

Linear Actuator Driver
Line driver type
LAD-01D-012
User Manual

Citizen Chiba Precision Co.,Ltd.

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Thank you for purchasing the Citizen Chiba Precision Linear Actuator Driver LAD-01D-012.
Before actual operation, please read this manual carefully to ensure correct and safe use of this driver for long time.
Please keep this manual safely for future use.
Contents of this manual are subject to change for improvements.

SAFETY PRECAUTIONS

Do not attempt to install, operate, maintain and inspect the equipment until you have read through this manual and appended document carefully, so you can use the equipment correctly. Do not use the equipment until you have a full knowledge of the equipment, safety information and precautions.

In this manual, the safety precaution levels are classified into “DANGER” and “CAUTION”.



DANGER

Indicates precautions that, if not heeded, could possibly result in death or serious injury.



CAUTION

Indicates precautions that, if not heeded, could result in relatively serious or minor injury or damage to the equipment.

Note that the CAUTION level may lead to a serious consequence according to conditions. Please follow the precaution of both levels because they are important for safety.

PROHIBIT and MANDATORY indicates by the following diagrammatic symbols.



PROHIBITED: Indicates prohibited actions that must not be performed.



MANDATORY: Indicates mandatory actions that must be performed.

After reading this manual, always keep it accessible to the operator.

1. General



DANGER

The following precautions should also be fully noted. Otherwise, an electric shock or injury may occur.

1. Never touch the inside of the driver.
Failure to observe this instruction may result in electrical shock.
2. Ground the earth terminal of the driver without fail.
Floating ground circuit may cause electrical shock.
3. Do not transport, wire, maintain and inspect the driver, while the LED is lightning after turning power OFF.
Failure to observe this instruction may result in electrical shock.
4. Do not damage, press, exert excessive force on, or place heavy objects on the cable.
Energized circuit may cause electrical shock.
5. Never touch the rod of the actuator while the actuator is running.
Failure to observe this instruction may result in injury.



CAUTION

1. Always use the actuator and driver in one of the specified combinations.
Failure to observe this instruction may result in burns.
2. Never use the equipment in an environment subject to water, corrosive gases, flammable gases or combustibles.
Failure to observe this instruction may result in electrical shock or fire.
3. Do not touch the driver, the actuator and peripheral device, since they become very hot.
Failure to observe this instruction may result in burns.
4. Do not touch the driver heatsinks or actuator while power is ON or straight after turning power OFF.
Failure to observe this instruction may result in burns.

2. Storage



1. Do not store the equipment in the location that the equipment is exposed to water, raindrops, hazardous gases or liquids.



1. Store in an area that is shaded from direct sunshine and has a temperature and humidity within the specified range.
2. Please contact with referred address on this manual in case of over-stored.

3. Transportation



1. Do not hold the cables and the actuator rod while transporting them. Failure to observe this instruction may result in injury.



1. Over-stacking of the products could cause them fall over. Therefore, be sure to follow the stacking guideline on the outerbox.

4. Installation



CAUTION

1. Do not step on the equipment nor place the heavy object on the equipment.
Failure to observe this instruction may result in injury.
2. Do not block the heat dissipating holes or put the foreign particles into them.
Failure to observe this instruction may result in fire.
3. The equipments must be installed in the specified direction.
Failure to observe this instruction may result in fire.
4. Leave specified clearance between the driver and control panel walls or other equipment.
Failure to observe this instruction may result in fire.
5. Do not give strong impact to the equipment.
Improper operation may cause injury.
6. Make an appropriate mounting of the equipment to its weight and output rating.
Failure to observe this instruction may result in injury.
7. Mount the equipment on incombustible material such as metal.
Failure to observe this instruction may result in fire.

5. Wiring



CAUTION

1. Wire the equipment correctly and securely.
Failure to observe this instruction may result in electrical shock, injury or fire.

6. Operation



CAUTION

1. Always Use the specified power supply voltage.
Failure to observe this instruction may result in electrical shock, injury or fire.
2. After fixing actuator body, keep actuator rod away from the mechanical system and perform test-run. Make sure the actuator works properly, and mount it to the machine.
Failure to observe this instruction may result in injury.
3. Do not make any extreme adjustments or setting changes of parameters.
Failure to observe this instruction may result in injury due to unstable operation.
4. When any alarm occurs, remove the cause and reset the alarm after securing the safety, then restart it.
Failure to observe this instruction may result in injury.
5. Do not approach to the machine since it may suddenly restart after the power resumption.
Design the machine to secure the safety for the operator even at a sudden restart.
Failure to observe this instruction may result in injury.



MANDATORY

1. In case of emergency, provide an external emergency stop circuit, so the machine can be shut down and power is interrupted immediately.

7. Maintenance and inspection



CAUTION

1. The capacity of the power line condenser becomes lower as the condenser gets deteriorated, producing the situation which could lead to a machine failure. To prevent any consequential accident or damage, it is recommended that the condenser be replaced every five years.



PROHIBITED

1. Never attempt to dismantle or repair.

8. Disposal



CAUTION

1. The driver should be treated as industrial waste when you dispose.

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1. Introduction

Thank you for purchasing Citizen Chiba Precision LAD-01D-012.

This product features many functions even in small package.

Please read these descriptions and instructions carefully prior to use to utilize those functions effectively. Make sure to keep this manual handy for your reference to find solution for questions or inquiries.

1-1. Standard accessories

Package of LAD-01D-012 contains following items as shown below. In the first, check the all items in the package. If any lack or damage, please contact with referred address noted on this manual.

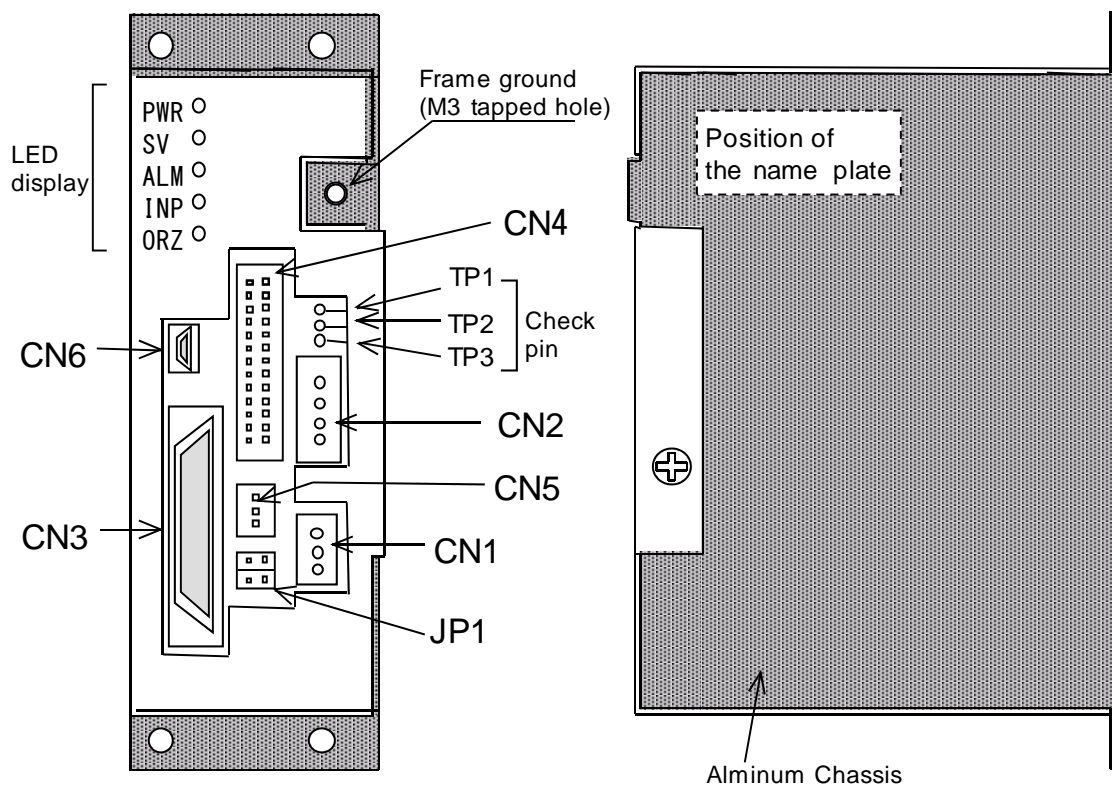
No	Accessory	Model	Manufacturer	Q'ty
1	CN1 connector housing	VHR-3N	JST Mfg. Co., Ltd.	1
2	CN2 connector housing	H4P-SHF-AA	JST Mfg. Co., Ltd.	1
3	CN3 connector	10136-3000PE	3M Company	1
4	CN3 connector cover	10336-52F0-008	3M Company	1
5	CN4 connector housing	DF1BZ-24DS-2.5RS	Hirose Electric Co., Ltd.	1
6	CN5 connector housing	H3P-SHF-AA	JST Mfg. Co., Ltd.	1
7	Contact pins for CN1	BVH-21T-P1.1	JST Mfg. Co., Ltd.	3
8	Contact pins for CN2/CN5	BHF-001T-0.8BS	JST Mfg. Co., Ltd.	7
9	Contact pins for CN4	DF1B-2428SC	Hirose Electric Co., Ltd.	20

1-2. Features

This driver is designed for our compact linear actuator. Outstanding features are as follows:

- Parameter and control gain setting function by serial communication
This product has the USB serial communication function. By installing our special software to your PC that enables to perform parameter setting and gain adjustment.
- Control mode switching function
2 control modes are installed on this product: position mode and current (torque) mode. These modes can be switched by external control signal. Command value for current control can be set up to 2 value parameters by serial communication function. Current value can be switched by external signal (GLOW).
- Gain setting switching function
Pre-set 2 types of gain setting through communication can be switched by external control signal. This function brings an improvement of positioning performance by selecting 2 gain parameters when forward movement load and reverse movement load are very different.

