

Highly accurate noncontact displacement sensor Model GY series

GYDC-05 digital output type controller Manual

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1. Read before use

1.1 About the picture display


In this book, the following pictures are displayed about the act that requires attention and the prohibition.


Picture display that shows danger of electric shock	
Picture display that shows danger of fire	
Picture display that requires attention	
Picture display that prohibits act	

1.2 Attention on safety


Please have reading this book often when this product is used (installation, wiring, driving, and maintenance), and pay enough attention to safety and the correct handling. Please note the following when you use this controller.

Attention in design

 Please design so that the entire system may work at the safety side or install the safety circuit when the sensor breaks down and the output becomes irregular.

 Please design so that the entire system may work at the safety side or install the safety circuit when the sensor output becomes irregular by abnormality in the sensor, the cable, and the power supply, noises, the vibrations, and impacts, etc.

Attention in driving

 Please do not touch the terminal directly. It causes the electric shock and the malfunction.

2. Outline

2.1 Outline of function

◆ Non-Contact linear sensor

The Model GY series employing the Wiedemann effect is an industrial linear-sensor. It is a displacement sensor that detects the position of the movable magnet by the occurrence of the twist distortion on a special magnetostrictive wire, and the measurement of the spread time of the distortion is done. There is no mechanical wear-out because the measurement thing and the main body of the sensor are non-contact.

◆ Absolute measurement

The magnet can absolutely show the position immediately after turning on of the power supply because it is a measurement method to apply the magnetostrictive phenomenon.

◆ Two highly accurate, analog channel and digital, parallel output

This product outputs displacement or the speed of the magnet by two channels as voltage/current.

In addition, it provides with a digital, parallel output of minimum resolution 1 μ m.

◆ SSI output(option)

SSI (Synchronous Serial Interface) is also equipped. Absolute data of 24bit can be transmitted at high speed.

◆ Quadrature output(option)

The pseudo quadrature pulse output based on the difference of absolute data is provided.

◆ Zero/Span adjustment

The zero/span of each channel of the analog output can be adjusted with the toggle switch of a front panel.

◆ Magnet dropout/disconnection warning

The wire disconnection or the magnet dropout is detected, and it shows with the alarm output and LED.

◆ DIN rail installation

Because the DIN rail is used for the installation of the product, the installation and detaching are easy.

2.2 Each part name

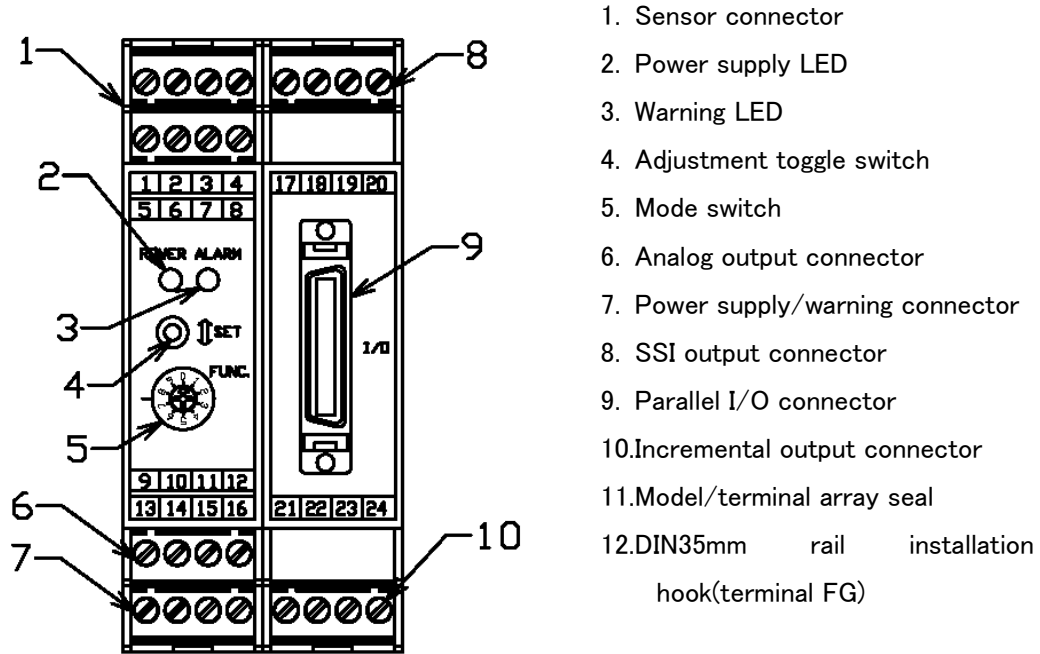


Figure1Main body front drawing

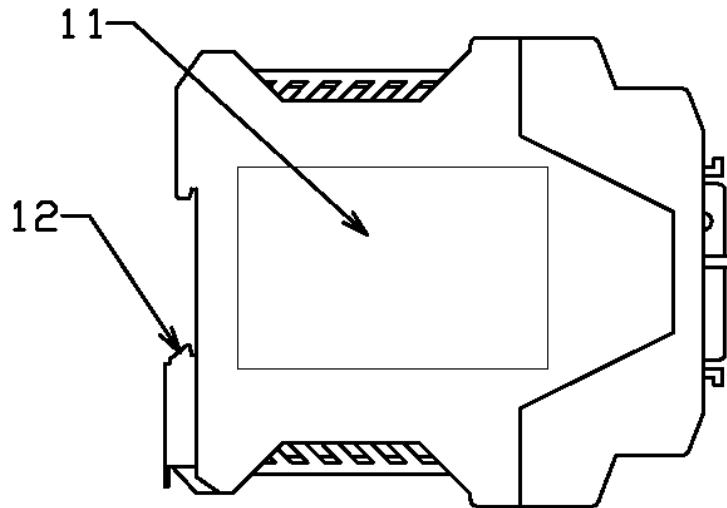


Figure2Main body left side drawing

3.2 Method of installation/detaching

◆ Installation method

To lock the main body, hang the bottom hook on the rail and push body as shown in the figure below left).

◆ Detaching method

Lift the case with the lock metal fitting depressed below.

