Smart encoders & actuators

# A41 Series Light Duty Incremental Encoders

## Features

- Compact industrial encoders
- Solid or hollow shaft version
- Universal output circuit: 5–30 VDC Push-Pull (Totem Pole) or NPN/PNP open collector (HTL), or Line Driver (TTL)
- Quadrature output signals with index (ABZ, /ABZ)
- High resolution up to 4096 PPR
- IP64 environmental rating

**A41 Series Medium Duty Incremental (Quadrature) Encoders**

| Part Number | Price | Pulses per Revolution | Dimensional Drawing | Shaft Type | Body Diameter | Input Voltage | Cable | Output |
|---|---|---|---|---|---|---|---|---|
| A41S-0100-HZCP6-AL2 | $;06bx[: | 100 | PDF | 1/4“ Solid | 41mm | 5–30 VDC | 2m (6.5 ft) pigtail | Universal circuit: Push-Pull (Totem Pole), or NPN/ PNP open collector (HTL), or Line Driver (TTL) |
| A41S-0200-HZCP6-AL2 | $06bx_: | 200 | PDF | | | | | |
| A41S-0360-HZCP6-AL2 | $06bx#: | 360 | PDF | | | | | |
| A41S-0500-HZCP6-AL2 | $;06bx!: | 500 | PDF | | | | | |
| A41S-1000-HZCP6-AL2 | $06bx?: | 1000 | PDF | | | | | |
| A41S-1024-HZCP6-AL2 | $;06bx,: | 1024 | PDF | | | | | |
| A41S-2000-HZCP6-AL2 | $06by0: | 2000 | PDF | | | | | |
| A41S-2048-HZCP6-AL2 | $06by1: | 2048 | PDF | | | | | |
| A41S-3600-HZCP6-AL2 | $06by2: | 3600 | PDF | | | | | |
| A41S-4096-HZCP6-AL2 | $06by3: | 4096 | PDF | | | | | |
| A41H-0100-HZCP6-AL2 | $06by4: | 100 | PDF | 1/4” Hollow | | | | |
| A41H-0200-HZCP6-AL2 | $06by5: | 200 | PDF | | | | | |
| A41H-0360-HZCP6-AL2 | $06by6: | 360 | PDF | | | | | |
| A41H-0500-HZCP6-AL2 | $06by7: | 500 | PDF | | | | | |
| A41H-1000-HZCP6-AL2 | $06by8: | 1000 | PDF | | | | | |
| A41H-1024-HZCP6-AL2 | $06by9: | 1024 | PDF | | | | | |
| A41H-2000-HZCP6-AL2 | $06bya: | 2000 | PDF | | | | | |
| A41H-2048-HZCP6-AL2 | $06byb: | 2048 | PDF | | | | | |
| A41H-3600-HZCP6-AL2 | $06byc: | 3600 | PDF | | | | | |
| A41H-4096-HZCP6-AL2 | $06byd: | 4096 | PDF | | | | | |

## Accessories - A41 Series

**Accessories for A41 Series Encoders**

| Part Number | Price | Description |
|---|---|---|
| PF4266 | $6by?: | Lika Electronic round mounting flange, 48mm bolt hole circle, metal. For use with Lika Electronic A41 series encoders. Mounting hardware included. |
| LKM-386 | $6bz8: | Lika Electronic servo mount clamp, metal. For use with Lika Electronic AQ58 and A41 series encoders. Mounting hardware included. |

PF4266

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# A41 Series Light Duty Incremental Encoders

## Specifications - A41 Series

| Electrical Specifications | |
|---|---|
| ***Resolution (PPR)*** | 100, 200, 360, 500, 1000, 1024, 2000, 2048, 3600, 4096 |
| ***Output Signals*** | Quadrature output signals with index (ABZ, /ABZ) |
| ***Counting Frequency*** | 100kHz maximum |
| ***Output Circuits*** | Universal circuit: Push-Pull (Totem Pole), or NPN/PNP open collector (HTL), or Line Driver (TTL) |
| ***Power Supply*** | +5VDC to +30VDC |
| ***Consumption*** | 70mA (typical) |
| ***Output Current (each channel)*** | 40mA maximum |
| ***Protection*** | Against inversion of polarity and short circuit |
| ***EMC*** | Electro-magnetic immunity according to EN61000-4-2 and EN61000-4-4 |
| **Mechanical Specifications** | |
| ***Shaft Diameter*** | Ø 6.35 mm (1/4") |
| ***Shaft Loading (axial, radial)*** | 20N maximum |
| ***Shaft Rotational Speed*** | 6000 rpm maximum |
| ***Starting Torque (@20°C)*** | 0.1 Ncm (typical) |
| ***Bearings Life*** | $10^9$ rev. min |
| ***Electrical Connections*** | Cable output 2m (6.5 ft) |
| ***Weight*** | 100g (3.5 oz) |
| **Materials** | |
| ***Flange*** | Anticorodal, UNI EN AW-6082 |
| ***Housing*** | Fiberglass epoxy resin |
| ***Bearings*** | ABEC 5 |
| ***Shaft*** | Stainless steel, non-magnetic, UNI EN 4305 |
| **Environmental Specifications** | |
| ***Shock*** | 250g, 6ms acc. to CEI EN 60068-2-27 |
| ***Vibrations*** | 10g, 5-2000 Hz acc. to CEI EN 60068-2-6 |
| ***Protection*** | IP64 |
| ***Operating Temperature Range*** | -25°C to 85°C (-13°F to 185°F) |
| ***Storage Temperature Range*** | -25°C to 85°C (-13°F to 185°F) (98% relative humidity without condensation) |
| ***Approvals*** | CE, UKCA, $_{c}UR_{us}$, RoHS |

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# A50 Series Medium Duty Incremental Encoders

## Features

- Small size hollow shaft encoders, 1/4" and 3/8"
- Ideally suited for motor feedback applications
- Extended standard operating temperature from -40°C to 100°C
- Universal output circuit: 5–30 VDC Push-Pull (Totem Pole), or NPN/PNP open collector (HTL), or Line Driver (TTL)
- Quadrature output signals with index (ABZ, /ABZ)
- IP65 environmental rating

**A50 Series Medium Duty Incremental (Quadrature) Encoders**

| Part Number | Price | Pulses per Revolution | Dimensional Drawing | Shaft Type | Body Diameter | Input Voltage | Cable | Output |
|---|---|---|---|---|---|---|---|---|
| A50H-0360-HZCP6-RL2 | $06byg: | 360 | PDF | 1/4" Hollow | 50mm | 5–30 VDC | 2m (6.5 ft) pigtail | Universal circuit: Push-Pull (Totem Pole), or NPN/ PNP open collector (HTL), or Line Driver (TTL) |
| A50H-1000-HZCP6-RL2 | $06byh: | 1000 | PDF | | | | | |
| A50H-1024-HZCP6-RL2 | $-06byi: | 1024 | PDF | | | | | |
| A50H-2048-HZCP6-RL2 | $-06byj: | 2048 | PDF | | | | | |
| A50H-0360-HZCP9-RL2 | $06byk: | 360 | PDF | 3/8" Hollow | | | | |
| A50H-1000-HZCP9-RL2 | $-06byl: | 1000 | PDF | | | | | |
| A50H-1024-HZCP9-RL2 | $06byn: | 1024 | PDF | | | | | |
| A50H-2048-HZCP9-RL2 | $06byo: | 2048 | PDF | | | | | |

## Accessories - A50 Series

**Accessories for A50 Series Encoders**

| Part Number | Price | Description |
|---|---|---|
| KIT-C50 | $6bza: | Lika Electronic encoder mounting plate, replacement, metal. For use with Lika Electronic A50 series encoders. Mounting hardware included. |

KIT-C50

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# A50 Series Medium Duty Incremental Encoders

## Specifications - A50 Series

| Electrical Specifications | |
|---|---|
| ***Resolution (PPR)*** | 360, 1000, 1024, 2048 |
| ***Output Signals*** | Quadrature output signals with index (ABZ, /ABZ) |
| ***Counting Frequency*** | 100kHz maximum |
| ***Output Circuits*** | Universal circuit: Push-Pull (Totem Pole), or NPN/PNP open collector (HTL), or Line Driver (TTL) |
| ***Power Supply*** | +5VDC to +30VDC |
| ***Consumption*** | 70mA (typical) |
| ***Output Current (each channel)*** | 40mA maximum |
| ***Protection*** | Against inversion of polarity and short circuit (except inductive circuit) |
| ***EMC*** | Electro-magnetic immunity according to EN61000-4-2 and EN61000-4-4 |
| **Mechanical Specifications** | |
| ***Shaft Diameter*** | Ø 6.35 mm (1/4"), 9.52 mm (3/8") |
| ***Shaft Loading (axial, radial)*** | 20N maximum |
| ***Shaft Rotational Speed*** | 6000 rpm maximum |
| ***Starting Torque (@20°C)*** | ≤0.25 Ncm (typical) |
| ***Bearings Life*** | $10^9$ rev. min |
| ***Electrical Connections*** | Cable output 2m (6.5 ft) |
| ***Weight*** | 100g (3.5 oz) |
| **Materials** | |
| ***Flange*** | Zamak 15, UNI EN1774 |
| ***Housing*** | Zamak 15, UNIT EN1774 |
| ***Bearings*** | ABEC 5 |
| ***Shaft*** | Stainless steel, non-magnetic, UNI EN 4305 |
| **Environmental Specifications** | |
| ***Shock*** | 250g, 6ms acc. to CEI EN 60068-2-27 |
| ***Vibrations*** | 10g, 5-2000 Hz acc. to CEI EN 60068-2-6 |
| ***Protection*** | IP65 |
| ***Operating Temperature Range*** | -40°C to 100°C (-40°F to 212°F) |
| ***Storage Temperature Range*** | -40°C to 100°C (-40°F to 212°F) (98% relative humidity without condensation) |
| ***Approvals*** | CE, UKCA, $_cUR_{us}$, RoHS |

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# AQ5x Series Programmable Incremental Encoders

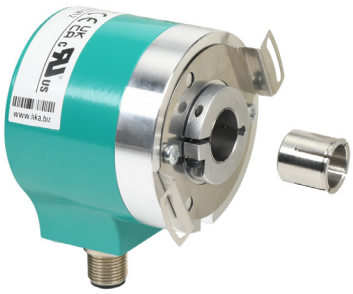
## Features

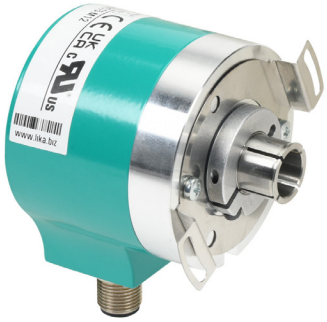
- Programmable incremental encoder
- Configurable resolution from 1 to 16,384 PPR (1024 default)
- Selectable index length of 90 or 180°
- Counting direction programmable CW or CCW
- Universal output circuit: 5–30 VDC Push-Pull (Totem Pole), or NPN/PNP open collector (HTL), or Line Driver (TTL)
- Quadrature output signals with index (ABZ, /ABZ)
- Programmable via USB cable and LIKA-IP-IQ software (free download at AutomationDirect on the AQ58S and AQ59H store pages)
- IP65 environmental rating

| AQ5x Series Medium Duty Incremental (Quadrature) Encoders | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ***Part Number*** | ***Price*** | ***Pulses per Revolution*** | ***Dimensional Drawing*** | ***Shaft Type*** | ***Body Diameter*** | ***Input Voltage*** | ***Cable*** | ***Output*** |
| ***AQ58S-PRG-HZCP9-M12*** | $06bye: | Up to 16,384 (14-bit) | PDF | 3/8" solid | 58mm | 5-30 VDC | M12 male | Universal circuit: Push-Pull (Totem Pole), or NPN/ PNP open collector (HTL), or Line Driver (TTL) |
| ***AQ59H-PRG-HZC15-M12*** | $;06byf: | | PDF | 6 to 15 mm hollow | 59mm | | | |

***Configurable Hollow Shaft Sizing***

The AQ59H encoder features a hollow shaft that can be resized using removable bushings. The images below show the installation of a BR1-12 bushing. See the "Accessories - AQ5x Series" on page tECD-9 for all available options.





***How to Configure your Encoder***

Use one of the following cable(s) to configure the encoder:

- KIT-IP/IQ58-USB-M12 programming cable
- Combination of KIT-IP/IQ58 and EC-IP/IQ58-M12
- Combination of KIT-IP/IQ58 and EC-M12F12-LKT12-05 or EC-M12F12-LKT12-10
- Download the software from the AQ58S-PRG-HZCP9-M12 or AQ59H-PRG-HZC15-M12 store page

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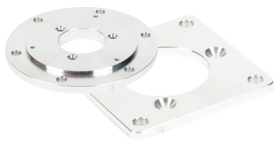
# AQ5x Series Programmable Incremental Encoders

## Accessories - AQ5x Series

| Accessories for AQ5x Series Encoders | | |
|---|---|---|
| **Part Number** | **Price** | **Description** |
| BR1-6 | $;6by]: | Lika Electronic reducer bushing, 15mm to 6mm, metal. For use with Lika Electronic AQ59 series encoders. |
| BR1-6.35 | $;6by,: | Lika Electronic reducer bushing, 15mm to 1/4in, metal. For use with Lika Electronic AQ59 series encoders. |
| BR1-8 | $6bz5: | Lika Electronic reducer bushing, 15mm to 8mm, metal. For use with Lika Electronic AQ59 series encoders. |
| BR1-9.52 | $6bzb: | Lika Electronic reducer bushing, 15mm to 3/8in, metal. For use with Lika Electronic AQ59 series encoders. |
| BR1-10 | $;6bzf: | Lika Electronic reducer bushing, 15mm to 10mm, metal. For use with Lika Electronic AQ59 series encoders. |
| BR1-11 | $6byu: | Lika Electronic reducer bushing, 15mm to 11mm, metal. For use with Lika Electronic AQ59 series encoders. |
| BR1-12 | $6byv: | Lika Electronic reducer bushing, 15mm to 12mm, metal. For use with Lika Electronic AQ59 series encoders. |
| BR1-12.7 | $6byx: | Lika Electronic reducer bushing, 15mm to 1/2in, metal. For use with Lika Electronic AQ59 series encoders. |
| PF4256 | $6bz0: | Lika Electronic round mounting flange, 61mm bolt hole circle, metal. For use with Lika Electronic AQ58 series encoders. Mounting hardware included. |
| PF0408 | $06bz1: | Lika Electronic spring-loaded encoder mount, metal. For use with Lika Electronic AQ58 series encoders. Mounting hardware included. |
| PF4257 | $6bz2: | Lika Electronic right angle bracket, metal. For use with Lika Electronic AQ58 series encoders. Mounting hardware included. |
| PF4259 | $6bz3: | Lika Electronic square mounting flange, 92mm bolt hole circle, metal. For use with Lika Electronic AQ58 series encoders. Mounting hardware included. |
| PF4274 | $06bz4: | Lika Electronic round mounting flange, 70mm bolt hole circle, metal. For use with Lika Electronic AQ58 series encoders. Mounting hardware included. |
| PF4258 | $6bz6: | Lika Electronic round mounting flange, 75mm and 100mm bolt hole circle, metal. For use with Lika Electronic AQ58 series encoders. Mounting hardware included. |
| PF5000-A | $6bz7: | Lika Electronic square mounting flange, 70mm bolt hole circle, metal. For use with Lika Electronic AQ58 series encoders. Mounting hardware included. |
| LKM-386 | $6bz8: | Lika Electronic servo mount clamp, metal. For use with Lika Electronic AQ58 and A41 series encoders. Mounting hardware included. |
| KIT-XX59 | $6bz9: | Lika Electronic servo mount clamp, metal. For use with Lika Electronic AQ58 and AQ59 series encoders. Mounting hardware included. |
| KIT-IP/IQ58 | $06bxv: | Lika Electronic programming cable, USB A to 4-position terminal block, 4.9ft/1.5m cable length. For use with Lika Electronic AQ58 and AQ59 series encoders. Requires Lika Electronic EC-IP/IQ58-M12 programming or EC-M12F12-LKT12-xx encoder cable. |
| EC-IP/IQ58-M12 | $6bxx: | Lika Electronic programming cable, M12 axial female to pigtail, 2ft cable length. For use with Lika Electronic AQ58 and AQ59 series encoders. Requires Lika Electronic KIT-IP/IQ58 programming cable. |
| KIT-IP/IQ58-USB-M12 | $06bxy: | Lika Electronic programming cable, USB A to M12 axial female, 1.6ft/0.5m cable length. For use with Lika Electronic AQ58 and AQ59 series encoders. |
| EC-M12F12-LKT12-05 | $6bxz: | Lika Electronic encoder cable, M12 axial female to pigtail, shielded, 16.4ft/5m cable length. For use with Lika Electronic AQ58 and AQ59 series encoders. |
| EC-M12F12-LKT12-10 | $;6bx]: | Lika Electronic encoder cable, M12 axial female to pigtail, shielded, 32.8ft/10m cable length. For use with Lika Electronic AQ58 and AQ59 series encoders. |

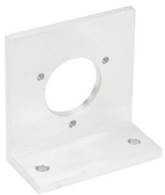
**Bore Reducers**



**Mounting Flanges**

**PF0408**

**LKM-386**



**PF4257**

**KIT-IP/IQ58**

**EC-IP/IQ58-M12**

**KIT-IP/IQ58-USB-M12**

**EC-M12F12-LKT12-05**

**KIT-XX59**

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# AQ5x Series Programmable Incremental Encoders

## Specifications - AQ5x Series

| Electrical Specifications | |
|---|---|
| ***Resolution (PPR)*** | Programmable from 1 to 16,384 (default 1024 PPR) |
| ***Accuracy*** | ± 0.15° |
| ***Output Signals*** | Quadrature output signals with index (ABZ, /ABZ) |
| ***Counting Frequency*** | 500kHz maximum |
| ***Output Circuits*** | Universal circuit: Push-Pull (Totem Pole), or NPN/PNP open collector (HTL), or Line Driver (TTL) |
| ***Power Supply*** | +5VDC to +30VDC |
| ***Consumption*** | 60mA (typical) |
| ***Output Current (each channel)*** | 40mA maximum |
| ***Protection*** | Against inversion of polarity and short circuit |
| ***EMC*** | Electro-magnetic immunity according to EN61000-4-2 and EN61000-4-4 |
| **Mechanical Specifications** | |
| ***Shaft Diameter*** | Ø 9.52 mm (3/8") |
| ***Hollow Shaft Diameter*** | Ø 15mm<br>(available bore reducer sleeves for 6mm, 1/4", 8mm, 3/8", 10mm, 11mm, 12mm, 1/2") |
| ***Shaft Loading (axial, radial)*** | 100N maximum |
| ***Shaft Rotational Speed*** | Typical 6000 rpm, temporary 12000 rpm maximum |
| ***Starting Torque (@20°C)*** | AQ58: 0.15 Ncm<br>AQ59: 0.4 Ncm |
| ***Bearings Life*** | $400 \times 10^6$ rev. min<br>($10^9$ rev. min. with shaft loading limited to 20N) |
| ***Electrical Connections*** | M12 |
| ***Weight*** | 200g (7 oz) |
| **Materials** | |
| ***Flange*** | Anticorodal, UNI EN AW-6082 |
| ***Housing*** | Anticorodal, UNI EN AW-6082 |
| ***Bearings*** | ABEC 5 |
| ***Shaft*** | Stainless steel, non-magnetic, UNI EN 4305 |
| **Environmental Specifications** | |
| ***Shock*** | 100g, 6ms acc. |
| ***Vibrations*** | 10g, 5-2000 Hz acc. |
| ***Protection*** | IP65 |
| ***Operating Temperature Range*** | -40°C to 85°C (-40°F to 185°F) |
| ***Storage Temperature Range*** | -40°C to 100°C (-40°F to 212°F)<br>(98% relative humidity without condensation) |
| ***Approvals*** | CE, UKCA, $_c$UR$_{us}$, RoHS |

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# A80 Series Medium Duty Incremental Encoders

## Features

- Feedback encoder for large motors
- Precise optical sensing
- Very flat design
- Hollow shafts up to 30mm diameter
- Bore reducing sleeves of 5/8", 19mm, 20mm, 7/8", 1", 1 1/8"
- Universal output circuit: 5–30 VDC Push-Pull (Totem Pole), or NPN/PNP open collector (HTL), or Line Driver (TTL)
- Quadrature output signals with index (ABZ, /ABZ)
- Diecast housing with IP64 environmental rating (dustproof, splashproof)

**A80H with M23 Connector**

**A80H with Pigtail Cable**

| A80 Series Medium Duty Incremental (Quadrature) Encoders | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ***Part Number*** | ***Price*** | ***Pulses per Revolution*** | ***Dimensional Drawing*** | ***Shaft Type*** | ***Body Diameter*** | ***Input Voltage*** | ***Cable*** | ***Output*** |
| ***A80H-1024-HZC30-M23*** | $06byp: | 1024 | PDF | Multiple hollow shafts between 5/8" and 30mm | 80 | 5–30 VDC | M23 male | Universal circuit: Push-Pull (Totem Pole), or NPN/ PNP open collector (HTL), or Line Driver (TTL) |
| ***A80H-1024-HZC30-RL2*** | $06byq: | | PDF | | | | 2m (6.5 ft) pigtail | |

***Configurable Hollow Shaft Sizing***

The A80H encoder features a hollow shaft that can be resized using removable bushings. The images below show the installation of a BR2-25.4 bushing to an A80H-1024-HZC30-M23. See "Accessories - A80 Series" on page tECD-12 for all available options.

