

Electric Gripper Instruction Manual

Servo Driver



Electric Gripper
(CGS0402 Series)



Servo Driver (D6180)



Dedicated Software

Revision History

Date	Rev.	Details
September 16 th 2020	0.0	First Edition

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1. Handling Precautions

This instruction manual divides handling-based precautions into "Warnings" and "Cautions".

WARNING

This is shown for potential dangers that may lead to death or serious injury if the product is mishandled.

CAUTION

This is shown for potential dangers that may lead to slight-to-moderate injury or cause physical damage to property if the product is mishandled.

The  Caution described in this section may lead to serious consequences whatever the circumstances. The content detailed for each definition is important, so be sure to follow the instructions within.

WARNING

Overview

- Do not use the product in an explosive atmosphere, inflammable gas atmosphere, corrosive atmosphere, somewhere exposed to water, oil or any other liquid, or next to combustibles. Doing so may cause you to receive an electric shock or cause an injury or fire.
- Do not carry out relocation, installation, connection or inspection work while the power is turned on. Be sure to perform such work after turning off the power. Doing it while the power is on may cause you to receive an electric shock or damage the driver.
- Installation, connection, and inspection work must be performed by a worker with knowledge of the equipment and who is well-acquainted with the safety information and precautions.
- The motor loses its holding force when the power is turned off.
- When the driver's protection function works, the motor stops and loses its holding force.
- When the driver's protection function works, cancel the protection function (turn back on/ cancel power) after removing the cause.
If operation is continued without removing the cause, the driver will malfunction causing injury or equipment breakdown.
- Only move, wire, maintain and inspect the driver after shutting down the power supply and confirming that the main power LED on the substrate is completely off.

Connection

- Ensure that the driver's power input voltage is kept within the rated range. Failure to do so may cause a fire, electric shock or damage the equipment.
- Be sure to connect the gripper in accordance with the connection diagram. Failure to do so may cause a fire, electric shock or damage the equipment.
- Do not forcibly bend, pull or insert the power wire or motor lead wire. Doing so may cause a fire, electric shock or damage the equipment.

Operation

- Please read this manual and fully understand the workings of the settings prior to use.
- Only use the motor at or below the rated current. If the rated current is exceeded, this may cause a fire or a burn injury due to motor heating.
- The motor may heat irregularly if used in an environment where it is difficult for heat to escape even when used at or below the motor's rated current. Take the installation environment into consideration and check the motor heating by conducting a trial run.

Repair/ Disassemble/ Reconstruct

- Do not repair, disassemble or reconstruct the product as this may cause an electric shock, injury, fire or lead to other serious consequences.
Please contact KSS if you need to perform any such tasks.



Overview

- Do not use the product in excess of the motor driver's specified values.
- Do not touch the driver motor while it is being powered or for a short time after power shutdown as it will be hot and may cause a burn injury.
- Only use the motor and driver when combined as instructed. Failure to do so may cause an injury or fire.

Storage

- Do not store the product in a place exposed to rain or water drops or in a place where there is toxic gas or liquid.
- Store the product in a place that is not directly exposed to sunlight and is within the agreed humidity and temperature ranges.

Installation

- Do not stand or place any heavy objects on the driver as this may cause an injury.
- Install it on a noncombustible material such as metal. Failure to do so may cause a fire.
- Ensure that the regulated distance is kept between the main unit and control board inner surface or other equipment. Failure to do so may cause a fire.
- The product has a natural heat radiation system, so keep heat radiation in mind when installing it. Install it at a distance of 20mm or more from other equipment. When the surrounding temperature rises due to the driver heating and exceeds the operating ambient temperature range, this may damage the driver and impact its longevity.
The driver is a circuit board type, so ensure that it is not contaminated by conductive foreign matter, dust or water.
- Provide a space of about 20mm or more to mount the connector on the driver.

Operation

- When connecting a mechanical system to conduct a test run, ensure that it is set so that emergency stop can be operated at any time. Failure to do so may cause an injury.
- If an error occurs, immediately shut down the driver's power. Failure to do so may cause an electric shock, injury or fire.
- Do not come into contact with the driving part while in operation because you may get caught in it and injured.
- The temperature of the motor may rise significantly due to operating conditions. In particular, when operating the motor continuously in a high-speed region, take heating in consideration and ensure that the motor surface temperature is 60°C or lower.

Maintenance and Inspection

- Do not touch the motor and driver while it is being powered or soon after shutting down the power as this may cause a burn injury.
- Do not touch the terminal when conducting an insulation resistance test or withstand voltage test as this may cause an electric shock.

