HarmonicDrive ®

AC Servo Driver for
24 VDC Power Supply

HA-680 Series Manual

(For FHA-8C, 11C, 14C/RSF-3A, and 5A)

● Thank you very much for your purchasing our HA-680 series AC servo driver for 24 VDC power supply.

● Parameter setting for this servo driver requires dedicated communication software PSF-520.

(The dedicated communication software can be downloaded from our website at http://www.hds.co.jp/.)

● Be sure to use sufficient safety measures when installing and operating the equipment so as to prevent an accident resulting in a serious physical injury damaged by a malfunction or improper operation.

● 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.

SOFTWARE Ver.1.0

ISO14001
（HOTAKA Plant）
ISO9001

TÜV
SUD
ISO 14001
ISO 9001
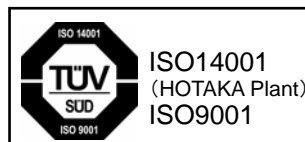
SAFETY GUIDE

For FHA series, RSF series, HA series
manufactured by Harmonic Drive Systems Inc
Read this manual thoroughly before designing the application, installation, maintenance or inspection of the actuator.

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.

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.

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

CAUTIONS FOR ACTUATORS AT APPLICATION DESIGNING

CAUTION Always use under followings conditions: -Ambient temperature: 0°C to 40°C -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	**CAUTION** 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

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

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. -Ambient temperature: 0(C to 50(C -Ambient humidity: less than 95% RH (Non condensation) -No contamination by water, oil or foreign matters -No corrosive, inflammable or explosive gas -No water or oil near devices	**CAUTION** Use sufficient noise suppressing means and safe grounding. -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.
CAUTION 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.	**CAUTION** Use a fast-response type ground-fault detector designed for PWM inverters. -Do not use a time-delay-type ground-fault detector.

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.	**WARNING** Use the specified power supply -To supply power to the 24VDC driver (HA-680 Series), use the secondary-side power supply with double insulation from the primary side.
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.	**CAUTION** 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.

Contents

MEMO

Chapter 1 Outlines of HA-680 driver

The HA-680 driver for 24VDC power supply is a dedicated driver that drives the FHA-C mini 24VAC type, an ultra-thin, hollow shaft structure actuator with a combination of an ultra-thin, precision control reduction gear Harmonic Drive® and flat AC servo motor, and the RSF supermini series, an ultra-small AC servo actuator with a combination of an ultra-small Harmonic Drive and ultra-small AC servo motor.

The HA-680 drivers provide many superior functions to allow the FHA-Cmini 24VAC type actuators and RSF supermini series actuators to excel in performance.

1-1   Main features

◆ Small and compact design

It is about half the size of a postcard, just the size of a card case. Its ultra-light design with a weight of 230 g is useful for small, space-saving devices.

◆ Substantial functions

Position control, speed control, and torque control are provided as standard. It is compact and has substantial functions at the same time.

◆ Easy function setting

Parameters can be set easily using dedicated communication software PSF-520.

◆ Wide range of operation state display

I/O signals, rotation speed, and deviation can be monitored using dedicated communication software PSF-520.

Up to eight previous alarms are also indicated as alarm history that is helpful for diagnosis.

◆ The main circuit power supply and the control power supply are separated.

Because the main circuit power supply and the control power supply are separated, safe diagnosis can be performed in case of failure.

◆ Easy test run adjustment

Adjustment can be performed using dedicated communication software PSF-520.

◆ Electronic gear suitable for mechanical system

The electronic gear function adjusts commands to a feed pitch of a driven mechanism such as gears or lead screws.

◆ Three types of input signals for position commands

Three types of input signals for the position command are selectable: two-pulse train, single-pulse train, and two-phase pulse train.

◆ Regenerative circuit provided as standard

It incorporates a regenerative circuit as standard. You can use it in applications with a large moment of inertia without worrying about regeneration.

1-2 Model of HA-680 driver

Model and sign of HA-680 driver are described as follows:

Note that the model varies depending on the actuator used.

◆ **HA-680 driver:**

HA-680-4 □-200

- AC servo driver
- 680 series
- Nominal current

4	4A
6	6A

- Corresponding sign
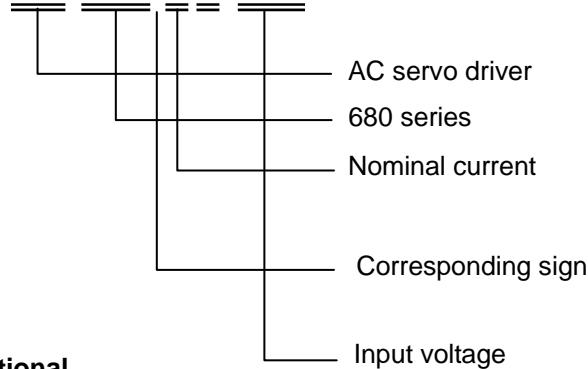
None	For FHA-Cmini 24VAC type
B	For RSF supermini series

- Input voltage

24	24VDC

● **Optional**

◆ **Extension cables: For FHA-Cmini 24VAC type (optional)**

	for HA-680
for a motor	EWC - MB * * -A06 – TN2
for an encoder	EWC - E * * -M06 - 3M14
for EIA-232C	HDM-RS232C (cable length: 1.5m)

* * means cable length: 03: 3m, 05: 5m, 10: 10m (three kinds of length are available.)

◆ **Extension cables: For RSF supermini series (optional)**

（**Require for connecting actuator and driver**）

	for HA-680
for a motor	EWC - M* * -JST04 – TN2
for an encoder	EWC - E * * -M09 - 3M14
for EIA-232C	HDM-RS232C (cable length: 1.5m)

* * means cable length: 03: 3m, 05: 5m, 10: 10m (three kinds of length are available.)

◆ **Connectors (optional): CNK-HA68-S1 / CNK-HA68-S2**

◆ **Dedicated communication software (provided free of charge): PSF-520**

Parameter setting and change can be performed using dedicated communication software PSF-520.

Dedicated communication software PSF-520 can be downloaded from our website at http://www. hds.co.jp/.

If you do not have an environment to download it from the Internet, please ask one of our branch offices.

1-3 Combinations with actuators

Five HA-680 models are available for use with actuators dealing with their nominal current and encoder systems. The correct combinations are as follows:

Model	HA-680-4-24	HA-680-6-24	HA-680-4B-24
Actuator model	FHA-8C-xx-E200-CE FHA-11C-xx-E200-CE	FHA-14C-xx-E200-CE	RSF-3A-xx-E020-C RSF-5A-xx-E050-C RSF-5A-xx-E050-BC

1-4 Specifications of HA-680 drivers

Item \ Driver model		HA-680-4-24		HA-680-6-24	HA-680-4B-24	
Combined actuator		FHA-8C-xx-E200-CE	FHA-11C-xx-E200-CE	FHA-14C-xx-E200-CE	RSF-3A-xx-E020-C	RSF-5A-xx-E050 RSF-5A-xx-E050-B
Allowable continuous current (Arms) note2		1.8	3.9	6.0	0. 65	1.2
Instantaneous max. current (Arms) note3		3.4	8.4	16.5	1. 2	2.3
Supply voltage	Control circuit power supply (CP)	DC24V(20~28V)				
	Main circuit power supply (MP)	DC24V(20~28V)				
Control method		Sinusoidal PWM control switching frequency 12.5kHz				
Encoder		4-line specification, serial transmission method, line driver input			14-line specification Line driver input	
I/O signal		DI: 5 points (insulation with phto coupler) DO: 5 points (insulation with phto coupler) Variable function assignment				
Encoder monitor		Phase-A,B,Z line driver output Phase-Z open collector output (insulation with phto coupler)				
Control mode		Speed, position and torque control				
Display		LED 2 points（green:1 point red:1 point） For power on, servo-on, alarm operation state display				
Speed control	Command voltage	DC0V~±10V/maxium speed				
	Input signal	FWD-enable, REV-enable, Alarm clear, Speed Command internal/external switch, Speed limiting, Current limiting				
	Output signal	Attained speed, Alarm, ready, limiting speed, limiting current, Phase-Z open collector output				
	Speed control range	1:1000 or more				
Position control	Command pulse interface	Line driver: 500kp/s(max) open collector: 200kp/s(max)				
	Command configuration	2- pulse (FWD/REV pulse train), 1 pulse method (sign+pulse train), 2-phase pulse method (90-degree phase difference 2-phase pulse train)				
	Input signal	FWD-inhibit, REV-inhibit, clear, Deviation clear, Speed limiting, Current limiting				
	Output signal	In-position, alarm, ready, limiting speed, limiting current, Phase-Z open collector output				
Torque control	Command voltage	DC0V~±10V/Max. torque				
	Input signal	FDW rotation start, REV rotation start, alarm clear, torque command internal/external switch, current limit				
	Output signal	Attained speed, alarm, operation ready, limiting current, Phase-Z open collector output				
Protection function		Overload, Max. deviation, Encoder break detection, encoder reception error, UVW error, regenerative error, operating temperature error, system error, overcurrent, load short circuit, memory error, overspeed				
Connector		I/O: 3M half-pitch 26-pin encoder: 3M half-pitch 14-pin RS-232C: Small-type 8-pin CAN: RJ type				
Regenerative absorption circuit		Incorporated (with an external capacitor/resistor installation terminal). The built-in resistance has a fuse.				
Structure		Semi-covered type (aluminum base with plastic cover)				
Installation method		Base mount (wall installation)				
Mass		230g				
Ambient conditions		Operating temp:0~50°C Storage temp:-20~85°C Operating humidity/storage humidity:95%RH or less (no condensation) No vibration or physical shock. No powder dust, metal powder, corrosive gas, flammable gas, or oil mist. No water or oil splashed. To be used indoors. No direct sunlight.				

Note 1: Parameter setting of this driver is performed depending on the actuator combined with it. It cannot be used for any other actuator.

Note 2: The value of the allowable continuous current is affected by the combination of the actuator.

Note 3: The value of the instantaneous maximum current is affected by the combination of the actuator.

1-5   External drawing of the HA-680 drivers

The HA-680 driver model indication and the mark shown in this manual are as follows:

Unit: mm
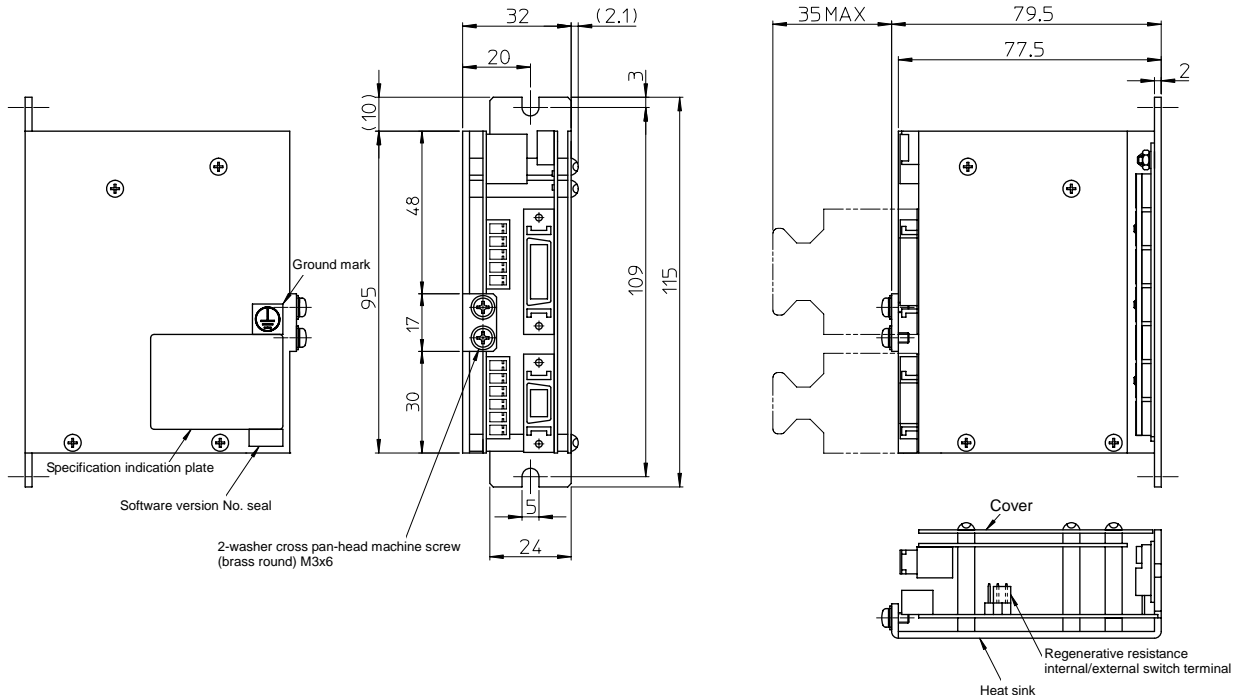
When HA-680 drivers are installed in a cabinet, leave enough ventilation space for cooling as shown below.
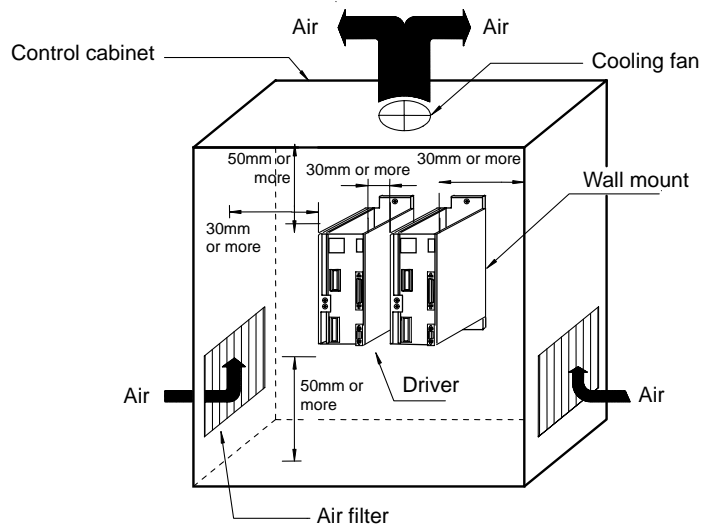
1-6 Names and functions of parts

- CN5: Not available (on the side)

- CN4: CAN connector

- CN3: EIA-232C serial port connector

- CAN terminal resistance switch jumper

- LED display

- TB2: Power supply connection terminal

- Ground connection terminal

- CN2: Control I/O connector

- CN1: Encoder connector

- TB1: Actuator/external regenerative resistance connection terminal

- Regenerative resistance switch jumper (on the side)

LED display unit

Displays the operation state of the HA-680 driver with the green and red LEDs.

TB2: Power supply connection terminals

The terminals for power supply. These are divided into terminals for the control circuit power supply and terminals for the main circuit power supply.

TB1: Actuator/external regenerative resistance connection terminal

The lead line of the actuator and an external regenerative resistance are connected here.

CN1: Encoder connector

The position detection encoder cable of the actuator is connected here.

CN2: Control I/O connector

This connector is for receiving control signals from the host controller.

CN3: Serial port connector

The connector for connection with a PC. This is used for monitoring the output current and setting parameters.

Connection with a PC requires dedicated communication cable "HDM-RS232C." Parameter setting requires dedicated communication software PSF-520.

CN4: CAN connector

Connector for CAN communication.

Note: Currently not available. For details, contact one of our branch offices.

CN5: Not available

This connector is for manufacture only. The customer should never use it.

Ground connection terminal

This terminal is for grounding. Connect the ground (earth) line here to prevent electric shock.

CAN terminal resistance switch jumper

Enables or disables the terminal resistance for CAN.

Note: Currently, the CAN function is not installed. Therefore, setting this jumper is meaningless.

Regenerative resistance switch jumper

Switches between the internal regenerative resistance and the external regenerative resistance. Installing the jumper between the center pin and left pin selects the internal regenerative resistance, and installing the jumper between the center pin and right pin selects the external regenerative resistance.

For details, refer to 3-8 Connecting regenerative absorption resistances/capacitors.

1-7 Outlines of I/O ports

1-7-1   TB2: Power supply connection terminal

Pin No.	Signal name	Description	
1	CP+	Control circuit power supply + (DC+24V)	
2	CP-	Control circuit power supply – (0V)	For details, refer to 3-5.
3	MP+	Main circuit power supply + (DC+24V)	
4	MP-	Main circuit power supply – (0V)	
5	NC	Do not connect	

1-7-2   TB1: Actuator connection terminal

Pin No.	Signal name	Description	
1	VM	External capacitor connection terminal	
2	R	External regenerative resistance connection terminal	For details, refer to 3-8.
3	GND	External capacitor/regenerative resistance connection terminal	
4	U	Actuator U-side connection terminal	
5	V	Actuator V-side connection terminal	For details, refer to 3-7.
6	W	Actuator W-side connection terminal	

1-7-3(1) CN1: Encoder connector (For FHA-Cmini 24VAC-type actuators)

Pin No.	Signal name	Description
1	Vcc	The power is supplied from the inside of the servo amplifier with the +5 V power supplied to the encoder.
2	NC	Do not connect.
3		
4		
5	SD+	Input terminal for the encoder data input signal from the actuator
6	NC	Do not connect.
7	SD-	Input terminal for the encoder data input signal from the actuator
8	GND	Common terminal of the +5 V power supplied to the encoder
9	NC	Do not connect.
10		
11		
12		
13		
14		

1-7-3(2) CN1: Encoder connector (For RSF supermini series actuators)

Pin No.	Signal name	Description
1	Vcc	The power is supplied from the inside of the servo amplifier with the +5 V power supplied to the encoder.
2	B+	Phase-B signal input+(LD)
3	Z+	Phase-Z signal input +(LD)
4	B-	Phase-B signal input -(LD)
5	A+	Phase-A signal input +(LD)
6	Z-	Phase-Z signal input -(LD)
7	A-	Phase-A signal input +(LD)
8	GND	Common terminal of the +5 V power supplied to the encoder
9	U+	Phase-U signal input +(LD)
10	U-	Phase-U signal input -(LD)
11	V+	Phase-V signal input +(LD)
12	V-	Phase-V signal input -(LD)
13	W+	Phase-Wsignal input +(LD)
14	W-	Phase-Wsignal input -(LD)

Note 1: LD indicates the line driver.

1-7-4   CN3: Serial port connector

Pin No.	Signal name	Description
1	FG	Frame ground
2	RXD	Transmission data
3	TXD	Reception data
4	DTR	Data terminal ready
5	GND	Signal ground
6	DSR	Data set ready
7	NC	Do not connect.
8	NC	Do not connect.

(Dedicated communication cable "HDM-RS232C" is required.)

1-7-5   CN4: CAN connector

Pin No.	Signal name	Description
1	CANH	CAN-High signal
2	CANL	CAN-Low signal
3	NC	Do not connect.
4	NC	Do not connect.
5	NC	Do not connect.
6	NC	Do not connect.
7	NC	Do not connect.
8	NC	Do not connect.

Note: Currently not available.

1-8 CN2: Overview of I/O signal

The CN2 connector performs input and output of control signals with the host control device. The connector has 26 pins, which are assigned for "position control," "speed control," and "torque control" as shown in the table below.

Position control

Pin No.	Signal	Symbol	I/O
1	Output 1 (in-position ready)	IN-POS	Output
2	Output 2(Alarm Output)	ALARM	Output
3	Output 3	—	Output
4	Output 4	—	Output
5	Output 5 (Phase-Z OC Output)	Z	Output
6	Output signal common	OUT-COM	Output
7	Input 1 (Servo-ON)	S-ON	Input
8	Input 2	—	Input
9	Input 3	—	Input
10	Input 4	—	Input
11	Input 5	—	Input
12	Input signal common	IN-COM	Input
13	Encoder monitor GND	MON-GND	Output
14	FWD pulse +	FWD+	Input
15	FWD pulse -	FWD-	Input
16	REV pulse +	REV+	Input
17	REV pulse -	REV-	Input
18	+24v	+24v	Input
19	—	—	—
20	—	—	—
21	Phase-A Output + (LD)	A+	Output
22	Phase-A Output - (LD)	A-	Output
23	Phase-B Output + (LD)	B+	Output
24	Phase-B Output - (LD)	B-	Output
25	Phase-Z Output + (LD)	Z+	Output
26	Phase-Z Output - (LD)	Z-	Output

Speed control

Pin No.	Signal	Symbol	I/O
1	Output 1(Attained speed Output)	HI-SPD	Output
2	Output 2 (Alarm Output)	ALARM	Output
3	Output 3	—	Output
4	Output 4	—	Output
5	Output 5 (Phase-Z OC Output)	Z	Output
6	Output signal common	OUT-COM	Output
7	Input 1 (Servo-ON)	S-ON	Input
8	Input 2 (FWD start)	FWD-EN	Input
9	Input 3 (REV start)	REV-EN	Input
10	Input 4	—	Input
11	Input 5	—	Input
12	Input signal common	IN-COM	Input
13	Encoder monitor GND	MON-GND	Input
14	—	—	—
15	—	—	—
16	—	—	—
17	—	—	—
18	—	—	—
19	Speed command	SPD-CMD	Input
20	Speed command ground	SPD-GND	Input
21	Phase-A Output + (LD)	A+	Output
22	Phase-A Output - (LD)	A-	Output
23	Phase-B Output + (LD)	B+	Output
24	Phase-B Output - (LD)	B-	Output
25	Phase-Z Output + (LD)	Z+	Output
26	Phase-Z Output - (LD)	Z-	Output

Note 1: OC indicates the open collector. LD indicates the line driver.

Note 2: For terminals without a signal name for input and output, function assignment can be changed in parameter setting. For details, refer to 2-1.

> ⚠ **CAUTION**
>
> **Do not connect the pins with "-" in the Signal column to the external device.**
> **If you do, failure may occur because it is connected to the internal circuit.**

Torque control

Pin No.	Signal	Symbol	I/O
1	Output 1 (Attained speed)	HI-SPD	Output
2	Output 2 (Alarm)	ALARM	Output
3	Output 3 (operation ready)	READY	Output
4	Output 4 (limiting current)	CUR-LMT-M	Output
5	Output 5 (Phase-Z Output OC)	Z	Output
6	Output signal common	OUT-COM	Output
7	Input 1(Servo-ON)	S-ON	Input
8	Input 2 (FWD start)	FWD-EN	Input
9	Input 3 (REV start)	REV-EN	Input
10	Input 4	—	Input
11	Input 5	—	Input
12	Input signal common	IN-COM	Input
13	Encoder monitor GND	MON-GND	Output
14	—	—	—
15	—	—	—
16	—	—	—
17	—	—	—
18	—	—	—
19	Torque command	TRQ-CMD	Input
20	Torque command ground	TRQ-GND	Input
21	Phase-A Output + (LD)	A+	Output
22	Phase-A Output - (LD)	A-	Output
23	Phase-B Output + (LD)	B+	Output
24	Phase-B Output - (LD)	B-	Output
25	Phase-Z Output + (LD)	Z+	Output
26	Phase-Z Output - (LD)	Z-	Output

Note 1: OC indicates the open collector. LD indicates the line driver.

Note 2: For Input 4 and Input 5, function assignment can be changed in parameter setting. For details, refer to 2-1.

⚠ CAUTION	**Do not connect the pins with "-" in the Signal column to the external device.** **If you do, failure may occur because it is connected to the internal circuit.**

1-9 LED display

The 2 LEDs (green and red) indicate the state of the HA-680 driver.

State	LED green	LED red	Remarks
Control power ON	ON	OFF	
The connected actuator and the actuator set to the driver are different.	Blinking	OFF	
Servo-ON	ON	ON	
Alarm (*1)	ON	Blinking	The number of times it blinks varies depending on the alarm. Refer to 1-10.
CPU error	Blinking	Blinking	The green and red LEDs blink alternately.

*1 If two or more alarms occur, only the latest alarm is displayed.

1-10 Outline of protective functions

The HA-680 driver has various types of protection function. When an error occurs in the system, it immediately turns off the servo, and outputs an "alarm" signal to the host device.

When these protection functions trip, driving of the actuator is stopped (the motor becomes servo-off), and the display LED blinks at 0.5-second intervals. (It illuminates in green and blinks in red: The number of times it blinks varies depending on the alarm. See below.)

If two or more alarms occur, only the latest alarm is displayed. Up to 8 latest alarms are recorded. Recorded alarms can be checked with "Alarm History" of dedicated communication software PSF-520.

Alarm code	Description	No. of times LED blinks	Releasing
Overload	Electronic thermal detected an overload state.	1	Available *1
Deviation counter overflow	The value of the deviation counter exceeded the parameter setting value.	2	Available *1
Encoder break detection	The encoder line was broken.	3	Not available *2
Encoder reception error	Serial encoder data could not be received 10 times in a row.	4	Not available *2
	Serial encoder data could not be received over an extended time period, and encoder monitor could not be outputted successfully.	5	
UVW error	All UVW signals of the encoder became the same level.	6	Not available *2
Regenerative error	The main circuit voltage detection circuit detected overvoltage.	7	Not available *2
Operation temperature error	The temperature of the HA-680 main unit tripped the temperature rise sensor.	8	Not available *2
System error	An error of the current detection circuit was detected.	9	Not available *2
Overcurrent	The current detection circuit detected excessive current.	10	Not available *2
Load short circuit	Excessive current flowed through the FET.	11	Not available *2
Memory error	Read/write of EEPROM failed.	12	Not available *2
Overspeed	The motor axis speed exceeded the maximum rotation speed +100 rpm for 0.5 s or longer.	13	Not available *2

*1 The servo does not turn on unless the S-ON signal is entered again after the alarm is cleared with the CLR signal.

*2: Shut off the power supply after remedying a cause of the alarm that releasing is impossible. Then turn on the power supply.

The following example illustrates how the LED blinks in case of an alarm.
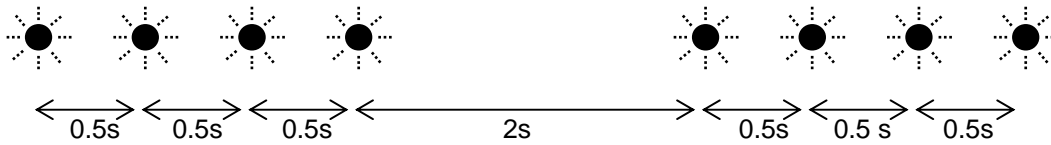
| $\leftarrow$ 0.5s $\rightarrow$ | $\leftarrow$ 0.5s $\rightarrow$ | $\leftarrow$ 0.5s $\rightarrow$ | $\leftarrow$ 2s $\rightarrow$ | $\leftarrow$ 0.5s $\rightarrow$ | $\leftarrow$ 0.5 s $\rightarrow$ | $\leftarrow$ 0.5s $\rightarrow$ |

In the above example, the LED blinks 4 times at 0.5-s intervals, which indicates an "encoder reception error."

1-11　　Protective functions

HA-680 drivers provide the following protective functions and show the alarm displays on 1-10.

◆ Overload

The driver always monitors the motor current, and if the current exceeds the curve in the figure below, the overload alarm occurs. Occurrence of the overload alarm varies depending on the actuator.

Overload alarm occurrence time

FHA-C mini AC24V type

RSF supermini series

FHA-C mini AC24V type	RSF supermini series (RSF-5A)
(1)　The alarm occurs when a current of more than 1.25 times the allowable continuous current of the actuator flows for about 170 seconds.	(1)　The alarm occurs when a current of more than 1.2 times the allowable continuous current of the actuator flows for about 35 seconds.
(2)　The alarm occurs when a current of 3 times the allowable continuous current of the actuator flows for about 16 seconds.	(2)　The alarm occurs when a current of 2 times the allowable continuous current of the actuator flows for about 5 seconds.

It is possible to clear the alarm by inputting ON signal to [CN2 Clear or Alarm clear] if it is not overload, again.

◆ Deviation counter overflow

The alarm occurs when the value of the deviation counter exceeds the parameter setting value (PSF-520 No.21 Allowable position deviation). This alarm can be reset by inputting an ON signal to "CN2 Alarm Clear: ALM-CLR" after inputting an ON signal to "CN2 Clear: CLEAR" or "CN2 Deviation Clear: DEV-CLR."

◆ Encoder break detection

This alarm occurs when the signal from the encoder is lost. To reset the alarm, you must shut down the power and turn it on again after diagnosing the cause.

◆ Encoder reception error

This alarm occurs when data cannot be received from the encoder successfully, or encoder signal output cannot be performed.

◆ UVW error

The alarm occurs when the encoder UVW signals are abnormal. To reset the alarm, you must shut down the power and turn it on again after diagnosing the cause.

To clear the alarm after troubleshooting, shut off the control power once and turn it on again.

◆ Regenerative error

The alarm occurs when the voltage of the main circuit exceeds 50 V. If the moment of inertia of the load is large, the main circuit voltage increases due to the energy generated during deceleration of the actuator.

The regenerative resistance of the regenerative absorption circuit incorporates a fuse. When the temperature of the regenerative resistance increases due to excessive regeneration and the fuse is blown, the regenerative circuit no longer works, and the main circuit voltage increases. If the regenerative error occurs immediately the control circuit power is shut down and turned on again, it may be due to a blown fuse. In this case, connect the external regenerative resistance and switch the jumper setting.

For connection of an external regenerative resistance and change of the jumper setting, refer to 3-8.

◆ Operating temperature error

The alarm occurs when the temperature of the HA-680 main unit increases and the temperature sensor trips. To reset the alarm, you must shut down the power and turn it on again after diagnosing the cause.

◆ System error

This alarm occurs when an error of the motor current detection circuit is detected. To reset the alarm, you must shut down the power and turn it on again after diagnosing the cause.

◆ Overcurrent

This alarm occurs when overcurrent is detected by the motor current detection circuit. To reset the alarm, you must shut down the power and turn it on again after diagnosing the cause.

◆ Load short circuit

The alarm occurs when excessive current flows through the FET. To reset the alarm, you must shut down the power and turn it on again after diagnosing the cause.

◆ Memory error

The alarm occurs when read/write fails due to failure of the EEPROM memory of the driver. It can be reset by shutting down the power and turning it on again. However, if the same phenomenon persists, it may be due to failure. Contact one of our branch offices.

◆ Overspeed

The alarm occurs when the rotation speed of the actuator exceeds the motor axis maximum rotation speed +100 rpm for 0.5 s or longer. To clear the alarm, shut off the control power once and turn it on again.

Chapter 2 I/O ports

The HA-680 driver exchanges signals with the host device via the CN2 connector (26-pin half-pitch connector). This chapter describes the details of the I/O signals.

2-1 Assignment of I/O signals

2-1-1   Assignment of input signals

Assignment of input signals varies depending on the setting value of "11: Input function assignment" in "Parameter" as shown below. For the setting method, refer to Chapter 6 "Parameter setting" and PSF-520 User's Manual.

・**Position control, input signal assignment parameter**

Setting value	CN2 Pin No.							
	Servo-ON	FWD inhibit	REV inhibit	Clear	Alarm clear	Deviation clear	Speed limiting	Current limiting
0	7	8	9	—	10	11	—	—
1	7	8	9	10	—	—	11	—
2	7	8	9	10	—	—	—	11
3	7	—	—	—	8	9	10	11

Note: The setting value "0" is the initial setting value.

・**Speed control, input signal assignment parameter**

Setting value	CN2 Pin No.						
	Servo-ON	FWD start	REV start	Alarm clear	External/ Internal command	Speed limiting	Current limiting
0	7	8	9	10	—	11	—
1	7	8	9	10	—	—	11
2	7	8	9	—	—	10	11
3	7	8	9	10	11	—	—
4	7	8	9	—	10	11	—
5	7	8	9	—	10	—	11

Note: The setting value "0" is the initial setting value.

