

SONY®



Rotary Encoder Unit

RA510 Series

Read all the instructions in the manual carefully before use and strictly follow them.
Keep the manual for future references.

Instruction Manual
1st Edition (Revised 2)

[For EU and EFTA countries]

CE Notice

Making by the symbol CE indicates compliance of the EMC directive of the European Community. Such marking is indicative meets or exceeds the following technical standards.

EN 55 011 Group 1 Class A / 91 :

"Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment"

EN 50 082-2 / 95:

"Electromagnetic compatibility - Generic immunity standard Part 2 : Industrial environment"

警告

本装置を機械指令 (EN 60 204-1) の適合を受ける機器にご使用の場合は、その規格に適合するように方策を講じてから、ご使用ください。

Warning

When using this device with equipment governed by Machine Directives EN 60 204-1, measures should be taken to ensure conformance with those directives.

Warnung

Wenn dieses Gerät mit Ausrüstungsteilen verwendet wird, die von den Maschinenrichtlinien EN 60 204-1 geregelt werden, müssen Maßnahmen ergriffen werden, um eine Übereinstimmung mit diesen Normen zu gewährleisten.

[For the customers in U. S. A.]

WARNING

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. You are cautioned that any changes or modifications not expressly approved in this manual could void your authority to operate this equipment.

■ General precautions

When using Sony Precision Technology products, observe the following general precautions along with those given specifically in this manual to ensure proper use of the products.

- Before and during operations, be sure to check that our products function properly.
- Provide adequate safety measures to prevent damages in case our products should develop malfunctions.
- Use outside indicated specifications or purposes and modification of our products will void any warranty of the functions and performance as specified of our products.
- When using our products in combination with other equipment, the functions and performances as noted in this manual may not be attained, depending on operating and environmental conditions.

Safety Precautions

Sony Precision Technology products are designed in full consideration of safety. However, improper handling during operation or installation is dangerous and may lead to fire, electric shock or other accidents resulting in serious injury or death. In addition, these actions may also worsen machine performance.

Therefore, be sure to observe the following safety precautions in order to prevent these types of accidents, and to read these "Safety Precautions" before operating, installing, maintaining, inspecting, repairing or otherwise working on this unit.

Warning indication meanings

The following indications are used throughout this manual, and their contents should be understood before reading the text.

Warning

Failure to observe these precautions may lead to fire, electric shock or other accidents resulting in serious injury or death.

Caution

Failure to observe these precautions may lead to electric shock or other accidents resulting in injury or damage to surrounding objects.

Note

This indicates precautions which should be observed to ensure proper handling of the equipment.

Warning



- Do not use this unit with voltages other than the specified supply voltage as this may result in fire or electric shock.
- Do not perform installation work with wet hands as this may result in electric shock.
- Do not disassemble or modify the unit as this may result in injury or damage the internal circuits.



Caution



- Be sure to check the machine and device conditions to ensure work safety before working on the machine.



- Be sure to cut off the power supply, air and other sources of drive power before working on the machine. Failure to do so may result in fire or accidents.



- When turning on the power supply, etc. to operate the machine, take care not to catch your fingers in peripheral machines and devices.

Handling Precautions

Installation precautions

When installing this unit, care should be given to the following points to prevent noise and electromagnetic wave interference from other equipment.

1. Do not pass lead and connecting cables through the same ducts as power lines.
2. Be sure to install the unit at least 0.5 m or more away from high voltage or large current sources or high-power relays.
3. Absolutely do not bring the unit near magnets or sources of electromagnetic waves.

Installation place precautions

1. This product should be used within an ambient temperature of 0 to 45°C (113°F). Avoid use in places exposed to direct sunlight or hot winds or near heating equipment.
2. Do not use in places subjected to strong vibrations or impacts.
3. If there is the chance that the scale unit may come into contact with cut or measured objects, tools or jigs, be sure to protect the unit with a sufficiently strong cover.
4. This product is constructed to be waterproof (IP64 equivalent), but use a protective cover if it can be exposed to oil or chips.

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Introduction

Thank you so much for purchasing our RA510.

If the usage and handling methods of this product are not appropriately carried out, it becomes not only impossible to make full use of its functions, but can also lead to a unexpected troubles and a reduction of its longevity.

We hope that you will read this instruction manual carefully, take care when using the product and use it in its specified manner.

What is stated hereafter are precautionary items aimed at making it possible to use this product correctly. Correctly make use of this product in accordance with the detailed handling items and various explanatory items listed.

In this instruction manual, we have made every possible endeavor to list all specifications, functions and their mutual relationships.

Items that are not listed in this instruction manual should be understood as being "impossible."

This instruction manual has been prepared to cover all areas. However, if there are any areas that are unclear, please contact our sales office.

Items to check when opening the product and accessories

■ Check the following items after opening the package.

- Is there any discrepancy with the product that you ordered?
- Was there any damage caused during shipping?
- Are any of the bolts loose?
- Are the accessories included?

■ Check the following accessories

- Standard accessories

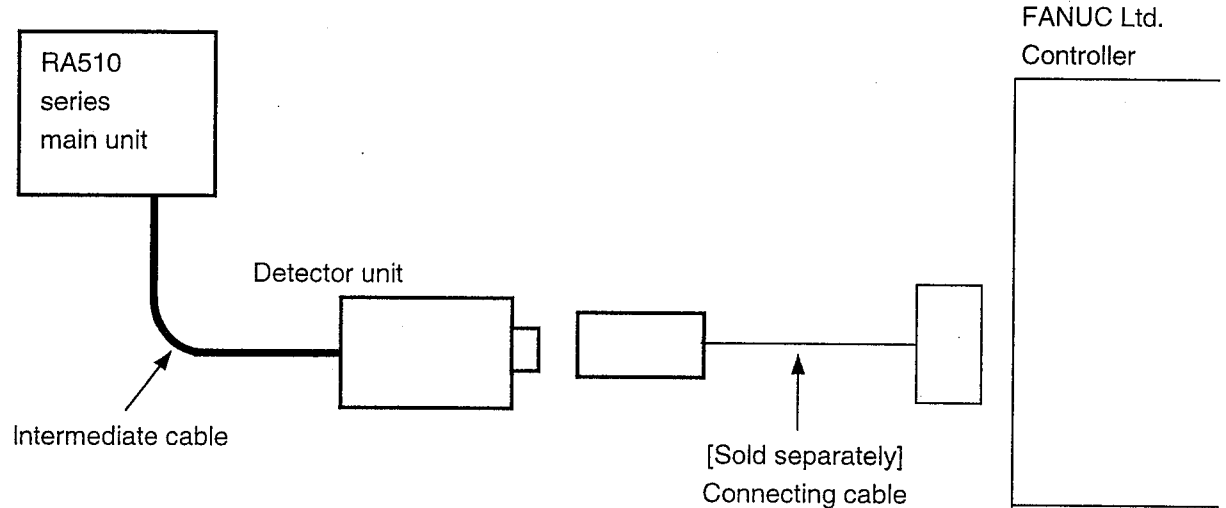
Accessory names	Measurement	Q'ty	Usage
Inspection results sheet		1	
Installation manual		1	
Hexagon socket head cap screws	M4×12	2	For scale securement
Flat washers	M4	2	
Round head screws (PSW)	M4×28	2	For detector unit securement

1. Outline

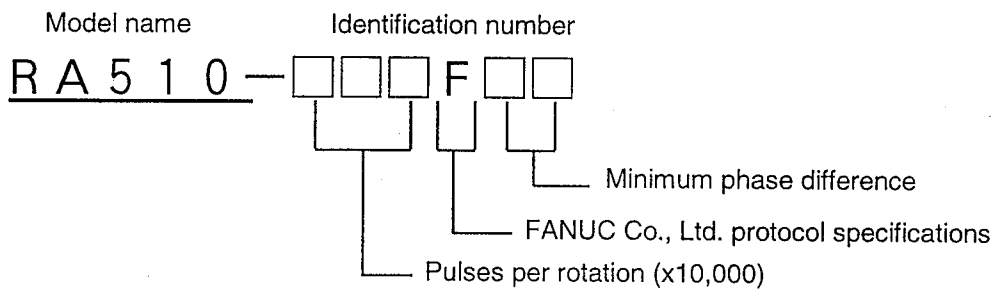
- The rotary encoder unit RA510 series is an absolute rotary encoder unit that has a battery back-up system.
- It can be connected directly to the FANUC Ltd.'s CNC absolute pulse encoder interface, doing away with the need to reset the origin point when turning on the power.
- Since the RA510 is an easily installed hollow shaft type, all that needs to be performed after inserting it into the shaft is to secure it with bolts, removing any need to perform troublesome centering operations.