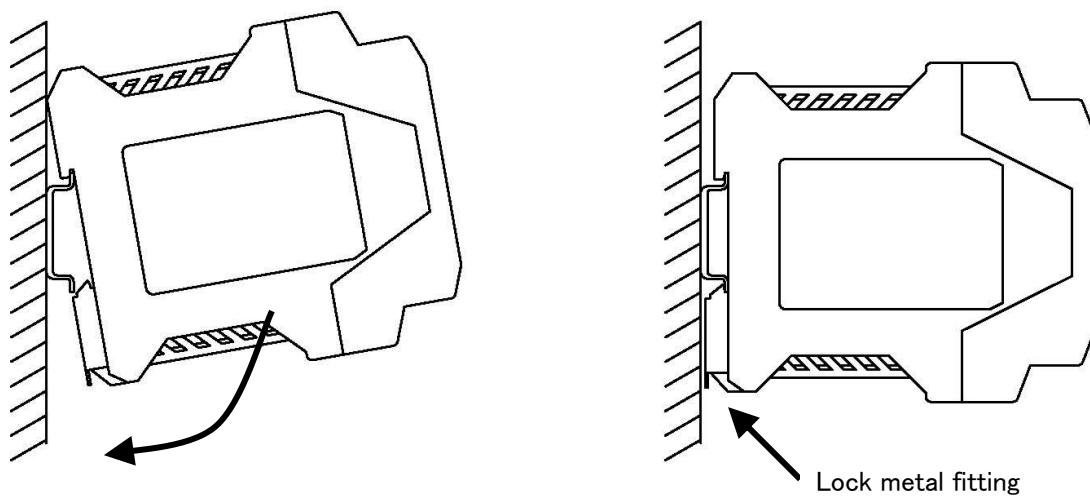


Figure4 Installation /detaching method

4. Wiring

4.1 Attention in wiring

⚠ Do not set up the cable near other power cables.

⚠ Do installation/detaching work after turning off the power supply.

⚠ Confirm neither the terminal nor the connector looseness before turning on the power supply.

4.2 Size of acceptable electric wire

The size of recommended electric wire of power supply/warning connector, the analog output connector, SSI output connector, and the incremental output connector is 0.2–2.5 mm square (AWG24–12 corresponding). Peel off L=7 mm coating as shown in the figure below.

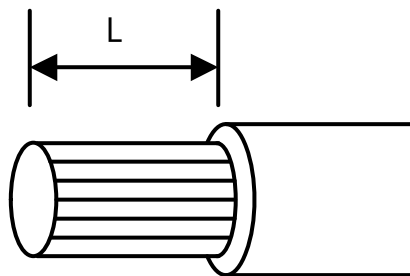


Figure5 peel off electric wire

4.3 Wiring method

This controller processes so little signal that wire noting the following matter to demonstrate the performance.

- ◆ The wiring length should be shortened as much as possible.
- ◆ The power supply line, the electric power line, the sensor cable, and the analog output line should be separated.
- ◆ Install the surge absorber on the coil products such as relays and electromagnetic switches.

4.4 Connection

4.4.1 Connection method

This controller's connector is two piece screw type. The connector is installed in the main body on ship.

The connection of the electric wire is made as shown in the figure below.

Screw tightening torque: 0.5[Nm] (1.0Nm max)

Width of driver: 3mm or less

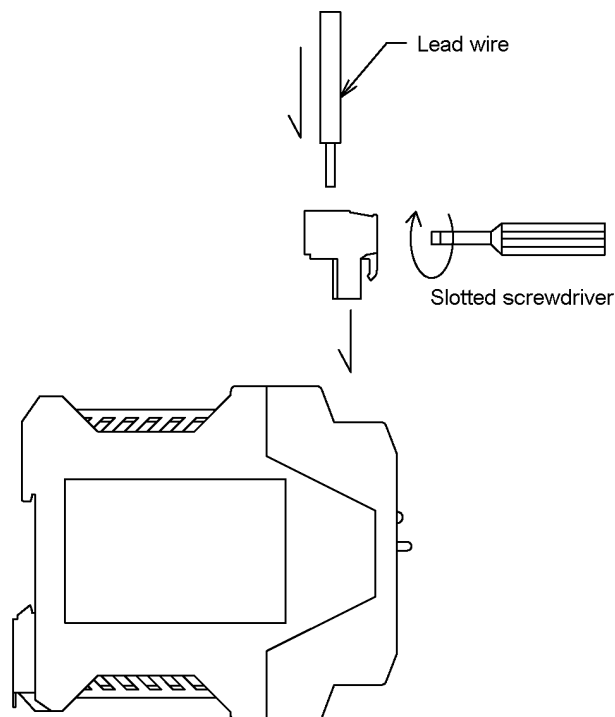


Figure6 Wiring to connector

4.4.2 Connection of probe

The connection of this controller and the probe is different according to the probe model and see the table below, and do the corresponding connection.

Probe calling model	Connection method
GYcRP、GYcRS、GYFRS、Ex-GYdT-R*、 Ex-GYdS-R*、GYSE-R	Connection method 1
GYMR4、GYMR5	Connection method 2
GYPM、GYGS、GYMS、GYPE2K	Connection method 3
GYHR、GYKM	Connection method 4

◆ Connection method 1

Controller side Connector pin number	Cable color	Probe side Connector pin number
1	Red	1
2	Yellow	2
3	White	3
4	Shield	Shield
5	Green	4
6	Black	5
7	Blue	6
8	Tea	7

◆ Connection method 2(Please do not connect any slash terminal.)

Controller side Connector pin number	Cable color	Probe side Connector pin number
1	Red	1
2		
3	White	3
4	Shield	Shield
5	Green	4
6	Black	5
7	Blue	6
8	Tea	7

◆ Connection method 3(Please do not connect any slash terminal.)

Controller side Connector pin number	Cable color
1	
2	
3	
4	
5	Red
6	White
7	Black
8	Shield

◆ Connection method 4(Please do not connect any slash terminal.)

Controller side Connector pin number	Cable color
1	
2	
3	
4	
5	Red
6	Black
7	Shield
8	White

4.4.3 Connection of power supply

This controller's rated voltage is 24V ($\pm 5\%$) 160mA.

Please supply the stabilized DC power between 13(+) and 14(0V) terminal.

4.4.4 Connection of analog output

At Terminal number 9(OUT1)-10(COM1) and 11(OUT2)-12(COM2), the voltage or current output at a rate proportional to the position/speed of the magnet can be obtained. Load resistance of the voltage/current output should be more than $2k\Omega$ /less than 500Ω respectively.

4.4.5 Connection of alarm output

The warning signals such as a cable disconnections and abnormal magnets are obtained on the terminal number 15-16(COM).

The output circuit chart of the warning signal is a figure below.

About details of the warning signal, please see the paragraph 6.1.

