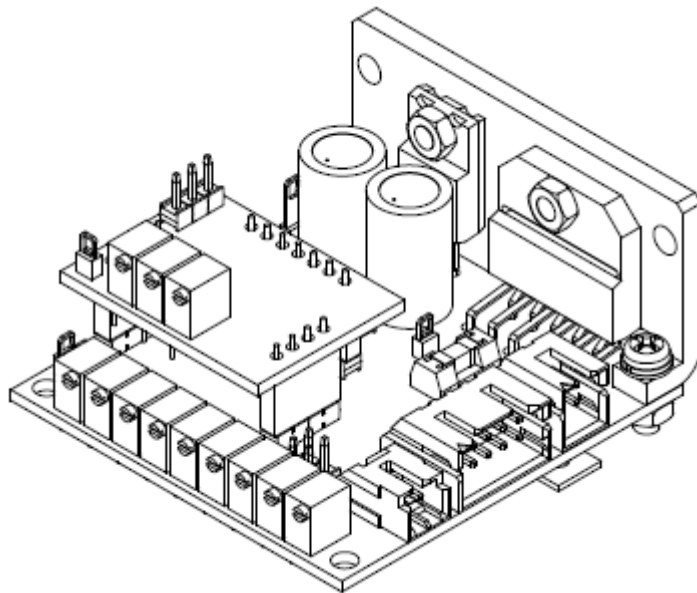


Galvanometer Scanner Servo Driver GVD2 Series Instruction Manual



CITIZEN CHIBA PRECISION CO., LTD.

Contents


1. Product Overview	3
1-1. Standard Accessories	3
1-2. Main Features	3
1-3. Details of Model Type and Serial Numbers	4
1-4. Name Plate	4
1-5. Specifications	5
1-6. Optional Cable	7
2. Settings	7
2-1. Outline and Name of Each Part	7
2-2. Setting Jumpers for Main Board	8
3. Installation and Wiring	9
3-1. Installation	9
3-2. Example of Connection	9
3-3. Connectors	10
3-4. Input / Output Interfaces	12
4. Adjustment	14
4-1. Volumes for Adjustments	14
4-2. Check Terminal	15
5. Product Warranty	16
6. Contact Information	16

Preface

Thank you very much for purchasing our GVD2 Series Galvanometer Scanner Driver.

This Instruction Manual explains the specifications, input/output interfaces, and important notes concerning GVD2 Series Galvanometer Scanner Driver. Please read this manual carefully to use this product properly.

Failure to follow the instructions may make our product not to perform fully but also may cause damages and accidents. For your safety, please keep this manual accessible even after read it all.

The definitions of signal words next to this symbol  in this Instruction Manual are as follow. Please be sure to follow them to avoid any danger.



This is the symbol used for notification of any general cautions, warnings, and dangers.

DANGER:

This signal word indicates direct hazards. Failure to follow this caution may result in death, serious injury and critical damage to property such as total loss of equipment or fire.

WARNING:

This signal word indicates indirect hazards. Failure to follow this caution may result in death, serious injury and critical damage to property such as total loss of equipment or fire.

CAUTION:

This signal word indicates potential hazards. Failure to follow this caution may result in minor or moderate injury or partial damage to equipment.

NOTE:

All rights reserved. This Instruction Manual may not be photocopied or reproduced without our prior written permission.

The contents of this Instruction Manual are subject to change without prior notice.

1. Product Overview

Our GVD2 Series is a set of servo drivers of one-axis mirror positioning system which is exclusively designed for Citizen Chiba Precision's galvanometer scanners. With its high precision, high controllability, and compactness, the servo drivers are suitable for small galvanometer scanners.



CAUTION

This product is the driver exclusively for Citizen Chiba Precision's galvanometer scanners.

It cannot control any galvanometer scanners made by other manufacturers.



CAUTION

This product is a driver exclusively for small galvanometer scanners, supporting GVM0930S, GVM0930L, GVM1445S, and GVM1445L. For our scanners other than these, please use GVD0 or GVD1 Series.



CAUTION

**Do not use this product without the bracket.
Failure to follow this caution may result in a damage.**

1-1. Standard Accessories

GVD2 package contains the following items besides the main unit. Please make sure that all items are contained in the package before use. If any item is missing or damaged, please contact our Sales representatives by "Section 6: Contact Information".