2. Configuration

2-1. Product configuration



2-2. Model name and identification number format



3. Specifications

Number of graduation lines	9000
Accuracy	Within $\pm 2.5''$

Mechanical characteristics

Number of maximum allowable revolutions	500 min ⁻¹
Moment of inertia	$7.8 \times 10^{-4} \text{N} \cdot \text{m}^2$
Starting torque	0.078 N · m or less (at 20°C)
Mass	1.2 kg
Oil resistance/water resistance	Equivalent to JEM IP64
Temperature range	0°C to 45°C (usage temperature) From -10°C to 60°C (storage temperature)
Humidity range	Relative humidity 30 to 90% (no condensation)
Fluctuation speed of temperature and humidity	To be at a fluctuation speed that does not cause condensation
Atmosphere	There is to be no corrosive gas
Anti-vibration properties	49m/s ² (50 to 2000Hz, according to our vibration testing data)
Shock resistance	147 m/s ²
Coupling	External

Electrical properties

Light source	Infrared light emitting diode
Light receiving element	Photo diode
Number of maximum response revolutions	See Table 1.
Number of origin response revolutions	See Table 1.
Minimum phase differential time	See Table 1.
Earthquake-proof properties	
With electricity on	49 m/s ²
With back-up electricity on	6.86 m/s ²
Power requirement	5 V $\pm 5\%$
Consumption current	
With electricity on (5v related)	300 mA
With back-up electricity on	Approximately 1.6mA (when encoder is stationary) Approximately 10mA (when encoder is moving)
Back-up time	One year per axle (Encoder stopped, from the battery's initial state)
Intermediate cable length	The standard is 0.9m
Length of connecting cable	To a maximum of 15m (Maximum of 30m. Please call us for details.)

4. Resolution and number of response revolutions

The number of maximum response revolutions and the number of maximum origin detection revolutions of the RA 510 series are shown below.

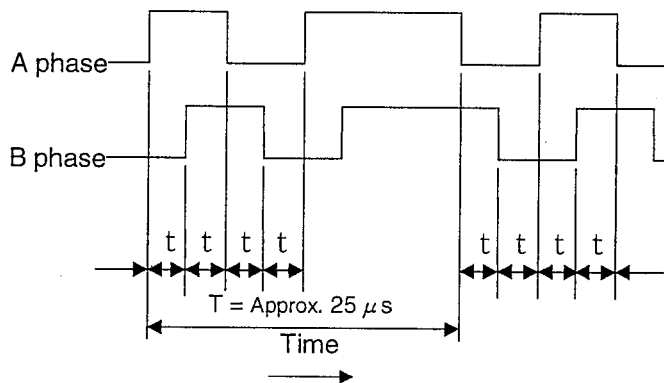
Table 1 Resolution and number of response revolutions

Resolution L (deg)	Output pulse number Pr (pulse/revolution)	Minimum phase differential time t (μ s)	
		0.3	0.6
0.0001	※ 3,600,000	F	30.0
		Fz	0.01~0.2
0.001	※ 360,000	F	120.0
		Fz	0.01~2.0

F : Indicates the number of maximum response revolutions (min^{-1}). Equivalent when using back up.

Fz: Indicates the number of maximum origin detection revolutions (min^{-1}).

※ A single revolution pulse number is a value resulting from an A phase/B phase signal that has been divided by 4. (4X; See Fig1)



- Make a connection to a controller that is able to read the minimum phase differential time (t).
- Make the minimum phase differential time that is readable by the controller as (X) and encoder's minimum phase differential time as (t) and make it so that $X < t$.
- A phase and B phase output signals are output with intervals between them. The figure on the left is an example of a transmission at a constant speed that is above the origin detection speed.

Figure 1. Example of output waveforms

The revolution rate is detected every $25 \mu\text{s}$. A pulse signal equivalent to the relative revolution angle of the scale and the head that have moved during this period is output. Due to the fact that the A/B output signal is created as a false signal, it may be output in the pulse width of the minimum phase difference time (t) even if the scale's movement speed is slow.

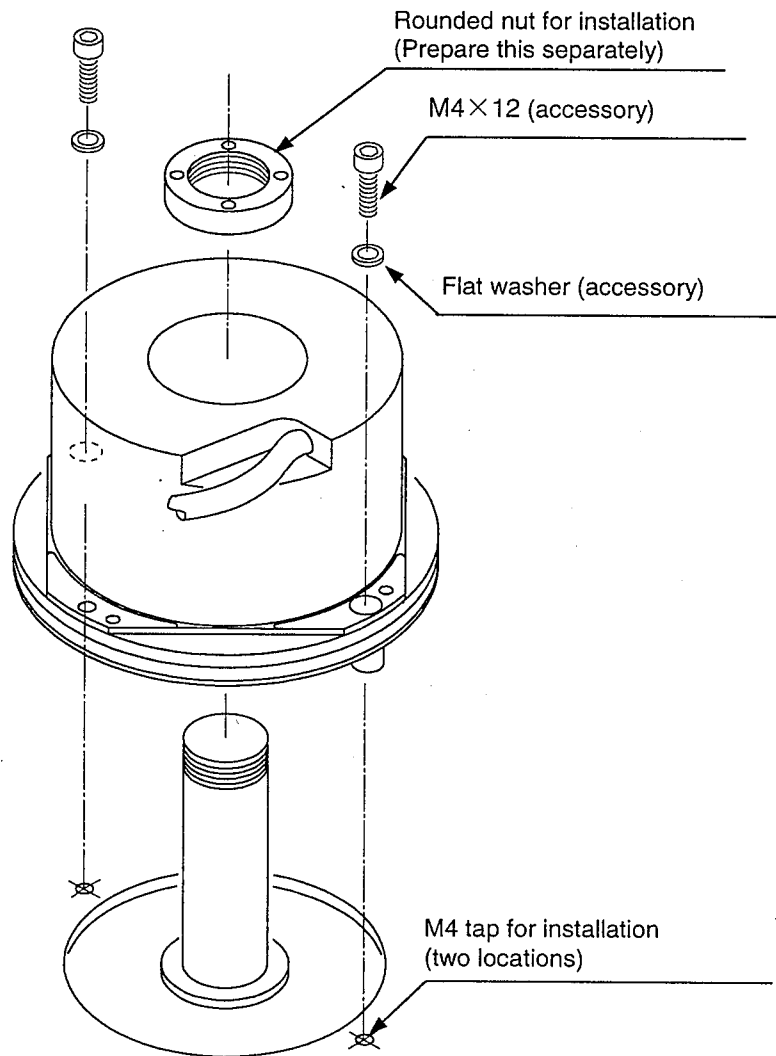
5. List of model types

Resolution		Minimum phase differential time t (μ s)	
(deg)	(pulse/revolution)	0.3	0.6
0.0001	3,600,000	RA510-360F03	RA510-360F06
0.001	360,000	RA510-036F03	RA510-036F06

