Koyo®

Value & Technology

Rotary Encoders

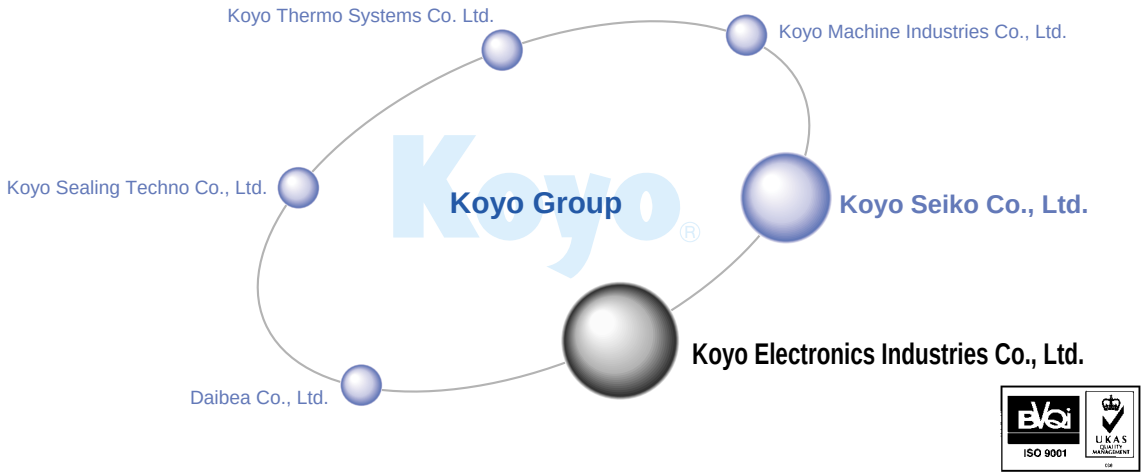
Incremental Encoders
TRD-S/TRD-SH/TRD-N/TRD-NH/TRD-J/TRD-GK

Absolute Encoders
TRD-NA/TRD-K/TRD-KL

From Compact to Heavy Industrial Models

Koyo®
光洋電子

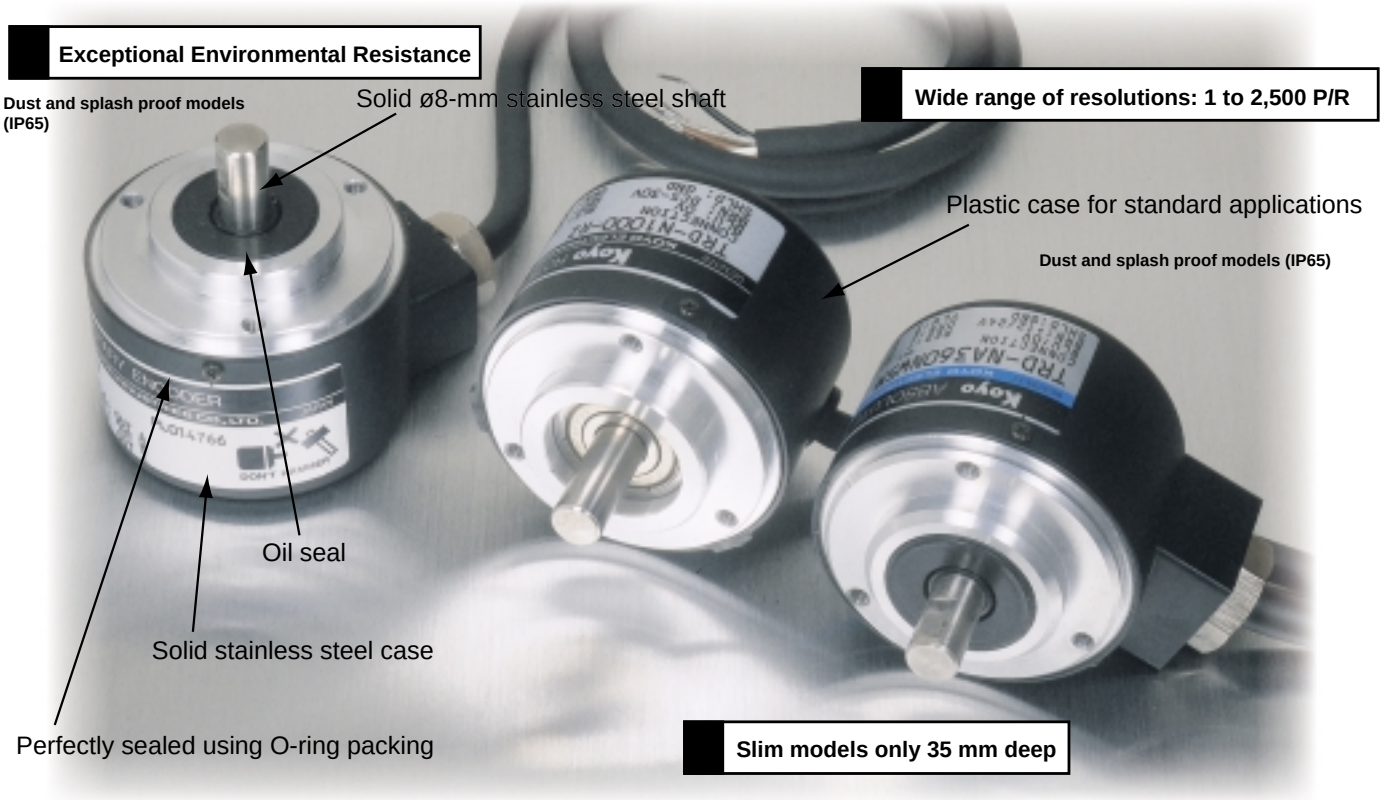
The Distillation of Mechatronics



Wide Knowledge Base

High-quality Technology

At Koyo Electronics, we push to the limit full use of the merits of a wide knowledge base and the expertise of the Koyo Group to manufacture an expert product, the rotary encoder, a highly-accurate product that is the distillation of mechatronics technology. The high-quality technology and high reliability of Koyo Rotary Encoders are also built into servomotors, and are expressed in the ultimate by their continuing to be built into many products by other companies as angle, length-measuring, and position sensors in major industrial machinery and equipment throughout Japan.



A New Standard for Rotary

TRD-N Series (Incremental Type)
TRD-NA Series (Absolute Type)

Specialist Rotary Encoders

Select Freely to Suit Your Application

Dust and splash proof IP65

Series/Resolution	Diameter (mm)		Type	Model	Page	
Pulse output depends on rotation angle						
Incremental type						
Compact machinery and devices → **Compact TRD-S series** 10 to 2,500 pulses/rotation	ø38		Dust proof	TRD-S□	P6	TRD-S
New standard in space-saving mountings → **Compact, slim design TRD-N series** 1 to 2,500 pulses/rotation	ø50	Standard low cost / Environmentally-hardened IP65	Dust proof plastic case	TRD-N□	P8	TRD-N
			Dust and splash proof die-cast case	TRD-N□-□W	P8	
Wide variation of standard models → **Compact, standard-use TRD-J series** 10 to 1,000 pulses/rotation	ø50	Standard type: Low cost / Environmentally-hardened IP65	Rear-mounted cable connection	TRD-J□	P13	TRD-J
			Dust and splash proof rear-mounted cable connection	TRD-J□-□W	P13	
		No rear space for cable: Environmentally-hardened IP65	Side-mounted cable connection	TRD-J□-□S	P13	
			Dust and splash proof side-mounted cable connection	TRD-J□-□WS	P13	
		Connector connection: Environmentally-hardened IP65	Connector	TRD-J□-□C	P13	
			Dust and splash proof connector	TRD-J□-□CW	P13	
Large-scale machinery, equipment, and heavy industry → **Large and powerful shaft loads TRD-GK series** 10 to 5,000 pulses/rotation	ø78 Environmentally-hardened IP65	Standard applications	Dust and splash proof rear-mounted cable connection	TRD-GK□	P13	TRD-GK
		Connector connection	Dust and splash proof connector	TRD-GK□-□C2	P13	
Directly connected to shaft without a coupling → **Compact hollow shaft TRD-SH series** 1 to 2,500 pulses/rotation	ø38 Shaft diameter ø8	Standard applications	Dust proof plastic case	TRD-SH□	P6	TRD-SH
Directly connected to shaft without a coupling → **Hollow shaft TRD-NH series** 1 to 2,500 pulses/rotation	ø50 Shaft diameter ø8	Standard applications / Environmentally-hardened IP65	Dust proof plastic case	TRD-NH□	P8	TRD-NH
			Dust and splash proof die-cast case	TRD-NH□-□W	P8	
Outputs absolute position signal depending on rotation angle						
Absolute type						
Compact machinery and devices → **Compact TRD-NA series** 32 to 1,024 resolution/rotation	ø50 Environmentally-hardened IP65	Standard applications	Dust and splash proof cable mounting	TRD-NA□	P22	TRD-NA
		With connector at cable tip	Dust and splash proof with intermediate connectors	TRD-NA□E	P22	
Large-scale machinery, equipment, and heavy industry → **Large and powerful shaft loads TRD-K series** 180 to 1,024 resolution/rotation	ø78 Environmentally-hardened IP65	Standard applications	Dust and splash proof cable mounting	TRD-K□-YS	P25	TRD-K
		Connector connection	Dust and splash proof connectors	TRD-K□-YC2	P25	
		With connector at cable tip	Dust and splash proof with intermediate connectors	TRD-K□-YPS	P25	
Specially-shaped cable and connectors to save space / OK even in water-splashed environments → **Large-scale, environmentally hardened space-saving TRD-KL series** 180 to 1,024 resolution/rotation	ø78 IP65 Solid aluminium die-cast case		Dust and splash proof cable mounting	TRD-KL□-Y	P28	TRD-KL
		Connector connection	Dust and splash proof connectors	TRD-KL□-YC2	P28	
Custom-made to your own specifications						
Special products						
Specifications changed based on standard product → **Special specifications**			No. of pulses, output type, shaft diameter and length, cable length, etc.			
Custom-made specifications → **Example of custom specifications**						

Incremental encoder slit plate

Absolute encoder slit plate

Servomotor applications

- Vibration-resistant through shaft
- ø8 through shaft
- Operates in high temperatures (to 100°C)
- Ultra-fine hollow shaft Pulse count absolute encoders
- Multi-turn absolute encoders

General applications

- Operates in cold storage (–30°C min.)
- Equipped with self-diagnostic function
- Can be used in vacuum
- Powerful load talent
- Powerful through load

List

List of KOYO Rotary Encoders

Only the basic models are listed below.
For other models, refer to the description of each series.

Type		Incremental			
Series		**TRD-S series**	**TRD-SH series**	**TRD-N series**	**TRD-NH series**
Appearance of basic model		 ø38 × 30 mm Diameter of shaft: ø6 mm	Hollow shaft  ø38 × 30 mm Diameter of the other shaft: ø8 mm	 ø50 × 35 mm Diameter of shaft: ø8 mm	Hollow shaft  ø50 × 35 mm Diameter of the other shaft: ø8 mm
Features		● Slim design: ø38-mm outer diameter and 30-mm depth ● Small diameter lineup up to 2,500 P/R ● Low cost contributes to system-wide cost reductions. ● 200-kHz high-speed response ● Wide range of resolutions	● Can connect directly to the other shaft without using a coupling. ● Slim design: ø38-mm outer diameter and 30-mm depth ● Small diameter lineup up to 2,500 P/R ● Low cost contributes to system-wide cost reductions. ● 200-kHz high-speed response ● Wide range of resolutions	● Small body with only 35 mm depth ● Protection options to meet environmental requirements ● Wide range of resolution ø8 mm thick reinforced shaft ● Source voltage ranging from 5 to 30 V ● Totem-pole output facilitating cable extension	● Can connect directly to the other shaft without using a coupling. ● Slim design with only 35 mm depth ● Select protective design to suit operating environment. ● Wide range of resolutions ● Solid ø8-mm shaft ● Source voltage ranging from 5 to 30 V ● Totem-pole output facilitating cable extension
Resolution		10 to 2500 (pulse/revolution)	10 to 2500 (pulse/revolution)	1 to 2500 (pulse/revolution)	1 to 2500 (pulse/revolution)
Signal output		Two-phase A and B + Phase Z	Two-phase A and B + Phase Z	Two-phase A and B + Phase Z	Two-phase A and B + Phase Z
Max. response frequency		200 kHz	200 kHz	100 kHz	100 kHz
Max. allowable revolution		6000 rpm	6000 rpm	5000 rpm	5000 rpm
Source voltage		TRD-S□A: 5 to 12 VDC±10% TRD-S□B: 12 to 24 VDC±10% TRD-S□V: 5 VDC±5%	TRD-SH□A: 5 to 12 VDC±10% TRD-SH□B:12 to 24 VDC±10% TRD-SH□V: 5 VDC±5%	4.75 to 30 VDC	4.75 to 30 VDC
Output type		NPN open collector output Line driver output	NPN open collector output Line driver output	Totem-pole output with partial load short circuit protection	Totem-pole output with partial load short circuit protection
Max. load to shaft	**Radial**	20 N	20 N	50 N	50 N
	Thrust	10 N	10 N	30 N	30 N
Initial torque		0.001 N•m max.	0.001 N•m max.	Dust proof: 0.003 N•m max. Dust and splash proof: 0.02 N•m max.	Dust proof: 0.003 N•m max. Dust and splash proof: 0.05 N•m max.
Protection		IP40: Simple dust proofed	IP40: Simple dust proofed	IP50: Dust proofed IP65: Dust and splash proofed	IP50: Dust proofed IP65: Dust and splash proofed
Operating temperature		–10 to +70°C	–10 to +70°C	–10 to +70°C	–10 to +70°C
Reference page		6	6	8	8

		Absolute		
TRD-J series	**TRD-GK series**	**TRD-NA series**	**TRD-K series**	**TRD-KL series**
				
ø50 × 50 mm Diameter of shaft: ø8 mm	ø78 × 60 mm Diameter of shaft: ø10 mm	ø50 × 35 mm Diameter of shaft: ø8 mm	ø78 × 66 mm Diameter of shaft: ø10 mm	ø78 × 66 mm Diameter of shaft: ø10 mm
◗ ø8 mm thick shaft and 50 mm body ◗ Vibration and shock resistant metal slit plate ◗ Source voltage ranging from 5 to 30 V ◗ Totem-pole output facilitating cable extension	● Strong shaft and durable bearing ● Quick response at 100 kHz ● Operating temperature ranging from –10 to +70°C ● Dust and splash proofed ● Totem-pole output facilitating cable extension	● Absolute positioning ● Dust and splash proofed ● Small body with only 35 mm depth ● Reinforced aluminum diecast casing ● Accurate Gray code ● Vibration and shock resistant metal slit plate	● Absolute positioning ● Resolution of up to 10 bits or 1,024 ● Strong shaft and durable bearing ● Dust and splash proofed ● Accurate Gray code ● Vibration and shock resistant metal slit plate	● Side cable and connector for minimum space ● Absolute positioning ● Resolution of up to 10 bits or 1,024 ● Reinforced aluminum diecast casing ● Dust and splash proofed ● Accurate Gray code ● Vibration and shock resistant metal slit plate
10 to 1000 (pulse/revolution)	10 to 5000 (pulse/revolution) (BZ: 100 to 5000 pulse/revolution)	32 to 1024 (resolution/revolution)	180 to 1024 (resolution/revolution)	180 to 1024 (resolution/revolution)
Two-phase A and B + Phase Z	Two-phase A and B + Phase Z (BZ: Normal/Reverse + Phase Z)	Gray binary code (10 bits max.)	Gray binary code (10 bits max.)	Gray binary code (10 bits max.)
50 kHz	100 kHz	20 kHz	20 kHz	20 kHz
5000 rpm	5000 rpm	3000 rpm	5000 rpm	5000 rpm
Excluding TRD-J□: 4.75 to 30 VDC TRD-J□V: 5 VDC±5%	10 to 30 VDC	10.8 to 26.4 VDC	10.8 to 26.4 VDC	10 to 30 VDC
Totem-pole structure preventing partial load short circuit Line driver output	Totem-pole structure preventing load short circuit	Open collector NPN or PNP	Open collector NPN	Open collector NPN
50 N	100 N	50 N	100 N	70 N
30 N	50 N	30 N	50 N	40 N
Dust proof: 0.003 N•m max. Dust and splash proof: 0.05 N•m max.	0.1 N•m max.	0.03 N•m max.	0.1 N•m max.	0.1 N•m max.
IP50: Dust proofed IP65: Dust and splash proofed	IP65: Dust and splash proofed	IP65: Dust and splash proofed	IP65: Dust and splash proofed	IP65: Dust and splash proofed
–10 to +50°C	–10 to +70°C	–10 to +60°C	–10 to +50°C	–10 to +60°C
13	18	22	25	38

TRD-S/SH Series Incremental Encoders

■ Features

- Small body with 38 mm diameter and 30 mm depth
- Although compact, lineup reaches 2,500 P/R
- Low cost contributes to system cost-effectiveness.

■ List of model numbers

Type	Appearance	Model number	Source voltage	Output	Output type	Pulse/revolution
Shaft		TRD-S□A	4.5 to 13.2 VDC	2-phase with home position in reverse operation ⌝⌞⌜	Open collector output	* 10, 20, 30, 40, 50, 60, 100, 200, 250, 300, 360, 400, 500, 600, 800, 1000, 1024, 1200, 2000, 2500 * 10 to 60: Open collector output only.
		TRD-S□B	10.8 to 26.4 VDC			
		TRD-S□V	4.75 to 5.25 VDC	2-phase with home position in forward operation ⌐⌟⌐	Line driver output	
Hollow shaft		TRD-SH□A	4.5 to 13.2 VDC	2-phase with home position in reverse operation ⌝⌞⌜	Open collector output	
		TRD-SH□B	10.8 to 26.4 VDC			
		TRD-SH□V	4.75 to 5.25 VDC	2-phase with home position in forward operation ⌐⌟⌐	Line driver output	

■ Model numbering system

TRD- S □ A

- Series
  - **S:** Shaft
  - **SH:** Hollow shaft
- Pulse/revolution
- Model
  - **A:** Source voltage 4.5 to 13.2 VDC, open collector output
  - **B:** Source voltage 10.8 to 26.4 VDC, open collector output
  - **V:** Source voltage 4.75 to 5.25 VDC, line driver output

■ Pulse and frequencies

Pulse/revolution		10	20	30	40	50	60	100	200	250	300	360	400	500	512	600	800	1000	1024	1200	2000	2500
Max. response frequency (kHz)*		1	2	3	4	5	6	10	20	25	30	36	40	50	50	60	80	100	100	120	200	200
Applicable models	TRD-S□A/TRD-SH□A	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	TRD-S□B/TRD-SH□B	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	TRD-S□V/TRD-SH□V							●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

* Maximum response frequency is defined by the following formula:
Maximum revolution speed = (Maximum response frequency/Pulse) X 60
The encoder does not respond to revolution faster than the maximum speed.

■ Electrical Specifications

Model			TRD-S□A/TRD-SH□A	TRD-S□B/TRD-SH□B	TRD-S□V/TRD-SH□V
Power source	Power source voltage		4.5 to 13.2 VDC	10.8 to 26.4 VDC	4.75 to 5.25 VDC
	Allowable ripple		3% rms max.		—
	Current consumption		50 mA max.		50 mA max.
Signal waveform			Two-phase + home position		Two-phase + home position
Maximum response frequency			200 kHz		200 kHz
Duty ratio			50 ± 25%		50 ± 25%
Phase difference width			25 ± 12.5%		25 ± 12.5%
Signal width at home position			100 ± 50%		100 ± 50%
Output	Rise / Fall time		1 µs max. (when cable length is 1 m)		—
	Output type		NPN open collector output		Line-driver*
	Output logic		Negative logic (active low)		Positive logic (active high)
	Output voltage	"H"	—		2.5 V min.
		"L"	0.4 V max.		0.5 V max.
	Influx current		30 mA max.		—
	Load power voltage		30 VDC max.		—

* Equivalent to 26C31, lever is equivalent to 26C32.