No	Accessories	Model	Manufacturer	QTY
1	Connector Housing for CN1	DF1B-4DS-2.5RC	HIROSE ELECTRIC CO., LTD.	1
2	Contact Pin for CN1	DF1B-2022SCA	HIROSE ELECTRIC CO., LTD.	4
3	Connector Housing for CN3	DF1B-2S-2.5R	HIROSE ELECTRIC CO., LTD.	1
4	Contact Pin for CN3	DF1B-2428SCA	HIROSE ELECTRIC CO., LTD.	2

1-2. Main Features

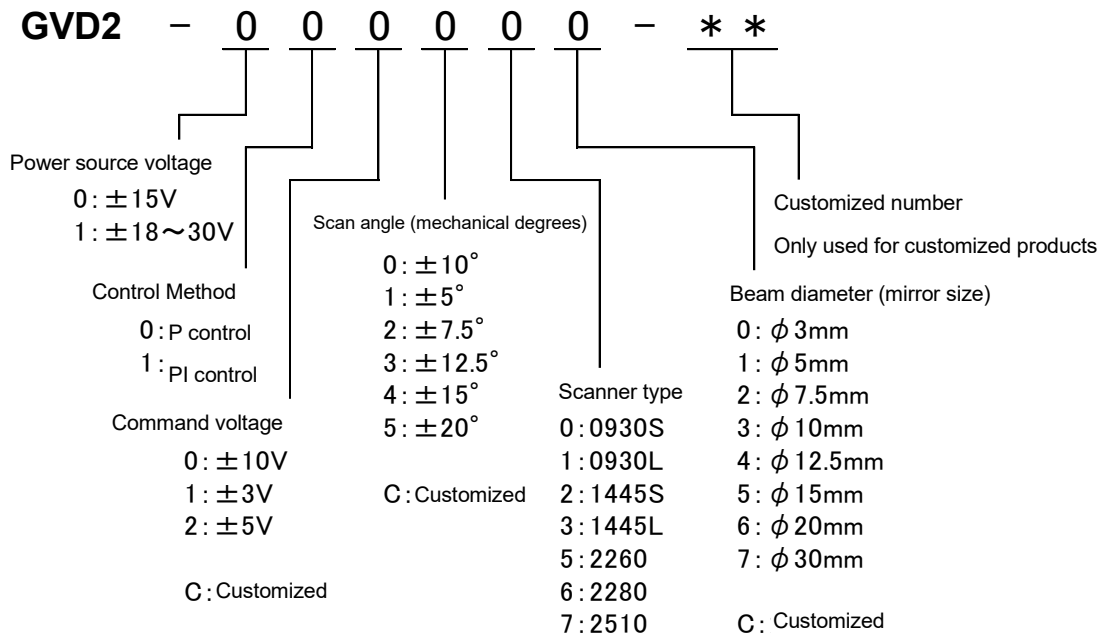
Our GVM Series Galvanometer Scanners are developed based on the small servomotor technology that we have developed and improved over a long time, and our newly developed small high-precision optical position sensor. The following are the features of the system combining GVM Series Galvanometer Scanners and the driver:

- Fast response / Low inertia / High torque
- High linearity and positioning accuracy
- Excellent temperature characteristics

1-3. Details of Model Type and Serial Numbers

The model types of GVD2 Series drivers vary according to the specifications.

The relationship between driver model number and each specification are as follows:



1-4. Name Plate

The name plate is attached to the power operational amplifier as shown in the picture below.



Details of Serial Numbers:

18 X 0001
Shipping Year Shipping Month Sequence Number

*The shipping year indicates last two digits of the year

*Following months are indicated as follows: October: X, November: Y, December: Z

This product is adjusted and inspected in a system by pairing GVM Series galvanometer scanner and the optical mirror. The name plate of scanner indicates serial numbers of compatible driver. Please be sure to use this product with the scanner which has same serial numbers.

1-5. Specifications

1-5-1. Main Specifications for Drivers

Power Source Voltage : DC ± 15 V to DC ± 30 V

Driving System : Linear Drive

Power Source Current : Approx. (+) 150 mA / Approx. (-) 130 mA
(at DC ± 15 V and servo lock)

*Maximum Output : Electrical output: 150 W, Peak current: 10 A

*By using GVM1445S under power source voltage of DC ± 15 V

1-5-2. Input Signals

Position Command Input : Voltage range: ± 3.0 V_{p-p} or ± 5.0 V_{p-p} or ± 10.0 V_{p-p} (Differential)*
(Single-ended inputs referred to ground are available.)

