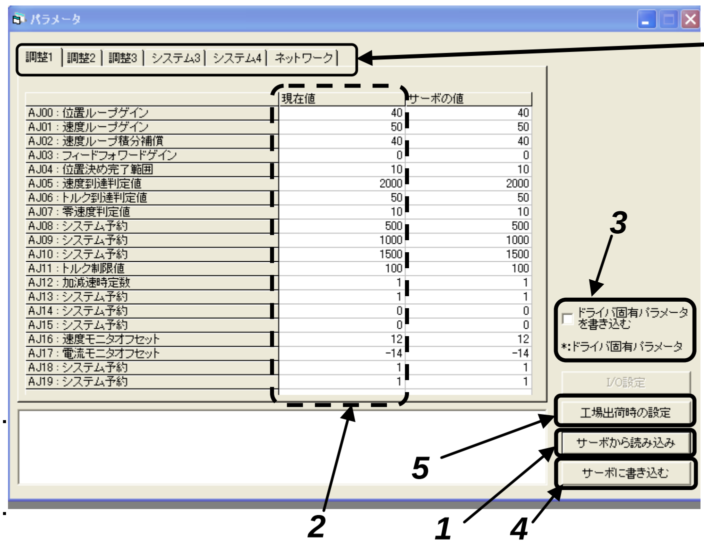
- Depending on the rotation position, a large load variation, does not allow the load to be estimated properly which makes auto-tuning impossible. Adjust using the manual.

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.



Tune 1: It is possible to check and change set values of tune mode parameters AJ00 to AJ19.
Tune 2: It is possible to check and change set values of tune mode parameters AJ20 to AJ39.
Tune 3: Reserved by the system.
System 3: It is possible to check and change set values of system parameters SP40 to SP59.
System 4: It is possible to check and change set values of system parameters SP60 to SP79.
Network: Parameters related to operations performed from CC-Link. It is used to set details of originating and other operations.

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].

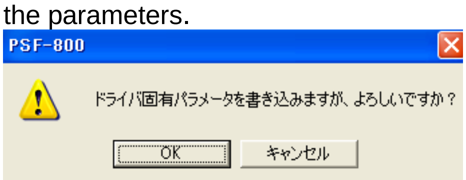
2 **Click the "Current Value" field of the parameter you want to change, and enter the desired value.**

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: Speed 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 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.

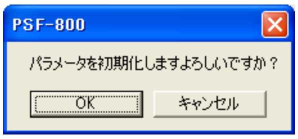
Procedure to reset parameters to their defaults (factory-set values)

Caution

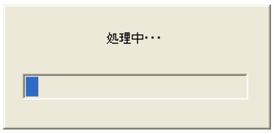
- Perform this operation while the servo is OFF. After the initialization, be sure to reconnect the HA-800C driver power.
- All parameters are initialized except for AJ16 and AJ17. Save the set values prior to the initialization of the required parameters. The parameters can be saved or read for the set values on a PC in accordance with "Saving the set values".
  By this operation, [Adjustment parameters], [System parameters], and [Network parameters] are initialized. Operation data (point data) is not 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 PC.
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.

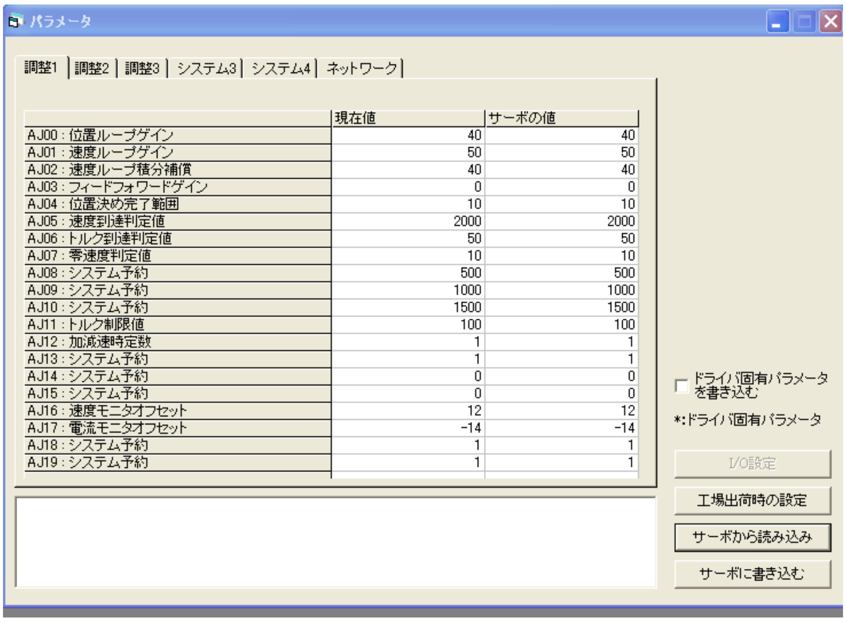
10-4-1. Saving set values

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].



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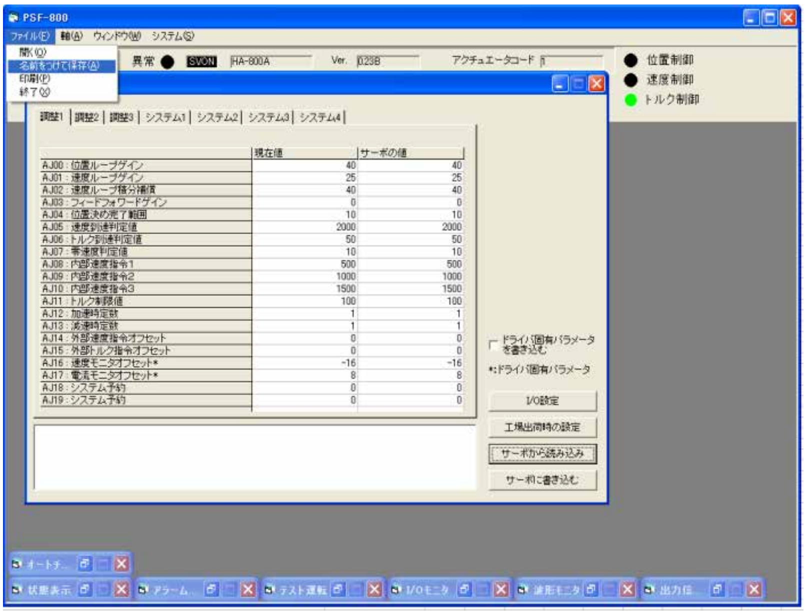
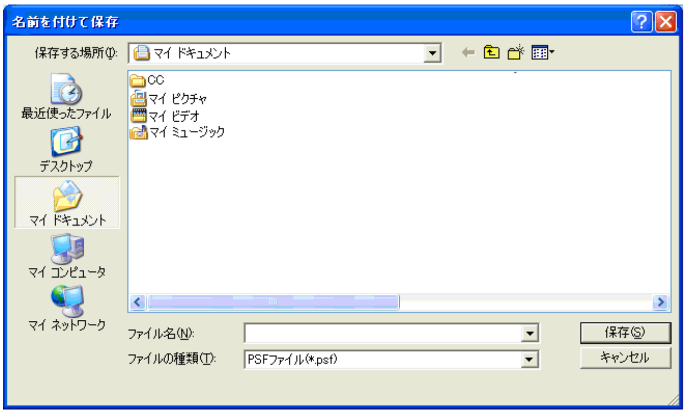
Communication software

2 **Select "Save As" from the "File" menu.**



3 **Set a desired folder and file name, and click the "Save" button.**



Caution

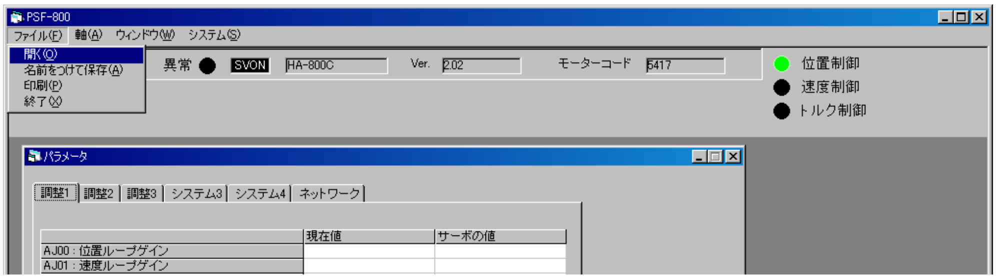
- Be sure to perform "Load from Servo" before performing "Save As" .
- The parameters saved by this operation are [Adjustment 1], [Adjustment 2], [Adjustment 3], [System 3], [System 4], [Network].
- Operation data (point table) set in the HA-800C is not saved by this operation. To save Operation data (point table), save the data using PSF-680CL or CC-Link command.(Refer to Appendix 3, 4 in this manual.).

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.

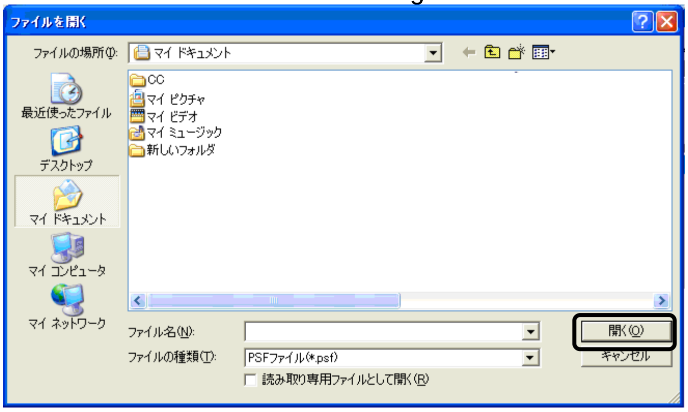
Loading procedure

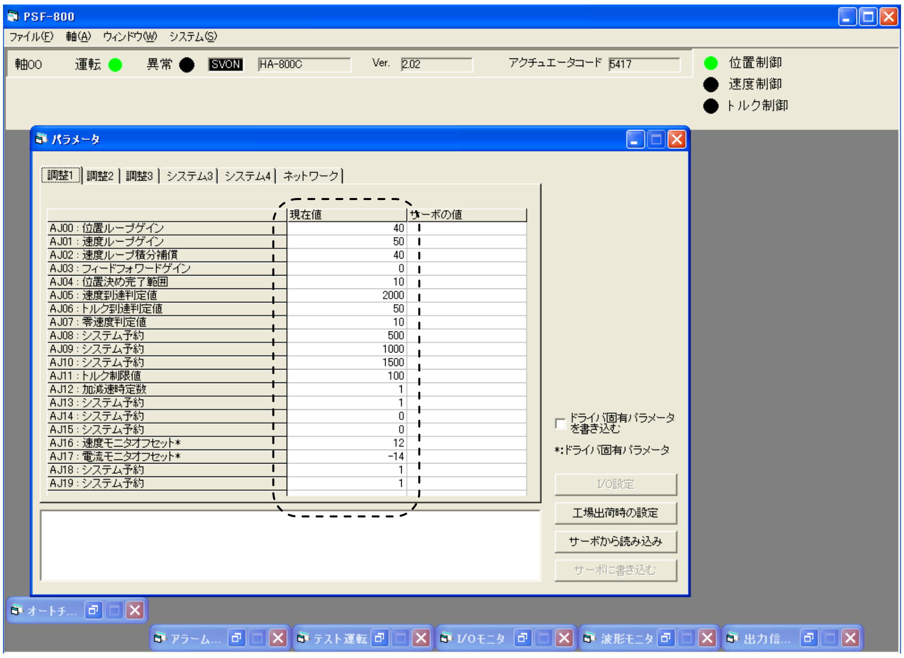
1 **Open the "Parameter Setting" window.**
Select "Open" from the "File" menu.



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].





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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.

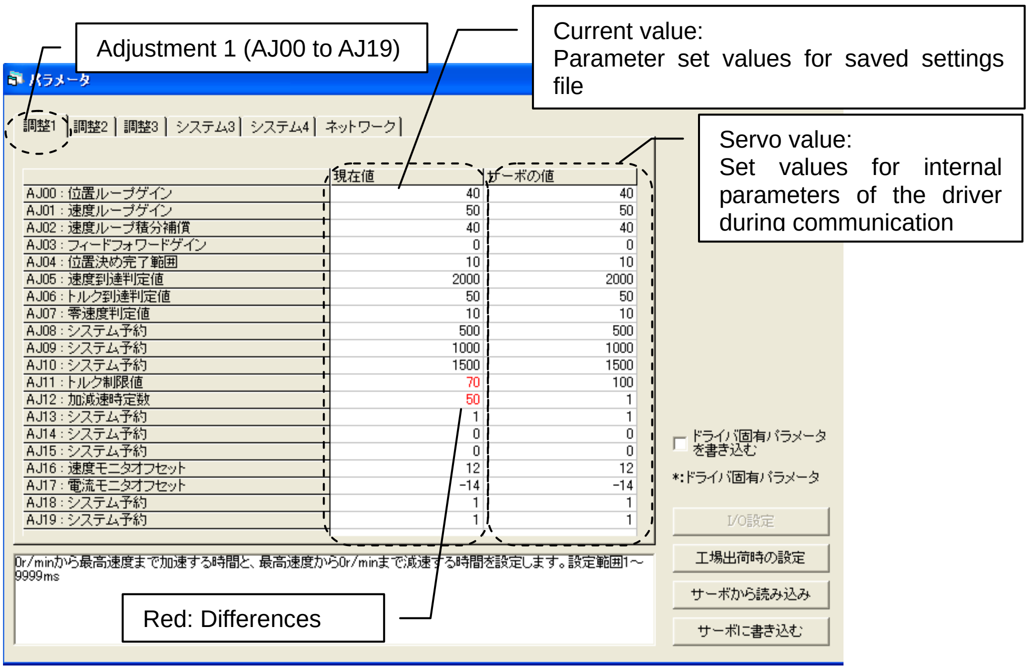
Comparison procedures

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].

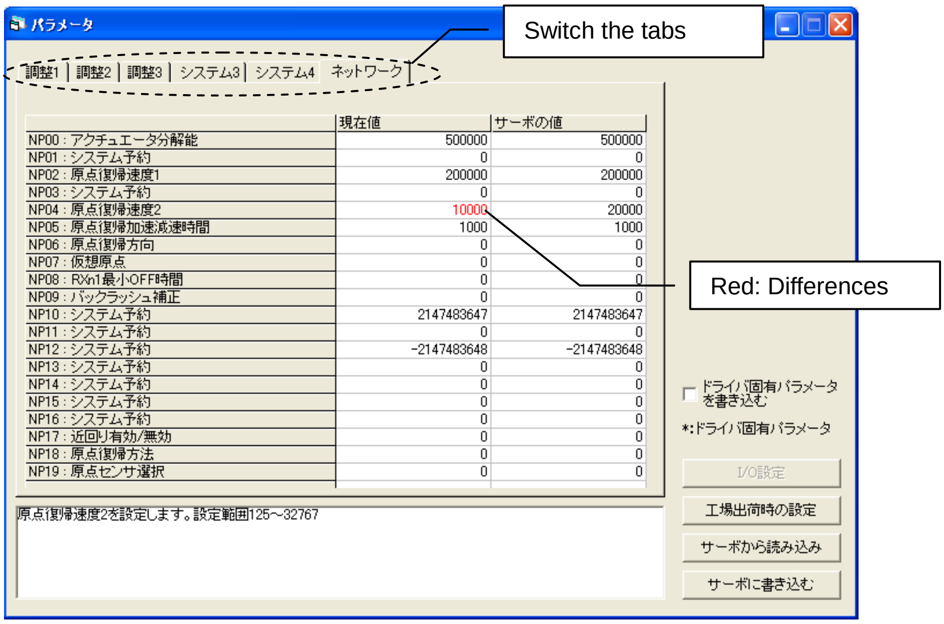
2 **Read the saved settings file. (Same as steps 1 to 2 in 10-4-2)**
Select "Open" from the "File" menu.
Set a desired file name, and click the "Open" button.

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.



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).

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Communication software

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.

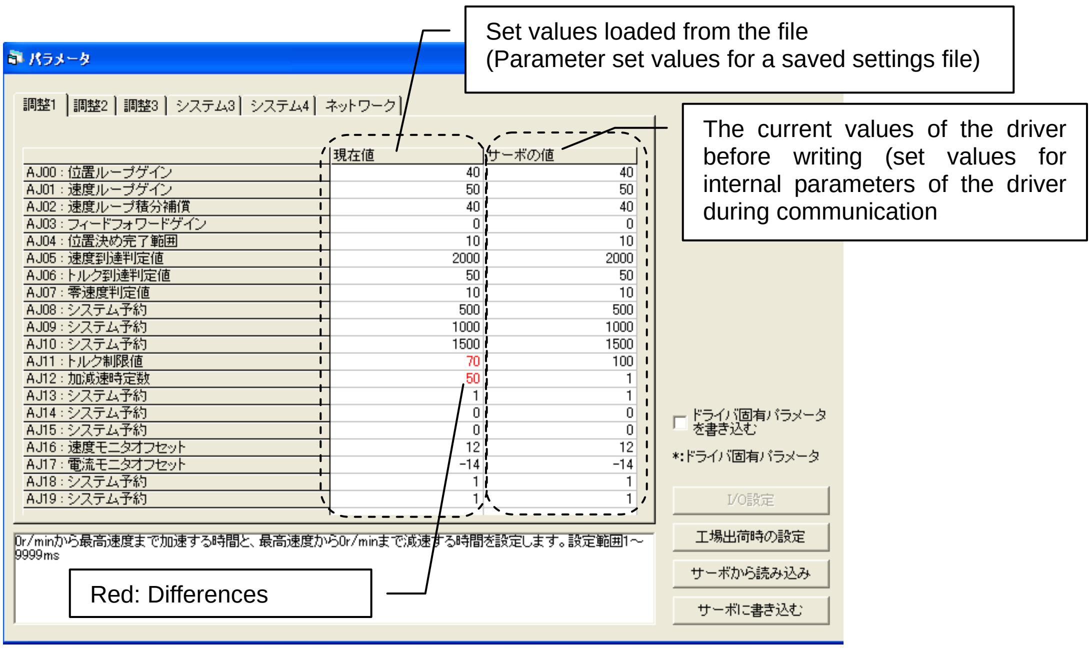
Comparison procedures

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.

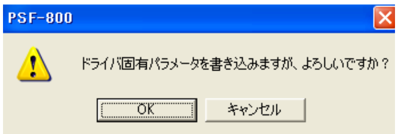
The set values for the saved settings file are loaded and displayed in the [Current Value].
The differences between the set values for the saved settings file and the set values for the internal parameters of the driver during communication are displayed in red.



3 Select the "Write driver-specific parameters" check box if you want to write the driver-specific parameters (AJ16: Speed monitor offset, AJ17: Speed monitor offset). (Same as step 3 in 10-3-1)

4 Click the "Write to Servo" button. (Same as step 4 in 10-3-1)

The set values for the saved settings file displayed in the [Set Value] is written to the driver during communication.
When the “Write driver-specific parameters” check box is selected, a verification screen appears. Click the “OK” button 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.

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], [System 4], [Network].
- Operation data (point table) set in the HA-800C is not written (copied) by this operation. To copy Operation data (point table), use PSF-680CL or CC-Link command.(Refer to Appendix 3, 4 in this manual.).

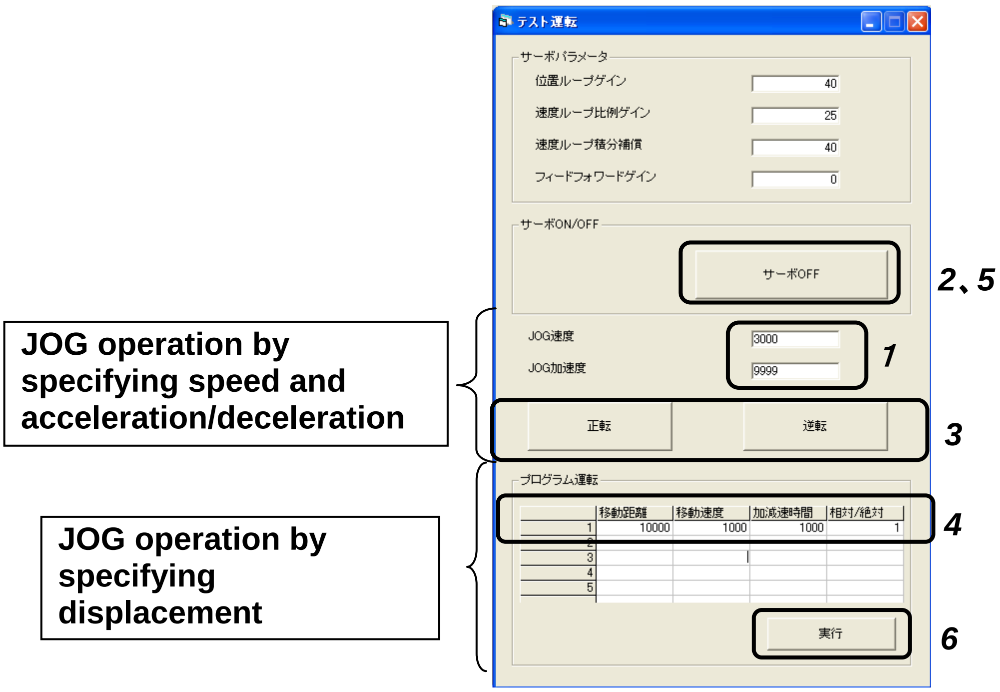
10-5 Test operation

You can specify a speed to perform simple JOG operation, or perform JOG operation by specifying a displacement.

WARNING	
	● **Any input signal operations except for emergency stops are ignored during JOG operation. Also, the actuator operates ignoring even the RYn4: FWD stroke end and RYn5: REV stroke end. Operate the actuator while carefully paying attention to the surrounding conditions.** ● **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

- RYn0: The "JOG operation" cannot be started when the servo is turned ON by the Servo-ON command input. RYn0: Set the Servo-ON command to 0.
- 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 3 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.
This can be used to check/verify with your host devices.

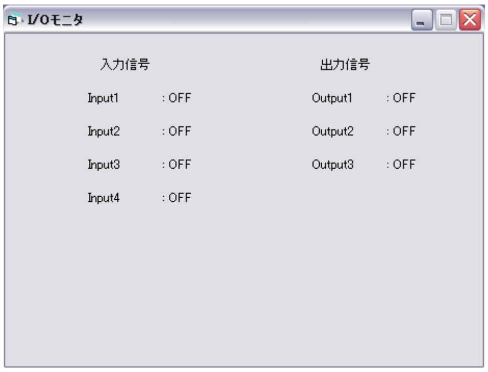
3 **If you click [Execute] button again, the output signal operation is ended and each output signal automatically returns to the pre-operation status.**

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-800C 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 I/O monitor

The statuses of pins to which input signals and output signals are assigned can be monitored.



The statuses of input and output signal pins are displayed.
The following statuses are available:

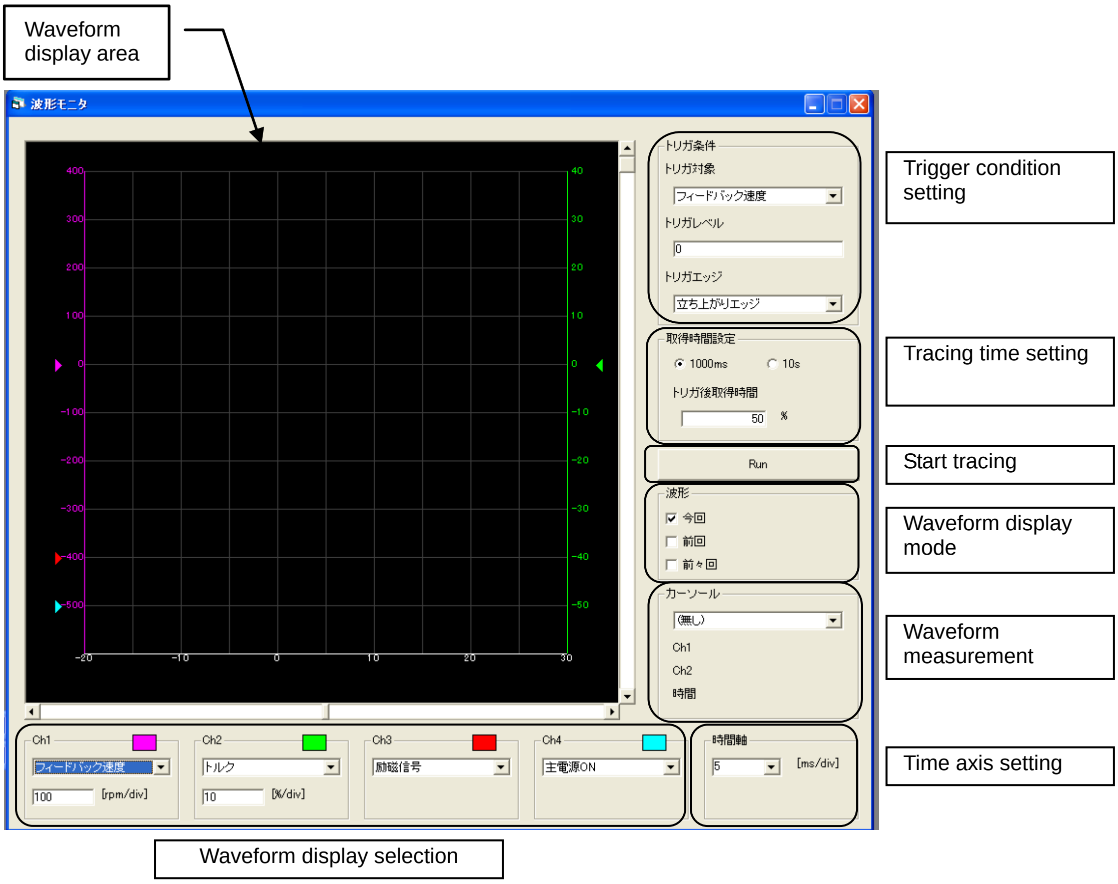
Input signals
ON: Input received
OFF: No input

Output signals
ON: Outputting
OFF: Output OFF

10 Communication software

10-8 Waveform monitoring

In addition to speed and torque, waveforms of various status signals can be displayed.



10

Communication software

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.

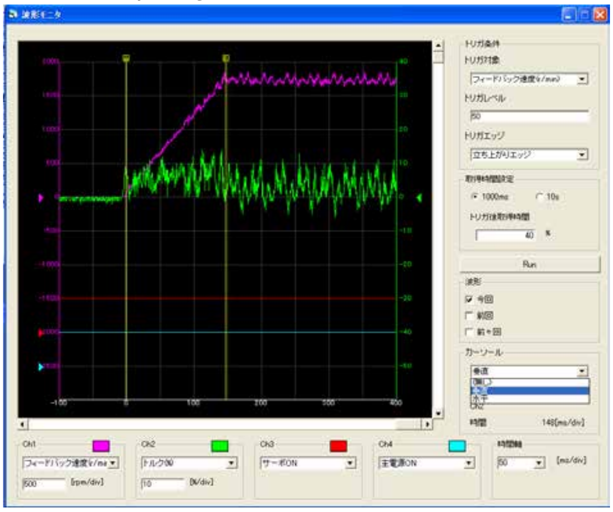
3 Set the tracing time.

If "1000ms" 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.

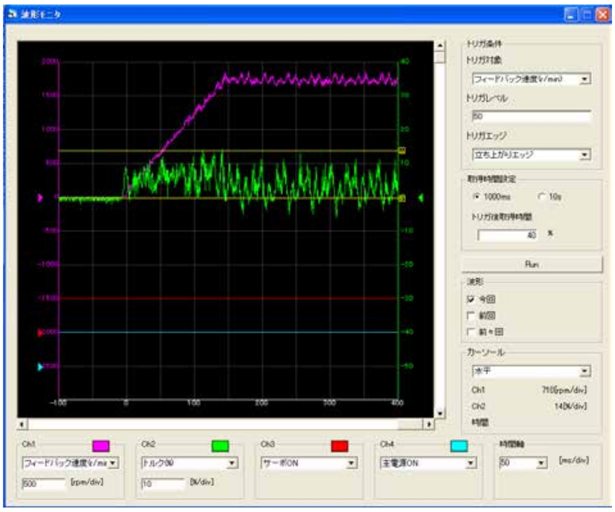
4 Click "Start Tracing".

The system waits for a trigger and when the set trigger level is reached, it 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 and 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.



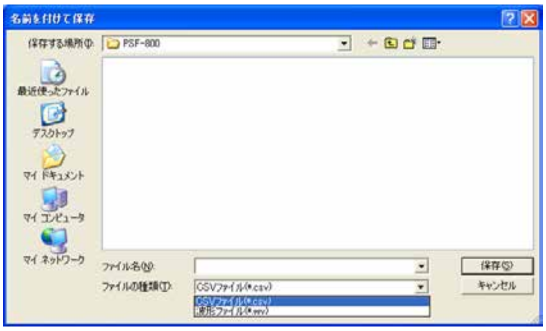
Time axis measurement (measurement of rise time)



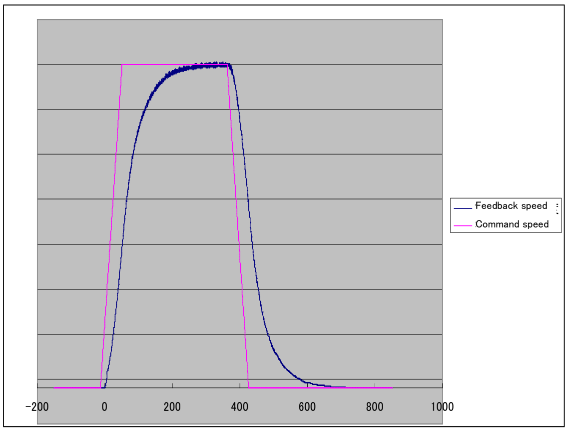
Speed/torque measurement

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.

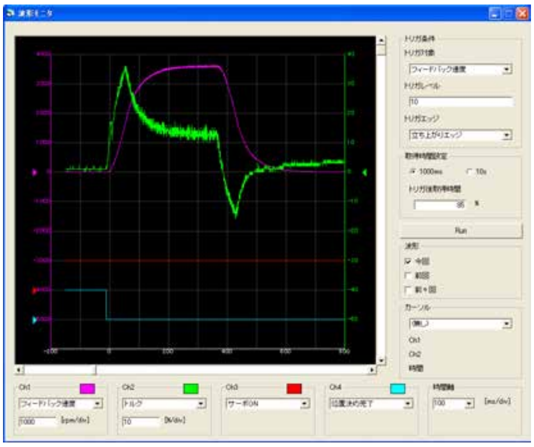


・CSV format



Excel display available.

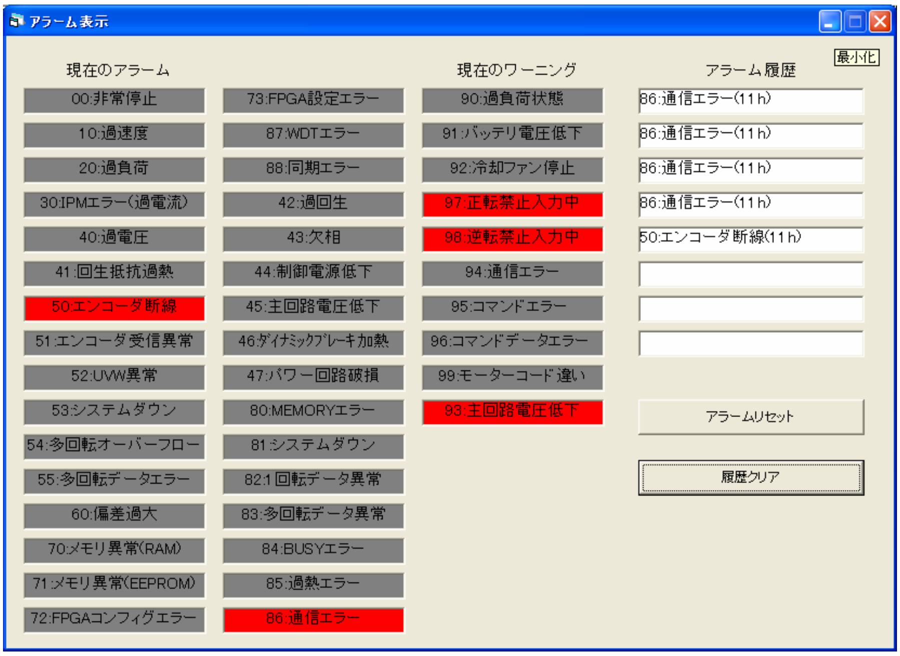
・wv format



Able to read the waveform on the PSF-800 again.

10-9 Alarms

If the HA-800C driver is generating an alarm or warning, you can check the content of the alarm/warning.
A present alarm or warning is shown in red.
You can also display and check the history of up to 8 most recent alarms.



Alarm reset

A resettable alarm whose status has been removed can be reset using the "Alarm Reset" button.