Disposal

- Treat the driver and motor as industrial waste when disposing of them.

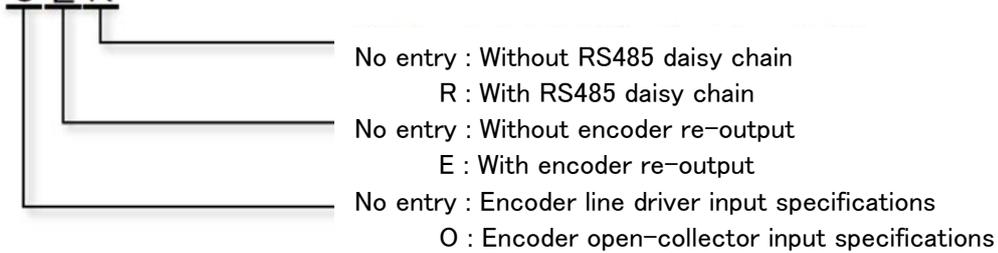
2. Summary

This product is a driver for the KSS Electric Gripper. It is embedded with a dedicated controller, enabling homing, grip operation and standby position operation. In addition, the parameters of each operation can be changed by the RS-485-compliant "AE LINK" serial communication protocol.

3. Model name / Product name D6180 Driver for an Electric Gripper

—Model Description—

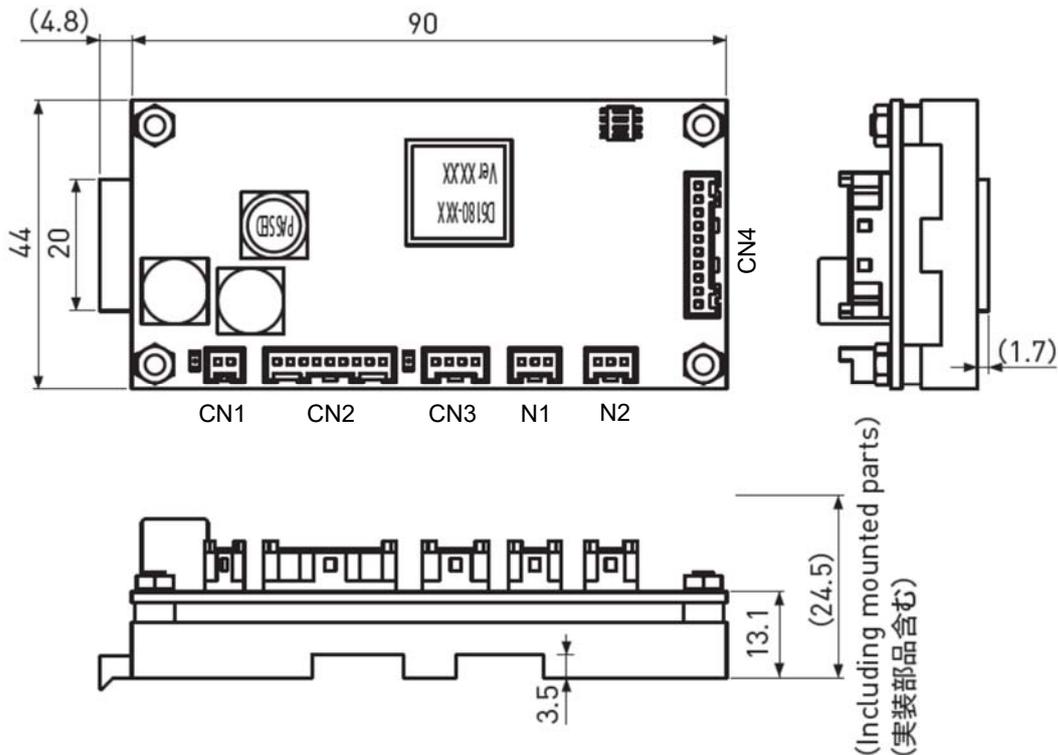
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※Model D6180 is the standard product. Other models are offered as options.

4. External Dimensions and Actual Weight

1) External Dimensions



※This product does not include connector housing and contacts.