* Please specify the command voltage specification when ordering the product. Please see
"1-3. Details of Model Type and Serial Numbers" for details.

Control Input : Servo OFF input (Active LOW)

1-5-3. Output Signals

(1) Analog Signal Output

Position Signal Output : Voltage range: ± 1.5 V_{p-p} or ± 2.5 V_{p-p} or ± 5.0 V_{p-p}
(Single-ended inputs referred to ground)

* Please specify the command voltage specification when ordering the product. Please see
"1-3. Details of Model Type and Serial Numbers" for details.

* The position signal output is equivalent to half (1/2) of the position command input scale.

Speed Signal Output : Voltage range: ± 10 V_{p-p} (Single-ended inputs referred to ground)

Current Signal Output : Voltage range: ± 10 V_{p-p} (Single-ended inputs referred to ground)

Position Error Signal Output : Voltage range: ± 10 V_{p-p} (Single-ended inputs referred to ground)

*The position error signal output is equivalent to half (1/2) of the positional command input scale.

(2) Digital Signal Output

Ready Output : Output voltage: +12 V to 0 V (12 V when Servo OFF; 0 V when Servo ON)

1-5-4. Storage and Operating Environment

Storage Environment:

Ambient temperature range	: (-) 10°C to (+) 80°C
Humidity range	: 10% to 80% RH (No condensation)
Operating location	: Indoor under clean atmosphere

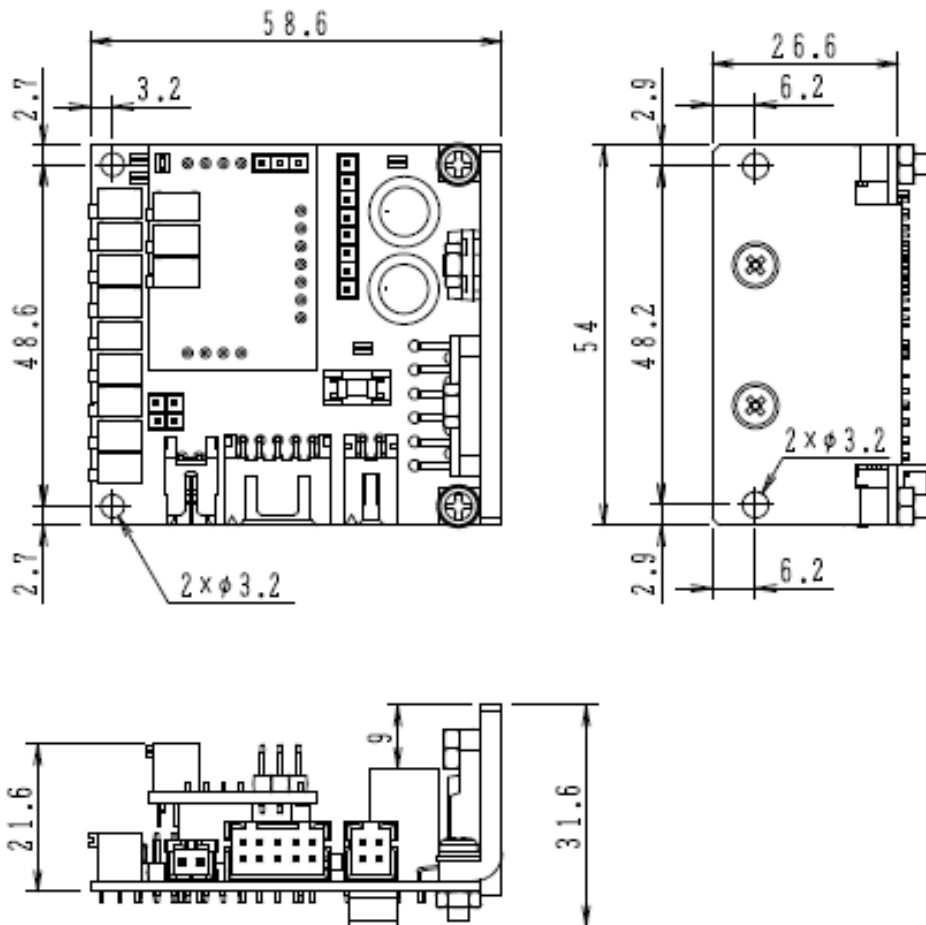
Operating Environment

Ambient temperature range	: 0°C to (+) 50°C
Humidity range	: 10% to 80% RH (No condensation)
Operating location	: Indoor under clean atmosphere