■ Mechanical specifications

Initial torque	0.001 N•m (+20°C) max.
Moment of inertia	0.3×10^{-6}kg•m^2
Allowable load	Radial:20 N
	Thrust:10 N
Maximum allowable speed (Note 1)	6000 rpm
Cable	External diameter ø5 mm 5-wire oil-proof shielded vinyl chloride cable Nominal section area of core: 0.14 mm^2 (Line driver output: 8 cores, 0.14 mm^2)
Weight	Approx. 100 g

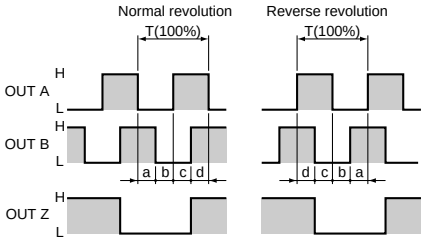
Note 1: Highest speed that can support mechanical integrity of the encoder

■ Environmental requirements

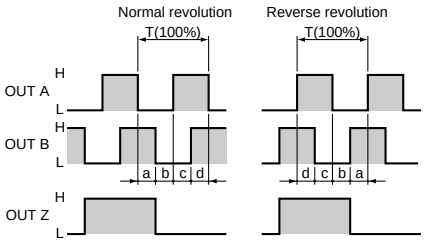
Ambient temperature	–10 to +70°C
Storage temperature	–25 to +85°C
Operating humidity	35 to 85% RH (with no condensation)
Withstand voltage	500 VAC (50 Hz/60 Hz) for one minute
Insulation resistance	50 MΩ min.
Vibration resistance	Durable for one hour along three axes at 10 to 55 Hz with 0.75 mm amplitude
Shock resistance	11 ms with 490 m/s^2 applied three times along three axes
Protection	Simple dust protection: IP40

■ Output signal timing chart

TRD-S□A/TRD-SH□A
TRD-S□B/TRD-SH□B

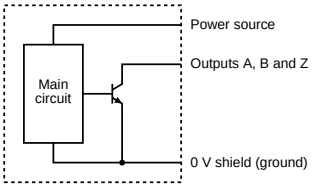


TRD-S□V/TRD-SH□V

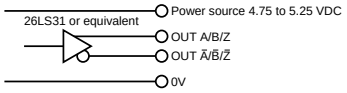


a, b, c, =1/4T±1/8T
"Normal" means clockwise revolution viewed from the shaft.

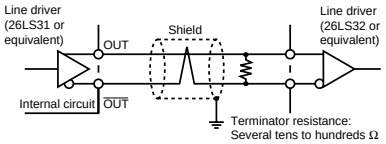
■ Open collector output circuit



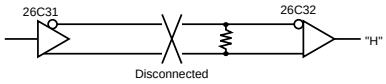
■ Line driver output circuit



● The line driver can use a RS-422A compliant twisted pair cable of up to 1,200 m.

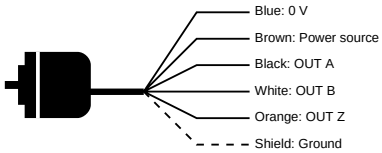


● Output signal turns to "H" level when the cable or connector is disconnected.



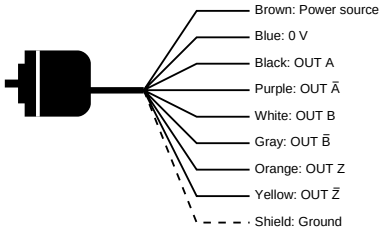
■ Open collector connections

Shielded cable is not connected to the encoder body.



■ Line driver connections

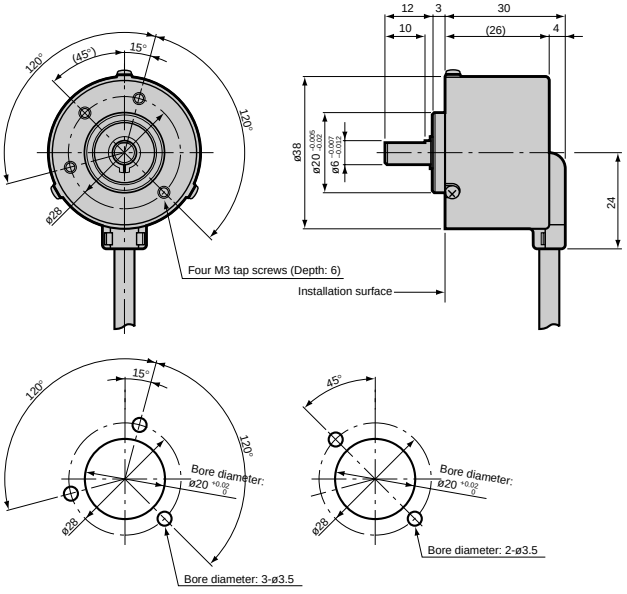
Shielded cable is not connected to the encoder body.



External Dimensions

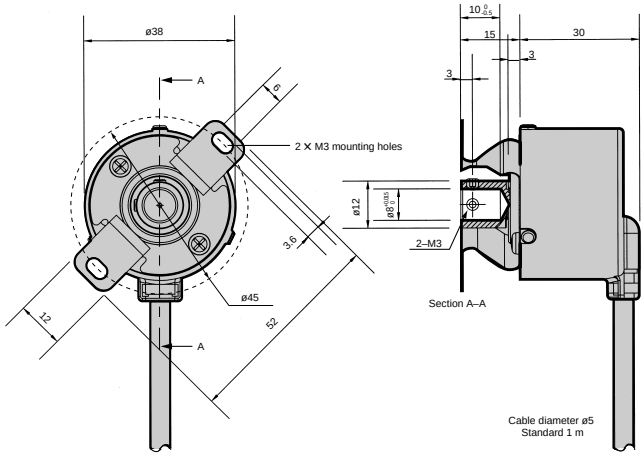
(in mm)

TRD-S□A/TRD-S□B/TRD-S□V



Mounting hole panel cutout (3 holes) Mounting hole panel cutout (2 holes)

TRD-SH□A/TRD-SH□B/TRD-SH□V



TRD-N/NH Series Incremental Encoders

■ Features

- Small body with 50 mm diameter and 35 mm depth
- Protection options to meet environmental requirements
  Dust and splash proofed (IP65) aluminum diecast casing
- Resolution ranging from 1 to 2,500 P/R
- ø8 mm thick reinforced stainless steel shaft
- Operating voltage ranging from 4.75 to 30 VDC
- Servo mounting is available for easy installation

■ List of model numbers

Type	Appearance	Model number	Output	Pulse/revolution
Dust proofed **ABS plastic cover**		**TRD-N□-S**	One-phase	1, 3, 4, 5, 10, 20, 30, 60, 100, 120, 200, 300, 360, 500, 600, 1000
		TRD-N□-RZ	Two-phase with home position in normal operation ⎍⎍	3, 4, 5, 10, 20, 30, 40, 50, 60, 100, 120, 200, 240, 250, 300, 360, 400, 480, 500, 600, 750, 1000, 1200, 2000, 2500
		TRD-N□-RZL	Two-phase with home position in reverse operation ⎎⎎	
Dust and splash proofed **Aluminium die-cast cover**		**TRD-N□-SW**	One-phase	1, 3, 4, 5, 10, 20, 30, 60, 100, 120, 200, 300, 360, 500, 600, 1000
		TRD-N□-RZW	Two-phase with home position in normal operation ⎍⎍	3, 4, 5, 10, 20, 30, 40, 50, 60, 100, 120, 200, 240, 250, 300, 360, 400, 480, 500, 600, 750, 1000, 1200, 2000, 2500
		TRD-N□-RZWL	Two-phase with home position in reverse operation ⎎⎎	
Dust proof hollow shaft **ABS plastic cover**		**TRD-NH□-S**	One-phase	1, 3, 4, 5, 10, 20, 30, 60, 100, 120, 200, 300, 360, 500, 600, 1000
		TRD-NH□-RZ	Two-phase with home position in normal operation ⎍⎍	3, 4, 5, 10, 20, 30, 40, 50, 60, 100, 120, 200, 240, 250, 300, 360, 400, 480, 500, 600, 750, 1000, 1200, 2000, 2500
		TRD-NH□-RZL	Two-phase with home position in reverse operation ⎎⎎	
Dust and splash proof Hollow shaft **Aluminium die-cast cover**		**TRD-NH□-SW**	One-phase	1, 3, 4, 5, 10, 20, 30, 60, 100, 120, 200, 300, 360, 500, 600, 1000
		TRD-NH□-RZW	Two-phase with home position in normal operation ⎍⎍	3, 4, 5, 10, 20, 30, 40, 50, 60, 100, 120, 200, 240, 250, 300, 360, 400, 480, 500, 600, 750, 1000, 1200, 2000, 2500
		TRD-NH□-RZWL	Two-phase with home position in reverse operation ⎎⎎	

■ Model numbering system

TRD-[N][ ]-[RZ][W][L]-[ ]

- Series
  N : Shaft
  NH : Hollow shaft
- Pulse/revolution
- Output signal
  S : One-phase
  RZ : Two-phase with home position in normal operation
- Protection
  Blank : Dust proofed (IP50)
  W : Dust and splash proofed (IP65)
- Home position reverse operation symbol
  If output signal is RZ, model numbers with "L" are home position reverse operation type.
- (Available options)

■ Pulse and frequencies

Pulse/revolution		1	3	4	5	10	30	40	50	60	100	120	200	240	250	300	360	400	480	500	600	750	1000	1200	2000	2500
Max. response frequency (kHz)		0.08	0.25	0.33	0.41	0.8	2.5	3.3	4.1	4.9	8.3	9.9	16	19	20	24	29	33	39	41	49	62	83	100	100	100
Applicable models	TRD-N□-S□	●	●	●	●	●	●			●	●	●	●			●	●			●	●		●			
	TRD-NH□-S□																									
	TRD-N□-RZ□		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	TRD-NH□-RZ□																									
	TRD-N□-RZL		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	TRD-NH□-RZL																									
	TRD-N□-RZWL		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	TRD-NH□-RZWL																									

* Maximum response frequency is defined by the following formula:
Maximum revolution speed = (Maximum response frequency/Pulse) × 60
The encoder does not respond to revolution aster than the maximum speed.

■ Specifications

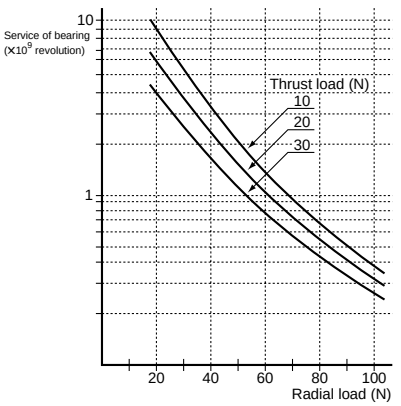
Model number			TRD-N□-S□ TRD-NH□-S□	TRD-N□-RZ□ /TRD-N□-RZ□L TRD-NH□-RZ□ /TRD-NH□-RZ□L
Power source	Power source voltage		4.75 to 30 VDC	4.75 to 30 VDC
	Allowable ripple		3% rms max.	3% rms max.
	Current consumption (no load)		40 mA max.	60 mA max.
Output wave form	Output signal type		One-phase	Two-phase + home position
	Duty ratio		50 ± 25% (square wave)	50 ± 25% (square wave)
	Signal width at home position		—	100 ± 50%
	Rise/Fall time		3 μs max.	3 μs max.
Output	Output type		Totem-pole	Totem-pole
	Output current	Outflow "H"	10 mA max.	10 mA max.
		Inflow "L"	30 mA max.	30 mA max.
	Output voltage	"H"	[(Load power voltage) – 2.5 V] min.	[(Load power voltage) – 2.5 V] min.
		"L"	0.4 V max.	0.4 V max.
	Load power voltage		35 VDC max.	35 VDC max.

Initial torque	Dust proof: 0.003 N•m max. (+20°C), Dust and splash proof: 0.02 N•m max. (+20°C), Hollow shaft: 0.05 N•m max. (+20°C)
Moment of inertia	2×10^{-6} kg•m^2
Allowable load	Radial: 50 N
	Thrust: 30 N
Maximum allowable speed (Note 1)	5000 rpm (Dust and splash proofed: Continuous: 3000 rpm, Instantaneous: 5000 rpm)
Cable	External diameter: ø6 mm 5-wire oil-proofed shielded cable Nominal section area of core: 0.3 mm^2
Weight	Approx. 150 g (Dust and splash proofed: Approx. 200 g)

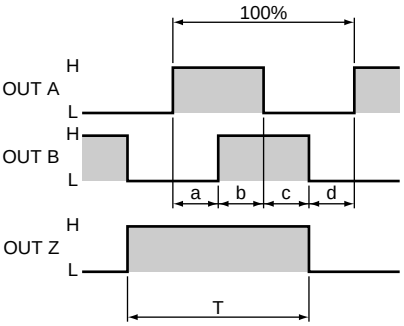
Note 1: Highest speed that can support mechanical integrity of the encoder

Ambient temperature	–10 to +70°C
Storage temperature	–25 to +85°C
Operating humidity	35 to 85% RH (with no condensation)
Withstand voltage	500 VAC at 50/60 Hz for 1 min (Excluding shield between power supply, signal cable, and case.)
Insulation resistance	50 MΩ min.
Vibration resistance	Durable for one hour along three axes at 10 to 55 Hz with 0.75 mm amplitude
Shock resistance	Metal slit plate at 500 P/R or less: 11 ms with 981 m/s^2 Glass slit plate at 600 P/R or more: 11 ms with 490 m/s^2 Applied three times along three axes
Protection	IP50: Dust proofed IP65: Dust and splash proofed

● Service life of bearing



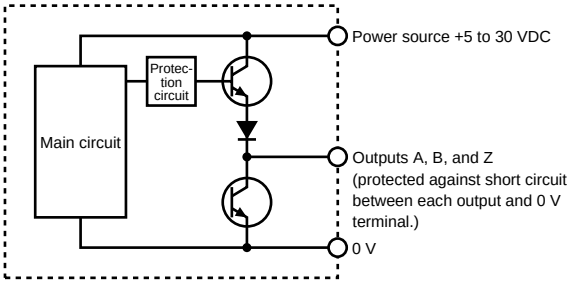
■ Output signal timing chart



12.5% ≤ a, b, c, d ≤ 37.5%
50% ≤ T ≤ 150%

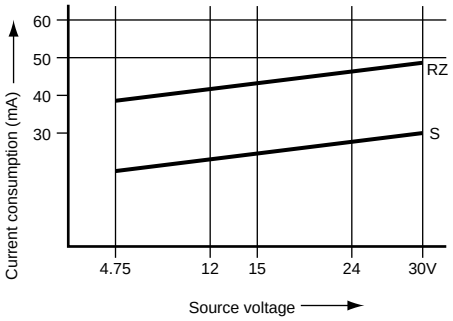
The above waveforms apply to normal (clockwise) revolution viewed from the shaft. OUT Z phase is reversed on the RZL and RZWL models.

■ Output circuit



■ Electrical characteristics (typical)

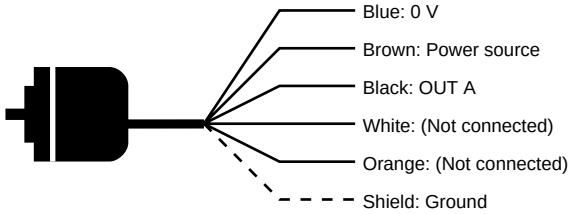
Current consumption



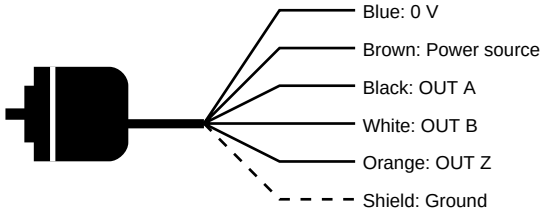
■ Terminal assignment

Shielded cable is not connected to the encoder body.

One-phase: TRD-N□-S□
: TRD-NH□-S□



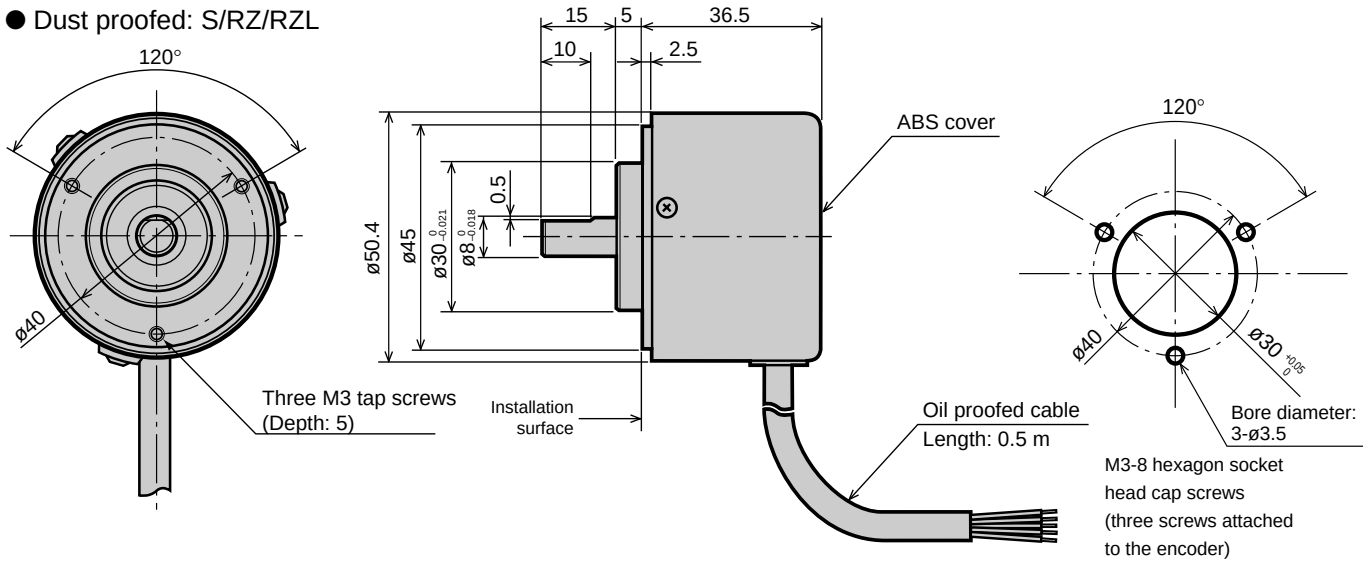
Two-phase with home position: TRD-N□-RZ□/RZ□L
: TRD-NH□N-RZ□/RZ□L



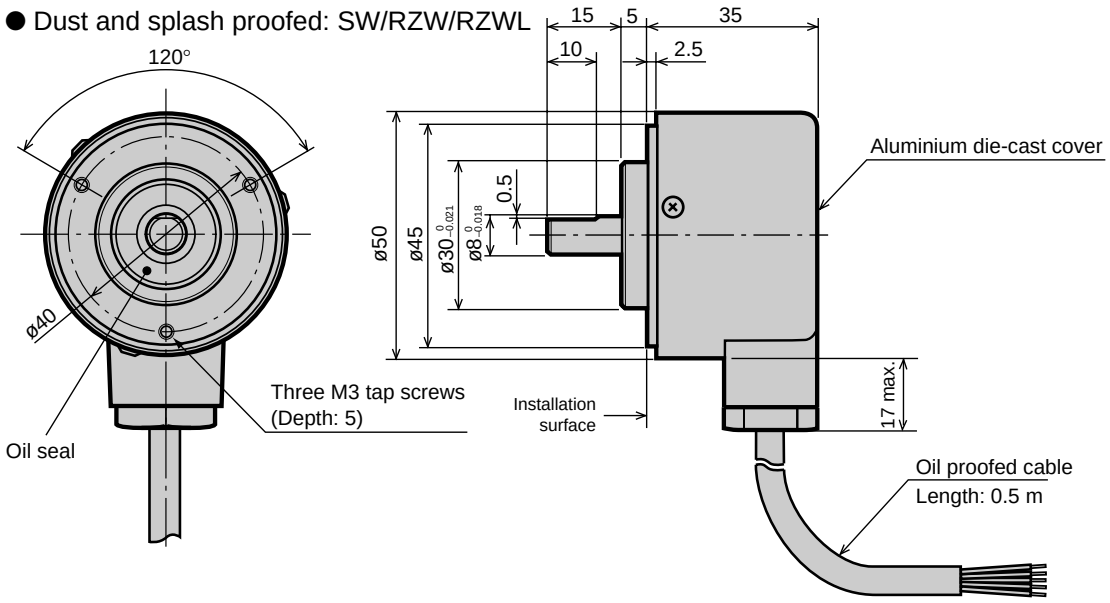
Dimensions TRD-N Series (shaft type)

(in mm)

