HarmonicDrive®

HA-675 Series

AC Servo Driver Manual

- Thank you very much for your purchasing our HA-675 series servo driver.
- 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.2.1

CE

TÜV MANAGEMENT SERVICE ISO 9001 ISO 14001

Certified ISO

SAFETY GUIDE

For actuators, motors, control units and drivers
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℃ to 40℃
-Ambient humidity: 20% to 80%RH (Non-condensation)
-Vibration: Max 24.5 m/S^2
-No contamination by water, oil
-No corrosive or explosive gas

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℃ to 50℃
-Ambient humidity: less than 95% RH (Non condensation)
-No contamination by water, oil or foreign matters
-No corrosive, inflammable or explosive gas

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

Do not touch terminals or inspect products at least 5 minutes after turning OFF power.
-Otherwise residual electric charges may result in electric shock.
-Make installation of products not easy to touch their inner electric components.

CAUTION

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

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

Chapter 1 **Outlines of HA-675 driver** ····· 1
1-1 Main features ····· 1
1-2 Models of HA-675 driver ····· 2
1-3 Combinations with actuators ····· 2
1-4 Specifications of HA-675 driver ····· 3
1-5 External drawing of the HA-675 drivers ····· 4
1-6 Front panel ····· 5
1-7 Outlines of I/O ports ····· 6
1-8 Operating display panel ····· 7
1-8-1 Outlines of operation modes ····· 7
1-8-2 Selecting a mode ····· 7
1-8-3 Functions of each mode ····· 8
1-9 Teach-box ····· 8
1-9-1 Specifications of the teach-box ····· 8
1-9-2 External drawing of the teach-box ····· 9
1-9-3 Main blocks of the teach-box panel ····· 10
1-9-4 Operation keys ····· 11
1-9-5 Operation modes ····· 13
1-10 Outlines of protection functions ····· 14
1-10-1 Alarms ····· 14
1-10-2 Protection functions ····· 15
Chapter 2 **Functions** ····· 18
2-1 Control system of HA-675 driver ····· 18
2-2 Encoder systems ····· 19
2-2-1 Incremental encoder ····· 19
2-2-2 Absolute encoder ····· 19
2-3 Tuning servo gains ····· 20
2-3-1 Position control block and position loop gain ····· 20
2-3-2 Speed control block, speed loop gain, and speed loop integral comp. ····· 21
2-4 Motion control functions ····· 22
2-4-1 Outlines of teach-box ····· 22
2-4-2 Outlines of programming ····· 23
2-5 Other functions ····· 27
2-5-1 In-position range ····· 27
2-5-2 Manual JOG operation ····· 27
2-5-3 Monitoring inputs and operating outputs ····· 27
2-5-4 Error count clear by S-ON ····· 28

2-5-5 Speed limit and current limit ····· 28
2-5-6 Automatic actuator identification for HA-675-1 driver ····· 29
2-5-7 Automatic gain control at positioning for HA-675-1 driver ····· 29
Chapter 3 **I/O ports** ····· 30
3-1 I/O port layout ····· 30
3-2 Models of I/O port connector CN2 ····· 30
3-3 I/O port connections ····· 31
3-3-1 Logical inputs ····· 31
3-3-2 Contact inputs ····· 31
3-3-3 Outputs ····· 32
3-3-4 Monitor outputs ····· 32
3-4 I/O port functions ····· 33
3-5 Connection example ····· 42
3-6 I/O ports for absolute position data **ABS** ····· 44
3-6-1 General descriptions of absolute encoder ····· 44
3-6-2 Outputting position data from output port: CN2 ····· 45
Chapter 4 **Installing HA-675 driver** ····· 46
4-1 Receiving inspection ····· 46
4-2 Notices on handling ····· 47
4-3 Location and installation ····· 48
4-3-1 Environment of location ····· 48
4-3-2 Notices on installation ····· 48
4-3-3 Installing ····· 49
4-4 Suppressing noise ····· 49
4-4-1 Devices for grounding ····· 49
4-4-2 Installing noise filter ····· 50
4-4-3 Instructions for cabling ····· 51
4-5 Connecting power cables ····· 52
4-5-1 Instruction for power supply ····· 52
4-5-2 Allowable size of cables ····· 52
4-5-3 Connecting the power cable ····· 53
4-5-4 Isolation transformer ····· 53
4-5-5 Protecting power lines ····· 54
4-6 Connecting a ground wire ····· 54
4-7 Connecting motor and regeneration resistor cables ····· 54
4-8 Connecting encoder and I/O cables ····· 55
4-8-1 Preparing the encoder cable and the I/O cable ····· 55
4-8-2 Pin layout of encoder connector (CN1) ····· 55
4-8-3 Pin layout of I/O signal connector (CN2) ····· 56

4-8-4 Connecting the encoder and the I/O signal cables ····· 56
4-8-5 Recommendation of EIA-232C (RS-232C) cable for CN3 ····· 56
4-9 Power ON and OFF sequence ····· 57
4-9-1 Power ON / OFF sequence circuit ····· 57
4-9-2 Frequency of power ON / OFF operation ····· 57
4-9-3 Power ON sequence ····· 57
4-9-4 Power OFF sequence ····· 58
Chapter 5 **Operations** ····· 59
5-1 Trial run ····· 59
5-1-1 Driving actuator only ····· 59
5-1-2 Setting parameters ····· 68
5-1-3 Tuning servo parameters ····· 70
5-1-4 Operations of teach-box ····· 72
5-1-5 Setting parameter data ····· 73
5-1-6 End of trial run ····· 76
5-2 Usual operation ····· 77
5-2-1 Notices for daily operations ····· 77
5-2-2 Daily maintenance ····· 77
Chapter 6 **Operations of the display panel** ····· 78
6-1 Summary of modes ····· 78
6-2 Selecting a mode ····· 78
6-3 Functions of each mode ····· 79
6-4 Monitor mode ····· 80
6-4-1 Operation in the monitor mode ····· 80
6-4-2 Functions of the monitor mode ····· 81
6-5 Tune mode ····· 89
6-5-1 Operation in the tune mode ····· 89
6-5-2 Functions of the tune mode ····· 91
6-6 Parameter mode ····· 96
6-6-1 Operation in the parameter mode ····· 96
6-6-2 Functions of the parameter mode ····· 98
6-7 Test mode ····· 107
6-7-1 Operation in the test mode ····· 107
6-7-2 Functions of the test mode ····· 109
6-8 Defaults of parameters ····· 114
Chapter 7 **Operations of the teach-box** ····· 117
7-1 Outlines of the teach-box ····· 117
7-2 Attaching and detaching the teach-box ····· 117
7-3 Operation keys ····· 118

7-4 Outlines of indications ····· 120
7-5 Operations of teach-box ····· 121
7-5-1 Common operations ····· 121
7-5-2 Operations for absolute system ABS ····· 123
7-5-3 Turing servo power ON and OFF ····· 124
7-6 Operation modes ····· 125
7-7 Program mode ····· 126
7-7-1 Setting the program mode ····· 126
7-7-2 Specifying an address ····· 127
7-7-3 Arranging address numbers ····· 127
7-7-4 Conditions in programming ····· 128
7-7-5 Programming of commands ····· 129
7-7-6 Examples of program ····· 130
7-7-7 Fine adjustment of positions ····· 132
7-7-8 Functions of program mode ····· 133
7-8 Test mode ····· 141
7-8-1 Turning on servo power ····· 141
7-8-2 Originating INC ····· 141
7-8-3 Operation in the test mode ····· 142
7-8-4 JOG operations ····· 143
7-9 Parameter mode ····· 144
7-9-1 Operation in parameter mode ····· 144
7-9-2 Commands in parameter mode ····· 145
Chapter 8 **Troubleshooting** ····· 153
8-1 Alarms and diagnostic tips ····· 153
8-2 Troubleshooting for improper actuator motion ····· 167
8-2-1 No rotation ····· 167
8-2-2 Unstable rotation ····· 168
8-2-3 Poor positioning accuracy ····· 170
8-3 Exchanging batteries ABS ····· 171
8-3-1 Duration of keeping a revolution count ····· 171
8-3-2 Exchanging procedures ····· 171
Chapter 9 **Options** ····· 172
9-1 Extension cables ····· 172
9-2 Connectors ····· 172
9-3 Software for setting up parameters ····· 173
9-4 Backup battery for absolute encoders ABS ····· 173
9-5 Isolation transformer (single-phase) ····· 174
Index ····· 175

Chapter 1 Outlines of HA-675 driver

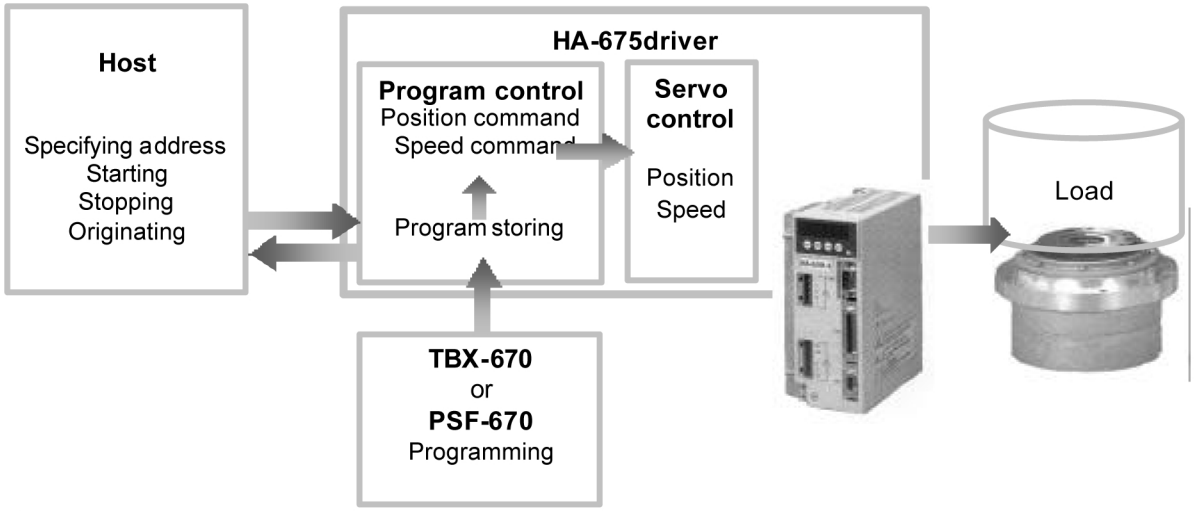
The HA-675 series are dedicated servo drivers with programmable motion control functions for the FHA-C series actuators, which are axially compact and featured a large through-hole. The actuators utilize Harmonic Drive® gear components for precise motion control and super flat AC servomotors.

The HA-675 drivers provide many superior motion control functions to allow the FHA-C series actuators to excel in performance.

1-1 Main features

◆ Unique programmable motion control functions

Additionally to the AC servo drive functions, the HA-675 drivers provide programmable functions to control position, speed, and acceleration, and logical functions such as repeat, jump and so on. Specifying a motion starting address performs a complicated programmed motion profile.



◆ Easy programming with the teach-box

You can create motion programs with the teach-box having operation keys and a LCD display with four lines by 20 digits without any complicated operation.

◆ For both absolute and incremental encoders

The FHA-C series actuators provides two kinds of encoders for detecting a position: the one is an incremental encoder for general applications and the other is an absolute encoder for keeping its current position data all the time, even in power failure. The HA-675 series drivers provides their models to accept both types of encoders. In this document, **INC** is attached for the descriptions for the incremental system only, and **ABS** is for the absolute system only.

◆ Easy parameter setting

Parameters have been set to match the driver with the FHA-C series actuator you have ordered. No setting for the actuator is necessary by users.

The HA-675 series provides four modes that can be adjusted by the end user: monitor mode, tune mode, parameter mode, and test mode. Parameters of these modes are indicated on the front panel using a 7-segment LED display and are easily set.

1-2 Models of HA-675 driver

Model number of The HA-675 driver is as follows

HA-675-2A-200

- AC servo driver HA series
- 675 series
- Nominal current

1	1 A
2	2.4 A
4	4 A

- Encoder

No	Incremental encoder INC	See Note 1.
A	Absolute encoder ABS	

- Input voltage

100	100V	See Note 2.
200	200V	

Note 1: The absolute system is not available for HA-675-1 (1A).
Note 2: Drivers for 100V is optional.

◆ **Extension cables (optional):**

	for HA-675-1	for HA-675-2 and -4
for a motor:	EWC - MB * * -A06 - TN	EWC - MB * * -M08 - TN
for an incremental encoder: INC	EWC - E* * - M06 - 3M14	EWC - E * * -B04 - 3M14
for an absolute encoder: ABS	-	EWC - S * * -B08 - 3M14

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

◆ **Connectors (optional):** CNK-HA65-S1/ CNK-HA65-S2

◆ **Software for setting up parameters (optional):** PSF-650
(Downloading is possible from our home page [http://www.hds.co.jp/])

◆ **Backup battery ABS (optional):** HAB-ER17/33 (attached to the shipped driver)

◆ **Isolation single phase transformer (optional):** PT1-200 04-200

- Ins. transformer: PT1 series
- 2nd volt. 200: AC 200V
- 2nd cur. 02: 2A, 04: 4A, 08: 8A
- Prim. volt 100: AC100V, 115: AC115V, 200: AC200V, 220: AC220V

1-3 Combinations with actuators

Five HA-675 models are available for use with FHA-C actuators dealing with their nominal current and encoder systems. The correct combinations are as follows:

Model / Volt.	Incremental system INC			Absolute system ABS	
	HA-675-1-200	HA-675-2-200	HA-675-4-200	HA-675-2A-200	HA-675-4A-200
200V	FHA-8C-xx-E200 FHA-11C-xx-E200 FHA-14C-xx-E200	FHA-17C-xx-E250 FHA-25C-xx-E250	FHA-32C-xx-E250 FHA-40C-xx-E250	FHA-17C-xx-S248 FHA-25C-xx-S248	FHA-32C-xx-S248 FHA-40C-xx-S248

Model / Volt.	Incremental system INC			Absolute system ABS	
	HA-675-1-100	HA-675-2-100	HA-675-4-100	HA-675-4A-100	HA-675-4A-100
100V	FHA-8C-xx-E200-A FHA-11C-xx-E200-A FHA-14C-xx-E200-A	FHA-17C-xx-E250-A	FHA-25C-xx-E250-A FHA-32C-xx-E250-A	FHA-17C-xx-S248-A	FHA-25C-xx-S248-A FHA-32C-xx-S248-A

1-4 Specifications of HA-675 driver

Model		Power supply: 200V			Power supply: 100V		
Incremental INC		HA-675-1-200	HA-675-2-200	HA-675-4-200	HA-675-1-100	HA-675-2-100	HA-675-4-100
Absolute ABS		—	HA-675-2A-200	HA-675-4A-200	—	HA-675-2A-100	HA-675-4A-100
Driver's nominal current		1.0 A	2.4 A	4.0 A	1.0 A	2.4 A	4.0 A
Driver's maximum current		3.2 A	7.3 A	18.0 A	3.2 A	7.3 A	18.0 A
Power supply	Main circuit	AC200 to 240V(1 / 3-phase) +10 to -15%			AC100 to115V(1-phase)+10 to -15%		
	Control circuit	AC 100 to 115V or AC200 to 240V(1-phase) +10 to -15%			AC100 to 115V(1-phase)+10 to -15%		
Power frequency		50/60Hz					
Applicable encoder		Incremental	Incremental or absolute		Incremental	Incremental or absolute	
Allowed revolution (motor)		No limits INC	+4095 to -4046 ABS		No limits INC	+4095 to -4046 ABS	
Power Control Method		Sinusoidal PWM control					
Allowed Environment		Operating temperature: 0 to 50℃ Storage temperature:-20 to 85℃ Operating/storage humidity: below 95%RH (No condensation) Vibration resistance: 4.9 m/s^2 (10 to 55Hz) Impact resistance: 98m/s^2					
Ventilation		Self cooling					
Installation		Base mount (Wall mount)					
Encoder interface		Serial transmission line driver input type					
Control mode		Position mode, speed mode					
Input signal		Clear, Servo-ON, Originating, Interlocking, Start, Stop, Addressing, Emergency stop, Origin signal, FWD-limit, REV-limit, ABS position date request, ABS revolution counter clear (Every signal is insulated by opt-isolators.)					
Output signal		Ready, Motion finish, Originated, Alarm, Alarm code (4-bit), Current address (Every signal is insulated by opt-isolators.)					
Position signal output		ABS absolute data, Phase-A, -B, -Z; line driver output					
Analog monitor		2ch: motor speed, current command					
Front panel	Configuration	Display: 7-segment LED 6 digits (red) Operation key: 4 keys					
	Monitor function	Motor speed (r/min), torque monitor (%), over load rate (%), error pulse, feedback pulse, Input signal monitor, output signal monitor, alarm history (up to 8 alarms)					
	Parameters	System parameters Tune parameters					
Protection function		Emergency stop inputs, FWD and REV limits, Over current, Overload, Over voltage, Error counter overflow, Over speed, Encoder failure, CPU failure, Memory failure, ABS revolution data error, ABS encoder system failure, ABS encoder overflow, ABS battery low voltage, ABS absolute data transmitting rule error					
Regeneration		By external resister	Built-in resister (power: 40W Max) External resistor is acceptable.		By external resister	Built-in resister (power: 40W Max) External resistor is acceptable.	
Functions		Monitoring, Self diagnosis, JOG operation, Trapezoidal speed profile, S-curve speed profile, Compound speed profile, Indexing, ABS backup battery for revolution counter					
Parameter		Motor parameter, system parameter, tune parameter					
Rush current suppressing		Rush current suppressing circuit is built-in					
Operation mode		Monitor mode (for usual operations), Test mode, Tune mode, Parameter mode					
Mass		1.5 kg	1.5 kg	1.7 kg	1.5 kg	1.5 kg	1.7 kg

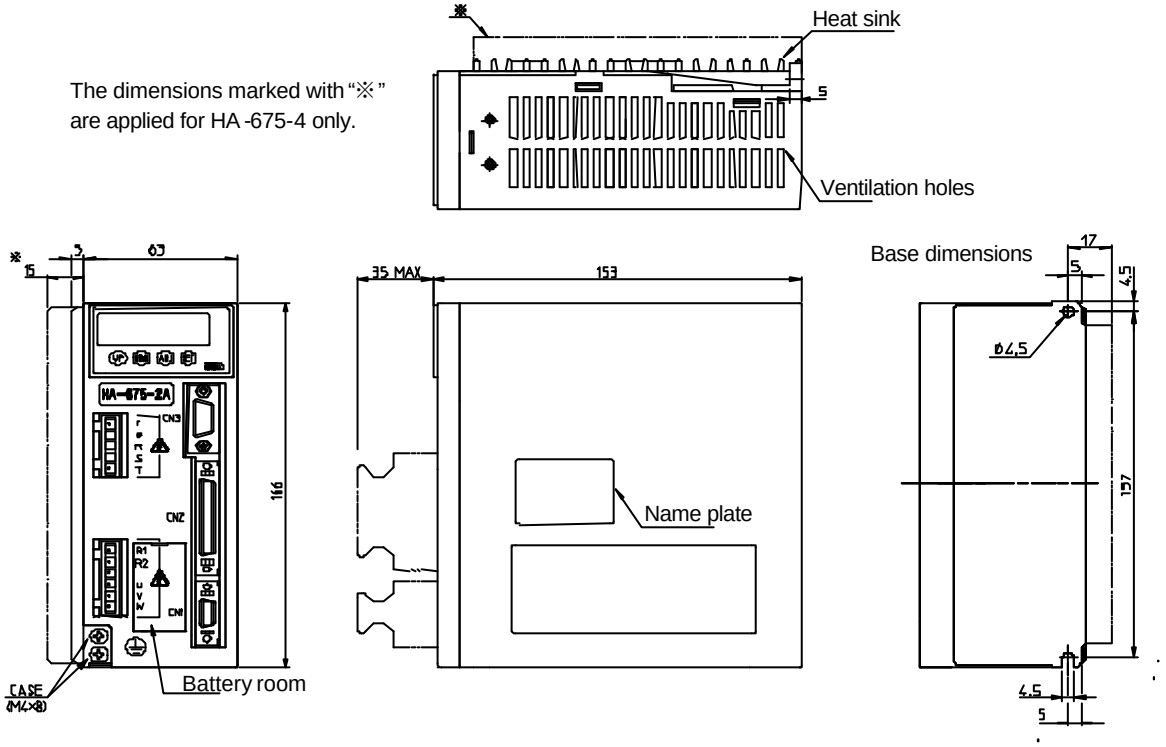
Note: The specifications marked with (ABS) are valid for absolute systems only, with (INC) are for incremental systems only, and specifications with no marks are valid for both systems.

1-5 External drawing of the HA-675 drivers

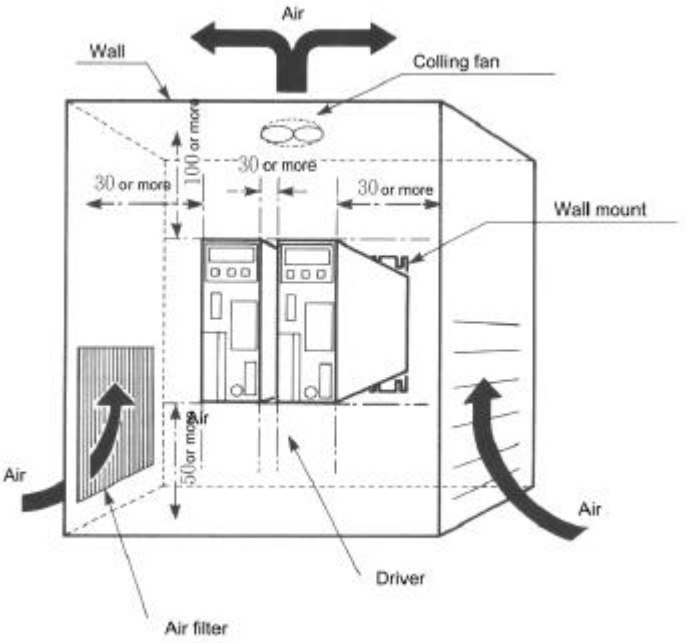
The external drawing is shown as follows:

Unit：mm (Third angle projection method)

The dimensions marked with "※" are applied for HA-675-4 only.

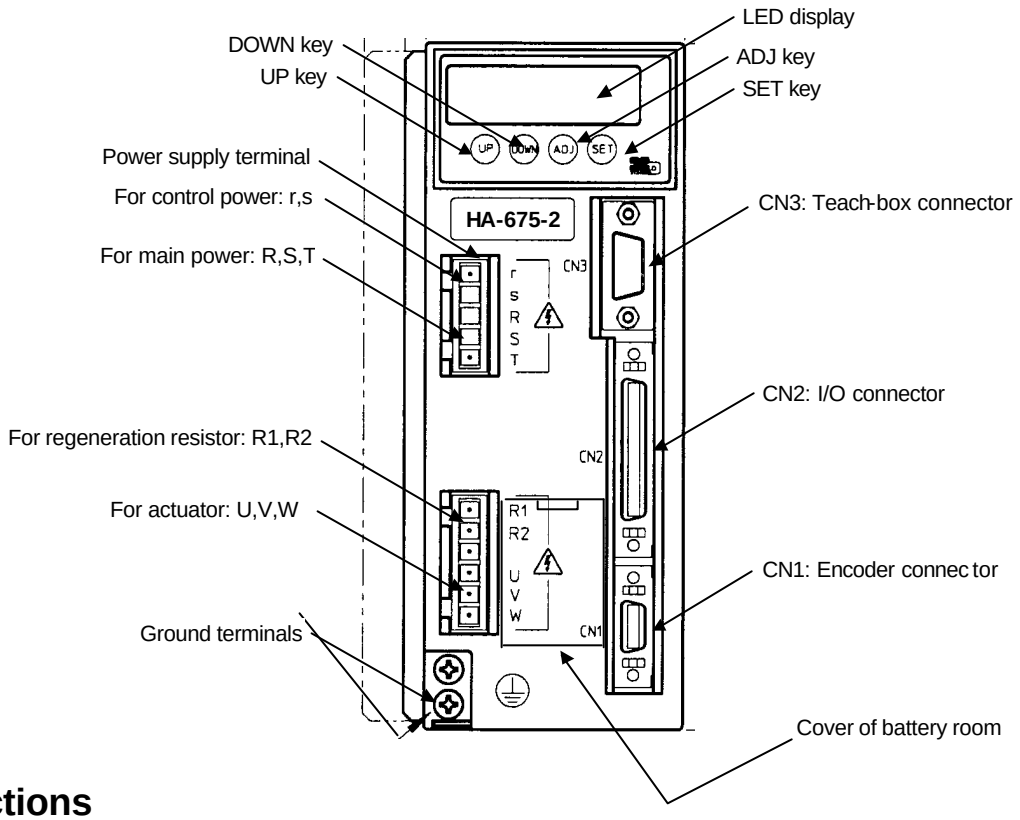


Note 1: When HA-675 drivers are installed in a cabinet, leave enough ventilation space as shown below.



1-6 Front panel

Names of front panel blocks



Functions

◆ **LED display**

This indicates operating the HA-675 driver states, parameter values, alarms, by a 6-digit 7-segment-LED.

◆ **[UP],[DOWN],[ADJ],[SET] keys**

These keys are used for changing indications, setting and tuning functional parameter values, and manual JOG operation of actuators.

◆ **CN1：encoder connector**

The connector accepts encoder cable connector.

◆ **CN2：I/O connector**

This accepts I/O signals to/from host devices.

◆ **CN3：Serial port connector (compliant with the EIA-232C standard)**

The connector accepts the teach-box cable connector, or a EIA-232C cable for PC.

◆ **Power supply terminals：r,s,R,S,T**

These terminals are provided for connecting the power supply. Control power is connected to [r,s] terminals, and main power is connected to [R,S,T] terminals.(R,S – Single Phase; R,S,T – Three Phase).

◆ **External regeneration resistor terminals：R1,R2**

If the built-in regeneration resistor is insufficient in its capacity to handle frequent start/stop operations of the actuator, an external resistor can be connected to these terminals.

◆ **Actuator terminals：U,V,W**

An actuator cable is connected to the terminals. Connect the motor wires to the driver's terminal have the same symbols as the wire's. If you confuse the symbols, the driver and the actuator may fail.

◆ **Ground terminals**

Connect grounds here to prevent electrical shock.

1-7 Outlines of I/O ports

The CN2 connector provides input and output signals to and from the host devices. The 50 pins of the connector are assigned to the following signals. Do not connect signals to pins marked "-".

Pin No.	Signal	Symbol	I/O
1	Input signal common	INPUT-COM	Input
2	Clear	CLEAR	Input
3	Servo-ON	S-ON	Input
4	Originating	ST-ORG	Input
5	Interlock	INTERLOCK	Input
6	Start	START	Input
7	Stop	STOP	Input
8	Input signal common	INPUT-COM	Input
9	Input bit 1	INPUT DATA 1	Input
10	Input bit 2	INPUT DATA 2	Input
11	Input bit 4	INPUT DATA 4	Input
12	Input bit 8	INPUT DATA 8	Input
13	Input bit 16	INPUT DATA 16	Input
14	Input bit 32	INPUT DATA 32	Input
15	Emergency stop+	ESTOP+	Input
16	Emergency stop−	ESTOP-	Input
17	FWD limit+	FSTOP+	Input
18	FWD limit−	FSTOP-	Input
19	REV limit+	RSTOP+	Input
20	REV limit−	RSTOP-	Input
21	Origin+	ORG+	Input
22	Origin−	ORG-	Input
23	Speed monitor	SPD-MON	Output
24	Current monitor	CUR-MON	Output
25	Monitor Ground	GND	Output

Pin No.	Signal	Symbol	I/O
26	+24V	+24V	Input
27	−	−	−
28	ABS Position data request	ABS-REQ	Input
29	−	−	−
30	ABS Revolution counter clear	ABS-CLEAR	Input
31	−	−	−
32	−	−	−
33	Ready	READY	Output
34	Motion finish	FINISH	Output
35	At-origin	ORG-END	Output
36	Alarm	ALARM	Output
37	Output bit 1	OUT-DATA 1	Output
38	Output bit 2	OUT-DATA 2	Output
39	Output bit 4	OUT-DATA 4	Output
40	Output bit 8	OUT-DATA 8	Output
41	Output bit 16	OUT-DATA 16	Output
42	Output bit 32	OUT-DATA 32	Output
43	Output common	OUT-COM	Output
44	Phase-A+(LD)	A+	Output
45	Phase-A−(LD)	A-	Output
46	Phase-B+(LD)	B+	Output
47	Phase-B−(LD)	B-	Output
48	Phase-Z+(LD)	Z+	Output
49	Phase-Z−(LD)	Z-	Output
50	Frame ground	FG	Output

Note 1: The pins marked with "ABS" (pin 28 & 30) are dedicated for absolute systems. Do not use them for incremental systems.

Note 2: OC: open collector port, LD: line driver port

Note 3: Do not use the pins marked "−". Using these pins may cause failure of interior circuitry.

Note 4: The [pin 38 to 41] output 4-bit alarm codes at an alarm state.

1-8 Operating display panel

The HA-675 driver provides a 6-digit LED display and four operation keys on the front panel. The panel executes monitoring, tuning, setting, and JOG operation.

1-8-1 Outlines of operation modes

The HA-675 driver provides the following four modes: monitoring, tuning, setting, and operations.

◆ **Monitor mode**

The HA-675 driver displays a current address number, motor speed, current position from a motor-encoder, pulse count in an error counter, input and output signal states, load condition, alarm history, and the code number for the actuator for which the driver is set. These are useful to diagnose the driver if it fails nor operates in an abnormal manner.

After applying power the [monitor mode] starts up. While the power is on, from the [monitor mode] as the main screen it is possible to switch to and from other modes.

◆ **Tune mode**

The [tuning mode] consists of various parameters to control the actuator motion. Setting the most suitable value for each parameter obtains the optimum performance of the actuator.

◆ **Parameter mode**

The [parameter mode] sets various parameter values relating to the fundamental operational functions such as: limiting values of speed and torque, and parameters to communicate with a teach-box.

For the absolute system, the revolution counter is possible to be cleared in the parameter mode.

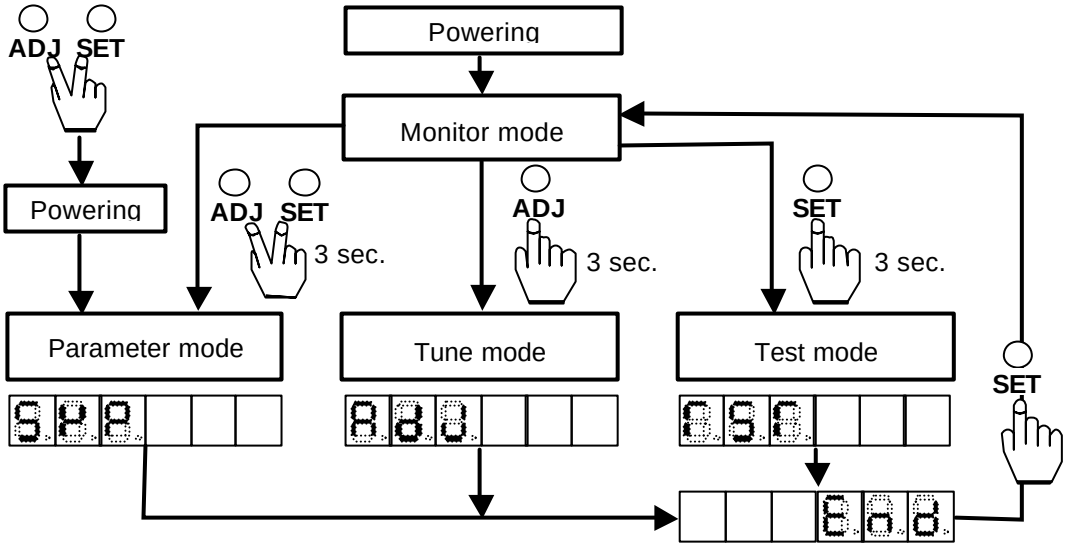
◆ **Test mode**

The [test mode] consists of required functions for system test; such as JOG operation functions, operations of pseudo output signals, and I/O signal monitors.

1-8-2 Selecting a mode

The figure shown below is an outline of mode selecting procedures. After turning on the driver the [monitor mode] starts up automatically. The [ADJ] and [SET] keys select a mode.

Powering with pressing both [ADJ] and [SET] keys in same time jumps to the monitor mode followed by leaving the fingers from the buttons. When an alarm occurs, the LED display converts to indicate the alarm automatically, and no operations on the panel become impossible. For clearing the revolution counter of the absolute system, the powering operation may be useful.



1-8-3 Functions of each mode

Each mode provides the following functions:

Mode	Code	Function	Setting & operation
Monitor mode	0	Current address	Setting is impossible.
	1	Motor speed	
	3	Error pulse count (Low)	
	4	Error pulse count (High)	
	5	Torque monitor	
	6	Overload rate	
	7	Feedback pulse (Low)	
	8	Feedback pulse (High)	
	c	I/O monitor	
	d1 to d8	Alarm history	
	E	Actuator code	
	F	Actuator serial number (Low)	
	G	Actuator serial number (High)	
	H	Actuator serial number (Affix)	
Tune mode	0	Speed loop gain	Setting is possible.
	1	Speed loop integral compensation	
	2	Position loop gain	
	3	Reserved (out of use)	
	4	In-position range	Setting is possible.
	A	Speed monitor offset	
	b	Current monitor offset	
Parameter mode	5	Error count clear by S-ON	Setting is possible.
	6	Position error allowance	
	A	Speed limit	
	b	Current limit	
	c	Signal logic	
	For J	ABS Revolution counter clear	Operation is possible
	G	Mechanical origin	Setting is possible
	H	ABS ABS send data timing	
	I	ABS Low battery voltage signal	
	n	Regenerative resistance	
	o	Automatic gain control	
	P	Alarm history clear	
Test mode	Jo	JOG operation	Operation is possible
	SP	JOG speed	Setting is possible.
	Ac	JOG acceleration	
	rdy & etc.	Output port operation	Operation is possible
	c	I/O port monitor	Setting is impossible.
	An	Analog monitor manual output	Operation is possible

Note: The parameters marked with (ABS) are valid for absolute systems only, and parameters with no marks are valid for both absolute and incremental systems.

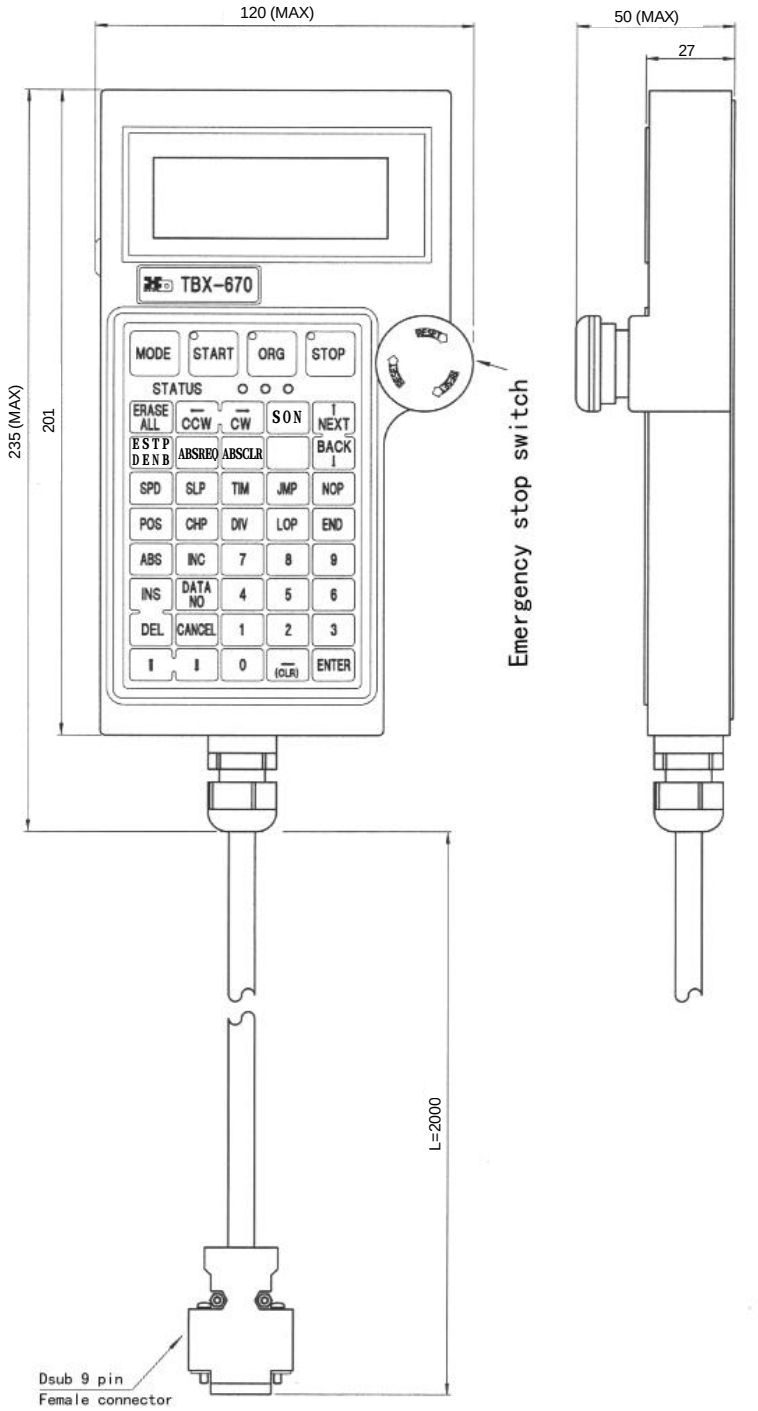
1-9 Teach-box

1-9-1 Specifications of the teach-box

Model	TBX-670
Display	LCD, 4 lines by 20 digits
Operation key	5 rows by 8 lines and 4 keys
Emergency stop switch	Mushroom push-lock switch
Operation mode	Parameter mode, Program mode, Test mode
Max. number of address	64 addresses
Programmable functions	Originating, Shortcut motion, Indexing, Jump, Repeat, Scurve acceleration profile, Software origin
Motion pattern	Individual positioning, Sequential positioning, Programmed positioning
Displacement and position unit	Pulse, Angle(1/1000°), metric (1/100mm)
Speed unit	Pulse/sec, r/min
Allowed Environment	Service temperature/ storage temperature: 0 to 40℃／-20 to 60℃ Service/storage humidity: below 95%RH (No condensation) Vibration resistance/impact resistance: 4.9 m/s^2 (10 to 55Hz) ／ 98m/s^2
External dimensions	200× 87× 25.5 mm
Mass	290 gram

1-9-2 External drawing of the teach-box

The external drawing is shown as follows: Unit：mm (Third angle projection method)



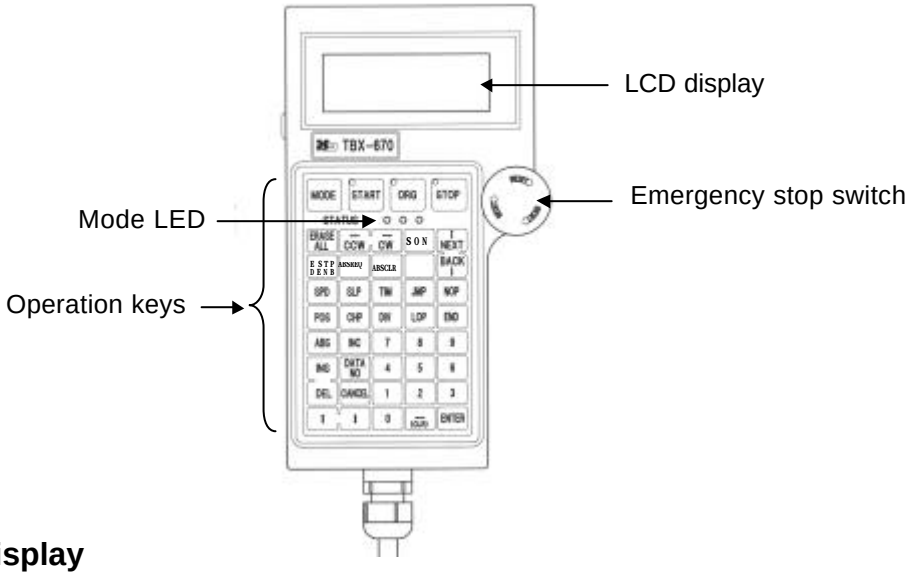
It is possible to add a commercially available EIA-232C (RS-232C) cable to extend the 2-meter teach-box cable. The extension cable should be less than 3 meters.

Recommended commercially available cable:

Classification:	Straight fully-connected EIA-232C cable
Specification:	D-sub 9pin female (inch screw) - D-sub 9pin male (inch nut)
Length:	Less than 3 meters

1-9-3 Main blocks of the teach-box panel

The teach-box panel consists of four blocks as follows:



◆ LCD display

The LCD display indicates all information with alphanumeric letters with four lines by 20 digits.

Upper three lines indicate commands and data, and the lowest line indicates the operation mode, the unit of the data and the address.

◆ Mode LEDs

Three red LEDs indicate the current operation mode.

Left:	Program mode
Center:	Test mode
Right:	Parameter mode

◆ Operation keys

All programs are created with forty-four keys of 5 rows by 8 lines and 4. On the key faces, instruction codes and numerals for operation are marked. Each code on a key face is same as the indicating code. The details of the codes are described on the next chapter.

◆ Emergency stop switch

The red mushroom switch is provided for emergency stop operation. Pressing the switch turns the state of the HA-675 driver to the same state of signal inputting (OFF) to [CN2-15, -16: emergency stop].

To recover from the emergency stop state, turn the switch to right (clockwise) to release the emergency signal, and input [ON] signal to [CN2-2: clear] or regenerate the HA-675 driver.

1-9-4 Operation keys

The teach-box provides three operation modes: [program], [test] and [parameter]. The functions of a key are different by the modes. The relation between keys and functions are as follows:

<table>
<tr><th rowspan="2">Key</th><th colspan="3">Operation mode</th></tr>
<tr><th>Program mode</th><th>Test mode</th><th>Parameter mode</th></tr>
<tr><td>MODE</td><td colspan="3">Specifies a mode from program, test, and parameter modes. Every pressing the key shifts the mode cyclically like program⇒test⇒parameter⇒program⇒… The LCD display or the LED indications indicate the current mode.
Program mode: DSET; Left LED
Test mode: TEST; Center LED
Parameter mode: PSET; Right LED</td></tr>
<tr><td>START</td><td>Starts the programmed actuator motion at the displaying address.</td><td>Starts the actuators motion in parameter specified mode.
OPM-0: individual positioning
OPM-1: sequential positioning
OPM-2: programmed motion</td><td></td></tr>
<tr><td>ORG</td><td colspan="3">The actuator starts for the origin. The originating speed and acceleration are set by [RSP: originating speed 1][RS2: originating speed 2][RAD: originating accelerating time] of [parameter mode].
Keeping the key pressing sets the current position as the origin. When the origin is set by this way, make the actuator free in rotation. (This function will be available when [NRT: software origin] in parameter mode is set.)</td></tr>
<tr><td>STOP</td><td colspan="2">Stops the actuator.</td><td></td></tr>
<tr><td>ERASE ALL</td><td>Pressing this key after [ENTER] erases all command data in the HA-675 driver. To cancel the erasing after pressing the key, press [CANCEL].</td><td></td><td></td></tr>
<tr><td>←CCW
CW→</td><td>Both keys adjust the position precisely.</td><td>Moves the actuator by JOG operation.</td><td>Both keys adjust the software origin precisely.</td></tr>
<tr><td>SON</td><td colspan="2">This turns the servo power for the HA-675 driver ON and OFF. For the absolute system and the [system parameter] →[H: data send timing] is set [0], transmitting the position data to a host is required before turning on the servo power.</td><td></td></tr>
<tr><td>ESTP DENB</td><td colspan="3">Before disconnecting the teach-box from the HA-675 driver, it is required to press the [ESTOP-DENB] and [ENTER] keys in the order. Without the operation, disconnecting the teach-box causes the [alarm 01: emergency stop].</td></tr>
<tr><td>ABS
ABSREQ</td><td colspan="3">This is used for a command to output a current resolving count of the encoder. The phase-A (pins 44 and 45) and phase-B (pins 46 and 47) output the current count.
The function is available only one time after the control power ON.</td></tr>
<tr><td>ABS
ABSCLR</td><td colspan="3">At the first power supplying after connecting with a FHA-C actuator or at events of alarms [53: ABS system failure], [54: revolution counter overflow] and [55: revolution count error], the key clears the revolution counter by pressing the key for around five seconds until making peee sound. The operation is ignored during the servo power is active.
Careful attentions are required to the operation, because the absolute encoder bses position data by the operation. The operation is ignored during the servo power in active.</td></tr>
<tr><td>SPD</td><td>Sets actuator speed.</td><td></td><td></td></tr>
<tr><td>SLP</td><td>Sets acceleration time.</td><td></td><td></td></tr>
<tr><td>TIM</td><td>Sets a delay time of output [CN2-34: motion finish] after positioning.</td><td></td><td></td></tr>
<tr><td>JMP</td><td>Sets an address to jump.</td><td></td><td></td></tr>
<tr><td>NOP</td><td>No operation.</td><td></td><td></td></tr>
</table>

Key	Mode		
	Program mode	**Test mode**	**Parameter mode**
POS	Sets a stop position.		
CHP	Sets a speed changing position.		
DIV	Divides equally a positional value of POS command.		
LOP	Repeats the motion from specified address to the preceding address having LOP.		
END	End of a motion program.		
ABS	Indicates position by the absolute system.		
INC	Indicates position by the incremental system.		
INS	Inserts an address.		
DATA NO	Specifies an address.	Specifies an address when [individual positioning] is specified.	
DEL	Pressing [ENTER] key after this [DEL] key erases the command data at indicating address. To cancel the erasing operation after pressing [DEL] key, press [CANCEL] key.		
CANCEL	Cancels preceding operation.		
0 to 9	Input numerals.		
↑ **NEXT**	Steps forward by an address.	Steps forward by an address when [individual positioning] is specified.	
↓ **BACK**	Steps backward by an address.	Steps backward by an address when [individual positioning] is specified.	
↑ ↓	These [cursor keys] scrolls indications.		
(CLR)	This works as the minus key or clears a command. Pressing [ENTER] key after this key erases the command data under the cursor. To cancel the operation after pressing the key, press [CANCEL] key.		
ENTER	Defines command inputting, inserting and erasing operation. While an address and command data are indicating, pressing this key stores the data in the EEPROM of the HA-675 driver.		

Note 1: Key operation except [STOP] key is ignored while the actuator is moving.

Note 2: Press keys one by one steadily. Pressing two or more keys may indicate “Over-run Error” on the teach box, because of impossibility for processing, and key operations are ignored.

1-9-5 Operation modes

Three modes are provided for teach-box operation as follows:

◆ Program mode

In the mode you can create motion programs using commands of position, speed, acceleration time, delay time, jump, indexing, repeat and so on.

◆ Test mode

In the test mode you can verify the programs created in the program mode. It is possible to confirm positions, to observe sequential motions at every address, and to test programs continuously.

◆ Parameter mode

The mode allows setting parameters required for originating, units of speed and position, acceleration profiles, an offset for backlash, an ball-screw lead, and availability of the shortcut motion.

The modes provide the following commands:

Mode	Command	Function	Default	Unit	Possible values
Program mode	SPD	Speed		p/s 1/100 r/min	pps: 500 to 1,000,000 The equivalent converted in p/s
	POS	Stop position		pulse 1/100mm 1/1000 °	-2,000,000 to +2,000,000 The equivalent converted in p/s -360,000 to +360,000
	CHP	Speed changing position		pulse 1/100mm 1/1000 °	-2,000,000 to +2,000,000 The equivalent converted in p/s -360,000 to +360,000
	SLP	Acceleration time		0.01 s	0 to 1000
	DIV	Indexing			0 to 200
	TIM	Delay time		0.01 s	0 to 9999
	JMP	Jump			0 to 63
	LOP	Repeat cycle			Number of repeat is 01 to 99.
	NOP	No operation			
	END	End of motion			
Parameter mode	ASP	Acceleration profile	0		0: Linear acceleration 1: S-curve acceleration
	BLR	Backlash offset	0	pulse	0 to 9999
	OPM	Motion profile	0		0: individual positioning 1: sequential positioning 2: programmed motion
	RED	Ball screw lead	0	Code	0 to 19
	MQU	Position unit	0		0: pulse 1: 1/1000 ° angular unit 2: 1/100mm
	SPU	Speed unit	0		0: p/s 1: 1/100 r/min
	RTD	Originating direction	0		0: CW viewed from output 1: CCW viewed from output
	RS2	Originating speed 2	20,000	p/s 1/100 r/min	500 to 50,000 The equivalent converted in p/s
	NRT	Software origin	0	pulse	－9999 to ＋9999
	RAD	Originating acceleration time	10	0.01 sec	0 to 1000
	RSP	Originating speed 1	200,000	p/s 1/100 r/min	500 to 1,000,000 The equivalent converted in p/s
	SCH	Pulse per revolution	1,000,000	pulse	1000 to 9,999,999
	SHC	Shortcut motion	0		0: unavailable 1: available

Note: Speeds and angles in above table are applied to output of actuators.

1-10 Outlines of protection functions

1-10-1 Alarms

HA-675 drivers provide various functions to protect actuators and drivers from the occurrence of abnormalities. When a function detect faults, the actuator enters a free rotation state, a two-digit alarm code is indicated on the display, and a set of 4-bit alarm signals is transmitted to the host.

[Monitor mode] →[d: alarm history] allows to check up to eight previous recorded alarms.

alarm code	Alarm description	4-bit code	CN2-41	CN2-40	CN2-39	CN2-38	alarm clear
01	Emergency stop	0011	OFF	OFF	ON	ON	Possible
02	FWD limit	0011	OFF	OFF	ON	ON	Possible
03	REV limit	0011	OFF	OFF	ON	ON	Possible
04	Programming error	0011	OFF	OFF	ON	ON	Possible
10	Over speed	1011	ON	OFF	ON	ON	Impossible
20	Over load	0001	OFF	OFF	OFF	ON	Possible
30	Over current	1001	ON	OFF	OFF	ON	Impossible
40	Over voltage	1011	ON	OFF	ON	ON	Impossible
41	Abnormal regeneration	1010	ON	OFF	ON	OFF	Impossible
50	Encoder failure	1101	ON	ON	OFF	ON	Impossible
51	Abnormal encoder signal	1101	ON	ON	OFF	ON	Impossible
52	INC UVW failure	1101	ON	ON	OFF	ON	Impossible
53	ABS ABS system failure	1101	ON	ON	OFF	ON	Impossible
54	ABS Revolution counter overflow	1101	ON	ON	OFF	ON	Impossible
55	ABS Revolution count error	1101	ON	ON	OFF	ON	Impossible
56	ABS Low battery voltage	1101	ON	ON	OFF	ON	Auto recov.
57	ABS Send data rule error	1101	ON	ON	OFF	ON	Impossible
60	Error counter overflow	0010	OFF	OFF	ON	OFF	Possible
70	Memory failure (RAM)	0101	OFF	ON	OFF	ON	Impossible
71	Memory failure (EEPROM)	0101	OFF	ON	OFF	ON	Impossible
76 or Flickering [0]	CPU failure	0100	OFF	ON	OFF	OFF	Impossible

Note 1: The alarm 52 is valid for incremental system only, and the alarms 53 through 57 are valid for absolute system. Other codes are valid for both incremental and absolute systems.

Note 2: Plural alarms are indicated in the order of codes.

Note 3: When [alarm 56: low battery voltage] occurs, the servo power supply does not turn off. If [parameter mode]→[I: low battery alarm] is set [1: no output], the alarm is indicated on the LED display, but no alarm signals including 4-bit codes are transmitted to the host.

Note 4: Shut off the power supply after remedying a cause of the alarm that releasing is impossible. Then turn on the power supply.

1-10-2 Protection functions

The HA-675 driver provides the following alarms to protect the servo system.

◆ Emergency stop (01)

When an emergency stop signal [OFF] comes to [CN2-15, -16 emergency stop: ESTOP] from a host, or when the emergency stop switch on the teach-box is pressed, the alarm occurs. To clear the alarm, input an [ON] signal to [CN2-2 clear: CLEAR] port.

◆ FWD limit (02), REV limit (03)

When an [OFF] signal comes to [CN2-17, -18: FWD limit: FSTOP] or [CN2-19, -20: REV limit: RSTOP] from a relating limit sensor with the exception of originating, the alarm happens. To clear the alarm, input a ON signal to [CN2-2: clear] port.

For the incremental systems, originating after clearing the alarm recovers from the limit sensor automatically. For the absolute systems, it is possible to move toward leaving direction from the limit. Create a program to escape from the sensor.

◆ Programming error (04)

To move the actuator in accordance with a program, [SPD: speed], [POS: stop position] and [SLP: acceleration time] are essential to be programmed. If any one of the data has not be set, the alarm occurs. To clear the alarm, input an [ON] signal to [CN2-2 clear: CLEAR] port.

◆ Over speed (10)

If an actuator exceeds its maximum speed or if an actuator rotates abnormally, the alarm occurs. To clear the alarm, shut off the control power once and turn it on again.

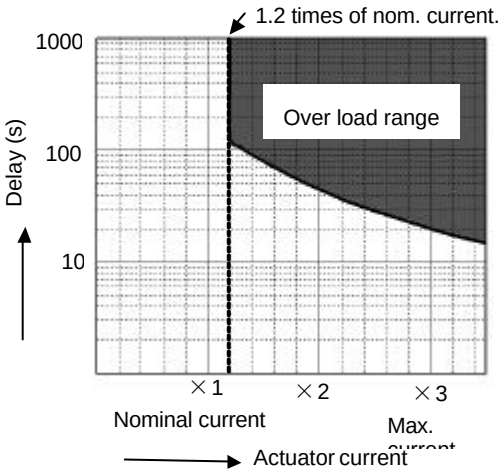
◆ Over load （20）

The driver always monitors the motor current, and if the current exceeds the curve in the figure below, the overload alarm occurs. For example:

(1) The alarm occurs if the current slightly exceeds 1.2 times of nominal current for a long duration.

(2) The alarm occurs if the current of three times of the nominal current flows for 20 seconds.

It is possible to clear the alarm by inputting signal to [CN2-2 clear: CLEAR].



◆ Over current (30)

The alarm occurs when the servo control element of the driver detects excessive current. To clear the alarm after troubleshooting, shut off the control power once and turn it on again.

◆ Over voltage (40)

The alarm occurs for HA-675-1 only.

It occurs when the main circuit voltage exceeds about 390V. The HA-675-1 drivers do not equip regeneration resistors to absorb regenerated energy at deceleration. When the load inertia is very big (example: 6 times or more of inertia of FHA-14C), the voltage of servo circuit increases highly and the alarm occurs. To release the alarm after troubleshooting, shut off the control power once and turn it on again.

◆ Abnormal regeneration （41）

The alarm occurs by activating the thermal switch of the regeneration resistor in the HA-675 driver at 100 degC. To clear the alarm after troubleshooting, shut off the control power once and turn it on again.

◆ Encoder failure （50）

The alarm occurs when the encoder signal ceases. To clear the alarm after troubleshooting, shut off the control power once and turn it on again.

The alarm also occurs when a built-in battery of the HA-675 driver for the absolute encoder is taken off in spite of normal conditions. To clear the alarm, shut off the control power once and turn it on again. **ABS**

◆ Abnormal encoder signal (51)

The alarm occurs when the driver has failed to receive two sequential signals. To clear the alarm after troubleshooting, shut off the control power once and turn it on again.

◆ UVW failure (52) INC

The alarm occurs when the encoder UVW signals are abnormal. To clear the alarm after troubleshooting, shut off the control power once and turn it on again.

◆ ABS system failure (53) ABS

For the absolute system, the alarm occurs when all power supplies (power supply, built-in condenser, and battery) for the encoder are failure. For example, it occurs at the first power supply after purchasing, and at power supply after disconnecting the cable between the driver and the encoder for a long duration.

To recover the alarm, turn off the [servo-ON: S-ON (CN-2 pin)] at first. Then carry out one of following three ways:

1. input the revolution data clear signal at least 4 seconds,
2. clear the revolution data by [J:ABS revolution data clear] in the parameter mode,
3. input [revolution data clear] signal from a host through CN-3: EIA-232C (RS-232C) port and shut off the control power once and turn it on again.

◆ Revolution counter overflow (54) ABS

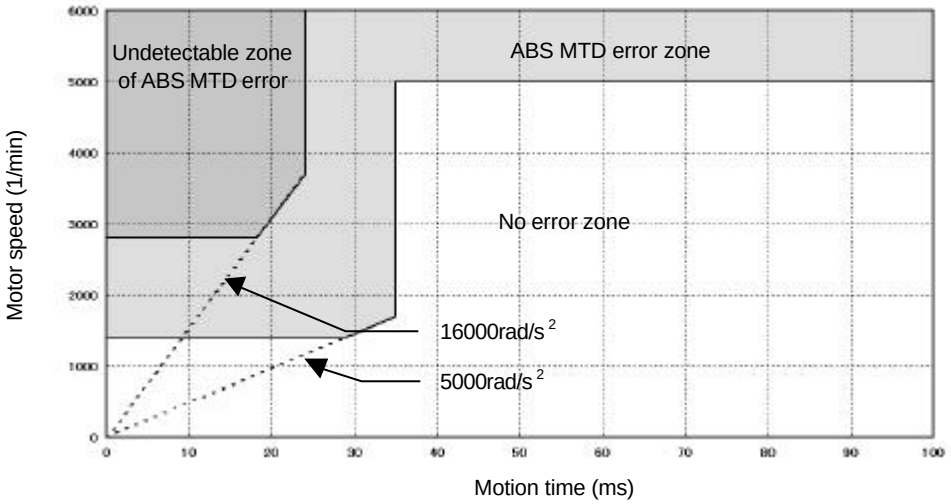
For the absolute system, the alarm occurs when the count for revolution goes beyond the range of +4095 to - 4096 turns (at motor axis).

The alarm may be cleared by the same procedures as ABS system failure (53)

◆ Revolution count error (55) ABS

While the absolute encoder is not supplied power by power supply but the encoder circuit is active only by the power of a built-in condenser and a built-in battery, the alarm occurs when the encoder rotates too fast at the acceleration rate and/or speed exceeding the allowed zone shown the figure below.

The alarm may be cleared by the same procedures as ABS system failure (53)



◆ Low battery voltage (56) ABS

For the absolute system, the alarm occurs when voltage of the built-in battery becomes lower than 2.8V. However, the actuator can be driven continuously, Exchange the battery having the voltage more than 3.0V, and then the system recovers automatically from the alarm.

Even in the alarm condition, the HA-675 driver keeps the revolution counter data if the control power supply is active. On the contrary if the power supply is inactive, the data may be lost due to further voltage drop after around 30 minutes from the alarm. Exchange the battery to new one promptly.

◆ Send data rule error (57) ABS

The absolute encoder rotates with the speed beyond the allowed range shown in the figure above during transmitting position data. To recover the alarm, shut off the control power once and turn it on again.

◆ Error counter overflow (60)

The alarm occurs when an error count exceeds the set value in [parameter mode]→[6: position error allowance]. It is possible to clear the alarm by inputting a signal to [CN2-2 clear: CLEAR]. The error count is cleared at the same time.

◆ Memory failure (RAM) (70)

The alarm occurs when the driver's RAM memory fails. It is impossible to clear the alarm.

◆ Memory failure (EEPROM) (71)

The alarm occurs when the driver's EEROM memory fails. It is impossible to clear the alarm.

◆ CPU failure (76 or flickering [0])

The alarm occurs when the driver's CPU fails. It is impossible to clear the alarm.

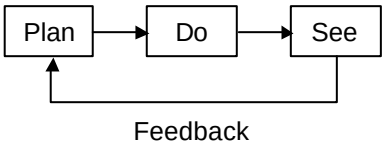
Chapter 2 Functions

2-1 Control system of HA-675 driver

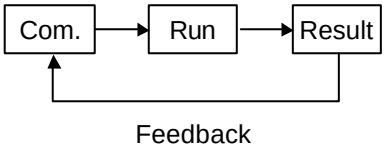
It is said that [plan, do, see] is essential to perform perfect jobs. In other words, the [plan, do, see] is the repeating cycle of command→action→result→feedback →modified command→action→feedback→・・・・・.
Driving machines precisely requires the same control as the above job cycle, that is [Motion command→run→ feedback→modified command→・・・・].

For example, assume the required motion is rotation to a target angle and stopping there. To perform the motion, the motor must be equipped with an angular sensor to detect current position, and the position data must be compared with the command. If the position data is different than the command, the motor rotates until the position data equals the command. This is an example of a servo system.

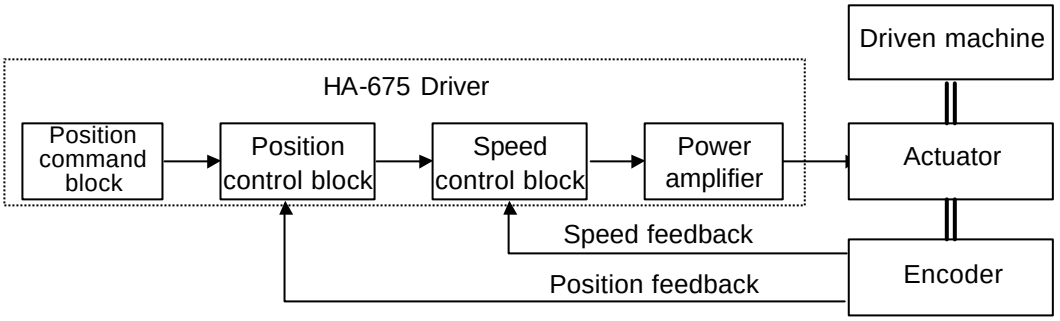
Perfect job cycle



Precise motion control



The fundamental configuration of the HA-675 driver is as follows:



The HA-675 driver function is consisted of four parts: the position command block, the position control block, the speed control block and the power amplifier.

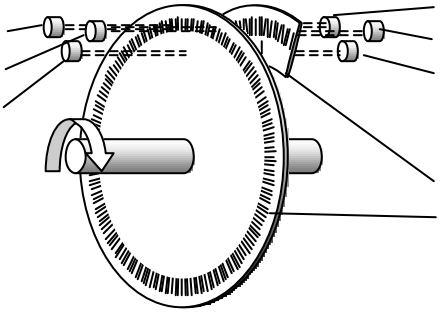
A command position from the position command block is compared to a feedback position. If there is a difference between them, the position control block commands to the power amplifier through the speed control block to flow current to the actuator until there is no difference.

2-2 Encoder system

The HA-675 driver allows to select an encoder as a functional member of the feedback system from two types: an incremental encoder and an absolute encoder.