2. Dimensional outlines and Part names



Connector	CN1	Connector for power input DC24V
	CN2	Connector for actuator
	CN3	Connector for I/O interface
	CN4	Connector for encoder of actuator
	CN5	Connector for external LSF input
	CN6	USB for parameter setting
	TP1	Analog monitor check pin 1
	TP2	Analog monitor check pin 2
	TP3	GND for Analog monitor
Jumper setting	LRD	to be open in this driver
	LFD	
LED display	PWR	Internal control power ON
	SV	Servo ON
	ALM	Alarm
	INP	Inposition
	ORZ	Homing finish

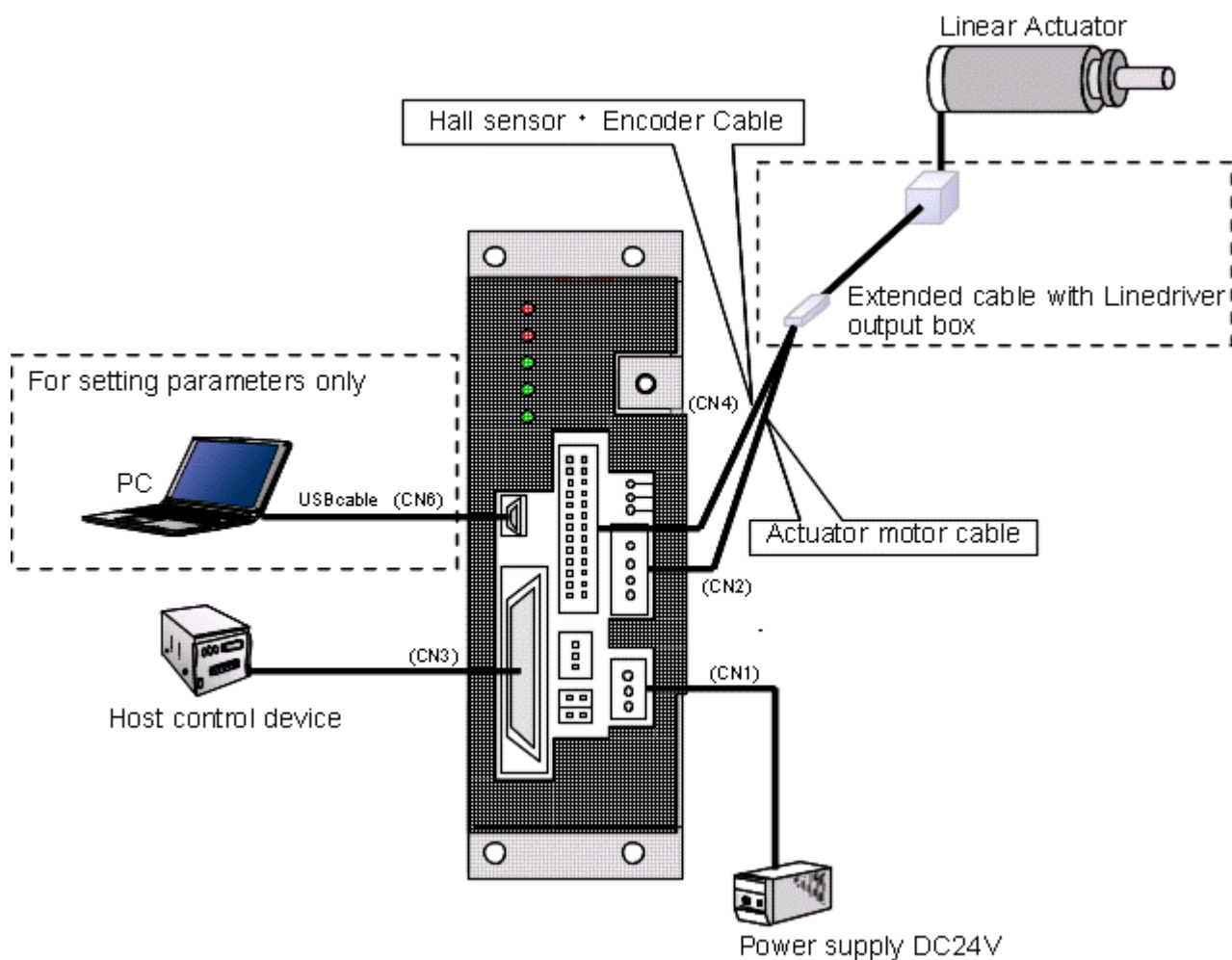


CAUTION

* USB cable connected to CN6 is not contained in this driver package.
Please prepare USB cable of Type A / Mini B separately.

3. General connecting configuration

Following shows a sample of general connecting configuration.





CAUTION

* This product is a line driver type driver. The extended cable with line driver output box is required when the linear actuator is operated.



4. Cautions

4-1. Operating cautions


To avoid electrical shock and injury, make sure to observe followings.

	In order to prevent electrical shock, ground the FG terminal of CN1 and chassis at one point.
	Do not transport, wire, maintain and inspect the driver, while the LED is lightning after turning power OFF. Do not touch terminals at least 5 minutes after switched off.
	Always use the actuator and driver in one of the specified combinations.
	Do not give strong impact to the equipment.
	Always keep power disconnected when the driver is unused for a long time.
	Always use the specified power supply voltage.
	After fixing actuator body, keep actuator rod away from the mechanical system and perform test-run. Make sure the actuator works properly, and mount it to the machine.
	When any alarm occurs, remove the cause and reset the alarm after securing the safety, then restart it.
	In case of emergency, provide an external emergency stop circuit, so the machine can be shut down and power is interrupted immediately.
	As this driver has no inrush current protector, wait at least 15 seconds when power is turned on once again after switched off.
	Do not damage, press, exert excessive force on, or place heavy objects on the cable.
	Never touch the actuator rod while the actuator is running.
	Never use the equipment in an environment subject to water, corrosive gases, flammable gases or combustibles.
	Do not touch the driver or the actuator since they may be hot while power is ON.
	Do not touch the driver heatsinks or the actuator since they may be hot while power is ON or straight after turning power OFF.
	Never approach to the motor and the machine driven by the motor while power is ON because they may become failure or malfunction.
	Do not make any extreme adjustments or setting changes of parameters.
Do not approach to the machine since it may suddenly restart after the power resumption. Design the machine to secure the safety for the operator even at a sudden restart.	



4-2. Storage cautions

	Store in an area that is shaded from direct sunshine and has a temperature and humidity within the specified range.
	Please contact with referred address on this manual in case of over-stored.
	Do not store the equipment in the location that the equipment is exposed to water, raindrops, hazardous gases or liquids.



4-3. Transportation cautions

	Do not hold the cables and the actuator rod while transporting them.
	Over-stacking of the products may cause them fall over. Therefore, be sure to follow the stacking guideline on the outerbox.

4-4. Installation cautions


	Do not put foreign particles in the driver.
	Pay attention to the heat dissipation. A proper consideration should be given to cool the driver so that the temperature around less than 50°C.
	When using some drivers, install them respectively with having a space more than 10mm next to each other.
	Make an appropriate mounting of equipments to their weights and output ratings.
	Mount the driver on incombustible material like metal.
	Do not step on the equipment nor place the heavy object on the equipment.
	Do not install the driver in an environment subject to excessive dust.
	Do not install the driver in an environment subject to corrosive gases.
	Do not install the driver in an environment subject to water or oil.
	Do not install the driver near the heating equipment. When it is unavoidable, keep the driver temperature less than 50°C by forced cooling or heating insulation.

4-5. Maintenance and inspection cautions

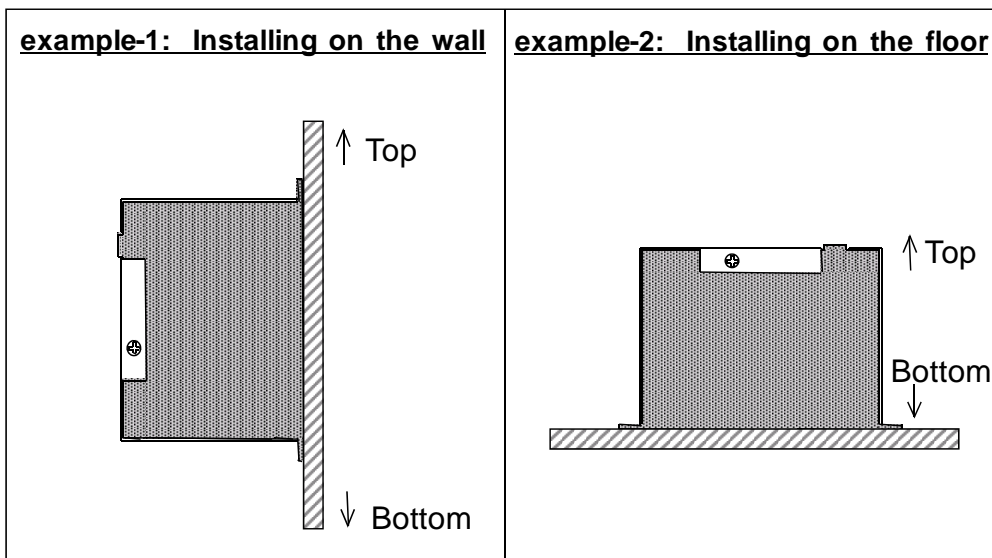
	The capacity of the power line condenser becomes lower as the condenser gets deteriorated, producing the situation which could lead to a machine failure. To prevent any consequential accident or damage, it is recommended that the condenser be replaced every 5 years.
	Never attempt to dismantle or repair.