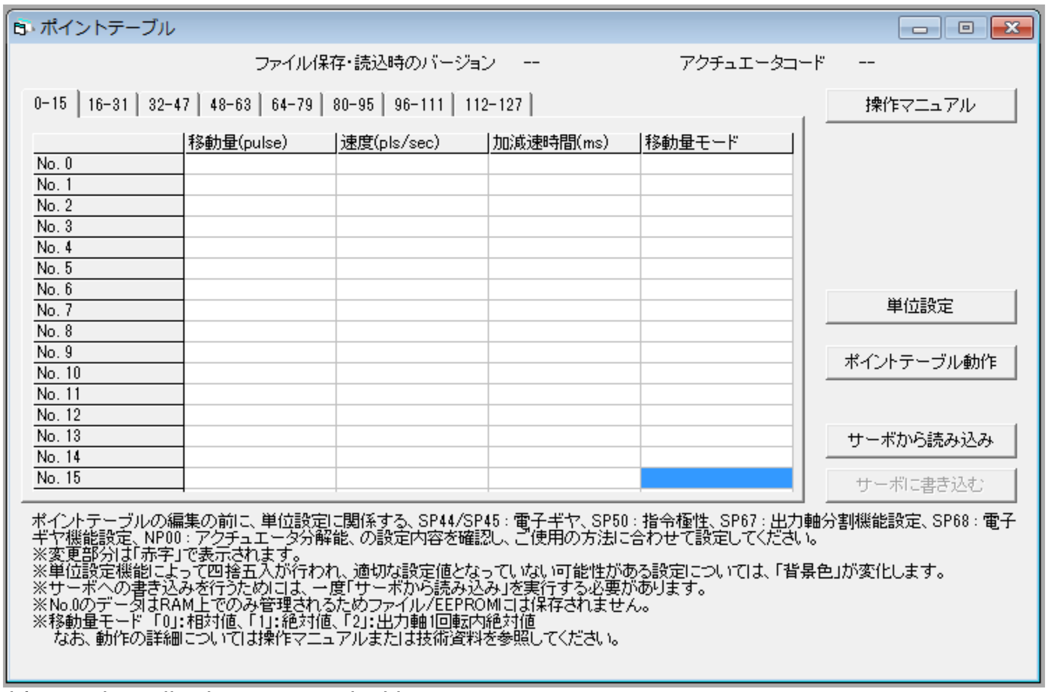
Clear history

You can clear the history of up to 8 most recent alarms using the "Clear History" button.

10-10 Editing and Operating PSF-800 Point Table

In the Point Table window, you can edit, operate, save HA-800C point table data, and write to the servo.

10-10-1. Editing and Operating PSF-800 Point Table



Point table can be edited or operated with

1. CC-Link communication *1
2. PSF-800 (HA-800C: Ver. 3.00 or later, PSF-800: Ver. 2.00 or later)*2
3. PSF-680CL*3

*1: Refer to [13-4 Communication profile] (P13-19).
*2: Can only be used with an actuator that has a 17-bit absolute encoder.
*3: To edit or operate a point table using PSF-680CL, it is necessary to change the station to No. 70 and turn the power OFF, then ON again. For details, refer to the PSF-680CL Operation Manual.

Caution

- Editing a point table on the PSF-800 point table window requires Ver. 3.00 or later for HA-800C and Ver. 2.00 or later for PSF-800.
- Before editing or operating a point table, always check the settings for SP44/SP45 : Electronic gear, SP50: Command polarity, SP67: Output shaft divide function setting, SP68: Electronic gear setting, NP00: Actuator resolution that are related to unit settings. Set these items according to the method to be used.
- Since data for point table No. 0 is managed only in RAM, it is not saved as a file or to EEPROM.
- The number of point tables available varies depending on the number of the set exclusive stations as follows.
  - 1-station occupancy: No. 0 to 31
  - 2-station occupancy: No. 0 to 127

10-10-2. Editing Point Table on PSF-800

Follow the procedures below to edit a point table.

Online (HA-800C power is ON and HA-800C is communicating with PSF-800 normally)

1. Set parameters in advance.[*1]
2. Read from the servo.
3. Set units.
4. Edit point table data.
   (a) Edit a point table.
   (b) Reading a File.[*2]
5. Write to the servo.
6. Save as a file.[*3]

Offline (HA-800C power is OFF or HA-800C is not communicating with PSF-800 normally due to communication cable not being connected or incorrect COM port being selected etc.)

1. Check parameters in advance.[*1]
2. Set units.
3. Edit point table data.
   (a) Edit a point table.
   (b) Reading a File.[*2]
4. Save as a file.[*3]

***1 Set [SP44: Electronic gear numerator], [SP45: Gear denominator], [SP50: Command polarity], [SP67: Output shaft divide function setting], [SP68: Electronic gear function setting], [NP00: Actuator resolution] that are related to unit settings according to the method to be used.**
***2: The point table data saved with the PSF-680CL can be written to HA-800C using PSF-800.**
***3: With the point table window selected, you can select Save As from the File menu to save the point table data (including unit settings). To write the point table data saved as a file to the servo, the point table data needs to be read from the servo once.**

Caution

- When online, the parameters related to the unit settings are automatically read from the servo when
  - Selecting the point table window for the first time,
  - Selecting unit settings,
  - Reading from the servo,
  - Writing to the servo,
  - Selecting saving as a file.

  Save the point table data (including unit settings) as a file as necessary.
- Since data for point table No. 0 is managed only in RAM, it is not saved as a file.
- The value is rounded off by the unit setting function and the background color changes for settings that may have an inappropriate set value. For details, see below.

Unit conversion is done by the formula below. The background color changes when the calculation result is not an integer.

Displacement

$$\text{Set value for displacement (0.001deg)} = \text{Number of command pulses} \times \frac{360{,}000}{\text{NP00: Actuator resolution}}$$

$$\text{Number of command pulses} = \text{Set value for displacement (0.001deg)} \times \frac{\text{NP00: Actuator resolution}}{360{,}000}$$

Speed

$$\text{Set value for speed (0.01r/min)} = \text{Command speed (pls/sec)} \times \frac{100 \times 60}{\text{NP00: Actuator resolution}}$$

$$\text{Command speed (pls/sec)} = \text{Set value for speed (0.01r/min)} \times \frac{\text{NP00: Actuator resolution}}{100 \times 60}$$

With some operating patterns, errors are accumulated and cause positional deviation. Check the set values before writing to the servo. In particular, the operating pattern that repeats operation with a relative value may cause positional deviation.

Ex.) When 0.001deg is set

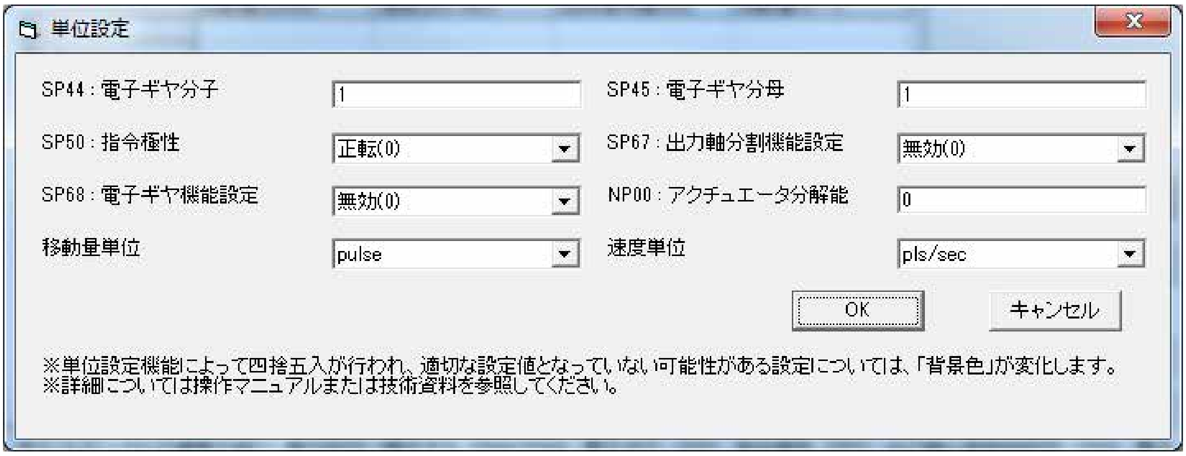
Actuator resolution: 1,000,000
Positional unit: 0.01deg
Set value for displacement : 30000 (30.000 deg)

$$\text{Number of command pulses (pulse)} = 30{,}000 \times \frac{1{,}000{,}000}{360{,}000}$$
$$= 83333.33 \rightarrow 83333$$

Positional deviation that is equivalent to 0.33 pulse = 0.00012deg occur with a single operation.
In this case, with 10,000 operations, positional deviation that is equivalent to 1.2 deg would occur.

10-10-3.Unit Settings

Positional unit and speed unit can be set for editing and operating with the point table window.



The available unit settings (positional unit, speed unit) varies depending on the connected actuator and the following parameter settings.

SP44: Electronic gear numerator
SP45: Electronic gear denominator
SP50: Command polarity
SP67: Output shaft divide function setting
SP68: Electronic gear function setting
NP00: Actuator resolution

The related parameters and settings vary depending on the applicable actuator. Refer to the following according to the actuator you use.

1. SHA series, FHA-Cmini series (17-bit absolute encoder (other than SHA-CG series))
2. SHA-CG series (17-bit absolute encoder)

Caution

- The positional unit and speed unit settings have an effect only when editing a point table with the point table window.
- Set [SP44: Electronic gear numerator], [SP45: Gear denominator], [SP50: Command polarity], [SP67: Output shaft divide function settings] , [SP68: Electronic gear function settings], [NP00: Actuator resolution] that are related to unit settings before setting units.
- Note that 0.001 deg and 0.01r/min indicate the angle or speed on the output shaft. On the value monitor in the status display mode, they indicates the position and speed on the motor shaft.
- The originating speed and originating acceleration/deceleration time vary according to the settings above. Be very careful with the settings. The positional unit and speed unit settings do not have an effect on the originating speed and originating acceleration/deceleration time indications.

1. SHA series, FHA-Cmini series (17-bit absolute encoder (other than SHA-CG series))

NP00: Actuator resolution
is relevant. (Used to convert NP00 from pulse to deg. and rev.)

Positional unit: pulse, 0.001deg
Speed unit: pps, 0.01r/min

2. SHA-CG series (17-bit absolute encoder)

SP67: Output shaft divide function setting
NP00: Actuator resolution
is relevant. (Used to convert NP00 from pulse to deg. and rev.)

When SP67 is 0
Positional unit: pulse, 0.001deg
Speed unit: pps, 0.01r/min

The NP00 setting does not have an effect in the following cases.
When SP67 is 1
Positional unit: 0.01deg (SP67=1)
Speed unit: 0.01deg (SP67=1)

When SP67 is 2
Positional unit: 0.001deg (SP67=2)
Speed unit: 0.001deg/sec (SP67=2)

When SP67 is 3
Positional unit: 0.0001deg(SP67=3)
Speed unit: 0.0001deg/sec(SP67=3)

10-10-4.Reading from the Servo

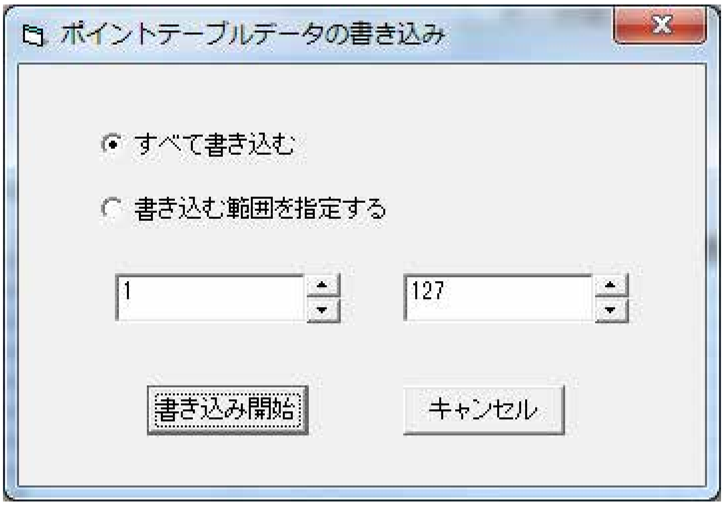
Read parameters related to the point table data and unit settings from the servo.

Caution

- Once read from the servo, the point table and unit settings being edited cannot be restored to its original state. Save the point table data (including unit settings) as a file as necessary.

10-10-5.Writing to the Servo

Write the point table data to the servo. To write the point table data to the servo, the point table data needs to be read from the servo once.



Write all

All the point table data No. 0 to 127 are written to the servo.

Specify the writing range

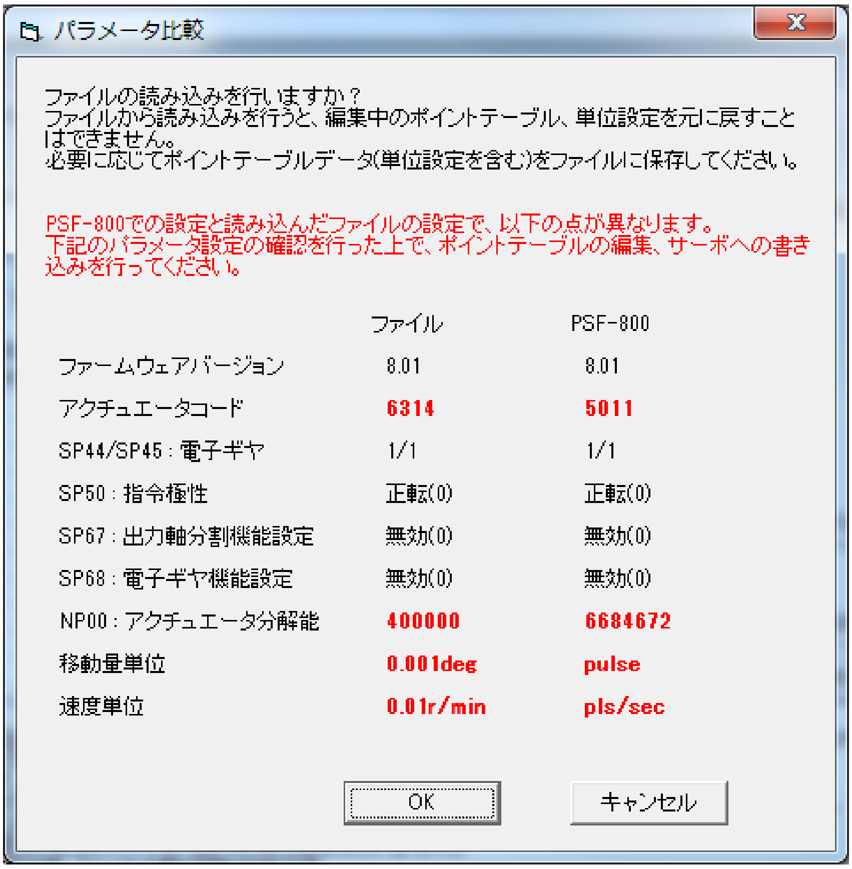
Data in the specified range between No.0 to 127 are written to the servo.

Caution

- Parameters are not written. Write parameters from the separate parameter window.
- When written to the servo, the point table data is saved in the RAM/EEPROM. Since data for point table No. 0 is managed only in RAM, it is not saved to EEPROM.
- When there is a difference in parameters between PSF-800 and the servo, a warning is displayed. Thoroughly review the warning details before writing to the servo.

10-10-6.Reading a File

When the saved point table data file is read into PSF-800[*1], the parameter comparison screen is displayed.
The parameters saved in the file are compared with the parameters set for PSF-800 and the different parameters are displayed in red.
For parameter settings, write from the parameter window.



Caution

- If the firm versions, actuator codes, or parameter settings are different, check the parameter settings and point table data before writing to the servo and performing any operation.
- Data can be written to the servo even if the parameter settings are different, but this may result in unexpected behavior. Check carefully before confirming the settings.
- If the actuator codes are different, this may result in unexpected behavior due to the difference of encoder resolution or reduction ratio. (The actuator code is a 4 digit code that identifies the connected actuator.)

10-10-7. Saving Point Table and Writing to Driver

The following explains how to backup the point table data on a personal computer and how to write (copy) the point table data already backed up on a personal computer into the the driver during communication.

Saving point table data

1. Read from the servo.
2. Save as a file.

Writing Point Table Data to Driver

1. Read from the servo.
2. Open the file.
3. Write to the servo. (Write all)

Caution

- When replacing the driver for maintenance, be sure to refer to [A-4 Driver replacement procedures].
  The data saved and written by this operation is [Point table (operation data)].
- [Adjustment 1], [Adjustment 2], [Adjustment 3], [System 3], [System 4], [Network] set in the HA-800C is not saved or written by this operation. To save or write these, use the parameter window.
- Write the point table data to the driver after writing [Adjustment 1], [Adjustment 2], [Adjustment 3], [System 3], [System 4], [Network] parameters to the driver.

10-10-8. Point table operation

In the Point Table Operation window, you can check operations based on the edited point table data. The point table operation window can be run when the following conditions are met.

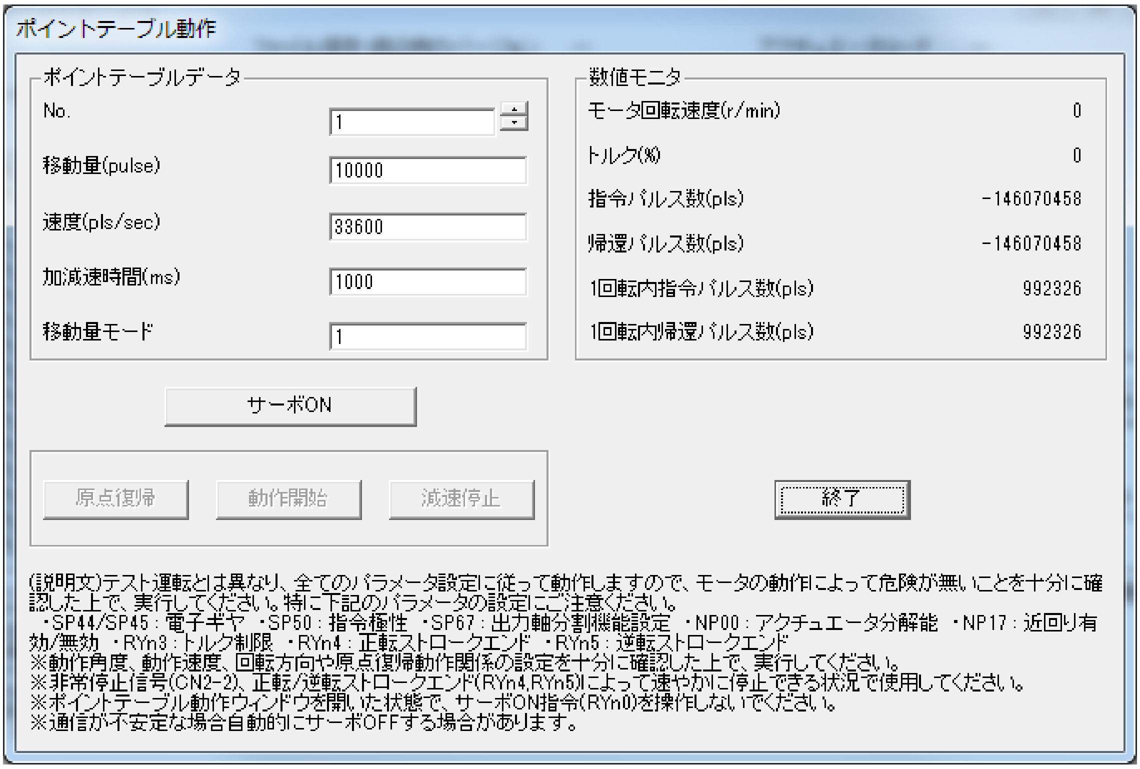
- Connected to the HA-800C and the power is ON (the green operation lamp is lit.)
- Point table is read from the HA-800C.
- No alarm is generated.
- Servo is OFF.
- In the position control mode (RY (n+2) 3 and RY (n+2) 4 are 0)

Caution

- Different from test operations (JOG operation, program operation), the motor operates according to all parameter settings. Make sure that the motor operation will cause no danger. In particular, be careful with the following parameter settings.
  - SP44/SP45: Electronic gear
  - SP50: Command polarity
  - SP67: Output shaft divide function setting
  - SP68: Electronic gear function setting
  - NP17: Shortcut enable/disable
  - RYn3: Torque limit
  - RYn4: FWD stroke end
  - RYn5: REV stroke end
- To perform point table operations, RYn4: FWD stroke end or RYn5: REV stroke end must be set to 1 through CC-Link communication. Point table operations can also be performed by turning ON the HA-800C power with the CC-Link master power OFF or CC-Link communication cable not connected.
- Thoroughly check the settings related to operation angle, operation speed, rotation direction, and originating operation before performing point table operations.
- Operations should be able to stop immediately with an emergency stop signal (CN2-2) or FWD/REV stroke end (RYn4, RYn5).
- While an editing is performed on the point table operation window, the following commands from the CC-Link are ignored. Pay enough attention to the master sequence as other CC-Link communication (RX, RY, RWw, RWr) still function. Note that the commands from the CC-Link are executed when the point table operation window is closed.

1-station occupancy	2-station occupancy	Signal name
RYn0	RYn0	Servo ON command
RYn1	RYn1	Startup
RYn2	RYn2	Startup options
RYn9	RYn9	Command code execution request
-	RY(n+2)3	Speed control switching
-	RY(n+2)4	Torque control switching
-	RY(n+2)5	JOG operation
-	RY(n+2)6	JOG rotation direction

- Once edited with the point table operation window, the point table data cannot be restored to its original state. Save the point table data (including unit settings) as a file as necessary.



Point table operation

1. Specify the point table No. to operate and check the contents of the point table data.
2. Click the Servo-ON button to turn the servo ON.
3. Click the Originating button to perform an originating operation as necessary.
4. If you click the Operation Start button, operation is performed according to the specified point table data.
5. When you close the point table operation window, click the servo-OFF button and check that the servo is turned OFF, then click Exit.
6. After editing the contents of the point table data, the data need to be written to the servo.

Value monitor

This can monitor the current motor rotation speed etc.

Caution

- Positional deviation of the machine could have occurred due to the point table operation. Be sure to set the appropriate position by reconnecting the power or performing originating before performing normal operations.
- A rotation speed greater than the max. rotational speed of the applicable actuator can be set, but in actual operation, operation is restricted to the max. rotational speed of the actuator by the controller and "AL10: Overspeed", "AL60: Excessive deviation", or some other alarm may be generated. Check the max. rotational speed of the actuator to be used, then set the speed value.

Chapter 11

Troubleshooting

Details of how driver alarms and warnings generate are explained in this chapter.

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. Immediately remove the cause of the warning. (The servo loop is turned OFF while the [Warning 93: Main circuit voltage low] is occurring.)

If the actuator 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. CN2-9: 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
AL01	Emergency stop	Possible*4
AL10	Overspeed	Impossible
AL20	Overload	Possible*4
AL30	IPM error (overcurrent)	Impossible
AL40	Overvoltage	Impossible
AL41	Regenerative resistor overheat	Impossible
AL42	Overregeneration*5	Impossible
AL43	Missing phase*5	Impossible
AL44	Control power voltage low*5*6	Impossible
AL45	Main circuit voltage low*5	Impossible
AL46	Overheated dynamic brake*5	Impossible
AL47	Damaged power circuit	Not permitted (Permitted) *8
AL50	Encoder disconnection	Impossible
AL51	Encoder receiving error*1	Impossible
AL52	UVW error*1	Impossible
AL53	System failure*2	Impossible
AL54	Multi revolution overflow*2	Impossible
AL55	Multi revolution data error*2	Impossible
AL60	Excessive deviation	Possible (Impossible)*4
AL70	Memory failure (RAM)	Impossible
AL71	Memory failure (EEPROM)	Impossible
AL72	FPGA configuration error	Impossible
AL73	FPGA setting error	Impossible
AL76	Processor error*6*7	Not permitted*6
AL80	MEMORY error*3	Impossible
AL81	System failure*3	Impossible
AL82	Single rotation data error*3	Impossible
AL83	Multi revolution data error*3	Impossible
AL84	BUSY error*3	Impossible
AL85	Overheat error*3	Impossible
AL86	Communication error*3	Impossible

*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: Once alarms are reset using the alarm clear input or the alarm clear command, the servo will not turn ON even if the servo ON signal is ON. After the reset, turn OFF the servo ON signal and then turn it ON again.
During position-controlled operation, alarms can be reset using the alarm clear input or the alarm clear command, but the deviation will not be cleared. If the excessive deviation alarm occurs, issue a deviation clear command to clear the deviation and then use the alarm clear input or alarm clear command to reset the alarm.
If the alarm is not cleared with the above operation, turn the power OFF, then ON again.
*5: This alarm may generate in HA-800C-24.
*6: This alarm is not stored in the alarm history.
*7: The alarm code read by the read command may be indeterminable depending on the occurrence condition of alarm.
*8: With HA-800C-24, the alarm cannot be cleared. With HA-800C-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
AL01	Emergency stop	An emergency stop signal was input.	The alarm occurs when the control circuit power is turned ON:	● If the emergency stop input logic is set to normally closed → Check whether an emergency stop signal was input. ● If the emergency stop input logic is set to normally open → Check that an emergency stop signal was not input. In cases other than above, contact our sales office.
			The alarm occurs during operation:	● Cancel the emergency stop signal and reconnect the control power supply or input an alarm clear signal. ● Disconnect the wiring of the emergency stop input → Make sure there are no short circuits, poor contacts or other problems. ● Malfunction due to noise → Check the noise environment. ● Control circuit error → Replace the driver.

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 → The command frequency is too large with respect to [SP44, 45: Electronic gear setting] and [SP67: Output shaft divide function setting]. Set appropriate electronic gear. Alternatively, modify the command frequency. ● Excessive value set for [RWwn5: Torque command] → Lower the [RWwn5: Torque command].

Alarm code	Alarm name	Description	Condition at occurrence	Action
AL20	Overload	The allowable continuous current was exceeded. (Refer to P7-4.)	The alarm also 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 [RYn0: Servo-ON] is 1:	● Control circuit error → Contact our sales office.
			The alarm occurs when [RYn0: Servo-ON] is 1, 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 (inertia) is excessive or acceleration/deceleration time is too short. → Lower the load inertia moment. → For speed control, increase the time set in [AJ12: Acceleration/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-800C-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 (operation can be resumed after 4 to 5 mins):	● Overload → Review the effective load rate of the actuator and lower the load rate. ● 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-800C-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.

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Alarm code	Alarm name	Description	Condition at occurrence	Action
AL40	Overvoltage	The main circuit voltage exceeded approx. 400VDC.	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-800C-3, -6, -24) → Connect a 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-800C-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-800C-24):	● The regenerative resistor is not properly wired or not connected. → Connect the regenerative resistor correctly.
			When an external regenerative resistor is used (HA-800C-24):	● The regenerative resistor is not properly wired or not connected. → Connect the regenerative resistor correctly. ● The parameter setting of regenerative resistor selection (SP64) 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-800C-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-800C driver.) ● Load inertia exceeds the adaptive range. → Review the configuration and use the resistor with load inertia 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 regenerative resistor selection (SP64) is wrong. → Change the setting of system parameter SP64 and select an external regenerative resistor.
AL43	Missing phase (HA-800C-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-800C-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.

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Alarm code	Alarm name	Description	Condition at occurrence	Action
AL45	Main circuit voltage low (HA-800C-24)	Although the main circuit power (R, S, T) is supplied, the main circuit DC voltage dropped.	The alarm occurs when the main circuit power is turned 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 occurs 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-800C-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 is excessive or an excessive negative load is 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	Power circuit abnormality	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 in the servo-ON signal. 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 during operation with servo-ON	● Abnormality due to short-duration servo-OFF command → The alarm may occur when a servo-OFF command is input for a short period of time. Check the controller sequence. → The alarm may occur when a servo-OFF command is executed for a short period of time, for example due to CC-Link communications being cut off.
		The alarm occurs due to errors in the driver power circuit.	The alarm occurs when the control power is turned ON or when a servo is turned ON.	● HA-800C 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-800C driver.)

Alarm code	Alarm name	Description	Condition at occurrence	Action
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 diagram 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.
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 diagram 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 diagram 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).

Alarm code	Alarm name	Description	Condition at occurrence	Action
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 originating.
			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 +4,095 to -4,096 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 +4,095 to -4,096 revolutions (motor shaft). → Clear the multi revolution data using [T08: Multi revolution clear] in the test mode.
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's output shaft moved 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.
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 clear the deviation, and then reconnect the power supply. ● Driver control circuit error → Contact our sales office.

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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 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. ● Inappropriate electronic gear setting → The command frequency is too large for [SP44, 45: Electronic gear setting] or [SP67: Output shaft divide function setting]. Set appropriate electronic gear. Alternatively, modify the command frequency. ● Excessive command speed → Lower the command speed on the operation data. ● Excessive load inertia moment → Lower the load inertia moment. → Increase the acceleration/deceleration time constant setting of the operation data.
			The speed does not rise with the command, and the alarm occurs sometime after that:	● 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:	● RYn4: FWD stroke end or RYn5: REV stroke end → Set RYn4: FWD stroke end and RYn5: REV stroke end to 1 ● 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. ● Inappropriate motion profile setting → If AL 60 is generated when the shortcut operation is performed, the alarm cannot be cleared. To clear the alarm, turn the driver power OFF, then ON again..

Alarm code	Alarm name	Description	Condition at occurrence	Action
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.
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 read by the read command 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.

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Alarm code	Alarm name	Description	Condition at occurrence	Action
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. ● 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 revolution 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).
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 below SHA20, FHA-Cmini series and HMAC08: 250 r/min or below ● 17-bit absolute encoder error → Contact our sales office. (Replace the actuator.)

Alarm code	Alarm name	Description	Condition at occurrence	Action
AL85	Overheat error	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 1 minute, and reconnect the power. ● No errors occur when the power is turned ON → Replace the driver.

*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 CC-Link 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 alarms that may be displayed is shown below.

Warning code	Warning name
90	Overload status
91	Battery voltage low
92	Cooling fan stopped (HA-800C-6 only) *1
93	Main circuit voltage low
97	FWD inhibit input effective
98	REV inhibit input effective
99	Wrong actuator

*1: HA-800C-24 is not supported.

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 (excludng 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-800C-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 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 RYn0: Servo-ON signal must be changed once to 0 and then changed back to 1 to turn ON the servo.

Warning code	Warning name	Description
UA97	FWD inhibit input effective	The alarm occurs when CC-Link RYn4: FWD stroke end is set to 0. Set to 1.
UA98	REV inhibit input effective	The alarm occurs when CC-Link RYn5: REV stroke end is set to 0. Set to 1.
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.

12-1 Option

Options you can purchase as necessary are explained.

Extension cables

HA-800C 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 cables (option)
				HA-800C-1	HA-800C-3	HA-800C-6	
SHA series	20	200	17-bit absolute	-	HA-800C-3D/E-200	-	Motor wire EWD-MB**-A06-TN3 Encoder wire EWD-S**-A08-3M14
	25	200		-	HA-800C-3D/E-200	-	
	32	200		-	-	HA-800C-6D/E-200	
	40	200		-	-	HA-800C-6D/E-200	
	25	100		-	-	HA-800C-6D/E-100	
FHA-Cmini series	8	200	4 wires, wire-saving type incremental	HA-800C-1C-200	-	-	Motor wire EWC-M**-A06-TN3 Encoder wire EWC-E**-M06-3M14
	11	200		HA-800C-1C-200	-	-	
	14	200		HA-800C-1C-200	-	-	
	8	100		HA-800C-1C-100	-	-	
	11	100		HA-800C-1C-100	-	-	
	14	100		HA-800C-1C-100	-	-	
	8	200	17-bit absolute	HA-800C-1D/E-200	-	-	Motor wire EWC-M**-A06-TN3 Encoder wire EWD-S**-A08-3M14
	11	200		HA-800C-1D/E-200	-	-	
	14	200		HA-800C-1D/E-200	-	-	
	8	100		HA-800C-1D/E-100	-	-	
	11	100		HA-800C-1D/E-100	-	-	
	14	100		HA-800C-1D/E-100	-	-	
FHA-C series	17	200	4 wires, wire-saving type Incremental	-	HA-800C-3C-200	-	Motor wire EWC-MB**-M08-TN3 Encoder wire EWC-E**-B04-3M14
	25	200		-	HA-800C-3C-200	-	
	32	200		-	-	HA-800C-6C-200	
	40	200		-	-	HA-800C-6C-200	
	17	200	13-bit absolute	-	HA-800C-3A-200	-	Motor wire EWC-MB**-M08-TN3 Encoder wire EWC-S**-B08-3M14
	25	200		-	HA-800C-3A-200	-	
	32	200		-	-	HA-800C-6A-200	
	40	200		-	-	HA-800C-6A-200	
	17	100	4 wires, wire-saving type incremental	-	HA-800C-3C-100	-	Motor wire EWC-MB**-M08-TN3 Encoder wire EWC-E**-B04-3M14
	25	100		-	-	HA-800C-6C-100	
	32	100		-	-	HA-800C-6C-100	
	17	100	13-bit absolute	-	HA-800C-3A-100	-	Motor wire EWC-MB**-M08-TN3 Encoder wire EWC-S**-B08-3M14
	25	100		-	-	HA-800C-6A-100	
	32	100		-	-	HA-800C-6A-100	
RSF series	17	200	14 wires incremental	-	HA-800C-3B-200	-	Motor wire EWA-M**-A04-TN3 Encoder wire EWA-E**-A15-3M14
RSF/RKF series	20	200		-	HA-800C-3B-200	-	
	25	200		-	HA-800C-3B-200	-	
	32	200		-	-	HA-800C-6B-200	

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Option

Actuator series	Model No.	Input voltage (V)	Encoder type	Combined driver HA-800C-24	Extension cables (option)
SHA series	40	200	17-bit absolute	HA-800C-24D/E	Motor wire EWD-MB**-A06-TMC Encoder wire EWD-S**-A08-3M14
	45	200		HA-800C-24D/E	
	58	200		HA-800C-24D/E	Motor wire EWD-MB**-D09-TMC Encoder wire EWD-S**-D10-3M14
	65	200		HA-800C-24D/E	

Actuator series	Model No.	Input voltage (V)	Encoder type	Combined driver	Extension cables (option)
HMA series	08	200	17-bit Absolute	HA-800C-3D/E-200	Motor wire EWD-MB**-A06-TN3 Encoder wire EWD-S**-A08-3M14
	09	100		HA-800C-6D/E-100	
		200		HA-800C-3D/E-200	
	12	200		HA-800C-6D/E-200	
	15	200		HA-800C-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-800C-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-HA80C-S1
CN1 type/CN2 type/motor-wire type/power-supply type/2 CC-Link connectors
CC-Link branch connector ・・・6 types
CNK-HA80C-S2
CN2 type/power-supply type/2 CC-Link connectors/CC-Link branch connector ・・・4 types
CNK-HA80C-S1-A
CN1 type/CN2 type/2 CC-Link connectors/CC-Link branch connector ・・・4 types
CNK-HA80C-S2-A
CN2 type/2 CC-Link connectors/CC-Link branch connector ・・・3 types

	CN1 type	CN2 type	Motor-wire type	Power-supply type
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

	CN4 type CC-Link connector	CN4 type CC-Link branch connector
Manufacturer	3M	3M
Model	35505-6000-B0M GF	35715-L010-B00 AK

Servo parameter setting software (PSF-800)

This software lets you set various servo parameters of your HA-800 driver from a personal computer. Use an EIA-232C cable to connect the CN3 connector on the HA-800 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.