2-2-1 Incremental encoder INC

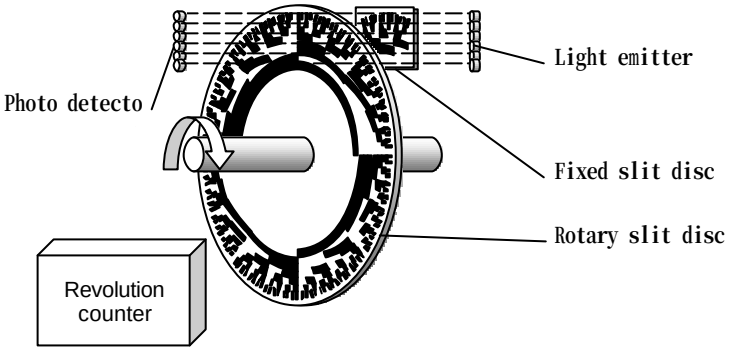
The incremental encoder outputs pulses corresponding to its rotary angle. Because of its simple mechanism, the incremental encoders are used commonly in spite of problems of loosing the current position data by power loosing.



As shown in the schematic figure, light given out from a light emitter reaches a photo detector passing through slits of the fixed disc and the rotary disc. When light reaches a photo detector, the detector signals a pulse immediately. As the disc turns, light reaches the photo detector intermittently. Consequently, counting output pulses allows measuring rotary position of the disc. Because the phase difference between pulses of phase-A and phase-B is 90 degrees electrically, it is possible to sense the rotating direction simultaneously. Generating the phase-Z signal at one time in a motor rotation, the signal allows to sense a origin precisely with a separately installed origin sensor.

2-2-2 Absolute encoder ABS

The absolute encoder housed in a FHA-C series actuator provides an absolute sensor to generate an absolute pulse train for a resolvable position, and a revolution counter to generate an absolute pulse train for a revolution of the motor. By those means, the absolute encoder measures its absolute position regardless the power supply, and makes originating sequential motion at power establishment.



The absolute encoder outputs a current absolute pulse train combined with an absolute pulse train of the revolution counter in response to the [ABS data request] signal only one time at power building. During normal operation, the absolute sensor generates incremental pulse train as same way as incremental encoders.

In the document, [absolute position] and [revolution] are applied not for the actuator but for the motor. Therefore, the position of the actuator is obtained by the following formula:

$$position\_of\_actuator = (absolute\_position + revolutions \times encoder\_resolution) \div reduction\_ratio$$

◆ Absolute sensor

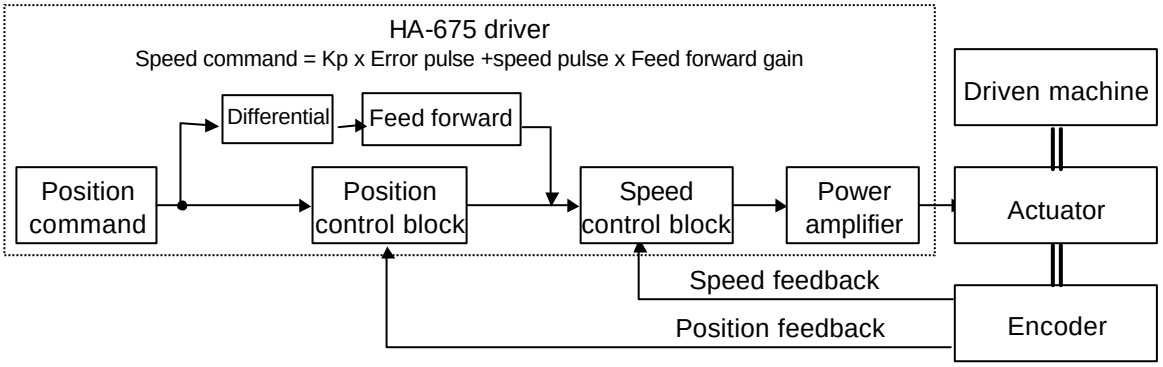
The absolute sensor is composed of an encoder disc, a series of light emitters, and a series of photo-detectors. The resolution of the encoder is 8192 positions per turn (13 bits). To obtain actual resolvable position of the actuator, the absolute pulse train should be multiplied by the reduction ratio of the actuator.

◆ Revolution counter

The revolution counter outputs a current absolute pulse train combined with an absolute pulse train of above mentioned absolute sensor in response to the [ABS data request] signal. The allowed range of the counter is from +4095 to –4096. To obtain an actual resolvable position of the actuator, the absolute pulse train should be multiplied by the reduction ratio of the actuator.

2-3 Tuning Servo gains

The HA-675 driver is fed back position and speed signals as follows:



In the figure, the closed loop of [speed control block]→[power amplifier]→[actuator]→[encoder]→[speed control block] is called a [speed loop].

In the same manner, the closed loop of [position control block]→[speed control block]→[power amplifier]→[actuator]→[encoder]→[position control block] is called a [position loop].

The details of the loops are described as follows:

2-3-1 Position control block and position loop gain

(1) The first function of the [position control block] is the [error count] calculation by the [error counter] in the block subtracting a feedback count from a command count.

(2) The second function is the block that converts the [error count] to a [speed command] multiplying a factor, and then transmits the [speed command] to the [speed control block]. The factor (Kp) is called [position loop gain].

$$V = Kp \times \text{Error count}$$

It is clear in the formula that a large [error pulse] is converted into a high [speed command] and a zero pulse into a zero speed command, in other words, a stop command.

(3) If the [position loop gain (Kp)] is high, a small [error count] is converted into a higher [speed command]. That is to say, higher gain provides the servo system with better response.

However, very high gain commands result in high [speed commands] from very minimal [error count] which will result in overshooting. To compensate for the overshoot the [position control block] generates a high speed reverse command, then overshoots in the opposite direction * * * finally hunting motion may take place.

Conversely, if the [position loop gain (Kp)] is very low, you will get very slow positioning motion (undershoot), and a poor servo response.

(4) In conclusion, it is important to set the optimum value to the [position loop gain (Kp)]. The HA-675 driver has been set with the most suitable value for general applications as a factory default. If the load inertia is very heavy and the default is not suitable, tune it carefully.

● **Tuning method**

[Tune mode]→[2: position loop gain]

2-3-2 Speed control block, speed loop gain, and speed loop integral compensation

(1) The first function of the [speed control block] is to subtract a feedback signal from a command signal.

(2) The second function is the block converts the difference to a [current command] multiplies it by a factor, and then transmits the [current command (I)] to the [power amplifier]. The factor (Kv) is called [speed loop gain].

$$I = Kv \times \text{speeddifference}$$

It is clear in the formula that a significant [speed difference] is converted into a high [current command] and zero difference into zero current command, in other words, a stop command.

(3) Same as the [position loop gain], higher gain gives better response, and too high gain results in hunting. Low gain gives no hunting but possibility of undershoots.

(4) The [speed loop integral compensation (Tv)] of The HA-675 driver makes less influence on load fluctuation.

$$I = Kv \times \left(1 + \frac{1}{Tv\,S}\right) \times \text{speeddifference}$$

If the [speed loop integral compensation (Tv)] is smaller, the speed response to the load fluctuation becomes better, but too small a value results in hunting. Excessive compensation requires no hunting, but will result in a poor response for load fluctuation.

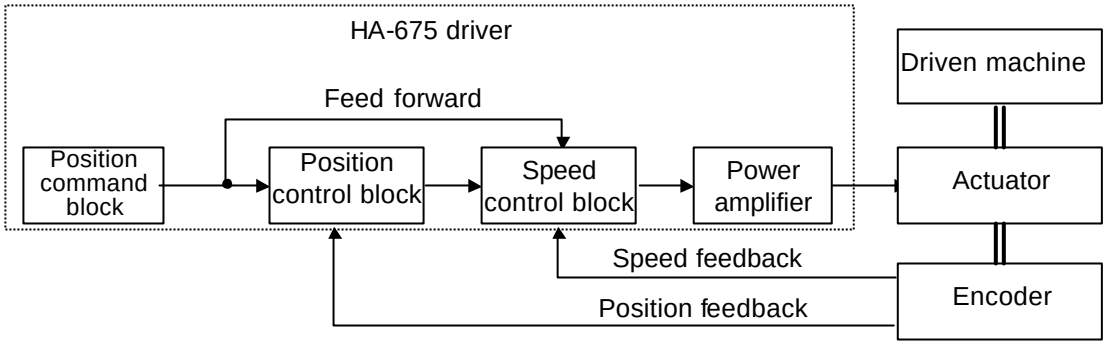
● **Tuning method**

[Tune mode]→[0.speed loop gain], and [1: speed loop integral compensation]

2-3-3 Feed forward gain

(1) In the position mode The HA-675 driver controls the error count, (the difference between [command pulse] and [feedback pulse]), to be [0]. At the beginning of inputting a command pulse train, the actuator starts slowly because of small error count.

(2) The [feed forward] function may accelerate the actuator as much as possible, adding speed pulses converted from the command pulse frequency directly to the driver's speed control loop.



(3) The relation between the feed forward and actuator motion is as follows:

Higher feeding allows for better following to command, but excessive feeding results in hunting and erratic motion.

Low feeding requires no hunting but a poor following of the command.

● **Tuning method**

[Tune mode]→[3:Feed forward]

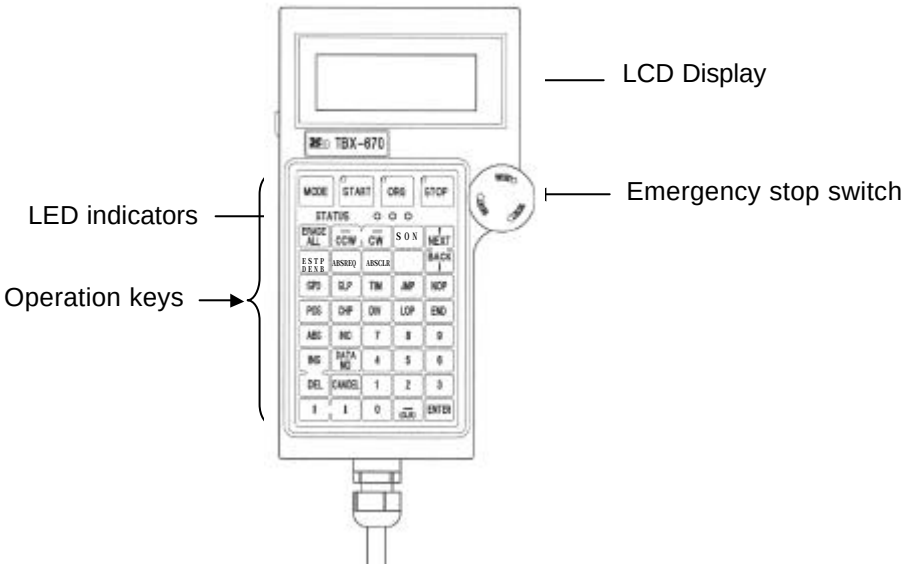
2-4 Motion control functions

You can create motion programs with the teach-box having operation keys and a LCD display without any complicated operation.

2-4-1 Outlines of teach-box

The teach-box provides a LCD display of 4 lines by 20 digits, a push-lock emergency-stop switch, 44 operation keys, and three LED indicators. The display and operation keys create all motion programs of the HA-675 driver.

The external view of the teach-box is shown in the figure below.



● Operation modes

Three modes are provided for teach-box operation. For the details of the modes, refer the chapter 7: operations of the teach-box.

◆ Program mode

In the mode you can create motion programs using commands of position, speed, acceleration time, delay time, jump, indexing, repeat and so on.

◆ Test mode

In the test mode you can verify the programs created in the program mode. It is possible to confirm positions, to observe sequential motions at every address, and to test programs continuously.

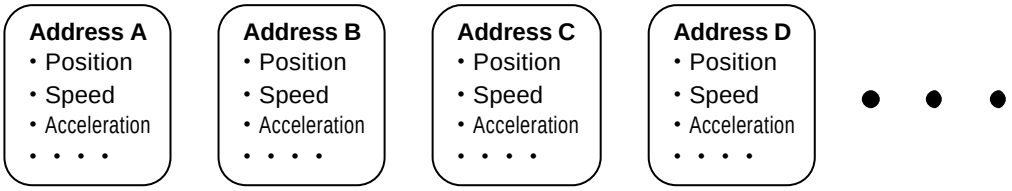
◆ Parameter mode

The mode allows setting parameters required for originating, units of speed and position, acceleration profiles, an offset for backlash, an ball-screw lead, and availability of the shortcut motion.

2-4-2 Outlines of programming

● Program format

For motion programs of an actuator the HA-675 driver may store up to 64 addresses which consists of commands such as stop position, speed changing position, speed, acceleration time, delay time, indexing, jump, repeat cycle, and so on.



Actuator motion starts by inputting a set of start address signals and a start signal from a host.

The actuator motion profile is different in the motion profile specification.

● Motion profile

The HA-675 driver provides three kinds of motion profiles.

◆ Individual positioning

The host specifies a start address. The actuator moves directly to the start address and stops at the position of the address having [POS] command. After that the HA-675 driver outputs the motion finish signal and the current address.

◆ Sequential positioning

The host specifies a start address. The actuator moves directly to the start address and stops at the position of the address having [POS] command.

After that the actuator moves sequentially by every [START] signal to the next address position of the [POS] command address.

When the sequence comes to the address having no command data, the sequence continues to the first address of the motion profile. At every positioning, the HA-675 driver outputs the motion finish signal and the current address.

◆ programmed motion

By the start input signal the actuator moves continuously following the address sequence and logical commands from the position of the starting address. When the addresses have a jump or repeat command, the command is executed.

When the sequence comes to the address having [END] command, the actuator stops and the HA-675 driver outputs the motion finish signal and the current address.

If [END] is not programmed, the sequence may continue from the address having no command data to the first address of the motion profile.

● Command

The commands of program mode are divided into two groups:

◆ Motion commands:
This group relates to actuator motion profile. The commands are programmed in the addresses having a position.

SPD:	speed
POS:	stop position
CHP:	speed changing position
SLP:	acceleration time
DIV:	indexing
TIM:	delay time

◆ Logical commands:
This group control logic of addresses. Motion commands are inhibited to program in the address having a logic command.

JMP:	jump
LOP:	repeat cycle
NOP:	no operation
END:	end of motion

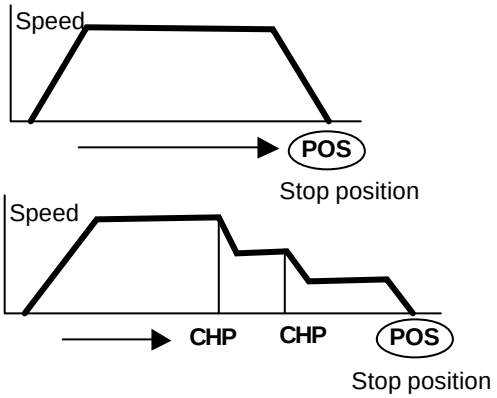
● Specifying increments and positions

For specifying increments and postions, both types of absolute values and incremental values are acceptable. Absolute value means the absolute positional distance from the origin, and incremental value means between the specified target position and the current position.

To specify a stop position, the [POS] command is programmed.

The [CHP] command is programmed for passing positions where speed may be changed without stopping.

Usually, for the motion profile having high speed feeding and creap speed positioning the [POS] command is programmed followed by the [CHP] commands.



Addresses which the [CHP] command is programmed are allowed to seriate up to four addresses, but not allowed five or more ones. If five or more addresses including the [CHP] command are seriately programmed, the alarm [04: programming error] may occurs at execution of the program..

◆ **Units of increments and positons**

The unit of the increments and positions is selectable from the three as follows:

0:	pulse
1:	angular unit (1/1000 °)
2:	linear unit (1/100 mm)

◆ **Units of speed**

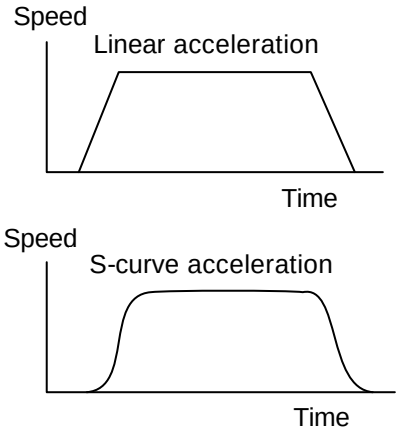
The unit of speed is selectable from the two as follows:

0:	p/s
1:	rotary speed (1/100 r/min)

● Acceleration and deceleration profile

The HA-675 driver provides two acceleration profiles: the linear acceleration profile and the S-curve acceleration profile.

The S-curve acceleration is available only for single speed profiles, not for compound speed profiles programmed with the [CHP] command.



● Indexing

For indexing motions, the indexing function equally divides the actuator movement from the start position to the position where the [POS] command is programmed.

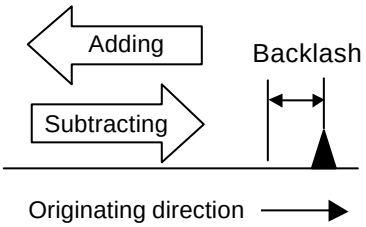
The actuator indexes by every start signal until the actuator comes to the [POS] position.

● Shortcut motion

For rotation of more than 180 degree, turning to oposite direction may get shorter time for positoning; this is called shortcut motion.

● Backlash offset

When the load mechanism has a backlash (play), the function can compensate it adding or abstracting from programmed position value at every reversing motion. This function may increase the positioning accuracy.



● Ball screw lead

When the load mechanism equips a ball screw for linear motion and [2: 1/100mm] is entered into [MQU: position unit], entering the code for the screw lead converts pulse to linear movement.

● Delay time

The command specifies the delay time from stopping at [POS] position to outputting the motion finish signal.

This will be used for waiting attenuation of the natural oscillation at stopping and so on.

● Jump

The command jumps to the specified address without conditions. This is available when the motion profile sets the program motion.

● Repeat cycle

The command repeats the motion from specified address to the previous commanded.

The command is available when the motion profile sets the program motion.

● Origination

To create and execute motion programs, it is necessary to establish an origin as the base point of the motion. The HA-675 driver allows to set an origin from three kinds as follows:

(1) encoder phase-Z position: has high repeatability, needs long originating time of maximum 20 sec.

(2) origin sensor position: has low repeatability, needs shorter originating time.

(3) current position: for the system having no origin sensor requiring no repetitive positions

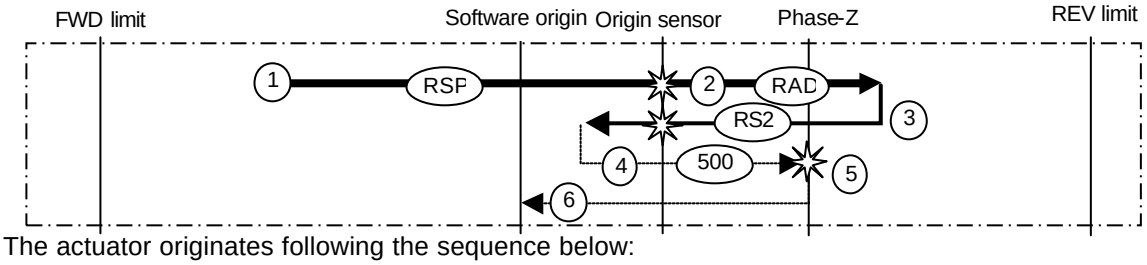
Parameters are provided for origination as follows. Set suitable data for the system to the parameters.
[RTD: origin direction], [RSP: originating speed 1], [RS2: originating speed 2]
[RAD: originating acceleration time], [NRT: software origin]

◆ Encoder phase-Z position as the mechanical origin

Set [0: phase-Z] into [parameter mode]→[G: origin].

This is the general way for the system requiring accurate repetitive positions.

An origin sensor is attached to the mechanism, and the position of the encoder phase-Z signal is established as the mechanical origin position. The figure below shows the originating sequence.

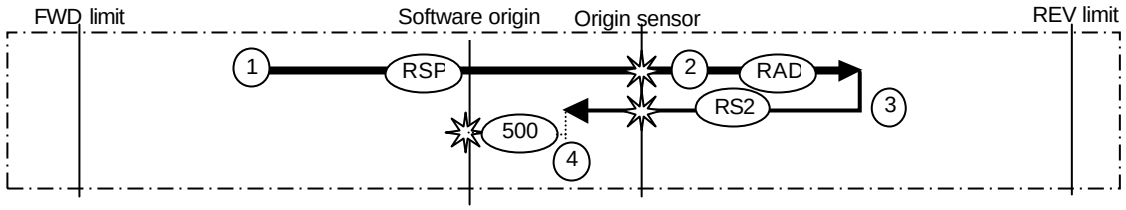


The actuator originates following the sequence below:

(1) The actuator starts at high speed of [RSP: originating speed 1] toward [RTD: origin direction].
(2) After sensing the origin sensor, it decelerates and stops in [RAD: originating acceleration time].
(3) It reverses at low speed of [RS2: originating speed 2].
(4) After sensing the sensor again, it reverses at very low speed of 500 pulse/second.
(5) When the phase-Z is sensed, it stops immediately, and the position is defined as the mechanical origin.
(6) **INC** For the incremental system, it moves to the position of [NRT: software origin] at very low speed of 500 pulse/second, and all positional counters are cleared to [0]. **ABS** For the absolute system, it moves by the distance of [NRT: software origin]. However, the counters are not cleared, but keep their counts.

◆ Origin sensor position as the mechanical origin

Set [1: origin sensor] into [parameter mode]→[G: origin].



The actuator originates following the sequence below:

(1) The actuator starts at high speed of [RSP: originating speed 1] toward [RTD: origin direction].
(2) After sensing the origin sensor, it decelerates and stops in [RAD: originating acceleration time].
(3) It reverses at low speed of [RS2: originating speed 2], and stops after sensing the sensor again. The stopped position is defined as the mechanical origin.
(4) **INC** For the incremental system, it moves to the position of [NRT: software origin] at very low speed of 500 pulse/second, and all positional counters are cleared to [0]. **ABS** For the absolute system, it moves by the distance of [NRT: software origin]. However, the counters are not cleared, but keep their counts.

◆ **Current position as the mechanical origin INC**

For the incremental system, this is the way for the system having no origin sensor requiring no repetitive positions. This is not available for the absolute position.

(1) Turn on the [CN2-4 originating: ST-ORG] holding ON state of [CN-5 Interlock: INTERLOCK].

(2) After 2ms or more, turn off the [CN2-4 originating: ST-ORG].
The current position is defined as the origin.

● **Software origin**

Sometimes, the software origin is helpful for programming in addition to the mechanical origin. For example, when the encoder index position is shifted from original mechanical position after troubleshooting. Without the software origin, you must shift every address position one by one. However, the software origin may shift all together without any program correction.

As for the actual orinating motion, the actuator performs the origination to the mechanical origin, then moves to the software origin.

2-5 Other functions

2-5-1 In-position range

Though the driver controls the actuator to make the [error count 0], it is not always possible due to the influence of external forces, acceleration, and deceleration. Establishing a positioning allowance is a good solution to the problem; that is [in-position range].

[Tune mode]→[4: in-position range] sets the allowance. The actuator position comes within the range calculated with the formula below, the [CN2-34 motion finish: FINISH] signal outputted.

$$\text{Actuator position} \leq \text{Command position} \pm \text{In-position range}$$

● Relating I/O signal pin

Output pin: CN2-34 motion finish: FINISH

● **Tuning method**

[Tune mode]→[4: In-position range]

2-5-2 Manual JOG operation

It is possible to operate the actuator manually for test, for tuning, and for diagnosis without commands from a host. Pressing the [UP] and [DOWN] keys on the front panel rotates the actuator at pre-set speed and at pre-set acceleration.

● **Operation and setting**

[Test mode]→[Jo: JOG operation], [SP: JOG speed], [Ac: JOG acceleration]

2-5-3 Monitoring inputs and operating outputs

It is possible to monitor input ports of [clear], [servo-ON], [FWD inhibit] and [REV inhibit] for test, for tuning, and for diagnosis.

It is also possible to manually output signals of [in-position], [attained speed], [alarm] and so on without relations to the actuator state by pressing the [UP] and [DOWN] keys on the front panel outputs signals in the test mode.

● **Operation and setting**

[Test mode]→[b：I/O monitor], [rdy：Output port operation]

2-5-4 Error count clear by S-ON

The HA-675 driver controls a motor so that the error count is always [0] during the servo power is active. However, when the servo power is shut down turning off the input of [CN-2-3 servo ON: S-ON] and only the control power is active, the error count may not be [0] proportioning to movement by external force, such as gravitational force and human power, from the position where the servo power is shut down.

If the servo power becomes active again turning on the input of [CN-2-3 servo ON: S-ON] when the error count is not [0], the actuator suddenly rotates at the moment with its maximum torque to cancel the error count to zero [0]. The sudden rotation may course personal injury especially during trial run, maintenance and troubleshooting.

For the absolute system, the function avoids the dangerous sudden rotation clearing the error count to [0] at re-activating the servo power.

For the incremental system, the actuator moves to the direction to make the error count [0] when the error count is within the range of +5000 to –5000 at the time of switching the [CN2-3 servo-ON: S-ON] on. If the count is out of the range, the function makes the count to prevent from the sudden rotation. However, originating operation is indispensable for position data after working the function, because of loosing the previous position data.

● **Setting method**

[Parameter mode]→[5: error count clear by S-ON]

2-5-5 Speed limit and current limit

It is possible to set a upper limits of the motor speed and/or current as a safety measures against accident at system trial. As the motor torque is proportional to the motor current, the hazardous torque may be pressed down by limiting motor current.

Generally, a host takes the safety measures for the whole system; the functions may reinforce the safety measures.

● **Operation and setting**

[parameter mode]→[A: speed limit] [b: current limit]

2-5-6 Automatic actuator identification for HA-675-1 driver

The function is available when an HA-675-1 driver and an FHA-8C/11C/14C actuator is connected correctly. Following power supply turning-ON to the driver after connecting with the actuator;

(1) the driver identifies the code of the actuator connected to it automatically, and

(2) if the identified code is different from a registered code, the newly identified code takes place of the registered code, and values of some parameters of the parameter mode and the tune mode are switched to initial values for the newly connected actuator.

When the identified code is different from the registered code, canceling operation of the automatic actuator identifying function may cause actuator seizure or damage.

Combine a driver and an actuator correctly.

Even for a wrong combination of a driver except HA-675-1 and FHA-8C/11C/14C actuator, works the automatic actuator identifying function. If automatic registration is carried out to the wrong combination, it may cause low torque problems or over current that may cause physical injury and fire.

2-5-7 Automatic gain control at positioning for HA-675-1 driver

HA-675-1 drivers for FHA-C mini series actuators (FHA-8C/11C/14C) provide an automatic speed-gain control function for positioning. To get short period for positioning, the function automatically makes speed loop gain higher when an error pulse number becomes small.

For the reason that the speed loop gain is proportionate to error pulse number (refer to 2-3-4 tuning servo gains), 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 [tune mode] →[0: speed loop gain] is higher than the automatic gain, the registered gain has priority.

● **Setting method**

[Parameter mode]→[o: automatic gain control]

Chapter 3 I/O ports

The CN2 connector provides input and output signals to and from the host devices. The 50 pins of the connector are assigned to the following signals. Do not connect signals to pins marked "-".

3-1 I/O port layout

The I/O port layout is shown as follows:

Pin No.	Signal	Symbol	I/O
1	Input signal common	INPUT-COM	Input
2	Clear	CLEAR	Input
3	Servo-ON	S-ON	Input
4	Originating	ST-ORG	Input
5	Interlock	INTERLOCK	Input
6	Start	START	Input
7	Stop	STOP	Input
8	Input signal common	INPUT-COM	Input
9	Input bit 1	INPUT DATA 1	Input
10	Input bit 2	INPUT DATA 2	Input
11	Input bit 4	INPUT DATA 4	Input
12	Input bit 8	INPUT DATA 8	Input
13	Input bit 16	INPUT DATA 16	Input
14	Input bit 32	INPUT DATA 32	Input
15	Emergency stop+	ESTOP+	Input
16	Emergency stop−	ESTOP-	Input
17	FWD limit+	FSTOP+	Input
18	FWD limit−	FSTOP-	Input
19	REV limit+	RSTOP+	Input
20	REV limit−	RSTOP-	Input
21	Origin+	ORG+	Input
22	Origin−	ORG-	Input
23	Speed monitor	SPD-MON	Output
24	Current monitor	CUR-MON	Output
25	Monitor ground	GND	Output

Pin No.	Signal	Symbol	I/O
26	+24V	+24V	Input
27	−	−	−
28	ABS Position data request	ABS-REQ	Input
29	−	−	−
30	ABS Revolution counter clear	ABS-CLEAR	Input
31	−	−	−
32	−	−	−
33	Ready	READY	Output
34	Motion finish	FINISH	Output
35	At-origin	ORG-END	Output
36	Alarm	ALARM	Output
37	Output bit 1	OUT-DATA 1	Output
38	Output bit 2	OUT-DATA 2	Output
39	Output bit 4	OUT-DATA 4	Output
40	Output bit 8	OUT-DATA 8	Output
41	Output bit 16	OUT-DATA 16	Output
42	Output bit 32	OUT-DATA 32	Output
43	Output common	OUT-COM	Output
44	Phase-A+(LD)	A+	Output
45	Phase-A−(LD)	A-	Output
46	Phase-B+(LD)	B+	Output
47	Phase-B−(LD)	B-	Output
48	Phase-Z+(LD)	Z+	Output
49	Phase-Z−(LD)	Z-	Output
50	Frame ground	FG	Output

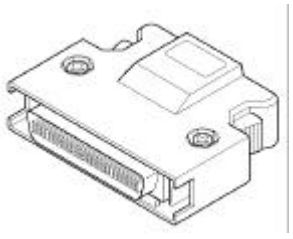
Note 1: Pins marked with **ABS** are dedicatedly used for the absolute system. Do not use them for the incremental system.
Note 2: OC: open collector port, LD: line driver port
Note 3: Do not use the pins marked "−". Using these pins may cause failure of interior circuitry.

3-2 Models of I/O port connector CN2

The models of the CN2 connector is as follows:

Connector: 10150-3000VE 3M

Cover: 10350-52F0-008 3M



3-3 I/O port connections

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

3-3-1 Logical inputs

The HA-675 driver provides 14 ports for logical inputs as shown in the figure to the right.

ABS: for absolute system only

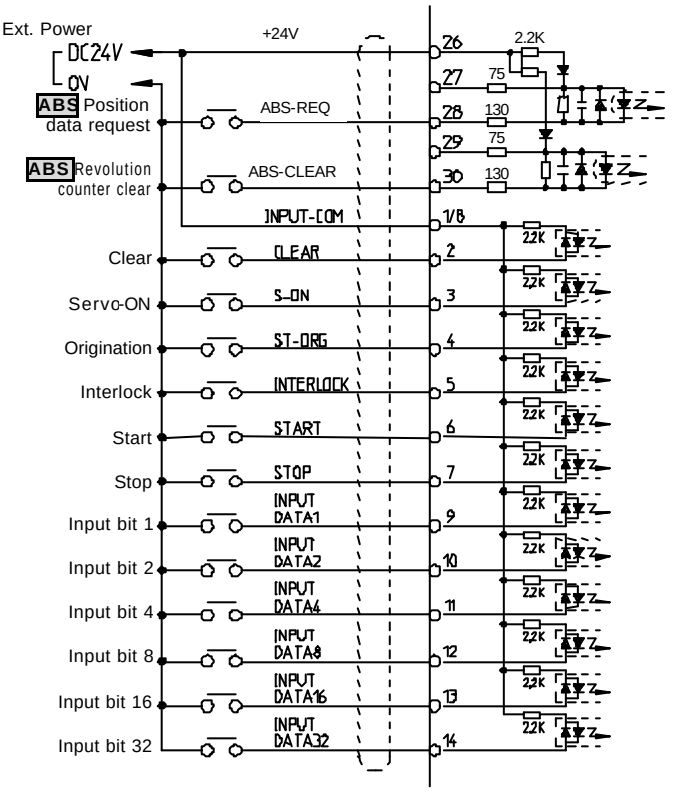
● **Specifications**

For pins No. 2 to 7 and 9 to 14:
Voltage: DC24V±10%
Current: 20mA or less (per port)

For pins No. 28 and 30:
Voltage: DC24V±10%
Current: 16mA (peak: 20mA)

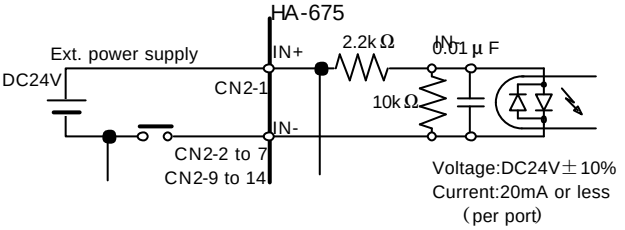
Inputs should keep ON for 2 ms or more.

The [CN2-30 revolution counter clear: ABS-CLEAR] input should keep ON for 4 seconds or more. ABS



● **Connection**

The HA-675 driver does not provide the power supply for input signals. Connect a [+24V] power supply for the signals to [CN2-1: input signal common] or [CN2-8: input signal common].



3-3-2 Contact inputs

The HA-675 driver provides 8 ports of 4 signals for contact inputs as shown in the figure to the right.

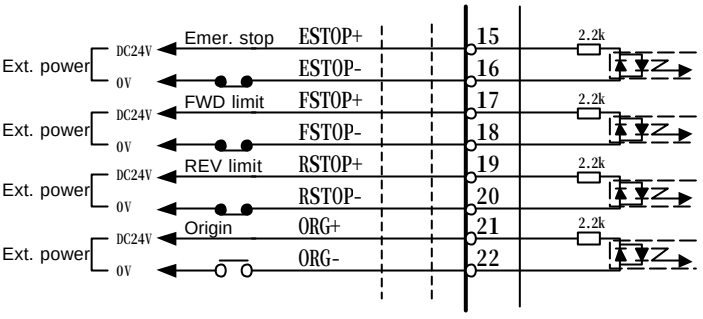
◆ **Specifications**

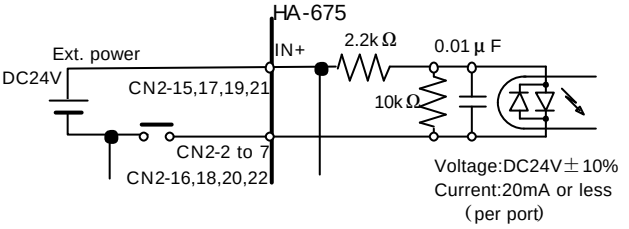
Voltage: DC24V ±10%
Current: 20mA or less

Inputs should keep ON for 2 ms or more.

● **Connection**

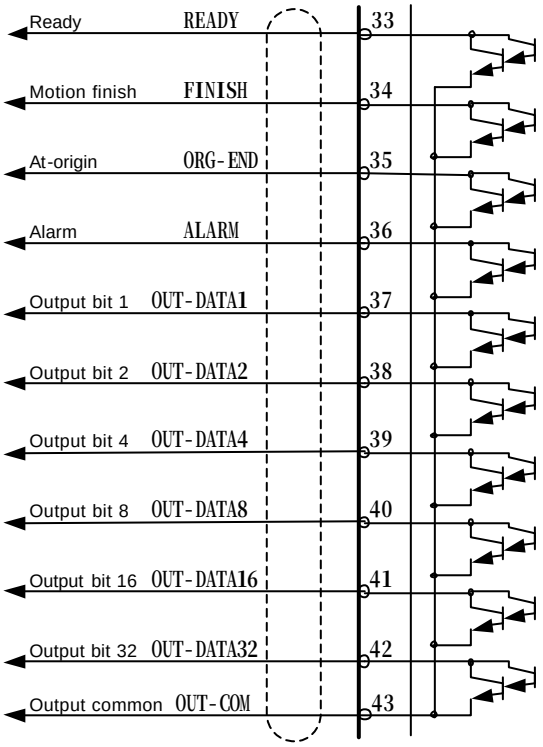
The HA-675 driver does not provide the power supply for input signals. Connect a [+24V] power supply for the signals to [CN2-15, 17, 19, 21].





3-3-3 Outputs

The HA-675 driver provides 11 ports of 10 signals for inputs as shown in the figure to the right.



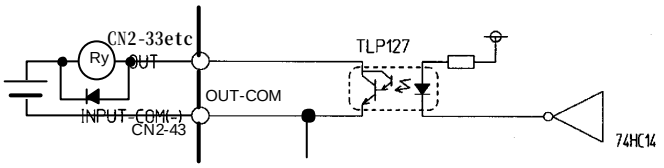
● Specifications

Port: Open collector
Voltage: DC24V or less
Current: 40mA or less (per port)

Every port is insulated by an opto-isolator.

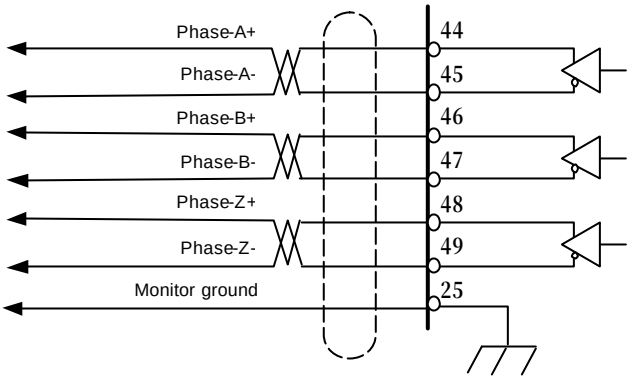
● Connection

Connect output signals between their respective output ports and [CN2-43: output common] port.



3-3-4 Monitor outputs

The HA-675 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）.

3-4 I/O port functions

This section describes I/O port functions.

CN2-1 Input signal common: INPUT-COM (input)

● **Function**

This is the common port for inputs: [**CN2-2 to 7, 9 to 14**] . Supply external power for inputs to this port.

● **Connection**

Connect [+24V] external power for inputs here.

CN2-2 Clear: CLEAR (input)

● **Function**

(1) If alarm exists:

This clears the alarm state, returns to operable state, and clears the error 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 error count to [0]. At the same time, this clears the command count and the feedback count.

● **Connection**

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

Refer to [CN2-1: input signal common].

CN2-3 Servo-ON: S-ON (input)

● **Function**

This turns the servo power for the HA-675 driver ON and OFF.

100ms later from when the input turns ON, the servo power of the HA-675 driver is ON and the actuator can be driven. When this turns OFF, the servo power turns OFF and the motor free to rotate.

● **Connection**

Connect [NO-contact signal (a-contact)]. The input should keep ON for 2 ms or more.

Refer to [CN2-1: input signal common].

CN2-4 Originating: ST-ORG (input)

● **Function**

This is the ready signal to start originating motion. After inputting the signal into this port, the input into [CN2-6 start: START] starts the originating motion.

● **Connection**

Connect [NO-contact signal (a-contact)]. The Input should keep ON for 2 ms or more.

Refer to [CN2-1: input signal common].

CN2-5 Interlock: INTERLOCK (input)

● **Function**

The input (ON) to the port stops actuator motion immediately.

Turning OFF the input restarts actuator motion.

The input (ON) to the [CN2-6 start: START] will be ignored.

As this port activates by [NO-contact signal (a-contact)], do not use this port for safety circuit.

● **Connection**

Connect [NO-contact signal (a-contact)]. The Input should keep ON for 2 ms or more.

Refer to [CN2-1: input signal common].

CN2-6 Start: START (input)

● **Function**

The input to the port starts actuator motion. The input is accepted at least 100ms later from when the servo power turns ON.

The input signal to the port will be ignored while [CN2-5 interlock: INTERLOCK] signal is ON.

The input signal to the port will be ignored while [CN2-7 stop: STOP] signal is ON.

● **Connection**

Connect [NO-contact signal (a-contact)]. The Input should keep ON for 2 ms or more.

Refer to [CN2-1: input signal common].

CN2-7 Stop: STOP (input)

● **Function**

The input (ON) to the port stops actuator motion with deceleration.

Turning ON [CN2-6 start: START], while the actuator stops by the input, restarts actuator motion.

● **Connection**

Connect [NO-contact signal (a-contact)]. The Input should keep ON for 2 ms or more.

Refer to [CN2-1: input signal common].

CN2-8 Input signal common: INPUT-COM (input)

● **Function**

This is the common port for inputs: [**CN2-2 to 7, 9 to 14**]. Supply external power for inputs to this port.

● **Connection**

Connect [+24V] of external power for inputs here.

CN2-9 to 14 Input bit: INPUT-DATA (input)

● **Function**

A set of six ports specifies a start address of programming motion with a 6-bit pattern.

The relation between addresses and inputs are as follows;

Address	CN 2-14	CN 2-13	CN 2-12	CN 2-11	CN 2-10	CN 2-9	Address	CN 2-14	CN 2-13	CN 2-12	CN 2-11	CN 2-10	CN 2-9	Address	CN 2-14	CN 2-13	CN 2-12	CN 2-11	CN 2-10	CN 2-9	Address	CN 2-14	CN 2-13	CN 2-12	CN 2-11	CN 2-10	CN 2-9
	32	16	8	4	2	1		32	16	8	4	2	1		32	16	8	4	2	1		32	16	8	4	2	1
0	O	O	O	O	O	O	16	O	I	O	O	O	O	32	I	O	O	O	O	O	48	I	I	O	O	O	O
1	O	O	O	O	O	I	17	O	I	O	O	O	I	33	I	O	O	O	O	I	49	I	I	O	O	O	I
2	O	O	O	O	I	O	18	O	I	O	O	I	O	34	I	O	O	O	I	O	50	I	I	O	O	I	O
3	O	O	O	O	I	I	19	O	I	O	O	I	I	35	I	O	O	O	I	I	51	I	I	O	O	I	I
4	O	O	O	I	O	O	20	O	I	O	I	O	O	36	I	O	O	I	O	O	52	I	I	O	I	O	O
5	O	O	O	I	O	I	21	O	I	O	I	O	I	37	I	O	O	I	O	I	53	I	I	O	I	O	I
6	O	O	O	I	I	O	22	O	I	O	I	I	O	38	I	O	O	I	I	O	54	I	I	O	I	I	O
7	O	O	O	I	I	I	23	O	I	O	I	I	I	39	I	O	O	I	I	I	55	I	I	O	I	I	I
8	O	O	I	O	O	O	24	O	I	I	O	O	O	40	I	O	I	O	O	O	56	I	I	I	O	O	O
9	O	O	I	O	O	I	25	O	I	I	O	O	I	41	I	O	I	O	O	I	57	I	I	I	O	O	I
10	O	O	I	O	I	O	26	O	I	I	O	I	O	42	I	O	I	O	I	O	58	I	I	I	O	I	O
11	O	O	I	O	I	I	27	O	I	I	O	I	I	43	I	O	I	O	I	I	59	I	I	I	O	I	I
12	O	O	I	I	O	O	28	O	I	I	I	O	O	44	I	O	I	I	O	O	60	I	I	I	I	O	O
13	O	O	I	I	O	I	29	O	I	I	I	O	I	45	I	O	I	I	O	I	61	I	I	I	I	O	I
14	O	O	I	I	I	O	30	O	I	I	I	I	O	46	I	O	I	I	I	O	62	I	I	I	I	I	O
15	O	O	I	I	I	I	31	O	I	I	I	I	I	47	I	O	I	I	I	I	63	I	I	I	I	I	I

Note 1: [**I**] means ON, and [**O**] means OFF.

● **Connection**

Connect [NO-contact signal (a-contact)]. The Input should keep ON for 2 ms or more.

Refer to [CN2-8: input signal common].

CN2-15, 16 Emergency stop: ESTOP (input)

● **Function**

This accepts an emergency stop signal. When the port turns OFF (input), the actuator stops with deceleration. At the same time, [alarm 01: inputting emergency stop] occurs, and the actuator becomes the servo-free state by turning off the servo power supply.

The same state may occur when the servo power supply is turned on while the signal is OFF state.

● **Connection**

Connect [NC contact (b-contact) signal]. However, it is possible to change it to [NO contact (a-contact) signal] by [parameter mode]→[c: signal logic].

The Input should keep ON for 2 ms or more.

Connect [＋24V] external power supply to [CN2-15 emergency stop+: ESTOP+].

CN2-17, 18 FWD limit: FSTOP (input)

CN2-19, 20 REV limit: RSTOP (input)

● **Function**

The [CN2-17, 18 FWD limit: FSTOP] accepts the forward-side limit sensor signal, and [CN2-19, 20 REV limit: RSTOP] accept the reverse-side limit sensor signal. When either port turns OFF (input), the actuator stops with deceleration. At the same time, [alarm 02: inputting FWD limit] for FSTOP signal or [alarm 03: inputting REV limit] for RSTOP signal occurs, and the actuator becomes the servo-free state by turning off the servo power supply.

However, if the servo power supply turns ON while one of the signals is OFF (input) state, no alarm occurs differently from [CN2-15, 16 emergency stop: ESTOP] signal case.

When the [CN2-17, 18 FWD limit: FSTOP] turns OFF (input) during originating motion, the actuator immediately reverses if [parameter mode] →[RTD: originating direction] of the teach-box is [0: clockwise viewing from output].

When the [CN2-19, 20 REV limit: RSTOP] turns OFF (input) during originating motion, the actuator immediately reverses if [parameter mode] →[RTD: originating direction] of the teach-box is [1: counter clockwise viewing from output].

● **Connection**

Connect [NC contact (b-contact) signal].

It is possible to convert it to [NO contact (a-contact) signal] by [parameter mode]→[c: signal logic]. However, if the [NO contact (a-contact) signal] is set to [c: signal logic], the alarm [02: FWD limit] or the alarm [03: REV limit] may occur at turning ON the servo power while either signal is [ON] status.

The Input should keep ON for 2 ms or more.

Connect [＋24V] external power supply to CN2-17, and CN2-19.

CN2-21, 22 Origin: ORG (input)

● **Function**

This accepts the origin sensor signal.

● **Connection**

Connect [NO-contact signal (a-contact)]. The Input should keep ON for 2 ms or more.

Connect [＋24V] external power supply to CN2-21.

CN2-23 Speed monitor: SPD-MON (output)

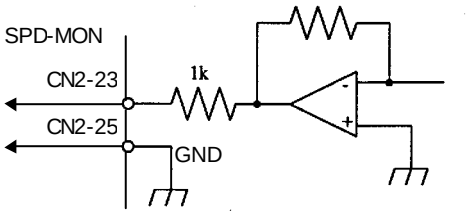
● **Function**

The port outputs a voltage signal proportional to the motor speed. Note that the voltage signal is not outputted during JOG operation, and is unstable until outputting the signal of [CN2-37 ready: READY] after activating power supply.

The actual motor speed is obtained by the following formula:

$$\text{Motor speed (r/min)} = \text{Command voltage} \times \frac{\text{Speed conversion factor}}{10.0\text{V}}$$

Refer [parameter mode]→[9: speed conversion factor].



◆ Specifications of output:

Voltage range: -12V to +12V
Output impedance: 1 kilo-ohm

● **Connection**

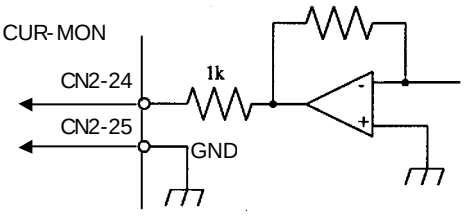
Connect the monitor to [CN2-23: speed monitor: SPD-MON] and [CN2-25: GND].

CN2-24 Current monitor: CUR-MON (output)

● **Function**

The port outputs a voltage signal proportional to the motor current. The relation between the voltage and the current is set so that the monitor voltage of [+10V] corresponds to the actuator maximum current. Note that the voltage signal is not outputted during JOG operation, and is unstable until outputting the signal of [CN2-37 ready: READY] after activating power supply.

$$\text{Monitor voltage(V)} = \text{Actuator current} \times \frac{10}{\text{Actuator maximum current}}$$



◆ Specifications of output:

Voltage range: -12V to +12V
Output impedance: 1 kilo-ohm

● **Connection**

Connect the monitor to [CN2-24: current monitor: CUR-MON] and [CN2-25: GND].

CN2-25 Monitor Ground: GRD

● **Function**

The port is the ground for [CN2-23 speed monitor] and [CN2-24 current monitor].

● **Connection**

Connect both grounds of [CN2-23 speed monitor: SPD-MON] and [CN2-24 current monitor: CUR-MON] here.

CN2-26 +24V: +24V (input)

CN2-28 Position data request: ABS-REQ(input) ABS

● Function

This is used for a command to output a current resolving count of the encoder. The [CN2-44, 45 phase-A : A+, A-] and [CN2-46, 47 phase-B: B+, B-] output the current count.

The function is available only one time after power ON. The commands of second and after are ignored. Setting [1: at turning on control power] to [H: timing for transmitting data] disregards the [CN2-28 position data request: ABS-REQ], because the data has transmitted at turning on control power.

If the current count is required, use the [current count request] command of communication protocols.

● Connection

Connect [NO-contact signal (a-contact)]. Refer to [CN2-1: input signal common].

CN2-30 Revolution counter clear: ABS-CLEAR(input) ABS

● Function

As the revolution counter has no data at the first power supplying after connecting with a FHA-C actuator, or at events of alarms [53: ABS system failure], [54: revolution counter overflow] and [55: revolution count error], the counter should be cleared.

However, when the back-up battery is detached during normal operation for the purpose of exchanging to new one, it is unnecessary to clear the counter because of the counter is active for around 30 minutes by the housed condenser.

● Clearing operation of the revolution counter

(1) Move manually the FHA-C actuator to an appointed origin.
(2) Turn OFF the input port [CN2-3 Servo-ON: S-ON]. (This is essentials.)
(3) Turn ON the [CN2-11 revolution counter clear: ABS-CLEAR] for more than 4 seconds.
(4) Shut off the power once and turn it on again, or send [reset command] from the host, because a difference has occurred between the current revolution count and the count in the absolute encoder.

● Connection

Connect [NO-contact signal (a-contact)]. Refer to [CN2-1: input signal common].

CN2-33 Ready: READY (output)

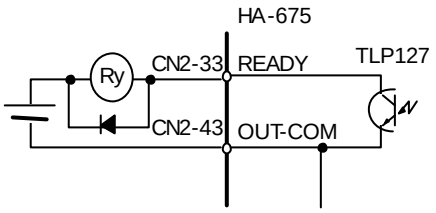
● Function

The HA-675 driver outputs the signal when initializing is completed after power supplying. The signal keeps ON even at alarm happening.

● Connection

(1) The figure to the right is a connection example of [CN2-33 ready: READY] port.

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



CN2-34 Motion finish: FINISH (output)

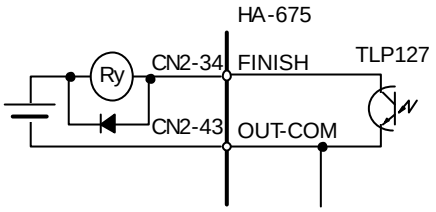
● Function

The HA-675 driver outputs the signal when the actuator completes the specified motion and an error count comes in the range of [tune mode]→[4: in-position range]. The signal will be reset by the next start signal.

● Connection

(1) An example of [CN2-34 motion finish: FINISH] connection is shown in the figure to the right.

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



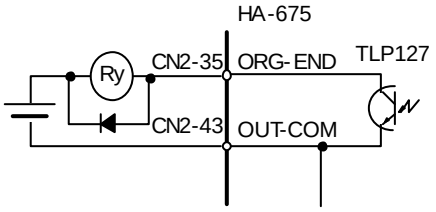
CN2-35 At-origin: ORG-END (output)

● **Function**

The HA-675 driver outputs the signal when the actuator completes the originating motion.

● **Connection**

(1) An example of [CN2-35 at-origin: ORG-END] connection is shown in the figure to the right.



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

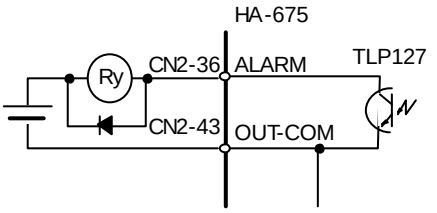
CN2-36 Alarm: ALARM (output)

● **Function**

The output turns OFF when the HA-675 driver senses an alarm. The output is [NC contact (b-contact) signal]. However, you can convert it to [NO contact (a-contact) signal] by [parameter mode]→[c: signal logic].

● **Connection**

(1) An example of [CN2-36 alarm: ALARM] connection is shown in the figure to the right.



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

CN2-37 to 42 Output bit: OUT-DATA(output)

● Function

A set of six ports outputs the motion complete address with a 6-bit pattern.

The relation between addresses and outputs are as follows;

Address	CN 2-42	CN 2-41	CN 2-40	CN 2-39	CN 2-38	CN 2-37	Address	CN 2-42	CN 2-41	CN 2-40	CN 2-39	CN 2-38	CN 2-37	Address	CN 2-42	CN 2-41	CN 2-40	CN 2-39	CN 2-38	CN 2-37	Address	CN 2-42	CN 2-41	CN 2-40	CN 2-39	CN 2-38	CN 2-37
	32	16	8	4	2	1		32	16	8	4	2	1		32	16	8	4	2	1		32	16	8	4	2	1
0	O	O	O	O	O	O	16	O	I	O	O	O	O	32	I	O	O	O	O	O	48	I	I	O	O	O	O
1	O	O	O	O	O	I	17	O	I	O	O	O	I	33	I	O	O	O	O	I	49	I	I	O	O	O	I
2	O	O	O	O	I	O	18	O	I	O	O	I	O	34	I	O	O	O	I	O	50	I	I	O	O	I	O
3	O	O	O	O	I	I	19	O	I	O	O	I	I	35	I	O	O	O	I	I	51	I	I	O	O	I	I
4	O	O	O	I	O	O	20	O	I	O	I	O	O	36	I	O	O	I	O	O	52	I	I	O	I	O	O
5	O	O	O	I	O	I	21	O	I	O	I	O	I	37	I	O	O	I	O	I	53	I	I	O	I	O	I
6	O	O	O	I	I	O	22	O	I	O	I	I	O	38	I	O	O	I	I	O	54	I	I	O	I	I	O
7	O	O	O	I	I	I	23	O	I	O	I	I	I	39	I	O	O	I	I	I	55	I	I	O	I	I	I
8	O	O	I	O	O	O	24	O	I	I	O	O	O	40	I	O	I	O	O	O	56	I	I	I	O	O	O
9	O	O	I	O	O	I	25	O	I	I	O	O	I	41	I	O	I	O	O	I	57	I	I	I	O	O	I
10	O	O	I	O	I	O	26	O	I	I	O	I	O	42	I	O	I	O	I	O	58	I	I	I	O	I	O
11	O	O	I	O	I	I	27	O	I	I	O	I	I	43	I	O	I	O	I	I	59	I	I	I	O	I	I
12	O	O	I	I	O	O	28	O	I	I	I	O	O	44	I	O	I	I	O	O	60	I	I	I	I	O	O
13	O	O	I	I	O	I	29	O	I	I	I	O	I	45	I	O	I	I	O	I	61	I	I	I	I	O	I
14	O	O	I	I	I	O	30	O	I	I	I	I	O	46	I	O	I	I	I	O	62	I	I	I	I	I	O
15	O	O	I	I	I	I	31	O	I	I	I	I	I	47	I	O	I	I	I	I	63	I	I	I	I	I	I

Note 1: [**I**] means ON, and [**O**] means OFF.

When an alarm happens, the set of four ports outputs the relating alarm code. The alarm codes are shown as follows:

Code	Alarm	CN 2-41	CN 2-40	CN 2-39	CN 2-38
01	Emergency stop	O	O	I	I
02	FWD limit	O	O	I	I
03	REV limit	O	O	I	I
04	Programming error	O	O	I	I
10	Over speed	I	O	I	I
20	Over load	O	O	O	I
21	Overheat	I	O	O	O
30	Over current	I	O	O	I
40	Over voltage	I	O	I	I
41	Abnormal regeneration	I	O	I	O
50	Encoder failure	I	I	O	I

Code	Alarm	CN 2-41	CN 2-40	CN 2-39	CN 2-38
51	Abnormal encoder signal	I	I	O	I
52	INC UVW failure	I	I	O	I
53	ABS ABS system failure	I	I	O	I
54	ABS Rev. counter overflow	I	I	O	I
55	ABS Rev. count error	I	I	O	I
56	ABS Low battery voltage	I	I	O	I
57	ABS Send data rule error	I	I	O	I
60	Error counter overflow	O	O	I	O
70	Memory failure (RAM)	O	I	O	I
71	Memory failure (EEPROM)	O	I	O	I
76 or Flickering [0]	CPU failure	O	I	O	O

Note 1: [**I**] means ON, and [**O**] means OFF.

Note 2: The alarm 52 is valid for incremental system only, and the alarms 53 through 57 are valid for absolute system. Other codes are valid for both incremental and absolute systems.

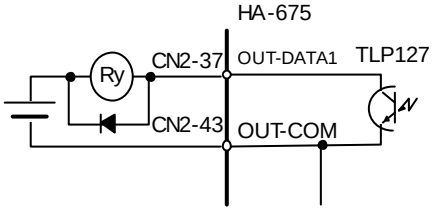
Note 3: The lower code is displayed for plural alarms.

Note 4: The actuator does not stop when the [alarm 56: Low battery voltage] occurs. When [1: no output] is set for [parameter mode] →[I: low battery voltage alarm], the LEDs indicate the alarm code only without outputting the 4-bit code to the host.

● Connection

(1) An example of [CN2-37 Output bit 1: OUT-DATA 1] connection is shown in the figure to the right.

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



CN2-43 Output common: OUT-COM (output)

● **Function**

This is the common port for the [CN2-33 to 42] ports.

CN2-44 Phase-A＋: A+ (output)

CN2-45 Phase-A－: A- (output)

CN2-46 Phase-B＋: B+ (output)

CN2-47 Phase-B－: B- (output)

CN2-48 Phase-Z＋: Z+ (output)

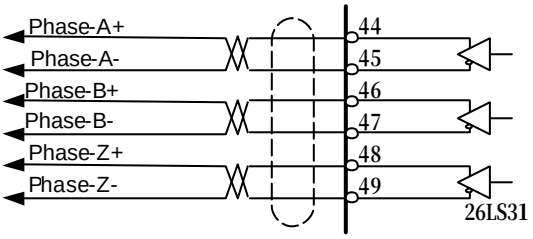
CN2-49 Phase-Z－: Z- (output)

● **Function**

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

● **Connection**

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



CN2-50 Ground: FG (output)

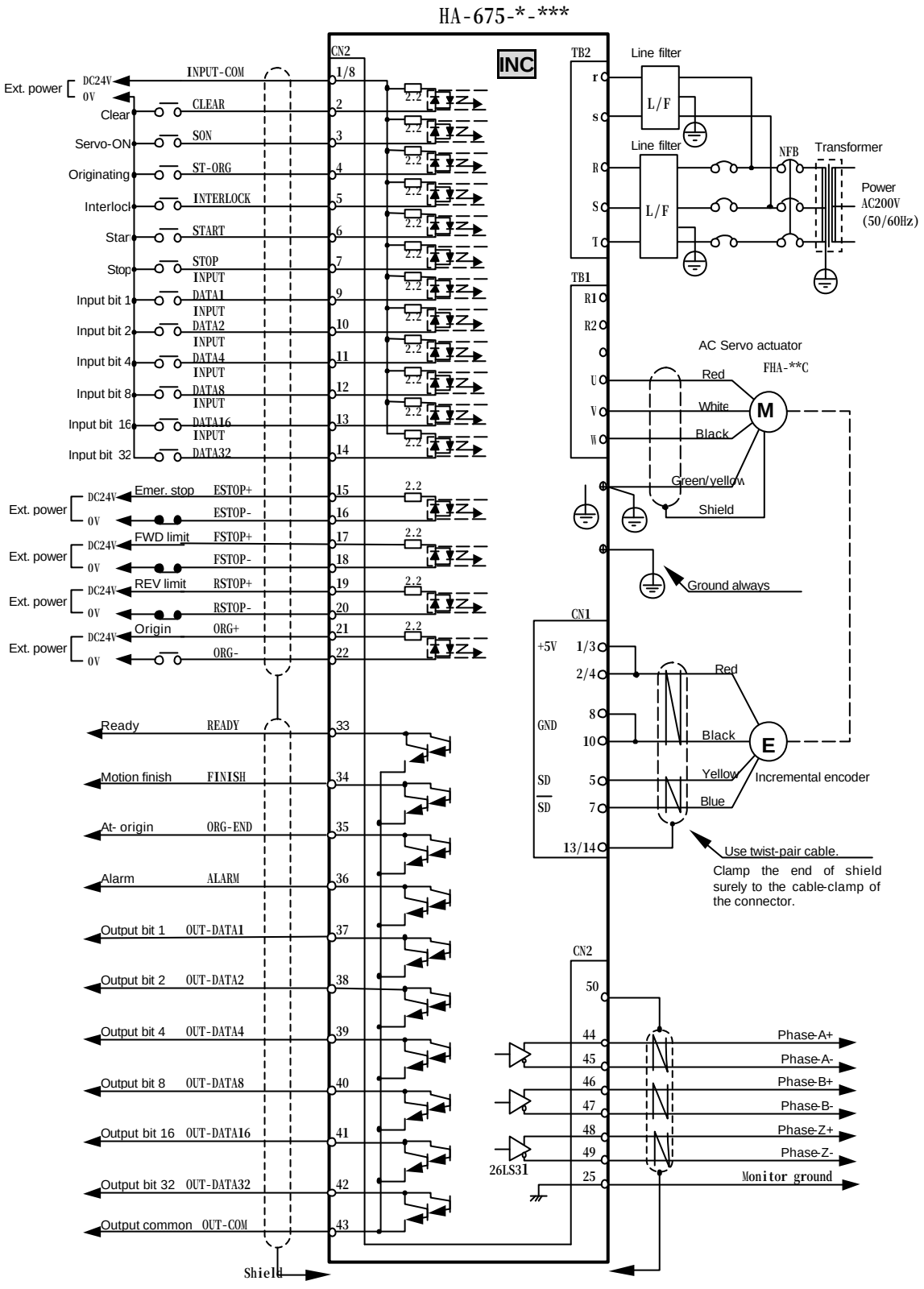
● **Function**

Connect shield of cable.