2) Actual Weight Approximately 45g

5. Electrical Specifications

- 1) Power supply Main power supply voltage: DC 24V \pm 10% consumption current 1A (MAX)
※Consumption current differs depending on the motor drive conditions.
- 2) Applicable actuator: KSS Electric Gripper (CGS0402 Series)
- 3) Maximum driving capacity: Maximum rating of driver: 0.25A (capability)
- 4) Driving method: Bipolar chopper constant-current system
- 5) I/O Signal
 - ① RS-485-compliant serial communication line half duplex
AE-LINK Start-stop system 38.4kbit/sec. (Baud rate 38400bps)
 - ② Control input: 3-point Start of homing, Start of Grip operation, and Return to standby position
Photocoupler input: Input resistance 4.7 k Ω (supports 24V signal)
 - ③ Control output: 3-point Completion of homing, Grip complete, and alarm
Open-collector output
 - ④ Encoder input: 2-point A-phase, B-phase
Line driver input
Open-collector input (Optional)
 - ⑤ Encoder re-output (Optional): 2-point A-phase, B-phase
Line driver output
- 6) Operating temperature range: 0°C \sim +50°C
- 7) Operating humidity range: 90%RH or less (Keep away from condensation)
- 8) Vibration during operation: 10 \sim 55Hz (d=0.15mm Fixed) X \cdot Y \cdot Z directions 1 hour
55Hz \sim 250Hz (2G 1-min. sweeping) X \cdot Y \cdot Z directions (shock) 10G (once)
- 9) Storage temperature range: -20°C \sim +60°C (Keep away from condensation)
- 10) Storage humidity range: 90%RH or less (Keep away from condensation)
- 11) Vibration during transportation (shock) : Same environment as "Vibration during operation"

6. Function

Power supply voltage monitoring function	The power supply input voltage is monitored and it will go to alarm state when the voltage is outside the range of 21V to 27V. In addition, the motor output will turn off automatically to protect the internal element.
Overload protection function	It will go to alarm state when an electrical current (actual current) of 220mA or more is applied for 15 sec. or more to the motor output line. In addition, the motor output will turn off automatically to protect the internal element.
Motor disconnection detection function	It will go to alarm state when the motor output command is 20mA or more and the actual current is 2mA or lower for 1 sec.

7. I/O Connector and Connection

※This product does not include connector housing and contacts.

1) N1, N2 Communication Connector

Used connector: B03B-PASK-1(LF)(SN) (J.S.T. MFG. CO., LTD. Japan)

It is a connector for AE-LINK connection.

Connect with upper level communication equipment.

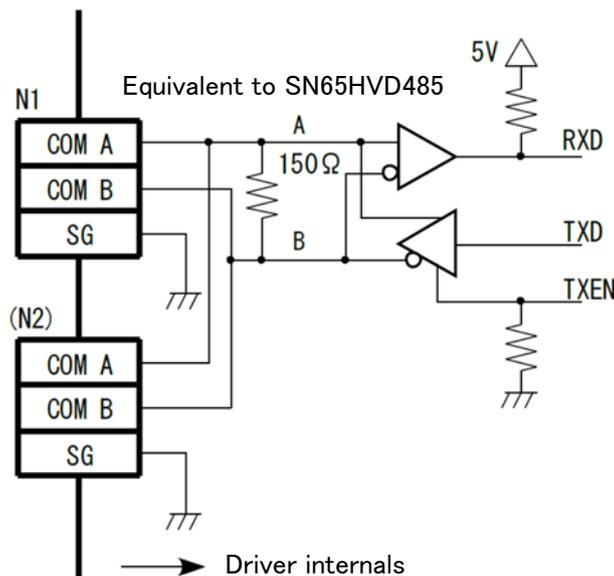
Pin No.	Name	Explanation
1	COM A	Signal line A
2	COM B	Signal line B
3	SG	Signal GND

COM A, COM B: It is an RS-485-compliant I/O port for communication.

SG: It is the signal GND of the communication part. It is connected to internal circuit GND and power input GND.

<AE-LINK communication circuit> AE-LINK communication circuit is shown in the below diagram.

⚠ CAUTION Carry out communication cable wiring only after shutting down the driver's power source.



2) CN1 Power input connector

Used connector: B02B-PASK-1(LF)(SN) (J.S.T. MFG. CO., LTD.)

Pin No.	Name	Explanation
1	DC24V	DC 24V power supply input
2	GND	

This is the power supply input connector. Supply the following voltage.
Supplied voltage: DC24V±10%MAX 1A

3) CN2 Encoder input, Motor output connector

Used connector: B09B-PASK-1(LF)(SN) (J.S.T. MFG. CO., LTD.)