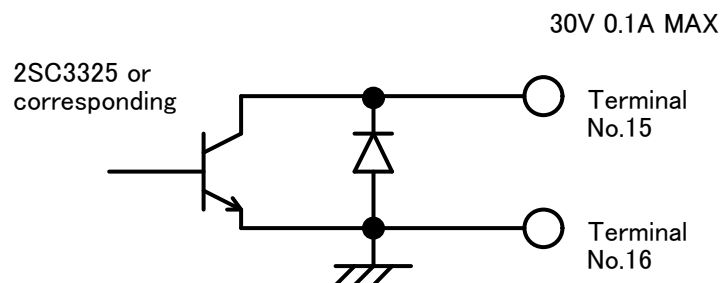


Figure7 Warning output circuit

The maximum acceptable voltage	30 [V]
The maximum current	100 [mA]
Vce saturation voltage	< 0.4 [V] (Ic = 100 [mA])

4.4.6 Connection of parallel I/O

Use the parallel I/O connector for parallel digital output.

Main body side connector: 10236-5212PL made of Sumitomo 3M company

Other party side connector (attachment): 10136-3000PE made of Sumitomo 3M company

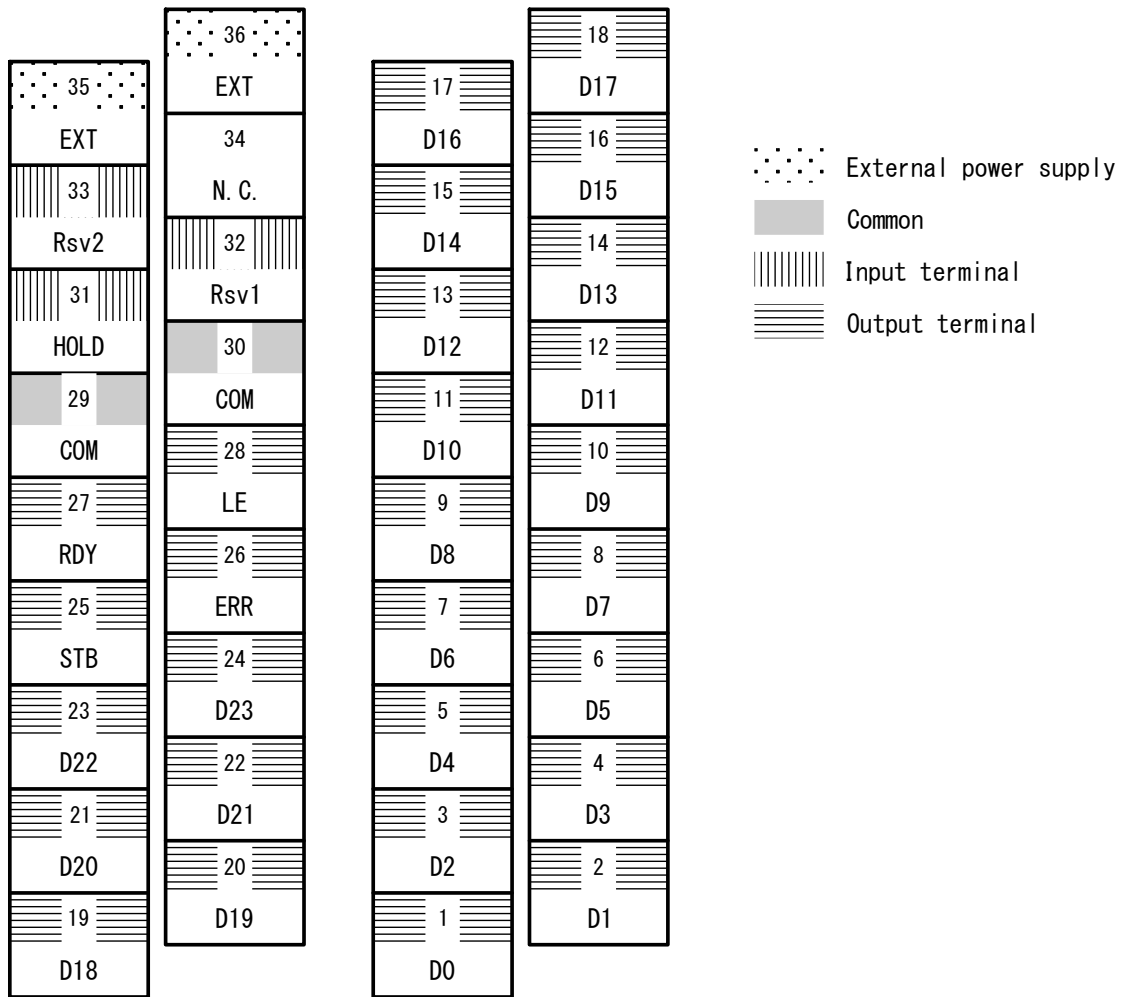


Figure8 Parallel I/O connector terminal array

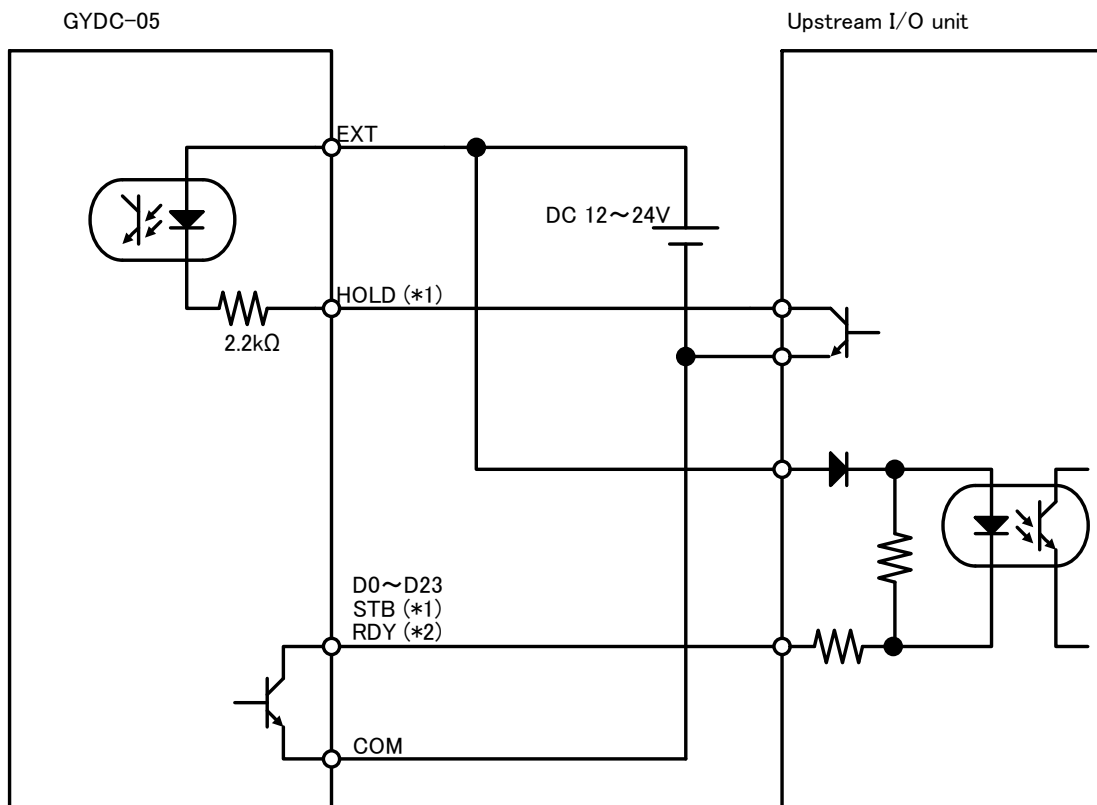


Figure9 Connection of parallel I/O

(*1) Connection by handshake method

(*2) Connection by latch method

About the handshake method and the latch method, please see the paragraph 5.1.2.

4.4.7 Connection of SSI output(option)

Use SSI output connectors (terminal number of 17-20) for SSI output.