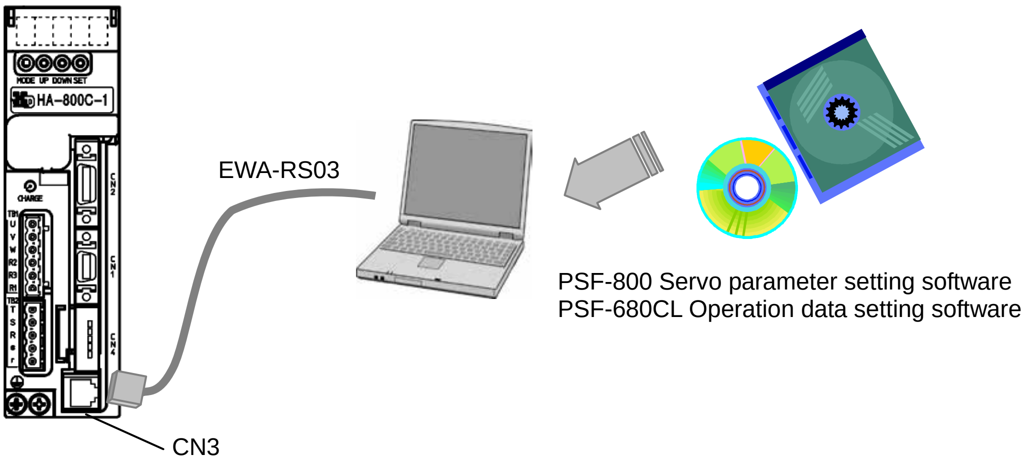
Operation data setting software (PSF-680CL)

This software is used to create operation data and set to HA-800C in advance when the driver is used for applications where displacement is known beforehand. It is possible to set, change, and check operation data by connecting CN3 of the HA-800 driver and PC on which operation data setting software PSF-680CL is installed using the EIA-232C cable.
You can download this operation data setting software from our website (http://www.hds.co.jp/). The operation data can also be set via CC-Link.

Model	PSF-680CL
Supported operating systems	Windows® ME, Windows® NT, Windows® 2000, 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.



12

Option

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℃, axis stopped, continuous use (The actual life varies depending on the condition of use.)

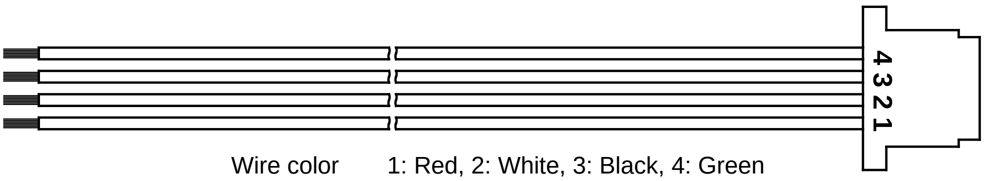
Caution

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

Monitor cable

When connecting to the monitor output connector CN9, use this signal cable to measure speed, torque and other signals using an oscilloscope.

Model	EWA-MON01-JST4



Wire color 1: Red, 2: White, 3: Black, 4: Green

Chapter 13

CC-Link communication function

This chapter explains the CC-Link communication functions.

13-1 Specification

The following explains the specifications of CC-Link communication.

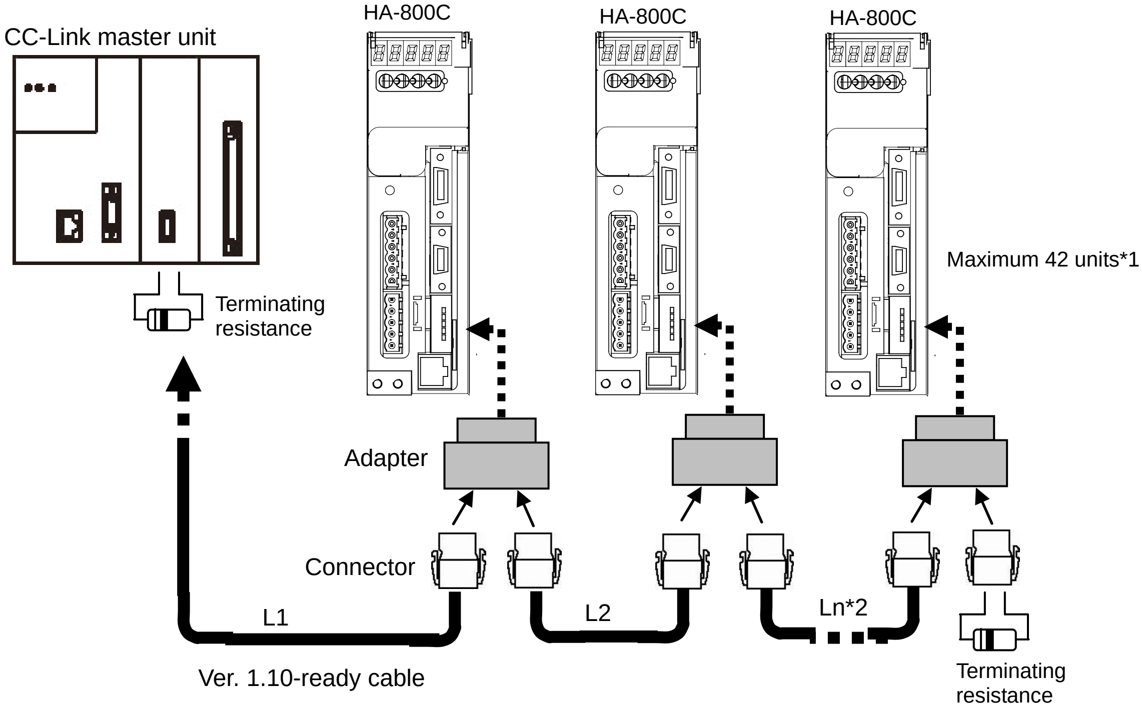
Communication specification

<table>
<tr><th colspan="2">Item</th><th colspan="5">Specification</th></tr>
<tr><td colspan="2">Station type</td><td colspan="5">Remote device station</td></tr>
<tr><td colspan="2">Applicable CC-Link version</td><td colspan="5">Ver1.10</td></tr>
<tr><td colspan="2">Communication speed</td><td colspan="5">10M/5M/2.5M/625k/156kbps</td></tr>
<tr><td colspan="2">Communication method</td><td colspan="5">Broad cast polling method</td></tr>
<tr><td colspan="2">Synchronous method</td><td colspan="5">Frame synchronous method</td></tr>
<tr><td colspan="2">Encoding method</td><td colspan="5">NRZI</td></tr>
<tr><td colspan="2">Transmission channel type</td><td colspan="5">Bus type (conforming to EIA RS-485)</td></tr>
<tr><td colspan="2">Error control method</td><td colspan="5">CRC ($X^{16}+X^{12}+X^{5}+1$)</td></tr>
<tr><td colspan="2">Connection cable</td><td colspan="5">CC-Link Ver. 1.10-ready cable
(3-core twisted pair cable with shield)</td></tr>
<tr><td colspan="2">Transmission format</td><td colspan="5">Conforming to HDLC</td></tr>
<tr><td colspan="2">Remote station number</td><td colspan="5">1 to 64</td></tr>
<tr><td colspan="2">Number of exclusive stations</td><td colspan="5">1 station/2 stations</td></tr>
<tr><td rowspan="3">Cable length</td><td>Communication speed</td><td>156kbps</td><td>625kbps</td><td>2.5Mbps</td><td>5Mbps</td><td>10Mbps</td></tr>
<tr><td>Maximum cable extension</td><td>1,200m</td><td>900m</td><td>400m</td><td>160m</td><td>100m</td></tr>
<tr><td>Cable length between stations*</td><td colspan="5">0.2m or more</td></tr>
<tr><td colspan="2">Number of connections</td><td colspan="5">Up to 42 units on remote device stations only, can be shared with other devices.</td></tr>
</table>

* When CC-Link Ver. 1.00-ready cables are also used. The specifications of maximum cable extension and cable length between stations are the same as for Ver. 1.00.

System configuration

An example of system configuration is shown below.

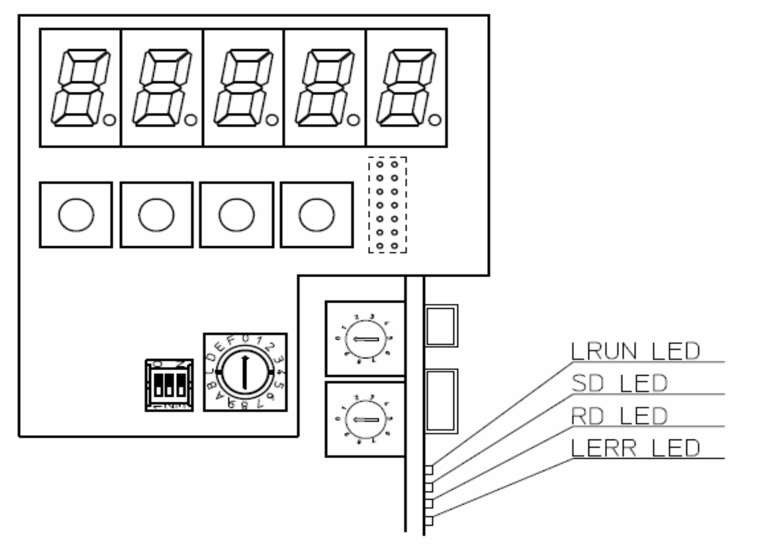


	Connector	Adapter
Manufacturer	35505-6000-B0M GF	35715-L010-B00 AK
Model	3M	3M

*1: Refer to [Maximum number of connections] (P13-18) for the maximum number of connections.
*2: Design the cable length such that the following conditions are satisfied.

Transmission rate	Cable length between stations (L1,L2)	Maximum cable extension (L1+L2+··Ln)
156kbps	20cm or more	1,200m
625kbps		900m
2.5Mbps		400m
5Mbps		160m
10Mbps		100m

Communications status monitor LED



Name	Explanation
LRUN	Lit when HA-800C is connected to the CC-Link network.
SD	Lit when HA-800C is sending data to the CC-Link line.
RD	Lit when HA-800C receives data from the CC-Link line.
LERR	Flicker in the following cases (1) There are errors in the station number and communication speed settings. (The LERR LED lights when the station number was set to 70 to connect the PSF-680CL.) (2) The station number setting was changed during operation. (3) The communication line is unstable due to influence of noise, etc.

HA-800C CC-Link Basic Specifications

● Differences in HA-800C functions according to the number of exclusive stations

For the HA-800C, 1- or 2-station occupancy can be used.
Set the number of exclusive stations for HA-800C according to the following differences in functions.

	1-station occupancy	2-station occupancy
No. of point tables	32	128
JOG operation	×	○
Speed control	×	○
Torque control	×	○
Value monitor Number of value monitors that can be acquired at the same time	Word x 2 (16bit data x2)	DWord x 2 (32bit data x2)

● Point table

A point table is a set of point data (operation data), stored in HA-800C memory, that brings together four data items required for positioning operations: [displacement (target value)], [rotation speed], [acceleration/deceleration time constant], and [displacement mode]. Actual positioning operations are performed by specifying the point number with CC-Link communications.
When using a point table, be sure to refer to [Displacement mode setting] (P13-6) and the [Start] in the timing chart.

No	Displacement (target value) pulse	Rotation speed pls/sec	Acceleration/deceleration time constant ms	Displacement mode
0	1000	30000	1000	0
1	2000	20000	1000	0
2	3000	20000	1000	0
・・・				
127	0	30000	1000	1

● Editing a point table

Point table data can be edited with

1. CC-Link communication,*1
2. PPSF-800 (HA-800C: Ver. 3.00 or later, PSF-800: Ver. 2.00 or later) *2 , or
3. PSF-680CL*3 .

When you know the required point data beforehand, it is possible to edit the point table in tabular form using PSF-800 or PSF-680CL.
When the required point table data is different for each operation or when more than 127 point data items are required (more than 31 for 1-station occupancy), edit the point data with CC-Link communication beforehand.
Since data for point table No. 0 is managed only in RAM, it is not saved to EEPROM.

*1: Refer to [13-4 Communication profile] (P13-19).
*2: Can only be used with an actuator that has a 17-bit absolute encoder.
*3: To edit or operate a point table using PSF-680CL, it is necessary to change the station to No. 70 and turn the power OFF, then ON again. For details, refer to the PSF-680CL Operation Manual.

Point table data setting range

The point table data setting range for the HA-800C is as in the table below.

Set value	Unit	Setting range
Displacement	pulse	-2147483648 to 2147483647
Rotation speed*1	pls/sec	125 to 2147483647
Acceleration/deceleration time*2	ms	1 to 9999
Displacement mode	-	0, 1, 2

*1: The max. rotational speed is set differently for each actuator. When setting the rotation speed, check the max. rotational speed for the actuator you are using and set accordingly. Also, when the output shaft divide function is enabled (other than when SP67=0 on the SHA-CG series), the lower limit for the setting range is 1.

*2: This corresponds to the time over which the motor accelerates from standstill to maximum speed and the time over which it decelerates from the maximum speed to standstill (speed 0). This is not the acceleration/deceleration time to/from the speed set in the point table.

Caution

- With the HA-800C, when a relative value from the current value is specified, the motor can only be operated a displacement of up to 2,147,483,646 pulses. If RYn1: Start is 1 or [Movement start] is selected in the point table operation window with conditions that result in an operation command exceeding this value, "0008h: Write range error" is output for "RWrn+2: Response code".
- A rotation speed greater than the max. rotational speed of the applicable actuator can be set, but in actual operation, operation is restricted to the max. rotational speed of the actuator by the controller and "AL10: Overspeed", "AL60: Excessive deviation", or some other alarm may be generated. Check the max. rotational speed of the actuator to be used, then set the speed value.

Displacement mode setting

The HA-800C has the following 3 displacement mode functions.

1. Relative value command

This sets the displacement from the current stop position and operates.

2. Absolute value command

This sets the target position from the origin and operates. The shortcut function can also be used.

3. Absolute value command within a single revolution of the output shaft[*1]

This performs an absolute value operation within the operating range of a single revolution of the output shaft from the origin with the rotation direction specified.

Displacement mode setting[*2](CC-Link communication write command code RWwn+2 Code number: 8305h, 9001h - 907Fh)

Set value	Function
0	Relative value command
1	Absolute value command
2	Absolute value command within a single revolution of the output shaft

*1: This is available for HA-800 software version 3.01 or later.
*2: This can also be edited from PSF-800 (Ver. 2.00 or later) or PSF-680CL. The setting value 2 cannot be set from PSF-680CL.

Caution

- The reference coordinate system becomes as follows according to [SP67: Output shaft divide function setting].
  SP67=0: NP00 pls/r
  SP67=1: 36000 pls/r
  SP67=2: 360000 pls/r
  SP67=3: 3600000 pls/r
- With an actuator that has an incremental encoder, when the electronic gear ratio [SP44/45] is set to other than 1/1 and the shortcut function is used, set [NP00: Actuator resolution] as follows.
  NP00 = Output shaft resolution (NP00 default value) / Electronic gear ratio (SP44/45)
- With HA-800 software versions 2.11 to 3.00, if a shortcut operation is performed after deviation clear processing (CN2-4, CC-Link communication write command (8020h)) exceeding ±31bit (-2147483648 to +2147483647 pls) from the origin is executed, "AL60: Excessive deviation" is generated. In this case, the alarm cannot be cleared. To clear the alarm, turn the driver power OFF, then ON again.

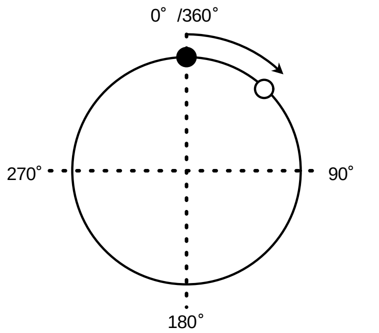
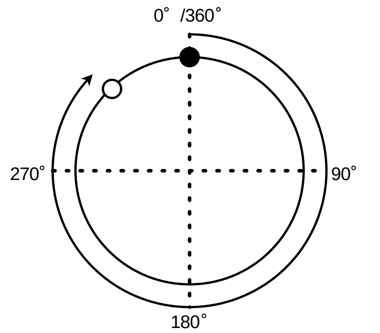
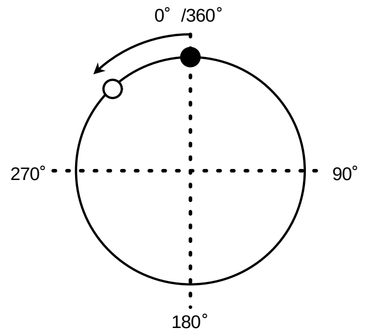
Shortcut function

For an operation that specifies the rotation angle using an index table or the like, the shortcut function rotates in whichever direction requires less movement given the position of the target value relative to the current value. The shortcut function can be enabled/disabled with the [NP17: Short cut enable/disable] setting. (NP17=0: Shortcut function disabled; NP17=1 Shortcut function enabled)
The shortcut function functions in the reference coordinate system set with [NP00: Actuator resolution] when the displacement mode setting is [Absolute value (1)]. When the shortcut function is enabled, the maximum operation is 180 degrees on the output shaft.
When the distance setting is greater than the actuator resolution, the operation uses the excess value of [Distance setting/actuator resolution] as the target position.

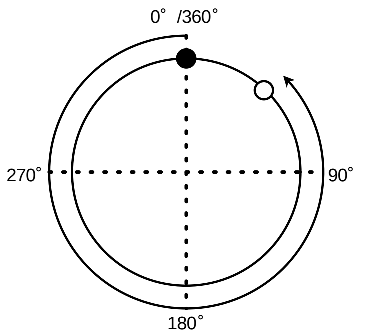
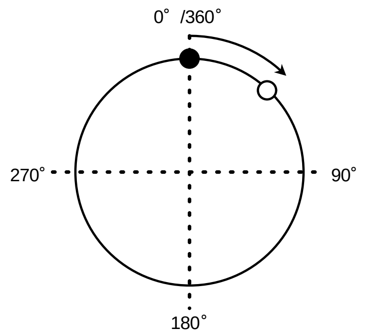
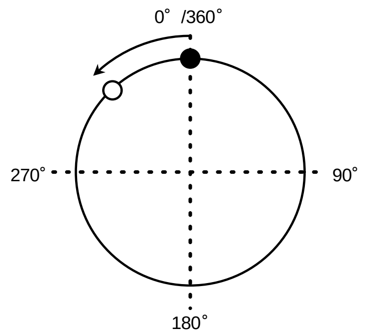
Example: Shortcut function

Actuator resolution: 6553600 pls/r
Operates as an actuator equivalent to one with a resolution of 360˚.

Example 1: Operates with cumulative feedback pulses = 0 and from a position of 0 within a single revolution of the actuator.

NP17=0/1 Displacement = 819200	NP17=0 Displacement = 5734400	NP17=1 Displacement = 5734400
		
Cumulative feedback pulses = 819200 Position within a single actuator revolution = 819200	Cumulative feedback pulses =5734400 Position within a single actuator revolution =5734400	Cumulative feedback pulses =-819200 Position within a single actuator revolution =5734400

Example 2: Operates with cumulative feedback pulses = 6553600 and from a position of 0 within a single revolution of the actuator

NP17=0 Displacement = 819200	NP17=1 Displacement = 819200	NP17=0/1 Displacement = 5734400
		
Cumulative feedback pulses = 819200 Position within a single actuator revolution = 819200	Cumulative feedback pulses = 7372800 Position within a single actuator revolution = 819200	Cumulative feedback pulses = 5734400 Position within a single actuator revolution =5734400

Absolute value command within a single revolution of the output shaft

For a shortcut operation with an absolute value command, operation is within 180˚ on the output shaft, but the rotation direction cannot be specified.
For index operations etc., in order to easily perform operations with the rotation direction specified, this function uses the [Absolute value command within a single revolution of the output shaft] command to operate

[Specifying the rotation direction with code] and
[Specifying the location within a single revolution of the output shaft with a value].

To perform an operation greater than a single revolution of the output shaft, use a relative value command or an absolute value command.
The range for the distance setting depends on [SP67: Output shaft divide function setting] as follows.

Set value	Displacement range
SP67=0	-NP00* to –1, +1 to +NP00*
SP67=1	-36000 to –1, +1 to +36000 (SHA-CG series only)
SP67=2	–360000 to –1, +1 to +360000 (SHA-CG series only)
SP67=3	–3600000 to –1, +1 to +3600000 (SHA-CG series only)

*: [NP00: Actuator resolution]

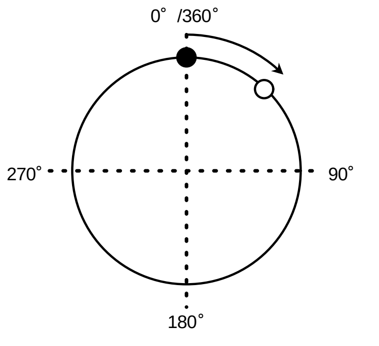
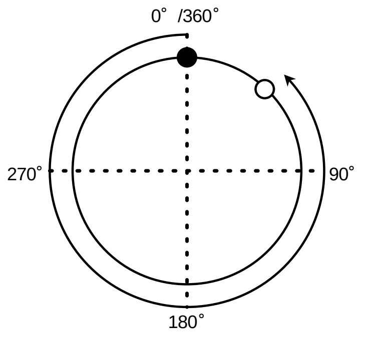
When the displacement mode setting is set to an absolute value command within a single revolution of the output shaft and the displacement is outside the setting range, if RYn1: Start is set to 1, then error code [0008h: Write range error] is set in the [RWrn+2: Response code].
*: This is available for HA-800 software versions 3.01 or later.

Caution

- With an absolute command within a single revolution of the output shaft, even if the shortcut setting is enabled (NP17=1), operations do not use the shortcut function, but use the rotation direction that is set with the distance setting code.

Example: Operation for absolute value command within a single revolution of the output shaft

SHA25A50CG (Actuator resolution: 6553600 [pls/r]), [SP67: Output shaft divide setting] is 0

Displacement = +819200	Displacement = -819200
	

Originating operations

On the HA-800C, one of the following three originating methods can be selected.

1. Origin sensor dog type originating

This method uses the origin signal (CN2-5: Origin signal) and the encoder phase-Z to perform an originating operation and sets the origin return complete position as the origin (current value 0).

2. Origin dog signal dog originating

This method uses the origin signal (RYn7: Origin Dog ON) and the encoder phase-Z to perform an originating operation and sets the origin return complete position as the origin (current value 0).

3. Data set originating (only for incremental encoders)

The current value is set as the origin (current value 0).

For an absolute encoder, when the actuator is installed on the machine, once the origin is set, basically, there is no need for subsequent originating operations. Also, even when an originating operation is performed, the current value does not become 0. For details on the origin setting on an absolute encoder, refer to [Origin setting] (P4-8) or [Origin setting] (P4-16).

Summary of selecting and performing originating method

1. Origin sensor dog type originating

(1) Set [RWwn+2: Command code 9207h (originating method selection)] to 0.
(2) Set [RWwn+2: Command code 9208h (origin sensor selection)] to 0.
(3) Set [RYn2: Start selection] to 1.
(4) Set [RYn0: Servo ON command] to 1.
(5) When [RYn1: Start] is set to 1, the originating operation is performed as in the figure below.

2. Origin dog signal dog originating

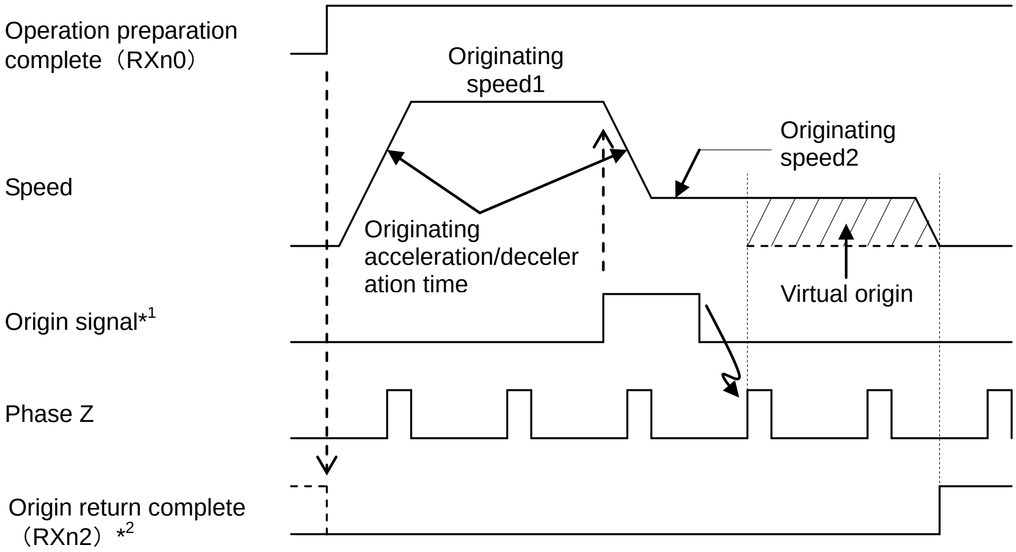
(1) Set [RWwn+2: Command code 9207h (originating method selection)] to 0.
(2) Set [RWwn+2: Command code 9208h (origin sensor selection)] to 1.
(3) Set [RYn2: Start selection] to 1.
(4) Set [RYn0: Servo ON command] to 1.
(5) When [RYn1: Start] is set to 1, the originating operation is performed as in the figure below.

3. Data set originating (only for incremental encoders)

(1) Set [RWwn+2: Command code 9207h (originating method selection)] to 1.
(2) Set [RYn2: Start selection] to 1.
(3) Set [RYn0: Servo ON command] to 1.
(4) When [RYn1: Start] is set to 1, the current value is set as the origin.

[Originating method selection], [Origin sensor selection], [Originating speed 1], [Originating speed 2], [Originating acceleration/deceleration time], [Originating direction], and [Virtual origin] can be set using PSF-800 or PSF-680CL.

Example: Example of operations for origin sensor dog type originating or origin dog signal dog originating



*1: With [RWwn+2: Command code 9208h (origin sensor selection)], select origin sensor [CN2-5: Origin signal] and CC-Link communication [RYn7: Origin Dog ON].

*2: RXn2: Origin return complete is 0 during originating operations and 1 after the origination operation is complete. When an encoder related alarm is generated, RXn2: Origin return complete is 0. For an incremental encoder, RXn2: Origin return complete is set to 0 when the power supply is turned ON. Also, for an absolute encoder, RXn2: Origin return complete is set to 1 when the power supply is turned ON. Normal operations can be performed even when origin return complete is 0.

Caution

- Even in an originating operation, [SP50: Command polarity], Electronic gear (including [SP67: Output shaft divide function settings] (SHA-CG series only)), and [S68: Electronic gear function setting] function. Keep this in mind when setting the originating speed, originating acceleration/deceleration time, originating direction, or virtual origin.
- Even for an actuator that has an absolute encoder, an origin sensor dog type originating or origin dog signal dog type originating can be performed, but the origin return complete position does not become the origin (current value 0).

13

CC-Link communication function

Network parameters list

The following parameters are set and displayed using the dedicated communication software PSF-800, PSF-680CL or CC-Link communication. This chapter explains the contents of these parameters*[1].

NP	Name used in PSF-800	Name used in PSF-680CL	Name used in CC-Link communication	Default
NP00*[2]	Actuator resolution	Resolution	Displacement per actuator revolution	*3
NP02	Originating speed 1	Originating speed 1	Originating speed 1	200000
NP04	Originating speed 2	Originating speed 2	Originating speed 2	20000
NP05	Originating acceleration/deceleration time	Originating acceleration speed	Originating acceleration/deceleration constant	1000
NP06	Originating direction	Originating direction	Originating direction	0
NP07*[2]	Virtual origin	Virtual origin	Virtual origin	0
NP08*[4]	RXn1 Minimum OFF time	-	Operation completion (RXn1) OFF time	0
NP09	Backlash offset	Backlash offset	Backlash offset value	0
NP17	Shortcut enable/disable	Shortcut	Shortcut enable/disable	0
NP18	Originating method	Originating method	Originating method	0
NP19	Origin sensor selection	Origin sensor selection	Origin sensor selection	0

*1: Some parameter names differ in the PSF-800, PSF-680CL, and CC-Link communication, but the functions are the same.
*2: [NP00: Actuator resolution] and [NP07: Virtual origin] are applied after the power is turned OFF, then ON again.
*3: It varies depending on the applicable actuator.
*4: [NP08: RXn1 Minimum OFF time] cannot be changed from PSF-680CL.

NP00: Actuator resolution

This parameter is for determining the coordinate system that will be the reference when the shortcut function is used. For details on the shortcut function, refer to [NP17: Short cut enable/disable] (P13-14).
Actuators are shipped from HDS with the "output shaft resolution" set to match the applicable actuator. For details, refer to the actuator manuals.

Set value	Function	Unit	Default
10 to 2147483647	Sets the reference coordinate system for the shortcut function.	Pulse/rev	*

Caution

- If the electronic gear [SP44/SP45] is set to other than 1/1 and the shortcut function (NP17=1) is used, always
  set [NP00: Actuator resolution] = Output shaft resolution / electronic gear (SP44/SP45).
- Do not change NP00 from its default value in any case other than the above.

NP02: Originating speed 1
NP04: Originating speed 2
NP05: Originating acceleration/deceleration time
NP06: Originating direction
NP18: Originating method
NP19: Origin sensor selection

Specify the operation speed, acceleration/deceleration time, originating direction, originating method, and origin sensor selection for originating operations. For details on originating operations, refer to Originating operations (P13-9).

NP02: Originating speed 1

Set value	Function	Unit	Default
125 to 2147483647	Specifies the speed for originating operations.	pls/sec	200000

NP04: Originating speed 2

Set value	Function	Unit	Default
125 to 32767	Specifies the speed for originating operations.	pls/sec	20000

NP05: Originating acceleration/deceleration time

Set value	Function	Unit	Default
1 to 9999	Specifies the acceleration/deceleration time for originating operations.	ms	1000

NP06: Originating direction

Set value	Function	Unit	Default
0	Performs an originating operation in the forward direction.	-	0
1	Performs an originating operation in the reverse direction.		

NP18: Originating method

Set value	Function	Unit	Default
0	Performs an originating operation using the origin signal and the encoder phase Z.	-	0
1	Sets the current value as the origin.		

NP19: Origin sensor selection

Set value	Function	Unit	Default
0	Uses CN2-5: Origin signal as the origin signal.	-	0
1	Uses RYn7: Origin Dog ON as the origin signal.		

Caution

- When [SP44, 45: Electronic gear numerator/denominator] or [SP67: Output shaft divide function setting] is changed, the displacement, speed, and acceleration/deceleration time change a great deal from operations before the change, so always check and revise the originating operation setting before operating.

NP07: Virtual origin

Sets the operation amount from the phase Z signal for originating operations. For details on originating operations, refer to [Originating operations] (P13-9).
Also, when using an absolute encoder, set the origin data for linking the actuator driver and the mechanical origin. For details on setting the origin, refer to [Origin setting] (P4-8) or [Origin setting] (P4-16).

Set value	Function	Unit	Default
-262144 to 262143	Sets the operation amount from the phase Z signal for originating operations. When using an absolute encoder, set the origin data for linking the actuator driver and the mechanical origin.	Pulse	0

NP08: RXn1 Minimum OFF time

Sets the minimum time for when Operation completion (RXn1) is turned OFF after the Start (RYn1) is turned ON. For an operation example, refer to [Start] (P13-48) in the timing chart below.

Set value	Function	Unit	Default
0 to 32767	Sets the minimum time for when Operation completion (RXn1) is turned OFF after the Start (RYn1) is turned ON.	ms	0

NP09: Backlash offset

When there is backlash in the device, the setting value is raised/lowered each time the actuator movement reverses in order to correct for the backlash and improve the positional accuracy.
The backlash offset is added to or subtracted from the command value based on the [NP06: Originating direction] and [NP07: Virtual origin] settings.
When the output shaft divide function is enabled (other than when SP67=0 on the SHA-CG series), backlash offset does not function.

When the movement direction reverses to the same direction as the originating direction, the backlash offset value is subtracted from the command value.
When the movement direction reverses to the opposite direction of the originating direction, the backlash offset value is added to the command value.

Set value	Function	Unit	Default
0 to 32767	Sets the backlash offset value.	Pulse	0

NP17: Shortcut enable/disable

For an operation that specifies the rotation angle using an index table or the like, the shortcut function rotates in whichever direction requires less movement given the position of the target value relative to the current value.
The shortcut function is enabled when the displacement mode setting is [Absolute value]. When the shortcut function is enabled, the maximum operation is 180 degrees on the output shaft.