6. Installation method

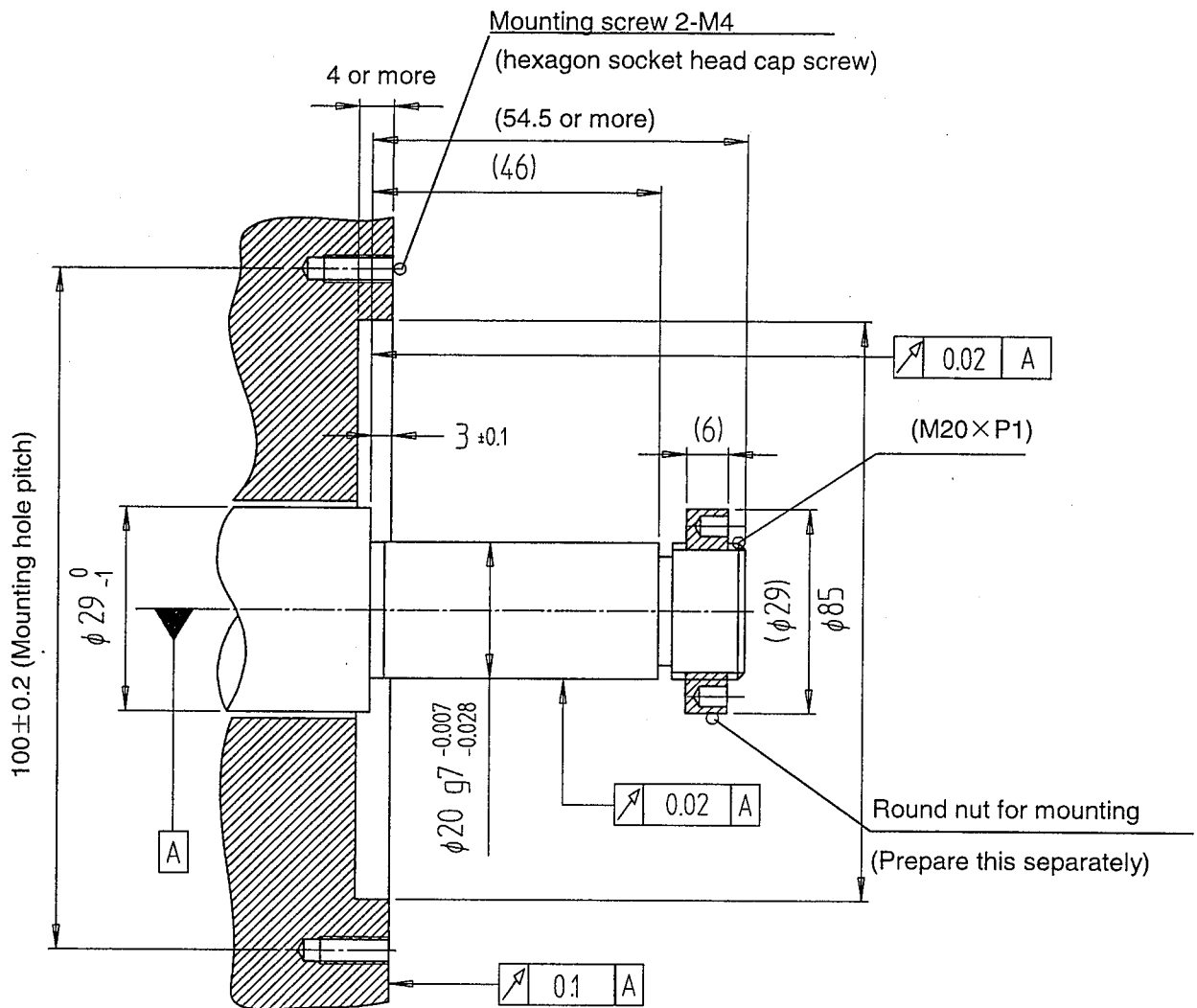
6-1. Installing the main unit

- (1) Gently insert the RA510 into the installation shaft. Take care not to use more force than is needed when performing this operation.
- (2) Secure the RA510 to the shaft using rounded nut designed for installation. As this nut is not included, prepare a rounded nut separately to meet the shape of the end.
- (3) Secure the RA510 main unit using the two appended M4 hexagon socket head cap screws and flat washers. (Tightening torque: 2.45 N·m)



6-2. Mounting measurements

Unit [mm]



* Please prepare round nuts for installation separately.

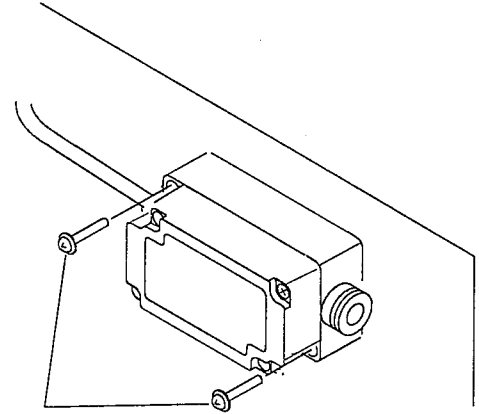
6-3. Securing the detector unit

- Select a position that is not exposed to oil or chips and secure the unit with round head screws (PSW M4X28).
- Keep in mind that the detector unit can be adjusted by removing the cover.

Note

When re-attaching the cover after having removed it once, make sure that the rubber packing fits properly into the groove.

Be aware that if the packing cannot be installed to its correct position due to being caught, the sealing properties of the detector unit will worsen.



Round head screws
(PSW M4X28)

7. Connection method

Connecting cables are used to connect the rotary encoder and the controller.

Determine the connecting cable to use by the type of connector used to connect to the controller.

Use a type of cable that has a conduit when using it in an environment where there is a possibility of the cable becoming damaged.

The connector is designed to be both dust protective and drip-proof. (Excluding connectors connected to the controller)



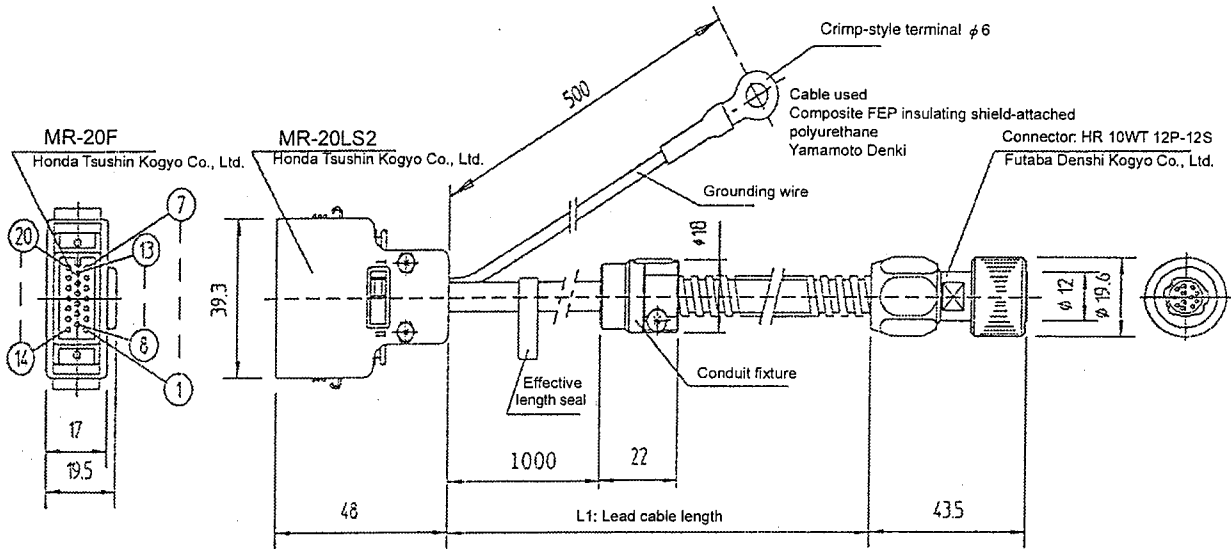
Warning

A polarity changeover switch is attached to the connector that is connected to the controller. It is possible to rotate the rotary encoder's reading direction in the opposing direction with this switch. While it is possible to control this switch during use, the feedback signal is reversed if it is changed over while in operation, creating a hazardous situation. To prevent mistaken operations involving the polarity changeover switch of the connector that is connected to the controller, be sure to attach covers and so on.

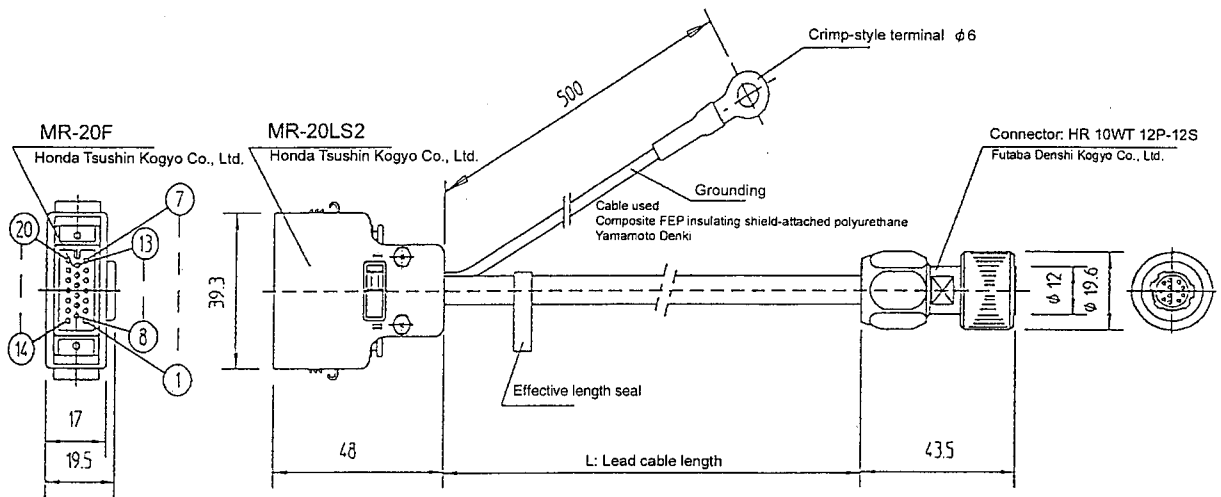
7-1. Connecting cable

Cable length	Type			
	MR connector		Mini Dsub connector	
	Conduit	No conduit	Conduit	No conduit
2m		CR3-02MN		CR3-02DN
3m		CR3-03MN		CR3-03DN
5m	CR3-05MC	CR3-05MN	CR3-05DC	CR3-05DN
7m	CR3-07MC	CR3-07MN	CR3-07DC	CR3-07DN
10m	CR3-10MC	CR3-10MN	CR3-10DC	CR3-10DN
15m	CR3-15MC	CR3-15MN	CR3-15DC	CR3-15DN

- Type CR3-□□MC (Possible to connect to conduit installed devices "FANUC 0")