1-5-5. Dimension and Weight

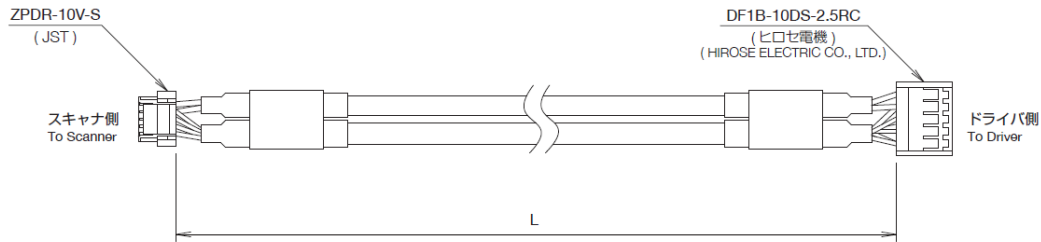
Structure	: Open frame
External Dimension	: 58.6 mm × 54 mm × 31.6 mm (including bracket)
Weight	: 55g (including the main unit with bracket and optional board)

External Layout Drawing (when mounted to optional board for PI Control specification)



1-6. Optional Cable

GVM-0930 Series and GVM-1445 Series scanners need the cable shown below to connect with driver. Please specify the cable length when ordering the product. The cable lengths and the models are as follows:

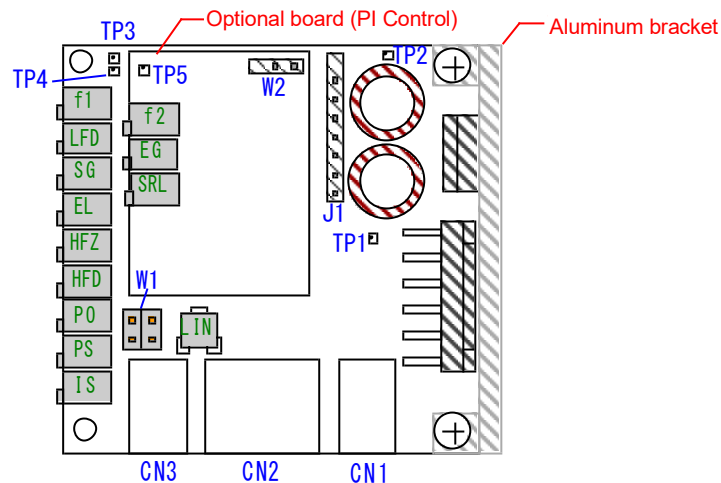


Model	Cable length (mm)
GC00	250
GC10	300
GC20	500
GC30	1000
GC40	3000
GC50	2000

2. Settings

2-1. Outline and Name of Each Part

Connectors, volume for adjustment, jumpers for various settings, and check terminals for monitoring are placed as shown below. This drawing is for PI Control specification which is mounted on the optional board.



- CN1 to CN3 : Connectors
- J1 : Monitoring or input / output terminals
- W1 and W2 : Jumpers for various settings
- TP1 to TP5 : Check terminals

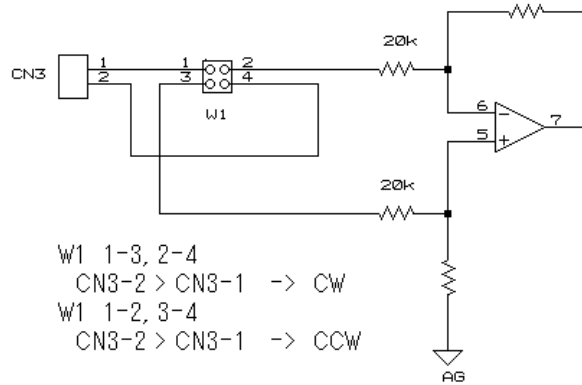
*The functions of Volumes for adjustment are indicated by abbreviations.