3-5 Connection example

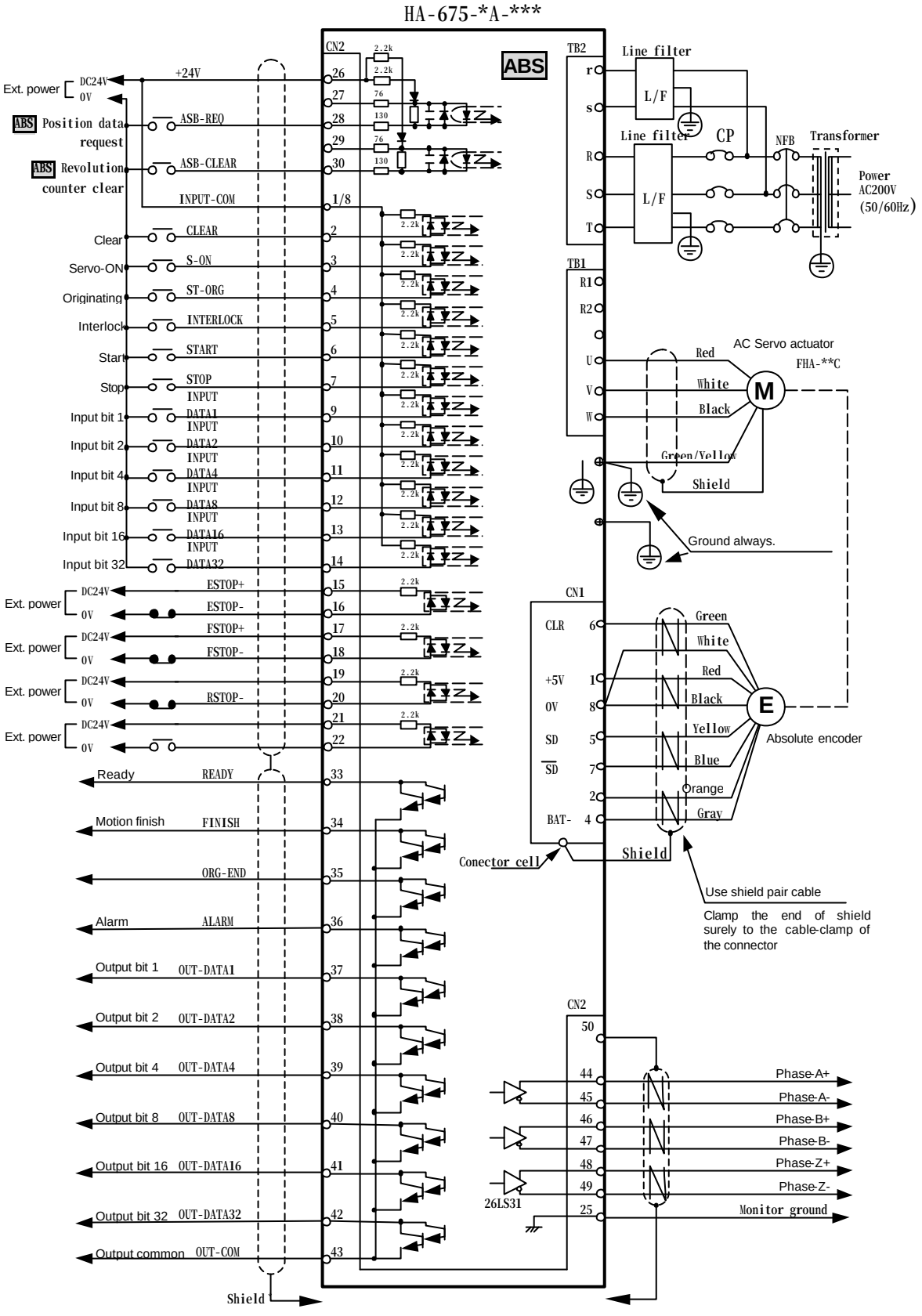
<< for incremental system >> INC

◆ The figure below shows a connection example for the incremental system.



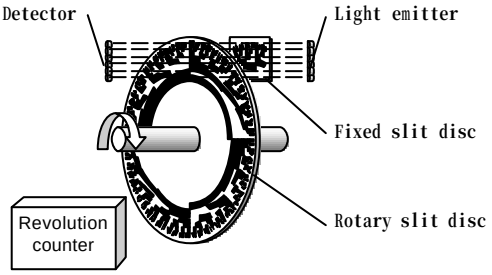
<< for absolute system >> ABS

◆ The figure below shows a connection example for the absolute system.



3-6 I/O ports for absolute position data ABS

3-6-1 General descriptions of absolute encoder



The absolute encoder housed in a FHA-C series actuator provides an absolute sensor to generate an absolute pulse train for a resolvable position, and a revolution counter to count revolutions of the motor.

- **Absolute sensor**

The absolute sensor is composed of an encoder disc, a series of light emitters, and a series of photo-detectors. The resolution of the encoder is 8192 positions per turn (13 bits).

- **Revolution counter**

An revolution count for the encoder is kept in the memory always, which is energized by a combination of the built-in condenser in the actuator for short time memorizing and the backup battery housed in the HA-675 driver for long time memorizing. By those means, the absolute encoder measures its absolute position regardless the power supply.

The allowed range of the counter is from +4095 to –4096.

At the following cases, it is necessary to clear the revolution counter, because the revolution count is null.

- the first power ON after installation
- after recovery from [alarm 53: ABS system failure], [alarm 54: Revolution counter overflow], or [alarm 55: Revolution count error]

To clear the revolution counter,

(1) Turn the FHA-C actuator to come to the motion origin.

(2) Input the [CN2-11 Revolution counter clear] signal for than more 4 seconds, or

(2') Make power-ON pressing both [ADJ] and [SET] keys of HA-675 driver's front panel and leave fingers from keys after beginning of indication on the panel, and clear the count to zero by [parameter mode] →[F or J: revolution counter clear].

- **Position data**

The position data consist two parts of data: the head part is a [revolution count] in the revolution counter and the rear part is an [absolute position] of the absolute sensor.

In the document, the [absolute position] and the [revolution count] are applied not for the actuator but for the motor. Therefore, the position of the actuator is obtained by the following formula:

$$position\_of\_actuator = (absolute\_position + revolutions \times encoder\_resolution) \div reduction\_ratio$$

There are two ways for outputting the position data as follows:

- Outputting from the output ports of the CN2 connector
- Transmitting from the serial ports of the CN3 connector in compliance with the EIA-232C (RS-232C) standard

- **Relating parameters**

CN2-10 Position data request: ABS-REQ (input)

CN2-11 Revolution counter clear: ABS-CLEAR (input)

3-6-2 Outputting position data from output port: CN2

Following the powering sequence, the ports of the [CN2-44 phase-A: A+] through [CN2-49 phase-Z: Z-] output pulse trains for the current position data just for once, automatically or by responding to the [CN2-28 position data request: ABS-REQ]. The timing for outputting the data is set by the [parameter mode] → [H: data output timing].

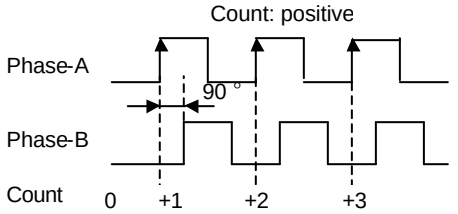
Following the pulse trains for position data, the ports output incremental pulse trains as same way as incremental encoder systems.

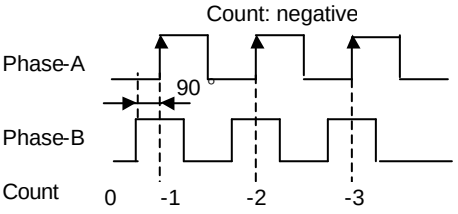
● **Revolution counts**

A revolution count is outputted in the form of two-phase pulse trains having phase-shift of 90 degree. For the positive counts, the phase-A train advances the phase-B train. Oppositely, the phase-A train lags behind the phase-B train for the negative count.

Discriminate a sign of the count positive or negative by the advanced shift or the lagged one. The count is obtained by counting edges of the phase-A pulse train.

The figures to the right show the signal patterns.

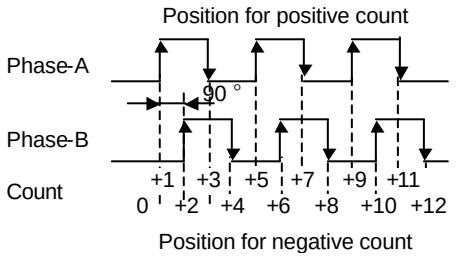


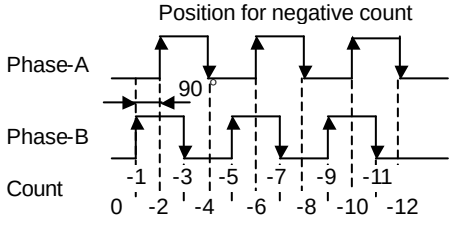


● **Absolute positions**

An absolute position is outputted in the form of two-phase pulse trains having phase-shift of 90 degree. For the positive counts, the position has positive sign and the phase-A train advances the phase-B train. Oppositely, the position has negative sign and the phase-A train lags behind the phase-B train for the negative count.

AS the absolute position is outputted in the quadrupled form, the position is obtained by counting edges of both phase-A and phase-B pulse trains. The examples to the right show that the absolute positions are [+12] and [-12].

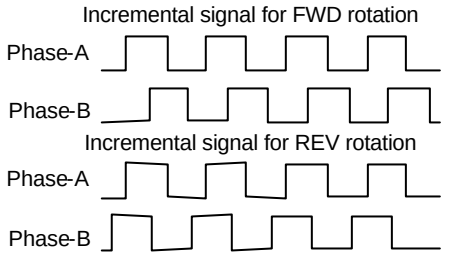




● **Incremental signals**

Following outputting pulse trains for position data, incremental signals are outputted in two-phase pulse trains. For forward revolution, the phase-A train advances the phase-B train. Oppositely, the phase-A train lags behind the phase-B train for the reverse rotation.

AS the incremental signals are outputted in the quadrupled form, the position is obtained by counting edges of both phase-A and phase-B pulse trains.

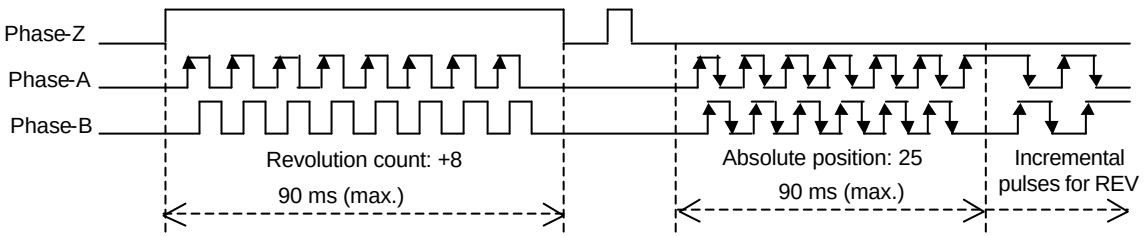


● **Outputting position data**

Responding to the input signal of [CN2-28 position data request: ABS-REQ] from a host, the HA-675driver outputs pulse trains in the order of a [revolution count] and an [absolute position].

Following the pulse trains for position data, the ports output incremental pulse trains. If the motor rotates after or during outputting the data in spite of [OFF] state of the [CN2-3 Servo-ON: S-ON] port, the incremental pulse trains are outputted immediately after outputting the pulse trains for position data.

The figure below shows an example of initial pulse trains for position data of:
the revolution count = +8; the absolute position = +25; reverse rotation after outputting the data



Chapter 4 Installing the HA-675 driver

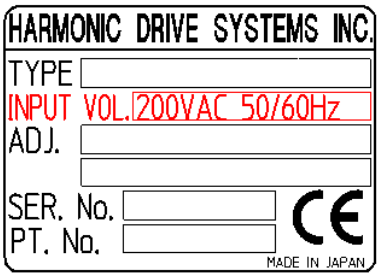
4-1 Receiving Inspection

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, immediately contact the dealer it was purchased from.

(2) The label, shown in the figure to the right, is attached on the right side of the HA-675 driver. Confirm the products you ordered by comparing with the model. If it is different, immediately contact the dealer it was purchased from.



The model code is interpreted as follows:

HA-675-2A-200

- HA: AC servo driver
- 675: 675 series
- 2: Nominal current

1	1A
2	2.4A
4	4A

- A: Available encoder

void	incremental encoder model
A	absolute encoder model

- 200: Input voltage

200	AC200V
100	AC100V

Note: The specification of 100V is optional.

(3) Under the [ADJ.] line, the code of the FHA-C series actuator to be driven by the HA-675 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-675 driver has been tuned for the actuator specified on the driver label. The wrong combination of HA-675 drivers and actuators may cause low torque problems or over current that may cause physical injury and fire.

(4) The HA-675 driver model is marked on the [POWER] line of the label of the HA-675 driver.

200V: 3-phase or single phase 200V

100: single-phase 100V

If the voltage to be supplied is different from the voltage on the label, immediately contact the dealer 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-675 driver resulting physical injury and fire.

4-2 Notices on handling

The HA-675 drivers are electronic devices. Handle them with care and take the following precautions:

(1) Handle the terminal cover carefully. Do not use the HA-675 driver without the terminal cover. Failure to observe this caution may result in electric shock or personal injury.

(2) Do not drop screws, solder balls, wire chips, or any other foreign objects through the ventilation gaps of the HA-675 driver. Failure to observe this caution may result in electric shock or personal injury.

(3) Do not insert electric wire, steel wire, or a screwdriver through the ventilation gaps of the HA-675 driver. Failure to observe this caution may result in electric shock or personal injury.

(1) Because the case is made of plastic, do not apply excess force or shock.

(2) The vibration resistance of the HA-675 driver is 4.9m/s^2(10 to 55Hz). Do not mount or transport the HA-675 driver in a manner where it would be subjected to high levels of vibration.

(3) Do not put the HA-675 driver on the place from where it can easily fall down.

(4) Do not put anything on the HA-675 driver. The case of the driver may break.

(5) The allowable storage temperature is from －20℃ to ＋85℃. 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-675 driver in areas where in corrosive gas or particles may be present.

(8) Do not tamper the DIP-switch on the bottom face of the driver.

4-3 Location and installation

4-3-1 Environment of location

The environmental conditions of the location are as follows:

◆ Service temperature: 0 deg.C to 50 deg.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 less than 50 deg.C.

◆ Service humidity: less than 95% 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 4.9m/sec^2 (0.5G) (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: less than 98m/s^2 (10G)

◆ Make sure that dust, water condensation, metal powder, corrosive gas, water, water drops, or oil mist is not exposed to the HA-675 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.

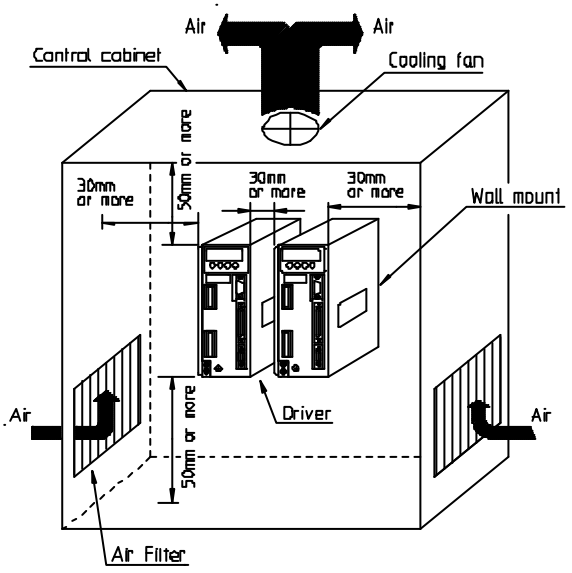
4-3-2 Notices on installation

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 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-675 driver.

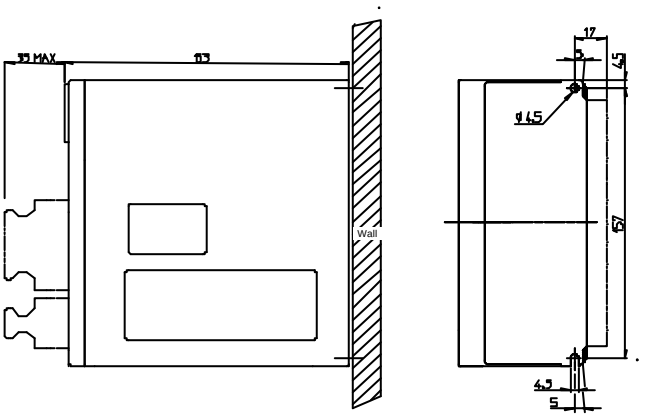
Driver	HA-675-1			HA-675-2		HA-675-4	
Actuator	FHA-8C	FHA-11C	FHA-14C	FHA-17C	FHA-25C	FHA-32C	FHA-40C
Power consumption	20W	30W	40W	30W	40W	50W	60W



4-3-3 Installing

The HA-675 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.



● Procedures

(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 driver on the M4 screw.

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

(4) Tighten the lower M4 screw.

4-4 Suppressing noise

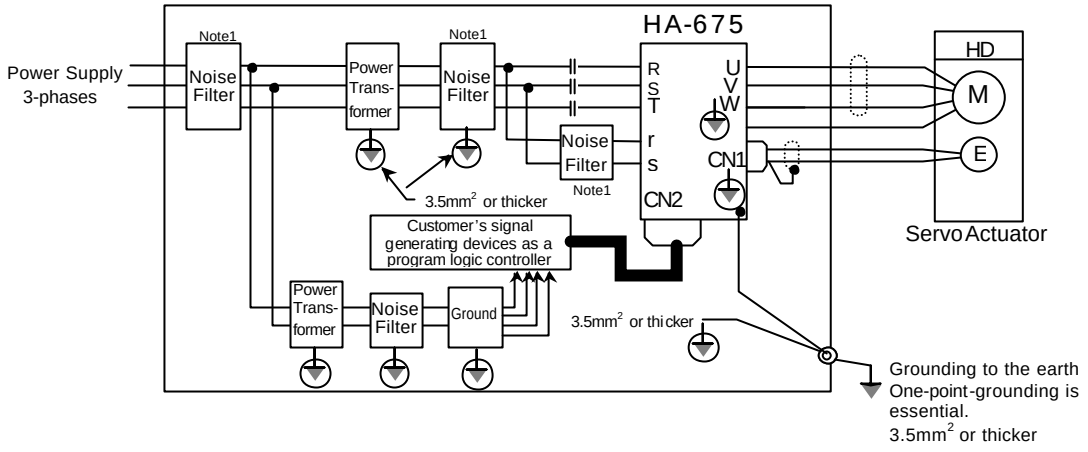
The HA-675 driver employs an IPM (power module) with a PWM control for main circuit. As the IPM generates switching noise by high-speed power switching, the noise may cause incorrect motion of other equipment or radio noise interference due to poor cabling or poor grounding.

In addition, it is necessary to provide proper cable management in order to suppress incorrect motion of the HA-675 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 as follows:

4-4-1 Devices for grounding

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



Note 1: For the grounding line filters, refer to [4-4-2 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.

4-4-2 Installing noise filter

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	Ratings	Manufacturer
Main power	Single phase	HA-675-1	SUP-P5H-EPR	250V, 5A	Okaya electric.
		HA-675-2			
		HA-675-4	SUP-P10H-EPR	250V, 10A	
	Three phase	HA-675-1	3SUP-H5H-ER-4	250V, 5A	
		HA-675-2			
		HA-675-4	3SUP-H10H-ER-4	250V, 10A	
Control power		All models	SUP-P5H-EPR	250V, 5A	

Install the noise filters and the HA-675 driver as near as possible with one another.

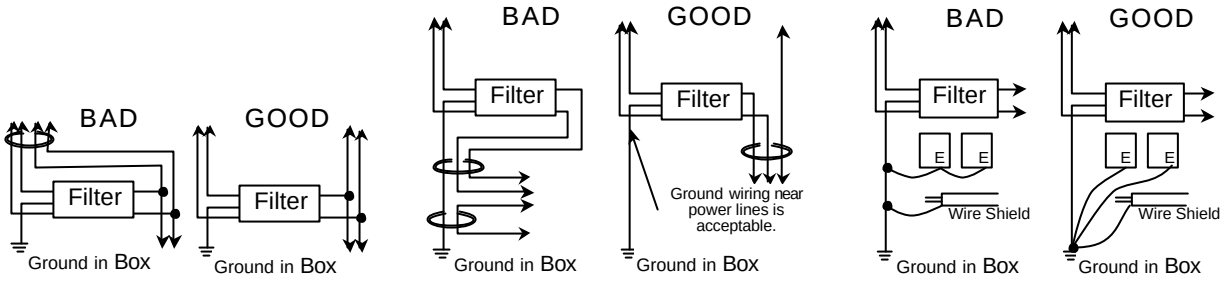
Install the noise filters to the lines of the electric devices other than the HA-675 driver in the same way. Always install the noise filters to the source of high frequency noise, such as electric welders and electrical discharge machines.

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)

4-4-3 Instructions for cabling

In addition to the noise suppression mentioned previously, one must also follow these instructions:

(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.

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

(2) Encoder signal cable (user's responsibility): 20m 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, and solenoids.

(4) Separate power cables (power source cables and motor cables) and I/O signal cables by more than 30cm. 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-675 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.

4-5 Connecting power cables

4-5-1 Instructions for power supply

WARNING

Before connecting the power cable to the HA-675 driver, turn-OFF the electricity to avoid electric shock. Failure to observe this caution may result in electric shock or personal injury.

CAUTION

(1) Connect the power cable to the HA-675 driver only after installing the driver on a wall.

(2) Ground the HA-675 driver, to avoid electric shock, malfunctions caused by external noise, and for the suppression of radio noise emissions.

4-5-2 Allowable size of cables

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

Terminals and Connectors	Symbol	Allowable Wire Sizes (mm^2)			
		HA-675-1		HA-675-2	HA-675-4
		FHA-8C,-11C	FHA-14C	FHA-17C, -25C	FHA-32C, -40C
Main Power Supply	R,S,T	0.75		1.25	1.25
Control Power Supply	r, s	0.75		1.25	1.25
Motor Leads	U,V,W,E	0.5 Note 3	0.75 Note 3	0.75 Note 3	1.25 Note 3
Ground	Ground mark	3.5		3.5	3.5
Regeneration Resister	R1,R2	-		0.75	1.25
Encoder Port	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: Optional cables of 3m/5m/10m long are available as follows:

for a motor: EWC-MB * * -A06-TN (for HA-675-1)
EWC-MB * * -M08-TN (for HA-675-2, and HA-675-4)

for an incremental encoder: EWC-E * * -M06-3M14 (for HA-675-1)
EWC-E * * -B04-3M14 (for HA-675-2, and HA-675-4)

for an absolute encoder: EWC-S * * -B08-3M14

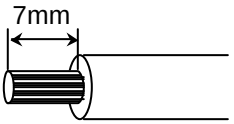
Cable length

03	3m
05	5m
10	10m

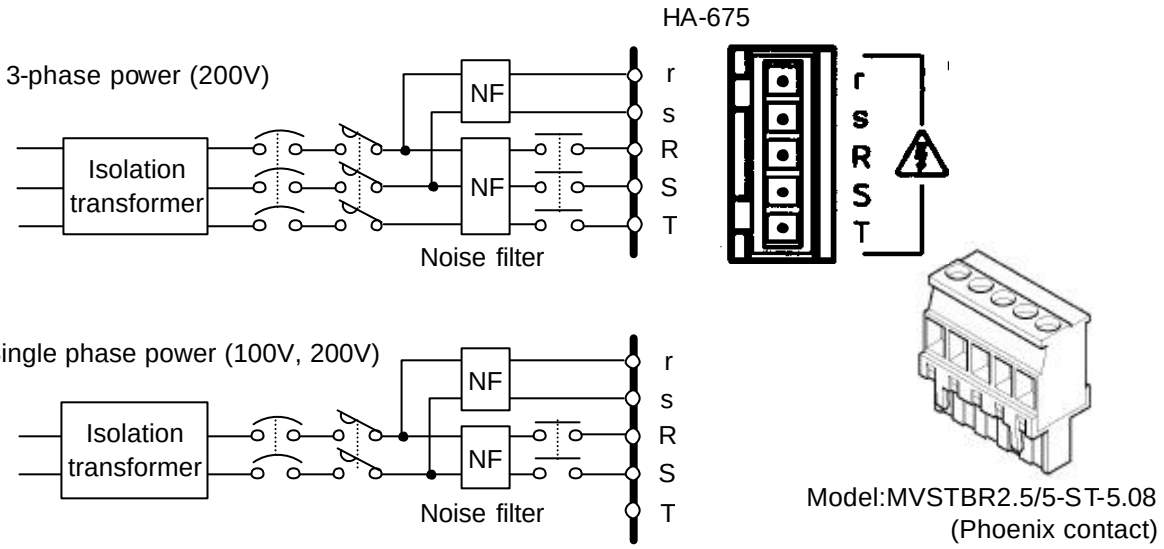
4-5-3 Connecting the power cable

The terminal block for the power is located on the front panel of the HA-675 driver. There is no phase order in connection to three-phase power lines.

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.

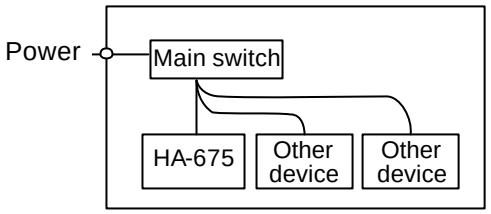


Install an isolation transformer and noise filters in the power lines to avoid electric shock and to guard against malfunctions caused by external noise.

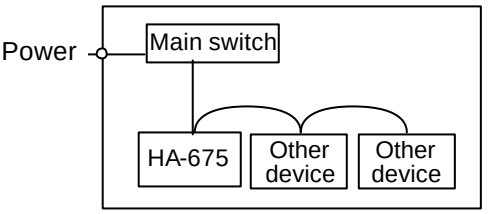


Model:MVSTBR2.5/5-ST-5.08
(Phoenix contact)

The 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



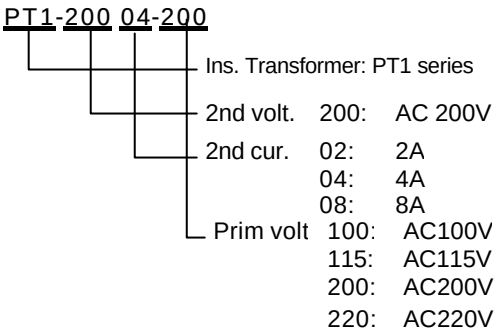
Bad cable management

4-5-4 Isolation transformer

The use of an isolation transformer is recommended to prevent problems caused by improper grounding and external noises.

Optional transformers are available as follows:

Transformer	Driver	Actuator
PT1-20002	HA-675-1	FHA-8C, FHA -11C
PT1-20004	HA-675-1	FHA-14C
	HA-675-2	FHA-17C, FHA -25C
PT1-20008	HA-675-4	FHA-32C, FHA -40C



Refer to [9-5 Insulation transformer] for the details of the transformers.

For 3-phase power supply, use 3-phase isolation transformers on user's responsibility.

4-5-5 Protecting power lines

We recommended protecting the driver by installing a circuit breaker or fuses from surge current at power-ON. Select the recommended circuit breakers or fuses using the table below.

Combinations of actuator and driver		FHA-8C,-11C HA-655-1	FHA-14C HA-655-1	FHA-17C HA-655-2	FHA-25C HA-655-2	FHA-32C HA-655-4	FHA-40C HA-655-4
Interrupting current of MCB or fuse (A)		3	5	5	10	15	20
Required capacity per driver(kVA)	Note 1	0.1	0.1	0.1	0.3	0.5	0.7
Surge current at power ON (A)	Note 2	15	15	15	15	15	15

Note 1: The value is for continuous duty at rated output.
Note 2: The values are quoted at ambient temperature of 25 deg.C.
Note 3: The values are quoted for actuators and drivers for 200V power supply.

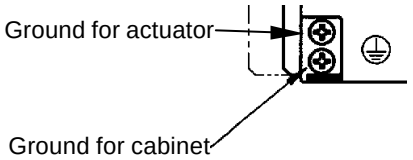
4-6 Connecting a ground wire

The minimum allowable size of ground wire is listed in the table below. Use the thickest wire possible.

Terminals and Connectors	Symbol	Allowable Wire Sizes (mm^2)
Ground(PE)	Ground mark	3.5

The HA-675 driver provides two ground terminals as shown the figure to the right. Connect the ground wire from the cabinet to either terminal and connect the ground wire from the actuator to the other terminal.

The leakage current is at least 3.5 mA. Therefore terminals must have a section of at least 3.5 mm^2 and be wired using ring terminals.



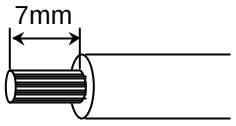
4-7 Connecting motor and regeneration resistor cables

WARNING

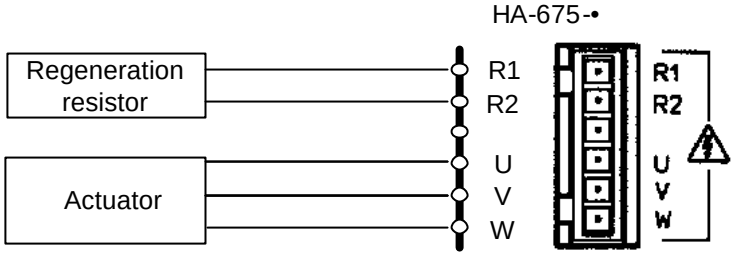
Wrong phase order and connection or disconnection of the motor cable during driving may cause abnormal actuator motion.

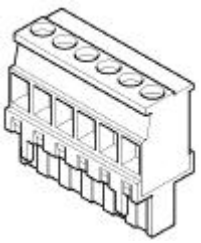
Connect the actuator cable to [U,V,W] terminals of the HA-675 driver as shown in the figure below. Refer to the phase order of the actuator cable in the actuator manual and connect the end terminal of cables to the driver terminal that have the same symbol.

Shown the figure to the right, strip the end of wires of the motor cable and resistor cables, and connect wires to each terminal firmly.



When a regeneration resistor is required, connect its wires to [R1, R2] terminals.





Model:MVSTBR2.5/6-ST-5.08
(Phoenix contact)

4-8 Connecting the encoder and the I/O cables

4-8-1 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 signal cables and for encoder signal cables. When a host controls several drivers, install I/O signal cables for each driver individually.

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

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

(2) Encoder signal cable (user's responsibility): 20m 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) Separate power cables (power source cables and motor cables) and I/O signal cables more than 30cm. Do not encase both cables in one pipe or duct, nor bundle them.

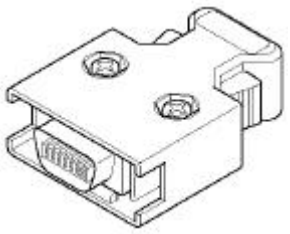
(4) Do not open the end of analog signal cables as speed signal cables.

Terminals and Connectors	Symbol	Allowable Wire Sizes (mm^2)
Encoder Port	CN1	$0.3mm^2$ twist pair shielded cable
I/O Signal Port	CN2	$0.35mm^2$ twist pair, or twist pair whole-shielded cable

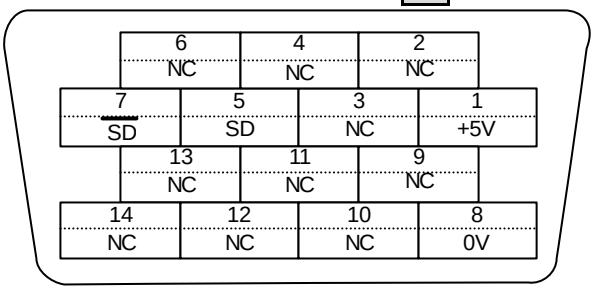
4-8-2 Pin layouts of encoder connector (CN1)

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

Plug: model: 10114-3000VE manufacturer: 3M
Shell: model: 10314-52F0-008 manufacturer: 3M

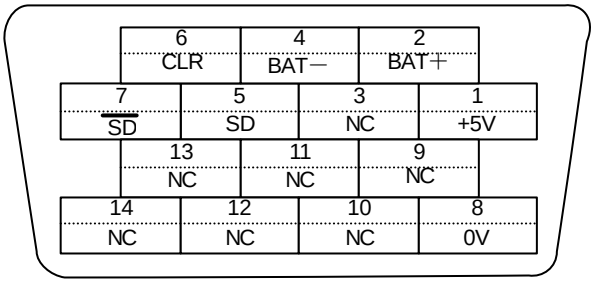


for incremental encoder **INC**



The layout shows the soldering side.

for absolute encoder **ABS**



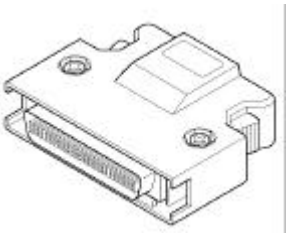
The layout shows the soldering side.

Note:. Do not use the pins marked "NC" that are already reserved. Wrong usage may cause failure.

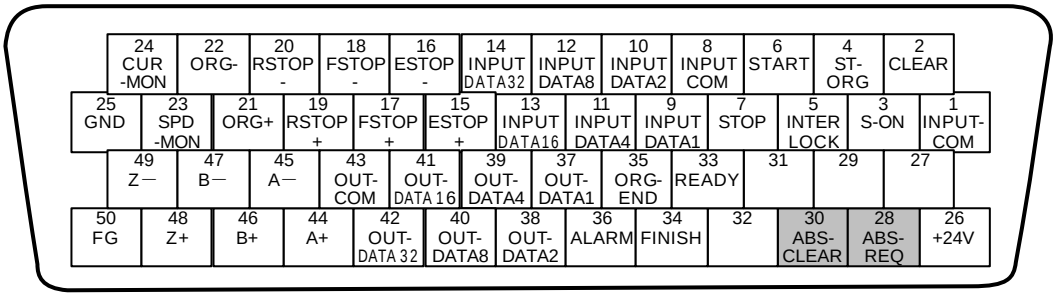
4-8-3 Pin layouts of the I/O signal connector (CN2)

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

Plug: model: 10150-3000VE manufacturer: 3M
Shell: model: 10350-52F0-008 manufacturer: 3M



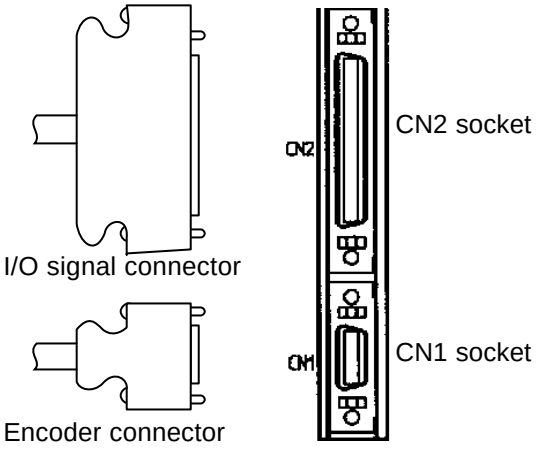
◆ Pin layout



Note 1: The layout shows the soldering side.
Note2: [ABS-REQ] and [ABS-CLEAR] are available for the absolute system. **ABS**

4-8-4 Connecting the encoder and the I/O signal cables

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

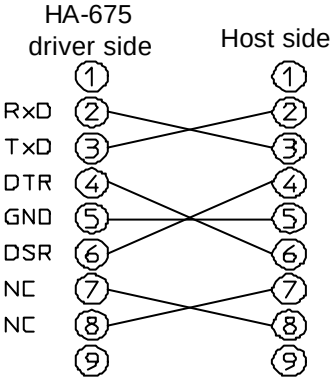


4-8-5 Recommendation of EIA-232C (RS-232C) cable for CN3

The specifications of a cable in compliance with the EIA-232C (RS-232C) standard for connecting between the CN3 connector of HA-655 driver and a host are as follows:

Appellation: EIA-232C (RS-232C) cross cable
Connector for HA-655Driver side: D-sub 9pins, female
with unified coarse thread screws: No.4-4 OUNC
Pin assignments: refer the figure to the right.

The cable is not included in our options, but is commercially available.



4-9 Power ON and OFF sequences

4-9-1 Power ON / OFF sequence circuit

Plan the sequence circuit to operate the switch for main power individually by an [emergency stop] signal and the [CN2-36 alarm: ALARM] signal of the HA-675 driver.

Do not make switching operation (turning ON or OFF) at the state that the servo-ON [CN2-3:S-ON] is ON.

4-9-2 Frequency of power ON / OFF operation

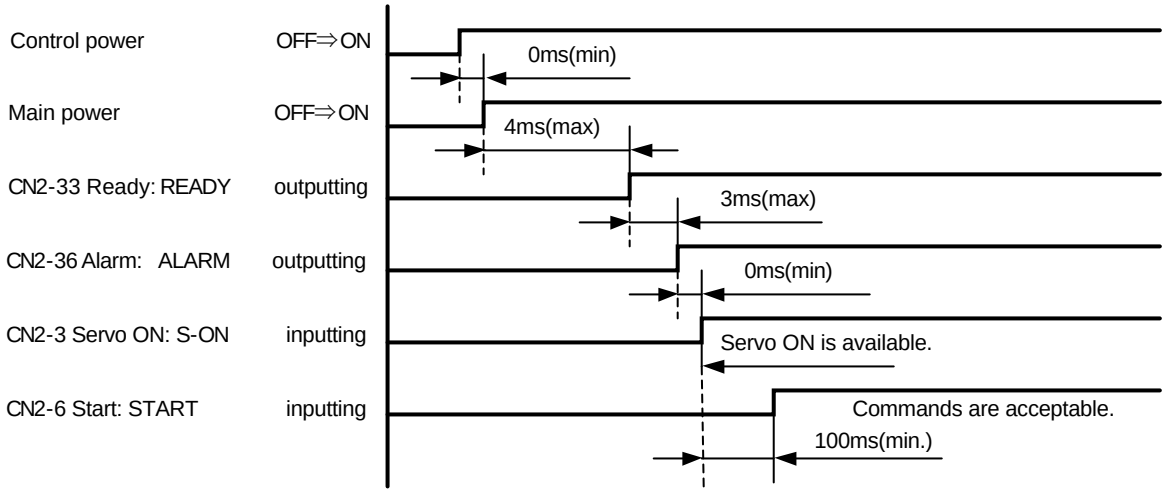
Since the HA-675 driver provides a capacitor for an input filter of a rectifier circuit, large transient current flows at every operation of main power switch. If the switching operation is too frequent, resisters for suppressing the transient current may deteriorate.

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.

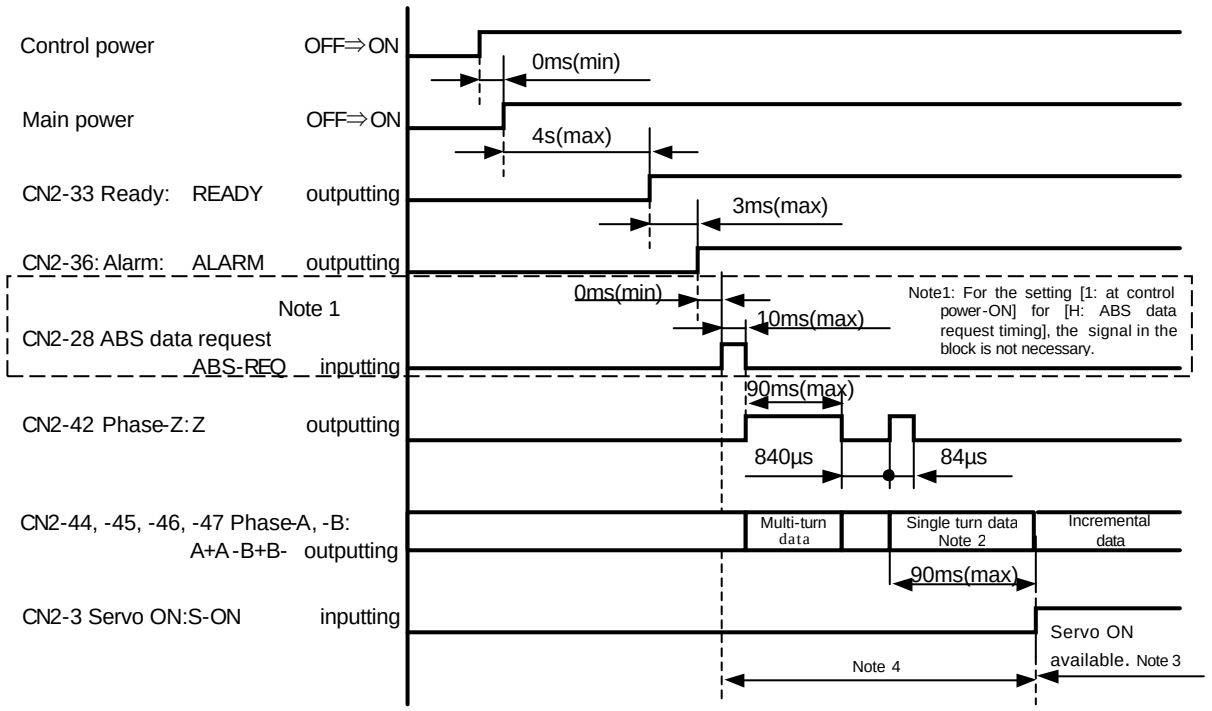
4-9-3 Power ON sequence

Plan the power ON sequence with the timing shown in the figures below.

◆ **Power ON sequence for incremental system INC**



◆ **Power ON sequence for absolute system ABS**



Note 1: The figure above shows the power-ON sequence for the setting [0: ABS-REQ signal] for the parameter of [parameter mode] →[H: ABS data request timing]. For the setting [1: at control power-ON], the signal in the block is not necessary.

Note 2: An absolute pulse train for absolute encoder is outputted after around 1 ms of outputting phase-Z signal.

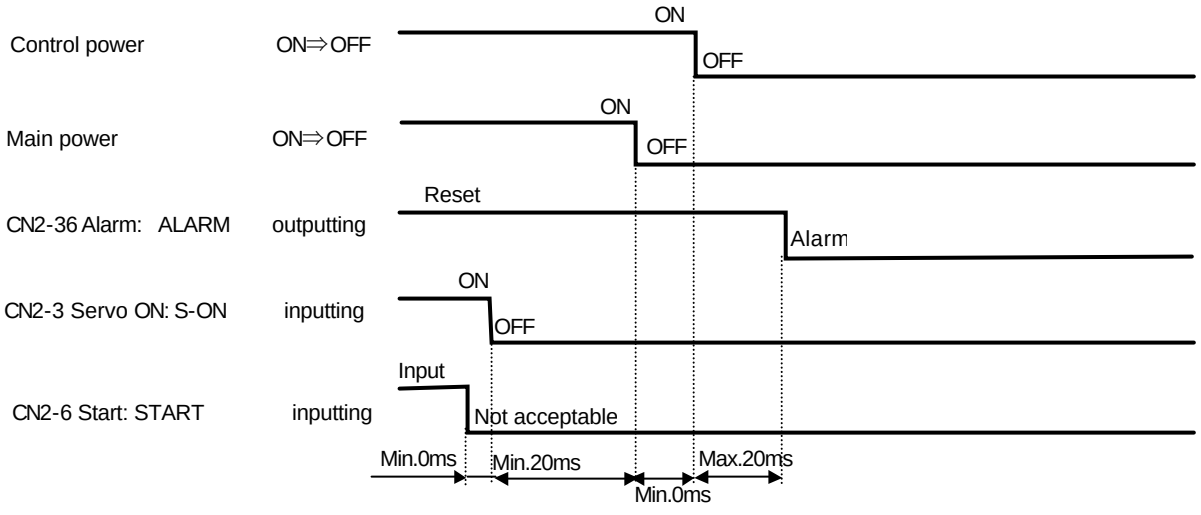
Refer to [3-6-2 Outputting position data from output port: CN2] for outputting position data.

Note 3: The servo-ON signal is unaccepted until completing the transmission of a set of pulse trains by the [position data request] signal.

Note 4: The [alarm 57] may occurs if the encoder rotates more than 127 resolvable position while the revolution counter is transmitting a pulse train.

4-9-4 Power OFF sequence

Plan the power OFF sequence with the timing shown in the figures below.



Chapter 5 Operations

Follow these instructions prior to operations.

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.

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

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

5-1-1 Driving actuator only

Drive the actuator only during a trial run.

● **Reason for a trial run**

(1) Verifying the power cable wiring

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

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

(4) Setting the origin for the absolute system **ABS**

Procedure of trial run

For HA-675-1 drivers to drive FHA-C mini(FHA-8C/11C/14C) actuators, start with the procedure (1).

For HA-675-2/4 specifying the incremental system, start with the procedure (4).

For HA-675-2/4 specifying the absolute system, start with the procedure (5).

◆ **Power-ON procedures for HA-675-1 drivers to drive FHA-C mini(FHA-8C/11C/14C) actuators**

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-675 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-675-1 driver identifies the code of the actuator connected to it automatically.

When the identified code is different from the pre-registered code, canceling operation of the automatic actuator identifying function may cause actuator seizure or damage.

Combine a driver and an actuator correctly.

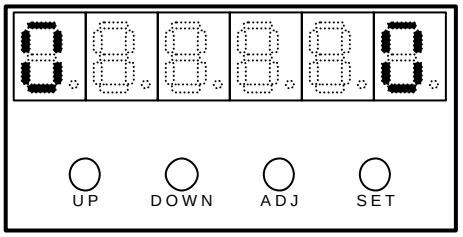
Even for a wrong combination of a driver except HA-655-1 and FHA-8C/11C/14C actuator, works the automatic actuator identifying function. If automatic registration is carried out to the wrong combination, it may cause low torque problems or over current that may cause physical injury and fire.

★ When identified code is same as the pre-registered code;

⇒ The indication (monitor mode) to the right appears on the display of the HA-675-1 driver. The identified code is same as the pre-registered code.

The next operation is turning the servo power ON. Start with the procedure (18).

Indication for same codes

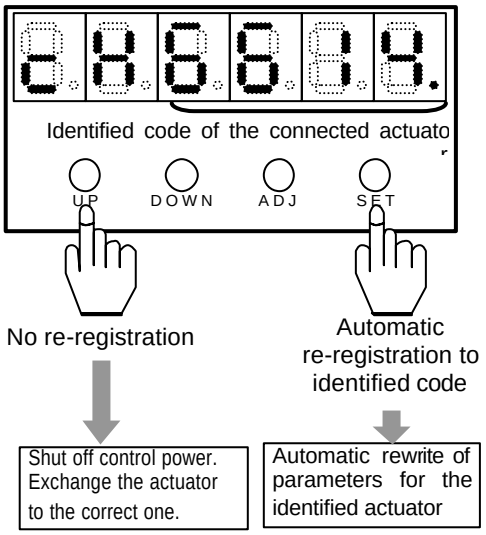


★ When identified code is different from the pre-registered code;

⇒ The indication (monitor mode) to the right appears on the display of the HA-675 driver showing [cH] and identified code. The identified code is different from the pre-registered code.

For the details of the actuator codes, refer [monitor mode] → [E: actuator code].

Indication for different codes



(2) To invalidate the automatic actuator identifying function and to keep the pre-registered code memorized in the HA-655-1 driver, press [UP] key.

⇒ Turns to the [monitor mode].

WARNING

When the identified code is different from the pre-registered code, canceling operation of the automatic actuator identifying function may cause actuator seizure or damage.

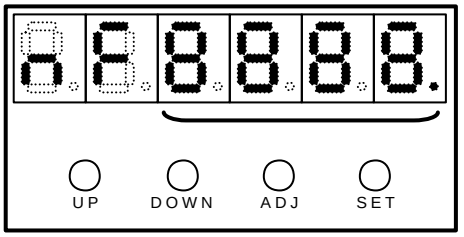
☞ Shut off the control power, and exchange the actuator to correct one. After exchanging, re-start the operation from the procedure (1).

(3) To re-register the actuator being connected to the driver now as the actuator to be used from now on, press [SET] key.

⇒ The parameters in the [parameter mode] and the [tune mode] are automatically rewritten for the re-registered actuator. Then the indication turns to the [monitor mode.
(For the details of the automatically rewritten parameters, refer to [6-9 Renewed parameters by automatic actuator identification].)

The next operation is turning the servo power ON. Start with the procedure (18).

Indication for no listed actuator



★ When the identified code of the connected actuator is not listed;

⇒ A combined indication of [nF] and a pre-registered code appears on the display of the HA-655 driver. The identified code is not listed in the HA-655-1 driver.

☞ Shut off the control power, and exchange the actuator to correct one. After exchanging, re-start the operation from the procedure (1).

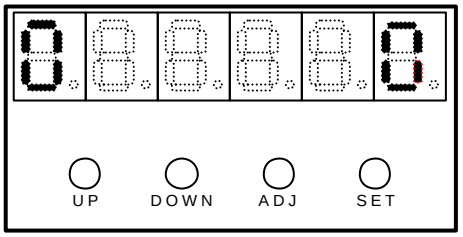
◆ Power-ON procedures for incremental system. INC

(4) Turn on power to the HA-675 driver. Turn on power to the host.

☺ Make sure there is not an abnormality.

⇒ Indication (monitor mode) appears on the display of the HA-675 driver.

☞ If no indication appears, there may be faulty power connections. Shut off power and inspect the wiring.



The following procedures start from the procedure (15: turning on servo power) .

◆ Power-ON procedures for absolute system. ABS

For the absolute system, following operations are required at the first stage.
a. Clearing revolution counter at first power-ON
b. Position data transmitting to a host at every power-ON

<<Clearing revolution counter>>

(5) Turn on the control power pressing both [ADJ] and [SET] keys in same time to jump to the parameter mode. Then turn on the power for the host.

⇒ The indication of [SyP---] (parameter mode) appears. No counts are set in the revolution counter at present. Clearing the revolution counter to zero is required to go to the next step.

✋ Though one of the [alarm 53 to 56] occurs, it would not be abnormal, but it may come from incomplete pressing both keys of [ADJ] and [SET]. Shut off the control power, and start from the operation (2).

✋ If other alarm occurs, , there may be faulty power connections. Shut off power and inspect the wiring.

(6) To clear the revolution counter, indicate [J] (revolution counter clear) using [UP] and [DOWN].

⇒ Every pressing the [UP] key shifts up the first code from [0] to [J].

⇒ Every pressing the [DOWN] key shifts down the first code from [J] to [0].

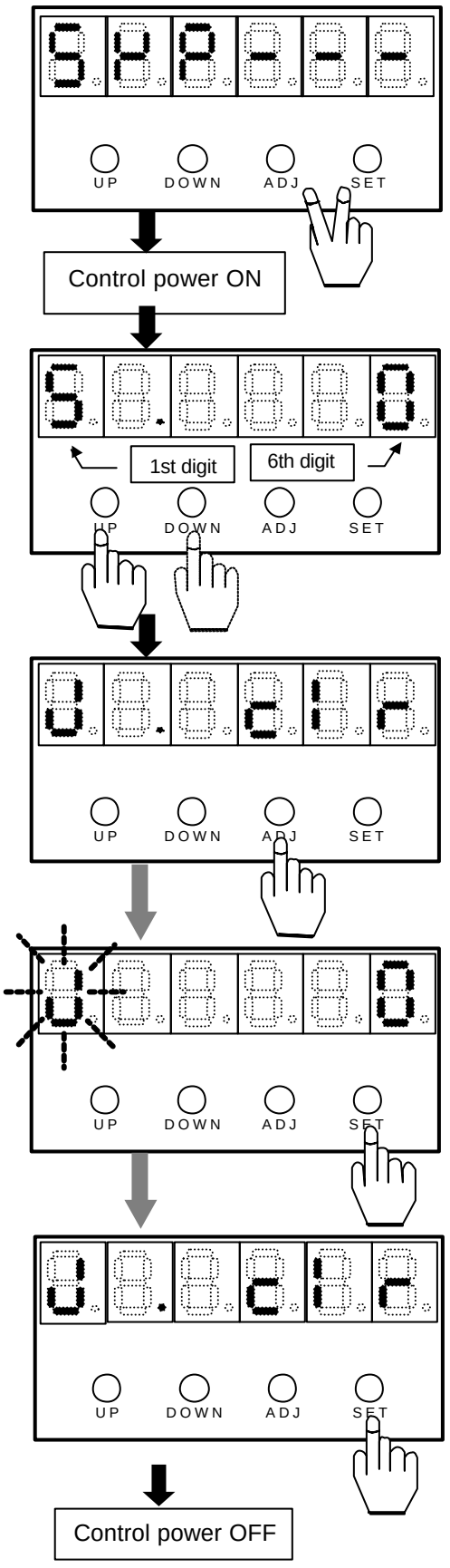
(7) To change a value, press the [ADJ] key at least 0.1 second.

⇒1st digit [J] flashes. You can change the value.

(8) Press the [SET] key, then [2500] is indicated. Keeping the pressing more the value decreases to [0].

⇒ [clr] will indicated. Then the clearing is completed.

(9) Shut off the control power.



<<Transmitting position data>>

(10)Turn on the control power pressing both [ADJ] and [SET] keys in same time again. Leave fingers from keys after indicating.

⇒ Enters into the [parameter mode].

(11)Indicate [H] (ABS send data timing) using keys of [UP] and [DOWN].

(12)Press the [ADJ] key at least 0.1 second.

⇒1st digit [H] flashes. You can change the value.

(13)Set [1] (automatic data transmitting after powering to control) using keys of [UP] and [DOWN].

(14) Press the [SET] key, then [2500] is indicated. Keeping the pressing more the value decreases to [0].

⇒ [clr] will indicated. Then the clearing is completed.

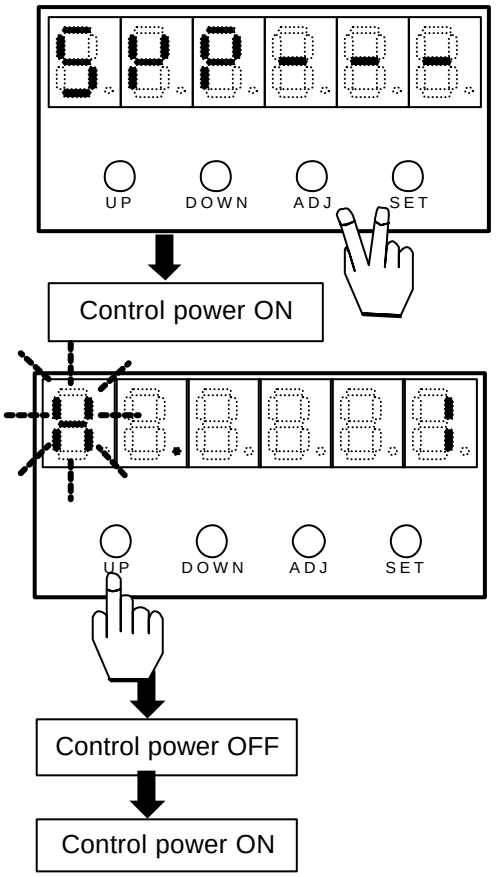
(15)Shut off the control power.

⇒Now it is ready to transmit a position data.

(16)Turn on the control power.

⇒The position data has been transmitted to the host at the same time of the powering, and it is ready to turn on the servo power.

(17)The following operations are as same as operations for the incremental system. Go to operation (18).



◆ **Turning on servo power**

Notes: The HA-675 drivers control [error count] to be [0] always to keep a commanded position while [CN2-3 servo-ON: S-ON] is ON state. However, while the [S-ON] is OFF and servo power is OFF, the [error count] may not keep [0] and an actual position may different from a commanded position by external forces, gravitation and so on.

ABS For the absolute system, the actuator may rapidly move to make [0] for the error count accrued during OFF state of [CN2-3 servo-ON: S-ON] by making ON for servo power. Especially, the dangerous rapid motion may occur during trial run, and maintenance, and troubleshooting. To prevent the rapid motion, set [1: clear] for [parameter mode]→[5: Error clear at re-powering servo] and turn ON the servo power.

INC For the incremental system, if the accrued error count is within the range from –5000 to +5000, the count is cleared automatically. In this case, origination is required because of loosing a current position count.

(18)Turn on main power via the host, and transmit [ON] signal to [CN2-3 servo-ON: S-ON] from the host.

⇒Turns the servo drive circuit active, and current can flow to the actuator.

◆ Manual JOG operation of the actuator

(19) To enter into the [test mode] from the [monitor mode], press the [SET] key at least three seconds.
⇒Indicates 6th to 4th digit in the order, and enters the [test mode] when there is no indication on 4th to 6th digit.

(20) Indicate [Jo] pressing the [UP] key or the [DOWN] key.

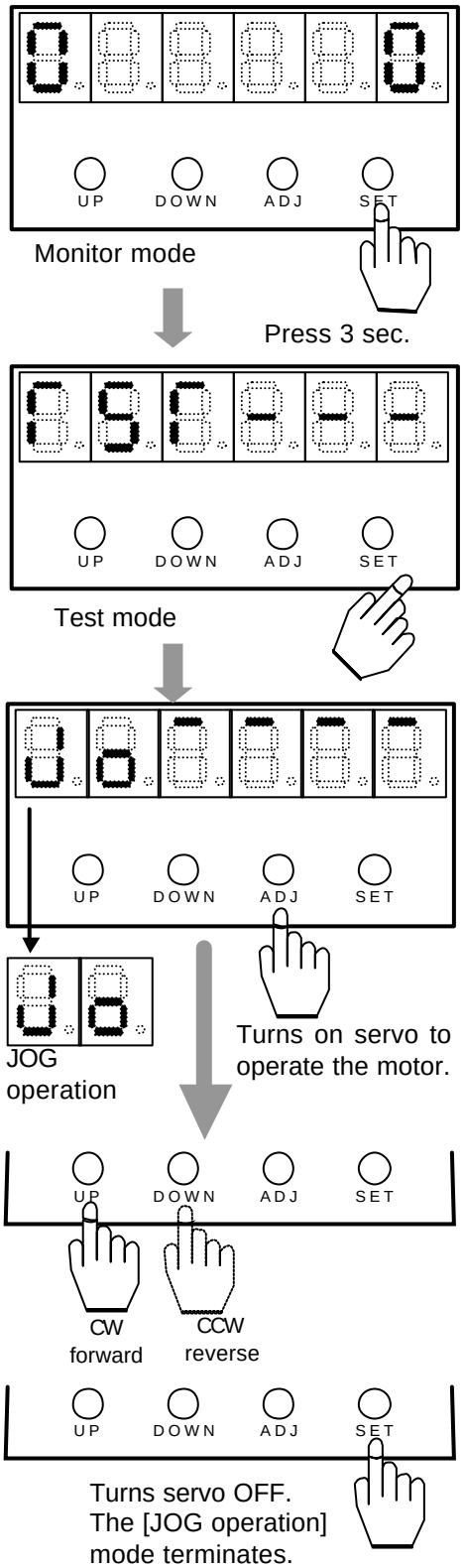
(21) To enter in the [JOG operation] mode, press the [ADJ] key at least 0.1 second.
⇒The first digit [J] flashes.⇒ You can operate the actuator.

(22) To operate the actuator forward, press the [UP] key.
⇒The actuator will rotate when the key is pressed, and will stop when the key is released.

(23) To operate the actuator reverse, press the [DOWN] key.
⇒The actuator will rotate when the key is pressed, and will stop when the key is released.

(24) To exit from the [JOG operation] mode, press the [SET] key at least 0.1 second.
⇒ Flashing of the first digit [J] stops, servo turns OFF, and the [JOG operation] mode terminates.

Note: The JOG operation is also possible by a personal computer loading the [PSF-650] software for communication. Refer [PSF-650 manual] for the details.



◆ Jog operation using teach-box TBX-670

The JOG operation is also possible using the teach-box TBX-670. Terminate the [test mode] once before the JOG operation.

CAUTION

Press keys of the teach-box one by one surely.
Pressing two or more key at a time may indicate [Over-run error] on the teach-box and the operation is ignored, due to impossible processing by the HA-675 driver.

(25) Attach the TBX-670 to the HA-675 driver.
⇒The display to the right will appear on the LCD display.

(26) Press any key on the teach-box.
⇒The next display appears.

(27) Press the [MODE] key.
⇒The display of the test mode appears.

(28) Set speed [JSP] and acceleration time [JAD] using numerical keys and [↑] [↓] keys.
The unit are [pulse/sec] for the speed [JSP] and, [10 msec] for the acceleration time [JAD].

(29) **INC** To set a temporary origin for the incremental system, keep pressing [ORG] key for more than 1 second.

ABS For the absolute system, set [0] to the [parameter mode] → [H: ABS send data timing], and press the [ABSREQ] key on the teach-box.

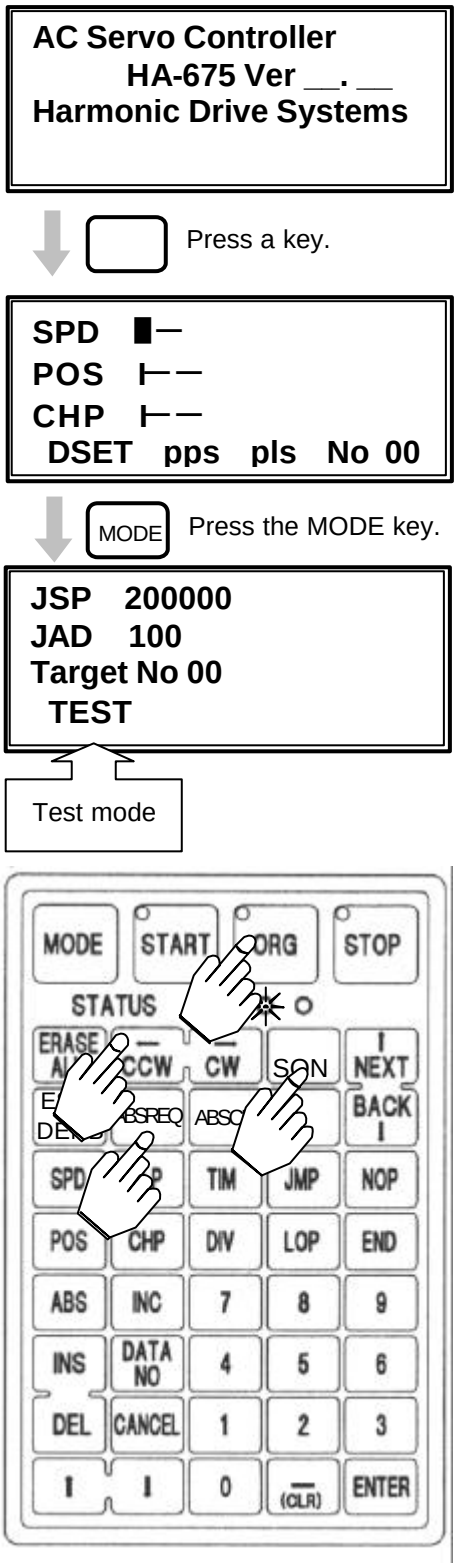
(30) Press the [SON] key on the teach-box.
⇒The servo power turns on.

(31) To rotate the actuator to clockwise, press the [CW] key for more than 1 second.

To rotate the actuator to counter clockwise, press the [CCW] key for more than 1 second.

To stop the actuator, leave your finger from the key.

To rotate the actuator as much as one pulse, press a corresponding of [CW] and [CCW] for less than 1 second.



◆ **Verifying Input signals**

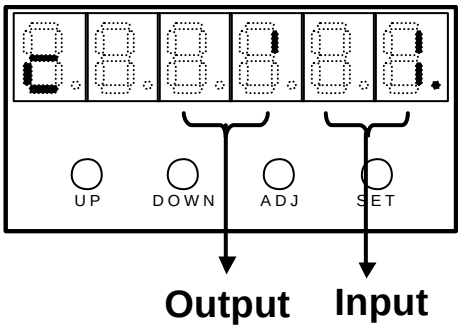
Note: Enter the [test mode] again after the JOG operation.