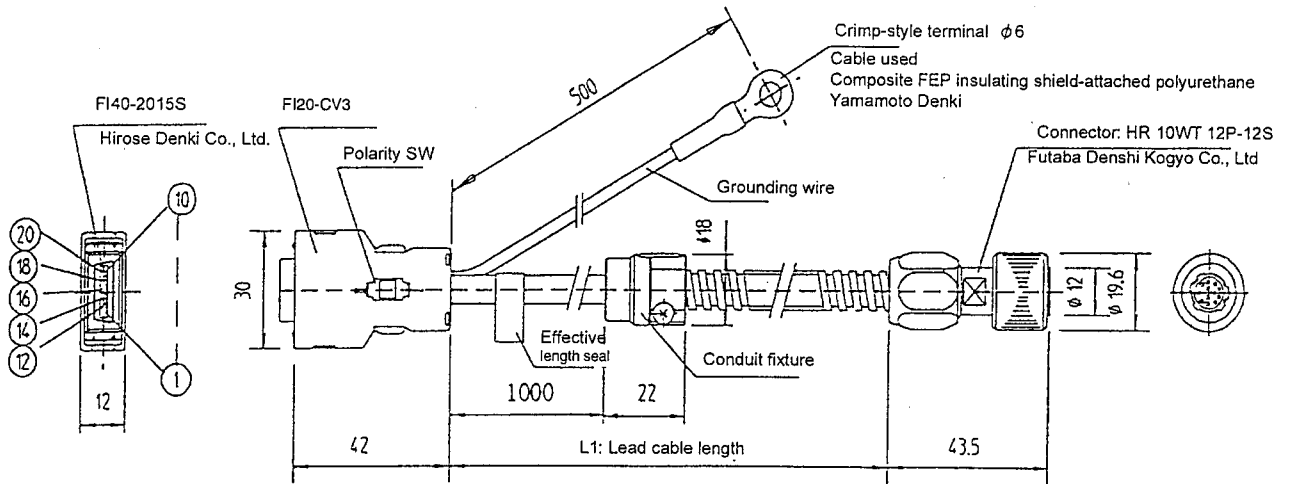
- Typ CR3-□□MN (Possible to connect to devices not installed with conduits "FANUC 0")



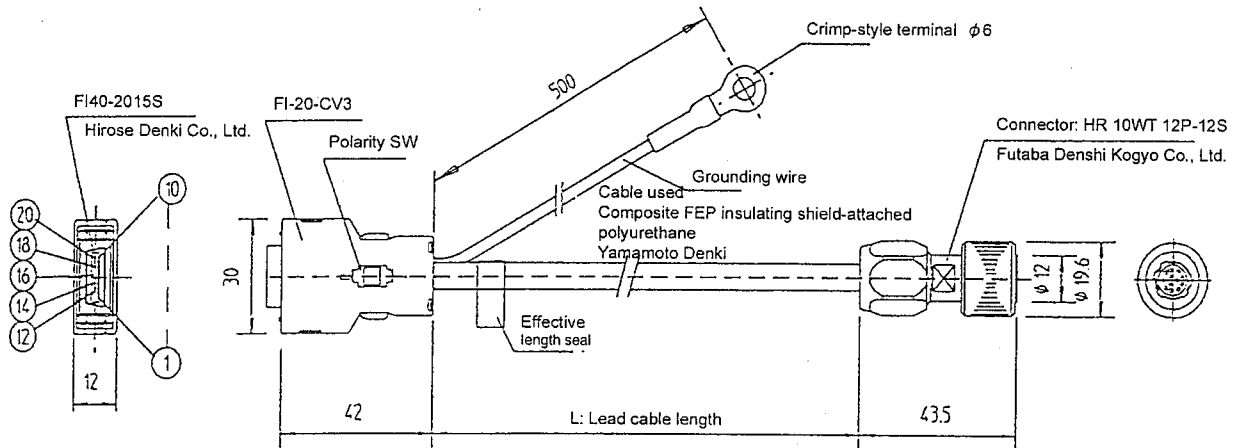
[Note]

Be sure to always connect a grounding wire to machinery.

- Type CR3-□□DC (Possible to connect to conduit installed devices "FANUC 16/18")



- Type CR3-□□DN (Possible to connect to devices not installed with conduits "FANUC 16/18")



[Note]

Be sure to always connect a grounding wire to machinery.

7-2. Connecting connector

- CR3-□□ MC, CR3-□□MN cable

Connector MR20LSF (Possible to connect to the "FANUC series 0")

No.	Wire color	Signal name	No.	Wire color	Signal name
1	Grey/purple	GND	12	—	—
2		GND	13	—	—
3		GMD	14	Black	Z phase
4	Blue/white	5V	15	Brown	Z̄ phase
5		5V	16	Red	A phase
6		5V	17	Orange	Ā phase
7	Light green/pink	Battery 6V	18	Yellow	B phase
8	—	—	19	Green	B̄ phase
9	—	—	20	Light blue	REQ
10	—	—	S	Shielded	FG
11	—	—			

A view as seen from the connector's connection side

- CR3-□□DC, CR3-□□DN cable

Connector FI40-2015S (Possible to connect to the "FANUC series 16/18")

No.	Wire color	Signal name	No.	Wire color	Signal name	
1	Red	A phase				
2	Orange	Ā phase	12	Grey/purple	GND	
3	Yellow	B phase				
4	Green	B̄ phase	14			GND
5	Black	Z phase				
6	Brown	Z̄ phase	16		GND	
7	Light green/pink	Battery 6V		White		
8	Light blue	REQ	18			5V
9	Blue	5V				
10			20		5V	
			S	Shielded	FG	

A view as seen from the connector's connection side

7-3. Precautions when using connecting cables

- Protecting the polarity changeover switch of the connecting cable

A polarity changeover switch is attached to the connector that connects connecting cables to the controller.

It is possible to rotate the rotary encoder's reading direction in the opposing direction with this switch.

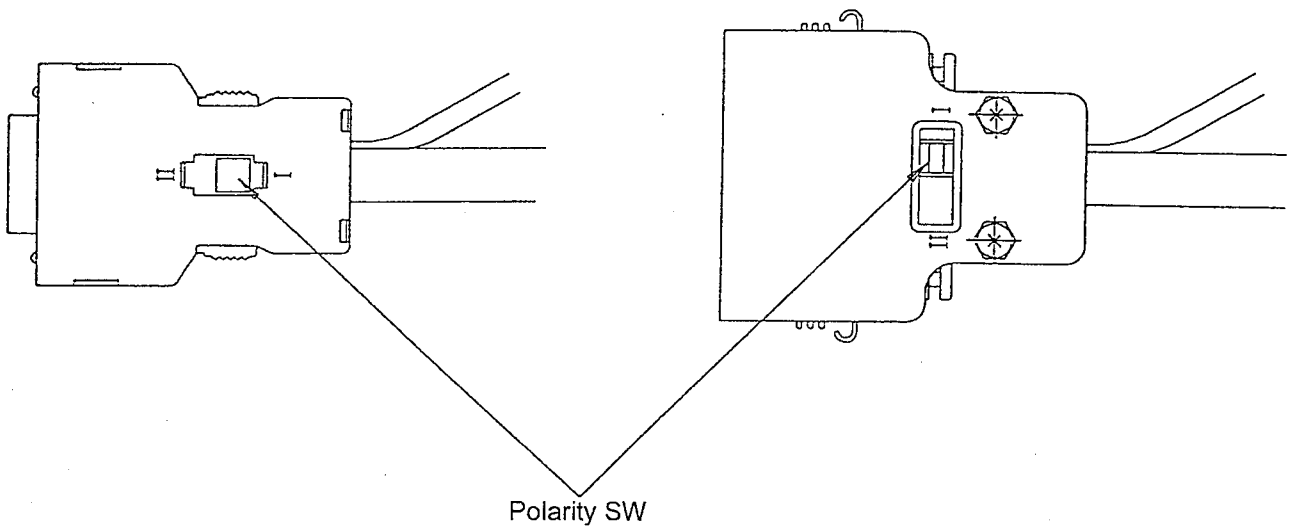
Warning

While it is possible to control this switch during use, the feedback signal is reversed if it is changed over while in operation, creating a hazardous situation.

To prevent mistaken operations involving the polarity changeover switch of the connector that is connected to the controller, be sure to attach covers and so on.

(Hirose Denki Co.,Ltd.)
FI-20-CV3

(Honda Tsushin Kogyo Co.,Ltd.)
MR-20LS2



- Smallest bent radius of the connecting cable

Set the bent radius of the connecting cable as is shown below.

If the cable being used does not work: The bent radius is to be 50mm or more.

If the cable being used works: The bent radius is to be 100mm or more.

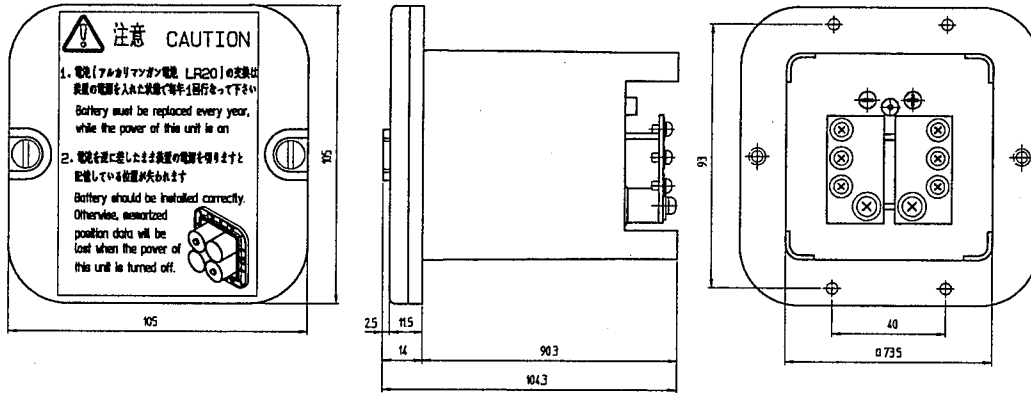
- The connecting cable's extension distance

The extension distance of the connecting cable is to be 15m or less.