・**Torque control, input signal assignment parameter**

Setting value	CN2 Pin No.					
	Servo-ON	FWD start	REV start	Alarm clear	External/ Internal command	Current limiting
0	7	8	9	10	—	11
1	7	8	9	10	11	—
2	7	8	9	—	10	11

Note: The setting value "0" is the initial setting value.

2-1-2　Assignment of output signals

Assignment of output signals varies depending on the setting value of "12: Output function assignment" in "Parameter" as shown below. For the setting method, refer to Chapter 6 "Parameter setting."

・**Position control, output signal assignment parameter**

Setting value	CN2 Pin No.					
	In-position ready	Alarm	Operation ready	Limiting speed	Limiting current	Phase-Z OC output
0	1	2	3	4	—	5
1	1	2	3	—	4	5
2	1	2	—	3	4	5

Note: The setting value "0" is the initial setting value.

・**Speed control, output signal assignment parameter**

Setting value	CN2 Pin No.					
	Attained speed	Alarm	Operation ready	Limiting speed	Limiting current	Phase-Z OC output
0	1	2	3	4	—	5
1	1	2	3	—	4	5
2	1	2	—	3	4	5

Note: The setting value "0" is the initial setting value.

・**Torque control, output signal assignment parameter**

Setting value	CN2 Pin No.				
	Attained speed	Alarm	Operation ready	Limiting current	Phase-Z OC output
0	1	2	3	4	5

Note: The setting value "0" is the initial setting value.

2-1-3　Type of I/O signal connector CN2

The models of the CN2 connector is as follows:

　　Connector:　10126-3000VE　　3M

　　Cover:　　　10326-52F0-008　3M
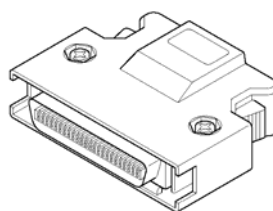
2-2　Position control

2-2-1　I/O port layout

The I/O port layout is shown as follows:

Pin	Signal name	Symbol	I/O	Pin	Signal name	Symbol	I/O
1	Output 1 (in-position ready)	IN-POS	Output	14	FWD pulse+	FWD+	Input
2	Output 2 (alarm output)	ALARM	Output	15	FWD pulse-	FWD-	Input
3	Output 3	—	Output	16	REV pulse+	REV+	Input
4	Output 4	—	Output	17	REV pulse-	REV-	Input
5	Output 5 (Phase-Z OC output)	Z	Output	18	+24V	+24V	Input
6	Output signal common	OUT-COM	Output	19	—	—	—
7	Input 1 (Servo-ON)	S-ON	Input	20	—	—	—
8	Input 2	—	Input	21	Phase-A output +(LD)	A+	Output
9	Input 3	—	Input	22	Phase-A output -(LD)	A-	Output
10	Input 4	—	Input	23	Phase-B output +(LD)	B+	Output
11	Input 5	—	Input	24	Phase-B output -(LD)	B-	Output
12	Input signal common	IN-COM	Input	25	Phase-Z output +(LD)	Z+	Output
13	Encoder Monitor ground	MON-GND	Output	26	Phase-Z output -(LD)	Z-	Output

Note 1: OC: open collector port, LD: line driver port

Note 2: Function assignment can be performed for the input signals other than servo on (8 to 11 pin) and the output signals of Outputs 3 and 4 (3, 4 pin).

Note 3: Logic change can be performed for the I/O signals other than Output 5 (Phase-Z OC output) using "13: Input pin logic setting" and "14: Output pin logic setting" in "Parameter."

Note 4: "Pin number 18 +24 V" is not the built-in power supply. The HA-680 driver does not incorporate the internal power supply for pulse input signals. For pulse input signals, an external +24-V power supply must be supplied.

> ⚠ **CAUTION**
>
> **Do not connect the pins with "-" in the Signal column to the external device.**
> **If you do, failure may occur because it is connected to the internal circuit.**

2-2-2   I/O port connections in the position control

This section describes the connection between the I/O ports and a host in the position control.

● Input signal

The HA-680 driver provides five ports for inputs as shown in the figure to the right.

◆ Specifications

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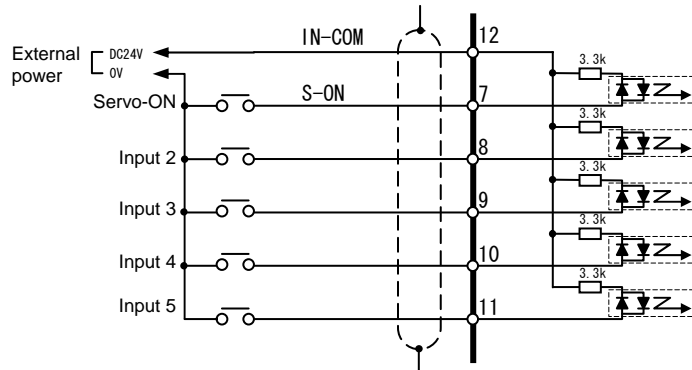
◆ Connection

The HA-680 driver does not provide the power supply for input signals. Connect a [+24V] power supply for the signals to [CN2-12: input signal common].
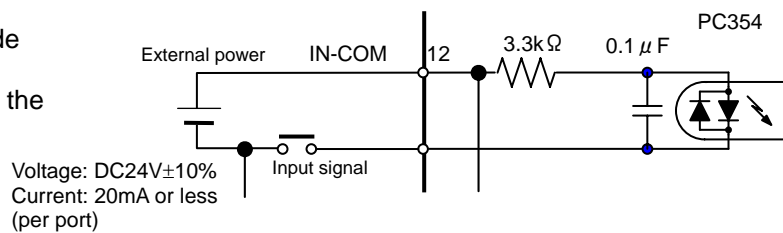
◆ Output signal

The HA-680 driver provides five ports for outputs as shown in the figure to the right.

◆ Specifications

Port: Open collector
Voltage: DC24V or less
Current: 40mA or less (per port)
Every port is insulated by an photocoupler.
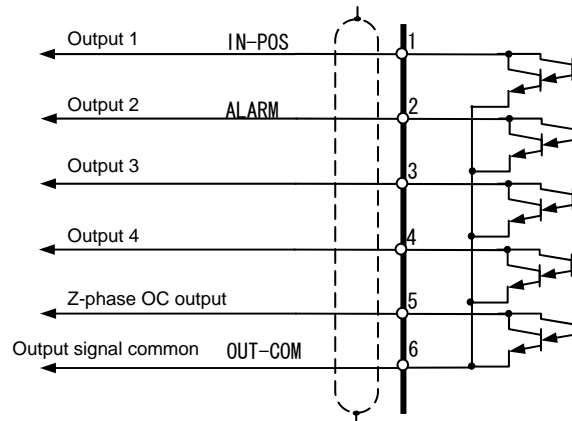
◆ Connections

Connect output signals between their respective output ports and [CN2-6: output signal common] port.
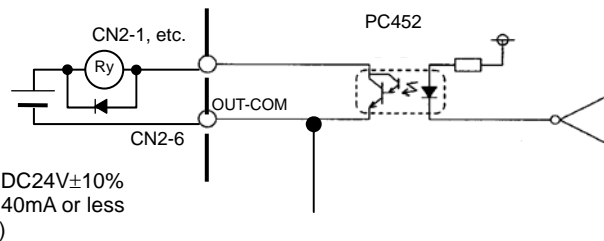
● **Monitor outputs**

The HA-680 driver provides 6 ports of 3 signals for encoder monitoring as shown in the figure to the right.

◆ **Specifications**

The phase-A, -B, and -Z signals are transmitted by line drivers (26LS31).

◆ **Connections**

Receive the signals by line receivers (AM26LS32 or equivalent).
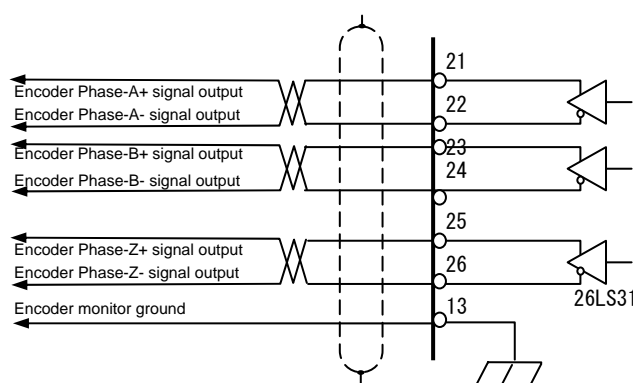
2-2-3   I/O port functions in the position control

This section describes I/O port functions in the position control.

CN2-1 In-position: IN-POS (output)

● **Function**

The signal is outputted as in-position ready when the deviation count becomes less than the value of [parameter]→[22: in-position ready range]. The output may be used to confirm in-position ready signal, etc. in a host.

Logic change can be performed with "14: Output pin logic setting" in "Parameter." With the fault value, the output transistor is turned on when the pulse-accumulated amount of the deviation counter is less than the positioning completion range setting value.

● **Connection**

(1)   The figure to the right is a connection example of [CN2-1 in-position ready: IN-POS] port.

(2)   Configure the output circuit for the ports as follows:
Supply voltage: +24V or less
Signal current: 40mA or less   (per port)
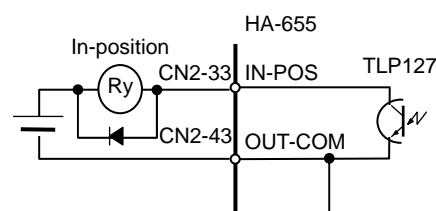
CN2-2 Alarm: ALARM (output)

● **Function**

The output turns OFF when HA-680 driver senses an alarm. The output is [NC contact (b-contact) signal].

Logic change can be performed with "14: Output pin logic setting" in "Parameter." With the fault value, the transistor is turned on during normal operation, and turned off when an error is detected.

● **Connection**

(1)   The figure to the right is a connection example of [CN2-2 Alarm: ALARM] port.

(2)   Configure the output circuit for the ports as follows:
Supply voltage: +24V or less
Signal current: 40mA or less   (per port)
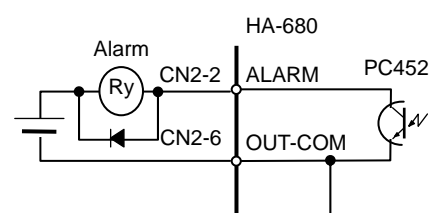
(I/O signal functions for position control)

CN2-3 Ready: READY (output)

● Function

The output turns ON when the driver becomes ready to drive after initialization, and the driver is possible to communicate with a host.

Note: The signal keeps ON even at alarm happening.

Logic change can be performed with "14: Output pin logic setting" in "Parameter." With the fault value, the transistor is turned on in the operation ready state.

● Connections

(1) The figure to the right is a connection example of [CN2-3 Ready: READY] port.

(2) Configure the output circuit for the ports as follows:
Supply voltage: +24V or less
Signal current: 40mA or less   (per port)
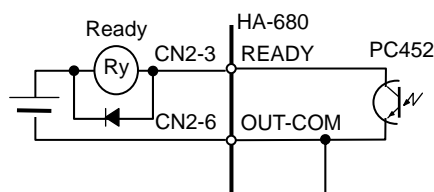
Can be set to CN2-3 or 4 Speed limiting: SPD-LMT-M (output)

● Function

This is outputted while the speed limit input signal is inputted and the speed is limited to the specified speed.

Logic change can be performed with "14: Output pin logic setting" in "Parameter." With the fault value, the transistor is turned on while the speed is limited.

● Connection

(1) Speed limited to CN2-3: An example of connection when SPD-LTM-M is set is shown.

(2) Configure the output circuit for the ports as follows:
Supply voltage: +24V or less
Signal current: 40mA or less   (per port)
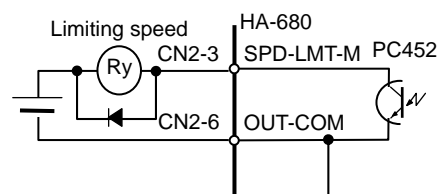
Can be set to CN2-4 Current limiting: CUR-LMT-M (output)

● Function

This is outputted while the current limit input signal is inputted and the current is limited to the specified current.

Logic change can be performed with "14: Output pin logic setting" in "Parameter."

● Connection

(1) The figure to the right is a connection example of [CN2-4 Current limiting: CUR-LMT-M] port.

(2) Configure the output circuit for the ports as follows:
Supply voltage: +24V or less
Signal current: 40mA or less   (per port)
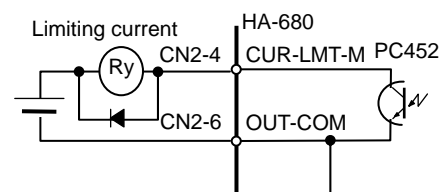
(I/O signal functions for position control)

CN2-5 Phase-Z (OC): Z (output)

● Function

The port outputs phase-Z pulse signal of the encoder. The signal is outputted one pulse per every one motor rotation. The signal may be used with the mechanical origin signal as a precise origin of the driven mechanism.

The transistor is turned on during Phase-Z output.

● Connection

(1) The figure to the right is a connection example of [CN2-5 Phase-Z: Z] port.

(2) The output signal is insulated by photocouplers. (Response frequency: 10kHz max)

(3) Configure the output circuit for the ports as follows:
Supply voltage: +24V or less
Signal current: 40mA or less   (per port)
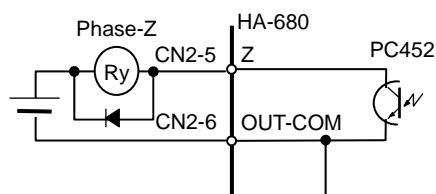
CN2-6 Output signal common: OUT-COM (output signal)

● Funtions

The common terminal for output signals CN2-1, 2, 3, 4, and 5

CN2-7 Servo-ON: S-ON (input)

● Function

This turns the servo power for the HA-680 driver ON and OFF.

After turning the input ON, the servo power of the HA-680 driver is ON and the actuator can be driven. When OFF, the servo power turns OFF and the motor is free to rotate.

Logic change can be performed with "13: Input pin logic setting" in "Parameter." With the fault value, the servo on state occurs when the input signal is on.

● Connection

Connect "NO (a contact) contact signal."

Connect +24 V of the input signal external power supply to "CN2-12 Input signal common."

Can be set to CN2-8 FWD inhibit: FWD-IH (input)
Can be set to CN2-9 REV-inhibit: REV-IH (input)

● Function

[FWD inhibit]: open state (OFF) of the input inhibits forward rotation.

[REV inhibit]: open state (OFF) of the input inhibits reverse rotation.

Open states (OFF) of both inputs inhibit rotation.

The inputs may be used to limit the motion range of load mechanism between limit sensors.

Logic change can be performed with "13: Input pin logic setting" in "Parameter." With the fault value, the prohibition state can be cleared with the input signal on (close).

● Connection

Connect "NC contact (b contact) signal." Connect +24 V of the input signal external power supply to "CN2-12 Input signal common."
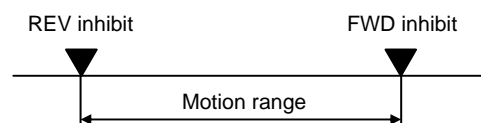
Can be set to CN2-10 Clear: CLEAR (input)

● Function

(1) If an alarm exists:
    This clears the alarm state, returns to operable state, and clears the deviation count to [0]. For alarms that cannot be cleared, shut off the control power once, and turn it on again.
(2) If no alarm exists:
    This clears the deviation count to [0]. At the same time, this clears the command count and the feedback count. At the same time, the command pulse count is set to the same value as the returned pulse count.

Logic change can be performed with "13: Input pin logic setting" in "Parameter." With the fault value, the clear function works at the edge of the input signal ON.

● Connection

Connect "NO (a contact) contact signal." Connect +24 V of the input signal external power supply to "CN2-12 Input signal common."

Can be set to CN2-8 or 10 Alarm clear: ALM-CLR (input)

● Function

This signal clears the alarm state and makes it ready for operation. However, the deviation count overflow error becomes the operation ready state when alarm clear: ALM-CLR is inputted after deviation clear: DEV-CLR is inputted.

When an alarm that cannot be cleared occurs, shut down the main circuit power supply and control circuit power supply, remove the cause of the alarm, and then turn on the power again.

Logic change can be performed with "13: Input pin logic setting" in "Parameter." With the fault value, the alarm clear function works at the edge of the input signal ON.

● Connection

Connect "NO (a contact) contact signal." Connect +24 V of the input signal external power supply to "CN2-12 Input signal common."

(I/O signal functions for position control)

Can be set to CN2-9 or 11 Deviation clear: DEV-CLR (input)

● Function

This signal clears the deviation counter and sets the deviation pulse count to "0." At the same time, the command pulse count is set to the same value as the returned pulse count.

Logic change can be performed with "13: Input pin logic setting" in "Parameter." With the fault value, the deviation clear function works at the ON edge of the input signal ON.

● Connection

Connect "NO (a contact) contact signal." Connect +24 V of the input signal external power supply to "CN2-12 Input signal common."

Can be set to CN2-10 or 11 Speed limiting: SPD-LMT (input)

● Function

This signal limits the speed to the value set in "16: Speed limit" in "Parameter."

If you continue to input a command pulse over the limit speed, the "deviation counter overflow" alarm occurs. This alarm can be cleared by "CN2 Clear: CLEAR" or "CN2 Alarm clear: ALM-CLR." Be careful when you release it because the speed increases instantaneously when the limit is released while the speed is limited.

Logic change can be performed with "13: Input pin logic setting" in "Parameter." With the fault value, the speed limit state occurs when the input signal is on.

● Connection

Connect "NO (a contact) contact signal." Connect +24 V of the input signal external power supply to "CN2-12 Input signal common."

Can be set to CN2-11 Current limiting: CUR-LMT (input)

● Function

This signal limits the current below the value set in "17: Forward rotation current limit" and "18: Reverse rotation current limit" in "Parameter."

If you continue to input a command pulse while the current is limited and no acceleration to the speed is possible because the current is limited, the "deviation counter overflow" alarm occurs. This alarm can be cleared by "CN2 Clear: CLEAR" or "CN2 Alarm clear: ALM-CLR." Be careful when you release it because the speed increases instantaneously when the limit is released while the current is limited.

Logic change can be performed with "13: Input pin logic setting" in "Parameter." With the fault value, the current limit state occurs when the input signal is on.

● Connection

Connect "NO (a contact) contact signal." Connect +24 V of the input signal external power supply to "CN2-12 Input signal common."

CN2-12 Input signal common: IN-COM (input)

● Function

The common for input signals CN2-7, 8, 9, 10, and 11. It provides the input signal external power supply.

● Connection

Connect +24 V of the input signal external power supply.

(I/O signal functions for position control)

CN2-13 Encoder monitor ground: MON-GND (output)

● Function

The common for encoder monitor terminals C2-21 to 26.

● Connection

Make connection as the ground for encoder monitor terminals C2-21 to 26.

CN2-14,15 FWD pulse: FWD+, FWD- (input)
CN2-16,17 REV pulse: REV+, REV- (input)
CN2-18 +24V：+24V (input)

● Function

These ports receive position commands in the position control.

The both [line driver] and [open collector] can be used for the commands. For the [open collector] system, both signal voltage of [+24V] and [+5V] are acceptable. The connection to the ports is different in the selections.

Note 1: The power supply to the port [CN2-26 +24V] is user's responsibility. The HA-655 driver does not have an internal power supply for inputs.

Note 2: Three types of command configurations of [2-pulse],[1-pulse],[2 phase pulse] are available by setting [parameter]→[25: command pulse input configuration]. This has no effect on the connection specifications.

Note 3: The host circuitry for the command pulses should be negative logic circuitry in which a lower voltage (OFF) is used as a logic "1" (active state) and a higher voltage level (ON) is used as a logic "0" (inactive state). In the case of [2-pulse] configuration, the opt-isolator of the no input pulses is OFF state.

Note 4: No command pulse can be accepted during servo off.

● Connection for open collector system

The details of the input ports are shown on the next page.

Specifications of the input ports are as follows:

Specifications of the input ports

(1) Power voltage:
     In case of +24V: +24V±10%
     In case of +5V: +5V±10%
(2) Signal current: 16mA (less than 20mA)

(I/O signal functions for position control)

> ⚠ **CAUTION**
>
> ### The connections are deferent by the supply voltage.
>
> The pin numbers to be connected are deferent by the supply voltage of [+5V] or [+24V]. The wrong connection may damage the driver.

◆ Connection for open collector commands and +24V power supply

(1) Connect FWD command to [CN2-15: FWD-] and [+24V].

(2) Connect REV command to [CN2-17: REV-] and [+24V].

(3) Connect [+24V] of external power supply to [CN2-18: +24V].

(4) Plan the command circuit for the ports as follows:
Supply voltage: +24V±10%
Signal current: 16mA (less than 20mA)
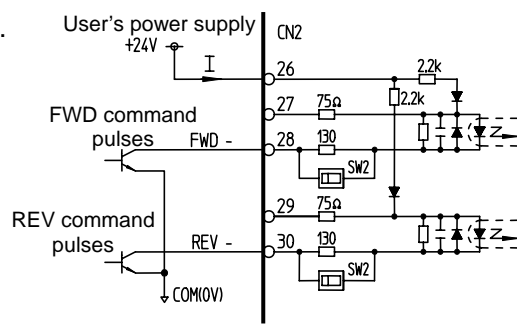
◆ Connection for open collector commands and +5V power supply

(1) Connect FWD command to [CN2-14: FWD+] and [CN2-15: FWD-].

(2) Connect REV command to [CN2-16: REV+] and [CN2-17: REV-].

(3) Open [CN2-18: +24V].

(4) Plan the command circuit for the ports as follows:
Supply voltage: +5V±10%
Signal current: 16mA (less than 20mA)
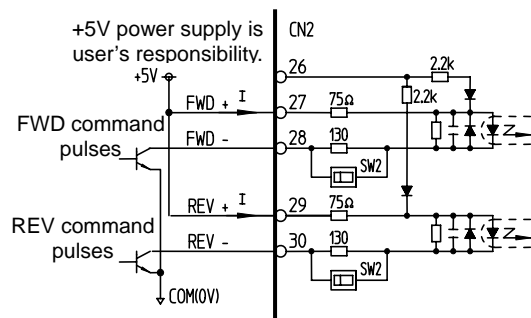
Note: Use resistances to suppress rush current to command circuits (FWD- and REV-).

● Connections for Line driver system

(1) Connect FWD command to [CN2-14: FWD+] and [CN2-15: FWD-].

(2) Connect REV command to [CN2-16: REV+] and [CN2-17: REV-].

(3) Open [CN2-18: +24V].

Note: Use line drivers of EIA-422A standard. If you want to use line drivers of other standard, technical arrangement with us is required.
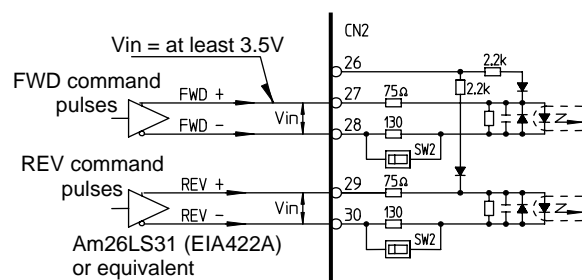
(I/O signal functions for position control)

CN2-21 Phase-A +(LD): A+ (output)
CN2-22 Phase-A -(LD): A- (output)
CN2-23 Phase-B +(LD): B+ (output)
CN2-24 Phase-B -(LD): B- (output)
CN2-25 Phase-Z+(LD): Z+ (output)
CN2-26 Phase-Z -(LD): Z- (output)

● **Function**

These ports transmit encoder signals of Phase-A, -B, -Z through the line driver (26LS31).

● **Connection**

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

Note: Use EIA-422A standard for line receiver.
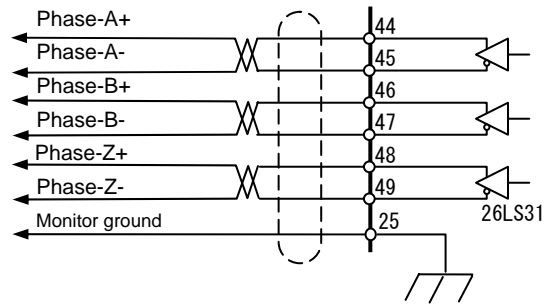
2-2-4　Connection examples in the position control
◆ Connection example 1-1: FHA-C mini 24VAC type

The figure below shows a connection example in the position control for [open collector] signals. The command format is "2 pulse method," and the setting values of "Parameter 11: Input function assignment" and "Parameter 12: Output function assignment" are "0." Note that the connection example varies depending on the actuator.

HA-680_V04
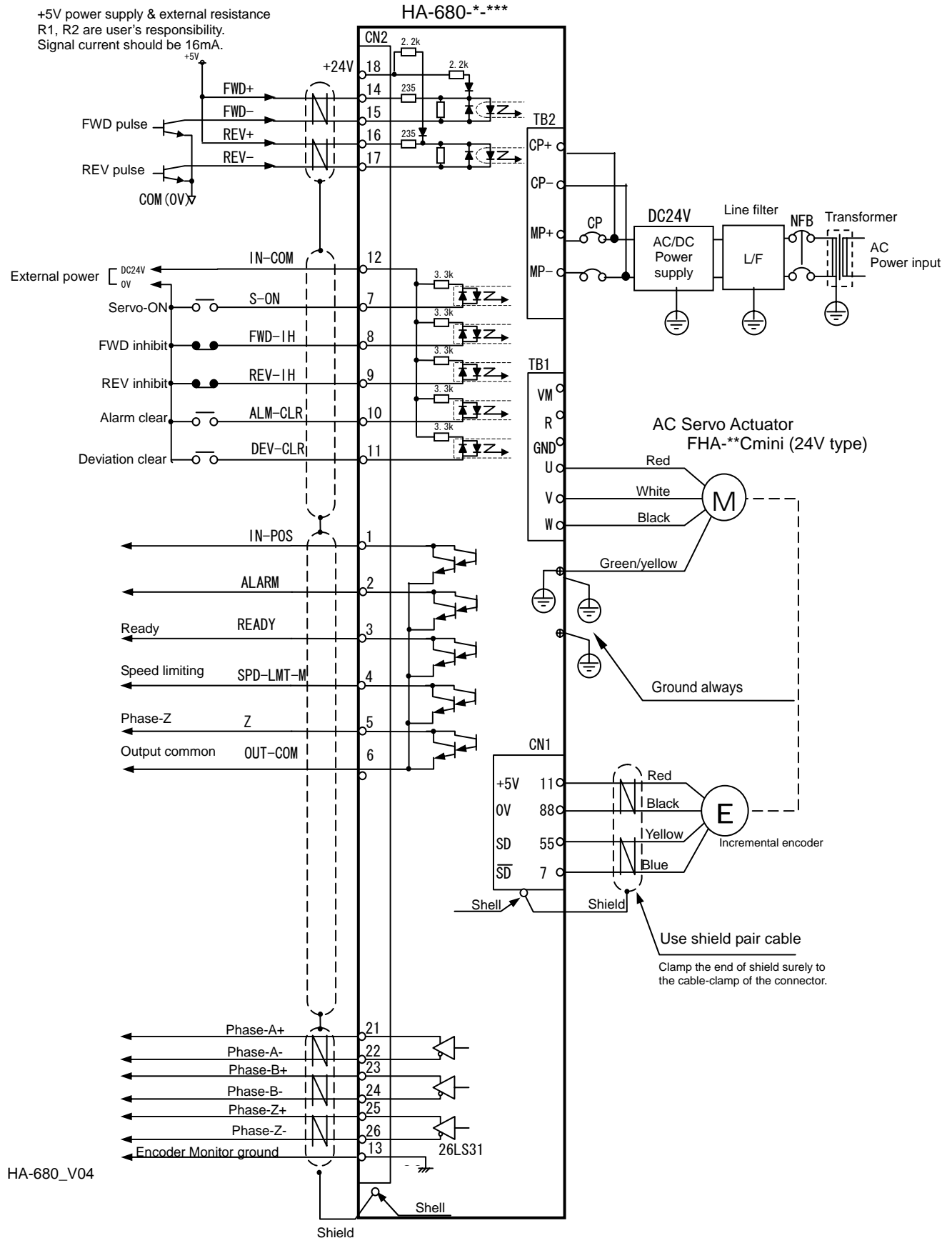
◆ Connection example 1-2: RSF supermini series

The figure below shows a connection example in the position control for [open collector] signals. The command format is "2 pulse method," and the setting values of "Parameter 11: Input function assignment" and "Parameter 12: Output function assignment" are "0." Note that the connection example varies depending on the actuator.

+5V power supply & external resistance R1, R2 are user's responsibility. Signal current should be 16mA.

HA-680-4B-24
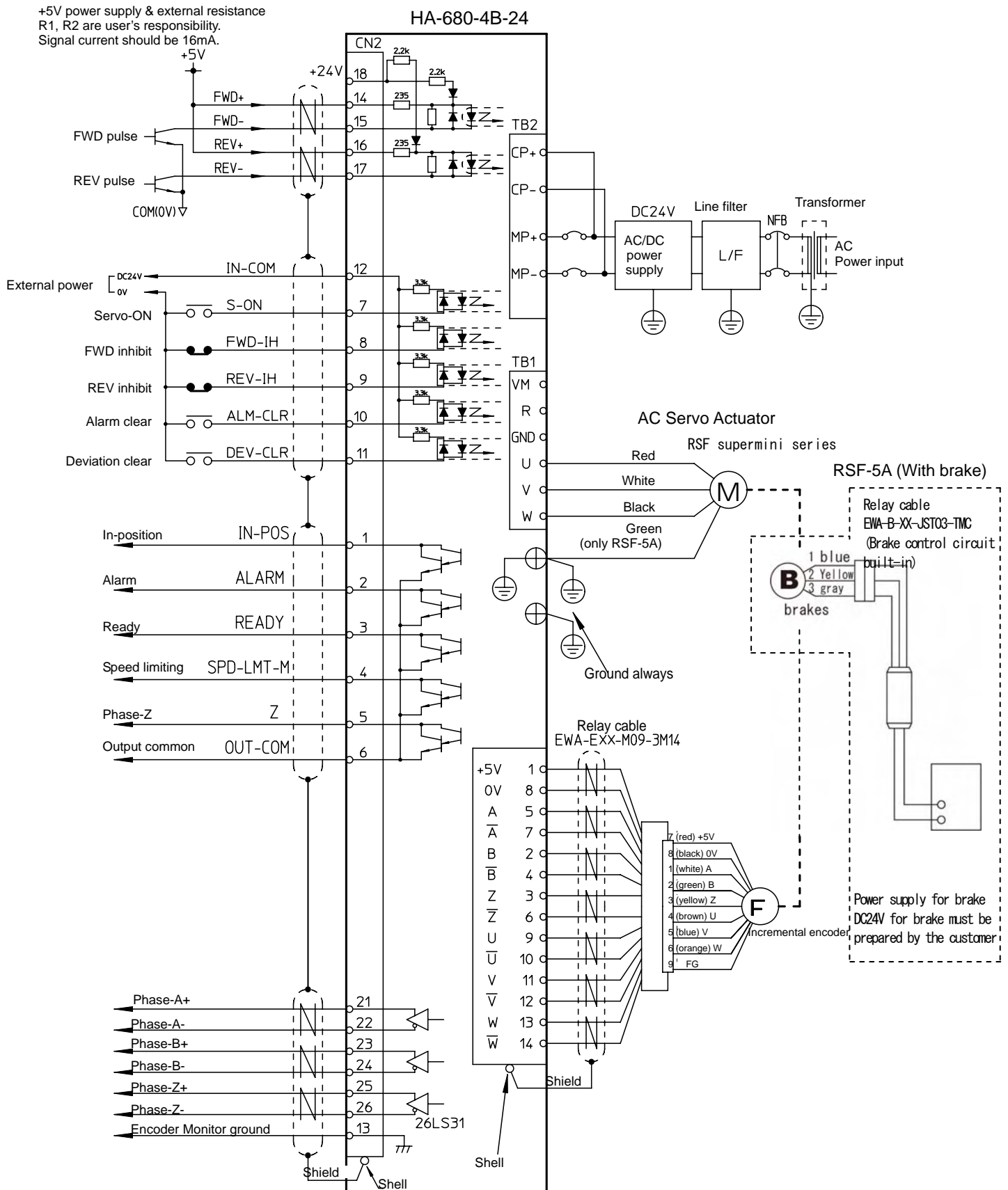
Connection example 2-1: FHA-C mini 24VAC type

The figure below shows a connection example in the position control for [line driver] signals. The command format is "2 pulse method," and the setting values of "Parameter 11: Input function assignment" and "Parameter 12: Output function assignment" are "0." Note that the connection example varies depending on the actuator.