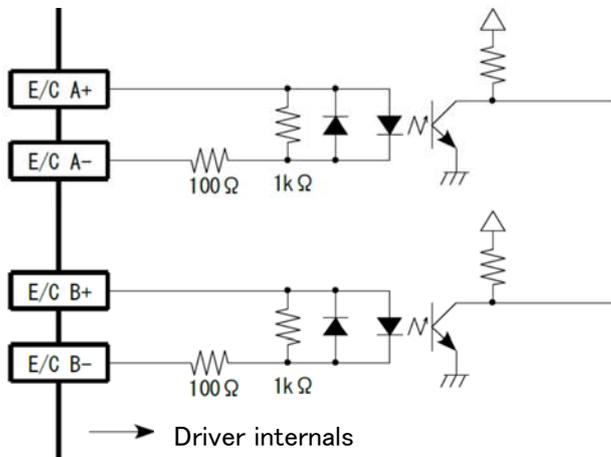
Pin No.	Name	Line driver specifications	Open-collector input specifications (Optional)
1	E /C A +	Encoder phase A + signal input	<Unconnected>
2	E /C A -	Encoder phase A - signal input	Encoder phase A signal input
3	E /C B +	Encoder phase B + signal input	<Unconnected>
4	E /C B -	Encoder phase B - signal input	Encoder phase B signal input
5	5V OUT	Encoder power supply output 5V	Encoder power supply output 5V
6	GND	Encoder power supply output GND	Encoder power supply output GND
7	CS	Cable shielded wire connection	Cable shielded wire connection
8	M+	Motor output +	Motor output +
9	M-	Motor output -	Motor output -

① Encoder signal input part

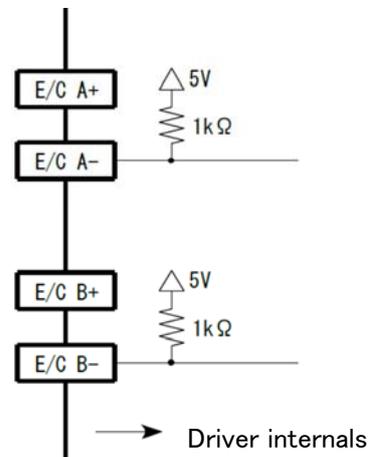
This is the encoder input port. It connects to the encoder phase A and B.

<Encoder input circuit>

Line driver specifications

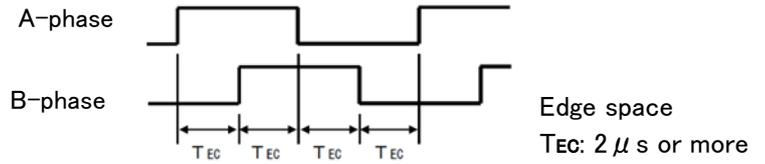


Open-collector specifications (Optional)



<Encoder Specifications>

Output state: Incremental (phase coefficient)
Resolution: 5 μ m/Pulse
Maximum frequency: 100kHz
Output circuit: Line driver
Open-collector (Optional)
Edge space: 2 μ or more



② Encoder power supply output 5V OUT, GND

Driver's internal circuit of 5V is output as the encoder's power supply.

※The power GND for the encoder is connected to the power input GND inside the driver.

③ Cable shield wire connection CS

This is the cable shield wire connection port.
This is connected to the power input GND inside the driver.

④ Motor output M+, M-

This is the motor output.

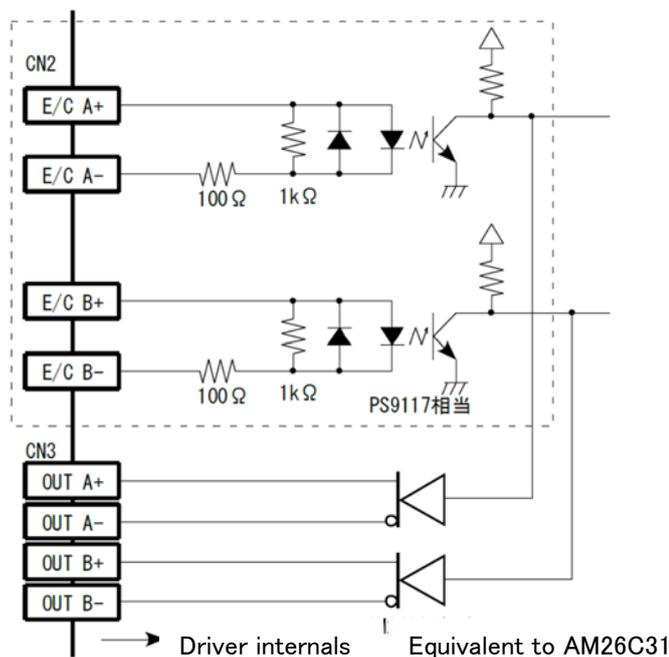
4) CN3 Encoder re-output connector

Used connector: B04B-PASK-1(LF)(SN) (J.S.T. MFG. CO., LTD.)