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# A80 Series Medium Duty Incremental Encoders

## Accessories - A80 Series

| Accessories for A80 Series Encoders | | |
|---|---|---|
| ***Part Number*** | ***Price*** | ***Description*** |
| ***BR2-15.875*** | $6byy: | Lika Electronic reducer bushing, 30mm to 5/8in, metal. For use with Lika Electronic A80 series encoders. Mounting hardware included. |
| ***BR2-19*** | $6byz: | Lika Electronic reducer bushing, 30mm to 19mm, metal. For use with Lika Electronic A80 series encoders. Mounting hardware included. |
| ***BR2-20*** | $;6by[: | Lika Electronic reducer bushing, 30mm to 20mm, metal. For use with Lika Electronic A80 series encoders. Mounting hardware included. |
| ***BR2-7/8*** | $6by_: | Lika Electronic reducer bushing, 30mm to 7/8in, metal. For use with Lika Electronic A80 series encoders. Mounting hardware included. |
| ***BR2-25.4*** | $6by#: | Lika Electronic reducer bushing, 30mm to 1in, metal. For use with Lika Electronic A80 series encoders. Mounting hardware included. |
| ***BR2-1-1/8*** | $;6by!: | Lika Electronic reducer bushing, 30mm to 1 1/8in, metal. For use with Lika Electronic A80 series encoders. Mounting hardware included. |
| ***EC-C12F-LKI8-05*** | $6bxq: | Lika Electronic encoder cable, M23 axial female to pigtail, shielded, 16.4ft/5m cable length. For use with Lika Electronic A80 series encoders. |
| ***EC-C12F-LKI8-10*** | $6bxs: | Lika Electronic encoder cable, M23 axial female to pigtail, shielded, 32.8ft/10m cable length. For use with Lika Electronic A80 series encoders. |
| ***E-PFL121*** | $6bxp: | M23 connector, 24 AWG, accepts cable diameter size 5mm. For use with Lika Electronic A80 series encoders. |
| ***KIT-C80*** | $6bzc: | Lika Electronic encoder mounting plate, replacement, metal. For use with Lika Electronic A80 series encoders. Mounting hardware included. |

**BR2-20**

**BR2-25.4**

**KIT-C80**

**EC-C12F-LKI8-05**

**E-PFL121**

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# A80 Series Medium Duty Incremental Encoders

## Specifications - A80 Series

| Electrical Specifications | |
|---|---|
| ***Resolution (PPR)*** | 1024 |
| ***Output Signals*** | Quadrature output signals with index (ABZ, /ABZ) |
| ***Counting Frequency*** | 300kHz maximum |
| ***Output Circuits*** | Universal circuit: Push-Pull (Totem Pole), or NPN/PNP open collector (HTL), or Line Driver (TTL) |
| ***Power Supply*** | +5VDC to +30VDC |
| ***Consumption*** | 70mA (typical) |
| ***Output Current (each channel)*** | 40mA maximum |
| ***Protection*** | Against inversion of polarity and short circuit |
| ***EMC*** | Electro-magnetic immunity according to EN61000-4-2 and EN61000-4-4 |
| **Mechanical Specifications** | |
| ***Shaft Diameter*** | Ø 30 mm |
| ***Reducing Sleeves*** | Ø 5/8" (15.875), 19, 20, 7/8", 1" (25.4), 1 1/8" |
| ***Shaft Loading (axial, radial)*** | 30N maximum |
| ***Shaft Rotational Speed*** | 6000 rpm maximum |
| ***Starting Torque (@20°C)*** | ≤1.5 Ncm (typical) |
| ***Bearings Life*** | $400 \times 10^6$ rev. min<br>($10^9$ rev. min. with shaft loading limited to 20N) |
| ***Electrical Connections*** | M23 12-pin plug or cable output 2m (6.5 ft) |
| ***Weight*** | 300g (10.6 oz) |
| **Materials** | |
| ***Flange*** | Die cast aluminum, UNI EN-AC-46100 |
| ***Housing*** | Die cast aluminum, UNI EN-AC-46100 |
| ***Bearings*** | ABEC 5 |
| ***Shaft*** | Stainless steel, non-magnetic, 1.4305 (UNI EN 10088-1) |
| **Environmental Specifications** | |
| ***Shock*** | 250g, 6ms acc. to CEI EN 60068-2-27 |
| ***Vibrations*** | 10g, 5-2000 Hz acc. to CEI EN 60068-2-6 |
| ***Protection*** | IP64 |
| ***Operating Temperature Range*** | -25°C to +85°C (-13°F to +185°F) |
| ***Storage Temperature Range*** | -40°C to +100°C (-40°F to +212°F)<br>(98% relative humidity without condensation) |
| ***Approvals*** | CE, UKCA, $_cUR_{us}$, RoHS |

Smart encoders & actuators

# AR01 Series Incremental Rotary Measuring Wheel Encoders

## Features

- Measuring wheel encoder
- Metric & US/imperial wheel sizes
  - Standard 4" wheel (12.5" circumference)
  - Optional 80mm wheel (250mm circumference)
- Universal output circuit: 5–30 VDC Push-Pull (Totem Pole), or NPN/PNP open collector (HTL), or Line Driver (TTL)
- Quadrature output signals with index (AB, /AB)
- Spring loaded arm with up to 30mm deflection
- Conveyor speed control, cut-to-length, and object positioning applications
- IP65 environmental rating

**AR01 Series Incremental Measuring Wheel Encoders**

| Part Number | Price | Pulses per Revolution | Dimensional Drawing | Shaft Type | Wheel Circumference | Linear Resolution* | | Input Voltage | Cable | Output |
|---|---|---|---|---|---|---|---|---|---|---|
| AR01-0250-HM12-A | $06bzh: | 250 | PDF | n/a (Wheel assembly) | 12.5" | 0.0125"/ct | 80cts/ inch | 5–30 VDC | M12 male | Universal circuit: Push-Pull (Totem Pole), or NPN/PNP open collector (HTL), or Line Driver (TTL) |
| AR01-1250-HM12-A | $-06bzi: | 1250 | PDF | | | 0.0025"/ct | 400cts/ inch | | | |

*** Resolution = (quadrature PPR x 4) / (inches circumference)**

## Accessories - AR01 Series

**Accessories for AR01 Series Encoders**

| Part Number | Price | Description |
|---|---|---|
| AR01X-WHEEL-A | $6bzd: | Lika Electronic encoder measuring wheel, replacement, 4in diameter (12.5in circumference), 15mm shaft, metal. For use with Lika Electronic AR01 series measuring wheel encoder assemblies. 15mm shaft bore size. BR1-xx shaft reducers can be used to accomodate shaft sizes from 6mm to 1/2 inch. |
| AR01X-WHEEL-B | $6bze: | Lika Electronic encoder measuring wheel, replacement, 80mm diameter (250mm circumference), 15mm shaft, metal. For use with Lika Electronic AR01 series measuring wheel encoder assemblies. 15mm shaft bore size. BR1-xx shaft reducers can be used to accomodate shaft sizes from 6mm to 1/2 inch. |
| AR01X-0250-HM12 | $06bys: | Lika Electronic AR01 series incremental (quadrature) rotary encoder, replacement, 5-30 VDC, universal (line driver or NPN/ PNP open collector) output, medium duty, 250 ppr, 15mm dual shaft, 58mm diameter body, IP65, radial exit, M12 male. |
| AR01X-1250-HM12 | $;06byt: | Lika Electronic AR01 series incremental (quadrature) rotary encoder, replacement, 5-30 VDC, universal (line driver or NPN/ PNP open collector) output, medium duty, 1250 ppr, 15mm dual shaft, 58mm diameter body, IP65, radial exit, M12 male. |
| EC-M12F8-LKM8-05 | $;6bxt: | Lika Electronic encoder cable, M12 axial female to pigtail, shielded, 16.4ft/5m cable length. For use with Lika Electronic AR01 series measuring wheel encoder assemblies. |
| EC-M12F8-LKM8-10 | $6bxu: | Lika Electronic encoder cable, M12 axial female to pigtail, shielded, 32.8ft/10m cable length. For use with Lika Electronic AR01 series measuring wheel encoder assemblies. |

**AR01X-WHEEL-A**

**AR01X-0250-HM12**

**EC-M12F8-LKM8-05**

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# AR01 Series Incremental Rotary Measuring Wheel Encoders

## Specifications - AR01 Series

| Electrical Specifications | |
|---|---|
| ***Resolution (PPR)*** | 250, 1250 |
| ***Output Signals*** | Quadrature output signals with index (AB, /AB) |
| ***Counting Frequency*** | 50kHz maximum |
| ***Output Circuits*** | Universal circuit: Push-Pull (Totem Pole), or NPN/PNP open collector (HTL), or Line Driver (TTL) |
| ***Power Supply*** | +5VDC to +30VDC |
| ***Consumption*** | 70mA (typical) |
| ***Output Current (each channel)*** | 40mA maximum |
| ***Protection*** | Against inversion of polarity and short circuit |
| ***EMC*** | Electro-magnetic immunity according to EN61000-4-2 and EN61000-4-4 |
| ***Optoelectronic Life*** | 100,000 hours minimum |
| **Mechanical Specifications** | |
| ***Wheel Circumference*** | AR01-WHEEL-A: 317.6 mm (standard)<br>AR01-WHEEL-B: 250mm (optional) |
| ***Spring Arm Max Deflection*** | 30mm |
| ***Shaft Max Rotational Speed*** | 2000rpm |
| ***Shaft Loading (axial, radial)*** | 50N maximum |
| ***Starting Torque (@20°C)*** | 1 Ncm (typical) |
| ***Bearings Life*** | $10^9$ rev. min. |
| ***Electrical Connections*** | M12 8-pin plug |
| ***Weight*** | 1.12 kg (2.50 lbs) |
| **Materials** | |
| ***Flange*** | Anodized aluminum, UNI EN AW-6082 |
| ***Housing*** | Zamac die cast |
| ***Bearings*** | ABEC 5 |
| ***Shaft*** | Stainless steel, non-magnetic, UNI EN 4305 |
| **Environmental Specifications** | |
| ***Shock*** | 250g, 6ms acc. to CEI EN 60068-2-27 |
| ***Vibrations*** | 10g, 5-2000 Hz acc. to CEI EN 60068-2-6 |
| ***Protection*** | IP65 |
| ***Operating Temperature Range*** | -25°C to 85°C (-13°F to 185°F) |
| ***Storage Temperature Range*** | -40°C to 100°C (-40°F to 212°F)<br>(98% relative humidity without condensation) |
| ***Approvals*** | CE, RoHS, UKCA |

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# Encoder Accessories

## Lika Encoder Accessories

| Accessories for Lika Encoders | | | |
|---|---|---|---|
| ***Part Number*** | ***Price*** | ***Description*** | ***Compatible With*** |
| ***LKM-386*** | $6bz8: | Lika Electronic servo mount clamp, metal. For use with Lika Electronic AQ58 and A41 series encoders. Mounting hardware included. | A41, AQ58S series |

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# DWx Series Light and Medium Duty Draw Wire Encoders

Draw Wire Encoders, also known as string encoders or string potentiometers, use a spring-loaded cable reel that is wrapped with a steel cable. The reel is connected to a rotary encoder or potentiometer that can provide very accurate feedback of how far the steel cable has been pulled out. Our Draw Wire Encoders provide encoder (quadrature) and analog (0-10V, 4-20mA) outputs and are available from 2 meter pull lengths up to 10 meter lengths.

Typical applications include linear measuring, vertical lift measurement, cylinder stroke measurement, or any application where accurate, inexpensive, and easy to install measurement of a linear distance is required.

## Features

***DWI Series***

- Encoder (quadrature) output 0.025–0.050 mm/count resolution
- Cost effective
- Miniature size (DWI-2M), robust and space saving construction
- Universal electrical output (line driver, open collector, etc.)
- Stainless steel draw wire
- Measuring lengths of 2000mm, 5000mm, and 10000mm
- Light duty IP64 and medium duty IP65 encoders available

***DWP Series***

- Analog voltage or current output: 0-10 V or 4-20 mA
- Robust design
- Smooth, stepless analog incrementing (potentiometer-based)
- Stainless steel draw wire
- Measuring lengths of 2000mm
- IP64

***DWA Series***

- Programmable Analog out: 0-10 V or 4-20 mA
- Easy to use Teach Mode (use pushbuttons on the back of the encoder or use digital inputs)
- Status LEDs
- Overrun function (alarm if wire is pulled outside the Teach limits)
- Convenient M12 cable connection
- Stainless steel draw wire
- Measuring lengths of 5000mm and 10000mm
- IP65

**DWx Series Light and Medium Duty Draw Wire Encoders**

| Part Number | Price | Duty Type | Measuring Length | Measuring Speed | Feed Distance per Encoder Revolution | Resolution | Dimensional Drawing | Input Voltage | Output |
|---|---|---|---|---|---|---|---|---|---|
| DWI-2M-H0500-RL2 | $-06ivb: | Light | 2000mm | 1m/sec max | 100mm | 0.050 mm/count (quadrature) | PDF | 5–30 VDC | Universal output circuit: Push-Pull (Totem Pole) or NPN/PNP open collector (HTL), or Line Driver (TTL) Quadrature (AB,/AB) |
| DWI-5M-H2000-RL2 | $-06ivc: | Medium | 5000mm | 2m/sec max | 200mm | 0.025 mm/count (quadrature) | PDF | | Universal output circuit: Push-Pull (Totem Pole) or NPN/PNP open collector (HTL), or Line Driver (TTL) Quadrature with index (ABZ, /ABZ) |
| DWI-10M-H2000-RL2 | $-06ivd: | | 10000mm | | | | PDF | | |
| DWP-2M-4A-RL2 | $-06ive: | | 2000mm | 1m/sec max | 100mm | Analog (stepless) | PDF | 10–30 VDC | 4–20 mA |
| DWP-2M-0V-RL2 | $;-06ivf: | | | | | | PDF | | 0–10 V |
| DWA-5M-4A-M12 | $-06iv7: | | 5000mm | 2m/sec max | 200mm | 16bit (min 0.366 µA/step) | PDF | 13–30 VDC | 4–20 mA |
| DWA-5M-0V-M12 | $-06iv8: | | | | | 16bit (min 0.153 mV/step) | PDF | | 0–10 V |
| DWA-10M-4A-M12 | $-06iv9: | | 10000mm | | | 16bit (min 0.366 µA/step) | PDF | | 4–20 mA |
| DWA-10M-0V-M12 | $-06iva: | | | | | 16bit (min 0.153 mV/step) | PDF | | 0–10 V |

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# DWI Series Light and Medium Duty Draw Wire Encoders

## Specifications - DWI Series

| DWI Series Specifications | | | | |
|---|---|---|---|---|
| **Model** | | DWI-2M-H0500-RL2 | DWI-5M-H2000-RL2 | DWI-10M-H2000-RL2 |
| **Price** | | $-06ivb: | $-06ivc: | $-06ivd: |
| **Drawing** | | PDF | PDF | PDF |
| Electrical Specifications | Resolution | 0.05 mm | 0.025 mm | |
| | Output Signals | AB, /AB | ABZ, /ABZ | |
| | Output Circuits | Universal output circuit: Push-Pull (Totem Pole) or NPN/PNP open collector (HTL), or Line Driver (TTL), Quadrature (AB,/AB) | Universal output circuit: Push-Pull (Totem Pole) or NPN/PNP open collector (HTL), or Line Driver (TTL), Quadrature with index (ABZ, /ABZ)[1] | |
| | Power Supply | 5–30 VDC | | |
| | Output Current | 40mA max | | |
| | Input Current | 60mA max | | |
| Mechanical Specifications | Feed Distance per Encoder Revolution | 100mm | 200mm | |
| | Wire Retraction Force | 3–5 N | 3.2–6.5 N | 3.2–6 N |
| | Measuring Length | 2000mm | 5000mm | 10000mm |
| | Measuring Speed | 1 m/sec max | 2 m/sec max | |
| | Linearity[2] | ± 0.3 mm | ± 0.5 mm | |
| | Repeatability | ± 0.1 mm | | |
| | Signal Cable | 2.0 m cable | | |
| | Weight | 0.2 kg | 0.8 kg | |
| Materials | Housing | Aluminum plus plastic | Aluminum | |
| | Draw Wire | Stainless steel, non-magnetic – UNI EN 4305 | | |
| Environmental Specifications | Shock | 100g, 6ms | | |
| | Vibrations | 10g, 5–2000 Hz | | |
| | Protection | IP64 | IP65 | |
| | Operating Temperature Range | -25°C to +85°C (-13°F to +185°F) | -40°C to +85°C (-40°F to +185°F) | |
| | Storage Temperature Range | -40°C to +100°C (-40°F to +212°F), 98% relative humidity, non-condensing | | |
| | Approvals | UKCA, CE, RoHS | | |

**1 - Note: The index pulse is output every one encoder revolution which corresponds to the Feed Distance per Encoder Revolution. The index pulse will trigger every 200mm.**
**2 - Note: Linearity is the measurement difference between the ideal or expected output position (a straight line) and the reported output position of the draw wire.**

DWI-2M-H0500-RL2

DWI-5M-H2000-RL2

DWI-10M-H2000-RL2

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# DWP Series Medium Duty Draw Wire Encoders

## Specifications - DWP Series

| DWP Series Specifications | | | |
|---|---|---|---|
| **Model** | | DWP-2M-4A-RL2 | DWP-2M-0V-RL2 |
| **Price** | | $-06ive: | $;-06ivf: |
| **Drawing** | | PDF | PDF |
| Electrical Specifications | Current Output | 4–20 mA ± 5% | |
| | Power Supply (for current output) | 10–30 VDC | |
| | Voltage Output | 0–10 V ± 5% | |
| | Power Supply (for voltage output) | 15–30 VDC | |
| | Input Current | 2mA max | |
| Mechanical Specifications | Feed Distance per Encoder Revolution | 100mm | |
| | Wire Retraction Force | 3–5 N | |
| | Measuring Length | 2000mm | |
| | Measuring Speed | 1 m/sec max | |
| | Linearity[1] | ± 0.25% of current position value | |
| | Repeatability | ± 0.15 mm | |
| | Signal Cable | 2.0 m cable | |
| | Weight | 0.2 kg | |
| Materials | Housing | Aluminum | |
| | Draw Wire | Stainless steel, non-magnetic – UNI EN 4305 | |
| Environmental Specifications | Shock | 100g, 6ms | |
| | Vibrations | 10g, 5–2000 Hz | |
| | Protection | IP64 | |
| | Operating Temperature Range | -25°C to +85°C (-13°F to +185°F) | |
| | Storage Temperature Range | -40°C to +100°C (-40°F to +212°F), 98% relative humidity, non-condensing | |
| | Approvals | UKCA, CE, RoHS | |

**1 - Note: Linearity is the measurement difference between the ideal or expected output position (a straight line) and the reported output position of the draw wire.**

DWP-2M-4A-RL2

DWP-2M-0V-RL2

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# DWA Series Medium Duty Draw Wire Encoders