◆

HA-680_V04

Connection example 2-2: RSF supermini series

The command format is "2 pulse method," and the setting values of "Parameter 11: Input function assignment" and "Parameter 12: Output function assignment" are "0." Note that the connection example varies depending on the actuator.

HA-680_V04
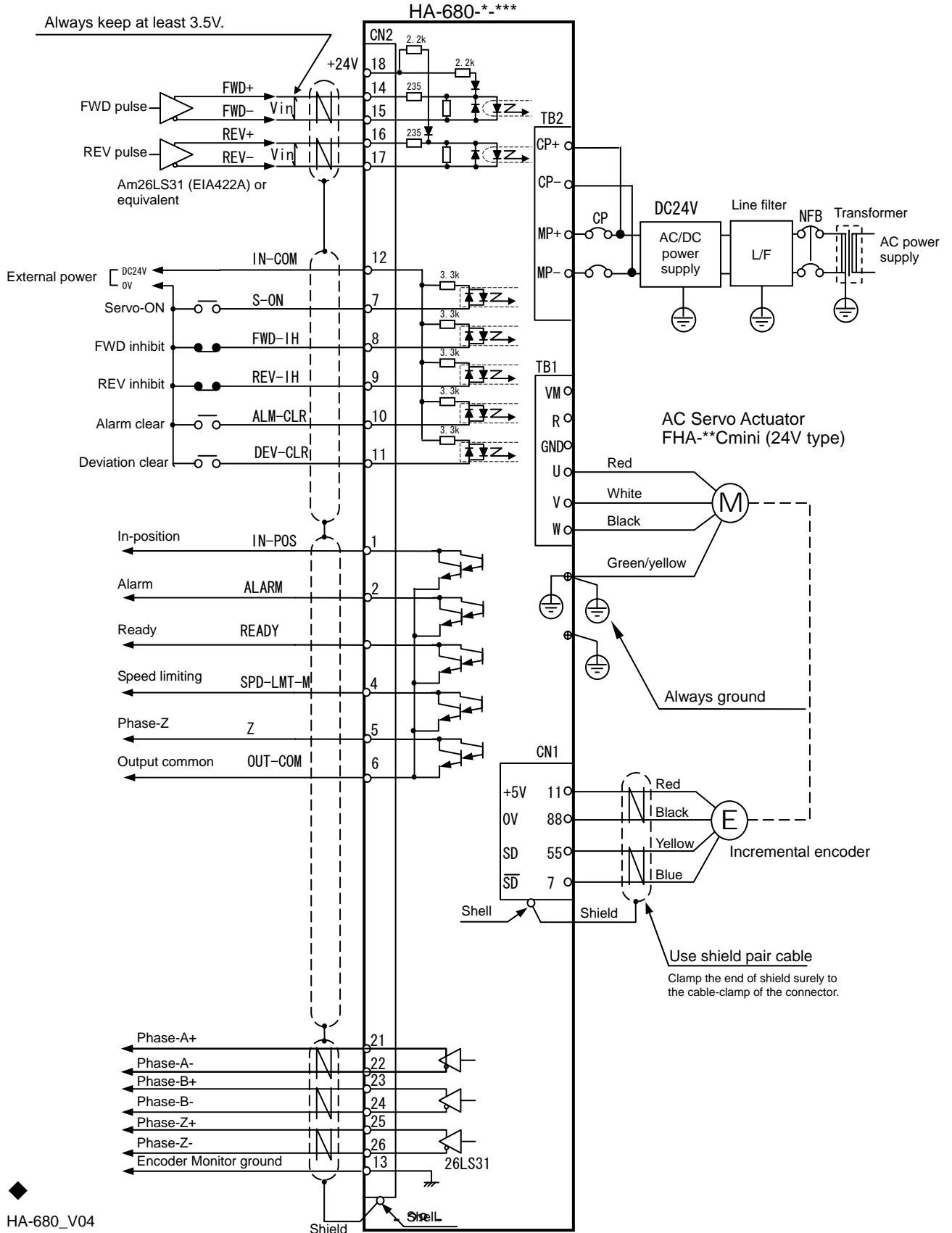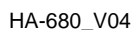
2-3 Speed control

2-3-1 Pin numbers and names of I/O signals

The I/O port layout is shown as follows:

Pin	Signal name	Symbol	I/O	Pin	Signal name	Symbol	I/O
1	Output 1 (Attained speed)	HI-SPD	Output	14	—	—	—
2	Output 2 (Alarm output)	ALARM	Output	15	—	—	—
3	Output 3	—	Output	16	—	—	—
4	Output 4	—	Output	17	—	—	—
5	Output 5 (Phase-Z OC)	Z	Output	18	—	—	—
6	Output common	OUT-COM	Output	19	Speed command	SPD-CMD	Input
7	Input 1 (Servo-on)	S-ON	Input	20	Speed command ground	SPD-GND	Input
8	Input 2 (FWD enable)	FWD-EN	Input	21	Phase-A+ (LD)	A+	Output
9	Input 3 (REV enable)	REV-EN	Input	22	Phase-A- (LD)	A-	Output
10	Input 4	—	Input	23	Phase-B+ (LD)	B+	Output
11	Input 5	—	Input	24	Phase-B- (LD)	B-	Output
12	Input signal common	IN-COM	Input	25	Phase-Z+ (LD)	Z+	Output
13	Encoder Monitor ground	MON-GND	Output	26	Phase-Z- (LD)	Z-	Output

Note 1: OC: open collector port, LD: line driver port

Note 2: Function assignment can be performed for Inputs 4 and 5 (10, 11 pin) and Outputs 3 and 4 (3, 4 pin).

Note 3: Logic change can be performed for the I/O signals other than Output 5 (Phase-Z OC output) using "13: Input pin logic setting" and "14: Output pin logic setting" in "Parameter."

⚠ CAUTION

Do not connect the pins with "-" in the Signal column to the external device.
If you do, failure may occur because it is connected to the internal circuit.

2-3-2   I/O port connections in the speed control

This section describes the connections between the I/O ports and the host in the speed control.

● **Inputs:**

The HA-680 driver provides five ports for inputs as shown in the figure to the right.

◆ **Specifications**

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

◆ **Connections**

The HA-680 driver does not provide the power supply for input signals. Connect a [+24V] power supply for the signals to [CN2-12: input signal common].
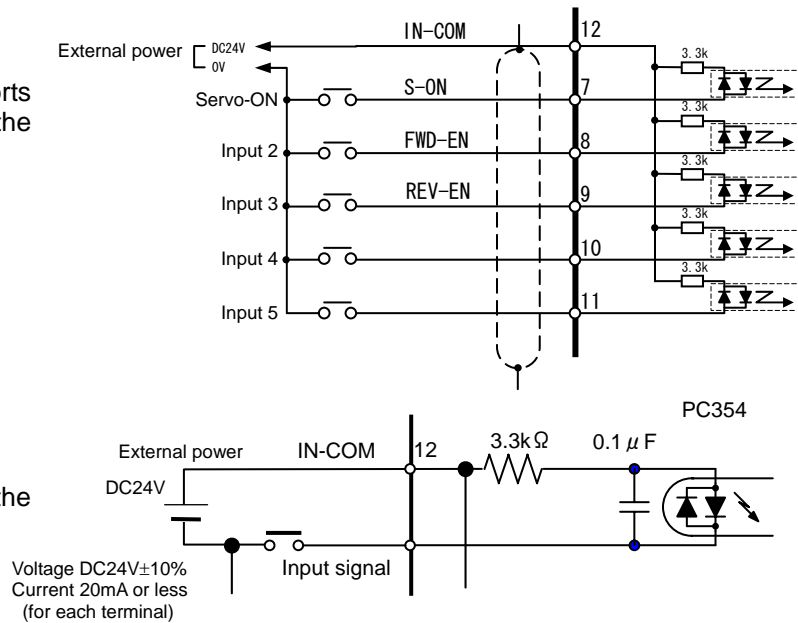
● **Outputs:**

The HA-680 driver provides five ports for outputs as shown in the figure to the right.

◆ **Specifications**

Voltage: DC24V±10%
Current: 40mA or less (per port)

All ports are insulated by photocouplers.

◆ **Connections**

 Connect output signals between their respective output ports and [CN2-6: output common] port.
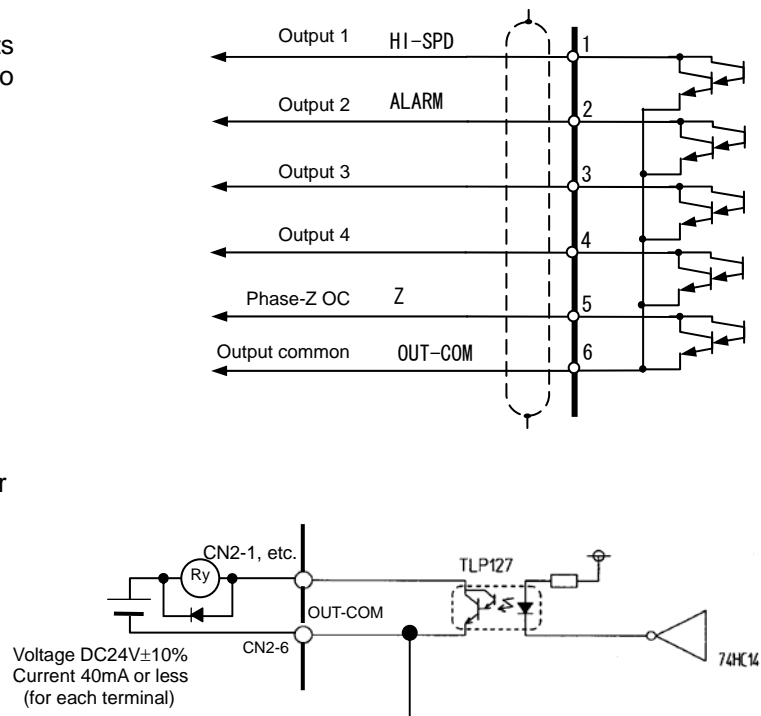
● **Monitor outputs:**

The HA-680 driver provides 6 ports of 3 signals for encoder monitoring as shown in the figure to the right.

◆ **Specifications**

The phase-A, -B, and -Z signals are transmitted by line drivers (26LS31).

◆ **Connection**

Receive the signals by line receivers (AM26LS32 or equivalent).

2-3-3   I/O port functions in the speed control

This section describes I/O port functions in the speed control.

CN2-1 Attained speed: HI-SPD (output)

● Function

The output turns ON when the motor of actuator rotates at a speed greater than the value of [parameter] →[31: attained speed].

Logic change can be performed with "14: Output pin logic setting" in "Parameter." With the default value, the transistor is turned on in the speed achievement state.

◆ Connection

(1)   The figure to the right shows an example of the [CN2-1 attained speed: HI-SPD] port connection.

(2)   Configure the output circuit for the ports as follows:
Supply voltage: DC24V or less
Signal current: 40mA or less (per port)

CN2-2 Alarm: ALARM (output)

● Function

The output turns OFF when the HA-680 driver senses an alarm. This signal is normal close (NC, b contact).

Logic change can be performed with "14: Output pin logic setting" in "Parameter." With the default value, the transistor is turned on during normal operation, and turned off when an error is detected.

◆ Connection

(1)   The figure to the right shows an example of the [CN2-2 Alarm: ALARM] port connection.

(2)   Configure the output circuit for the port as follows:
Supply voltage: DC24V or less
Signal current: 40mA or less (per port)

(I/O signal functions for speed control)

Can be set to CN2-3 Ready: READY (output)

● Function

The output turns ON when the driver becomes ready to drive after initialization, and the driver is possible to communicate with a host.

Logic change can be performed with "14: Output pin logic setting" in "Parameter." With the default value, the transistor is turned on in the normal operation ready state.

Note: The output keeps ON even in alarm status.

◆ Connection

(1) The figure to the right shows an example of the [CN2-3 Ready: READY] port connection.

(2) Configure the output circuit for the port as follows:
Supply voltage: DC24V or less
Signal current: 40mA or less (per port)

Can be set to CN2-3 or 4 Speed limiting: SPD-LMT-M (output)

● Function

This is outputted while the speed limit input signal is inputted and the speed is limited to the specified speed.

Logic change can be performed with "14: Output pin logic setting" in "Parameter." With the default value, the transistor is turned on while the speed is limited.

◆ Connection

(1) The figure to the right shows an example of the [CN2-3 or 4 Speed limiting: SPD-LMT-M] port connection.

(2) Configure the output circuit for the port as follows:
Supply voltage: DC24V or less
Signal current: 40mA or less (per port)
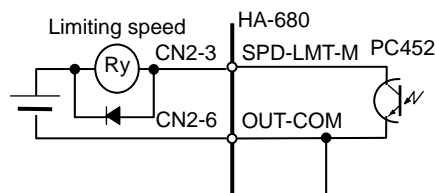
Can be set to CN2-4 Current limiting: CUR-LMT-M (output)

● Function

The output turns ON for limiting current responding to the [CN2-13 current limit: CUR-LMT] and keeps ON during inputting the signal.

Logic change can be performed with "14: Output pin logic setting" in "Parameter." With the default value, the transistor is turned on while the current is limited.

◆ Connection

(1) The figure to the right shows an example of the [CN2-4 Current limiting: CUR-LMT-M] port connection.

(2) Configure the output circuit for the port as follows:
Supply voltage: DC24V or less
Signal current: 40mA or less (per port)
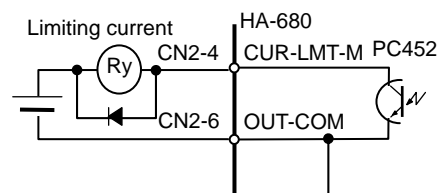
(I/O signal functions for speed control)

CN2-5 Phase-Z (OC): Z (output)

● Function

The port outputs phase-Z pulse signal of the encoder. The signal is outputted one pulse per every one motor rotation. The signal may be used with the mechanical origin signal as a precise origin of the driven mechanism.

The transistor is turned on during Phase-Z output.

◆ Connection

(1)   An example of [CN2-5 phase-Z: Z] connection is shown in the figure to the right.

(2)   The port is insulated by photocouplers.
      (response frequency: 10kHz max)

(3)   Configure the output circuit for the ports as follows:
      Supply voltage: DC24V or less
      Signal current: 40mA or less

CN2-6 Output common: OUT-COM (output)

● Function

This is the common port for the [CN2-1, 2, 3, 4, 5] ports.

CN2-7 Servo-ON: S-ON (input)

● Function

This turns the servo power for the HA-680 driver ON and OFF.

After about 100ms from turning the input ON, the servo power of the HA-680 driver is ON and the actuator can be driven. When OFF, the servo power turns OFF and the motor is free to rotate.

Logic change can be performed with "13: Input pin logic setting" in "Parameter." With the default value, servo power turns ON at normal close.

◆ Connection

Connect [NO-contact signal (a-contact)].

Connect +24 V of the input signal external power supply to "CN2-12 Input signal common."

(I/O signal functions for speed control)

CN2-8 FWD enable: FWD-EN (input)
CN2-9 REV enable: REV-EN (input)

● Function

While the [FWD enable] is [ON] the actuator rotates forward when the [CN2-19 speed command: SPD-CMD] is [+command]. In contrast, the actuator rotates in reverse for the [CN2-19] is [-command].

While the [REV enable] is [ON] the actuator rotates in reverse when the [CN2-19 speed command: SPD-CMD] is [+command]. Conversely, the actuator rotates forward when the [CN2-19] is [-command].

When both signals of [FWD enable] and [REV enable] are [ON] or [OFF], the actuator is holding the position or zero speed depending on the setting of [parameter]→[38: zero clamp].

Exchanging the signals of [FWD enable] and [REV enable] should be carried out when the actuator stops and the [CN2-7 servo ON: S-ON] is ON state. Otherwise, the actuator may move rapidly falling into dangerous situation.

Logic change can be performed with "13: Input pin logic setting" in "Parameter." With the default value, rotation starts at signal on.

CN2-19 Speed command: SPD-CMD		+ Command		- Command	
CN2-8 FWD enable: FWD-EN		ON	OFF	ON	OFF
CN2-9 REV enable: REV-EN	ON	Zero clamp, zero speed	REV rotation	Zero clamp, zero speed	FWD rotation
	OFF	FWD rotation	Zero clamp, zero speed	REV rotation	Zero clamp, zero speed

> ⚠ **WARNING**
>
> **The [zero clamp] or the [zero speed] does not function causing servo-free in the status listed below. If actuators are applied a large unbalanced load, servo-free state may cause physical injury.**
>
> **(1) No power supply for the main circuit and/or the control circuit**
>
> **(2) [OFF] state of [CN2-7 servo-ON: S-ON]**
>
> **(3) Occurrence of an alarm**
>
> **(4) The parameter "38: Zero clamp" is "0".**

◆ Connection

Connect [NO-contact signal (a-contact)]. Connect +24 V of the input signal external power supply to "CN2-12 Input signal common."

(I/O signal functions for speed control)

Can be set to CN2-10 Alarm clear: ALM-CLR (input)

● Function

This signal clears the alarm state and makes it ready for operation. When an alarm that cannot be cleared occurs, shut down the main circuit power supply and control circuit power supply, remove the cause of the alarm, and then turn on the power again.

◆ Connection

Connect "NO (a contact) contact signal." Connect +24 V of the input signal external power supply to "CN2-12 Input signal common."

Logic change can be performed with "13: Input pin logic setting" in "Parameter." With the default value, the alarm is cleared at the edge of the signal ON.

Can be set to CN2-10 or 11 external/internal command: CMD-CHG (input)

● Functions

This signal switches between the "external command value" from the external device and the 4 "internal command value" set in "32: Internal speed command value" in "Parameter" inside the HA-680 driver.

Logic change can be performed with "13: Input pin logic setting" in "Parameter." With the default value, the operation is as follows.

      Open: external command value
      Close: internal command value

◆ Connection

Connect +24 V of the input signal external power supply to "CN2-12 Input signal common."

Can be set to CN2-10 or 11 Speed limit: SPD-LMT (input)

● Function

This signal limits the speed to the value set in "16: Speed limit" in "Parameter."

Logic change can be performed with "13: Input pin logic setting" in "Parameter." With the default value, the speed limit state occurs when the input signal is on.

◆ Connection

Connect "NO (a contact) contact signal! Connect +24 V of the input signal external power supply to "CN2-12 Input signal common."

Can be set to CN2-11 Current limit: CUR-LMT (input)

● Function

This signal limits the current below the value set in "17: Forward rotation current limit" and "18: Reverse rotation current limit" in "Parameter."

Logic change can be performed with "13: Input pin logic setting" in "Parameter." With the default value, the current limit state occurs when the input signal is on.

◆ Connection

Connect [NO-contact signal (a-contact)]. Connect +24 V of the input signal external power supply to "CN2-12 Input signal common."

(I/O signal functions for speed control)

CN2-12 Input signal common: IN-COM (input)

● Function

The common for input signals CN2-7, 8, 9, 10, and 11. It provides the input signal external power supply.

◆ Connection

Connect +24 V of the input signal external power supply.

CN2-13 Encoder Monitor ground: MON-GND (output)

● Function

This is the common port for the monitor ports [**CN2-21~26**].

◆ Connection

Make connection as the ground for encoder monitor terminals C2-21 to 26.

CN2-19 Speed command: SPD-CMD (input)

● Function

Input the speed command voltage signal which is obtained by [parameter]→[9: speed conversion factor]. This speed command voltage can be obtained using "30: Speed command input factor" in "Parameter."

$$\text{Motor speed} = \text{Speed command voltage} \times \frac{\text{Speed command input factor}}{10.0V}$$

The direction of rotation is specified by the polarity (+/-) of the speed command and input signals of [CN2-8 FWD enable: FWD-EN] and [CN2-9 REV enable: REV-EN].

While the [FWD enable]: is ON the actuator rotates forward when the [CN2-19 Speed command: SPD-CMD] is [+]. In contrast, the actuator rotates in reverse for the [CN2-19] is [-].

While the [REV enable]: is ON the actuator rotates in reverse the [CN2-19 Speed command: SPD-CMD] is [+]. In contrast, the actuator rotates forward when the [CN2-19] is [-].

When both signals [FWD enable] and [REV enable] are ON or OFF, depending on the setting of [parameter]→[38: zero clamp], the actuator is either holding the position (setting:1) or zero speed (setting: 0).

CN2-19 Speed command :SPD-CMD		**+ Command**		**- Command**	
CN2-8 FWD enable :FWD-EN		ON	OFF	ON	OFF
CN2-9 REV enable: REV-EN	ON	Zero clamp, zero speed	REV rotation	Zero clamp, zero speed	FWD rotation
	OFF	FWD rotation	Zero clamp, zero speed	REV rotation	Zero clamp, zero speed

Observe the allowable input voltage.

The range of the input voltage is between –10 V and +10 V.

Any voltage outside this range may damage the driver.

CAUTION

(I/O signal functions for speed control)

◆ Connection

Connect the voltage signal to the [CN2-19: speed command: SPD-COM] and the [CN2-20: SPD-GND].

Because the impedance of the analog command input of HA-680 is low, use an output impedance of 1 Kohms or lower.

If the output impedance is too high, there may be a difference in voltage between the command and driver sides. If it is impossible to use impedance below 1 Kohms for reasons of the system, adjust the difference using the parameters "35: Analog command A/D value (Mid)," "36: Analog command A/D value (Max)," and "37: Analog command A/D value (Min)."
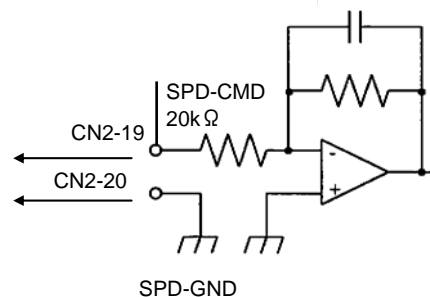
Plan the speed command input circuit referring to the examples below.

◆ Example of external speed command
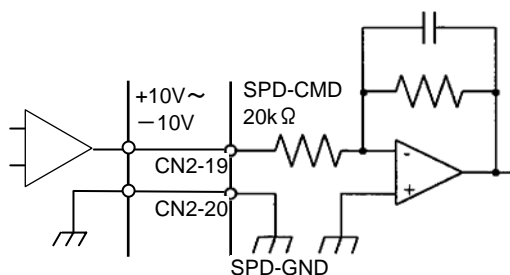
CN2-20 Speed command ground: SPD-GND (input)

● Function

The port is the common ground for the [CN2-19 speed command: SPD-CMD].

(I/O signal functions for speed control)

CN2-21 Phase-A +(LD): A+ (output)
CN2-22 Phase-A -(LD): A- (output)
CN2-23 Phase-B +(LD): B+ (output)
CN2-24 Phase-B -(LD): B- (output)
CN2-25 Phase-Z +(LD): Z+ (output)
CN2-26 Phase-Z -(LD): Z- (output)

● **Function**

These ports transmit encoder signals of Phase-A, -B, -Z from the line driver (26LS31).

◆ **Connection**

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

Note: Use EIA-422A standard for line receiver.
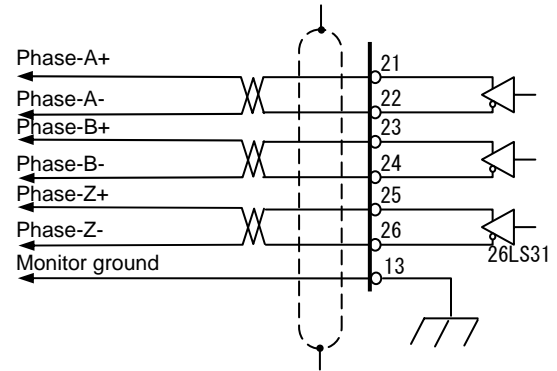
2-3-4   Connection examples in the speed control
◆ Connection example 1: FHA-C mini 24VAC type

The figure below shows a connection example in the speed control for the incremental system. The setting values of "Parameter 11: Input function assignment" and "Parameter 12: Output function assignment" are "0." Note that the connection example varies depending on the actuator.

HA-680-*-***

HA-680_V04

◆ Connection example 2: RSF supermini series

The figure below shows a connection example in the speed control for the incremental system. The setting values of "Parameter 11: Input function assignment" and "Parameter 12: Output function assignment" are "0." Note that the connection example varies depending on the actuator.

HA-680-4B-24

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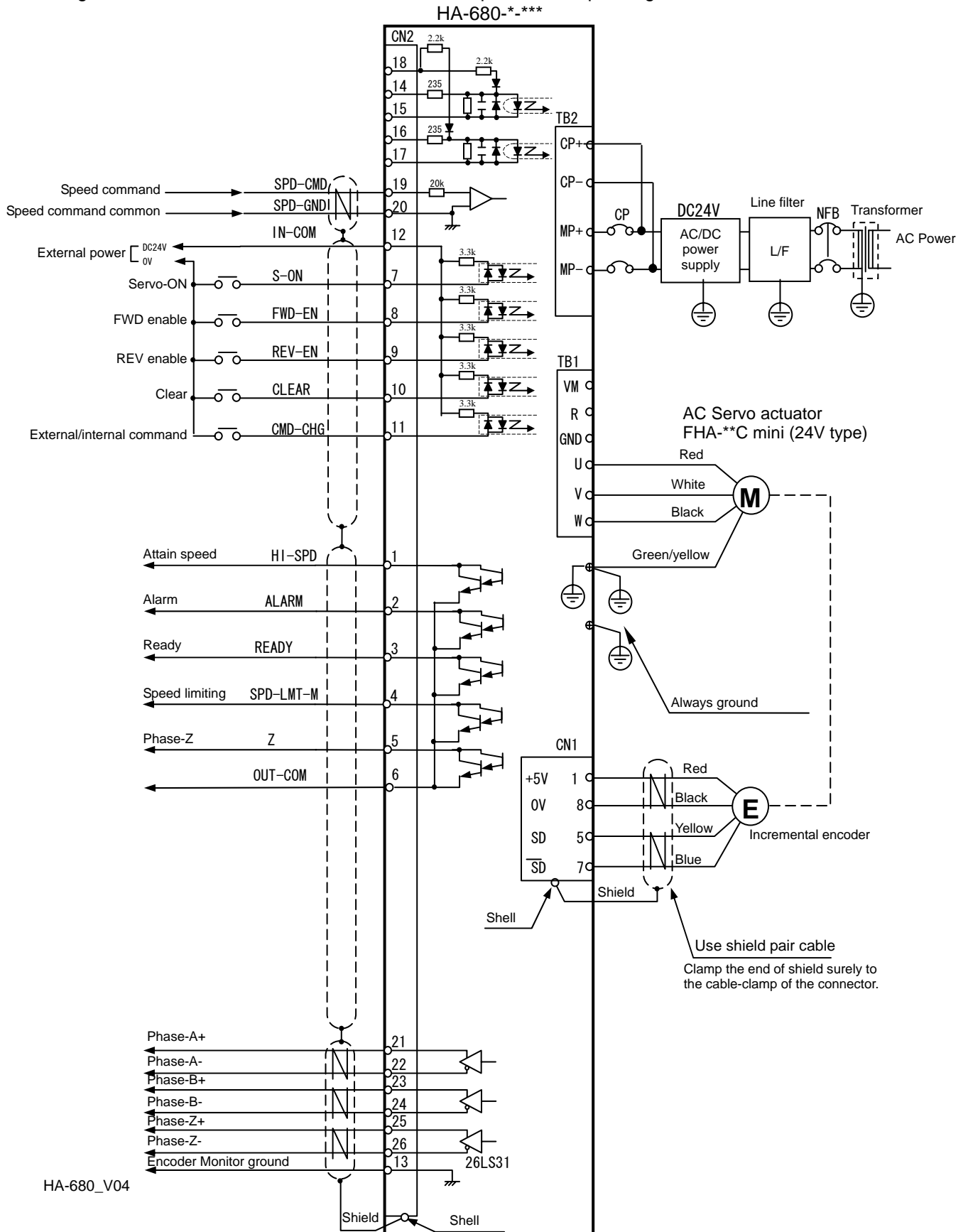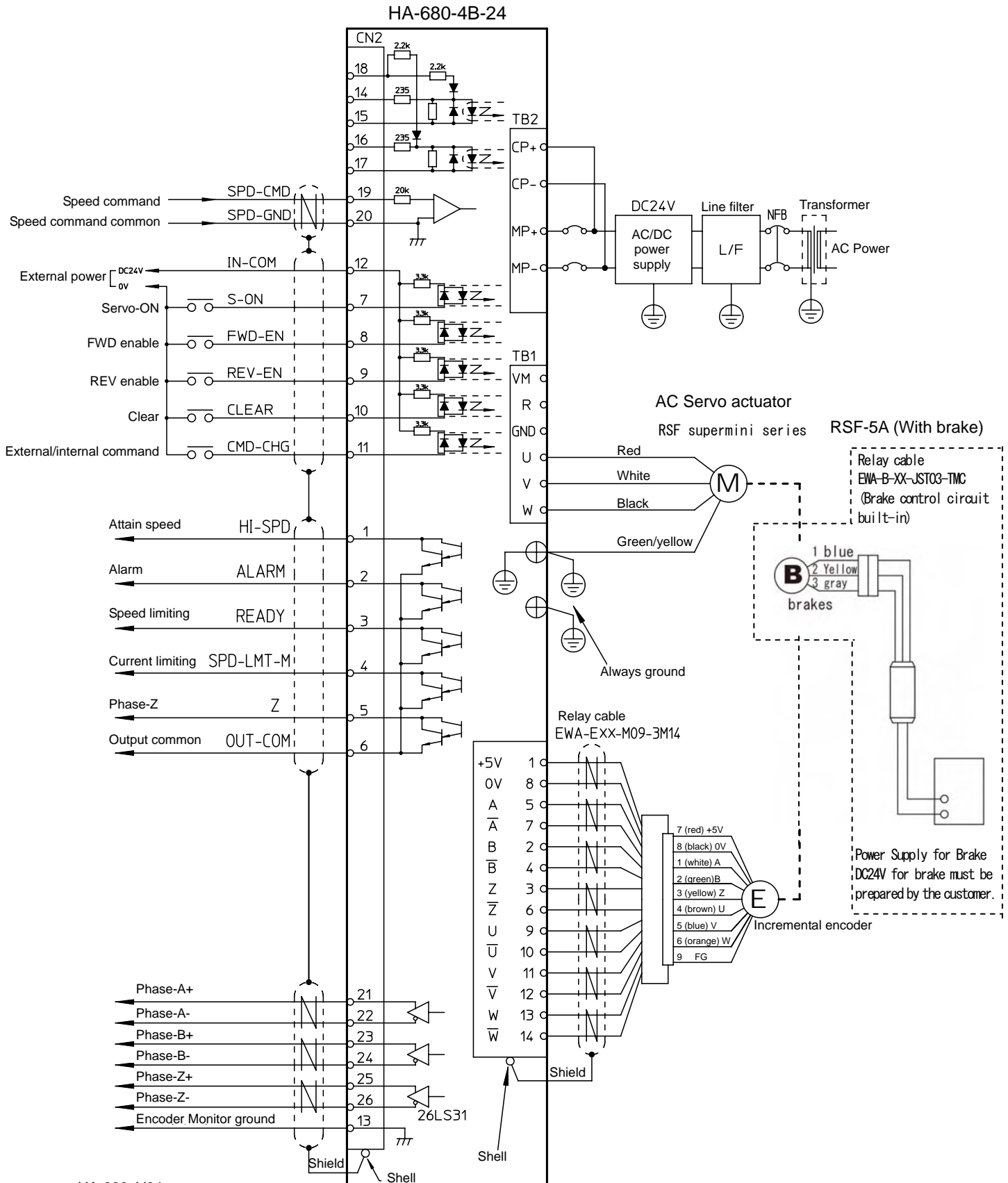
2-4 Torque control

2-4-1 Pin numbers and names of I/O signals

The pin numbers and their names for torque control are as shown in the table below.