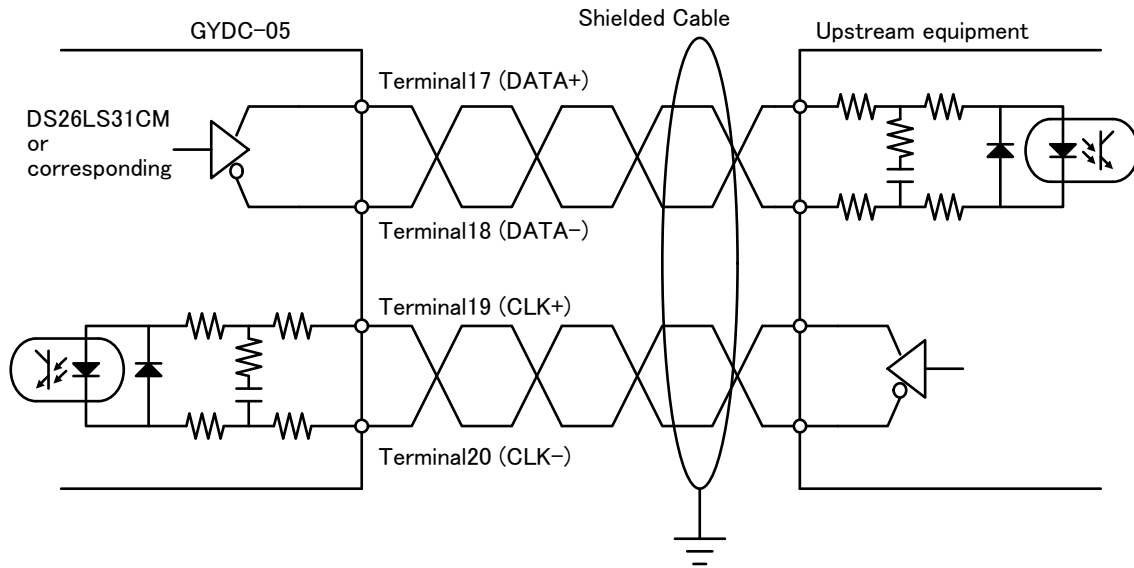


Figure10 Wiring for SSI output

Please wire the cable for (CLK+)/ (CLK-) and (DATA +)/(DATA -) as a pair respectively as shown in the above figure by using the twist pair shield line.

4.4.8 Connection of incremental output(option)

Use incremental output connectors (terminal number of 21-24) for an incremental output.

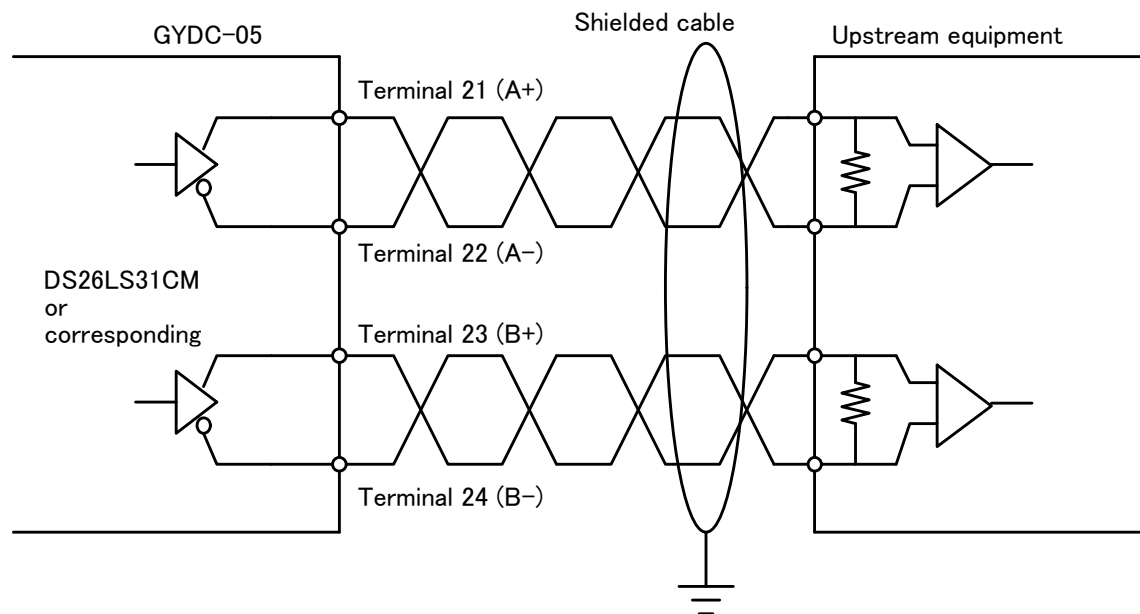


Figure11 Wiring for incremental output

Please wire the cable for (A+)/(A-) and (B+)/(B-) as a pair respectively as shown in the above figure by using the twist pair shield line.

4.5 Confirmation

Please turn on the power supply when all wirings are completed.

After turning on the power supply, and alarm LED lights for about 0.5 second. After alarm LED is turned off, the controller becomes normal operation. Meanwhile, the sensor output is irregular and the alarm output is off.