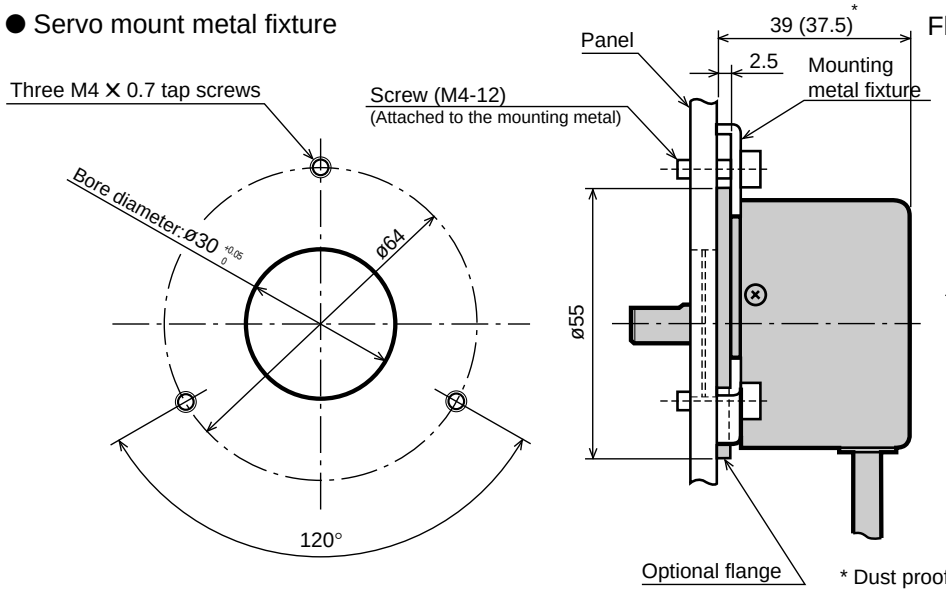
● Dust proofed: S/RZ/RZL



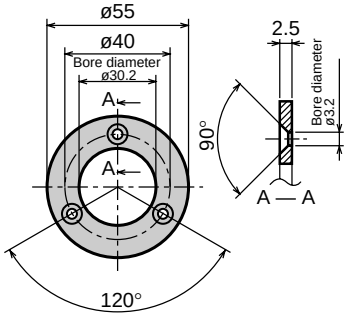
● Dust and splash proofed: SW/RZW/RZWL



● Servo mount metal fixture

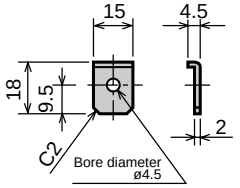


Flange **NF-55** (Option)



Servo mount metal fixture **NM-9**

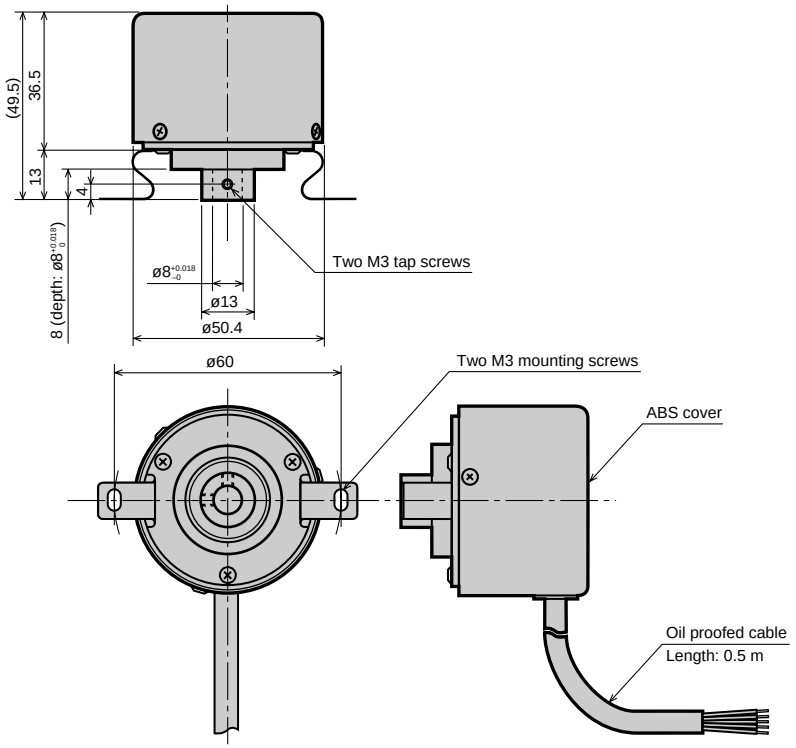
Attachment to optional flange



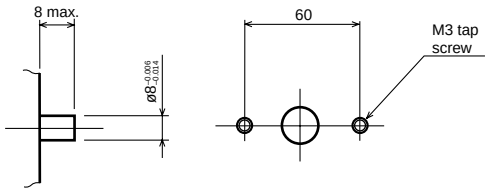
Dimensions TRD-NH Series (hollow shaft)

Unit: mm

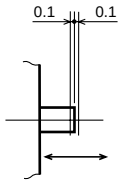
● Dust proofed : **S / RZ / RZL**



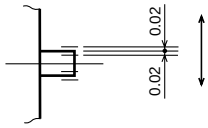
Mounting part



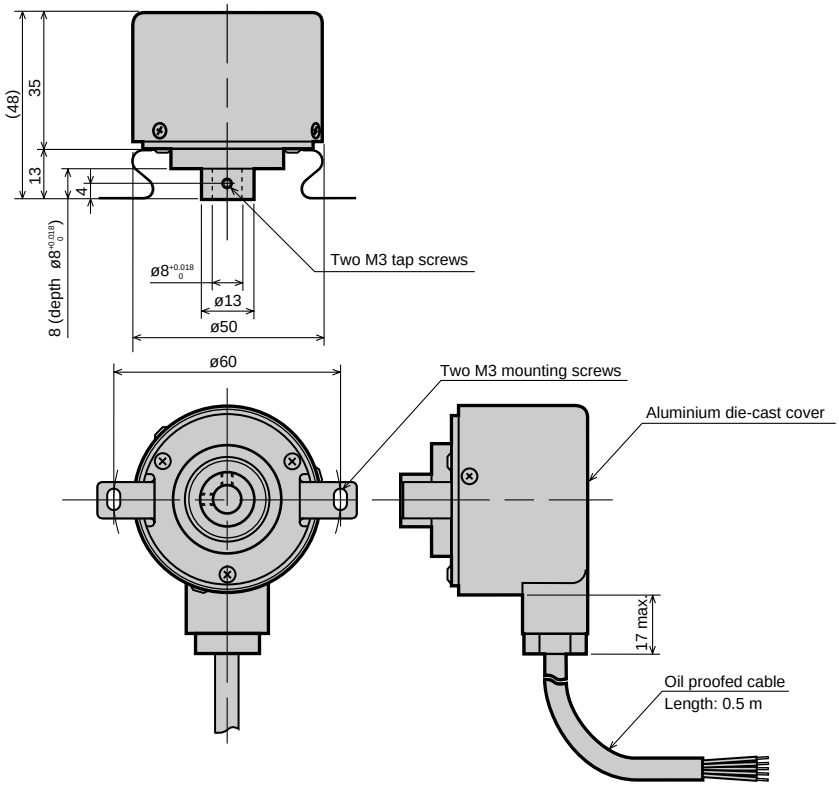
Shaft direction variation



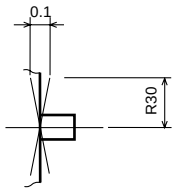
Shaft angle direction variation



● Dust and splash proofed : **SW/RZW/RZWL**



Degree of mounting surface angle over shaft.

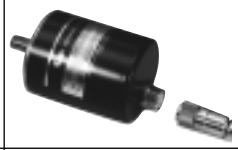


TRD-J Series Incremental Encoders

■ Features

- ø8 mm thick shaft and ø50 mm body
- Vibration and shock resistant metal slit plate durable at 1,000 P/R
- Operating voltage ranging from 4.75 to 30 VDC
- Totem-pole output facilitating cable extension

■ List of model numbers

Type	Appearance	Model number	Output	Pulse / revolution
With rear cable		TRD-J□-S	One-phase	
		TRD-J□-RZ	Two-phase with home position in normal operation ⎍	
		TRD-J□-RZL	Two-phase with home position in reverse operation ⎎	
		TRD-J□-RZV	Two-phase with home position and line driver	10*
Dust and splash proofed		TRD-J□-SW	One-phase	30
		TRD-J□-RZW	Two-phase with home position in normal operation ⎍	40
		TRD-J□-RZWL	Two-phase with home position in reverse operation ⎎	50
		TRD-J□-RZVW	Two-phase with home position and line driver	60
With connector		TRD-J□-SC	One-phase	100
		TRD-J□-RZC	Two-phase with home position in normal operation ⎍	120
		TRD-J□-RZCL	Two-phase with home position in reverse operation ⎎	200
		TRD-J□-RZVC	Two-phase with home position and line driver	240
Dust and splash proofed with connector		TRD-J□-SCW	One-phase	300
		TRD-J□-RZCW	Two-phase with home position in normal operation ⎍	360
		TRD-J□-RZCWL	Two-phase with home position in reverse operation ⎎	400
		TRD-J□-RZVCW	Two-phase with home position and line driver	500
With side cable		TRD-J□-SS Note 1	One-phase	600
		TRD-J□-RZS Note 1	Two-phase with home position in normal operation ⎍	750
		TRD-J□-RZSL Note 1	Two-phase with home position in reverse operation ⎎	1000
		TRD-J□-RZVS Note 1	Two-phase with home position and line driver	* One-phase only for 10 pulse
Dust and splash proofed with side cable		TRD-J□-SWS Note 1	One-phase	
		TRD-J□-RZWS Note 1	Two-phase with home position in normal operation ⎍	
		TRD-J□-RZWSL Note 1	Two-phase with home position in reverse operation ⎎	
		TRD-J□-RZVWS Note 1	Two-phase with home position and line driver	

Note: Consult your OMRON dealer for delivery period.

■ Model numbering system

TRD-J □ -RZ V W L - ☐

- Series
- Pulse/revolution
- Output signal
  S: One-phase/**RZ:** Two-phase with home position in normal operation
- Output type
  Blank: Totem-pole/**V:** Line driver
- Connection
  Blank: Rear cable
  W: Dust and splash proofed/**C:** Connector/**CW:** Dust and splash proofed with connector
  S : Side cable/**WS:** Dust and splash proofed with side cable
- Home position reverse operation symbol
  If output signal is RZ, model numbers with "L" are home position reverse operation type.
- (Available options)

■ Pulse and frequencies

Pulse/revolution		10	30	40	50	60	100	120	200	240	300	360	400	500	600	750	1000
Max. response frequency (kHz)*		0.5	1.5	2	2.5	3	5	6	10	12	15	18	20	25	30	37.5	50
Applicable models	TRD-J□-S□	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	TRD-J□-RZ□		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	TRD-J□-RZV□		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

* Maximum response frequency is defined by the following formula:
Maximum revolution speed = (Maximum response frequency/Pulse) × 60
The encoder dows not respond to revolution faster than the maximum speed.

■ Electrical Specifications

Model			TRD-J□-S□	TRD-J□-RZ□	TRD-J□-RZV□
Power source	Power source voltage		4.75 to 30 VDC	4.75 to 30 VDC	4.75 to 5.25 VDC
	Allowable ripple		3% rms max.	3% rms max.	3% rms max.
	Current consumption (no load)		40 mA (See "Electrical Characteristics" below.) max.	60 mA (See "Electrical Characteristics" below.) max.	130 mA max.
Output wave form	Output signal type		One-phase	Two-phase + home position	Two-phase + home position
	Duty ratio		50 ± 25% (square wave)	50 ± 25% (square wave)	50 ± 25% (square wave)
	Signal width at home position		—	50 to 150%	50 to 150%
	Rise/Fall time		3 µs (Max. Cable 50 cm) max.	3 µs (Max. Cable 50 cm) max.	2 µs (Max. Cable 50 cm) max.
Output	Output Type		Totem-pole	Totem-pole	Line-driver*
	Output current	Outflow "H"	10 mA max.	10 mA max.	—
		Inflow "L"	30 mA max.	30 mA max.	—
	Output voltage	"H"	[(Load power voltage) – 2.5 V] min.	[(Load power voltage) – 2.5 V] min.	2.5 V max.
		"L"	0.4 V max.	0.4 V max.	0.5 V max.
	Output standard	TTL 5V	10TTL	10TTL	—
	Load power voltage		30 VDC max.	30 VDC max.	—

* Equivalent to 26LS31
(Output signal is compatible to TTL)

■ Mechanical specifications

Initial torque	0.003 N•m (+20°C) max. (Dust and splash proofed: Min. 0.02 N•m)
Moment of inertia	2×10^{-6} kg•m^2
Allowable load	Radial: 50 N
	Thrust: 30 N
Maximum allowable speed (Note 1)	5000 rpm (Dust and splash proofed: 3000 rpm)
Service life of bearing	5×10^9 revolution (calculated value at the maximum load)
Cable	External diameter ø5 mm (W type: ø6 mm) 5-wire oil-proof shielded vinyl chloride cable Nominal section area of core: 0.3 mm^2 (Line driver output: 8 cores, 0.14 mm^2)
Weight	220 g (with 0.5 m cable) max.

Note 1: Highest speed that can support mechanical integrity of the encoder

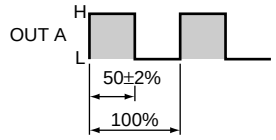
■ Environmental requirements

Ambient temperature	–10 to +50°C
Storage temperature	–25 to +85°C
Operating humidity	35 to 85% RH (with no condensation)
Withstand voltage	500 VAC for one minute (between terminals and case)
Insulation resistance	50 MΩ min.
Vibration resistance	Durable for one hour along three axes at 10 to 55 Hz with 0.75 mm amplitude
Shock resistance	11 ms with 490 m/s^2 applied three times along three axes
Protection	IP50: Dust proofed IP65: Dust and splash proofed

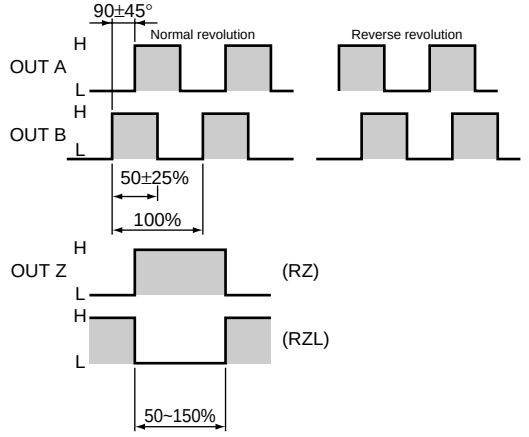
Totem-pole output **TRD-J□ -S□ /TRD-J□ -RZ□**

■ Output signal timing chart

One-phase: **TRD-J□ -S□**



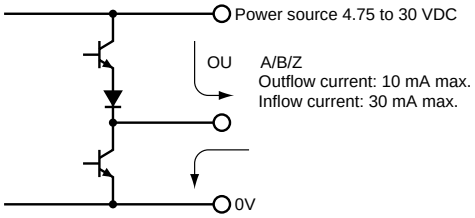
Two-phase with home position: **TRD-J□ -RZ□**



"Normal" means clockwise revolution viewed from the shaft.

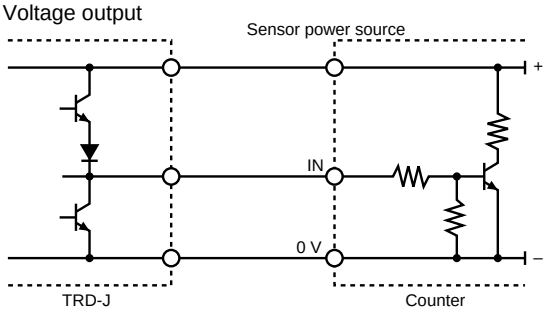
■ Output circuit

Totem-pole output:

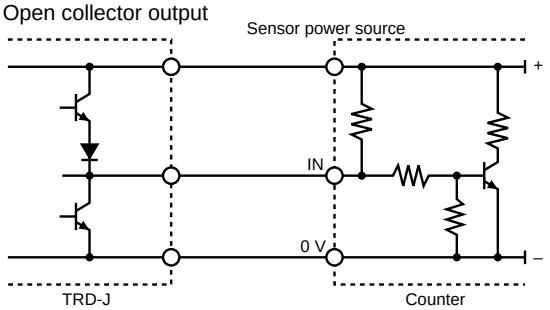


The above circuit can be applied to voltage output or open collector output as follows:

● Voltage output

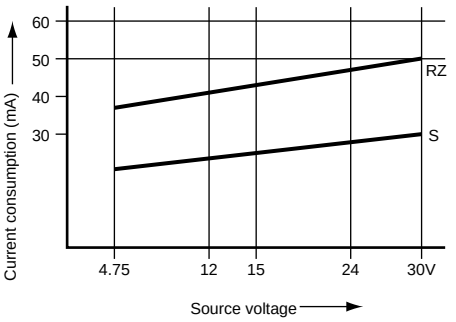


● Open collector output



■ Electrical characteristics

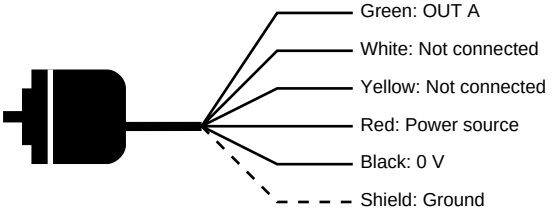
Current consumption characteristics



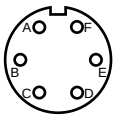
■ Terminal assignment

Shielded cable is not connected to the encoder body.

One-phase: **TRD-J□ -S□**



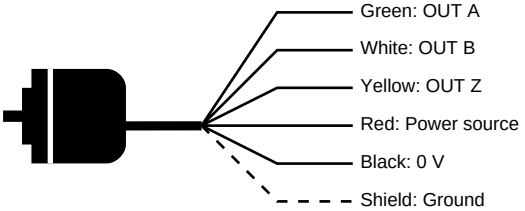
Pin out of connector



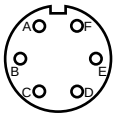
Rear view

Pin code
A: OUT A
B: Not connected
C: Not connected
D: Power source
E: 0V
F: Not connected

Two-phase with home position: **TRD-J□ -RZ□**



Pin out of connector



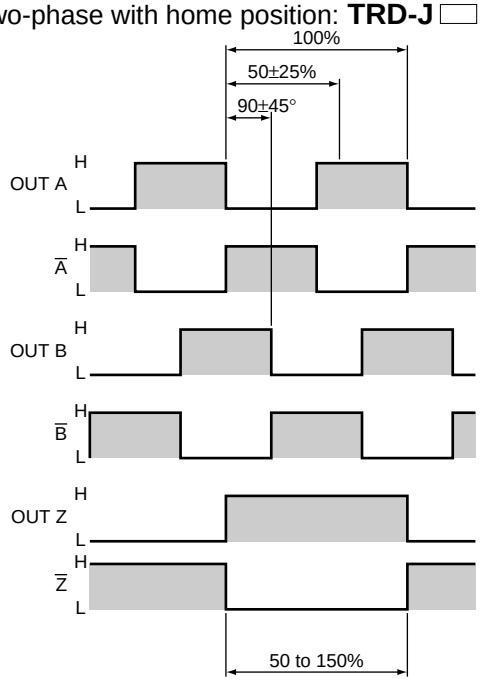
Rear view

Pin code
A: OUT A
B: OUT B
C: OUT Z
D: Power source
E: 0 V
F: Not connected

Line driver **TRD-J ☐ -RZV**

■ Output signal timing chart

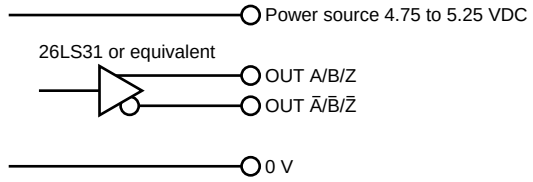
Two-phase with home position: **TRD-J ☐ -RZV ☐**



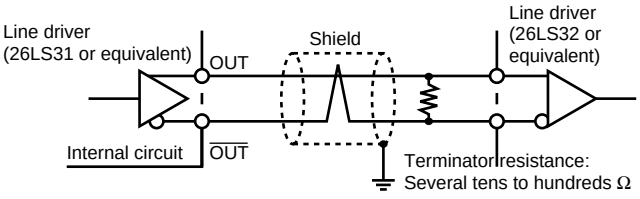
"Normal" means clockwise revolution viewed from the shaft.

■ Output circuit

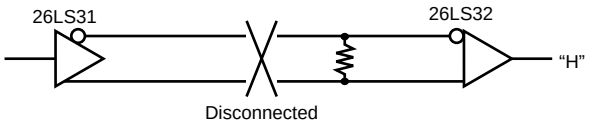
Line driver Output



● The line driver can use a RS-422A compliant twisted pair cable of up to 1,200 m.

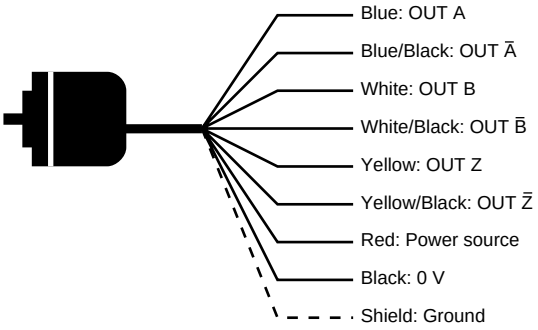


● Output signal turns to "H" level when the cable or connector is disconnected.