## Specifications - DWA Series

| DWA Series Specifications | | | | | |
|---|---|---|---|---|---|
| **Model** | | DWA-5M-4A-M12 | DWA-5M-0V-M12 | DWA-10M-4A-M12 | DWA-10M-0V-M12 |
| **Price** | | $-06iv7: | $-06iv9: | $-06iv8: | $-06iva: |
| **Drawing** | | PDF | PDF | PDF | PDF |
| Electrical Specifications | Resolution | 65536 steps (min. step = 0.048 mm) | | | |
| | Power Supply | 13–30 VDC | | | |
| | Output Circuit | 4–20 mA | | 0–10 V | |
| | Output Range | Adjustable by teach-in buttons | | | |
| | Input current | 1.5 W | | | |
| | Protection | Against inversion of polarity and short-circuit | | | |
| | EMC | Electro-magnetic immunity, according to: EN-61000-4-2 and EN-61000-4-4 | | | |
| | Optoelectronic Life | >100,000 hours | | | |
| | Functions | Teach window of travel length<br>Overrun limit alarm | | | |
| Mechanical Specifications | Feed Distance per Encoder Revolution | 200mm | | | |
| | Wire Retraction Force | 3.2–6.5 N | 3.2–6 N | 3.2–6.5 N | 3.2–6 N |
| | Measuring Length | 5000 | 10000 | 5000 | 10000 |
| | Measuring Speed | 2 m/sec max | | | |
| | Linearity[1] | ± 0.5 mm | | | |
| | Repeatability | ± 0.1 mm | | | |
| | Signal Cable | M12 plug | | | |
| | Weight | 0.8 kg | | | |
| Materials | Housing | Aluminum | | | |
| | Draw Wire | Stainless steel, non-magnetic – UNI EN 4305 | | | |
| Environmental Specifications | Shock | 100g, 6ms | | | |
| | Vibrations | 10g, 5–2000 Hz | | | |
| | Protection | IP65 | | | |
| | Operating Temperature Range | -40°C to +85°C (-40°F to +185°F) | | | |
| | Storage Temperature Range | -40°C to +100°C (-40°F to +212°F), 98% relative humidity, non-condensing | | | |
| | Approvals | UKCA, CE, RoHS | | | |

**1 - Note: Linearity is the measurement difference between the ideal or expected output position (a straight line) and the reported output position of the draw wire.**

DWA-10M-4A-M12

DWA-10M-0V-M12

DWA-5M-0V-M12

DWA-5M-4A-M12

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# Windows Configuration Software

## Lika Configuration Software

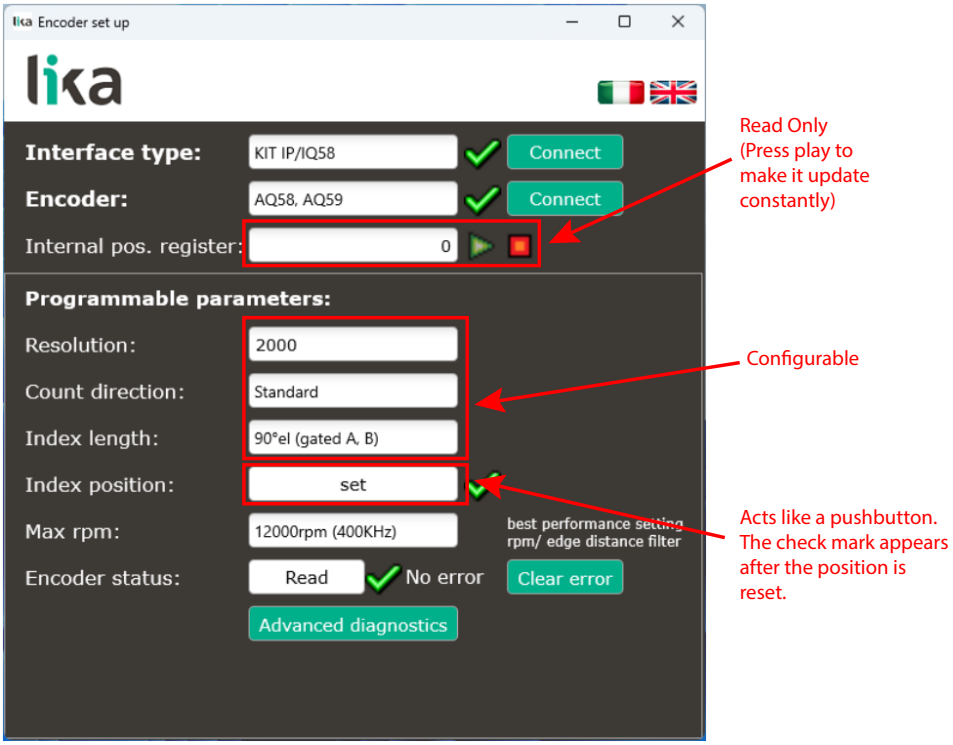
AQ58S and AQ59H programmable incremental encoders can use software expressly developed and released by Lika Electronic to easily program and configure the device.

This software is for use with the AQ58S and AQ59H programmable encoders only.

Use one of the following methods to configure the AQ58S or AQ59H encoder:

- KIT-IP/IQ58-USB-M12 programming cable.
- Combination of KIT-IP/IQ58 and EC-IP/IQ58-M12 programming kit.
- Combination of KIT-IP/IQ58 and EC-M12F12-LKT12-xx cable.

| Lika Electronic Windows Configuration Software | | | |
|---|---|---|---|
| ***Part Number*** | ***Price*** | ***Requires*** | ***Use With*** |
| ***LIKA-IP-IQ*** | $;-6i[3: | KIT-IP/IQ58-USB-M12 or KIT-IP/ IQ58 programming cable | AQ58 and AQ59 series Lika encoders. |



# Encoder Selection Guide

## SAE Dimension Encoders & Metric Dimension Encoders

### Encoder Selection Guide

| Type | Duty | Series | Encoder Diameter | Shaft Diameter | Shaft Type | Operating Voltage (VDC) and Electrical Output | IP Rating | Cable | Max Radial Load (N) | Max Axial Load (N) | Available Resolutions (PPR) | Brand |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Incremental | Modular Kit | AMT | 28mm, 42mm | 2, 3, 4, 5, 6, 8 mm 3/16, 1/4, 3/8, 1/2, 5/8 inch | Hollow | 5V Line Driver (TTL) or 5V Push-Pull (Totem Pole) | IP20 | Custom cables sold separately | N/A | N/A | Programmable up to 4096 | Same Sky |
| | | MTRA | 31mm | 5mm 1/4", 3/8" | Hollow | 5V Line Driver (TTL) or 5V Push-Pull (Totem Pole) | IP20 | Custom cables sold separately | N/A | N/A | 400, 1000 | SureStep |
| | Light Duty | TRD-S(H)R | 38mm, 40mm | 8mm | Solid or Hollow | 5V Line Driver (TTL) or 5-26V NPN/PNP Open Collector (HTL) | IP50 or IP65 | Integral 2m pigtal cable | 20 | 10 | 100, 200, 360, 500, 600, 1000, 1024, 2000, 2500 | JTEKT |
| | | A41 | 41mm | 1/4" | Solid or Hollow | 5-30VDC Universal output circuit: Push-Pull (Totem Pole), or NPN/PNP Open Collector (HTL), or Line Driver (TTL) | IP64 | Integral 2m pigtal cable | 20 | 20 | 100, 200, 360, 500, 1000, 1024, 200, 2048, 3600, 4096 | Lika |
| | Medium Duty | A50 | 50mm | 1/4", 3/8" | Hollow | | IP65 | M12 cables sold seperately | 20 | 20 | 360, 1000, 1024, 2048 | |
| | | A80 | 80mm | 30mm (reducer bushings available for 19 & 20mm, 5/8", 7/8", 1, and 1 1/8") | Hollow | | IP64 | M23 cables sold separately | 30 | 30 | 1024 | |
| | | AQ58/59 | 58mm, 59mm | 3/8" solid, 15mm hollow (reducer bushings available for 6, 8, 10, 11, 12 mm; 1/4, 3/8, 1/2 inch) | Solid or Hollow | | IP65 | M12 cables sold seperately | 100 | 100 | Programmable from 1 to 16,384 (default 1024) | |
| | | AR01 | 58mm | 15mm | Solid Dual-shaft | | IP65 | M12 cables sold seperately | 50 | 50 | 250 (linear res: 0.36 deg/cts) 1250 (linear res: 0.072 deg/cts) | |
| | | TRDA-20 | 2" | 3/8" | Solid | 5VDC Line Driver (TTL) or 5-30VDC Push-Pull (Totem Pole) | IP50 | Integral 2m pigtal cable | 50 | 30 | 100, 360, 500, 1000, 1024, 2500 | JTEKT |
| | | TRDA-25 | 2.5" flange (w/2.0" body) | 3/8" | Solid | | IP65 | Military Spec (MS) cables sold seperately | 50 | 30 | 100, 360, 500, 1000, 1014, 2500 | |
| | | TRD-N(H) | 50mm | 8mm | Solid or Hollow | | IP65 | Integral 2m pigtal cable | 50 | 30 | 3, 4, 5, 10, 30, 40, 50, 60, 100, 120, 200, 240, 250, 300, 360, 400, 480, 500, 600, 750, 1000, 1024, 1200, 2000, 2500 | |
| | Heavy Duty | TRD-GK | 78mm | 10mm | Solid | 10-30VDC Push-Pull (Totem Pole) | IP65 | Integral 2m pigtal cable | 100 | 50 | 30, 100, 120, 200, 240, 250, 300, 360, 400, 500, 600, 1000, 1200, 2000, 2500, 3600, 5000 | |
| Absolute | Medium Duty | TRD-NA | 50mm | 8mm | Solid | 10-30V NPN/PNP Open Collector (HTL) | IP65 | Integral 2m pigtal cable | 50 | 30 | 32, 64, 128, 180, 256, 360, 512, 720, 1024 (gray code) | |

# Light Duty Incremental Encoders (SAE Dimension Encoders)

## TRDA-2E series

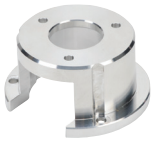
## Accessories

| Accessories for TRDA-2E Series Encoders | | |
|---|---|---|
| ***Part Number*** | ***Price*** | ***Description*** |
| ***F-2D*** | $06p0: | JTEKT round mounting flange, 1.86in bolt hole circle, (1.05in height), metal. For use with JTEKT TRDA-2E series encoders. Flange and encoder mounting hardware included. |
| ***F-3D*** | $06p1: | JTEKT round mounting flange, 2.95in bolt hole circle (1.34in height), metal. For use with JTEKT TRDA-2E series encoders. Flange and encoder mounting hardware included. |
| ***F-6D*** | $06p2: | JTEKT round mounting flange, 1.86in bolt hole circle, (1.34in height), metal. For use with JTEKT TRDA-2E series encoders. Flange and encoder mounting hardware included. |
| ***F-7D*** | $06p3: | JTEKT round mounting flange, 1in bolt hole circle (0.20in height), metal. For use with JTEKT TRDA-2E series encoders. Flange and encoder mounting hardware included. |
| ***F-8D*** | $06p4: | JTEKT round mounting flange, 2.95in bolt hole circle, (1.71in height), metal. For use with JTEKT TRDA-2E series encoders. Flange and encoder mounting hardware included. |
| ***2ET-035D*** | $05hy: | JTEKT right angle bracket, metal. For use with JTEKT TRDA-2E series encoders. Bracket and encoder mounting hardware included. |

***Couplings***
For encoders with a solid shaft, please select a coupling that fits your encoder. All couplings are in stock, ready to ship.

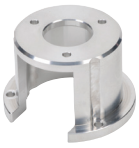
See the "Encoder Couplings" section for more information.

***2ET-035D***



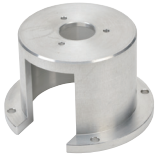
***F-2D***

***F-3D***



***F-6D***

***F-7D***



***F-8D***

# Light Duty Incremental Encoders (SAE Dimension Encoders)

## Specifications – TRDA-2E series

| Electrical Specifications (SAE Dimension Light Duty) | | | | |
|---|---|---|---|---|
| ***Model*** | | | ***TRDA-2ExxxxBD (open collector)*** | ***TRDA-2ExxxxVD (line driver)*** |
| ***Power Supply*** | ***Operating Voltage **** | | 12–24 VDC (nominal) * Range: 10.8–26.4 VDC | 5VDC (nominal) * Range: 4.75–5.25 VDC |
| | ***Allowable Ripple*** | | 3% rms max. | |
| | ***Current Consumption*** | | 50mA max. no load | |
| ***Output Waveform*** | ***Signal Waveform*** | | Quadrature + home position | |
| | ***Max. Response Frequency*** | | 200kHz | |
| | ***Operating Speed*** | | (max response frequency / resolution) x 60 | |
| | ***Duty Ratio (Symmetry)*** | | 50% ±25% | |
| | ***Index Signal Width (at Home Position)*** | | 100% ±50% | |
| ***Output*** | ***Rise/Fall Time ***** | | 1µs max. ** | 100 ns max. ** |
| | ***Output Type*** | | Open collector (NPN sinking) | Line driver (26C31 or equivalent) |
| | ***Output Logic*** | | Negative logic (active low) | Positive logic (active high) |
| | ***Output Current*** | ***Inflow*** | 30mA max. | 20mA max. |
| | | ***Outflow*** | – | |
| | ***Output Voltage*** | ***H*** | – | 2.5 V min. |
| | | ***L*** | 0.4 V max. | 0.5 V max. |
| | ***Load Power Supply Voltage*** | | 30VDC max. | – |
| | ***Short-circuit Protection*** | | Between eachoutput and 0V | – |

** To be supplied by Class II source.*
*** With a cable of 2m or less; Max load.*

| Mechanical Specifications | |
|---|---|
| ***Starting Torque*** | 0.01 N·m [0.09 lb·in] max. @ 20 °C [68 °F] |
| ***Max. Allowable Shaft Load*** | Axial: 20N [4.5 lb]; Radial: 30N [6.7 lb] |
| ***Max. Allowable Speed*** | 5000 rpm (highest speed that can support the mechanical integrity of encoder) |
| ***Wire Size*** | 26 AWG, shielded, oil-resistant PVC |
| ***Mounting Orientation*** | can be mounted in any orientation |
| ***Weight*** | approx. 170g [6.0 oz] (with 2m cable) |

| Environmental Specifications | |
|---|---|
| ***Ambient Temperature*** | -10 to 70 °C [14 to 158 °F] |
| ***Storage Temperature*** | -25 to 85 °C [-13 to 185 °F] |
| ***Operating Humidity*** | 35–85% RH (non-condensing) |
| ***Voltage Withstand*** | 630V grounded through capacitor (a 630V cap is connected between 0V & FG lines) |
| ***Insulation Resistance*** | 50 MΩ min. (excluding shield) |
| ***Vibration Resistance*** | durable for one hour along three axes @ 10 to 55 Hz with 0.75 mm half-amplitude |
| ***Shock Resistance*** | 490 $m/s^2$ (11 ms applied three times along three axes) |
| ***Protection*** | IP50 |
| ***Agency Approvals*** | $_{C}UL_{US}$ (E189395) |

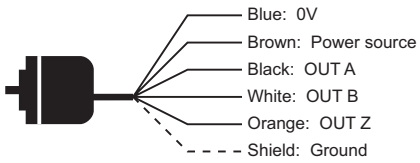
# Light Duty Incremental Encoders (SAE Dimension Encoders)

## Specifications – TRDA-2E series

### Wiring Diagrams

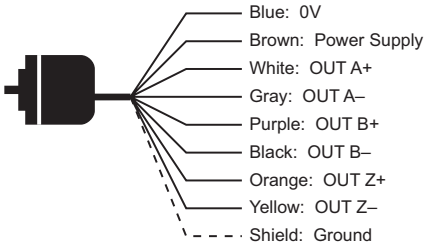
Open Collector Connections

Cable shield is connected to the encoder body (frame ground)



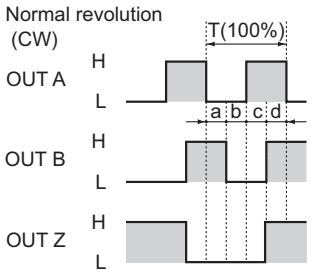

Line Driver Connections

Cable shield is connected to the encoder body (frame ground)



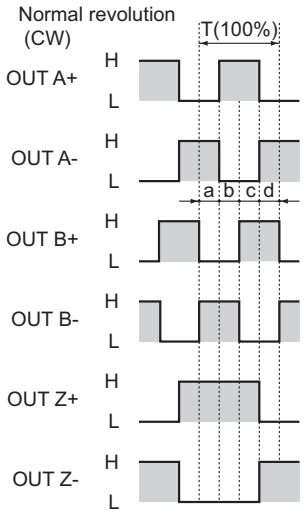

### Channel Timing Charts

Open Collector Models (TRDA-2ExxxBD)




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

Line Driver Models (TRDA-2ExxxVD)




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

### How to read the timing charts

***Open Collector Models***

Out A and Out B are 90 degrees out of phase. Like any quadrature encoder, four unique logic states are created internally to the encoder. This is based on the rising edge to rising edge (one cycle) on channel A or B that indicates one set of bars on the internal encoder disk has passed by the optical sensor.

OUT Z is the absolute reference added to an incremental encoder and is also known as home position. It signifies a full rotation of the encoder shaft.

***Line Driver Models***

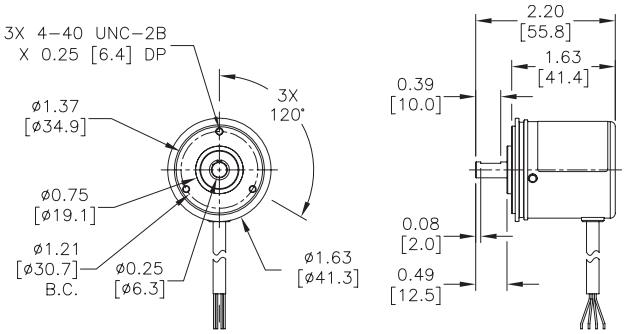
Channel A (OUT A and A-not) and Channel B (OUT B and B-not) are also 90 degrees out of phase on line driver encoders. OUT Z is the same as on open collector models, and is the absolute reference (home position). It signifies one full rotation of the encoder shaft.

# Light Duty Incremental Encoders (SAE Dimension Encoders)

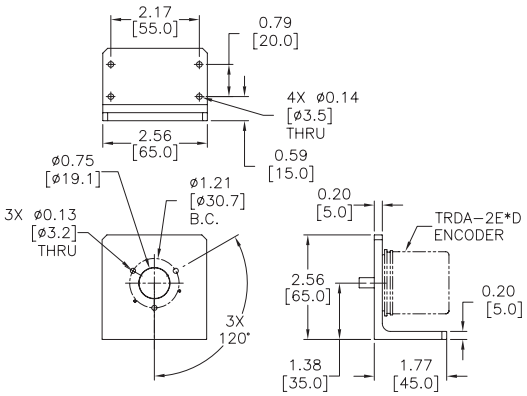
## Dimensions – TRDA-2E series

***Dimensions = in [mm]***

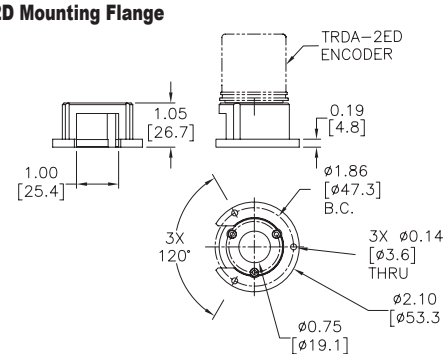
**TRDA-2ExxxxD**



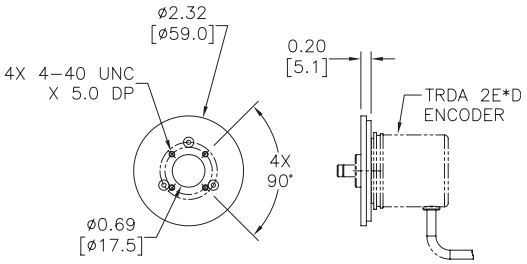

**2ET-035D Mounting Bracket**



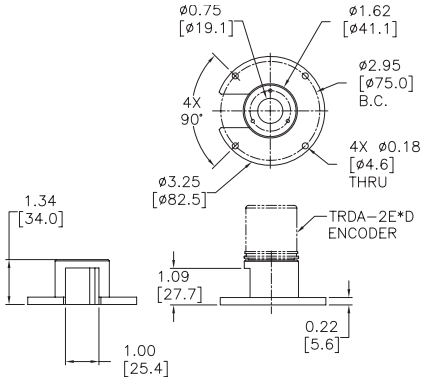

**F-2D Mounting Flange**



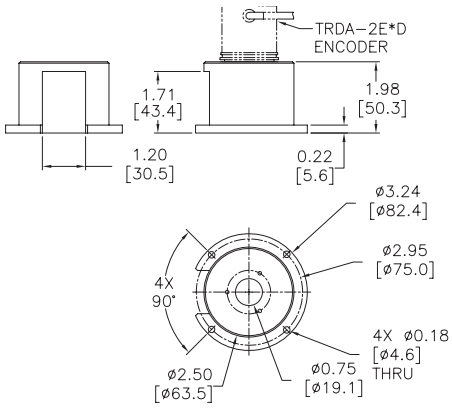

**F-7D Mounting Flange**



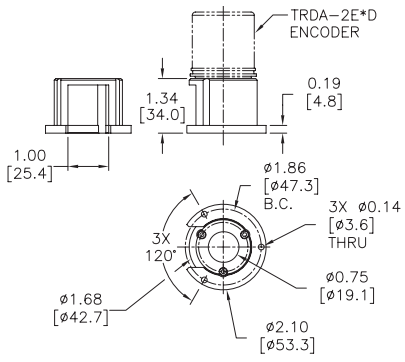

**F-3D Mounting Flange**




**F-8D Mounting Flange**




**F-6D Mounting Flange**



# Medium Duty Incremental Encoders (SAE Dimension Encoders)

## TRDA-20 series

## Features

A medium duty encoder that is cost-effective for small applications; has the following features:

- Small body with 2.0 in. diameter and 1.7 in. depth
- 0.375 in. diameter solid shaft
- Resolution available from 100 pulses per revolution to 2500 pulses per revolution
- Totem pole or line driver output
- Up to 100 kHz response frequency (totem pole)
- Up to 200 kHz response frequency (line driver)
- Two-meter cable with tinned ends
- IP50 environmental rating

*TRDA-20R1N models*

**TRDA-20 Medium Duty Solid-shaft Incremental Encoders (Totem-pole and Line-driver Output Models)**

| Part Number | Price | Pulses per Revolution | Input Voltage | Output | Body Dia. |
|---|---|---|---|---|---|
| TRDA-20R1N100RZD | $008#a: | 100 | 5–30 VDC | Totem-pole sink/source | 2.0 in. |
| TRDA-20R1N360RZD | $008#d: | 360 | | | |
| TRDA-20R1N500RZD | $008#e: | 500 | | | |
| TRDA-20R1N1000RZD | $008#9: | 1000 | | | |
| TRDA-20R1N1024RZD | $008#b: | 1024 | | | |
| TRDA-20R1N2500RZD | $008#c: | 2500 | | | |
| TRDA-20R1N100VD | $008_?: | 100 | 5VDC | Line-driver (differential) | |
| TRDA-20R1N360VD | $008#1: | 360 | | | |
| TRDA-20R1N500VD | $008#2: | 500 | | | |
| TRDA-20R1N1000VD | $;008_!: | 1000 | | | |
| TRDA-20R1N1024VD | $;008_,: | 1024 | | | |
| TRDA-20R1N2500VD | $008#0: | 2500 | | | |

## Accessories

**Accessories for TRDA-20 Series Encoders ***

| Part Number * | Price | Description |
|---|---|---|
| TRDA-20R1D | $06p5: | Mounting flange, round, 1.5 inch bolt-hole circle |
| TRDA-20R2D | $06p6: | Mounting flange, round, 1.625 inch bolt-hole circle |
| TRDA-20SND | $06p7: | Mounting flange, square |
| LM-001D** | $;005h]: | Mounting bracket for TRDA-20 & TRDA-25 encoders |

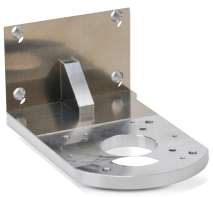
** The accessories in this table work only with TRDA-20R1Nxxxxxx series encoders, unless marked otherwise.*

*** Use of LM-001D also requires a TRDA-20SND replacement mounting flange, plus four customer-supplied 6-32 x 0.50 in long fasteners.*

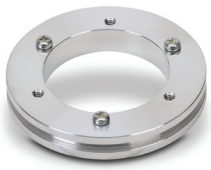
***Couplings***

For encoders with a solid shaft, please select a coupling that fits your encoder. All couplings are in stock, ready to ship.

See the "Encoder Couplings" section for more information.



*LM-001D*



*TRDA-20R1D*

*TRDA-20R2D*

*TRDA-20SND*

# Medium Duty Incremental Encoders (SAE Dimension Encoders)

## Specifications – TRDA-20 series

| Electrical Specifications (SAE Dimension Medium Duty) | | | | |
|---|---|---|---|---|
| ***Model*** | | | ***TRDA-20R1NxxxxRZD (Totem-pole)*** | ***TRDA-20R1NxxxxVD (Line Driver)*** |
| ***Power Supply*** | ***Operating Voltage **** | | 5–30 VDC (nominal) * Range: 4.75–30.0 VDC | 5VDC (nominal) * Range: 4.75–5.25 VDC |
| | ***Allowable Ripple*** | | 3% rms max | |
| | ***Current Consumption*** | | 60 mA max | |
| ***Output Waveform*** | ***Signal Waveform*** | | Quadrature + home position | |
| | ***Max. Response Frequency*** | | 100 kHz | 200 kHz |
| | ***Operating Speed*** | | (max response frequency / resolution) x 60 | |
| | ***Duty Ratio (Symmetry)*** | | 50% ±25% | |
| | ***Index Signal Width (at home position)*** | | 100% ±50% | |
| ***Output*** | ***Rise/Fall Time ***** | | 3µs max ** | 100 ns max ** |
| | ***Output Type*** | | Totem-pole | Line driver (26C31 or equivalent) |
| | ***Output Current*** | ***Inflow*** | 30 mA max | 20 mA max |
| | | ***Outflow*** | 10 mA max | |
| | ***Output Voltage*** | ***H*** | [(power voltage voltage) - (2.5V)] min | 2.5V min |
| | | ***L*** | 0.4V max | 0.5V max |
| | ***Load Power Supply Voltage*** | | 35 VDC max | – |
| | ***Short-Circuit Protection*** | | between each output and 0V terminal | – |

** To be supplied by Class II source.*
*** With a cable of 2m or less; Max load.*

| Mechanical Specifications | | |
|---|---|---|
| ***Starting Torque*** | 0.003 N·m (0.002 lb·ft) max @ 20 °C [68 °F] | |
| ***Max Allowable Shaft Load*** | Radial: 50N (11.2 lb); Axial: 30N (6.7 lb) | |
| ***Max Allowable Speed*** | 5000 rpm (max speed that the mechanical integrity of encoder can support) | |
| ***Wire Size*** | 0.2 $mm^2$ [24 AWG] shielded, oil-resistant PVC | |
| ***Mounting Orientation*** | can be mounted in any orientation | |
| ***Weight*** | approx 270g (9.52 oz) [with 2m cable] | |

| Environmental Specifications | | |
|---|---|---|
| ***Ambient Temperature*** | -10 to 70 °C [14 to 158 °F] | |
| ***Storage Temperature*** | -25 to 85 °C [-13 to 185 °F] | |
| ***Operating Humidity*** | 35 to 85 %RH | |
| ***Voltage Withstand*** | 500 VAC @ 50/60Hz for one minute | grounded through capacitor |
| ***Insulation Resistance*** | 50 MΩ min (excluding shield) | |
| ***Vibration Resistance*** | 10 to 55 Hz with 0.75 mm half amplitude; durable for one hour along three axes | |
| ***Shock Resistance*** | 11 ms ~ 500 P/R metal slit 981 $m/s^2$ applied three times along three axes<br>11 ms ~ 600 P/R glass slit 490 $m/s^2$ applied three times along three axes | |
| ***Protection*** | IP50 | |
| ***Agency Approvals*** | $_{C}UL_{US}$ (E189395) | |

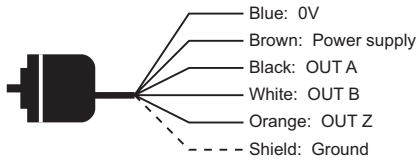
# Medium Duty Incremental Encoders (SAE Dimension Encoders)

## Specifications – TRDA-20 series

### Wiring Diagrams

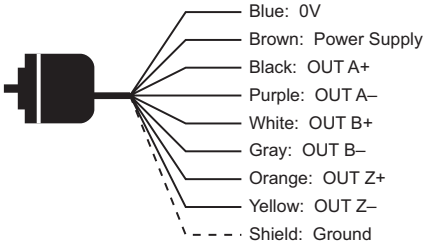
Totem Pole Connections

Cable shield is connected to the encoder body (frame ground)




Line Driver Connections

Cable shield is connected to the encoder body (frame ground)




### How to read the timing charts

***Totem Pole Models***

Out A and Out B are 90 degrees out of phase. Like any quadrature encoder, four unique logic states are created internally to the encoder. This is based on the rising edge to rising edge (one cycle) on channel A or B that indicates one set of bars on the internal encoder disk has passed by the optical sensor.

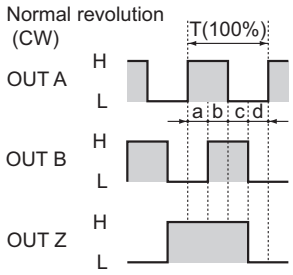
OUT Z is the absolute reference added to an incremental encoder and is also known as home position. It signifies a full rotation of the encoder shaft.

***Line Driver Models***

Channel A (OUT A and A-not) and Channel B (OUT B and B-not) are also 90 degrees out of phase on line driver encoders. OUT Z is the same as on open collector models, and is the absolute reference (home position). It signifies one full rotation of the encoder shaft.

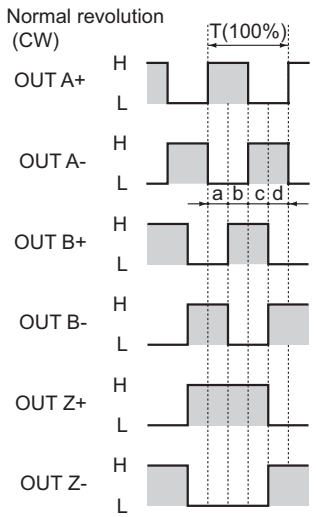
### Channel Timing Charts

Totem Pole Models (TRDA-20R1NxxxRZD)




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

Line Driver Models (TRDA-20R1NxxxVD)



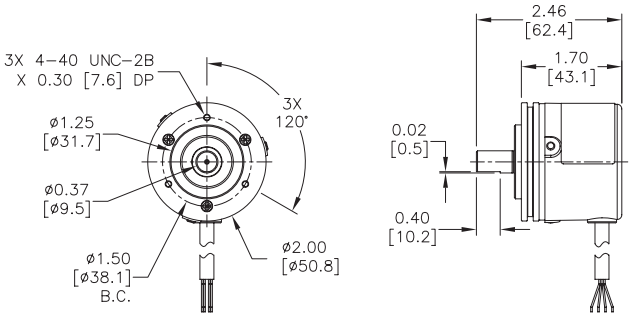

a, b, c, d = 1/4T±1/8T
"Normal" means clockwise revolution viewed from the shaft

# Medium Duty Incremental Encoders (SAE Dimension Encoders)

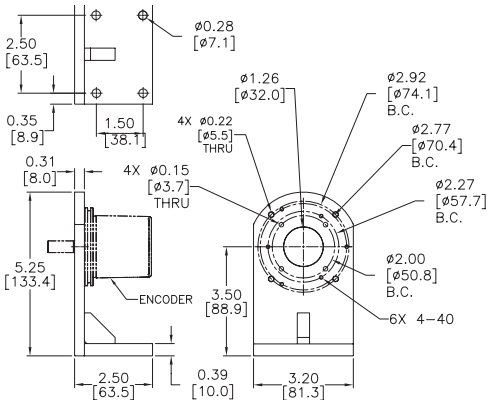
## Dimensions – TRDA-20 series

***Dimensions = in [mm]***

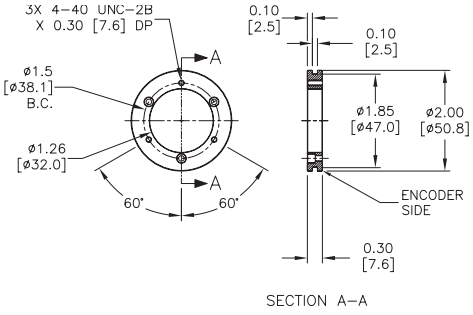
**TRDA-20R1Nxxxxxx D**



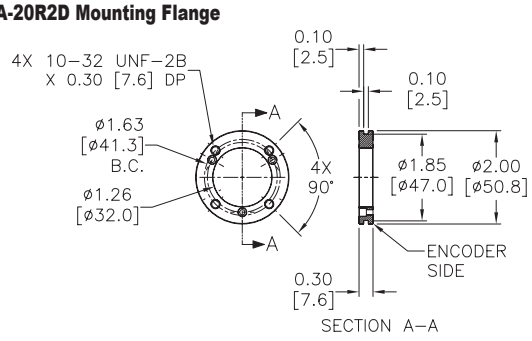

**LM-001D Mounting Bracket**



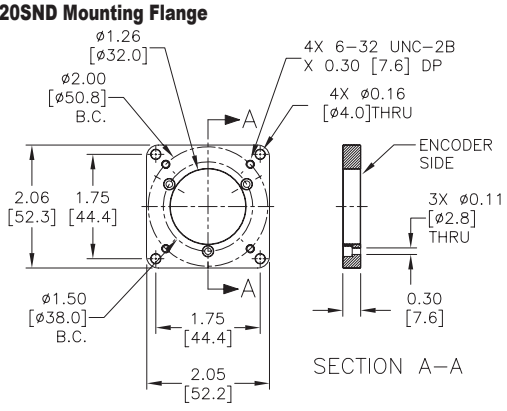

**TRDA-20R1D Mounting Flange**




**TRDA-20R2D Mounting Flange**




**TRDA-20SND Mounting Flange**



# Medium Duty Incremental Encoders (SAE Dimension Encoders)

## TRDA-25 series

## Features

A medium duty encoder that is cost-effective for small applications; has the following features:

- Small body with 2.0 in. diameter and 2.15 in. depth
- 0.375 in diameter solid shaft
- Removable 2.5 in. round flange
- Resolution available from 100 pulses per revolution to 2500 pulses per revolution
- Totem pole or line driver output
- Up to 100 kHz response frequency (totem pole)
- Up to 200 kHz response frequency (line driver)
- Military-style connector (cable sold separately)
- IP65 environmental rating

**TRDA-25 Medium Duty Solid-shaft Incremental Encoders – (Totem-pole and Line-driver Output Models) – MS Connector ***

| Part Number * | Price | Pulses per Revolution | Input Voltage | Output | Body Dia. |
|---|---|---|---|---|---|
| TRDA25RN100RZWDMS | $008#g: | 100 | 5–30 VDC | Totem-pole sink/source | 2.0 in. (2.5 in. round flange) |
| TRDA25RN360RZWDMS | $-008#j: | 360 | | | |
| TRDA25RN500RZWDMS | $008#k: | 500 | | | |
| TRDA25RN1000RZWDMS | $;008#f: | 1000 | | | |
| TRDA25RN1024RZWDMS | $008#h: | 1024 | | | |
| TRDA25RN2500RZWDMS | $-008#i: | 2500 | | | |
| TRDA25RN100VWDMS | $008#4: | 100 | 5VDC | Line-driver (differential) | |
| TRDA25RN360VWDMS | $008#7: | 360 | | | |
| TRDA25RN500VWDMS | $008#8: | 500 | | | |
| TRDA25RN1000VWDMS | $008#3: | 1000 | | | |
| TRDA25RN1024VWDMS | $008#5: | 1024 | | | |
| TRDA25RN2500VWDMS | $008#6: | 2500 | | | |

** TRDA25RNxxxxxWDMS encoders do NOT include cables or connectors, which are sold separately in the "Accessories" section.*

*TRDA-25 models*

## Accessories

***Couplings***

For encoders with a solid shaft, please select a coupling that fits your encoder. All couplings are in stock, ready to ship.

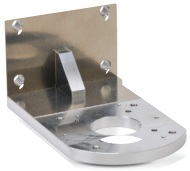
See the "Encoder Couplings" section for more information on.

**Accessories for TRDA-25 Series Encoders ***

| Part Number * | Price | Description |
|---|---|---|
| TRDA-25RND | $06p8: | Mounting flange, round (2.5 in. dia. w/ 1.88 in B.C.) |
| TRDA-25SND | $06p9: | Mounting flange, square (2.5 in. dia.) |
| TRDA-25CON-RZWD | $042e: | Connector for TRDA-25RNxxxRZWD-MS, Totem Pole output, 7-pin MS connector |
| TRDA-25CBL-RZWD-10** | $04ub: | Cable for TRDA-25RNxxxRZWD-MS, Totem Pole output, 7-pin MS connector, 10 ft |
| TRDA-25CBL-RZWD-20** | $004uc: | Cable for TRDA-25RNxxxRZWD-MS, Totem Pole output, 7-pin MS connector, 20 ft |
| TRDA-25CBL-RZWD-30** | $004ud: | Cable for TRDA-25RNxxxRZWD-MS, Totem Pole output, 7-pin MS connector, 30 ft |
| TRDA-25CON-VWD | $;042f: | Connector for TRDA-25RNxxxVWD-MS, Line Driver output, 10-pin MS connector |
| TRDA-25CBL-VWD-10** | $004ue: | Cable for TRDA-25RNxxxVWD-MS, Line Driver output, 10-pin MS connector, 10 ft |
| TRDA-25CBL-VWD-20** | $;004uf: | Cable for TRDA-25RNxxxVWD-MS, Line Driver output, 10-pin MS connector, 20 ft |
| TRDA-25CBL-VWD-30** | $004ug: | Cable for TRDA-25RNxxxVWD-MS, Line Driver output, 10-pin MS connector, 30 ft |
| LM-001D*** | $;005h]: | Mounting bracket for TRDA-20 & TRDA-25 encoders |

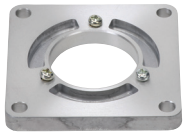
** The accessories in this table work only with TRDA-25RNxxxxxWD-MS series encoders, unless marked otherwise.*
*** Cables have IP65 environmental rating.*
**** Use of LM-001D also requires a TRDA-25SND replacement mounting flange, plus four customer-supplied 6-32 x 0.50 in long fasteners.*

*TRDA-25-CON-RZWD*



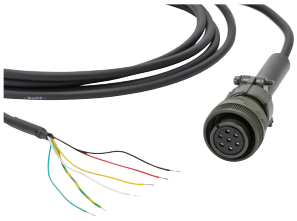
*LM-001D*

*TRDA-25RND*

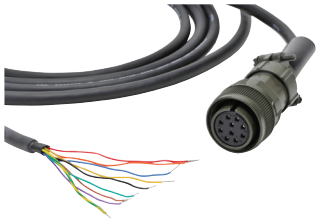


*TRDA-25SND*

*TRDA-25-CON-VWD*



*TRDA-25CBL-RZWD*



*TRDA-25CBL-VWD*

# Medium Duty Incremental Encoders (SAE Dimension Encoders)

## Specifications – TRDA-25 series

| Electrical Specifications – TRDA-25 (SAE Dimension Medium Duty) | | | | |
|---|---|---|---|---|
| ***Model*** | | | ***TRDA25RNxxxxRZWDMS (Totem-pole)*** | ***TRDA25RNxxxxVWDMS (Line Driver)*** |
| ***Power Supply*** | ***Operating Voltage **** | | 5–30 VDC (nominal) * Range: 4.75–30.0 VDC | 5VDC (nominal) * Range: 4.75–5.25 VDC |
| | ***Allowable Ripple*** | | 3% rms max | |
| | ***Current Consumption*** | | 60 mA max | |
| ***Output Waveform*** | ***Signal Waveform*** | | Quadrature + home position | |
| | ***Max. Response Frequency*** | | 100 kHz | 200 kHz |
| | ***Operating Speed*** | | (max response frequency / resolution) x 60 | |
| | ***Duty Ratio (Symmetry)*** | | 50% ±25% | |
| | ***Index Signal Width (at home position)*** | | 100% ±50% | |
| ***Output*** | ***Rise/Fall Time ***** | | 3µs max ** | 100 ns max ** |
| | ***Output Type*** | | Totem-pole | Line driver (26C31 or equivalent) |
| | ***Output Current*** | ***Inflow*** | 30 mA max | 20 mA max |
| | | ***Outflow*** | 10 mA max | |
| | ***Output Voltage*** | ***H*** | [(power voltage voltage) - (2.5V)] min | 2.5V min |
| | | ***L*** | 0.4V max | 0.5V max |
| | ***Load Power Supply Voltage*** | | 35 VDC max | – |
| | ***Short-Circuit Protection*** | | between each output and 0V terminal | – |

** To be supplied by Class II source.*
*** With a cable of 2m or less; Max load.*

| Mechanical Specifications | | |
|---|---|---|
| ***Starting Torque*** | 0.05 N·m [0.04 lb·ft] @ 20 °C [68 °F] | |
| ***Max Allowable Shaft Load*** | Radial: 50N [11.2 lb]; Axial: 30N [6.7 lb] | |
| ***Max Allowable Speed*** | 3000 rpm (max speed that the mechanical integrity of encoder can support) | |
| ***Wire Size*** | – | |
| ***Mounting Orientation*** | can be mounted in any orientation | |
| ***Weight*** | approx 280g [9.88 oz] | |
| **Environmental Specifications** | | |
| ***Ambient Temperature*** | -10 to 70 °C [14 to 158 °F] | |
| ***Storage Temperature*** | -25 to 85 °C [-13 to 185 °F] | |
| ***Operating Humidity*** | 35 to 85 %RH | |
| ***Voltage Withstand*** | 500 VAC @ 50/60Hz for one minute | grounded through capacitor |
| ***Insulation Resistance*** | 50 MΩ min (excluding shield) | |
| ***Vibration Resistance*** | 10 to 55 Hz with 0.75 mm half amplitude; durable for one hour along three axes | |
| ***Shock Resistance*** | 11 ms ~ 500 P/R metal slit 981 $m/s^2$ applied three times along three axes<br>11 ms ~ 600 P/R glass slit 490 $m/s^2$ applied three times along three axes | |
| ***Protection*** | IP65 | |
| ***Agency Approvals*** | $_cUL_{US}$ (E189395) | |

# Medium Duty Incremental Encoders (SAE Dimension Encoders)

## Specifications – TRDA-25 series

### Connector Pin-out

TRDA25RNxxxRZWDMS (Totem Pole)

| Connector | Pin | Signal |
|---|---|---|
|  Viewed from wiring side (rear) | A | Out A |
| | B | Out B |
| | C | Out Z |
| | D | Power Supply |
| | E | n.c. |
| | F | 0V |
| | G | ground |



A shielding wire is connected to frame ground.