Please confirm the following at the first time.

- ◆ The power-supply voltage starts must being normal
- ◆ The analog output must change correctly corresponding to magnet position or speed.
- ◆ There must be neither nasty smell nor an allophone.

5. Interface

5.1 Parallel I/O

5.1.1 Data form

Parallel data D0-D23 can be output by negative logic or the positive logic of the binary or the gray code. The factory default value is negative logic of the binary code. To change the output code, see paragraph 6. 4. The paragraph to change a logical polarity is 6. 5.

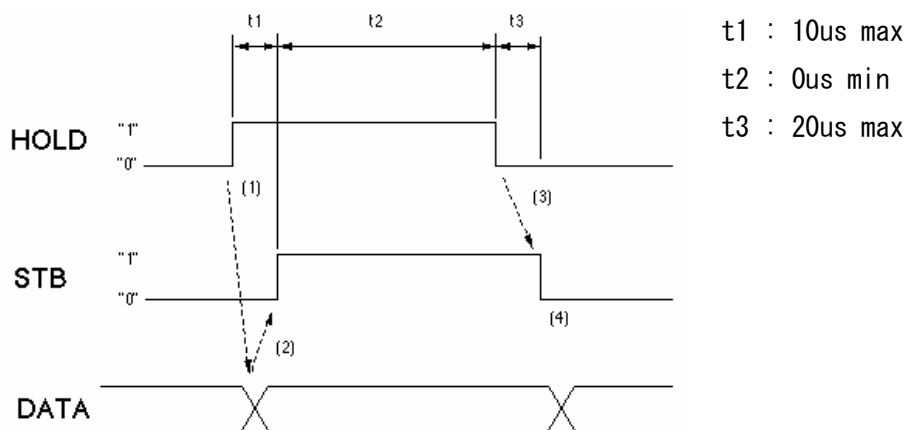
5.1.2 Timing

Generally, the low-pass filter to decrease the influence of the noise to the input circuit of PLC has been inserted. Therefore, data might not be able to be read correctly when only data signal D0-D23 is connected. Therefore, please read data surely by using either of following method.

◆ Handshake method

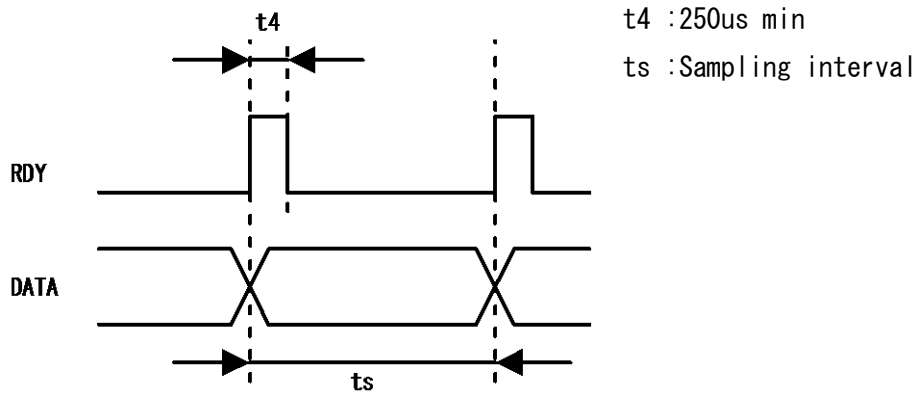
The HOLD signal and the STB signal are used. The HOLD signal is a signal to fix data and the STB signal informs to the user side of the fixation of the signal. Please read data by the following sequence.

- ① Turn on the HOLD signal from the equipment on the user side.
- ② After data is fixed, the STB signal is turned on.
- ③ Please read data signal D0-D23 to the equipment on the user side by standing up about the STB signal.
- ④ Turn off the HOLD signal.



◆ Latch method

The RDY signal is a signal turned on after data is fixed. Please read data by using standing up of this signal as interrupt. Because the RDY signal is generated according to a sampling period of the sensor and the same timing, the processing speed of the equipment on the user side should be able to follow to this.



5.2 SSI output

This controller has SSI (Synchronous Serial Interface) in addition to a parallel output of the standard.

24bit data that shows the position or the speed is sent by using clock (CLK+/CLK-) and data (DATA+/DATA-) lines.

5.2.1 Data form

Data is composed of 24bit the code in common with parallel output, which can be select from the binary or the gray code. To change the code, please see the paragraph 6. 4.

5.2.2 Timing chart

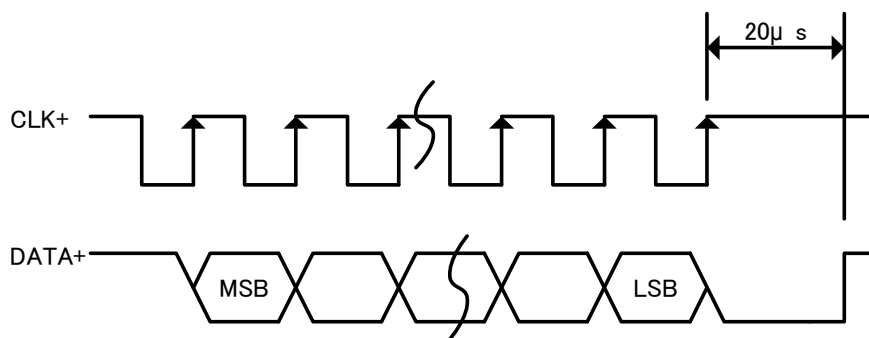


Figure12 SSI communication timing chart

On rising edge the first clock, the latest data is sent to the internal shift register and MSB is sent to the DATA line at the same time.

Data is sent to LSB at the time of each rising edge of the clock.

After LSB is sent, DATA + becomes L.

The sequence is ended when a new clock is not supplied within 20 μs or less, and DATA + becomes H.

When a new clock is supplied within 20 μs or less, the same data is sequentially sent from MSB again.

An internal shift register is reset when 20 μs passes from last rising edge of the clock even if the number of clocks doesn't come up to 25.

5.2.3 Limitation of cable length

Because the delay of the signal is generated by the cable impedance, the maximum transmission distance is limited by the clock frequency as shown in the figure below. The cable length must be within the range of the slash.

The supply clock frequency to this controller corresponds to an arbitrary frequency from 100 kHz to 750 kHz.