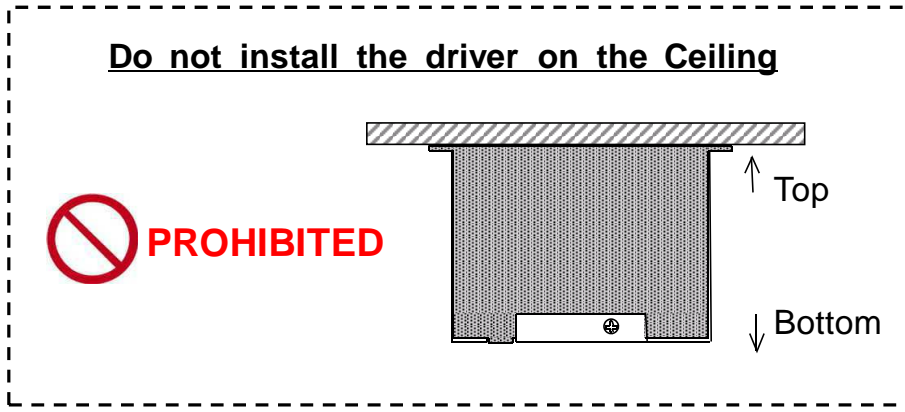
5. Installation

5-1. Installation direction and clearance

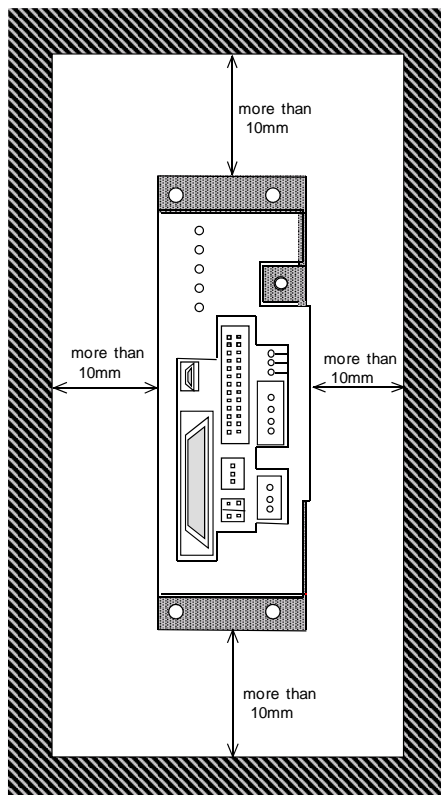
	<p>CAUTION</p> <ul style="list-style-type: none"> * The equipments must be installed in the specified direction. * Leave specified clearance between the driver and control panel walls or other equipment. * Failure to observe this instruction may result in breakdown.
---	--

Install the driver in the direction as shown below, where no vibration and impulse occur.





Please secure 10mm over surrounding clearance at installation as shown below. Please secure clearance over 10 mm when multiple drivers are installed and used.
 Inner temperature of the control panel should not be over environmental condition for use.



5-2. Foreign particle inclusion

- I. Please prevent chips that produced during the processing, from entering the motor driver at assembling control panel.
- II. Please prevent oil, water and metal chips from entering the motor driver through cooling fan.

5-3. Cable stress

- I. Clamp the cable firmly so that the stress such as bending stress and wire weight stress cannot be added at cable junction and installed connector pin.
- II. When the actuator itself is applied to use in motion, please fix the cable with gentle slack from connector juncture not to give stress on connector juncture.
- III. Please prevent the cable jacketing from cutting by sharp edge, rubbing by machine corner and stamping.

6. Option cables

This product is Line driver type Driver. When the linear actuator is operated, the extended cable with Line driver output box is required.

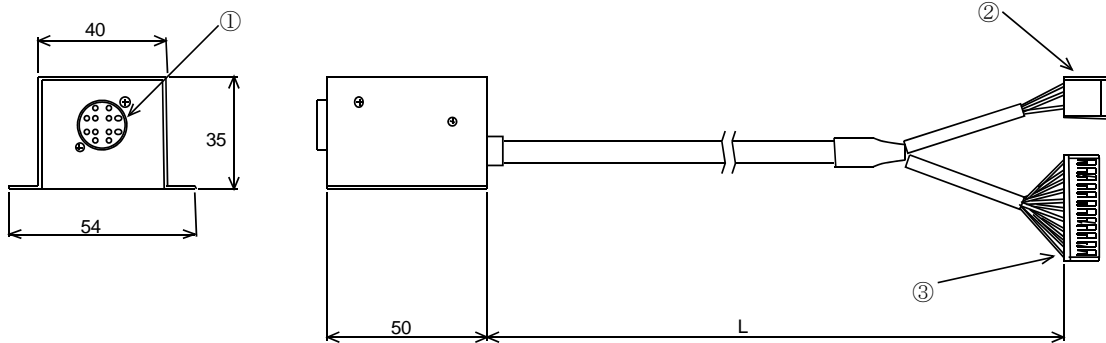
Please refer to bellow figure to select necessary cable.

This type is to be connected directly between motor and driver.

MA-321-030(Cable length 3m)

MA-321-050(Cable length 5m)

MA-321-100(Cable length 10m)



CAUTION This extended cable is to be connected directly between motor and driver.

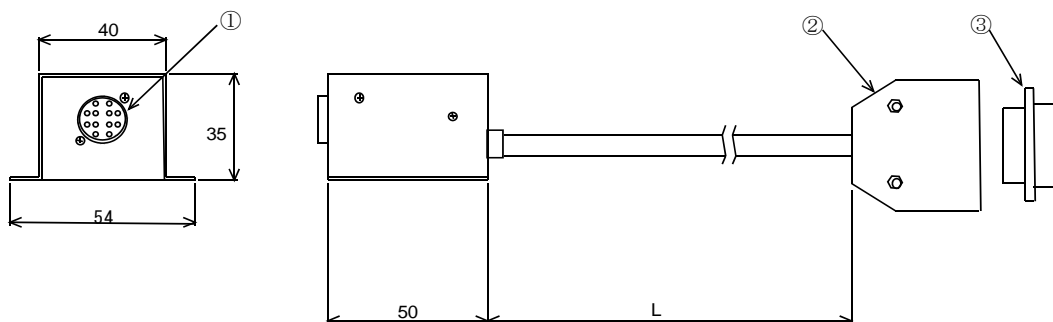
①	
Hirose:RP17-13J-12SC	
Pin No.	Signal name
1	Moter coil U phase
2	Moter coil V phase
3	Moter coil W phase
4	Hall sensor U phase
5	Hall sensor V phase
6	Hall sensor W phase
7	5V
8	OV
9	Encoder A phase
10	Encoder B phase
11	Encoder Z phase
12	Limit sensor

②	
J.S.T.:H4P-SHF-AA	
Pin No.	Signal name
1	Moter coil U phase
2	Moter coil V phase
3	Moter coil W phase
4	Shield

③	
Hirose:DF1B-24DS-2.5RC	
Pin No.	Signal name
1	Encoder A phase +
2	Encoder A phase -
3	Encoder B phase +
4	Encoder B phase -
5	Encoder Z phase +
6	Encoder Z phase -
7	Hall sensor U phase +
8	Hall sensor U phase -
9	Hall sensor V phase +
10	Hall sensor V phase -
11	Hall sensor W phase +
12	Hall sensor W phase -
13	5V
14	5V
15	OV
16	OV
17	Shield
18	Shield
19	LSR+
20	LSR+
21	LSF-
22	LSF-
23	OV
24	OV

This type is not able to be connected directly between motor and driver. This can be used when the driver is installed in the case.

MA-322-030(Cable length 3m)
 MA-322-050(Cable length 5m)
 MA-322-100(Cable length 10m)



CAUTION

This extended cable is not able to be connected directly between motor and driver. It is necessary to set up a cable of connecting between MRP-25F01 connector and the driver separately.

①	
Hirose: RP17-13J-12SC	
Pin No.	Signal name
1	Moter coil U phase
2	Moter coil V phase
3	Moter coil W phase
4	Hall sensor U phase
5	Hall sensor V phase
6	Hall sensor W phase
7	5V
8	OV
9	Encoder A phase
10	Encoder B phase
11	Encoder Z phase
12	Limit sensor

②	
HONDA: MRP-25M01	
Pin No.	Signal name
1	Moter coil U phase
2	Moter coil V phase
3	Moter coil W phase
4	Shield
5	Encoder A phase +
6	Encoder A phase -
7	Encoder B phase +
8	Encoder B phase -
9	Encoder Z phase +
10	Encoder Z phase -
11	Hall sensor U phase +
12	Hall sensor U phase -
13	Hall sensor V phase +
14	Hall sensor V phase -
15	Hall sensor W phase +
16	Hall sensor W phase -
17	5V
18	OV
19	Limit sensor +
20	Limit sensor -
21	Shield
22	NC
23	NC
24	NC
25	NC