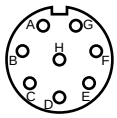


■ Terminal assignment

Shielded cable is not connected to



Pin out of connector



Rear view

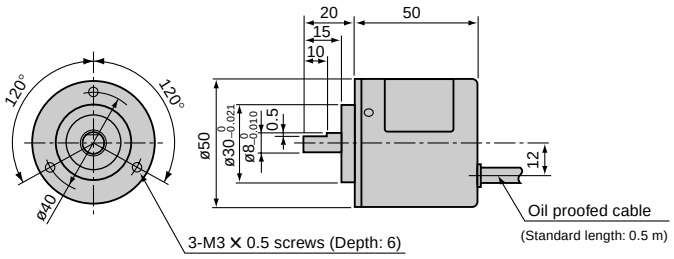
Pin code

A: OUT A
B: OUT Ā
C: OUT B
D: OUT B̄
E: OUT Z
F: OUT Z̄
G: Power source
H: 0 V

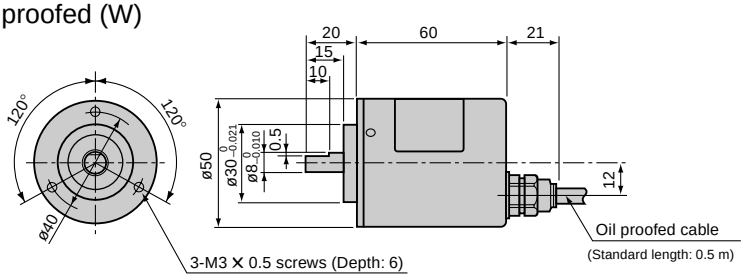
External Dimensions

(in mm)

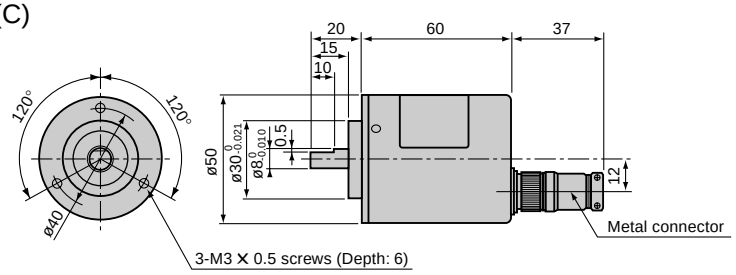
● With side cable



● Dust and splash proofed (W)



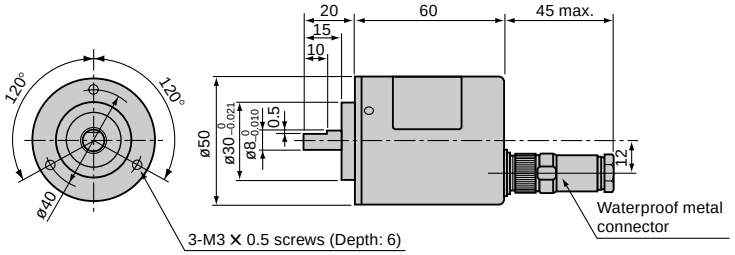
● With connector (C)



Model numbers of connectors
- Totem-pole (S□/RZ□)
  Body: R03-R6F
  Cable: R03-PB6M (Attached)
- Line driver (RZV□)
  Body: R03-R8F
  Cable: R03-PB8M (Attached)
  (of Tajimi Musen)

* Section area: Max. 0.3 mm²
Diameter of cable duct : ø6.2

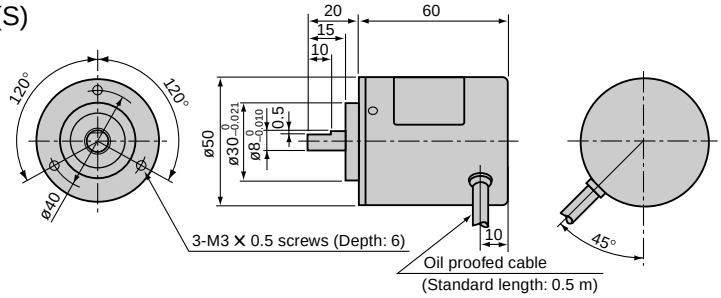
● Dust and splash proofed with connector (CW)



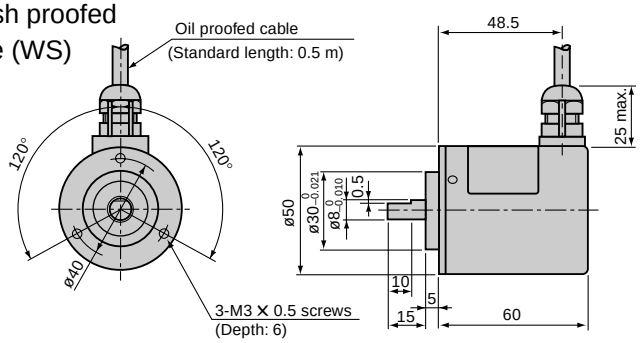
Model numbers of connectors
- Totem-pole (S□/RZ□)
  Body: R04-R6F
  Cable: R04-P6M (Attached)
- Line driver (RZV□)
  Body: R04-R8F
  Cable: R04-P8M (Attached)
  (of Tajimi Musen)

* Section area: Max. 0.3 mm²
Diameter of cable duct : ø6.2

● With side cable (S)



● Dust and splash proofed with side cable (WS)



TRD-GK Series Incremental Encoders

■ Features

- Strong shaft that supports (radial: 100 N, thrust: 50 N)
  Tough bearing serviceable for 1.2 × 10^{10} revolutions
- Quick response and wide ranging operating temperature (–10°C to +70°C)
- Dust and splash proofed
- Totem-pole output allowing longer cable extension
- Servo mounting is available for easy installation

■ List of model numbers

Type	Appearance	Model number	Output	Pulse/revolution
Dust and splash proofed with rear cable		TRD-GK□-R	Two-phase	10, 12, 15, 50, 60
		TRD-GK□-RZ	Two-phase with home position in normal operation ⎍	30, 10, 120, 200, 240, 250, 300, 360, 400, 500, 600, 800, 1000, 1200, 1500, 1800, 2000, 2500, 3600, 5000
		TRD-GK□-RZL	Two-phase with home position in reverse operation ⎎	
		TRD-GK□-BZ	Normal/Reverse detection and home position in normal operation ⎍	30, 60, 100, 120, 200, 240, 250, 300, 360, 400, 500, 600, 800, 1000, 1200, 1500, 1800, 2000, 2500, 3000, 3600, 4000, 5000
Dust and splash proofed with connector		TRD-GK□-RC2	Two-phase	10, 12, 15, 50, 60
		TRD-GK□-RZC2	Two-phase with home position in normal operation ⎍	30, 100, 120, 200, 240, 250, 300, 360, 400, 500, 600, 800, 1000, 1200, 1500, 1800, 2000, 2500, 3600, 5000
		TRD-GK□-RZC2L	Two-phase with home position in reverse operation ⎎	
		TRD-GK□-BZC2	Normal/Reverse detection and home position in normal operation ⎍	30, 60, 100, 120, 200, 240, 250, 300, 360, 400, 500, 600, 800, 1000, 1200, 1500, 1800, 2000, 2500, 3000, 3600, 4000, 5000

■ Model numbering system

TRD-GK□-RZC2L-□

- Series
- Pulse/revolution
- Output signal
  R : Two-phase
  RZ: Two-phase with home position in normal operation
  BZ: With Normal/Reverse detection
- Connection
  Blank: Rear cable
  C2 : Connector
- Home position reverse operation symbol
  If output signal is RZ, model numbers with "L" are home position reverse operation type.
- (Available options)

■ Pulse and frequencies

Pulse/revolution		10	12	15	30	50	60	100	120	200	240	250	300	360	400
Max. response frequency (kHz)*		0.83	1	1.25	2.5	4.17	5	8.33	10	16.7	20	20.8	25	30	33.3
Applicable models	TRD-GK□-R□	●	●	●		●	●								
	TRD-GK□-RZ□				●			●	●	●	●	●	●	●	●
	TRD-GK□-BZ□				●		●	●	●	●	●	●	●	●	●
Pulse/revolution		**500**	**600**	**800**	**1000**	**1200**	**1500**	**1800**	**2000**	**2500**	**3000**	**3600**	**4000**	**5000**	
Max. response frequency (kHz)*		**41.7**	**50**	**66.7**	**83.3**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	
Applicable models	TRD-GK□-R□														
	TRD-GK□-RZ□	●	●	●	●	●	●	●	●	●		●		●	
	TRD-GK□-BZ□	●	●	●	●	●	●	●	●	●	●	●	●	●	

* Maximum response frequency is defined by the following formula:
Maximum revolution speed = (Maximum response frequency / pulse) × 60
The encoder does not respond to revolution faster than the maximum speed.

■ Electrical Specifications

Model number			TRD-GK□-R□/-RZ□	TRD-GK□-BZ□
Power source	Power source voltage		10 to 30 VDC	10 to 30 VDC
	Allowable ripple		3% rms max.	3% rms max.
	Current consumption (Io load)		At less than 16 VDC: 50 mA max./At 16 VDC or more: 70 mA max.	At less than 16 VDC: 50 mA max./At 16 VDC or more: 70 mA max.
Output wave form	Output signal		R: Two-phase/RZ: Two-phase + home position	Normal/Reverse detection + home position
	Duty ratio		50 ± 25%	10 to 60% (2001P or more: 50 ±25%)
	Signal width at home position		At 400P or less: 25 to 150%/At 500P or more: 1° ±30'* (1800P, 3600P, 5000P: 50 to 150%)	At 400P or less: 25 to 150%/At 500P or more: 1° ±30' (60P, 3600P: 100 to 300%, 1800P: 50 to 150%)
	Rise/Fall time		3 μs (Cable: 2 m or shorter) max.	3 μs (Cable: 2 m or shorter) max.
Output	Output type		Totem-pole	Totem-pole
	Output current	Outflow "H"	30 mA max.	30 mA max.
		Inflow "L"	30 mA max.	30 mA max.
	Output voltage	"H"	[(Power source voltage) – 4 V] min.	[(Power source voltage) – 4 V] min.
		"L"	2 V max.	2 V max.
	Load power voltage		35 VDC max.	35 VDC max.

* Home position is not generated on the R model.

■ Mechanincal specifications

Initial torque	0.1 N•m (+20°C) max.
Moment of inertia	1×10^{-5} kg•m^2
Allowable load	Radial: 100 N
	Thrust: 50 N
Maximum allowable speed (Note 1)	5000 rpm
Service life of bearing	1.2×10^{10} revolutions (at maximum allowable load)
Cable	External diameter: ø6 mm 5-wire oil-proofed shielded vinyl chloride cable Nominal section area of core: 0.3 mm^2
Weight	Rear cable type: Approx. 600 g (with 2 m cable) Connector type: Approx. 500 g

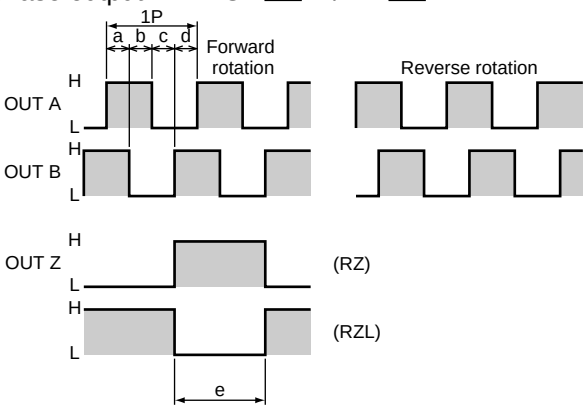
Note 1: Highest speed that can support mechanical integrity of the encoder

■ Environmental requirements

Ambient temperature	–10 to +70°C	
Storage temperature	–25 to +85°C	
Operating humidity	35 to 85% RH (with no dewing)	
Withstand voltage	500 VAC for one minute	Excluding shield between power supply, signal cable, and case.
Insulation resistance	50 MΩ min.	
Vibration resistance	At 500P or less: 0.75 mm At 600P or more: 0.35 mm	Durable for one hour along X, Y, and Z axes at 10 to 55 Hz
Shock resistance	At 500P or less: 11 ms with 980 m/s^2 At 600P or more: 11 ms with 294 m/s^2	Applied three times along X, Y, and Z axes
Protection	IP65: Dust and splash proofed	

■ Output signal timing chart

2-phase output: TRD-GK□-R/-RZ□



a, b, c, d = (1/4±1/8) P

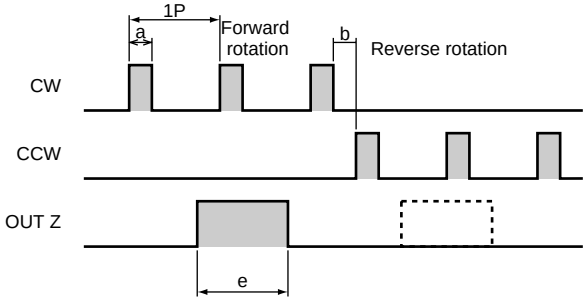
e: 400 P or less: 25 to 150%

500 P or more: 1°±30'

(At 1,800, 3,600, 5000 pulses only: 50 to 150%)

* OUT Z generates home position in both directions.
* OUT Z is not included in the R model.

Normal/Reverse detection: TRD-GK□-BZ□



a = (1/4±1/8) P b ≥ 1/4P

e: 400 P or less: 25 to 150%

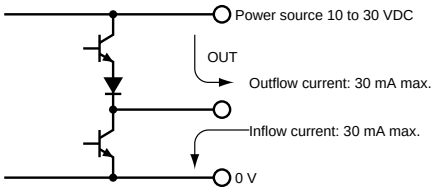
500 P or more: 1°±30'

(At 60, 3,600 P: 100 to 300%, 1,800 P: 50 to 150%)

* OUT Z generates home position in both directions.
* OUT Z is not included in the R model.

■ Output circuit

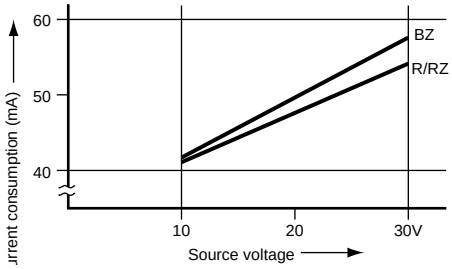
Totem-pole output:



Totem-pole output is compatible with both voltage output and open collector output.

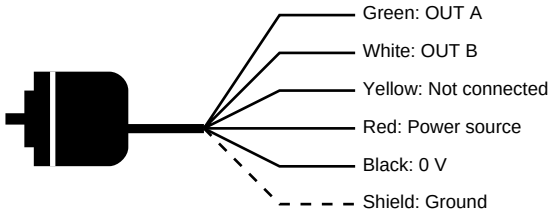
For connection examples, refer to page 15, TRD-J Series.

■ Electrical characteristics (typical)

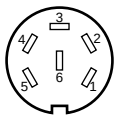


■ Terminal assignment

TRD-GK□-R□



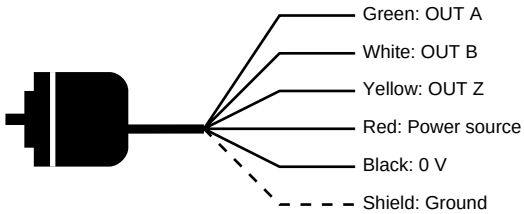
Pin out of connector



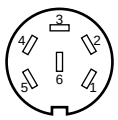
Rear view

Pin number
1: OUT A
2: OUT B
3: Not connected
4: Power source
5: 0 V
6: Shield

TRD-GK□-RZ□



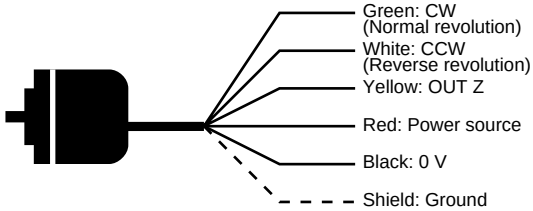
Pin out of connector



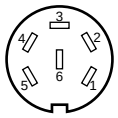
Rear view

Pin number
1: OUT A
2: OUT B
3: OUT Z
4: Power source
5: 0 V
6: Shield

TRD-GK□-BZ□



Pin out of connector



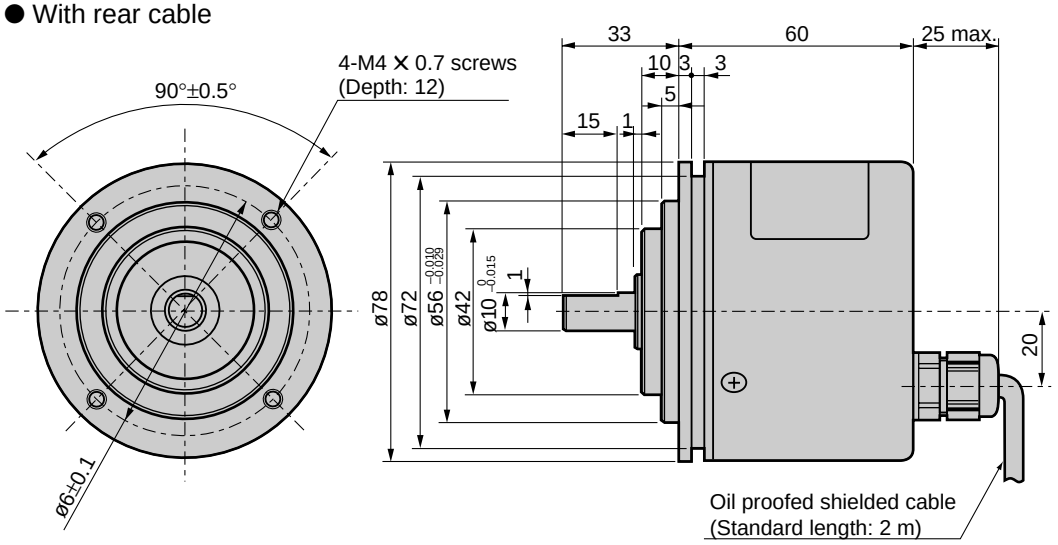
Rear view

Pin number
1: CW
2: CCW
3: OUT Z
4: Power source
5: 0 V
6: Shield

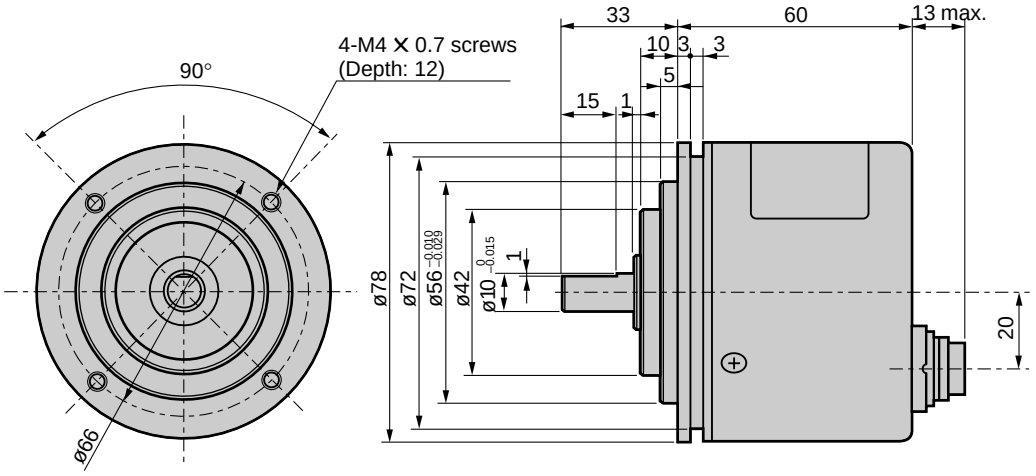
External Dimensions

(in mm)

● With rear cable



● With connector (C2)

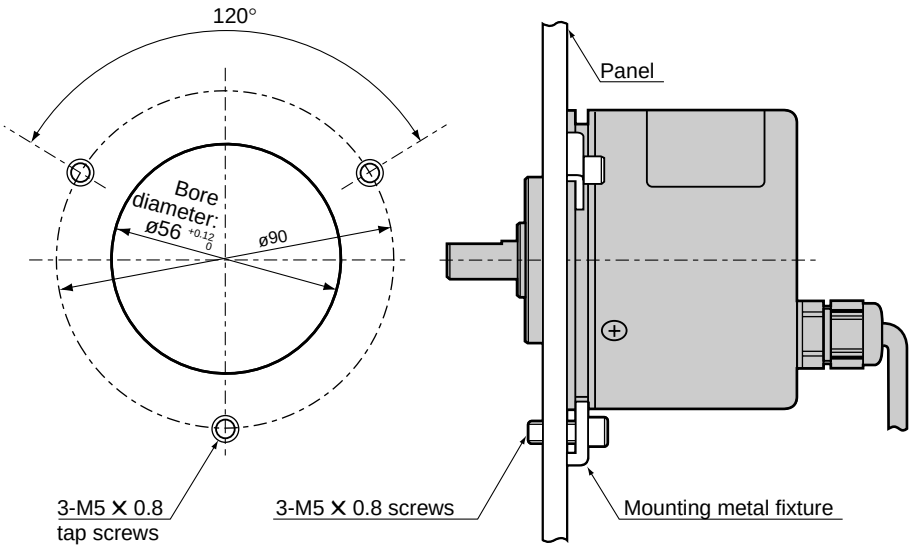


Model numbers of connectors (option)

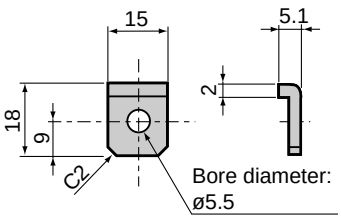
- Straight: BMCC-6
- Angular: BAFC-6

* Refer to page 32 for detailed descriptions of the options.