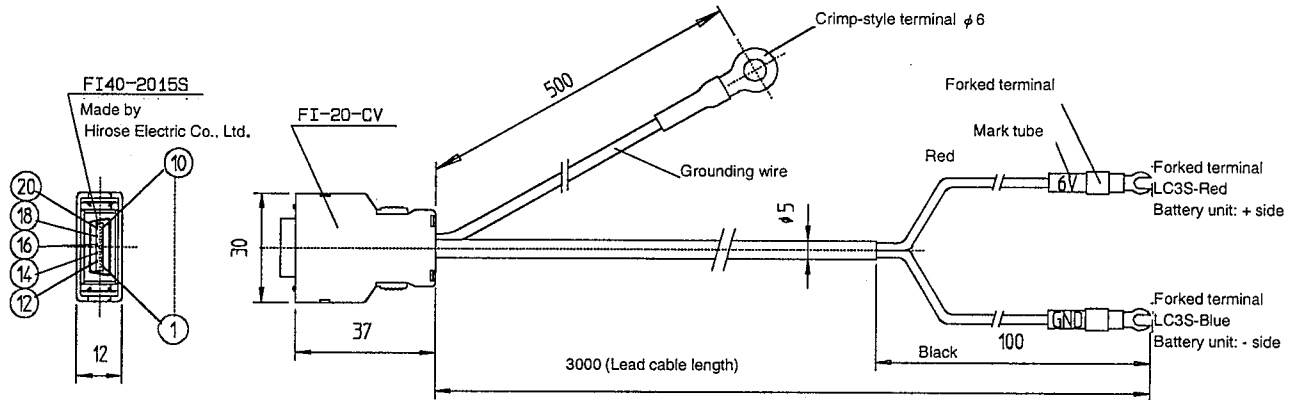
7-4. Connecting the battery box

The following products are available as back-up batteries.

(1) Battery box



(2) Connecting cable for a battery box (for connecting to FANUC system 16/18 and others)



(3) Connector pin configuration (As seen from the connecting side of the connector)

The output connectors are "FI40-2015S" made by Hirose Electric Co., Ltd.

No	Wire color	Signal	No	Wire color	Signal
1					
2			12		
3	Black	GND	14		
4					
5					
6			16		
7	Red	Battery 6V	18		
8					
9					
10			20		
			S	Shield	FG

8. Analog waveforms

Note

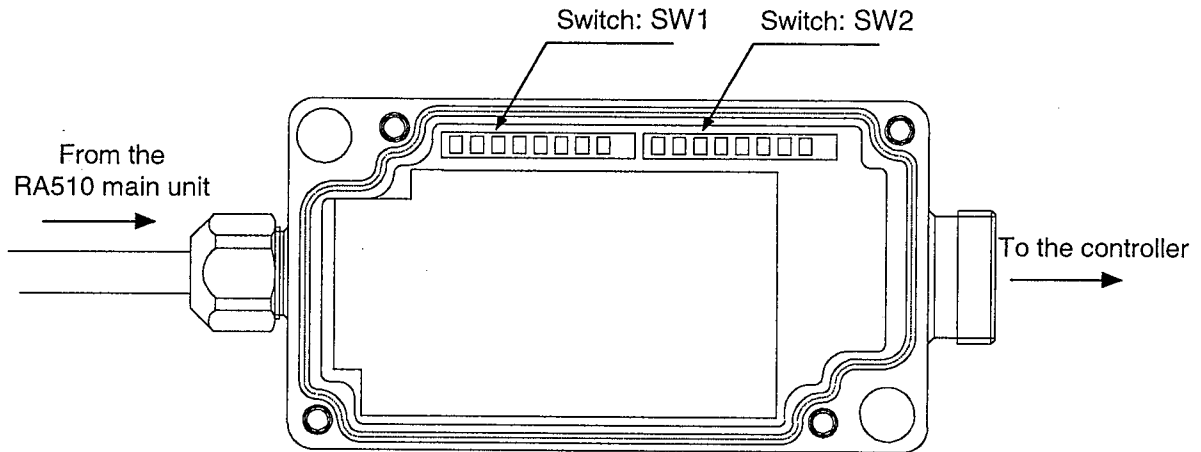
There is no need to adjust the rotary encoder's analog waveform since it has been factory adjusted. If this falls out of adjustment, the unit may fail to satisfy accuracy specifications. Please call our service center if you experience any problems.

9. Setting internal switches of the detector unit

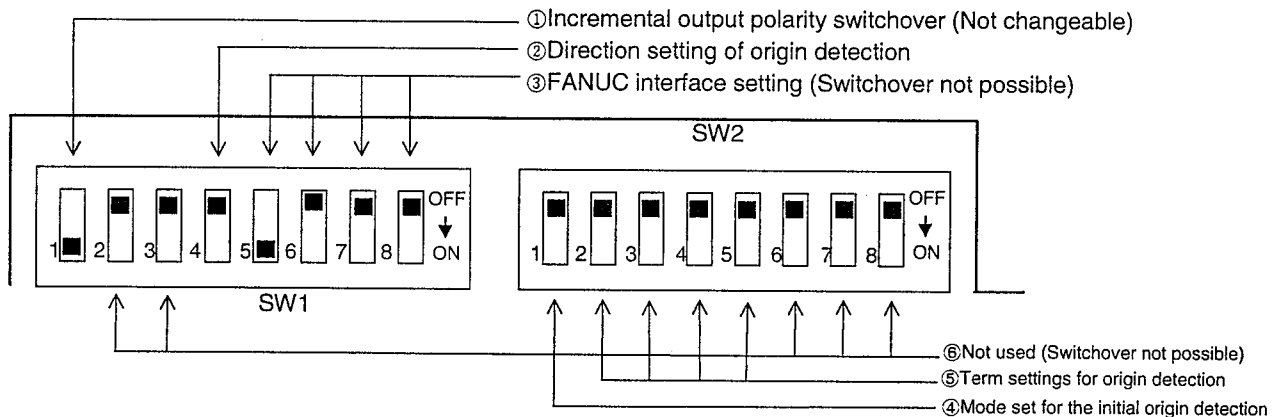
9-1. Names of switches

There are 2 switches of 8 poles in the detector unit.

Figure 2. The interior of the detector unit



9-2. Detailed explanation of each switch



When the switch is in the ↓ direction (lower side), it is ON.

The information stated above are the settings at the time of shipping.

Details for each switch are as follows.

(1) SW 1-1: For output polarity switchover (Setting at the time of shipping: ON)

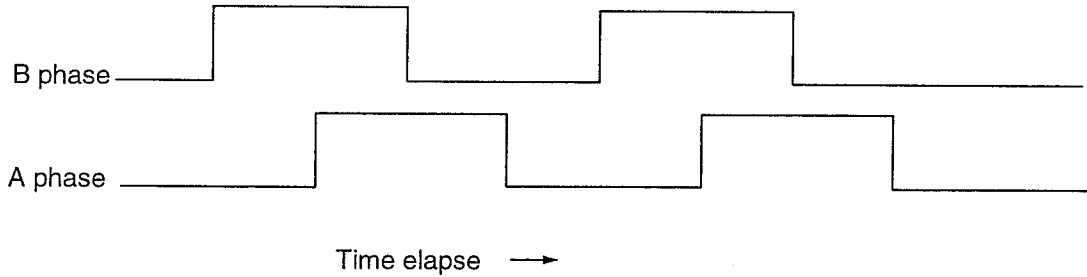
This switch is a switch for changing the output polarity of the incremental pulse signal output.

Be certain to always use it in the ON position.

The state of the switch is only detected when the power is on.

Change the incremental pulse signal output polarity using the polarity switchover switch that is installed in the standard cable's connector. **Be aware that at that time, the polarity of the absolute data will also reverse.**

- [Conditions]
- The SW1-1 is turned ON.
 - The connecting cable's switch is in the 1 mode.
 - Axis rotating direction CW (See Figure 4 on page 23.)



(2) SW1-4: Direction setting of origin detection

This switch is used to set the origin detection direction. Use this by regulating the detection direction in order to accurately detect the origin's position. The state of the switch is detected when the power is turned on.

With the switch OFF, the origin is detected with the axis rotating direction CCW.

With the switch ON, the origin is detected with the axis rotating direction CW.

(3) SW1-5 to SW1-8: FANUC interface setting

These switches are used for interface settings. Do not change the settings. At the time of shipping from the plant, the settings are to be as shown below.

- SW1-5 ON
- SW1-6 OFF
- SW1-7 OFF
- SW1-8 OFF

(4) SW2-1: Mode set for the initial origin detection

Perform the setting of origin detection terms when attaching rotary encoders to machinery.

The setting mode for origin detection terms is activated when the switch is ON. Under ordinary circumstance, perform this in the OFF position.

(5) SW2-2 to SW2-5: Term settings for origin detection

Set detection terms in the initial origin detection mode stated above.