2-2. Setting Jumpers for Main Board

The functions of the jumpers and settings are as follows. **Please set them up by all power off.**

2-2-1. Setting for Position Command Input W1

Position command input voltage for CN3 and scanning direction will be changed by this setting.



Input Method	Setting for W1
Differential	1 – 2
When CN3-2 > CN3-1, CCW	3 – 4
Differential	1 – 3
When CN3-2 > CN3-1, CW	2 – 4
Single-ended	1 – 2
When CN3-2 > CN3-1, CCW	3 – 4
Single-ended	1 – 3
When CN3-2 > CN3-1, CW	2 – 4

<- Initial Setting

<- Initial Setting

As for the single-ended, please set potential of Input Signal on GND side equivalent to Power Source GND externally.

2-2-2. Setting for Second Notch Filter Circuit W2 (For PI Control Only)

Because PI Control driver has optional board, 2nd notch filter for removing resonance can be used. This 2nd notch filter works effectively to second resonance which would inhibit the control under unusual load. W2 should be disabled normally.

2 nd Notch Filter Circuit	W2
Enabled	1 and 2 Short-Circuited
Disabled	2 and 3 Short-Circuited

<- Initial Setting

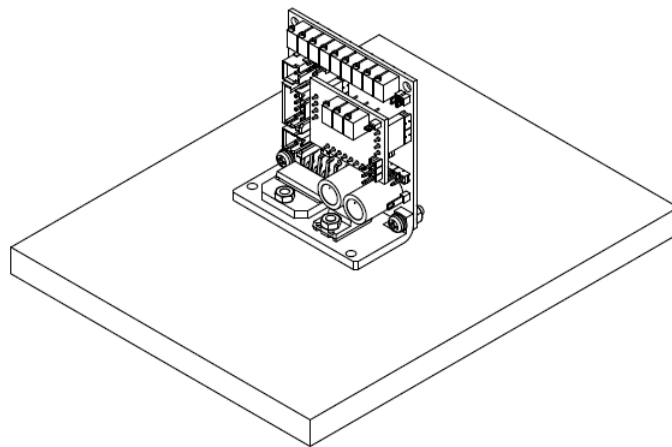
3. Installation and Wiring

3-1. Installation

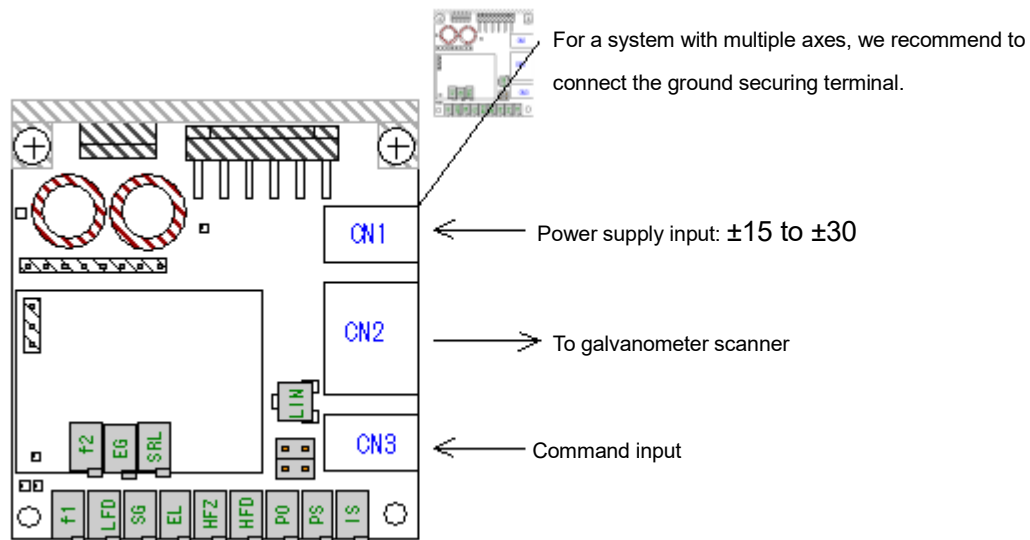
It is necessary to cool the driver according to the driving condition of scanner.