(32)Indicate [c: I/O monitor] by pressing the [UP] or [DOWN] key. The forth digit indicates output states and the sixth indicates input states.

(33)Input signals to proper ports from the host.

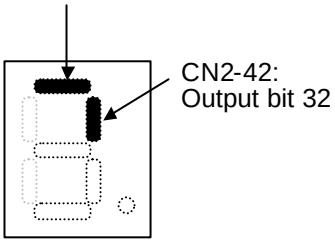
☺ Verify the indications as shown in the figure below.

✋ If abnormality happens, the I/O signal cable may be faultily connected or there is fault in output functions of the host. Shut off power, and inspect them.

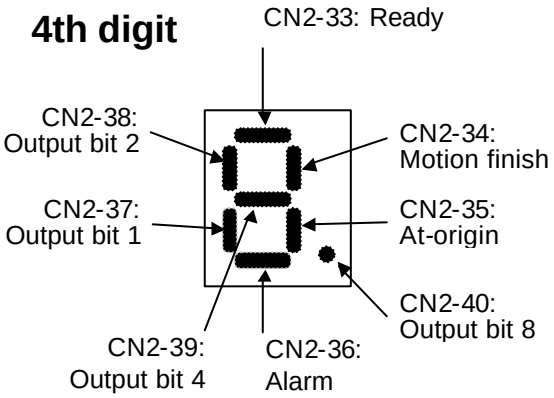


【OUTPUT】

3rd digit

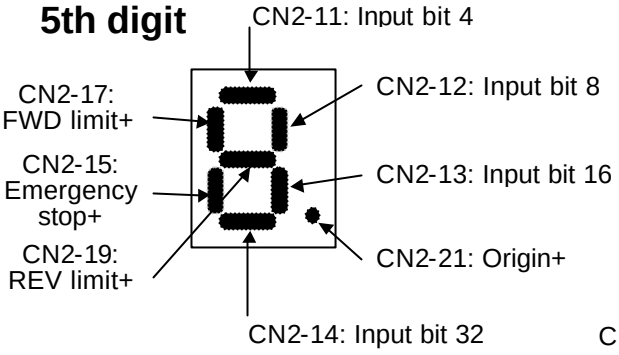


4th digit

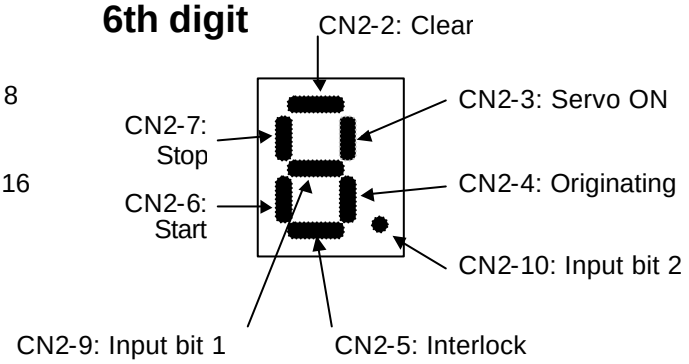


【INPUT】

5th digit



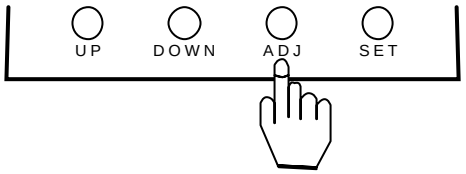
6th digit



◆ Verifying output signals

(34) Indicate [rdy: output port operation] by pressing the [UP] or [DOWN] key.

(35) To operate output ports, press the [ADJ] key for 0.1second or more.



⇒1st digit flashes. You can operate output ports. (Pressing [ADJ] key for 0.1 second or more again will inhibit [output port operation].

(36) Press the [UP] key to specify which output port is to be operated.
⇒Every time you press this key it will shift the code number in the order of the figures to the right.

(37) Press the [DOWN] key to turn ON/OFF the selected port.
⇒Every time you press this key it will change the port state (ON→OFF→ON→).

(38)Check the host input state reacting to the above operation.

(39) Verify the signals are received.

(40) To terminate operation of the output port, press [SET] key for 0.1 second or more.
⇒ Flashing of 1st digit stops and [output port operation] is inhibited.

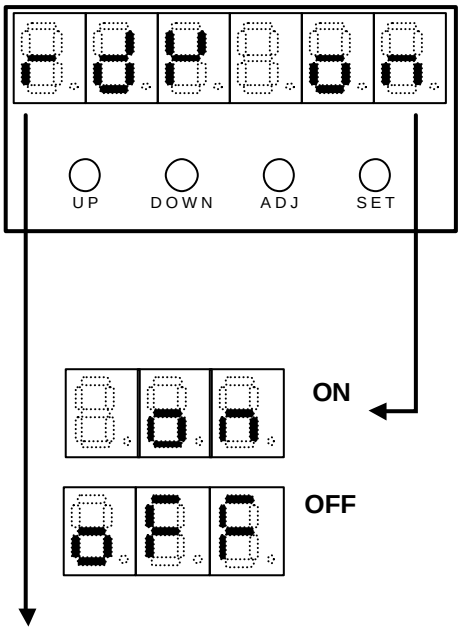
☞ If abnormal, the output functions of the host or the i/o signal cable may be improperly connected. Shut off power and inspect the I/O cable wiring and host function again.

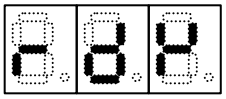
(41) Indicate [END] with [UP] and [DOWN] keys. Press [SET] while [End] is indicated.

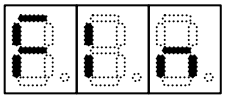
⇒ The indication mode then returns to the [monitor mode].

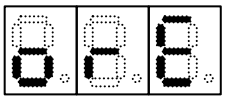
(42) If there is no abnormality during the trial run, all wiring is correct.

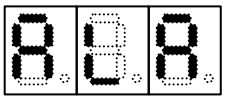
Continue to the next step of setting parameters.

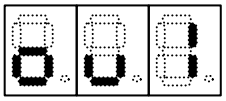


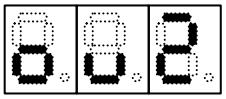

Ready
READY: CN2-33

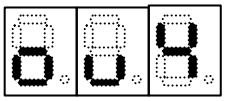

Motion finish
FINISH:CN2-34

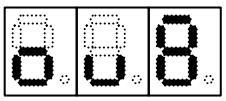

Originated
ORG-END:CN2-35

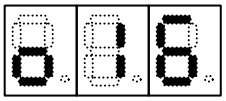

Alarm
ALARM:CN2-36

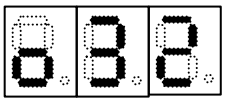

Address output 1
OUT-DATA1:CN2-37


Address output 2
OUT-DATA2:CN2-38


Address output 4
OUT-DATA4:CN2-39


Address output 8
OUT-DATA8:CN2-40


Address output 16
OUT-DATA16:CN2-41


Address output 32
OUT-DATA32:CN2-42

5-1-2 Setting parameters

After the actuator trial run you may begin setting the parameters via the parameter mode.

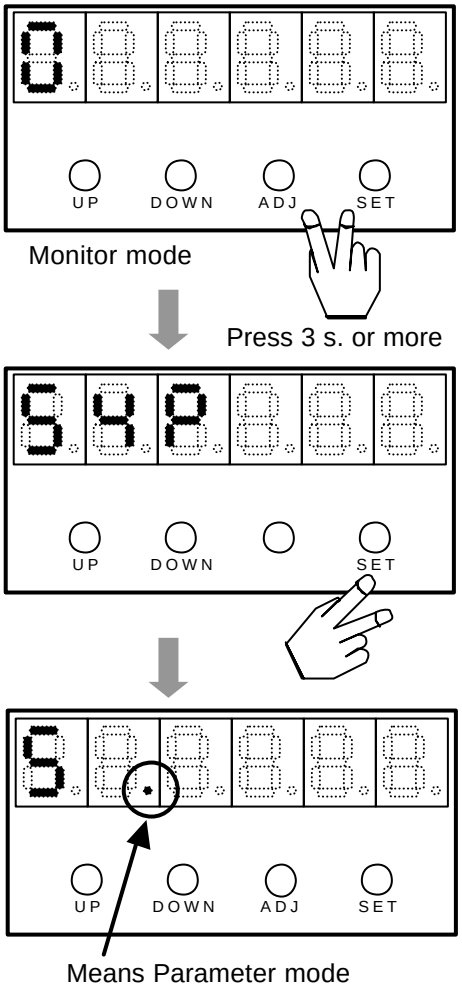
All parameters are dependent upon the driven machine system. The abstracts of the parameters in the parameter mode are described in the table below:

Name	Description	Parameters
5: Error count clear by Servo-ON	Clears error count or not by [servo-ON] input signal.	0: No function 1: Clears it
6: Allowable position error	Allowance of position error count ⇒ Alarm 60	1 to 1000
A: Speed limit	Upper limit of motor speed (r/min)	1 to max. motor speed
b: Current limit	Upper limit of motor current; 100% to max. current	1 to 100
c: Signal logic	Signal logic for alarm, emergency stop and etc.	0 to 15
F or J: ABS Revolution counter clear	Sets back the revolution count to zero by key operation	0: revolution count = 0
G: Mechanical origin	Encoder phase-Z or external sensor	0: ORG & phase-Z 1: ORG & ext. sensor
H: ABS ABS send data timing	Specifies the timing of sending the position data.	0: ABS-REQ signal 1: control power on
I: ABS Low battery voltage signal	Specifies to output [alarm 56: low battery voltage] signal or not	0: outputting 1: not outputting
n: Regeneration resistance	Existence of regeneration resistance	1: not connected 0: connected
o : Automatic gain control	Specifies to set higher speed gain at positioning or not.	0: no setting 1: setting
P: Clearing alarm history	Specifies to clear alarm histories or not.	0: no clearing 1: clearing

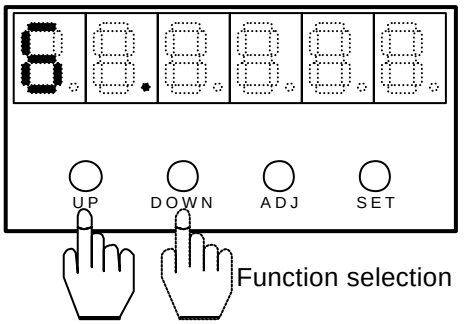
(43) To enter the [parameter mode] from the [monitor mode], press both [ADJ] and [SET] keys at the same time for three seconds or more.

⇒Enters [parameter mode] when there is no indication on 4—6th digit. Then the decimal point of the second digit turns ON, that means [parameter mode].

Note: While [servo-ON: S-ON (CN2-3 pin)] signal is ON, changing to parameter mode will turn OFF the signal and the system will go into the servo-OFF state.



(44) Press [UP] or [DOWN] key to change the functional items of the parameter mode.



(45) To change a value, press [ADJ] key for 0.1 second or more.
⇒1st digit [6] flashes. You can change the value.

(46) Change the value with the [UP] and [DOWN] keys.

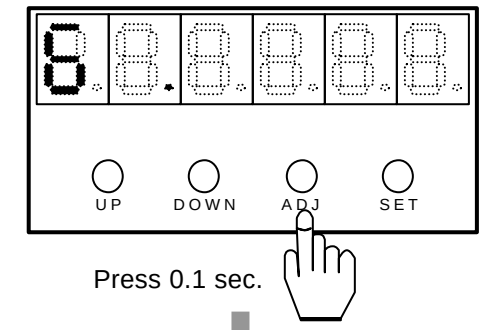
[UP] key increases the value.
[DOWN] key decreases the value.
Keeping key pressing increases changing speed of the value.

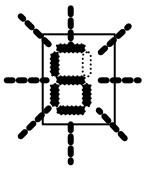
(47) To define the new value, press [SET] key for 0.1 second or more.

⇒The value is stored in the memory. The new value has been instituted.

(48) To cancel change in operation and to make the previous value effective before defining, press [ADJ] key for 0.1 second or more.

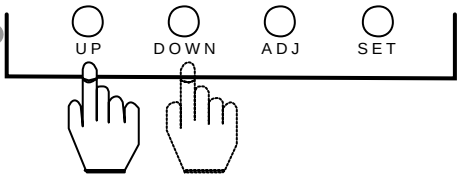
⇒The previous value is restored.



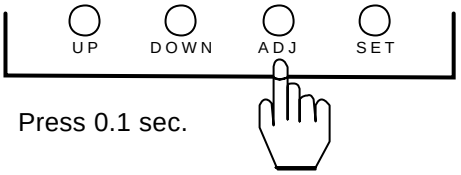


While 1st digit code flickers, you can change the value.

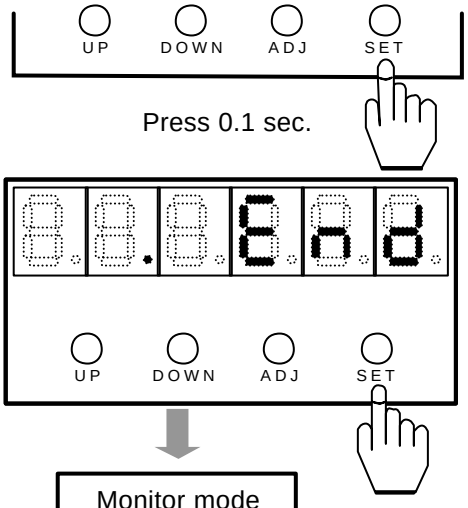
Changing



Canceling



Setting new value



(49)To terminate the [parameter mode] and to return to the [monitor mode], press [SET] key while [End] is indicated.
⇒ The indication mode then returns to the [monitor mode].

5-1-3 Tuning servo parameters

After setting the parameters of [parameter mode], couple the actuator with the driven machine; and you may start tuning the servo parameters.

Usually it is not necessary to tune the parameters, because these servo parameters have been set to the proper values for the actuator as standard defaults. Only if the actuator is hunting, overshooting, or undershooting should you then carefully tune the parameters.

The abstracts of the parameters in [tune mode] are described in the table below:

Name	Description	Parameters
0: Speed loop gain	Proportional speed loop gain to improve response to commands	High: better response; too high: hunting Low: no hunting; too low: overshoot
1: S-loop integral compensation	Lowering the influence of load torque fluctuation	High: No hunting; too high: overshoot Low: better response; too low: hunting
2: Position loop gain	Proportional position loop gain to improve response to commands	High: better response; too high: hunting Low: no hunting; too low: overshoot
3: Reserved	Out of use	
4: In-position range	Allowable error range for positioning	Integer between 1 and 9999
A: Speed monitor offset	Adjusting analog signal value of [CN2-23 speed monitor: SPD-MON]	+127 to -128 (equivalence of +3.5V to –3.5V)
b: Current monitor offset	Adjusting analog signal value of [CN2-23 current monitor: CUR-MON]	+127 to -128 (equivalence of +3.5V to –3.5V)

(50) Shut power OFF for safety.

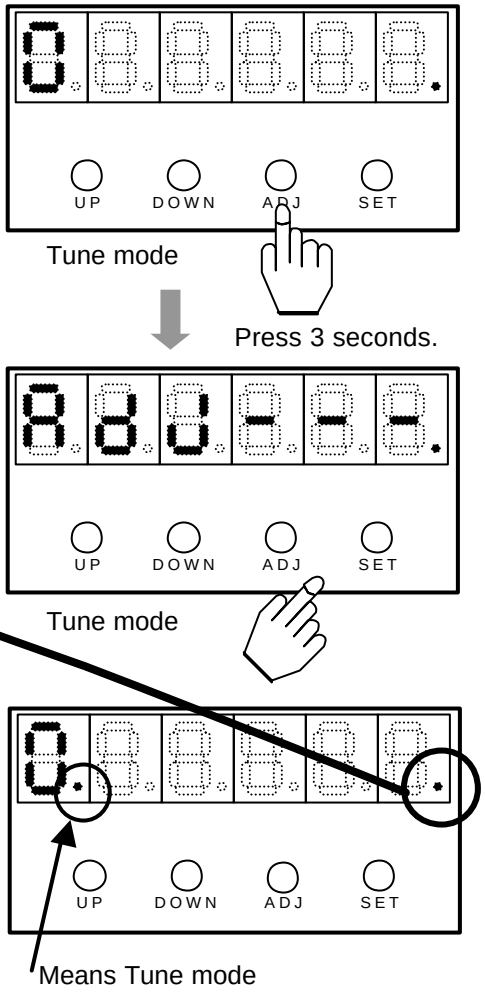
(51) Couple the actuator with the drive machine.

(52) Turn power ON.

(53)To enter [tune mode] from [monitor mode], press [ADJ] key for three seconds or more.
⇒Enters [tune mode] when there is no indication on 4-6th digit. Then the decimal point of the first digit turns ON, that means [parameter mode].

(54)Press [UP] or [DOWN] key to change the functional items of the [tune mode].

Note: If the decimal point of the sixth digit is ON, the servo is active (ON) and the actuator will respond to command signals. If the decimal point is OFF, the servo is inactive (OFF).



(55) To change a value, press [ADJ] key for 0.1 second or more.
⇒1st digit [0] flashes. You can change the value.

(56) Change the value with the [UP] and [DOWN] keys.

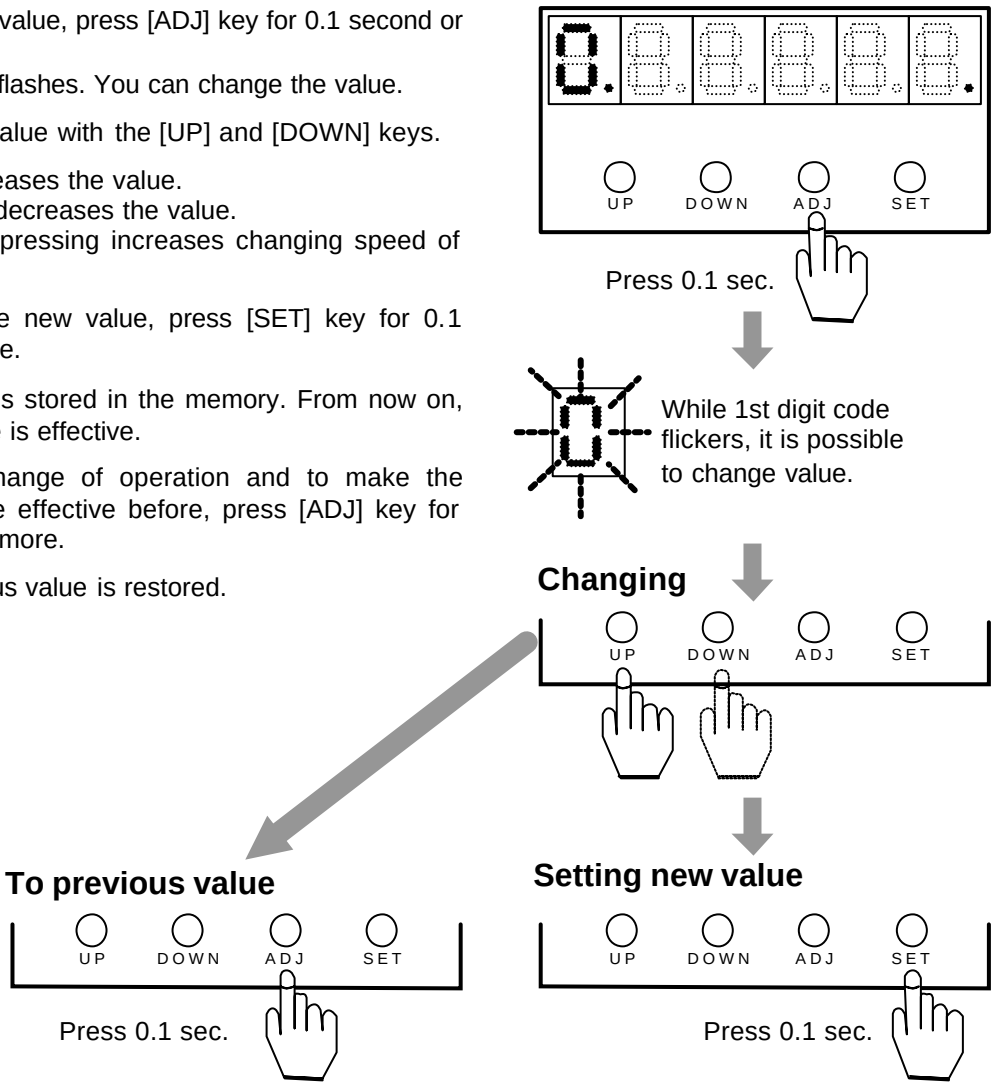
[UP] key increases the value.
[DOWN] key decreases the value.
Keeping key pressing increases changing speed of the value.

(57) To define the new value, press [SET] key for 0.1 second or more.

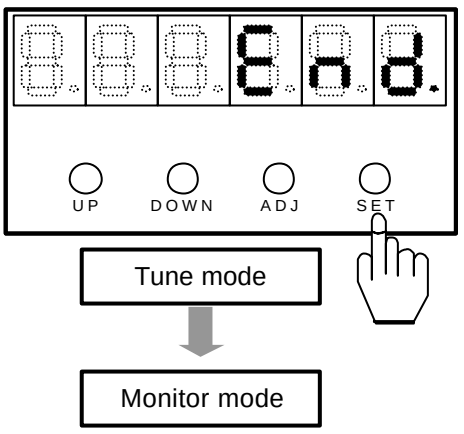
⇒The value is stored in the memory. From now on, the new value is effective.

(58) To cancel change of operation and to make the previous value effective before, press [ADJ] key for 0.1 second or more.

⇒The previous value is restored.



(59) To terminate the [tune mode] and to return to the [monitor mode], press [SET] while [End] is indicated.
⇒ The indication mode then returns to the [monitor mode].



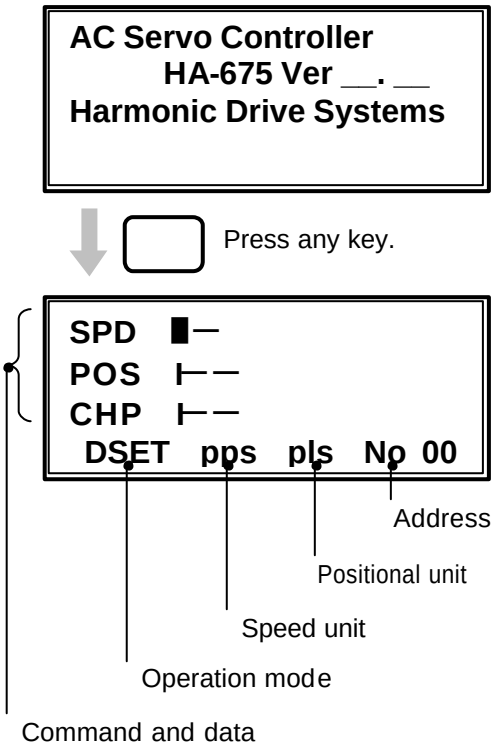
5-1-4 Operations of teach-box

The next stage of set-up operation is parameter setting in the teach-box.

(60) Attach the connector of the teach-box to the CN3 socket of the HA-675 driver.
⇒After the connection, the display indicates the messages shown in the figure to the right. After the message appears, the teach-box becomes active.

(61) Press any key of the teach-box.
⇒The indication changes as shown in the figure to the right. After changing the message, operation by the teach-box becomes possible.

Every pressing the [MODE] key of the teach-box shifts the mode cyclically.



● Manipulating the cursor

The cursor is provided to select a command with the [↑][↓] keys.

(62) To make appear the upper part of the indication, manipulate the cursor upward by the [↑] key.

(63) To make appear the lower part of the indication, manipulate the cursor downward by the [↓] key.

● Entering and erasing command data

◆ Selecting a command for data input

Two ways are provided to select a command for data input in the [program mode] or in the [parameter mode].

By cursor: place the cursor on the command by the [↑][↓] keys.

By command keys: press the relating command key like the [SPD] key. The cursor moves to the corresponding command.

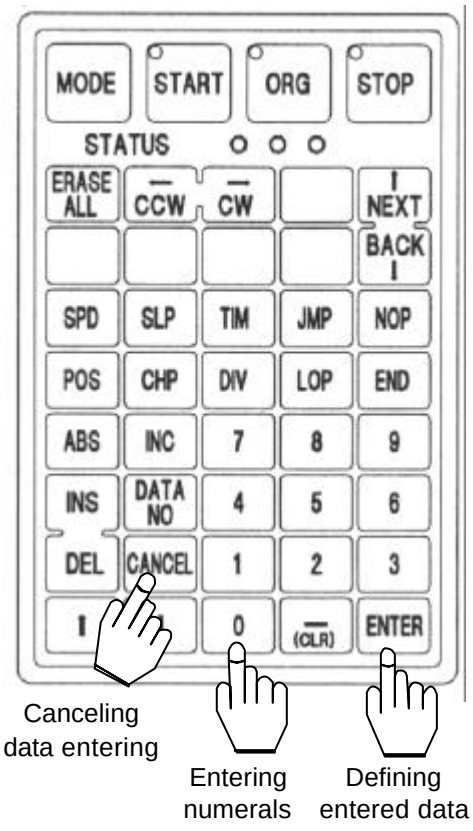
◆ Entering and defining data

(64) To enter data to the command under the cursor, press numeral keys. Every pressing shifts the cursor rightward.

(65) To define newly entered data, press [ENTER] key. The data is defined and stored in the HA-675 driver.

◆ Canceling the data entering

(66) To cancel the data entering and recover the previous data before defining the entering data, press [CANCEL] key.



◆ **Correcting the entering data**

(67) To correct the entering data, press [CANCEL] key.
⇒The entering data is canceled.

(68) After the erasing, enter the new correct data.

◆ **Erasing defined data**

(69) To erase the all defined data of the indicating address, press [DEL] key.
⇒The indication of [ERASE OK?] shown in the figure to the right will appears.

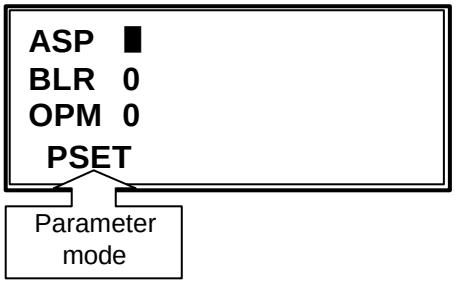
(70) Press [ENTER] key to erase them.
⇒All data of the address are erased.

Note: It is impossible to erase addresses. Set [NOP] command for it.

5-1-5 Setting parameter data

(71) Press [MODE] key on the teach-box to indicate [PSET].
⇒The right LED indicator lights up.

There is no command keys in the parameter mode. Every command in the mode is specified by cursor operation.



The mode allows setting parameters required for originating, units of speed and position, acceleration profiles, an offset value for backlash, a ball-screw lead, and availability of shortcut motion. Refer the [7-6 parameter mode] for setting data.
The parameter mode provides the following commands:

Command	Function	Default	Unit	Data
ASP	Acceleration profile	0		0: Linear acceleration 1: S-curve acceleration
BLR	Backlash offset	0	pulse	0 to 9999
OPM	Motion profile	0		0: individual positioning 1: sequential positioning 2: programmed motion
RED	Ball screw lead	0	Code	0 to 19
MQU	Position unit	0		0: pulse 1: 1/1000 ° angular unit 2: 1/100mm
SPU	Speed unit	0		0: p/s 1: 1/100 r/min
RTD	Originating direction	0		0: CW viewed from output 1: CCW viewed from output
RS2	Originating speed 2	20,000	p/s 1/100 r/min	500 to 50,000 The equivalent converted in p/s
NRT	Software origin	0	pulse	-9999 to +9999
RAD	Originating acceleration time	10	0.01 sec	0 to 1000
RSP	Originating speed 1	200,000	p/s 1/100 r/min	500 to 1,000,000 The equivalent converted in p/s
SCD	Pulse per revolution	1,000,000	pulse	1000 to 9,999,999
SHC	Shortcut motion	0		0: unavailable 1: available

● Setting parameters for origination

To create and execute motion programs, it is necessary to establish an origin as the base point of the motion. The HA-675 driver allows to set an origin from three kinds as follows:

(1) current position: for the system having no origin sensor requiring
(2) encoder phase-Z position: has high repeatability, needs long originating time of maximum 20 sec.
(3) origin sensor position: has low repeatability, needs shorter originating time.

Relating the origination, the following parameters are provided. Set proper values for the load.

Command	Function	Default	Unit	Possible values
RTD	Originating direction	0		0: CW viewed from output 1: CCW viewed from output
RAD	Originating acceleration time	10	0.01 sec	0 to 1000
RSP	Originating speed 1	200,000	p/s 1/100 r/min	Actuator speed of 500 to 1,000,000 The equivalent converted in p/s
RS2	Originating speed 2	20,000	p/s 1/100 r/min	Actuator speed of 500 to 50,000 The equivalent converted in p/s
NRT	Software origin	0	pulse	−9999 to +9999

◆ Software origin

Sometimes, the software origin is helpful for programming in addition to the mechanical origin. For example, when the encoder index position is shifted from original mechanical position after troubleshooting. Without the software origin, you must shift every address position one by one. However, the software origin may shift all together without any program correction.

As for the actual orinating motion, the actuator performs the origination to the mechanical origin, then moves to the software origin.

◆ Setting origin at the current position INC

Do not set origin at a current position for the load requiring repetitive accuracy.

If the origin set at a current position for the load requiring repetitive accuracy, different positions are set by setting operations. When HA-675 driver runs a program requiring repetitive accuracy, the actuator executes unexpected motion, which may cause serious physical damages.

This setting is only possible for the incremental system without origin sensors not requiring repetitive accuracy. You can not set the current position as the origin for absolute systems

There two way to set origin at the current position:
(1) setting by the teach-box TBX-670,
(2) setting by the host

≪Setting by teach-box TBX-670≫

(72) To set an origin at the current position, press the [ORG] key on the teach-box 1 second or more.
(73) Leave your finger at a sound of [pee….].
⇒The current position of the actuator is defined as the origin.

≪Setting by the host≫

(74) Turn on the [CN2-4 originating: ST-ORG] holding ON state of [CN-5 Interlock: INTERLOCK].

(75) After 2ms or more, turn off the [CN2-4 originating: ST-ORG].
⇒The current position is defined as the origin.

Note: If the origin defined at the FWD or REV limit, the [alarm 02: FWD limit] or the [alarm 03:REV limit] may occur.

CAUTION

Fix tightly the origin sensor and a dog for the sensor.

Loosen fixing may cause unstable origin in its position.

And attaching the origin sensor at close position to the encoder phase-Z may also cause unstable origin. Leave both positions with each other.

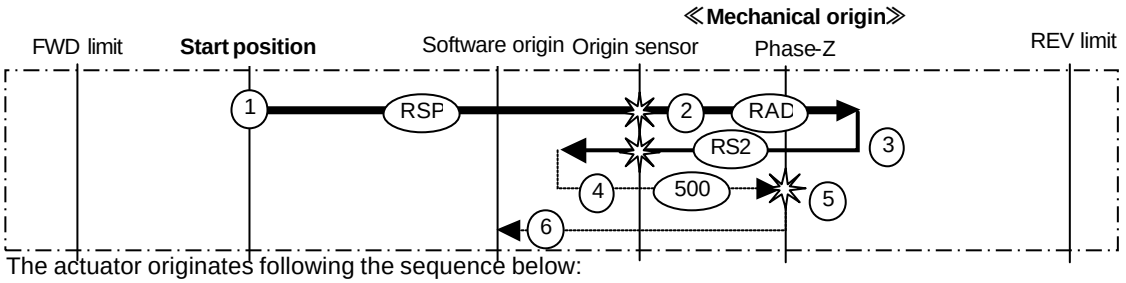
◆ Encoder phase-Z position as the mechanical origin

(76) To define the phase-Z position as the origin, set [0: phase-Z] to [parameter mode] →[G: mechanical origin].

To get precise origin, an origin sensor is attached to the load mechanism, and the phase-Z position of the encoder is defined as the [mechanical origin]. The figures below show the originating sequence.

Note: In the following descriptions, the [RTD: originating direction] is supposed to be set [0: CW]. When [1: CCW] is set, exchange FWD for REV, and REV for FWD.

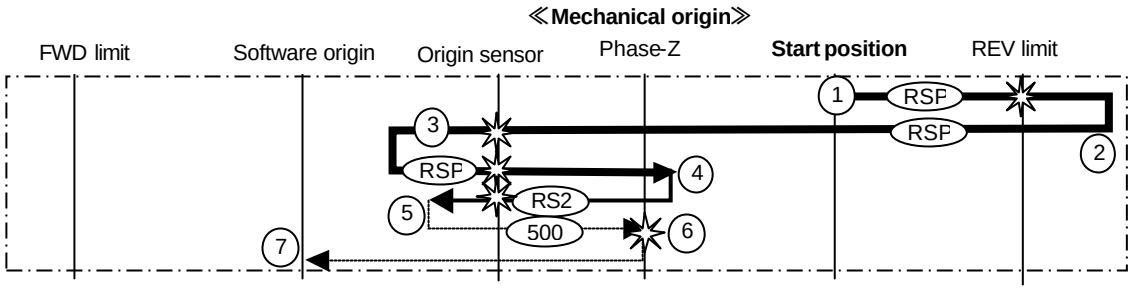
≪The start position is between the FWD limit and the origin sensor.≫



The actuator originates following the sequence below:

(1) The actuator starts at high speed of [RSP: originating speed 1] toward [RTD: origin direction].
(2) After sensing the origin sensor, it decelerates and stops in [RAD: originating acceleration time].
(3) It reverses at low speed of [RS2: originating speed 2].
(4) After sensing the sensor again, it reverses at very low speed of 500 pulse/second.
(5) When the phase-Z is sensed, it stops immediately, and the position is defined as the mechanical origin.
(6) **INC** For the incremental system, it moves to the position of [NRT: software origin] at very low speed of 500 pulse/second, and all positional counters are cleared to [0].
ABS For the absolute system, it moves by the distance of [NRT: software origin]. However, the counters are not cleared, but keep their counts.

≪The start position is between the REV limit and the origin sensor.≫



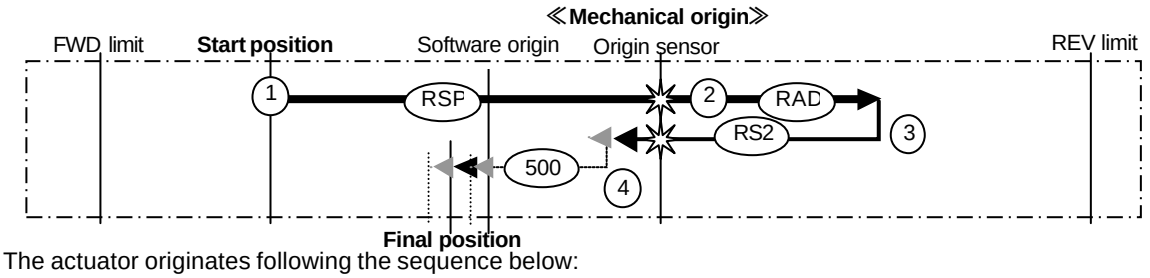
The actuator originates following the sequence below:

(1) The actuator starts at high speed of [RSP: originating speed 1] toward [RTD: origin direction].
(2) After sensing the REV limit, it decelerates and stops in [RAD: originating acceleration time].
(3) It reverses toward FWD at [RSP] speed. By sensing the origin sensor, it decelerates and stops in [RAD] time.
(4) It reverses toward REV at [RSP] speed. By sensing the origin sensor, it decelerates and stops in [RAD] time.
(5) It reverses toward FWD at low speed of [RS2: originating speed 2].
(6) After sensing the sensor again, it reverses at very low speed of 500 pulse/second.
(7) When the phase-Z is sensed, it stops immediately, and the position is defined as the mechanical origin.
(8) **INC** For the incremental system, it moves to the position of [NRT: software origin] at very low speed of 500 pulse/second, and all positional counters are cleared to [0].
ABS For the absolute system, it moves by the distance of [NRT: software origin]. However, the counters are not cleared, but keep their counts.

◆Origin sensor as the mechanical origin

(77) To define the origin sensor as the origin, set 1: origin sensor] to [parameter mode] →[G: mechanical origin].

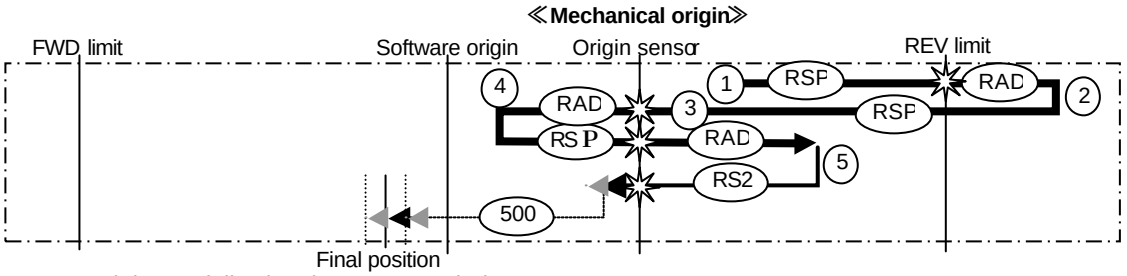
≪The start position is between the FWD limit and the origin sensor.≫



The actuator originates following the sequence below:

(1) The actuator starts at high speed of [RSP: originating speed 1] toward [RTD: origin direction].
(2) After sensing the origin sensor, it decelerates and stops in [RAD: originating acceleration time].
(3) It reverses at low speed of [RS2: originating speed 2]. When the origin sensor is sensed, it stops, and the position is defined as the mechanical origin. The lower [RS2] speed obtains closer origin to the sensor.
(4) **INC** For the incremental system, it moves to the position of [NRT: software origin] at very low speed of 500 pulse/second, and all positional counters are cleared to [0].
ABS For the absolute system, it moves by the distance of [NRT: software origin]. However, the counters are not cleared, but keep their counts.

≪The start position is between the REV limit and the origin sensor.≫



The actuator originates following the sequence below:

(1) The actuator starts at high speed of [RSP: originating speed 1] toward [RTD: origin direction].
(2) After sensing the REV limit, it decelerates and stops in [RAD: originating acceleration time].
(3) It reverses toward FWD at [RSP] speed. By sensing the origin sensor, it decelerates and stops in [RAD] time.
(4) It reverses toward REV at [RSP] speed. By sensing the origin sensor, it decelerates and stops in [RAD] time.
(5) It reverses at low speed of [RS2: originating speed 2]. When the origin sensor is sensed, it stops, and the position is defined as the mechanical origin. The lower [RS2] speed obtains closer origin to the sensor.
(6) **INC** For the incremental system, it moves to the position of [NRT: software origin] at very low speed of 500 pulse/second, and all positional counters are cleared to [0].
ABS For the absolute system, it moves by the distance of [NRT: software origin]. However, the counters are not cleared, but keep their counts.

5-1-6 End of trial run

When above operations are finished, terminate the trial run.
(78) Shut power OFF.

5-2 Usual operation

As the HA-675 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

1. Do not do any wiring while power is active.

Removing wires or connectors while power is on may cause electric shock or may cause 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, an electric charge remains in the driver. Do not touch terminals for at least five minutes from power-OFF to avoid electric shock.

2. 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

As the HA-675 driver employs highly reliable parts, no special daily maintenance is required except the maintenance under user's rules for electronic equipment.

1. Shut down electric power before maintenance.

Maintenance while power is active may cause electric shock.

3. Do not touch terminals for at least five minutes after power-OFF stage.

Even with power-OFF, an electric charge remains in the driver. Do not touch terminals for 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-650 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 Operation of the display panel

The display panel of the HA-675 driver is equipped with a six-digit LED display and four operation keys. Monitoring information, tuning operations, setting operations, and jog operation are done using the display panel.

6-1 Summary of modes

The HA-675 driver provides the following four modes: monitor, tuning, parameter, and test.

◆ **Monitor mode**

The HA-675 driver displays a current address number, motor speed, current position from a motor-encoder, pulse count in an error counter, input and output signal states, load condition, alarm history, and the code number for the actuator for which the driver is combined. These are useful to diagnose the driver if it fails or operates in an abnormal manner.

After applying control power the [monitor mode] starts up. While the power is on, from the [monitor mode] as the main screen it is possible to switch to and from other modes.

◆ **Tune mode**

The [tuning mode] consists of various parameters to control the actuator motion. Setting the most suitable value for each parameter obtains the optimum performance of the actuator.

◆ **Parameter mode**

The [parameter mode] sets various parameter values relating to the fundamental operational functions such as: limiting values of speed and torque, and parameters to communicate with a teach-box.

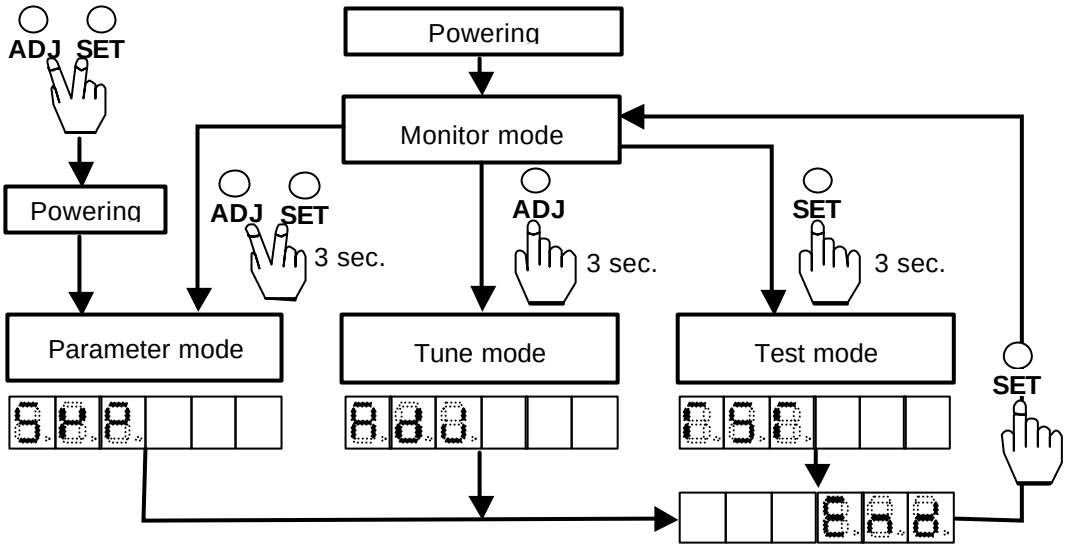
◆ **Test mode**

The [test mode] consists of required functions for system test; such as JOG operation functions, operations of pseudo output signals, and I/O signal monitors.

6-2 Selecting a mode

The figure shown below is an outline of mode selecting procedures. After turning on the driver the [monitor mode] starts up automatically. The [ADJ] and [SET] keys select a mode.

Powering with pressing both [ADJ] and [SET] keys in same time and leaving the fingers from the keys jumps to the monitor mode. When an alarm occurs, the LED display converts to indicate the alarm automatically, and no operations on the panel become impossible. For clearing the revolution counter of the absolute system, the powering operation may be useful.



6-3 Functions of each mode

Each mode provides the following functions:

Mode	Code	Function	Setting & operation
Monitor mode	0	Current address	Setting is impossible.
	1	Motor speed	
	3	Error pulse count (Low)	
	4	Error pulse count (High)	
	5	Torque monitor	
	6	Overload rate	
	7	Feedback pulse (Low)	
	8	Feedback pulse (High)	
	c	I/O monitor	
	d1 to d8	Alarm history	
	E	Actuator code	
	F	Actuator serial number (Low)	
	G	Actuator serial number (High)	
	H	Actuator serial number (Affix)	
Tune mode	0	Speed loop gain	Setting is possible.
	1	Speed loop integral compensation	
	2	Position loop gain	
	3	Reserved (out of use)	
	4	In-position range	Setting is possible.
	A	Speed monitor offset	
	b	Current monitor offset	
Parameter mode	5	Error count clear by S-ON	Setting is possible.
	6	Position error allowance	
	A	Speed limit	
	b	Current limit	
	c	Signal logic	
	For J	**ABS** Revolution counter clear	Operation is possible
	G	Mechanical origin	Setting is possible
	H	**ABS** ABS send data timing	
	I	**ABS** Low battery voltage signal	
	n	Regenerative resistance	
	o	Automatic gain control	
	P	Alarm history clear	
Test mode	Jo	JOG operation	Operation is possible
	SP	JOG speed	Setting is possible.
	Ac	JOG acceleration	
	rdy & etc.	Output port operation	Operation is possible
	c	I/O port monitor	Setting is impossible.
	An	Analog monitor manual output	Operation is possible

Note: The parameters marked with (ABS) are valid for absolute systems only, and parameters with no marks are valid for both absolute and incremental systems.

6-4 Monitor mode

The HA-675 driver displays a current address number, motor speed, current position from a motor-encoder, pulse count in an error counter, input and output signal states, load condition, alarm history, and the code number for the actuator for which the driver is set. These are useful to diagnose the driver if it fails nor operates in an abnormal manner.

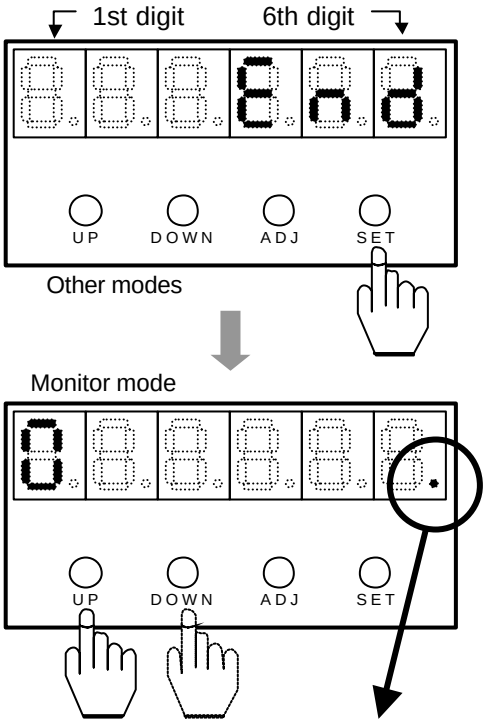
After applying power the [monitor mode] starts up. While the power is on, from the [monitor mode] as the main screen it is possible to switch to and from other modes.

The monitor mode provides the following functions:

Mode	Code	Function	Setting & operation
Monitor mode	0	Current address	Setting is impossible.
	1	Motor speed	
	3	Error pulse count (Low)	
	4	Error pulse count (High)	
	5	Torque monitor	
	6	Overload rate	
	7	Feedback pulse (Low)	
	8	Feedback pulse (High)	
	c	I/O monitor	
	d1 to d8	Alarm history	
	E	Actuator code	
	F	Actuator serial number (Low)	
	G	Actuator serial number (High)	
	H	Actuator serial number (Affix)	

6-4-1 Operation in the monitor mode

After powering or finishing operations in other modes, the drive automatically enters the [monitor mode]. Therefore, there is no special code for the [monitor mode].



● Operation procedure

(1) To enter the [monitor mode] from other modes, press [SET] key after displaying [END].
⇒ The monitor mode begins.

(2) Press [UP] or [DOWN] key to change the functional items of monitor mode.
⇒ Every time you press the [UP] key it shifts a code of the first digit one by one from [0] to [H], and indicates a value corresponding to the code.

⇒ Every time you press the [DOWN] key it shifts a code of the first digit one by one from [H] to [0], and indicates a value corresponding to the code.

● Details of display

1st digit: Codes in the mode.

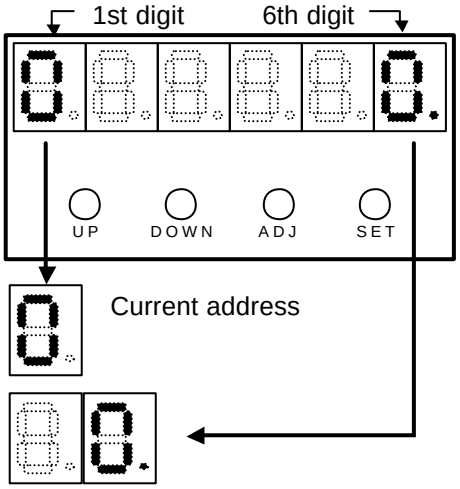
Decimal point of the sixth digit: When the point is on, the servo is active (ON) and the actuator is able to respond to a command signal. When the point is off, the servo is inactive (OFF).

6-4-2 Functions of the monitor mode

Current address

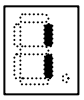
● Function

The “current address” indicates the currently executing address or the address just executed.



● Details of display

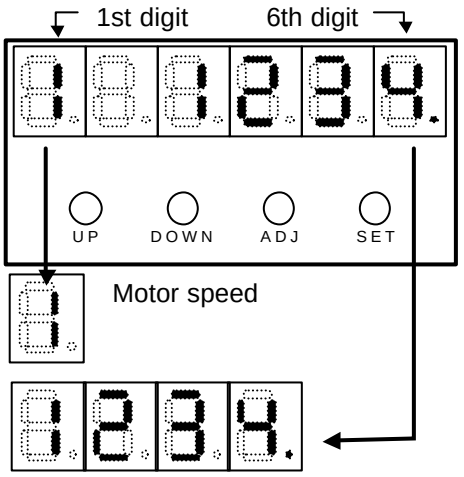
1st digit: [0: Current address]
2-4th digit: No indication
5-6th digit: Indicates current address.



Motor speed

● Function

The “motor speed” indicates the present motor speed in r/min.
The actuator speed is obtained by dividing the motor speed by the reduction ratio of the actuator gear.

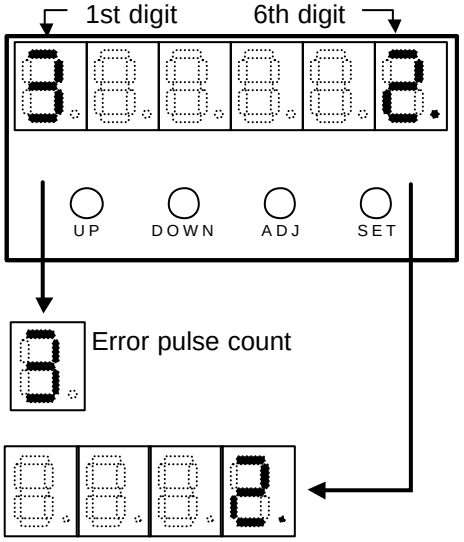


● Details of display

1st digit: [1: Motor speed]
2nd digit: No indication means positive counts, and [-] indicates negative counts.
3-6th digit: Indicates motor speed in r/min.

[Monitor mode]

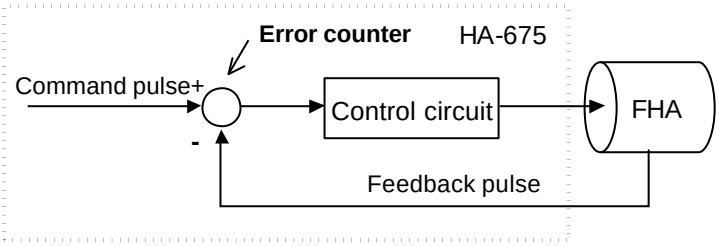
Error pulse count (low)



Current error pulse count
Unit: pulse
(ex.) error pulse = two pulses

● Function

The fundamental functions of servomotors are for positioning and rotating responding to a command signals. A block diagram of servo motor control is shown as follows:



A series of position data taught the teach-box are stored in the memory of the HA-675 driver.

Responding to a command from a host, the HA-675 driver outputs rotation commands to the actuator. When the actuator starts rotation, the position sensor (encoder) feeds back a current position into the HA-675 driver as the "feedback pulse count."

The HA-675 driver continues outputting rotation commands to the actuator until there is no difference (error pulse count) from "command pulse count" to "feedback pulse count."

This indicates the lower part of the current error pulse count.

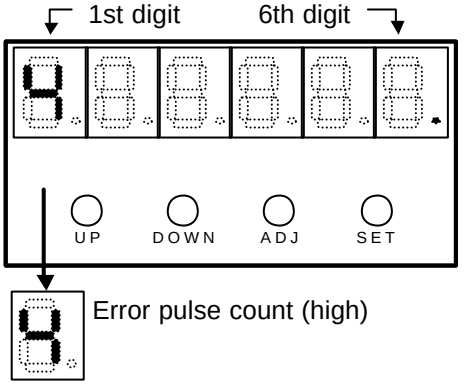
● Details of display

1st digit: [3: error pulse count (low)]
2nd digit: No indication means positive counts, and [-] indicates negative counts.
3-6th digit: Indicates current quadrature error pulse counts in pulse unit.

● Relational items

[Feedback pulse]: [Monitor mode]→[7: Feedback pulse (Low)], [8: Feedback pulse (Low)]

Error pulse count (high)



● Function

This indicates the high part of an error quadrature pulse count.
Combining with the [3:error pulse count (low)], the whole quadrature error pulse count is indicated.

● Details of display

1st digit: [4: error pulse count (high)]
2nd digit: No indication means positive counts, and [-] indicates negative counts.
3-6th digit: Indicates current quadrature error pulse counts in pulse unit.

[Monitor mode]

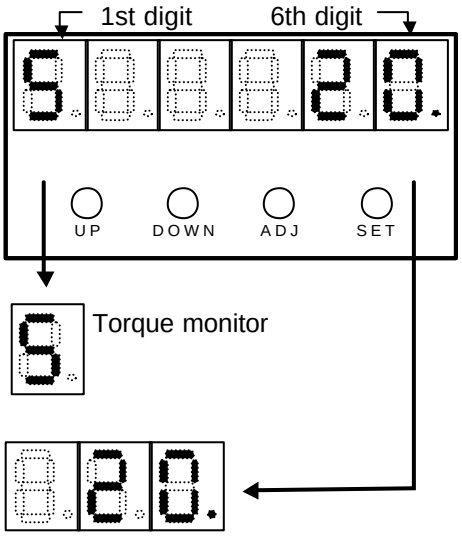
Torque Monitor

● Function

This indicates current output torque of the actuator in “%” where “100%” corresponds to the maximum torque.

● Details of display

1st digit: [5: Torque monitor]
2nd digit: No indication means positive counts, and [-] indicates negative counts.
3rd digit: No indication
4-6th digit: Indicates current output torque in “%” where “100%” corresponds to the maximum torque.



Current output torque where “100%” corresponds to the maximum torque
Unit: %
(ex.) Torque = 20%

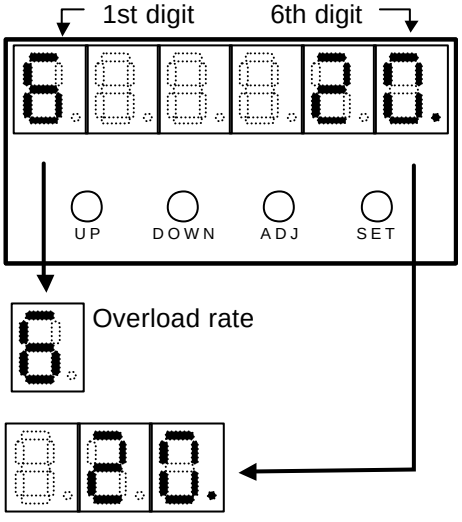
Overload rate

● Function

This indicates current overload rate of the actuator in “%.” If the value reaches [100], the overload protection function shuts off the motor current, and issues an [Alarm 20].
The rate is determined by the overload protection characteristics of the actuator.
When the driver is overloaded, it accumulates the amount of overload and the indication increases the rate. When the driver released from the overload, the indication decreases it.
When you want to set higher servo-gain to get shorter positioning period, the higher servo-gain is permitted if the overload rate remains [0] after actual actuator motions.

● Details of display

1st digit: [6: Overload rate]
2-3rd digit: No indication
4-6th digit: Indicates the current [overload rate] in “%” where “100%” is equal to the [overload protection characteristics] of the actuator.



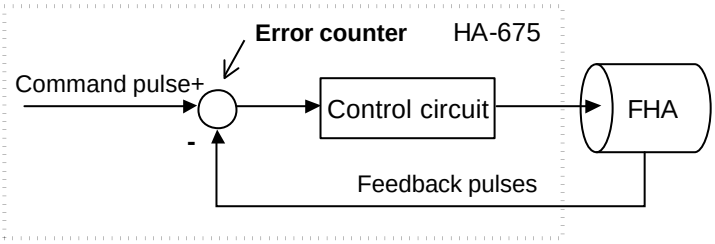
The current overload rate where “100%” is equal to the [overload protection characteristics] of the actuator.
Unit: %
(ex.) Overload rate=20%

[Monitor mode]

Feedback pulse (Low)

● Function

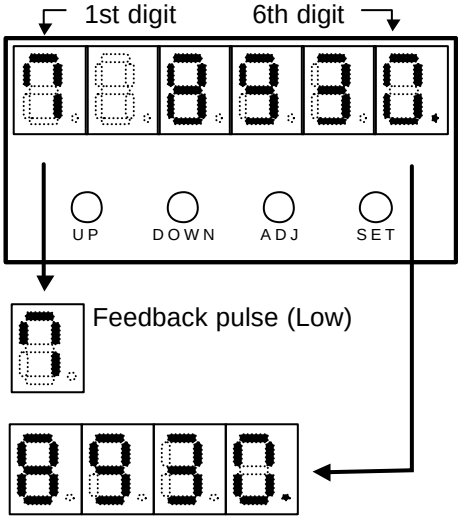
The fundamental functions of servomotors are positioning and rotation responding to a command signal. A block diagram of servo motor control is shown as follows:



[Feedback pulse] indicates a feedback quadrature pulse count (accumulated) that is reset to [0] position when the HA-675 driver is powered. As the count will become a large number, the count is divided in two parts: low 4th digit part and high part (up to 4th digits).

For the absolute encoder, the position data of the encoder is indicated.

[7: Feedback pulse (Low)] indicates the low part, and [8:feedback pulse (high)] indicates the high part.



Low 4th digit part of feedback quadrature pulse count
Unit: 4 times of feedback pulse
(ex.) Low 4th digit part of feedback quadrature pulses = 8930

● Details of display

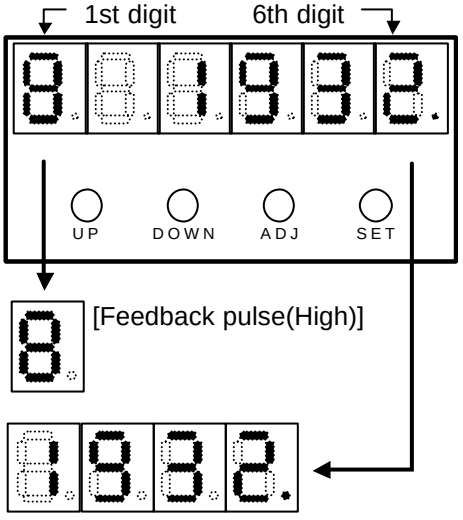
1st digit: [7: Feedback pulse (Low)]
2nd digit: no indication: positive (forward) position, [—]: negative (reverse) position
3-6th digit: Indicates a feedback quadrature pulse count (accumulated), which has been reset to the [0] position when the HA-675 driver powered.

Feedback pulse (High)

● Function

This indicates the high part of a feedback quadrature pulse count (accumulated).
Combining with the [6:feddback pulse (Low)], the whole pulse count is indicated.

The high part of the example is “1932” and the low part “8930”, therefore the feedback quadrature count is “19328930.”



High part of feedback quadrature pulse count
Unit: 4 times of feedback pulse
(ex.) High part of feedback quadrature pulses = 1932

● Details of display

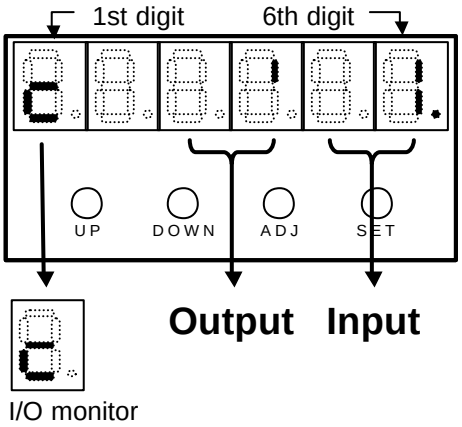
Same as [7: feedback pulse (Low)]

● Related functions

[Command pulse]: [Monitor mode]→[9: Command pulse (Low)], [A: Command pulse (High)]
[Error pulse count]: [Monitor mode]→[3:Error pulse count (Low)], [4:Error pulse count (High)]

[Monitor mode]

I/O monitor



● Function

The display indicates input/output signal states of [CN2] connector pins as follows:

Output signals: Third and forth igits
Input signals: Fifth and sixth digits

Each element of both 7-segment indicators lights up when the related signal is input or output.

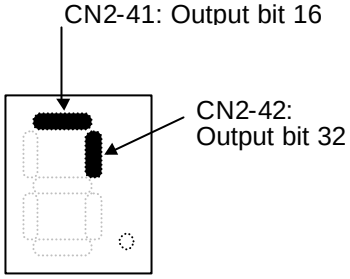
The indications are limited only for logical signals, not for encoder signals.