Pin	Signal name	Symbol	I/O	Pin	Signal name	Symbol	I/O
1	Output 1 (Attained speed)	HI-SPD	Output	14	—	—	—
2	Output 2 (Alarm output)	ALARM	Output	15	—	—	—
3	Output 3	READY	Output	16	—	—	—
4	Output 4	CUR-LMT-M	Output	17	—	—	—
5	Output 5 (Phase-Z OC)	Z	Output	18	—	—	—
6	Output common	OUT-COM	Output	19	Torque command	TRQ-CMD	Input
7	Input 1 (Servo-on)	S-ON	Input	20	Torque command ground	TRQ-GND	Input
8	Input 2 (FWD enable)	FWD-EN	Input	21	Phase-A+ (LD)	A+	Output
9	Input 3 (REV enable)	REV-EN	Input	22	Phase-A- (LD)	A-	Output
10	Input 4	—	Input	23	Phase-B+ (LD)	B+	Output
11	Input 5	—	Input	24	Phase-B- (LD)	B-	Output
12	Input signal common	IN-COM	Input	25	Phase-Z+ (LD)	Z+	Output
13	Encoder Monitor ground	MON-GND	Output	26	Phase-Z- (LD)	Z-	Output

Note 1: OC: open collector port, LD: line driver port
Note 2: Function assignment can be performed for Inputs 4 and 5 (10, 11 pin).
Note 3: Logic change can be performed for the I/O signals other than Output 5 (Phase-Z OC output) using "13: Input pin logic setting" and "14: Output pin logic setting" in "Parameter."

> ⚠ **CAUTION**
>
> **Do not connect the pins with "-" in the Signal column to the external device.**
> **If you do, failure may occur because it is connected to the internal circuit.**

2-4-2　I/O port connections in torque control

This section describes the connection between the I/O ports and a host in torque control.

● **Inputs:**

The HA-680 driver provides five ports for inputs as shown in the figure to the right.

◆ **Specifications**

Voltage:　DC24V±10%
Current:　20mA or less (per port)
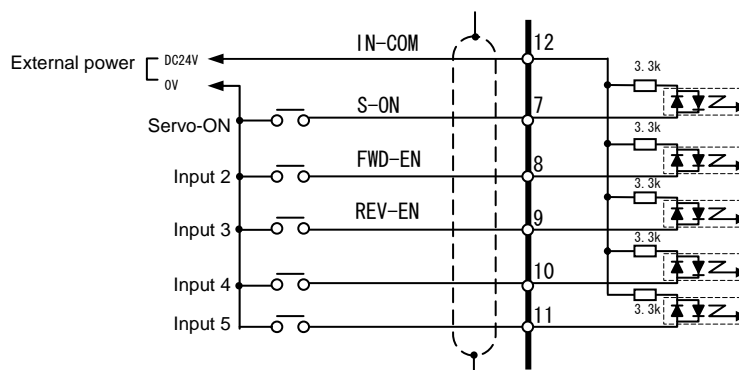
◆ **Connection**

The HA-680 driver does not provide the power supply for input signals. Connect a [+24V] power supply for the signals to [CN2-1: input signal common].
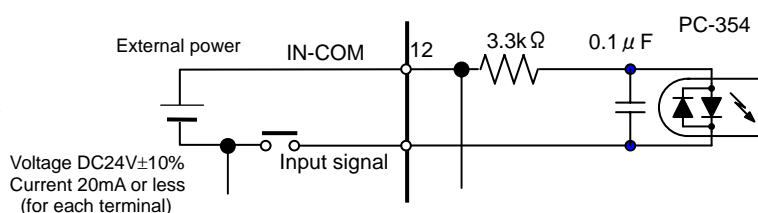
● **Outputs:**

The HA-680 driver provides five ports for outputs as shown in the figure to the right.

◆ **Specifications**

Voltage:　DC24V±10%
Current:　40mA or less (per port)

All ports are insulated by photocouplers.
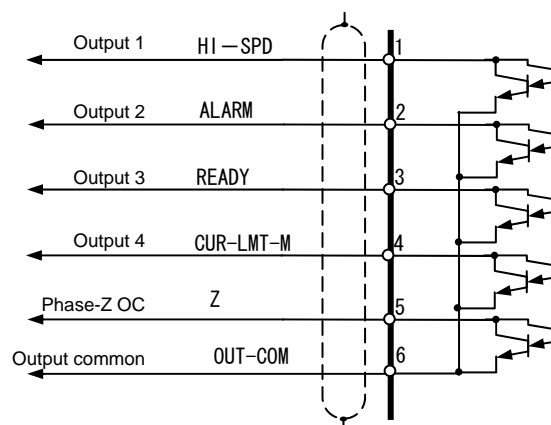
◆ **Connection**

Connect output signals between their respective output ports and [CN2-6: output common] port.
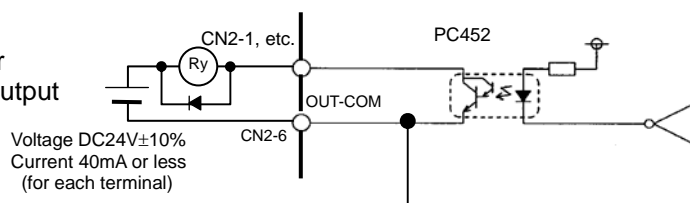
● Monitor outputs:

The HA-680 driver provides 6 ports of 3 signals for encoder monitoring as shown in the figure to the right.

◆ Specifications

The phase-A, -B, and -Z signals are transmitted by line drivers (26LS31).

◆ Connection

Receive the signals by line receivers (AM26LS32 or equivalent).
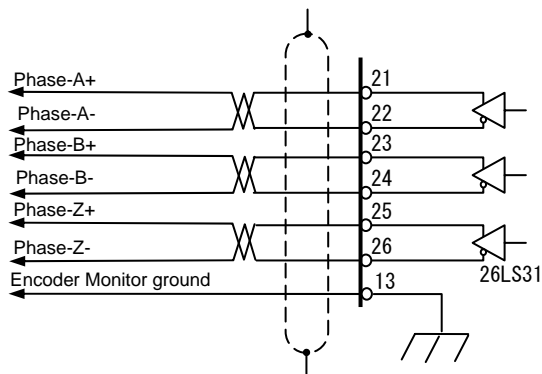
2-4-3   I/O port functions in torque control

This section describes I/O port functions in torque control.

CN2-1 Attained speed: HI-SPD (output)

● Function

The output turns ON when the motor of actuator rotates at a speed greater than the value of [parameter] →[31: attained speed].

Logic change can be performed with "14: Output pin logic setting" in "Parameter." With the factory-shipped value, the output transistor is turned on when the speed is attained.

◆ Connection

(1) The figure to the right shows an example of the [CN2-1 attained speed: HI-SPD] port connection.

(2) Configure the output circuit for the ports as follows:
Supply voltage: DC24V or less
Signal current: 40mA or less (per port)

CN2-2 Alarm: ALARM (output)

● Function

The output turns OFF when the HA-680 driver senses an alarm. This signal is normal close (NC, b contact).

Logic change can be performed with "14: Output pin logic setting" in "Parameter." With the factory-shipped value, the transistor is turned on during normal operation, and turned off when an error is detected.

◆ Connection

(1) The figure to the right shows an example of the [CN2-2 Alarm: ALARM] port connection.

(2) Configure the output circuit for the port as follows:
Supply voltage: DC24V or less
Signal current: 40mA or less (per port)

(I/O signal functions for torque control)

CN2-3 Ready: READY (output)

● Function

The output turns ON when the driver becomes ready to drive after initialization, and the driver is possible to communicate with a host.

Logic change can be performed with "14: Output pin logic setting" in "Parameter." With the factory-shipped value, the transistor is turned on during normal operation.

Note: The output keeps ON even in alarm status.

◆ Connection

(1) The figure to the right shows an example of the [CN2-3 Ready: READY] port connection.

(2) Configure the output circuit for the port as follows:
Supply voltage: DC24V or less
Signal current: 40mA or less (per port)
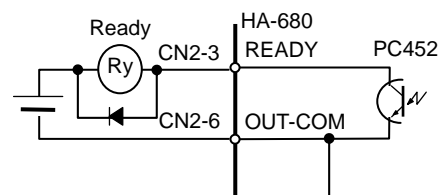
CN2-4 Current limiting: CUR-LMT-M (output)

● Function

This is outputted while the current limit input signal is inputted and the current is limited to the specified current.

Logic change can be performed with "14: Output pin logic setting" in "Parameter." With the factory-shipped value, the transistor is turned on during the current limiting.

◆ Connection

(1) The figure to the right shows an example of the [CN2-4 Current limiting: CUR-LMT-M] port connection.

(2) Configure the output circuit for the port as follows:
Supply voltage: DC24V or less
Signal current: 40mA or less (per port)

CN2-5 Phase-Z (OC): Z (output)

● Function

The port outputs phase-Z pulse signal of the encoder. The signal is outputted one pulse per every one motor rotation. The signal may be used with the mechanical origin signal as a precise origin of the driven mechanism.

The transistor is turned on during Phase-Z output.

◆ Connection

(1) An example of [CN2-5 phase-Z: Z] connection is shown in the figure to the right.

(2) The port is insulated by photocouplers.
(response frequency: 10kHz max)

(3) Configure the output circuit for the ports as follows:
Supply voltage: DC24V or less
Signal current: 40mA or less
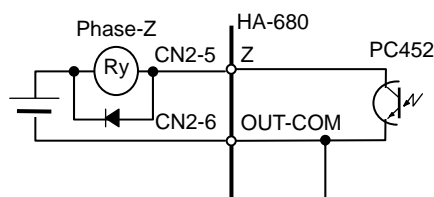
(I/O signal functions for torque control)

CN2-6 Output common: OUT-COM (output)

● Function

This is the common port for the [CN2-1, 2, 3, 4, 5] ports.

CN2-7 Servo-ON: S-ON (input)

● Function

This turns the servo power for the HA-680 driver ON and OFF.

After about 100ms from turning the input ON, the servo power of the HA-680 driver is ON and the actuator can be driven. When OFF, the servo power turns OFF and the motor is free to rotate.

Logic change can be performed with "14: Output pin logic setting" in "Parameter." With the factory-shipped value, the servo on state occurs when the input signal is on.

◆ Connection

Connect [NO-contact signal (a-contact)].

Connect +24 V of the input signal external power supply to "CN2-12 Input signal common."

CN2-8 FWD enable: FWD-EN (input)
CN2-9 REV enable: REV-EN (input)

● Function

While the [FWD enable] is [ON] the actuator rotates forward when the [CN2-19 Torque command: TRQ-CMD] is [+command]. In contrast, the actuator rotates in reverse for the [CN2-19] is [-command].

While the [REV enable] is [ON] the actuator rotates in reverse when the [CN2-19 Torque command: TRQ-CMD] is [+command]. Conversely, the actuator rotates forward when the [CN2-19] is [-command].

When both signals of [FWD enable] and [REV enable] are [ON] or [OFF], the actuator is holding the position or zero speed depending on the setting of [parameter]→[38: zero clamp].

Exchanging the signals of [FWD enable] and [REV enable] should be carried out when the actuator stops and the [CN2-7 servo ON: S-ON] is ON state. Otherwise, the actuator may move rapidly falling into dangerous situation.

Logic change can be performed with "13: Input pin logic setting" in "Parameter." With the factory-shipped value, rotation starts at signal on.

CN2-19 Torque command : TRQ-CMD		**+ Torque Command**		**- Torque Command**	
CN2-8 FWD enable : FWD-EN		ON	OFF	ON	OFF
CN2-9 REV enable: REV-EN	ON	Torque zero	REV rotation	Torque zero	FWD rotation
	OFF	FWD rotation	Torque zero	REV rotation	Torque zero

◆ Connection

Connect [NO-contact signal (a-contact)]. Connect +24 V of the input signal external power supply to "CN2-12 Input signal common."

(I/O signal functions for torque control)

Can be set to CN2-10 Alarm clear: ALM-CLR (input)

● Function

This signal clears the alarm state and makes it ready for operation. When an alarm that cannot be cleared occurs, shut down the main circuit power supply and control circuit power supply, remove the cause of the alarm, and then turn on the power again.

Logic change can be performed with "13: Input pin logic setting" in "Parameter." With the factory-shipped value, the alarm clear function works at the edge of the input signal ON.

◆ Connection

Connect [NO-contact signal (a-contact)]. Connect +24 V of the input signal external power supply to "CN2-12 Input signal common."

Can be set to CN2-10 or 11 external/internal common: CMD-CHG (input)

● Function

This signal switches between the "external command value" from the external device and the "internal command value" set in "40: Internal torque command value" in "Parameter" inside the HA-680 driver.

Logic change can be performed with "13: Input pin logic setting" in "Parameter." With the factory-shipped value, the operation is as follows.

    Open: external command value
    Close: internal command value

◆ Connection

Connect +24 V of the input signal external power supply to "CN2-12 Input signal common."

Can be set to CN2-11 Current limit: CUR-LMT (input)

● Function

This signal limits the current below the value set in "17: Forward rotation current limit" and "18: Reverse rotation current limit" in "Parameter."

Logic change can be performed with "13: Input pin logic setting" in "Parameter." With the factory-shipped value, the current limit state occurs when the input signal is on.

◆ Connection

Connect [NO-contact signal (a-contact)].Connect +24 V of the input signal external power supply to "CN2-12 Input signal common."

CN2-12 Input signal common: IN-COM (input)

● Function

The common for input signals CN2-7, 8, 9, 10, and 11. It provides the input signal external power supply.

◆ Connection

Connect +24 V of the input signal external power supply.

(I/O signal functions for torque control)

CN2-13 Monitor ground: GND (output)

● Function

This is the common port for the monitor ports [**CN2-21~26**].

◆ Connection

Make connection as the ground for encoder monitor terminals C2-21 to 26.

CN2-19 Torque command: TRQ-CMD (input)

● Function

Input the torque command voltage signal which is obtained by [parameter]→[41: torque command input factor].

$$\text{Motor torque} = \text{Torque command voltage} \times \frac{\text{Torque command input factor}}{10.0V}$$

The direction of rotation is specified by the polarity (+/-) of the torque command and input signals of [CN2-8 FWD enable: FWD-EN] and [CN2-9 REV enable: REV-EN].

While the [FWD enable]: is ON the actuator rotates forward when the [CN2-19 Torque command: TRQ-CMD] is [+]. In contrast, the actuator rotates in reverse for the [CN2-19] is [-].

While the [REV enable]: is ON the actuator rotates in reverse the [CN2-19 Torque command: TRQ-CMD] is [+]. In contrast, the actuator rotates forward when the [CN2-19] is [-].

When both signals [FWD enable] and [REV enable] are ON or OFF, the motor is free to rotate.

CN2-19 Torque command input	:TRQ-CMD	**+ Torque command**		**- Torque command**	
CN2-4 FWD enable	:FWD-EN	ON	OFF	ON	OFF
CN2-5 REV enable: REV-EN	ON	Torque zero	REV rotation	Torque zero	FWD rotation
	OFF	FWD rotation	Torque zero	REV rotation	Torque zero

> **⚠ CAUTION**
>
> ### Observe the allowable input voltage.
>
> The range of the input voltage is between –10 V and +10 V.
>
> Any voltage outside this range may damage the driver.

(I/O signal functions for torque control)

◆ Connection

Connect the voltage signal to the [CN2-19: Torque command: TRQ-COM] and the [CN2-20: Torque command ground TRQ -GND].

Because the impedance of the analog command input of HA-680 is low, use an output impedance of 1 Kohms or lower.

If the output impedance is too high, there may be a difference in voltage between the command and driver sides. If it is impossible to use impedance below 1 Kohms for reasons of the system, adjust the difference using the parameters "35: Analog command A/D value (Mid)," "36: Analog command A/D value (Max)," and "37: Analog command A/D value (Min)."
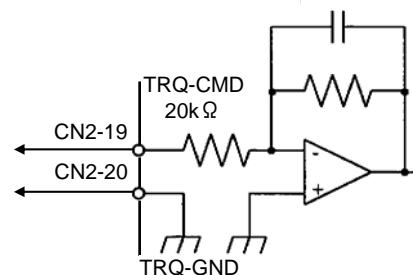
Plan the torque command input circuit referring to the examples below.

◆ Example of external speed command
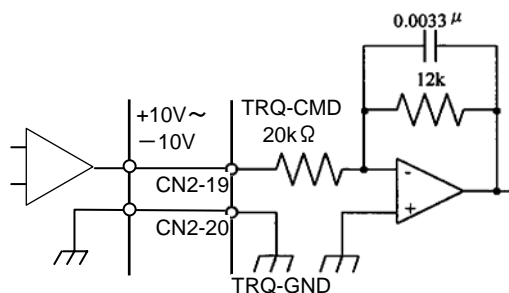
CN2-20 Torque command ground: TRQ-GND (input)

● Function

The port is the common ground for the [CN2-19 torque command: TRQ-CMD].

(I/O signal functions for torque control)

CN2-21 Phase-A +(LD): A+ (output)
CN2-22 Phase-A -(LD): A- (output)
CN2-23 Phase-B +(LD): B+ (output)
CN2-24 Phase-B -(LD): B- (output)
CN2-25 Phase-Z +(LD): Z+ (output)
CN2-26 Phase-Z -(LD): Z- (output)

● **Function**

These ports transmit encoder signals of Phase-A, -B, -Z from the line driver (26LS31).

◆ **Connection**

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

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

Phase-A+   21
Phase-A-   22
Phase-B+   23
Phase-B-   24
Phase-Z+   25
Phase-Z-   26
Encoder Monitor ground   13

26LS31
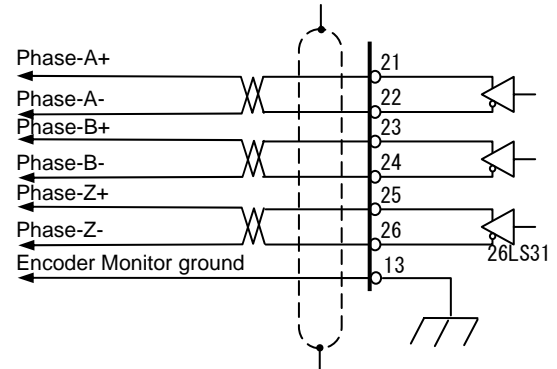
2-4-4   Connection examples in torque control
◆ Connection example 1: FHA-C mini 24VAC type

The figure below shows a connection example in torque control. The setting values of "Parameter 11: Input function assignment" and "Parameter 12: Output function assignment" are "0." Note that the connection example varies depending on the actuator.

HA-680_V04

◆ Connection example 2: RSF supermini series

The figure below shows a connection example in torque control. The setting values of "Parameter 11: Input function assignment" and "Parameter 12: Output function assignment" are "0." Note that the connection example varies depending on the actuator.

HA-680-4B-24
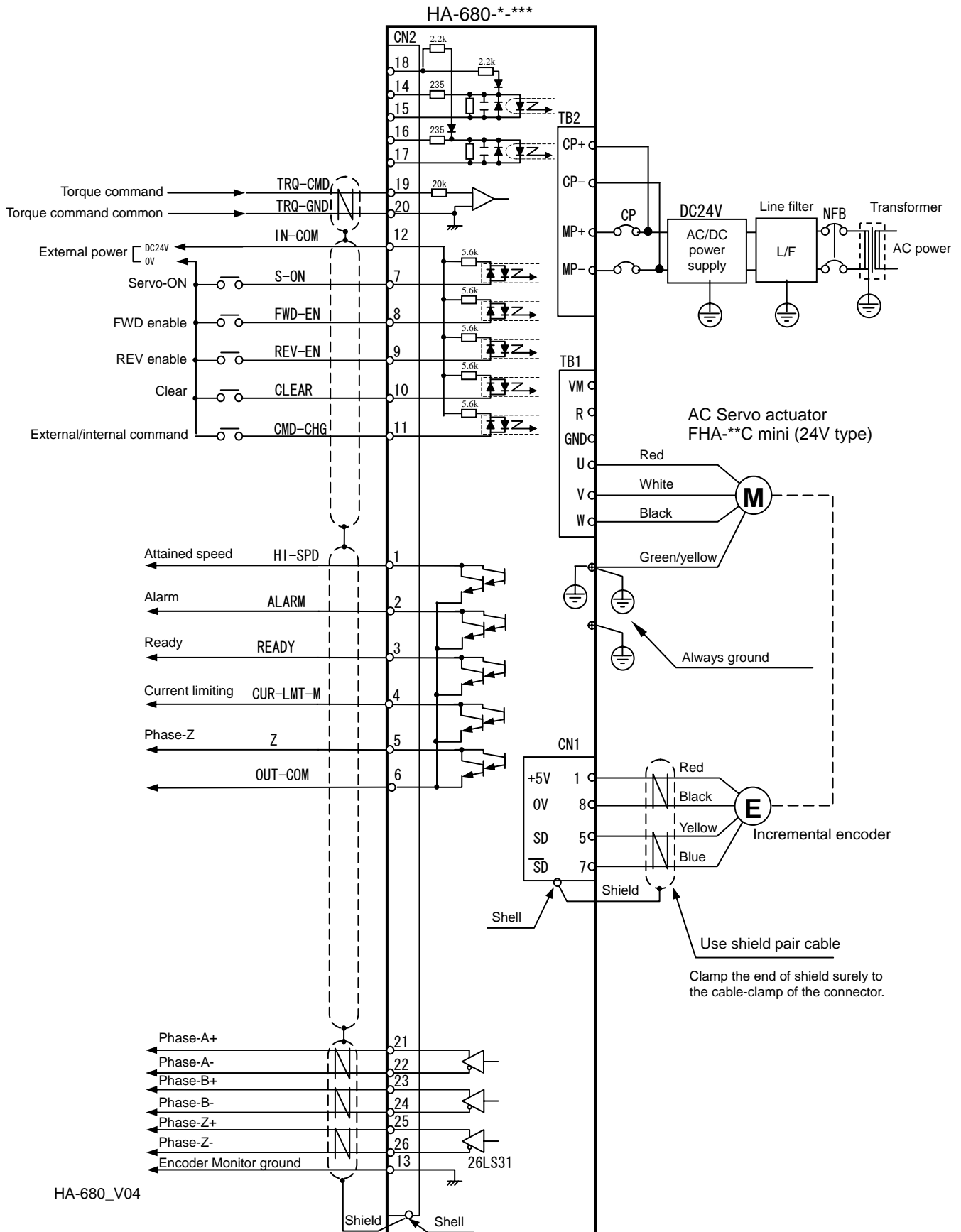
HA-680_V04
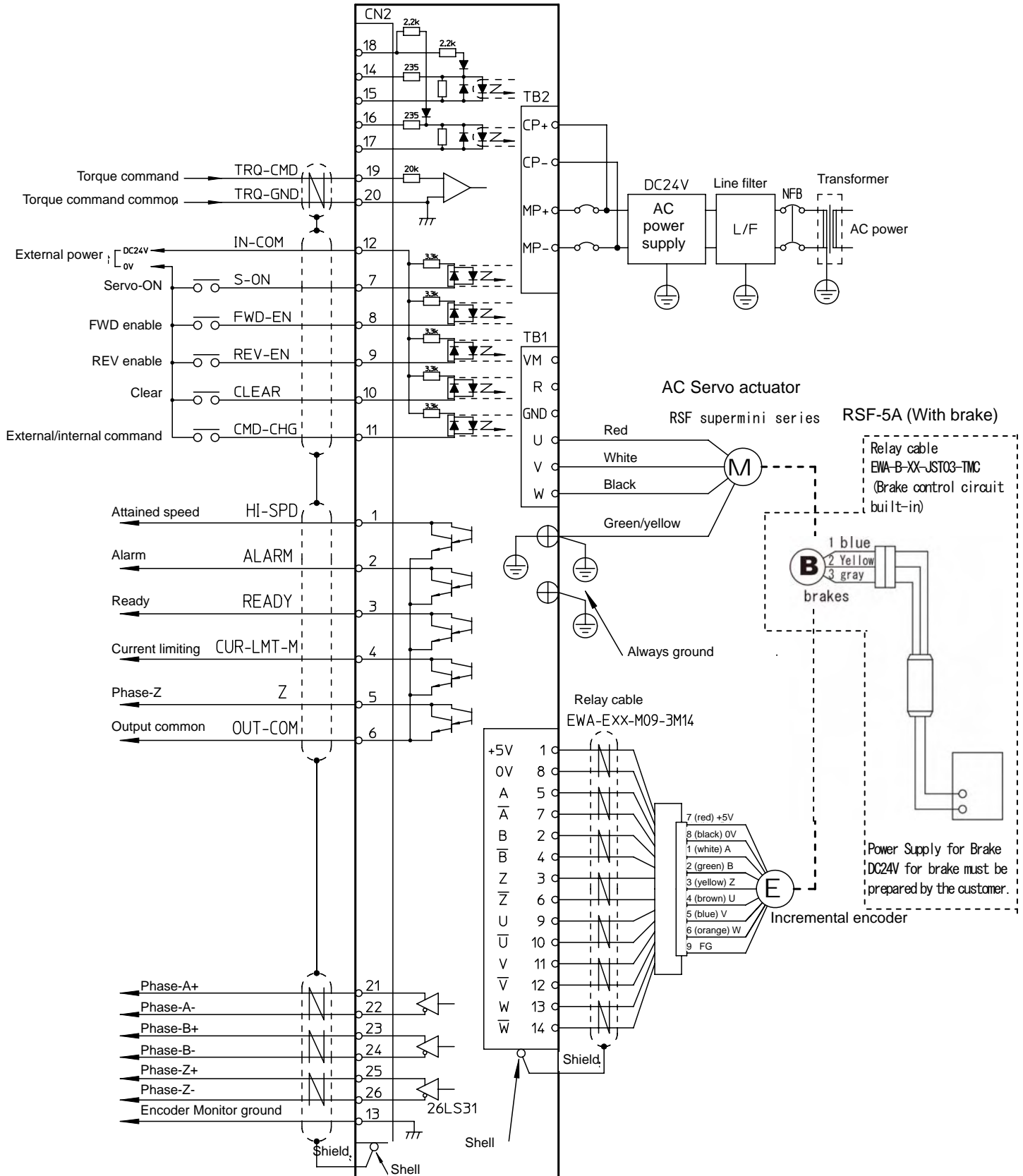
Chapter 3 Installing HA-680 driver

3-1   Receiving Inspection

Check the followings when products are received.

● Inspection procedure

(1)   Check the shipping container and item for any damage that may have been caused during transportation. If the item is damaged, contact us immediately.

(2)   There is a nameplate attached to the heat sink of the HA-680 driver.

Check whether the item is the one you ordered by looking at the nameplate. If it is different, immediately contact the dealer whom it was purchased from.

The model code is interpreted as follows:

HA-680-4□-24

— AC servo driver

— 680 series

— Nominal current

4	4A
6	6A

— Available encoder

None	For FHA-CminiAC24V type
B	For RSF supermini series

— Input voltage

24	DC24V
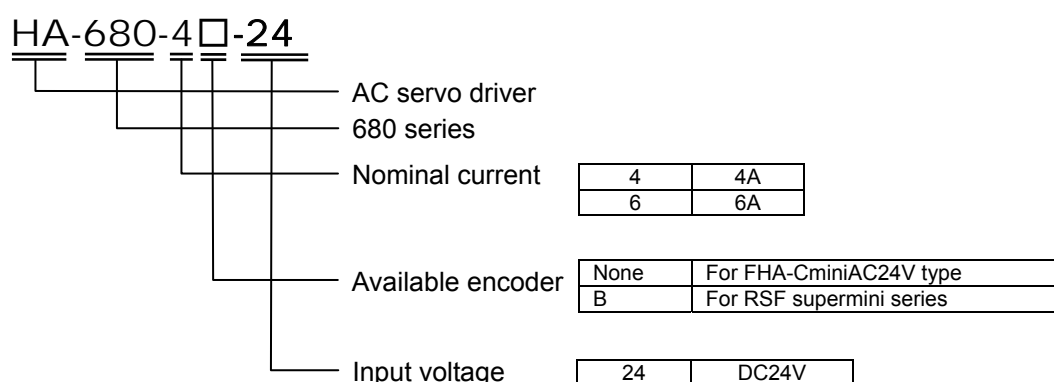
(3)   Under the [ADJ.] line, the code of the FHA-C series actuator to be driven by the HA-680 driver is typed. To avoid confusion, group the actuator with its appropriate driver.

⚠ **WARNING**

Only connect the actuator specified on the driver label.

The HA-680 driver has been tuned for the actuator specified on the driver label. The wrong combination of HA-680 drivers and actuators may cause low torque problems or over current that may cause physical injury and fire.

---

(4)   The input voltage for the HA-680 driver is identified with the last code of the model code in the [INPUT VOL.] frame on the label.

24: 24VAC power supply

If the voltage to be supplied is different from the voltage on the label, immediately contact the dealer whom it was purchased from.

⚠ **WARNING**

Do not supply voltage other than the voltage specified on the label.

The wrong power supply voltage may damage the HA-680 driver resulting physical injury and fire.

3-2　Notices on handling

The HA-680 drivers are electronic devices. Handle them with care and take the following precautions:

⚠ **WARNING**	**(1)**	**Do not drop screws, solder balls, wire chips, or any other foreign objects into the inside of the HA-680 driver. Failure to observe this caution may result in electric shock or personal injury.**
	(2)	**Do not insert electric wire, steel wire, or a screwdriver into the inside of the HA-680 driver. Failure to observe this caution may result in electric shock or personal injury.**

⚠ **CAUTION**	**(1)**	**Because the cover is made of plastic, do not apply excess force or shock.**
	(2)	**The vibration resistance of the HA-680 driver is 5m/s^2 (10 to 55Hz). Do not mount or transport the HA-680 driver in a manner where it would be subjected to high levels of vibration.**
	(3)	**Do not put the HA-680 driver on the place from where it can easily fall down.**
	(4)	**Do not put anything on the HA-680 driver. The case of the driver may break.**
	(5)	**The allowable storage temperature is from -20°C to +85°C. Do not expose it to sunlight for long periods of time, and do not store it in areas where temperatures are likely to fluctuate greatly.**
	(6)	**The allowable storage relative humidity is less than 95%. Do not store it in highly humid place or in areas where temperatures are likely to fluctuate greatly.**
	(7)	**Do not store the HA-680 driver in areas where in corrosive gas or particles may be present.**

3-3   Location and installation

3-3-1   Environment of location

The environmental conditions of the location are described blow. Decide the location by definitely observing the following conditions.

◆ Service temperature: 0°C to 50°C
Use the driver in a cabinet. The temperature in the cabinet may be higher than the atmosphere because of power loss of the housed devices and its size. Plan the cabinet size, ventilation system, and device locations so the ambient temperature of the driver, which is always 50°C or less.