● Servo mount metal fixture



KM-9 attachments (option)



TRD-NA Series Absolute Encoders

■ Features

- Small body with ø50 mm diameter and 35 mm depth
- Dust and splash proofed with reinforced aluminum diecast casing
- ø8 mm thick reinforced stainless steel shaft
- Accurate Gray code
- Metal slit with shock resistance of 980 m/s^2

■ List of model numbers

● NPN output

Resolution	Direction	With cable		With relay connector	With FC connector*	
		Cable length 2 m	Cable length 5 m	Cable length 2 m	Cable length 2 m	Cable length 5 m
32 (5 bit)	CW	TRD-NA32NW	TRD-NA32NW5M	TRD-NA32NWE	–	–
	CCW	TRD-NA32RNW	TRD-NA32RNW5M	TRD-NA32RNWE	–	–
64 (6 bit)	CW	TRD-NA64NW	TRD-NA64NW5M	TRD-NA64NWE	–	–
	CCW	TRD-NA64RNW	TRD-NA64RNW5M	TRD-NA64RNWE	–	–
128 (7 bit)	CW	TRD-NA128NW	TRD-NA128NW5M	TRD-NA128NWE	–	–
	CCW	TRD-NA128RNW	TRD-NA128RNW5M	TRD-NA128RNWE	–	–
180 (8 bit)	CW	TRD-NA180NW	TRD-NA180NW5M	TRD-NA180NWE	–	–
	CCW	TRD-NA180RNW	TRD-NA180RNW5M	TRD-NA180RNWE	–	–
256 (8 bit)	CW	TRD-NA256NW	TRD-NA256NW5M	TRD-NA256NWE	–	–
	CCW	TRD-NA256RNW	TRD-NA256RNW5M	TRD-NA256RNWE	–	–
360 (9 bit)	CW	TRD-NA360NW	TRD-NA360NW5M	TRD-NA360NWE	TRD-NA360NWF	TRD-NA360NWF5M
	CCW	TRD-NA360RNW	TRD-NA360RNW5M	TRD-NA360RNWE	–	–
512 (9 bit)	CW	TRD-NA512NW	TRD-NA512NW5M	TRD-NA512NWE	–	–
	CCW	TRD-NA512RNW	TRD-NA512RNW5M	TRD-NA512RNWE	–	–
720 (10 bit)	CW	TRD-NA720NW	TRD-NA720NW5M	TRD-NA720NWE	TRD-NA720NWF	TRD-NA720NWF5M
	CCW	TRD-NA720RNW	TRD-NA720RNW5M	TRD-NA720RNWE	–	–
1024 (10 bit)	CW	TRD-NA1024NW	TRD-NA1024NW5M	TRD-NA1024NWE	–	–
	CCW	TRD-NA1024RNW	TRD-NA1024RNW5M	TRD-NA1024RNWE	–	–

Note 1: Highest speed that can support mechanical integrity of the encoder

● PNP output

Resolution	Direction	With cable		With relay connector
		Cable length 2 m	Cable length 5 m	Cable length 2 m
32 (5 bit)	CW	TRD-NA32PW	TRD-NA32PW5M	TRD-NA32PWE
	CCW	TRD-NA32RPW	TRD-NA32RPW5M	TRD-NA32RPWE
64 (6 bit)	CW	TRD-NA64PW	TRD-NA64PW5M	TRD-NA64PWE
	CCW	TRD-NA64RPW	TRD-NA64RPW5M	TRD-NA64RPWE
128 (7 bit)	CW	TRD-NA128PW	TRD-NA128PW5M	TRD-NA128PWE
	CCW	TRD-NA128RPW	TRD-NA128RPW5M	TRD-NA128RPWE
180 (8 bit)	CW	TRD-NA180PW	TRD-NA180PW5M	TRD-NA180PWE
	CCW	TRD-NA180RPW	TRD-NA180RPW5M	TRD-NA180RPWE
256 (8 bit)	CW	TRD-NA256PW	TRD-NA256PW5M	TRD-NA256PWE
	CCW	TRD-NA256RPW	TRD-NA256RPW5M	TRD-NA256RPWE
360 (9 bit)	CW	TRD-NA360PW	TRD-NA360PW5M	TRD-NA360PWE
	CCW	TRD-NA360RPW	TRD-NA360RPW5M	TRD-NA360RPWE
512 (9 bit)	CW	TRD-NA512PW	TRD-NA512PW5M	TRD-NA512PWE
	CCW	TRD-NA512RPW	TRD-NA512RPW5M	TRD-NA512RPWE
720 (10 bit)	CW	TRD-NA720PW	TRD-NA720PW5M	TRD-NA720PWE
	CCW	TRD-NA720RPW	TRD-NA720RPW5M	TRD-NA720RPWE
1024 (10 bit)	CW	TRD-NA1024PW	TRD-NA1024PW5M	TRD-NA1024PWE
	CCW	TRD-NA1024RPW	TRD-NA1024RPW5M	TRD-NA1024RPWE

■ Composition of model number

TRD-NA □ □ □ W □ □

- Series
- Resolution
- Direction
  - **Blank:** Normal revolution (CW)
  - **R** : Reverse revolution (CCW)
- Output type
  - **N:** NPN open collector
  - **P:** PNP open collector
- Protection
  - **W:** Dust and splash proofed (IP65)
- Connection
  - **Blank:** With cable
  - **E** : With relay connector at cable end
  - **F** : With FC connector at cable end
- Cable length
  - **Blank:** 2 m
  - **5M** : 5 m

■ Electrical Specifications

Model number		TRD-NA□□NW		TRD-NA□□PW
Power Voltage	Power source voltage	10.8 to 26.4 VDC		←
	Allowable ripple	3% rms max.		←
	Current consumption	70 mA max.		100 mA max.
Output code		Gray binary*1		←
Max. response frequency		20 kHz*2		←
Precision		(360/resolution × 2)°		←
Direction		Normal (CW) or reverse (CCW)*3		←
Output	Output Type	Open collector NPN Output		Open collector PNP Output
	Output Logic	Negative (Low active)		Positive (High active)
	Residual voltage	0.4 V max.	1.5 V max.	0.5 V max.
	Inflow Current	16 mA	32 mA	30 mA
	Load power voltage	30 VDC max.		←
Rise/Fall time		2.0 μs (at 1 kΩ load resistance) max.		3.0 μs (at 1 kΩ load resistance) max.

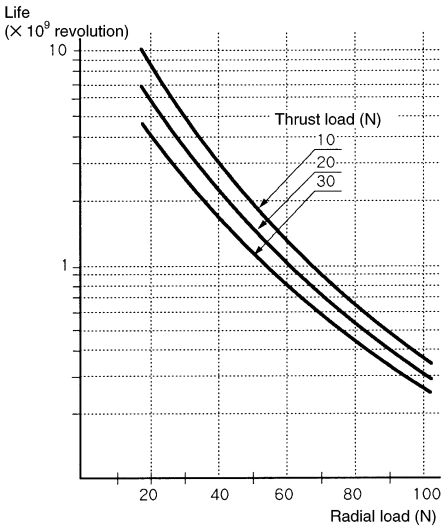
*1 38 Gray codes at 180 resolution, 76 Gray codes at 360 resolution, and 152 Gray codes at 720 resolution
*2 Maximum revolution speed = (Maximum response frequency/Resolution) × 60 The encoder does not respond to revolution faster than the maximum speed.
*3 When viewed from the shaft, CW is clockwise direction and CCW is anti-clockwise direction.

■ Mechanical specifications

Initial torque	0.03 N•m (+20°C) max.
Moment of inertia	2×10^{-6}kg•m^2
Allowable load	Radial: 50 N
	Thrust: 30 N
Maximum allowable speed (Note 1)	3000 rpm (continuous) 5000 rpm (instantaneous)
Cable	External diameter:ø7 mm 12-core oil-proofed shielded vinyl chloride cable Nominal section area of core: 0.14 mm^2
Weight	Approx. 300 g (with 2 m cable)

Note 1: Highest speed that can support mechanical integrity of the encoder.

● Service life of bearing

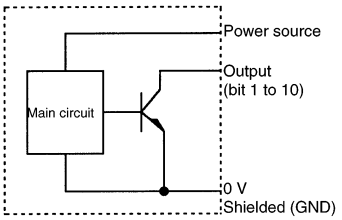


■ Environmental requirements

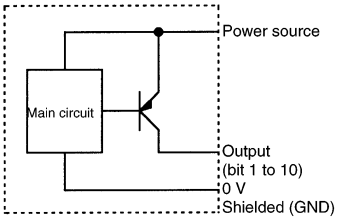
Ambient temperature	Operating temperature: –10 to +60°C Storage temperature: –25 to +85°C
Operating/storage humidity	25 to 85%RH (with no condensation)
Withstand voltage	Removed for capacitor earth
Insulation resistance	10 MΩ min.
Vibration resistance	Durable for one hour along three axes at 10 to 55 Hz with 0.75 mm amplitudes
Shock resistance	11 ms with 980 m/s^2 applied three times along three axes
Protection	IP65: Dust and splash proofed

■ Output circuit

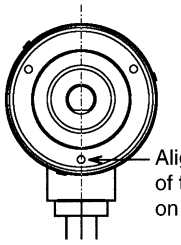
TRD-NA□□NW(NPN 出力)



TRD-NA□□PW(PNP 出力)



■ Home position



Align the downward notch of the shaft with the hole on the cable side.

■ Terminal assignment

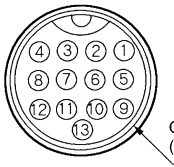
GND (shielded cable) is not connected to the encoder body. The enclosure is grounded through 0 V line.

Color of core cable	Connector pin number	1024/720 Resolution	512/360 Resolution	256/180 Resolution	128 Resolution	64 Resolution	32 Resolution
Blue	1	0V	←	←	←	←	←
Brown	2	+12/24V	←	←	←	←	←
Black	3	bit 1 (2^0)	Not connected	←	←	←	←
Red	4	bit 2 (2^1)	bit 1 (2^0)	Not connected	←	←	←
Orange	5	bit 3 (2^2)	bit 2 (2^1)	bit 1 (2^0)	Not connected	←	←
Yellow	6	bit 4 (2^3)	bit 3 (2^2)	bit 2 (2^1)	bit 1 (2^0)	Not connected	←
Green	7	bit 5 (2^4)	bit 4 (2^3)	bit 3 (2^2)	bit 2 (2^1)	bit 1 (2^0)	Not connected
Purple	8	bit 6 (2^5)	bit 5 (2^4)	bit 4 (2^3)	bit 3 (2^2)	bit 2 (2^1)	bit 1 (2^0)
Gray	9	bit 7 (2^6)	bit 6 (2^5)	bit 5 (2^4)	bit 4 (2^3)	bit 3 (2^2)	bit 2 (2^1)
White	10	bit 8 (2^7)	bit 7 (2^6)	bit 6 (2^5)	bit 5 (2^4)	bit 4 (2^3)	bit 3 (2^2)
Black/White	11	bit 9 (2^8)	bit 8 (2^7)	bit 7 (2^6)	bit 6 (2^5)	bit 5 (2^4)	bit 4 (2^3)
Red/White	12	bit10 (2^9)	bit 9 (2^8)	bit 8 (2^7)	bit 7 (2^6)	bit 6 (2^5)	bit 5 (2^4)
–	13	Not connected	←	←	←	←	←
Shield	–	GND	←	←	←	←	←

* () In parentheses is the bit corresponding to binary code.

MSB

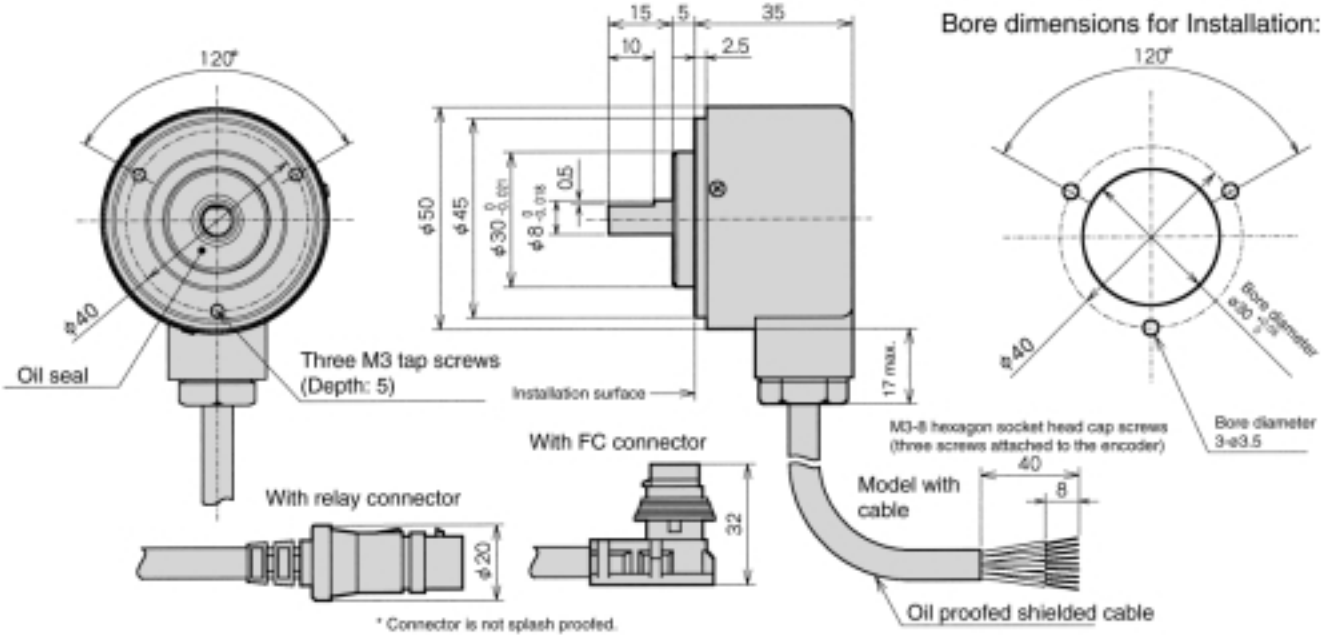
Pin out of connector



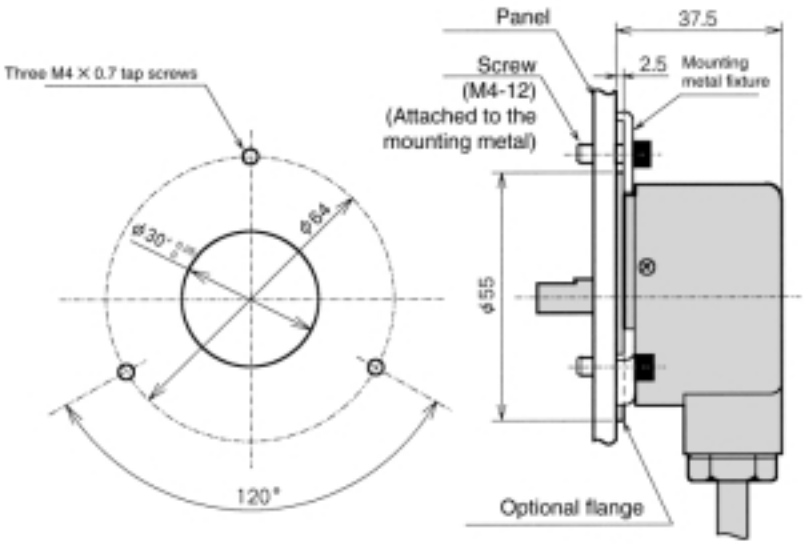
Rear view

External Dimensions

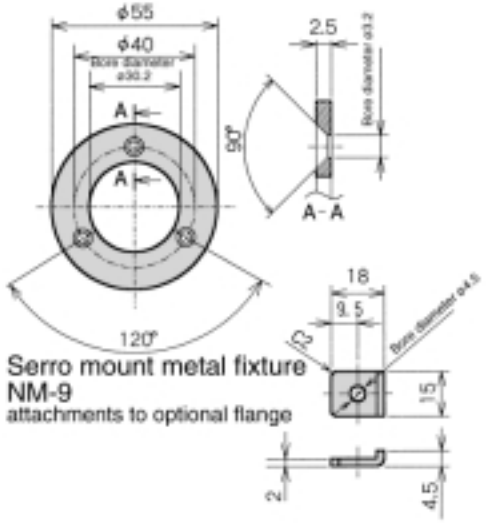
(in mm)



Servo mount metal fixture



Flange NF-55 (Option)



Serro mount metal fixture NM-9
attachments to optional flange

TRD-K Series Absolute Encoders

■ Features

- Resolution of up to 10 bits or 1,024
- Strong shaft that supports 100 N/radial and 50 N/thrust using a reinforced spindle
- ø10 mm thick reinforced stainless steel shaft
- Accurate gray code output
- Shock resistant metal slit plate durable at 980 m/s^2
- Servo mounting is available for easy installation

■ List of model numbers

Type	Model number	Resolution	Cable length	Notes	
				With FC-20/21 connector	With extension cable connector
Dust and splash proof side cable	TRD-K180-YS	180 (8 bit)	2 m		
	TRD-K256-YS	256 (8 bit)			
	TRD-K360-YS	360 (9 bit)		TRD-K360-YCS	TRD-K360-YPS
	TRD-K512-YS	512 (9 bit)		TRD-K512-YCS	TRD-K512-YPS
	TRD-K720-YS	720 (10 bit)		TRD-K720-YCS	TRD-K720-YPS
	TRD-K1024-YS	1024 (10 bit)		TRD-K1024-YCS	TRD-K1024-YPS
Dust and splash proof rear connector	TRD-K360-YC2	360 (9 bit)	N/A		
	TRD-K512-YC2	512 (9 bit)			
	TRD-K720-YC2	720 (10 bit)			
	TRD-K1024-YC2	1024 (10 bit)			

■ Model numbering system

TRD-K □ - Y C S

- Classification of series
- Resolution (180, 256, 360, 512, 720, 1024)
- Gray code output
- With side cable
- Connection
  - **C:** With FC-20/21 connector
  - **P:** With extension cable connector
  - **C2:** Dust and splash proofed with rear connector

■ Electrical Specifications

Power source	Power source voltage	DC 10.8 to 26.4 V
	Allowable ripple	3% rms max.
	Current consumption	70 mA max.
Output code		Gray binary
Max. response frequency		20 kHz
Precision		(360/resolution × 2)°
Direction		Output code increments in normal direction (CW)
Output	Output type	NPN open collector output
	Output logic	Negative (Low active)
	Residual voltage	0.4 V max.
	Inflow current	30 mA max.
	Load power voltage	30 VDC max.
Rise/Fall time		2.0 μs (at 1 Ω load resistance) max.