Set value	Function	Unit	Default
0	The shortcut function is disabled.	-	0
1	The shortcut function is enabled.		

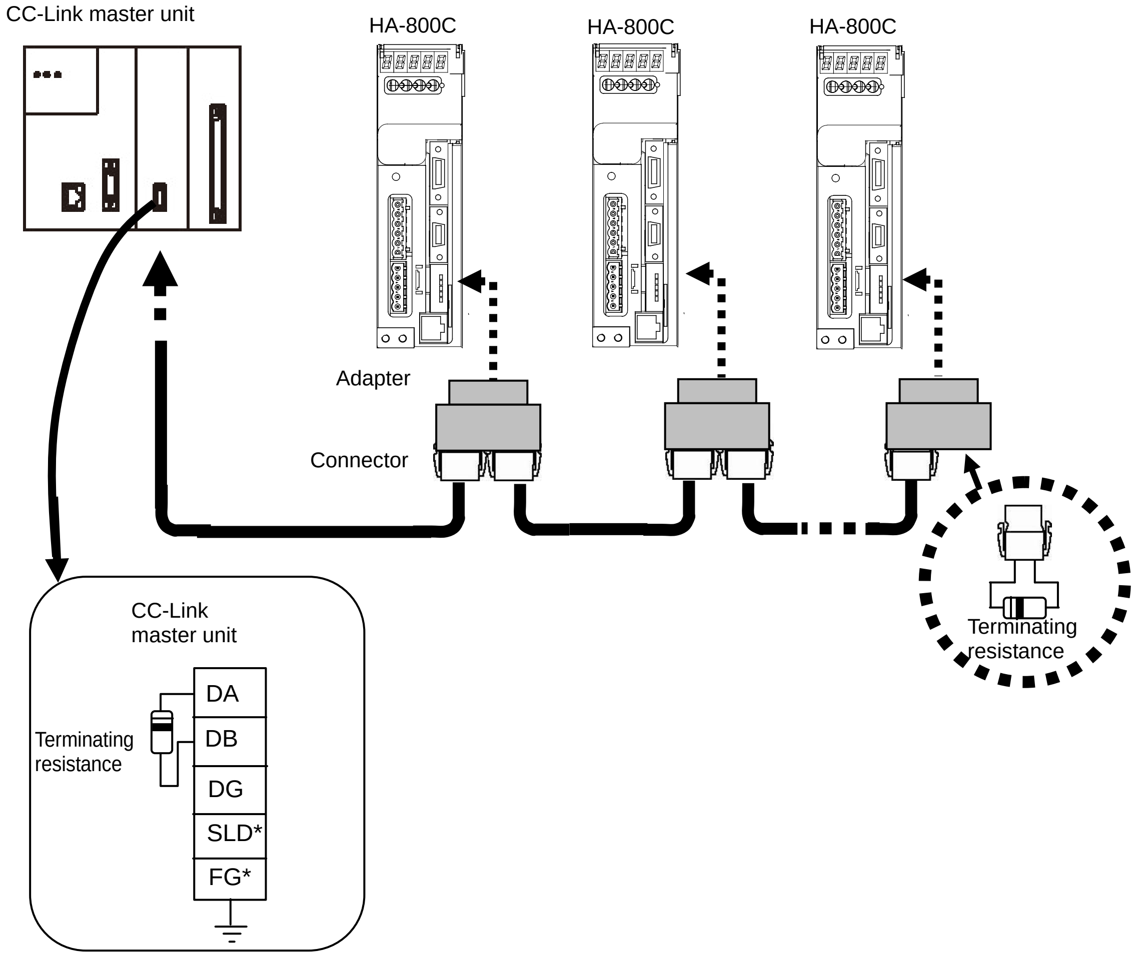
Caution

- If the electronic gear [SP44/SP45] is set to other than 1/1 and the shortcut function (NP17=1) is used, always
  set [NP00: Actuator resolution] = Output shaft resolution/electronic gear (SP44/SP45).

13-2 Wiring method

Terminating resistance

Mount 1 terminating resistance each on the CC-Link master side and the terminating servo driver side.



* The FG terminal and SLD terminal are the same terminal inside the driver. Connect the braided shield wire to the FG terminal, as it normally cannot be connected to the SLD terminal.

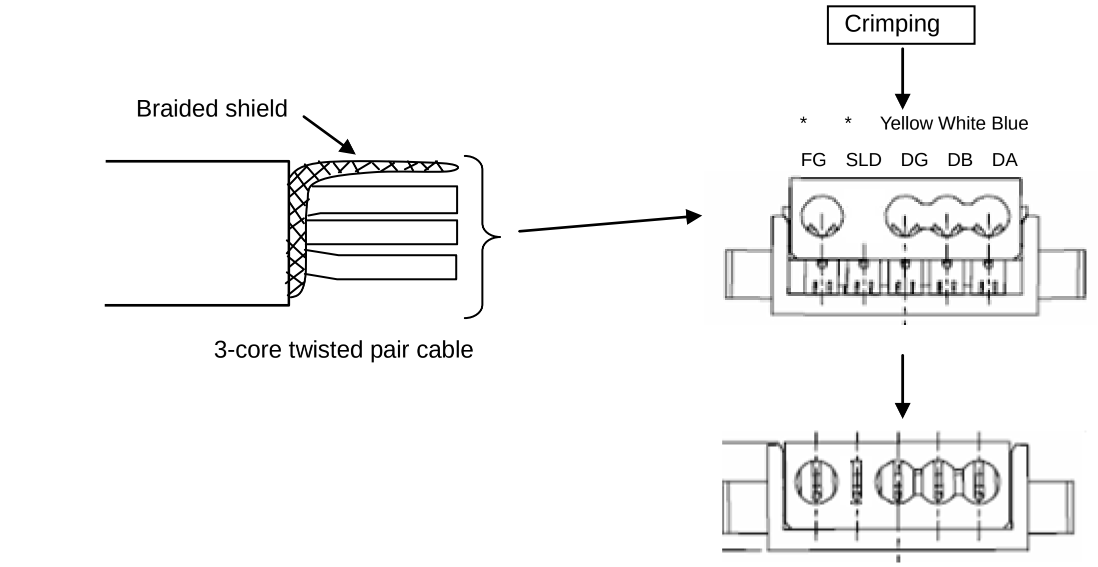
Terminating resistance that can be used for CC-Link must have the following specifications.

Cable used	Terminating resistance
Ver. 1.10-ready dedicated CC-Link cable	110Ω ± 5% 1/2W
Ver. 1.00-ready dedicated CC-Link cable	110Ω ± 5% 1/2W
Ver. 1.10-ready dedicated high-performance CC-Link cable	130Ω ± 5% 1/2W

Wiring method of CC-Link connector

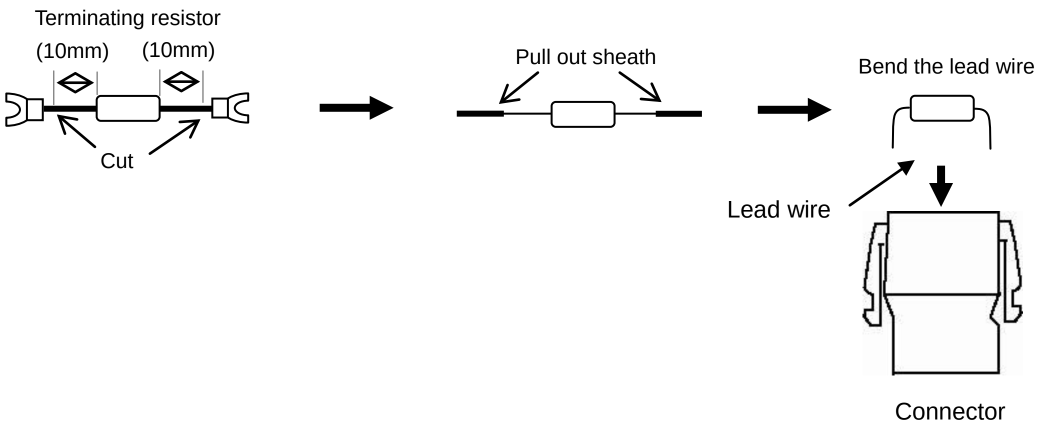
1 **Peel the sheath of the cable and separate wire and braided shield inside.**

2 **Insert the shielded wire and lead wire to the connector (35505-6000-B0M GF) and crimp them.**



* The FG terminal and SLD terminal are the same terminal inside the driver. Connect the braided shield wire to the FG terminal, as it normally cannot be connected to the SLD terminal.

3 **At the last shaft, process the terminating resistor attached to the CC-Link master unit as shown below and crimp between DA and DB of the connecter (35505-6000-B0M GF).**



13
CC-Link communication function

13-3 Setting method

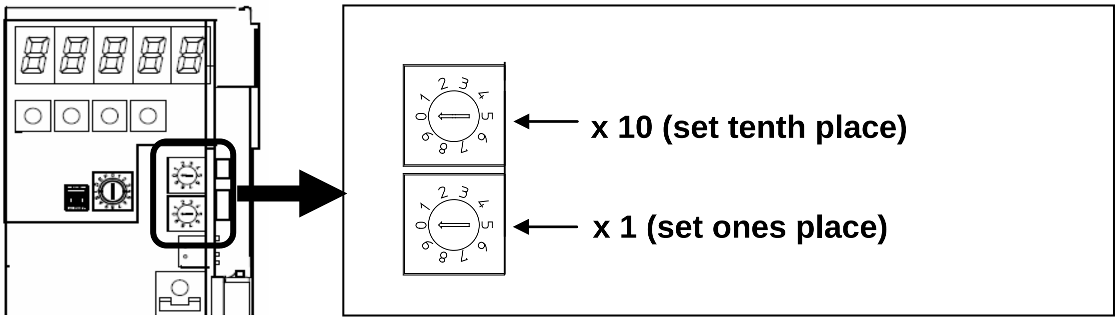
The following explains how to set CC-Link communication.

How to assign station numbers

Make sure to set station numbers before turning the power supply to the servo amplifier ON.
If station numbers are set when the poser supply is ON, L ERR LED (red) flickers.

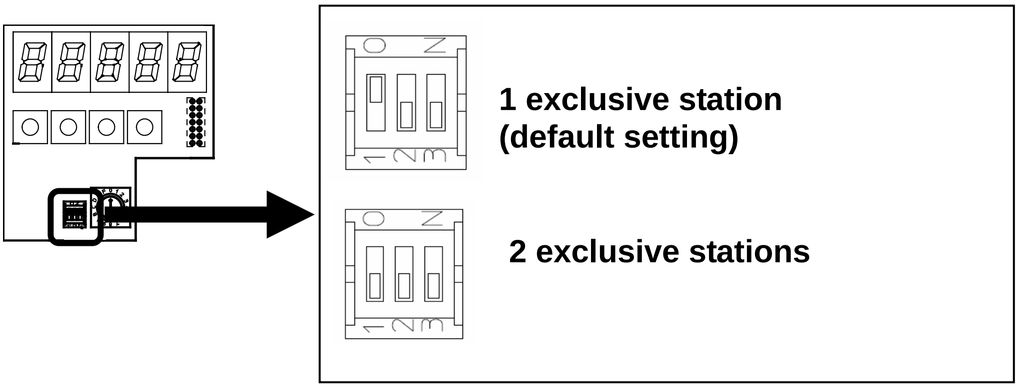
1 **Set a station number in the range from 1 to 64.**

Set the station number after checking the number of stations in the other CC-Link devices. Turning ON the power when number 70 is set activates the communication mode with the PSF-680CL. Turning ON the power when number 90 is set activates the internal EEPROM initialization mode.

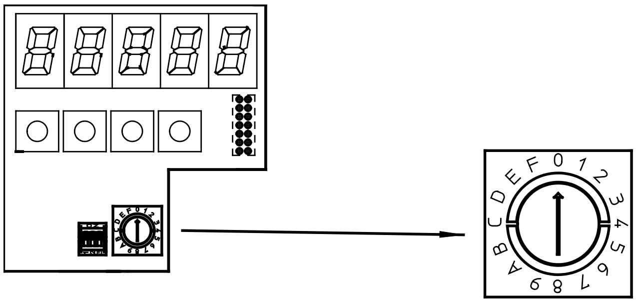


Rotary switch set value	Explanation
1 to 64	Indicate a station number, and perform CC-Link communication.
70	Perform communication with PSF-680CL Ver. 2.00.
90	The operation data is cleared.

2 **A single servo driver HA-800C occupies 1 or 2 stations.**



3 **Set the baud rate.**



No.	Baud rate
0	156kbps (Default setting)
1	625kbps
2	2.5Mbps
3	5Mbps
4	10Mbps
5 to 9	Not used

Caution

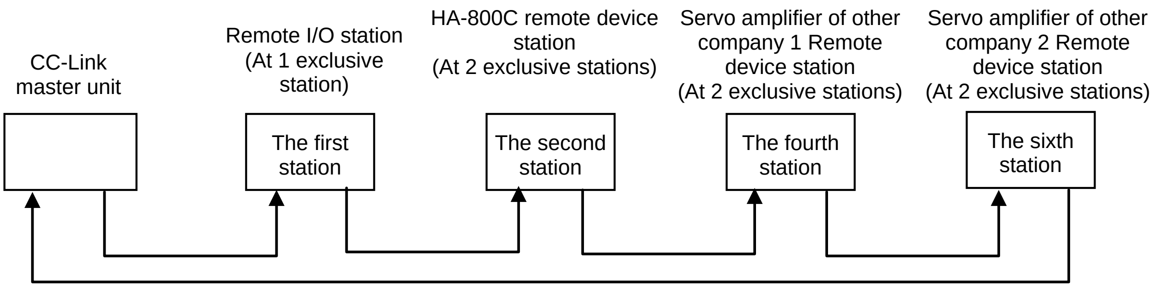
- Changes to station numbers, number of exclusive stations, and baud rate after turning the power supply ON are invalid and L ERR LED flickers.

Maximum number of connected units

The maximum number of connections 42 must satisfy the following conditions.

{(1 x a) + (2 x b) + (3 x c) + (4 x d)} ≦ 64
a: Number of units for 1 exclusive station
b: Number of units for 2 exclusive stations
c: Number of units for 3 exclusive stations (not used in HA-800C)
d: Number of units for 4 exclusive stations (not used in HA-800C)
{(16 x A) + (54 x B) + (88 x C)} ≦ 2,304
A: Number of remote I/O stations ≦ 64 units
B: Number of remote devise stations ≦ 42 units
C: Number of local stations ≦ 26 units

- **Example: If 4 units are connected, station numbers can be set as follows.**



Number of connections: 4 units

13-4 Communication profile

The HA-800C operates using 1- or 2-station occupancy. The following communication profiles are available:

I/O signal (I/O device) RX・RY, RWw・RWr

1 exclusive station

HA-800C → Master		Master → HA-800C	
Device No.	**Signal name**	**Device No.**	**Signal name**
RXn0	Preparation complete (Ready)	RYn0	Servo ON command
RXn1	Operation completion	RYn1	Start
RXn2	Originating complete	RYn2	Start selection
RXn3	Torque limiting	RYn3	Torque limit
RXn4	FWD stroke ending	RYn4	FWD stroke end
RXn5	REV stroke ending	RYn5	REV stroke end
RXn6	Battery voltage low	RYn6	Unused
RXn7	Servo alarm	RYn7	Origin Dog ON
RXn8	Monitoring	RYn8	Monitor execution request
RXn9	Instruction code complete	RYn9	Instruction code execution request
RXnA	Current point table bit 0	RYnA	Point table No. selection bit 0
RXnB	Current point table bit 1	RYnB	Point table No. selection bit 1
RXnC	Current point table bit 2	RYnC	Point table No. selection bit 2
RXnD	Current point table bit 3	RYnD	Point table No. selection bit 3
RXnE	Current point table bit 4	RYnE	Point table No. selection bit 4
RXnF	Operation data instruction error	RYnF	Deceleration stop
RX(n+1)0 ・ ・ RX(n+1)9	Reserved	RY(n+1)0 ・ ・ RY(n+1)9	Reserved
RX(n+1)A	Error status flag	RY(n+1)A	Error reset request flag
RX(n+1)B	Remote READY	RY(n+1)B	Unused
RX(n+1)C ・ ・ RX(n+1)F	Reserved	RY(n+1)C ・ ・ RY(n+1)F	Reserved

HA-800C → Master			Master → HA-800C		
Address	**Description**	**Default**	**Address**	**Description**	**Default**
RWrn	Monitor 1 data	--	RWwn	Monitor 1	--
RWrn+1	Monitor 2 data	--	RWwn+1	Monitor 2	--
RWrn+2	Response code	--	RWwn+2	Instruction code	--
RWrn+3	Read data	--	RWwn+3	Write data	--

2 exclusive stations

HA-800C → Master		Master → HA-800C	
Device No.	**Signal name**	**Device No.**	**Signal name**
RXn0	Preparation complete (Ready)	RYn0	Servo ON command
RXn1	Operation completion	RYn1	Start
RXn2	Originating complete	RYn2	Start selection
RXn3	Torque limiting	RYn3	Torque limit
RXn4	FWD stroke ending	RYn4	FWD stroke end
RXn5	REV stroke ending	RYn5	REV stroke end
RXn6	Battery voltage low	RYn6	Unused
RXn7	Servo alarm	RYn7	Origin Dog ON
RXn8	Monitoring	RYn8	Monitor execution request
RXn9	Instruction code complete	RYn9	Instruction code execution request
RXnA	Current point table bit 0	RYnA	Point table No. selection bit 0
RXnB	Current point table bit 1	RYnB	Point table No. selection bit 1
RXnC	Current point table bit 2	RYnC	Point table No. selection bit 2
RXnD	Current point table bit 3	RYnD	Point table No. selection bit 3
RXnE	Current point table bit 4	RYnE	Point table No. selection bit 4
RXnF	Operation data instruction error	RYnF	Deceleration stop
RX(n+1)0 · · RX(n+1)F	Unused	RY(n+1)0 · · RY(n+1)F	Unused
RX(n+2)0	Current point table bit 5	RY(n+2)0	Point table No. selection bit 5
RX(n+2)1	Current point table bit 6	RY(n+2)1	Point table No. selection bit 6
RX(n+2)2	Unused	RY(n+2)2	Unused
RX(n+2)3	Under speed control	RY(n+2)3	Speed control switching
RX(n+2)4	Under torque control	RY(n+2)4	Torque control switching
RX(n+2)5	Zero speed output	RY(n+2)5	JOG operation
RX(n+2)6	Attained speed output	RY(n+2)6	JOG rotation direction
RX(n+2)7	Attained torque output	RY(n+2)7	Unused
RX(n+2)8 · · RX(n+2)F	Unused	RY(n+2)8 · · RY(n+2)F	Unused
RX(n+3)0 · · RX(n+3)9	Reserved	RY(n+3)0 · · RY(n+3)9	Reserved
RX(n+3)A	Error status flag	RY(n+3)A	Error reset request flag
RX(n+3)B	Remote READY	RY(n+3)B	Unused
RX(n+3)C · · RX(n+3)F	Reserved	RY(n+3)C · · RY(n+3)F	Reserved

Slave → Master			Master → Slave		
Address	Description	Default	Address	Description	Default
RWrn	Least significant 16 bits of monitor 1 data	--	RWwn	Monitor 1	--
RWrn+1	Most significant 16 bits of monitor 1 data	--	RWwn+1	Monitor 2	--
RWrn+2	Response code	--	RWwn+2	Instruction code	--
RWrn+3	Read data	--	RWwn+3	Write data	--
RWrn+4	Unused	--	RWwn+4	Speed command	--
RWrn+5	Least significant 16 bits of monitor 2 data	--	RWwn+5	Torque command	--
RWrn+6	Most significant 16 bits of monitor 2 datat	--	RWwn+6	JOG operation speed	--
RWrn+7	Unused	--	RWwn+7	JOG operation acceleration/deceleration time constant	--

Details of I/O signals RX･RY and RWw･RWr

Output signal RX HA-800C ⇒ Master (RXn)

Device No.		Signal name	Description
1 exclusive station	2 exclusive stations		
RXn0	RXn0	Preparation complete	This signal becomes 1 when the servo is turned ON and operable.
RXn1	RXn1	Operation completion	This signal becomes 1 when the current stop position is within the range specified by tune mode 1 [AJ04: In-position range] with respect to the position specified by positioning operation. For this signal, also refer to [Start] in the timing chart explained later in this chapter. This becomes 0 after the power is turned ON until a positioning operation or originating operation.
RXn2	RXn2	Originating complete	This signal becomes 1 if the HA-800C driver recognizes the origin. (The signal becomes 1 after turning the power supply ON in case of HA-800C-*A/D.) For details on the originating operation, refer to "Originating operation" (P13-9).
RXn3	RXn3	Torque limiting	This signal becomes 1 when [RYn3: Torque limit] becomes 1 and the output torque is limited to the value set by tune mode 1 [AJ11: Torque limit].
RXn4	RXn4	FWD stroke ending	This signal becomes 1 when [RYn4: FWD stroke end] is 0.
RXn5	RXn5	REV stroke ending	This signal becomes 1 when [RYn5: REV stroke end] is 0.
RXn6	RXn6	Battery voltage low	1 is output when encoder backup battery voltage drops.(HA-800C-*A/D)
RXn7	RXn7	Servo alarm/warning	This signal indicates that HA-800C is generating an alarm or warning. The resettable alarm can be reset through the write command code [8010h: Alarm reset]. For details, refer to [Chapter 11 Troubleshooting].
RXn8	RXn8	Monitoring	This signal becomes 1 when [RYn8: Monitor execution request] becomes 1 and the monitor with the code specified by [RWwn: Monitor 1] and [RWwn+1: Monitor 2] is being executed.
RXn9	RXn9	Instruction code complete	This signal becomes 1 when [RYn9: Instruction code execution request] is set to 1 and execution of the instruction specified by [RWwn+2: Instruction code] is completed.

Device No.		Signal name	Description
1 exclusive station	2 exclusive stations		
RXnA	RXnA	Current point table Bit 0	When execution of operation data selected by [RYnA to RYnE: Point table No. selection bits 0 to 4] is completed and the stop position is within the range specified by tune mode 1 [AJ04: In-position range] with respect to the position specified by positioning operation, the bits corresponding to the executed operation data numbers become 1. RXnA to RXnE operate at the same timing as RXn1. If RXn1 = 0, RXnA to RXnE become “00000.” This is the same as the operation completion pattern for point data 0.
RXnB	RXnB	Current point table Bit 1	
RXnC	RXnC	Current point table Bit 2	
RXnD	RXnD	Current point table Bit 3	
RXnE	RXnE	Current point table Bit 4	
RXnF	RXnF	Operation data instruction error	If the data has not been assigned, 1 is set. This error can be reset for 1-station occupancy RY (n+1) A and 2-station occupancy RY (n+3) A using the error reset request flag.
	RX(n+2)0	Current point table Bit 5	Same as for RXnA to RXnE. When 2 stations are occupied, 128 combinations of operation data can be set in total.
	RX(n+2)1	Current point table Bit 6	
	RX(n+2)3	Under speed control	This signal becomes 1 when [RY(n+2)3: Speed control switching] becomes 1 and operation with speed control is being executed.
	RX(n+2)4	Under torque control	This signal becomes 1 when [RY(n+2)4: Torque control switching] becomes 1 and operation with torque control is being executed.
	RX(n+2)5	Zero speed output	This signal becomes 1 when the motor speed is lower than the value set by tune mode 1 [AJ07: Zero speed judgment value]. Switching from position control to speed control ([RY(n+2)3: Speed control switching] ⇒ 1), from position control to torque control ([RY(n+2)4: Torque control switching] ⇒ 1), and from speed control or torque control to position control is not possible unless this bit becomes 1.
	RX(n+2)6	Attained speed output	This signal becomes 1 when the motor speed reaches the value set by tune mode 1 [AJ05: Attained speed judgment value] or higher.
	RX(n+2)7	Attained torque output	If the value of the motor torque has reached or exceeded the value set in the tune mode1 AJ06: Attained torque judgment value, the value is 1.
RX(n+1)A	RX(n+3)A	Error status flag	This signal becomes 1 if commands are not sent according to the profile. It can be reset by the error reset request flag. If an error occurs and an error status flag is set, the error status flag will be retained until the control power supply is turned OFF or the error is reset.
RX(n+1)B	RX(n+3)B	Remote READY	When the error status flag (RX(n+1)A) = 0 and the servo alarm warning (RXn7) = 0 and the error reset request flag (RY(n+1)A) = 0, the remote READY becomes 1.

Input signal RY Master ⇒ HA-800C (RYn)

Device No. 1 exclusive station	Device No. 2 exclusive stations	Signal name	Description
RYn0	RYn0	Servo ON	When the control/main circuit power is turned ON, if [RXn7: Servo alarm] changes from 0 to 1, the servo turns ON. If the servo is turned ON properly, [RXn0: Setup complete] is 1.
RYn1	RYn1	Start	If this bit is set to 1 when [RYn2: Start selection] is 1, originating is executed. If this bit is set to 1 when [RYn2: Start selection] is 0, operation specified by operation data selected by [RYnA to RYnE: Point table No. selection bits 0 to 4] ([RYnA to RYnE: Point table No. selection bits 0 to 4], [RY(n+2)0, RY(n+2)1: Point table No. selection bits 5 to 6] in case two stations are occupied) is executed.
RYn2	RYn2	Start selection	When RYn1: Start is 1, originating is performed by this bit if 1 is set. If 0 is set, positioning is performed. For details on the originating operation, refer to "Originating operation" (P13-9).
RYn3	RYn3	Torque limit	If this bit is 1, output torque is limited to the value set by tune mode 1 [AJ11: Torque limit].
RYn4	RYn4	FWD stroke end	This signal is the stroke end input on the forward side. If this signal is 0, no torque is generated on the forward side and [warning 97: FWD inhibit input effective] is generated. 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].
RYn5	RYn5	REV stroke end	This signal is the stroke end input on the reverse side. If this signal is 0, no torque is generated on the reverse side and [warning 98: REV inhibit input effective] is generated. 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].
RYn6	RYn6	Reserved	This is a reserved bit. Use the driver by setting this signal to 0.
RYn7	RYn7	Origin Dog ON	This is the origin sensor signal bit when the Originating method is set to 0 and Origin sensor selection is set to 1. Input the sensor status such that the sensor is turned ON when the signal is set to 1 and the sensor is turned OFF when the signal is set to 0. For details on the originating operation, refer to "Originating operation" (P13-9).

Device No.		Signal name	Description
1 exclusive station	2 exclusive stations		
RYn8	RYn8	Monitor output execution request	If this signal is set to 1, the monitors corresponding to the codes set in [RWwn: Monitor 1] and [RWwn+1: Monitor 2] are executed and the monitor values are continuously output to [RWrn: Monitor 1 data] and [RWrn+1: Monitor 2 data] ([RWrn: Least significant 16 bits of monitor 1 data] and [RWrn+1: Most significant 16 bits of monitor 1 data] as well as [RWrn+5: Least significant 16 bits of monitor 2 data] and [RWrn+6: Most significant 16 bits of monitor 2 data] if 2 stations are occupied). Moreover, [RXn8: Monitoring] is set to 1 while the values are output. The output data is changes every CC-Link communication cycle.
RYn9	RYn9	Instruction code execution request	If the signal is set to 1, the instruction set in [RWwn+2: Instruction code] is executed. When the execution is completed, [RXn9: Instruction code complete] is set to 1.
RYnA	RYnA	Point table No. selection bit 0	If [RYn2: Start selection] is 0 and [RYn1: Start] is 1, operation data specified by this bit is executed. If the operation is started with other data than the data that has already been executed, the operation data that started later is executed.
RYnB	RYnB	Point table No. selection bit 1	
RYnC	RYnC	Point table No. selection bit 2	
RYnD	RYnD	Point table No. selection bit 3	
RYnE	RYnE	Point table No. selection bit 4	
RYnF	RYnF	Deceleration stop	When this bit is set to 1 while the actuator is operating, the operation statuses during this time are as follows. Originating operation: decelerates to stop over a time specified by the write command code [9205h: Originating acceleration/deceleration time constant]. Point table operation: decelerates to stop over an acceleration/deceleration time constant specified by the point table. JOG operation: decelerates and momentarily stops over a time specified by the [RWwn7: JOG operation acceleration/deceleration time constant]. If set to 0, operation will resume using the value set for RWwn7. Also, If RYn1: Start is set to 1 with this bit at 1, a command instruction error (error code 0010h) will be output.
	RY(n+2)0	Point table No. selection bit 5	When 2 stations are occupied, if [RYn2: Start selection] is 0 and [RYn1: Start] is 1, operation data specified by [RYnA to RYnE: Point table No. selection bits 0 to 4] and this bit is executed.
	RY(n+2)1	Point table No. selection bit 6	
	RY(n+2)3	Speed control switching	If this bit becomes 1, speed control is performed at the speed set in [RWwn+4: Speed command data]. It is not possible to switch from position control to speed control unless [RX(n+2)5: Zero speed output] becomes 1. If you switch the position control, set this bit to 0 when the [RX (n+2)5: Zero speed output] is 1.
	RY(n+2)4	Torque control switching	When this bit becomes 1, the torque is controlled with the torque set for the torque command data. It is not possible to switch from position control to torque control unless [RX(n+2)5: Zero speed output] becomes 1. If you switch the position control, set the value of [RWwn4: Speed command data] smaller than [AJ07: Zero speed judgment value], and when the [RX (n+2)5: Zero speed output] is 1, set this bit to 0. If you switch to position control, set this bit to 0 when the [RX (n+2)5: Zero speed output] is 1.
	RY(n+2)5	JOG operation	If this bit becomes 1, JOG operation is performed at the speed set by [RWwn+6: JOG operation speed], with the time set by [RWwn+7: JOG operation acceleration/deceleration time constant], and to the direction specified by [RY(n+2) 6: JOG rotation direction].
	RY(n+2)6	JOG rotation direction	This signal sets actuator's rotation direction when JOG is performed with [RY(n+2)5: JOG operation]. The actuator rotates to CW if this bit is 0 and to CCW if this bit is 1.
RY(n+1)A	RY(n+3)A	Error reset request flag	When an error code is returned to [RWrn+2: Response code], the error code is cleared by setting this bit to 1.

Details of data reading/writing RWw・RWr

(a) Writing RWr (HA-800C ⇒ Master)

Address		Signal name	Description
1 exclusive station	2 exclusive stations		
RWrn		Monitor 1 data	If [RYn8: Monitor execution request] is set to 1, data of monitor code set by [RWwn: Monitor 1] is set here.
RWrn+1		Monitor 2 data	If [RYn8: Monitor execution request] is set to 1, data of monitor code set by [RWwn+1: Monitor 2] is set here.
RWrn+2		Response code	f an instruction in normal format is not issued to the HA-800C driver from the CC-Link line, set the error description with the code.For the explanation of error descriptions and codes, refer to the (b) [RWrn+2: Response code] List.
RWrn+3		Read data	Data specified here is set if it is specified to read set value with [RWwn+2: Instruction code] and [RYn9: Instruction code execution request] is set to 1.
	RWrn	Least significant 16 bits of monitor 1 data	If [RYn8: Monitor execution request] is set to 1 when 2 stations are occupied, the least significant 16 bits of data of monitor code set by [RWwn: Monitor 1] is set here.
	RWrn+1	Most significant 16 bits of monitor 1 data	If [RYn8: Monitor execution request] is set to 1 when 2 stations are occupied, the most significant 16 bits of data of monitor code set by [RWwn: Monitor 1] is set here.If data specified by monitor code is 16-bit data, 0 is set.
	RWrn+2	Response code	If the command is not sent according to the profile, the description of the error is set with a code. For the explanation of error descriptions and codes, refer to the (b) [RWrn+2: Response code] List.
	RWrn+3	Read data	Data specified here is set if it is specified to read set value with [RWwn+2: Instruction code] and [RYn9: Instruction code execution request] is set to 1.
	RWrn+5	Least significant 16 bits of monitor 2 data	If [RYn8: Monitor execution request] is set to 1 when 2 stations are occupied, the least significant 16 bits of data of monitor code set by [RWwn+1: Monitor 2] is set here.
	RWrn+6	Most significant 16 bits of monitor 2 data	If [RYn8: Monitor execution request] is set to 1 when 2 stations are occupied, the most significant 16 bits of data of monitor code set by [RWwn+1: Monitor 2] is set here.If data specified by monitor code is 16-bit data, 0 is set.

(b) [RWrn+2: Response code] List

Code No.	Description	Details	Action
0000h	No error	When the control power supply is turned ON and when cleared by error reset request flag (RY(n+1)A, RY(n+3)A)	
0001h	Code error of monitor code 1	It indicates the set value of [RWwn: Monitor 1] is out of range.	Check the set value of RWwn.
0002h	Code error of monitor code 2	It indicates the set value of [RWwn+1: Monitor 2] is out of range.	Check the set value of RWwn+1.
0004h	Parameter selection error	It indicates the set value of [RWwn+2: Instruction code] is out of range.	Check the set value of RWwn+2.