TRDA25RNxxxVWDMS (Line Driver)

| Connector | Pin | Signal |
|---|---|---|
|  Viewed from wiring side (rear) | A | Out A+ |
| | B | Out B+ |
| | C | Out Z+ |
| | D | Power Supply |
| | E | n.c. |
| | F | 0V |
| | G | ground |
| | H | Out A– |
| | I | Out B– |
| | J | Out Z– |



A shielding wire is connected to frame ground.

### How to read the timing charts

***Totem Pole Models***

Out A and Out B are 90 degrees out of phase. Like any quadrature encoder, four unique logic states are created internally to the encoder. This is based on the rising edge to rising edge (one cycle) on channel A or B that indicates one set of bars on the internal encoder disk has passed by the optical sensor.

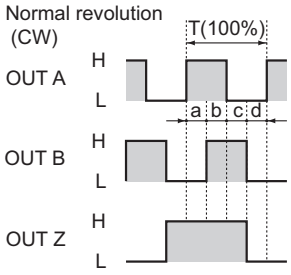
OUT Z is the absolute reference added to an incremental encoder and is also known as home position. It signifies a full rotation of the encoder shaft.

***Line Driver Models***

Channel A (OUT A and A-not) and Channel B (OUT B and B-not) are also 90 degrees out of phase on line driver encoders. OUT Z is the same as on open collector models, and is the absolute reference (home position). It signifies one full rotation of the encoder shaft.

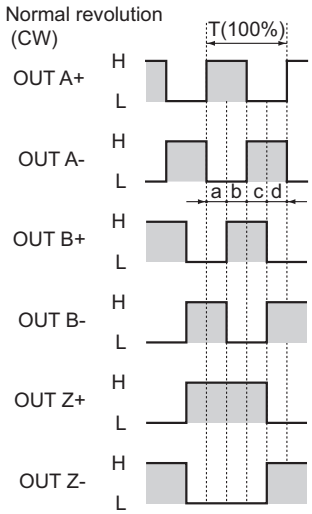
## Channel Timing Charts

Totem Pole Models (TRDA25RNxxxRZWDxx)




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

Line Driver Models (TRDA25RNxxxVWDxx)



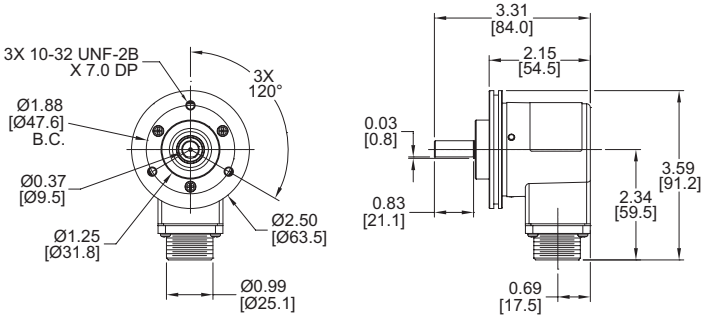

a, b, c, d = 1/4T±1/8T
"Normal" means clockwise revolution viewed from the shaft

# Medium Duty Incremental Encoders (SAE Dimension Encoders)

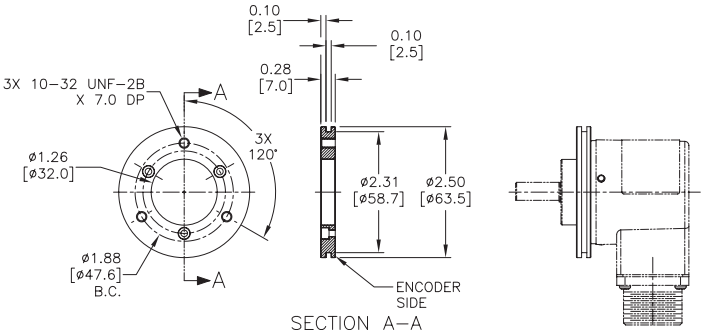
## Dimensions – TRDA-25 series

***Dimensions = in [mm]***

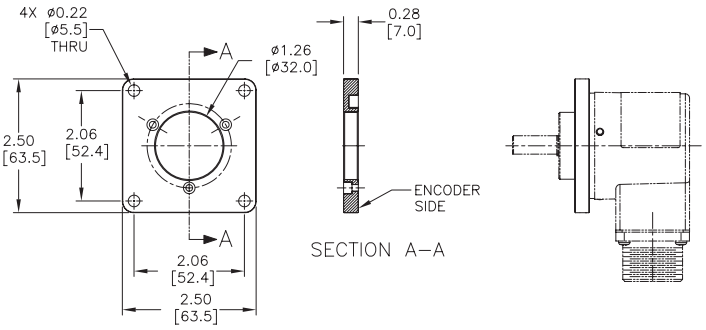
**TRDA25RN Encoder**




**TRDA-25RND Mounting Flange**




**TRDA-25SND Mounting Flange**



# Light Duty Incremental Encoders (Metric Dimension Encoders)

## TRD-MX series Features

A light duty incremental rotary encoder that is cost-effective for small applications; has the following features:

- Small body with 25 mm diameter and 29 mm depth
- 4 mm diameter solid shaft
- Resolution available from 100 pulses per revolution to 1024 pulses per revolution
- Open collector output (4.5–13.2 or 10.8–26.4 VDC), or line driver output (4.75–5.25 VDC)
- Up to 100 kHz response frequency
- Two-meter cable with tinned ends
- IP50 environmental rating
- Mounting bracket and couplings are available

*TRD-MXxxxx-AD/BD models*

*TRD-MXxxxx-VD models*

**Light Duty Solid-shaft Incremental Encoders (NPN Open-collector Output, TRD-MXxxxAD/BD)**

| Part Number | Price | Pulses per Revolution | Input Voltage | Output | Body Dia. |
|---|---|---|---|---|---|
| TRD-MX100AD | Retired | 100 | 4.5–13.2 VDC | NPN Open Collector | 25 mm |
| TRD-MX360AD | $-094j: | 360 | | | |
| TRD-MX500BD | Retired | 500 | 10.8–26.4 VDC | | |

**Light Duty Solid-shaft Incremental Encoders (Line Driver Output, TRD-MXxxxVD)**

| Part Number | Price | Pulses per Revolution | Input Voltage | Output | Body Dia. |
|---|---|---|---|---|---|
| TRD-MX100VD | Retired | 100 | 4.75–5.25 VDC | Line Driver | 25 mm |
| TRD-MX360VD | Retired | 360 | | | |
| TRD-MX500VD | Retired | 500 | | | |

## Accessories

**Accessories for TRD-MX Series Encoders**

| Part Number | Price | Description |
|---|---|---|
| MM-4D | Retired | Servo mounting clamp for TRD-MX series encoders |
| MT-030D | $;05h[: | Right-angle mounting bracket for TRD-MX series encoders |

***Couplings***

For encoders with a solid shaft, please select a coupling that fits your encoder. All couplings are typically in stock, and ready to ship.

See the "Encoder Couplings" section for more information.

*MM-4D*

*MT-030D*

*Couplings*

# Light Duty Incremental Encoders (Metric Dimension Encoders)

## Specifications – TRD-MX series

| Electrical Specifications (Metric Dimension Light Duty TRD-MX) | | | | | |
|---|---|---|---|---|---|
| **Model** | | | **TRD-MXxxxAD (open collector)** | **TRD-MXxxxBD (open collector)** | **TRD-MXxxxVD (line driver)** |
| **Power Supply** | **Operating Voltage *** | | 5–12 VDC (nominal) * 4.5–13.2 VDC | 12–24 VDC (nominal) * 10.8–26.4 VDC | 5VDC (nominal) * 4.75–5.25 VDC |
| | **Allowable Ripple** | | 3% rms max | | |
| | **Current Consumption** | | 50 mA max (no load) | | |
| | **Circuit Protection Required** | | Limit current to 100 mA or less | | – |
| **Output Waveform** | **Signal Waveform** | | Quadrature + home position | | |
| | **Max. Response Frequency** | | 100 kHz | | |
| | **Operating Speed** | | (max response frequency / resolution) x 60 Hz | | |
| | **Duty Ratio (Symmetry)** | | 50% ±25% | | |
| | **Index Signal Width (at Home Position)** | | 100% ±50% | | |
| **Output** | **Rise/Fall Time ****** | | 2µs ** (sink current < 30 mA) | | 0.1 µs max ** (source current < 20 mA) |
| | **Output Type** | | Open collector (NPN sinking) | | Line driver (26C31 or equivalent) |
| | **Output Logic** | | Negative logic (active low) | | Positive logic (active high) |
| | **Output Current** | **Inflow** | 30 mA max | | 20 mA max |
| | | **Outflow** | – | | |
| | **Output Voltage** | **H** | – | | 2.5V min (source current < 20 mA) |
| | | **L** | 0.4V max (sink current < 30 mA) | | 0.5V max (source current < 20 mA) |
| | **Load Power Voltage** | | 30 VDC max | | – |
| | **Short-circuit Protection** | | – | | – |

** To be supplied by Class II source.*
*** Cable length ≤2m or less. Maximum load.*

| Mechanical Specifications (Metric Dimension Light Duty TRD-MX) | |
|---|---|
| **Starting Torque** | 0.001 N·m [0.009 lb·in] max @ 20 °C [68 °F] |
| **Max. Allowable Shaft Load** | Axial: 5N [1.1 lb]; Radial: 10N [2.2 lb] |
| **Max. Allowable Speed** | 6000 rpm (highest speed that can support the mechanical integrity of encoder) |
| **Wire Size** | 26 AWG, shielded, oil-resistant PVC |
| **Weight** | approx 120g [0.3 lb] |

| Environmental Specifications (Metric Dimension Light Duty TRD-MX) | |
|---|---|
| **Ambient Temperature** | -10 to 70 °C [14 to 158 °F] |
| **Storage Temperature** | -25 to 85 °C [-13 to 185 °F] |
| **Operating Humidity** | 35–85% RH (non-condensing) |
| **Withstand Voltage *** | 630V grounded through capacitor (a 630V cap is connected between 0V & FG lines) |
| **Insulation Resistance** | 20 MΩ min |
| **Vibration Resistance** | durable for one hour along three axes @ 10 to 55 Hz with 0.75 mm half-amplitude |
| **Shock Resistance** | 490 $m/s^2$ (11 ms applied 3-times, each X, Y, Z) |
| **Mounting Orientation** | can be mounted in any orientation |
| **Protection** | IP50 |
| **Agency Approvals** | CE, RoHS, $_{C}UL_{US}$ (E189395) |

** Withstand voltage is good for power supply, signal, and case; not good for shield wire.*

# Light Duty Incremental Encoders (Metric Dimension Encoders)

## Specifications – TRD-MX series

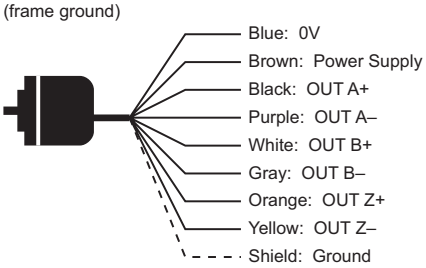
## Wiring Diagrams

Open Collector Connections

Cable shield is connected to the encoder body (frame ground)


Line Driver Connections

Cable shield is connected to the encoder body (frame ground)




## How to read the timing charts

***Open Collector Models***

Out A and Out B are 90 degrees out of phase. Like any quadrature encoder, four unique logic states are created internally to the encoder. This is based on the rising edge to rising edge (one cycle) on channel A or B that indicates one set of bars on the internal encoder disk has passed by the optical sensor.

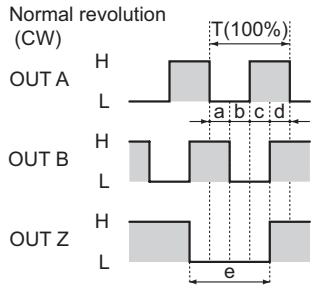
OUT Z is the absolute reference added to an incremental encoder and is also known as home position. It signifies a full rotation of the encoder shaft. It pulses once per revolution.

***Line Driver Models***

Channel A (OUT A and A-not) and Channel B (OUT B and B-not) are also 90 degrees out of phase on line driver encoders. OUT Z is the same as on open collector models, and is the absolute reference (home position). It signifies one full rotation of the encoder shaft. It pulses once per revolution.

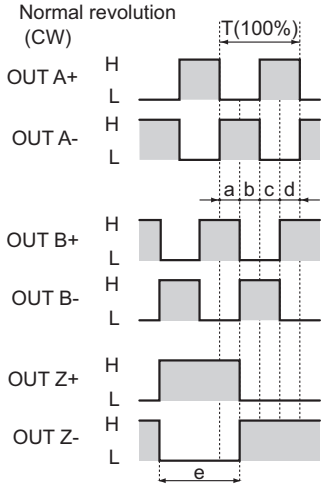
## Channel Timing Charts

Open Collector Models (TRD-MXxxxAD/BD)




a, b, c, d = 0.25T ±0.125T; e = 1T ±0.125T
"Normal" means clockwise revolution viewed from the shaft

Line Driver Models (TRD-MXxxxVD)

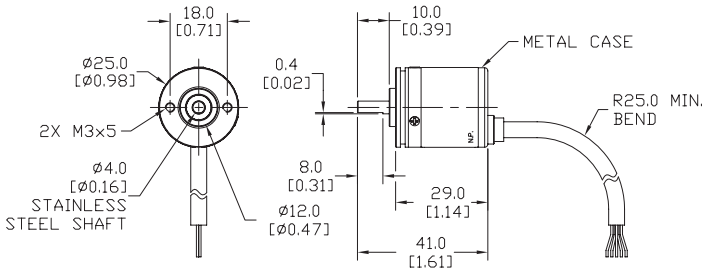



a, b, c, d = 0.25T ±0.125T; e = 1T ±0.125T
"Normal" means clockwise revolution viewed from the shaft

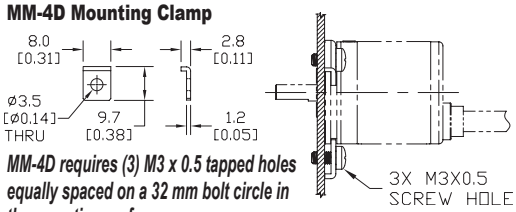
## Dimensions – TRD-MX series

***Dimensions = mm [in]***

**TRD-MXxxxxD**

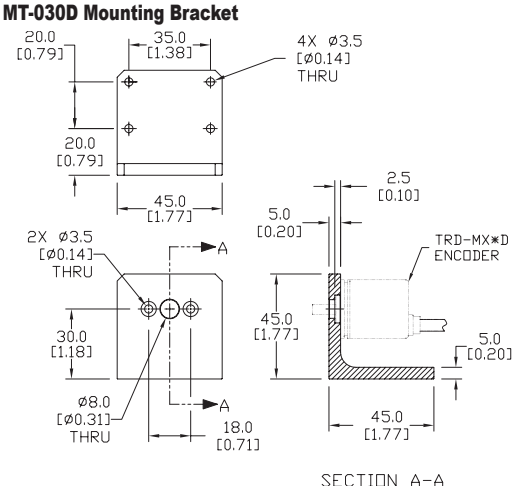



**MM-4D Mounting Clamp**




*MM-4D requires (3) M3 x 0.5 tapped holes equally spaced on a 32 mm bolt circle in the mounting surface.*

**MT-030D Mounting Bracket**



# Light Duty Incremental Encoders (Metric Dimension Encoders)

## TRD-SR series

### Features

A light duty incremental (quadrature) encoder that is cost-effective for small applications and has the following features:

- Small body available in 38mm or 40mm diameters
- Separate dust proof (IP50 rating) and water resistant (IP65) ratings
- 6 mm solid shaft
- Resolution available from 100 pulses per revolution to 2500 pulses per revolution
- Open collector or line driver output
- Up to 200 kHz response frequency
- Two-meter cable, pigtail
- Mounting dimensions: 2 and 3 hole patterns on 28mm and 30mm diameters

*Solid-shaft (TRD-SR) model*

**TRD-SR Light Duty Solid Shaft Incremental Encoders (NPN Open Collector and Line Driver models)**

| Part Number | Price | Pulses per Revolution | Drawing | Input Voltage | Output | Weight | Protection Rating | Body Diameter |
|---|---|---|---|---|---|---|---|---|
| TRD-SR100AD | $05468: | 100 | PDF | 5–26 VDC | NPN open collector | 160g with 2m cable | IP50 | 38mm |
| TRD-SR200AD | $0546a: | 200 | PDF | | | | | |
| TRD-SR360AD | $0546c: | 360 | PDF | | | | | |
| TRD-SR500AD | $-0546j: | 500 | PDF | | | | | |
| TRD-SR600AD | $0546s: | 600 | PDF | | | | | |
| TRD-SR1000AD | $0546e: | 1000 | PDF | | | | | |
| TRD-SR1024AD | $0546g: | 1024 | PDF | | | | | |
| TRD-SR2000AD | $-0546i: | 2000 | PDF | | | | | |
| TRD-SR2500AD | $0546n: | 2500 | PDF | | | | | |
| TRD-SR100VD | $05469: | 100 | PDF | 5VDC | Line driver (differential) | | | |
| TRD-SR200VD | $0546b: | 200 | PDF | | | | | |
| TRD-SR360VD | $0546d: | 360 | PDF | | | | | |
| TRD-SR500VD | $0546k: | 500 | PDF | | | | | |
| TRD-SR600VD | $0546z: | 600 | PDF | | | | | |
| TRD-SR1000VD | $;0546f: | 1000 | PDF | | | | | |
| TRD-SR1024VD | $0546h: | 1024 | PDF | | | | | |
| TRD-SR2000VD | $-0546l: | 2000 | PDF | | | | | |
| TRD-SR2500VD | $0546o: | 2500 | PDF | | | | | |
| TRD-SR100AWD | $05474: | 100 | PDF | 5–26 VDC | NPN open collector | 190g with 2m cable | IP65 | 40mm |
| TRD-SR200AWD | $05476: | 200 | PDF | | | | | |
| TRD-SR360AWD | $05478: | 360 | PDF | | | | | |
| TRD-SR500AWD | $0547a: | 500 | PDF | | | | | |
| TRD-SR600AWD | $0547c: | 600 | PDF | | | | | |
| TRD-SR1000AWD | $0547e: | 1000 | PDF | | | | | |
| TRD-SR1024AWD | $0547g: | 1024 | PDF | | | | | |
| TRD-SR2000AWD | $-0547i: | 2000 | PDF | | | | | |
| TRD-SR2500AWD | $0547k: | 2500 | PDF | | | | | |
| TRD-SR100VWD | $05475: | 100 | PDF | 5VDC | Line driver (differential) | | | |
| TRD-SR200VWD | $05477: | 200 | PDF | | | | | |
| TRD-SR360VWD | $05479: | 360 | PDF | | | | | |
| TRD-SR500VWD | $0547b: | 500 | PDF | | | | | |
| TRD-SR600VWD | $0547d: | 600 | PDF | | | | | |
| TRD-SR1000VWD | $;0547f: | 1000 | PDF | | | | | |
| TRD-SR1024VWD | $0547h: | 1024 | PDF | | | | | |
| TRD-SR2000VWD | $-0547j: | 2000 | PDF | | | | | |
| TRD-SR2500VWD | $-0547l: | 2500 | PDF | | | | | |