This setting is used in order to match the edge of the origin output signal with the edge of the A, B phase output signal to carry out evermore precise origin detection.

- SW2-2 Origin detection term setting switch 1
- SW2-3 Origin detection term setting switch 2
- SW2-4 Origin detection term setting switch 3
- SW2-5 Origin detection term setting switch 4

Settings are to be established in accordance with the switch initial setting procedures of origin detection terms stated on the following page.

(6) SW1-2, SW1-3 and SW2-6 to SW2-8: Unused switches

To be OFF at the time of shipping from the plant. Leave this in the OFF position.

9-3. Switch initial setting procedures

Establish settings in accordance with procedures (1) to (6) stated below.

(1) Turn OFF the machine's power, and make settings for the DIP switches shown below.

- SW 1-4: Origin detection direction setting (From the CW direction...ON; From the CCW direction...OFF /See Figure 4 on page 23.)
- Turn ON the SW 2-1, and set to the initial origin detection mode.

(2) Turn ON the machine's power, and pass through the rotary encoder origin from the approach direction that has been set with the SW 1-4 (origin detection direction setting). If the detection head is in a direction opposite to the established approach direction, pass through the rotary encoder's origin one time, and then pass through the re-established approach direction.

(3) If two LEDs (☆, ★ of the figure below) in the amplifier box are lit for 5 second periods, establish the settings shown below.

If they are lit, the settings of the SW 2-2, 3, 4 and 5 match, making it possible to perform step 6.

※ If the settings are not correct, perform the following settings in steps (4) and (5).

(4) Perform settings for the SW2-2 and the SW2-3. (Confirm the mode the switch is in with the ☆ LED.)

If the light is turned on, the switch's settings are not correct. Make settings other than the ones currently being used.

The four combinations are shown below. Determine the combinations where the LED☆ is turned off.

(However, if the settings are complete upon finishing (4), two LEDs will turn on.)

SW2-2	ON	ON	OFF	OFF
SW2-3	ON	OFF	ON	OFF

Note) If one of the LEDs; either ☆ or ★; is either flashing or off, the settings are not correct.

(5) Perform the settings listed in step (4) for the SW2-4 and the SW2-5.

(At this time, confirm the LED in with ★ LED.)

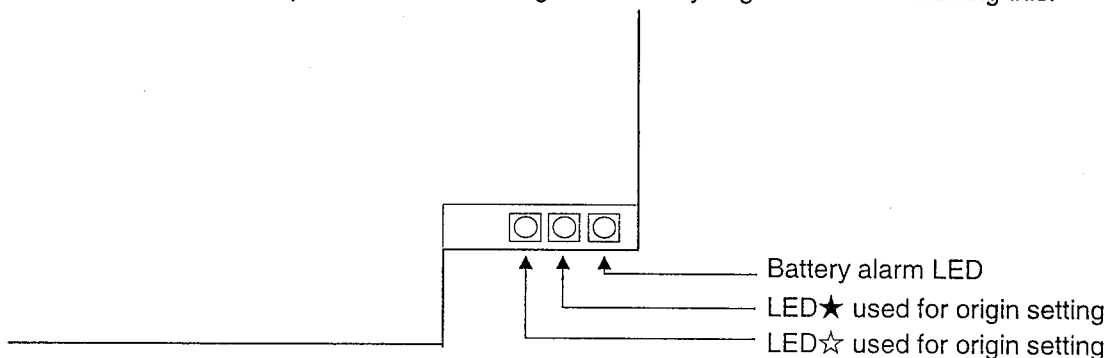
SW2-4	ON	ON	OFF	OFF
SW2-5	ON	OFF	ON	OFF

The two LEDs will be turned on if the four switch settings are completed.

(6) Turn OFF the SW2-1, bringing switch setting to a completion.

- The initial origin detection is completed. Use it as is.

There is no need to perform switch settings for ordinary origin detection following this.



10. Back-up power

10-1. Consumption current when using back-up power

It is possible to use back-up power for one year per axis using four "D" size alkaline batteries with the encoder in a non-active state.

The consumption current for 1 axis is as follows.

- Encoder in a non-active state: Approx. 1.6mA
- When operating at a speed that is less than 0.5min^{-1} : Approx. 10mA

Use four "D" size alkaline batteries that have been lined up at 6V as back-up batteries.

The longevity of the batteries will be reduced when the encoder is operated in the back-up state as consumption current increases.

It is advisable to leave the encoder in a non-active state when using back-up power.

We also provide a battery box unit which is sold separately.

One battery box unit is mounted for each rotary encoder axle.

10-2. Main power voltage when using back-up power

If back-up power is used with batteries when the CNC power is not on, set the supplied voltage of the rotary encoder at 0.3V or less.

Be aware that the battery's consumption current (back-up current) when operated during back up is enlarged if this voltage is exceeded, leading to a shortening of the longevity of the battery.

10-3. Period of time for battery replacement

- A low battery voltage alarm will sound when the battery is low on remaining power.
- If this low battery voltage alarm sounds, replace the batteries with the power ON.
- If replacement is performed with the power OFF, a positioning data ineffective alarm will sound, making it essential to perform origin detection once again.
- Although there is a waiting period of 72 hours from the time the low battery voltage alarm sounds to the time when the positioning data ineffective alarm sounds, it is advisable to replace the batteries as soon as possible following the sounding of the alarm.
- Pay attention to the polarity of (+, -) of the batteries, being careful not to connect them in the opposite direction.

- Use alkaline batteries and be sure to replace all four batteries at the same time using the same product when making replacements.

Example) Sony's Stamina Alkaline battery LR20SG ("D" size type), etc

- When replacing batteries be careful not to touch connection areas with your hands as this can lead to malfunctions in connections.

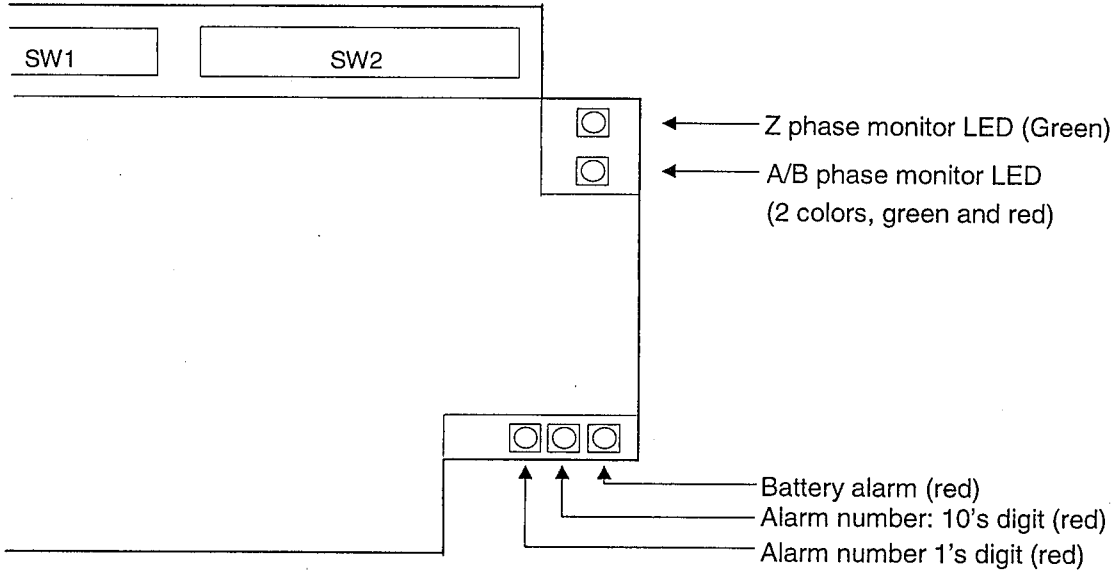
**[Note] Do not make five or more rotations in the same direction during battery backup.
(This can cause data overflow and deletion.)**

11. Monitor LED

As is shown below, there are five monitor LEDs contained within the detector unit.

Refer to these LEDs as they can be used to judge the state of the encoder.

LED name	Description
Z phase monitor (green)	Blinks on and off depending upon the output level of the Z phase
A/B phase monitor (green, red)	Blinks on and off depending upon the output level of A and B phases. (The blinking speed is in proportion to the feed speed)
Alarm monitor (red)	Both are turned on in ordinary conditions. They blink on and off during abnormal circumstances (when positioning data is ineffective).
Battery alarm (red)	Turns off when the battery's voltage is at or above 4.3V, blinks on and off between 4.3 and 4.0V, and is on at or below 4.0V.



It is possible to accurately determine the source of the alarm by the number of blinks made by the last two digits of the alarm number shown in the monitor LED when an alarm sounds. (When no alarm has been sounded, the two LEDs remain turned on.)

Example) When alarm number 924 has sounded, (The last two digits of 924 denote 24.)

Alarm number 10's digit LED blinks two times in a constant period.

Alarm number 1's digit LED blinks four times in a constant period.

Refer to the following page for details on alarm numbers.