Code No.	Description	Details	Action
0008h	Writing range error	It indicates that it was attempted to write with [RWwn+2: Instruction code], but [RWwn+3: Write data] is out of range. RYn1: Error when Start is set to 1: This error indicates the followings: 1. When the displacement from the current value exceeds 2147483646pls with the Displacement mode set to a relative value/absolute value, or when the displacement mode is set to an absolute value that occurs within a single revolution of the output shaft, the displacement amount is set to a value outside the setting range (0 or a value that exceeds the resolution per single output shaft revolution) and the operation cannot be executed. 2. The originating speed 1 or originating speed 2 is 125pls/sec or less.	Check the set value of RWwn+3. Check the set value of displacement. Check the set values of the originating speed 1 and originating speed 2.
0010h	Command instruction error	This error occurs in the following cases. It indicates that it is attempted to change control mode to a mode other than position control mode or attempted to change back to position control with [RY(n+2)3: Speed control switching] or [RY(n+2)4: Torque control switching] when [RX(n+2)5: Zero speed output] is 0. [RYn1: Start] is set to 1 when [RYnF: Deceleration stop] is 1.	In case of changing mode from position control to another mode or from another mode to position control, switch the control mode when [RX(n+2)5: Zero speed output] is 1. Set [RYnF: Deceleration stop] to 0 and [RYn1: Start] to 1.
0200h	Parameter value range error	An out-of-range value is set for the originating speed 1 or the actuator resolution.	Set an appropriate value and turn on the power again.
0800h	Point table not set yet	It indicates that execution cannot be made because operation data is not set in the point table specified from CC-Link.	Writing data to the target point table
4000h	Reading setting not made yet	It indicates that it was attempted to read data of the point table, but the target point table did not have any set data.	Reading the number of table in which data is written

- If an error occurs and error information is set in the response code, the error information in the response code will be retained until the control power supply is turned OFF or the error is reset.
- The error information is assigned to each response code bit. If multiple errors occur, multiple bits become 1.

(c) Reading RWw (Master ⇒ HA-800C)

Address		Signal name	Description
1 exclusive station	2 exclusive stations		
RWwn	RWwn	Monitor 1	Requests the status data of the HA-800C driver. For details of the codes to set, refer to [Monitor code] (P13-29). In order to monitor data corresponding to the code set here, set [RYn8: Monitor execution request] to 1.
RWwn+1	RWwn+1	Monitor 2	Requests the status data of the HA-800C driver. For details of the codes to set, refer to [Monitor code] (P13-29). In order to monitor data corresponding to the code set here, set [RYn8: Monitor execution request] to 1.
RWwn+2	RWwn+2	Instruction code	Reads and writes the parameters and operation data. For details of the code number to set, refer to [Command code] (P13-35). In order to execute the instruction code set here, set [RYn9: Instruction code execution request] to 1.
RWwn+3	RWwn+3	Write data	RWwn+2: Sets the write data when the write command codes are set with the command codes. If there is no write data, you do not need to set the write data.
	RWwn+4	Speed command	Set [RY(n+2)3: Speed command execution request] to 1 and set the speed command value (motor rotation speed r/min) when speed control is performed. The setting range is from ±0 to maximum speed of applicable actuator x reduction ratio r/min. To switch speed control to position control, this set value must be lower than the value set by tune mode 1 [AJ07: Zero speed judgment value]. Forward rotation with a positive command value and reverse rotation with a negative command value.
	RWwn+5	Torque command	This signal set the torque command (%) when torque control is performed with [RY(n+2)4: Torque command execution request] set to 1. The setting range is ±0 to 100 (%), where torque is zero at 0 and the maximum at 100 (%). To switch torque control to position control, the motor rotation speed must be lower than the value set by tune mode 1 [AJ07: Zero speed judgment value]. Forward rotation with a positive command value and reverse rotation with a negative command value.

Address		Signal name	Description
1 exclusive station	2 exclusive stations		
	RWwn+6	JOG operation speed	Set JOG speed (motor rotation speed [r/min]) when [RY(n+2)5: JOG operation] is executed (set value 1). It is possible to change JOG speed by changing this setting during JOG operation.The setting range is from 10 to maximum speed of the applicable actuator x reduction ratio, and the unit is r/min. Moreover, if a value exceeding the maximum motor speed is set, the motor stops. Note that [SP44, 45: Electronic gear setting] and [SP68: Electronic gear function setting] have an effect.
	RWwn+7	JOG operation acceleration/deceleration time constant	Set acceleration time of the motor and deceleration time at stopping (set value 0) when [RY(n+2)5: JOG operation] is executed (set value 1). The set value is the time it takes for the motor to accelerate to the maximum speed from stopped status and the setting range is 1 to 9999. The unit is ms. Note that [SP44, 45: Electronic gear setting] and [SP68: Electronic gear function setting] have an effect.

Monitor code

If the monitor code is set to [RWwn: Monitor 1] and [RWwn+1: Monitor 2] and 1 is set to [RYn8: Monitor execution request], the specified monitor data is set to [RWrn: Monitor 1 data] and [RWrn+1: Monitor 2 data].

Code No.		Description	Unit
1 exclusive station	2 exclusive stations		
0000h	0000h	No monitor (The monitor value is fixed to 0)	
0001h		Reserved	
0002h		Reserved	
0003h		Reserved	
0004h		Reserved	
0005h	0005h	Cumulative command pulse (1 exclusive station: Least significant 16 bits, 2 exclusive stations: 32 bits)	pulse
0006h		Cumulative command pulse Most significant 16 bits	pulse
0007h		Reserved	
0008h	0008h	Point table No. executed immediately before (When the power supply is turned ON, 1 exclusive station: FFh and 2 exclusive stations: FFFFh are read.)	No
0009h		Reserved	
000Ah	000Ah	Cumulative feedback pulses[*1] (1 exclusive station: Least significant 16 bits, 2 exclusive stations: 32 bits) When combined with an absolute encoder: Cumulative feedback pulses = ABS position (current position of absolute encoder) - Value set for virtual origin When combined with an incremental encoder: Cumulative feedback pulses = When the control power supply is turned ON (0) and when Origin return operation complete (0)	pulse
000Bh		Cumulative feedback pulses[*1] Most significant 16 bits	pulse
000Ch		Reserved	
000Dh		Reserved	
000Eh	000Eh	Deviation pulses (1 exclusive station: Least significant 16 bits, 2 exclusive stations: 32 bits)	pulse
000Fh		Deviation pulses Most significant 16 bits	pulse
0010h	0010h	Actuator command pulses within a single revolution[*1] (return the command within a single revolution by absolute value) (1-station occupancy: Least significant 16 bits, 2-station occupancy: 32-bit)	pulse
0011h		Actuator command pulses within a single revolution[*1] (return the command within a single revolution by absolute value) Most significant 16 bits	pulse
0012h	0012h	Output torque monitor	%
0013h	0013h	Peak torque	%
0014h		Reserved	
0015h		Reserved	
0016h	0016h	Motor speed (1 exclusive station: Least significant 16 bits, 2 exclusive stations: 32 bits)	r/min
0017h		Motor speed Most significant 16 bits	r/min
0018h	0018h	Main circuit power voltage	V

Code No.		Description	Unit
1 exclusive station	2 exclusive stations		
0019h	0019h	ABS position reading * (1 exclusive station: Least significant 16 bits, 2 exclusive stations: Least significant 32 bits) When combined with an absolute encoder: ABS position = Current position of absolute encoder When combined with an incremental encoder: Indeterminable	pulse
001Ah		ABS position reading Medium 16 bits *	pulse
001Bh	001Bh	ABS position reading * (1 exclusive station: Most significant 16 bits, 2 exclusive stations: Most significant 32 bits)	pulse
001Ch	001Ch	Actuator position within 1 revolution (return the position within a single revolution by absolute value), output only in the position control (1-station occupancy: Low 16-bit, 2-station occupancy: 32-bit)	pulse
001Dh		Position within 1 actuator rotation Most significant 16 bits	pulse
001Eh	001Eh	Cumulative feedback pulses*2 (1 exclusive station: Least significant 16 bits, 2 exclusive stations: 32 bits)	pulse
001Fh		Cumulative feedback pulses*2 Most significant 16 bits	pulse

If a reserved code is set, [0001h: Monitor code 1 error] or [0002h: Monitor code 2 error] is set to [RWrn+2: Response code].

* Only when combined with an absolute encoder. Also, with the SHA-CG output shaft single revolution model, the output range is [0 - 2^{17} x speed reduction ratio -1] pulses.

*1 For [0010h: Actuator command pulses within a single revolution] and [001Bh: Actuator position within a single revolution], the meanings of the values vary according to the setting for [SP67: Output shaft divide function setting] and [NP00: Actuator resolution]. For details, refer to [Notices for using SHA-CG(-S)].

*2 The value of [001Eh: Cumulative feedback pulses] is found by dividing [000Ah: Cumulative feedback pulses] by the electronic gear ratio. With the models other than SHA-CG series or when SP67 is set to 0, 0 is always output.

Instruction code

(1) Details of read instruction codes

If you specify the code number (0010h - 0B0Eh) that corresponds to the desired data for [RWwn+2: Command code] and set [RYn9: Command code execution request] to 1, the desired data will be stored in [RWrn+3: Read data]. Set the command code number that corresponds to the item for [RWwn+2: Command code]. The code number and return data are 4-digit hexadecimal.
If a code number not described in this section is specified, an error code [0004h: Parameter selection error] is set to [RWrn+2: Response code]. At this point, [0000] is stored in [RWrn+3: Read data].

<table>
<tr><th>Item</th><th>Code No.</th><th>Data contents</th></tr>
<tr><td>Reading current alarm/warning</td><td>0010h</td><td>The currently generated alarms (code No.) are read. If multiple alarms are generated at once, only the latest alarm code is read.
Alarm code numbers are decimal numbers.
Example) When “AL60” (excessive deviation) is output, “60” (decimal) is converted to “003C” (hexadecimal).</td></tr>
<tr><td>Reading alarm history</td><td>0020h to 0027h</td><td>The history of up to 8 most recent alarms is read.
From 0020h (latest) to 0027h (oldest)</td></tr>
<tr><td>Reading the total operating hours in alarm history</td><td>0030h to 0037h</td><td>The total operating hours of the driver (unit: h) when alarms of 0020h to 0027h occur is read.</td></tr>
<tr><td>Reading input signal status</td><td>0040h</td><td>The status of input signals is read. The format of data to be read is as follows.
<table>
<tr><th>Bit 4 to Bit 15</th><th>Bit 3</th><th>Bit 2</th><th>Bit 1</th><th>Bit 0</th></tr>
<tr><td>Always 0</td><td>Origin signal</td><td>Deviation clear</td><td>Alarm clear</td><td>Emergency stop</td></tr>
</table></td></tr>
<tr><td>Reading output signal status</td><td>0050h</td><td>The status of output signal is read.The format of data to be read is as follows.
<table>
<tr><th>Bit 3 to Bit 15</th><th>Bit 2</th><th>Bit 1</th><th>Bit 0</th></tr>
<tr><td>Always 0</td><td>Origin return (recognition) complete</td><td>Alarm</td><td>Operation preparation complete</td></tr>
</table></td></tr>
<tr><td>Reading current discharge time</td><td>0081h</td><td>The cumulative time when the control circuit power is ON from the shipment from our factory is read.The unit is h.</td></tr>
<tr><td>Reading adjustment parameters</td><td>0100h to 013Bh</td><td>The set value of the adjustment parameter is read. For the explanation on code number and adjustment parameters, refer to [*1 Adjustment parameters].</td></tr>
<tr><td>Reading system parameters</td><td>0200h to 0227h</td><td>The set value of the system parameter is read. For the explanation about code numbers and system parameters, refer to [*2 System parameters].</td></tr>
<tr><td>Reading displacement (target value) of operation data No. 0 to 127</td><td>0400h to 047Fh
0500h to 057Fh</td><td>The set displacement (target position) of the operation data is read. The unit is [pulse]. The displacement (target position) is set by 32 bits and the least significant 16 bits are read by 04__h and the most significant 16 bits are read by 05__h.
The operation data No. 0 is __00h and No. 127 is __7Fh.</td></tr>
<tr><td>Reading maximum speed of operation data No. 0 to 127</td><td>0600h to 067Fh
0700h to 077Fh</td><td>The maximum speed set value of operation data is read. The unit is [pls/sec]. The maximum speed is set by 32 bits and the least significant 16 bits are read by 06__h and the most significant 16 bits are read by 07__h. The operation data No. 0 is __00h and No. 127 is __7Fh.</td></tr>
<tr><td>Reading acceleration/deceleration time constant of operation data No. 0 to 127</td><td>0800h to 087Fh</td><td>The acceleration/deceleration time constant of operation data is read. The set value is the time it takes for the motor to accelerate to the maximum speed from stopped status and the time it takes to decelerate from the maximum speed to stop. The setting range is 1 to 9999 and the unit is ms. The operation data No. 0 is 0800h and No. 127 is 087Fh.</td></tr>
</table>

Item	Code No.	Data contents
Reading displacement mode	0A00h to 0A7Fh (No. 0 to 127)	Reads the value set for displacement (target value). The set value range is 0 to 2. 0 is a relative value (displacement from the currently stopped position), 1 is an absolute value (displacement from the origin), and 2 is an absolute value that occurs within a single revolution of the output shaft. For details on the displacement mode, refer to Displacement mode setting (P13-6).
Reading the least significant 16 bits of actuator displacement per rotation	0B00h	Reads the value set for the actuator resolution (low, 16-bit). The units are in pulses. If you add a speed reducer to the actuator's output shaft and set in a shortcut, set the value with (actuator resolution x added reduction ratio).
Reading the most significant 16 bits of actuator displacement per rotation	0B01h	Reads the value set for the actuator resolution (high, 16-bit). The units are in pulses. If you add a speed reducer to the actuator's output shaft and set in a shortcut, set the value with (actuator resolution x added reduction ratio).
Reading the least significant 16 bits of originating speed 1	0B02h	The least significant 16 bits of the set value of the originating speed 1 are read. The unit is [pls/sec].
Reading the most significant 16 bits of originating speed 1	0B03h	The most significant 16 bits of the set value of the originating speed 1 are read. The unit is [pls/sec].
Reading originating speed 2	0B04h	The set value of the originating speed 2 is read. The unit is [pls/sec].
Reading originating acceleration/deceleration time constant	0B05h	The acceleration/deceleration time constant at originating is read. The set value is the time it takes for the motor to accelerate up to the maximum speed and the time it takes to decelerate from the maximum speed to stop (speed 0). The unit is ms.
Reading originating direction	0B06h	The direction of originating is read. The set value is 0 or 1. The originating direction is CW when the set value is 0 and CCW when the value is 1.
Reading originating method	0B07h	The method of originating is read. The set value is 0 or 1. If 0 is set, the originating operation is performed by an external sensor or origin Dog ON. If the value is 1, the origin is the actuator position when [RYn2: Start selection] is set to 1 and [RYn1: Start] is 1.
Reading origin sensor selection	0B08h	The input destination of origin sensor signal is read. The set value is 0 or 1. When the value is 0, originating is performed based on input from [CN2-5: Origin signal] . If 1 is set, the originating operation is performed by an input from CC-Link RYn7: origin Dog ON.
Reading least significant 16 bits of virtual origin	0B09h	The least significant 16 bits of virtual origin are read. The unit is [pulse]. The same data as [0B0Ch: Least significant 16 bits of virtual origin] is read.
Reading backlash offset value	0B0Ah	The set value of backlash offset is read. The unit is [pulse].
Reading set value of shortcut enabled/disabled	0B0Bh	The set value of shortcut function enabled/disabled is read. The set value is 0 or 1. The shortcut function is disabled when the set value is 0 and enabled when the value is 1. When using a shortcut function, check the actuator resolution setting. For details on the shortcut function, refer to Displacement mode setting (P13-6).
Reading least significant 16 bits of virtual origin	0B0Ch	Reads the virtual origin (low, 16-bit). The units are in pulses. The contents are identical to those in 0B09h: Virtual origin (low, 16-bit).
Reading most significant 16 bits of virtual origin	0B0Dh	The most significant 16 bits of virtual origin are read. The unit is [pulse].
Reading operation completion (RXn1) OFF time	0B0Eh	The set value of operation completion (RXn1) OFF time is read. The unit is [ms].

*1 Reading adjustment parameters (0100h to 013Bh)

No.	Code No.	Parameter name	No.	Code No.	Parameter name
0100h	AJ00	Position loop gain	011Eh	AJ30	System reservation
0101h	AJ01	Speed loop gain	011Fh	AJ31	
0102h	AJ02	Speed loop integral compensation	0120h	AJ32	
0103h	AJ03	Feed-forward gain	0121h	AJ33	
0104h	AJ04	In-position range	0122h	AJ34	
0105h	AJ05	Attained speed judgment value	0123h	AJ35	
0106h	AJ06	Attained torque judgment value	0124h	AJ36	
0107h	AJ07	Zero speed judgment value	0125h	AJ37	
0108h	AJ08	System reservation	0126h	AJ38	
0109h	AJ09		0127h	AJ39	
010Ah	AJ10		0128h	AJ40	
010Bh	AJ11	Torque limit	0129h	AJ41	
010Ch	AJ12	Acceleration/deceleration time constant	012Ah	AJ42	
010Dh	AJ13	System reservation	012Bh	AJ43	
010Eh	AJ14		012Ch	AJ44	
010Fh	AJ15		012Dh	AJ45	
0110h	AJ16	Speed monitor offset	012Eh	AJ46	
0111h	AJ17	Current monitor offset	012Fh	AJ47	
0112h	AJ18	System reservation	0130h	AJ48	
0113h	AJ19	System reservation	0131h	AJ49	
0114h	AJ20	Feed-forward filter	0132h	AJ50	
0115h	AJ21	Load inertia moment ratio	0133h	AJ51	
0116h	AJ22	Torque constant compensation factor	0134h	AJ52	
0117h	AJ23	Spring constant compensation factor	0135h	AJ53	
0118h	AJ24	Positioning Automatic Gain	0136h	AJ54	
0119h	AJ25	System reservation	0137h	AJ55	
011Ah	AJ26		0138h	AJ56	
011Bh	AJ27		0139h	AJ57	
011Ch	AJ28		013Ah	AJ58	
011Dh	AJ29		013Bh	AJ59	

*2 Reading system parameters (0200h to 0227h)

No.	Code No.	Parameter name	No.	Code No.	Parameter name
0200h	SP40	CP3 output signal setting	0214h	SP60	Automatic positioning gain setting enable/disable setting
0201h	SP41	System reservation	0215h	SP61	Encoder monitor output pulses
0202h	SP42		0216h	SP62	Input signal logic
0203h	SP43		0217h	SP63	Output signal logic
0204h	SP44	Electronic gear numerator*	0218h	SP64	Regenerative resistor selection
0205h	SP45	Electronic gear denominator*	0219h	SP65	FWD/REV inhibit operation
0206h	SP46	System reservation	021Ah	SP66	Absolute encoder function setting
0207h	SP47	System reservation	021Bh	SP67	Output shaft divide function setting
0208h	SP48	Deviation clear upon servo-ON	021Ch	SP68	Electronic gear function setting
0209h	SP49	Allowable position deviation	021Dh	SP69	Feed-forward control function setting
020Ah	SP50	Command polarity	021Eh	SP70	System reservation
020Bh	SP51	Speed input factor	021Fh	SP71	
020Ch	SP52	System reservation	0220h	SP72	
020Dh	SP53	Torque input factor	0221h	SP73	
020Eh	SP54	Status display setting	0222h	SP74	
020Fh	SP55	DB enable/disable setting	0223h	SP75	
0210h	SP56	System reservation	0224h	SP76	
0211h	SP57		0225h	SP77	
0212h	SP58		0226h	SP78	
0213h	SP59	Angle compensation enable/disable setting	0227h	SP79	

* In combination with absolute encoders (HA-800C-*A, D, E), electronic gear numerator/denominator cannot be changed.

Details of writing instruction codes (RWwn+2)

It writes data requested to write by the code number (8010h to 920Eh) specified by [RWwn+2: Instruction code] to the HA-800C driver.
Set the command code number to corresponding items to [RWwn+2: Command code] and the write data to [RWwn+3: write data]. Then, if you set [RYn9: Command code execution request] to 1, the corresponding data can be written. Also, if no write data is required, settings are not required. The code number and return data are 4-digit hexadecimal.
If a code number not described in this section is specified, an error code [0004h: Parameter selection error] is set to [RWrn+2: Response code]. Moreover, the error code [0008h: Writing range error] is set if it is attempted to set data exceeding the allowable setting range.

Caution

- When writing multiple parameters continuously, turn the command code execution request OFF, then turn it ON again after the link scan time has passed. For details, check the write command code (xxx).

Item	Code No.	Data contents
Alarm reset	8010h	It resets HA-800C driver alarms that can be reset without rebooting the power supply (refer to [Chapter 11 Troubleshooting]). Execute the instruction code [8020h: Deviation pulse clear] before executing this command.
Deviation pulse clear*1	8020h	Deviation pulses are cleared. If HA-800C driver alarms occur, clear deviation first and then execute the instruction code [8010h: Alarm reset].
Changing adjustment parameters (RAM)	8100h to 813Bh	Changes the set values for the adjustment parameters. For this command code, since only the values for the adjustment parameters expanded onto the RAM change, when saving the set values, execute the command code 8280h: Parameter batch write. Refer to [*1 Adjustment parameter (8100h to 813Bh write)] for the code numbers and adjustment parameters.
Changing system parameters (RAM)	8200h to 8227h	System parameters are written. This instruction code only changes system parameter values stored in RAM. After making changes, execute the instruction code [8280h: Batch parameter write] and restart the HA800C. System parameters are enabled after rebooting. For the explanation of code numbers and system parameters, refer to [*2 Writing system parameters (8200h to 8227h]).
Batch parameter write to EEPROM	8280h	Saves the adjustment parameters and system parameters in the EEPROM all at once by changing the command code 8100h to 813Bh: Changing the adjustment parameters (RAM) and command code 8200h to 8227h: Changing the system parameters (RAM). If the HA-800C driver's control circuit power is turned OFF without these command codes in place, the changed values are lost.
Writing of displacement (target value) of operation data No. 0	8300h, 8301h	8300h and 8301h set the operation data No.0 of the displacement (target value) The units are in pulses. The low 16-bit is written by 8300h, and the high 16-bit is written by 8301h. The setting range is a signed 32-bit width. When writing, make sure to write in low and high sequence. If the high is 0, make sure to write it as 0.

*1: When using the deviation pulse clear, be sure to refer to the caution in [CN2-4 Deviation clear] (P5-5).

Item	Code No.	Data contents
Writing rotation speed of operation data No. 0	8302h, 8303h	8302h and 8303h set the rotation speed of operation data No.0 actuator. The units are in pls/sec. The low 16-bit is written by 8302h, and the high 16-bit is written by 8303h. When writing, make sure to write in low and high sequence. If the high is 0, make sure to write it as 0. The setting range is 007Dh to the maximum rotational speed of applicable actuator. The actuator's rotation speed can be converted to pls/sec using the following formula. For the absolute encoder, the electronic gear is 1/1 fixed. $\frac{\text{Rotation speed (r/min)}}{60} \times \text{Motor shaft resolution} \times \frac{\text{Electronic gear numerator}}{\text{Electronic gear denominator}}$
Writing acceleration/deceleration time constant of operation data No. 0	8304h	8304h sets the operation data No.0 of the acceleration/deceleration time constant. Its units are in ms. The value set here corresponds to the time over which the motor accelerates from standstill to maximum speed and the time over which it decelerates from the maximum speed to standstill (speed 0). The setting range is 1 to 9999 (1 to 270Fh) .
Writing mode setting for displacement of operation data No. 0	8305h	Command codes 8300h, 8301h: Sets the displacement mode with the displacement that was written for the displacement (target value) of the operation data No. 0. However, 0 is a relative value (displacement from the currently stopped position), 1 is an absolute value (displacement from the origin), and 2 is an absolute value that occurs within a single revolution of the output shaft. For details on the displacement mode, refer to Displacement Mode Setting (P13-6).
Setting of displacement (target value) of operation data No. 1 to 127 (RAM)	8B01h to 8B7Fh 8C01h to 8C7Fh	8B01h to 8B7Fh and 8C01h to 8C7Fh set the operation data No. 1 to 127 of the displacement (target value). The units are in pulses. The low 16-bit is set at 8B01h to 8B7Fh, and the high 16-bit is set at 8C01h to 8C7Fh. The setting range is a signed 32-bit width. When writing, make sure to write in low and high sequence. If the high is 0, make sure to write it as 0. For this command code, since the operation data expanded onto the RAM is changed, when the power to the HA-800C is turned OFF, the changed values will be disabled. To store the set values, execute 9100h: Batch save the operation data No1k to 127 of the EEPROM. Setting example: To set 0007FFFFh for operation data No. 1, set FFFFh to 8B01h and 0007h to 8C01h.

Item	Code No.	Data contents
Rotation speed setting of operation data No. 1 to 127 (RAM)	8D01h to 8D7Fh 8E01h to 8E7Fh	8D01h to 8D7Fh and 8E01h to 8E7Fh set the operation data No. 1 to 127 of the actuator's rotation speed. The units are in pls/sec. The low 16-bit is written from 8D01h to 8D7Fh, and the high 16-bit is written from 8E01h to 8E7Fh. When writing, make sure to write in low and high sequence. If the high is 0, make sure to write it as 0. The setting range is 007Dh to the maximum rotational speed of applicable actuator. The actuator's rotation speed can be converted to pls/sec using the following formula. $\frac{\text{Rotation speed (r/min)}}{60} \times \text{Actuator resolution} \times \frac{\text{Electronic gear numerator}}{\text{Electronic gear denominator}}$ Since this instruction code changes operation data stored in RAM, changed values become invalid when the HA-800C power supply is turned OFF. To store set values, execute [9100h: Batch saving of operation data No. 1 to 127 to EEPROM]. Setting example: To set 00002FF0h for operation data No. 1, set 2FF0h to 8D01h and 0000h to 8E01h.
Acceleration/deceleration time constant setting of operation data No. 1 to 127 (RAM)	8F01h to 8F7Fh	8F01h to 8F7Fh is set for operation data No. 1 to 127 of the acceleration/deceleration time constant. Its units are in ms. The value set here corresponds to the time over which the motor accelerates from standstill to maximum speed and the time over which it decelerates from the maximum speed to standstill (speed 0). The setting range is 1 to 9999 (1 to 270Fh) . For this command code, since the operation data expanded onto the RAM is changed, when the power to the HA-800C is turned OFF, the changed values will be disabled. To store the set values, execute 9100h: Batch save the operation data No1 to 127 of the EEPROM.
Displacement mode setting (RAM)	9001h to 907Fh	Command codes 8B01h to 8B7Fh and 8C01h to 8C7Fh: Sets the displacement mode with the displacement that was set for the displacement (target value) settings of the operation data No. 1 to 127. 0 is a relative value (displacement from the currently stopped position), 1 is an absolute value (displacement from the origin), and 2 is an absolute value that occurs within a single revolution of the output shaft. For this command code, since only the operation data expanded onto the RAM is changed, when the power to the HA-800C is turned OFF, the changed values will be invalid. To store the set values, execute 9100h: Batch save the operation data No1 to 127 of the EEPROM. For details on the displacement mode, refer to Displacement Mode Setting (P13-6).
Batch saving of operation data No. 1 to 127 to EEPROM	9100h	It saves all settings of code numbers [8B01h to 8B7Fh and 8C01h to 8C7Fh: Setting of displacement (target value) of operation data No. 1 to 127], [8D01h to 8D7Fh and 8E01h to 8E7Fh: Rotation speed setting of operation data No. 1 to 127], [8F01h to 8F7Fh: Setting of acceleration/deceleration time constant of operation data No. 1 to 127], and [9001h to 907Fh: Changing mode setting of target position to EEPROM] at the same time. Since operation data No.0 is managed only in the RAM, EEPROM is not saved.

Item	Code No.	Data contents
Setting of least significant 16 bits of actuator displacement per rotation (RAM/EEPROM) *2	9200h	Sets the low 16-bit resolution for the actuator. This value is set according to the applicable actuator's default settings, however if the 920Bh: Shortcut function is available, the values change (provided that the resolution is changed using a reducer attached to the output shaft of the actuator or it is changed by setting the electronic gear to a value other than 1.) When writing, always write in low to high sequence. If the high is 0, be sure to write 0. Setting example: If the resolution is 2,000,000 (001E8480h), set 8480h to 9200h and 001Eh to 9201h.
Setting of most significant 16 bits of actuator displacement per rotation (RAM/EEPROM) *2	9201h	
Setting of least significant 16 bits of originating speed 1 (RAM/EEPROM)	9202h	Sets the originating speed 1. The units are in pls/sec. The least significant 16 bits is written by 9202h, and the most significant 16 bits is written by 9203h. When writing, always write in low to high sequence. If the high is 0, be sure to write 0. The setting range is 007Dh to the maximum rotational speed of applicable actuator. The actuator's rotation speed can be converted to pls/sec using the following formula. $\frac{\text{Rotation speed (r/min)}}{60} \times \text{Actuator resolution} \times \frac{\text{Electronic gear numerator}}{\text{Electronic gear denominator}}$ The default is that 9202h is 0D40h, 9203h is 0003h.
Setting of most significant 16 bits of originating speed 1 (RAM/EEPROM)	9203h	
Setting of originating speed 2 (RAM/EEPROM)	9204h	It sets originating speed 2. The unit is pls/sec and the setting range is from 007Dh to 7FFFh. Actuator's rotation speed can be converted to pls/sec with the following formula. $\frac{\text{Rotation speed (r/min)}}{60} \times \text{Actuator resolution} \times \frac{\text{Electronic gear numerator}}{\text{Electronic gear denominator}}$ The default is 4E20h.
Originating acceleration/deceleration time constant (RAM/EEPROM)	9205h	Set the acceleration/deceleration time constant of the originating. Its units are in ms. The values set here corresponds to the time over which the motor accelerates from standstill to maximum speed and the time over which it decelerates from the maximum speed to standstill (speed 0). The setting range is 1 to 9999 (1 to 270Fh). The default is 3E8h.

*2: The setting change of the displacement per revolution or virtual origin of the actuator is enabled by reconnecting the control power supply after changing the setting.

Item	Code No.	Data contents
Writing originating direction setting (RAM/EEPROM)	9206h	It sets the direction of originating. The set value is 0 or 1. If the value is 0, originating is performed in the CW direction. If the value is 1, originating is performed in the CCW direction. The default is 0.
Selection of originating method (RAM/EEPROM)	9207h	It sets the method of originating. The set value is 0 or 1. When the value is 0, originating is performed via an external sensor. If 1 is set, the actuator's stop position when [RYn2: Start selection] is 1 and [RYn1: Start] is 1 is recognized as the origin. The default is 0.
Selection of origin sensor (RAM/EEPROM)	9208h	It selects input destination of origin sensor signals. The set value is 0 or 1. If the value is 0, origin sensor signals are input to [CN2-5: Origin signal]. If 1 is set, signals are input to [RYn7: Origin signal]. The default is 0.
Setting of least significant 16 bits of virtual origin (RAM/EEPROM) *1*2	9209h	It sets the least significant 16 bits of virtual origin. The unit is pulse and the setting range is from 8000h to 7FFFh (-32768 to 32767). The default is 0. When writing, always write in low to high sequence. If the high is 0, be sure to write 0.
Setting of backlash offset value (RAM/EEPROM)	920Ah	It sets the backlash offset value. The unit is [pulse] and the setting range is from 0 to 7FFFh (0 to 32767). The default is 0.
Setting of shortcut enabled/disabled (RAM/EEPROM)	920Bh	It sets whether the shortcut function should be enabled or disabled. The set value is 0 or 1. If 0 is set, the shortcut is disabled. If 1 is set, the function is enabled. The shortcut function does not operate normally if [9200h: Setting of least significant 16 bits of actuator displacement per rotation] and [9201h: Setting of most significant 16 bits of actuator displacement per rotation] are not properly set. Check the set value if the resolution changes from the default setting during usage. The default is 0. When using a shortcut function, check the actuator resolution setting. For details on the shortcut function, refer to Displacement mode setting (P13-6).
Setting of least significant 16 bits of virtual origin (RAM/EEPROM) *1*2	920Ch	It sets the least significant 16 bits of virtual origin. The unit is pulse and the setting range is from 8000h to 7FFFh (-32768 to 32767). The default is 0. When writing, always write in low to high sequence. If the high is 0, be sure to write 0.
Setting of most significant 16 bits of virtual origin (RAM/EEPROM) *1*2	920Dh	It sets the most significant 16 bits of virtual origin. The unit is pulse and the setting range is from 3 to FFFD (+3 to -4). The default is 0. When writing, always write in low to high sequence. If the high is 0, be sure to write 0.
Operation completion (RXn1) OFF time (RAM/EEPROM)	920Eh	Sets the time for when Operation completion (RXn1) is turned OFF after the Start (RYn1) is turned ON. The setting range is 0 to 7FFFh and the units are in ms. Ex. If the Start (RYn1) is turned ON when the displacement set by the absolute value and the current value are the same, the actuator does not operate. But, the Operation completion (RXn1) is turned OFF only when the time has been set. Also, if the amount of operation is minimal, and the operation finishes in less time than what is set. Operation completion (RXn1) is turned OFF only when the time has been set. Refer to the timing chart "Start" (P13-48). The default is 0.

*1: If the virtual origin is set in combination with absolute encoder, positioning is performed using the set position as the origin (Position 0).

*2: The setting change of the displacement per revolution or virtual origin of the actuator is enabled by reconnecting the control power supply after changing the setting.