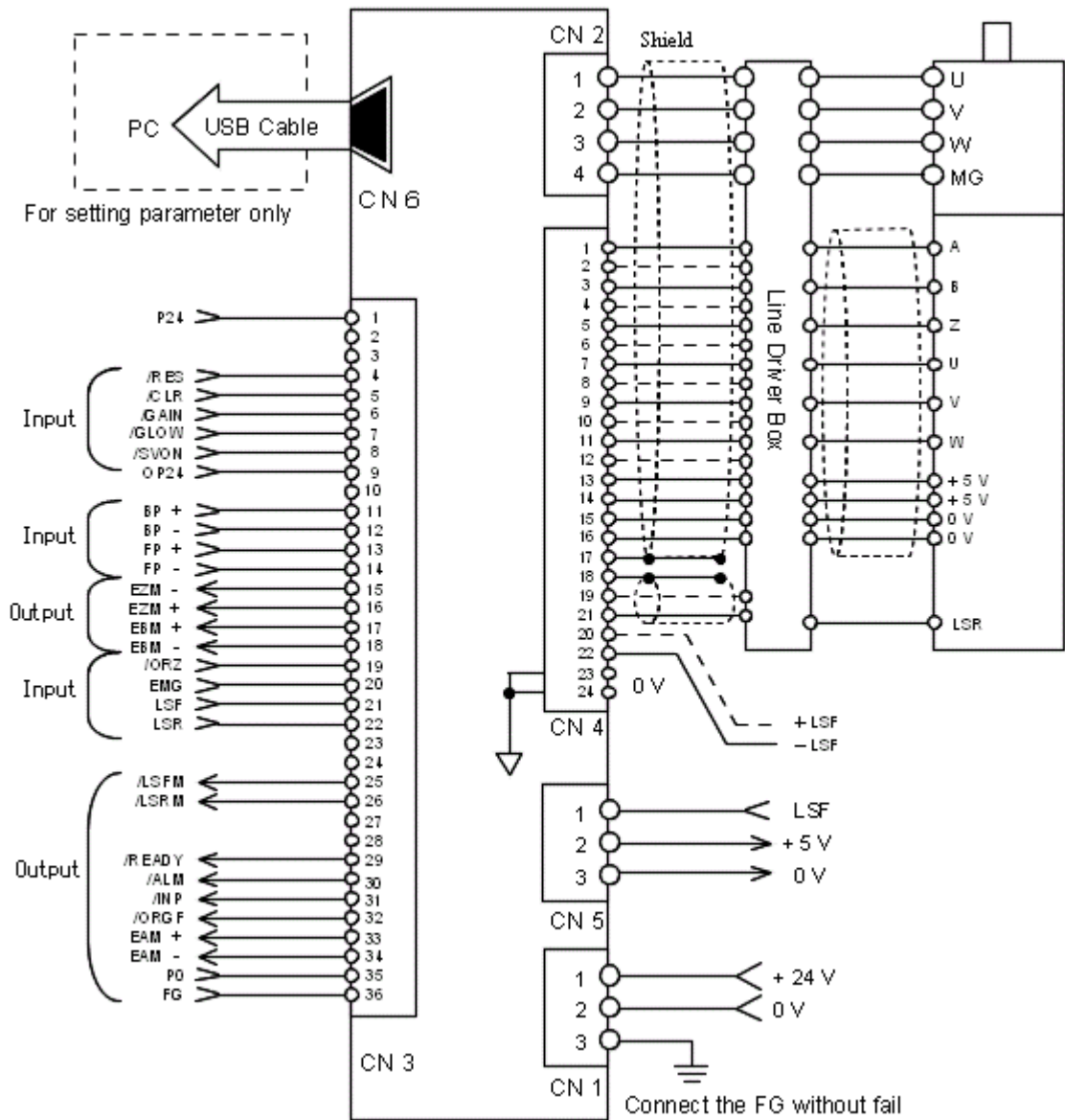
③
HONDA: MRP-25F01

- 7. Wiring
- 8.

CAUTION

- * In order to prevent electrical shock, ground the FG terminal of CN1 and chassis at one point.
- * Do not transport, wire, maintain and inspect the driver, while the LED is lightning after turning power OFF.
- * Do not touch terminals at least 5 minutes after turning OFF power.
- * Never attempt to dismantle or repair.
- * Do not open or close the motor power line, while the actuator is driving.

7-1.Wiring diagram



CAUTION


The encoder monitor outputs of #15,16,17,18,33,34 pin are RS422 line driver output. Differ from other input/out signal they are not insulated from driver internal control power.

7-2. Wiring cautions

7-2-1 Connector CN1 wiring

It is the connector for main power supply. Applicable voltage is DC24V.


Connect certainly to FG terminal or FG terminal of cabinet and earth at one point.

 **CAUTION** Make sure to take 15 seconds more interval at next power-on after power off because the function for inrush current prevention is not employed in power input circuit of driver.

Pin No.	Signal name	Accessory	Model	Manufacturer
1	+24VDC	Connector housing	VHR-3N	J.S.T
2	0V	Contact pins	BVH-21T-P1.1	
3	Frame ground			

7-2-2 Connector CN2 wiring


This is the connector to output the driving current to linear actuator.

 **CAUTION** Do not earth CN2 terminal (U,V,W) and make short cut each other. It may cause a failure.

Pin No.	Signal name	Accessory	Model	Manufacturer
1	Motor coil U phase	Connector housing	H4P-SHF-AA	J.S.T
2	Motor coil V phase	Contact pins	BHF-001T-0.8BS	
3	Motor coil W phase			
4	Frame ground			


7-2-3 Connector CN4 wiring

This is the connector to input to encoder and sensor.

 **CAUTION** Power source 5V (#13 & #14 pin) is for the hole sensor of linear actuator, encoder and limit sensor. Do not use for other purpose.


Pin No.	Signal name	Pin No.	Signal name
1	Encoder A phase	2	Encoder A phase
3	Encoder B phase	4	Encoder B phase
5	Encoder Z phase	6	Encoder Z phase
7	Hall sensor U phase	8	Hall sensor U phase
9	Hall sensor V phase	10	Hall sensor V phase
11	Hall sensor W phase	12	Hall sensor W phase
13	+5V for sensor	14	+5V for sensor
15	0V for sensor	16	0V for sensor
17	Shield	18	Shield
19	LSF(+)	20	LSF(+)
21	LSF(-)	22	LSF(-)
23	0V for sensor	24	0V for sensor

Accessory	Model	Manufacturer
Connector housing	DF1B-24DS-2.5RC	Hirose
Contact pins	DF1B-2428SC	

 **CAUTION** Make sure to connect LSR (+) and LDR (-) with limit sensor of linear actuator. If not connected, it may cause a failure.

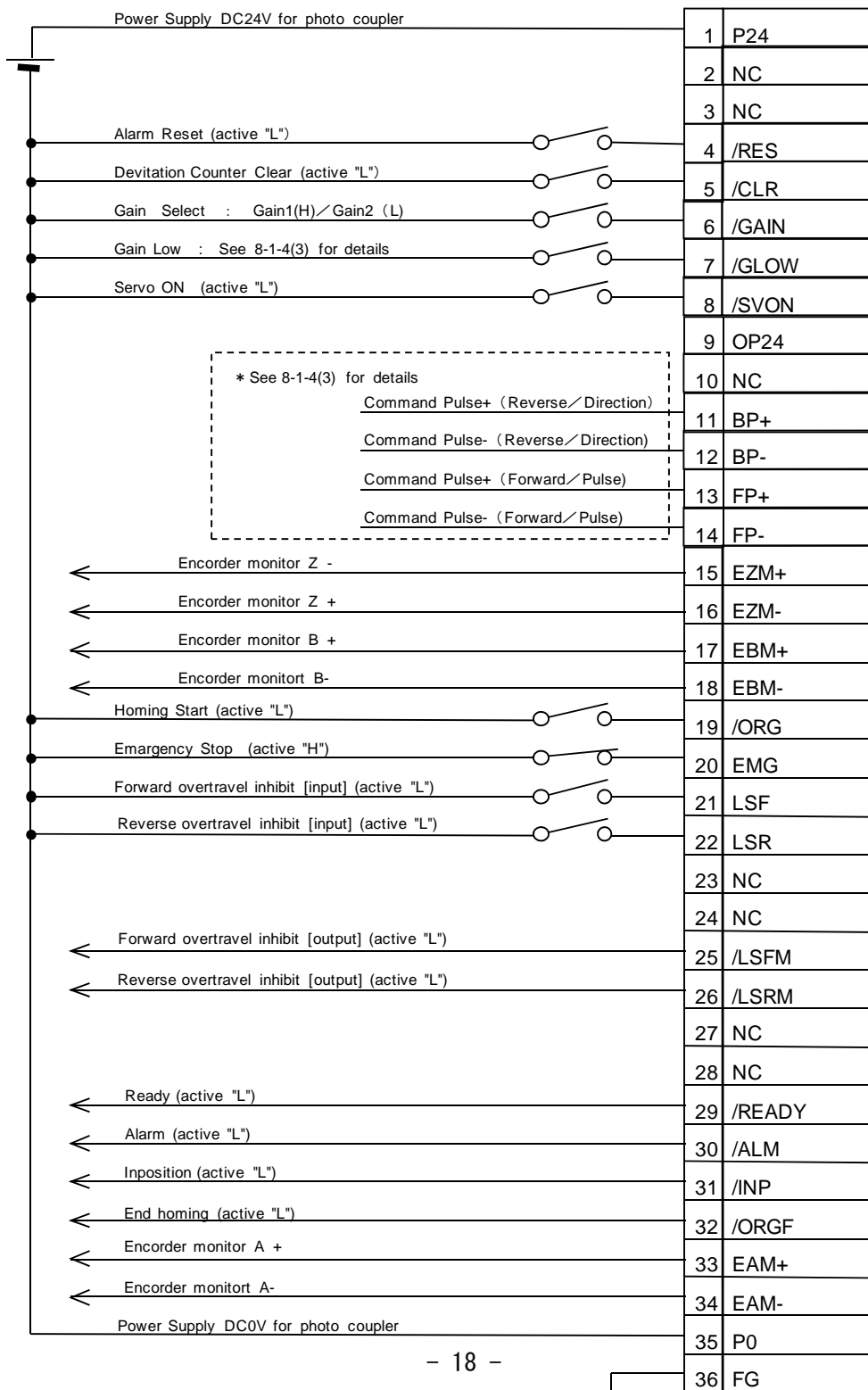
7-2-4 Connector CN3 wiring

Please wire in reference to “the sample of connector CN3 wiring” on below figure. The power source 24V for photo-coupler and command pulse open collector is to be prepared by the customers.




CAUTION

- Set apart the wirings to power line (CN1, CN2) as much as possible. Do not let them pass through same duct and bind together. It may cause a malfunction.
- Each terminal on control output does not have current limit resistor. Do not apply electricity over DC50V, 10mA. It may cause a failure.



7-2-5. Connector CN5 wiring

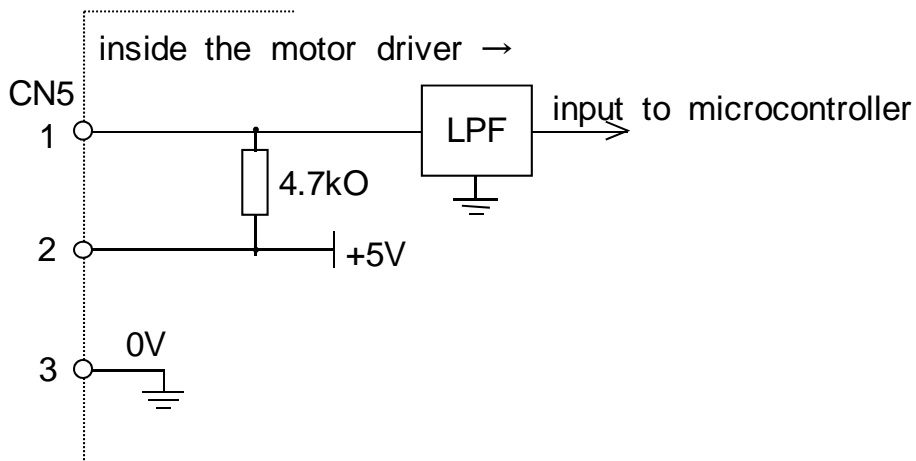
This connector is to connect with external forward limit sensor.