■ Mechanical specifications

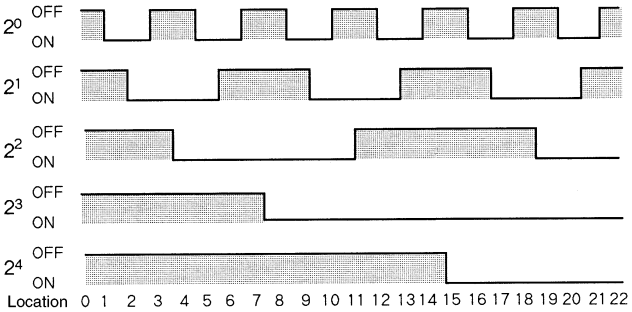
Initial torque	0.1 N•m (+20°C) max.
Moment of inertia	1 × 10^{-5} kg • m^2
Allowable load	Radial: 100 N
	Thrust: 50 N
Maximum allowable speed (Note I)	5000 rpm
Cable	External diameter: ø7.8 mm 12-core oil-proofed shielded vinyl chloride cable Nominal section area of core: 0.3 mm^2
Weight	Weight with side cable: Approx. 750 g (with 2 m cable) With connector: Approx. 500 g

Note 1: Highest speed that can support mechanical integrity of the encoder

■ Environment requirements

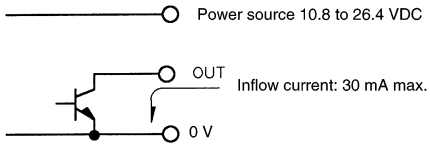
Ambient temperature	–10 to +50°C
Storage temperature	–25 to +80°C
Operating humidity	35 to 85% RH (with no condensation)
Withstand voltage	500 VAC at 50/60 Hz for one minute (between terminals and case)
Insulation resistance	10 MΩ (measured with 500 VDC Megger) min.
Vibration resistance	Durable for one hour along three axes at 10 to 55 Hz with 0.75 mm amplitudes
Shock resistance	11 ms with 980 m/s^2 applied three times along three axes
Protection	IP65: Dust and splash proofed

■ Output signal timing chart



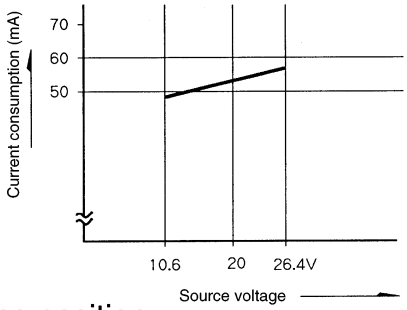
■ Output circuit

Open collector

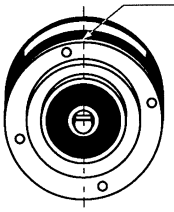


■ Electrical characteristics

Current consumption



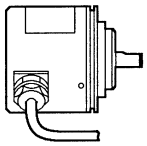
■ Home position



Align the upward notch of the shaft with the small screw fixing the cover on the name plate.

■ Terminal assignment

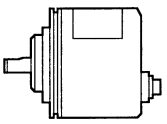
● With side cable



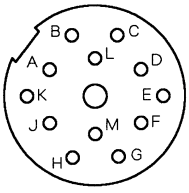
Shielded cable is not connected to the encoder body.

Color of core cable \ Model number	TRD-K1024-□ TRD-K720-□	TRD-K360-□ TRD-K512-□	TRD-K180-□ TRD-K256-□
Red	Power source +12/24 V	←	←
Black	Power source 0 V	←	←
Brown	Outputs 2^0	←	←
Orange	2^1	←	←
Yellow	2^2	←	←
Green	2^3	←	←
Blue	2^4	←	←
Purple	2^5	←	←
Gray	2^6	←	←
White	2^7	←	←
Pink	2^8	←	Not connected
Light blue	2^9	Not connected	Not connected
Shield	GND	←	←

● Dust and splash proofed with connector



Pin out of connector



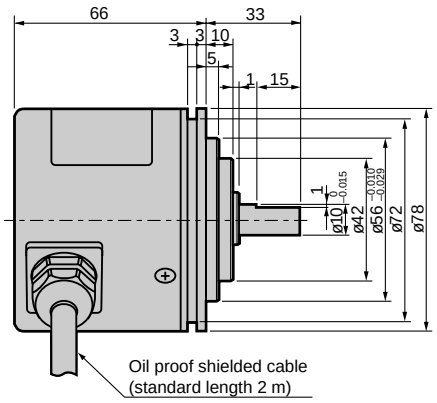
* Rear view

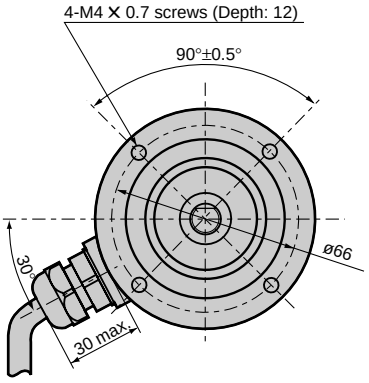
Pin number \ Model number	TRD-K1024-□ TRD-K720-□	TRD-K360-□ TRD-K512-□
A	Power source +12/24 V	←
B	Outputs 2^0	←
C	2^1	←
D	2^2	←
E	2^3	←
F	2^4	←
G	2^5	←
H	2^6	←
J	2^7	←
K	2^8	←
L	2^9	Not connected
M	Power source 0 V	←

External Dimensions

(in mm)

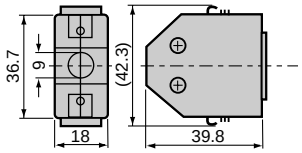
● With side cable (TRD-K ☐ -YS)





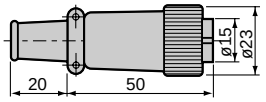
FC-20/21 connector (TRD-K ☐ -YCS)

Model: Honda MR-16L/MR-16M



Extension cable connector (TRD- ☐ -YPS)

Model: Hirose RM15TPD-12P



* Connector is not equipped with the cable for TRD-K☐-YS

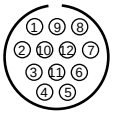
Pin out of connector

● FC-20/21 connector

Section view

Pin number	Color	Signal name	Pin number	Color	Signal name
1	Purple	2^5	9	White	2^7
2	Blue	2^4	10	Gray	2^6
3	Green	2^3	11	Red	Vcc
4	Yellow	2^2	12		N.C.
5	Orange	2^1	13		N.C.
6	Brown	2^0	14		N.C.
7	Light blue	2^9	15	Black	0V
8	Pink	2^8	16	Shield	GND

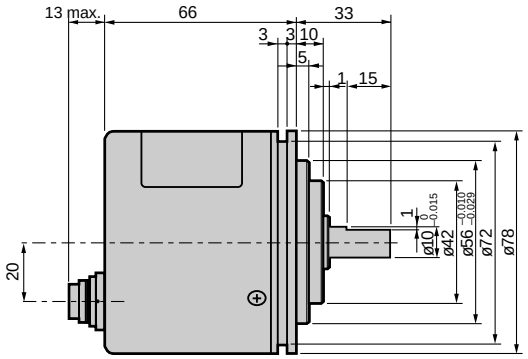
● Extension cable connector

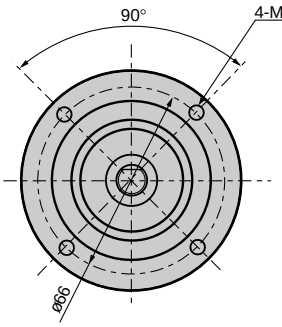


Section view

Pin number	Color	Signal name	Pin number	Color	Signal name
1	Red	Vcc	7	Purple	2^5
2	Brown	2^0	8	Gray	2^6
3	Orange	2^1	9	White	2^7
4	Yellow	2^2	10	Pink	2^8
5	Green	2^3	11	Light blue	2^9
6	Blue	2^4	12	Black	0V

● Dust and splash proof side connector (TRD-K ☐ -YC2)



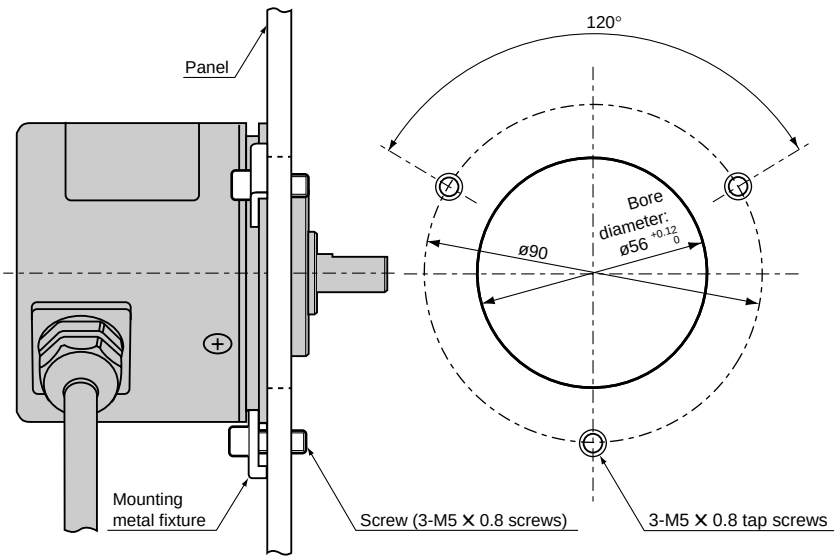


Model numbers of connectors (options)

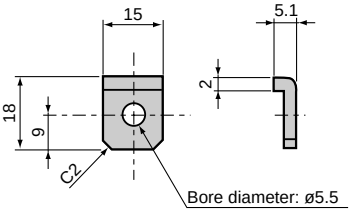
● Straight: BMCC-12
● Angular: BAFC-12

* Refer to page 32 for detailed descriptions of the options.

Servo mount metal fixture



KM-9 servo mount metal fixture (supplied)



TRD-KL Series Absolute Encoders

■ Features

- Side cable and connector for minimum space
- Dust and splash proofed for operation not affected by water or oil
- ø10 mm thick reinforced stainless shaft and aluminum die-cast casing
- Accurate gray code output
- Shock resistant metal slit plate durable at 980 m/s^2
- Servo mounting is available for easy installation

■ List of model numbers

With cable			With connector		
Model number	Resolution	Cable length	Model number	Resolution	Cable length
TRD-KL180-Y	180 (8 bit)	2 m	TRD-KL180-YC2	180 (8 bit)	–
TRD-KL250-Y	250 (8 bit)		TRD-KL250-YC2	250 (8 bit)	
TRD-KL256-Y	256 (8 bit)		TRD-KL256-YC2	256 (8 bit)	
TRD-KL360-Y	360 (9 bit)		TRD-KL360-YC2	360 (9 bit)	
TRD-KL500-Y	500 (9 bit)		TRD-KL500-YC2	500 (9 bit)	
TRD-KL512-Y	512 (9 bit)		TRD-KL512-YC2	512 (9 bit)	
TRD-KL720-Y	720 (10 bit)		TRD-KL720-YC2	720 (10 bit)	
TRD-KL1000-Y	1000 (10 bit)		TRD-KL1000-YC2	1000 (10 bit)	
TRD-KL1024-Y	1024 (10 bit)		TRD-KL1024-YC2	1024 (10 bit)	

■ Model numbering system

TRD- KL [ ] - Y [ ]

- Series
- Resolution (180, 250, 256, 360, 500, 512, 720, 1000, 1024)
- Connection
  Blank: With cable
  C2 : With connector
- Gray code output

■ Electrical Specifications

Power source	Power source voltage	10 to 30 VDC
	Allowable ripple	3% rms max.
	Current consumption	70 mA max.
Output code		Gray binary
Max. response frequency		20 kHz
Precision		(360/resolution × 2)°
Direction		Output code increments in normal direction
Output	Output type	NPN open collector output
	Output logic	Negative (Low active)
	Residual voltage	0.4 V max.
	Inflow current	30 mA max.
	Load power voltage	30 VDC max.
Rise/Fall time		2.0 μs (at 1 kΩ load resistance) max.

■ Mechanical specifications

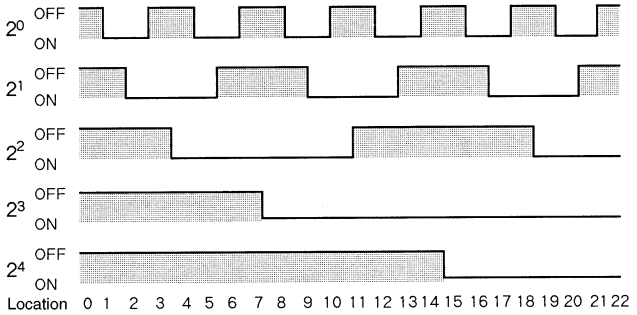
Initial torque	0.1 N•m (+20°C) max.
Moment of inertia	1 × 10^{-5} kg • m^2
Allowable load	Radial: 70 N
	Thrust: 40 N
Maximum allowable speed (Note 1)	5000 rpm
Cable	External diameter: ø7.8 mm 12-core oil-proofed shielded vinyl chloride cable Nominal section area of core: 0.3 mm^2
Weight	With side cable: Approx. 700 g (with 2 m cable) With connector: Approx. 450 g

Note 1: Highest sped that can support mechanical integrity of the encoder

■ Environmental requirements

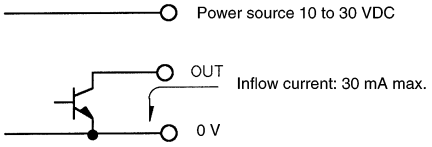
Ambient temperature	–10 to +60°C
Storage temperature	–25 to +80°C
Operating humidity	35 to 85% RH (with no dewing)
Withstand voltage	AC 500 V at 50/60 Hz for one minute (between terminals and case)
Insulation resistance	10 MΩ (measured with DC 500 V Megger) min.
Vibration resistance	Durable for one hour along three axes at 10 to 55 Hz with 0.75 mm amplitudes
Shock resistance	11 ms with 980 m/s^2 applied three times along three axes
Protection	IP65: Dust and splash proofed

■ Output signal timing chart



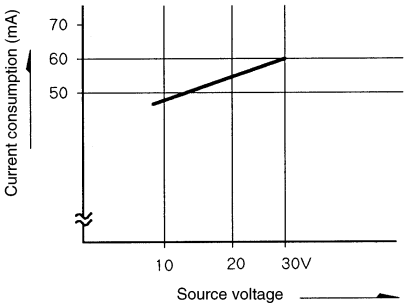
■ Output circuit

Open collector

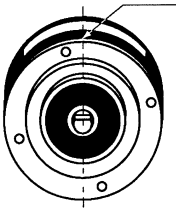


■ Electrical characteristics

Current consumption



■ Home position

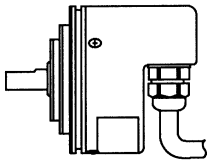


Align the upward notch of the shaft with the small screw fixing the cover on the name plate.

■ Terminal assignment

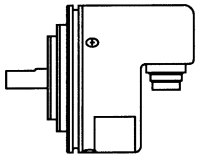
Shielded cable is not connected to the encoder body.

● With cable

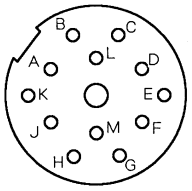


Model number / Color of core cable	TRD-KL1024-Y TRD-KL1000-Y TRD-KL720-Y	TRD-KL512-Y TRD-KL500-Y TRD-KL360-Y	TRD-KL256-Y TRD-KL250-Y TRD-KL180-Y
Red	Power source +12/24 V	←	←
Black	Power source 0 V	←	←
Brown	Outputs 2^0	←	←
Orange	2^1	←	←
Yellow	2^2	←	←
Green	2^3	←	←
Blue	2^4	←	←
Purple	2^5	←	←
Gray	2^6	←	←
White	2^7	←	←
Pink	2^8	←	Not connected
Light blue	2^9	Not connected	Not connected
Shield	GND	←	←

● With connector



Pin out of connector



* Rear view

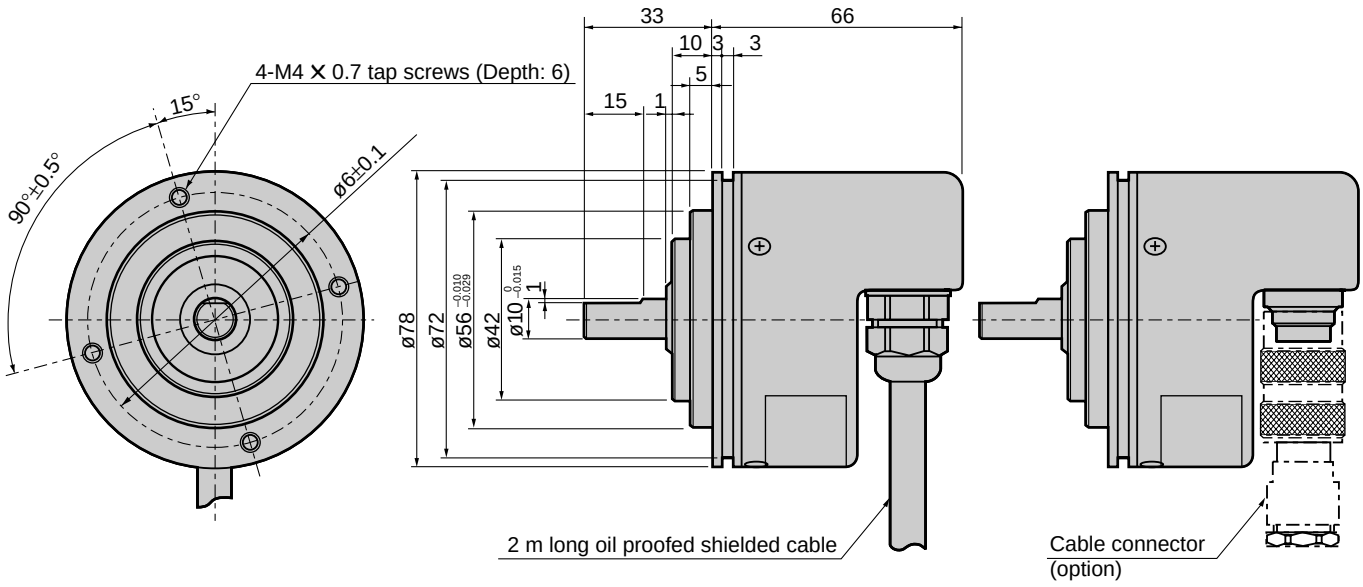
Model number / Pin number	TRD-KL1024-YC2 TRD-KL1000-YC2 TRD-KL720-YC2	TRD-KL512-YC2 TRD-KL500-YC2 TRD-KL360-YC2	TRD-KL256-YC2 TRD-KL250-YC2 TRD-KL180-YC2
A	Power source +12/24 V	←	←
B	Outputs 2^0	←	←
C	2^1	←	←
D	2^2	←	←
E	2^3	←	←
F	2^4	←	←
G	2^5	←	←
H	2^6	←	←
J	2^7	←	←
K	2^8	←	Not connected
L	2^9	Not connected	Not connected
M	Power source 0 V	←	←

External Dimensions

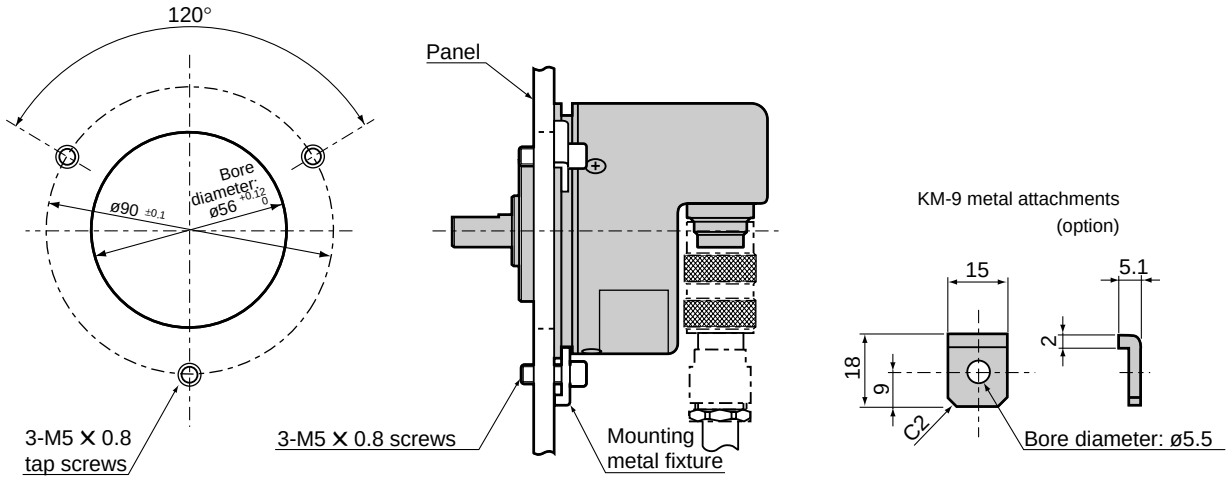
(in mm)

With cable
(TRD-KL□-Y)

With connector
(TRD-KL□-YC2)



Servo mount metal fixture



Customized models

In addition to the standard models, KOYO offers products tailored to the customer's requirements. Some examples are listed below.