*1 Writing adjustment parameters (8100h to 813Bh)

No.	Code No.	Parameter name	No.	Code No.	Parameter name
8100h	AJ00	Position loop gain	811Eh	AJ30	System reservation
8101h	AJ01	Speed loop gain	811Fh	AJ31	
8102h	AJ02	Speed loop integral compensation	8120h	AJ32	
8103h	AJ03	Feed-forward gain	8121h	AJ33	
8104h	AJ04	In-position range	8122h	AJ34	
8105h	AJ05	Attained speed judgment value	8123h	AJ35	
8106h	AJ06	Attained torque judgment value	8124h	AJ36	
8107h	AJ07	Zero speed judgment value	8125h	AJ37	
8108h	AJ08	System reservation	8126h	AJ38	
8109h	AJ09		8127h	AJ39	
810Ah	AJ10		8128h	AJ40	
810Bh	AJ11	Torque limit	8129h	AJ41	
810Ch	AJ12	Acceleration/deceleration time constant	812Ah	AJ42	
810Dh	AJ13	System reservation	812Bh	AJ43	
810Eh	AJ14		812Ch	AJ44	
810Fh	AJ15		812Dh	AJ45	
8110h	AJ16	Speed monitor offset	812Eh	AJ46	
8111h	AJ17	Current monitor offset	812Fh	AJ47	
8112h	AJ18	System reservation	8130h	AJ48	
8113h	AJ19	System reservation	8131h	AJ49	
8114h	AJ20	Feed-forward filter	8132h	AJ50	
8115h	AJ21	Load inertia moment ratio	8133h	AJ51	
8116h	AJ22	Torque constant compensation factor	8134h	AJ52	
8117h	AJ23	Spring constant compensation factor	8135h	AJ53	
8118h	AJ24	Positioning Automatic Gain	8136h	AJ54	
8119h	AJ25	System reservation	8137h	AJ55	
811Ah	AJ26		8138h	AJ56	
811Bh	AJ27		8139h	AJ57	
811Ch	AJ28		813Ah	AJ58	
811Dh	AJ29		813Bh	AJ59	

*2 Writing system parameters (8200h to 8227h)

No.	Code No.	Parameter name	No.	Code No.	Parameter name
8200h	SP40	CP3 output signal setting	8214h	SP60	Automatic positioning gain setting enable/disable setting
8201h	SP41	System reservation	8215h	SP61	Encoder monitor output pulses
8202h	SP42		8216h	SP62	Input signal logic
8203h	SP43		8217h	SP63	Output signal logic
8204h	SP44	Electronic gear numerator *	8218h	SP64	Regenerative resistor selection
8205h	SP45	Electronic gear denominator *	8219h	SP65	FWD/REV inhibit operation
8206h	SP46	System reservation	821Ah	SP66	Absolute encoder function setting
8207h	SP47	System reservation	821Bh	SP67	Output shaft divide function setting
8208h	SP48	Deviation clear upon servo-ON	821Ch	SP68	Electronic gear function setting
8209h	SP49	Allowable position deviation	821Dh	SP69	Feed-forward control function setting
820Ah	SP50	Command polarity	821Eh	SP70	System reservation
820Bh	SP51	Speed input factor	821Fh	SP71	
820Ch	SP52	System reservation	8220h	SP72	
820Dh	SP53	Torque input factor	8221h	SP73	
820Eh	SP54	Status display setting	8222h	SP74	
820Fh	SP55	DB enable/disable setting	8223h	SP75	
8210h	SP56	System reservation	8224h	SP76	
8211h	SP57		8225h	SP77	
8212h	SP58		8226h	SP78	
8213h	SP59	Angle compensation enable/disable setting	8227h	SP79	

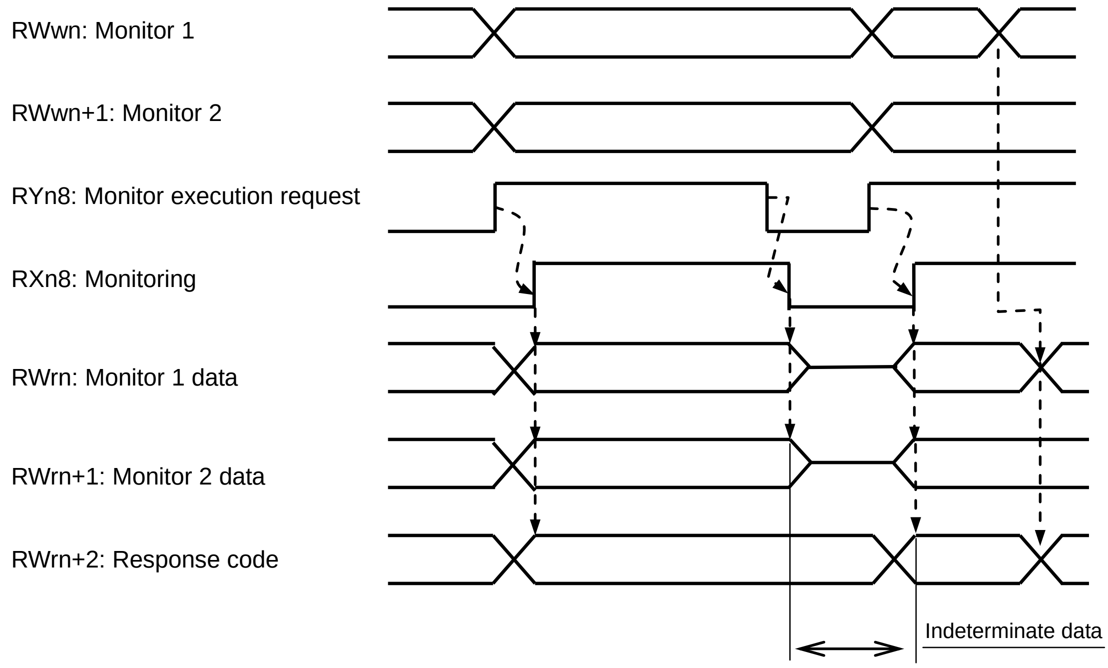
Do not rewrite system reserved parameters.
System parameters become enabled after rebooting the power supply to HA-800C. Make sure to execute [8280h: Batch parameter write to EEPROM] before rebooting the power supply.

* In combination with absolute encoders (HA-800C-*A, D, E), electronic gear numerator/denominator cannot be changed.

Timing chart

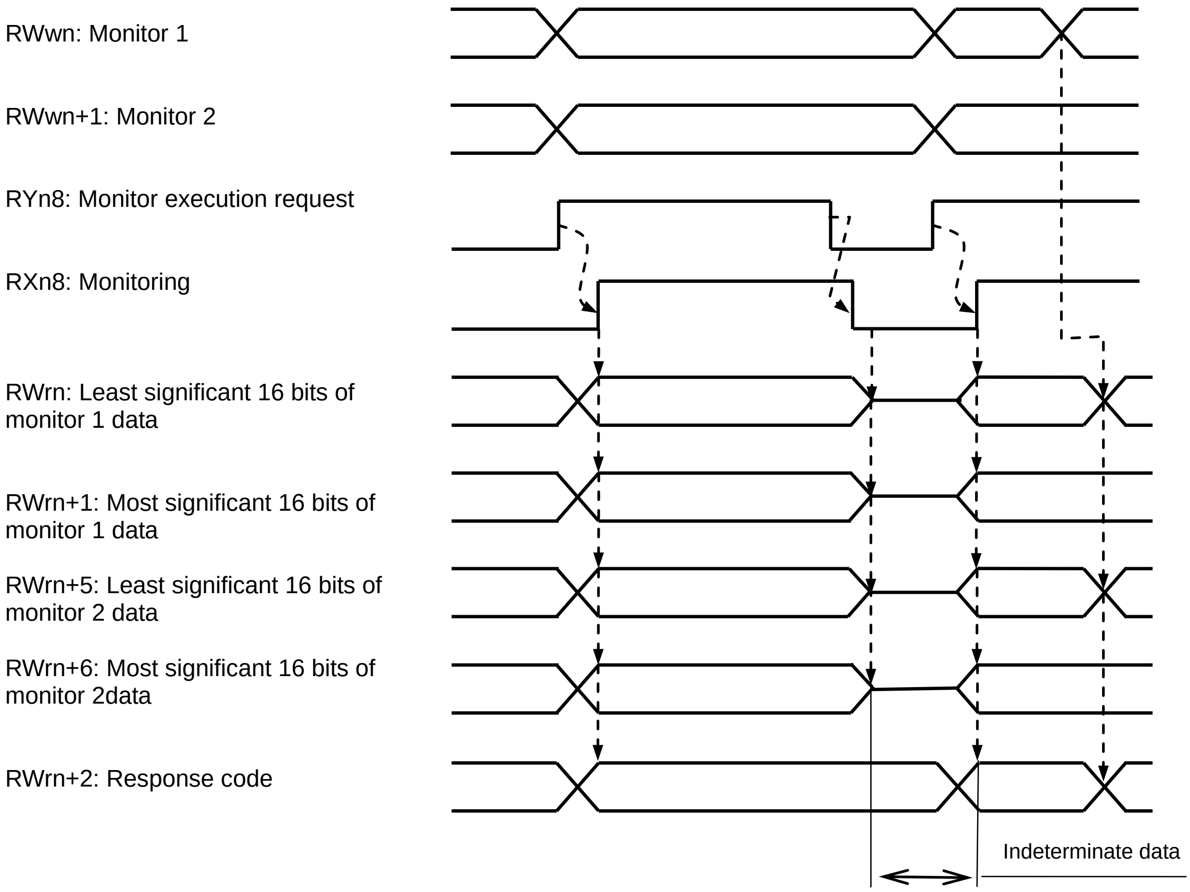
The timing chart of communication with the master is shown below.

- **Monitor code (1 exclusive station)**



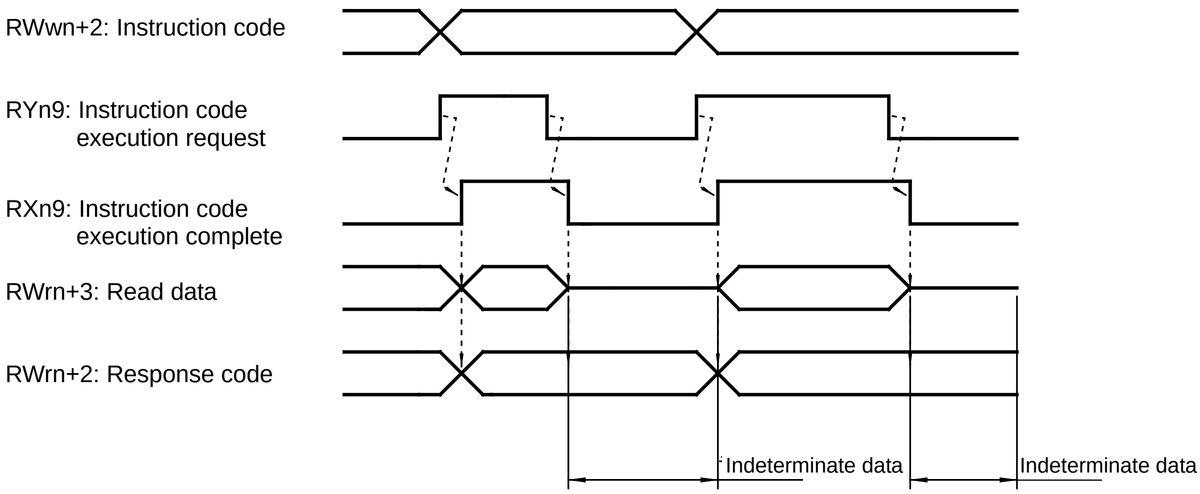
- While [RYn8: Monitor execution request] is turned ON, [RWrn: Monitor 1 data] and [RWrn+1: Monitor 2 data] are updated in every communication cycle of CC-Link.
- [RWwn: Monitor 1] or [RWwn+1: Monitor 2] is changed while [RYn8: Monitor execution request] is turned ON, the changed monitor data is output.
- If [RYn8: Monitor execution request] is turned OFF, [RWrn: Monitor 1 data] and [RWrn+1: Monitor 2 data] become indeterminate.

- **Monitor code (2 exclusive stations)**



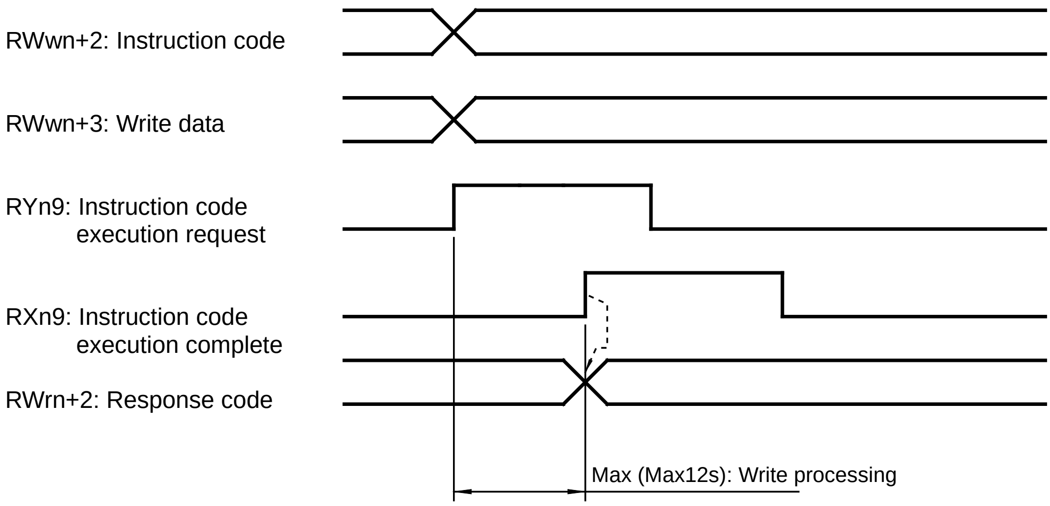
- If 32-bit monitor data is specified when 2 stations are occupied, signals are output to least significant 16 bits of monitor data (RWrn or RWrn+5) and most significant 16 bits of monitor data (RWrn1 or RWrn+6). In case of 16-bit data, 0 is set for the most significant digit.

- **Reading instruction code**



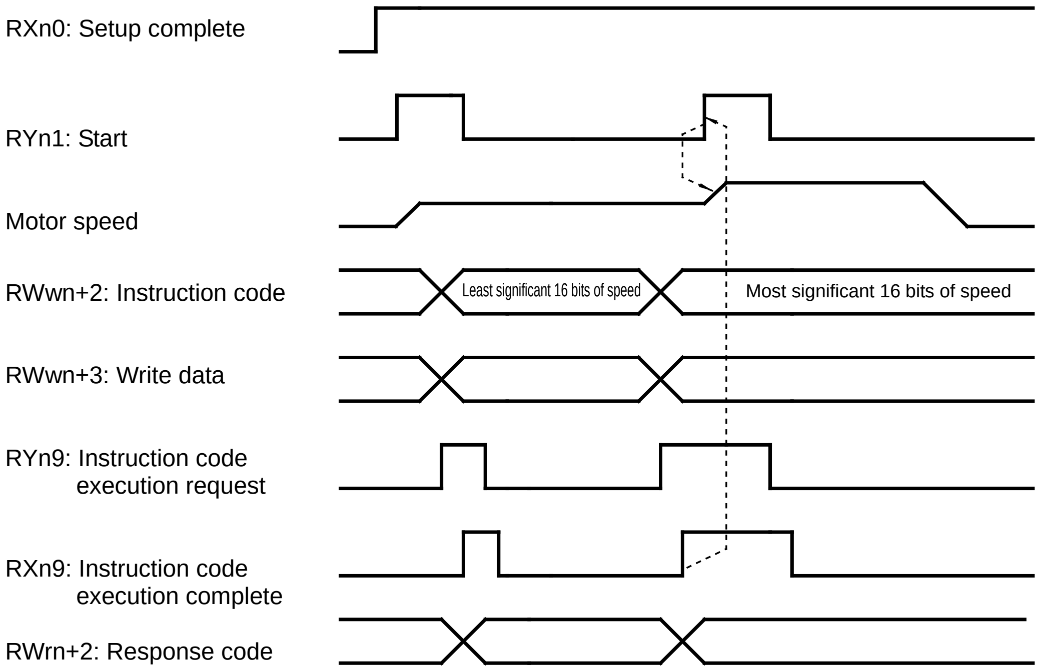
- Data corresponding to the code specified by [RWwn+2: Instruction code] is output to [RWrn+3: Read data] at the timing of [RXn9: Instruction code execution complete] is turned ON.
- If [RYn9: Instruction code execution request] is turned OFF, [RXn9: Instruction code execution complete] is turned OFF and [RWrn+3: Read data] value becomes indeterminate.

- **Writing instruction code**



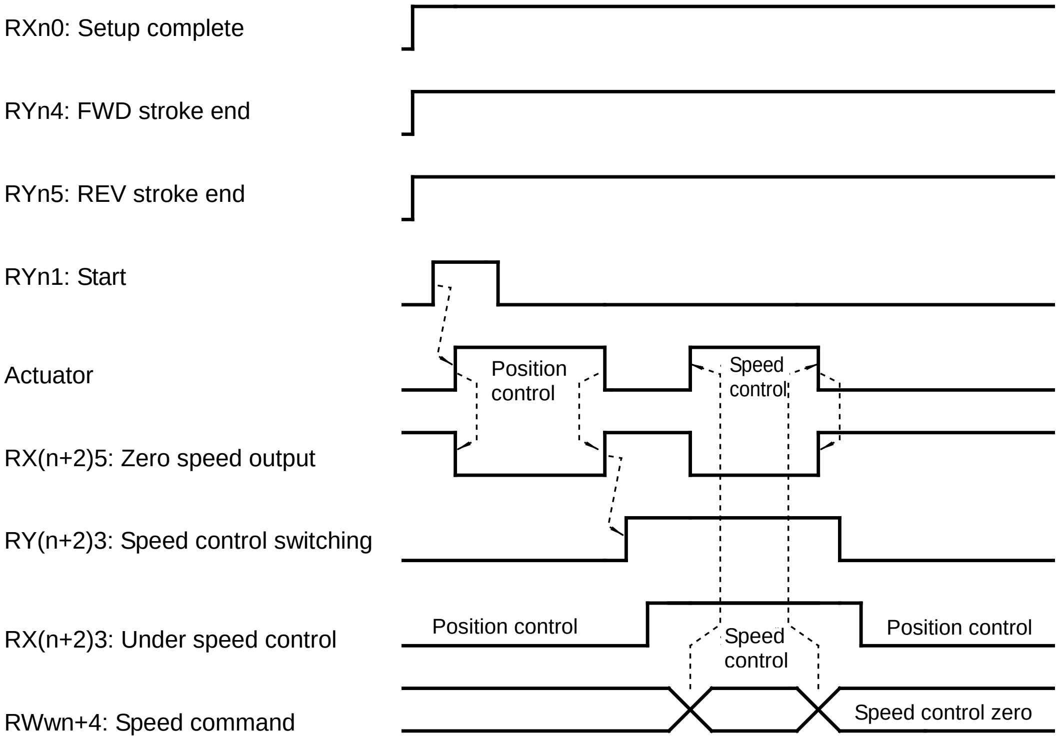
- If [RYn9: Instruction code execution request] is turned ON, processing of rewriting data specified by [RWwn+2: Instruction code] with the data specified by [RWwn+3: Write data] starts.
- When writing multiple parameters continuously, turn the command code execution request OFF, then turn it ON again after 1 or more communication cycles have passed.
- When rewrite process is completed, [RXn9: Instruction code execution complete] is turned ON. Although rewrite processing time varies depending on the data to be rewritten, the maximum time is 12 seconds (batch saving of operation data No. 1 to 127 to EEPROM).

- **Override (speed)**



- The actuator speed is changed by changing the speed data and turning [RYn1: Start] ON while the actuator is operating.
- Make sure to write speed change in the order from least significant 16 bits to most significant 16 bits. (Writing is required even if the most significant 16-bit data is the same as before the change.) If only the least significant 16 bits are changed and [RYn1: Start] is turned ON, [0800h: Point table not set yet] is returned to the [RWrn+2: Response code].
- HA-800C is able to execute position override as well.
- Override operation is possible when operation data to be overridden is set to another data No. in advance, the point table No. in which override data is set from [RYnA to RYnE, RY(n+2)0, RY(n+2)1: Point table No. selection] is specified while the actuator is operating, and [RYn1: Start] is turned ON.

- **Control mode switching (position → speed → position)**



- If [RY(n+2)3: Speed control switching] is turned ON while [RX(n+2)5: Zero speed detection] is turned ON, HA-800C operates with speed control.
- If the control is switched to speed control, [RX(n+2)3: Under speed control] is turned ON.
- When the speed is controlled, it operates at the speed set in (RWwn+4). The setting unit is in r/min, and the setting range is ±0 to the maximum speed of applicable actuator x reduction ratio.
- Switching from speed control to position control as well as turning ON zero speed detection (RX (n+2)5) is required When zero speed detection (RX(n+2)5) is turned OFF, and also when speed control switching (RY(n+2)3) is turned OFF, switching the control mode is not possible. (0010h: Command instruction error is returned in RWrn+2: Response code.)
- It is possible to use HA-800C by switching among position control, speed control, and torque control. For details, refer to the following.

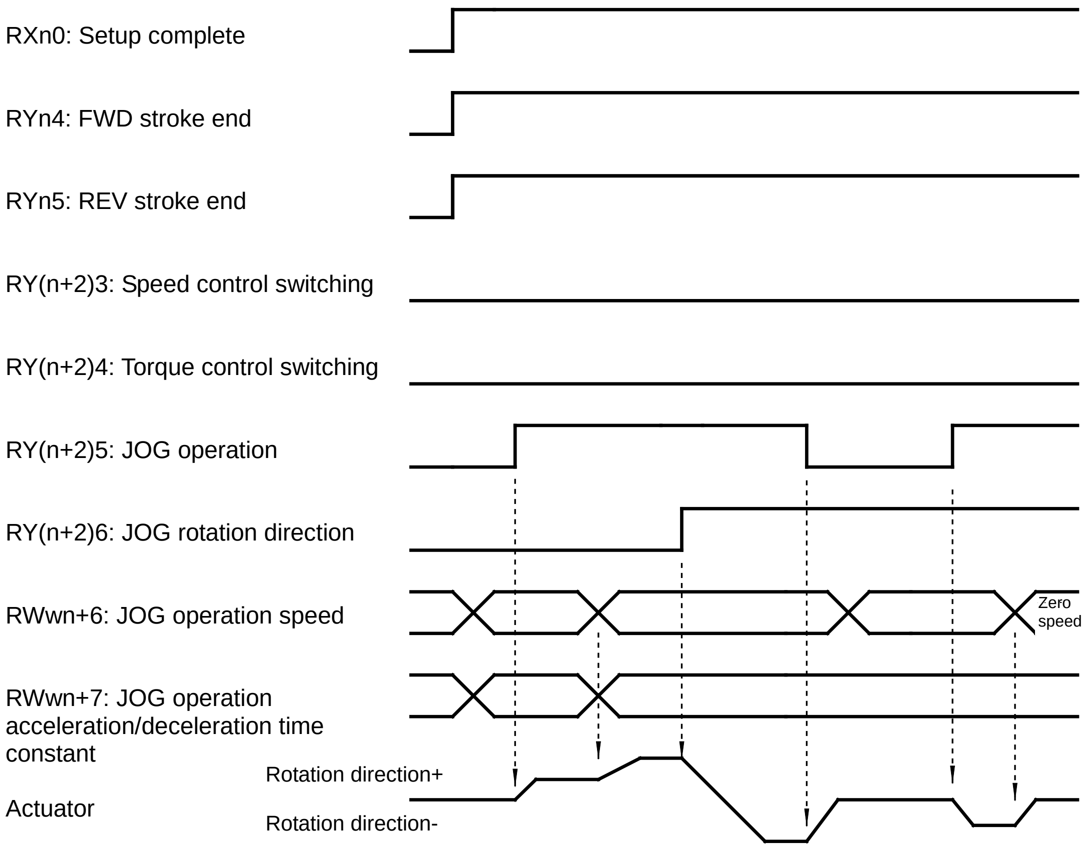
[RY(n+2)3: Speed control switching] and [RY(n+2)4: Torque control switching] set value and control mode

RY(n+2)3: Speed control switching	RY(n+2)4: Torque control switching	Control mode	Remarks
OFF	**OFF**	**Position control**	
ON	**OFF**	**Speed control**	**With the speed command, [RY(n+2)5: JOG operation] via [RWwn+4: Speed command] is not possible.**
OFF	**ON**	**Torque control**	**With the torque command, [RY(n+2)5: JOG operation] via [RWwn+5: Torque command] is not possible.**
ON	**ON**	**No switching**	

Control mode switching conditions

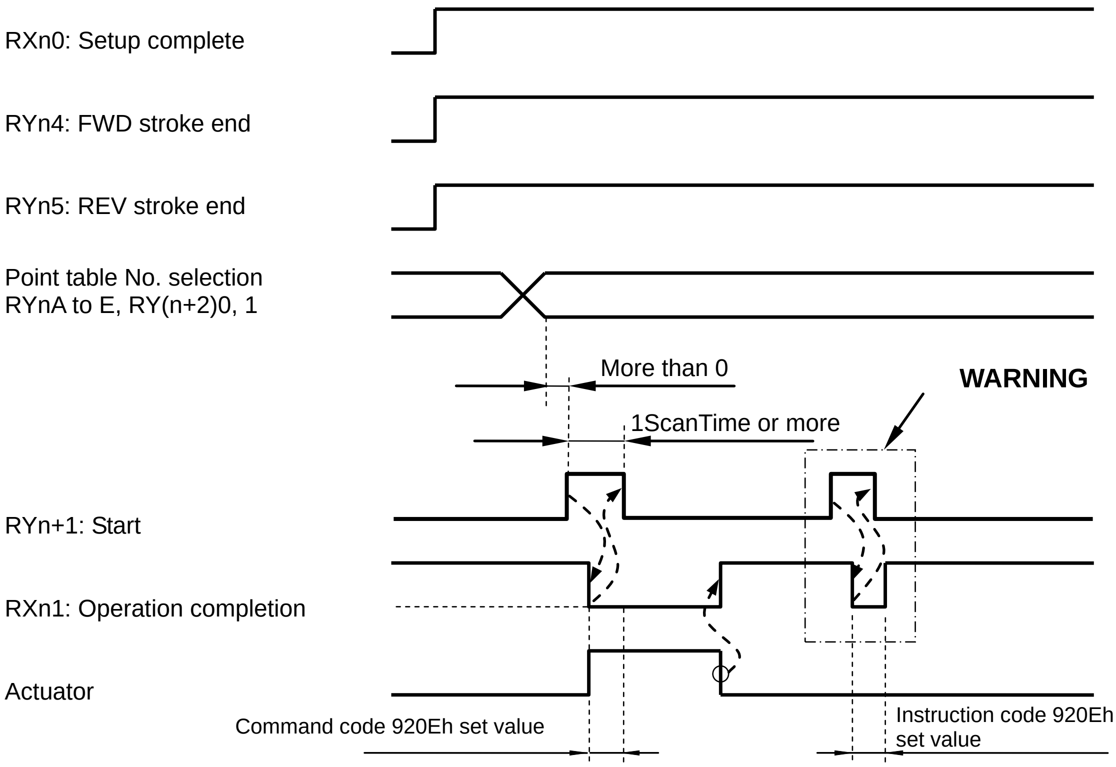
Control mode switching	Conditions
Position control ⇒ Speed control	**Switching is possible when [RX(n+2)5: Zero speed detection] is turned ON.**
Speed control ⇒ Position control	**Switching is possible when [RX(n+2)5: Zero speed detection] is turned ON.**
Position control ⇒ Torque control	**Switching is possible when [RX(n+2)5: Zero speed detection] is turned ON.**
Torque control ⇒ Position control	**Switching is possible when [RX(n+2)5: Zero speed detection] is turned ON.**
Speed control ⇒ Torque control	**No condition (switching is possible while the actuator is operating)**
Torque control ⇒ Speed control	**No condition (switching is possible while the actuator is operating)）**

- **JOG operation**



- If [RY(n+2)5: JOG operation] is turned ON, JOG operation is started in the direction set by [RY(n+2)6: JOG rotation direction] (OFF: CW direction, ON: CCW direction), according to the set values of [RWwn+6: JOG operation speed] and [RWwn+7: JOG operation acceleration/ deceleration time constant].
- If the set values of [RWwn+6: JOG operation speed] and [RWwn+7: JOG operation acceleration/deceleration time constant] are changed during JOG operation, JOG operation is changed according to the changed values.
- If [RY(n+2)6: JOG rotation direction] is changed during JOG operation, the rotation direction is changed. At this point, the set value of [RWwn+7: JOG operation acceleration/deceleration time constant] is reflected in the deceleration and acceleration.
- If [RY(n+2)5: JOG operation] is turned OFF, the actuator decelerates to a stop.
- If [RWwn+6: JOG operation speed] is set to 0, the actuator decelerates to a stop.

- **Start**



- The actuator starts operation by specifying point table No. and turning [RYn1: Start] ON.
  When the operation is started, [RXn1: Operation completion] is turned OFF. It turns ON after the operation is completed.
- If the position identical to the current value is specified and the start (RYn1) is turned ON, the motor will not run and the operation completion (RXn1) will turn OFF and then ON again. At this time, the time can be set to 0 to 32,767 ms (0 to 7FFFh) with CC-Link communication command code 920Eh or to the NP06: RXn1 minimum OFF time.
- After the control power supply is turned ON, operation completion (RXn1) is OFF. Operation completion (RXn1) is turned ON after the Start (RYn1) is turned ON and the operation is complete.
  Operation completion (RXn1) becomes 0 after the power is turned ON until a positioning operation or originating operation or when position control is switched from speed control/torque control to position control.
- If the motor excitation is turned OFF (due to servo-ON command (RYn0) OFF, alarm warning etc.) during operation (during operation completion (RXn1) is OFF), the operation completion (RXn1) stays OFF and the operation is canceled. If the motor excitation is turned ON again, the canceled operation does not restart. Also, the operation completion (RXn1) is OFF.
- If the decelerates to stop (RYnF) is turned ON during operation (during operation completion (RXn1) is OFF), the operation completion (RXn1) stays OFF and the operation is canceled. If the decelerates to stop (RYnF) is turned OFF, the canceled operation does not restart and the operation completion (RXn1) is OFF.
- After the operation is complete, with the operation completion (RXn1) ON, if the position deviation exceeds the in-position range (the current stop position moved to out of in-position range specified with the positioning operation) due to the causes such as disturbance, overshoot etc. or JOG operation (via CC-Link communication, PSF-800 communication, etc.), the operation completion (RXn1) turns OFF.
  When the causes are removed (or JOG operation, etc., is performed) and the position deviation is returned to in-position range of the last executed point data, the operation completion (RXn1) turns ON.

Appendix

Appendix

The list of default parameters and regenerative resistors are explained.

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-800C-3D/E-200					HA-800C-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-800C-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-800C-6D/E-200					HA-800C-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-800C-24D/E-200					HA-800C-24D/E-200				HA-800C-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(-S)					SHA32-CG(-S)				
	Actuator reduction ratio	50	80	100	120	160	50	80	100	120	160	50	80	100	120	160
	Combined driver	HA-800C-3D/E-200					HA-800C-3D/E-200					HA-800C-6D/E-200				
d13	Applicable actuator Code	8311	8321	8331	8341	8351	8011 8012	8021 8022	8031 8032	8041 8042	8051 8052	8111 8112	8121 8122	8131 8132	8141 8142	8151 8152
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(-S)					SHA40-CG(-S)				
	Actuator reduction ratio	50	80	100	120	160	50	80	100	120	160
	Combined driver	HA-800C-6D/E-200					HA-800C-24D/E-200				
d13	Applicable actuator Code	8211 8212	8221 8222	8231 8232	8241 8242	8251 8252	8211 8212	8221 8222	8231 8232	8241 8242	8251 8252
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(-S)				
	Actuator reduction ratio	51	81	101	121	161	50	80	100	120	160
	Combined driver	HA-800C-6D/E-100					HA-800C-6D/E-100				
d13	Applicable actuator Code	5611	5621	5631	5641	5651	8611 8612	8621 8622	8631 8632	8641 8642	8651 8652
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-800C-1C-200			HA-800C-1C-200			HA-800C-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-800C-1C-100			HA-800C-1C-100			HA-800C-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-800C-1D-200			HA-800C-1D-200			HA-800C-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-800C-1D-100			HA-800C-1D-100			HA-800C-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-800C-3C-200					HA-800C-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-800C-6C-200					HA-800C-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-800C-3C-100					HA-800C-6C-100					HA-800C-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-800C-3C-200					HA-800C-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-800C-6C-200					HA-800C-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-800C-3C-100					HA-800C-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-800C-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-800C-3A-200			HA-800C-3A-200			HA-800C-6A-200			HA-800C-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-800C-3A-100			HA-800C-6A-100			HA-800C-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-800C-3B-200		HA-800C-3B-200		HA-800C-3B-200		HA-800C-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-800C-3D/E-200		HA-800C-6D/ E-200	HA-800C-24D/E-200		HA-800C-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

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-800 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>200V specification</th></tr>
<tr><th>Model</th><th>HA-800C-1</th><th>HA-800C-3</th><th>HA-800C-6</th><th>HA-800C-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>24 A</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>2400J</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

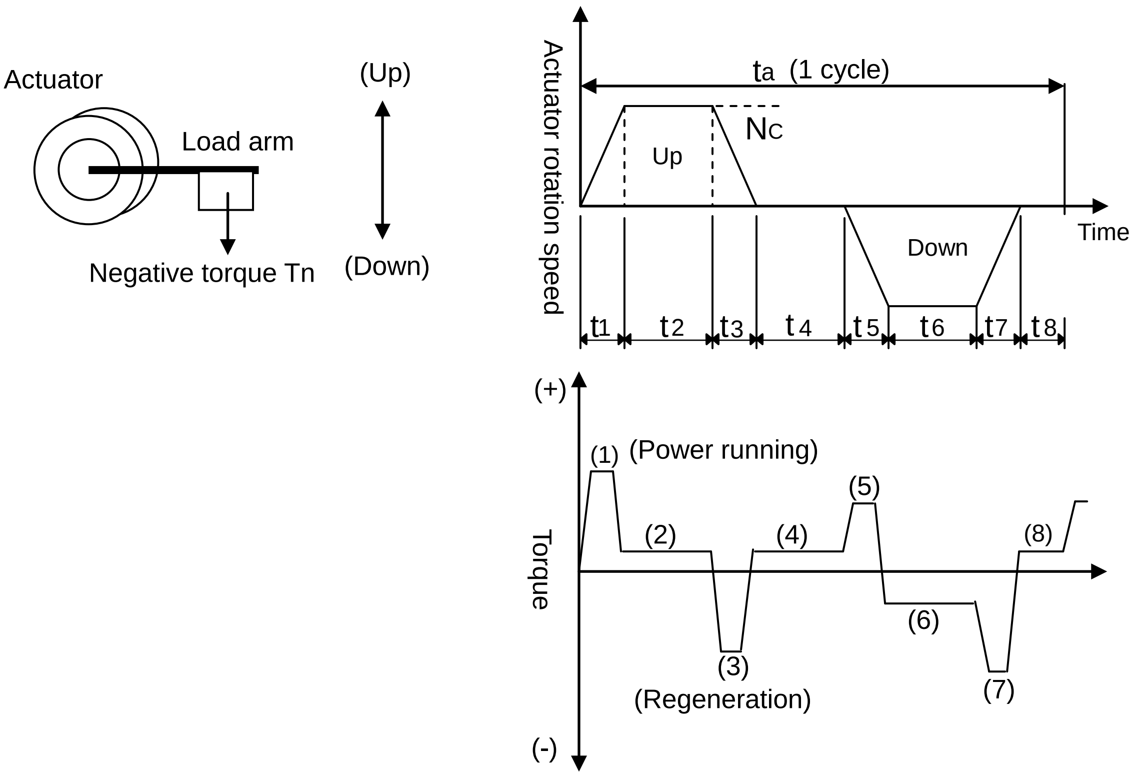
Examine installing a regenerative resistor in the following conditions:

- 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 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} × T2 × 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} × T6 × 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-800C 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-800C-1	30	-	-	33Ω - 5%
HA-800C-3	30	3W max.	50Ω ± 5%	33Ω - 5%
HA-800C-6	52	8W max.	33Ω ± 5%	33Ω - 5%
HA-800C-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 of the built-in regenerative resistor <Wi> 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-800C-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-800C-1 HA-800C-3 HA-800C-6	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-800C-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: 36000J 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. Accordingly, 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 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-800C-24, set [SP64: Regenerative resistor selection] to [1]. For details, refer to [SP64: Regenerative resistor selection] (P8-9).