	CAUTION	The sensor power source +5V is for the limit sensor. Do not use for other purpose.
---	---------	---

Pin No.	Signal name
1	Sensor input
2	+5V for sensor
3	0V for sensor

Accseeory	Model	Manufacturer
Connector housing	H3P-SHF-AA	J.S.T
Contact pins	BHF-001T-0.8BS	

The input circuit diagram is shown on below. As shown on the figure, it is not insulated from outside of the controller. Please wire carefully.



9. Functions

8-1.CN3

8-1-1 Input/Output details

No	Signal name	Signal contents	Action	I/O diagram
1	P24	Phot coupler power supply 24V input	Connect with DC24V power + to photo coupler drive	Input 2
2	NC		Do not connect anything.	
3	/TRQ	Motor control mode switch	To switch Position control mode and current control mode. Command of current control mode is to be set up by parameter PRMNo.30 & 31 beforehand.	
4	/RES	Alarm reset	To reset alarm situation and restart motor driver. To reset by Low edge.	
5	/CLR	Deviation counter clear	To clear position deviation on Low level.	
6	/GAIN	Gain switch	To switch Gain set up 1 (parameter PRMN.10-19) and Gain set up 2 (parameter PRMN.20-29). Use High level for Gain set up 1. Use Low level for Gain set up 2.	
7	/GLOW	Gain LOW	To switch PI control to P control in position control mode. High level : PI control Low level : P control To switch two current command value in thrust control mode. High level : current command 1 (PRMNo.30) Low level : current command 2 (PRMNo.31)	Input 1
8	/SVON	Servo ON	To activate Servo by LOW level and activate in Alarm situation and when Emergency stop input is not ON.	
9	OP24	24V input for command pulse open collector	Need to connect with 24V when command pulse is input by open collector.	
10	NC		Do not connect anything.	
11	BP+	Command pulse+(Backward/direction)	Position command can be input by pulse. Refer to 7-1-3 Input/Output interface in detail.	
12	BP-	Command pulse-(Backward/direction)		
13	FP+	Command pulse+(Forward)		
14	FP-	Command pulse-(Forward)		
15	EZM-	Endoder monitor Z-	Output differentially by RS-422 line driver IC. Not insulated from motor driver internal power supply.	Output 2
16	EZM+	Endoder monitor Z+		
17	EBM+	Endoder monitor B+		
18	EBM-	Endoder monitor B-		
19	/ORZ	Start origin search	To start Origin search by motor driver. During Origin search, Gain LOW, Gain switch and Control mode switch are not available. Command pulse acceptance, niether.	Input 2
20	EMG	Emergency stop	To connect with Emergency stop button. If applied, moter stopps immediately and excitation is stopped. It stops on High level.	
21	LSF	No forward movement (input)	To prohibit motor from moving forward. Command pulse for forward movement is ignored.	
22	LSR	No backward movement (input)	To prohibit motor from moving backward. Command pulse for backward movement is ignored.	
23	NC		Do not connect anything.	Output 1
24	NC		Do not connect anything.	
25	/LSFM	In No forward movement	LSF is input and Low level is output in No forward movement situation.	
26	/LSRM	In No backward movement	LSR is input and Low level is output in No backward movement situation.	Output 1
27	NC		Do not connect anything.	
28	NC		Do not connect anything.	
29	/READY	Ready	Output when servo ON command pulse is acceptable. In Low and ready situation.	Output 1
30	/ALM	Alarm	Light is flickered at High level in no Alarm. High-Low level repeat in Alarm. Refer to 8-3-2 in detail.	
31	/INP	In position	Output in Low level when absolute value of position deviation is below the setting. The setting can be changed by parameter PRMNo.9.	
32	/ORGF	Origin return finish	Output in Low level when Origin return finishes normally after triger by orign serch start signal. In High level just after servo ON and during Origin search. Not insulated from motor driver internal power supply.	
33	EAM+	Encoder monitor A+	Output differentially by RS-422 line driver IC. Not insulated from motor driver internal power supply.	Output 2
34	EAM-	Encoder monitor A-		
35	P0	Photo coupler power OV input	Connect with DC24V power supply OV to drive I/O photo coupler	
36	FG	Shield	The terminal to connect with shield wire of CN3 cable.	

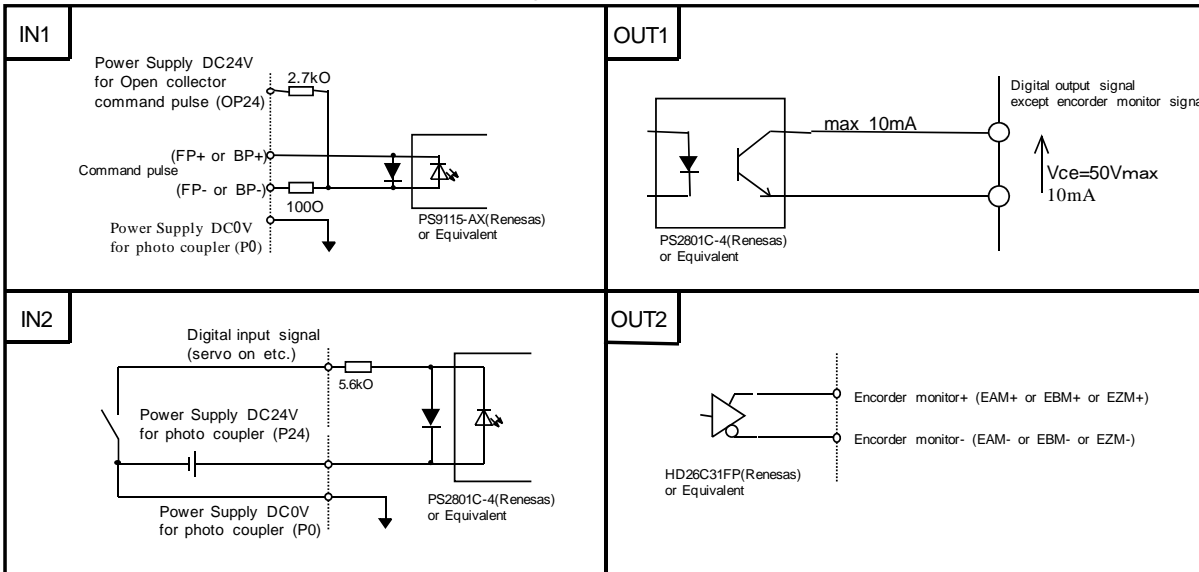


CAUTION

At the part noted as parameter PRMNo, parametes can be set up and changed.
Please refer to 9. Parameter setting in detail.

8-1-2 Input /Output diagrams

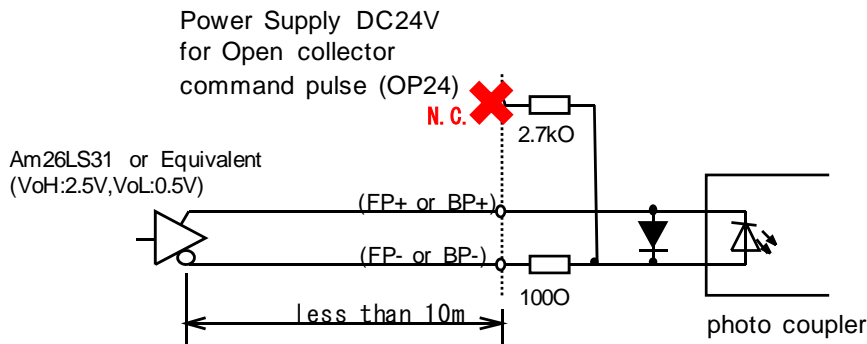
The connector CN3 input/output diagram is shown as below.



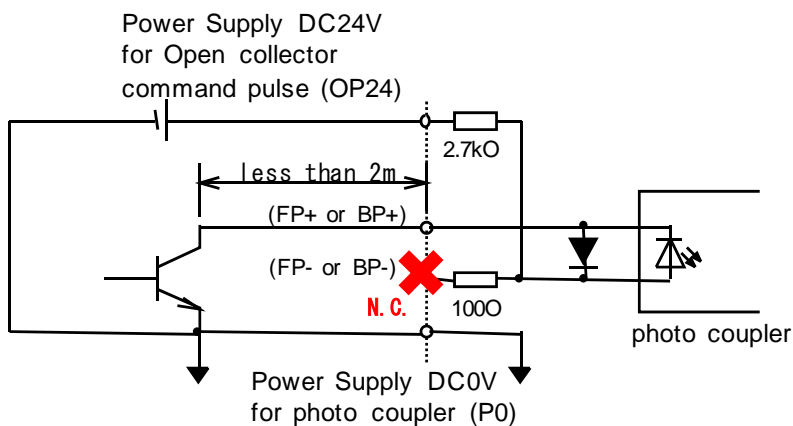
8-1-3 Connection of command pulse input circuit

The command pulse input circuit is shown on 8-1-2 Input1. There are two methods to connect input circuit.

① Differential line driver method



② Open collector method



CAUTION

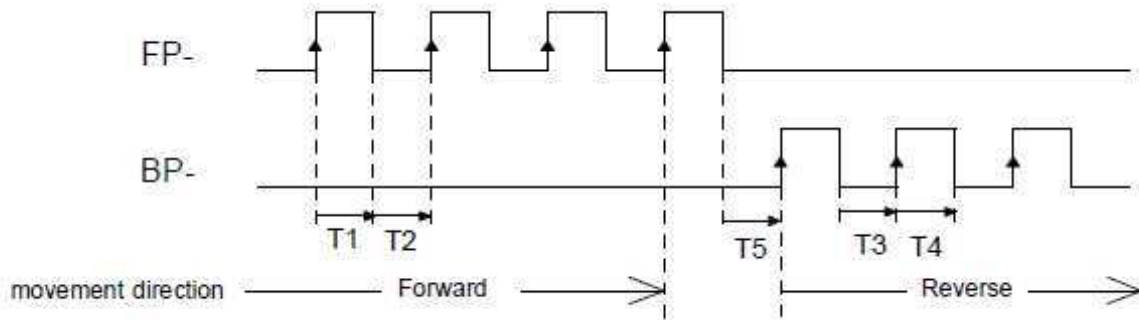
Because photo-couplers are applied to the command pulse input interface. If resistors are connected to the command pulse signal line, reduced volume cause a malfunction.