Pin No.	Name	Explanation
1	OUT A+	Encoder phase A + signal output
2	OUT A-	Encoder phase A - signal output
3	OUT B+	Encoder phase B + signal output
4	OUT B-	Encoder phase B - signal output

It re-outputs the N2 encoder input.

<Encoder re-output circuit>



5) CN4 Control signal I/O connector

Used connector: B10B-PASK-1(LF) (SN) (J.S.T. MFG. CO., LTD.)

Pin No.	Name	Explanation
1	ORG +	Start of homing +
2	ORG -	Start of homing -
3	STR +	Start of Grip operation +
4	STR -	Start of Grip operation -
5	END +	Return to standby position +
6	END -	Return to standby position -
7	ORG OUT	Completion of homing
8	HOLD OUT	Grip complete
9	ALM OUT	Alarm
10	COM	Output signal COM

① Control signal input part

This is the input port for each control signal.

<Control input circuit>

Input level

Rated voltage DC24V ± 10%

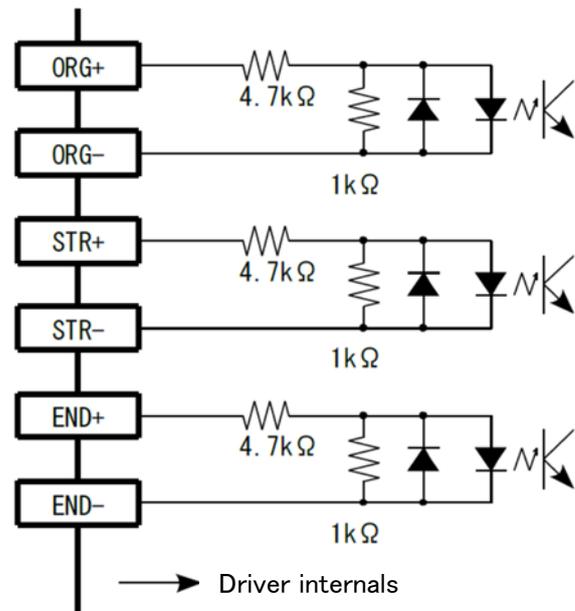
ON voltage DC15V or more (4.0mA or more)

OFF voltage DC5V or less (1.0mA or less)

Input logic

When photocoupler is ON (lit): Signal detected

When photocoupler is Off (unlit): Signal not detected



Name	Signal	Control
Start of homing	ORG + ORG -	Starts the homing by detecting the edge of detection from non-detection.
Start of Grip operation	STR + STR-	Starts the grip operation by detecting the edge of detection from non-detection.
Return to standby position	END + END-	Starts the return to standby operation by detecting the edge of detection from non-detection.

②Control signal output part

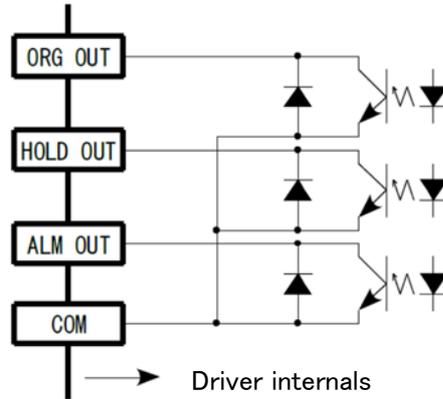
This is the output port for each control signal.

<Control output circuit>

Output level

DC30V (5mA)

Saturation voltage when ON $V_{CE} (SAT) \leq 0.4V$



Name	Signal	ON (Photocoupler LED lit)	OFF (Photocoupler LED unlit)
Completion of homing	ORG OUT	When homing is normally completed	<ul style="list-style-type: none"> • During homing • After turning on the power
Grip complete	HOLD OUT	During gripping	<ul style="list-style-type: none"> • Other than gripping
Alarm	ALM OUT	During normal operation	<ul style="list-style-type: none"> • During alarm

③Output COM (COM)

This is the output signal COM port.

8. Display

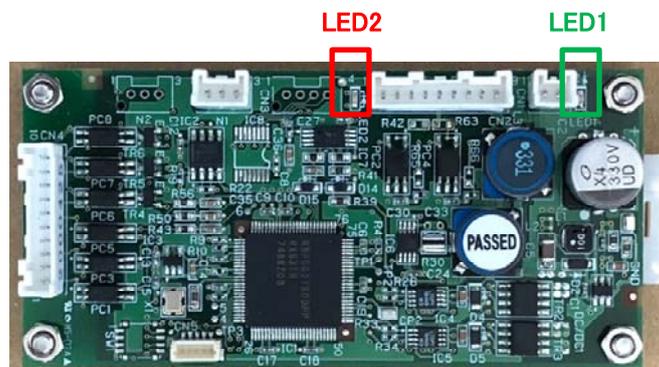
There are two LEDs in the driver.