● Details of display

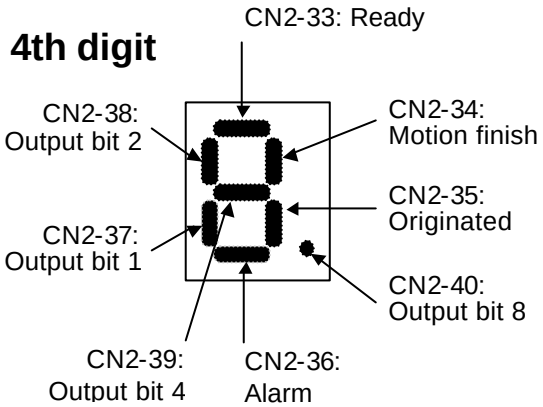
1st digit: [c: I/O monitor]
2nd digit: No indication
3-4th digit: Indicates output signal states
5-6th digit: Indicates input signal states

Output

3rd digit

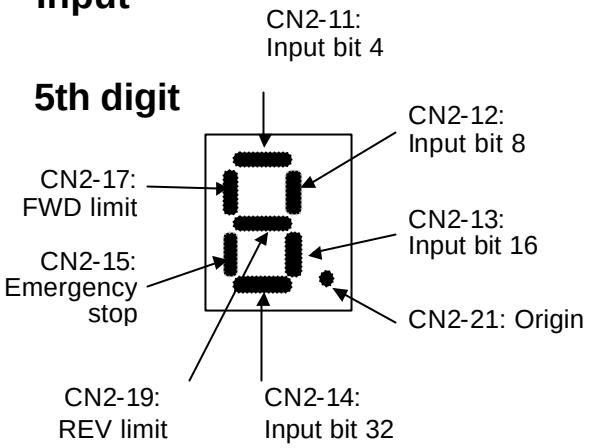


4th digit

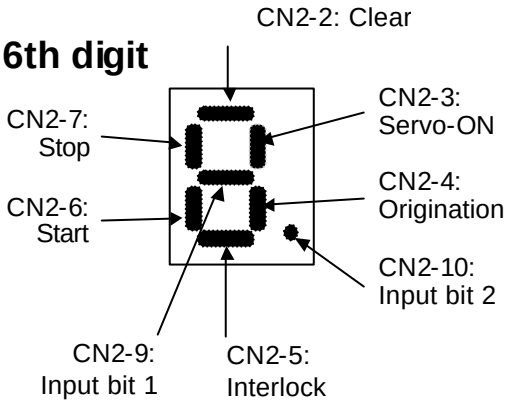


Input

5th digit



6th digit

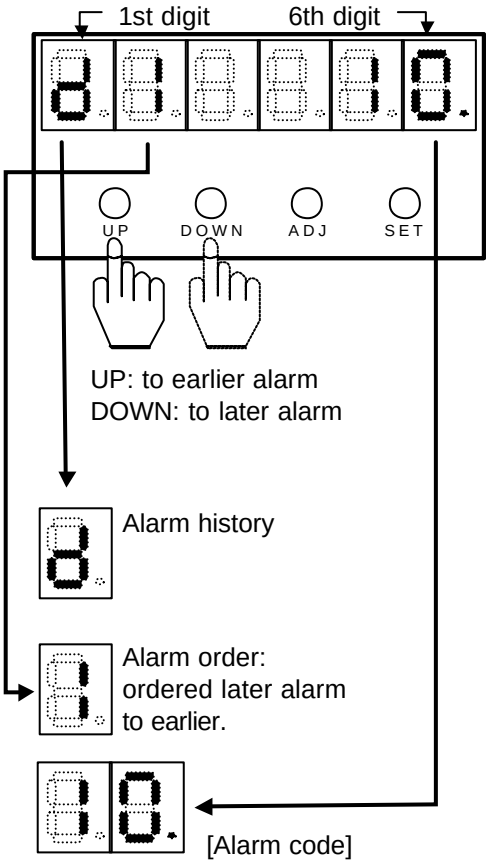


[Monitor mode]

Alarm history

● Function

The “alarm history” indicates up to eight previous alarms with codes.



● Details of display

1st digit: [d: alarm history]
2nd digit: The order of the indicated alarm:
[1] indicates the latest alarm,
and [8] indicates the earliest one.
3-4th digit: No indication
5-6th digit: Indicates an alarm code.

Code	Alarm description
01	Emergency stop
02	FWD limit
03	Rev limit
10	Over speed
20	Over load
21	Overheat
30	Over current
40	Over voltage
41	Abnormal regeneration
50	Encoder failure
51	Abnormal encoder signal
52	INC UVW failure
53	ABS ABS system failure
54	ABS Revolution counter overflow
55	ABS Revolution count error
56	ABS Low battery voltage
57	ABS Send data rule error
60	Error counter overflow
70	Memory failure(RAM)
71	Memory failure(EEPROM)
76 or flickering [0]	CPU failure

● Operations

(1) To indicate earlier alarm codes, press [UP] key.
⇒Every time you press the [UP] key it increases the alarm-order on the second digit, and indicates the alarm code on the 5-6th digit corresponding to the alarm order. The alarm-order on the 2nd digit is limited to [8]. Pressing the [UP] key more indicates an [E: actuator code].

(2) To indicate later alarm codes, press [DOWN] key.
⇒Every time you press the [DOWN] key it decreases the alarm-order on the second digit, and indicates the alarm code on the 5-6th digit corresponding to the alarm order. The alarm-order on the 2nd digit is limited to [1]. Pressing the [DOWN] key more is indicates a [c: I/O monitor].

(3) To clear the alarm history, set [1] to [parameter mode]→[P: alarm history clear] and re-power following shutting off power supply. After re-powering, [0] is set to [P: alarm history clear] automatically.

[Monitor mode]

Actuator code

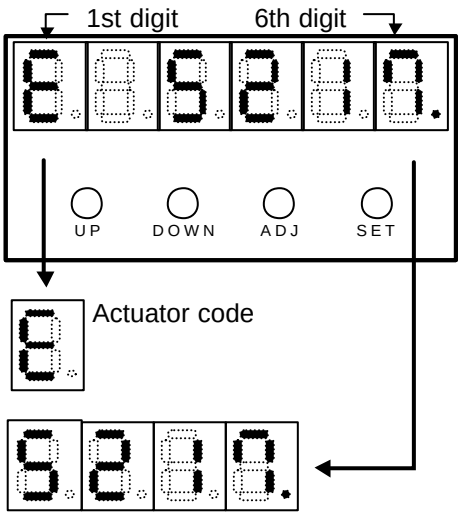
● Function

This indicates the code of the HA-675 driver is set for.
The relation of the codes and actuators is as follows:

WARNING

Do not connect an actuator that has another code than the indicated code.

Wrong combinations of HA-675 drivers and actuators may cause low torque problems and over current that may cause physical injury and fire.



The actuator code of [5217] means that the actuator to be combined is FHA-17C-50.

● Actuator code list

Encoder		Incremental encoder				Absolute encoder			
Voltage	Reduction ratio	1/30	1/50	1/100	1/160	1/30	1/50	1/100	1/160
200 V	FHA-8C	6204	6214	6234	-	-	-	-	-
	FHA-11C	6404	6414	6434	-	-	-	-	-
	FHA-14C	6604	6614	6634	-	-	-	-	-
	FHA-17C	-	5217	5237	5247	-	5218	5238	5248
	FHA-25C	-	5417	5437	5447	-	5418	5438	5448
	FHA-32C	-	5617	5637	5647	-	5618	5638	5648
	FHA-40C	-	5717	5737	5747	-	5718	5738	5748
100 V	FHA-8C	6304	6314	6334	-	-	-	-	-
	FHA-11C	6504	6514	6534	-	-	-	-	-
	FHA-14C	6704	6714	6734	-	-	-	-	-
	FHA-17C	-	5117	5137	5147	-	5118	5138	5148
	FHA-25C	-	5317	5337	5347	-	5318	5338	5348
	FHA-32C	-	5517	5537	5547	-	5518	5538	5548

● Details of display

1st digit: [E: Actuator code]
2nd digit: No indication
3-6th digit: Indicates an [Actuator code]. The relation of the codes and actuators is shown above.

[Monitor mode]

Actuator serial number (Low) (position / speed)

Actuator serial number (High) (position / speed)

Actuator serial number (Affix) (position / speed)

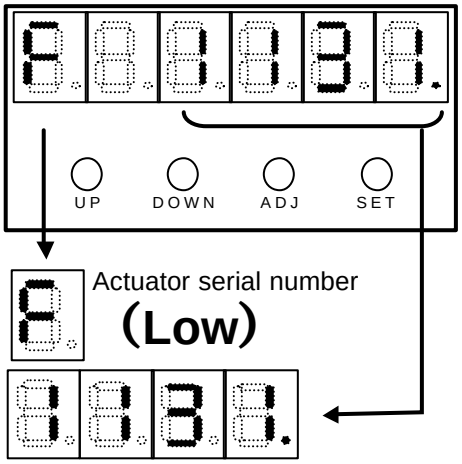
● Function

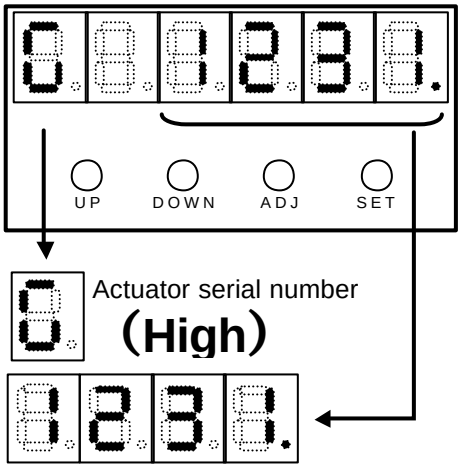
A set of the three parameters;
[F: actuator serial number (low),
[G: actuator serial number (high), and
[H: actuator serial number (affix)
indicates a serial number of the connected actuator of FHA-mini series (FHA-8C/11C/14C) driven by the HA-655-1 driver.

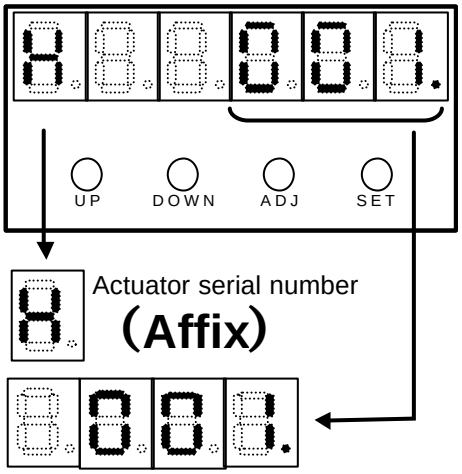
The serial number of a FHA-C mini series actuator consists of an 8figure fundamental part and a 3figure affix part; the fundamental part consists a 4-figure low part and a 4-figure high part.

The figure to the right shows an example of the serial number of [12311131-001]:
High part=1231 [G: actuator serial number (High)]
Low part=1131 [F: actuator serial number (Low)]
Affix part=001 [H: actuator serial number (Affix)]

When an actuator except the FHA-C mini series, each parameters indicates [0].







● Details of display

◆ [F: actuator serial number (Low)]

1st digit: [F: actuator serial number (Low)]
2nd digit: No indication
3rd to 6th digit: Indicates a low part of a serial number.

◆ [G: actuator serial number (High)]

1st digit: [G: actuator serial number (High)]
2nd digit: No indication
3rd to 6th digit: Indicates a high part of a serial number.

◆ [H: actuator serial number (Affix)]

1st digit: [H: actuator serial number (Affix)]
2nd to 3rd digit: No indication
4th to 6th digit: Indicates an affix part of a serial number.

6-5 Tune mode

The tuning mode consists of various parameters to control the actuator motion. Setting the most suitable value for each parameter will ensure the optimum performance of the actuator.

The [tune mode] indicates and sets the following items.

Mode	Code	Function	Setting & operation
Tune mode	0	Speed loop gain	Possible
	1	Speed loop integral compensation	
	2	Position loop gain	
	3	Reserved	-
	4	In-position range	Possible
	A	Speed monitor offset	
	b	Current monitor offset	

6-5-1 Operation in the tune mode

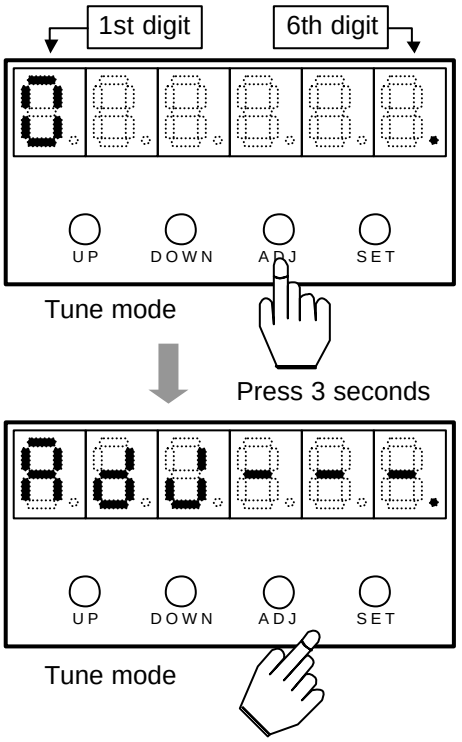
● Selecting operations of function items

(1) To enter [tune mode] from [monitor mode], press [ADJ] key for three seconds or more.

⇒Enters [tune mode] when there is no indication on 4－6th digit.

(2) Press the [UP] or [DOWN] key to change the functional items of [tune mode].
⇒ Every time you press the [UP] key it shifts a code of the first digit one by one from [0] to [b], and indicates a value corresponding to the code.

⇒Every time you press the [DOWN] key it shifts a code of the first digit one by one from [b] to [0], and indicates a value corresponding to the code.



● Function

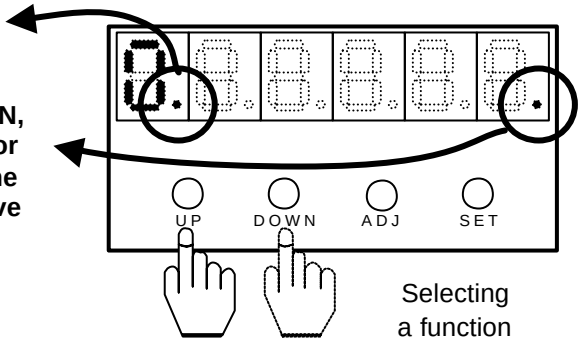
(1) During [tune mode] entering:
1-3rd digit: Indicates [AdJ].
4-6th digit: Indicates [－]during entering, and no indication after entering

(2) During [tune mode]:

1st digit: Codes in the mode.

Decimal point of the sixth digit:

If the decimal point of the sixth digit is ON, the servo is active (ON) and the actuator will respond to command signals. If the decimal point is OFF, the servo is inactive (OFF).



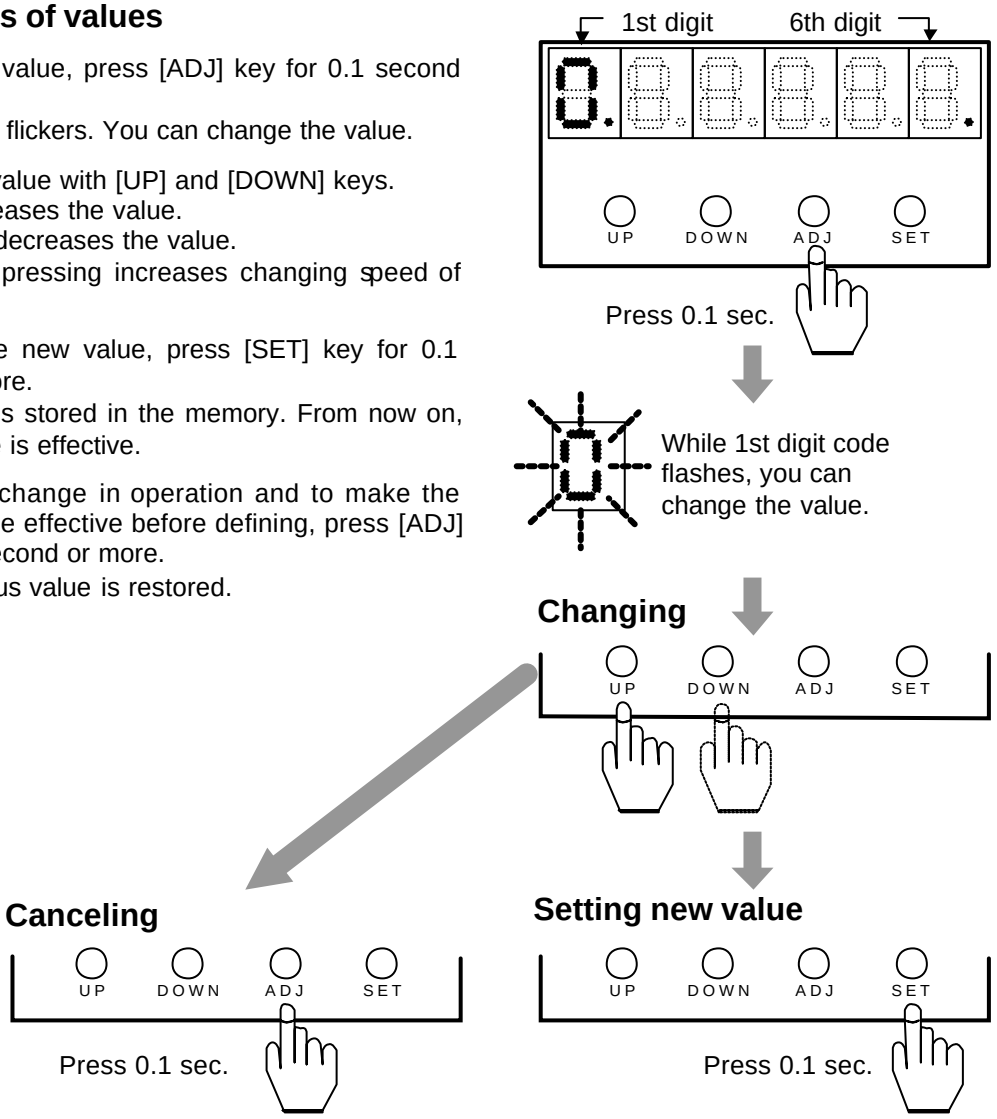
● Operations of values

(1) To change a value, press [ADJ] key for 0.1 second or more.
⇒1st digit [0] flickers. You can change the value.

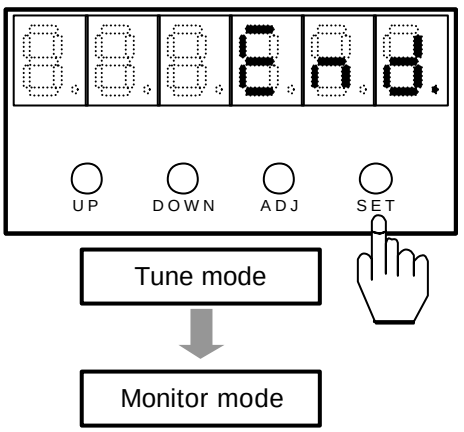
(2) Change the value with [UP] and [DOWN] keys.
[UP] key increases the value.
[DOWN] key decreases the value.
Keeping key pressing increases changing speed of the value.

(3) To define the new value, press [SET] key for 0.1 second or more.
⇒The value is stored in the memory. From now on, the new value is effective.

(4) To cancel a change in operation and to make the previous value effective before defining, press [ADJ] key for 0.1 second or more.
⇒The previous value is restored.



(5) To transfer to the [monitor mode] from the tune mode, press the [SET] key after displaying the [END].
⇒ The monitor mode begins.



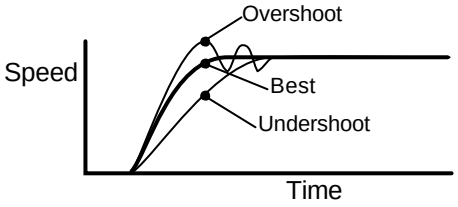
6-5-2 Functions of tune mode

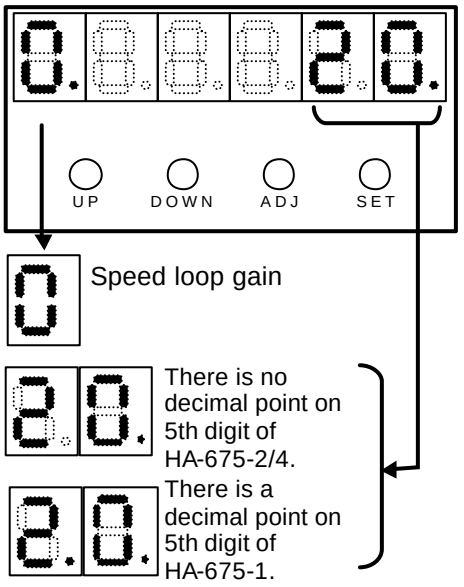
0 Speed loop gain

● Function

The HA-675 drivers make actuators follow programmed commands precisely by triple feedback loops of position, speed, and current. The [speed loop gain] adjusts the proportional gain of the speed feedback loop. The relation between the gain and actuator motion is as follows:

High gain ⇒ eliminates hunting and gives low response to load torque variation.
Low gain ⇒high response to load torque variation, too low a gain makes the servo system hunt.





Set the highest gain within the limits of no hunting and minimum overshooting by a step command.

● Details of display

1st digit: [0: speed loop gain]
2nd to 6th digit: Indicates the current [speed loop gain].
For HA-675-2/4: An integer from [1] to [9999] can be set. (No point on 5th digit)
For HA-675-1: A value from [0.1] to [999.9] can be set. (With a point on 5th digit)
Notes: When a PSF650 is used, no decimal point is indicated for the [speed loop gain].
To get the [speed loop gain] for a system using a PSF650 and an HA-655-1 driver, multiply [0.1] by an indicated value.

● Operations

(1) To change a value, press [ADJ] key for 0.1 second or more.
⇒1st digit [0] flashes. You can change the value.
(2) If the actuator is hunting or takes a long time for its speed to settle after a step command, then press [DOWN] key to set a lower level.
If the actuator takes a long time for its speed after a step command, then press [UP] key to set a higher level.
(3) To define the new value, press [SET] key for 0.1 second or more.
⇒ Flashing of 1st digit [0] stops and the new value is defined.
(4) To cancel a change in operation, press [ADJ] key for 0.1 second or more.
⇒Flashing of 1st digit [0] stops and the previous value is restored.

● Related functions

[Speed loop integral compensation]: [tune mode]→[1: Speed loop integral compensation]
[Position loop gain]: [tune mode]→[2:position loop gain]

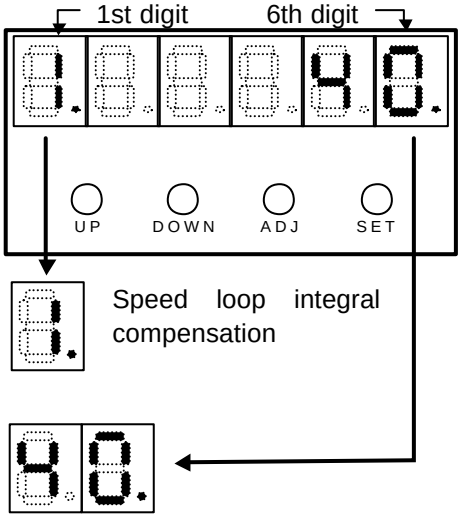
[Tune mode]

Speed loop integral compensation

● Function

The HA-675 driver is equipped with a [Speed loop integral compensation] function to make speed fluctuation minimal against load torque variation. The relation between the gain and actuator motion is as follows:

High gain ⇒ eliminates hunting and gives low response to load torque variation.
Low gain ⇒high response to load torque variation, too low a gain makes the servo system hunt.



● Details of display

1st digit: [0:Speed loop integral compensation]
2-6th digit: Indicates the current [Speed loop integral compensation]. A value from [1] to [9999] can be set.

● Operations

(1) To change a value, press [ADJ] key for 0.1 second or more.
⇒1st digit [1] flashes. You can change the value.
(2) When the actuator does hunting, press [DOWN] key to set a lower value.
When the response is low to load torque variation, press [UP] key to set a higher value.
(3) To define the new value, press [SET] key for 0.1 second or more.
⇒ Flashing of 1st digit [1] stops and the new value is defined.
(4) To cancel a change in operation, press [ADJ] key for 0.1 second or more.
⇒Flashing of 1st digit [1] stops and the previous value becomes effective.

● Related functions

[Speed loop gain]: [tune mode]→[0:Speed loop gain]
[Position loop gain]: [tune mode]→[2:position loop gain]

[Tune mode]

Position loop gain

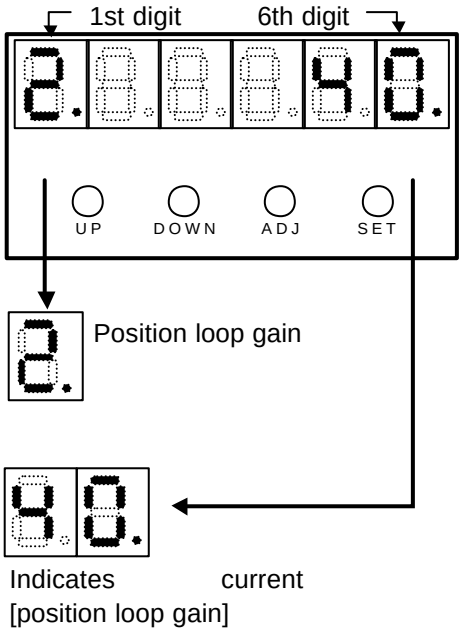
● Function

The HA-675 driver is equipped with triple feedback loops of position, speed and current to make actuator motion follow programmed command precisely. [Position loop gain] adjusts proportional gain of feedback loop gain. The relation between the gain and actuator motion is as follows:

High gain ⇒ obtains small position and following error.
Excessive gain makes the servo system unstable and causes it to hunt.
Low gain ⇒ Inadequate gain results in a large following error to command signal.

Set the highest gain without hunting and minimize overshoot and undershoot by a step command.

After trial operation with higher servo gain to make short positioning period, if the value of [monitor mode] → [6: overload rate] is [0], the higher gain is permissible.



● Details of display

1st digit: [2: position loop gain]
2-6th digit: Indicates current [position loop gain]. A value from [10] to [9999] can be set.

● Operations

(1) To change a value, press [ADJ] key for 0.1 second or more.
⇒1st digit [2] flashes. You can change the value.

(2) When the actuator does hunting, press [DOWN] key to set a lower value.
When the position following a command is poor, press [UP] key to set a higher value.

(3) To define a new value, press [SET] key for 0.1 second or more.
⇒ Flashing of 1st digit [2] stops and the new value is defined.

(4) To cancel a change in operation, press [ADJ] key for 0.1 second or more.
⇒Flashing of 1st digit [2] stops and the previous value becomes effective.

● Related functions

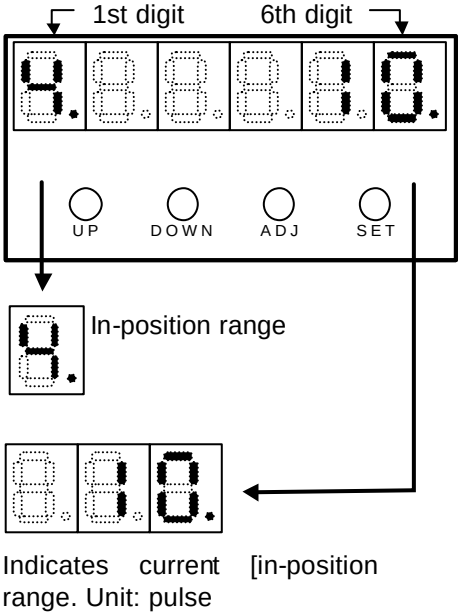
[Speed loop gain]: [tune mode]→[0:Speed loop gain]
[Speed loop integral compensation]: [tune mode]→[1:Speed loop integral compensation]
[Overload rate]: [monitor mode]→[6: overload rate]

[Tune mode]

In-position range

● Function

[CN2-34 motion finish: FINISH] signal is outputted when an error count becomes less than the value of the [in-position range]. The error count is the difference between [command pulse count] and [feedback pulse count],



● Details of display

1st digit: [4: in-position range]
2nd digit: No indication
3-6th digit: indicates the current [in-position range]. A value from [0] to [9999] can be set.

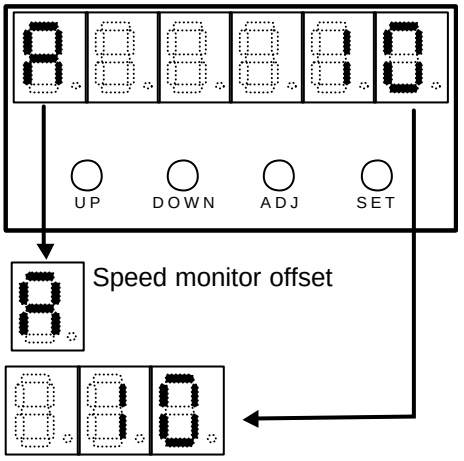
● Operations

(1) To change a value, press [ADJ] key for 0.1 second or more.
⇒1st digit [4] flashes. You can change the value.
(2) To make [in-position range] narrow, press [DOWN] key to set a lower value.
To make it wide, press [UP] key to set a higher value.
(3) To define the new value, press [SET] key for 0.1 second or more.
⇒ Flashing of 1st digit [4] stops and the new value is defined.
(4) To cancel a change in operation, press [ADJ] key for 0.1 second or more.
⇒Flashing of 1st digit [4] stops and the previous value becomes effective.

Speed monitor offset

● Function

[CN2-23 Speed monitor: SPD-MON] output signal may have offset voltage of 0.8V at the maximum or –0.8V at the minumum. Though the output has been adjusted at our shipment optimally, re-adjust it if, required. [-3.5V to +3.5V] of the adjustable range corresponds with the numeral range of [-128 to 127].



● Details of display

1st digit: [A: Speed monitor offset]
2nd to 3rd digit: [-] for negative value only
4th to 6th digit: Indicates current [Speed monitor offset]
[-128] to [127] can be set.

● Operations

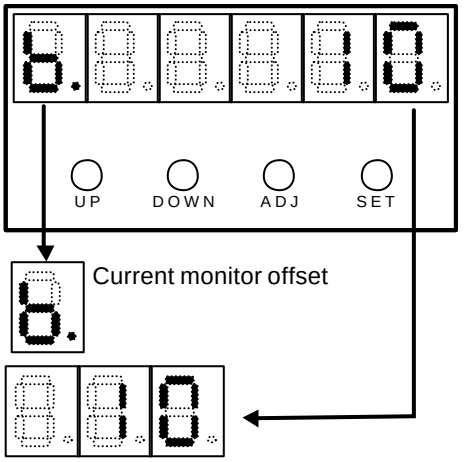
(1) To change a value, press the [ADJ] key at least 0.1 second.
⇒1st digit [A] flashes. You can change the value.
(2) To increase the value, press the [UP] key. And to decrease the value, press the [DOWN] key.
(3) To define the new value, press the [SET] key at least 0.1 second.
⇒ Flashing of 1st digit [A] stops and the new value is defined.
(4) To cancel a change in operation, press the [ADJ] key at least 0.1 second.
⇒Flashing of 1st digit [A] stops and the previous value becomes effective.

[Tune mode]

Current monitor offset

● Function

[CN2-24 Current monitor: CUR-MON] output signal may have offset voltage of 0.8V at the maximum or –0.8V at the minumum. Though the output has been adjusted at our shipment optimally, re-adjust it, if required. [-3.5V to +3.5V] of the adjustable range corresponds with the numeral range of [-128 to 127].



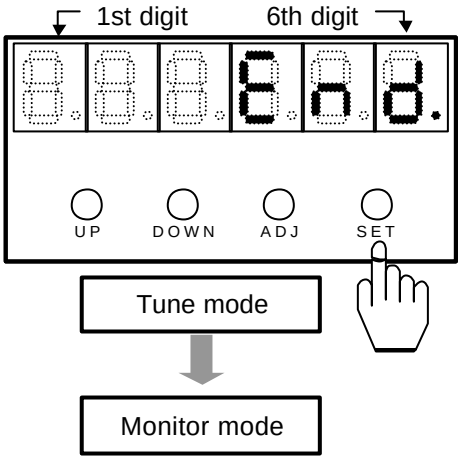
● Details of display

1st digit: [b: Current monitor offset]
2nd to 3rd digit: [-] for negative value only
4th to 6th digit: Indicates current [Speed monitor offset]
[-128] to [127] can be set.

● Operations

(1) To change a value, press the [ADJ] key at least 0.1 second.
⇒1st digit [b] flashes. You can change the value.
(2) To increase the value, press the [UP] key. And to decrease the value, press the [DOWN] key.
(3) To define the new value, press the [SET] key at least 0.1 second.
⇒ Flashing of 1st digit [b] stops and the new value is defined.
(4) To cancel a change in operation, press the [ADJ] key at least 0.1 second.
⇒Flashing of 1st digit [b] stops and the previous value becomes effective.

End of tune mode



● Function

This terminates the [tune mode] and returns to the [monitor mode]. Indicating [End] and pressing the [SET] key returns to the [monitor mode].

● Details of display

1-3rd digit: No indication
4-6th digit: Indicates [End]

● Operations

(1) To terminate the [tune mode] and to return to the [monitor mode], press [SET] with [End] indicated.
⇒ The indication mode returns to the [monitor mode].

6-6 Parameter mode

The [parameter mode] sets various parameter values relating to the fundamental operational functions such as: limiting values of speed and torque, and parameters to communicate with a teach-box.

The parameter mode indicates and sets the following items.

Mode	Code	Function	Setting & operation
Parameter mode	5	Error count clear by S-ON	Setting is possible.
	6	Position error allowance	
	A	Speed limit	
	b	Current limit	
	c	Signal logic	
	For J	**ABS** Revolution counter clear	Operation is possible
	G	Mechanical origin	Setting is possible
	H	**ABS** ABS send data timing	
	I	**ABS** Low battery voltage signal	
	n	Regenerative resistance	
	o	Automatic gain control	
	P	Alarm history clear	

6-6-1 Operation in the parameter mode

● Selecting operations of function items

(1) To enter [parameter mode] from [monitor mode], press both [ADJ] and [SET] keys at the same time for three seconds or more.

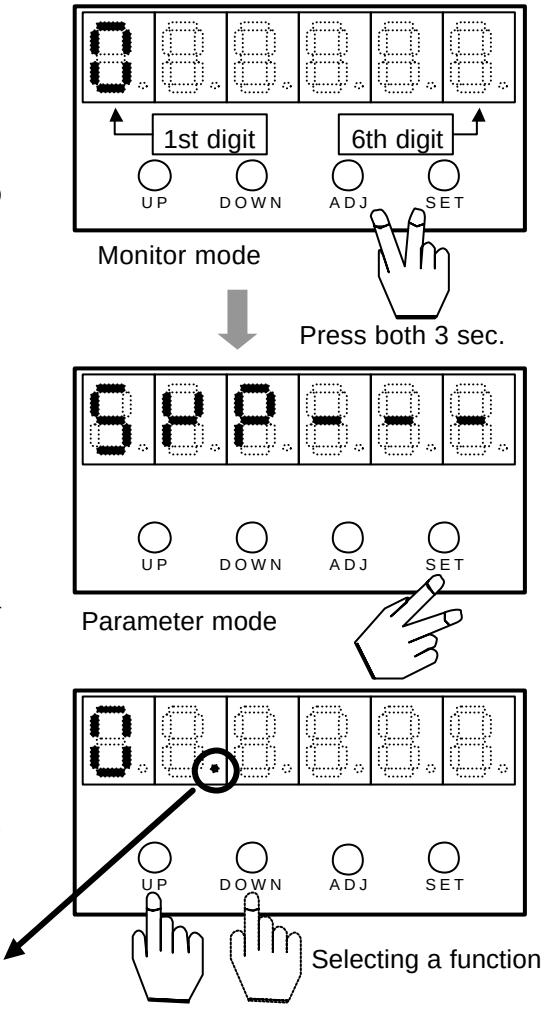
⇒ Enters [parameter mode] when there is no indication on 4—6th digit.

(Note): While [CN2-3 servo-ON: S-ON] signal is ON, changing to [parameter mode] turns the signal OFF and the system goes into the servo-OFF state.

(2) Press [UP] or [DOWN] key to change the functional items of [parameter mode]

⇒ Every time you press the [UP] key it shifts a code of the first digit one by one from [0] to [P], and indicates a value corresponding to the code.

⇒Every time you press the [DOWN] key it shifts a code of the first digit one by one from [P] to [0], and indicates a value corresponding to the code.



● Function

(1) During [parameter mode] entering:

1-3rd digit: indicates [SyP].

4-6th digit: Indicates [-] during entering, and no indication after entering.

(2) During [parameter mode]:

1st digit: Codes in the mode

2-6th digit: A value of the code

Decimal point of the second digit: indicates that the state is in the parameter mode.

● Operations of values

(1) To change a value, press [ADJ] key for 0.1 second or more.
⇒1st digit [0] flashes. You can change the value.

(2) Change the value with the [UP] and [DOWN] keys.

[UP] key increases the value.

[DOWN] key decreases the value.

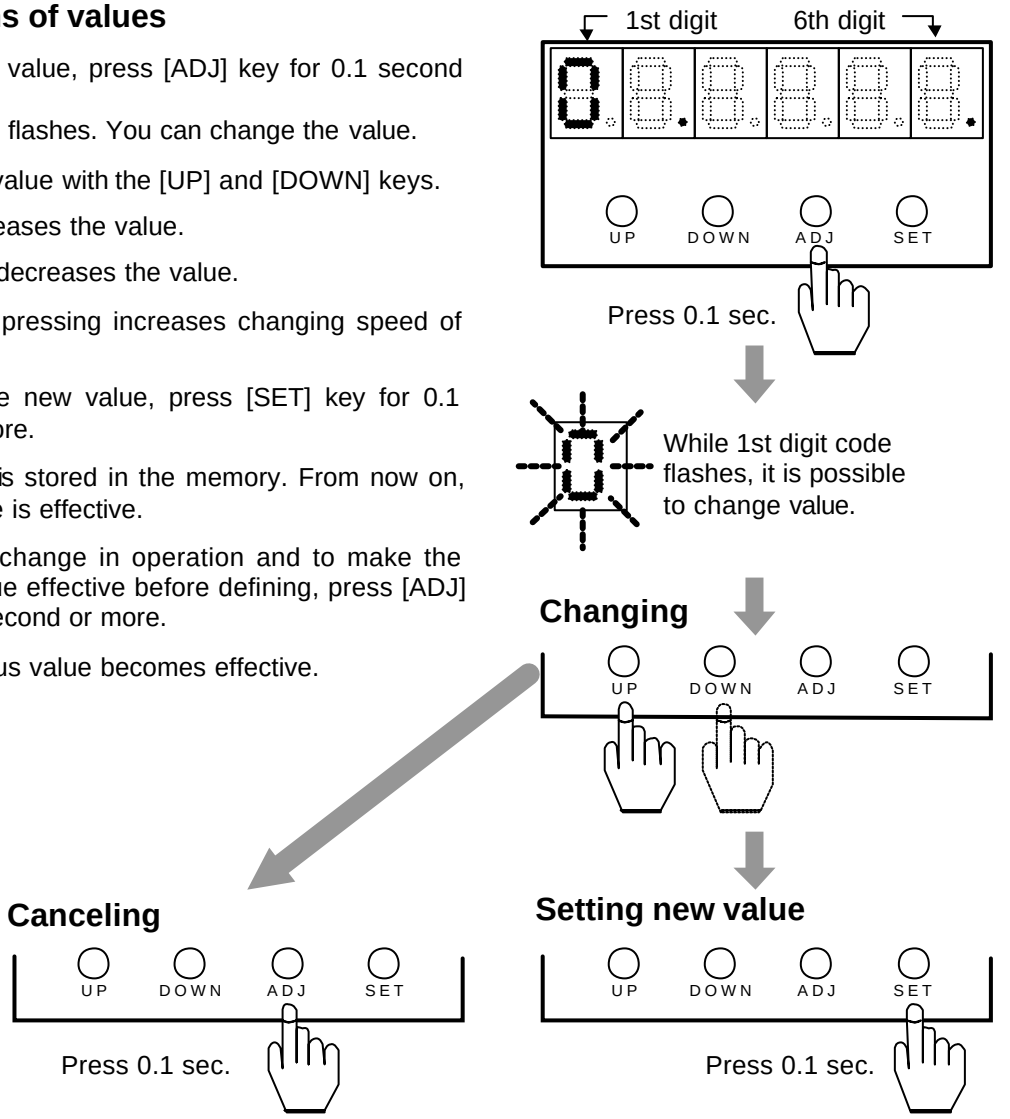
Keeping key pressing increases changing speed of the value.

(3) To define the new value, press [SET] key for 0.1 second or more.

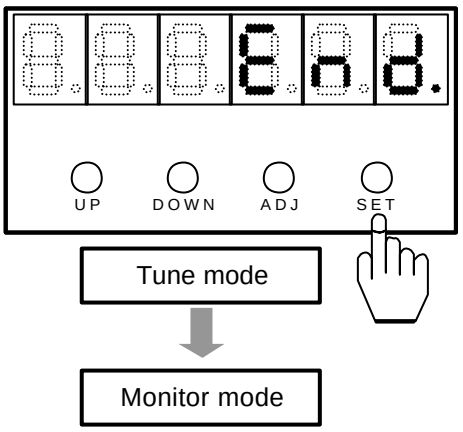
⇒The value is stored in the memory. From now on, the new value is effective.

(4) To cancel a change in operation and to make the previous value effective before defining, press [ADJ] key for 0.1 second or more.

⇒The previous value becomes effective.



(5) To transfer to the [monitor mode] from the parameter mode, press the [SET] key after displaying the [END].
⇒ The monitor mode begins.



6-6-2 Functions of parameter mode

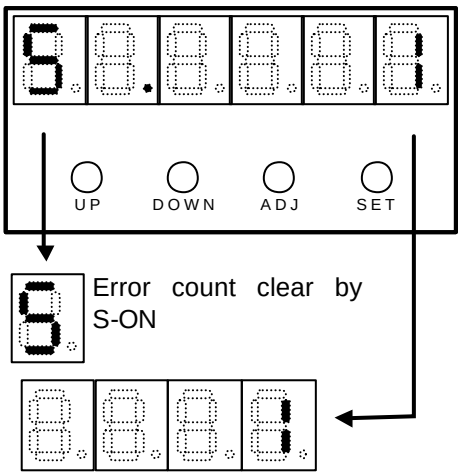
Error count clear by S-ON

● Function

The HA-675 driver controls a motor so that the error count is always [0] during the servo power is active. However, when the servo power is shut down turning off the input of [CN-2-3 servo ON: S-ON] and only the control power is active, the error count may not be [0] proportioning to movement by external force, such as gravitational force and human power, from the position where the servo power is shut down.

If the servo power becomes active again turning on the input of [CN-2-3 servo ON: S-ON] when the error count is not [0], the actuator suddenly rotates at the moment with its maximum torque to cancel the error count to zero [0]. The sudden rotation may course personal injury especially during trial run, maintenance and troubleshooting.

For the absolute system, the function avoids the dangerous sudden rotation clearing the error count to [0] at re-activating the servo power.



Error count clear by S-ON
Default: 0

For the incremental system, the actuator moves to the direction to make the error count [0] when the error count is within the range of +5000 to –5000 at the time of switching the [CN2-3 servo-ON: S-ON] on. If the count is out of the range, the function makes the count to prevent from the sudden rotation. However, originating operation is indispensable for position data after working the function, because of loosing the previous position data.

Value	Function	Remarks
0	Not clear	Default
1	Clear	

● Details of display

1st digit: [5: Error count clear by S-ON]
2nd to 5th digit: No indication
6th digit: Indicates current [Error count clear by S-ON]

● Operations

(1) To change a value, press the [ADJ] key at least 0.1 second.
⇒1st digit [5] flashes. You can change the value.

(2) To set [not clear], set [0] by the [DOWN] key.
To set [clear], set [1] by the [UP] key.

(3) To define the new value, press the [SET] key at least 0.1 second.
⇒ Flashing of 1st digit [5] stops and the new value is defined.

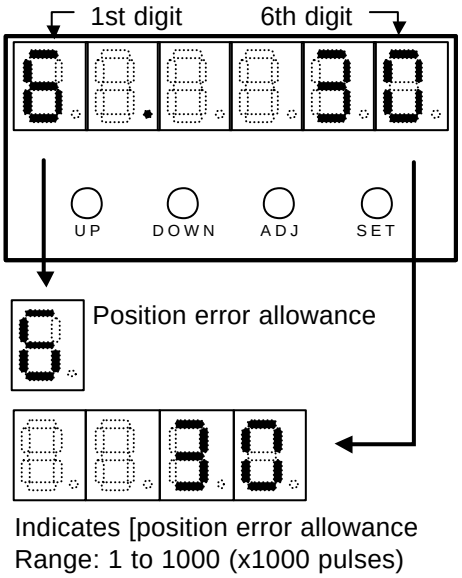
(4) To cancel a change in operation, press the [ADJ] key at least 0.1 second.
⇒Flashing of 1st digit [5] stops and the previous value becomes effective.

[Parameter mode]

6. Position error allowance

● Function

[Error counter] calculates [error count] subtracting the [feedback count] from [position command]. A large position error may result in an abnormality.
When the position error exceeds the [position error allowance], an [alarm 60] occurs and the servo power turns OFF.
The allowable error count is obtained by multiplying [1000] and a set value.



● Details of display

1st digit: [6: position error allowance]
2nd digit: No indication
3-6th digit: Indicates the current [position error allowance]. A value from [1] to [1000] can be set.

● Operations

(1) To change a value, press [ADJ] key for 0.1 second or more.
⇒1st digit [6] flashes. You can change the value.
(2) To make the allowance narrow, press [DOWN] key.
To make it wide, press [UP] key.
(3) To define the new value, press [SET] key for 0.1 second or more.
⇒ Flashing of 1st digit [6] stops and the new value is defined.
(4) To cancel a change in operation, press [ADJ] key for 0.1 second or more.
⇒Flashing of 1st digit [6] stops and the previous value becomes effective.

[Parameter mode]

A Speed limit

● Function

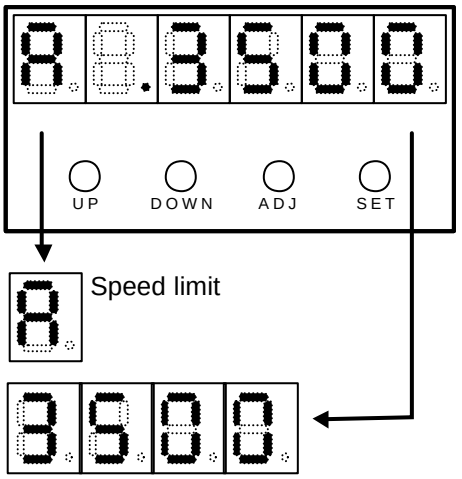
This function limits the maximum motor speed to protect the actuator and driven mechanism.

● Details of display

1st digit: [A: speed limit]
2nd digit: No indication
3-6th digit: Indicates current [speed limit]. A value from [1] to [max. motor speed] can be set.

● Operations

(1) To change a value, press [ADJ] key for 0.1 second or more.
⇒1st digit [A] flashes. You can change the value.
(2) Set a value to [speed limit] by [UP] and [DOWN] keys.
(3) To define the new value, press [SET] key for 0.1 second or more.
⇒ Flashing of 1st digit [A] stops and the new value is defined.
(4) To cancel a change in operation, press [ADJ] key for 0.1 second or more.
⇒Flashing of 1st digit [A] stops and the previous value becomes effective.



Indicates [speed limit].
Unit: r/min
Range: 1 - max. motor speed

b Current limit

● Function

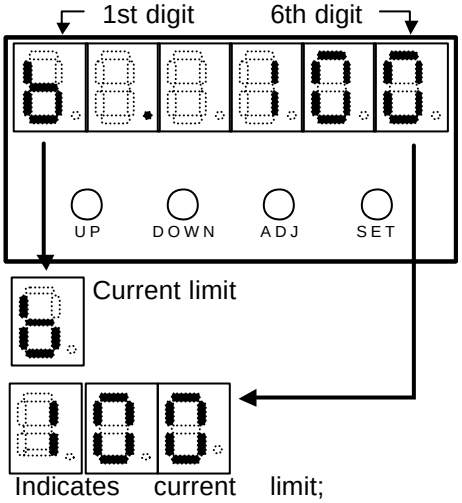
This function limits the maximum motor current to protect the actuator and driven mechanism.
The maximum motor current corresponds to 100%.

● Details of display

1st digit: [b: current limit]
2-3rd digit: No indication
4-6th digit: Indicates current [current limit]. A value from [1] to [100] can be set.

● Operations

(1) To change a value, press [ADJ] key for 0.1 second or more.
⇒1st digit [b] flashes. You can change the value.
(2) Set a value to [current limit] with the [UP] and [DOWN] keys.
(3) To define the new value, press [SET] key for 0.1 second or more.
⇒ Flashing of 1st digit [b] stops and the new value is defined.
(4) To cancel a change in operation, press [ADJ] key for 0.1 second or more.
⇒Flashing of 1st digit [b] stops and the previous value becomes effective.



Indicates current limit;
Range: 1-100%

[Parameter mode]

Signal logic

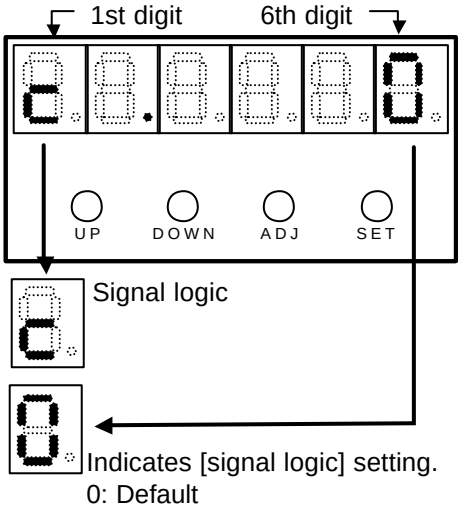
● Function

The signal logic (normal open / normal close) of alarm output, emergency stop input, and FWD and REV limits is defined as the table below.

From safety points of view, the logic should be "normal close", which is default. However, it is possible to set it to "normal open" as follows:

Set a sum of the figures of which signals to be "normal open". For example, when FWD and REV limits are "normal open", set [12] which is [4+8=12].

Signal		Normal close	Normal open
CN2-36 Alarm	ALARM	0	1
CN2-15 Emergency stop		0	2
CN2-17 FWD limit	FSTOP	0	4
CN2-19 REV limit	RSTOP	0	8



● Details of display

1st digit: [c: signal logic]
2-4th digit: No indication
5-6th digit: Indicates current [signal logic] setting.

● Operations

(1) To change a value, press [ADJ] key for 0.1 second or more.
⇒1st digit [c] flickers. You can change the value.
(2) Set a value by [UP] and [DOWN] keys.
(3) To define the new value, press [SET] key for 0.1 second or more.
⇒ Flickering of 1st digit [c] stops and the new value is defined.
(4) To cancel the changing operation, press [ADJ] key for 0.1 second or more.
⇒Flickering of 1st digit [c] stops and the previous value becomes effective.

[Parameter mode]

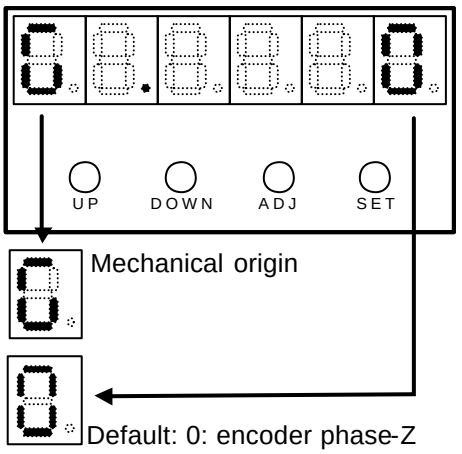
Mechanical origin

● Function

For the HA-675 driver, a mechanical origin is necessary as a base point to follow a motion pass programmed by the TBX-670 teach-box or the programming software PSF-670.

The HA-675 driver allows selecting the mechanical origin from two kinds of sensors, and has origination sequence programs for the mechanical origins respectively.

Value	Mechanical origin	Repeatability	Origination time	Default
0	Encoder phase-Z	High	Max.20sec.	0
1	External sensor	Low	shorter	—



● Details of display

1st digit: [G: mechanical origin]
2-5th digit: No indication
6th digit: Indicates current [mechanical origin] setting.

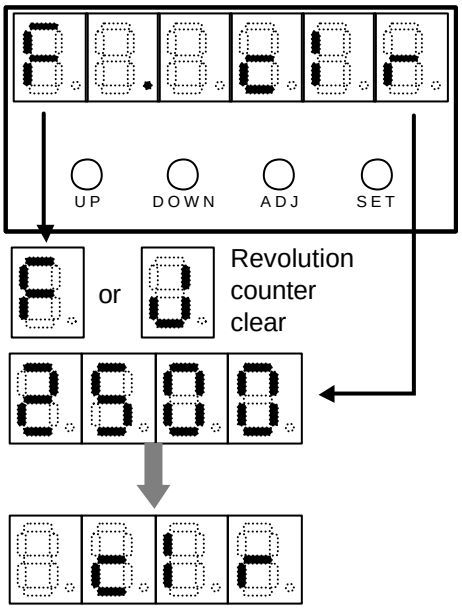
● Operations

(1) To change a value, press [ADJ] key for 0.1 second or more.
⇒1st digit [G] flickers. You can change the value.
(2) Set [0] for [encoder phase-Z] or [1] for [external sensor] by [UP] and [DOWN] keys.
(3) To define the new value, press [SET] key for 0.1 second or more.
⇒ Flickering of 1st digit [G] stops and the new value is defined.
(4) To cancel the changing operation, press [ADJ] key for 0.1 second or more.
⇒Flickering of 1st digit [G] stops and the previous value becomes effective.

Revolution counter clear ABS

● Function

It is required to clear the [revolution counter] to zero at the origin, after the first powering to the HA-655 driver and after recovering from [alarm 53], [alarm 54] and [alarm 55]. This function clears the revolution counter manually. Both indications of [F] and [J] has same functions.
For the incremental system, operation is possible, but no functions is obtained.



● Details of display

1st digit: [F or J: revolution counter clear]
2nd digit: No indication
3rd to 6th digit: Indicates time for revolution counter clear.

● Operations

(1) To change a value, press the [ADJ] key at least 0.1 second.
⇒1st digit [J] flashes. You can change the value.
(2) Press the [SET] key, then [2500] is indicated. Keeping the pressing more the value decreases to [0]. Then [clr] will indicated.

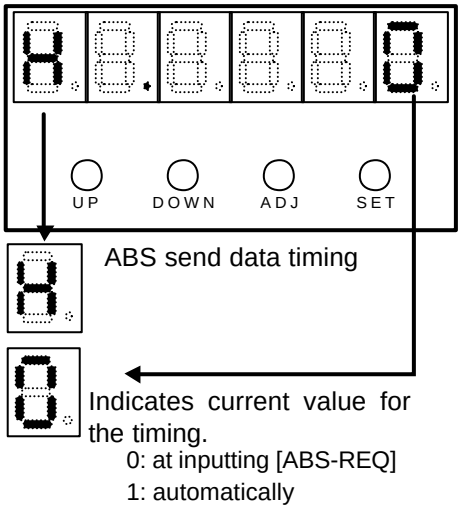
[Parameter mode]

H ABS send data timing ABS

● Function

Following the powering sequence, the ports of the [CN2-44 phase-A: A+] through [CN2-49 phase-Z: Z-] output pulse trains for the current complex absolute data just for once. This sets the timing.

Value	Timing	Setting
0	At inputting [CN2-10: ABS-REQ]	Default
1	Automatically after powering	—



● Details of display

1st digit: [H: ABS send data timing]
Decimal point of 2nd digit: parameter mode
3rd to 5th digit: No indication
6th digit: Indicates current value for the timing.

● Operations

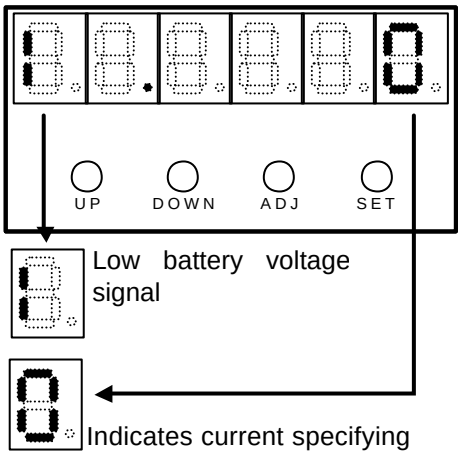
(1) To change a value, press the [ADJ] key at least 0.1 second.
⇒1st digit [H] flashes. You can change the value.
(2) Set [0] or [1] with the keys of [UP] and [DOWN].
(3) To define the new value, press the [SET] key at least 0.1 second.
⇒ Flashing of 1st digit [H] stops and the new value is defined.
(4) To cancel a change in operation, press the [ADJ] key at least 0.1 second.
⇒Flashing of 1st digit [H] stops and the previous value becomes effective.

I Low battery voltage alarm ABS

● Function

This specifies whether to output the [alarm 56: battery low voltage] signal or not, when voltage the backup battery becomes low.

Value	[alarm 56: battery low voltage]	Setting
0	Outputs	Default
1	No output	



● Details of display

1st digit: [I: Low battery voltage signal]
Decimal point of 2nd digit: parameter mode
3rd to 5th digit: No indication
6th digit: Indicates current specifying.

● Operation

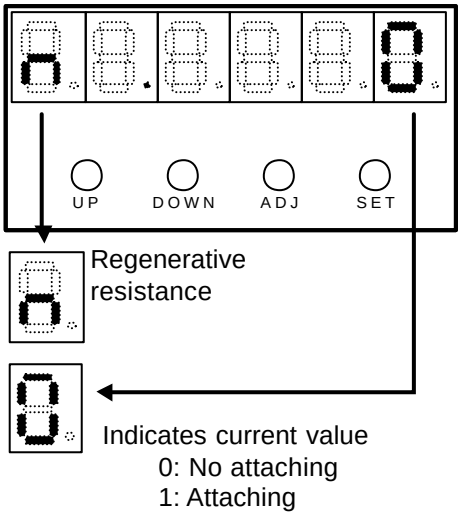
(1) To change a value, press the [ADJ] key at least 0.1 second.
⇒1st digit [I] flashes. You can change the value.
(2) Set [0] or [1] with the keys of [UP] and [DOWN].
(3) To define the new value, press the [SET] key at least 0.1 second.
⇒ Flashing of 1st digit [I] stops and the new value is defined.
(4) To cancel a change in operation, press the [ADJ] key at least 0.1 second.
⇒Flashing of 1st digit [I] stops and the previous value becomes effective.

[Parameter mode]

Regenerative resistance (for HA-675-1 only)

● Function

Regenerative resistances are not built in the HA-675-1 drivers. To big load inertia (ex. $J_L=6J_M$ or more for FHA-14C), [AL40: over voltage] alarm may happen depending on driving conditions. When an external regenerative resistance is attached for a remedy against the alarm, [1: attaching] is set to this parameter. For other drivers, keep the default value.



Value	Regenerative resistance
0	No attaching
1	Attaching

● Details of display

1st digit: [n: Regenerative resistance]
Decimal point of 2nd digit: parameter mode
3rd to 5th digit: No indication
6th digit: Indicates current value.

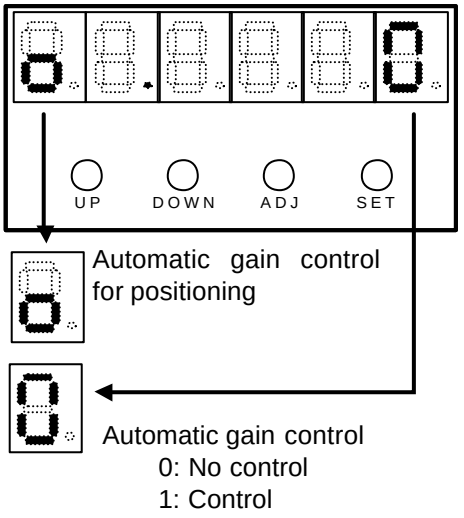
● Operation

(1) To change a value, press the [ADJ] key at least 0.1 second.
⇒1st digit [n] flashes. You can change the value.
(2) Set [0] or [1] with the keys of [UP] and [DOWN].
(3) To define the new value, press the [SET] key at least 0.1 second.
⇒ Flashing of 1st digit [n] stops and the new value is defined.
(4) To cancel a change in operation, press the [ADJ] key at least 0.1 second.
⇒Flashing of 1st digit [n] stops and the previous value becomes effective.

[Parameter mode]

Automatic gain control (for HA-655-1 only) (position)

● Function



HA-675-1 drivers for FHA-C mini series actuators (FHA-8C/11C/14C) provide an automatic speed-gain control function for positioning. To get short period for positioning, the function automatically makes speed loop gain higher when an error pulse number becomes small.

For the reason that the speed loop gain is proportionate to error pulse number (refer to 2-3 tuning servo gains), 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 [tune mode] →[0: speed loop gain] is higher than the automatic gain, the registered gain has priority.

Value	Automatic gain control
0	No control
1	Control

The automatic gain control function is not provided for other actuators than FHA-C mini series.

● Details of display

1st digit: [o: Automatic gain control]
Decimal point of 2nd digit: parameter mode
3rd to 5th digit: No indication
6th digit: Indicates current value.

● Operation

(1) To change a value, press the [ADJ] key at least 0.1 second.
⇒1st digit [o] flashes. You can change the value.
(2) Set [0] or [1] with the keys of [UP] and [DOWN].
(3) To define the new value, press the [SET] key at least 0.1 second.
⇒ Flashing of 1st digit [o] stops and the new value is defined.
(4) To cancel a change in operation, press the [ADJ] key at least 0.1 second.
⇒Flashing of 1st digit [o] stops and the previous value becomes effective.

[Parameter mode]

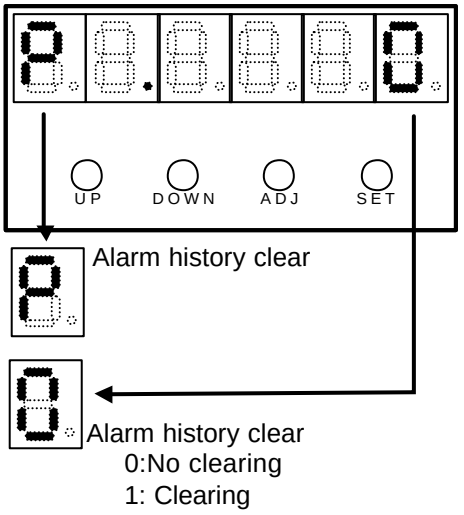
Alarm history clear (position/speed mode)

● Function

It is possible to clear an alarm history during trouble shooting.

To clear it, set [1] for the parameter, and shut off power supply and turn it on again.

The value returns to [0] automatically after rebuilding the power supply.



Value	Alarm history clear
0	No clearing
1	Clearing

● Details of display

1st digit: [P: Alarm history clear]

Decimal point of 2nd digit: parameter mode

3rd to 5th digit: No indication

6th digit: Indicates current value.

● Operation

(1) To change a value, press the [ADJ] key at least 0.1 second.
⇒1st digit [P] flashes. You can change the value.

(2) Set [0] or [1] with the keys of [UP] and [DOWN].

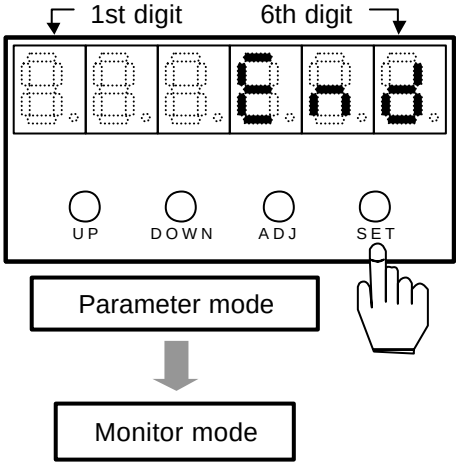
(3) To define the new value, press the [SET] key at least 0.1 second.
⇒ Flashing of 1st digit [P] stops and the new value is defined.

(4) To cancel a change in operation, press the [ADJ] key at least 0.1 second.
⇒Flashing of 1st digit [P] stops and the previous value becomes effective.

End of parameter mode

● Function

This terminates the [parameter mode] and returns to the [monitor mode]. Indicating [End] and pressing the [SET] key returns you to the [monitor mode].



● Details of display

1-3rd digit: No indication
4-6th digit: indicates [End].

● Operations

To terminate the [parameter mode] and to return to the [monitor mode], press [SET] with [End] indicated.
⇒ The parameter mode returns to the [monitor mode].