8-1-4 Input / Output interface

(1) Command pulse

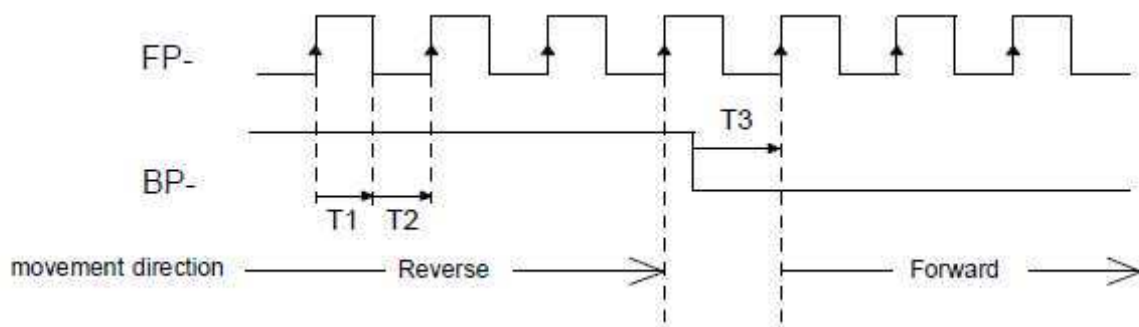
The following 3 forms of command pulse input can be selected by Setting Software PRMNo.32.

a) Forward / Reverse mode



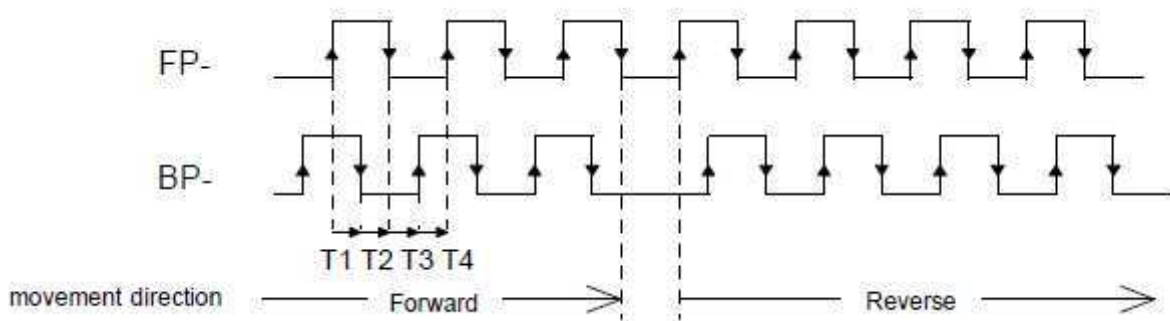
$T1, T2, T3, T4, T5 \geq \text{over } 0.08\mu\text{sec}$

b) Pulse / Direction mode



$T1, T2, T3 \geq \text{over } 0.08\mu\text{sec}$

c) 2 phase pulse mode (If FP goes ahead BP, The actuator works in reverse.)



$T1, T2, T3, T4, T5 \geq \text{over } 0.08\mu\text{sec}$

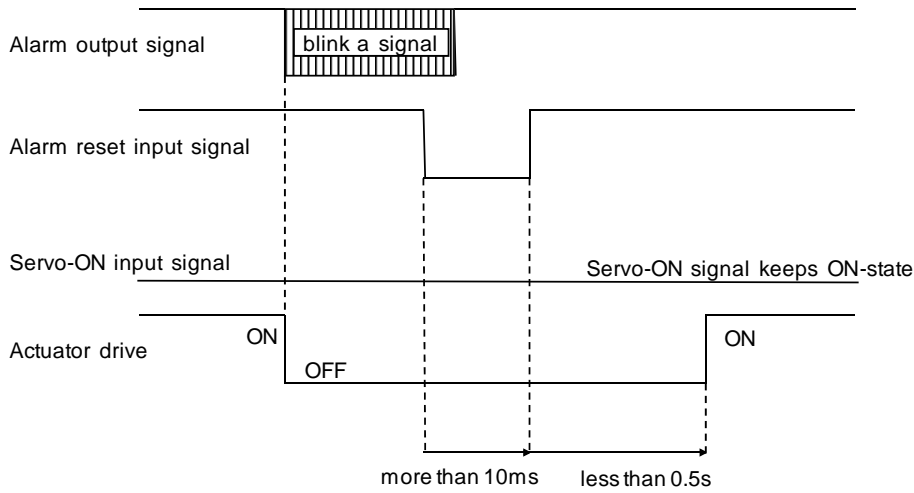


CAUTION

- At the part noted as parameter PRMNo, parameters can be set up and changed. Please refer to 9. Parameter setting in detail.
- To change command pulse input method, retain in E2PROM and restart are needed.

(2)Reset input

Reset input is used to cancel alarm output. At power on, power on reset is applied. So, it is not necessary in particular. Please take the timing for set input as shown below.

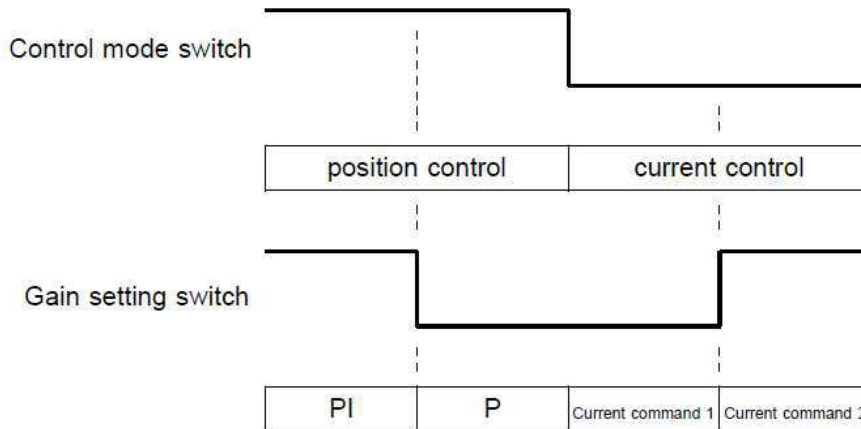


CAUTION

Above explanation is noted to indicate the action return time when servo ON command is ON input. From safety point, we recommend to switch servo ON input to servo OFF when alarm is detected.

(3)Control mode switching, Gain Low input

Action modes vary by combination of two signals of control mode switch input and gain Low input. Input pattern in each mode is shown as below.



名称	説明
PI control	It is the control mode and the normal positioning action mode. Speed proportional gain (PRMNo11,21) and speed integration gain (PRMNo12,22) are applied. Gain Low gain (PRMNo19,29) is neglected.
P control	In case to lower tremor at position control mode and rest, gain is reduced by propotional control. Gain Low gain (PRMNo19,29) is applied, and speed proportional gain (PRMNo11,21) and speed integration gain (PRMNo12,22) are neglected.

8-2. Protective functions

LAD-01D-012 has following protective functions. When Protective function works, the driver outputs Alarm and stop motor in a normal manner to stay it free. The contents of Alarm are displayed by LED on the driver.

8-2-1 Protective functions details

Function names	Contents
Full torque	To be output when the driver operates to apply max current for one sec more. A possible cause is overload. Possible solution is to have longer acceleration/deceleration time or less load.
Driver power supply voltage error	①Power supply over-voltage Power supply voltage into the motor driver is monitored. If over 32V is monitored for 50 ms, the driver is in Alarm situation. ②Power supply voltage decrease Power supply voltage into the motor driver is monitored. If less 15V is monitored for 50 ms, the driver is in Alarm situation.
Full count	To be output when position deviation counter value of the motor driver overflows(+/-32767 count). A possible cause is overload or too higher frequency of input pulse. Please check following: ○ Whether over actuator max speed ○ Whether output torque saturates due to current monitoring If no problem on above points, a possible solution is to have longer acceleration/deceleration time, less load or slower speed.
Driver overheat	The motor driver gets alarm stop when the temperature of ambience of motor drive unit on the driver power module board is monitored as over 60°C for 1 sec. A possible cause is overload and overspeed. Possible solution is to have longer acceleration/deceleration time or less load.
Hall sensor error	To be output when hall sensor junction has an error. A possible cause is connector connection error or a snap of hall sensor cable. Please check connection between the driver and hall sensor or connection of connector CN4.
Encoder error	To be output when encoder A phase and B phase have a error in connection. A possible cause is disconnection of connector, connector error and snap of encoder cable. Please check connection/junction between driver and encoder and connection of connector CN4.
Emergency stop	The motor driver gets alarm stop when conduct is broken between emergency stop input terminal and photocoupler power input OV and emergency stop input terminal is on High level.

To cancel Alarm situation, in the first, turn off power and remove a possible cause, then apply power again or input reset signal.

8-2-2 Alarm LED flickering display

During Alarm stop situation, Alarm LED flickers in the pattern as shown below.

By flickering time per cycle, Alarm contents can be confirmed.

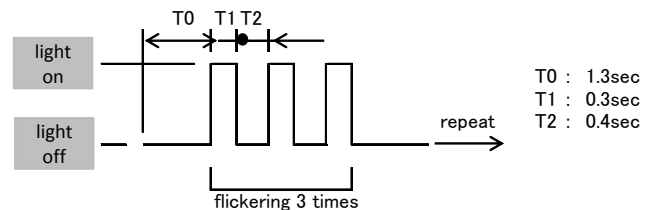
CN 3 Alarm output occurs in ON/OFF pattern as shown below.

Flickering time per cycle and alarm contents

Flickering time	Alarm contents
7	Full torque alarm
6	Driver power supply voltage
5	Full count
4	Driver overheat
3	Hall sensor error
2	Encoder error
1	Emergency stop

Example of flickering display

ex) Alarm of hall sensor malfunction. (flickering 3 times)



8-3.LED display

Below table shows the contents of LED display contents on driver front panel.

Display	Functions and contents
PWR	To light when main power DC24V+24V is supplied and control power supply in driver is verified. When display does not appear or flicker at power on, a failure may happen. Then, turn off power immediately.
SV	To light on when servo is ON and command pulse input is acceptable. To light off at servo OFF.
ALM	To light off during normal operation without alarm. To flicker at alarm. Alarm reason can be identified by flickering time. Refer to 8-3-2 Alarm flickering display in detail.
INP	To light on when residue in deviation counter is within inposition zone set by parameter PRMNo.9. Positioning finish can be confirmed.
ORZ	When using the origin search function with driver, light goes ON when origin search is end. After light is ON, it goes OFF when servo is OFF or stopped with alarm.