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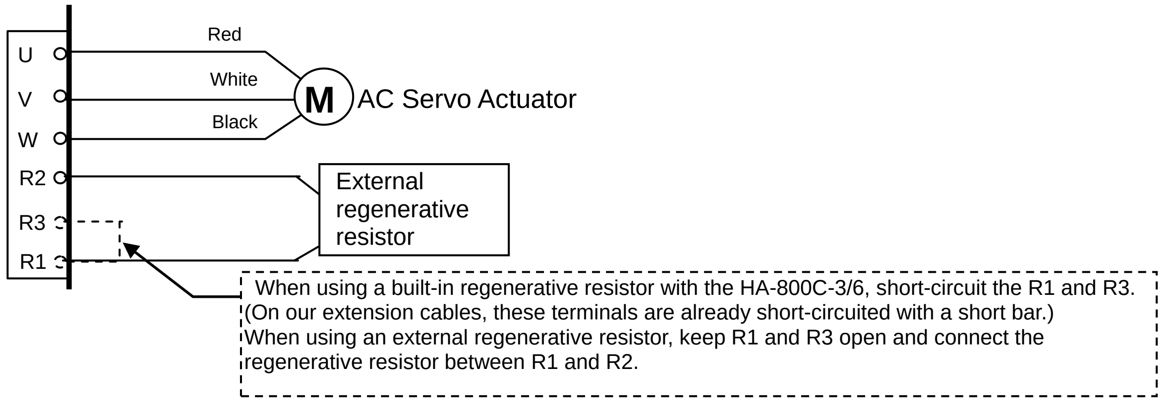
Appendix

CAUTION

Regenerative resistors become very hot. Determine the position of the radiation, installation position, wiring path, etc. by giving thorough consideration to safety.

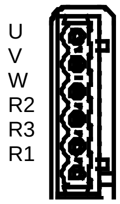
- **Connecting to the driver**

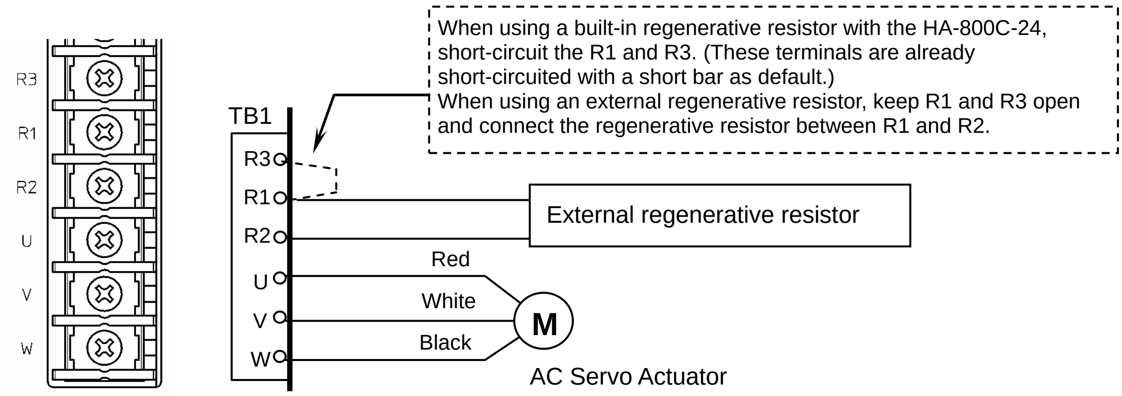
  Connect the external regenerative resistor between the R1 and R2 terminals of the HA-800 driver.



Terminal block for motor connection (for TB1)

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



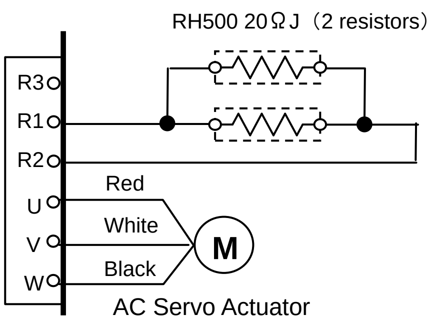


Terminal block for motor connection

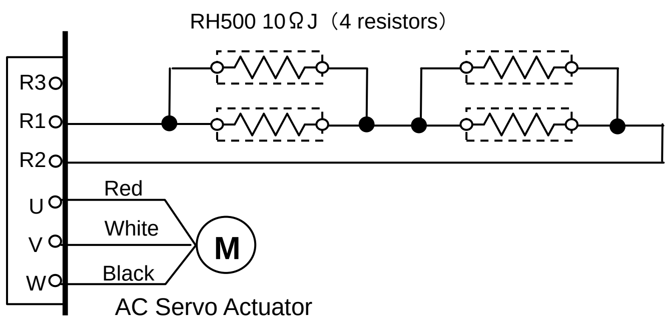
Screw size	Crimp terminal outer diameter	Reference
M4	ϕ8mm	Round crimp terminal (R-type) 3.5-R4 (J.S.T. Mfg. Co., Ltd) 5.5-4NS (J.S.T. Mfg. Co., Ltd)

- **Connection example of 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 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-800C-3D-200				
Max. rotational speed	r/min	117.6	74.1	59.4	49.6	37.3
Actuator inertia moment (Without brake)	kg·m²	0.23	0.58	0.91	1.30	2.3
	kgf·cm·s²	2.4	6.0	9.3	13	24
Actuator inertia moment (With brake)	kg·m²	0.26	0.65	1.00	1.4	2.6
	kgf·cm·s²	2.6	6.6	10	15	26.0
Allowable load inertia moment when a built-in regenerative resistor is used (repeat cycle)	kg·m²	0.93	2.3	3.6	5.1	7.7
	kgf·cm·s²	9.5	23	37	52	78
Allowable load inertia moment when a built-in regenerative resistor is used (non-repeating cycle)	kg·m²	1.7	3.8	4.8	5.8	7.7
	kgf·cm·s²	17.3	39	49	59	78
Allowable load inertia moment when an external regenerative resistor is used	kg·m²	2.4	3.8	4.8	5.8	(7.7)
	kgf·cm·s²	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-800C-3D-200					
Max. rotational speed	r/min	509.1	109.8	69.1	55.4	46.3	34.8
Actuator inertia moment (without brake)	kg·m²	0.029	0.56	1.4	2.2	3.2	5.6
	kgf·cm·s²	0.30	5.7	14	22	32	57
Actuator inertia moment (with brake)	kg·m²	0.034	0.66	1.7	2.6	3.7	6.6
	kgf·cm·s²	0.35	6.7	17	26	38	67
Allowable load inertia moment when a built-in regenerative resistor is used (repeat cycle)	kg·m²	0.034	0.79	2.0	3.1	4.4	7.9
	kgf·cm·s²	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·m²	0.071	1.3	3.4	5.4	7.7	13.8
	kgf·cm·s²	0.724	13.2	34.7	55.1	78.5	140
Allowable load inertia moment when an external regenerative resistor is used	kg·m²	0.32	5.6	8.8	11	14	20
	kgf·cm·s²	3.3	57	90	112	144	201
	External regenerative resistor	RH220B33ΩJ					

Actuator model No.		SHA32A-SG/HP					
Actuator reduction ratio		11	51	81	101	121	161
Combined driver		HA-800C-6D-200					
Max. rotational speed	r/min	436.4	94.1	59.3	47.5	39.7	29.8
Actuator inertia moment (without brake)	kg·m²	0.091	2.0	5.1	8.0	11	20
	kgf·cm·s²	0.93	21	52	81	117	207
Actuator inertia moment (with brake)	kg·m²	0.11	2.3	5.9	9.2	13	23
	kgf·cm·s²	1.1	24	60	94	135	238
Allowable load inertia moment when a built-in regenerative resistor is used (repeat cycle)	kg·m²	0.1065	2.3	5.9	9.2	13	23
	kgf·cm·s²	1.087	24	60	94	135	238
Allowable load inertia moment when a built-in regenerative resistor is used (non-repeating cycle)	kg·m²	0.277	6.0	15.3	24	33	60
	kgf·cm·s²	2.827	61.2	156	244	336	612
Allowable load inertia moment when an external regenerative resistor is used	kg·m²	0.99	20	32	40	50	70
	kgf·cm·s²	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-800C-6D-200					HA-800C-24D-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·m²	5.0	13	20	28	50	5.0	13	20	28	50
	kgf·cm·s²	51	130	202	290	513	51	130	202	290	513
Actuator inertia moment (with brake)	kg·m²	6.1	15	24	34	61	6.1	15	24	34	61
	kgf·cm·s²	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·m²	1.2	3	4.8	6.8	12.2	40	92	114	137	182
	kgf·cm·s²	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·m²	6.1	15	24	34	61	58	92	114	137	182
	kgf·cm·s²	62.2	153	244	346	622	590	930	1170	1400	1860
Allowable load inertia moment when an external regenerative resistor is used	kg·m²	58	92	114	137	182	58	(92)	(114)	(137)	(182)
	kgf·cm·s²	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 series and 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-800C-24D-200					HA-800C-24D-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 series and parallel.					Connect two RH500_20ΩJ in parallel, or connect four RH500_10ΩJ in series and parallel.			

Actuator model No.		SHA65A-SG			
Actuator reduction ratio		81	101	121	161
Combined driver		HA-800C-24D-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 series and parallel.			

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Appendix

Actuator model No.		SHA20A-CG					SHA25A-CG(-S)				
Actuator reduction ratio		50	80	100	120	160	50	80	100	120	160
Combined driver		HA-800C-3D/E-200					HA-800C-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	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(-S)				
Actuator reduction ratio		50	80	100	120	160
Combined driver		HA-800C-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(-S)									
Actuator reduction ratio		50	80	100	120	160	50	80	100	120	160
Combined driver		HA-800C-6D/E-200					HA-800C-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 series and parallel.				

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Appendix

SHA series (voltage: 100V)

Actuator model No.		SHA25A-SG					SHA25A-CG(-S)				
Actuator reduction ratio		51	81	101	121	161	50	80	100	120	160
Combined driver		HA-800C-6D/E-100					HA-800C-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)	$\mathrm{kg \cdot m^2}$	0.56	1.42	2.2	3.2	5.6	0.50	1.3	2.0	2.9	5.1
	$\mathrm{kgf \cdot cm \cdot s^2}$	5.7	14.4	22	32	57	5.1	13.0	20	29	52
Actuator inertia moment (with brake)	$\mathrm{kg \cdot m^2}$	0.66	1.66	2.6	3.7	6.6	0.60	1.5	2.4	3.4	6.1
	$\mathrm{kgf \cdot cm \cdot s^2}$	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)	$\mathrm{kg \cdot m^2}$	3.3	8.0	11	14	20	3.7	8.8	11	14	20
	$\mathrm{kgf \cdot cm \cdot s^2}$	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)	$\mathrm{kg \cdot m^2}$	5.6	8.8	11	14	20	5.6	8.8	11	14	20
	$\mathrm{kgf \cdot cm \cdot s^2}$	57	90	112	144	201	57	90	112	144	201
Allowable load inertia moment when an external regenerative resistor is used	$\mathrm{kg \cdot m^2}$	5.6	8.8	(11)	(14)	(20)	5.6	(8.8)	(11)	(14)	(20)
	$\mathrm{kgf \cdot cm \cdot s^2}$	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-800C-1*-100 HA-800C-1*-200			HA-800C-1*-100 HA-800C-1*-200			HA-800C-1*-100 HA-800C-1*-200		
Max. rotational speed	r/min	200	120	60	200	120	60	200	120	60
Actuator inertia moment	$\mathrm{kg \cdot m^2}$	0.0026	0.0074	0.029	0.0060	0.017	0.067	0.018	0.050	0.20
	$\mathrm{kgf \cdot cm \cdot s^2}$	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)	$\mathrm{kg \cdot m^2}$	0.0078	0.022	0.087	0.018	0.051	0.20	0.054	0.15	0.60
	$\mathrm{kgf \cdot cm \cdot s^2}$	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)	$\mathrm{kg \cdot m^2}$	0.0078	0.022	0.087	0.018	0.051	0.20	0.054	0.15	0.60
	$\mathrm{kgf \cdot cm \cdot s^2}$	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	$\mathrm{kg \cdot m^2}$	(0.0078)	(0.022)	(0.087)	(0.018)	(0.051)	(0.20)	(0.054)	(0.15)	(0.60)
	$\mathrm{kgf \cdot cm \cdot s^2}$	(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-800C-3*-200					HA-800C-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-800C-6*-200					HA-800C-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-800C-3*-100					HA-800C-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-800C-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-800C-3*-200					HA-800C-3*-200				
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	1.1	2.9	4.6	6.5	11.5
	kgf·cm·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·m^2	0.63	1.6	2.5	3.5	6.3	2.5	6.3	10	14.2	25.5
	kgf·cm·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·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	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-800C-6*-200					HA-800C-6*-200				
Max. rotational speed	r/min	80	50	40	33	25	70	43	35	29	22
Actuator inertia moment	kg·m^2	2.1	5.3	8.2	12	21	5.5	14	22	32	56
	kgf·cm·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·m^2	4.2	10.7	17	24	43	2.7	7	11	15	28
	kgf·cm·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·m^2	6.3	15.8	24.6	35.4	63	10	26	40.5	58	104
	kgf·cm·s^2	64	161	251	367	642	102	265	413	592	1061
Allowable load inertia moment when an external regenerative resistor is used	kg·m^2	6.3	15.8	24.6	35.4	63	16.5	42	66	95	168
	kgf·cm·s^2	64	161	251	367	642	168	428	673	979	1713
	External regenerative resistor	RH220B33ΩJ					RH220B33ΩJ				

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-800C-3*-100					HA-800C-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-800C-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)

<table>
<tr><td colspan="2">Motor model No.</td><td>HMAC08</td><td>HMAB09</td><td>HMAB09</td><td>MAB12</td><td>HMAB15</td><td>HMAA21A</td></tr>
<tr><td colspan="2">Combined driver</td><td colspan="2">HA-800C-3D/E-200</td><td>HA-800C-6D/E-100</td><td>HA-800C-6D/E-200</td><td colspan="2">HA-800C-24D/E-200</td></tr>
<tr><td>Max. rotational speed</td><td>r/min</td><td>6000</td><td>5600</td><td>4800</td><td>4800</td><td>4000</td><td>3000</td></tr>
<tr><td rowspan="2">Actuator inertia moment (no brake)</td><td>$\times 10^{-4}$ kg·m^2</td><td>0.734</td><td>1.78</td><td>1.78</td><td>6.45</td><td>15.8</td><td>125</td></tr>
<tr><td>$\times 10^{-4}$ kgf·cm·s^2</td><td>7.49</td><td>18.2</td><td>18.2</td><td>65.8</td><td>161</td><td>1280</td></tr>
<tr><td rowspan="2">Actuator inertia moment (with brake)</td><td>$\times 10^{-4}$ kg·m^2</td><td>0.828</td><td>2.16</td><td>2.16</td><td>6.83</td><td>19.8</td><td>141</td></tr>
<tr><td>$\times 10^{-4}$ kgf·cm·s^2</td><td>8.45</td><td>22.1</td><td>22.1</td><td>69.7</td><td>202</td><td>1444</td></tr>
<tr><td rowspan="2">Allowable load inertia moment when a built-in regenerative resistor is used (repeat cycle)</td><td>$\times 10^{-4}$ kg·m^2</td><td>2.48</td><td>3.00</td><td>6.48</td><td>10.3</td><td>59.4</td><td>183</td></tr>
<tr><td>$\times 10^{-4}$ kgf·cm·s^2</td><td>25.4</td><td>30.6</td><td>66.3</td><td>105</td><td>606</td><td>1867</td></tr>
<tr><td rowspan="2">Allowable load inertia moment when a built-in regenerative resistor is used (non-repeat cycle)</td><td>$\times 10^{-4}$ kg·m^2</td><td>2.48</td><td>6.48</td><td>6.48</td><td>20.5</td><td>59.4</td><td>338</td></tr>
<tr><td>$\times 10^{-4}$ kgf·cm·s^2</td><td>25.4</td><td>66.3</td><td>66.3</td><td>209</td><td>606</td><td>3448</td></tr>
<tr><td rowspan="3">Allowable load inertia moment when an external regenerative resistor is used</td><td>$\times 10^{-4}$ kg·m^2</td><td>(2.48)</td><td>6.48</td><td>(6.48)</td><td>20.5</td><td>(59.4)</td><td>423</td></tr>
<tr><td>$\times 10^{-4}$ kgf·cm·s^2</td><td>(25.4)</td><td>66.3</td><td>(66.3)</td><td>209</td><td>(606)</td><td>4332</td></tr>
<tr><td>External regenerative resistor</td><td colspan="4">RH220B33ΩJ</td><td colspan="2">Connect two RH500_20ΩJ in parallel, or connect four RH500_10ΩJ in series and parallel.</td></tr>
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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 four types of data that are retained in the non-volatile memory. They are adjustment parameters, system parameters, network parameters, operation data (point table).

Adjustment parameters AJxx

Symbol	Name	Display, Edit, Save			
		Main unit display panel	Servo parameter setting Software PSF-800 *2	Operation data setting Software PSF-680CL	CC-Link communication *3
AJ00	Position loop gain	Displaying set values Editing set values	Displaying set values Editing set values Saving a file (psf extension)	(Cannot be operated)	Displaying set values Reading adjustment parameters (Command code: 0100 to 0113) Editing set values Changing adjustment parameters (RAM) (Command code: 8100 to 8113) Parameters batch writing to EEPROM (Command code: 8280)
AJ01	Speed loop gain				
AJ02	Speed loop integral compensation				
AJ03	Feed-forward gain				
AJ04	In-position range				
AJ05	Attained speed judgment value				
AJ06	Attained torque judgment value				
AJ07	Zero speed judgment value				
AJ08	System reservation *1				
AJ09	System reservation *1				
AJ10	System reservation *1				
AJ11	Torque limit				
AJ12	Acceleration/deceleration time constant				
AJ13	System reservation *1				
AJ14	System reservation *1				
AJ15	System reservation *1				
AJ16	Speed monitor offset				
AJ17	Current monitor offset				
AJ18	System reservation *1				
AJ19	System reservation *1				
AJ20	Feed-forward filter	Displaying set values Editing set values	Displaying set values Editing set values Saving a file (psf extension)	(Cannot be operated)	Displaying set values Reading adjustment parameters (Command code: 0114 to 0127) Editing set values Changing adjustment parameters (RAM) (Command code: 8114 to 8127) Parameters batch writing to EEPROM (Command code: 8280)
AJ21	Load inertia moment ratio				
AJ22	Torque constant compensation factor				
AJ23	Spring constant compensation factor				
AJ24	Automatic positioning gain				
AJ25	System reservation *1				
AJ26	System reservation *1				
AJ27	System reservation *1				
AJ28	System reservation *1				
AJ29	System reservation *1				
AJ30	System reservation *1				
AJ31	System reservation *1				
AJ32	System reservation *1				
AJ33	System reservation *1				
AJ34	System reservation *1				
AJ35	System reservation *1				
AJ36	System reservation *1				
AJ37	System reservation *1				
AJ38	System reservation *1				
AJ39	System reservation *1				
AJ40 to AJ59	System reservation *1	Displaying set values	Displaying set values Saving a file (psf extension)	(Cannot be operated)	Displaying set values Reading adjustment parameters (Command code: 0128 to 013B)

*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 CC-Link communication function, do not execute the adjustment parameters change (RAM) 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	Operation data setting Software PSF-680CL	CC-Link 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)	(Cannot be operated)	Displaying set values Reading adjustment parameters (Command code: 0200 to 0213) Editing set values Changing adjustment parameters (RAM) (Command code: 8200 to 8213) Parameters batch writing to EEPROM (Command code: 8280)
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	Torque input factor				
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)	(Cannot be operated)	Displaying set values Reading adjustment parameters (Command code: 0214 to 0227) Editing set values Changing adjustment parameters (RAM) (Command code: 8214 to 8227) Parameters batch writing to EEPROM (Command code: 8280)
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	Output shaft divide function setting				
SP68	Electronic gear function setting				
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 system parameters using CC-Link communication function, do not execute the system parameters change (RAM) command for system reservation.

Network parameters

Symbol	Name	Display, Edit, Save			
		Main unit display panel	Servo parameter setting Software PSF-800 *2	Operation data setting Software PSF-680CL	CC-Link communication *3
Network 00	Actuator resolution *9	(Cannot be operated)	Displaying set values Editing set values Saving a file (psf extension)	Displaying set values Editing set values Saving a file	Displaying set values (reading) Editing set values (writing) * For details, refer to the below table.
Network 01	System reservation *1				
Network 02	Originating speed 1				
Network 03	System reservation *1				
Network 04	Originating speed 2				
Network 05	Originating acceleration/ deceleration time				
Network 06	Originating direction				
Network 07	Virtual origin *9				
Network 08	RXn1 Minimum OFF time *4				
Network 09	Backlash offset				
Network 10	System reservation *1				
Network 11	System reservation *1				
Network 12	System reservation *1				
Network 13	System reservation *1				
Network 14	System reservation *1				
Network 15	System reservation *1				
Network 16	System reservation *1				
Network 17	Shortcut enable/disable				
Network 18	Originating method				
Network 19	Origin sensor selection				

*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 network parameters using CC-Link communication function, operations on the system reservation cannot be done.
*4: When editing parameters using PSF-680CL, operations on the system reservation cannot be done. Operations on RXn1 Minimum OFF time cannot be done.
*9: The setting change of the resolution and virtual origin of the actuator is enabled by reconnecting the control power supply after changing the setting.

Network parameters (details)

PSF-800		PSF-680CL	CC-Link communication		
Symbol	Parameter name	Parameter name *6	Name used for CC-Link communication	Command code for displaying set values (reading)	Command code for editing set values (writing) *5
Network 00	Actuator resolution *9	Resolution *9	Displacement per actuator revolution (low 16-bit) *9	0B00	9200
			Displacement per actuator revolution (high 16-bit) *9	0B01	9201
Network 02	Originating speed 1	Originating speed 1	Originating speed 1 (low 16-bit)	0B02	9202
			Originating speed 1 (high 16-bit)	0B03	9203
Network 04	Originating speed 2	Originating speed 2	Originating speed 2	0B04	9204
Network 05	Originating acceleration/deceleration time	Originating acceleration speed	Originating acceleration/deceleration constant	0B05	9205
Network 06	Originating direction	Originating direction	Originating direction	0B06	9206
Network 07	Virtual origin *9	Virtual origin *9	Virtual origin (low 16-bit) *9	0B0C (0B09)	920C (9209)
			Virtual origin (high 16-bit) *9	0B0D	920D
Network 08	RXn1 Minimum OFF time	-*7	Operation completion (RXn1) OFF time	0B0E	920E
Network 09	Backlash offset	Backlash offset	Backlash offset value	0B0A	920A
Network 17	Shortcut enable/disable	Shortcut	Shortcut enable/disable	0B0B	920B
Network 18	Originating method	Originating method	Originating method	0B07	9207
Network 19	Origin sensor selection	Origin sensor selection	Origin sensor selection	0B08	9208

*5: If written to network parameters through CC-Link communication, the data is written to both RAM and EEPROM.
*6: If the data is transmitted from PSF-680CL with "Transmit parameters" checked, it is written to both RAM and EEPROM.
*7: RXn1 Minimum OFF time cannot be displayed or edited from PSF-680CL.
*8: For setting details of the network parameters, refer to [13-4 Communication profile] in this manual or separate PSF-680CL Operation Manual.
*9: The setting change of the resolution and virtual origin of the actuator is enabled by reconnecting the control power supply after changing the setting.

Operation data (point table)

Operation data (point table)		Display, Edit, Save			
Operation data No. (point table No.)	Data set value	Main unit display panel	Servo parameter setting Software PSF-800	Operation data setting Software PSF-680CL *3	CC-Link communication *3
Operation data No. 0 (RAM only) *1	Displacement (target value) No. 0	(Cannot be operated)	(Cannot be operated) *4	(Cannot be operated)	Displaying set values (reading) Editing set values (writing) * For details, refer to the below table.
	Rotation speed No. 0				
	Acceleration/deceleration time constant No. 0				
	Displacement mode No. 0				
Operation data No. 1 (RAM and EEPROM) *2	Displacement (target value) No. 1	(Cannot be operated)	(Cannot be operated) *4	Displaying set values Editing set values Saving a file (csv extension)	Displaying set values (reading) Editing set values (writing) * For details, refer to the below table.
	Rotation speed No. 1				
	Acceleration/deceleration time constant No. 1				
	Displacement mode No. 1				
Operation data No. 2 to 127 (RAM and EEPROM) *2	Displacement (target value) No. 2 to 127				
	Rotation speed No. 2 to 127				
	Acceleration/deceleration time constant No. 2 to 127				
	Displacement mode No. 2 to 127				

*1: Operation data No. 0 is RAM data only. There is no retaining function to EEPROM.
*2: Operation data No. 1 to 127 is array format data with the same contents. There are 127 types from No. 1 to 127.
*3: For setting details of the operation data, refer to [13-4 Communication profile] in this manual or separate PSF-680CL Operation Manual.
*4: Editing is possible for actuators with a 17-bit absolute encoder installed. Also, the software has to be version 3.00 or later for HA-800C and version 2.00 or later for PSF-800.

Operation data (point table) (details)

Operation data (point table)		CC-Link communication		
Data set value		Command code for displaying operation data (reading)	Command code for editing operation data (writing) *4	Operation data No. 1 to 127 batch writing to EEPROM
Displacement (target value) No. 0	Low 16bit	0400	8300	
	High 16bit	0500	8301	
Rotation speed No. 0	Low 16bit	0600	8302	
	High 16bit	0700	8303	
Acceleration/deceleration time constant No. 0		0800	8304	
Displacement mode No. 0		0A00	8305	
Displacement (target value) No. 1	Low 16bit	0401	8B01	9100
	High 16bit	0501	8C01	
Rotation speed No. 1	Low 16bit	0601	8D01	
	High 16bit	0701	8E01	
Acceleration/deceleration time constant No. 1		0801	8F01	
Displacement mode No. 1		0A01	9001	
Displacement (target value) No. 2 to 127	Low 16bit	0402 to 047F	8B02 to 8B7F	
	High 16bit	0502 to 057F	8C02 to 8C7F	
Rotation speed No. 2 to 127	Low 16bit	0602 to 067F	8D02 to 8D7F	
	High 16bit	0702 to 077F	8E02 to 8E7F	
Acceleration/deceleration time constant No. 2 to 127		0802 to 087F	8F02 to 8F7F	
Displacement mode No. 2 to 127		0A02 to 0A7F	9002 to 907F	

*4: Write data to RAM by executing operation data edit (write) command code. When you need to write operation data No. 1 to 127 to EEPROM, execute batch write to EEPROM command after writing to RAM is complete.

A -4 Driver replacement procedures

The following explains the procedures to replace the HA-800C 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, 2) CC-Link station number: Up ______ Down ______ ・Rotary switch (SW3) CC-Link communication speed: ______ ・Dip switch (SW4) CC-Link number of exclusive stations: Left side Center OFF (Down) ______ Right side OFF (Down) ______ * The center and right side dip switches (SW4) do not have any functions. They are normally switched OFF (Down).	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): ______________ * When communicating with PSF-800, set the CC-Link station number for the driver main unit rotary switch (SW1, 2) to other than 70 and 90, then connect the control power supply.	PSF-800 Communication software 10-4-1 Saving set values
5	Saving operation data *2	Save the operation data (point table) set in the driver currently used (retained in EEPROM) before the replacement. [Operation data No. 1 to 127] ・Name of the file to save (csv extension): ______________ ※ When communicating with PSF-680CL, set the CC-Link station number for the driver main unit rotary switch (SW1, 2) to 70, then connect the control power supply.	PSF-800 Communication software 10-10-7. Saving Point Table and Writing to Driver. PSF-680CL Communication software Separate PSF-680CL Operation Manual * Also refer to the notices described in Appendix 4 in this manual.

*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.

*2: When the operation data No. 1 to 127 are not used, or the operation data is set by host controller using CC-Link communication each time, saving and writing of the operation data are not necessary.
If you do not know the using condition, save/write the operation data.

Procedures	Description		Places to check/Manual
6	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.	
7	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 10 after the CHARGE lamp is turned OFF (discharged) to prevent electrical shock.	
8	Writing operation data*3	Write the operation data saved in [5. Saving operation data] to the new driver. * When communicating with PSF-680CL, set the CC-Link station number for the driver main unit rotary switch (SW1, 2) to 70, then connect the control power supply.	PSF-800 Communication software 10-10-7. Saving Point Table and Writing to Driver PSF-680CL Communication software Separate PSF-680CL Operation Manual * Also refer to the PSF-680CL Usage notices described in Appendix 4 in this manual.
9	Writing parameters *3	Write the parameters saved in "4. Saving parameters" to the new driver. [Adjustment parameters] [System parameters] [Network parameters] * When communicating with PSF-800, set the CC-Link station number for the driver main unit rotary switch (SW1, 2) to other than 70 and 90, then connect the control power supply.	PSF-800 Communication software 10-4-4. Writing a saved settings file to the driver.
10	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**.	
11	Switch settings	Set the switch status noted in "3. Checking the switch settings" to the new driver. ・Rotary switch (SW1, 2) CC-Link station number ・Rotary switch (SW3) CC-Link communication speed ・Dip switch (SW4) CC-Link number of exclusive stations	Front side of the driver main unit, inside of the LED display cover 1-9 Display panel This completes the driver replacement work.
		This completes the driver replacement work.	

*3: When [5. Saving operation data] is performed using the PSF-800, perform the steps 8 and 9 in the order of [step 9, then step 8].

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Appendix

CAUTION

This work requires wiring changes. Exercise caution to prevent accidents such as electric shock.

●PSF-680CL Usage notices

The following describes brief procedures and notices for copying operation data (point table) No.1 to 127 using PSF-680CL. For details, refer to the PSF-680CL Operation Manual.

1. Setting the driver to be connected

   The driver to be connected needs to be set with PSF-680CL.
   Check [1-3 Setting the connection target] in the PSF-680CL Operation Manual.
   Note, when it is newly installed, it is a setting with HA-800C.

2. Setting communication ports

   The COM port number of the personal computer needs to be set with PSF-680CL.
   Check [1-2 Required environment] in the PSF-680CL Operation Manual.

3. Station number setting

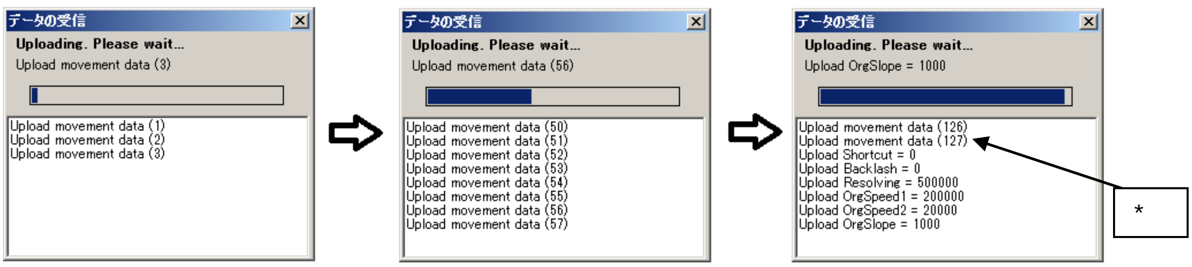
   When communicating with HA-800C servo driver using PSF-680CL, set the CC-LINK station number for the HA-800C servo driver to 70.Set the station number rotary switch to 70 and reconnect the servo driver control power supply, then the CC-Link station number becomes 70.