6-7 Test mode

The test mode consists of required functions for system test, such as JOG operation functions, operations of pseudo output signals, and I/O signal monitors.

WARNING

1. Turn OFF the servo power surely before transferring to the test mode.

Transferring to the test mode, while the servo power is ON state, turns OFF the servo power. This may result in accidents that may cause physical injury and fire.

2. Before transferring to the test mode, make the value in the error counter [0: zero] inputting ON signal to [CN2 clear: CLEAR].

Transferring to the test mode, the servo power turns ON automatically. For safety, input ON signal to [CN2 clear: CLEAR] to make the value in the error

The [test mode] indicates and operates the following items:

Mode	Code	Function	Setting & operation
Test mode	Jo	JOG operation	Possible
	SP	JOG speed	Possible
	Ac	JOG acceleration	
	rdy & etc.	Output port operation	Possible
	c	I/O port monitor	impossible
	An	Analog monitor manual output	Possible

6-7-1 Operation in the test mode

● Selecting operations of function items

(1) To enter the [test mode] from the [monitor mode], press the [SET] key for three seconds or more.

⇒Enters [test mode] when there is no indication on 4 －6th digit.

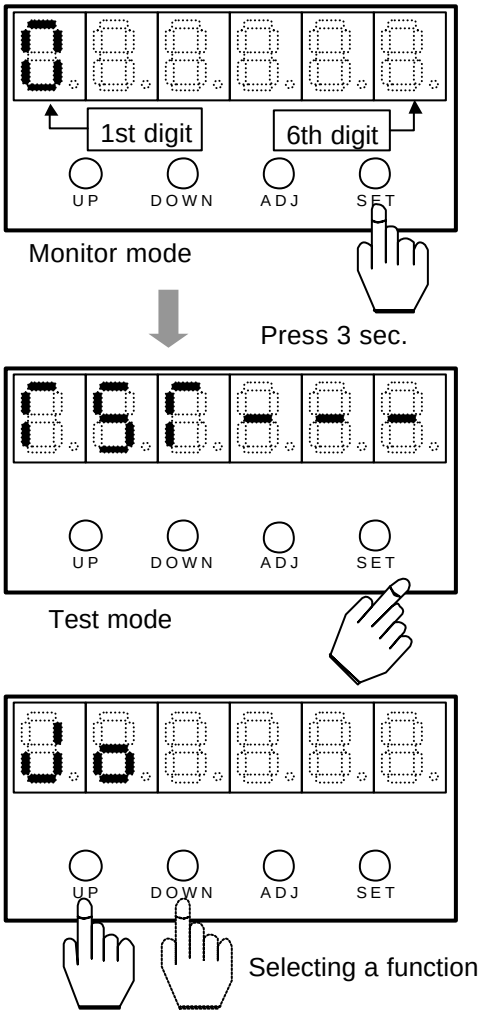
(2) Press the [UP] or [DOWN] key to change the functional items of the [test mode]

⇒ Every time you press the [UP] key it shifts a code of the first digit one by one from [Jo] to [An], and indicates a value corresponding to the code.

⇒Every time you press the [DOWN] key it shifts a code of the first digit one by one from [An to [Jo], and indicates a value corresponding to the code.

● Function

(1) During [test mode] entering:
1-3rd digit: indicates [TST].
4-6th digit: Indicates [－]during entering, and no indication after entering.
(2) During [test mode]:
1-2nd digit: Codes in the mode



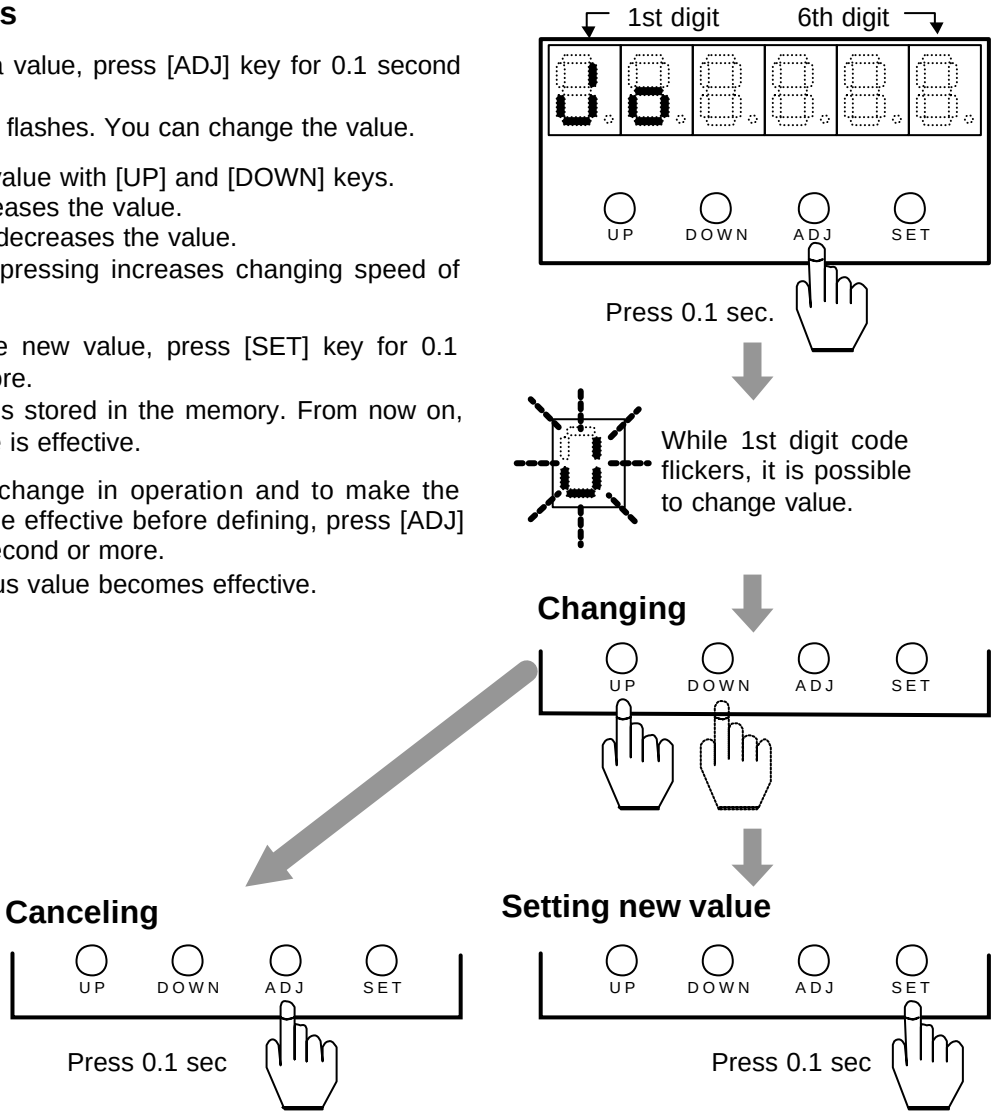
● Operations

(1) To change a value, press [ADJ] key for 0.1 second or more.
⇒1st digit [0] flashes. You can change the value.

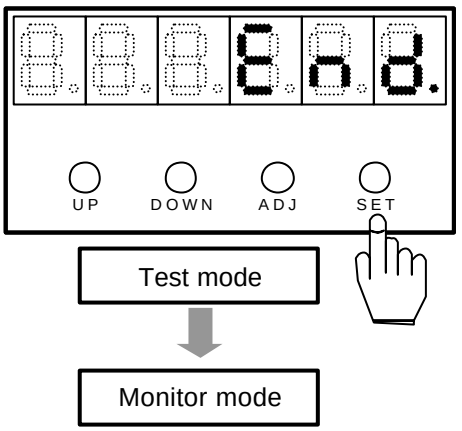
(2) Change the value with [UP] and [DOWN] keys.
[UP] key increases the value.
[DOWN] key decreases the value.
Keeping key pressing increases changing speed of the value.

(3) To define the new value, press [SET] key for 0.1 second or more.
⇒The value is stored in the memory. From now on, the new value is effective.

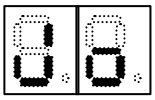
(4) To cancel a change in operation and to make the previous value effective before defining, press [ADJ] key for 0.1 second or more.
⇒The previous value becomes effective.



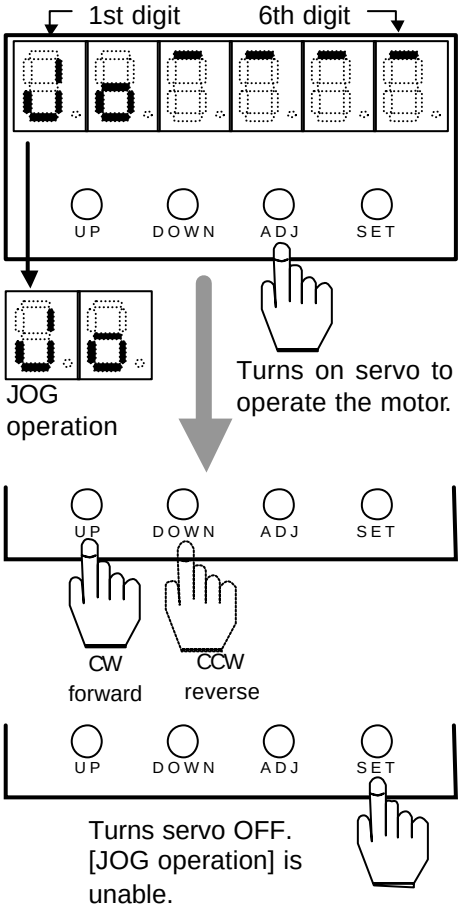
(5) To transfer to the [monitor mode] from the test mode, press the [SET] key after displaying the [END].
⇒ The monitor mode begins.



6-7-2 Functions of test mode



JOG operation



● Function

Pressing [UP] or [DOWN] key rotates the motor with the speed of [test mode]→[SP:JOG speed].

● Details of display

1st and 2nd digit: [Jo: JOG operation]
3rd to 6th digit: No indications

● Operations

WARNING

Before JOG operation, make sure load conditions and motor/ encoder cable installations are correct.

Activating JOG operation mode turns servo ON automatically. Improper load and poor cable installation may result in accidents that may cause physical injury and fire.

CAUTION

Before transferring to the test mode, make the value in the error counter [0: zero] inputting ON signal to [CN2 clear: CLEAR].

Transferring to the test mode, the servo power turns ON automatically. For safety, input ON signal to [CN2 clear: CLEAR] to make the value in the error counter [0: zero] before transferring to the test mode from monitor mode.

CAUTION

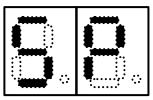
1. During JOG operations, no signals output to speed monitor nor current monitor.
2. During JOG operation, position is not controlled because the position mode is switched to the speed mode. Stopped position may shift by external torque and force, and during long unconcerned period.

(1) To transfer to in [JOG operation] mode, Press the [ADJ] key at least 0.1 second.
⇒1st digit [J] flashes and servo turns ON automatically. ⇒JOG operation is available.
(2) To operate the motor forward, press the [UP] key.
⇒The motor will rotate when the key is pressed, and will stop when the key is left.
(3) To operate the motor reverse, press the [DOWN] key.
⇒The motor will rotate when the key is pressed, and will stop when the key is released.
(4) To exit from [JOG operation] mode, press the [SET] key at least 0.1 second.
⇒Flashing of 1st digit [J] stops, servo turns OFF automatically, and [JOG operation] mode terminates.

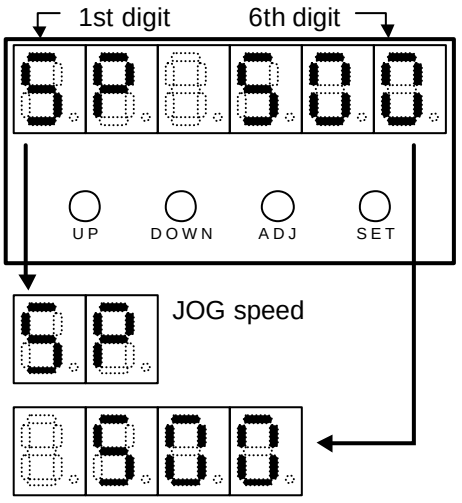
● Related functions

[JOG speed]: [test mode]→[SP: JOG speed]
[JOG acceleration]: [test mode]→[Ac: JOG acceleration]

[Test mode]



JOG speed



Indicates current [JOG speed].
Unit: r/min; 10r/min step
Range: 100 to motor max. speed

● Function

The motor speed in [JOG operation] mode is set in [10r/min] increments. The unit is [r/min].

After re-powering, the value returns to the default of [10].

● Details of display

1-2nd digit: [SP: JOG speed]
3-6th digit: [JOG speed]; unit: r/min

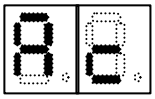
● Operations

(1) To set [JOG speed], press [ADJ] key for more than 0.1second or more.
⇒1st digit [S] flashes. You can change the value.

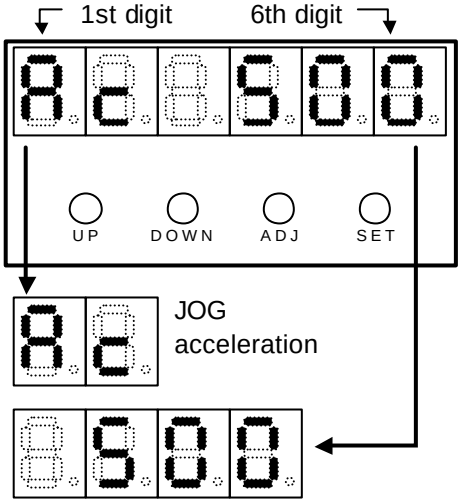
(2) To set [JOG speed] press [UP] to increase the value, or [DOWN] key for decrease it.

(3) To define the new value, press [SET] key for 0.1 second or more.
⇒ Flashing of 1st digit [S] stops and the new value is defined.

(4) To cancel a change in operation, press [ADJ] key for 0.1 second or more.
⇒Flashing of 1st digit [S] stops and the previous value becomes effective.



JOG acceleration



Indicates current [JOG acceleration]
Unit: msec

● Function

The motor acceleration and deceleration in [JOG operation] mode is set by the accelerating time from [0] to [JOG speed] in [100msec] unit.
After re-powering, the value returns to the default of [1].

● Details of display

1-2nd digit: [Ac: JOG acceleration]
3-6th digit: [JOG accelerating time]; unit: msec

Operations

(1) To set [JOG acceleration], press [ADJ] key for more than 0.1second or more.
⇒1st digit [A] flashes. You can change the value.

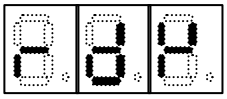
(2) To set [JOG acceleration] press [UP] to increase the value, or [DOWN] key for decrease it.

(3) To define the new value, press [SET] key for 0.1 second or more.
⇒ Flashing of 1st digit [A] stops and the new value is defined.

(4) To cancel a change in operation, press [ADJ] key for 0.1 second or more.
⇒Flashing of 1st digit [A] stops and the previous value becomes effective.

● Related functions

[JOG operation]: [test mode]→[Jo: JOG operation]
[JOG speed]: [test mode]→[SP: JOG speed]



[Test mode]

Output port operation

● Function

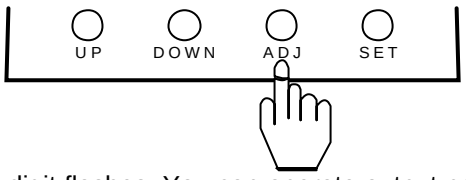
It is possible to operate turn (ON/OFF) output ports manually.

● Details of display

1-3rd digit: indicates the code for the output port.
4-6th digit: indicates current state of the port.

● Operations

(1) To operate output ports, press [ADJ] key for 0.1second or more.

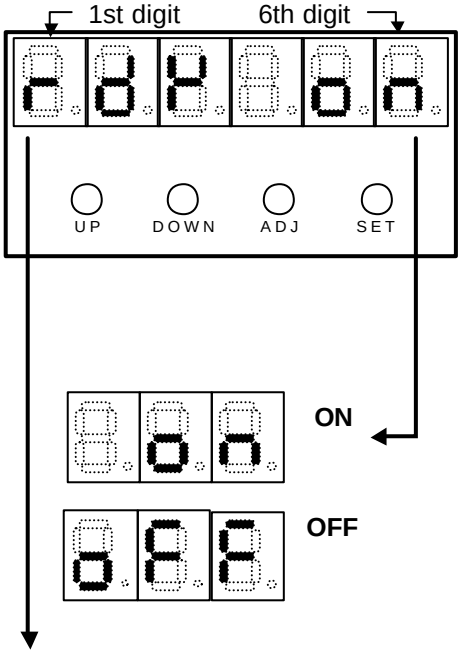


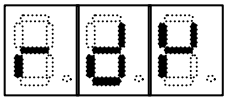
⇒1st digit flashes. You can operate output ports.
(Pressing [ADJ] key for 0.1 second or more again inhibits [output port operation].

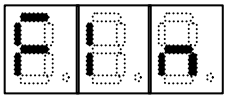
(2) Press [UP] key to specify an output port to be operated.
⇒Every time you press it shifts the code number in the order of the figures to the right.

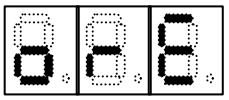
(3) Press [DOWN] key to operate ON/OFF the selected port.
⇒Every time you press the change the port state (ON→OFF→ON→).

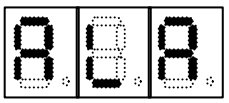
(4) To terminate the output port operation, press [SET] key for 0.1 second or more.
⇒ Flashing of 1st digit stops and [output port operation] is inhibited.

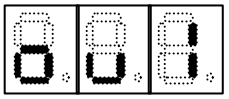


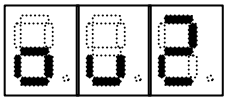

Ready
READY: CN2-33

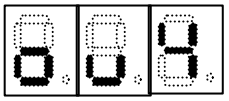

Motion finish
FINISH:CN2-34

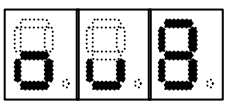

Originated
ORG-END:CN2-35

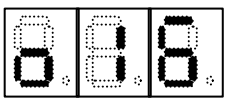

Alarm
ALARM:CN2-36

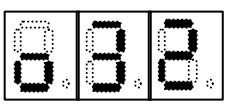

Output bit 1
OUT-DATA1:CN2-37


Output bit 2
OUT-DATA2:CN2-38


Output bit 4
OUT-DATA4:CN2-39


Output bit 8
OUT-DATA8:CN2-40


Output bit 16
OUT-DATA 16:CN2-41


Output bit 32
OUT-DATA32:CN2-42

[Test mode]

I/O monitor

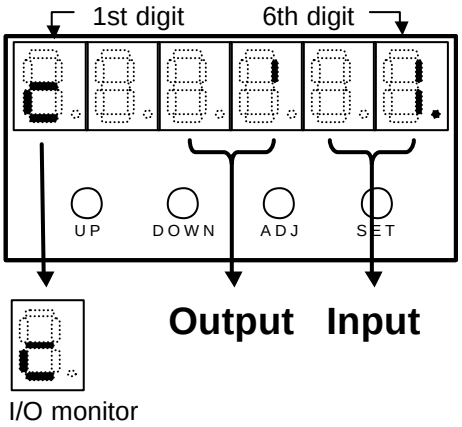
● Function

The display indicates input/output signal states of [CN2] connector pins as follows:

Output signals: Third and forth igits
Input signals: Fifth and sixth digits

Each element of 7-segment indicators lights up when the related signal is input or output.

The indications are limited only for logical signals, not for encoder signals.

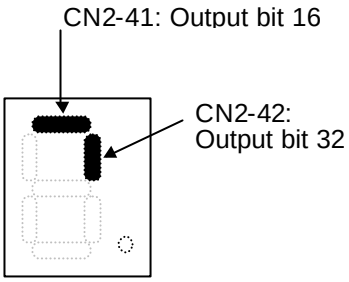


● Details of display

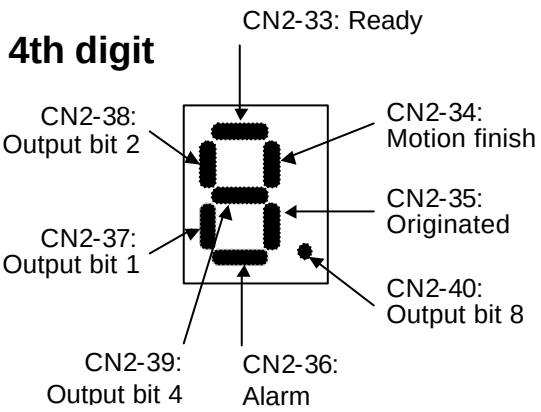
1st digit: [c:I/O monitor]
2nd digit: No indication
3-4th digit: Indicates output signal states
5-6th digit: Indicates input signal states

Output

3rd digit

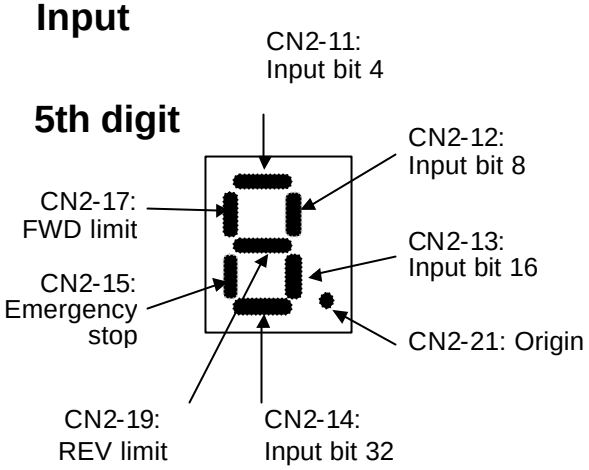


4th digit

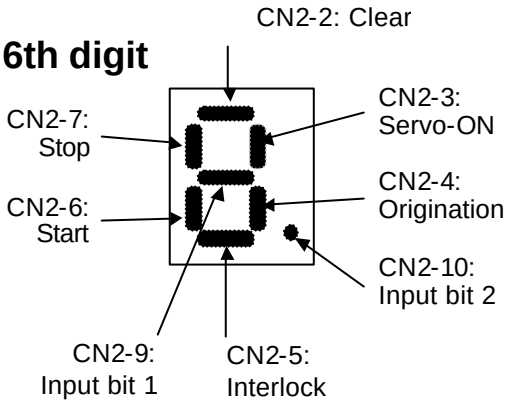


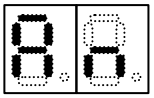
Input

5th digit



6th digit





[Test mode]

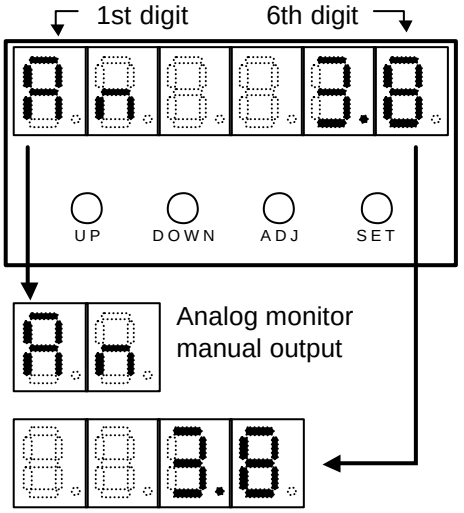
Analog monitor manual output

● Function

It is possible to output voltage signals manually through the monitor ports.

Do not use this [analog monitor manual output] function for controlling servo systems.
The function is provided only for checking wire installation, and the output voltage may have too big error to control servo systems.

CAUTION



Two analog ports are provided for monitoring.

[CN2-23 Speed monitor: SPD-MON]

CN2-24 Current monitor: CUR-MON]

● Details of display

1-2nd digit: [An: analog monitor manual output]
3-6th digit: indicates current output voltage.

Indicates current output voltage
Unit: 0.1V
Range: -10V to +10V

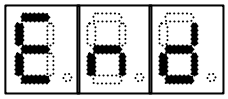
● Operations

(1) To transfer to in the [analog monitor manual output] mode, press the [ADJ] key at least 0.1 second.
⇒The 1st digit [A] flashes, then you can output voltage signals.
(Pressing the [ADJ] key at least 0.1 second again inhibits the [analog monitor manual output].

(2) To output voltage from [speed monitor: SPD-MON (CN2-23pin)], press the [UP] key.
⇒While pressing, the pin continues to output varying voltage signal within the range of [-10V] to [+10V].Ending the pressing keeps output voltage continuously.

(3) To output voltage from [current monitor: CUR-MON (CN2-24pin)], press the [DOWN] key.
⇒While pressing, the pin continues to output varying voltage signal within the range of [-10V] to [+10V].Ending the pressing keeps output voltage continuously.

(4) To terminate [analog monitor manual output] operation, press the [SET] key at least 0.1 second.
⇒ Flashing of 1st digit stops, [analog monitor manual output] operation is inhibited, and the value returns to the default of [0].



End of test mode

● Function

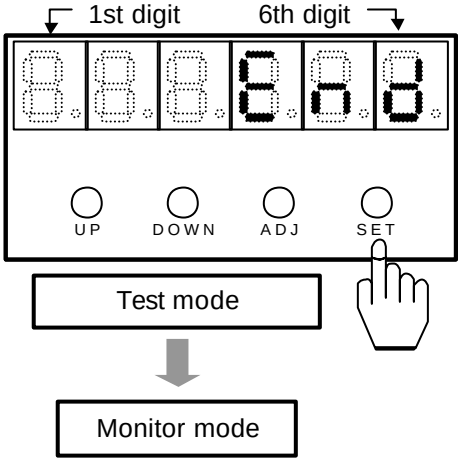
This terminates the [test mode] and returns to the [monitor mode]. Indicating [End] and pressing the [SET] key returns you to the [monitor mode].

● Details of display

1-3rd digit: No indication
4-6th digit: Indicates [End]

● Operations

To terminate the [test mode] and to return to the [monitor mode], press [SET] with [End] indicated.
⇒ The test mode returns to the [monitor mode].



6-8 Defaults of parameters

The following table shows the defaults of the parameters:

● For incremental system (power supply voltage: 200V) INC

Mode	Code	Parameter	Actuator (voltage: 200V)								
			FHA-8C		FHA-11C		FHA-14C		FHA-17C		
			-50-E250	-100-E250	-50-E250	-100-E250	-50-E250	-100-E250	-50-E250	-100-E250	-160-E250
Tune mode	0	Speed loop gain	3.5	3.5	3.5	4.0	4.0	4.0	8.0	8.0	8.0
	1	S-loop integral compensation	20	20	20	20	20	20	20	20	20
	2	Position loop gain	40	40	40	40	40	40	40	40	40
	4	In-position range	10	10	10	10	10	10	10	10	10
	A	Speed monitor offset	Adjusted at shipping								
	b	Current monitor offset	Adjusted at shipping								
	5	Error count cleared by S-ON	0	0	0	0	0	0	0	0	0
	6	Position error allowance	100	100	100	100	100	100	100	100	100
	A	Speed limit	6500	6500	6500	6500	6500	6500	6500	6500	6500
	b	Torque limit	100	100	100	100	100	100	100	100	100
	c	Alarm logic	0	0	0	0	0	0	0	0	0
	G	Machine origin	0	0	0	0	0	0	0	0	0
	H	ABS ABS send data timing	0	0	0	0	0	0	0	0	0
	I	ABS Low battery voltage alarm	0	0	0	0	0	0	0	0	0
	n	Regenerative resistance	0	0	0	0	0	0	0	0	0
	o	Automatic gain control	1	1	1	1	1	1	1	1	1
	P	Alarm history clear	0	0	0	0	0	0	0	0	0

Mode	Code	Parameter	Actuator (voltage: 200V)								
			FHA-25C			FHA-32C			FHA-40C		
			-50-E250	-100-E250	-160-E250	-50-E250	-100-E250	-160-E250	-50-E250	-100-E250	-160-E250
Tune mode	0	Speed loop gain	50	50	50	80	80	80	120	120	120
	1	S-loop integral compensation	40	40	50	40	40	40	40	40	40
	2	Position loop gain	40	40	40	40	40	40	40	40	40
	4	In-position range	10	10	10	10	10	10	10	10	10
	A	Speed monitor offset	Adjusted at shipping								
	b	Current monitor offset	Adjusted at shipping								
	5	Error count cleared by S-ON	0	0	0	0	0	0	0	0	0
	6	Position error allowance	100	100	100	100	100	100	100	100	100
	A	Speed limit	4600	4600	4600	4100	4100	4100	3600	3600	3600
	b	Torque limit	100	100	100	100	100	100	100	100	100
	c	Alarm logic	0	0	0	0	0	0	0	0	0
	G	Machine origin	0	0	0	0	0	0	0	0	0
	H	ABS ABS send data timing	0	0	0	0	0	0	0	0	0
	I	ABS Low battery voltage alarm	0	0	0	0	0	0	0	0	0
	n	Regenerative resistance	0	0	0	0	0	0	0	0	0
	o	Automatic gain control	1	1	1	1	1	1	1	1	1
	P	Alarm history clear	0	0	0	0	0	0	0	0	0

● For incremental system (power supply voltage: 100V) INC

Mode	Code	Parameter	Actuator (voltage: 100V)								
			FHA-8C		FHA-11C		FHA-14C		FHA-17C		
			-50-E250-A	-100-E250-A	-50-E250-A	-100-E250-A	-50-E250-A	-100-E250-A	-50-E250-A	-100-E250-A	-160-E250-A
Tune mode	0	Speed loop gain	3.5	3.5	3.5	4.0	4.0	4.0	8.0	8.0	8.0
	1	S-loop integral compensation	20	20	20	20	20	20	20	20	20
	2	Position loop gain	40	40	40	40	40	40	40	40	40
	4	In-position range	10	10	10	10	10	10	10	10	10
	A	Speed monitor offset	Adjusted at shipping								
	b	Current monitor offset	Adjusted at shipping								
Parameter mode	5	Error count cleared by S-ON	0	0	0	0	0	0	0	0	0
	6	Position error allowance	100	100	100	100	100	100	100	100	100
	A	Speed limit	6500	6500	6500	6500	6500	6500	6500	6500	6500
	b	Torque limit	100	100	100	100	100	100	100	100	100
	c	Alarm logic	0	0	0	0	0	0	0	0	0
	G	Machine origin	0	0	0	0	0	0	0	0	0
	H	ABS ABS send data timing	0	0	0	0	0	0	0	0	0
	I	ABS Low battery voltage alarm	0	0	0	0	0	0	0	0	0
	n	Regenerative resistance	0	0	0	0	0	0	0	0	0
	o	Automatic gain control	1	1	1	1	1	1	1	1	1
	P	Alarm history clear	0	0	0	0	0	0	0	0	0

Mode	Code	Parameter	Actuator (voltage: 100V)					
			FHA-25C			FHA-32C		
			-50-E250-A	-100-E250-A	-160-E250-A	-50-E250-A	-100-E250-A	-160-E250-A
Tune mode	0	Speed loop gain	50	50	50	120	120	120
	1	S-loop integral compensation	40	40	50	40	40	40
	2	Position loop gain	37	37	37	50	50	50
	4	In-position range	10	10	10	10	10	10
	A	Speed monitor offset	Adjusted at shipping					
	b	Current monitor offset	Adjusted at shipping					
Parameter mode	5	Error count cleared by S-ON	0	0	0	0	0	0
	6	Position error allowance	100	100	100	100	100	100
	A	Speed limit	4600	4600	4600	4100	4100	4100
	b	Torque limit	100	100	100	100	100	100
	c	Alarm logic	0	0	0	0	0	0
	G	Machine origin	0	0	0	0	0	0
	H	ABS ABS send data timing	0	0	0	0	0	0
	I	ABS Low battery voltage alarm	0	0	0	0	0	0
	n	Regenerative resistance	0	0	0	0	0	0
	o	Automatic gain control	1	1	1	1	1	1
	P	Alarm history clear	0	0	0	0	0	0

● For absolute system (power supply voltage: 200V) ABS

Mode	Code	Parameter	Actuator (voltage: 200V)											
			FHA-17C			FHA-25C			FHA-32C			FHA-40C		
			-50-S248	-100-S248	-160-S248	-50-S248	-100-S248	-160-S248	-50-S248	-100-S248	-160-S248	-50-S248	-100-S248	-160-S248
Tune mode	0	Speed loop gain	25	25	25	50	50	50	80	80	80	120	120	120
	1	S-loop integral compensation	40	40	40	40	40	50	40	40	40	40	40	40
	2	Position loop gain	40	40	40	40	40	40	40	40	40	40	40	40
	4	In-position range	10	10	10	10	10	10	10	10	10	10	10	10
	A	Speed monitor offset	Adjusted at shipping											
	b	Current monitor offset	Adjusted at shipping											
Parameter mode	5	Error count cleared by S-ON	0	0	0	0	0	0	0	0	0	0	0	0
	6	Position error allowance	100	100	100	100	100	100	100	100	100	100	100	100
	A	Speed limit	5000	5000	5000	4600	4600	4600	4100	4100	4100	3600	3600	3600
	b	Torque limit	100	100	100	100	100	100	100	100	100	100	100	100
	c	Alarm logic	0	0	0	0	0	0	0	0	0	0	0	0
	G	Machine origin	0	0	0	0	0	0	0	0	0	0	0	0
	H	ABS send data timing	0	0	0	0	0	0	0	0	0	0	0	0
	I	ABS Low battery voltage alarm	0	0	0	0	0	0	0	0	0	0	0	0
	n	Regenerative resistance	0	0	0	0	0	0	0	0	0	0	0	0
	o	Automatic gain control	1	1	1	1	1	1	1	1	1	1	1	1
	P	Alarm history clear	0	0	0	0	0	0	0	0	0	0	0	0

● For absolute system (power supply voltage: 100V) ABS

Mode	Code	Parameter	Actuator (voltage: 100V)								
			FHA-17C			FHA-25C			FHA-32C		
			-50-S248-A	-100-S248-A	-160-S248-A	-50-S248-A	-100-S248-A	-160-S248-A	-50-S248-A	-100-S248-A	-160-S248-A
Tune mode	0	Speed loop gain	50	50	50	50	50	50	120	120	120
	1	S-loop integral compensation	40	40	40	40	40	40	40	40	40
	2	Position loop gain	40	40	40	37	37	37	50	50	50
	4	In-position range	10	10	10	10	10	10	10	10	10
	A	Speed monitor offset	Adjusted at shipping								
	b	Current monitor offset	Adjusted at shipping								
Parameter mode	5	Error count cleared by S-ON	0	0	0	0	0	0	0	0	0
	6	Position error allowance	100	100	100	100	100	100	100	100	100
	A	Speed limit	5000	5000	5000	4600	4600	4600	4100	4100	4100
	b	Torque limit	100	100	100	100	100	100	100	100	100
	c	Alarm logic	0	0	0	0	0	0	0	0	0
	G	Machine origin	0	0	0	0	0	0	0	0	0
	H	ABS send data timing	0	0	0	0	0	0	0	0	0
	I	ABS Low battery voltage alarm	0	0	0	0	0	0	0	0	0
	n	Regenerative resistance	0	0	0	0	0	0	0	0	0
	o	Automatic gain control	1	1	1	1	1	1	1	1	1
	P	Alarm history clear	0	0	0	0	0	0	0	0	0

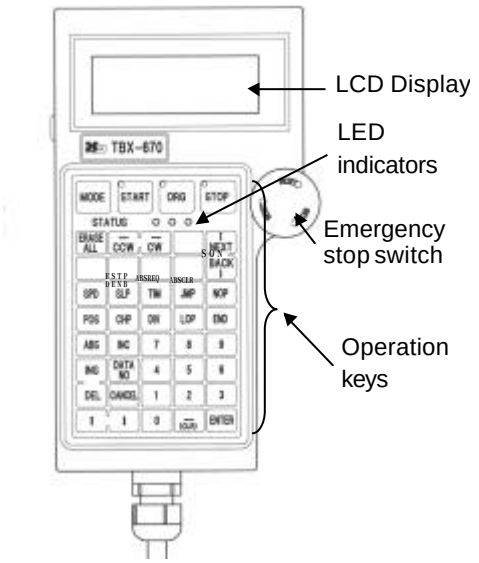
Chapter 7 Operations of the teach-box

The teach-box creates motion programs and sets parameter values.

7-1 Outlines of the teach-box

The teach-box equips a LCD display of 4 lines by 20 digits, a push-lock emergency-stop switch, 44 operation keys, and three LED indicators. The display and operation keys create all motion programs for the HA-675 driver.

The figure to the right shows the external view of the teach-box.



◆ Display

The LCD display indicates information with alphanumeric letters with four lines by 20 digits.

Upper three lines indicate commands and data, and the lowest line indicates the operation mode, the unit of the data and the address.

◆ LED indicators

Three red LEDs indicate the current operation mode.
Left: Program mode
Center: Test mode
Right: Parameter mode

◆ Operation keys

All programs are created with forty-four keys of 5 rows by 8 lines and 4. On the key faces, instruction codes and numerals for operation are marked. Each code on a key face is same as the indicating code.

◆ Emergency stop switch

The red mushroom switch is provided for emergency stop operation. Pressing the switch turns the state of the HA-675 driver to the same state of signal inputting (OFF) to [CN2-15, -16: emergency stop].

To recover from the emergency stop state, turn the switch to right (clockwise) to release the emergency signal, and input [ON] signal to [CN2-2 clear: CLEAR] or re-energize the HA-675 driver.

7-2 Attaching and detaching the teach-box

Attach or detach the teach-box before turning ON the control power of the HA-675 driver or during OFF state of the servo power.

● Attaching the teach-box

(1) To use the tech-box to the HA-675 driver, connect the connector of the teach-box to CN3 socket of the driver.
⇒The display to the right will appear on the LCD display.

AC Servo Controller
HA-675 Ver __. __
Harmonic Drive Systems

● Detaching the teach-box

(1) Press the [ESTP DENB] and the [ENTER] keys sequentially.
⇒The teach-box makes "pee…" sound.
Note: Do not carry out this operation except for detaching a teach-box.

(2) Pull out the connector of the teach-box from CN3 socket of the driver.
Note: The [alarm 01: emergency stop] occurs at pulling out the connector without the HA-675 operation of item (1). To recover from the state, input a signal to [CN2-2 clear: CLEAR] port.

7-3 Operation keys

The teach-box provides three operation modes: [program], [test] and [parameter]. The functions of a key are different by the modes. The relation between keys and functions are as follows:

Key	Operation mode		
	Program mode	**Test mode**	**Parameter mode**
MODE	Specifies a mode from program, test, and parameter modes. Every pressing shifts the mode cyclically like program⇒test⇒parameter⇒program⇒… The LCD display or the LED indications indicate the current mode. Program mode: DSET; Left LED Test mode: TEST; Center LED Parameter mode: PSET; Right LED		
START	Starts the programmed actuator motion at the displaying address.	Starts the actuators motion in parameter specified mode. OPM-0: individual positioning OPM-1: sequential positioning OPM-2: programmed motion	
ORG	The actuator starts for the origin. The originating speed and acceleration are set by [RSP: originating speed 1][RS2: originating speed 2][RAD: originating accelerating time] of [parameter mode]. Keeping the key pressing sets the current position as the origin. When the origin is set by this way, make the actuator free in rotation. (This function will be available when [NRT: software origin] in parameter mode is set.)		
STOP	Stops the actuator.		
ERASE ALL	Pressing this key after [ENTER] erases all command data in the HA-675 driver. To cancel the erasing after pressing the key, press [CANCEL].		
←CCW CW→	Both keys adjust the position precisely.	Moves the actuator by JOG operation.	Both keys adjust the software origin precisely.
SON	This turns the servo power for the HA-675 driver ON and OFF. For the absolute system and the [system parameter] →[H: data send timing] is set [0], transmitting the position data to a host is required before turning on the servo power.		
ESTP DENB	Before disconnecting the teach-box from the HA-675 driver, it is required to press the [ESTOP-DENB] and [ENTER] keys in the order. Without the operation, disconnecting the teach-box causes the [alarm 01: emergency stop].		
ABS ABSREQ	This is used for a command to output a current resolving count of the encoder. The phase-A (pins 44 and 45) and phase-B (pins 46 and 47) output the current count. The function is available only one time after power ON.		
ABS ABSCLR	At the first power supplying after connecting with a FHA-C actuator or at events of alarms [53: ABS system failure], [54: revolution counter overflow] and [55: revolution count error], the key clears the revolution counter by pressing the key for around five seconds until making peee sound. The operation is ignored during the servo power is active. Careful attentions are required to the operation, because the absolute encoder loses position data by the operation.		
SPD	Sets actuator speed.		
SLP	Sets acceleration time.		
TIM	Sets a delay time of output [CN2-34: motion finish] after positioning.		
JMP	Sets an address to jump.		
NOP	No operation.		

Key	Mode		
	Program mode	**Test mode**	**Parameter mode**
POS	Sets a stop position.		
CHP	Sets a speed changing position.		
DIV	Divides equally a positional value of POS command.		
LOP	Repeats the motion from specified address to the preceding address having LOP.		
END	End of a motion program.		
ABS	Indicates position by the absolute system.		
INC	Indicates position by the incremental system.		
INS	Inserts an address.		
DATA NO	Specifies an address.	Specifies an address when [individual positioning] is specified.	
DEL	Pressing [ENTER] key after this [DEL] key erases the command data at indicating address. To cancel the erasing operation after pressing [DEL] key, press [CANCEL] key.		
CANCEL	Cancels preceding operation.		
0 to 9	Input numerals.		
↑ **NEXT**	Steps forward by an address.	Steps forward by an address when [individual positioning] is specified.	
↓ **BACK**	Steps backward by an address.	Steps backward by an address when [individual positioning] is specified.	
↑ ↓	These [cursor keys] scrolls indications.		
___ **(CLR)**	This works as the minus key or clears a command. Pressing [ENTER] key after this key erases the command data under the cursor. To cancel the operation after pressing the key, press [CANCEL] key.		
ENTER	Defines command inputting, inserting and erasing operation. While an address and command data are indicating, pressing this key stores the data in the EEPROM of the HA-675 driver.		

Note 1: Key operation except [STOP] key is ignored while the actuator is moving.

Note 2: Press keys one by one steadily. Pressing two or more keys may indicate “Over-run Error” on the teach box, because of impossibility for processing, and key operations are ignored.

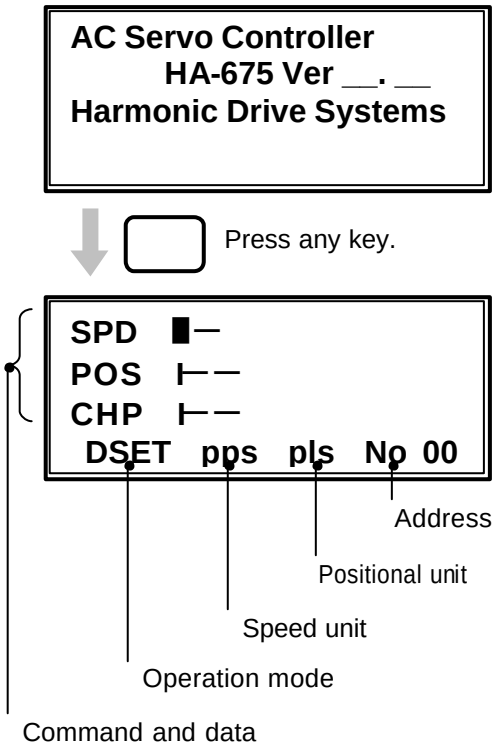
7-4 Outlines of indications

After connecting the teach-box to the HA-675 driver, the display indicates the messages shown in the figure to the right. Then the teach-box becomes active.

Pressing any key of teach-box changes the indication shown in the figure to the right. After changing the message, operation by the teach-box becomes possible.

The LCD display indicates information with alphanumeric letters with four lines by 20 digits.

Upper three lines indicate commands and data, and the lowest line indicates the operation mode, the unit of the data and the address.



◆ Indicating commands and data

The data under the cursor [▮] is able to be edited.

The [↑][↓] keys (cursor keys) on the bottom line of the teach-box scroll up and down the cursor.

◆ Operation mode

Three modes are provided for teach-box operation as follows:

PSET: Parameter mode
DSET: Program mode
TEST: Test mode

[MODE] key selects a mode.

The commands and data corresponding to the mode are indicated on upper three lines.

◆ Speed unit

This indicates a unit of actuator speed.

pps: speed command pulses per one second (p/s)
rpm: actuator's revolution per one minute (r/min)

◆ Positional unit

This indicates a unit of position.

pls: pulse

deg: angular unit of 1/1000 °

mm: linear unit of 1/100mm

◆ Address

This indicates an address number from [00] から [63]. Up to 64 positions are possible to be programmed.

7-5 Operations of teach-box

7-5-1 Common operations

● Selecting an operation mode

Every pressing the [MODE] key of the teach-box shifts modes cyclically.

◆ Program mode

```
SPD  ▮–
POS  ⊢ –
CHP  ⊢ –
 DSET  pps  pls  No 00
```

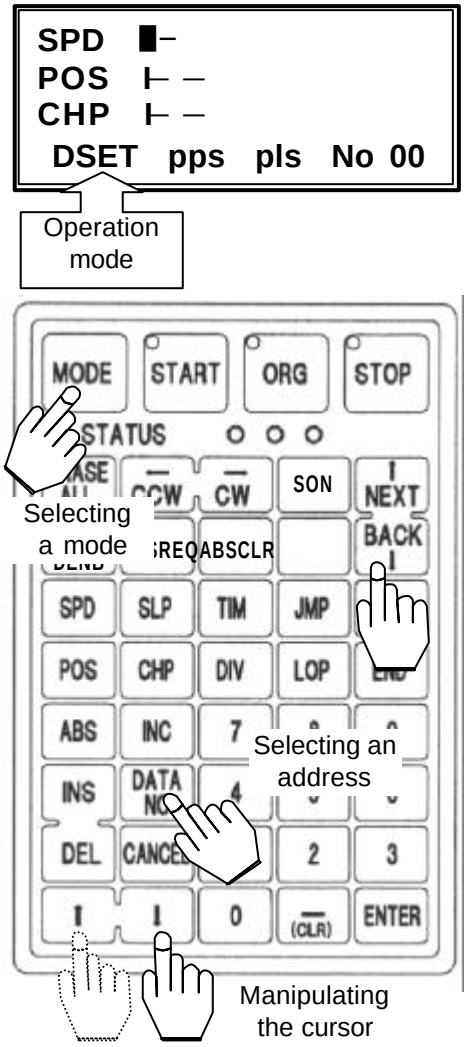
◆ Test mode

```
Target No 00


 TEST
```

◆ Parameter mode

```
ASP  ▮
BLR  0
OPM  0
 PSET
```



● Manipulating the cursor

The cursor is provided to select a command with the [↑][↓] keys.

The [↑] key moves the cursor upward, and makes the upper part of the indication appear.
The [↓] key moves the cursor downward, and makes the lower part of the indication appear.

● Entering and erasing command data

◆ Selecting a command to input data

Two ways are provided to select a command for data input in the [program mode] or in the [parameter mode].

(1) By cursor: place the cursor on the command by the [↑][↓] keys.

(2) By command keys: press the relating command key like the [SPD] key. The cursor moves to the corresponding command.

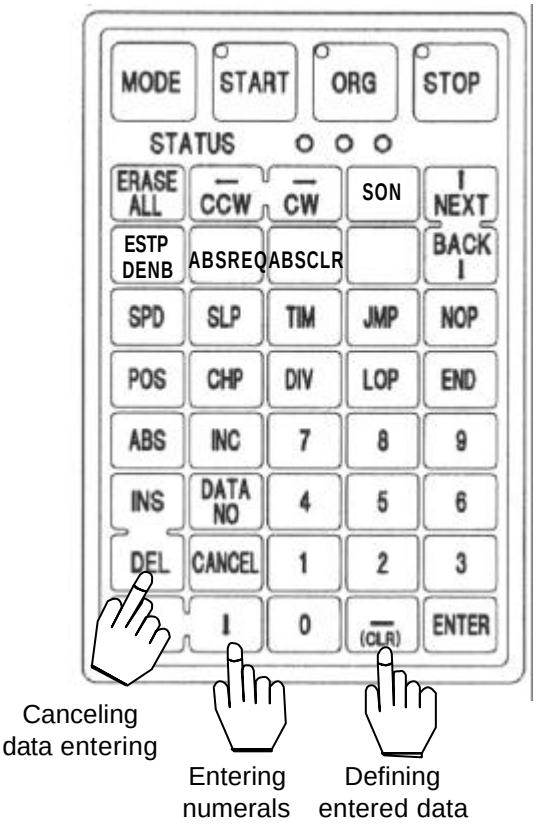
◆ Entering and defining data

(1) To enter the data to the command under the cursor, press numeral keys.
⇒Every pressing shifts the cursor rightward.

(2) To define newly entered data, press [ENTER] key.
⇒The data is defined and stored in the HA-675 driver.

◆ Canceling the data entering

(1) To cancel the data entering and recover the previous data before defining the entering data, press [CANCEL] key.



◆ Correcting the entered data

(1) To correct the entered data, press [—] and [ENTER] keys in the sequence.
⇒The entered data is erased.

(2) After the erasing old data, enter the correct data.

◆ Erasing defined data

(1) To erase the all defined data of the indicating address, press [DEL] key.
⇒The indication of [ERASE OK?] shown in the figure to the right will appears.

(2) Press [ENTER] key to erase them.
⇒All data of the address are erased.

(3) To cancel the erasing, press [CANCEL] key.

Note: It is impossible to erase addresses. Set [NOP] command for it.

◆ Erasing all defined data

(1) To erase all defined command data, press [ERASE ALL] key.
⇒The indication of [ALL ERASE OK?] shown in the figure to the right will appears.

(2) Press [ENTER] key to erase them. All defined data are erased. The erasing may spend around five seconds. Do not carry out any other key operation until the end of erasing.

(3) To cancel the erasing, press [CANCEL] key.

● Warning sound

If you get warning sounds while entering data, quit entering and reenter the correct data.

Long [peeee] sound: sounds for the data exceeding its limit.

Short [pee] sound: sounds for unacceptable keying to be neglected.

7-5-2 Operations for absolute system ABS

ABSCLR Revolution counter clear ABS

● Function

It is required to clear the [revolution counter] to zero at the origin at the events:

(1) after the first powering to the HA-675 driver, and

(2) after recovering from [alarm 53], [alarm 54] and [alarm 55].

This key clears the revolution counter manually.

● Operation

(1) To clear the revolution counter clears, press the key for around five seconds until making peee sound.
⇒ The count in the revolution counter is cleared to zero.

There are another ways to clear the counter:

◆ Inputting [CN2-30 revolution counter clear: ABS-CLEAR] for more than four seconds.

◆ Turning on the control power pressing both [ADJ] and [SET] keys of the HA-675 driver in same time, and making the value in the parameter [F or J: revolution counter clear] to zero.

Note 1: The clearing operation for the revolution counter does not make the position data to zero.
Note 2: Careful attentions are required to the operation, because the current position of the absolute encoder is changed by the operation.
Note 3: The operation is ignored during the servo power is active.

● Related functions

[CN2-30 revolution counter clear: ABS-CLEAR]

[Parameter mode]→[F or J: revolution counter clear]

ABSREQ Position data request ABS

● Function

It is necessary to transmit the position data to the host once after powering to the control circuit, whether the host needs the data. Without the data transmission, the HA-675 driver does not allow powering to its servo circuit.

When [H: ABS send data timing] of [parameter mode] is set [0], the pressing [ABSREQ] key transmits position data through [CN2-44 through 49: phase-A, -B, -Z]. Oppositely, [H: ABS send data timing] is set [1] (automatic transmitting after powering), pressing the key does not transmit the data, because the data have been transmitted at powering.

The function is available only one time after power ON. The data are not transmitted after transmitting data once or responding the [CN2-28: Position data request ABS-REQ].

● Related functions

[CN2-42 through 49: phase-A, -B, -Z]

[Parameter mode]→[H: ABS send data timing]

7-5-3 Turing servo power ON and OFF

SON

Servo-ON

This turns the servo power for the HA-675 driver ON and OFF.

Pressing [SON] key turns ON the servo power of the HA-675 driver to be possible to drive the actuator. Pressing the key while the servo power is active makes the servo power OFF, and the motor becomes free to rotate.

For the absolute system, if [parameter mode]→[H: ABS send data timing] of [parameter mode] is set [0], it is necessary to transmit the position data to the host by pressing [ABSREQ] key or other ways before turning the servo power ON. Oppositely, [H: ABS send data timing] is set [1] (automatic transmitting after powering), it is unnecessary to transmit the data again, because the data have been transmitted at powering automatically.

● Related functions

[CN2-2 servo ON: S-ON]

[CN2-42 through 49 phase-A, -B, -Z]

[Parameter mode]→[H: ABS send data timing]

7-6 Operation modes

Three modes are provided for teach-box operation as follows:

◆ Program mode

In the mode you can create motion programs using commands of position, speed, acceleration time, delay time, jump, indexing, repeat and so on.

◆ Test mode

In the test mode you can verify the programs created in the program mode. It is possible to confirm positions, to observe sequential motions at every address, and to test programs continuously.

◆ Parameter mode

The mode allows setting parameters required for originating, units of speed and position, acceleration profiles, an offset for backlash, an ball-screw lead, and availability of the shortcut motion.

The modes provide the following commands:

Mode	Command	Function	Default	Unit	Possible values
Program mode	SPD	Speed		p/s 1/100 r/min	pps: 500 to 1,000,000 The equivalent converted in p/s
	POS	Stop position		pulse 1/100mm 1/1000 °	-2,000,000 to +2,000,000 The equivalent converted in p/s -360,000 to +360,000
	CHP	Speed changing position		pulse 1/100mm 1/1000 °	-2,000,000 to +2,000,000 The equivalent converted in p/s -360,000 to +360,000
	SLP	Acceleration time		0.01 s	0 to 1000
	DIV	Indexing			0 to 200
	TIM	Delay time		0.01 s	0 to 9999
	JMP	Jump			0 to 63
	LOP	Repeat cycle			Number of repeat is 01 to 99.
	NOP	No operation			
	END	End of motion			
Parameter mode	ASP	Acceleration profile	0		0: Linear acceleration 1: S-curve acceleration
	BLR	Backlash offset	0	pulse	0 to 9999
	OPM	Motion profile	0		0: individual positioning 1: sequential positioning 2: programmed motion
	RED	Ball screw lead	0	Code	0 to 19
	MQU	Position unit	0		0: pulse 1: 1/1000 ° angular unit 2: 1/100mm
	SPU	Speed unit	0		0: p/s 1: 1/100 r/min
	RTD	Originating direction	0		0: CW viewed from output 1: CCW viewed from output
	RS2	Originating speed 2	20,000	p/s 1/100 r/min	500 to 50,000 The equivalent converted in p/s
	NRT	Software origin	0	pulse	−9999 to+9999
	RAD	Originating acceleration time	10	0.01 sec	0 to 1000
	RSP	Originating speed 1	200,000	p/s 1/100 r/min	500 to 1,000,000 The equivalent converted in p/s
	SCD	Pulse per revolution	1,000,000	pulse	1000 to 9,999,999
	SHC	Shortcut motion	0		0: unavailable 1: available

Note: Speeds and angles in above table are applied to output of actuators.

7-7 Program mode

In the mode you can create motion programs using commands of position, speed, acceleration time, delay time, jump, indexing, repeat and so on.

The mode provides the following functions:

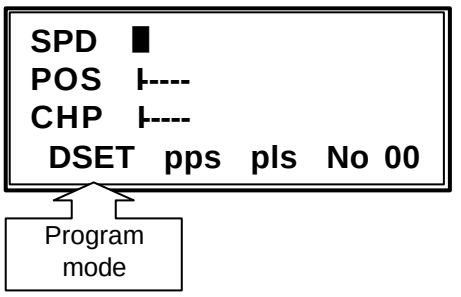
Mode	Command	Group	Function	Unit	Data
Program mode	SPD	Motion	Speed	p/s 1/100 r/min	pps: 500 to 1,000,000 The equivalent converted in p/s
	POS		Stop position	pulse 1/100mm 1/1000 °	-2,000,000 to +2,000,000 The equivalent converted in p/s -360,000 to +360,000
	CHP		Speed changing position	pulse 1/100mm 1/1000 °	-2,000,000 to +2,000,000 The equivalent converted in p/s -360,000 to +360,000
	SLP		Acceleration time	0.01 s	0 to 1000
	DIV		Indexing		0 to 200
	TIM		Delay time	0.01 s	0 to 9999
	JMP	Logical	Jump		0 to 63
	LOP		Repeat cycle		Number of repeat is 01 to 99.
	NOP		No operation		
	END		End of motion		

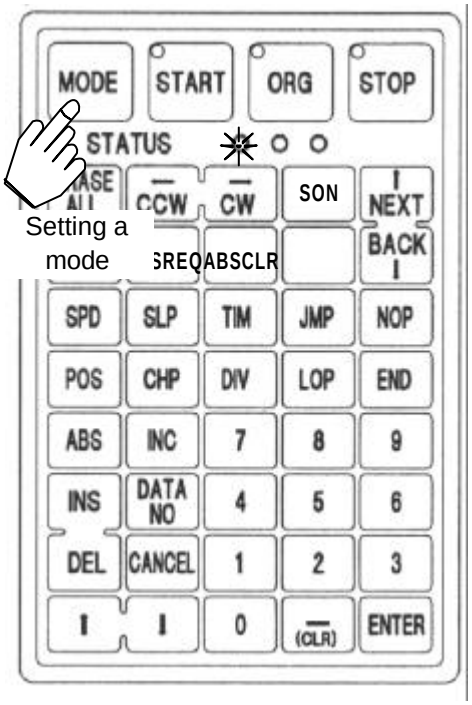
The commands of the program mode consist of two groups.

Motion commands: relate to actuator motion. Refer the above table.

Logical commands: control logic of addresses. Refer to the above table.

With regard to conditions in programming using the two command groups, refer to [7-7-4 Conditions in programming].





7-7-1 Setting the program mode

Press [MODE] key of the teach-box. [DSET] appears and the left LED lights.

In addition to cursor manipulation, command keys are provided for the program mode operation.

7-7-2 Specifying an address

Programs are created by the procedures of specifying an [address], and entering commands of position, speed, acceleration time and so on, and data in the address.

● Specifying an address

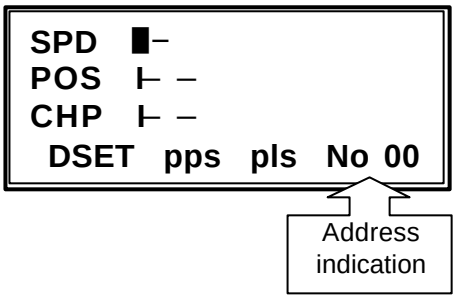
Two ways are provided for specifying an address.

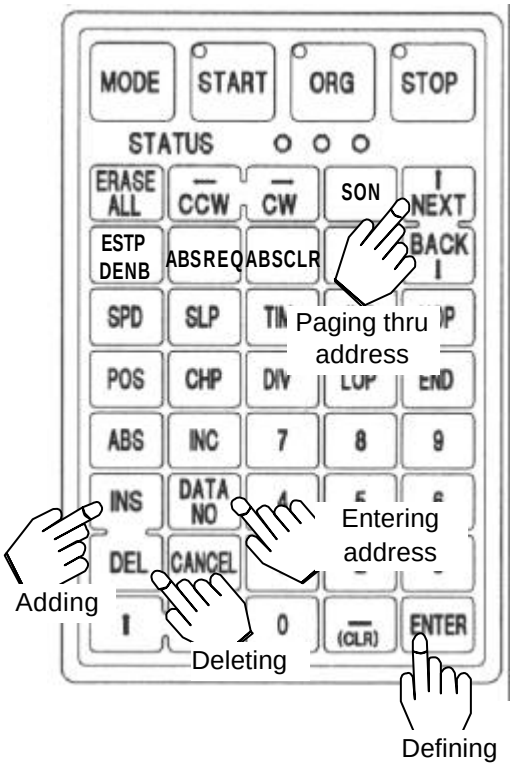
◆ Paging by [NEXT] and [BACK] keys:
Every pressing the [NEXT] key or [BACK] key, increases or decreases the address number.

◆ Entering address by [DATA NO] key and [0 to 9] keys:

(1) After pressing [DATA NO] key, enter the address number by numeral keys.

(2) Press [ENTER] key. The specified address and commands are indicated.





7-7-3 Arranging address numbers

The arrangement of address numbers are different by specifying [Parameter mode]⇒[OPM: Motion profile].

● For [OPM 0: individual positioning]

By the [START] input signal the actuator moves directly to the position of the address specified by [CN2-9 to 14: input bits] and stops at the position of the address having the [POS] command. After the positioning, the HA-675 driver outputs the [CN2-34: motion finish] signal and the current address.

Then the driver waits the next address specifying inputs and the [START] signal.

Groups of addresses closed with the [POS] command are independent with each other, and there are no relations among the groups.

Therefore, the arrangement of address numbers is relatively free. However, the motion pattern is depended on a host system.

● For [OPM 1: sequential positioning]

Same as for the above [OPM 0: motion profile], by the [START] input signal the actuator moves directly to the position of the address specified by [CN2-9 to 14: input bits] and stops at the position of the address having the [POS] command. After the positioning, the HA-675 driver outputs the [CN2-34: motion finish] signal and the current address.

After that the actuator moves sequentially by every [START] signal to the next address position of the [POS] command address.

When the sequence comes to the address having no command data, the sequence continues to the first address of the motion profile. At every positioning, the HA-675 driver outputs the [CN2-34: motion finish] signal and the current address.

Therefore, the addresses are numbered sequentially to the motion profile properly.

● For [OPM 2: programmed motion]

By the [START] input signal the actuator moves continuously following the address sequentially and logical commands from the position of the starting address specified by [CN2-9 to 14: input bits]. When addresses have jump and repeat commands, the commands are executed.

When the sequence comes to the address having the [END] command, the actuator stops and the HA-675 driver outputs the [CN2-34: motion finish] signal and the current address. If [END] is not programmed, the sequence jumps from the address having no command data to the first address of the motion profile.

Therefore, it is possible to divide addresses from [0] to [63] to create sequential programs, and to specify a motion profile program by the [CN2-9 to 14: input bits] signal.

7-7-4 Conditions in programming

The commands of program mode are divided in two groups:

Motion commands: relate to actuator motion.

SPD	Speed
POS	Stop position
CHP	Speed changing position
SLP	Acceleration time
TIM	Delay time
DIV	Indexing

Logical commands: control logic of addresses.

JMP	Jump
LOP	Repeat
NOP	No operation
END	End of motion

The conditions in programming using commands of two groups are as follows:

- It is not possible to enter motion commands and a logical command in one address.
  If a logical command is entered in the address having motion commands, the motion commands are deleted.
  If a motion command is entered in the address having a logical command, the logical command is deleted.
- Logical commands are available for program motion profile only.
  Do not use logical commands for individual positioning profile nor sequential positioning profile.
- A single address allows a single logical command.
  For instance, if [JMP] command is entered in the address having [LOP] command, the [LOP] command is deleted.