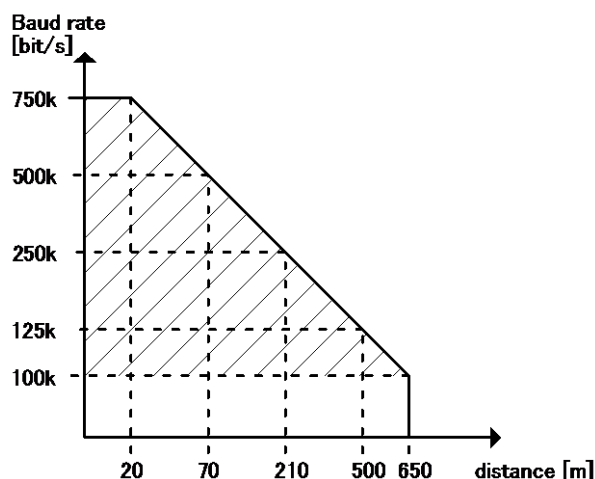


Figure13 Relation between transmission distance and clock frequency

5.2.4 Synchronization

This controller can measure magnet position/speed by using SSI by two kinds of methods.

◆ Internal synchronization(standard)

Measuring with internal timer at constant cycle (sampling rate), and read SSI data on arbitrary timing.

◆ External synchronization

Method for measurement with the first falling edge of clock from the outside. The output data becomes the second last data. The measurement timing can be synchronized when two or more sensors are used. However, when the cycle of the measurement is shorter than that of the measurement time required, an accurate measurement cannot be performed. Please follow the following expression at the shortest measurement cycle.

$$T_{min} [ms] = ((Stroke+Deadzone) \text{ mm} \div 2700) + 0.7$$

⚠ The measurement stops when the clock is stopped at an external synchronization option.

⚠ When the clock is stopped at an external synchronization option, magnet error is not detected.

5.3 Quadrature output

5.3.1 Data form

The pseudo quadrature pulse output is provided in this option. The output is RS-422 differential level, and Z phase is not output.

5.3.2 Timing

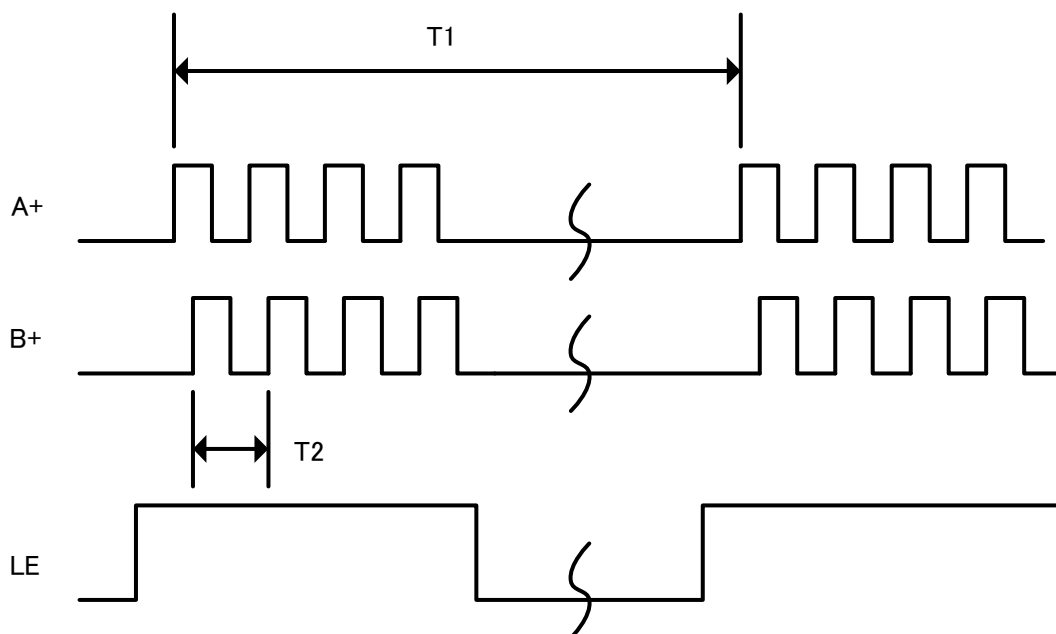


Figure14 Incremental output time chart

The train of impulses that corresponds to the amount of the movement at each sampling period ($T1$) is generated as shown in the above figure. Please note that the train of impulses does not become a continuous pulse like the rotary encoder because of the pseudo calculation of the output from the location information. Pulse frequency ($1/T2$) is fixed to 250 kHz. The LE signal is activated (negative logic) when no pulse is output so that it can be used as a counter latch signal.

6. Adjustment/maintenance

6.1 Error detection

This controller outputs the warning signal and warning LED lights when abnormality is detected. The detectable error is as follows.

- ◆ Dropout or damage of sensor magnet (float)
- ◆ Disconnection and faulty wiring of sensor cable
- ◆ The system error. (damage of internal data)

Lighting of warning LED is different as follows depending on error content. When two or more errors are detected at the same time, the error with higher priority level is shown. The warning signal keeps becoming on (factory default) regardless of an error content.

Priority Order	Appearance of warning LED lighting	Error content and solution
Low	Light short at intervals of one second. 	Error of sensor magnet (or float) <ul style="list-style-type: none"> ◆ Confirm whether the magnet is in the range of stroke. ◆ Confirm whether the magnet is not damaged. ◆ Confirm whether there is ferromagnetic in a ferromagnetic not acceptable area. (Depend on the specification of the probe.)
Medium	Blink at intervals of 0.2 seconds. 	Error of sensor cable <ul style="list-style-type: none"> ◆ The faulty wiring of the sensor cable. ◆ The disconnection of the sensor cable.
Hi	Keep lighting	The system is in abnormal state. <ul style="list-style-type: none"> ◆ Return all parameter to factory default. See paragraph 6.6

⚠ Alarm LED lights for about 0.5 seconds immediately after turning on of the power supply. That is not error.

6.2 Adjustment of analog output

As for analog output 1 and analog output 2, Zero/Span adjustment is possible respectively.

The adjustable range is $\pm 3\%$ FS in both zero and span.

It is recommended to adjust after about 15 minutes have passed since the power supply was turned on. “Zero Point” is defined as the point near sensor head.

“Full-scale Point” is defined as end of stroke.