Since driver bracket attached at shipment alone cannot provide sufficient heat radiation, please be sure to cool the driver when driving the scanner.

To mount the driver on a heat sink, please fix it by using three mounting holes and screw as shown in the drawing below. Also, to ensure sufficient heat radiation, please apply silicon grease with high thermal conductance to the mounting surface.



3-2. Example of Connection



* When command input is single ended, please make sure to set the potential of GND on the controller side equivalent to GND of this product.

3-3. Connectors

The specifications for connectors of the driver are as follows:

3-3-1. Connector for Input Power Source CN1

Manufactured by HIROSE ELECTRIC CO., LTD.

Pairing Connector : DF1B-4DS-2.5RC

Contact : DF1B-2022SCA (Applicable wires: AWG22 to 20)

Terminal No.	Signal Name / Function
1	DC (-) Return (GND)
2	DC (+) Return (GND)
3	DC (-) Voltage IN
4	DC (+) Voltage IN

The input range of power source voltage is $\pm 15V$ to $\pm 30V$.

3-3-2. Connector for Galvanometer Scanner CN2

Manufactured by HIROSE ELECTRIC CO., LTD.

Pairing Connector : DF1B-10DS-2.5RC

Contact : DF1B-2428SCA (Applicable wires: AWG28 to 24)

Terminal No.	Signal Name / Function	Terminal No.	Signal Name / Function
1	Positional Signal Output 1	2	Positional Signal Output 2
3	GND	4	GND
5	AGC	6	GND
7	GND	8	GND (Motor Cable Shield)
9	Motor Winding (-)	10	Motor Winding (+)

*Connectors are assembled into galvanometer scanner cables or exclusive cables before shipping.

3-3-3. Connector for Position Command Signal Input CN3

Manufactured by HIROSE ELECTRIC CO., LTD.

Pairing Connector : DF1B-2S-2.5R

Contact : DF1B-2428SCA (Applicable wires: AWG28 to 24)

Terminal No.	Signal Name / Function
1	(-) Position Command Input
2	(+) Position Command Input

*Make sure to connect unnecessary terminal to GND when input by single-end.

3-3-4. Connector for Monitoring or Input / Output J1

Input or output the signals by 8-pin pin header.

Terminal No.	Signal Name/Function
1	Speed Monitoring
2	Position Monitoring
3	GND
4	Position Error Monitoring
5	Current Monitoring
6	Positional Sensor AGC Monitoring
7	Ready Output
8	Servo-OFF Input

3-3-5. Jumpers to Connect Optional Board J2, J3, and J4

It is not necessary to set by customer normally.

For PI Control, the optional board is connected by using J2, J3, and J4.

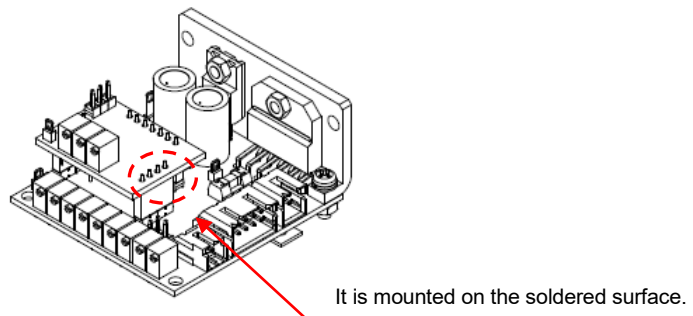
For P Control, J2, J3, and J4 are set as OPEN in appropriate position by jumpers.

(The settings vary according to the specifications when ordering the product.)

3-3-6. Ground Matching Terminal

When operating by two axes, a sudden motion of one axis would shake GND and affect the other scanner. To ease the impact of such case, Ground Matching Terminal which makes GNDs equivalent is provided.

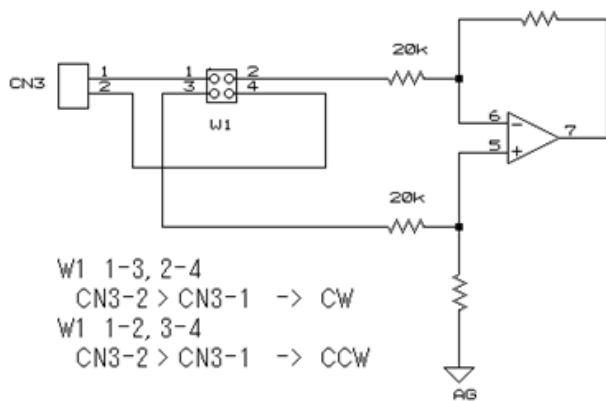
M3 tapped hole is also provided. Connecting Ground Matching Terminal to each other by using a thick wire with crimping terminal enhances the GNDs.