   * When communicating with HA-800C servo driver using PSF-800, set the CC-LINK station number for the HA-800C servo driver to other than 70 and 90.Set the station number rotary switch to other than 70 and 90, and reconnect the servo driver control power supply, then the CC-Link station number becomes other than 70 and 90.

4. Saving operation data

(1) Start the PSF-680CL software.
(2) Select "Edit" - "Receive" from the menu.

The PSF-680CL receives the operation data in the HA-800C servo driver. The below screen is displayed while the data is being received. At this time, check that data is received up to "movement data (127)".



* When [1. Setting the driver to be connected] is HA-800C, data up to "movement data (127)" is transferred in order.
* When [1. Setting the driver to be connected] is HA-680CL, data up to "movement data (31)" is transferred in order.

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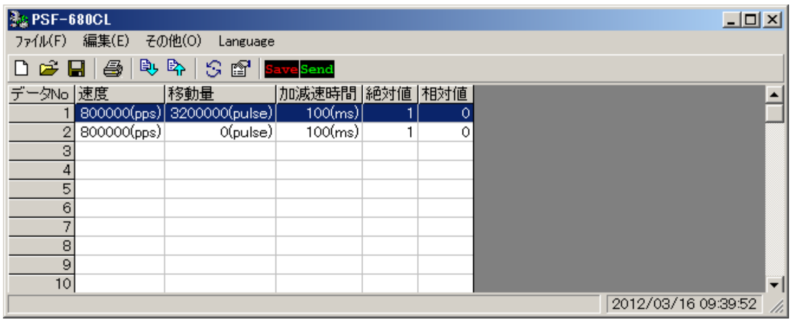
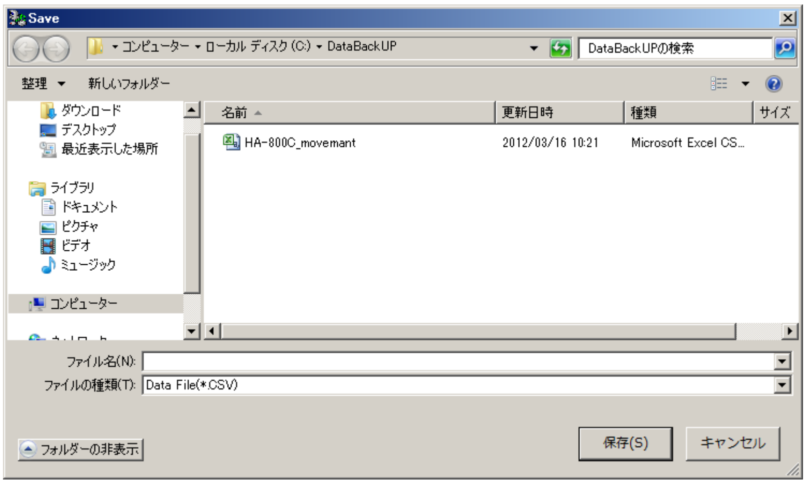
Appendix

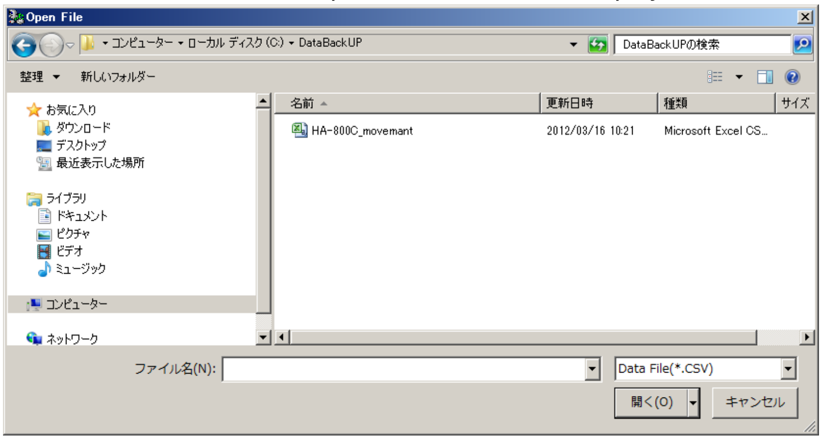
(3) The received data is displayed on the PSF-680CL screen.
Only the set operation data is displayed in numerical values.
Unset (unused) operation data is displayed as blank.

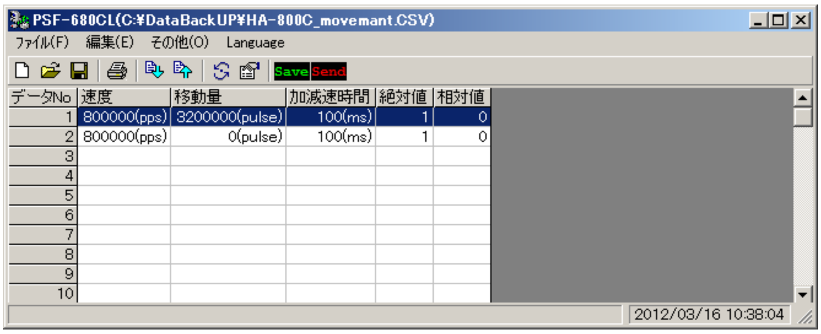


(4) Select "File" - "Save As" from the menu.
The SAVE screen like below is displayed. Enter the file name and "Save".
The operation data received from HA-800C servo driver (the operation data displayed on PSF-680CL screen) is saved in a file.(csv extension)



5. Writing operation data (write the saved operation data file to HA-800C)
(1) Start the PSF-680CL software.
(2) Select "File" - "Open" from the menu.
The Open File screen like below is displayed. Select the saved operation data file and "Open".
The contents of the saved operation data file are displayed on the PSF-680CL screen.





(3) Select "Edit" - "Transmit" from the menu.
The data transmission screen like below is displayed.

☐Check the "Transmit operation data".
〇Select the "Transmit All".
<u>☐Uncheck the "Transmit parameters".*1</u>

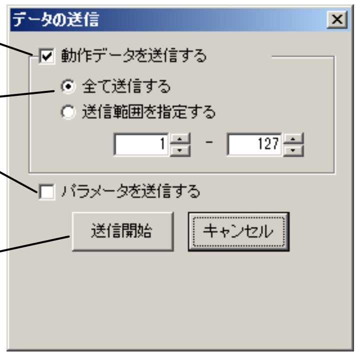
Click the "Start transmission" to transmit the operation data. The operation data displayed on the PSF-680CL screen is transmitted to the HA-800C servo driver.

Check the "Transmit operation data".

Select the "Transmit All".

Uncheck the "Transmit parameters".

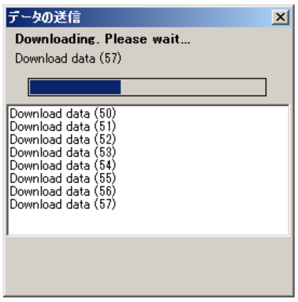
Click the "Start transmission" to transmit the operation data.



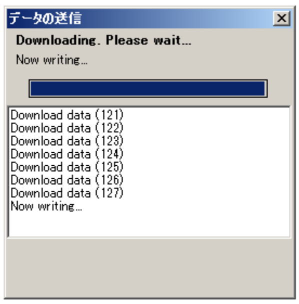
*1 Parameters in the "Transmit parameters" here refer to network parameters. Network parameters are copied using PSF-800.Therefore, when transmitting data from PSF-680CL, remove the check mark to disable the transmission.
If sent by mistake, by writing saved parameters with PSF-800, the correct values for the network parameters will be restored.

The below screen is displayed while the data is being transmitted.
Date (1) to (127) will be transmitted. After transmitting 127 operation data, writing to EEPROM is executed.(writing to EEPROM takes 20 seconds.) When writing is complete, the data transmission screen disappears.

Data being transmitted



Data being transmitted



Data being written to EEPROM

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Appendix

A -5 Actuator/motor replacement procedures

The following explains the procedures to replace the actuator/motor for maintenance.

○Actuator with incremental encoder ①

・For an application that does not perform the originating operation that is an embedded function of the HA-800C.

Procedures	Description		Places to check/Manual
1	Checking the items (items to be replaced)	Check the nameplate of the actuator currently used before the replacement.	Nameplate of the actuator main unit
2	Checking the items (new items)	Check the nameplate of the new actuator. Check that the model No. is the same as the one currently used. * If the model is different, it cannot be replaced.	
3	Replacing items	(1) Remove all the wiring from the actuator to be replaced. (2) Remove the actuator to be replaced from the machine. (3) Install the new actuator on the machine. (4) Connect the motor wires and encoder wires to the new driver.	
4	Checking the operation	(1) Connect the power to the driver. (2) Check that no error is present. (3) With the PSF-800 JOG operation, check if the rotating direction, etc. is the same as before replacement. (4) Perform tuning as necessary.	

*When the host controller controls the position using the actuator and motor phase-Z signals, a process is required to match the actuator and motor phase-Z signals with the mechanical system coordinates in the host controller.

CAUTION

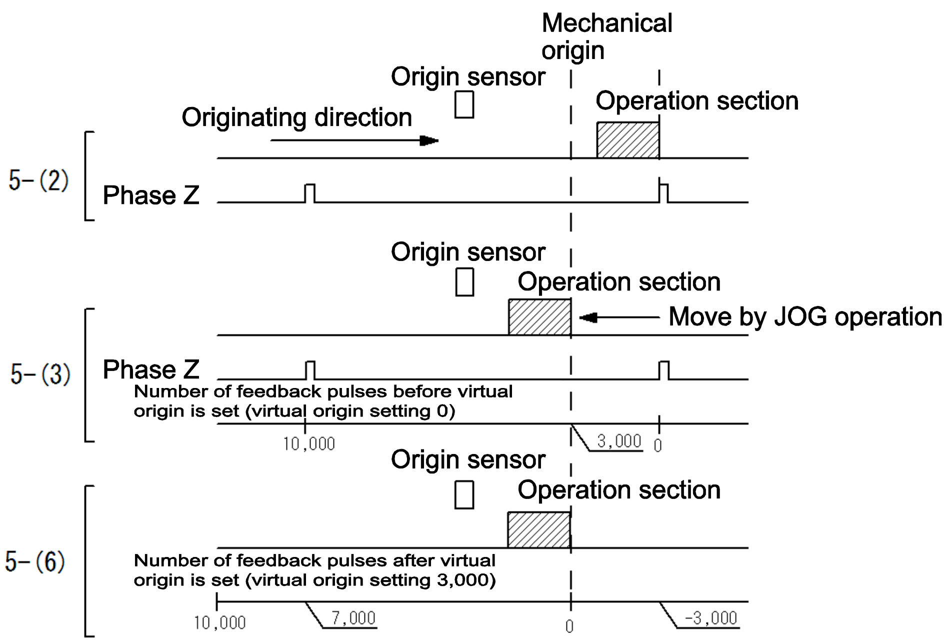
When replacing the actuator motor, adjustment of the device/machine coordinate settings may be required. Replace according to the specifications of the system, which includes the device main unit and host controller.
The replacement procedures explained in this manual is an example of the general replacement procedures.

○Actuator with incremental encoder ②

・For an application that performs the originating operation that is an embedded function of the HA-800C.

Procedures	Description		Places to check/Manual
to 4	Actuator with incremental encoder ① ・Same as for an application that does not perform the originating operation that is an embedded function of the HA-800C.		
5	Adjusting mechanical origin	(1) Clear the virtual origin setting that was used for the replaced actuator to 0 and reconnect the power. (At this time, write down the set values just in case.) (2) Perform the usual originating operation and check that the feedback pulse has been cleared to 0 with PSF-800. (3) By performing the JOG operation etc., move the operation section to the mechanical origin position of the system. (Be sure to carry out from the operation (2) without shutting down the power.) (4) Write down the number of feedback pulses while stopped at the mechanical origin position .(Be sure to carry out from the operation (2) without shutting down the power.) (5) Network parameter 07: Enter the value of (4) in the virtual origin and write to the driver. (writing with CC-Link command code is also possible) (6) After the power is reconnected, if you perform the originating operation, it stops at the mechanical origin position specified in (3) and the feedback pulse becomes 0.	Network parameters (1) Virtual origin setting before replacement : __________ (4) Number of feedback pulses at the mechanical origin position after replacement : __________

(Ex.) For the originating operation method that makes the first phase Z (after the origin sensor is passed) become the origin using an incremental encoder (example of when the number of feedback pulses in 5-(4) is 3,000.)



CAUTION

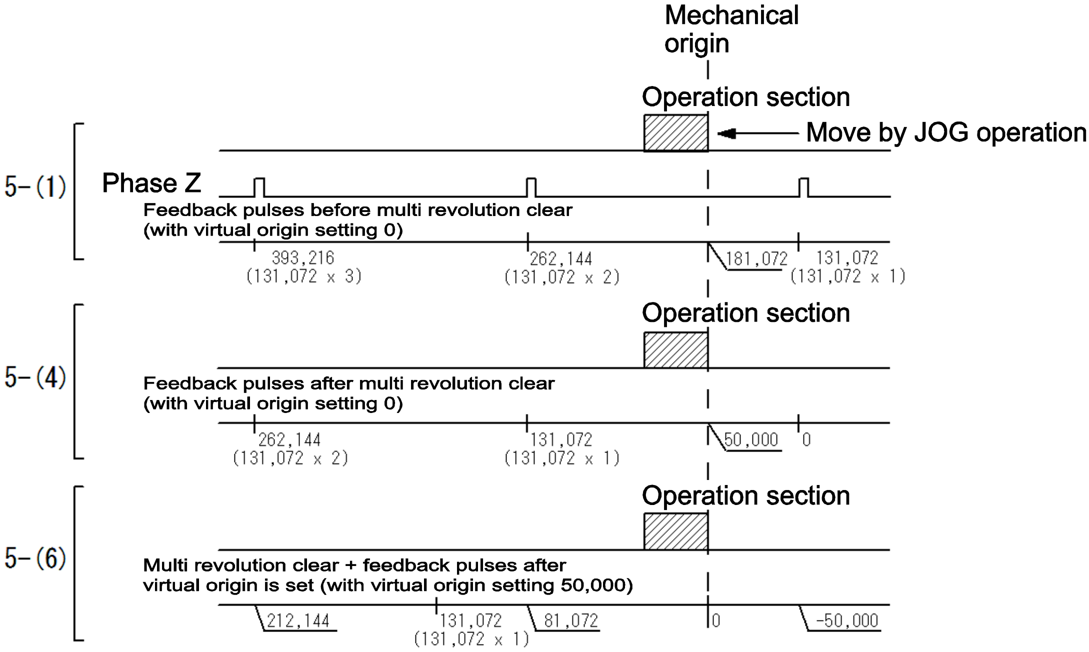
When replacing the actuator motor, adjustment of the device/machine coordinate settings may be required. Replace according to the specifications of the system, which includes the device main unit and host controller.
The replacement procedures explained in this manual is an example of the general replacement procedures.

○Actuator with absolute encoder

- For an application that performs the originating operation that is an embedded function of the HA-800C.
  (When using encoder 0 position as the origin)

Procedures	Description		Places to check/Manual
to 3	Actuator with incremental encoder ① ・Same as for an application that does not perform the originating operation that is an embedded function of the HA-800C.		
4	Checking the operation	(1) Connect the power to the driver. (2) When connecting the power for the first time, perform multi revolution clear (refer to P9-9) by operating the panel. (3) After reconnecting the power, with the PSF-800 JOG operation, check if the rotating direction is the same as before replacement. (4) Perform tuning as necessary.	Multi revolution clear operation HA-800C Manual P9-9
5	Adjusting mechanical origin (Refer to P4-8, P4-16)	(1) By performing the JOG operation etc., move the operation section to the mechanical origin position of the system. (2) Perform multi revolution clear by operating the panel. (3) Reconnect the power. (4) Check that the operation section is at the mechanical origin position and write down the number of feedback pulses displayed on PSF-800. If the operation section is moved from the mechanical origin due to gravity etc., move the operating section back to the mechanical origin position by JOG operation etc., then write down the number of feedback pulses. (5) Network parameter 07: Enter the value of (4) in the virtual origin and write to the driver. (writing with CC-Link command code is also possible) (6) After the power is reconnected, the set mechanical origin position becomes the feedback pulse number 0 position.	HA-800C Manual P4-8, P4-16 (4) Number of feedback pulses at the mechanical origin position after replacement : ________

(Ex) 17 bit absolute encodor origin setting related diagram (example of when the number of feedback pulses in 5-(4) is 50,000.)



CAUTION

When replacing the actuator motor, adjustment of the device/machine coordinate settings may be required. Replace according to the specifications of the system, which includes the device main unit and host controller.
The replacement procedures explained in this manual is an example of the general replacement procedures.

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Appendix

A -6 Notices for using SHA-CG(-S)

This explains the notices for when using the SHA-CG(-S)

Caution

- When using the SHA-CG series, always check the necessary setting, referencing [17-bit absolute encoder] (P4-4).

The SHA-CG(-S) has the following two features that differentiate it from previous SHA series (SHA-SG/HP).

1. Output shaft single revolution absolute model
2. Output shaft divide function

1. Output shaft single revolution absolute model

The SHA-CG output shaft single revolution absolute model (SHA-CG-S) assumes a machine that only moves the index table in one direction. When the machine continues to rotate in just one direction, the absolute encoder eventually exceeds the number of revolutions that can be detected with multi-revolution detection and it becomes impossible to manage position information accurately.
Therefore, each time the output shaft turns through single revolution, the cumulative multi revolution counter is cleared to 0 to achieve the output shaft single revolution absolute function. This is how position information is accurately managed when the shaft continuously turns in just one direction.
When using this function, set [SP66: Absolute encoder function setting] to 0.
Also, with the SHA-CG output shaft single revolution model, the output range of the CC-Link communication monitor code 0019h - 001Bh: ABS position readout is [0 - 2^{17} x speed reduction ratio -1] pulses.

2. Output shaft divide function

With the SHA-CG series, in order to make it easier to make the settings for performing index table and other indexing operations in units of the output shaft angle, operation commands can be set in the actuator in angle units with [SP67: Output shaft divide function setting] and the setting on the host device can be omitted.
With the [SP67: Output shaft divide function setting], the corresponding electronic gear value is set automatically from the SP67 setting and the applicable actuator.

SP67=0: According to [NP00: Actuator resolution]
SP67=1: Division of single output shaft rotation into 36,000 parts (equivalent to 0.01 degree resolution)
SP67=2: Division of single output shaft rotation into 360,000 parts (equivalent to 0.001 degree resolution)
SP67=3: Division of single output shaft rotation into 3,600,000 parts (equivalent to 0.0001 degree resolution)

Note that the output range and polarity of the CC-Link communication monitoring content below depend on [SP67: Output shaft divide function setting] and [SP50: instruction polarity] setting.

Caution

- [SP67: Output shaft divide function setting] is the function that sets the operation command resolution. It does not guarantee the precision of positioning on the output shaft. For details on the output shaft positioning precision, refer to [AC Servo Actuator SHA Series Manual].
- When changing [SP67: Output shaft divide function setting], be sure to reference the affecting range in [SP67: Output shaft divide function setting] (P8-10)
- When the output shaft divide function is enabled (other than when SP67=0 on the SHA-CG series), the distance and the output shaft rotational speed are set in angle units. Keep this mind when setting the point table data and originating speed.
- After setting the operation sequence on the host device, when [SP67: Output shaft divide function setting] is changed, the displacement, speed, and acceleration/deceleration time change a great deal from operations before the change, so always check and revise the operation data setting before operating.
- The lower speed limits according to the output shaft divide function setting are as follows.
  SP67=0: 125 pls/sec
  SP67=1: 1 x 0.01deg/sec
  SP67=2: 1 x 0.001deg/sec
  SP67=3: 1 x 0.0001deg/sec

Electronic gear value for when output shaft divide function is set

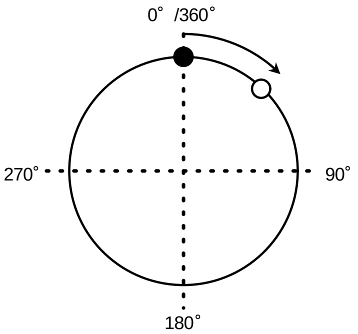
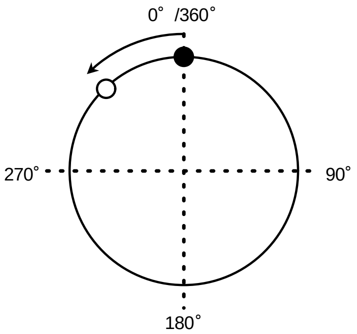
	SP67=1 36,000 divisions			SP67=2 360,000 divisions			SP67=3 3,600,000 divisions		
Reduction ratio	**Numerator**	**Denominator**	**Numerator/denominator**	**Numerator**	**Denominator**	**Numerator/denominator**	**Numerator**	**Denominator**	**Numerator/denominator**
50	8192	45	182.0	4096	225	18.2	2048	1125	1.82
80	65536	225	291.3	32768	1125	29.1	16384	5625	2.91
100	16384	45	364.1	8192	225	36.4	4096	1125	3.64
120	32768	75	436.9	16384	375	43.7	8192	1875	4.37
160	131072	225	582.5	65536	1125	58.3	32768	5625	5.83

Examples of combined operations
 Ex. 1: SHA-CG (-S), when output shaft divide function is not used (SP67=0)
 Ex. 2: SHA-CG (-S), when output shaft divide function is used (SP67=1)

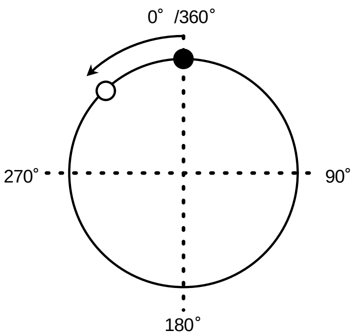
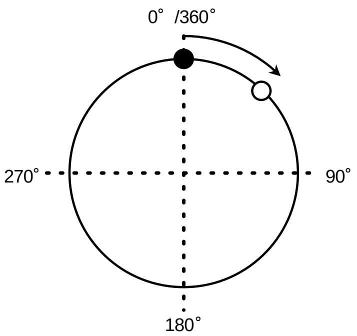
Ex. 1: SHA-CG (-S), when output shaft divide function is not used (SP67=0)

SHA25A50CG (Resolution of output shaft: 6553600 [pls/r]), [SP67: when output shaft divide setting] is 0.

When forward operation command is input (command pulses: 819200)

SP50=0 (default)	SP50=1
Clockwise rotation with command pulse increase 45° operation in clockwise direction  Actuator command pulses within a single revolution Actuator position within a single revolution Monitor data: 819200 Increase with clockwise rotation	Counter clockwise rotation with command pulse increase 45° operation in counter-clockwise direction  Actuator command pulses within a single revolution Actuator position within a single revolution Monitor data: 819200 Increase with counter-clockwise rotation

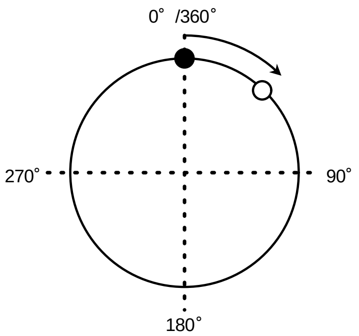
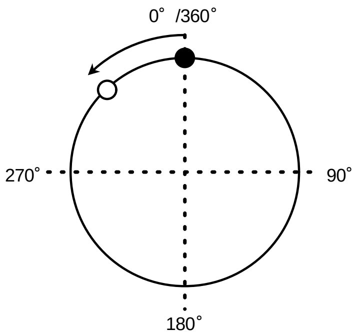
When reverse operation command is input (command pulses: 819200)

SP50=0 (default)	SP50=1
Counter clockwise rotation with command pulse decrease 45° operation in counter-clockwise direction  Actuator command pulses within a single revolution Actuator position within a single revolution Monitor data: 5734400 Increase with clockwise rotation	Clockwise rotation with command pulse decrease 45° operation in clockwise direction  Actuator command pulses within a single revolution Actuator position within a single revolution Monitor data: 5734400 Increase with counter-clockwise rotation

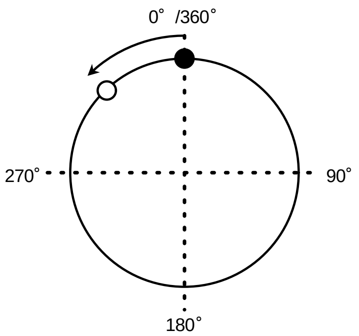
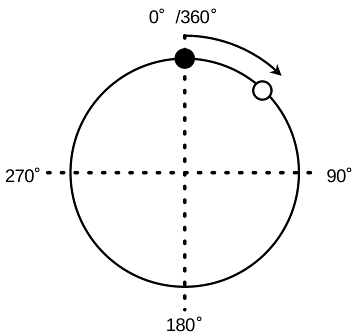
Ex. 2: SHA-CG (-S), when output shaft divide function is used (SP67=1)

SHA25A50CG (Resolution of output shaft: 6553600 [pls/r]), [SP67: when output shaft divide setting] is 1.

When forward operation command is input (command pulses: 4500)

SP50=0 (default)	SP50=1
Clockwise rotation with command pulse increase 45° operation in clockwise direction  Actuator command pulses within a single revolution Actuator position within a single revolution Monitor data: 4500 Increase with clockwise rotation	Counter clockwise rotation with command pulse increase 45° operation in counter-clockwise direction  Actuator command pulses within a single revolution Actuator position within a single revolution Monitor data: 4500 Increase with counter-clockwise rotation

When reverse operation command is input (command pulses: 4500)

SP50=0 (default)	SP50=1
Counter clockwise rotation with command pulse decrease 45° operation in counter-clockwise direction  Actuator command pulses within a single revolution Actuator position within a single revolution Monitor data: 31500 Increase with clockwise rotation	Clockwise rotation with command pulse decrease 45° operation in clockwise direction  Actuator command pulses within a single revolution Actuator position within a single revolution Monitor data: 31500 Increase with counter-clockwise rotation

Monitor value example

Value example: for output shaft resolution = 6553600 [pls/r], ([NP00: actuator resolution] = 6553600 (default value))

Monitor code No.	0005h	000Ah	001Eh	0010h	001Ch	0019h	
Description (units)	Cumulative command pulses (command pulse unit)	Cumulative feedback pulses (feedback pulse unit)	Cumulative feedback pulses (command pulse unit)	Command within a single revolution (command pulse unit)	Position within a single revolution (command pulse unit)	ABS position (feedback pulse unit)	
Actuator						Other than SHA-CG-S	SHA-CG-S
SP67: Output shaft divide function setting = 0[*1]	-6553601	-6553601	-6553601	6553599	6553599	-6553601	6553599
	-6553600	-6553600	-6553600	0	0	-6553600	0
	-6553599	-6553599	-6553599	1	1	-6553599	1
				・・・			
	-2	-2	-2	6553598	6553598	-2	6553598
	-1	-1	-1	6553599	6553599	-1	6553599
	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
				・・・			
	6553599	6553599	6553599	6553599	6553599	6553599	6553599
	6553600	6553600	6553600	0	0	6553600	0
	6553601	6553601	6553601	1	1	6553601	1
SP67: Output shaft divide function setting = 1[*2]	-36001	-6553783	-36001	35999	35999	-6553783	6553417
	-36000	-6553600	-36000	0	0	-6553600	0
	-35999	-6553418	-35999	1	1	-6553418	182
				・・・			
	-2	-365	-2	35998	35998	-365	6553235
	-1	-183	-1	35999	35999	-183	6553417
	0	0	0	0	0	0	0
	1	182	1	1	1	182	182
	2	364	2	2	2	364	364
				・・・			
	35999	6553417	35999	35999	35999	6553417	6553417
	36000	6553600	36000	0	0	6553600	0
	36001	6553782	36001	1	1	6553782	182

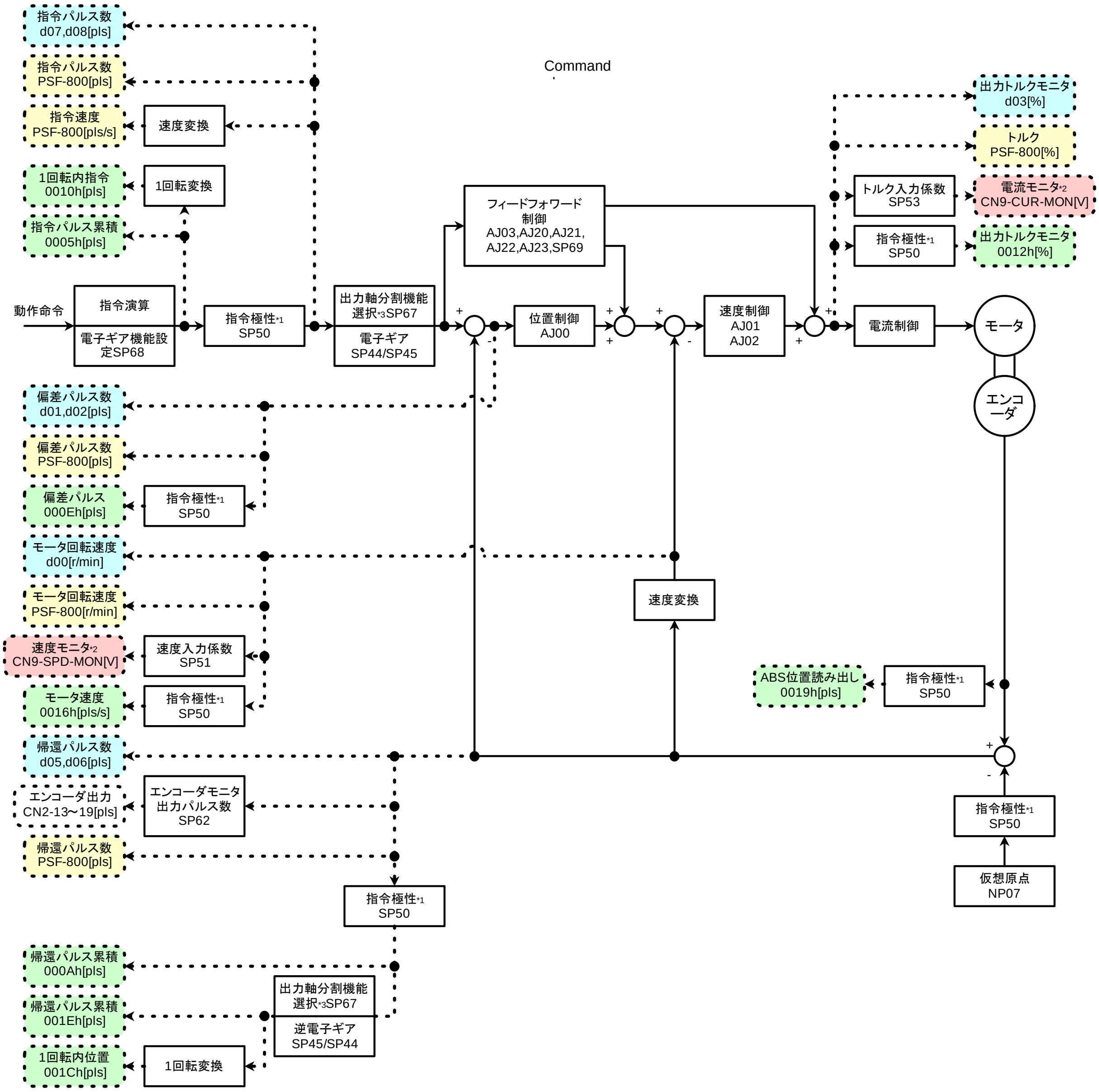
*1: Value example for when [SP67: Output shaft divide function setting] = 0 and the electronic gear ratio (SP44/SP45) is 1.

*2: Same as the above example, the meanings of the command pulse unit and feedback pulse unit values are different when [SP67: Output shaft divide function setting] = 2,3 or the electronic gear ratio (SP44/SP45) is other than 1. For an actuator with [Output shaft resolution: 6553600], [Feedback pulse unit: 6553600] is equivalent to [Command pulse unit: 360000] when P67=2, and [Command pulse unit: 3600000] when SP67=3. When the electronic gear ratio (SP44/SP45) is other than 1, [Feedback pulse unit: 6553600] is equivalent to [Command pulse unit: Actuator resolution (NP00)].

Caution

- The reference coordinate system for [0010h: Actuator command pulses within a single revolution] and [001Bh: Actuator position within a single revolution] are as follows according to [SP67: Output shaft divide function setting].
  SP67=0: NP00 pls/r
  SP67=1:36000 pls/r
  SP67=2: 360000 pls/r
  SP67=3: 3600000 pls/r
- With an actuator that has an incremental encoder, when the electronic gear ratio [SP44/SP45] is set to other than 1/1, set [NP00: Actuator resolution] as follows.
  NP00 = Output shaft resolution (NP00 default value) / Electronic gear ratio (SP44/45)

A-7 Control block diagram



*1: When [SP50: Command polarity] is set to 0, this is equivalent to multiplying the command pulses by +1. When it is set to 1, this is equivalent to multiplying the command pulses by -1.
*2: For details on the calculation of the motor rpm [r/min] and current A from the [Speed monitor] and [Current monitor] monitor voltage, refer to [Monitor output] (P5-8).
*3: Converts the encoder pulse units to command pulse units according to [SP67: Output shaft divide function setting].

Apx

Appendix

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Warranty period and terms

The warranty period of the HA-800C 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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All specifications and dimensions in this manual subject to change without notice.
This manual is correct as of February 2023.

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