# Light Duty Incremental Encoders (Metric Dimension Encoders)

## TRD-SHR series

### Features

A light duty incremental (quadrature) encoder that is cost-effective for small applications and has the following features:

- Small body available in 38mm or 40mm diameters
- Separate dust proof (IP50 rating) and water resistant (IP65) ratings
- 8 mm hollow shaft
- Resolution available from 100 pulses per revolution to 2500 pulses per revolution
- Open collector or line driver output
- Up to 200 kHz response frequency
- Two-meter cable, pigtail
- IP50=45mm Ø mounting pattern (can change to 40mm with SHRS-040D), IP65=40mm Ø mounting pattern

*Hollow-shaft (TRD-SHR) model*

**TRD-SHR Light Duty Hollow Shaft Incremental Encoders (NPN Open Collector and Line Driver models)**

| Part Number | Price | Pulses per Revolution | Drawing | Input Voltage | Output | Weight | Protection Rating | Body Diameter |
|---|---|---|---|---|---|---|---|---|
| TRD-SHR100A5D | $0546p: | 100 | PDF | 5–26 VDC | NPN open collector | 170g with 2m cable | IP50 | 38mm |
| TRD-SHR200A5D | $;0546t: | 200 | PDF | | | | | |
| TRD-SHR360A5D | $0546v: | 360 | PDF | | | | | |
| TRD-SHR500A5D | $0546y: | 500 | PDF | | | | | |
| TRD-SHR600A5D | $;0546[: | 600 | PDF | | | | | |
| TRD-SHR1000A5D | $0546#: | 1000 | PDF | | | | | |
| TRD-SHR1024A5D | $0546?: | 1024 | PDF | | | | | |
| TRD-SHR2000A5D | $05470: | 2000 | PDF | | | | | |
| TRD-SHR2500A5D | $05472: | 2500 | PDF | | | | | |
| TRD-SHR100V5D | $0546q: | 100 | PDF | 5VDC | Line driver (differential) | | | |
| TRD-SHR200V5D | $0546u: | 200 | PDF | | | | | |
| TRD-SHR360V5D | $0546x: | 360 | PDF | | | | | |
| TRD-SHR500V5D | $;0546]: | 500 | PDF | | | | | |
| TRD-SHR600V5D | $0546_: | 600 | PDF | | | | | |
| TRD-SHR1000V5D | $;0546!: | 1000 | PDF | | | | | |
| TRD-SHR1024V5D | $;0546,: | 1024 | PDF | | | | | |
| TRD-SHR2000V5D | $05471: | 2000 | PDF | | | | | |
| TRD-SHR2500V5D | $05473: | 2500 | PDF | | | | | |
| TRD-SHR100AW0D | $0547n: | 100 | PDF | 5–26 VDC | NPN open collector | 200g with 2m cable | IP65 | 40mm |
| TRD-SHR200AW0D | $0547p: | 200 | PDF | | | | | |
| TRD-SHR360AW0D | $0547s: | 360 | PDF | | | | | |
| TRD-SHR500AW0D | $0547u: | 500 | PDF | | | | | |
| TRD-SHR600AW0D | $0547x: | 600 | PDF | | | | | |
| TRD-SHR1000AW0D | $0547z: | 1000 | PDF | | | | | |
| TRD-SHR1024AW0D | $;0547[: | 1024 | PDF | | | | | |
| TRD-SHR2000AW0D | $0547#: | 2000 | PDF | | | | | |
| TRD-SHR2500AW0D | $0547?: | 2500 | PDF | | | | | |
| TRD-SHR100VW0D | $0547o: | 100 | PDF | 5VDC | Line driver (differential) | | | |
| TRD-SHR200VW0D | $0547q: | 200 | PDF | | | | | |
| TRD-SHR360VW0D | $;0547t: | 360 | PDF | | | | | |
| TRD-SHR500VW0D | $0547v: | 500 | PDF | | | | | |
| TRD-SHR600VW0D | $0547y: | 600 | PDF | | | | | |
| TRD-SHR1000VW0D | $;0547]: | 1000 | PDF | | | | | |
| TRD-SHR1024VW0D | $0547_: | 1024 | PDF | | | | | |
| TRD-SHR2000VW0D | $;0547!: | 2000 | PDF | | | | | |
| TRD-SHR2500VW0D | $;0547,: | 2500 | PDF | | | | | |

# Light Duty Incremental Encoders (Metric Dimension Encoders)

## Specifications – TRD-SR/SRH series

| Electrical Specifications | | | | |
|---|---|---|---|---|
| ***Model*** | | | ***TRD-SRxxxxAx<br>TRD-SHRxxxxAxx<br>(open collector)*** | ***TRD-SRxxxxVx<br>TRD-SHRxxxxVxx<br>(line driver)*** |
| ***Power Supply*** | ***Operating Voltage **** | | 5–26 VDC (nominal) *<br>Range: 4.75–26.4 VDC | 5VDC (nominal) *<br>Range: 4.75–5.25 VDC |
| | ***Allowable Ripple*** | | 3% max. | |
| | ***Current Consumption*** | | 90mA max. | |
| ***Signal Waveform*** | | | Quadrature + home position | |
| ***Resolutions Available*** | | | 100 to 2500 pulses per revolution | |
| ***Max. Response Frequency*** | | | 200kHz | |
| ***Max. Electrical Speed***** | | | (max response frequency / resolution) x 60 | |
| ***Duty Ratio*** | | | 50% ±25% | |
| ***Phase Difference Width*** | | | 25% ±12.5% | |
| ***Signal Width at Home Position*** | | | 100 ±50% | |
| ***Output*** | ***Rise/Fall Time*** | | 1µs max. (when cable length is 1m) | |
| | ***Output Type*** | | NPN open collector output, sinking | Line driver output<br>(26C31 or equivalent) |
| | ***Output Logic*** | | Negative logic<br>(active low) | Positive logic<br>(active high) |
| | ***Output Voltage*** | ***H*** | – | 2.5 V min. |
| | | ***L*** | 0.4 V max. | 0.5 V max. |
| | ***Current*** | | 30mA max. | 20 mA max. |
| | ***Load Power Voltage*** | | 30 VDC max. | – |
| | ***Short-Circuit Protection*** | | Between output and power supply | – |

| Mechanical Specifications | |
|---|---|
| ***Starting Torque*** | 0.001 Nm (0.00074 ft/lb) max |
| ***Shaft Moment of Inertia*** | 0.6 x $10^4$ kg·$m^2$ |
| ***Max. Allowable Shaft Load*** | Radial: 30N (6.7 lb·f); Axial: 20N (4.5 lb·f) |
| ***Max. Mechanical Speed***** | 6000rpm (maximum possible without compromising encoder mechanical integrity) |
| ***Wire Size*** | AWG26 |
| ***Mounting Orientation*** | can be mounted in any orientation |

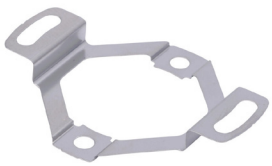
| Environmental Specifications | |
|---|---|
| ***Ambient Temperature*** | -10 to 80 °C (14 to 176 °F) |
| ***Storage Temperature*** | -25 to 85°C ( -13 to 185°F) |
| ***Operating Humidity*** | 35–85% RH (non-condensing) |
| ***Withstand Voltage*** | Grounded through capacitor |
| ***Insulation Resistance*** | 50MΩ 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 standard encoders. IP65 for encoders with "W" in the part number. |
| ***Agency Approvals*** | $_{C}UL_{US}$ (E189395) |

**** To be supplied by Class II source.***
***** Encoder maximum speed is the lesser value of Max. Electrical Speed and Max. Mechanical Speed.***

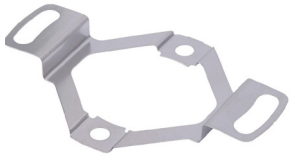
# Light Duty Incremental Encoders (Metric Dimension Encoders)

## TRD-SR/SHR series Mounting Accessories

| Mounting Accessories | | | | | |
|---|---|---|---|---|---|
| *Part Number* | *Price* | *Description* | *Weight* | *Drawing* | *Compatibility* |
| SHRS-040D* | $5nnv: | Flexible mounting bracket for IP50 hollow shaft encoders, converts standard 45mm mounting to 40mm mounting. | <2g | PDF | TRD-SHR series, IP50 |
| SHRS-045D* | $5nnx: | Replacement 45mm flexible mounting bracket for IP50 rated hollow shaft encoders. | | PDF | |
| SHRS-W40D* | $5nnz: | Replacement 40mm flexible mounting bracket for IP65 rated hollow shaft encoders. | | PDF | TRD-SHR series, IP65 |
| SRT-035D | $5nny: | Right angle mounting bracket for solid shaft TRD-SR encoders. | 140g | PDF | TRD-SR series |
| ** Note: The IP50 flexible mounting brackets will not fit on the IP65 encoders. Likewise, the IP65 flexible mounting bracket will not fit on the IP50 encoders.* | | | | | |



*SHRS-040D*



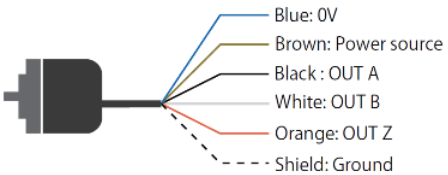
*SHRS-045D*

*SHRS-W40D*

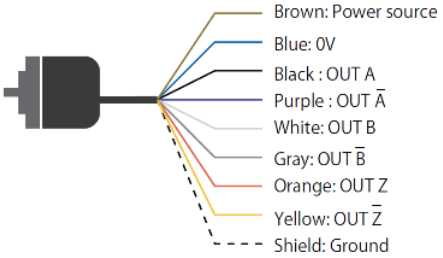
*SRT-035D*

## Wiring diagrams

***Open Collector Models***
Cable shield is NOT connected to the encoder body (frame ground)

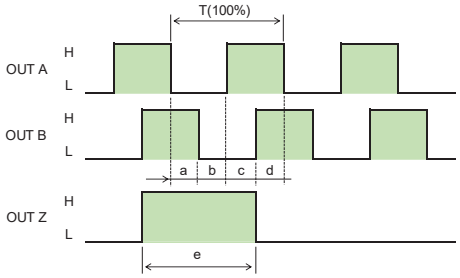



***Line Driver Models***
Cable shield is NOT connected to the encoder body (frame ground)

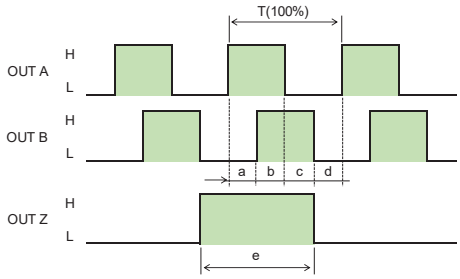



## Channel timing charts

***TRD-SR/SHR "A" Models***




***TRD-SR/SHR "V" Models***




T = a + b + c + d  a, b, c, d = 1 / 4 T ± 1 / 8 T  e = 1 ±

This Output waveform is Normal revolution (CW).
"Normal" means clockwise revolution viewed from the shaft end.

## How to read the timing charts

***Open Collector Models***
Out A and Out B are 90 degrees out of phase. Like any quadrature encoder, four unique logic states are created internally to the encoder. This is based on the rising edge to rising edge (one cycle) on channel A or B that indicates one set of bars on the internal encoder disk has passed by the optical sensor.

OUT Z is the absolute reference added to an incremental encoder and is also known as home position. It signifies a full rotation of the encoder shaft.

***Line Driver Models***
Channel A (OUT A and A-not) and Channel B (OUT B and B-not) are also 90 degrees out of phase on line driver encoders. OUT Z is the same as on open collector models, and is the absolute reference (home position). It signifies one full rotation of the encoder shaft.

# Light Duty Incremental Encoders (Metric Dimension Encoders)

## TRD-S(H) series

## Features

A light duty encoder that is cost-effective for small applications and has the following features:

- Small body with 38 mm diameter and 30 mm depth
- Dust proof (IP40 rating)
- 6 mm solid shaft or 8 mm hollow shaft
- Resolution available from 100 pulses per revolution to 2500 pulses per revolution
- Open collector or line driver output
- Up to 200 kHz response frequency
- Two-meter cable, tinned ends

*Solid-shaft (TRD-S) model*

*Hollow-shaft (TRD-SH) model*

**Light Duty Solid Shaft Incremental Encoders (NPN Open Collector and Line Driver models)**

| Part Number | Price | Pulses per Revolution | Input Voltage | Output | Body Diameter |
|---|---|---|---|---|---|
| TRD-S100AD | Retired | 100 | 5-12 VDC | NPN open collector | 38mm |
| TRD-S360AD | Retired | 360 | | | |
| TRD-S500AD | Retired | 500 | | | |
| TRD-S1000AD | Retired | 1000 | | | |
| TRD-S1024AD | Retired | 1024 | | | |
| TRD-S2500AD | Retired | 2500 | | | |
| TRD-S250BD | Retired | 250 | 12–24 VDC | NPN open collector | |
| TRD-S300BD | Retired | 300 | | | |
| TRD-S600BD | Retired | 600 | | | |
| TRD-S1000-BD | Retired | 1000 | | | |
| TRD-S1024-BD | Retired | 1024 | | | |
| TRD-S1200BD | Retired | 1200 | | | |
| TRD-S100-VD | $0094p: | 100 | 5VDC | Line driver (differential) | |
| TRD-S250VD | Retired | 250 | | | |
| TRD-S300VD | Retired | 300 | | | |
| TRD-S400VD | Retired | 400 | | | |
| TRD-S800VD | Retired | 800 | | | |
| TRD-S1000-VD | Retired | 1000 | | | |
| TRD-S1200VD | Retired | 1200 | | | |
| TRD-S2500-VD | Retired | 2500 | | | |

**Light Duty Hollow Shaft Incremental Encoders (NPN Open Collector and Line Driver models)**

| Part Number | Price | Pulses per Revolution | Input Voltage | Output | Body Diameter |
|---|---|---|---|---|---|
| TRD-SH100AD | Retired | 100 | 5-12 VDC | NPN open collector | 38mm |
| TRD-SH360AD | $0288q: | 360 | | | |
| TRD-SH500AD | Retired | 500 | | | |
| TRD-SH1000AD | Retired | 1000 | | | |
| TRD-SH1024AD | Retired | 1024 | | | |
| TRD-SH2500AD | Retired | 2500 | | | |
| TRD-SH400BD | Retired | 400 | 12–24 VDC | NPN open collector | |
| TRD-SH500-BD | Retired | 500 | | | |
| TRD-SH600BD | Retired | 600 | | | |
| TRD-SH1000-BD | Retired | 1000 | | | |
| TRD-SH1200BD | Retired | 1200 | | | |
| TRD-SH2000BD | Retired | 2000 | | | |
| TRD-SH2500-BD | Retired | 2500 | | | |
| TRD-SH100-VD | Retired | 100 | 5VDC | Line driver (differential) | |
| TRD-SH200VD | Retired | 200 | | | |
| TRD-SH250VD | Retired | 250 | | | |
| TRD-SH300VD | Retired | 300 | | | |
| TRD-SH360-VD | Retired | 360 | | | |
| TRD-SH400VD | Retired | 400 | | | |
| TRD-SH500-VD | Retired | 500 | | | |
| TRD-SH600VD | Retired | 600 | | | |
| TRD-SH800VD | Retired | 800 | | | |
| TRD-SH1000-VD | Retired | 1000 | | | |
| TRD-SH1200VD | Retired | 1200 | | | |
| TRD-SH2000VD | Retired | 2000 | | | |
| TRD-SH2500-VD | Retired | 2500 | | | |

# Light Duty Incremental Encoders (Metric Dimension Encoders)

## Specifications – TRD-S(H) series

| Electrical Specifications | | | | | |
|---|---|---|---|---|---|
| ***Model*** | | | ***TRD-SxxxxAD<br>TRD-SHxxxxAD<br>(open collector)*** | ***TRD-Sxxxx-BD<br>TRD-SHxxxxBD<br>(open collector)*** | ***TRD-Sxxxx-VD<br>TRD-SHxxxxVD (line driver)*** |
| ***Power Supply*** | ***Operating Voltage **** | | 5–12 VDC (nominal) *<br>Range: 4.75–13.2 VDC | 12–24 VDC (nominal) *<br>Range: 10.8–26.4 VDC | 5VDC (nominal) *<br>Range: 4.75–5.25 VDC |
| | ***Allowable Ripple*** | | 3% max. | | |
| | ***Current Consumption*** | | 50 mA max. | | |
| ***Signal Waveform*** | | | Quadrature + home position | | |
| ***Max. Response Frequency*** | | | 200kHz | | |
| ***Operating Speed*** | | | (max response frequency / resolution) x 60 | | |
| ***Duty Ratio*** | | | 50% ±25% | | |
| ***Phase Difference Width*** | | | 25% ±12.5% | | |
| ***Signal Width at Home Position*** | | | 100 ±50% | | |
| ***Output*** | ***Rise/Fall Time*** | | 1µs max. (when cable length is 1m) | | – |
| | ***Output Type*** | | NPN open collector output, sinking | | Line driver output (26C31 or equivalent) |
| | ***Output Logic*** | | Negative logic (active low) | | Negative logic (active high) |
| | ***Output Voltage*** | ***H*** | – | | 2.5 V min. |
| | | ***L*** | 0.4 V max. | | 0.5 V max. |
| | ***Current*** | | 30mA max. | | 20 mA max. |
| | ***Load Power Voltage*** | | 35 VDC max. | | – |
| | ***Short-Circuit Protection*** | | Between output and power supply | | – |
| **** To be supplied by Class II source*** | | | | | |

| Mechanical Specifications | |
|---|---|
| ***Starting Torque*** | 0.001 Nm (0.00074 ft/lb) max |
| ***Max. Allowable Shaft Load*** | Radial: 20N (4.5 lb); Axial: 10N (2.25 lb) |
| ***Max. Allowable Speed*** | 6000 rpm (highest speed that can support the mechanical integrity of encoder) |
| ***Wire Size*** | AWG26 |
| ***Mounting Orientation*** | can be mounted in any orientation |
| ***Weight*** | approx. 150g (5.3 oz) with 2m cable |

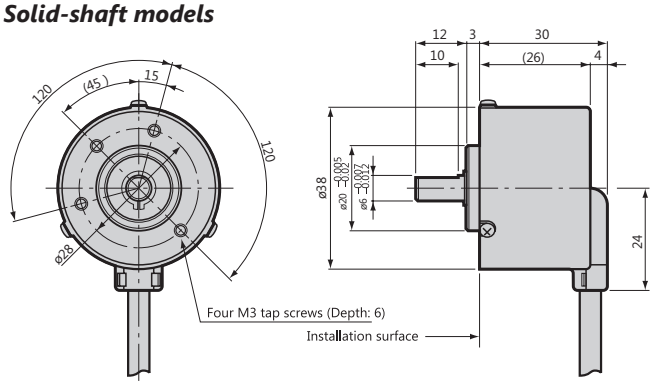
| Environmental Specifications | |
|---|---|
| ***Ambient Temperature*** | -10 to 70°C; 14 to 158°F |
| ***Storage Temperature*** | -25 to 85°C; -13 to 185°F |
| ***Operating Humidity*** | 35–85% RH |
| ***Withstand Voltage*** | 500VAC (50/60Hz) for one minute |
| ***Insulation Resistance*** | 50MΩ min. |
| ***Vibration Resistance*** | durable for one hour along three axes at 10 to 55 Hz with 0.75 amplitude |
| ***Shock Resistance*** | 11 ms with 490 $m/s^2$ applied three times along three axes |
| ***Protection*** | IP40 |

# Light Duty Incremental Encoders (Metric Dimension Encoders)

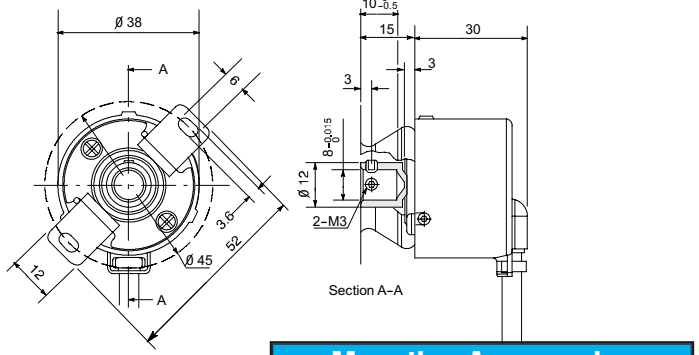
## Dimensions – TRD-S(H) series

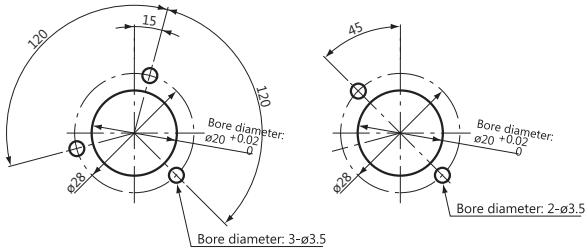
All dimensions in mm
1mm = 0.03937in

### *Solid-shaft models*




### *Hollow-shaft models*

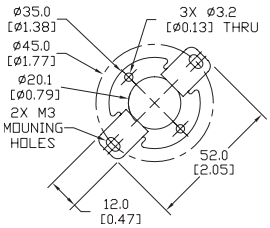


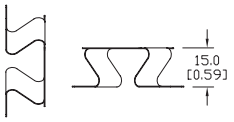




Mounting hole panel cutout (3 holes)