1) LED1 (green) : Main power LED

It lights up when the main power is supplied.

2) LED2 (red) : Alarm LED

It lights up when the alarm is sounded, and turns off when in normal status.



9. Operations

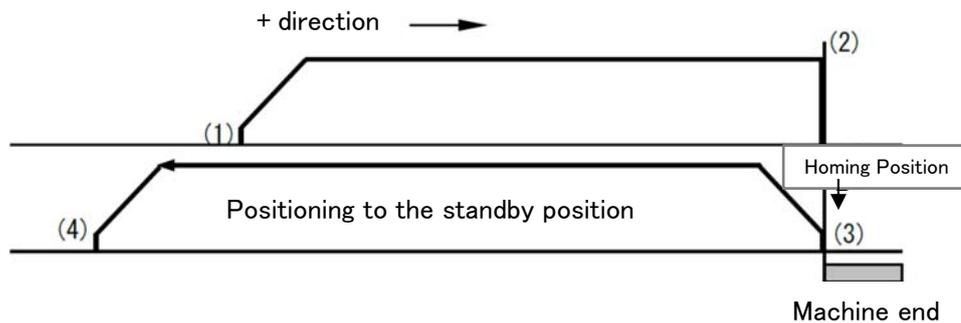
9. 1. Homing

Homing is performed by input of start of homing. When homing signal is input during the alarm, the alarm is automatically canceled and homing is performed.

The below diagram describes + direction (closed direction), but the - direction (open direction) enables homing as well. When performing homing to the - direction, set the [Homing current] of setting parameter to minus.

The operation of homing pattern is as follows.

- (1) The "speed control under limited" operation starts with the maximum speed as [Approach speed to grip start] and the limited current as the [Homing current].
 ※When the [Homing current] is at or below the motor output current required for the [Approach speed to grip start], the actual speed will not be the [Approach speed to grip start].
- (2) When the operation (1) initiated and contacts the machine end, if the time within the range of the \pm [Grip complete current range] that the motor output current is based on [Homing current] is longer than [Time of grip judgement], the contact point will be homing position and the encoder count value being cleared.
- (3) The motor output current gradually reduces and weakens, and shifts to positioning control.
- (4) The operation of homing ends when positioning toward the [standby position] is completed.



9. 2. Grip Operation

Grip operation is performed at input of "Start of Grip operation".

"Start of Grip operation" is ignored while the alarm is going off or other operations are being executed.

If "Start of Grip operation" is input when homing is incomplete, the grip error alarm is triggered.

If "Return to standby position" is detected during grip operation, gripping is immediately stopped and it is positioned at the standby position.

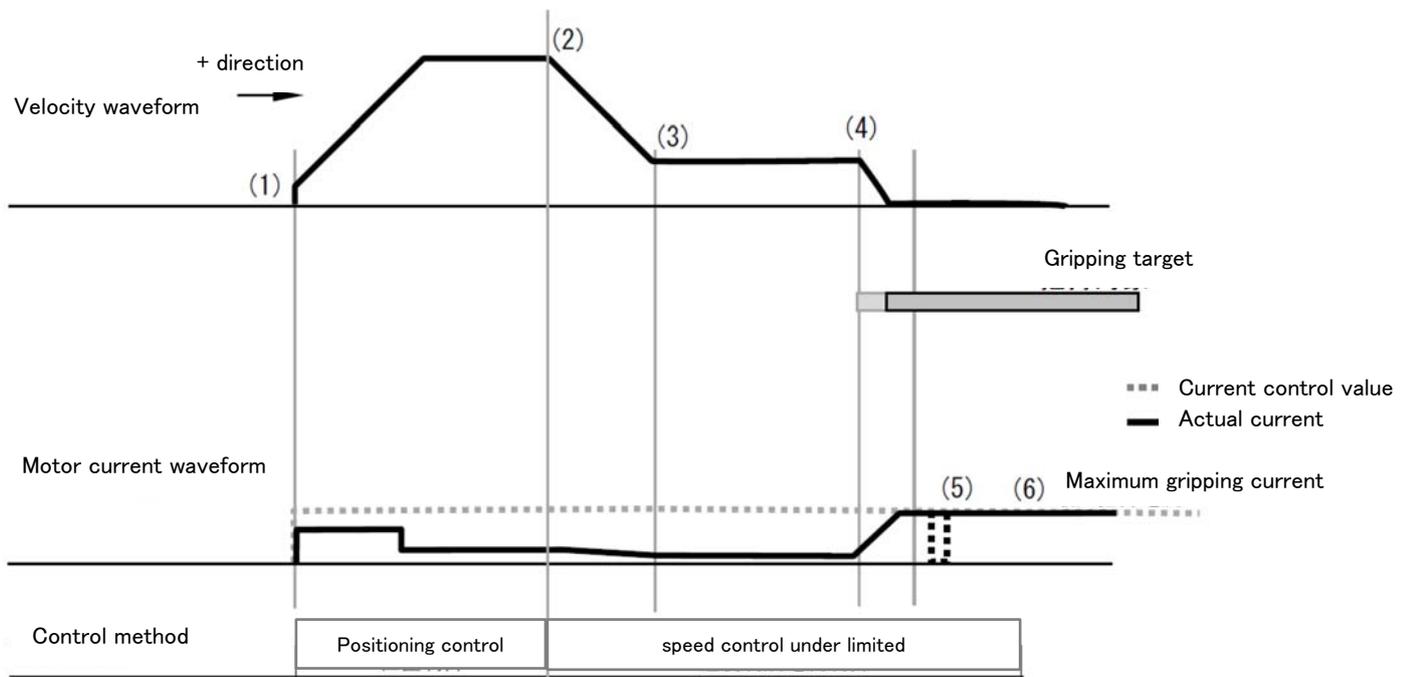
The below diagram describes + direction (closed direction), but the - direction (open direction) enables homing as well.