◆ Service humidity: 95% or less relative humidity, without condensation
Make sure that water condensation does not occur due to fluctuating temperatures in the storage area or because of frequent heat-and-cool (run-and-stop) operations.

◆ Vibration: less than 5m/sec^2 (10Hz to 55Hz)
When there is a great deal of vibration near the driver, attach a shock absorber under the base to dampen the vibration.

◆ Impact: The location should be free from impact.

◆ Make sure that dust, water condensation, metal powder, corrosive gas, water, water drops, or oil mist is not exposed to the HA-680 driver.
Do not install the driver in a corrosive gas environment, because the gas may cause damage to connecting parts (connectors, etc.).

◆ Install the driver in a cabinet. Do not expose it to the sunlight.

3-3-2   Notices on installation

Install the driver vertically and allow for wide spaces for air to flow sufficiently.

Leave 30mm or more from walls, 50mm or more from floor and 100mm or more from ceiling, and adjacent devices as shown the figure below.

When planning the ventilation system for the cabinet, refer to the table below, which lists the power consumption of the HA-680 driver.

Driver	HA-680-4	HA-680-4	HA-680-6	HA−680−4B	
Actuator	FHA-8C	FHA-11C	FHA-14C	RSF-3A	RSF-5A
Power consumption	10W	20W	40W	10W	10W
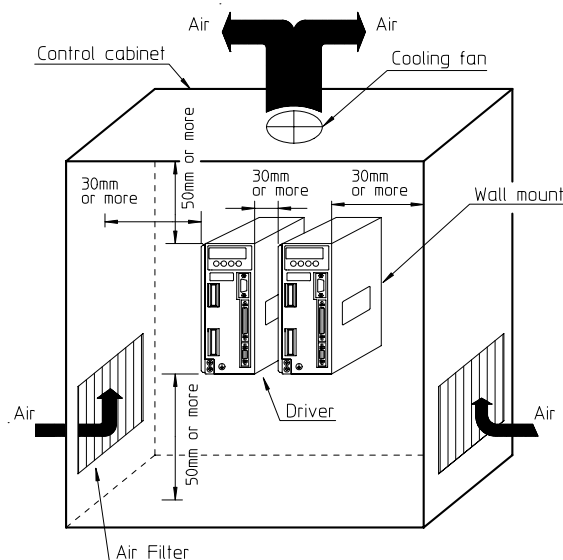
3-3-3 Installing

The HA-680 driver should be mounted on a wall as shown in the figure to the right.

Two mounting holes are provided on the back of the driver. The thickness of the wall should be more than 2mm.

● Procedure

(1) Screw an M4 machine screw in the tapped hole on the wall.

(2)   Put the lower mounting hole (cut hole) of the back of the HA-680 driver on the M4 screw.

(3) Screw tightly through the upper mounting hole with M4 screws.

(4) Tighten the lower M4 screw.
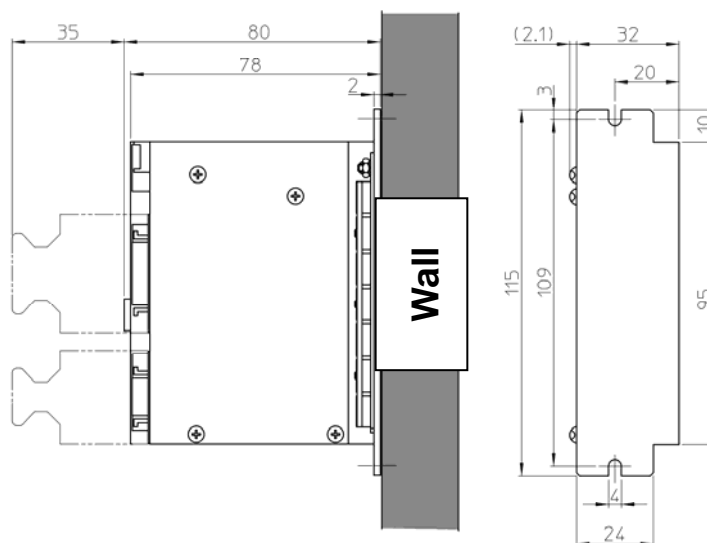
3-4   Suppressing noise

The HA-680 driver employs a FET (power element) with a PWM control for main circuit. As the element generates switching noise by high-speed power switching, the noise may cause incorrect motion of other equipment or radio noise interference due to poor cabling or poor grounding.

In addition, it is necessary to provide proper cable management in order to suppress incorrect motion of the HA-680 driver by external noise from hosts, which contain electronic components, such as a CPU.

To prevent troubles by noise emissions always install cabling and grounding described below.

3-4-1   Devices for grounding

Refer to the figure below when grounding all devices of the system.
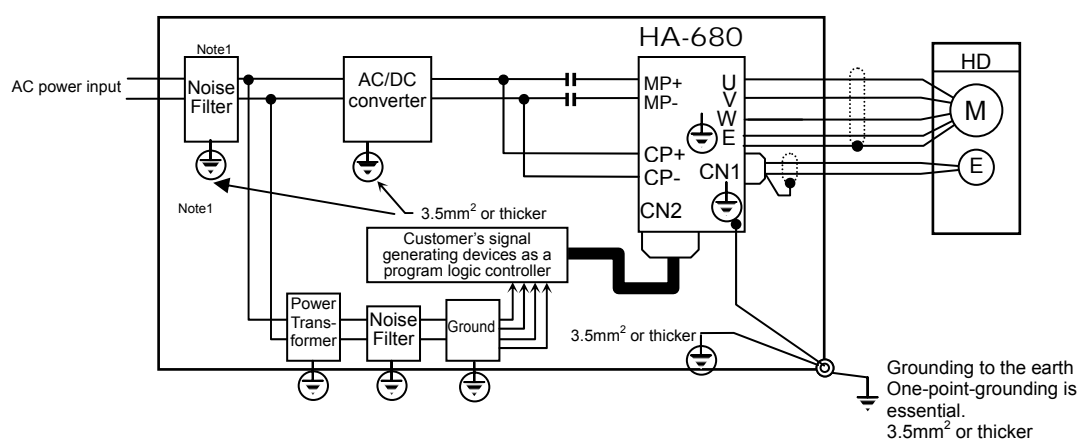
Note 1: For the grounding line filters refer to [3-4-2 installing noise filter].

◆ **Grounding motor frame**

When actuators are grounded at driven machine through the motor frame, current flows through floating capacity (Cf) of the motor from power amplifier of the driver. To avoid influence of the current, always connect the ground terminal (motor frame) of the motor to the ground terminal of the driver, and connect the ground terminal of the driver to the ground directly.

◆ **Grounding ducts**

When the motor cables are housed in a metal conduit or a metal box, ground their metal parts. The ground should be connected to earth at a single point.

3-4-2   Installing noise filters

Noise filters are recommended to guard against incorrect motion caused by impulse noise that may be emitted from power line and to suppress noise emissions to the line from inside of the driver.

When plural drivers are used, install noise filters for each driver.

Select bi-directional noise filters that can suppress external and internal noise.

Recommended noise filters are listed in the figure below:

driver	Model	Manufacturer
All models	SUP-P8H-EPR-4	Okaya electric.

Install the noise filters and the HA-680 driver as near as possible with one another.

Install the noise filters to the lines of the electric devices other than the HA-680 driver in the same way. Always install the noise filters to the source of high frequency noise, such as electric welders and electrical discharge machines.

Incorrect use of noise filters can seriously reduce its effectiveness. Inspect them with the following instructions:

◆ Separate the filtered side and the unfiltered side of the power supply cables from each other. Do not bundle both together. Do not encase them within the same duct.
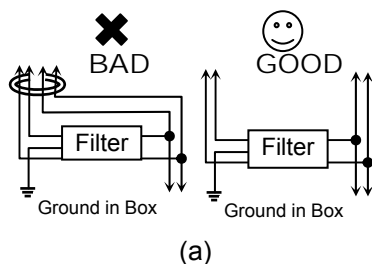
◆ Do not bundle the grounding cable with the filtered side of power cables or signal wires. Do not encase them within the same duct.
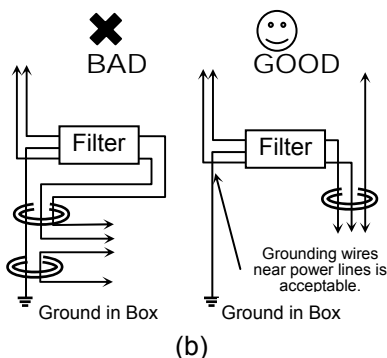
◆ Avoid daisy-chain wiring of ground cables. Ground them to a frame box or ground plate at a single point

(a)   (b)   (c)
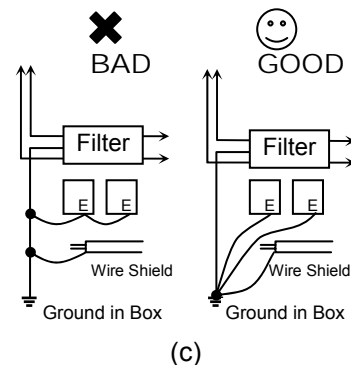
3-4-3   Instructions for cabling

In addition to the noise suppression mentioned previously, the following instructions must be observed.

(1)   Use twisted pair cables for I/O signals, and for encoder signals cables. When a host controls several drivers, prepare I/O signal cables for each driver individually.

(2)   Make the length of signal cables as short as possible.

    (a) I/O signal cable: 3m or less

    (b) Encoder signal cable (user's responsibility): 10m or less, providing that the condition of wire conductivity is less than 0.04 ohm/m.
Optional cables of 3m/5m/10m long are available.

(3)   Install surge protector devices to magnetic relays coils, magnetic switches (conductor), and solenoids.

(4)   Separate power cables (power source cables and motor cables) and I/O signal cables in 30cm or more. Do not encase both cables in one pipe or duct, and do not bundle them.

(5)   Do not open the end of analog signal cables such as speed signal cables.

(6)   As the HA-680 driver is designed for industrial use, it provides no specific radio interference provisions. Accordingly, line filters should be inserted for the power supply cables in the event that the driver:

    -   is used in the vicinity of private residences.
    -   causes apparent radio interference.

3-5   Connecting power cables

3-5-1   Instructions for power supply

> ⚠ **WARNING**
>
> **Before connecting the power cable to the HA-680 driver, turn-OFF the electricity to avoid electric shock.**

> ⚠ **CAUTION**
>
> **(1) Connect the power cable to the HA-680 driver only after installing the driver on a wall.**
>
> **(2) Ground the HA-680 driver, to avoid electric shock, malfunctions caused by external noise, and for the suppression of radio noise emissions.**

3-5-2   Allowable size of cables

The minimum allowable wire sizes of power cables, ground wires, and other cables are listed below. We recommend wires as thick as possible.

Cable	Symbol	Allowable Wire Sizes (mm^2)		
		HA-680-4 FHA-8C FHA-11C	HA-680-6 FHA-14C	HA-680-4B RSF-3A RSF-5A
Main Power Supply	MP+,MP-	1.25		
Control Power Supply	CP+,CP-	1.25		
Motor Leads Note 3	U,V,W,E	0.5	0.75	0.33
Ground (FG) line	Ground mark	1.25		
For external resistance / external capacitor	VM,R,GND	1.25		
Encoder Port Note 3	CN1	0.3mm^2 twist pair shielded cable Note 3.		
I/O Signal Port	CN2	0.35mm^2 twist pair, or twist pair whole-shielded cable		

Note 1. When bundling wires or encasing into conduits (plastic or metal pipes), use the wire of one upper size.

Note 2. In hot environments, such as the temperature in a cabinet, use heat-resistant cable (IV or HIV).

Note 3. We provide the following relay cables (3 m/5 m/10 m) for the motor and encoder. Note that the model varies depending on the actuator used.

◆ **For FHA-CminiAC24V type**

for a motor: EWC-MB*_*-A06-TN2

for an encoder: EWC-E*_*-M06-3M14

◆ **For RSF supermini series**

for a motor: EWA-M*_*-JST04-TN2

for an encoder: EWA-E*_*-M09-3M14

Cable length

03	3m
05	5m
10	10m

3-5-3   Connecting power cables

The terminal block for the power is located on the front panel of the HA-680 driver.

Shown the figure to the right, strip the end of wires of the power supply cable and the motor cable, and connect wires to each terminal firmly. When working the connection cable, be careful not to damage the wire.

To prevent malfunction of the HA-680 driver due to external noise, insert the "noise filter" into the power line.

Model:
MC1.5/5-G-3.81
(Phoenix contact)
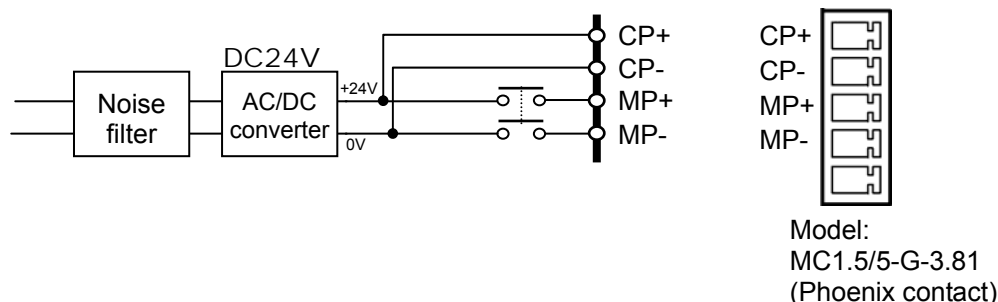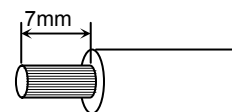
The HA-680 driver contains a surge-current-suppress-circuit of capacitor type. Although the circuit reduces line voltage fluctuation, avoid daisy-chain wiring of the power lines, and connect units with a main switch.
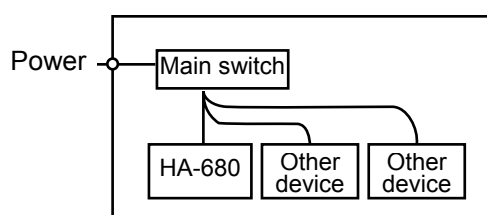
Good cable management
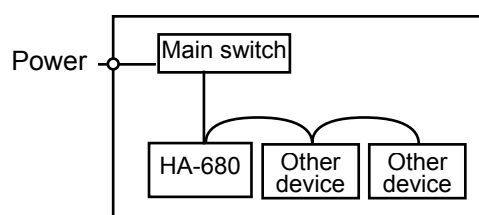
Bad cable management

The HA-680 driver is the DC power input type. Use the power supply with the following power supply capacity.

Driver	Actuator	Power supply capacity (W)	
		Continuous rating	Instantaneous
HA-680-4	FHA-8C	40	120
	FHA-11C	80	240
HA-680-6	FHA-14C	120	360
HA-680-4B	RSF-3A 、RSF-5A	20	50

The following products are recommended.

Driver	Actuator	Recommended AC/DC power supply	Manufacturer
HA-680-4	FHA-8C	JWS70P-24	Densei Lambda
	FHA-11C	JWS120P-24	
HA-680-6	FHA-14C	JWS240P-24	
HA-680-4B	RSF-3A 、RSF-5A	JWS70P-24	

⚠ **WARNING**

To supply power, use the secondary-side power supply with double insulation from the primary side.

3-6 Connecting the ground wire

Use an electric wire of the following size or more:

Terminal/connector	Allowable Wire Sizes (mm^2)
Ground(PE)	1.25

The HA-680 driver is provided with grounding terminal.

3-7 Connecting motor and regeneration resistor cables

Connect the motor cable to [U, V, W] terminals of the HA-680 driver as shown in the figure below. Refer to the phase order of the motor cable in the actuator manual and connect the end terminal of cables to the driver terminal that have the same symbol. No alarms are provided for wrong phase order or for open-phases. In addition, refer to "3-5-3 Connecting power cable" for working on the both sides of cable.
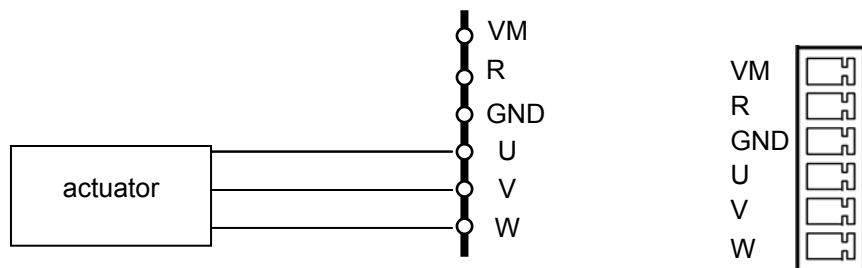
Model:MC1.5/6-G-3.81
(Phoenix contact)

Wrong phase order and connection or disconnection of the motor cable during driving may cause abnormal actuator motion.

WARNING

3-8   Connecting regenerative absorption resistance / capacitors

HA-680 has a regenerative absorption circuit as standard. The capacity of the regenerative resistance incorporated into the main unit is 2 W. Under the operating conditions in which operation can be performed only with the main unit, set the tact time above the calculation result shown in the table below.

For the RSF supermini series actuators, the regenerative absorption circuit incorporated as standard has sufficient capacity. No external resistance or capacitor is required.

Driver	Actuator	Formula
HA-680-4	FHA-8C	$0.3 \times$ Load inertia+0.1 (second)
	FHA-11C	$0.6 \times$ Load inertia+0.5 (second)
HA-680-6	FHA-14C	$1.7 \times$ Load inertia+2.0 (second)

> ⚠ **CAUTION**
> - **If the tact time is shorter than the calculation result, connect an external resistance or external capacitor.**
> - **If the tact time is shorter than the calculation result and no external resistance or external capacitor is connected, the built-in fuse of the regenerative resistance may be blown during operation.**
> - **The built-in fuse cannot be restored once blown. As a result, the regenerative circuit stops, causing a regenerative error alarm.**
> - **When the alarm occurs, refer to "7-1 Alarms and diagnostic tips."**

Use the following as a guide when selecting the capacity of the external resistance/capacitor to be connected.

(1) If an external capacitor is connected when the load inertia ratio is 2 or less:

Driver	Actuator	Recommended capacitor mode	Capacity $\times$ quantity	Manufacturer
HA-680-4	FHA-8C	UPJ1H102MHH	1000µF $\times$ 1	
	FHA-11C	UPJ1H222MHH	2200µF $\times$ 1	Nichicon
HA-680-6	FHA-14C	UPJ1H222MHH	2200µF $\times$ 4	

Connect it to the VM and GND terminals of the HA-680 driver, as shown below.
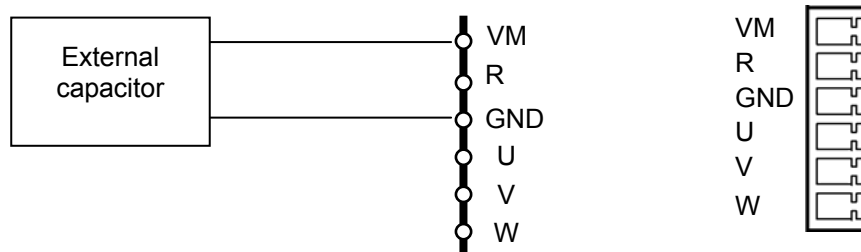
Terminal block mode:
MC1.5/6-G-3.81
(Phoenix contact)

(2) If an external resistance is connected, or the load inertia ratio is 2 or more:
The resistance is 30 ohms. Use the following formula for the capacity.

$$2 \times \frac{\text{Tact time calculation result}}{\text{Actual tact time}} \text{ (W)}$$

Connect it to the R and GND terminals of the HA-680 driver, as shown below.

Terminal block model: MC1.5/6-G-3.81
(Phoenix contact)
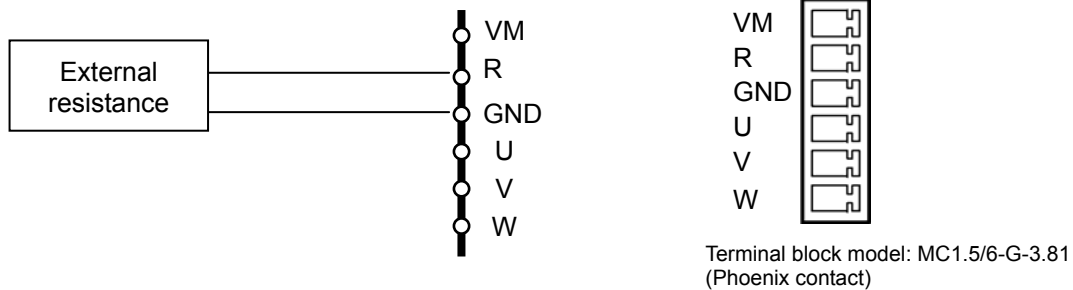
Change the setting of the regenerative resistance internal/external switch terminal of the HA-680 driver, as shown below. The external resistance is not effective unless the setting is changed.

Regenerative resistance internal/external switch terminal

Default setting
(internal regenerative resistance)

Regenerative resistance internal/external switch terminal

When an external resistance is connected

Cover

Regenerative resistance internal/external switch terminal (Default setting)

Heat sink
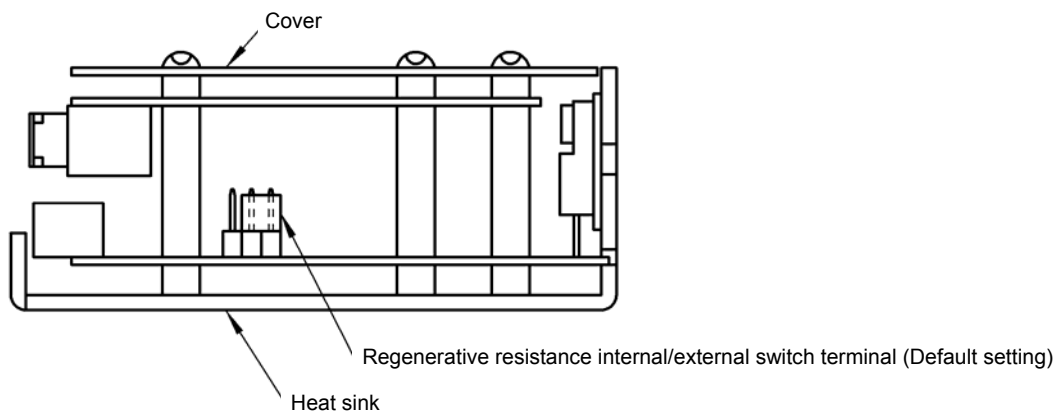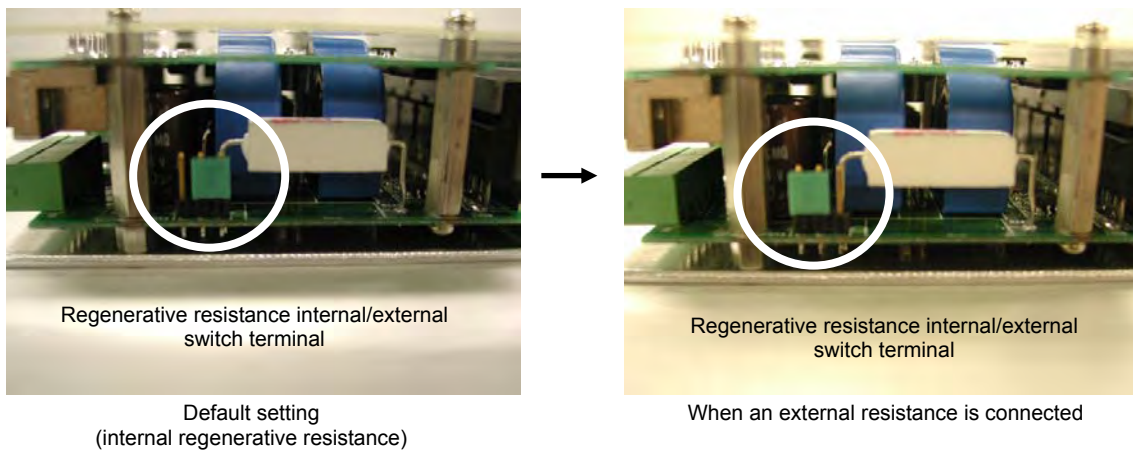
3-9   Connecting cables for the encoder and the I/O

3-9-1   Preparing the encoder cable and the I/ O cable

Follow these instructions for the preparation of the encoder cable and the I/O cable.

(1) Use twisted pair cables for I/O signals, and for encoder signals cables. When a host controls several drivers, prepare I/O signal cables for each driver individually.

(2) Make the length of signal cables as short as possible.

   (a) I/O signal cable: 3m or less

   (b) Encoder signal cable (user's responsibility): 20m or less, providing that the condition of wire conductivity is less than 0.04 ohm/m. Cable for 3m/5m/10m are available for option.

(3) Separate power cables (power source cables and motor cables) and I/O signal cables in 30cm or more. Do not encase both cables in one pipe or duct, nor bundle them.

(4) Do not open the end of analog signal cables as speed signal cables.

Terminals/Connectors	Symbol	Allowable Wire Sizes (mm^2)
Encoder connectors	CN1	$0.3mm^2$ twist pair shielded cable
External I/O connector	CN2	$0.35mm^2$ twist pair cable, twist pair whole-shielded cable

3-9-2   Pin layout of encoder connector (CN1)
◆ Pin layout 1: FHA-C mini 24VAC type

The models and the pin layout of the encoder connectors are as follows:
Note that pin layout may vary depending on the actuator.

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

Encoder connector

6 NC	4 NC	2 NC

7 SD	5 SD	3 NC	1 +5V

13 NC	11 NC	9 NC

14 NC	12 NC	10 NC	8 0V
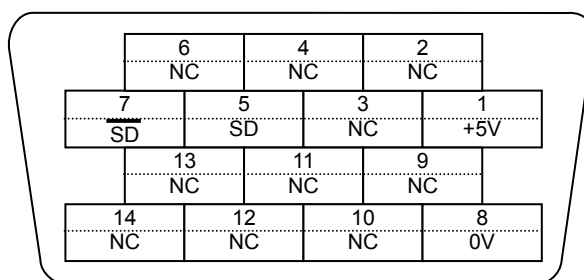
Viewed from soldering side

⚠ **CAUTION**   **Do not use the pins marked "NC" that are already reserved. Wrong usage may cause failure.**

◆ Pin layout 2: RSF supermini series

The models and the pin layout of the encoder connectors are as follows:
Note that pin layout may vary depending on the actuator.

Connector: Model 10114-3000VE   Manufacturer: 3M
Cover: Model 10314-52F0-008   Manufacturer: 3M
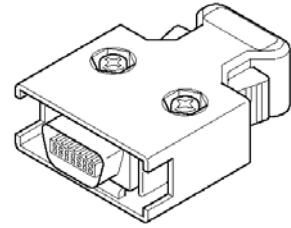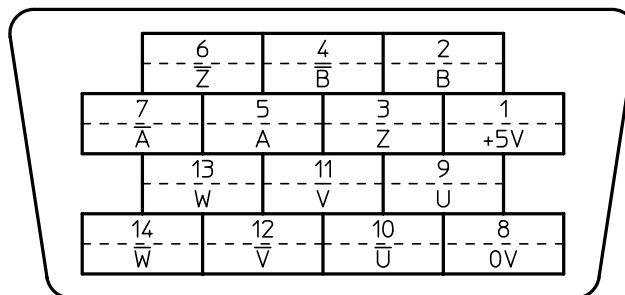
Encoder connector

Viewed from soldering side

3-9-3   Pin-layouts of the I/O signal connector (CN2)

The models and the pin layout of the encoder connector are as follows:

Connector: Model 10126-3000VE   Manufacturer: 3M
Cover: Model 10326-52F0-008   Manufacturer: 3M

◆ **For position control**

12 IN- COM	10 Input 4	8 Input 2	6 OUT-COM	4 Output 4	2 Output 2 ALARM
13 MON-GND	11 Input 5	9 Input 3	7 Input 1 S-ON	5 Output 5 Z	3 Output 3	1 Output 1 IN-POS
25 Z+	23 B+	21 A+	19	17 REV-	15 FWD-
26 Z-	24 B-	22 A-	20	18 +24V	16 REV+	14 FWD+
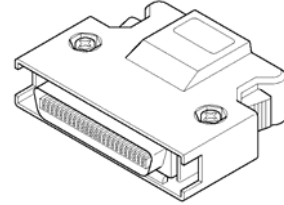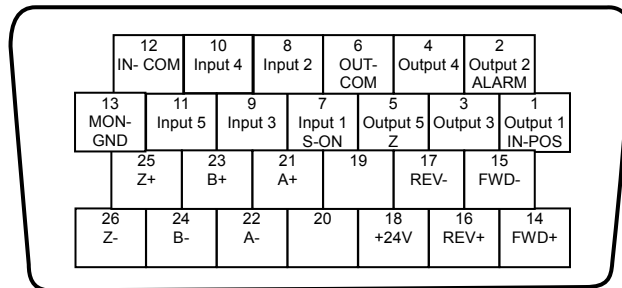
Viewed from soldering side

◆ **For speed control**

12 IN-COM	10 Input 4	8 Input 2 FWD-EN	6 OUT-COM	4 Output 4	2 Output 2 ALARM
13 MON-GND	11 Input 5	9 Input 3 REV-EN		5 Output 5 Z	3 Output 3	1 Output 1 HI-SPD
25 Z+	23 B+	21 A+	19 SPD-CMD	17	15
26 Z-	24 B-	22 A-	20 SPD-COM	18	
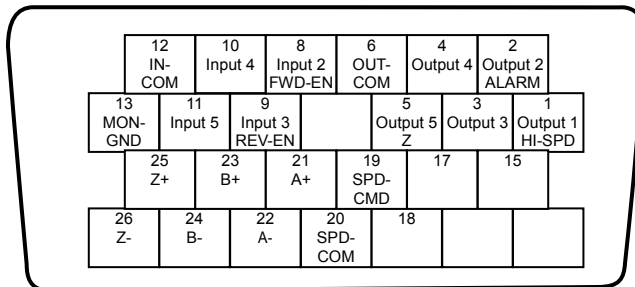
Viewed from soldering side

◆ **For torque control**

12 IN-COM	10 Input 4	8 Input 2 FWD-EN	6 OUT-COM	4 Output 4 CUR-LMT-M	2 Output 2 ALARM
13 MON-GND	11 Input 5	9 Input 3 REV-EN	7 Input 1 S-ON	5 Output 5 Z	3 Output 3 READY	1 Output 1 HI-SPD
25 Z+	23 B+	21 A+	19 TRQ-CMD	17	15
26 Z-	24 B-	22 A-	20 SPD-COM	18	16	14
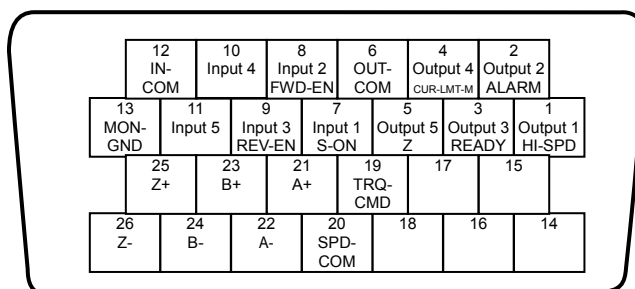
Viewed from soldering side

3-9-4 Connecting cables for the encoder and I/O signals

Firmly connect both connectors of the encoder cable and the I/O signal cable to [CN1] and [CN2] sockets of HA-680 driver respectively.