TRD-J Hollow-shaft

● Directly connected to the other shaft without coupling

Resolution		To 1,000 P/R
Max. response frequency		50 kHz
Source voltage		4.75 to 30 V
Output signal		Two-phase + home position
Output type		Totem-pole
Output current or voltage	**Source**	10 mA
	Sink	30 mA
Maximum allowable speed		5000 rpm
Ambient temperature		–10 to +50°C

incremental encoders

External dimensions: ø50 × 50 mm

TRD-VP Series Through Shaft

● AC Servomotor with UVW Phases

Resolution		1000P/R 2000P/R 2500P/R
Max. response frequency		200 kHz
Source voltage		5 V±0.25 V
Output signal		ABZ-phases + UVW-phases
Output type		Line driver output
Output current or voltage	**Source**	H: 2.5 V
	Sink	L: 0.5 V
Maximum allowable speed		6000 rpm
Ambient temperature		–10 to +85°C

incremental encoders

External dimensions: ø35 × 18.5 mm

TRD-A Series

● High resolution at 2048 P/R or 4098 P/R
Absolute encoders

Resolution		2048P/R 4096P/R
Max. response frequency		20 kHz
Source voltage		10.8 to 26.4 V
Output signal		Gray binary code
Output type		NPN open collector
Output current or voltage	**Source**	—
	Sink	30 mA
Maximum allowable speed		5000 rpm
Ambient temperature		–10 to +5°C

absolute encoders

External dimensions: ø72 × 70 mm

Characteristic Specifications and Options

Options

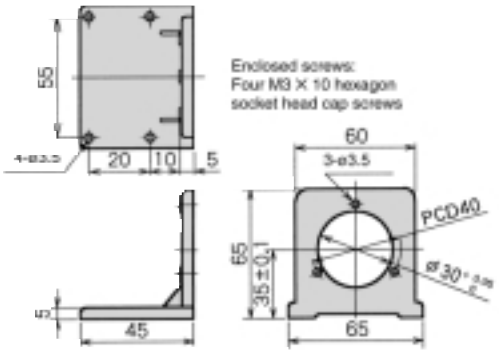
Characteristic Specifications

Option	Applicable models						
	TRD-S/SH	TRD-N/NH	TRD-J	TRD-GK	TRD-NA	TRD-K	TRD-KL
Longer or shorter cable	●	●	●	●	●	●	●
Modified cable ends (with connectors)	●	●	●	●	●	●	●
Non-standard pulse	●	●	●	●			
Longer shaft	●	●	●	●	●	●	●
Thicker or thinner shaft	●	●	●	●	●	●	●
PNP output with short circuit protection				●			
Reverse rotation (The count increases in counterclockwise revolution.)						●	●

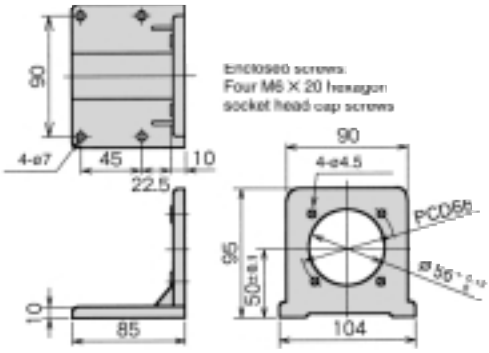
Options

● Bracket

JT-035 (for TRD-N/TRD-J/TRD-NA)

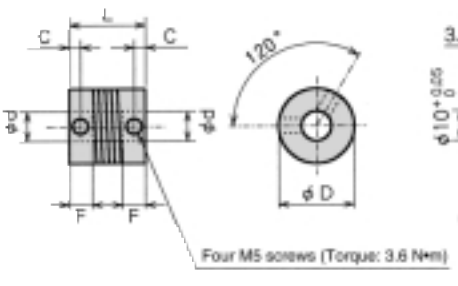


RT-11 (for TRD-GK/TRD-K/TRD-KL)

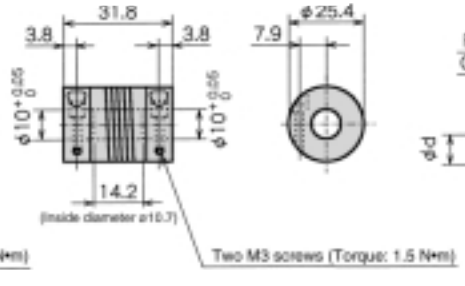


● Couplings

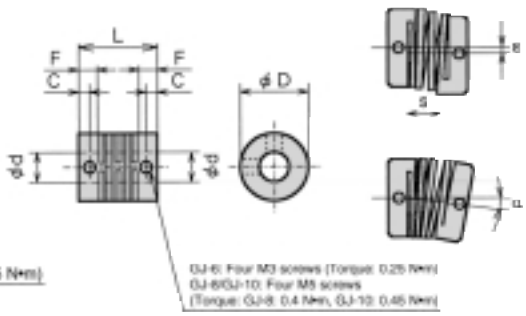
RU-075／JU-100／RU-100



KU-100



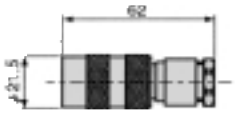
GJ-6／GJ-8／GJ-10



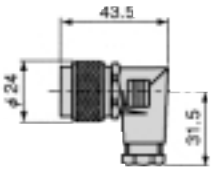
Type	Model	Applicable encoder	Material	d	D	L	F	C	M	α	ε	s
Metal coupling	RU-075	TRD-S	Aluminum alloy (7075)	6	19.1	19.1	4.8	9.5	M3 × 0.5	5°MAX.	0.25mmMAX.	0.12mmMAX.
	JU-100	TRD-N／J／NA		8 +0.05	25.4	25.4	6.9	3.8	M5 × 0.8	5°MAX.	0.25mmMAX.	0.12mmMAX.
	RU-100	TRD-GK／K／KL		10 +0.05	25.4	25.4	6.9	3.8	M5 × 0.8	5°MAX.	0.25mmMAX.	0.12mmMAX.
	KU-100	TRD-GK／K／KL		–						5°MAX.	0.25mmMAX.	0.12mmMAX.
Plastic coupling	GJ-6	TRD-S	Glass fiber reinforced polyacetal	6 +0.018	15	21.6	5.2	2.8	M3	6°MAX.	0.5mmMAX.	0.12mmMAX.
	GJ-8	TRD-N／J／NA		8 +0.05	19	24.0	6.8	3.5	M4	5°MAX.	0.5mmMAX.	0.12mmMAX.
	GJ-10	TRD-GK／K／KL		10 +0.05	22	26.2	7.1	3.6	M4	5°MAX.	0.5mmMAX.	0.12mmMAX.

● Cable connector (for TRD-GK/TRD-K/TRD-KL Series)

Straight



Angular



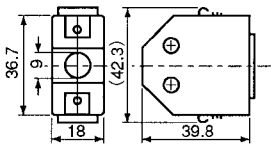
Type	For TRD-GK Series		For TRD-K/TRD-KL Series	
	Straight	Angular	Straight	Angular
Model number	BMCC-6	BAFC-6	BMCC-12	BAFC-12
Number of pins	6P		12P	
Section area	0.75 mm² max.		0.25 mm² max.	
Terminal	Soldered			
External diameter of cable	5 to 8 mm			
Protection	IP67 (connected and locked)			

● Relay cables

Applicable absolute encoders	Appearance	Cable length	Model number	Remarks
TRD-NA360NWE TRD-NA720NWE		3 m	F-30GF	For FC-80-C/160/320 and FC-81F-C/161F-C/321F-C programmable cam switches
		5 m	F-50GF	
		10 m	F-100GF	
TRD-NA□NWE TRD-NA□PWE		3 m	F-30G	Extension cable
		5 m	F-50G	
		10 m	F-100G	
TRD-K360-YC2 TRD-KL360-YC2 TRD-K720-YC2 TRD-KL720-YC2		2 m	F-20ANC2	For FC-80-C/160/320 and FC-81F-C/161F-C/321F-C programmable cam switches
		5 m	F-50ANC2	
		2 m	F-20BNC2	
		5 m	F-50BNC2	
TRD-K360-YC2 TRD-KL360-YC2 TRD-K720-YC2 TRD-KL720-YC2		2 m	F-20ANC2A	
		5 m	F-50ANC2A	
		2 m	F-20BNC2A	
		5 m	F-50BNC2A	
TRD-K360-YC2 TRD-K512-YC2 TRD-K720-YC2 TRD-K1024-YC2 TRD-KL360-YC2 TRD-KL512-YC2 TRD-KL720-YC2 TRD-KL1024-YC2		2 m	F-20C2	For FC-20/21 programmable cam switches
		2 m	F-20C2A	
TRD-K□-YPS		5 m	F-50J	Extension cable For FC-20/21 programmable cam switches
		15 m	F-150J	

● FC-20/FC-21 connector

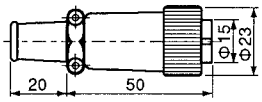
Model: Honda MR-16L/MR-16M



See page 23 for pin alignment.

● Extension cable connector

Model: Hirose RM15TPD-12P



● KOYO Programmable Cam Switches

(electronic cam switches)

Used with absolute rotary encoders, the cam switches precisely position processing machines. Applicable processes include assembling, printing, pressing and packaging.
A wide variety of models are available to suit your needs.

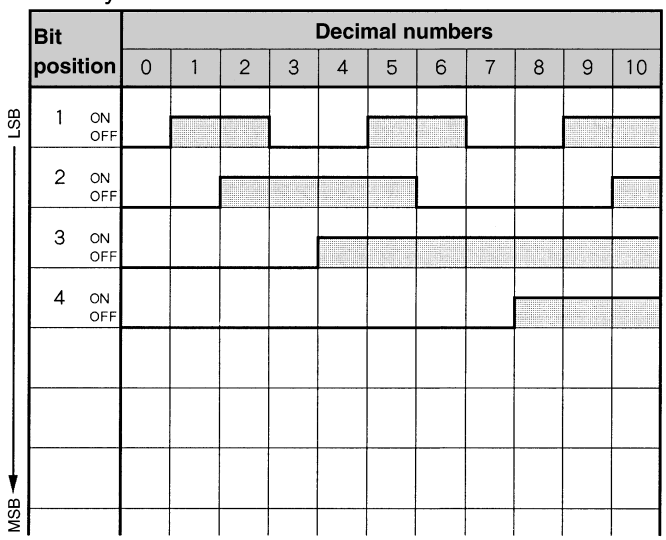
Mechanism of absolute rotary encoder

■ Mechanism of absolute rotary encoder

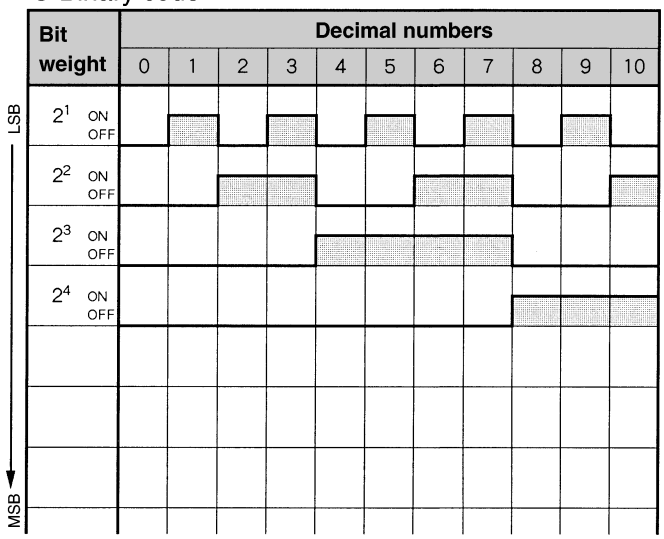
Based on a reference position, the absolute rotary encoder provides absolute angles of rotation. Through parallel encoding, these angles are expressed in Gray codes.
The absolute encoder uses no counter for determining angles. Precision is not affected by electrical noise or vibration called "chattering". In case of power shut-down, correct angles are generated upon power recovery. A machine controlled by the encoder can be easily set up. It need not be initialized to its home position.

■ What is the Gray code?

● Gray code



● Binary code



* "ON" denotes the period when signal is generated by tran sistor and electrical current is supplied.

The above figures show how decimal numbers are coded in two methods.
In binary coding, two or more contiguous bits change their status to express a decimal number incremented by one. In Gray coding, only one bit changes its status to express the same increment.
Bit - wise response to input signal varies between the encoder and the device connected. In binary coding, this may cause erroneous reading or omission of certain bits.

■ List of output codes

Decimal number	bit 10	9	8	7	6	5	4	3	2	1
0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	1
2	0	0	0	0	0	0	0	0	1	1
31	0	0	0	0	0	1	0	0	0	0
32	0	0	0	0	1	1	0	0	0	0
37	0	0	0	0	1	1	0	1	1	1
38	0	0	0	0	1	1	0	1	0	1
63	0	0	0	0	1	0	0	0	0	0
64	0	0	0	1	1	0	0	0	0	0
75	0	0	0	1	1	0	1	1	1	0
76	0	0	0	1	1	0	1	0	1	0
127	0	0	0	1	0	0	0	0	0	0
128	0	0	1	1	0	0	0	0	0	0
151	0	0	1	1	0	1	1	1	0	0
152	0	0	1	1	0	1	0	1	0	0
217	0	0	1	0	1	1	0	1	0	1
218	0	0	1	0	1	1	0	1	1	1
255	0	0	1	0	0	0	0	0	0	0
256	0	1	1	0	0	0	0	0	0	0
435	0	1	0	1	1	0	1	0	1	0
436	0	1	0	1	1	0	1	1	1	0
511	0	1	0	0	0	0	0	0	0	0
512	1	1	0	0	0	0	0	0	0	0
871	1	0	1	1	0	1	0	1	0	0
872	1	0	1	1	0	1	1	1	0	0
1022	1	0	0	0	0	0	0	0	0	1
1023	1	0	0	0	0	0	0	0	0	0

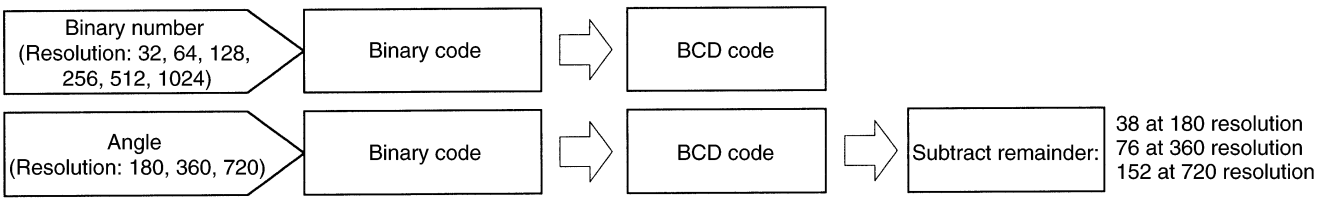
Resolution 1024
Resolution 512
Resolution 256
Resolution 128
Resolution 64
Resolution 32
Resolution 180
Resolution 360
Resolution 720

"1" and "0" denote the status of transistor output as follows: "1" = ON "0" = OFF

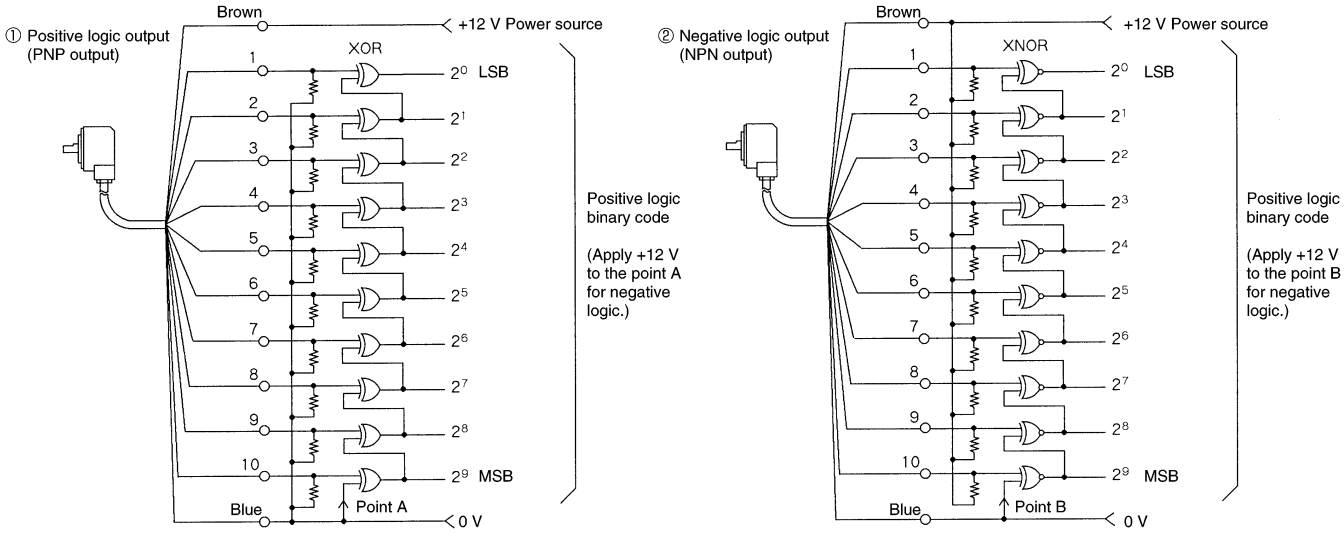
5bit → Resolution 32
6bit → Resolution 64
7bit → Resolution 128
8 bit (Resolution 180, 256)
9 bit (Resolution 360, 512)
10 bit (Resolution 720, 1024)

Conversion of output codes

Gray codes can be converted to binary codes or BCD codes ad follows:



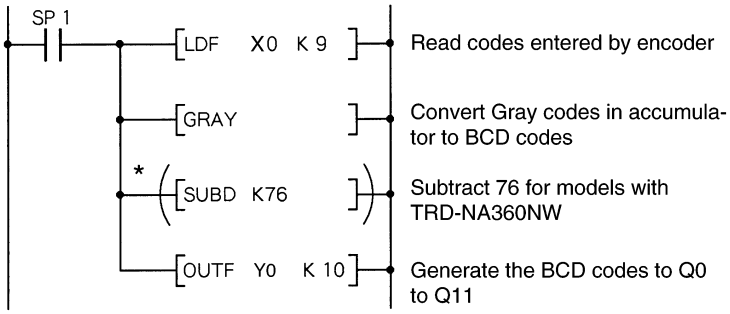
Converting a Gray code to a binary code at 1,024 resolution



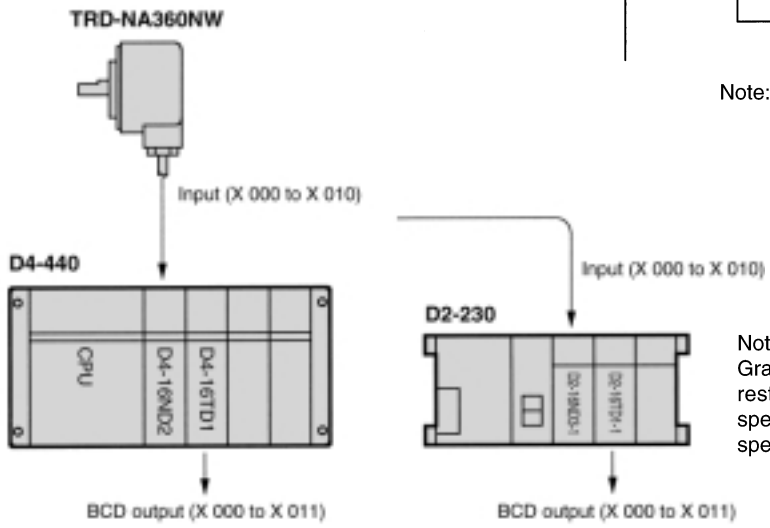
● Gray to binary conversion by programmable controller

Between TRD-NA and D4-450,440/D2-250,240

TRD-NA360NW output	D4-450,440/D2-250,240 input
Red LSB	X 000
Orange	X 001
Yellow	X 002
Green	X 003
Purple	X 004
Gray	X 005
White	X 006
Black/White	X 007
Red/White MSB	X 010



Note: Subtract 76 when using TRD-NA360□ models with 360 resolution. This is not necessary on other models. Omit the SUBC command for TRD-NA512□ models at 512 resolution and TRD-NA1024□ models at 1024 resolution.

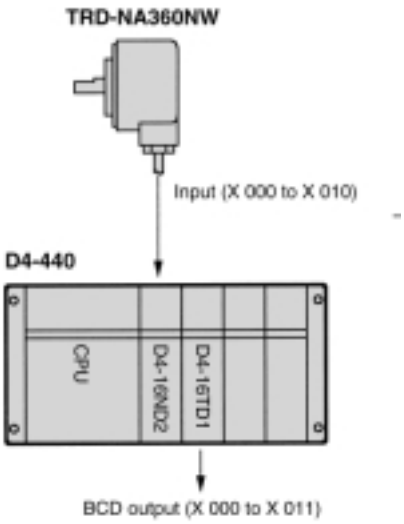


Note
Gray to binary conversion by PC is restricted by its program execution speed. At 20 ms/scan, set the encoder speed to 8 rpm or less.