List of alarms

Alarm number	Description	Measures	Level
901	An excessive speed alarm has been detected in the GR7001/ANACTRL block.	Check the maximum speed, turn on the power again and reset the origin.	B
902	The internal resistor in the GR7001/GR1001 block is re-written.	After inspecting the back-up power, turn on the power again and reset the origin.	B
903	Counter data of the GR7001/GR1001 block has been damaged.	After inspecting the back-up power, turn on the power again and reset the origin.	B
904	Excessive speed alarm in the GR7001/GR2002 block (PULSE BLOCK)	Turn on the power again and reset the origin.	B
910	Initial origin is being reset	After changing the settings of the initial origin switch in the amp box, turn on the power again.	B
911	The data of the A/B edge setting DIP switch does not match with the data located on the RAM.	Start from the beginning by performing initial origin settings.	C
912	Back-up power has been cut-off, or the battery's voltage is low.	Replace the old batteries with new ones and turn on the power again.	C
913	The signal used for origin detection (*REQ signal) is requesting origin detection (L level).	After detecting the origin, return this signal to a high impedance state.	C
914	The counter speed of the GR7001/GR1001 block is faster than the specified value.	Use it within the specified speed (maximum response speed).	C
920	The output allowable flag of the GR7001/PULSE has been wrongfully cleared.	Check the condition of the connecting cable.	C
921	Absolute data boundary value error	Check the condition of the connecting cable.	C
922	Watchdog timer overflow	Check the condition of the connecting cable.	C
923	Invalid command reading	Check the condition of the connecting cable.	C
924	Address error	Check the condition of the connecting cable.	C
930	The RAM data is irregular.	Check the condition of the back-up power and the connecting cable.	C
931	A, B edge setting status register at the time of origin output is irregular.	Check the condition of the connecting cable.	C
932	The character string that has been written into the RAM is irregular.	Check the condition of the back-up power and the connecting cable.	C
933	GR7001/PULSE/DEFCOUNT deviation counter data overflow	Contact the service center.	A
934	DIP switch reading mistake	Contact the service center.	A
940	Absolute positioning data conversion overflow	Turn on the power again.	B
942	Excessive deviation of counter data relative positioning	Turn on the power again.	B

A: A very quick response is needed.

B: Release it by turning on the power again.

C: Turn on the power again after making verifications.

12. Positioning data

12-1. Output waveforms

Output signals from the rotary encoder are the six line driver output phases of the A phase, \overline{A} phase, B phase, \overline{B} phase, Z phase and \overline{Z} phase.

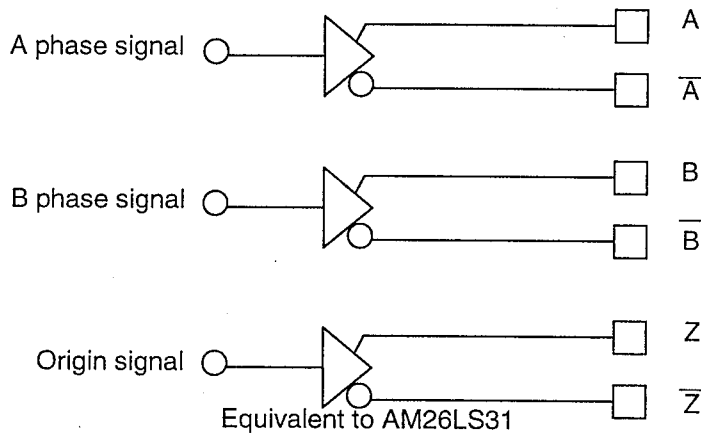
Absolute data is output from the A phase and the B phase when a \overline{REQ} signal has been input following a turning on of the power. After this it becomes an ordinary incremental output.

Z phase origin output is output within approx. 0.5 s from the rotary encoder's origin positioning.

[Note]

- Output during the resetting period changes to high impedance (disconnected).
- Output is started approx. 0.5 s after resetting is completed.
- The relations between origin signals and A phases and B phases are not regulated.

12-2. Output forms



$I_{OH,OL}: \max \pm 30\text{mA}$
 $V_{OH}: \min + 2.5\text{V}$
(at $I_{OH} = -30\text{mA}$)
 $V_{OL}: \max + 0.5\text{V}$
(at $I_{OL} = 30\text{mA}$)

12-3. Direction of polarity

The rotary encoder's axle rotates in the CW direction shown in figure 4 below.

- Make sure to switch the output polarity changeover switch (SW1-1) in the detector unit to ON when using the unit.

The following table shows the relationship between incremental and absolute outputs.

	Incremental output	Absolute output
Polarity switch on the connection cables connector set to "I"	B-phase advanced	Minus direction

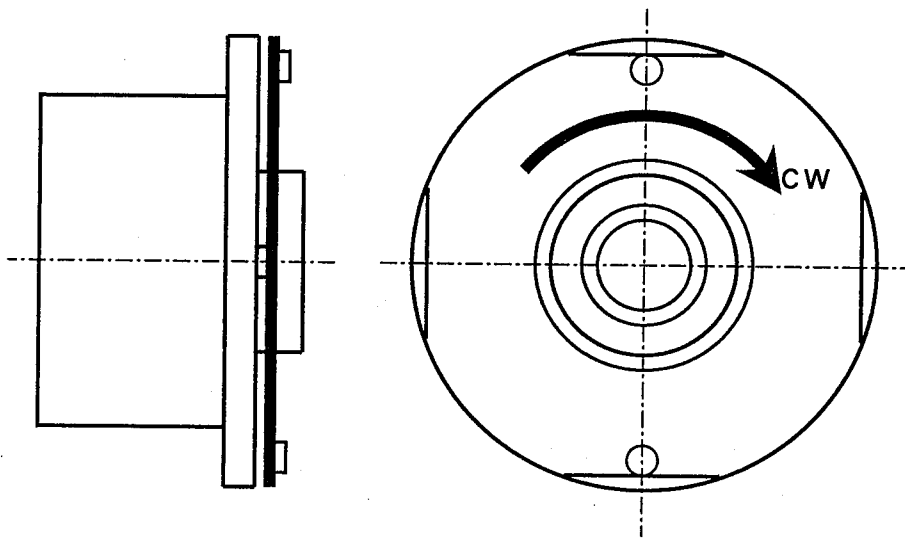


Figure 4

12-4. Incremental signals

The two phase signals of A phase and B phase are output. The fluctuation points of the A and B phase signals are regulated as 1 pulse. As signals are output at the pulse width of the smallest phase differential time t even when sent at a constant speed, make a connection to a device that can read the signals. (See Figure 5 below.)

Example of A and B phase incremental signal output (Direction of axial rotation: counterclockwise)