When performing homing in the - direction, set the [Grip current] to minus.

The grip operation pattern is as follows.

- (1) Operation starts at the [Approach speed to grip start] toward the [Grip start position].
- (2) Deceleration starts so that it becomes the [Grip speed] at the [Grip start position].
- (3) After deceleration ends, it switches to the speed control under limited while the maximum current is the [Grip current] and the speed limit is the [Grip speed].
- (4) The output current is increased after coming into contact with the gripping target until reaching the [Grip current].
- (5) If the [Grip speed] exceeds 1mm/sec., the current control turns off (approx. 5ms) and then the output current is increased until reaching the [Grip current].
- (6) The grip is complete if the state that satisfies the following conditions continues beyond the [Time of grip judgement].
 - If the motor output current is within the \pm [Grip complete current range] based on the [Grip current] criteria.
 - If the actual position is within the \pm [Grip complete position range] based on the [Grip complete position] criteria.

※If the [Grip current] for this operation is at or below the motor output current needed for each speed, the actual speed will not reach the commanded speed.



9. 3. Standby Position Operation

Positioning is performed up to the [Standby position] at input of return to standby position. When return to standby position is input during the grip error alarm, the said alarm is canceled and return to standby position is performed.

Return to standby position is ignored when a different alarm is triggered.

The standby position operation pattern is as follows.

- (1) It gradually weakens and shifts to positioning control.
- (2) Positioning operation is performed toward the [standby position].

10. Parameter

10. 1. Parameter Description

The parameters used for the driver are in the following table.

Use the dedicated software (D6180 Controller) or command to change the parameters.

When changing the parameters, shut down the driver's power and connect the communication cable.

Refer to the "Dedicated Software Edition" Instruction Manual for details about parameter setting and operating methods.

No.	Items [Unit]	Minimum	Maximum	Explanation
1	Homing current [mA]	-200	200	Push-on current during the start of homing.
2	Approach speed to grip start [mm/s]	0.5	20.0	Approach speed for start of homing, grip start, and standby positions.
3	Standby position [mm]	-20.000	20.000	Determines the standby position of the Electric Gripper.
4	Grip start position [mm]	-20.000	20.000	Determines the start position of grip operation.
5	Grip complete position [mm]	-20.000	20.000	Reference position to determine the completion of grip operation.
6	Grip current [mA]	-200	200	Value of motor current during gripping. This parameter determines the gripping force.
7	Grip speed [mm/s]	0.5	20.0	Value of speed limit during the grip operation.
8	Grip complete position range [mm]	0.000	20.000	Reference to determine the completion of grip operation. Grip operation is determined to be complete when the actual position is grip complete position \pm this parameter range.
9	Grip complete current range [mA]	5	100	Reference to determine the completion of grip operation. Grip operation is determined to be complete when motor current is grip current \pm this parameter.
10	Time of grip judgement [ms]	0	32767	Final determination of grip completion is made when the gripping operation completion determination of the grip complete position and the grip complete current continues for more than this parameter.
13	Maximum time of homing [s]	1	60	Determines the maximum time for the start of homing. A homing error occurs if homing is not complete even after the start of homing and this parameter has been exceeded.
14	Maximum time of Gripping operation [s]	1	60	Determines the maximum time for grip operation. A grip error occurs if gripping is not complete even after the start of grip operation and this parameter has been exceeded.