7-7-5 Programming of commands

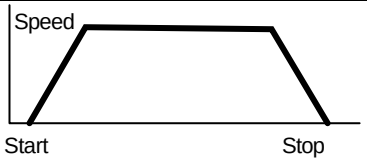
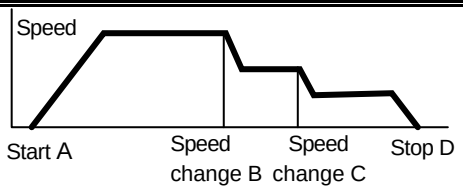
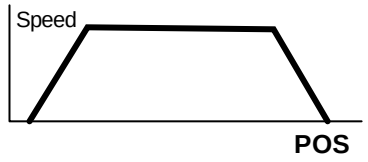
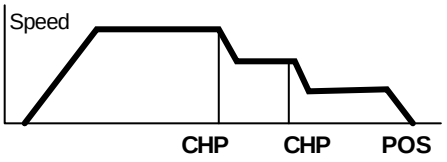
The program mode creates programs of actuator motion using various commands. This section describes general information of the programming.

There are two kinds of the speed profile as follows:

Single speed profile: consists one speed from start to stop.

Compound speed profile: includes plural speeds during motion from start to stop.

Command usage and parameter functions are different by the speed profile.

Speed profile	Single speed profile	Compound speed profile
Example		
POS CHP	Enter a value in [POS] of stop address. 	Enter a value in [CHP] of speed-change addresses. Enter a value in [POS] of stop address. 
DIV	Available	Unavailable
ASP	Linear acceleration S-curve acceleration	Linear acceleration: Available S-curve acceleration: Unavailable
SHC	Available	Available

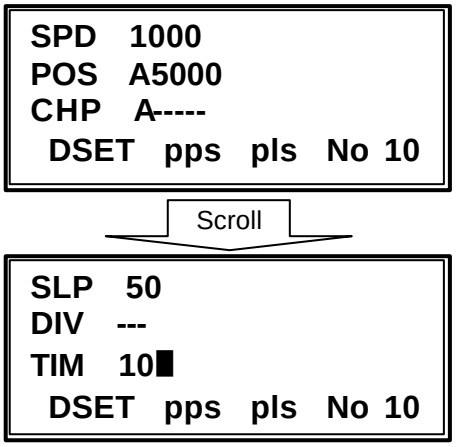
7-7-6 Examples of program

Some program examples are descried below.

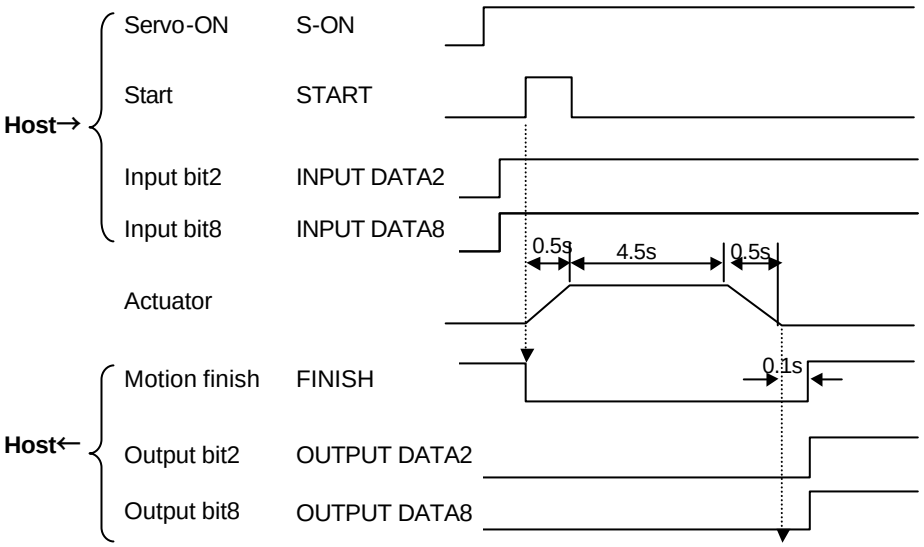
◆ Example 1:

Motion profile: individual positioning
Address: 10

Address 10	
Speed:	1000 p/s
Position:	5000 pulse
Acceleration:	0.5s
Delay:	0.1s



For the motion programmed in the figure to the right, the actuator starts by the servo-ON signal with the bit-pattern signal of 10(2+8) specifying the address from a host. After positioning and 0.1 sec. delay, the HA-675 driver outputs the motion finish signal and the current address of 10 (=2+8).



◆ Example 2: Motion profile: sequential positioning

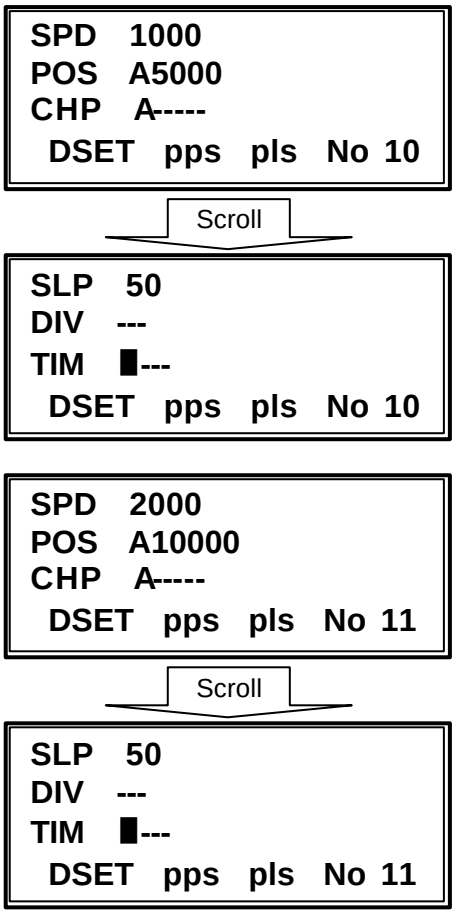
Address 10	
Speed:	1000 p/s
Position:	5000 pulse
Acceleration:	0.5s

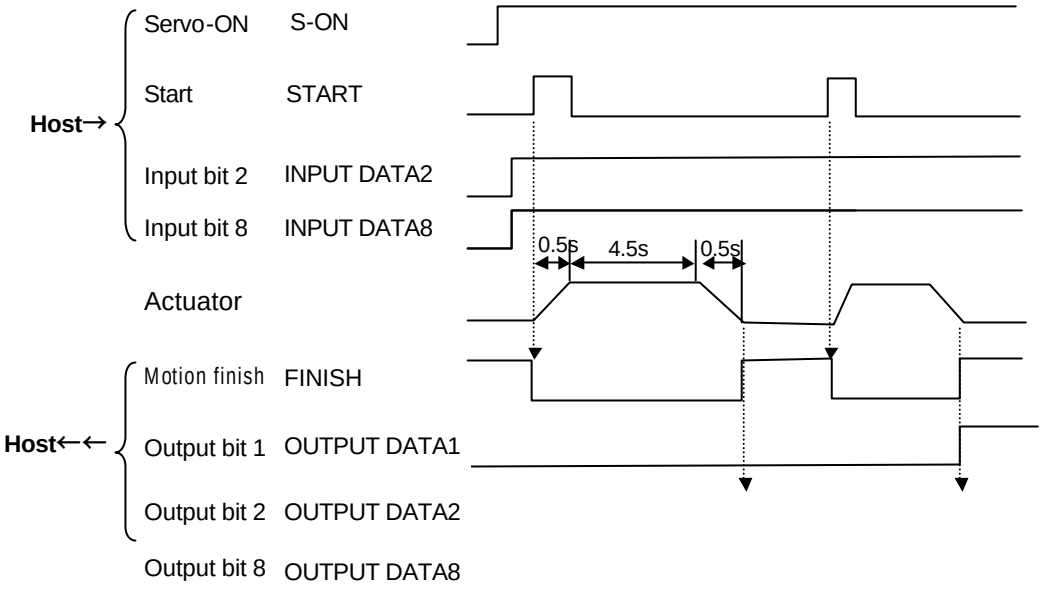
Address 11	
Speed:	2000 p/s
Position:	10000 pulse
Acceleration:	0.5s

For the motion programmed in the figure to the right, the actuator starts by the start signal with the bit-pattern signal of 10(2+8) specifying the address from a host.

After positioning, the HA-675 driver outputs the motion finish signal and current address of 10 (=2+8) to the host.

By the next start signal, the actuator starts to the position of address 11. After positioning, the HA-675 driver outputs the motion finish signal and current address of 11 (=1+2+8).





◆ Example 3:

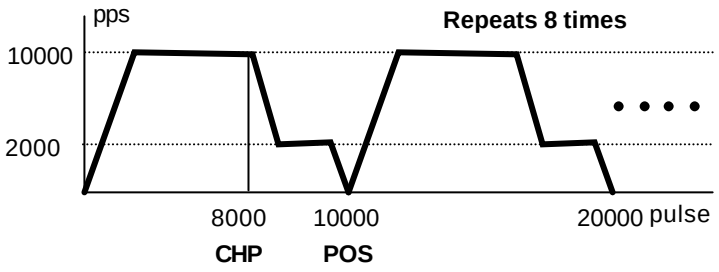
Motion profile: program motion

(1) For the motion programmed in the figure to the right, the actuator starts by the start signal with the bit-pattern signal of 10(2+8) specifying the address from a host with the speed of 10000p/s, and passes at the point of 8000pulse from the start point.

(2) At the point the speed changes (decreases in this case) to 2000p/s. The actuator stops at 2000pulse position from the speed changing point (8000+2000=10000pulse position from the start point). After 2 seconds delay, the HA-675 driver outputs the motion finish signal.

(3) The motion from the address 10 to 11 is repeated 8 times. This means that the stopping position shifts 10000 pulses at every stopping to the positive direction.

(4) After 8 times repeating, HA-675 driver outputs the motion finish signal and the current address of 13.



7-7-7 Fine adjustment of positions

Fine adjustment of address positions is possible to get better precision using [←CCW] and [→CW] keys.

● Operations

(1) To establish the origin, press [ORG] key.

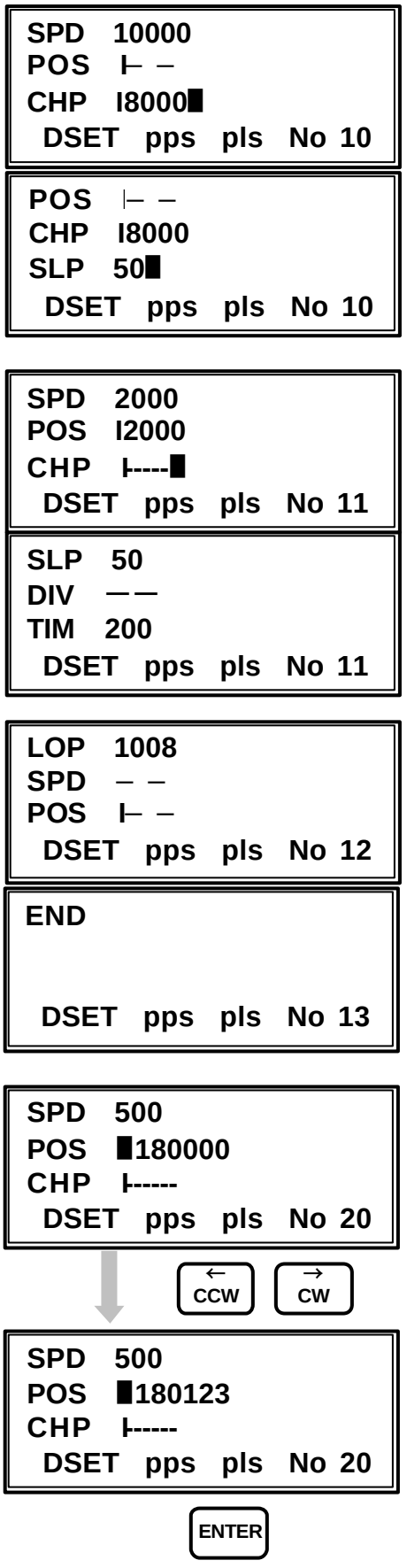
(2) Indicate the address to be adjusted using [NEXT] and [BACK] keys or [DATA NO] key.

(3) Press [START] key to move the actuator to come to the indicating position.

(4) Move the cursor to [POS] command by [↑] and [↓] keys.

(5) To make fine adjustment of the stopping position of the actuator, press [←CCW] or [→CW] key in short time. To move it continuously, press either key more than 1 second.

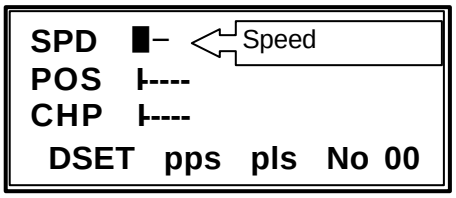
(6) To record the refined position, press [ENTER] key. The position is indicated.



7-7-8 Functions of program mode

SPD Speed

● Function



Range: 500 to 1,000,000
Unit: 0: p/s
1: 1/100 r/min

The [SPD] specifies the speed to move to the position of the [POS] or [CHP] command of the address.

The unit of the speed is indicated on the second position of the forth line.

pps: p/s
rpm: 1/100 r/min

The unit is specified by [parameter mode]⇒[SPU: speed unit] for all addresses, so that intermixed usage of units are not allowed. A speed value makes a difference in the actuator speed depending on the units.
Convert units with the following formulas:

$$\text{speed in rpm} = \frac{\text{speed in pps}}{\text{encoder resolution}} \times 60 \times 100 \qquad \text{speed in pps} = \frac{\text{speed in rpm} \times \text{encoder resolution}}{60 \times 1000}$$

The encoder resolution means the resolution of actuator motion.

The actuator does not move without the speed data.

The lowest speed data is 500p/s converted in p/s unit.

However, the following formula should be met to move the actuator even if the speed is higher than 500p/s.

SPD (speed data)> SLP (acceleration time)× 5

● Operations

(1) To enter speed data, press [SPD] key. Or move the cursor on [SPD] by [↑] and [↓] keys.
(2) Enter the data by numeral keys.
(3) To define the entered data, press [ENTER] key.
(4) To cancel the entering and to recover old data before defining, press [CANCEL] key.

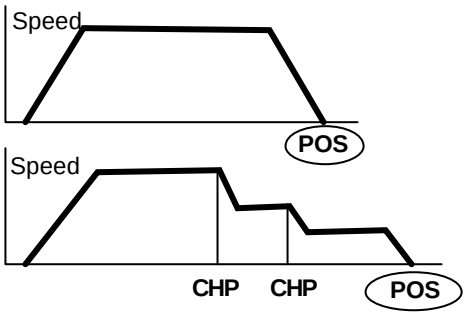
● Relational items

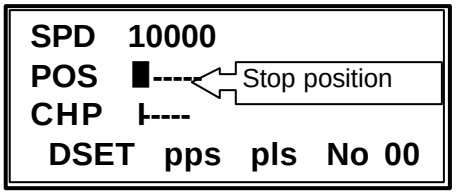
Speed unit: [parameter mode]⇒[SPU: speed unit]
acceleration time: [program mode]⇒[SLP: acceleration time]

POS Stop position

● Function

The [POS] specifies the stop position of the actuator.





Range:
pls: -2,000,000 to +2,000,000
deg: -360,000 to +360,000
mm: -2,000,000 to +2,000,000
Unit:
pls: pulse
deg: 1/1000 °
mm: 1/100 mm

Both data types of relative (increment) and absolute are acceptable. The type is specified at value entering.
The unit of the position is indicated on the third position of the forth line.

pls: pulse
deg: 1/1000 °: Enter 1000 for 1 °.
mm: 1/100 mm: Enter 100 for 1mm.

The unit is specified by [parameter mode]⇒[MQU: position unit] for all addresses, so that intermixed usage of units are not allowed. A position value makes a difference in the actuator motion depending on the units.

$$\text{Position(deg)} = \frac{\text{position(pls)} \times 360 \times 1000}{\text{encoder resolution}} \qquad \text{Position(mm)} = \frac{\text{position(pls)} \times \text{ball screw lead(mm)} \times 100}{\text{encoder resolution}}$$

$$\text{Position(pls)} = \frac{\text{position(deg)} \times \text{encoder resolution}}{360 \times 1000} \qquad \text{Position(pls)} = \frac{\text{position(mm)} \times \text{encoder resolution} \times \text{reduction ratio}}{\text{ball screw lead(mm)} \times 100}$$

The actuator does not move without the position value.

Entering values in both [POS] and [CHP] commands of an address is not allowed. If a value is entered to either one, the value in the other is deleted.

● Operations

(1) To enter a stop position, press [POS] key. Or move the cursor on [POS] by [↑] and [↓] keys.
(2) To enter a relative value, press [INC] key. [I] is indicated on the right of [POS].
To enter an absolute value, press [ABS] key. [A] is indicated on the right of [POS].
(3) Enter the data by numeral keys.
(4) To define the entered data, press [ENTER] key.
(5) To cancel the entering and to recover the old data before defining, press [CANCEL] key.

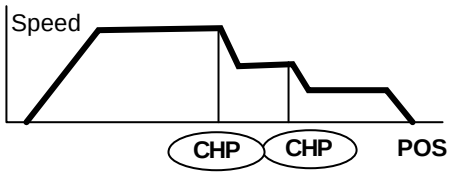
● Relational items

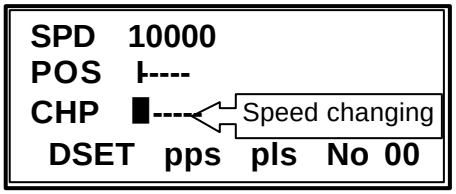
Position unit: [parameter mode]⇒[MQU: position unit]
Speed changing position: [program mode]⇒[CHP: speed changing position]

CHP Speed changing position

● Function

The [CHP] specifies the speed changing position for the compound speed profile where is a passing-through point.





Range:
pls: -2,000,000 to +2,000,000
deg: -360,000 to +360,000
mm: -2,000,000 to +2,000,000
Unit:
pls: pulse
deg: 1/1000 °
mm: 1/100 mm

Both data types of relative (increment) and absolute are acceptable. The type is specified at value entering.
The unit of the position is indicated on the third position of the forth line.

pls: pulse
deg: 1/1000 ° : Enter 1000 for 1 ° .
mm: 1/100 mm: Enter 100 for 1mm.

The unit is specified by [parameter mode]⇒[MQU: position unit] for all addresses, so that intermixed usage of units are not allowed. A position value makes a difference in the actuator motion depending on the units.

$$\text{Position(deg)} = \frac{\text{position(pls)} \times 360 \times 1000}{\text{encoder resolution}} \qquad \text{Position(mm)} = \frac{\text{position(pls)} \times \text{ball screw lead(mm)} \times 100}{\text{encoder resolution}}$$

$$\text{Position(pls)} = \frac{\text{position(deg)} \times \text{encoder resolution}}{360 \times 1000} \qquad \text{Position(pls)} = \frac{\text{position(mm)} \times \text{encoder resolution} \times \text{reduction ratio}}{\text{ball screw lead(mm)} \times 100}$$

The actuator does not move without the position value.

Entering values in both [POS] and [CHP] commands of an address is not allowed. If a value is entered to one of both, the value in the other is deleted.

If the address, which is to be entered [POS] value, is entered [CHP] value, [CN2-34 motion finish] signal is not outputted.

● Operations

(1) To enter a speed changing position, press [CHP] key. Or move the cursor on [CHP] by [↑] and [↓] keys.
(2) To enter a relative value, press [INC] key. [I] is indicated on the right of [CHP].
To enter an absolute value, press [ABS] key. [A] is indicated on the right of [CHP].
(3) Enter the data by numeral keys.
(4) To define the entered data, press [ENTER] key.
(5) To cancel the entering and to recover old data before defining, press [CANCEL] key.

● Relational items

Position unit: [parameter mode]⇒[MQU: position unit]
Stop position: [program mode]⇒[POS: stop position]

SLP Acceleration time

● Function

The [SLP] specifies acceleration time from the current speed to the speed specified by this command.

Without inputting the acceleration time, actuators do not move.

When [POS] command specifies a position, the acceleration time is the time from speed [0] to the speed specified by this command. Deceleration time is equal to the acceleration time.

The motion time from start to stop in speed profile shown in the upper figure to the right is as follows:

$$\text{Motion time(s)} = \frac{\text{POS}}{\text{SPD}} + \frac{\text{SLP}}{100}$$

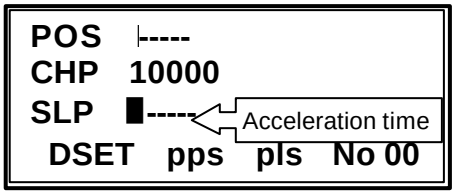
The motion time for the profile, shown in the middle figure, of which top speed does not reach the speed specified by the [SPD], is as follows:

$$\text{Motion time(s)} = \sqrt{\frac{\text{POS}}{\text{SPD}} \times \frac{\text{SLP}}{100}}$$

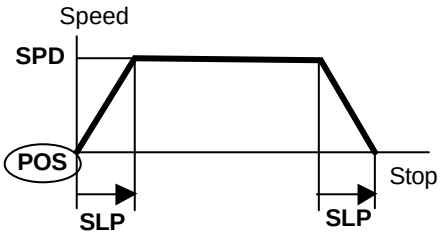
When the [CHP] command specifies a position, the acceleration time is the time from the current speed to the speed specified by this command. Refer the lowest figure.

● Operations

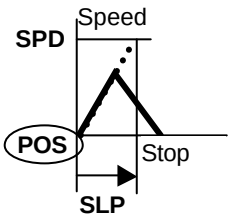
(1) To enter an acceleration time, press [SLP] key. Or move the cursor on [SLP] by [↑] and [↓] keys.
(2) Enter the data by numeral keys.
(3) To define the entered data, press [ENTER] key.
(4) To cancel the entering and to recover old data before defining, press [CANCEL] key.



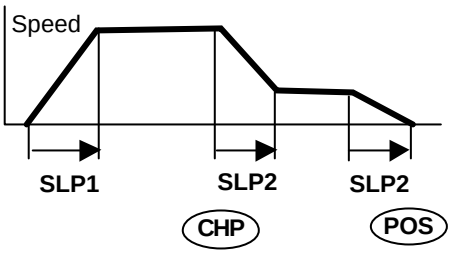
Range: 0 to 1000
Unit: 0.01 s



For POS≧SPD×SLP×100 (unit: pulse)



For POS＜SPD×SLP×100 (unit: pulse)



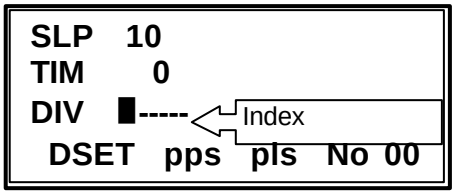
DIV Indexing

● Function

For the indexing motion, the [DIV] specifies a number to divide the actuator movement equally.

The actuator moves as much as indexing movement by every [CN2-6: start] input until the actuator comes to the [POS] position.

A remainder by the dividing is broken up into 1 pulse among divisions. Therefore, the remainder is not accumulated.



Range: 0 to 200
Unit: 1

At the [POS] position, the HA-675 driver outputs the motion finish signal and current address.

No entering to the command sets [0] to the value.

The command is possible to be used with [TIM: delay time] command.

During the indexing, the indexing is terminated and started new motion if another address is specified and [CN2-6: start] signal inputted.

● Operations

(1) To enter the indexing value, press [DIV] key. Or move the cursor on [DIV] by [↑] and [↓] keys.
(2) Enter the data by numeral keys.
(3) To define the entered data, press [ENTER] key.
(4) To cancel the entering and to recover old data before defining, press [CANCEL] key.

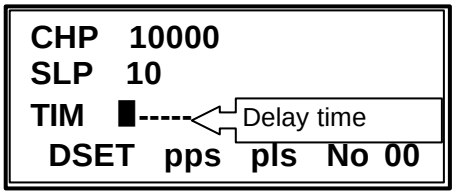
TIM Delay time

● Function

The [TIM] specifies the delay time from stopping at [POS] position to outputting [CN2-34: motion finish] signal.

This will be used for waiting for attenuation of natural oscillation at stopping and so on.

No entering to the command sets [0] to the value.



Range: 0 to 9999
Unit: 0.01 s

● Operations

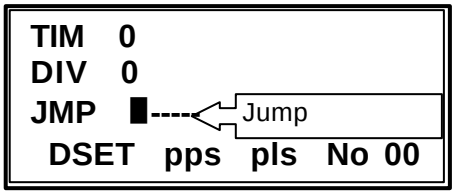
(1) To enter the delay time, press [TIM] key. Or move the cursor on [TIM] by [↑] and [↓] keys.
(2) Enter the data by numeral keys.
(3) To define the entered data, press [ENTER] key.
(4) To cancel the entering and to recover old data before defining, press [CANCEL] key.

JMP Jump

● Function

The [JMP] jumps to the specified address with no conditions.

The command is available when [parameter mode]⇒ [OPM: motion profile] is set [2: program motion].



Range: 0 to 63
Unit: 1

CAUTION

1 Use the [JMP: jump] command only for the program motion.
If the command is used in other motions, the command is ignored, and the actuator moves unexpectedly.

2 Confirm that no value in the [JMP] command, when it is unused.
Take care that the actuator jumps to [address 0], if the command has [0] value. If a value including [0] is set in [JMP], delete it pressing [－] key and [ENTER] key sequentially.

● Operations

(1) To enter the address to jump, press [JMP] key. Or move the cursor on [JMP] by [↑] and [↓] keys.
(2) Enter the data by numeral keys.
(3) To define the entered data, press [ENTER] key.
(4) To cancel the entering and to recover old data before defining, press [CANCEL] key.

LOP Repeat cycle

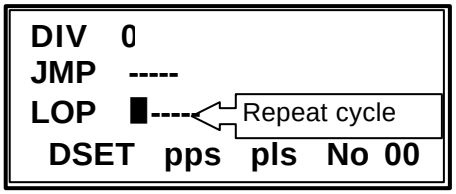
● Function

The [LOP] repeats the motion from the specified address to the previous address of the [LOP] command.

The command is logically prohibited to be entered in the [address 00], because the repeating cycle is available for the previous address.

It is also prohibited to program a duplex loop which consists a loop including another loop.

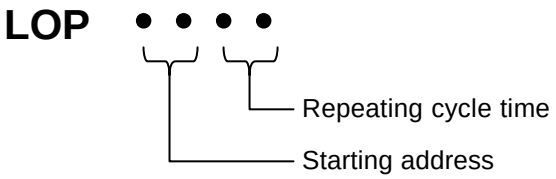
The command is available when [parameter mode]⇒ [OPM: motion profile] is set [2: program motion].



Range: [01 00] to [62 99]

● Indication

The data part consists four digit numerals. The upper two digits are for a starting address, and the lower two digits are for a repeating cycle time



CAUTION

1 **Use the [LOP: repeat cycle] command only for the program motion.**
If the command is used in other motions, the command is ignored, and the actuator moves unexpectedly.

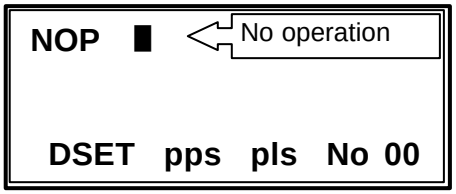
2 **Confirm that no value in the [LOP] command, when it is unused.**
Take care that [0] is meaningless value, if you expect something to [0], the actuator moves unexpectedly. If a value including [0] is set in [LOP], delete it pressing [－] key and [ENTER] key sequentially.

● Operations

(1) To enter the address to jump, press [LOP] key. Or move the cursor on [LOP] by [↑] and [↓] keys.
(2) To erase the old data, press [-] key.
(3) Enter the data by numeral keys.
(4) To define the entered data, press [ENTER] key.
(5) To cancel the entering and to recover old data before defining, press [CANCEL] key.

NOP No operation

● Function



The [NOP] command performs no action in a sequence. But it passes through to the next address.

The command is available when [parameter mode]⇒ [OPM: motion profile] is set [2: program motion].

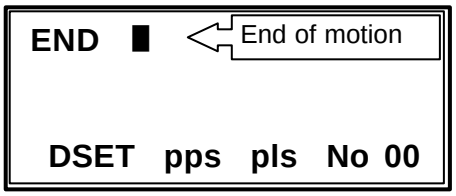
The command is convenient to use for unnecessary address, for continuing a program having meaningless addresses.

● Operations

(1) To program no operation, press [NOP] key.
(2) To define the entered data, press [ENTER] key. Other commands than the [NOP] are deleted.
(3) To cancel the programming and to recover old state before defining, press [CANCEL] key.

END End of motion

● Function



The [END] terminates the program, and outputs [CN2-34: motion finish] signal.

The command is available when [parameter mode]⇒ [OPM: motion profile] is set [2: program motion].

Without [END] command for program motion, the program repeats endlessly.

● Operations

(1) To program the end of the motion, press [END] key.
(2) To define the entered data, press [ENTER] key. Other commands than the [END] are deleted.
(3) To cancel the programming and to recover old state before defining, press [CANCEL] key.

7-8 Test mode

In the test mode you can verify the programs created in the program mode. It is possible to confirm positions, to observe sequential motions at every address, and to test programs continuously.

The operation procedures in the test mode are as follows:

(1) Turn on power supplies for the control and the servo at first.

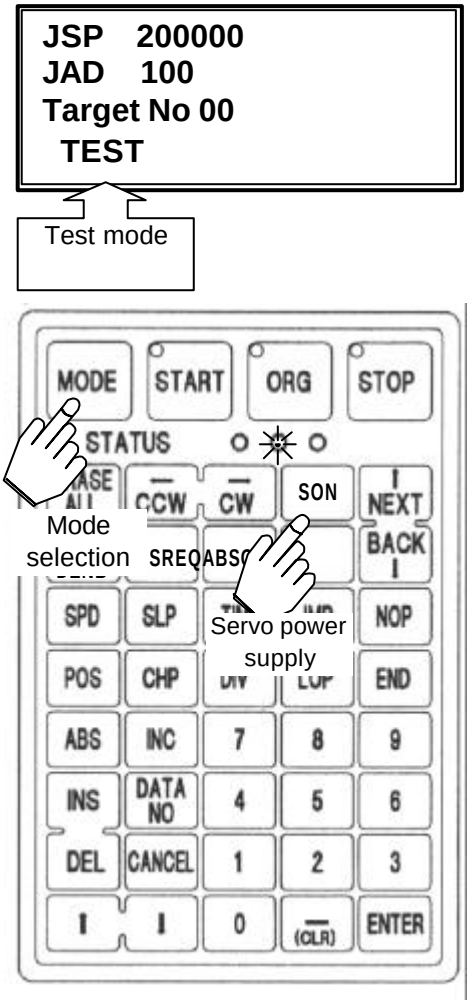
(2) Perform origination for the incremental system.

(3) Select the test mode.

(4) Operate the teach-box corresponding to a motion profile.

(5) JOG operation, if necessary.

Details of operations are described as follows:



7-8-1 Turning on servo power

(1) Input a signal to [CN2-3: servo-ON] port of the HA-675 driver.
Or press the [SON] key of the teach-box.
⇒The servo power turns on.

Note: The servo power turns on under the "close" conditions of
[CN2-15, 16 emergency stop: ESTOP+/-],
[CN2-17, 18 FWD limit: FSTOP+/-], and
[CN2-19, 20 REV limit: RSTOP+/-]
of the HA-675 driver. If the servo power does not turn on, verify these inputs.

7-8-2 Originating INC

Two kinds of origination are provided for the incremental system:

● Origination to origin sensor

This origination is performed to the origin equipped on the load mechanism. The originating procedure is as follows:

(1) Press the [ORG] key on the teach-box for short time. ⇒The actuator performs originating motion.

● Defining current position as the origin

This is applied in the case of no origin sensor and no requirement for repeatability.

(1) Check that [CN2-15, 16 emergency stop: ESTOP+/-], [CN2-17, 18 FWD limit: FSTOP+/-], and [CN2-19, 20 REV limit: RSTOP+/-] are all [OFF].

(2) Press [ORG] key on the teach-box for more than one second, and leave the finger from the key after the pee sound.
⇒The current position of the actuator becomes the origin.

For the absolute system, origination is unnecessary usually. However, it is possible to make origination using an origin sensor to establish an original position.

7-8-3 Operation in the test mode

The operation in the test mode differs in the setting of [parameter mode]⇒[OPM: motion profile].

● Individual positioning profile

(1) Press the [MODE] key on the teach-box to indicate [TEST].
⇒The center LED indicator lights.

(2) Indicate the address to be tested by [NEXT] and [BACK] keys or [DATA NO] key and [0 to 9] keys.

(3) Press the [START] key.
⇒The actuator moves and stops at the position or movement programmed in the address.

● Sequential positioning profile

(1) Press the [MODE] key on the teach-box to indicate [TEST].
⇒The center LED indicator lights.

(2) Press [START] key.
⇒The actuator moves to the addressed position.
⇒The actuator moves and stops by every [START] key pressing at the addresses in succession.

● Program motion profile

(1) Press the [MODE] key on the teach-box to indicate [TEST].
⇒The center LED indicator lights.

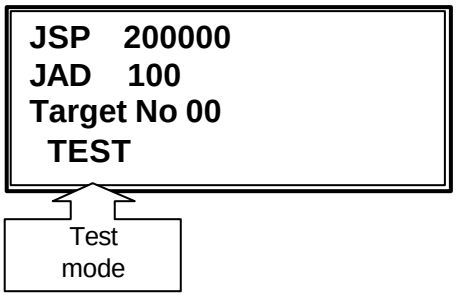
(2) Press the [START] key.
⇒The actuator moves sequentially to the programmed positions starting from the addressed position
⇒and stops at the position of the address having [END] command.

● Stopping the actuator in the test mode

To stop the actuator, input a signal to [CN2-7: stop] port, or press [STOP] key of the teach-box.
⇒The actuator stops.

7-8-4 JOG operations

(1) Press the [MODE] key on the teach-box to indicate [TEST].
⇒The center LED indicator lights.



● Setting JOG speed

(1) To set the JOG speed, move the cursor on [JSP] by [↑] and [↓] keys.

(2) Enter the value by numeral keys.
The value is allowed in the range of [1000~999999], and the unit is [P/S] (pulse / second).

CAUTION

The JOG speed should be less than the maximum speed of the actuator.

The allowable JOG speed is obtained by the formula shown below:

$$Vmax = \frac{Smax \times R}{60}$$

Where,
Vmax: allowable JOG speed (p/s)
Smax: maximum actuator speed (r/min)
R: resolution of encoder (p/r)

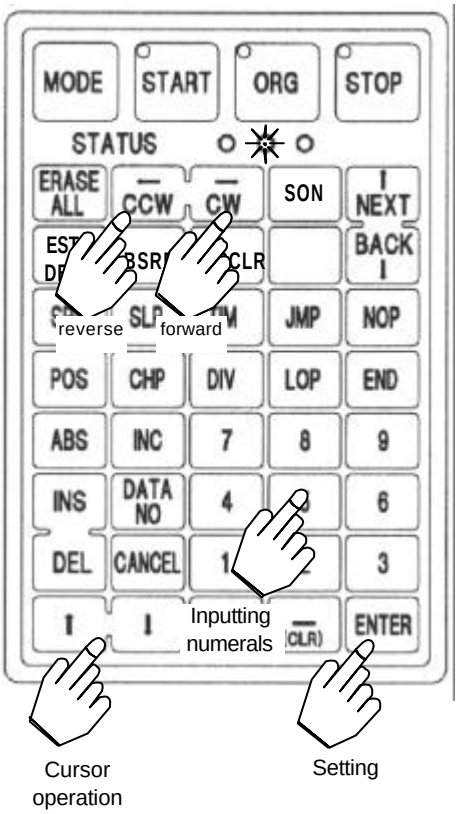
(3) Press [ENTER] key.

● Setting acceleration and deceleration time

(1) To set the acceleration and deceleration time for JOG operation, move the cursor on [JAD] by [↑] and [↓] keys.

(2) Enter the value by numeral keys.
The value is allowed in the range of [1~1000], and the unit is [10 milliseconds].

(3) Press [ENTER] key.



● JOG operations

(1) For forward rotation, press [CW] key for more than 1 second.

(2) For reverse rotation, press [CCW] key for more than 1 second.

(3) For stopping, leave your pressing finger from the key.

(4) To rotate the actuator in forward, press [CW] key for more than 1 second.

(5) To rotate the actuator in reverse, press [CCW] key for more than 1 second.

7-9 Parameter mode

The mode allows setting parameters required for originating, units of speed and position, acceleration profiles, an offset for backlash, an ball-screw lead, and availability of the shortcut motion.

Parameter mode provides the following commands:

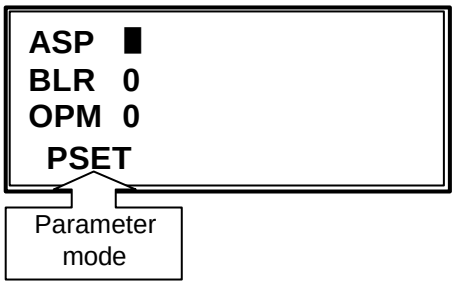
Mode	Command	Function	Default	Unit	Data
Parameter mode	ASP	Acceleration profile	0		0: Linear acceleration 1: S-curve acceleration
	BLR	Backlash offset	0	pulse	0 to 9999
	OPM	Motion profile	0		0: individual positioning 1: sequential positioning 2: programmed motion
	RED	Ball screw lead	0	Code	0 to 19
	MQU	Position unit	0		0: pulse 1: 1/1000 ° angular unit 2: 1/100mm
	SPU	Speed unit	0		0: p/s 1: 1/100 r/min
	RTD	Originating direction	0		0: CW viewed from output 1: CCW viewed from output
	RS2	Originating speed 2	20,000	p/s 1/100 r/min	500 to 50,000 The equivalent converted in p/s
	NRT	Software origin	0	pulse	−9999 to +9999
	RAD	Originating acceleration time	10	0.01 sec	0 to 1000
	RSP	Originating speed 1	200,000	p/s 1/100 r/min	500 to 1,000,000 The equivalent converted in p/s
	SCD	Pulse per revolution	Different in actuator	pulse	1000 to 9,999,999
	SHC	Shortcut motion	0		0: unavailable 1: available

7-9-1 Operation in the parameter mode

Press the [MODE] key on the teach-box to indicate [PSET]. The right LED indicator lights.

There is no command key in the parameter mode. All commands are specified by cursor operation.

The details of commands are described as follows:



7-9-2 Commands in parameter mode

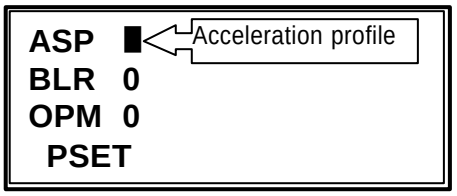
ASP Acceleration profile

● Function

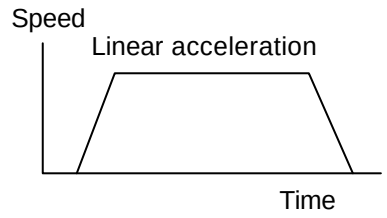
The HA-675 driver provides two acceleration profiles: linear and S-curve.

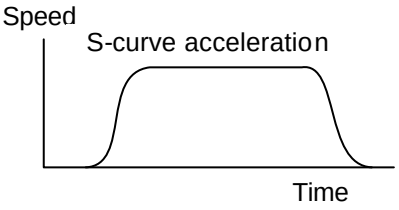
The linear acceleration profile is used generally, meanwhile for rapid acceleration to high speed the S-curve profile is employed for smooth acceleration with low mechanical oscillation.

However, even if the S-curve acceleration is specified, the command does not perform its function for compound speed profile using [CHP], but for the single speed profile.



0: Linear acceleration (default)
1: S-curve acceleration





● Operations

(1) To enter the acceleration profile, move the cursor on [ASP] by [↑] and [↓] keys.
(2) Press [0] (linear) or [1] (S-curve).
(3) To define the value, press [ENTER] key.
(4) To cancel the entering and to recover old data before defining, press [CANCEL] key.

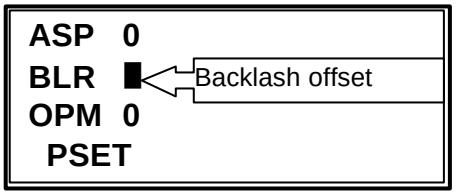
BLR Backlash offset

● Function

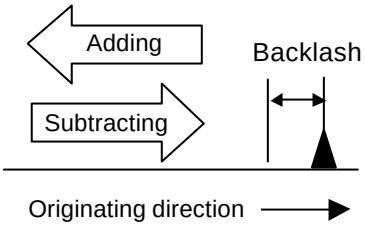
When the load mechanism has a backlash, [BLR] compensates it adding or abstracting from programmed position value at every reversing motion to increase a positioning accuracy.

For opposite direction to originating direction, the offset value is added to the programmed value.

For direction to originating direction, the offset value is subtracted from the programmed value.



Range: -9999 to 9999
Default: 0



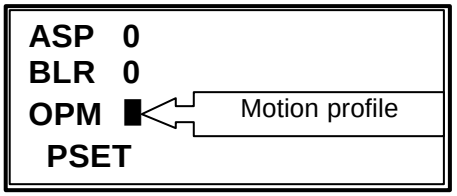
● Operations

(1) To enter the backlash offset value, move the cursor on [BLR] by [↑] and [↓] keys.
(2) Enter the value by numeral keys.
(3) To define the value, press [ENTER] key.
(4) To cancel the entering and to recover old data before defining, press [CANCEL] key.
(5) Examine the value is suitable driving the actuator in the test mode. If the value is not suitable, correct the offset and examine it until it becomes suitable.

OPM Motion profile

● Function

[OPM] specifies an actuator motion profile.



0: individual positioning
1: sequential positioning
2: program motion
Default: 0

◆ 0: Individual positioning

By the [START] input signal the actuator moves directly to the position of the address specified by [CN2-9 to 14: input bits] and stops at the position of the address having the [POS] command. After the positioning, the HA-675 driver outputs the [CN2-34: motion finish] signal and the current address.

Then the driver waits the next address specifying inputs and the [START] signal.

Groups of addresses closed with the [POS] command are independent with each other, and there are no relations among the groups.

◆ 1: Sequential positioning

Same as for the above [OPM 0: motion profile], by the [START] input signal the actuator moves directly to the position of the address specified by [CN2-9 to 14: input bits] and stops at the position of the address having the [POS] command. After the positioning, the HA-675 driver outputs the [CN2-34: motion finish] signal and the current address.

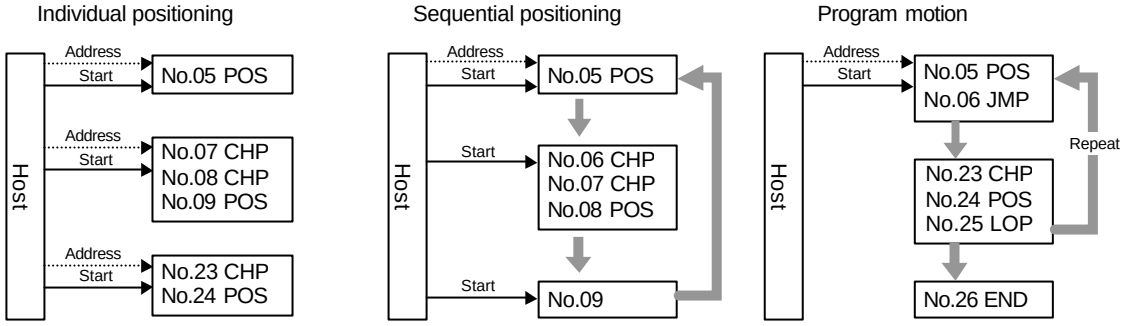
After that the actuator moves sequentially by every [START] signal to the next address position of the [POS] command address.

When the sequence comes to the address having no command data, the sequence continues to the first address of the motion profile. At every positioning, the HA-675 driver outputs the [CN2-34: motion finish] signal and the current address.

◆ 2: Programmed motion

By the [START] input signal the actuator moves continuously following the address sequentially and logical commands from the position of the starting address specified by [CN2-9 to 14: input bits]. When addresses have jump and repeat commands, the commands are executed.

When the sequence comes to the address having the [END] command, the actuator stops and the HA-675 driver outputs the [CN2-34: motion finish] signal and the current address. If [END] is not programmed, the sequence jumps from the address having no command data to the first address of the motion profile.



● Operations

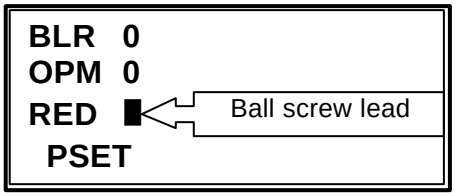
(1) To enter the motion profile value, move the cursor on [OPM] by [↑] and [↓] keys.
(2) Enter the value by numeral keys.
(3) To define the value, press [ENTER] key.
(4) To cancel the entering and to recover old data before defining, press [CANCEL] key.

RED Ball screw lead

● Function

When the load mechanism equips a ball screw for linear motion and [2: 1/100mm] is entered into [MQU: position unit], enter the code of the table below for the lead of the screw to the command.

If [MQU] has other code than [2], it is unnecessary to enter a code to this [RED] command.



Refer to the table below.
Default: 0

● Codes of lead

Code	Lead (mm)	Code	Lead (mm)	Code	Lead (mm)	Code	Lead (mm)	Code	Lead (mm)
0	0.5	4	2.5	8	6.0	12	16.0	16	40.0
1	1.0	5	3.0	9	8.0	13	20.0	17	50.0
2	1.5	6	4.0	10	10.0	14	25.0	18	64.0
3	2.0	7	5.0	11	12.0	15	32.0	19	80.0

If the lead of your screw is not listed in the table, enter [0: pulse] into [MQU] and also enter value of pulse unit into [POS] of program mode. The relation between leads and movement is as follows:

$$\text{Movement(mm)} = \text{command pulse} \times \frac{\text{lead(mm)}}{\text{actuator resolution}}$$

Actuator model	Incremental system						Absolute system		
	FHA-?• C -30 -E-200	FHA-?• C -50 -E-200	FHA-?• C -100 -E-200	FHA-?• C -50 -E-250	FHA-?• C -100 -E-250	FHA-?• C -160 -E-250	FHA-?• C-50 S-248	FHA-?• C-100 -S-248	FHA-?• C-160 -S-248
Actuator resolution	240,000	400,000	800,000	500,000	1,000,000	1,600,000	409,600	819,200	1,310,720

● Operations

(1) To enter a ball screw code, move the cursor on [RED] by [↑] and [↓] keys.
(2) Enter the code by numeral keys.
(3) To define the code, press [ENTER] key.
(4) To cancel the entering and to recover old data before defining, press [CANCEL] key.

● Relational items

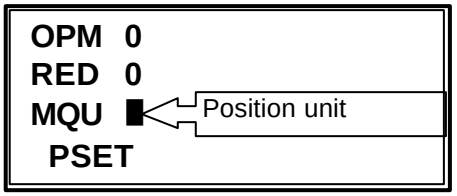
Position unit: [parameter mode]⇒[MQU: Position unit]
Pulse per revolution: [parameter mode]⇒[SCD: pulse per revolution]

MQU Position unit

● Function

The [MQU] defines a unit of positions used in program mode. The unit is specified for all addresses, so that intermixed usage of units are not allowed. A position value makes a difference in the actuator motion depending on the units.

0: pulse
1: 1/1000 ° (angular unit)
2: 1/100 mm (linear unit)



0: pulse
1: 1/1000 °
2: 1/100 mm
Default: 0

● Operations

(1) To enter the position unit, move the cursor on [MQU] by [↑] and [↓] keys.
(2) Enter the value by numeral keys.
(3) To define the value, press [ENTER] key.
(4) To cancel the entering and to recover old data before defining, press [CANCEL] key.

● Relational items

Linear unit: [parameter mode]⇒[RED: ball screw lead]
Stop position: [program mode]⇒[POS: stop position]

SPU Speed unit

● Function

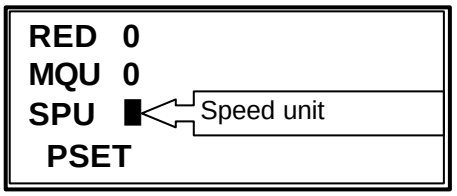
The [SPD] defines a unit of speed used in program mode. The unit is specified for all addresses, so that intermixed usage of units are not allowed. A speed value makes a difference in the actuator speed depending on the units.

0: p/s
1: 1/100 r/min

The following formulas are able to convert pulse value into linear and rotary values:

$$\text{Linear speed}(mm/s) = \text{command}(p/s) \times \frac{\text{ball screw lead}(mm)}{\text{actuator revolution}}$$

$$\text{Rotary speed}(r/min) = \text{command}(p/s) \times \frac{60}{\text{actuator revolution}}$$



0: pulse/s
1: 1/100 r/min
Default: 0

Actuator model	Incremental system						Absolute system		
	FHA-?• C -30 -E-200	FHA-?• C -50 -E-200	FHA-?• C -100 -E-200	FHA-?• C -50 -E-250	FHA-?• C -100 -E-250	FHA-?• C -160 -E-250	FHA-?• C-50 S-248	FHA-?• C-100 -S-248	FHA-?• C-160 -S-248
Actuator resolution	240,000	400,000	800,000	500,000	1,000,000	1,600,000	409,600	819,200	1,310,720

● Operations

(1) To enter the speed unit, move the cursor on [SPU] by [↑] and [↓] keys.
(2) Enter the code by numeral keys.
(3) To define the code, press [ENTER] key.
(4) To cancel the entering and to recover old code before defining, press [CANCEL] key.

● Relational items

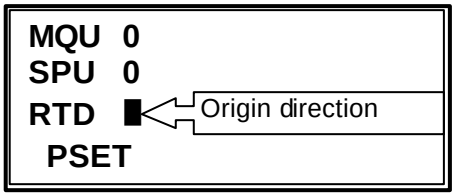
Speed: [program mode]⇒[SPD: speed]
Pulse per revolution: [parameter mode]⇒[SCD: pulse per revolution]

RTD Origin direction

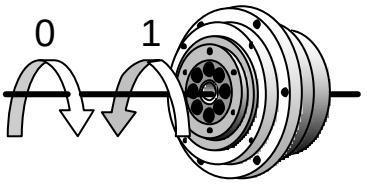
● Function

The [RTD] defines the rotary direction toward the mechanical origin for origination.

0: clockwise viewing from the output member
1: counter clockwise viewing from the output member



0: clockwise viewing from output
1: counter clockwise viewing from output
Default: 0



● Operations

(1) To enter a code of origin direction, move the cursor on [RTD] by [↑] and [↓] keys.
(2) Enter the code by numeral keys.
(3) To define the code, press [ENTER] key.
(4) To cancel the entering and to recover old code before defining, press [CANCEL] key.

● Relational items

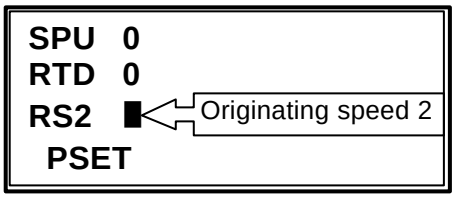
Originating speed: [parameter mode]⇒[RSP: Originating speed 1]、[RS2: Originating speed 2]
Originating acceleration time: [parameter mode]⇒[RAD: originating acceleration time]

RS2 Originating speed 2

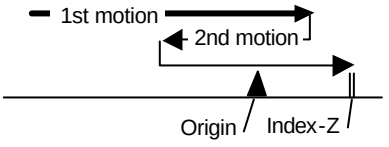
● Function

The [RS2] defines the speed for second motion in the originating sequence. The originating sequence of the HA-675 driver is as follows:

(1) The first motion to sense the origin sensor
(2) The second low speed motion to re-sense the sensor, after passing over and reversing
(3) The third motion to sense the index-Z of the encoder, after passing over and reversing



Range: 500 to 50000
Default: 20,000



● Details of the speed

The [RS2] allows a value from 500 to 50000. However, the meaning of the value is different by a definition of [parameter mode]⇒[SPU: speed unit].

◆ SPU: 0 (p/s)

$$\text{Linear speed (mm/s)} = \text{value} \times \frac{\text{Ball screw lead (mm)}}{\text{actuator resolution}} \qquad \text{Rotary speed (r/min)} = \text{value} \times \frac{60}{\text{actuator resolution}}$$

◆ SPU: 1 (1/100 r/min)

$$\text{Rotary speed (r/min)} = \frac{\text{value}}{100} \times \frac{60}{\text{actuator resolution}}$$

Actuator model	Incremental system						Absolute system		
	FHA-?• C -30 -E-200	FHA-?• C -50 -E-200	FHA-?• C -100 -E-200	FHA-?• C -50 -E-250	FHA-?• C -100 -E-250	FHA-?• C -160 -E-250	FHA-?• C-50 S-248	FHA-?• C-100 -S-248	FHA-?• C-160 -S-248
Actuator resolution	240,000	400,000	800,000	500,000	1,000,000	1,600,000	409,600	819,200	1,310,720

● Operations

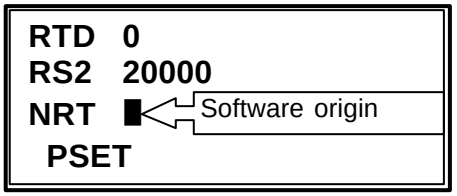
(1) To enter a speed value, move the cursor on [RS2] by [↑] and [↓] keys.
(2) Enter the value by numeral keys.
(3) To define the value, press [ENTER] key.
(4) To cancel the entering and to recover old value before defining, press [CANCEL] key.

NRT Software origin

● Function

In addition to mechanical origin, the software origin is helpful for programming. For example, when the encoder index position is shifted from original mechanical position after troubleshooting. Without the software origin, you must shift every address position one by one. However, the origin is able to shift all together without program correction.

As for the actual orinating motion, the actuator performs the origination to the mechanical origin, then moves to the software origin in the speed of [RS2: originating speed 2].



Range: -9999 to +9999
Default: 0

● Operations

◆ **Setting by the numeral keys:** changing the value with watching position.

(1) To set the software origin, move the cursor on [NRT] by [↑] and [↓] keys.
(2) Enter the value by numeral keys.
(3) To define the code, press [ENTER] key.
(4) To cancel the entering and to recover old code before defining, press [CANCEL] key.

◆ **Setting at the actual position**: by operating the actuator

(1) Finish all operations for mechanical origin setting.
(2) Input a signal to [CN2-3: servo-ON] port of the HA-675 driver. ⇒Servo power turns on.
Note 1: Pressing the [SON] key is also possible to turn servo power on.
Note 2: The servo power turns on under the "close" conditions of [CN2-15, 16: emergency stop], [CN2-17, 18: FWD limit], and [CN2-19, 20: REV limit] of the HA-675 driver. If the servo power does not turn on, verify these inputs.
(3) Move the cursor on [NRT] by [↑] and [↓] keys.
(4) Press [ORG] key. The actuator performs origination to mechanical origin.
(5) After the origination, move the actuator to the desired position for software origin with jog operation by [CCW] and [CW] keys.
(6) Press [ENTER] key after the positioning. The software origin is defined.

● Relational items

Origin direction: [parameter mode]⇒[RTD: origin direction]
Originating speed: [parameter mode]⇒[RSP: Originating speed 1], [RS2: Originating speed 2]
Originating acceleration time: [parameter mode]⇒[RAD: Originating acceleration time]

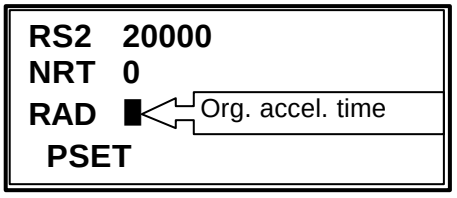
RAD Originating acceleration time

● Function

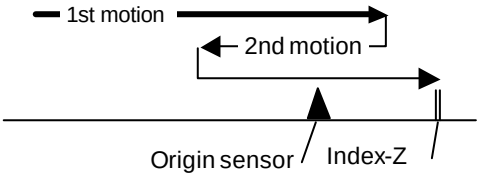
The originating sequence is as follows:

(1) The first motion to sense the origin sensor
(2) The second low speed motion to re-sense the sensor, after passing over and reversing
(3) The third motion to sense the index-Z of the encoder, after passing over and reversing

[RAD] defines the accelerating time for the first motion in the originating sequence. The time is defined as the time from speed [0] to the speed of [parameter mode]⇒[originating speed 1].



Range: 0 to 1000
Unit: 0.01 s
Default: 10



● Operations

(1) To enter an acceleration time, move the cursor on [RAD] by [↑] and [↓] keys.
(2) Enter the value by the numeral keys.
(3) To define the code, press [ENTER] key.
(4) To cancel the entering and to recover old code before defining, press [CANCEL] key.

● Relational items

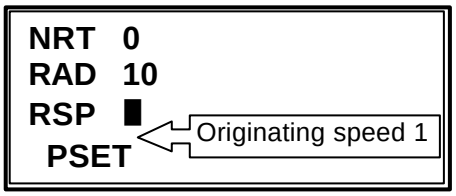
Originating speed: [parameter mode]⇒[RSP: Originating speed 1], [RS2: Originating speed 2]

RSP Originating speed 1

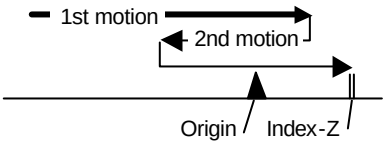
● Function

The [RSP] defines the speed for first motion in the originating sequence. The originating sequence is as follows:

(1) The first motion to sense the origin sensor
(2) The second low speed motion to re-sense the sensor, after passing over and reversing
(3) The third motion to sense the index-Z of the encoder, after passing over and reversing



Range: 500 to 1,000,000
Default: 200,000



● Details of the speed

The [RS2] allows a value of from 500 to 50000. However, the meaning of the value is different by a definition of [parameter mode]⇒[SPU: speed unit].

◆ SPU: 0 (p/s)

$$\text{Linear speed (mm/s)} = \text{value} \times \frac{\text{Ball screw lead (mm)}}{\text{actuator revolution}}$$

$$\text{Rotary speed (r/min)} = \text{value} \times \frac{60}{\text{actuator revolution}}$$

◆ SPU: 1 (1/100 r/min)

$$\text{Rotary speed (r/min)} = \frac{\text{value}}{100} \times \frac{60}{\text{actuator revolution}}$$

Actuator model	Incremental system						Absolute system		
	FHA-?• C -30 -E-200	FHA-?• C -50 -E-200	FHA-?• C -100 -E-200	FHA-?• C -50 -E-250	FHA-?• C -100 -E-250	FHA-?• C -160 -E-250	FHA-?• C-50 S-248	FHA-?• C-100 -S-248	FHA-?• C-160 -S-248
Actuator resolution	240,000	400,000	800,000	500,000	1,000,000	1,600,000	409,600	819,200	1,310,720

● Operations

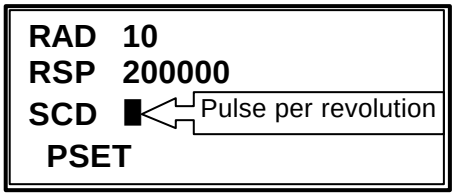
(1) To enter a speed value, move the cursor on [RSP] by [↑] and [↓] keys.
(2) Enter the value by numeral keys.
(3) To define the code, press [ENTER] key.
(4) To cancel the entering and to recover old code before defining, press [CANCEL] key.

SCD Pulse per revolution

● Function

[SCD] defines the pulse number per revolution.

When a reducer is attached to the output frange of FHA-C actuator, multiply the reduction ratio of the reducer to the actuator resolution.



Range: 1000 to +9,999,999
Default: 1,000,000

The actuator resolutions are as follows:

Actuator model	Incremental system						Absolute system		
	FHA-?• C -30 -E-200	FHA-?• C -50 -E-200	FHA-?• C -100 -E-200	FHA-?• C -50 -E-250	FHA-?• C -100 -E-250	FHA-?• C -160 -E-250	FHA-?• C-50 S-248	FHA-?• C-100 -S-248	FHA-?• C-160 -S-248
Actuator resolution	240,000	400,000	800,000	500,000	1,000,000	1,600,000	409,600	819,200	1,310,720

● Operations

(1) To enter pulse number per revolution, move the cursor on [SCD] by [↑] and [↓] keys.
(2) Enter the value by numeral keys.
(3) To define the value, press [ENTER] key.
(4) To cancel the entering and to recover old value before defining, press [CANCEL] key.

SHC Shortcut motion

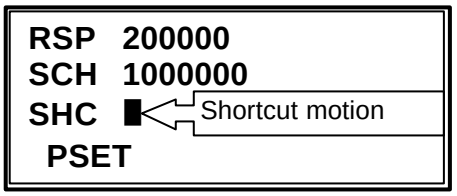
● Function

For rotation of more than 180 degrees, turning to oposite direction may get shorter time for positoning; this is called shortcut motion.

However, if wires or something go through the hollow shaft of an FHA-C actuator, the shortcut motion would break them.

[SHC] specifies whether shortcut motion is active or inactive.

If the load is the linear motion mechanism and [MQU: position unit] has [0: pulse], the specification of [1: active] to this command may make oposite motion. Specify [0: inactive] for the linear motion mechanism.



0: inactive
1: active
Default: 0

When [MQU: position unit] has [2: 1/100mm], the oposite motion will not occur even if [1: active] is specified.

● Operations

(1) To specify a shortcut motion code, move the cursor on [SHC] by [↑] and [↓] keys.
(2) Enter the code by numeral keys.
(3) To define the code, press [ENTER] key.
(4) To cancel the entering and to recover old code before defining, press [CANCEL] key.

Chapter 8 Troubleshooting

8-1 Alarms and diagnostic tips

The HA-675 drivers provide various functions to protect actuators and drivers against abnormal operating conditions. When these functions detect faults, the actuator stops (the motor enters a free rotation state.), a two-digit alarm code is indicated on the display panel, and a corresponding alarm signal is transmitted to the hosts.

alarm code	Alarm description	4-bit code	CN2-41	CN2-40	CN2-39	CN2-38	alarm clear
01	Emergency stop	0011	OFF	OFF	ON	ON	Possible
02	FWD limit	0011	OFF	OFF	ON	ON	Possible
03	REV limit	0011	OFF	OFF	ON	ON	Possible
04	Programming error	0011	OFF	OFF	ON	ON	Possible
10	Over speed	1011	ON	OFF	ON	ON	Impossible
20	Over load	0001	OFF	OFF	OFF	ON	Possible
30	Over current	1001	ON	OFF	OFF	ON	Impossible
40	Over voltage	1011	ON	OFF	ON	ON	Impossible
41	Abnormal regeneration	1010	ON	OFF	ON	OFF	Impossible
50	Encoder failure	1101	ON	ON	OFF	ON	Impossible
51	Abnormal encoder signal	1101	ON	ON	OFF	ON	Impossible
52	INC UVW failure	1101	ON	ON	OFF	ON	Impossible
53	ABS ABS system failure	1101	ON	ON	OFF	ON	Impossible
54	ABS Revolution counter overflow	1101	ON	ON	OFF	ON	Impossible
55	ABS Revolution count error	1101	ON	ON	OFF	ON	Impossible
56	ABS Low battery voltage	1101	ON	ON	OFF	ON	Auto recov.
57	ABS Send data rule error	1101	ON	ON	OFF	ON	Impossible
60	Error counter overflow	0010	OFF	OFF	ON	OFF	Possible
70	Memory failure (RAM)	0101	OFF	ON	OFF	ON	Impossible
71	Memory failure (EEPROM)	0101	OFF	ON	OFF	ON	Impossible
76 or Flickering [0]	CPU failure	0100	OFF	ON	OFF	OFF	Impossible

Note 1: The alarm 52 is valid for incremental system only, and the alarms 53 through 57 are valid for absolute system. Other codes are valid for both incremental and absolute systems.