8-4.Check terminals

Check terminals at front of driver have following functions and contents as shown below.

Display	Functions and contents
TP1	Analog monitor 1 terminal. Actuator speed wave form is output at defolt. Output contents can be changed by parameter PRMNo.7 setting.
TP2	Analog monitor 2 terminal. Actuator speed wave form is output at defolt. Output contents can be changed by parameter PRMNo.7 setting.
TP3	Reverence ground terminal for Analog monitor.

8-5.Origin search functions

Switching CN3 Origin search start input terminal from High level to Low level permits the driver to start Origin search. After Origin search completes, CN3 Origin search finish output terminal becomes Low level and LED light tells it.

·Origin search mode and action

2 types of Origin search method are selectable by setting of parameter PRMNo.40 as shown below. Default employs B mode.

Mode	Contents
A	Goes back with it's origin speed until limit sensor is switched ON. Then goes forward until limit sensor is OFF and stops when it search the Z phase of the encoder.
B	Goes back with it's origin speed until limit sensor is switched ON. Then goes forward and stop when the limit sensor is switched OFF.

10. Parameter setting

Using special parameter setting software, Communication through USB cable(Type A-Type Mini B) between CN6 connector and Personal Computer permits driver's function setting, parameter value setting and gain parameter setting.

9-1 System requirements

OS : Windows XP (Home Edition or Professional Edition)
Microsoft .NET Framework Ver1.1 over are installed.

9-2 Parameter setting software

Following shows the display of the parameter setting software.

Connection procedure

- ① connect USB cable
- ② turn on driver's power
- ③ activate parameter setting software
- ④ click "接続"
- ⑤ it's completed when status displayed showed "接続コンポート"

ファイル

USB接続

状態表示

COM9(に接続)

E2PROMA保存

基本設定

ゲイン1

ゲイン2

指令値

原点出し

アラーム表示

PRMNo	設定内容	Read値	Write値		単位	
1	モータポール数[3相設定のみ]	2	Read	0	Write	-
2	モータ種類設定[0:単相,1:3相]	0	Read	0	Write	-
3,4	エンコーダパルス数[p/r,または10nm/p]	500	Read	0	Write	p/r
5	モータ種類設定[0:回転,1:リニア]	1	Read	0	Write	-
6	空き	1	Read	0	Write	-
7	アナログモニタ1データセレクタ	0	Read	0	Write	-
8	アナログモニタ2データセレクタ	1	Read	0	Write	-
9	インポジション範囲(絶対値で入力)	16	Read	0	Write	pulse

Parameter changed by Write will be stored in E2PROM inside the driver
When restarting by repowering on the driver, restarts at changed parameter value

Type value in "Write 値"
and click "Write" so that
It'll be written to the appropriate parameter

After connected, click "Read" so that
you can see parameter value which
is set now.



CAUTION

- When sets Motor type and Command pulse input method, writing by Write button does not become valid immediately. After restored in E2PROM, driver re-start is required.
- When sets Gain settings and Analog monitor setting and other parameter setting, writing by Write bottom becomes valid immediately. While actuator operation, an adjustment is possible.
- Storage into E2PROM needs to be executed after actuator servo OFF. During servo ON, storage in E2PROM is not available.
- Beware that parameters, which can be valid by Write value immediately such as Gain setting and Analog monitor setting, return to original at next power-on as long as storage in E2PROM is not executed.

9-3 Parameter setting items

Below table shows items which can be set or changed by parameter setting software.

Motor type setting and encoder pulse number were already set at shipment if this equipment was purchased in a set with Actuator.

Please do not change them.

9-3-1 Basic setting

PRMNo	Setting contents	Description
1	Numbers of motor pole	<ul style="list-style-type: none"> To input a motor numbers of pole. 4 poles → Input 4 To be neglected if single phase motor is set by PRMNo2=0.
2	Motor type setting 1	<ul style="list-style-type: none"> To select a type of single phase or 3 phase. 0 ... Single phase, 1 ... 3 phase To input.
3,4	Numbers of encoder pulse	<ul style="list-style-type: none"> At rotary motor setting by PRMNo5=0 <ul style="list-style-type: none"> ... Input a pulse number per motor's rotation [p/rev] At linear motor setting by PRMNo5=1 <ul style="list-style-type: none"> ... Input a resolution of linear encoder [$\times 10\text{nm}$] Example: If 5μm resolution, input is 500.
5	Motor type setting 2	<ul style="list-style-type: none"> To select a type of rotary or linear 0 ... Rotary motor, 1 ... Linear motor To input.
6	Void	
7	Analog monitor 1 data select	To select a monitor data which is output at check pin TP1 (*1)
8	Analog monitor 2 data select	To select a monitor data which is output at check pin TP2 (*1)
9	In-position range	<p>To input a position deviation range in absolute value for in position output.</p> <p>If input 16, in-position output gives ± 16 pulse range against target position.</p>

(*1) Monitor data selection

Setting value	Monitoring items
0	Position command value
1	Present position
2	Current command value
3	Current value
4	Speed command value
5	Present speed
6	Position deviation

9-3-2 Gain setting 1

The gain setting value when the gain switch input signal is at High.

PRMNo	Setting contents	Descriptions
10	Current gain 1	· To set up Current amp gain when Gain switch terminal is at High.
11	Speed propotional gain 1	· To set up Speed amp propotional gain when Gain switch terminal is at High.
12	Speed intagrations gain 1	· To set up Speed amp integraion gain when Gain switch terminal is at High.
13	Position 1	· To set up Position amp gain when Gain switch terminal is at High.
14	Position FF gain 1	· To set up Position feedforward gain when Gain switch terminal is at High.
15	Forward dicrection current limit 1	· To set up Current limit value at forward movement when Gain switch terminal is at High.
16	Backward direction current limit 1	· To set up Motor speed limit when Gain switch terminal is at High.
17, 18	Speed limit 1	· To set up Current amp gain when Gain switch terminal is at High. · At Rotary motor setting by PRMNo5=0 · · · Input a motor revolution [rpm] · At Linear motor setting by PRMNo5=1 · · · Input a motor speed [mm/sec]
19	Gain at Low gain 1	· To set up Speed amp gain Low gain when Gain switch terminal is at High and when Gain Low is input in Position control mode. At Position control and Gain Low input, Speed amp is in Proportional control with Propotional gain to Gain Low gain value.

9-3-3 Gain setting 2

The gain setting value when the gain switch input signal is at Low.

PRMNo	Setting contents	Description
20	Current gain 2	· To set up Current amp gain when Gain switch terminal is at Low.
21	Speed propotional gain 2	· To set up Speed amp propotional gain when Gain switch terminal is at Low.
22	Speed integration gain 2	· To set up Speed amp integraion gain when Gain switch terminal is at Low.
23	Position gain 2	· To set up Position amp gain when Gain switch terminal is at Low.
24	Position FF gain 2	· To set up Position feedforward gain when Gain switch terminal is at Low.
25	Forward direction current limit 2	· To set up Current limit value at forward movement when Gain switch terminal is at Low.
26	Backward direction current limit 2	· To set up Motor speed limit when Gain switch terminal is at Low.
27, 28	Speed limit 2	· To set up Current amp gain when Gain switch terminal is at Low. · At Rotary motor setting by PRMNo5=0 · · · Input a motor revolution [rpm] · At Linear motor setting by PRMNo5=1 · · · Input a motor speed [mm/sec]
29	Gain at gain Low 2	· To set up Speed amp gain Low gain when Gain switch terminal is at Low and when Gain Low is input in Position control mode. At Position control and Gain Low input, Speed amp is in Proportional control with Propotional gain to Gain Low gain value.

9-3-4 Command value related

PRMNo	Setting contents	Description
30	Thrust command value 1	· To input Motor thrust setting value by Current value when Gain Low terminal is at High level. Unit is $\times 0.1A$. To set 1A, input 10.
31	Thrust command value 2	· To input Motor thrust setting value by Current value when Gain Low terminal is at Low level. Unit is $\times 0.1A$. To set 1A, input 10.
32	Position command method selectio	· To select Input method for Position command pulse input. 0 · · · Forward pulse · Backward pulse input method 1 · · · Commandpulse · Direction input method 2 · · · 2 phase pulse input method

9-3-5 Origin search related

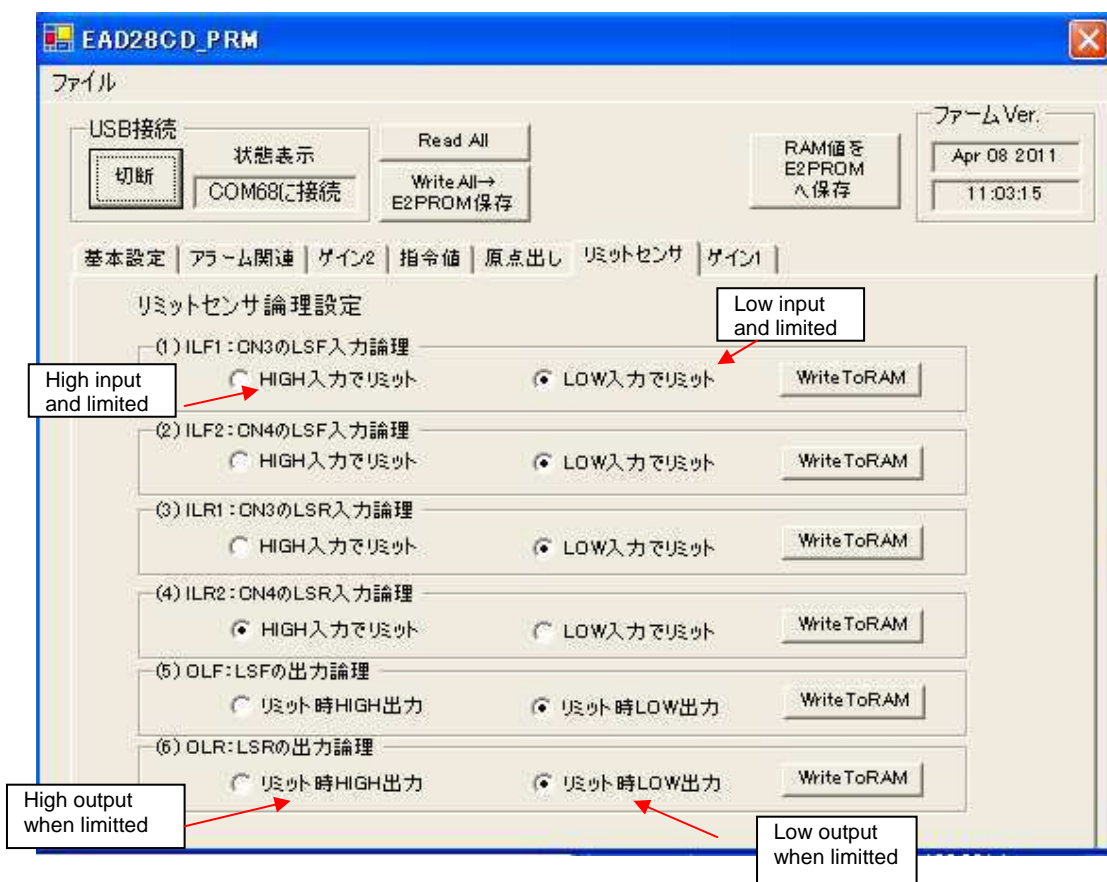
Following tables shows the various settings for Origin search which start by Origin search start input ON.