**Do not use this M3 tapped hole to secure the board to a chassis, etc.
Failure to follow this caution may result in the terminal to be removed.**

3-4. Input / Output Interfaces

3-4-1. Position Command Signal Input CN3

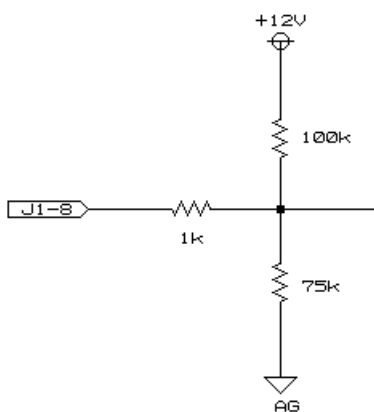


The input impedance is 20 kΩ.

Command Input is enabled by Error Input or Single-Ended Input.

The scanning direction according to the command is defined by setting W1 Jumper.

3-4-2. Digital Input (Servo-OFF) J1-8

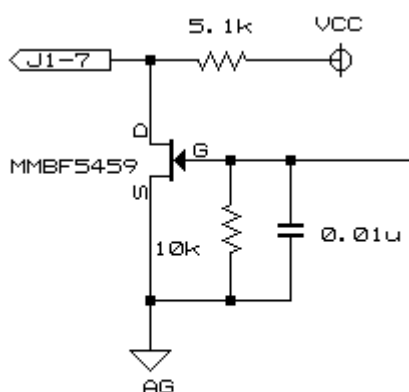


It is pulled up to 12 V by 100 kΩ.

Setting the voltage LOW makes the scanner axis Servo-OFF. The Ready Output also becomes LOW at the same time.

*If desire to operate Servo-ON / Servo-OFF repeatedly, please leave 10 seconds between Servo-ON / Servo-OFF.

3-4-3. Digital Output (Ready Output) J1-7

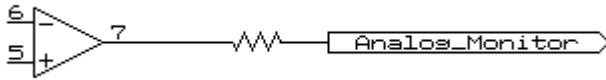


When power is supplied appropriately to the positive and negative sides of the power source input and Power Operational Amplifier Output becomes ON, Ready Signal will be output by High (+12 V).

Enable -> +12V or O.D.

Disable -> Low

3-4-4. Analog Monitoring Signals



The analog monitoring signals from J1 are output through 1 k Ω protective resistor.

J-1 pin: Speed Monitoring

It outputs a voltage proportional to the scanner speed. The output scale varies according to driver specifications for it outputs the speed signal of internal servo circuit.

J1-2 pin: Position Monitoring

It outputs a voltage proportional to the angle of scanner.

The scale is the setting value of position command input scale [V/°] times (*) 0.5 V.

J1-4 pin: Position Error Monitoring

It outputs a voltage proportional to the error between position command input and position sensor output.

The scale is the setting value of position command input scale [V/°diff] times (*) 0.5 V.

J1-5 pin: Current Monitoring

It outputs a voltage proportional to the current flowing into the scanner.

The scale is 1 V/A.

J1-6 pin: AGC Voltage Monitoring

It allows to monitor the input voltage of the position sensor for scanner. Normally, the voltage is 10V or less.

4. Adjustments

4-1. Volumes for Adjustments

The functions of the volumes are as follows:

4-1-1. Main Board

Part No.	Name	Description of Adjustment
VR1	IS	<p><u>Adjustment for Position Command Input Scale</u></p> <p>This allows to adjust the voltage scale of position command input. It changes unit voltage of deflection angles of the mirror.</p> <p>The voltage scale decreases by driving CCW (reduces the maximum scan angle).</p>
VR2	LFD	<p><u>Adjustment for Position Signal Derivative Gain</u></p> <p>This allows to adjust overshoots and undershoots to be small under positioning control. It works effectively for low frequency components.</p>
VR3	SG	<p><u>Adjustment for Proportional Gain on Position Signal</u></p> <p>For PI Control, this allows to adjust the first overshoot under positioning control.</p> <p>For P Control, this allows to adjust the gain proportional to position error.</p>
VR4	F1	<p><u>Adjustment for Removing Primary Resonance</u></p> <p>This allows to adjust the center frequency of notch filter that damps the primary resonance of galvanometer scanners. The center frequency decreases by driving CW.</p>
VR5	HFD	<p><u>Adjustment for Current Integral Gain</u></p> <p>This allows to adjust overshoots and undershoots to be small under positioning control. It works effectively for high frequency components.</p>
VR6	HFZ	<p><u>Minor Tuning for Frequency Band on Current Integration Feedback Signals</u></p> <p>This allows minor tuning for the center frequency of VR5. It eliminates the overshoots remaining after the adjustment of VR5.</p> <p>The effect is very small; if all the overshoots cannot be eliminated, please readjust it by combination of LFD and HFD.</p>
VR7	EL	<p><u>Adjustment for Error Limiter</u></p> <p>This allows to adjust response speed of large step. The response speed increases by driving CCW. It is enabled only for P Control.</p>
VR8	PS	<p><u>Adjustment for Position Signal Scale</u></p> <p>This allows to adjust the feedback amount of the scanner's angle sensor. Same as VR1, it changes unit voltage of deflection angles of the mirror.</p> <p>However, this also changes the loop gain at the same time and therefore please do not use this for adjustment on angles.</p>
VR9	LIN	<p><u>Correction of Linearity</u></p> <p>Linearity of the position sensor signal has been adjusted with pairing scanner before delivery.</p>

VR10	PO	<p><u>Adjustment for Position Command Input Offset</u></p> <p>This allows to add offsets to position command input.</p> <p>This also allows to adjust the origin of mirror after scanner is mounted. Origin of mirror moves CW by driving CW when it is seen from the mirror side.</p>
------	----	---

4-1-2. Optional Board (Only For PI Control Specifications)

Part No.	Name	Description of adjustment
VR1	SRL	<p><u>Adjustment for Slew Rate Limiter of Position Command Input</u></p> <p>This allows to adjust the response speed of large step by limiting the maximum speed.</p> <p>The maximum speed increases by driving CCW. Appropriate adjustment reduces wobble and jitter.</p>
VR2	EG	<p><u>Adjustment for Position Error Amplifier Gain</u></p> <p>This allows to adjust the acceleration while scanner is driving. The response of the scanner increases by driving CW and makes overshoots larger.</p>
VR3	F2	<p><u>Adjustment for Removing Secondary Resonance</u></p> <p>This allows to adjust the center frequency of notch filter that damps the secondary resonance of galvanometer scanners. The center frequency decreases by driving CW.</p>

4.2 Check Terminals

The details of the check terminals are as follows:

Part No.	Name	
TP1	Power Amplifier Output	This allows to monitor the voltage applied to scanners.
TP2	GND	This is the reference potential for monitoring signals.
TP3	1 st Notch Filter Output	This allows to monitor torque command passed through 1 st notch filter.
TP4	Torque Command	This allows to monitor torque command before it passes through the notch filter.
TP5	2 nd Notch Filter Output (Only for PI Control)	<p>This allows to monitor torque command passed through 2nd notch filter.</p> <p>It is mounted on PI control optional board.</p>

5. Product Warranty

1. Duration of this warranty is one year from the date of delivery. If the customer discovered a defect in material and workmanship within this period, we will repair the product for free only if the customer carry it in or return it to our company address by customer's expense. Please note that it would take several days to repair.
2. For the defect caused by "misuse" or "mishandling" by any party, or the defect caused later than one year from the date of delivery, the customer is responsible for repairing charges. We will repair the product only if the customer carry it in to our company address or the customer is responsible to all shipping charges.
3. We are not liable to the damages caused during transit. Please pack the product with sufficient cushioning materials to prevent external vibration.

6. Contact Information

CITIZEN CHIBA PRECISION Co.,LTD.

Sales Department

1811-3, Yoshihashi, Yachiyo, Chiba 276-0047, Japan

Telephone: +81-47-458-7935 Facsimile: +81-47-458-7962

<http://ccj.citizen.co.jp>