Mounting hole panel cutout (2 holes)

### *TRD-SH-BKT (bracket)*



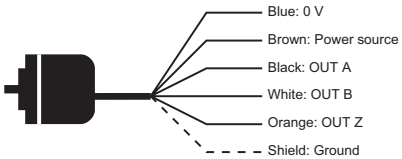



| Mounting Accessories | | |
|---|---|---|
| ***Part #*** | ***Price*** | ***Description*** |
| ***TRD-SH-BKT*** | $1n_1: | JTEKT flexible mounting bracket, replacement, metal. For use with JTEKT TRD-SH series hollow shaft encoders. |

## Wiring diagrams

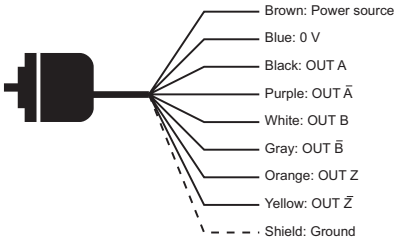
### Open collector connections

Cable shield is not connected to the encoder body; enclosure is grounded through the 0V wire



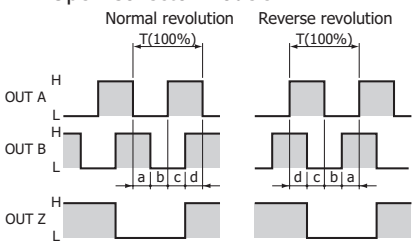

### Line driver connections

Cable shield is not connected to the encoder body; enclosure is grounded through the 0V wire

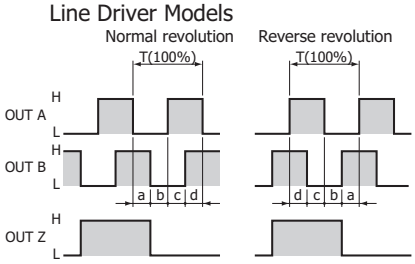



## Channel timing charts

### Open Collector Models




### Line Driver Models




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

## How to read the timing charts

***Open Collector Models***

Out A and Out B are 90 degrees out of phase. Like any quadrature encoder, four unique logic states are created internally to the encoder. This is based on the rising edge to rising edge (one cycle) on channel A or B that indicates one set of bars on the internal encoder disk has passed by the optical sensor.

OUT Z is the absolute reference added to an incremental encoder and is also known as home position. It signifies a full rotation of the encoder shaft.

***Line Driver Models***

Channel A (OUT A and A-not) and Channel B (OUT B and B-not) are also 90 degrees out of phase on line driver encoders. OUT Z is the same as on open collector models, and is the absolute reference (home position). It signifies one full rotation of the encoder shaft.

# Medium Duty Incremental Encoders (Metric Dimension Encoders)

## TRD-N(H) series

## Features

The medium duty encoder offers the greatest flexibility of choice in a very high-quality encoder, all for a very low price. Features:

- Small body with 50 mm diameter and 35 mm depth
- Splash proof (IP65 rating)
- 8 mm solid shaft or 8 mm hollow shaft
- Incremental resolution available from 3 pulses per revolution to 5,000 pulses per revolution
- Line driver or Totem-pole (push-pull) output
- Up to 200 kHz response frequency

*Solid-shaft (TRD-N) model*

*Hollow-shaft (TRD-NH) model*

**Incremental Medium Duty Solid Shaft Encoders (Totem-pole Output, TRD-Nxxx-RZWD)**

| Part Number | Price | Pulses per Revolution | Input Voltage | Output | Body Dia. |
|---|---|---|---|---|---|
| TRD-N3-RZWD | $;008,1: | 3 | 5–30 VDC | Totem-pole (push-pull) sink/source | 50 mm |
| TRD-N4-RZWD | $;008,5: | 4 | | | |
| TRD-N5-RZWD | $0093z: | 5 | | | |
| TRD-N10-RZWD | $008?u: | 10 | | | |
| TRD-N30-RZWD | $008??: | 30 | | | |
| TRD-N40-RZWD | $;008,3: | 40 | | | |
| TRD-N50-RZWD | $0093y: | 50 | | | |
| TRD-N60-RZWD | $;0093[: | 60 | | | |
| TRD-N100-RZWD | $008?s: | 100 | | | |
| TRD-N120-RZWD | $008?x: | 120 | | | |
| TRD-N200-RZWD | $008?z: | 200 | | | |
| TRD-N240-RZWD | $;008?]: | 240 | | | |
| TRD-N250-RZWD | $008?_: | 250 | | | |
| TRD-N300-RZWD | $;008?!: | 300 | | | |
| TRD-N360-RZWD | $;008,0: | 360 | | | |
| TRD-N400-RZWD | $;008,2: | 400 | | | |
| TRD-N480-RZWD | $;008,4: | 480 | | | |
| TRD-N500-RZWD | $0093x: | 500 | | | |
| TRD-N600-RZWD | $;0093]: | 600 | | | |
| TRD-N750-RZWD | $0093_: | 750 | | | |
| TRD-N1000-RZWD | $008?q: | 1000 | | | |
| TRD-N1024-RZWD | $;008?t: | 1024 | | | |
| TRD-N1200-RZWD | $008?v: | 1200 | | | |
| TRD-N2000-RZWD | $008?y: | 2000 | | | |
| TRD-N2500-RZWD | $;008?[: | 2500 | | | |
| TRD-N3000-RZWD | $008?#: | 3000 | | | |
| TRD-N3600-RZWD | $;008?,: | 3600 | | | |
| TRD-N5000-RZWD | $0093v: | 5000 | | | |

**Incremental Medium Duty Hollow Shaft Encoders (Totem-pole Output, TRD-NHxxx-RZWD)**

| Part Number | Price | Pulses per Revolution | Input Voltage | Output | Body Dia. |
|---|---|---|---|---|---|
| TRD-NH3-RZWD | $;008!q: | 3 | 5–30 VDC | Totem-pole (push-pull) sink/source | 50 mm |
| TRD-NH4-RZWD | $;008!v: | 4 | | | |
| TRD-NH5-RZWD | $;;008!]: | 5 | | | |
| TRD-NH10-RZWD | $;008!c: | 10 | | | |
| TRD-NH30-RZWD | $;008!n: | 30 | | | |
| TRD-NH40-RZWD | $;;008!t: | 40 | | | |
| TRD-NH50-RZWD | $;008!z: | 50 | | | |
| TRD-NH60-RZWD | $;008!_: | 60 | | | |
| TRD-NH100-RZWD | $;008!a: | 100 | | | |
| TRD-NH120-RZWD | $;008!e: | 120 | | | |
| TRD-NH200-RZWD | $;008!g: | 200 | | | |
| TRD-NH240-RZWD | $;008!h: | 240 | | | |
| TRD-NH250-RZWD | $;-008!j: | 250 | | | |
| TRD-NH300-RZWD | $;-008!l: | 300 | | | |
| TRD-NH360-RZWD | $;008!p: | 360 | | | |
| TRD-NH400-RZWD | $;008!s: | 400 | | | |
| TRD-NH480-RZWD | $;008!u: | 480 | | | |
| TRD-NH500-RZWD | $;008!y: | 500 | | | |
| TRD-NH600-RZWD | $;;008![: | 600 | | | |
| TRD-NH750-RZWD | $;008!#: | 750 | | | |
| TRD-NH1000-RZWD | $;008!9: | 1000 | | | |
| TRD-NH1024-RZWD | $;008!b: | 1024 | | | |
| TRD-NH1200-RZWD | $;008!d: | 1200 | | | |
| TRD-NH2000-RZWD | $;;008!f: | 2000 | | | |
| TRD-NH2500-RZWD | $;-008!i: | 2500 | | | |
| TRD-NH3000-RZWD | $;008!k: | 3000 | | | |
| TRD-NH3600-RZWD | $;008!o: | 3600 | | | |
| TRD-NH5000-RZWD | $;008!x: | 5000 | | | |

# Medium Duty Incremental Encoders (Metric Dimension Encoders)

## TRD-N(H) series

**Incremental Medium Duty Solid Shaft Encoders (Line Driver Output, TRD-Nxxx-RZVWD)**

| Part Number | Price | Pulses per Revolution | Input Voltage | Output | Body Dia. |
|---|---|---|---|---|---|
| TRD-N3-RZVWD | $008?d: | 3 | 5VDC | Line driver (differential) | 50 mm |
| TRD-N4-RZVWD | $008?h: | 4 | | | |
| TRD-N5-RZVWD | $-008?l: | 5 | | | |
| TRD-N10-RZVWD | $008?0: | 10 | | | |
| TRD-N30-RZVWD | $008?a: | 30 | | | |
| TRD-N40-RZVWD | $;008?f: | 40 | | | |
| TRD-N50-RZVWD | $008?k: | 50 | | | |
| TRD-N60-RZVWD | $008?o: | 60 | | | |
| TRD-N100-RZVWD | $;008!?: | 100 | | | |
| TRD-N120-RZVWD | $008?2: | 120 | | | |
| TRD-N200-RZVWD | $008?4: | 200 | | | |
| TRD-N240-RZVWD | $008?5: | 240 | | | |
| TRD-N250-RZVWD | $008?7: | 250 | | | |
| TRD-N300-RZVWD | $008?9: | 300 | | | |
| TRD-N360-RZVWD | $008?c: | 360 | | | |
| TRD-N400-RZVWD | $008?e: | 400 | | | |
| TRD-N480-RZVWD | $008?g: | 480 | | | |
| TRD-N500-RZVWD | $-008?j: | 500 | | | |
| TRD-N600-RZVWD | $008?n: | 600 | | | |
| TRD-N750-RZVWD | $008?p: | 750 | | | |
| TRD-N1000-RZVWD | $;;008!!: | 1000 | | | |
| TRD-N1024-RZVWD | $;;008!,: | 1024 | | | |
| TRD-N1200-RZVWD | $008?1: | 1200 | | | |
| TRD-N2000-RZVWD | $008?3: | 2000 | | | |
| TRD-N2500-RZVWD | $008?6: | 2500 | | | |
| TRD-N3000-RZVWD | $008?8: | 3000 | | | |
| TRD-N3600-RZVWD | $008?b: | 3600 | | | |
| TRD-N5000-RZVWD | $-008?i: | 5000 | | | |

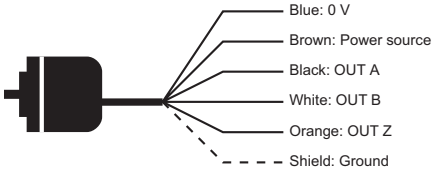
**Incremental Medium Duty Hollow Shaft Encoders (Line Driver Output, TRD-NHxxx-RZVWD)**

| Part Number | Price | Pulses per Revolution | Input Voltage | Output | Body Dia. |
|---|---|---|---|---|---|
| TRD-NH3-RZVWD | $;008!1: | 3 | 5VDC | Line driver (differential) | 50 mm |
| TRD-NH4-RZVWD | $;008!5: | 4 | | | |
| TRD-NH5-RZVWD | $008#v: | 5 | | | |
| TRD-NH10-RZVWD | $008#p: | 10 | | | |
| TRD-NH30-RZVWD | $008#?: | 30 | | | |
| TRD-NH40-RZVWD | $;008!3: | 40 | | | |
| TRD-NH50-RZVWD | $;008!8: | 50 | | | |
| TRD-NH60-RZVWD | $008#y: | 60 | | | |
| TRD-NH100-RZVWD | $008#n: | 100 | | | |
| TRD-NH120-RZVWD | $008#s: | 120 | | | |
| TRD-NH200-RZVWD | $008#u: | 200 | | | |
| TRD-NH240-RZVWD | $;008#]: | 240 | | | |
| TRD-NH250-RZVWD | $008#_: | 250 | | | |
| TRD-NH300-RZVWD | $;008#!: | 300 | | | |
| TRD-NH360-RZVWD | $;008!0: | 360 | | | |
| TRD-NH400-RZVWD | $;008!2: | 400 | | | |
| TRD-NH480-RZVWD | $;008!4: | 480 | | | |
| TRD-NH500-RZVWD | $;008!7: | 500 | | | |
| TRD-NH600-RZVWD | $008#x: | 600 | | | |
| TRD-NH750-RZVWD | $008#z: | 750 | | | |
| TRD-NH1000-RZVWD | $-008#l: | 1000 | | | |
| TRD-NH1024-RZVWD | $008#o: | 1024 | | | |
| TRD-NH1200-RZVWD | $008#q: | 1200 | | | |
| TRD-NH2000-RZVWD | $;008#t: | 2000 | | | |
| TRD-NH2500-RZVWD | $;008#[: | 2500 | | | |
| TRD-NH3000-RZVWD | $008##: | 3000 | | | |
| TRD-NH3600-RZVWD | $;008#,: | 3600 | | | |
| TRD-NH5000-RZVWD | $;008!6: | 5000 | | | |

## Wiring diagrams

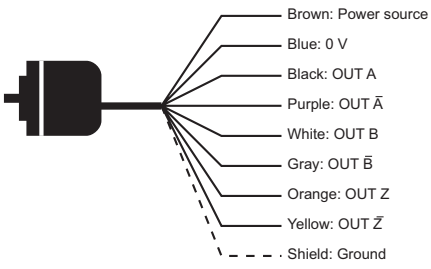
### *Totem-pole (push-pull) connections*

Cable shield is not connected to the encoder body; enclosure is grounded through the 0V wire




### *Line driver connections*

Cable shield is not connected to the encoder body; enclosure is grounded through the 0V wire



# Medium Duty Incremental Encoders (Metric Dimension Encoders)

## Specifications – TRD-N(H) series

| Electrical Specifications | | | | |
|---|---|---|---|---|
| **Model** | | | **TRD-N(H)xxxx-RZWD (Totem-pole)** | **TRD-N(H)xxxx-RZVWD (Line Driver)** |
| **Power Supply** | **Operating Voltage *** | | 5–30 VDC (nominal) * Range: 4.75–30.0 VDC | 5VDC (nominal) * Range: 4.75–5.25 VDC |
| | **Allowable Ripple** | | 3% rms max. | |
| | **Current Consumption** | | 60 mA max. | |
| **Signal Waveform** | | | Quadrature + home position | |
| **Max. Response Frequency** | | | 100 kHz | 100kHz for ≤ 3000 ppr<br>200kHz for > 3000 ppr |
| **Operating Speed** | | | (max response frequency / resolution) x 60 | |
| **Duty Ratio** | | | 50% ±25% (square wave) | |
| **Signal Width at Home Position** | | | 100% ±50% | |
| **Output** | **Rise/Fall Time ****| | | 3µs max ** | 100 ns max ** |
| | **Output Type** | | Totem Pole (Push Pull) | Line Driver (26C31 or equivalent) |
| | **Output Current** | | Negative logic (active low) | Positive logic (active high) |
| | **Output Current** | **"H" (inflow)** | 30 mA max. | 20 mA max |
| | | **"L" (outflow)** | 10 mA max. | |
| | **Output Voltage** | **"H"** | [(Load power volt) - 2.5V] | 2.5V min |
| | | **"L"** | 0.4V max | 0.5V max |
| | **Load Power Voltage** | | 35 VDC max | – |

** To be supplied by Class II source*
*** Cable length ≤2m or less. Maximum load.*

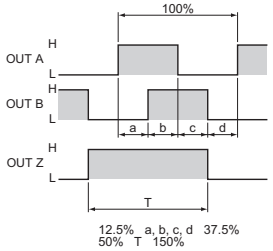
| Mechanical Specifications | | |
|---|---|---|
| **Starting Torque** | N (solid shaft): 0.02 N·m [0.18 lb·ft] ; NH (hollow shaft): 0.05 N·m [0.44 lb·ft] | |
| **Max. Allowable Shaft Load** | Radial: 50N [11.24 lb] ; Axial: 30N [6.74 lb] | |
| **Max. Allowable Speed** | Continuous: 3,000 rpm; Instantaneous: 5,000 rpm | |
| **Wire Size** | 24 AWG | |
| **Weight** | Approx. 270g [9.52 oz] with 2m cable | |

| Environmental Specifications | | |
|---|---|---|
| **Ambient Temperature** | -10 to 70 °C [14 to 158 °F] | |
| **Storage Temperature** | -25 to 85 °C [-13 to 185 °F] | |
| **Operating Humidity** | 35–85% RH | |
| **Withstand Voltage *** | 500 VAC (50/60Hz) for one minute * | Grounded through a capacitor |
| **Insulation Resistance** | 50 MΩ min. (excluding shield between power supply, signal cable and case) | |
| **Vibration Resistance** | durable for one hour along three axes at 10 to 55 Hz with 0.75 mm amplitude (excluding shield between power supply, signal cable and case) | |
| **Shock Resistance** | ≤500 ppr (metal slit) = 11 ms with 981 m/s$^2$ applied three times along three axes<br>≥600 ppr (glass slit) = 11 ms with 490 m/s$^2$ applied three times along three axes | |
| **Mounting Orientation** | can be mounted in any orientation | |
| **Protection** | IP65 | |
| **Agency Approvals** | $_{C}UL_{US}$ (E189395) | |

** Voltage withstand is good for power supply, signal, and case; not good for shield wire.*

## Channel timing chart

Output Signal Timing Chart - Totem Pole Models




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

## Accessories

### *Couplings*

For encoders with a solid shaft, please select a coupling that fits your encoder. All couplings are typically in stock, ready to ship.

See the "Encoder Couplings" section for more information.

### *Mounting Flange & Brackets*

| Mounting Accessories | | |
|---|---|---|
| **Part #** | **Price** | **Description** |
| ***JT-035D*** | $05hz: | Mounting Bracket: Metal; for use with all TRD-N/NH/NA encoders |
| ***NM-9D**** | $-6ia: | Mounting Clamp: Metal; for use with all TRD-N/NA encoders * |
| ***NF-55D**** | $0ebs: | Mounting Flange Kit: includes aluminum flange & NM-9D clamp; for use with all TRD-N/NA encoders * |
| ***TRD-NH-BKT*** | $1n_2: | JTEKT flexible mounting bracket, replacement, metal. For use with JTEKT TRD-NH series hollow shaft encoders. |

** Order NF-55D (flange & clamp) for new installations.*
*Order NM-9D (clamp) for replacement parts only.*

**TRD-NH-BKT**

**NM-9D**

**JT-035D**

**NF-55D**

## How to read the timing charts

### *Totem Pole Models*

Out A and Out B are 90 degrees out of phase. Like any quadrature encoder, four unique logic states are created internally to the encoder. This is based on the rising edge to rising edge (one cycle) on channel A or B that indicates one set of bars on the internal encoder disk has passed by the optical sensor.

OUT Z is the absolute reference added to an incremental encoder and is also known as home position. It signifies a full rotation of the encoder shaft.

### *Line Driver Models*

Channel A (OUT A and A-not) and Channel B (OUT B and B-not) are also 90 degrees out of phase on line driver encoders. OUT Z is the same as on open collector models, and is the absolute reference (home position). It signifies one full rotation of the encoder shaft.