PRMNo	Setting contents	Description
40	Switching Origin search method	<ul style="list-style-type: none"> To set up Origin search method of Origin search function 0 ... A type (After backward limit, moves forward upto limit cancel, Z phase edge) 1 ... B type (After backward limit, moves forward upto limit cancel)
41,42	Origin search speed	<ul style="list-style-type: none"> To set up Motor speed during Origin search mode. At Rotary motor setting by PRMNo5=0 ... Input a motor revolution [rpm] At Linear motor setting by PRMNo5=1 ... Input a motor speed [mm/sec]
43	Setting Origin search direction	Not available for Motor driver for Linear actuator
44	Setting a time for Origin search time-out	To set up a time for Origin search time-out for Z phase Origin search Unit is sec.. If input is 20, time-out is 20 sec..

9-3-6 Limit sensor related

Logic setting of Limit sensor input and Limit output of this Driver can be changed.

As shown on below table, clicking High or Low check box permit Limit sensor's input logic and limit output logic to change. Like other parameters, it can be stored in Motor driver by clicking E2PROM Storage.



10. Operation

10-1. Inspection before operation

- (1) Be sure to have no error in wiring.
 - Be sure to connect connector CN1, CN2 and CN3 particularly and check loose clamp.
 - Make sure to connect CN3 LSR input.
- (2) Be sure to have rated input power supply.
- (3) Be sure to check short cut by wire waste.
- (4) Be sure to check loose screw, terminal and connector.
- (5) Be sure to check short cut or earth of cables connected to actuator.

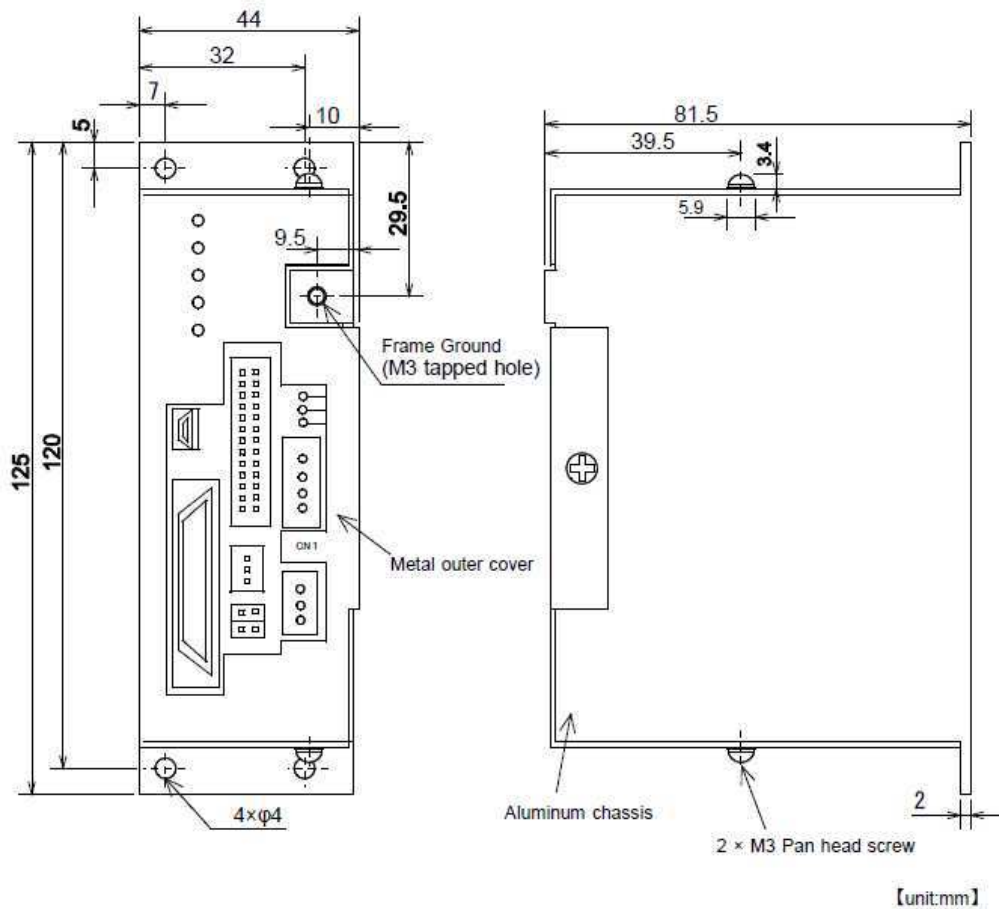
10-2. Test run

- (1) For safety, please do following work in the first.
 - Do not leave anything on the rod of the actuator.
 - Make sure to fix the actuator not to move by reaction.
- (2) In reference with 7-2-4, connect the input signal of connector CN3 and supply power by the external photo coupler power (DC24V).
- (3) Input power to the driver. Confirm that LED (PWR) lighting on the driver is on.
- (4) Turn on the servo ON input. Then, LED (RDY) on the driver is lighting and Motor is locked by servo lock.
- (5) Input the forward movement pulse.
 - Since the rod is pushed inside the actuator at factory shipment, backward pulse input secures a stop through LSR ON.
 - Beware of exceeding max speed of the actuator.

11. Specifications

Item		Specifications
Type		LAD-01D-012
Basic specifications	Motor power supply	24V±10% (Current capacity 1~3A)
	Control I/O power supply	24V±10%
	Operation conditions	Temperature 0°C~50°C, Humidity10%~80% (No condensation, No ice)
	Storage conditions	Temperature-20°C~85°C, Humidity10%~80% (No condensation, No ice)
	Motor drive circuit control method	3 phase sign wave PWM method
	Feedback	Incremental encoder (Line driver)
	Motor control mode	Position control and thrust control (switching by I/O)
	Control I/O circuit method	Encoder monitor output : Differential output by line driver
Input signal	Command input method	Pulse string input method
	Other input signals	Servo ON, Gain LOW, Gain switch signal, Alarm reset,
Output signal	Output signal	Alarm, In position, In forward prohibited, In backward prohibited,
	Encoder monitor output signal	A,B,Z phase Differential output by line driver
Functions	Encoder evaluation	X4 fixed
	Command pulse evaluation	None (2 phase pulse input method: X quad evaluation fixed)
	Communication	USB to Personal computer
	Control parameter	Set up by communication
	Display LED	Power ON, In position, Alarm, Origin return finish,Ready
	Alarm LED lighting cause	Driver over heat, Full torque, Over voltage, Hall sensor error, Encoder
Weight		Approx. 380g

12. Dimensional outlines



13. Coverage of warranty

(1) This warranty on free of charge base covers a failure caused by:

Within one year after delivery,

Installation, wiring, connection to other devices, operating methods, inspection or maintenance that does not comply with industry standards or instruction specified in this manual and Carried back to our company by the customer or shipped back to our company.

Please take it into account that a repair work requires a considerable dates.

(2) Repair fee is applied if the failure was caused by customer's mistake in handling or operation and the delivery date is pass over one year.

Even in such a case, only carried back or shipped back equipment are accepted and repaired on free of charge base same as above.

Since a repair job requires certain dates, please kindly consider to purchase spare equipment in case of system integration to important system.

(3) When the failed equipment is shipped back to us, please make sure to pack it with adequate amount of cushion to prevent damage by vibration.

14. Version list

·The changes from Ver1.0 to Ver1.1

- ① P19, P24, OP23 and PO was revised to mean power supply input explicitly.
- ② P20, Article 8-1-3 Error correction in open collector method diagram
- ③ P23, Article 8-2-1 On the table, full count threshold value was added.
- ④ P24, Article 8-5 The caution to LSR Origin search mode was added.
- ⑤ P28, Article 11 “ No condensation, No ice” was added in Humidity on the table.

·The changes from Ver1.1 to Ver1.2

- ① P22, Article 3-1-4(3) Error correction in the table
- ② P24, Article 8-5 Origin search method was changed.
- ③ P27, Article 9-3-5 Description on the table was changed.
- ④ P28, Article 11 “Ready” was added in Output signal on the table.

·The changes from Ver1.2 to Ver1.3

- ① P16, Article 7-1 The connection diagram was corrected to correct + - reverse of Encoder monitor Z phase.
- ② P18, Article 7-2-4 The wiring diagram was corrected to correct + - reverse of Encoder monitor Z phase.
- ③ P20, Article 8-1-1 The table was corrected to correct + - reverse of Encoder monitor Z phase.

·The changes from Ver1.3 to Ver1.4

- ① P8, Article 1-1's standard accessory, The connector cover was changed from 10336-42F0-008 to 10336-52F0-008.
- ② P28, Article 9-3-6, The description on limit sensor setting was added.