1mm = Encoder 200 pulse (800 pulse at AB phase coefficient count)

10. 2. Parameter initial values

The initial values (factory defaults) of this parameter are as follows.

No.	Items [Unit]	Initial value
1	Homing current [mA]	80
2	Approach speed to grip start [mm/s]	12.5
3	Standby position [mm]	-7.000
4	Grip start position [mm]	-2.500
5	Grip complete position [mm]	0.000
6	Grip current [mA]	50
7	Grip speed [mm/s]	5.0
8	Grip complete position range [mm]	1.250
9	Grip complete current range [mA]	25
10	Time of grip judgement [ms]	100
13	Maximum time of homing [s]	5
14	Maximum time of Gripping operation [s]	5

※Precautions

- * Limit the gripping current to 150[mA].
- * Acceleration is a fixed value of 125 [mm/s²].

11. Alarms

When the driver detects an error, the driver alarm is triggered and this state is maintained until the alarm is reset. Reset the driver after removing the cause of the error.

The alarm details can be checked by the dedicated software. When checking the details, shut down the driver's power supply and connect the communication cable.

Error causes and their details are described below.

Name of error cause	Cause factors	Action	Alarm resetting method
Homing error	When homing is not completed even when the operation time of homing exceeds the maximum time of homing.	• Stop operation when that happens	• Start of homing • Cancel from the dedicated application
Grip error	<ul style="list-style-type: none"> • When grip operation is started even though homing is not completed normally. • When return to standby position is detected even though homing is not completed normally. • When grip operation is not completed even when the maximum time of grip operation is exceeded during the operation. 	• Stop operation when that happens	<ul style="list-style-type: none"> • Start of homing • Return to standby position • Cancel from the dedicated application
Overload	When the actual motor current is 220mA for 1sec.	<ul style="list-style-type: none"> • Stop operation when that happens • Motor output: OFF 	<ul style="list-style-type: none"> • Turn back the power • Start of homing • Cancel from the dedicated application
Motor disconnection	When the actual motor current is 2mA or less for 1sec. even though the current command is 20mA or more.	<ul style="list-style-type: none"> • Stop operation when that happens • Motor output: OFF 	<ul style="list-style-type: none"> • Turn back the power • Start of homing • Cancel from the dedicated application
Power supply voltage drop error	When the power voltage is 21V or lower during homing or completion of homing.	<ul style="list-style-type: none"> • Stop operation when that happens • Motor output: OFF 	<ul style="list-style-type: none"> • Turn back the power • Start of homing • Cancel from the dedicated application
Power supply overvoltage error	When power voltage exceeds 27V.	<ul style="list-style-type: none"> • Stop operation when that happens • Motor output: OFF 	<ul style="list-style-type: none"> • Turn back the power • Start of homing • Cancel from the dedicated application

12. Restricted Substances

The product contains the below restricted substances at a level equal to or below the threshold, and it does not contain prohibited substances.

List of restricted substances (RoHS Directive 10-compliant)

No.	Substances	Threshold
1	Cadmium and its compounds	100ppm or less
2	Hexavalent chromium compounds	1,000ppm or less
3	Lead and its compound	1,000ppm or less
4	Mercury and its compounds	1,000ppm or less
5	Polybrominated biphenyls (PBB)	1,000ppm or less
6	Polybrominated diphenyl ethers (PBDE)	1,000ppm or less
7	Bis(2-ethylhexyl) phthalate (DEHP)	1,000ppm or less
8	Dibutyl phthalate (DBP)	1,000ppm or less
9	Butyl benzyl phthalate (BBP)	1,000ppm or less
10	Diisobutyl phthalate (DIBP)	1,000ppm or less

List of prohibited substances

No.	Substances	Threshold
11	Bis (tributyltin) oxide (TBTO)	Prohibited
12	Tributyltin (TBT), Triphenyltin (TPT)	Prohibited
13	Polychlorinated biphenyls (PCB)	Prohibited
14	Polychlorinated naphthalenes (PCN) (3 or more chlorines)	Prohibited
15	Short chain chlorinated paraffins (PCA)	Prohibited
16	Asbestos	Prohibited
17	Azocolourants and azodyes	Prohibited
18	Ozone-depleting substances	Prohibited
19	Radioactive substances	Prohibited

13. Installation

This product can be directly installed on a 35mm wide DIN rail (DIN standardized product, JIS-C-2812 standardized product).