CN2 socket

CN1 socket

I/O signal connector

Encoder connector
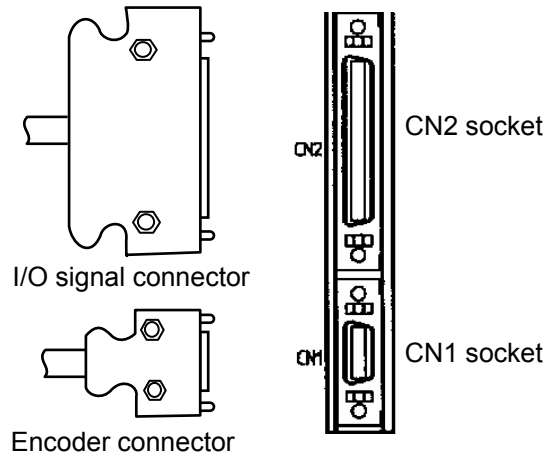
3-9-5   EIA-232C (RS-232C) cable specifications

For EIA-232C (RS-232C), dedicated cable "HDM-RS232C" (cable length 1.5 m) is provided.

If you provide cables separately, refer to the following specifications:

(1) Applicable terminal type for cables (driver side)
Socket terminal: DF11-2428-SCF (Mfg by Hirose)
Socket: DF11-8DS-2C (Mfg by Hirose)

(2) Applicable line for cables: 0.2mm^2 shield line

(3) Maximum wiring length: within 10m

Pin assignments: refer the figure to the right.

HA-680 driver side   Host side

FG   ①   ①
RxD ②   ②
TxD ③   ③
DTR ④   ④
GND ⑤   ⑤
DSR ⑥   ⑥
NC   ⑦   ⑦
NC   ⑧   ⑧
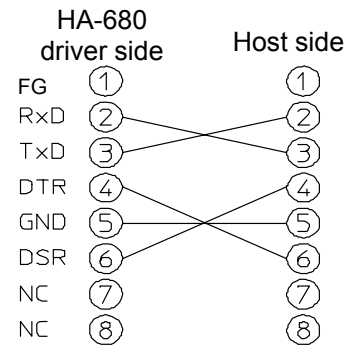
3-10 Power ON and OFF sequences

3-10-1   Power ON / OFF sequence circuit

Configure the sequence circuit to operate the switch for main power individually by an [emergency stop] signal and the [CN2 alarm: ALARM] signal of the HA-680 driver.

Do not make switching operation (turning ON or OFF) at the state that the servo-ON [CN2-7: Servo-ON: S-ON] is OFF.

3-10-2   Frequency of power ON / OFF operation

Since the HA-680 driver provides a capacitor for an input filter of a rectifier circuit, large transient current flows at every operation of main power switch. If the switching operation is too frequent, resisters for suppressing the transient current may deteriorate.

The switching frequency should not exceed 5 times in an hour and 30 times in a day. Furthermore, the interval between turning OFF and ON should keep more than 30 seconds.

3-10-3   Power on and off sequences

Program the sequence on the high-level equipment to power on and off the HA-680 driver at the following timings:
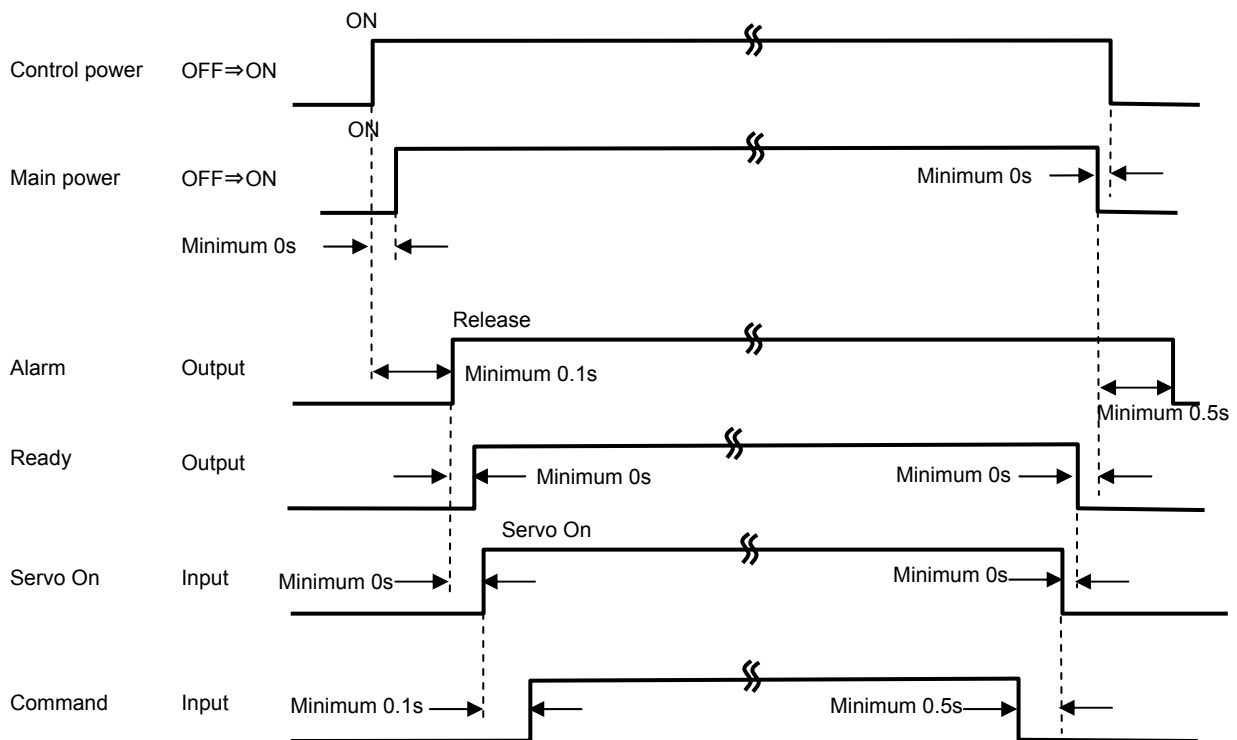
Chapter4 Functions of dedicated communication software PSF-520

Dedicated communication software PSF-520 is communication software for parameter setting and change for the HA-680 driver.

Note: To set and/or change parameters, dedicated communication software PSF-520 is required.

The overview of the functions of PSF-520 is shown below. For details and operation methods, refer to a separate document, "PSF-520 User's Manual."

◆ **Status display**

> Displays basic information such as the software version of the HA-680 driver.

◆ **State display**

> Displays the operation state such as rotation speed.

◆ **Parameter setting**

> Allows you to set, change, and save parameters.

◆ **I/O signal monitoring**

> Displays the states of the I/O signals.

◆ **Alarm display**

> Displays the current and 8 latest alarms.

◆ **Waveform monitoring**

> Performs waveform measurement of speed, torque, etc. during operation.

◆ **Command transmission**

> Allow you to perform JOG operation.

Chapter5 Operations

Follow these instructions prior to operations.

> ⚠ **WARNING**
>
> **When electric power is active, do not make any wiring works.**
> **In advance of wiring work, shut off electric power supply to be free from electric shock.**

> ⚠ **CAUTION**
>
> 1. Inspect the cabling before turning the power ON and correct poor cabling if necessary.
>   (1) Is the cabling correct?
>   (2) Is there any temporary cabling? Are all wires connected to the terminals?
>   (3) Are there any loose terminal connections?
>   (4) Are the wires grounded properly?
>
> 2. Never wire the unit or make changes to the wiring while the power is ON. Turn the power OFF first.
>
> 3. Clean around the equipment. Make sure there are no wire chips or tools in the equipment.

5-1 Trial run

> ⚠ **CAUTION**
>
> 1. Complete the trial run before actual operation.
>
> 2. Drive the actuator only during the trial run; disconnect the actuator from the driven mechanism or load.

5-1-1   Driving actuator only

Drive the actuator only without load during the trial run.

- **Reason for the trial run**

(1) Verifying the power cable wiring

(2) Verifying the motor cable wiring (the servomotor cable and the encoder cable)

(3) Verifying the I/O signal communication with the host device

● Procedure of trial run

◆ Power-ON procedure for control circuit of HA-680

Following power supply turning-ON to the driver, the driver identifies the code of the actuator connected to it automatically. The following operations vary whether the identified code is same as a pre-registered code or not.

(1) Turn on power to the HA-680 driver. Turn on power to the host.

- Make sure there is not an abnormality.
- If no indication appears, there may be faulty power connections. Shut off power and inspect the wiring.
- ⇒ The HA-680 driver identifies the code of the actuator connected to it automatically.

★ **If the actuator code set in the driver and the actuator that is actually connected match:**

⇒ The green LED (power on) of the HA-680 driver illuminates. As a result of auto identification, the actuator code matches.

The next operation is turning the servo power ON. Start with the procedure (3) "Turning on the main circuit power".

★ **If the actuator code set in the driver and the actuator that is actually connected do not match:**

⇒ The green LED of the HA-680 driver blinks. As a result of auto identification, the actuator code does not match.

(2) Shut down the control circuit power supply. Check the adjustment actuator on the nameplate, and connect a correct actuator. After connection, start again from Step 1.

◆ Turning on main circuit power

(3) Turn on main circuit power, and transmit [ON] signal to [CN2-7 servo-ON: S-ON].

⇒ The red LED of the HA-680 driver illuminates. The drive circuit is turned on, and a current flows through the actuator.

(4) For the position mode, transmit [ON] signal to [CN2 clear: CLEAR] or CN2 deviation clear: DEV-CLR].

⇒ Clear the internal deviation counter to zero.

After that, operation is performed using communication software PSF-520. For details, refer to a separate document, "PSF-520 User's Manual."

◆ **Operating the actuator by JOG operation**

(5) JOG operation can be performed using the host device on which communication software PSF-520 is installed. Start up PSF-520.

(6) Open the Parameter Setting window.

(7) Specify the operation pattern using "43: JOG operation acceleration/deceleration time constant," "44: JOG operation feed pulse count," "45: JOG operation S-shape selection," and "46: JOG operation speed" in "Parameter."

(8) Open the Command Transmission window.

(9) Press the JOG Operation button, and check the operation of the actuator.

5-1-2　Setting parameters

Following trial run of the actuator you can change/set the parameters via the parameter. To set and/or change parameters, dedicated communication software PSF-520 is required.

For details of parameter setting, refer to Chapter 6 "Parameter Setting" and the user's manual of dedicated communication software PSF-520.

◆ **Parameter setting**

(10) Open the Parameter Setting window of dedicated communication software PSF-520.

(11) Click the "Read from the servo" button to read the parameters.

(12) Select the parameter you want to change, and enter a value.

(13) To cancel the changed value to the original setting value, click the "Read from the file" or "Read from the servo" button.

(14) To update the changed setting value, click the "Write to the servo" button.

　Note: Some parameters require turning on the control circuit power again to update the setting values. For details, refer to Chapter 6 "Parameter Setting" and the user's manual of dedicated communication software PSF-520.

(15) To save the setting value to disk, click the "Write to the file" button.

5-1-3　End of trial run

When above operations are finished, terminate the trial run.

(16) Shut down the power according to the power shut down sequence as described in 3-10-3.

5-2 Normal operation

As the HA-655 driver runs by commands from a host, no special intervention is required for normal operations. In this section, instructions for daily operations and maintenance are explained.

5-2-1 Notices for daily operations

> **WARNING**
>
> ### 1. Do not make any wiring while power is active.
>
> Disconnecting wires or connectors while power is active may cause electric shock or abnormal mechanical motion resulting in serious physical injury.
>
> ### 2. Do not touch terminals for at least five minutes after power has been shut off [POWER OFF].
>
> Even during power-OFF, electric charge remains in the driver. Do not touch terminals at least five minutes from power-OFF to avoid electric shock.
>
> ### 3. Do not operate drivers with frequent ON/OFF operation.
>
> Frequent power ON/OFF operation may cause deterioration of electronic elements. Start / stop operation should be performed by using input signals.

5-2-2 Daily maintenance

Since the HA-680 driver employs highly reliable parts, no special daily maintenance is required except the maintenance under user's rules for electronic equipment.

> **WARNING**
>
> ### 1. Shut down electric power before maintenance.
>
> Maintenance while power is active may cause electric shock.
>
> ### 2. Do not touch terminals for at least five minutes after power-OFF stage.
>
> Even with power-OFF, electric charge remains in the driver. Do not touch terminals at least five minutes after power-OFF to avoid electric shock.
>
> ### 3. Do not perform insulation resistance or high voltage breakdown tests.
>
> The test causes damage to the HA-680 driver circuit that results in abnormal motion.

Check point	Interval	Inspection standard	Treatment
Terminal screws	Yearly	No loosen screws	Tightening screws
Exterior	Yearly	No dust or metal chips on the case	Cleaning
Interior Circuitry	Yearly	No color change, no faults, no abnormalities	Consult with Harmonic Drive Systems

Chapter 6 Setting up parameters

All operations such as parameter setting, display, and adjustment can be performed using dedicated communication software PSF-520. This chapter describes details of the parameters. For information on how to use the software, refer to a separate document, "PSF-520 User's Manual."

6-1 Parameter list

	No.	Parameter name	Setting range
Gain-related	00	Position loop gain	10~9999
	01	Speed loop proportional gain	10~9999
	02	Speed loop integral gain	10~9999
	03	Speed loop derivative gain	0~9999
	04	Speed feed-forward factor	0~9999
	05	Acceleration feed-forward factor	0~9999
	06	Torque command filter	0~9999
	07	Speed step correction	0~9999
	08	Torque step correction	0~9999
	09	Step correction switch range	0~9999
Operation setting general	10	Control mode	0~5
	11	Input function assignment	0~20
	12	Output function assignement	0~20
	13	Input pin logical setting	0~31
	14	Output pin logical setting	0~15
	15	Control input filter time costant	0~99
	16	Speed limiting	0~*1
	17	FWD current limiting	0~*2
	18	REV current limiting	0~*2
	19	Regenerative brake ON/OFF	0,1
	20	Rotaty direction	0,1
Position control-related	21	Allowable position deviation	0~32767
	22	In-position ready range	0~9999
	23	Command pulse input factor-numerator	1~999
	24	Command pulse input factor-denominator	1~999
	25	Command pulse input form	0~2
	26	Multiplication at 2-phase input	1,2,4
	27	Servo-on deviation clear	0,1
	28	Angle correction	0,1
	29	Auto gain setting at positioning	0,1
Speed control-related	30	Speed command input factor	1~*1
	31	Attained speed determination value	1~*1
	32	Internal speed command value	0~*1
	33	Acceleration time constant	1~9999
	34	Deceleration time constant	1~9999
	35	Analog command A/D value (Mid)	0~8192
	36	Analog command A/D value (Max)	0~8192
	37	Analog command A/D value (Min)	0~8192
	38	Zero clamp	0,1
	39	Reserved for the system	*3
Torque control-related	40	Internal command input factor	0~*2
	41	Torque command input factor	0~*2
	42	Reserved for the system	*3
JOG-related	43	JOG operation acceleration/deceleration time constant	1~9999
	44	JOG operation feed pulse count	1~9999
	45	JOG operation S-shape selection	0,1
	46	JOG operation speed	0~*1
Communication-related	47	Communication setting	0,1
	48	CAN ID	*3
	49	CAN communication speed	*3

*1: This is the maximum rotation speed of the applicable actuator x reduction ratio.

*2: The setting varies depending on the applicable actuator.

*3: This area is reserved for the system. Do not perform any setting.

6-2 Function of the parameters

00: Position loop gain   (position / speed)

● Function

This parameter specifies the gain of the position loop. Determine the value based on the frictional torque and rigidity of the machine.

High setting $\Rightarrow$ The position error is small, and high tracking performance to commands is obtained. If the setting is too high, the servo system will be unstable and hunting may easily occur; it should be decreased so that no hunting can occur.

Low setting $\Rightarrow$ If the setting is too low, a problem may occur; for example, the tracking performance to commands may be poor, or position precision may not be obtained.

When no hunting occurs and neither overshoot nor undershoot occurs, set the maximum gain.

For speed control, it is effective only when zero clamp is set ("Parameter" $\Rightarrow$ "38: Zero clamp").

● Setting

unit	Lower limit	Upper limit	Default
-	10	9999	note

Note: The actual setting varies with the AC servo actuator model. When changing the value, consider the defaults shown in Section 6-3, "Default parameters" as the standard (guide setting).

01: Speed loop proportional gain   (position / speed)

● Function

This parameter specifies the proportional gain of the speed loop. Determine the value based on the moment of inertia, the frictional torque, and the rigidity of the machine.

High setting $\Rightarrow$ If the setting is too high, the servo system will be unstable, and hunting and overshoot will easily occur.

Low setting $\Rightarrow$ If the setting is too low, the responsiveness and tracking performance will be poor.
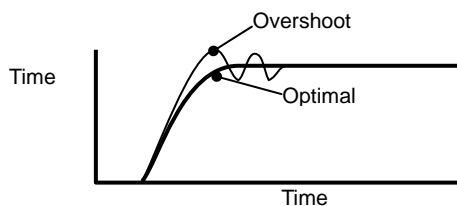
When no hunting occurs and neither overshoot nor undershoot occurs, set the maximum gain.

● Setting

unit	Lower limit	Upper limit	Default
-	10	9999	note

Note: The actual setting varies with the AC servo actuator model. When changing the value, consider the defaults shown in Section 6-3, "Default parameters" as the standard (guide setting).

02: Speed loop integral gain   (position / speed)

● Function

This parameter specifies the speed loop integral gain.

High setting ⇒ If the setting is too high, the servo system will be unstable, and hunting and overshoot will easily occur.

Low setting ⇒ If the setting is too low, the responsiveness and tracking performance will be poor.

● Setting

unit	Lower limit	Upper limit	Default
-	10	9999	note

Note: The actual setting varies with the AC servo actuator model. When changing the value, consider the defaults shown in Section 6-3, "Default parameters" as the standard (guide setting).

03: Speed loop derivative gain   (position / speed)

● Function

This parameter specifies the speed loop derivative gain.

Usually set this factor to 0.

High setting ⇒ If the setting is too high, the servo system will be unstable, and hunting and overshoot will easily occur.

● Setting

unit	Lower limit	Upper limit	Default
-	0	9999	note

Note: The actual setting varies with the AC servo actuator model. When changing the value, consider the defaults shown in Section 6-3, "Default parameters" as the standard (guide setting).

04: Speed feed-forward factor   (position)

● **Function**

This parameter specifies the factor used to give the first-order derivative value to a speed command. Usually set this factor to 0.

This setting is usually required to improve the speed.

● **Setting**

unit	Lower limit	Upper limit	Default
-	0	9999	0

05: Acceleration feed-forwad factor   (position)

● **Function**

This parameter specifies the factor used to give the second-order derivative value to a torque command. Usually set this factor to 0.

This setting is usually required to improve the speed.

● **Setting**

unit	Lower limit	Upper limit	Default
-	0	9999	0

06: Torque command filter   (position / speed / torque)

● **Function**

For the purpose of suppressing the self-excited oscillation with the mechanical system, this parameter specifies the factor for the cutoff frequency of the low pass filter of a torque command.

Usually set this factor to 0.

● **Setting**

unit	Lower limit	Upper limit	Default
-	0	9999	0

07: Speed step correction   (position)

● Function

This parameter specifies the speed command correction amount that is to be added to the speed command, depending on the positive or negative amount in the command.

Usually set this parameter to 0. It should be set when the speed is to be improved.

High setting $\Rightarrow$ If the setting is too high, the servo system will be unstable, and hunting and overshoot will easily occur.

● Setting

unit	Lower limit	Upper limit	Setting
−	0	9999	0

The setting relates to the one in [09: Step correction switching range] of [Parameter].

08: Torque step correction   (position)

● Function

This parameter specifies the torque command correction amount that is to be added to the torque command, depending on the positive or negative amount in the command.

Usually set this parameter to 0. It should be set when the speed is to be improved.

High setting $\Rightarrow$ If the setting is too high, the servo system will be unstable, and hunting and overshoot will easily occur.

● Setting

unit	Lower limit	Upper limit	Setting
−	0	9999	0

The setting relates to the one in [09: Step correction switching range] of [Parameter].

09: Step correction switch range (position)

● Function

This parameter specifies the amount of position deviation for the deviation counter where the following will take effect: speed step correction ([Parameter] $\Rightarrow$ [07: Speed step correction]) and torque step correction ([Parameter] $\Rightarrow$ [08: Torque step correction]).

The values of "Speed step correction" and "Torque step correction" become effective when the amount of position deviation becomes bigger than those set values.

● Setting

unit	Lower limit	Upper limit	Default
Pulse	0	9999	4000

Note: For ordinary use, leave this parameter unchanged from 0.

10: Control mode (The power must be turned on again after setting a change.)
(position / speed / torque)

● Function

The HA-680 driver can control the actuator in either the [position control], [speed control] or [torque control]. This function selects an operating mode.

In the position control a command signal is composed of pulse trains, while in the speed mode or torque mode it is composed of an analog voltage.

[0]: position control (factory default) [1]: speed control [2]: torque control

● Setting

unit	Lower limit	Upper limit	Default
-	0	5	0

Note 1: The power must be turned on again after setting a change. The previous value is effective until you turn on the power again.

Note 2: The upper limit value is 5. However, do not use setting values 3, 4, and 5 because these are reserved for the system.

11: Input function assignment

(The power must be turned on again after setting a change.)

(position / speed / torque)

● **Function**

This function selects the function of the input signal. The relations between the setting value and function selection are as follows.

・**Position control, input signal assignment parameter**

Setting	CN2 pin no.							
	Servo-ON	FWD inhibit	REV inhibit	Clear	Alarm clear	Deviation clear	Speed limit	Current limit
0	7	8	9	—	10	11	—	—
1	7	8	9	10	—	—	11	—
2	7	8	9	10	—	—	—	11
3	7	—	—	—	8	9	10	11

・**Speed control, input signal assignment parameter**

Setting	CN2 pin no.						
	Servo-ON	FWD enable	REV enable	Clear	Internal/ external command	Speed limit	Current limit
0	7	8	9	10	—	11	—
1	7	8	9	10	—		11
2	7	8	9	—	—	10	11
3	7	8	9	10	11	—	—
4	7	8	9	—	10	11	—
5	7	8	9	—	10	—	11

・**Torque control, input signal assignment parameter**

Setting	CN2 pin no.					
	Servo-ON	FWD enable	REV enable	clear	Internal/ external command	Current limit
0	7	8	9	10	—	11
1	7	8	9	10	11	—
2	7	8	9	—	10	11

● **Setting**

unit	Lower limit	Upper limit	Default
-	0	20	0

Note 1: The upper limit value is 20. However, the actual setting range is as shown above depending on the control mode. Do not set any values outside the range because these are reserved for the system.

Note 2: The power must be turned on again after setting a change. The previous value is effective until you turn on the power again.

12: Output function assignment
(The power must be turned on again after setting a change.)

(position / speed / torque)

● Function

This function selects the function of the output signal. The relations between the setting value and function selection are as follows.

・**Position control, output signal assignment parameter**

Setting	CN2 pin no.					
	In-position ready	Alarm	Ready	Limiting speed	Limiting current	Phaze-Z OC output
0	1	2	3	4	—	5
1	1	2	3	—	4	5
2	1	2	—	3	4	5

・**Speed control, output signal assignment parameter**

Setting	CN2 pin no.					
	Attained speed	Alarm	Ready	Limiting speed	Limiting current	Phaze-Z OC output
0	1	2	3	4	—	5
1	1	2	3	—	4	5
2	1	2	—	3	4	5

・**Torque control, output signal assignment parameter**

Setting	CN2 pin no.				
	Attained speed	Alarm	Ready	Limiting current	Phaze-Z OC output
0	1	2	3	4	5

● Setting

unit	Lower limit	Upper limit	Default
-	0	20	0

Note 1: The upper limit value is 20. However, the actual setting range is as shown above depending on the control mode. Do not set any values outside the range because these are reserved for the system.

Note 2: The power must be turned on again after setting a change. The previous value is effective until you turn on the power again.

13: Input pin logical setting
(The power must be turned on again after setting a change.)

(position / speed / torque)

● **Function**

This function sets the logic to enable the functions of the external input signals.
Set the sum of the desired logic values in the following table.

Example: To enable Input 4 and Input 5 as normal open: 8+16=24

Therefore, set the value as 24.

Signal	Normal close	Normal open
CN2-7 Input 1(Servo-ON: S-ON)	0	1
CN2-8 Input 2	0	2
CN2-9 Input 3	0	4
CN2-10 Input 4	0	8
CN2-11 Input 5	0	16

● **Setting**

unit	Lower limit	Upper limit	Default
―	0	31	0

Note: The power must be turned on again after setting a change. The previous value is effective until you turn on the power again.

14: Output pin logical setting
(The power must be turned on again after setting a change.)

(position / speed / torque)

● **Function**

This function sets the logic to determine the function operation state of the external output signals.
Set the sum of the desired logic values in the following table.

Example: To enable Output 3 and Output 4 as normal open: 4+8=12

Therefore, set the value as 12.

Signal	Normal close	Normal open
CN2-1 Output 1	0	1
CN2-2 Output 2	0	2
CN2-3 Output 3	0	4
CN2-4 Output 4	0	8
CN2-5 Output 5 (Phaze-Z OC output: Z)	0	―

● **Setting**

unit	Lower limit	Upper limit	Default
―	0	15	2

Note: The power must be turned on again after setting a change. The previous value is effective until you turn on the power again.

Note: Logical setting of Output 5 (Phase-Z OC output) cannot be performed.

15: Control input filter time constant
(position / speed / torque)

● Function

This function sets the time constant of the soft low-pass filter applied to the signals at the control input terminal other than forward rotation/reverse rotation command pulses.

If it is used in an environment where there is external high-frequency noise, set the value so that the control input signal is not easily affected by the noise.

● Setting

unit	Lower limit	Upper limit	Default
ms	0	99	0

16: Speed limiting
(position / speed)

● Function

This function sets the motor rotation speed at which the speed limit becomes effective when the speed limit function is assigned to the signal input in the parameter "13: Input pin logical setting."

A value from [1] to [Motor maximum rotation speed] can be entered.

● Setting

unit	Lower limit	Upper limit	Default
r/min	0	Motor maximum rotation speed	Motor maximum rotation speed

Note 1: Motor rotation speed = Actuator rotation speed x reduction ratio

Note 2: When operation continues with the motor rotation speed limited during position control, an error counter overflow alarm occurs.

> ⚠ **WARNING**
>
> **This parameter cannot be set for torque control. The upper limit value of the parameter is "motor maximum rotation speed." When the load of the actuator is small (including no load), it may rotate at the maximum rotation speed instantaneously.**

17: FWD current limiting (The power must be turned on again after setting a change.)
18: REV current limiting (The power must be turned on again after setting a change.)
(position / speed / torque)

● Function

This function sets the current limit value at the forward rotation and reverse rotation sides in the current limit state when the current limit function is assigned to the signal input in the parameter "13: Input pin logical setting."

Set the maximum current values at the forward rotation and reverse rotation sides in percentages of the allowable continuous current.

● Setting

unit	Lower limit	Upper limit	Default
%	0	note1	note2

Note 1: The setting value varies depending on the model of the actuator. The upper limit value is calculated using the following formula based on the values listed in the catalogue and manual of the AC servo actuator.
The rated torque is 100%.

Maximum current ÷ Allowable continuous current × 100 (%) = Upper limit value (%)

Note 2: The setting value varies depending on the model of the actuator. When you change the value, use the "6-3 Default parameter list" as the standard values.

Note 3: The power must be turned on again after setting a change. The previous value is effective until you turn on the power again.

19: Regenerative brake ON/OFF   (position / speed / torque)

● Function

If this parameter is set on, input of a servo-on signal causes an emergency stop according to the driver control (regenerative brake), and the servo is turned off after it stops.

If this parameter is set off, input of a servo-on signal causes the servo to be turned off according to the driver control, and the motor is left free.

0: Does not operate the regenerative brake.
1: Operates the regenerative brake.

● Setting

unit	Lower limit	Upper limit	Lower limit
−	0	1	0

20: Rotary diection (The power must be turned on again after setting a change.)

(position / speed / torque)

● Function

This function specifies the rotary direction of the actuator when responding to rotary direction commands (FWD or REV) of "Command input signal".

The relation among them is as follows:

Setting	FWD command	REV command
0	FWD rotation	REV rotation
1	REV rotation	FWD rotation

● Setting

unit	Lower limit	Upper limit	Default
-	0	1	0

Note: The power must be turned on again after setting a change. The previous value is effective until you turn on the power again.

21: Allowable position deviation (position)

● Function

The [deviation counter] calculates [deviation count] subtracting the [feedback count] from the [position command]. A large position deviation may result in an abnormality.

When the position error exceeds the [Allowable position deviation], a [max. deviation alarm] occurs and the servo power shuts off.

The relation among the allowable position deviation, position loop gain, command pulse input factor, and pulse command speed is determined by the following formula in a stationary state. Set an appropriate maximum pulse command value according to the speed.

$$\text{Allowable position deviation} = \frac{\text{Pulse command speed [p/s]}}{\text{Position loop gain}} \times \frac{\text{Command pulse input factor (numerator)}}{\text{Command pulse input factor (denominator)}}$$

For the actuator that tries rotation by command pulse input, an alarm is outputted when the deviation pulse exceeds the allowable value when rotation is not possible due to failure of the mechanism.

● Setting

unit	Lower limit	Upper limit	Default
Pulse	0	32767	30000

22: In-position ready range   (position)

● Function

When the difference between "command pulse count" and "returned pulse count," which is "deviation pulse count," decreases below the setting value of "in-position ready range," the signal is outputted to "CN2 In-position ready output: IN-POS" as completion of positioning.

This value only monitors the state of position deviation and does not directly affect the rotation control of the servo actuator.

● Setting

unit	Lower limit	Upper limit	Default
Pulse	0	9999	10

23: Command pulse input factor-numerator
(The power must be turned on again after setting a change.)
24: Command pulse input factor-denominator

(The power must be turned on again after setting a change.)   **(position)**

● Function

This parameter is used with "Command pluse input factor - denominator" as electronic gear function. It is used to have integral number for the relationship of the input pulse number and the amount of moment of the machine that the actuator drives.

The formula of the relationship of "numerator and denominator" as follows:

◆ For rotary operation:

$$\text{Angle of movement per input pulse} = \frac{\text{command pulse input factor -numerator}}{\text{command pulse input factor -denominator}} \times \frac{360}{\text{*Actuator resolution}} \times \frac{1}{\text{Reduction ratio of load mechanism}}$$

◆ For linear operation:

$$\text{Amount of feed per input pulse} = \frac{\text{command pulse input factor -numerator}}{\text{command pulse input factor -denominator}} \times \frac{\text{Load mechanism feed pitch}}{\text{*Actuator resolution}}$$

* Actuator resolution = Encoder resolution (4 times) x Actuator duty factor

On the basis of this formula, set the parameter value so that both the numerator and denominator will be integers.

● Setting

	unit	Lower limit	Upper limit	Default
Numerator	－	1	999	1
Denominator	－	1	999	1

Note 1: The power must be turned on again after setting a change. The previous value is effective until you turn on the power again.

Note2: By default, the internal pulse is performed with the encoder resolution (4 times). The amount of movement of the actuator will thus be the one corresponding to the encoder resolution (4 times).
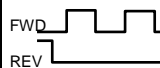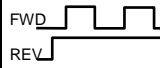
25: Command pulse input form

(The power must be turned on again after setting a change.) **(position)**

● Function

Three types of command signals can be inputted to the HA-680 driver as follows:

Type	2-pulse train	1-pulse train	2-phase pulse train
Command pulse input form	Forward FWD REV Reverse FWD REV	Forward FWD REV Reverse FWD REV	Forward FWD REV 90° Reverse FWD REV 90°
FWD CN2-14,15	Forward	Pulse input	Phase-A
REV CN2-16,17	Reverse	Polarity	Phase-B
Setting	0	1	2

● Setting

unit	Lower limit	Upper limit	Default
-	0	2	0

Note: The power must be turned on again after setting a change. The previous value is effective until you turn on the power again.