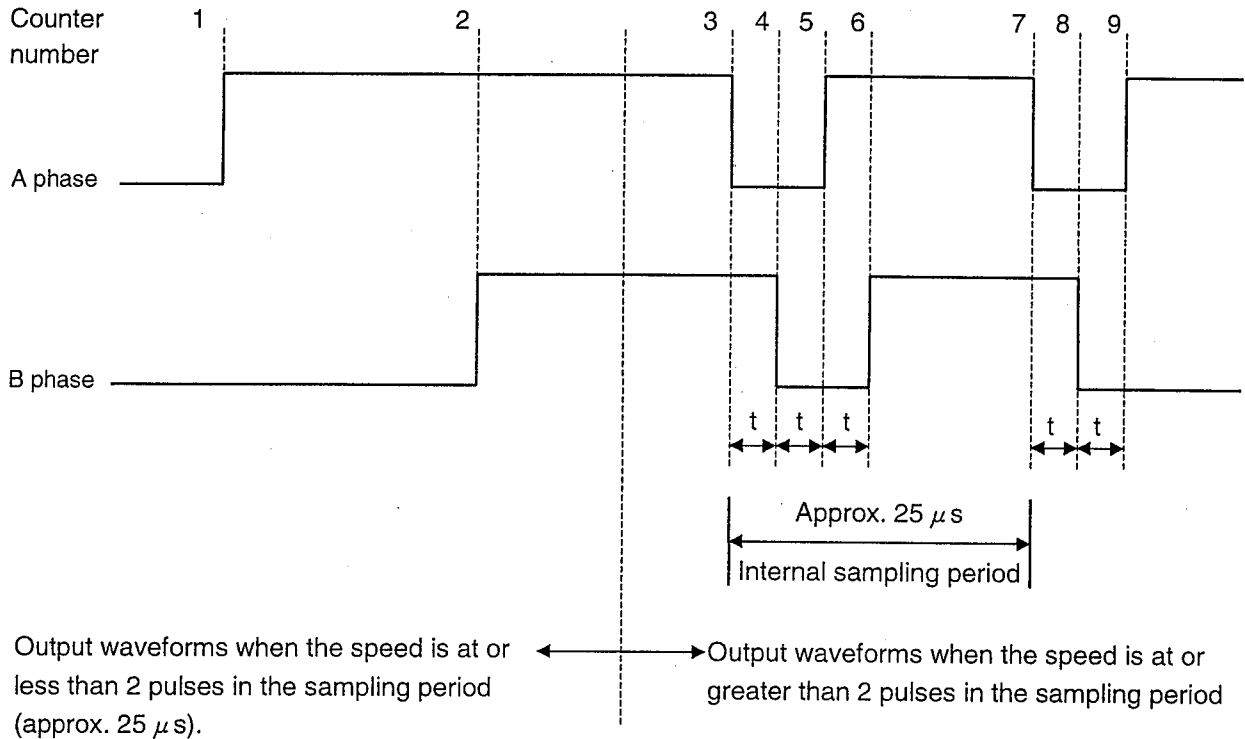


Figure 5. Incremental signals

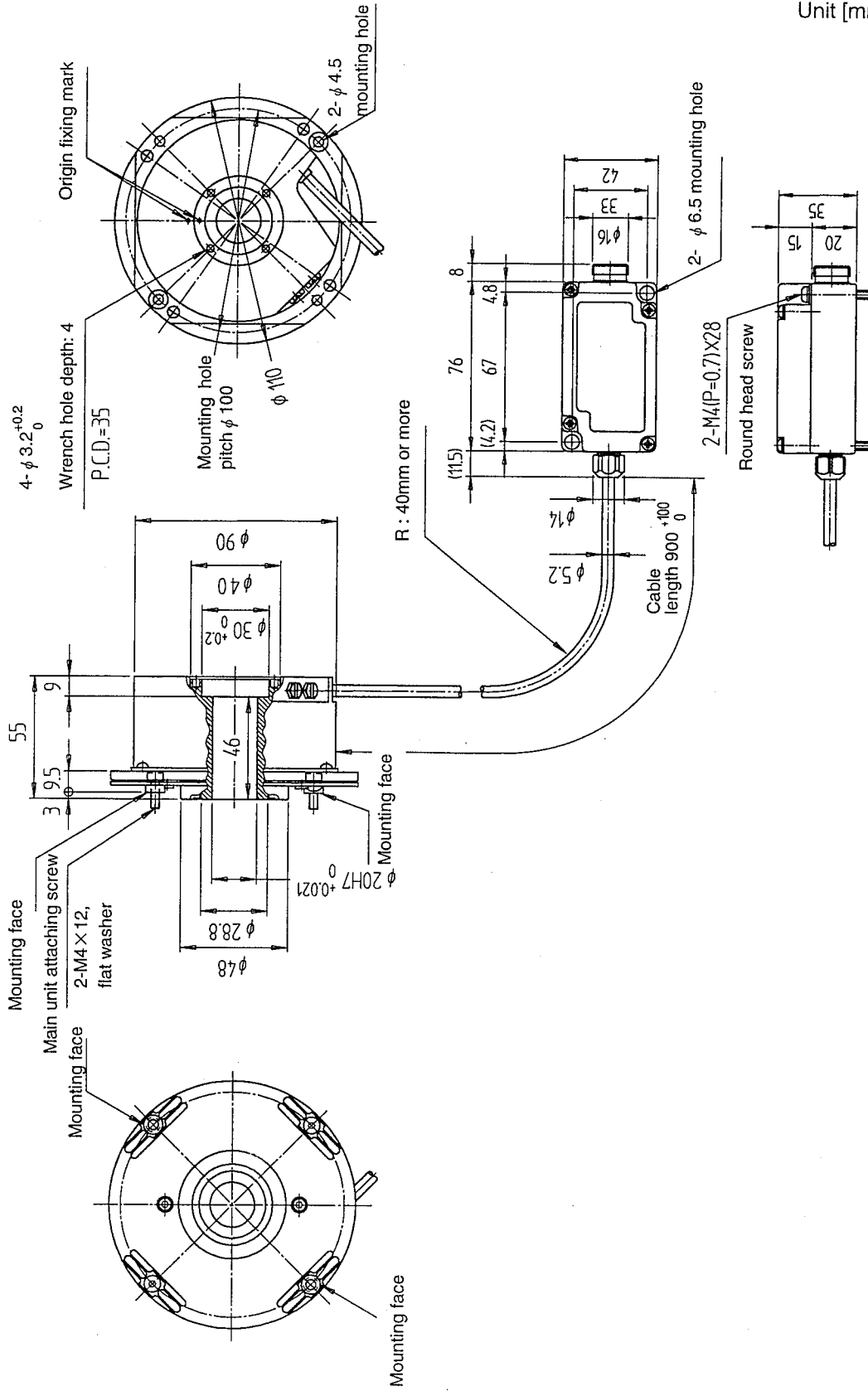
12-5. Alarm output

An alarm is sounded externally if irregularities have been detected in the rotary encoder's interior. The output method for alarms differs between the case when irregularities have been detected with the power ON and the case when irregularities have been detected with the power OFF.

- (1) When an alarm has sounded with the power ON, every line drive output shall be high impedance. (The high impedance mode cannot be released unless the power has been turned OFF once.) Be certain to perform safety measures such as detecting this on the NC unit side and performing an emergency shutdown.
- (2) Next, in accordance with the alarm that occurs when the power has been turned on again, the absolute data alarm bit turns ON. (Refer to "List of alarms.")
- (3) When an alarm has sounded with the power OFF, perform operations in a manner similar to step (2) with the power on.
- (4) The alarm is released with the determination of the absolute position through the detection of the origin. And effective positioning data is output.

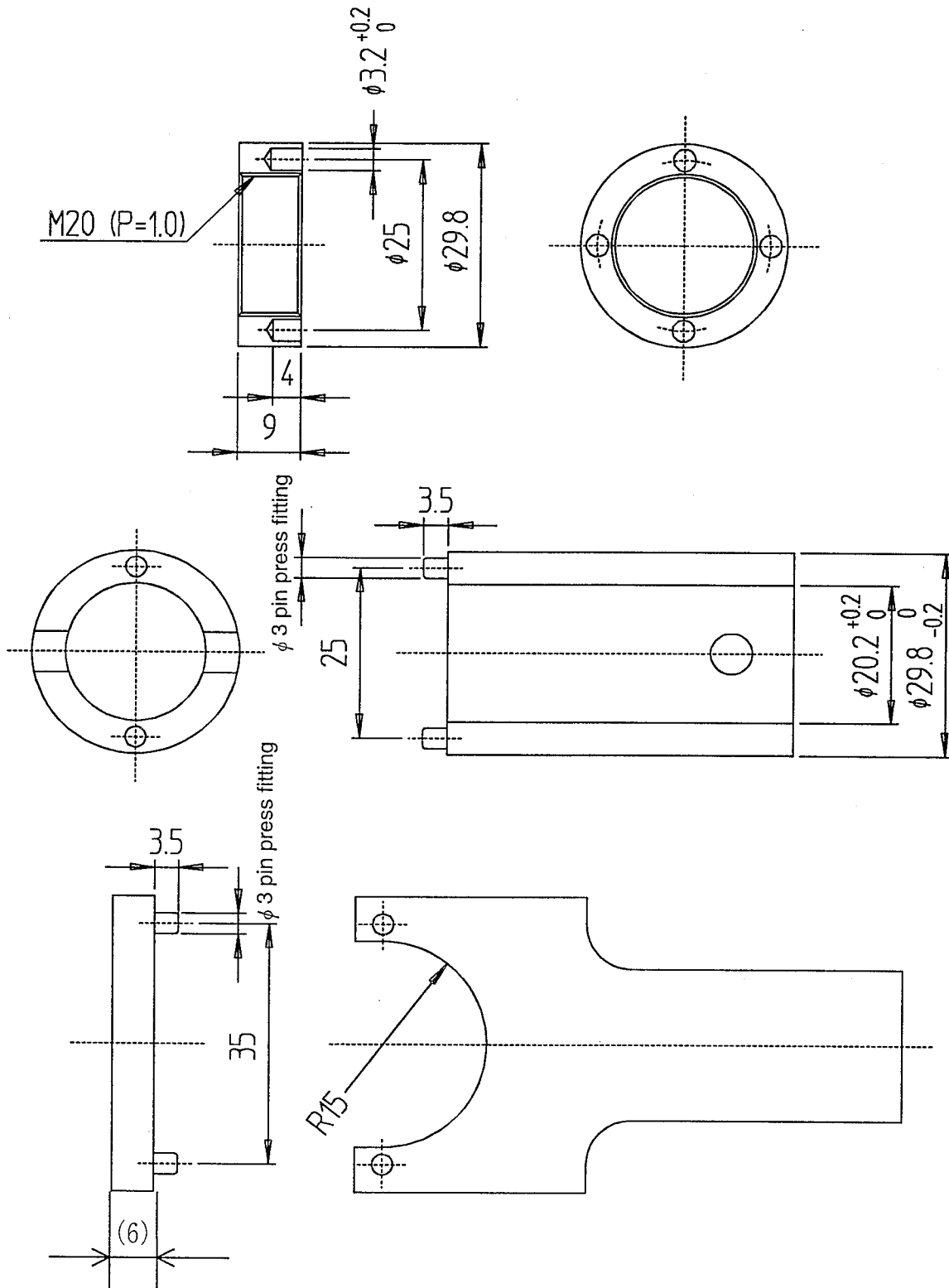
13. Dimensions

Unit [mm]



14. Reference for wrenches and tightening nuts

Unit [mm]



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