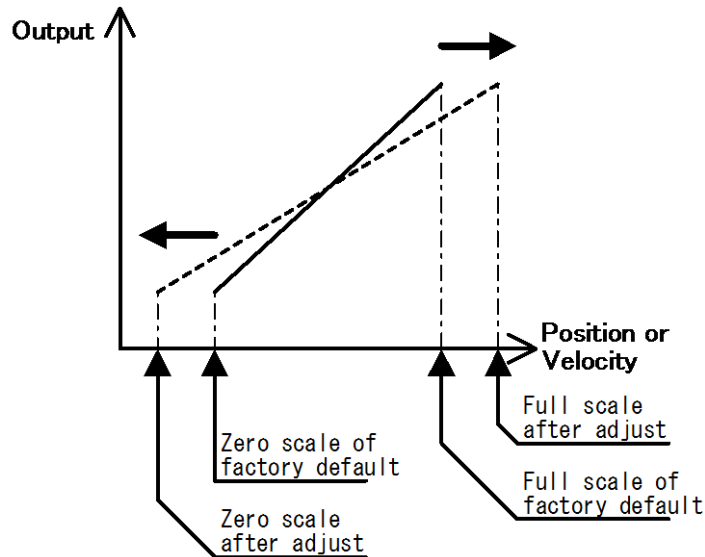


Figure15 Zero/Span adjustment

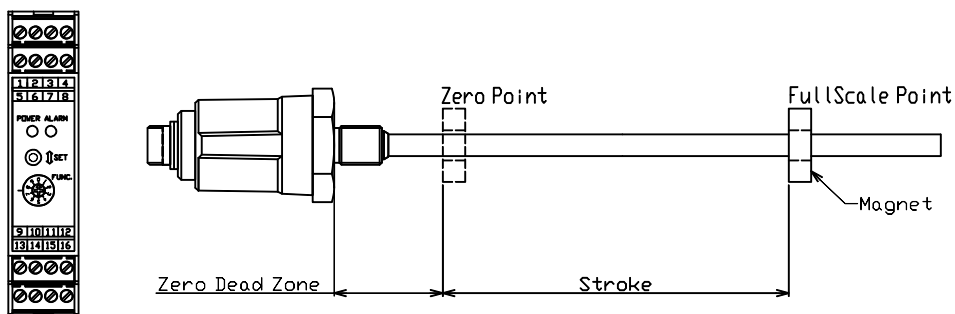


Figure 16 Zero Point and FullScale Point

6.2.1 Adjustment of Zero

◆ For the positional output type

- ① Fix the magnet (Or, float) to the position of Zero.
- ② Set “Mode switch” to 1 for adjust analog output 1, set 3 for analog output 2.
- ③ Push the adjustment toggle switch up and down until output reaches the value of the desire. When the adjustment toggle switch is hold, the amount of the adjustment grows.
- ④ When the adjustment ends, return “Mode switch” to 0.

◆ For the speed output type

- ① Fix the magnet (Or, float) to the position of Zero.
- ② Set “Mode switch” to 1 for adjust analog output 1, set 3 for analog output 2.
- ③ Push the adjustment toggle switch up and down until output reaches the value of the desire. When the adjustment toggle switch is hold, the amount of the adjustment grows.
- ④ When the adjustment ends, return “Mode switch” to 0.

6.2.2 Adjustment of span

◆ For the positional output type

- ① Fix the magnet (Or, float) to the position of Full-scale point.
- ② Set “Mode switch” to 2 for adjust analog output 1, set 4 for analog output 2.
- ③ Push the adjustment toggle switch up and down until output reaches the value of the desire. When the adjustment toggle switch is hold, the amount of the adjustment grows.
- ④ When the adjustment ends, return “Mode switch” to 0.

◆ For the speed output type

- ① Move the magnet (Or, float) at the speed of the desire within the range of the stroke.
- ② Set “Mode switch” to 2 for adjust analog output 1, set 4 for analog output 2.
- ③ Push the adjustment toggle switch up and down until output reaches the value of the desire. When the adjustment toggle switch is hold, the amount of the

adjustment grows.

- ④When the adjustment ends, return "Mode switch" to 0.

6.3 Change polarity of the alarm output

- ①Set "Mode switch" to 5.
- ②To turn on an internal transistor when warning is generated (factory default), hold up the adjustment toggle switch for two seconds or more. Oppositely, to turn off an internal transistor when warning is generated, hold down the adjustment toggle switch for two seconds or more.
- ③The polarity of the alarm output changes.
- ④Return "Mode switch" to 0.

6.4 Change the code of digital output

- ①Set "Mode switch" to 6.
- ②To set the code to binary (factory default), hold up adjustment toggle switch for two seconds or more. Hold down for gray code.
- ③Return "Mode switch" to 0.
- ④Turn on the power supply again (code does not be changed until power supply is turned on again).

6.5 Change the polarity of digital output

- ①Set "Mode switch" to 7.
- ②To set negative logic (factory default), hold up adjustment toggle switch for two seconds. To set positive logic, hold down the toggle switch for two seconds.
- ③Return "Mode switch" to 0.
- ④ Turn on the power supply again (polarity does not be changed until power supply is turned on again).

6.6 Reset to factory default settings

- ①Set "Mode switch" to 9.
- ②To return all settings to factory default value, hold up the adjustment toggle switch for two seconds.
- ③Return "Mode switch" to 0.

④ Turn on the power supply again (settings do not be changed until power supply is turned on again).

7. Model

GYDC-05 [①]-[②][③]-[④]-[⑤]-Z[⑥]-[⑦]/[⑧]-[⑨]

① Output option

Symbol	Specification
1	Standard
2	Incremental output option (250kHz)
5A	Asynchronous SSI output option
5S	Synchronous SSI output option

② Resolution

Symbol	Resolution	Symbol	Resolution
D2	0.1mm	D7	0.002mm
D3	0.05mm	D8	0.001mm
D4	0.01mm (standard)		

③ Direction of output

Symbol	Specification
D	increase when magnet moves to tip
R	decrease when magnet moves to tip

①②③ becomes 1D4D (standard, positive direction, and 0.01mm resolution) when not specify is given.

④ Connected probe type

Symbol	Agreement probe	Symbol	Agreement probe
RS	GYcRS probe	GS	GYGS probe
R5	GYMR5 probe	PM	GYPM probe
FS	GYFRS probe	HR	GYHR probe
SE	GYSE-R probe	RP	GYcRP probe
		MS	GYMS、GYPE2K probe
		R4	GYMR4 probe

When GS, PM, HR, RP, MS, and R4 are selected, ② becomes only D2.

⑤ Stroke [mm] (The maximum stroke follows the probe specification.)

⑥ Root dead zone [mm] (Minimum root dead zone follows the probe specification.)