26: Multiplication at 4-phase input

(The power must be turned on again after setting a change.) **(position)**

● Function

When [command pulse input form] is set at [2-phase pulse], it is possible to make the motion command pulse count two or four times greater than the command pulse count.

1: Same as the command count
2: Two times the command count
4: Four times the command count

● Setting

unit	Lower limit	Upper limit	Default
-	1	4	4

Note: The power must be turned on again after setting a change. The previous value is effective until you turn on the power again.

27: Servo-on deviation clear   (position)

● Function

Even when the servo power is OFF, the control power is still ON. If the position of the load mechanism shifts due to gravity or manual force while the servo power is OFF, the deviation count changes. If the servo power is turned ON, the actuator rotates rapidly to make the deviation count return to [0].

This rapid motion may be dangerous. The Servo-ON function allows the deviation count to be reset to [0] when the servo power is turned on. Thus, the actuator will not move when the servo power is restored. However, the position deviation data is lost and the actuator will not return to its original position.

Select the input signal at which the deviation counter is cleared.

0: The deviation counter is not cleared when the servo on signal is inputted.
1: The deviation counter is cleared when the servo on signal is inputted.

● Setting

unit	Lower limit	Upper limit	Default
—	0	1	0

Note: When the deviation counter is cleared, the command pulse count becomes the same value as the returned pulse count.

28: Angle correction

(The power must be turned on again after setting a change.)   **(position)**

● Function

The HA-680 drivers with 4-line specifications provide [angle correction] function, which improves one-way positioning accuracy compensating it with a pre-analyzed error of the Harmonic Drive® component. The function improves the accuracy about 30%.

0: without angle correction
1: with angle correction

● Setting

unit	Lower limit	Upper limit	Default
-	0	1	0

Note 1: The power must be turned on again after setting a change. The previous value is effective until you turn on the power again.

Note 2: If no correction data are recorded in the connected actuator, this parameter cannot be set to 1. (0 is read even if it is set to 1.)

* This is not supported by the RSF supermini series actuators.

29: Auto gain setting at positioning   (position)

● **Function**

To get short period for positioning, the function automatically makes speed loop gain higher when a deviation pulse number becomes small.

For the reason that the speed loop gain is proportionate to deviation pulse number, a positioning speed at small error pulse number becomes comparatively low. In the case, the responsibility for the positioning may be improved by the higher speed loop gain.

If the speed loop gain registered in [parameter] →[01: Speed loop proportional gain] is higher than the automatic gain, the registered gain has priority.

0: without auto gain setting at positioning
1: with auto gain setting at positioning

● **Setting**

unit	Lower limit	Upper limit	Default
-	0	1	1

30: Speed command input factor

(The power must be turned on again after setting a change.)   **(speed)**

● **Function**

This function sets the motor's rotation speed when the input command voltage is 10 V.

The relation between the input voltage and motor rotation speed is determined by the speed command input factor in the following formula.

$$\text{Motor rotation speed} = \text{Input command voltage} \times \frac{\text{Torque command input factor}}{10.0V}$$

● **Setting**

unit	Lower limit	Upper limit	Default
r/min	1	Motor maximum rotation speed	*

Note: The power must be turned on again after setting a change. The previous value is effective until you turn on the power again.

Note: Motor rotation speed = Actuator rotation speed × reduction ratio

* The setting value varies depending on the model of the actuator.

31: Attained speed determination value (speed / torque)

● Function

This parameter is set at [speed control] or [torque control]. The [CN2 attained speed: HI-SPD] signal is outputted when the actuator speed is more than the value of [attained speed].

● Setting

unit	Lower limit	Upper limit	Default
r/min	1	Motor maximum rotation speed	2000

Note: Motor rotation speed = Actuator rotation speed $\times$ reduction ratio

32: Internal speed command (speed)

● Function

The function can operate the actuator without an input signal. This is convenient for test operations without hosts and for system diagnosis.

Actuator motion at the interion speed starts with the input to [CN2 external/internal command: CMD -CHG] and stops when input is OFF.

To reverse an actuator with an [internal speed command], turn ON [CN2 REV enable: REV-EN].

● Setting

unit	Lower limit	Upper limit	Default
r/min	0	Motor maximum rotation speed	1

Note: Motor rotation speed = Actuator rotation speed $\times$ reduction ratio

33: Acceleration time constant (speed)

● Function

This function sets the time in which the motor is accelerated from 0 r/min to the maximum rotation speed during speed control.

For external speed commands, when a speed command faster than the setting value is entered, the setting value has higher priority; when a speed command slower than the setting value is entered, the speed command has higher priority.

For internal speed commands, acceleration is performed based on the setting value.

● Setting

unit	Lower limit	Upper limit	Default
ms	1	9999	1

34: Deceleration time constant (speed)

● Function

This function sets the time in which the motor is decelerated from the motor maximum rotation speed to 0 r/min during speed control.

For external speed commands, when a speed command faster than the setting value is entered, the setting value has higher priority; when a speed command slower than the setting value is entered, the speed command has higher priority.

For internal speed commands, deceleration is performed based on the setting value.

● Setting

unit	Lower limit	Upper limit	Default
ms	1	9999	1

35: Analog command A/D value (Mid)
(Speed / torque)

● Function

This function sets the offset value when the analog command is 0V (a command value to stop the motor). Enter 0V to the analog command, and set the analog input voltage value in the value monitor of the state display window of communication software PSF-520. For details, refer to a separate document, "PSF-520 User's Manual."

● Setting

unit	Lower limit	Upper limit	Default
-	0	8192	4096

36: Analog command A/D value (Max)

(Speed / torque)

● Function

This function sets the offset value when the analog command is -10V. Enter -10V to the analog command, and set the "analog command A/D value" in the value monitor of the state display window of communication software PSF-520. For details, refer to a separate document, "PSF-520 User's Manual."

● Setting

unit	Lower limit	Upper limit	Default
-	0	8192	8192

37: Analog command A/D value (Min)

(Speed / torque)

● Function

This function sets the offset value when the analog command is +10V. Enter +10V to the analog command, and set the "analog command A/D value" in the value monitor of the state display window of communication software PSF-520. For details, refer to a separate document, "PSF-520 User's Manual."

● Setting

unit	Lower limit	Upper limit	Default
-	0	8192	0

38: Zero clamp   (speed)

● Function

During speed control, the motor stops when both FWD enable (FWD-EN) and REV enable (REV-EN) are on or off. When the motor moves due to external force, it stops where it comes to rest because no position control is performed. If zero clamp is enabled, position control is provided so that the motor retains the position before moving due to external force.

● Setting

unit	Lower limit	Upper limit	Default
-	0	1	0

0 indicates that it is disabled, and 1 indicates that it is enabled.

39: Reserved for the system

This parameter is reserved for the system. Do not change the setting.

40: Internal command input factor   (torque)

● Function

"Internal torque command value" allows you to operate the actuator without an input signal. It is useful for a test run of the actuator alone and for system diagnosis. The command value can be set here.

For operation of the actuator using "internal command," internal commands are selected when a signal is entered (on) to "CN2 Internal/external command: CMD-CHG." External commands are selected when a signal is turned off.

To rotate the actuator in the reverse direction with this "internal speed command value," turn on "CN2 REV enable: REV-EN."

● Setting

unit	Lower limit	Upper limit	Default
%	0	note	1

Note: The setting value varies depending on the model of the actuator. The upper limit value is calculated using the following formula based on the values listed in the catalogue and manual of the AC servo actuator.

The allowable continuous torque is 100%.

Maximum current ÷ Allowable continuous current × 100 (%) = upper limit (%)

41: Torque command input factor   (torque)

● Function

This function sets the output torque when the input command voltage is 10 V.

● Setting

unit	Lower limit	Upper limit	Default
%	0	note	note

Note: The setting value varies depending on the model of the actuator. The upper limit value is calculated using the following formula based on the values listed in the catalogue and manual of the AC servo actuator.

The rated torque is 100%.

Maximum current ÷ Allowable continuous current × 100 (%) = upper limit (%)

$$\text{Output current} = \text{Allowable continuous current} \times \frac{\text{Torque command input factor}}{100} \times \frac{\text{Command voltage factor}}{100}$$

42: Reserved for the system

This parameter is reserved for the system. Do not change the setting.

43: JOG operation acceleration/ deceleration time constant   (position / speed / torque)

● **Function**

This function sets the time in which the motor is accelerated from 0 r/min to the maximum rotation speed and the time in which the motor is decelerated from the motor maximum rotation speed to 0 r/min during JOG operation.

● **Setting**

unit	Lower limit	Upper limit	Default
ms	1	9999	500

44: JOG operation feed pulse count   (position)

● **Function**

When position control is set, it can be moved for the amount of movement set in this parameter.

● **Setting**

unit	Lower limit	Upper limit	Default
Pulse	1	9999	100

45: JOG operation S-shape selection   (position)

● **Function**

This function allows you to select S-shape acceleration/deceleration during JOG operation.

0: S-shape OFF (linear acceleration/deceleration)
1: S-shape ON (S-shape acceleration/deceleration)

● **Setting**

unit	Lower limit	Upper limit	Default
–	0	1	0

Note: In other control modes, this parameter is not effective even if it is set.

46: JOG operation speed

(position / speed / torque)

● **Function**

This function sets the motor maximum rotation speed for operation by JOG commands.

● **Setting**

unit	Lower limit	Upper limit	Default
r/min	0	Motor maximum rotation speed	500

Remark: Motor rotation speed ＝ Actuator rotation speed × ratio

47: Communication setting

● **Function**

This function selects whether the end code of the communication data is in uppercase or lowercase.

0: Lowercase
1: Uppercase

● **Setting**

unit	Lower limit	Upper limit	Default
—	0	1	0

This setting does not affect PSF-520 and HA-680. Use the default value without changing it.

48: CAN ID
49: CAN Communication speed

This parameter is reserved for the system. Do not change the setting.

6-3 Default parameter list

No.	Description	unit	FHA-8C-30	FHA-8C-50	FHA-8C-100
00	Position loop gain	−	40	40	40
01	Speed loop proportional gain	−	75	75	75
02	Speed loop integral gain	−	20	20	20
03	Speed loop derivative gain	−	0	0	0
04	Speed feed-forward factor	−	0	0	0
05	Acceleration feed-forward factor	−	0	0	0
06	Torque command filter	−	0	0	0
07	Speed step correction	−	0	0	0
08	Torque step correction	−	0	0	0
09	Step correction switch range	Pulse	4000	4000	4000
10	Control mode	−	0	0	0
11	Input function assignment	−	0	0	0
12	Output function assignment	−	0	0	0
13	Input pin logical setting	−	0	0	0
14	Output pin logical setting	−	2	2	2
15	Control input filter time costant	ms	0	0	0
16	Speed limit	r/min	6000	6000	6000
17	FWD current limiting	%	188	194	185
18	REV current limiting	%	188	194	185
19	Regenerative brake ON/OFF	−	0	0	0
20	Rotary direction	−	0	0	0
21	Allowable position deviation	Pulse	30000	30000	30000
22	In-position ready range	Pulse	10	10	10
23	Command pulse input factor-numerator	−	1	1	1
24	Command pulse input factor-denominator	−	1	1	1
25	Command pulse input form	−	0	0	0
26	Muliplication at 2-phase input	−	4	4	4
27	Servo-ON deviation clear	−	0	0	0
28	Angle correction	−	0	0	0
29	Auto gain setting at positioning	−	1	1	1
30	Speed command input factor	r/min	6000	6000	6000
31	Attained speed determination value	r/min	2000	2000	2000
32	Internal speed command value	r/min	1	1	1
33	Acceleration time constant	ms	1	1	1
34	Deceleration time constant	ms	1	1	1
35	Analog command A/D value (Mid)	−	4096	4096	4096
36	Analog command A/D value (Max)	−	8192	8192	8192
37	Analog command A/D value (Min)	−	0	0	0
38	Zero clamp	−	0	0	0
39	Reserved for the system note	−	0	0	0
40	Internal command input factor	%	1	1	1
41	Torque command input factor	−	188	194	185
42	Reserved for the system note	−	0	0	0
43	JOG operation acceleration/deceleration time constant	ms	500	500	500
44	JOG operation feed pulse count	Pulse	100	100	100
45	JOG operation S-shape selection	−	0	0	0
46	JOG operation speed	r/min	500	500	500
47	Communication setting	−	0	0	0
48	CAN ID note	−	0	0	0
49	CAN communication speed note	−	0	0	0

Note: This area is reserved for the system. Do not perform any setting.

No.	Description	unit	FHA-11C-30	FHA-11C-50	FHA-11C-100
00	Position loop gain	—	40	40	40
01	Speed loop proportional gain	—	225	225	225
02	Speed loop integral gain	—	20	20	20
03	Speed loop derivative gain	—	0	0	0
04	Speed feed-forward factor	—	0	0	0
05	Acceleration feed-forward factor	—	0	0	0
06	Torque command filter	—	0	0	0
07	Speed step correction	—	0	0	0
08	Torque step correction	—	0	0	0
09	Step correction switch range	pulse	4000	4000	4000
10	Control mode	—	0	0	0
11	Input function assignment	—	0	0	0
12	Output function assignment	—	0	0	0
13	Input pin logical setting	—	0	0	0
14	Output pin logical setting	—	2	2	2
15	Control input filter time costant	ms	0	0	0
16	Speed limit	r/min	6000	6000	6000
17	FWD current limiting	%	211	234	200
18	REV current limiting	%	211	234	200
19	Regenerative brake ON/OFF	—	0	0	0
20	Rotary direction	—	0	0	0
21	Allowable position deviation	pulse	30000	30000	30000
22	In-position ready range	pulse	10	10	10
23	Command pulse input factor-numerator	—	1	1	1
24	Command pulse input factor-denominator	—	1	1	1
25	Command pulse input form	—	0	0	0
26	Muliplication at 2-phase input	—	4	4	4
27	Servo-ON deviation clear	—	0	0	0
28	Angle correction	—	0	0	0
29	Auto gain setting at positioning	—	1	1	1
30	Speed command input factor	r/min	6000	6000	6000
31	Attained speed determination value	r/min	2000	2000	2000
32	Internal speed command value	r/min	1	1	1
33	Acceleration time constant	ms	1	1	1
34	Deceleration time constant	ms	1	1	1
35	Analog command A/D value (Mid)	—	4096	4096	4096
36	Analog command A/D value (Max)	—	8192	8192	8192
37	Analog command A/D value (Min)	—	0	0	0
38	Zero clamp	—	0	0	0
39	Reserved for the system note	—	0	0	0
40	Internal command input factor	%	1	1	1
41	Torque command input factor	—	211	234	200
42	Reserved for the system note	—	0	0	0
43	JOG operation acceleration/deceleration time constant	ms	500	500	500
44	JOG operation feed pulse count	pulse	100	100	100
45	JOG operation S-shape selection	—	0	0	0
46	JOG operation speed	r/min	500	500	500
47	Communication setting	—	0	0	0
48	CAN ID note	—	0	0	0
49	CAN communication speed note	—	0	0	0

Note: This area is reserved for the system. Do not perform any setting.

No.	Description	unit	FHA-14C-30	FHA-14C-50	FHA-14C-100
00	Position loop gain	−	40	40	40
01	Speed loop proportional gain	−	250	250	250
02	Speed loop integral gain	−	20	20	20
03	Speed loop derivative gain	−	0	0	0
04	Speed feed-forward factor	−	0	0	0
05	Acceleration feed-forward factor	−	0	0	0
06	Torque command filter	−	0	0	0
07	Speed step correction	−	0	0	0
08	Torque step correction	−	0	0	0
09	Step correction switch range	pulse	4000	4000	4000
10	Control mode	−	0	0	0
11	Input function assignment	−	0	0	0
12	Output function assignment	−	0	0	0
13	Input pin logical setting	−	0	0	0
14	Output pin logical setting	−	2	2	2
15	Control input filter time costant	ms	0	0	0
16	Speed limit	r/min	6000	6000	6000
17	FWD current limiting	%	247	304	280
18	REV current limiting	%	247	304	280
19	Regenerative brake ON/OFF	−	0	0	0
20	Rotary direction	−	0	0	0
21	Allowable position deviation	pulse	30000	30000	30000
22	In-position ready range	pulse	10	10	10
23	Command pulse input factor-numerator	−	1	1	1
24	Command pulse input factor-denominator	−	1	1	1
25	Command pulse input form	−	0	0	0
26	Muliplication at 2-phase input	−	4	4	4
27	Servo-ON deviation clear	−	0	0	0
28	Angle correction	−	0	0	0
29	Auto gain setting at positioning	−	1	1	1
30	Speed command input factor	r/min	6000	6000	6000
31	Attained speed determination value	r/min	2000	2000	2000
32	Internal speed command value	r/min	1	1	1
33	Acceleration time constant	ms	1	1	1
34	Deceleration time constant	ms	1	1	1
35	Analog command A/D value (Mid)	−	4096	4096	4096
36	Analog command A/D value (Max)	−	8192	8192	8192
37	Analog command A/D value (Min)	−	0	0	0
38	Zero clamp	−	0	0	0
39	Reserved for the system note	−	0	0	0
40	Internal command input factor	%	1	1	1
41	Torque command input factor	−	247	304	280
42	Reserved for the system note	−	0	0	0
43	JOG operation acceleration/deceleration time constant	ms	500	500	500
44	JOG operation feed pulse count	pulse	100	100	100
45	JOG operation S-shape selection	−	0	0	0
46	JOG operation speed	r/min	500	500	500
47	Communication setting	−	0	0	0
48	CAN ID note	−	0	0	0
49	CAN communication speed note	−	0	0	0

Note: This area is reserved for the system. Do not perform any setting.

No.	Description	unit	RSF-3A-30	RSF-3A-50	RSF-3A-100
00	Position loop gain	—	100	100	100
01	Speed loop proportional gain	—	120	120	120
02	Speed loop integral gain	—	10	10	10
03	Speed loop derivative gain	—	0	0	0
04	Speed feed-forward factor	—	0	0	0
05	Acceleration feed-forward factor	—	0	0	0
06	Torque command filter	—	0	0	0
07	Speed step correction	—	0	0	0
08	Torque step correction	—	0	0	0
09	Step correction switch range	pulse	4000	4000	4000
10	Control mode	—	0	0	0
11	Input function assignment	—	0	0	0
12	Output function assignment	—	0	0	0
13	Input pin logical setting	—	0	0	0
14	Output pin logical setting	—	2	2	2
15	Control input filter time costant	ms	0	0	0
16	Speed limit	r/min	10000	10000	10000
17	FWD current limiting	%	229	212	201
18	REV current limiting	%	229	212	201
19	Regenerative brake ON/OFF	—	0	0	0
20	Rotary direction	—	0	0	0
21	Allowable position deviation	pulse	30000	30000	30000
22	In-position ready range	pulse	10	10	10
23	Command pulse input factor-numerator	—	1	1	1
24	Command pulse input factor-denominator	—	1	1	1
25	Command pulse input form	—	0	0	0
26	Muliplication at 2-phase input	—	4	4	4
27	Servo-ON deviation clear	—	0	0	0
28	Angle correction	—	0	0	0
29	Auto gain setting at positioning	—	0	0	0
30	Speed command input factor	r/min	10000	10000	10000
31	Attained speed determination value	r/min	2000	2000	2000
32	Internal speed command value	r/min	1	1	1
33	Acceleration time constant	ms	1	1	1
34	Deceleration time constant	ms	1	1	1
35	Analog command A/D value (Mid)	—	4096	4096	4096
36	Analog command A/D value (Max)	—	8192	8192	8192
37	Analog command A/D value (Min)	—	0	0	0
38	Zero clamp	—	0	0	0
39	Reserved for the system note	—	0	0	0
40	Internal command input factor	%	1	1	1
41	Torque command input factor	—	229	212	201
42	Reserved for the system note	—	0	0	0
43	JOG operation acceleration/deceleration time constant	ms	500	500	500
44	JOG operation feed pulse count	pulse	100	100	100
45	JOG operation S-shape selection	—	0	0	0
46	JOG operation speed	r/min	500	500	500
47	Communication setting	—	0	0	0
48	CAN ID note	—	0	0	0
49	CAN communication speed note	—	0	0	0

Note: This area is reserved for the system. Do not perform any setting.

No.	Description	unit	RSF-5A-30	RSF-5A-50	RSF-5A-100
00	Position loop gain *	—	100 (120)	100 (120)	100 (120)
01	Speed loop proportional gain *	—	65 (130)	65 (130)	65 (130)
02	Speed loop integral gain	—	10	10	10
03	Speed loop derivative gain	—	20	20	20
04	Speed feed-forward factor	—	0	0	0
05	Acceleration feed-forward factor	—	0	0	0
06	Torque command filter	—	0	0	0
07	Speed step correction	—	0	0	0
08	Torque step correction	—	0	0	0
09	Step correction switch range	pulse	4000	4000	4000
10	Control mode	—	0	0	0
11	Input function assignment	—	0	0	0
12	Output function assignment	—	0	0	0
13	Input pin logical setting	—	0	0	0
14	Output pin logical setting	—	2	2	2
15	Control input filter time costant	ms	0	0	0
16	Speed limit	r/min	10000	10000	10000
17	FWD current limiting	%	211	257	253
18	REV current limiting	%	211	257	253
19	Regenerative brake ON/OFF	—	0	0	0
20	Rotary direction	—	0	0	0
21	Allowable position deviation	pulse	30000	30000	30000
22	In-position ready range	pulse	10	10	10
23	Command pulse input factor-numerator	—	1	1	1
24	Command pulse input factor-denominator	—	1	1	1
25	Command pulse input form	—	0	0	0
26	Muliplication at 2-phase input	—	4	4	4
27	Servo-ON deviation clear	—	0	0	0
28	Angle correction	—	0	0	0
29	Auto gain setting at positioning	—	1	1	1
30	Speed command input factor	r/min	10000	10000	10000
31	Attained speed determination value	r/min	2000	2000	2000
32	Internal speed command value	r/min	1	1	1
33	Acceleration time constant	ms	1	1	1
34	Deceleration time constant	ms	1	1	1
35	Analog command A/D value (Mid)	—	4096	4096	4096
36	Analog command A/D value (Max)	—	8192	8192	8192
37	Analog command A/D value (Min)	—	0	0	0
38	Zero clamp	—	0	0	0
39	Reserved for the system note	—	0	0	0
40	Internal command input factor	%	1	1	1
41	Torque command input factor	—	211	266	253
42	Reserved for the system note	—	0	0	0
43	JOG operation acceleration/deceleration time constant	ms	500	500	500
44	JOG operation feed pulse count	pulse	100	100	100
45	JOG operation S-shape selection	—	0	0	0
46	JOG operation speed	r/min	500	500	500
47	Communication setting	—	0	0	0
48	CAN ID note	—	0	0	0
49	CAN communication speed note	—	0	0	0

Note: This area is reserved for the system. Do not perform any setting.

*: The value shown inside of parentheses is for the acturator with brakes.

Chapter 7 Troubleshooting

7-1 Alarms and diagnostic tips

The HA-680 drivers provide various functions to protect actuators and drivers against abnormal operating conditions. When these protection functions trip, driving of the actuator is stopped (the motor becomes servo-off), and the display LED blinks at 0.5-second intervals. (It illuminates in green and blinks in red: The number of times it blinks varies depending on the alarm. See below.)

If two or more alarms occur, only the latest alarm is displayed. Up to 8 latest alarms are recorded. Recorded alarms can be checked with "Alarm History" of dedicated communication software PSF-520.

Alarm code	Description	No. of times LED blinks	Releasing
Overload	Electronic thermal detected an overload state.	1	Available *1
Deviation counter overflow	The value of the deviation counter exceeded the parameter setting value.	2	Available *1
Encoder break detection	The encoder line was broken.	3	Not available *2
Encoder reception error	Serial encoder data could not be received 10 times in a row.	4	Not available *2
	Serial encoder data could not be received over an extended time period, and encoder monitor could not be outputted successfully.	5	
UVW error	All UVW signals of the encoder became the same level.	6	Not available *2
Regenerative error	The main circuit voltage detection circuit detected overvoltage.	7	Not available *2
Operating temperature error	The temperature of the HA-680 main unit tripped the temperature rise sensor.	8	Not available *2
System error	An error of the current detection circuit was detected.	9	Not available *2
Overcurrent	The current detection circuit detected excessive current.	10	Not available *2
Load short circuit	Excessive current flowed through the FET.	11	Not available *2
Memory error	Read/write of EEPROM failed.	12	Not available *2
Overspeed	The motor axis speed exceeded the maximum rotation speed +100 rpm for 0.5 s or longer.	13	Not available *2

*1 The servo does not turn on unless the S-ON signal is entered again after the alarm is cleared with the CLR signal.

*2 Turn off the power after handling the alarm. After that, turn on the power again by following the power on sequence.

The following example illustrates how the LED blinks in case of an alarm.
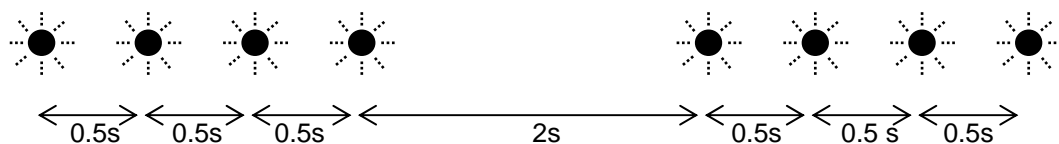
In the above example, the LED blinks 4 times at 0.5-s intervals, which indicates an "encoder reception error."

> ⚠ **WARNING**
>
> **Do not make wiring works after powering the driver for troubleshooting.**
>
> The troubleshooting while power is active may result in getting electric shocks. Shut off the electric power source before any wiring changes are made.

> ⚠ **CAUTION**
>
> 1. Clean around the device. Make sure there are no wire chips or tools inside the equipment.
>
> 2. When two or more persons are working on the equipment, make sure all are alerted and safe before power is restored to the machine.

Overload (Alarm clear: available)

● Description

The driver always monitors the motor current, and if the current exceeds the curve in the figure below, the overload alarm occurs. Occurrence of the overload alarm varies depending on the actuator.

Overload alarm occurrence time

FHA-C mini AC24V type

RSF supermini series

FHA-C mini AC24V type		RSF supermini series(RSF-5A)	
(1)	The alarm occurs when a current of more than 1.25 times the allowable continuous current of the actuator flows for about 170 seconds.	(1)	The alarm occurs when a current of more than 1.2 times the allowable continuous current of the actuator flows for about35 seconds.
(2)	The alarm occurs when a current of 3 times the allowable continuous current of the actuator flows for about 16 seconds.	(2)	The alarm occurs when a current of 3 times the allowable continuous current of the actuator flows for about 5 seconds.

It is possible to clear the alarm by inputting ON signal to [CN2 Clear or Alarm clear] if it is not overload, again.

● Diagnostic tips

(1) Alarm occurs when control power is turned on:
   ◆ Cause 1:   The control circuit of the HA-680 driver may have failed.
      ⇒ Remedy: Contact Harmonic Drive Systems. (Replace the HA-680 driver)

(2) The alarm occurs while running (it is possible to restart after shutting off control power):
   ◆ Cause 1:   Running at over load state
      ⇒ Remedy: Review the actuator's actual load profile to lower the duty.

(3) Alarm occurs after hunting motion:
   ◆ Cause 1:   Hunting motion is caused by poor gain adjustment
      ⇒ Remedy: Adjust gains in [parameter]→[00: position loop gain], [01: Speed loop proportional gain], [02: speed loop integral gain] and [03: Speed loop derivative gain] proportional to the load.

(4) Alarm does not occur when driving the actuator only (no load), but alarm occurs with load:
   ◆ Cause 1:   Wrong connection of motor and encoder cables
      ⇒ Remedy: Connect cables correctly referring to [chapter 3 : Installing the HA-680 driver] in this manual.

(5) Alarm occurs when driving the actuator only (no load):
   ◆ Cause 1:   Wrong connection of motor and encoder cables
      ⇒ Remedy: Connect cables correctly referring to [chapter 3: Installing the HA-680 driver] in this manual.

Deviation counter overflow (Alarm clear: available)

● Description

The alarm occurs when the value of the deviation counter exceeds the parameter setting value (PSF-520 No.21 Allowable position deviation). This alarm can be reset by inputting an ON signal to "CN2 Alarm Clear: ALM-CLR" after inputting an ON signal to "CN2 Clear: CLEAR" or "CN2 Deviation Clear: DEV-CLR."

● Diagnostic tips

(1) If the alarm occurs when the power is turned on:

◆ Cause 1: Main circuit was turned ON while inputting command pulse. The power was applied while the actuator was driving.
⇒ Remedy: Stop command pulse or the actuator, and turn on the power, again.

◆ Cause 2: HA-680 driver control circuit failure
⇒ Remedy: Contact Harmonic Drive Systems. (Replace the HA-680 driver)

(2) If the alarm occurs during acceleration or deceleration:

◆ Cause 1: Gain is too low.
⇒ Remedy: Adjust gains in [parameter]→[00: position loop gain], [01: Speed loop proportional gain], [02: speed loop integral gain] and [03: Speed loop derivative gain] proportional according to the load.

◆ Cause 2: Parameters of the [Command pulse input factor] are wrong.
⇒ Remedy: Set the parameter correctly in [parameter]→[23: Command pulse input factor-numerator], [24: Command pulse input factor-denominator], again.

◆ Cause 3: [Command pulse frequency] is too large.
⇒ Remedy: Decrease the [Command output pulse frequency] setting of the higher-level system. The appropriate frequency is normal rotation speed of actuator (r/min) × 60 or less.

◆ Cause 4: The load inertia is too large.
⇒ Remedy 1: Reduce the load inertia.
⇒ Remedy 2: Modify the command pulse frequency of the host to accelerate and decelerate more slowly.

(3) If the speed does not increase according to the command and the alarm occurs after a while:

◆ Cause 1: OFF state of input signal [CN2: FWD inhibit] or [CN2: REV inhibit].
⇒ Remedy: Verify breakage of CN2 connector cable.

(4) Actuator did not rotate.

◆ Cause 1: Incorrect motor cable connection or wrong phase order
⇒ Remedy 1: Correct the connection between the motor cable and the connector.
⇒ Remedy 2: Connect the motor cable and the connector in correct phase order referring to [Chapter 3-7: Connecting motor and regeneration resistor cables] of this manual.

◆ Cause 2: Poor encoder connector (CN1) connection.
⇒ Remedy: Plug the CN1 connector firmly.

Encoder break detection (Alarm clear: not available)

● Description

This alarm occurs when the encoder signal ceases (primarily, encoder break is detected). To release the alarm after troubleshooting, shut off the control power and turn it on again.

● Diagnostic tips

(1) Alarm occurs when the control power is turned on:

◆ Cause 1: The encoder connector (CN1) may not be connected or may be improperly wired, or encoder may be broken.
⇒ Remedy: Verify connection of encoder connector (CN1) and connect it firmly.

◆ Cause 2: The encoder circuit may have failed.
⇒ Remedy: Contact Harmonic Drive Systems.(Replace actuator)

◆ Cause 3: The control circuit of the HA-680 driver may have failed.
⇒ Remedy: Contact Harmonic Drive Systems. (Replace the HA-680 driver)

(2) Alarm occurs during running (recovers when the actuator cooled down)

◆ Cause 1: Encoder malfunctions when the actuator temperature rises.
⇒ Remedy: Review the actuator operating load, duty cycle, and its cooling system.

Encoder reception error (Alarm clear: not available)

● Description

This alarm occurs when the driver fails to receive data from encoder. The alarm also occurs when the driver fails to output the encoder signal. To release the alarm after troubleshooting, shut off the control power and turn it on again.