Note 2: Plural alarms are indicated in the order of codes.

Note 3: When [alarm 56: low battery voltage] occurs, the servo power supply does not turn off. If [parameter mode]→[I: low battery alarm] is set [1: no output], the alarm is indicated on the LED display, but no alarm signals including 4-bit codes are transmitted to the host.

Note 4: Shut off the power supply after remedying a cause of the alarm that releasing is impossible. Then turn on the power supply.

Causes and remedies of alarms are described as follows.

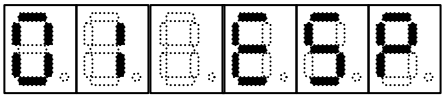
WARNING

Do not make wiring works after powering the driver for troubleshooting.

The troubleshooting while power is active may result in getting electric shocks or in electrocution. Shut off the electric power source before any wiring changes are

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.



Emergency stop (alarm clear: Possible)

● Description

The alarm will occur if an emergency stop signal (OFF) comes from a host, or if the emergency stop switch on the teach-box is pressed, or if the teach-box is disconnected from the driver. To clear the alarm, input the ON signal to [CN2-2 clear: CLEAR] port, or press [CLR] on the teach-box, or shut off the control power once and turn it on again.

● Diagnostic tip

◆ Cause 1: An emergency stop signal comes from a host.

⇒Remedy: Clear up the cause of the emergency stop, input ON signal to [CN2-2 clear: CLEAR] port, shut off the control power once and turn it on again.

◆ Cause 2: The emergency stop switch on the teach-box is pressed

⇒Remedy: Clear up the cause of the emergency stop, input ON signal to [CN2-2: clear: CLEAR] port, shut off the control power once and turn it on again.

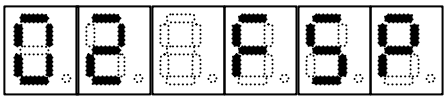
◆ Cause 3: The teach-box is disconnected from the driver.

⇒Remedy: Clear up the cause of the emergency stop, input ON signal to [CN2-2: clear] port, shut off the control power once and turn it on again.

To avoid the emergency-stop state and to operate the system normally after detaching the teach-box, press the [ESTP DENB] key. Following the "pee…" sound detach the teach-box.

◆ Cause 4: The emergency stop circuit has failed.

⇒Remedy: Verify the emergency stop circuit.



FWD limit (alarm clear: Possible)

● Description

The alarm will occur if an OFF signal comes from the forward limit sensor with the exception of originating. To clear the alarm, input a ON signal to [CN2-2 clear: CLEAR] port, or press [CLR] on the teach-box, or shut off the control power once and turn it on again.

● Diagnostic tip

◆ Cause 1: The actuator exceeds the limit by a wrong program.

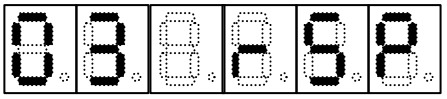
⇒Remedy: Check and correct the program so that the actuator does not exceed the limit. After that, input ON signal to [CN2-2 clear: CLEAR] port, shut off the control power once and turn it on again.

◆ Cause 2: The FWD limit sensor may be failed.

⇒Remedy: Replace the sensor, and input ON signal to [CN2-2 clear: CLEAR] port, shut off the control power once and turn it on again.

◆ Cause 3:The FWD limit sensor circuit may be failed.

⇒Remedy: Check the sensor circuit failure.



REV limit (alarm clear: Possible)

● Description

The alarm will occur if an OFF signal comes from the reverse limit sensor with the exception of originating. To clear the alarm, input a ON signal to [CN2-2 clear: CLEAR] port, or press [CLR] on the teach-box, or shut off the control power once and turn it on again.

● Diagnostic tip

◆ Cause 1: The actuator exceeds the limit by a wrong program.

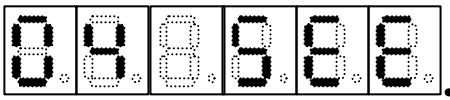
⇒Remedy: Check and correct the program so that the actuator does not exceed the limit. After that, input ON signal to [CN2-2 clear: CLEAR] port, shut off the control power once and turn it on again.

◆ Cause 2: The REV limit sensor may be failed.

⇒Remedy: Replace the sensor, and input ON signal to [CN2-2 clear: CLEAR] port, shut off the control power once and turn it on again.

◆ Cause 3:The REV limit sensor circuit may be failed.

⇒Remedy: Check the sensor circuit failure.



Programming error (alarm clear: Possible)

● Description

The alarm may occur at turning ON the [CN2-6 start: START] after specifying a program number.

To move the actuator in accordance with a program, [SPD: speed], [POS: stop position] and [SLP: acceleration time] are essential to be programmed. If any one of the data has not be set, the alarm occurs. To clear the alarm, input an [ON] signal to [CN2-2 clear: CLEAR] port.

● Diagnostic tip

◆ Cause 1: Lacked data of [SPD: speed], [POS: stop position] and [SLP: acceleration time] in the specified program number

⇒Remedy: Confirm them, and input data to the lacked item.

◆ Cause 2: Faulty program by the TBX-670 teach-box

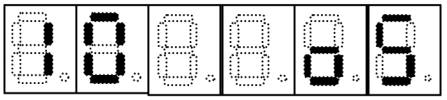
⇒Remedy: If no lacked data of three items, erase the motion program by [ERASE ALL] key, and remake the program.

◆ Cause 3: Faulty downloaded program from PSF-670 software

⇒Remedy: If no lacked data of three items, download the program again.

◆ Cause 4: Each of five or more sequential addresses includes the [CHP: speed changing position].

⇒Remedy: Decrease the sequential addresses including the [CHP: speed changing position] to four or less.



Over speed

(alarm clear: Impossible)

● Description

The alarm will occur if the motor exceeds its maximum speed or if it rotates abnormally. To clear the alarm, shut off the control power once and turn it on again.

● Diagnostic tip

(1) Alarm occurs when control power is turned on:

◆ Cause 1: The control circuit of the HA-675 driver may have failed.

⇒Remedy: Contact Harmonic Drive Systems. (Replace The HA-675 driver)

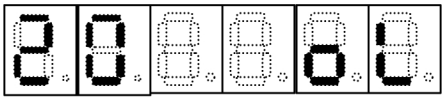
(2) Motor ran at a high speed when servo power is turned on:

◆ Cause 1: No or improper connection of the [CN1: encoder connector]

⇒Remedy: Connect the [CN1: encoder connector] firmly.

◆ Cause 2: Encoder failure

⇒Remedy: Contact Harmonic Drive Systems. (Replace The HA-675 driver)



Over load

(alarm clear: possible)

● Description

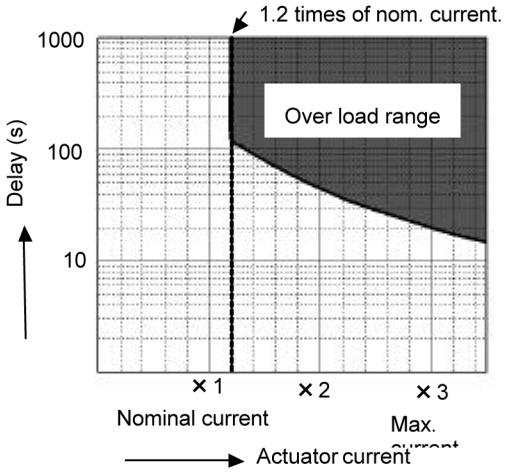
The driver always monitors the motor current and if the current exceeds the curve in the figure below, then an overload alarm occurs.

For example:

(1) The alarm occurs if the current is 1.2 times of nominal current for a long period of time.

(2) The alarm occurs if the current of three times of the nominal current flows for 20 seconds.

It is possible to clear the alarm by inputting the ON signal to [CN2-2 clear: CLEAR], if the overload condition has been corrected.



● Diagnostic tip

(1) Alarm occurs when control power is turned on:

◆ Cause 1: The control circuit of the HA-675 driver may have failed.

⇒Remedy: Contact Harmonic Drive Systems. (Replace the HA-675 driver)

(2) Alarm occurs when servo power is turned on:

◆ Cause 1: The encoder connector (CN1) may not be connected.

⇒Remedy: Verify connection of encoder connector (CN1).

(3) 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.

(4) Alarm occurs after hunting motion.

◆ Cause 1: Hunting motion is caused by poor gain adjustment

⇒Remedy: Adjust gains in [tune mode]→[0: speed loop gain],[1: speed loop integral compensation] and [2: position loop gain] proportional to the load.

(5) Alarm does not occur when driving the actuator only, but alarm occurs with load.

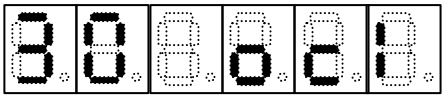
◆ Cause 1: Wrong connection of motor and encoder cables

⇒Remedy: Connect cables correctly referring to [chapter 4 : Installing the HA-675 driver] in this manual.

(6) Alarm occurs when driving the actuator only

◆ Cause 1: Wrong connection of motor and encoder cables

⇒Remedy: Connect cables correctly referring to [chapter 4: Installing the HA-675 driver] in this manual.



Over current （alarm clear: Impossible）

● Description

This alarm occurs when the servo control element of the driver detects over current. To clear the alarm after troubleshooting, shut off the control power and turn it on again.

● Diagnostic tip

(1) Alarm occurs when control power is turned on:

◆ Cause 1: The control circuit of the HA-675 driver may have failed.

⇒Remedy: Contact Harmonic Drive Systems.
（Replace the HA-675 driver）

(2) Alarm occurs by input signal of [CN2-3: S-ON (servo-ON)] is activated

◆ Cause 1: The control or main circuit of the HA-675 driver may have failed.

⇒Remedy: Contact Harmonic Drive Systems.
（Replace the HA-675 driver）

(3) Alarm occurs by input signal of [CN2-3: S-ON (servo-ON)] is activated, but alarm doesn't occur when off the motor cable (U,V,W) is disconnected from the driver

◆ Cause 1: Short connection in the motor cable

⇒Remedy: Verify the connection of the motor cable and correct it as needed.

◆ 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 [tune mode]→[7: acceleration time constant] and [8: deceleration time constant].

◆ Cause 2: Gain is set too high or too low

⇒Remedy 1: Adjust gains [parameter mode]→[0: speed loop gain], [1: speed loop integral compensation] and [2: position loop gain].

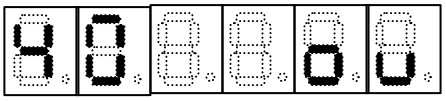
(5) The alarm occurs while running (it is possible to restart after 4 to 5 minutes):

◆ 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-655 driver is more than 50 deg C.

⇒Remedy: Review the driver's installation and it's cooling system.



Over Voltage (release: impossible)

● Description

The alarm occurs for HA-675-1 only. For HA-675-2/4, this alarm does not occur.

It occurs when the main circuit voltage exceeds about 394V. The HA-655-1 drivers do not equip regeneration resistors to absorb regenerated energy at deceleration. When the load inertia is very big (example: 6 times or more of inertia of FHA-14C), the voltage of servo circuit increases highly and the alarm occurs. To release the alarm after troubleshooting, shut off the control power once and turn it on again.

However, the alarm will occur repeatedly if the load conditions are not lightened. Attach a proper resistance to the terminals for an external regenerative resistance, or prolong acceleration and deceleration periods. When a resistance is attached, set [1: attached] to [parameter mode]→[n: regenerative resistance].

● Diagnostic tips

(1) The alarm occurs while running:

◆ Cause 1: Too large moment of inertia

⇒Remedy 1: Attach a regenerative resistance (around 100 ohms and 100W) to R1 and R2 terminals.
And set [1: attached] to [parameter mode]→[n: regenerative resistance].

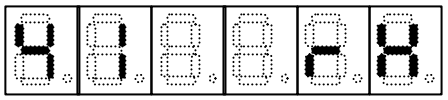
⇒Remedy 2: Prolong acceleration and deceleration periods.

⇒Remedy 3: Reduce the maximum speed.

⇒Remedy 4: Reduce moment of inertia of the load.

◆ Cause 2: Abnormal over voltage detection circuit

⇒Remedy: Contact Harmonic Drive Systems. (Replace the HA-675-1 driver)



Abnormal regeneration (clr: Impossible)

● Description

This alarm occurs when the thermal switch of the regeneration resistor in the HA-675 driver is activated at 100℃. To clear the alarm after troubleshooting, shut off the control power and turn it on again.

● Diagnostic tip

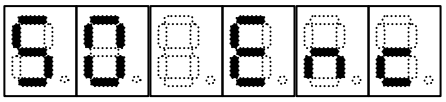
(1) Alarm occurs during deceleration

◆ Cause 1: The capacity of the regeneration resistor is too small.

⇒Remedy: Install an external resistor to make the capacity larger.

◆ Cause 2: The regeneration circuit of the HA-675 driver may have failed.

⇒Remedy: Contact Harmonic Drive Systems.（Replace the HA-675 driver）



Encoder failure （alarm clear: Impossible）

● Description

This alarm occurs when the encoder signal ceases. To clear the alarm after troubleshooting, shut off the control power and turn it on again.

● Diagnostic tip

(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.

⇒Remedy: Verify connection of encoder connector (CN1) and connect it firmly.

◆ Cause 2: The control circuit of the HA-675 driver may have failed.

⇒Remedy: Contact Harmonic Drive Systems.（Replace the HA-675 driver）

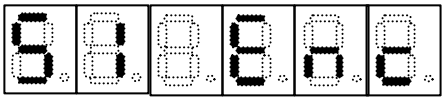
◆ Cause 3: The encoder circuit may have failed.

⇒Remedy: Contact Harmonic Drive Systems.
（Replace actuator）

(2) Alarm occurs during running (recovers after cooling of the actuator)

◆ Cause 1: Encoder malfunctions when the actuator temperature rises.

⇒Remedy: Review the actuator operating load, duty cycle, and its cooling system.



Abnormal encoder signal (Impossible)

● Description

This alarm occurs when the driver fails to receive the two sequential encoder signals. To clear the alarm after troubleshooting, shut off the control power and turn it on again.

● Diagnostic tip

(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 control circuit of the HA-675 driver may have failed.

⇒Remedy: Contact Harmonic Drive Systems.（Replace the HA-675 driver）

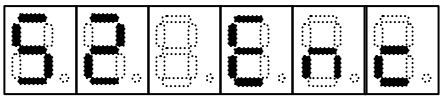
◆ Cause 3: The encoder circuit may have failed.

⇒Remedy: Contact Harmonic Drive Systems.（Replace the actuator）

(2) Temporally alarm occurs during running:

◆ Cause 1: Malfunction may be caused by surrounding electrical noise.

⇒Remedy: Install the driver correctly referring [Chapter 4－4: Noise Suppression] in this manual



UVW failure INC （alarm clear: Impossible）

● Description

The alarm occurs when the encoder UVW signals are abnormal. To clear the alarm after troubleshooting, shut off the control power and turn it on again.

● Diagnostic tip

(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 control circuit of the HA-675 driver may have failed.

⇒Remedy: Contact Harmonic Drive Systems.（Replace the HA-675 driver）

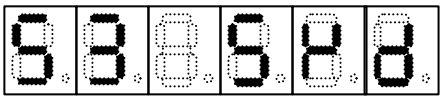
◆ Cause 3: The encoder circuit may have failed.

⇒Remedy: Contact Harmonic Drive Systems.
（Replace actuator）

(2) Alarm occurs temporarily while running:

◆ Cause 1: Malfunction may be caused by surrounding electrical noise.

⇒Remedy: Install the driver correctly referring [Chapter 4-4: Noise Suppression].



ABS system failure ABS (release: pos.)

● Description

For the absolute system, the alarm occurs at the first power supply after purchasing. And it also occurs at power supply after disconnecting the cable between the driver and the encoder for a long duration.

Moreover, it occurs when all power supplies (power supply, built-in condenser, and backup battery) for the encoder are failure.

● Diagnostic tips

(1) Alarm occurs when the control power is turned on:

◆ Cause 1: The first power supply after purchasing

⇒Remedy: Input the [CN2-30 revolution counter clear: ABS-CLEAR] signal at least 4 seconds, and shut off the control power once and turn it on again.

◆ Cause 2: The power supply after disconnecting the cable between the driver and the encoder for a long duration：

⇒Remedy: Input the [CN2-30 revolution counter clear: ABS-CLEAR] signal at least 4 seconds, and shut off the control power once and turn it on again.

◆ Cause 3: The encoder connector (CN1) may not be connected or may be connected poorly.

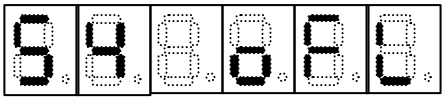
⇒Remedy: Verify connection of encoder connector (CN1) and connect it firmly.

◆ Cause 4: The control circuit of the HA-675 driver may have failed.

⇒Remedy: Contact Harmonic Drive Systems. (Replace the HA-675 driver)

◆ Cause 5: The encoder circuit may have failed.

⇒Remedy: Contact Harmonic Drive Systems. (Replace the actuator)



Revolution counter overflow ABS

(release: impossible)

● Description

For the absolute system, the alarm occurs when the revolution count goes beyond the range of +4095 to - 4096 turns (motor axis).

● Diagnostic tips

(1) Alarm occurs when the control power is turned on:

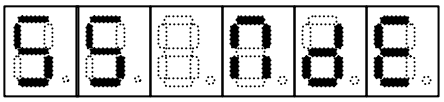
◆ Cause 1: The encoder connector (CN1) may not be connected or may be connected poorly.
⇒Remedy: Verify connection of encoder connector (CN1) and connect it firmly.

◆ Cause 2: The control circuit of the HA-675 driver may have failed.
⇒Remedy: Contact Harmonic Drive Systems. (Replace the HA-675 driver)

◆ Cause 3: The encoder circuit may have failed.
⇒Remedy: Contact Harmonic Drive Systems. (Replace the actuator)

(2) Alarm occurs during running:

◆ Cause 1: The motor turns goes beyond the range of +4095 to - 4096 revolution.
⇒Remedy: Input the [CN2-30 revolution counter clear: ABS-CLEAR] signal at least 4 seconds, and shut off the control power once and turn it on again.

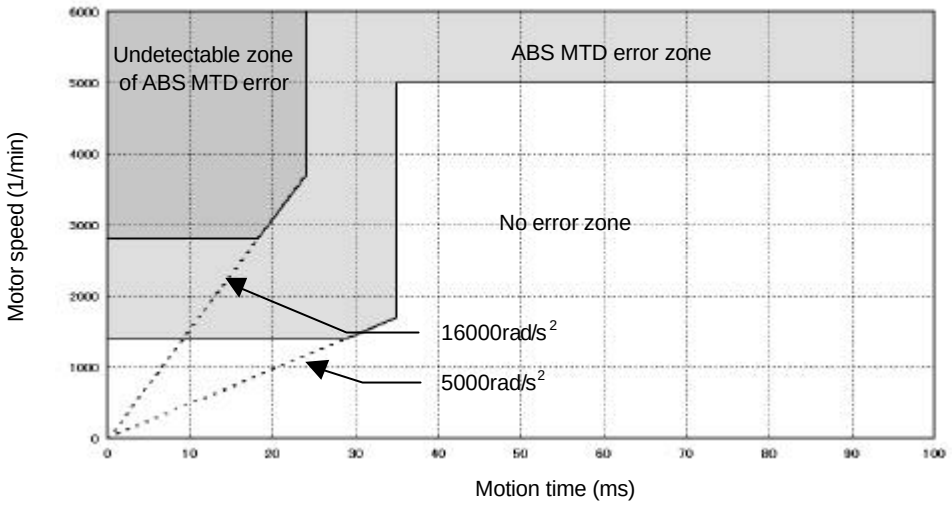


Revolution count error ABS

(release: impossible)

● Description

While the absolute encoder is not supplied power by power supply but the encoder circuit is active only by the power of a built-in condenser and a built-in battery, the alarm occurs when the encoder rotates too fast at the acceleration rate and/or speed exceeding the allowed zone shown the figure below.



● Diagnostic tips

(1) Alarm occurs when the control power is turned on:

◆ Cause 1: The encoder rotates during no control power supply.

⇒Remedy: Input the [CN2-30 revolution counter clear: ABS-CLEAR] signal at least 4 seconds, and shut off the control power once and turn it on again.

◆ Cause 2: The encoder connector (CN1) may not be connected or may be connected poorly.

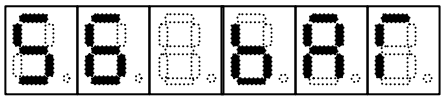
⇒Remedy: Verify connection of encoder connector (CN1) and connect it firmly.

◆ Cause 3: The control circuit of the HA-675 driver may have failed.

⇒Remedy: Contact Harmonic Drive Systems. (Replace the HA-675 driver)

◆ Cause 4: The encoder circuit may have failed.

⇒Remedy: Contact Harmonic Drive Systems. (Replace the actuator)



Low battery voltage ABS

(release: impossible)

● Description

For the absolute system, the alarm occurs when voltage of the built-in battery becomes lower than 2.8V. Exchange the battery having the voltage more than 3.0V, and then the system recovers automatically from the alarm.

Even in the alarm condition, the HA-675 driver keeps the multi-turn counter data if the control power supply is active. On the contrary if the power supply is inactive, the data may be lost due to further voltage drop after around 30 minutes from the alarm. Exchange the battery to new one promptly referring to [7-3 How to exchange battery].

● Diagnostic tips

(2) Alarm occurs when the control power is turned on:

◆ Cause 1: The voltage of the built-in battery isles than 2.80V.

⇒Remedy: Change the battery for a new one in 30 minutes. However, do not change it while the actuator is moving

◆ Cause 2: 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 3: The control circuit of the HA-675 driver may have failed.

⇒Remedy: Contact Harmonic Drive Systems. (Replace the HA-675 driver)

◆ Cause 4: The encoder circuit may have failed.

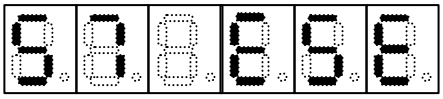
⇒Remedy: Contact Harmonic Drive Systems. (Replace the actuator)

(2) Alarm occurs during running:

◆ Cause 1: The voltage of the built-in battery isles than 2.80V.

⇒Remedy: Change the battery for a new one in 30 minutes. However, do not change it while the actuator is moving

⇒Remedy: Continue to supply power.



Send data rule error ABS (release: imp.)

● Description

The absolute encoder rotates more than 127 resolvable pulses by external torque during transmitting absolute data.

● Diagnostic tips

(1) Alarm occurs when the control power is turned on:

◆ Cause 1: The absolute encoder rotates more than 127 resolvable pulses by external torque during transmitting absolute data.

⇒Remedy: Shut off the control power once and turn it on again.

◆ Cause 2: The encoder connector (CN1) may not be connected or may be connected poorly.

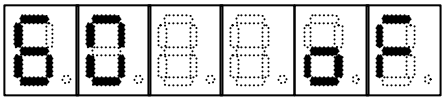
⇒Remedy: Verify connection of encoder connector (CN1) and connect it firmly.

◆ Cause 3: The control circuit of the HA-675 driver may have failed.

⇒Remedy: Contact Harmonic Drive Systems. (Replace the HA-675 driver)

◆ Cause 4: The encoder circuit may have failed.

⇒Remedy: Contact Harmonic Drive Systems. (Replace actuator)



Error counter overflow (Possible)

● Description

The alarm occurs when an error count exceeds the set value in [parameter mode]→[6: position error allowance]. It is possible to clear the alarm by inputting ON signal to [CN2-2 clear: CLEAR]. The error count is reset simultaneously.

● Diagnostic tip

(1) Alarm occurs when the control power is turned on:

◆ Cause 1: The control circuit of the HA-675 driver may have failed.

⇒Remedy: Contact Harmonic Drive Systems.（Replace the HA-675 driver）

(2) Alarm occurs during acceleration or deceleration

◆ Cause 1: Gain is too low

⇒Remedy: Adjust gains [parameter mode]→[0: speed loop gain], [1: speed loop integral compensation] and [2: position loop gain].

◆ Cause 2: The load inertia is too large

⇒Remedy1: Reduce the load inertia.

⇒Remedy2: Modify the motion profile to accelerate and decelerate more slowly.

(3) Actuator did not rotate.

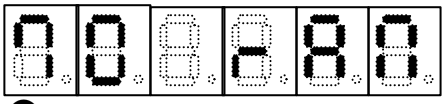
◆ Cause 1: Incorrect motor cable connection or wrong phase order

⇒Remedy1: Correct the connection between the motor cable and the connector.

⇒Remedy2: Connect the motor cable and the connector in correct phase order referring to [Chapter 4－7: Connection Servomotor Cable and Regeneration Resistor] of this manual.

◆ Cause 2: Poor encoder connector (CN1) connection.

⇒Remedy: Plug the CN1 connector firmly.



Memory failure (RAM) (Impossible)

● Description

This alarm occurs when the driver's RAM memory fails. It is impossible to clear the alarm.

● Diagnostic tip occurs

(1) Alarm occurs when control power is turned on:

◆ Cause 1: The control circuit of the HA-675 driver may have failed.

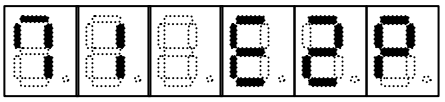
⇒Remedy: Contact Harmonic Drive Systems.
（Replace the HA-675 driver）

(2) Alarm occurs while running

◆ Cause 1: Malfunction of a control element of the HA-675 driver

⇒Remedy: Contact Harmonic Drive Systems.
（Replace the HA-675 driver）

Make sure that the installed location is suitable, referring [4-3 location and installation] of this manual.



Memory failure (EEPROM)

(Impossible)

● Description

This alarm occurs when the driver's EEPROM memory fails. It is impossible to clear the alarm.

● Diagnostic tip occurs

(1) Alarm occurs when the control power is turned on:

◆ Cause 1: The control circuit of the HA-675 driver may have failed.

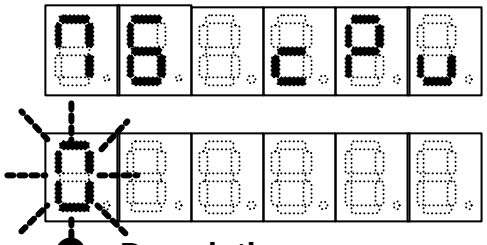
⇒Remedy: Contact Harmonic Drive Systems.
(Replace the HA-675 driver)

(2) Alarm occurs during running

◆ Cause 1: Malfunction of a control element of the HA-675 driver

⇒Remedy: Contact Harmonic Drive Systems.
(Replace the HA-675 driver)

Make sure that the installed location is suitable, referring [4-3 location and installation] of this manual.



or

CPU failure

(alarm clear: Impossible)

● Description

This alarm occurs when the driver's CPU fails. It is impossible to clear the alarm.

● Diagnostic tip

(1) Alarm occurs when the control power is turned on:

◆ Cause 1: The control circuit of the HA-675 driver may have failed.

⇒Remedy: Contact Harmonic Drive Systems. (Replace the HA-675 driver)

(2) Alarm occurs during running

◆ Cause 1: Malfunction may be caused by surrounding electrical noise.

⇒Remedy: Install the driver correctly referring to [Chapter 4－4 noise suppression].

◆ Cause 2: The control circuit of the HA-675 driver may have failed.

⇒Remedy: Contact Harmonic Drive Systems. (Replace the HA-675 driver)

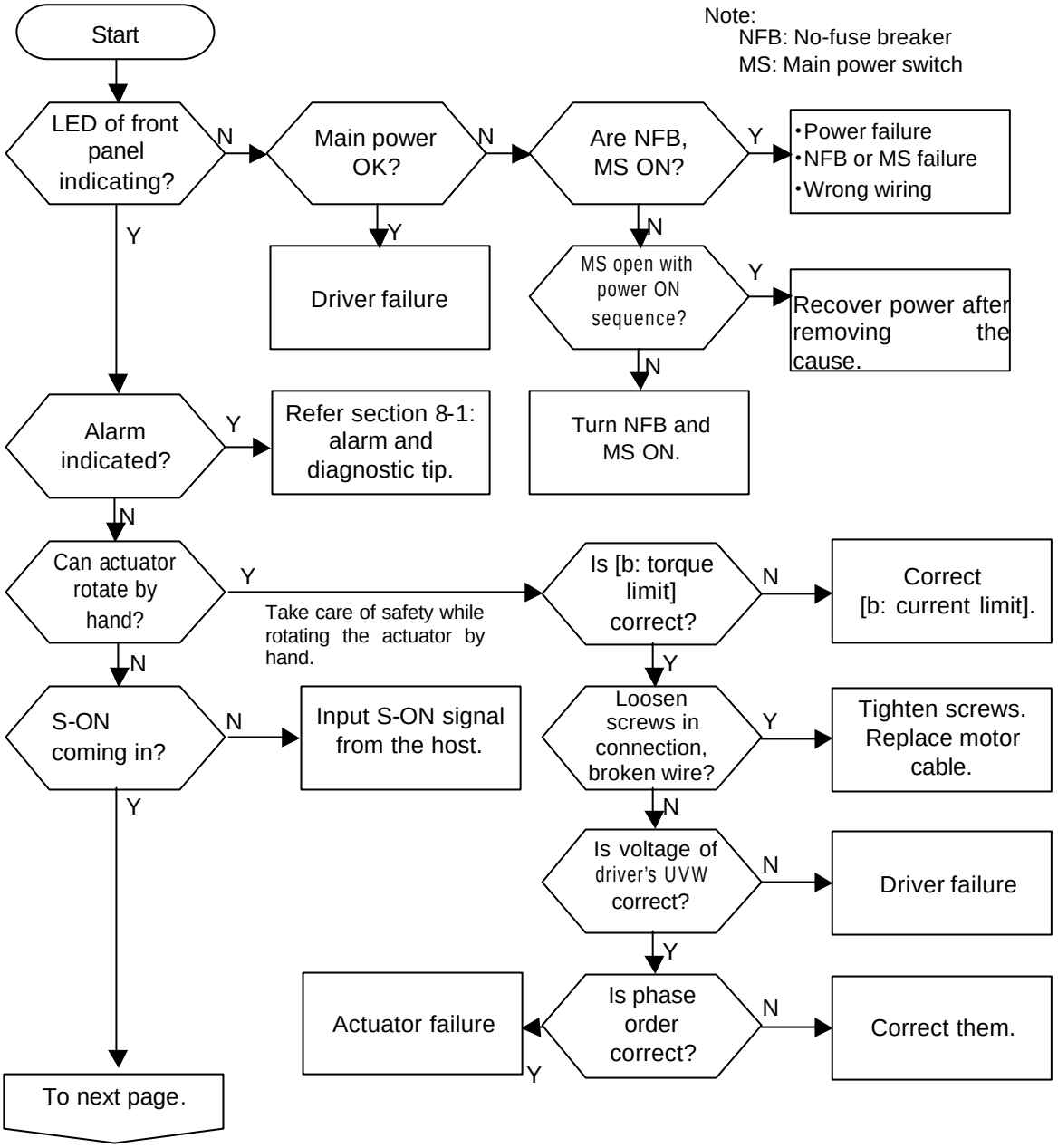
8-2 Troubleshooting for improper actuator motion

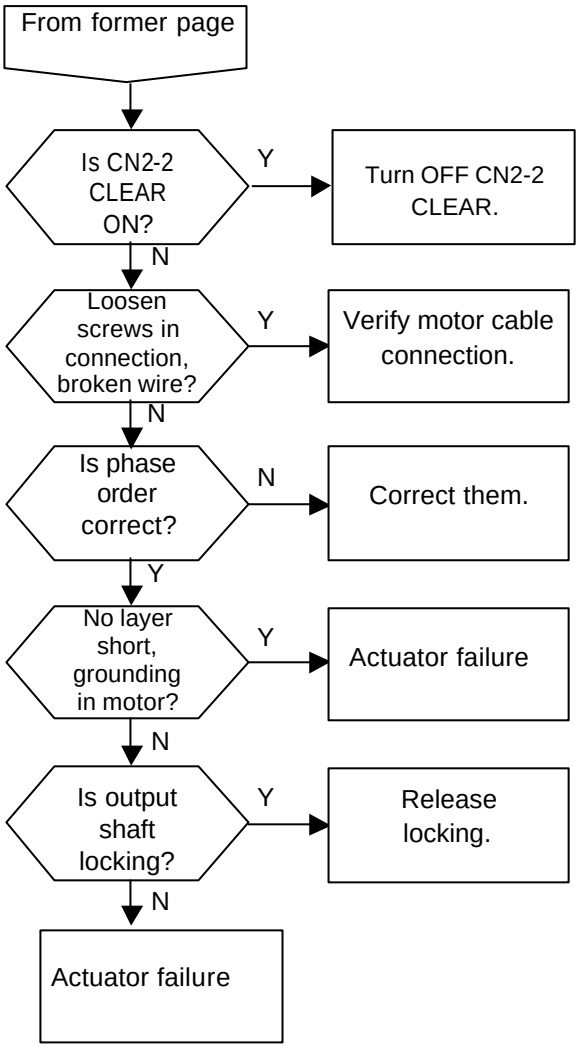
Troubleshooting procedures for problems other than alarms are described. They are also described for the following cases:

- No rotation
- Unstable rotation
- Poor positioning accuracy

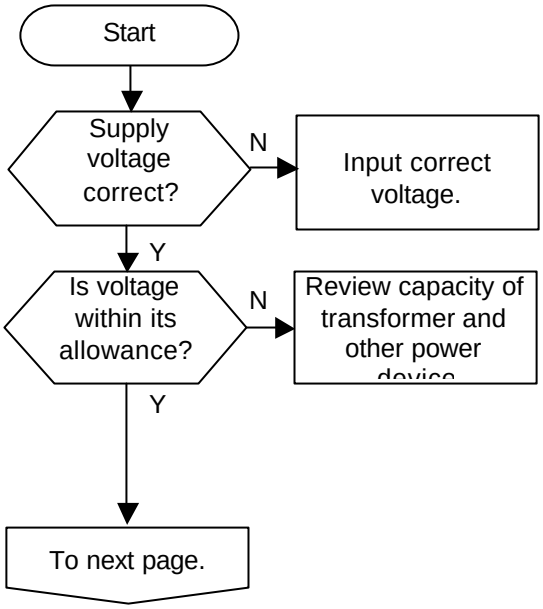
Note: In the flowcharts, [Y] means [yes], and [N] means [no].

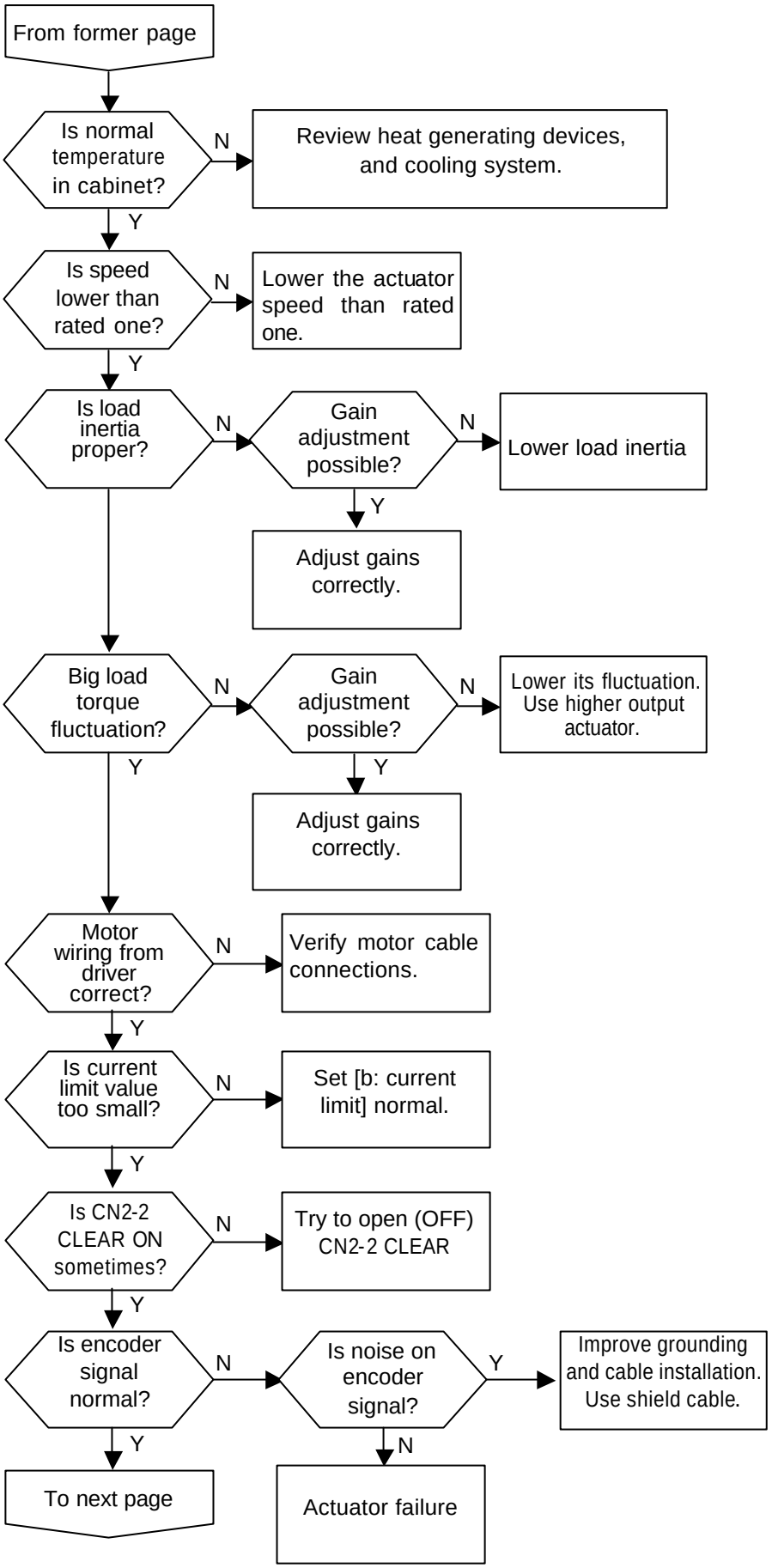
8-2-1 No rotation

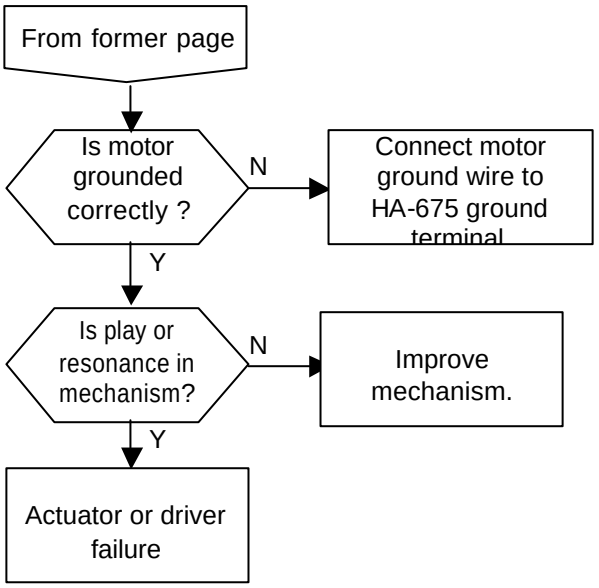




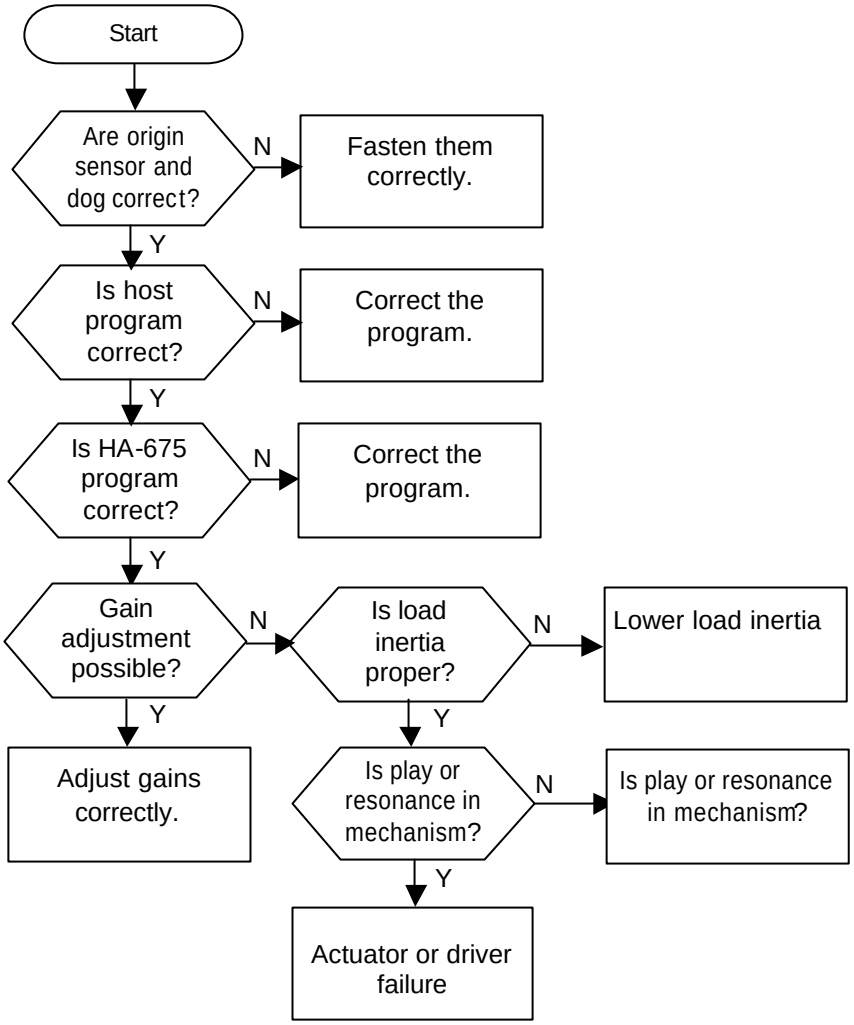
8-2-2 Unstable rotation




From former page
Is normal temperature in cabinet?
N
Review heat generating devices, and cooling system.
Y
Is speed lower than rated one?
N
Lower the actuator speed than rated one.
Y
Is load inertia proper?
N
Gain adjustment possible?
N
Lower load inertia
Y
Adjust gains correctly.
Big load torque fluctuation?
N
Gain adjustment possible?
N
Lower its fluctuation. Use higher output actuator.
Y
Y
Adjust gains correctly.
Motor wiring from driver correct?
N
Verify motor cable connections.
Y
Is current limit value too small?
N
Set [b: current limit] normal.
Y
Is CN2-2 CLEAR ON sometimes?
N
Try to open (OFF) CN2-2 CLEAR
Y
Is encoder signal normal?
N
Is noise on encoder signal?
Y
Improve grounding and cable installation. Use shield cable.
Y
N
To next page
Actuator failure



8-2-3 Poor positioning accuracy



8-3 Exchanging batteries ABS

The HA-675 driver houses a backup battery to keep revolution counts in the duration of no power supply. Moreover, the absolute encoder of the FHA-C actuator equips a condenser to keep the count in the duration of exchanging the battery.

8-3-1 Duration of keeping a revolution count

(1) Battery

Purpose: Keeping a revolution count in the duration of no power supply

Lifetime: One year after control power OFF (conditions: unused, continuous discharge without rotation at ambient temperature: 25degC)
(actual lifetime depends on servicing conditions.)

Model : lithium battery; ER17/33 (3.6V 1600mAh) manufactured by Hitachi Maxell co., Ltd.
(Refer [8-4 Backup battery for absolute encoders])

(2) Condenser

Purpose: Keeping a revolution count in the duration of exchanging the battery

Duration: about half-hour after control power OFF (conditions: charged at least 3 hours, at ambient temperature: 25degC, no rotation)

8-3-2 Exchanging procedures

When [alarm 56: low battery voltage] occurs, exchange to new battery by the following procedures:

Shat off all power supply for the HA-675 driver.

Note 1: Shut off motor power supply for exchanging the battery, surely. It is possible to exchange batteries while the control power supply is active.

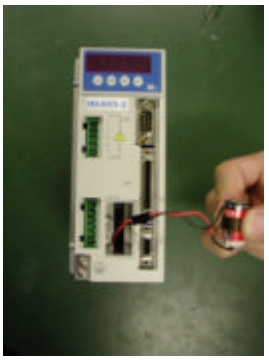
Note 2: The [alarm 56: low battery voltage] may automatically be released if the new battery has voltage of 3.0 V or more.

Note 3: Though [alarm 50: encoder failure] occurs at power ON operation after exchanging the battery, the encoder system is normal. To recover the problem, shut off the power once and turn it on again.

1. Detach a cover of battery case on the front panel of the HA-675 driver.

2. Pull out the battery from the case by pulling both ends of a ribbon.

3. Disconnect the leads of the battery from the junction connecter.



4. Connect the leads of the new battery to the junction connecter.

5. Cram the battery with the leads and the connecter into the case.

6. Attach a cover of battery case on the front panel of the HA-675 driver.

Chapter 9 Options

9-1 Extension cables

Three kinds of optional extension cables of 3m/5m/10m long are available for connecting an FHA-C actuator and an HA-675 driver: for a motor including brake wires, for an incremental encoder system, and for an absolute encoder system.

Ordering model:

for motors: EWC-MB * * -A06-TN (for HA-675-1)

EWC-MB * * -M08-TN (for HA-675-2/4)

for incremental encoders:

EWC-E* * - M06-3M14 (for HA-675-1 only) **INC**

EWC-E * * -B04-3M14 (for HA-675-2, HA-675-4) **INC**

Cable length

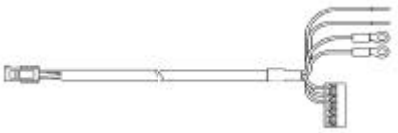
03	3m
05	5m
10	10m

for absolute encoders:

EWC-S * * -B08-3M14 **ABS**

Cable length

03	3m
05	5m
10	10m



External view of extension cable

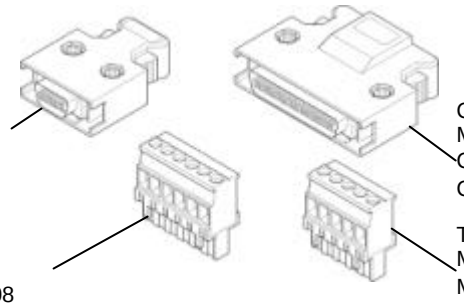
External view of extension cable
for incremental and absolute encoder

Note: EIA-232C communication cable is user's responsibility.
Recommended cable: EIA-232C cross cable with a D-sub female 9-pin connector for HA-675 driver side (with unified coarse thread screws: No.4-4 OUNC).

9-2 Connectors

Connectors for CN1 and CN2 connectors of HA-675, and terminal blocks for motor connection and power supply are optionally available as follows:

Ordering model: CNK-HA65-S1



Connector for CN1
Mfg by Sumitomo 3M
Connector: 10114-3000VE
Case: 10314-52F0-008

Terminal block for motor
Mfg by Phoenix contact
Model:MVSTBR2.5/6-ST/5.08

Connector for CN2
Mfg by Sumitomo 3M
Connector: 10150-3000VE
Case: 10350-52F0-008

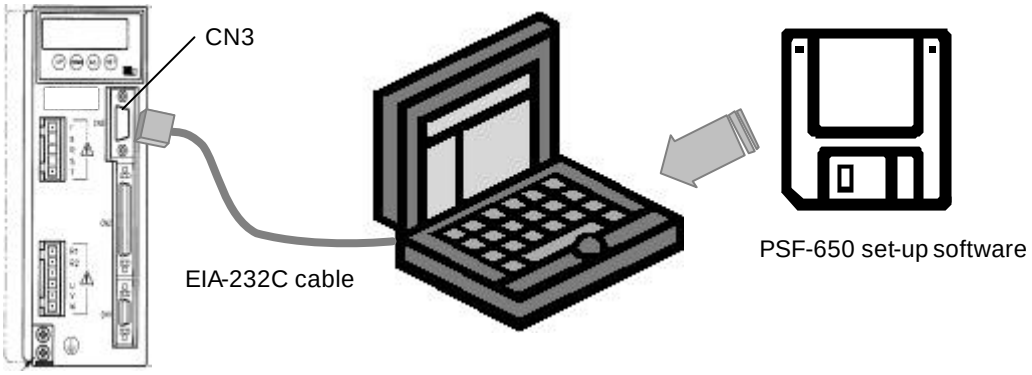
Terminal block for power supply
Mfg by Phoenix contact
Model: MVSTBR2.5/5-ST/5.08

9-3 Software for setting up parameters

The software helps out with setting up parameters of HA-675 driver connecting a personal computer.

For the details of the software, please ask us the instructions of PSF-650 software.

Ordering model:	PSF-650
Operating system:	Windows95/98/Me/NT/2000/Xp Notice: Windows is a registered trademark of Microsoft Corporation.
Link to CN3 port of HA-675 driver:	EIA-232C cable (un-optional item) with a D-sub female 9-pin connector for HA-675 driver side (with unified coarse thread screws: No.4-4 OUNC).

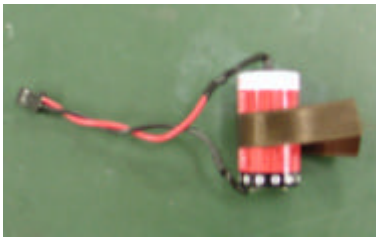


9-4 Backup battery for absolute encoders ABS

For protecting the absolute memory against volatilizing while control power is OFF, the HA-675 driver provides a battery.

Ordering model: HAB-ER17/33

Specifications: lithium battery
model: ER17/33 (3.6V 1600mAh) manufactured by Hitachi Maxell co., Ltd.



Note 1: The lifetime of the first battery shipped in the HA-675 driver is about one year excluding duration of control power ON. (Provided that ambient temperature is25degC, without rotation)
Actual lifetime depends on servicing conditions.

Note 2: The leads with a connector and the ribbon are not attached to batteries procured by users from the manufacturer or a dealer. Attach them to the battery before exchanging batteries.

9-5 Isolation transformer (single-phase)

The single-phase isolation transformers are used for noise suppression.

◆ Models

The model of the Isolation transformer is as follows:

PT1-200 04-200

- Ins. Transformer: PT1 series
- 2nd volt. 200: AC 200V
- 2nd cur. 02: 2A / 04: 4A / 08: 8A
- Prim. volt 100: AC100V / 115: AC115V / 200: AC200V / 220: AC220V

◆ Specifications

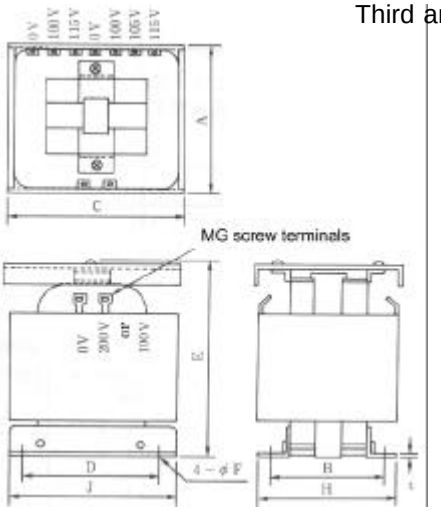
The specifications of transformers are as follows:

	PT1-20004-XXX	PT1-20004-XXX	PT1-20008-XXX
Number of phases	Single phase		
Rated 2nd voltage	200V	200V	200V
Rated 2nd current	2A	4A	8A
Rated prim. Volt.	AC100/115/200/220V, 50/60Hz		
Rated capacity	400VA	800VA	1600VA
Isolation class	B-class Isolation		
Ins. resistance	500M ohm or more (DC 1000V)		
Withstand voltage	AC2000V 1minute (50/60Hz)		
Amb. temperature	−10 to +55℃		
Overheat protection	Built-in thermal protector (cutoff temperature: 130℃)		

◆ External dimensions

The external dimensions of the transformers are as follows:

Third angle projection method Unit: mm

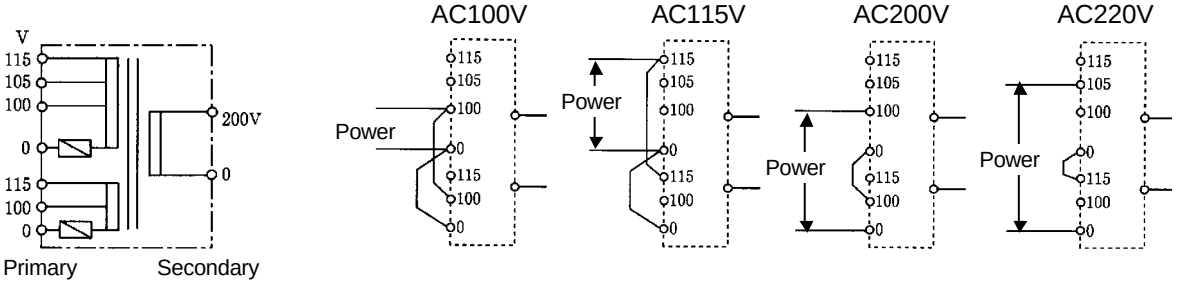


Model	A	B	C	D	E	F
PT1-20002	125	80	105	80	160	5.5
PT1-20004	145	96	150	120	160	6.5
PT1-20008	180	127	165	127	195	6.5

Model	G	H	J	t	Mass
PT1-20002	4	95	95	1.6	4.4kg
PT1-20004	4	120	140	1.6	7.5kg
PT1-20008	4	150	155	2.3	14.5kg

◆ Connections

The schematic of the transformers are shown below in the figure to the left. When the primary voltage is one of 100/115/200/220V, connect terminals as shown below in the figures to the right.



Index

+24V ····· 37
Abnormal encoder signal ····· 160
Abnormal regeneration ····· 159
ABS send data timing ····· 102
ABS system failure ····· 161
ABS-CLEAR ····· 38
ABSCLR ····· 123
Absolute encoder ····· 19,44
Absolute position ····· 19,44,45
Absolute sensor ····· 19
Absolute system ····· 19
ABSREQ ····· 123
ABS-REQ ····· 36
Acceleration and deceleration time ····· 136,143
Acceleration profile ····· 145
Actuator code ····· 87
Actuator serial number ····· 88
ALARM ····· 39
Alarm code ····· 40,153
Alarm history ····· 86
Alarm history clear ····· 106
Allowable size of cables ····· 52
Allowable wire sizes ····· 52
Allowed range of revolution counter ····· 19,44
Allowed range of the counter ····· 19
Analog monitor manual output ····· 113
Arranging address numbers ····· 127
ASP ····· 145
At-origin ····· 39
Automatic actuator identification ····· 29
Automatic gain control ····· 29,105
Backlash offset ····· 145
Backup battery ····· 173
Ball screw lead ····· 147
BLR ····· 145
Cable ····· 52
Canceling the data entering ····· 72,122
CHP ····· 135
Circuit breaker ····· 54
CLEAR ····· 33
Clearing revolution counter ····· 62
CN2 connector model ····· 30
Combinations with actuators ····· 2
Compound speed profile ····· 129
Conditions in programming ····· 128
Connecting power cables ····· 53
Connecting regeneration resistor cables ····· 54
Connector ····· 55,56,172
Contact inputs ····· 31
Correcting the entering data ····· 73,122
CPU failure ····· 166
CUR-MON ····· 37
Current address ····· 81
Current command ····· 21
Current limit ····· 28,100
Current monitor ····· 37
Current monitor offset ····· 95
Current position ····· 74
Defaults of parameters ····· 114
Defaults of the parameters ····· 114
Delay time ····· 137
DIM ····· 137
Display ····· 117
Duration of keeping revolution count ····· 171
EIA-232C ····· 5
EIA-232C cable ····· 172
Emergency stop ····· 35,154
Emergency stop switch ····· 10,117
Encoder ····· 19
Encoder cable ····· 55
Encoder connector ····· 55
Encoder failure ····· 160
Encoder phase-Z position ····· 75
END ····· 140
End of motion ····· 140
Entering and defining data ····· 72,122
Entering and erasing command data ····· 72,122
Environment of location ····· 48
Environmental condition ····· 48
Erasing defined data ····· 73,122
Error count clear by S-ON ····· 28,98
Error counter overflow ····· 164
Error counts ····· 20
Error pulse counts ····· 82
ESTOP ····· 35
Exchanging batteries ····· 171
Extension cables ····· 2,172
External dimensions ····· 4
External drawing ····· 4
Feed forward ····· 21
Feedback ····· 18
Feedback pulse ····· 84
FG ····· 41
Fine adjustment of positions ····· 132
FINISH ····· 38
Frequency of power ON / OFF operation ····· 57
Front panel ····· 5
FSTOP ····· 36
Functions of modes ····· 79
Fuse ····· 54
FWD limit ····· 36,154
Gain ····· 20
GND ····· 37
Ground ····· 54

Grounding 49
Grounding cable 54
Grounding ducts 50
Grounding motor frame 50
High voltage breakdown test 77
Humidity 48
Hunting 91
I/O monitor 27,85,112
I/O port connection 31
I/O ports 30
I/O signal cable 55
Impact 48
IN-COM 33
Incremental 19
Incremental encoder 19
Incremental signals 45
Indexing 137
Individual positioning 127,146
In-position range 27,93
Input bits 35
Input signal common 33,34
INPUT-DATA 35
Installing 49
Instructions for cabling 51
INTERLOCK 34
Isolation transformer 53,174
JMP 138
JOG acceleration 110
JOG operation 27,109,143
Jog operation using teach-box 65
JOG speed 110,143
Jump 138
LCD display 10
LED indicator 117
Location 48
Logical commands 128
Logical inputs 31
LOP 139
Low battery voltage 163
Low battery voltage alarm 102
Maintenance 77
Manipulating the cursor 72,121
Manual JOG operation 27,64
Mechanical origin 75,102
Mechanical origin 75
Memory failure (EEROM) 166
Memory failure (RAM) 165
Mode LED 10,117
Model 46
Monitor mode 80
Monitor outputs 32
Motion commands 128
Motion control function 22
Motion finish 38,140
Motion profile 146
Motor speed 81
MQU 148
No operation 140
No rotation 171
Noise filter 50
Noise suppression 49
Nominal values 3
NOP 140
Notices on handling 47
Operation key 11,108,117
Operation mode 13,125
Operations of teach-box 72
OPM 146
Options 172
Ordering information 2
ORG 36
ORG-END 39
Origin 36
Origin direction 149
Origin sensor 75
Originating 33,142
Originating acceleration time 151
Originating speed 1 151
Originating speed 2 149
OUT-COM 41
OUT-DATA 40
Output 32
Output bit 40
Output common 41
Output port operation 111
Outputting position data 45
Over current 158
Over speed 156
Over voltage 159
Overheat 158
Overload 157
Overload rate 83
Overshoot 91,93
Parameter mode 96,125,144
Phase-A output 41
Phase-B output 41
Phase-Z 41
Pin layouts of connectors 55,56
Pin-layout 55,56
Pin-layout of encoder connector 55
Pin-layout of I/O signal connector 56
Poor positioning accuracy 170
POS 134
Position data 19,44
Position data request 37,123
Position error allowance 99
Position loop 20
Position loop gain 20,91
Position unit 148
Power consumption 48

Power supply ····· 52
Power supply terminals ····· 5
Power-OFF sequence ····· 58
Power-ON sequence ····· 57
Program examples ····· 130
Program mode ····· 126
Programmable motion control function ····· 1
Programmed motion ····· 128,146
Programming error ····· 155
Pulse per revolution ····· 152
RAD ····· 151
READY ····· 38
RED ····· 147
Regenerative resistance ····· 104
Repeat cycle ····· 139
REV limit ····· 36,155
Revolution counts ····· 19,45
Revolution count error ····· 162
Revolution counter ····· 19,44
Revolution counter clear ····· 38,103,123
Revolution counter overflow ····· 162
RS2 ····· 149
RSTOP ····· 36
RTD ····· 149
SCD ····· 152
Selecting a command ····· 72,122
Selecting a mode ····· 78
Send data rule error ····· 164
Sequential positioning ····· 127,146
Serial port connector ····· 5
Service humidity ····· 48
Service temperature ····· 48
Servo gain ····· 20
Servo parameters ····· 70
Servo-ON ····· 33,124
Setting an origin ····· 71
Setting parameter data ····· 73
Setting parameters ····· 68
Setting parameters for origination ····· 74
SHC ····· 152
Shortcut motion ····· 152
Signal logic ····· 101
Single speed profile ····· 129
SLP ····· 136
Software for setting up parameters ····· 173
Software origin ····· 74,150
S-ON ····· 33
SPD ····· 133
SPD-MON ····· 37
Specifications ····· 3
Specifications of EIA-232C cable ····· 56
Specifications of input ports ····· 31
Specifications of output ports ····· 32
Specifying an address ····· 128
Speed ····· 133
Speed changing position ····· 135
Speed limit ····· 28,100
Speed loop ····· 20
Speed loop gain ····· 21,91
Speed loop integral compensation ····· 21,92
Speed monitor ····· 37
Speed monitor offset ····· 94
Speed profile ····· 129
Speed unit ····· 148
START ····· 34
STOP ····· 34
Stop position ····· 134
ST-ORG ····· 33
Teach-box ····· 8,117
Temperature ····· 48
Test mode ····· 107,125,141
TIM ····· 137
Torque monitor ····· 83
Transmitting position data ····· 63
Trial run ····· 59
Troubleshooting ····· 167
Tune mode ····· 89
Tuning servo gains ····· 20
Undershoot ····· 91
Unstable motion ····· 168,172
Usual operation ····· 77
UVW failure ····· 161
Ventilation space ····· 4
Verifying Input signals ····· 66
Verifying output signals ····· 66
Vibration ····· 48
Warning sound ····· 122
Wire size ····· 52

Warranty Period and Terms

The HA-675 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-675 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-675 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-675 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

Certified to ISO9001／ISO14001(TÜV PRODUCT SERVICE JAPAN)

All specifications and dimensions in this manual subject to change without notice.

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