⑦ Analog, positional output (OUT1)

Symbol	Magnet position
AD	0~10 [V] (standard)
AR	10~0 [V]
BD	4~20 [mA]
BR	20~4 [mA]
CD** or CR**	- - [V] ~**[V]
VZ/F	Specified voltage
IZ/F	Specified current

*Z: zero point (root) output

F: Full-scale point (tip) output

⑧ Option: Analog output (OUT2)

Select from ⑦ in case of positional output.

At the speed output

Symbol	
VA []	±10 [V]
WB []	4~20 [mA]

[] is a rating velocity (1.00~999mm/sec). Order in three significant digit and write decimal point as "R".

⑨ Magnet or float

Symbol	Correspondence magnet	Symbol	Correspondence float
M0	No. ϕ magnet	F28S	ϕ 28SUS316 float
M0SM	No. ϕ SPM magnet	F30S	ϕ 30SUS316L float
M0LM	No. ϕ LPM magnet	F40S	ϕ 40SUS316(B) float
M2P	No. 2 P magnet	F42S	ϕ 42.5 sphere SUS316 float
M2PN	No. 2 PN magnet	F50S	ϕ 50SUS316 float
M3	No. 3 magnet	F54S	ϕ 54SUS304 float
M11	No. 11 magnet	F25N	RF-A10 plastic float
M11N	No. 11N magnet	F28N	RF-A6 plastic float
T142	No. T14-M2 magnet		
T144	No. T14-M4 magnet		
T162	No. T16-M2 magnet	MG*	Magnets other than the above-mentioned
T163	No. T16-M3 magnet	FL*	Floats other than the above-mentioned

8. Specification

8.1 General specification

Item	Specification
Model	GYDC-05
Power supply	DC24V ($\pm 5\%$) 160mA (standard)
Operating temperature range	0~65°C
Storage temperature range	-20~75°C
Operating humidity range	10~90%RH (no condensation)
Use atmosphere	No causticity gas/combustible gas/firedamp
Cooling method	Natural air-cooling
Externals	45W × 99H × 114D
Mass	150g or less

8.2 Performance specification

Item	Specification								
Voltage output	0-10V or 10-0V 16bit resolution load current Max 5mA Load resistance Min 2k Ω								
Current output	4-20mA or 20-4mA 16bit resolution load resistance Max 500 Ω								
Alarm output	Open collector output 30V 0.1A								
Digital output	0.001mm, 0.005mm, 0.01mm, 0.05mm, 0.1mm								
Sampling rate	<table border="1"> <thead> <tr> <th>stroke [mm]</th> <th>Sampling rate [Hz]</th> </tr> </thead> <tbody> <tr> <td>~1000</td> <td>1000</td> </tr> <tr> <td>1000~2500</td> <td>500</td> </tr> <tr> <td>2500~</td> <td>250</td> </tr> </tbody> </table>	stroke [mm]	Sampling rate [Hz]	~1000	1000	1000~2500	500	2500~	250
stroke [mm]	Sampling rate [Hz]								
~1000	1000								
1000~2500	500								
2500~	250								
Temperature coefficient	± 10 ppm%FS								
EMC test	500 Vpp 1us, 25~60Hz, by noise simulator								

8.3 Externals size

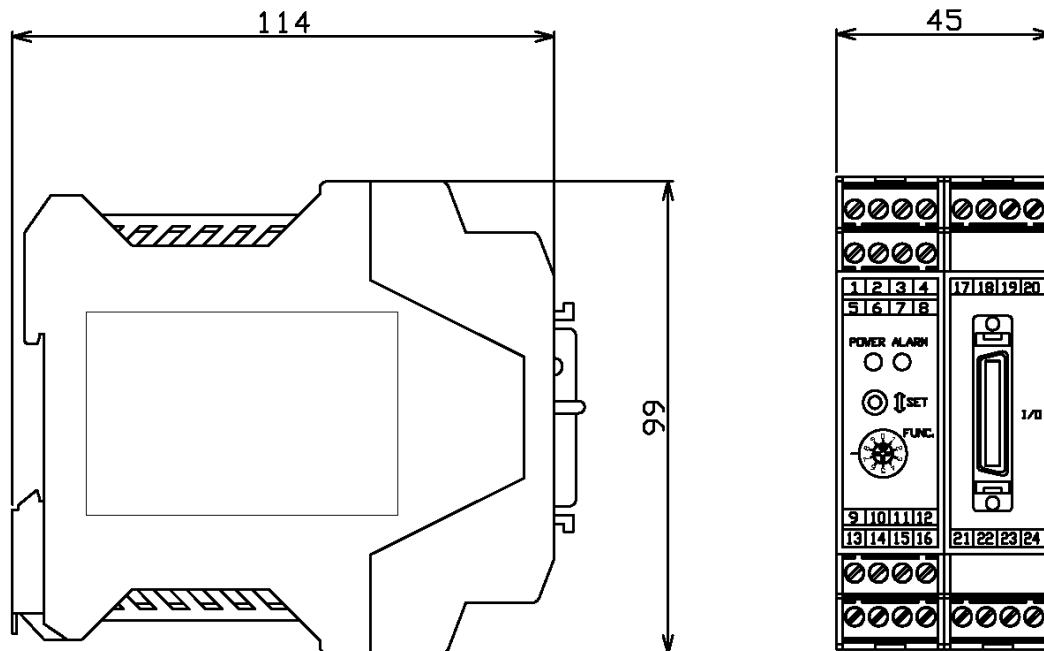


Figure17 Externals dimensional drawing

The product described to this material doesn't become a specification corresponding to the critical usage (medical equipment, vehicle, aerospace, and nuclear power control, etc.) in which extremely advanced reliability is required. Please consult us beforehand when you examine use to such a usage.

In general, electronic equipment might malfunction or break down though our tries to improve the quality and reliability. Please design safety of the device and the system so that the life, the body, and the property might not be violated due to the malfunction and the breakdown of our product in the responsibility on the buyer side.

I will assume the guaranteed term of this product to be one year after it delivers it. If the breakdown by our responsibility in the guaranteed term, we repair the returned product or send the substitute for no-charge. However, in following cases, it is beyond the limits of the guarantee.

- ◆ By an improper condition, the environment, handling, and use
- ◆ By causes other than our product
- ◆ At remodeling or the repair that depends besides our company
- ◆ Due to the phenomenon not predictable in our technology at shipment time
- ◆ Due to the natural disaster, etc.

Only the delivered our product is guaranteed and the damage caused by the breakdown of this product is excluded.

GYDC-05 manual

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The content of the description might change without a previous notice for the improvement.