● Diagnostic tips

(1) Alarm occurs when the control power is turned on:

◆ Cause 1: The encoder connector (CN1) may not be connected or may be connected poorly.
⇒ Remedy: Verify connection of encoder connector (CN1) and connect it firmly.

◆ Cause 2: The encoder circuit may have failed.
⇒ Remedy: Contact Harmonic Drive Systems. (Replace actuator)

◆ Cause 3: The control circuit of the HA-680 driver may have failed.
⇒ Remedy: Contact Harmonic Drive Systems. (Replace the HA-680 driver)

(2) Temporally alarm occurs during running:

◆ Cause 1: Malfunction may be caused by surrounding electrical noise.
⇒ Remedy: Install the driver correctly referring [Chapter 3-4: Suppressing noise] in this manual.

UVW error (Alarm clear: not available)

● Description

The alarm occurs when the encoder UVW signals are abnormal. To release the alarm after troubleshooting, shut off the control power and turn it on again.

● Diagnostic tips

(1) Alarm occurs when the control power is turned on:

◆ Cause 1: The encoder connector (CN1) may not be connected or may be connected poorly.
⇒ Remedy: Verify connection of encoder connector (CN1) and connect it firmly.

◆ Cause 2: The encoder circuit may have failed.
⇒ Remedy: Contact Harmonic Drive Systems. (Replace actuator)

◆ Cause 3: The control circuit of the HA-680 driver may have failed.
⇒ Remedy: Contact Harmonic Drive Systems. (Replace the HA-680 driver)

(2) Alarm occurs temporarily while running:

◆ Cause 1: Malfunction may be caused by surrounding electrical noise.
⇒ Remedy: Install the driver correctly referring [Chapter 3-4: Suppressing noise] in this manual.

Regenerative error (Alarm clear: not available)

● Description

The alarm occurs when the voltage of the main circuit exceeds 50 V. If the load inertia is large, the main circuit voltage increases due to the energy generated during deceleration of the actuator. This alarm can be cleared by shutting down the control circuit power and turning it on again. However, this alarm may occur every time under the same load conditions. Connect a regenerative resistance to the external regenerative resistance connection terminal, or extend the acceleration/ deceleration time. If a regenerative resistance is connected, you must switch the regenerative resistance switching jumper to the external side.

The regenerative resistance of the regenerative absorption circuit incorporates a fuse. When the temperature of the regenerative resistance increases due to excessive regeneration and the fuse is blown, the regenerative circuit no longer works, and the main circuit voltage increases. If the regenerative error occurs immediately the control circuit power is shut down and turned on again, it may be due to a blown fuse. In this case, connect an external regenerative resistance and switch the jumper setting.

● Diagnostic tips

(1) Alarm occurs while the motor is running:

◆ Cause 1: The load inertia is too large.
⇒ Remedy 1: Connect an external resistance or capacitor according to "3-8 Connecting regenerative absorption resistances/capacitors" in this manual.

⇒ Remedy 2: Extend the deceleration time.

⇒ Remedy 3: Lower the maximum speed.

⇒ Remedy 4: Reduce the load inertia.

◆ Cause 2: Failure of the overload detection circuit.

⇒ Remedy: Contact Harmonic Drive Systems. (Replace the HA-680 driver)

Operating temperature error (Alarm clear: not available)

● Description

The alarm occurs when the temperature of the HA-680 main unit increases and the temperature sensor trips. To release the alarm after troubleshooting, shut off the control power and turn it on again.

● Diagnostic tips

(1) Alarm occurs when the control circuit power is turned on:

◆ Cause 1: Failure of the temperature sensor of the HA-680 driver.
⇒ Remedy: Contact Harmonic Drive Systems. (Replace the HA-680 driver)

(2) Alarm occurs while the motor is running:

◆ Cause 1: The motor is in an overload state while running.
⇒ Remedy: Review the effective load factor of the actuator to reduce the load factor.

◆ Cause 2: The ambient temperature around the HA-680 driver is over 50°C.
⇒ Remedy: Review the installation location and cooling system of the HA-680 driver.

System error (Alarm clear: not available)

● Description

This alarm occurs when an error of the current detection circuit is detected. To release the alarm after troubleshooting, shut off the control power and turn it on again.

● Diagnostic tips

(1) Alarm occurs when the control circuit power is turned on:

◆ Cause 1: Failure of the current detection circuit of the HA-680 driver
⇒ Remedy: Contact Harmonic Drive Systems. (Replace the HA-680 driver)

(2) Alarm occurs occasionally while the motor is running:

◆ Cause 1: Malfunction due to external noise
⇒ Remedy: Take noise prevention measures according to "3-4 Suppressing noise" in this manual.

◆ Cause 2: Failure of the current detection circuit of the HA-680 driver
⇒ Remedy: Contact Harmonic Drive Systems. (Replace the HA-680 driver)

Over current (Alarm clear: not available)

● Description

This alarm occurs when the current detection circuit detects the over current. To release the alarm after troubleshooting, shut off the control power and turn it on again.

● Diagnostic tips

(1) Alarm occurs when control power is turned on:

◆ Cause 1: The control circuit of the HA-680 driver may have failed.
⇒ Remedy: Contact Harmonic Drive Systems. (Replace the HA-680 driver)

(2) Alarm occurs by input signal of [CN2-7: S-ON (servo-ON)] is activated:

◆ Cause 1: The control or main circuit of the HA-680 driver may have failed.
⇒ Remedy: Contact Harmonic Drive Systems. (Replace the HA-680 driver)

(3) Alarm occurs by input signal of [CN2-7: S-ON (servo-ON)] is activated, but doesn't occur when the input signal is ON and the motor cable (U, V, W) is disconnected:

◆ Cause 1: Short connection in the motor cable
⇒ Remedy: Verify the connection of the motor cable and correct it or replace it if necessary.

◆ Cause 2: Short connection in the motor winding
⇒ Remedy: Contact Harmonic Drive Systems. (Replace actuator)

(4) Alarm occurs during acceleration or deceleration:

◆ Cause 1: Excessive load inertia and the accelerating or decelerating time is too short.
⇒ Remedy 1: Reduce the load inertia.
⇒ Remedy 2: Set longer times for [parameter]→[33: acceleration time constant] and [34: deceleration time constant].

◆ Cause 2: Gain is set too high or too low
⇒ Remedy 1: Adjust gains in [parameter]→[00: position loop gain], [01: Speed loop proportional gain], [02: speed loop integral gain] and [03: Speed loop derivative gain] proportional according to the load.

(5) The alarm occurs while running (it is possible to restart after 4 to 5 minutes):

◆ Cause 1: Running at over load state
⇒ Remedy: Review the actuator's actual load profile to lower the duty.

◆ Cause 2: Ambient temperature of the HA-680 driver is more than 50°C.
⇒ Remedy: Review the driver's installation and it's cooling system.

Load short circuit (Alarm clear: not available)

● Description

The alarm occurs when excessive current flows through the FET. To release the alarm after troubleshooting, shut off the control power and turn it on again.

● Diagnostic tips

(1) Alarm occurs when the control circuit power is turned on:

◆ Cause 1: Failure of the control circuit of the HA-680 driver
⇒ Remedy: Contact Harmonic Drive Systems. (Replace the HA-680 driver)

(2) Alarm occurs at an input (ON) of the input signal "CN2-7: Servo on":

◆ Cause 1: Failure of the main circuit or control circuit of the HA-680 driver
⇒ Remedy: Contact Harmonic Drive Systems. (Replace the HA-680 driver)

(3) Alarm occurs by input signal of [CN2-7: S-ON (servo-ON)] is activated, but doesn't occur when the input signal is ON and the motor cable (U, V, W) is disconnected:

◆ Cause 1: Short connection in the motor cable
⇒ Remedy: Verify the connection of the motor cable and correct it or replace it if necessary.

◆ Cause 2: Short connection in the motor winding
⇒ Remedy: Contact Harmonic Drive Systems. (Replace actuator)

(4) Alarm occurs during acceleration or deceleration:

◆ Cause 1: Excessive load inertia and the accelerating or decelerating time is too short.
⇒ Remedy 1: Reduce the load inertia.
⇒ Remedy 2: Set longer times for [parameter]→[33: acceleration time constant] and [34: deceleration time constant].

◆ Cause 2: Gain is set too high or too low
⇒ Remedy 1: Adjust gains in [parameter]→[00: position loop gain], [01: Speed loop proportional gain], [02: speed loop integral gain] and [03: Speed loop derivative gain] proportional according to the load.

(5) The alarm occurs while running (it is possible to restart after 4 to 5 minutes):

◆ Cause 1: Running at over load state
⇒ Remedy: Review the actuator's actual load profile to lower the duty.

◆ Cause 2: Ambient temperature of the HA-680 driver is more than 50°C.
⇒ Remedy: Review the driver's installation and it's cooling system.

Memory Error (EEPROM) (Alarm clear: not available)

● Description

This alarm occurs when the driver's EEPROM memory fails. To release the alarm after troubleshooting, shut off the control power and turn it on again

● Diagnostic tips

(1) Alarm occurs when the control power is turned on:

◆ Cause 1:   The control circuit of the HA-680 driver may have failed.
　　⇒ Remedy: Contact Harmonic Drive Systems. (Replace the HA-680 driver)

(2) Alarm occurs during running

◆ Cause 1:   Malfunction of a control circuit element of the HA-680 driver
　　⇒ Remedy: Contact Harmonic Drive Systems. (Replace the HA-680 driver)

Over speed (Alarm clear: not available)

● **Description**

The alarm occurs when the motor axis speed exceeds the maximum rotation speed +100 rpm for 0.5 s or longer. It can be reset by shutting down the power and turning it on again.

● **Diagnostic tips**

(1) Alarm occurs when the control circuit power is turned on:

◆ Cause 1:   Failure of the control circuit of the HA-680 driver
⇒ Remedy: Contact Harmonic Drive Systems. (Replace the HA-680 driver)

(2) Alarm occurs when you enter a rotation command and the actuator rotates at high speed:

◆ Cause 1:   (Position control) "Command pulse frequency" is too large.
⇒ Remedy: Lower the "command pulse frequency" in the host device.
Set it to a frequency lower than the maximum rotation speed (r/min) of the actuator.

◆ Cause 2:   (Speed control) "Speed command input voltage" is too high.
⇒ Remedy: Lower the "speed command output voltage" in the host device.

◆ Cause 3:   "Speed command input factor" is too high.
⇒ Remedy: Lower [30: Speed command input factor] in [Parameter].

◆ Cause 4:   Wrong setting of "analog voltage command gain"
⇒ Remedy: Change [30: Speed command input factor] in [Parameter].

◆ Cause 5:   A significant overshoot due to insufficient gain adjustment
⇒ Remedy: Adjust gains in [parameter]→ [01: Speed loop proportional gain], [02: speed loop integral gain] and [03: Speed loop derivative gain] proportional according to the load.

◆ Cause 6:   Wrong connection of the motor or encoder
⇒ Remedy: Perform connection properly by referring to "Chapter 3 Installing HA-680 driver" in this manual.

7-2 Troubleshooting for improper actuator motions

Troubleshooting procedures for problems other than alarms are described separately in the position control, in the speed control and in the Torque control. They are also described for the following cases:

◆ No rotation
◆ Unstable rotation
◆ Poor positioning accuracy

Note: In the flowcharts, "Y" and "N" represent "Yes" and "No", respectively.

7-2-1 Improper motions in position control

◆ No rotation in position control

```
            ┌─────────────────┐
            \  Previous page   /
             └───────┬────────┘
                     │
                     ▼
          ╱───────────────╲      Y     ┌──────────────────┐
         ⟨  Is CN2 CLEAR    ⟩─────────▶│   Turn OFF       │
         ⟨     ON?          ⟩          │   CN2 CLEAR.     │
          ╲───────┬───────╱            └──────────────────┘
                  │ N
                  ▼
          ╱───────────────╲
         ⟨ Are motor wire  ⟩    Y      ┌──────────────────┐
         ⟨  connection      ⟩─────────▶│  Check motor cable│
         ⟨ screws loose? Is ⟩          │   connection.    │
         ⟨ the motor wire   ⟩          └──────────────────┘
         ⟨ disconnected?    ⟩
          ╲───────┬───────╱
                  │ N
                  ▼
          ╱───────────────╲
         ⟨ Is phase order   ⟩   N      ┌──────────────────┐
         ⟨  correct          ⟩────────▶│ Correct the phase│
         ⟨ between motor     ⟩         │ order between them.│
         ⟨ and driver?       ⟩         └──────────────────┘
          ╲───────┬───────╱
                  │ Y
                  ▼
          ╱───────────────╲
         ⟨ No layer short,  ⟩   Y      ┌──────────────────┐
         ⟨  grounding        ⟩────────▶│  Actuator fault  │
         ⟨ in motor?         ⟩         └──────────────────┘
          ╲───────┬───────╱
                  │ N
                  ▼
          ╱───────────────╲
         ⟨ Is the actuator  ⟩   Y      ┌──────────────────┐
         ⟨ shaft locked?     ⟩────────▶│ Unlock the actuator│
          ╲───────┬───────╱            │   shaft.         │
                  │ N                  └──────────────────┘
                  ▼
         ┌──────────────────┐
         │  Actuator fault  │
         └──────────────────┘
```

◆ Unstable rotation in position control

```
            ╭─────────────────╮
            │      Start       │
            ╰────────┬────────╯
                     │
                     ▼
          ╱───────────────╲      N     ┌──────────────────┐
         ⟨ Is the power    ⟩──────────▶│  Apply the proper│
         ⟨ supply voltage   ⟩          │   voltage.       │
         ⟨ normal?          ⟩          └──────────────────┘
          ╲───────┬───────╱
                  │ Y
                  ▼
          ╱───────────────╲      N     ┌──────────────────┐
         ⟨ Is the power    ⟩──────────▶│ Check the power  │
         ⟨ supply voltage   ⟩          │ capacity, input  │
         ⟨ fluctuation within⟩         │ capacity, etc.   │
         ⟨ its allowance?    ⟩         └──────────────────┘
          ╲───────┬───────╱
                  │ Y
                  ▼
            ┌─────────────────┐
            \  To next page.   /
             └────────────────┘
```

```
         ┌──────────────────┐
         │  Previous page    │
         └──────────────────┘
                 │
                 ▼
         ╱────────────────╲         N    ┌─────────────────────────────┐
        ╱  Is normal       ╲──────────▶  │ Review heat generating      │
        ╲  temperature in   ╱            │ devices, and cooling system.│
         ╲ cabinet?        ╱             └─────────────────────────────┘
          ╲──────────────╱
                 │ Y
                 ▼
         ╱────────────────╲         N    ┌──────────────────────────────────────┐
        ╱  Is the command  ╲──────────▶  │ Make the command pulse level          │
        ╲  pulse normal? Is ╱            │ (voltage, synchronization, frequency,  │
        ╲  any noise        ╱            │ etc.) normal.                          │
         ╲ generated?      ╱             │ Check whether noise is being generated.│
          ╲──────────────╱              └──────────────────────────────────────┘
                 │ Y
                 ▼
         ╱────────────────╲         N    ┌──────────────────────────┐
        ╱  Is the actuator  ╲──────────▶ │ Decrease the actuator     │
        ╲  revolution speed  ╱           │ revolution speed below    │
        ╲  below the max.    ╱           │ the allowance.            │
         ╲ allowance?       ╱            └──────────────────────────┘
          ╲──────────────╱
                 │ Y
                 ▼
         ╱────────────────╲    N    ╱──────────────╲   N   ┌──────────────────┐
        ╱  Is load inertia  ╲────▶ ╱ Does gain      ╲────▶ │ Decrease the load │
        ╲  proper?          ╱      ╲ adjustment      ╱     │ inertia.          │
         ╲────────────────╱        ╲ succeed?       ╱      └──────────────────┘
                 │ Y                ╲──────────────╱
                 │                      │ Y
                 │                      ▼
                 │              ┌──────────────────┐
                 │              │ Set the gain to   │
                 │              │ the proper value. │
                 │              └──────────────────┘
                 ▼
         ╱────────────────╲    N    ╱──────────────╲   N   ┌──────────────────────────┐
        ╱  Is the load      ╲────▶ ╱ Does gain      ╲────▶ │ · Has the load fluctuation│
        ╲  fluctuation       ╱     ╲ adjustment      ╱     │   decreased?              │
        ╲  normal?          ╱      ╲ succeed?       ╱      │ · Use a large actuator.   │
         ╲────────────────╱        ╲──────────────╱       └──────────────────────────┘
                 │ Y                    │ Y
                 │                      ▼
                 │              ┌──────────────────┐
                 │              │ Set the gain to   │
                 │              │ the proper value. │
                 │              └──────────────────┘
                 ▼
         ╱────────────────╲         N    ┌──────────────────────┐
        ╱  Are motor wiring ╲──────────▶ │ Verify motor cable    │
        ╲  from driver and   ╱           │ connections.          │
        ╲  phase order       ╱           └──────────────────────┘
         ╲ correct?        ╱
          ╲──────────────╱
                 │ Y
                 ▼
         ╱────────────────╲         N    ┌──────────────────────┐
        ╱  Is [parameter]→  ╲──────────▶ │ Set [parameter] →     │
        ╲  [17, 18: current  ╱           │ [17, 18: current limit]│
        ╲  limit] value too  ╱           │ normal                │
         ╲ small?          ╱             └──────────────────────┘
          ╲──────────────╱
                 │ Y
                 ▼
         ╱────────────────╲         N    ┌──────────────────────┐
        ╱  Is CN2 CLEAR     ╲──────────▶ │ Open CN2 CREAR.       │
        ╲  sometimes         ╱           └──────────────────────┘
        ╲  being input?     ╱
         ╲────────────────╱
                 │ Y
                 ▼
         ┌──────────────────┐
         │   Next page       │
         └──────────────────┘
```

```
┌─────────────────┐
│  Previous page  │
└─────────────────┘
         │
         ▼
   ⬡ Is the encoder ⬡ ──N──▶ ⬡ Is there a noise ⬡ ──Y──▶ ┌──────────────────┐
     signal normal?            included in the              │ Securely shield and │
         │                     encoder                      │ ground the encoder  │
         Y                     signal?                      │ cable.              │
         │                         │                        └──────────────────┘
         │                         N
         │                         ▼
         │                 ┌──────────────────┐
         │                 │ Replace the actuator. │
         │                 └──────────────────┘
         ▼
   ⬡ Does rattle or ⬡ ──N──▶ ┌──────────────────┐
     resonance occur           │ Improve the        │
     in the mechanical         │ mechanical system. │
     system?                   └──────────────────┘
         │
         Y
         ▼
┌──────────────────┐
│ Replace the actuator │
│ or driver.           │
└──────────────────┘
```

◆ **Poor positioning accuracy in position control**

```
   ╭─────────╮
   │  Start  │
   ╰─────────╯
        │
        ▼
  ⬡ Is the         ⬡ ──N──▶ ┌──────────────────┐
    higher-level            │ Amend the program. │
    system program         └──────────────────┘
    normal?
        │
        Y
        ▼
  ⬡ Is the         ⬡ ──N──▶ ┌──────────────────────┐
    command                 │ Correct the pulse count. │
    pulse normal?           │ Check the noise.         │
        │                   └──────────────────────┘
        Y
        ▼
  ⬡ Is the input  ⬡ ──N──▶ ┌──────────────────────┐
    command                 │ Reconsider the          │
    pulse timing            │ command pulse circuit.  │
    normal?                 └──────────────────────┘
        │
        Y
        ▼
  ⬡ Is the         ⬡ ──N──▶ ┌──────────────────────┐
    command                 │ Correct the command     │
    pulse input             │ pulse input factor.     │
    factor valid?           └──────────────────────┘
        │
        ▼
┌─────────────┐
│  Next page  │
└─────────────┘
```

```
                    ┌─────────────────┐
                    │  Previous page   │
                    └────────┬─────────┘
                             │
                             ▼
        ┌──────────────┐  N   ┌──────────────┐  N   ┌──────────────┐
        │ Does gain    ├─────▶│ Is the load  ├─────▶│ Decrease the │
        │ adjustment   │      │ inertia      │      │ load         │
        │ succeed?     │      │ proper?      │      │ inertia.     │
        └──────┬───────┘      └──────┬───────┘      └──────────────┘
               │ Y                   │ Y
               ▼                     ▼
        ┌──────────────┐      ┌──────────────┐  N   ┌──────────────┐
        │ Correct the  │      │ Does rattle  ├─────▶│ Improve the  │
        │ gain         │      │ or resonance │      │ mechanical   │
        │ properly.    │      │ occur in the │      │ system.      │
        └──────────────┘      │ mechanical   │      └──────────────┘
                              │ system?      │
                              └──────┬───────┘
                                     │ Y
                                     ▼
                              ┌──────────────┐
                              │ Replace the  │
                              │ actuator     │
                              │ or driver.   │
                              └──────────────┘
```

7-2-2   Improper motions in speed and torque control
◆ No rotation in speed and torque control

Previous page A

Are motor wire connection screws loose? Is the motor wire disconnected?
→ Y → Check motor cable connection.
↓ N

Is phase order correct between motor and driver?
→ N → Correct the phase order between them.
↓ Y

Motor rare short circuited? Is the motor grounded?
→ Y → Actuator failure
↓ N

Is the actuator shaft locked?
→ Y → Unlock the actuator shaft.
↓ N

Actuator failure

Previous page B

Is voltage of driver's UVW correct?
→ N → Driver failure
↓ Y

Is phase order correct between motor and driver?
→ N → Correct the phase order between them.
↓ Y

Actuator failure

◆ **Unstable rotation in speed and torque control**

Start

Is the power supply voltage normal?
→ N → Apply the proper voltage.
↓ Y

Is the power supply voltage fluctuation within its allowance?
→ N → Check the power capacity, input capacity, etc.
↓ Y

Is the temperature in the panel normal?
→ N → Examine the heating elements in panel, and consider the cooling system.
↓ Y

To next page

```
┌─────────────────┐
│  Previous page  │
└─────────────────┘
         │
         ▼
    ╱────────────╲
   ╱ Is the command╲        ┌──────────────────────────────────┐
  ╱  voltage normal? ╲  N   │ If there is a ripple on signal,    │
  ╲  Is any noise    ╱────▶ │ stabilize it. Check whether noise  │
   ╲  generated?    ╱       │ is being generated.                │
    ╲──────────────╱        └──────────────────────────────────┘
         │ Y
         ▼
    ╱────────────╲
   ╱ Is the actuator╲       ┌──────────────────────────────┐
  ╱ revolution speed ╲  N   │ Decrease the actuator          │
  ╲ below the max.   ╱────▶ │ revolution speed below         │
   ╲ allowance?     ╱       │ the allowance.                 │
    ╲──────────────╱        └──────────────────────────────┘
         │ Y
         ▼
    ╱────────────╲          ╱────────────╲
   ╱  Is the load ╲    N   ╱  Does gain   ╲   N   ┌──────────────────┐
  ╱  inertia proper?╲────▶╱  adjustment    ╲────▶ │ Decrease the load │
   ╲               ╱      ╲  succeed?      ╱      │ inertia.          │
    ╲─────────────╱        ╲──────────────╱       └──────────────────┘
         │                      │ Y
         │                      ▼
         │              ┌──────────────────┐
         │              │ Set the gain to the│
         │              │ proper value.     │
         │              └──────────────────┘
         ▼
    ╱────────────╲          ╱────────────╲          ┌──────────────────────────┐
   ╱  Is the load ╲    N   ╱  Does gain   ╲   N     │ · Has the load fluctuation │
  ╱  fluctuation   ╲────▶ ╱  adjustment    ╲──────▶ │   decreased?               │
   ╲  normal?      ╱      ╲  succeed?      ╱         │ · Use a large actuator.    │
    ╲──────────────╱       ╲──────────────╱         └──────────────────────────┘
         │ Y                    │ Y
         │                      ▼
         │              ┌──────────────────┐
         │              │ Set the gain to the│
         │              │ proper value.     │
         │              └──────────────────┘
         ▼
    ╱────────────╲
   ╱ Is motor wiring╲       ┌──────────────────┐
  ╱ from driver      ╲  N   │ Verify motor cable │
  ╲ disconnected or  ╱────▶ │ connections.       │
   ╲ it the phase    ╱      └──────────────────┘
    ╲ order correct? ╱
    ╲──────────────╱
         │ Y
         ▼
    ╱────────────╲
   ╱ Is [parameter]→╲       ┌──────────────────┐
  ╱ [17,18:current   ╲  N   │ Set [parameter] → │
  ╲ limit] value too ╱────▶ │ [17, 18: current  │
   ╲ small?          ╱      │ limit] normal.    │
    ╲──────────────╱        └──────────────────┘
         │ Y
         ▼
    ╱────────────╲          ╱────────────╲         ┌──────────────────┐
   ╱ Is the encoder╲    N   ╱ Is there a noise╲  Y  │ Securely shield   │
  ╱  signal normal? ╲────▶ ╱ included in the   ╲──▶ │ and ground the    │
   ╲               ╱      ╲  encoder signal?  ╱     │ encoder cable.    │
    ╲─────────────╱        ╲──────────────╱         └──────────────────┘
         │ Y                    │ N
         │                      ▼
         │              ┌──────────────────┐
         │              │ Replace the       │
         │              │ actuator.         │
         │              └──────────────────┘
         ▼
┌─────────────────┐
│  To next page   │
└─────────────────┘
```

```
        ┌──────────────────┐
        /   Previous page    \
        └──────────────────┘
                 │
                 ▼
        ╱────────────────╲
       /  Does rattle or   \          N    ┌──────────────────┐
      <   resonance occur    >─────────────▶│   Improve the    │
       \  in the mechanical /              │ mechanical system.│
        \     system?      /               └──────────────────┘
         ╲────────────────╱
                 │ Y
                 ▼
        ┌──────────────────┐
        │ Replace the actuator │
        │    or driver.     │
        └──────────────────┘
```

Chapter 8 Options

8-1 Relay cables

◆ Relay cable 1: FHA-C mini 24VAC type

These are relay cables that connect the FHA-C mini 24VAC-type actuators and HA-680 driver. There are 3 types of relay cable: for motors, for encoders, and for EIA-232C.

● **Relay cable models** ("****" indicates the cable length (3m, 5m, or 10 m).)

(1) For motors:
EWC-MB**-A06-TN2
 └────────────── Cable length (03=3m, 05=5m, 10=10m)

(2) For encoders:
EWC-E**-M06-3M14
 └────────────── Cable length (03=3m, 05=5m, 10=10m)

(3) For EIA-232C:
HDM-RS232C Cable length: 1.5m

◆ Relay cable 2: RSF supermini series

These are relay cables that connect the RSF supermini series actuators and HA-680 driver. There are 3 types of relay cable: for motors, for encoders, and for EIA-232C.

● **Relay cable models** ("****" indicates the cable length (3m, 5m, or 10 m).)

(1) For motors:
EWA-M**-JST04-TN2
 └────────────── Cable length (03=3m, 05=5m, 10=10m)

(2) For encoders:
EWA-E**-M09-3M14
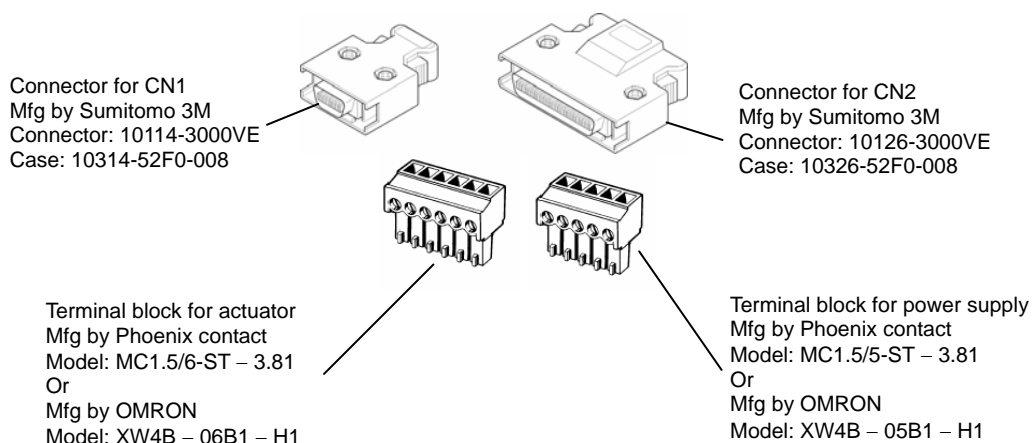 └────────────── Cable length (03=3m, 05=5m, 10=10m)

(3) For EIA-232C:
HDM-RS232C Cable length: 1.5m

When you use an actuator with a brake, a relay cable for the brake is required in addition to the relay cables described above. In addition, a separate power supply is required for releasing the brake. For details, refer to "AC Servo Actuator RSF Supermini Series Manual".

8-2 Connectors

Connectors for CN1 and CN2 connectors of HA-680, and terminal blocks for motor connection and power supply for options are available as follows:

◆ Connector type: CNK-HA68-S1
  For CN1 / For CN2 / For motor connection / For power supply........................ 4 types
◆ Connector type: CNK-HA68-S2
  For CN2 / For power supply .... 2 types

Connector for CN1
Mfg by Sumitomo 3M
Connector: 10114-3000VE
Case: 10314-52F0-008

Connector for CN2
Mfg by Sumitomo 3M
Connector: 10126-3000VE
Case: 10326-52F0-008

Terminal block for actuator
Mfg by Phoenix contact
Model: MC1.5/6-ST − 3.81
Or
Mfg by OMRON
Model: XW4B − 06B1 − H1

Terminal block for power supply
Mfg by Phoenix contact
Model: MC1.5/5-ST − 3.81
Or
Mfg by OMRON
Model: XW4B − 05B1 − H1

8-3 Dedicated communication software RSF-520 (free)

This software allows you to set and/or change parameters to the HA-680 driver from your PC.

To change the servo parameters of the driver, connect "CN3" of the HA-680 driver and the PC with dedicated communication software PSF-520 installed with the EIA-232C cross cable (dedicated cable HDM-RS232C: Cable length 1.5 m).

For details of dedicated communication software PSF-520, refer to a separate document, "PSF-520 User's Manual."

Dedicated communication software PSF-520 can be downloaded from our website at http://www.hds.co.jp/.

If you do not have an environment to download it from the Internet, please ask one of our branch offices.

    Model: PSF-520
    Supported OS: Windows/Me/NT/2000/Xp
                    (note: Windows is the registered trademark of Microsoft.)

    Items to be provided:
            EIA-232C cross cable (HDM-RS232C cable length: 1.5m)
            HA-680 driver side: Socket terminal: DF11-2428-SCF (Hirose)
                                    Socket   DF11-8DS-2C (Hirose)

Warranty Period and Terms

The HA-680 series servo drivers are warranted as follows:

■ Warranty period

Under the condition that the actuator are handled, used and maintained properly followed each item of the documents and the manuals, all the HA-655 series drivers are warranted against defects in workmanship and materials for the shorter period of either one year after delivery or 2,000 hours of operation time.

■ Warranty terms

All the HA-655 series drivers are warranted against defects in workmanship and materials for the warranted period. This limited warranty does not apply to any product that has been subject to:

(1) User's misapplication, improper installation, inadequate maintenance, or misuse.

(2) Disassembling, modification or repair by others than Harmonic Drive Systems, Inc.

(3) Imperfection caused by the other than the FHA-C series actuator and the HA-655 servo driver.

(4) Disaster or others that does not belong to the responsibility of Harmonic Drive Systems, Inc.

Our liability shall be limited exclusively to repairing or replacing the product only found by Harmonic Drive Systems, Inc. to be defective. Harmonic Drive Systems, Inc. shall not be liable for consequential damages of other equipment caused by the defective products, and shall not be liable for the incidental and consequential expenses and the labor costs for detaching and installing to the driven equipment

HARMONIC DRIVE SYSTEMS | **INC**