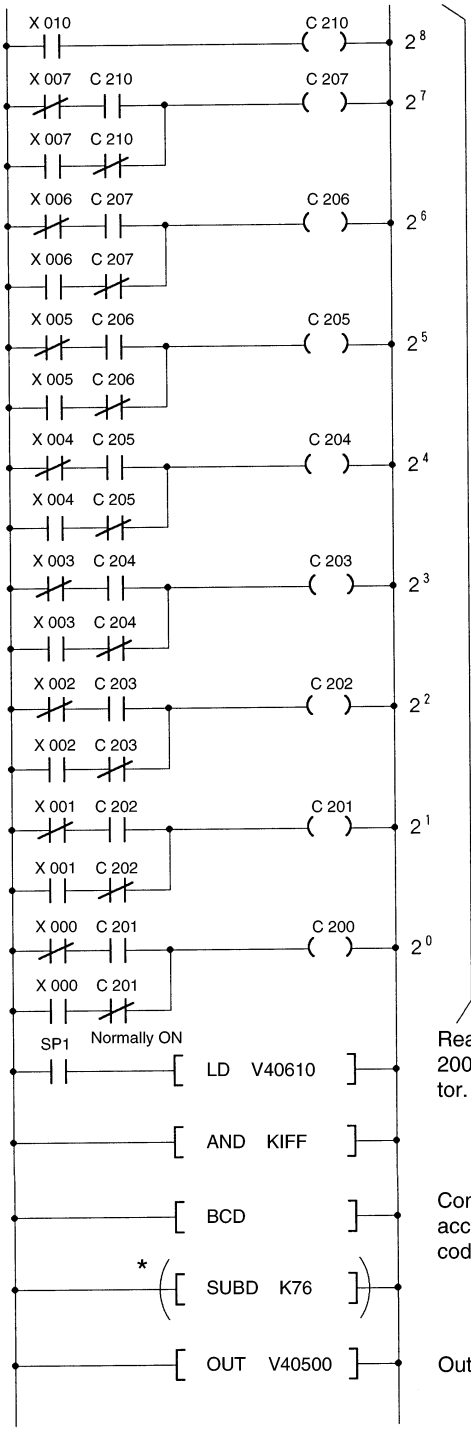
Mechanism of absolute rotary encoder

Between TRD-NA and D2-230

TRD-NA360NW output	D2-230 input
Red LSB	X 000
Orange	X 001
Yellow	X 002
Green	X 003
Purple	X 004
Gray	X 005
White	X 006
Black/White	X 007
Red/White MSB	X 010



Note
Gray to binary conversion by PC is restricted by its execution speed. At 20 ms/scan, set the encoder speed to 8 rpm or less.



Circuit converts Gray codes from the absolute encoder to binary codes.

Read 16 bits of registers 200 to 217 to accumulator.

Convert binary codes in accumulator to BCD codes

Output to Y0 to Y017

Note: Subtract 76 when using TRD-NA360☐ models with 360 resolution. This is not necessary on other models.

Connections

■ Connecting an encoder with a KOYO electronic counter

Use the following tables when selecting a counter to be connected with an encoder:

(1) Sensor power source: Use the following table to select voltage/current of a sensor power source for each rotary encoder.

Counter		Rotary encoder						
Model number	Sensor power source	TRD-N		TRD-J			TRD-GK	
		S	RZ/RZL	S	RZ/RZL	RZV	R/RZ/RZL	BZ
KCN-A KCN-S	24 VDC/15 mA	▲	▲	▲	▲	×	▲	▲
KCN-W KCN-B	24 VDC/60 mA	●	●	●	●	×	●	●
KCV	24 VDC/60 mA	●	●	●	●	×	▲	▲
KCY	24 VDC/15 mA	▲	▲	▲	▲	×	▲	▲
KCX	12 VDC/50 mA	●	▲	●	●	×	●	▲
KCX-B	24 VDC/80 mA	●	●	●	●	×	●	▲
KCX-RN	12 VDC/100 mA	●	●	●	●	×	●	●
TC-V	24 VDC/60 mA	●	●	●	●	×	▲	▲
TC-4L	12 VDC/30 mA	▲	▲	●	▲	×	▲	▲
TC-4 □※	12 VDC/50 mA	●	▲	●	●	×	●	▲
TC-6 □	12 VDC/50 mA	●	▲	●	▲	×	▲	▲

●: Integrated ▲: Optional ×: Incompatible

(2) Home position output (OUT Z) logic When connecting a home position output (OUT Z) of a rotary encoder to a reset/preset input of a counter, use the following table to select a home position output logic which suits with the input type of the counter.

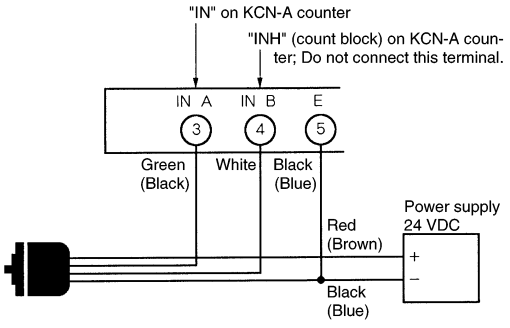
Counter	Rotary encoder			
Model number	TRD-N/J/GK		TRD-J	TRD-GK
	RZ	RZL	RZV	BZ
KCN-A/KCN-S/KCN-W/KCN-B	●	●	×	●
KCV	●	●	×	●
KCY	×	●	×	×
KCX	●	×	×	●
KCX-B	●	●	×	●
KCX-RN	×	●	×	×
TC-V	●	●	×	●
TC-4L	×	●	×	×
TC-61/41	●	●	×	●
TC-6/4/4A/4B/4S/4W	×	●	×	×

●: Integrated ×: Incompatible

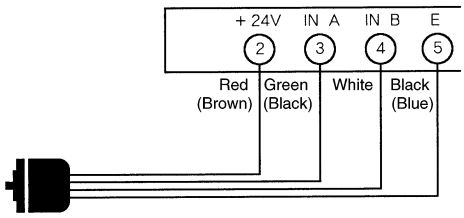
Connection examples

The colors in parentheses apply to TRD-N series counters.
The colors without parentheses apply to TRD-J/GK series counters.

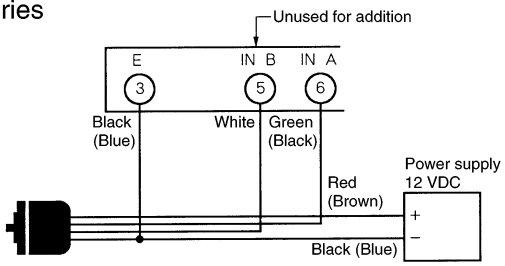
● KCN-A/KCN-S Series



● KCV Series

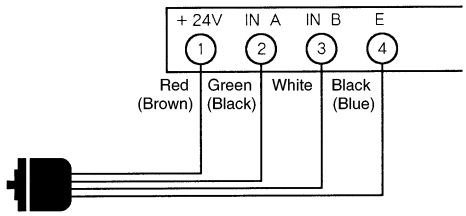


● KCY Series

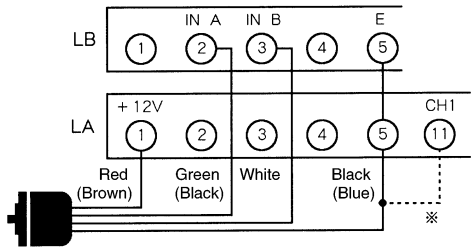


* For the TRD-GD□-BZ encoders, turn the switch 3 to the position B (separate input of addition and subtraction). For the RZ/RZL encoders, turn the switch to the position A.

● KCX-B Series

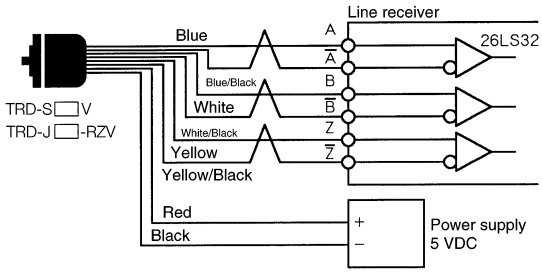


● KCX-RN Series



* For the TRD-GK□-BZ encoders, short circuit the terminal LA5-LA11.

● Connecting a line driver output



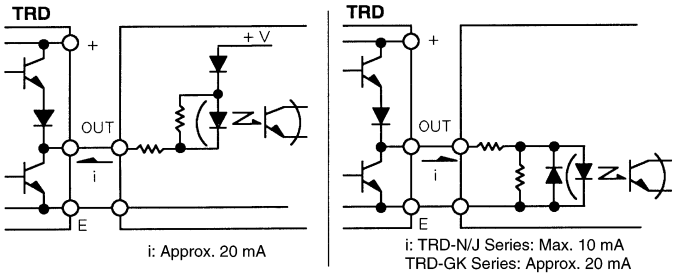
● Connect to G-01Z (High-speed Counter Module for SG-8B). Refer to G-01Z data sheets for details.

Precautions and noise prevention

■ Photocoupler

A rotary encoder can directly drive a photocoupler.

Using the totem-pole structure, a TRD model can be connected as follows:



Use a sensible photocoupler. Connect it with the resistance and diodes.

■ DC stabilized power source

When connecting a rotary encoder, if the internal power supply of the counter or other connected device (sensor power supply, etc.) is insufficient, use a commercially-available stabilized power source.

Precautions

Rotary encoders are constructed using precision parts, so the functions may be damaged if the encoder is shocked. Take care when handling.

■ Megger test

Each encoder can withstand a voltage of 500 V between its case and electronic circuit. However, do not test it with a Megger as it may be destructive to the internal circuit.

* On the TRD-GK Series, the shielded cable is connected to the case, but isolated from the electronic circuit.
On the TRD-N/J/NA/K/KL Series, the shielded cable is not connected to the case.

■ Installation

- Do not apply too much force to the shaft. Never try to twist it.
- Use a specified coupling for connecting the encoder shaft and the shaft of a machine to be controlled. Do not squeeze the shaft into the coupling. The two shafts should be centered carefully to prevent overload.
- The service life of the bearing is largely affected by the amount of load to the shaft. Try to reduce the load as much as possible.
- Never demount the rotary encoder. Its resistance to oil and water willbe lost. Try to avoid these objects even if your model is dust and splash proofed. Wipe out any oil or water attached.

■ Vibration

Vibration may cause the encoder to generate false signals. Select an appropriate place for installation. The higher the pulse frequency is, the encoder is the more sensitive to vibration because the interval between slits becomes smaller. It may misinterpret vibration as the rotation of its shaft and rotary slit plate.

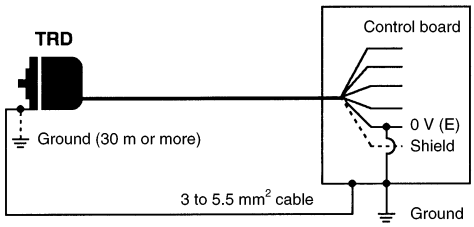
■ Wiring and connection

Follow the specified procedure to ensure correct wiring. For the totem-pole output, short circuit protection is provided between the output terminal and the 0 V power source, but not between the output terminal and the positive source terminal.

Noise prevention

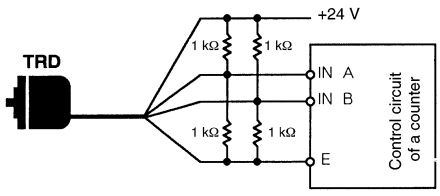
- Do not share the same power source or cable duct with other device.
- Using a capacitor or surge absorber, eliminate sparks from relay s and switches.
- Do not use the encoder near an arc welder or an electric furnace. Use an electromagnetic shield if necessary.
- Always use a shielded cable for extension.
- For the TRD-S/SH/N/NH/J/NA/K/KL Series, connect the shielded cable to the 0 V terminal, or ground it.
  On the TRD-GK models, the shielded cable is internally connected to the case.
- False pulse may be generated when the power is turned on or off. Wait for 0.1 second or 0.5 second after turning the power on or off.
- If electric potential exists between the encoder and the control board, connect their frames using a 3 to 5.5 mm^2 cable. This helps minimize noise and error.
- Grounding: The effects of noise differ depending on the relationship between the encoder and the peripheral devices. If noise occurs, make the connections as shown in the following table.

Distance from control board	Procedure
Less than 30 m	Using a 3 to 5.5 mm^2 cable, connect the encoder frame and the control board. Connect the 0 V terminal (E) to the control board using a similar cable, then ground it.
30 m or more	Follow the above procedure, then ground the rotary encoder.

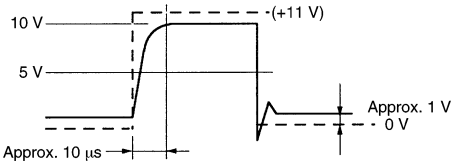


■ Extending cable

To extend cable, use a coaxial cable or a cable with small resistance and capacity to avoid signal interference. Lower the frequency of the encoder.
Signal may be dephased or distorted by noise in long distance transfer.
When extending cable, use a +24 V power source as follows:



The following diagram shows the signal distortion over the different lengths of cable:
Solid line: 100 m Dashed line: 2 m



Use a line driver output for long distance or high frequency transfer. Also use a twisted pair shielded cable and RS-422A line receiver.

Price List

● TRD-S Series

Model	Price	
	10 to 1,000 P/R	1,200 to 2,500 P/R
TRD-S□A	¥10,000	¥11,000
TRD-S□B		
TRD-S□V *		

● TRD-SH Series

Model	Price	
	10 to 1,000 P/R	1,200 to 2,500 P/R
TRD-SH□A	¥11,000	¥12,000
TRD-SH□B		
TRD-SH□V *		

* The pulse rate for TRD-□V/SH□V models is 100 to 1,000 P/R.

● TRD-N Series

Model	Price				
	1 to 200 P/R	240 to 600 P/R	750 to 1,200 P/R	2000P/R	2500P/R
TRD-N□-S	¥ 8,000	¥10,000	¥11,500	—	—
TRD-N□-SW	¥ 9,500	¥11,500	¥13,000	—	—
TRD-N□-RZ -RZL	¥12,000	¥14,000	¥16,000	¥18,000	¥20,000
TRD-N□-RZW -RZWL	¥13,500	¥15,500	¥17,500	¥19,500	¥21,500

● TRD-NH Series

Model	Price				
	1 to 200 P/R	240 to 600 P/R	750 to 1,200 P/R	2000P/R	2500P/R
TRD-NH□-S	¥ 9,500	¥11,500	¥13,000	—	—
TRD-NH□-SW	¥ 11,000	¥13,000	¥14,500	—	—
TRD-NH□-RZ -RZL	¥13,500	¥15,500	¥17,500	¥19,500	¥21,500
TRD-NH□-RZW -RZWL	¥15,000	¥17,000	¥19,000	¥21,000	¥23,000

● TRD-J Series

Model	Price		
	10 to 200 P/R	240 to 600 P/R	750 to 1,000 P/R
TRD-J□-S	¥ 8,000	¥10,000	¥11,500
TRD-J□-SW	¥ 9,500	¥11,500	¥13,000
TRD-J□-SC	¥10,500	¥12,500	¥14,000
TRD-J□-SS *	¥ 9,000	¥11,000	¥12,500
TRD-J□-RZ -RZL	¥12,000	¥14,000	¥16,000
TRD-J□-RZW -RZWL	¥13,500	¥15,500	¥17,500
TRD-J□-RZC -RZCL	¥14,500	¥16,500	¥18,500
TRD-J□-RZS * -RZSL	¥13,000	¥15,000	¥17,000

Model	Price		
	10 to 200 P/R	240 to 600 P/R	750 to 1,000 P/R
TRD-J□-SCW	¥15,000	¥17,000	¥18,500
TRD-J□-RZCW	¥19,000	¥21,000	¥23,000
TRD-J□-RZCWL	¥19,000	¥21,000	¥23,000
TRD-J□-SWS *	¥10,500	¥12,500	¥14,000
TRD-J□-RZWS *	¥14,500	¥16,500	¥18,500
TRD-J□-RZWSL *	¥14,500	¥16,500	¥18,500
TRD-J□-RZV	¥13,500	¥15,500	¥17,500
TRD-J□-RZVW	¥15,000	¥17,000	¥19,000
TRD-J□-RZVC	¥16,000	¥18,000	¥20,000
TRD-J□-RZVCW	¥20,500	¥22,500	¥24,500
TRD-J□-RZVS *	¥14,500	¥16,500	¥18,500
TRD-J□-RZVWS *	¥16,000	¥18,000	¥20,000

● TRD-GK Series

Model	Price				
	10 to 15 P/R	30 to 400 P/R	500 to 1,00 P/R	1,500 to 2,500 P/R	3,000 to 5,000 P/R
TRD-GK□-R	¥45,000	¥45,000 (50/60 P/R only)	—	—	—
TRD-GK□-RZ -RZL	—	¥55,000	¥65,000	¥65,000	—
TRD-GK□-BZ	—	¥60,000	¥70,000	¥70,000	¥70,000
TRD-GK□-RC2	¥50,000	¥50,000	—	—	—
TRD-GK□-RZC2 -RZC2L	—	¥60,000	¥65,000	¥65,000	—
TRD-GK□-BZC2	—	¥65,000	¥75,000	¥75,000	¥75,000

* Be sure to specify the resolution when ordering.

● TRD-NA Series

Model	Price
TRD-NA□NW -NA□RNW -NA□PW -NA□RPW	¥30,000
TRD-NA□NW5M -NA□RNW5M -NA□PW5M -NA□RPW5M	¥31,200
TRD-NA□NWE -NA□RNWE -NA□PWE -NA□RPWE	¥30,000
TRD-NA□NWF	¥30,000
TRD-NA□NWF5M	¥31,200

● TRD-K Series

Model	Price
TRD-K180-YS	¥37,000
TRD-K256-YS	¥40,000
TRD-K360-YS	¥40,000
TRD-K512-YS	¥43,000
TRD-K720-YS	¥45,000
TRD-K1024-YS	¥48,000
TRD-K360-YCS	¥41,600
TRD-K512-YCS	¥44,600
TRD-K720-YCS	¥46,600
TRD-K1024-YCS	¥49,600
TRD-K360-YPS	¥42,950
TRD-K512-YPS	¥45,950
TRD-K720-YPS	¥47,950
TRD-K1024-YPS	¥50,950
TRD-K360-YC2	¥45,000
TRD-K512-YC2	¥48,000
TRD-K720-YC2	¥50,000
TRD-K1024-YC2	¥53,000

● TRD-KL Series

Model	Price
TRD-KL180-Y	¥42,000
TRD-KL250-Y	¥45,000
TRD-KL256-Y	
TRD-KL360-Y	
TRD-KL500-Y	¥48,000
TRD-KL512-Y	
TRD-KL720-Y	¥50,000
TRD-KL1000-Y	¥53,000
TRD-KL1024-Y	
TRD-KL180-YC2	¥47,000
TRD-KL250-YC2	¥50,000
TRD-KL256-YC2	
TRD-KL360-YC2	
TRD-KL500-YC2	¥53,000
TRD-KL512-YC2	
TRD-KL720-YC2	¥55,000
TRD-KL1000-YC2	¥58,000
TRD-KL1024-YC2	

* Be sure to specify the resolution when ordering.

● Options

Name	Model	Price
Mounting bracket	JT-035	¥1,320
	RT-11	¥5,550
Coupling	JU-100	¥3,500
	RU-075	¥3,000
	RU-100	¥3,500
	KU-100	¥4,700
	GJ-6	¥ 650
	GJ-8	¥ 780
	GJ-10	¥ 920
Servo mount metal fixture	KM-9	¥ 130
Servo mount flange	NF-55	¥ 800
Connector cable	F-30GF	¥4,450
	F-50GF	¥5,350

Name	Model	Price
Connector cable	F-100GF	¥7,650
	F-30G	¥3,000
	F-50G	¥4,050
	F-100G	¥6,350
	F-20ANC2	¥7,400
	F-50ANC2	¥8,700
	F-20BNC2	¥7,400
	F-50BNC2	¥8,700
	F-20ANC2A	¥8,700
	F-50ANC2A	¥9,850
	F-20BNC2A	¥8,700

Name	Model	Price
Connector cable	F-50BNC2A	¥ 9,850
	F-20C2	¥ 9,650
	F-20C2A	¥11,000
	F-50J	¥ 6,730
	F-150J	¥11,230
Cable connector	BMCC-6	¥ 4,600
	BMCC-12	¥ 5,800
	BAFC-6	¥ 5,800
	BAFC-12	¥ 6,700

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