# Medium Duty Absolute Encoders (Metric Dimension Encoders)

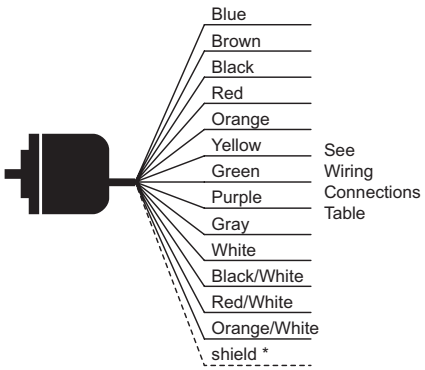
## TRD-NA series

## Features

Why use an absolute encoder? Absolute encoders provide their exact position at all times, allowing monitoring equipment to read the correct position, even when power cycles. Features include:

- Small body with 50mm diameter and 35mm depth
- Splash proof (IP65 rating)
- 8mm solid shaft
- Absolute resolution available from 32 pulses per revolution to 2048 pulses per revolution
- Open collector output
- Up to 20kHz response frequency

*Standard shaft (TRD-NA) model*




* Cable shield is not connected to the encoder body;

### Absolute Medium Duty Solid Shaft Encoders

| Part Number | Price | Resolution | Input Voltage | Output | Body Dia. |
|---|---|---|---|---|---|
| TRD-NA32NWD | $00975: | 5 bit gray code, 32 pulses per revolution | 10–26 VDC | NPN open collector | 50 mm |
| TRD-NA64NWD | $00978: | 6 bit gray code, 64 pulses per revolution | | | |
| TRD-NA128NWD | $00972: | 7 bit gray code, 128 pulses per revolution | | | |
| TRD-NA180NWD | $00973: | 8 bit gray code, 180 pulses per revolution | | | |
| TRD-NA256NWD | $00974: | 8 bit gray code, 256 pulses per revolution | | | |
| TRD-NA360NWD | $00976: | 9 bit gray code, 360 pulses per revolution | | | |
| TRD-NA512NWD | $00977: | 9 bit gray code, 512 pulses per revolution | | | |
| TRD-NA720NWD | $00979: | 10 bit gray code, 720 pulses per revolution | | | |
| TRD-NA1024NWD | $00971: | 10 bit gray code, 1024 pulses per revolution | | | |
| TRD-NA2048NWD | $01n_0: | 11 bit gray code, 2048 pulses per revolution | | | |

### Wiring Connections

| Wire color | Connector Pin No. | Resolution | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 2048 | 1024 / 720 | 512 / 360 | 256 / 180 | 128 | 64 | 32 |
| Blue | 1 | 0V | | | | | | |
| Brown | 2 | 12/24V | | | | | | |
| Black | 3 | bit 0 (20) * | bit 0 (20) * | no connection | | | | |
| Red | 4 | bit 1 (21) * | bit 1 (21) * | bit 0 (20) * | no connection | | | |
| Orange | 5 | bit 2 (22) * | bit 2 (22) * | bit 1 (21) * | bit 0 (20) * | no connection | | |
| Yellow | 6 | bit 3 (23) * | bit 3 (23) * | bit 2 (22) * | bit 1 (21) * | bit 0 (20) * | no connection | |
| Green | 7 | bit 4 (24) * | bit 4 (24) * | bit 3 (23) * | bit 2 (22) * | bit 1 (21) * | bit 0 (20) * | no connection |
| Purple | 8 | bit 5 (25) * | bit 5 (25) * | bit 4 (24) * | bit 3 (23) * | bit 2 (22) * | bit 1 (21) * | bit 0 (20) * |
| Gray | 9 | bit 6 (26) * | bit 6 (26) * | bit 5 (25) * | bit 4 (24) * | bit 3 (23) * | bit 2 (22) * | bit 1 (21) * |
| White | 10 | bit 7 (27) * | bit 7 (27) * | bit 6 (26) * | bit 5 (25) * | bit 4 (24) * | bit 3 (23) * | bit 2 (22) * |
| Black / White | 11 | bit 8 (28) * | bit 8 (28) * | bit 7 (27) * | bit 6 (26) * | bit 5 (25) * | bit 4 (24) * | bit 3 (23) * |
| Red / White | 12 | bit 9 (29) * | bit 9 (29) * (MSB) | bit 8 (28) * (MSB) | bit 7 (27) * (MSB) | bit 6 (26) * (MSB) | bit 5 (25) * (MSB) | bit 4 (24) * (MSB) |
| Orange / White | 13 | bit 10 (210) * (MSB) | no connection | | | | | |
| Shield | – | GND ** | | | | | | |

*** Numbers in parentheses ( ) are the bits corresponding to binary code.**
**** GND (cable shield) is not connected to encoder body; the enclosure is grounded through the 0VDC line.**
*Note: Numbers in parentheses ( ) are the bits corresponding to binary code.*

# Medium Duty Absolute Encoders (Metric Dimension Encoders)

## Specifications – TRD-NA series

| Electrical Specifications | | |
|---|---|---|
| ***Model*** | | ***TRD-NAxxxx-NWD*** |
| ***Power Supply*** | ***Operating Voltage **** | 12–24 VDC (nominal) *<br>Range: 10.8–26.4 VDC |
| | ***Allowable Ripple*** | 3% rms max. |
| | ***Current Consumption*** | 70mA max. |
| ***Output Code*** | | Gray binary (38 gray codes at 180 resolution, 76 at 360 resolution, and 152 at 720 resolution) |
| ***Max. Response Frequency*** | | 20kHz (Maximum revolution speed = (max. response frequency / resolution) x 60). (The encoder does not respond to revolution faster than the maximum speed.) |
| ***Accuracy*** | | 360 / Resolution x 2 = degree of accuracy |
| ***Direction of Rotation*** | | Normal (CW) or reversed (CCW) (When viewed from the shaft, CW is clockwise direction, and CCW is counterclockwise direction) |
| ***Rise/Fall Time*** | | 2µs max. (at 1kW load resistance and when cable length is 2m or less) |
| ***Output*** | ***Output Type*** | NPN open collector |
| | ***Output Logic*** | Negative logic (active low) |
| | ***Sinking Current*** | 32mA max. |
| | ***Residual Voltage*** | 16mA or less: 0.4 V max.<br>16mA → 32mA: 1.5 V max. |
| | ***Load Power Voltage*** | 35VDC max. |
| ** To be supplied by Class II source* | | |

| Mechanical Specifications | |
|---|---|
| ***Starting Torque*** | 0.03 N·m [0.02 lb·ft] |
| ***Max. Allowable Shaft Load*** | Radial: 50N [11.24 lbs] ; Axial: 30N [6.74 lbs] |
| ***Max. Allowable Speed*** | Continuous: 3000 rpm, instantaneous: 5000 rpm; (highest speed that can support the mechanical integrity of encoder) |
| ***Wire Size*** | 26 AWG |
| ***Weight*** | Approx. 300g (10.58 oz) with 2m cable |

| Environmental Specifications | |
|---|---|
| ***Ambient Temperature*** | -10 to 60 °C [14 to 140 °F] |
| ***Storage Temperature*** | -25 to 85 °C [-13 to 185 °F] |
| ***Operating Humidity*** | 25–85% RH (with no condensation) |
| ***Insulation Resistance*** | 10MΩ min. |
| ***Vibration Resistance*** | Durable for one hour along three axes at 10 to 55 Hz with 0.75 mm amplitude |
| ***Shock Resistance*** | 11ms with 980m/s$^2$ applied three times along three axes |
| ***Mounting Orientation*** | Can be mounted in any orientation |
| ***Protection*** | IP65 |
| ***Agency Approvals*** | $_{C}UL_{US}$ (E189395) |

## Accessories

***Couplings***

For encoders with a solid shaft, please select a coupling that fits your encoder. All couplings are typically in stock, ready to ship.

See the "Encoder Couplings" section for more information.

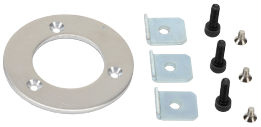
***Mounting Bracket & Clamps***

| Mounting Accessories | | |
|---|---|---|
| ***Part #*** | ***Price*** | ***Description*** |
| ***JT-035D*** | $05hz: | Mounting Bracket: Metal; for use with all TRD-N/NH/NA encoders |
| ***NM-9D**** | $-6ia: | Mounting Clamp: Metal; for use with all TRD-N/NA encoders * |
| ***NF-55D**** | $0ebs: | Mounting Flange Kit: includes aluminum flange & NM-9D clamp; for use with all TRD-N/NA encoders * |
| ** Order NF-55D (flange & clamp) for new installations. Order NM-9D (clamp) for replacement parts only.* | | |

**JT-035D**

**NM-9D**

**NF-55D**

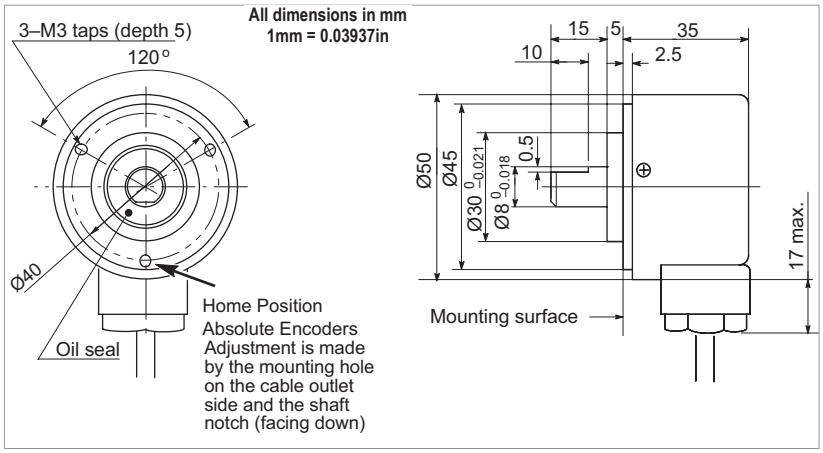


# Medium Duty Absolute and Incremental Encoders (Metric Dimension Encoders)

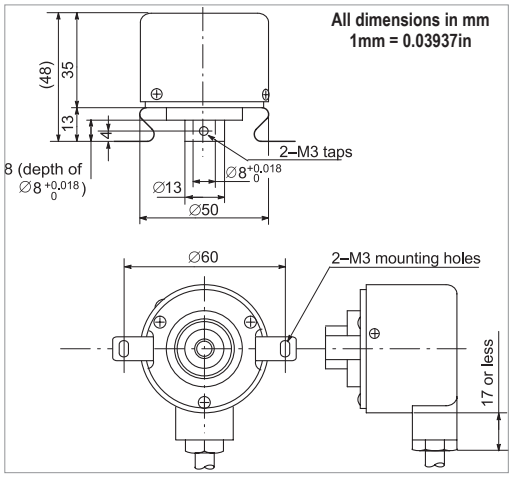
## Dimensions – TRD-N(H) & TRD-NA series

The following are the external dimensions of both incremental and absolute medium duty encoders and optional mounting accessories.

***Solid Shaft Incremental and Absolute Encoders (TRD-N, TRD-NA)***



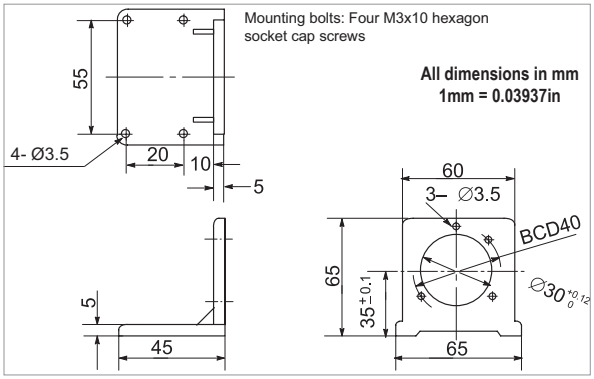

***Hollow Shaft Incremental Encoders only (TRD-NH)***



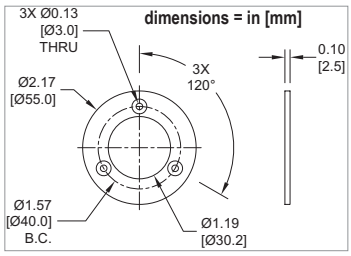

***Optional Mounting Flange and Brackets for Medium Duty Encoders***

***NOTE: NF-55D flange & included NM-9D bracket: Requires (3) M4 x 0.7 tapped holes equally spaced on a 64mm bolt circle in the mounting surface.***

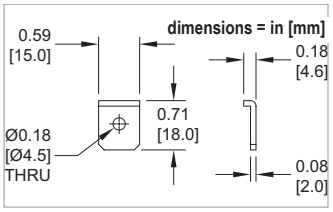
**JT-035D (bracket)**



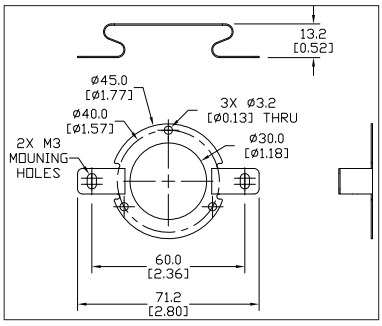

**NF-55D (flange)**




**NM-9D (clamp)(included with NF-55D)**




**TRD-NH-BKT (bracket)**



# Heavy Duty Incremental Encoders (Metric Dimension Encoders)

## TRD-GK series

## Features

A heavy duty encoder is the most rugged encoder you can buy. Top-of-the-line bearings allow a service life of 12 billion revolutions. Features include:

- 10 mm solid shaft
- Rugged body with 78 mm diameter and 60 mm depth
- Splash-proof IP65 rating
- Incremental operation from 30 pulses per revolution to 5,000 pulses per revolution
- 100 kHz maximum response frequency
- 10-30 VDC, Totem-pole output

*Solid-shaft (TRD-GK) model*

**Heavy Duty Standard Shaft Incremental Encoders**

| Model | Price | Pulses per Revolution | Input Voltage | Output | Body Diameter |
|---|---|---|---|---|---|
| TRD-GK30-RZD | $;0096]: | 30 | 10-30 VDC | Totem-pole (sink/source) | 78mm |
| TRD-GK100-RZD | $0096n: | 100 | | | |
| TRD-GK120-RZD | $0096p: | 120 | | | |
| TRD-GK200-RZD | $0096u: | 200 | | | |
| TRD-GK240-RZD | $0096v: | 240 | | | |
| TRD-GK250-RZD | $0096y: | 250 | | | |
| TRD-GK300-RZD | $0096z: | 300 | | | |
| TRD-GK360-RZD | $0096_: | 360 | | | |
| TRD-GK400-RZD | $0096#: | 400 | | | |
| TRD-GK500-RZD | $0096?: | 500 | | | |
| TRD-GK600-RZD | $;0096,: | 600 | | | |
| TRD-GK800-RZD | Retired | 800 | | | |
| TRD-GK1000-RZD | $-0096l: | 1000 | | | |
| TRD-GK1200-RZD | $0096o: | 1000 | | | |
| TRD-GK1500-RZD | Retired | 1500 | | | |
| TRD-GK1800-RZD | Retired | 1800 | | | |
| TRD-GK2000-RZD | $;0096t: | 2000 | | | |
| TRD-GK2500-RZD | $0096x: | 2500 | | | |
| TRD-GK3600-RZD | $;0096[: | 3600 | | | |
| TRD-GK5000-RZD | $;0096!: | 5000 | | | |

**Electrical Specifications**

| Model | | TRD-GKxxxx-RZD |
|---|---|---|
| Power Supply | Operating Voltage | 10–30 VDC (nominal) * Range: 9.7–30.9 VDC |
| | Allowable Ripple | 3% rms max. |
| | Current Consumption | At less than 16VDC: 50 mA max. / at 16VDC or more: 70mA max. |
| Output Waveform | Output Signal | Quadrature + home position |
| | Duty Ratio | 50% ±25% |
| | Max. Frequency Response | 100kHZ max. |
| | Operating Speed | (max response frequency / resolution) x 60 |
| | Signal Width at Home Position | At 400P or less: 25 to 150%; at 500P or more: 1° at 30' |
| | Rise/Fall Time | 2µs max. (when cable length is 2m or less) |
| Output | Output Type | Totem-pole |
| | Current: Outflow: H | 30mA max. |
| | Voltage: H | (power source voltage - 4V) min. |
| | Voltage: L | 2V max. |
| | Load Power Voltage | 35VDC max. |

** To be supplied by Class II source*

**Mechanical Specifications**

| | |
|---|---|
| Starting Torque | Max. 0.1 N·m (0.07 ft·lbs) max. at 20°C (68°F) |
| Max. Allowable Shaft Load | Radial: 100N (22.48 lbs) Axial: 50N (11.24 lbs) |
| Max. Allowable Speed | 5,000 rpm |
| Service Life of Bearing | 12 billion revolutions (at max. allowable speed) |
| Wire Size | AWG24 |
| Weight | Approx. 600g (21.16 oz) with 2m cable |

**Environmental Specifications**

| | |
|---|---|
| Ambient Temperature | -10 to 70 °C [14 to 158 °F] |
| Storage Temperature | -25 to 85 °C [-13 to 185 °F] |
| Operating Humidity | 35–85% RH (with no condensation) |
| Insulation Resistance | 50MΩ min. |
| Vibration Resistance | At 500P or less: Durable for one hour along three axes at 10 to 55 Hz with 0.75 mm amplitude<br>At 600P or more: Durable for one hour along three axes at 10 to 55 Hz with 0.35 mm amplitude |
| Shock Resistance | At 500P or less: 11 ms with 980 $m/s^2$ applied three times along three axes<br>At 600P or more: 11 ms with 294 $m/s^2$ applied three times along three axes |
| Protection | IP65 |

# Heavy Duty Incremental Encoders (Metric Dimension Encoders)

## TRD-GK series Accessories

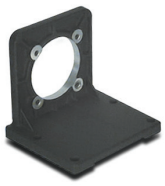
***Couplings***

For encoders with a solid shaft, please select a coupling that fits your encoder. All couplings are in stock, ready to ship.

See the "Encoder Couplings" section for more information.

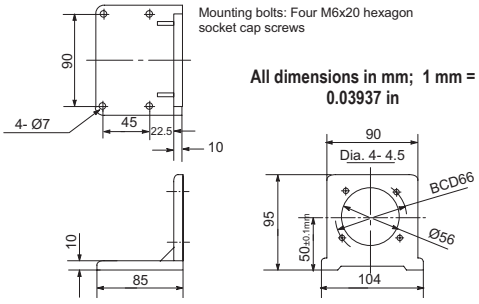
***Mounting Brackets***

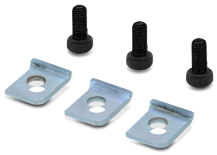
Mounting brackets for all TRD-GK encoders.



RT-11D

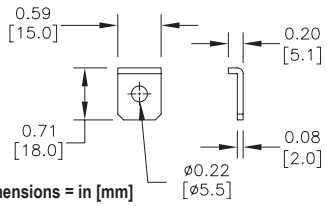
- **$05h_:**



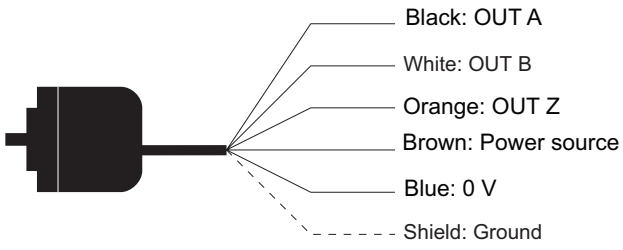



KM-9D

- **$-6i8:**




## Wiring diagram




***Cable shield is not connected to the encoder body; enclosure is grounded through the 0V wire.***

## How to read the timing charts

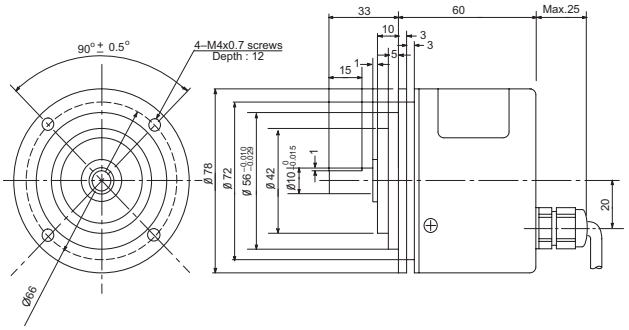
***Totem Pole Models***

Out A and Out B are 90 degrees out of phase. Like any quadrature encoder, four unique logic states are created internally to the encoder. This is based on the rising edge to rising edge (one cycle) on channel A or B that indicates one set of bars on the internal encoder disk has passed by the optical sensor.

OUT Z is the absolute reference added to an incremental encoder and is also known as home position. It signifies a full rotation of the encoder shaft.

## Dimensions

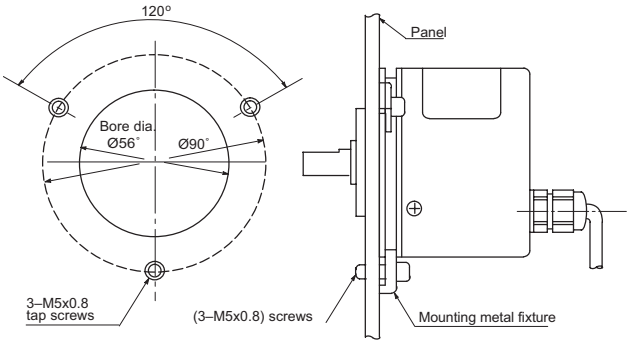
***External dimensions***



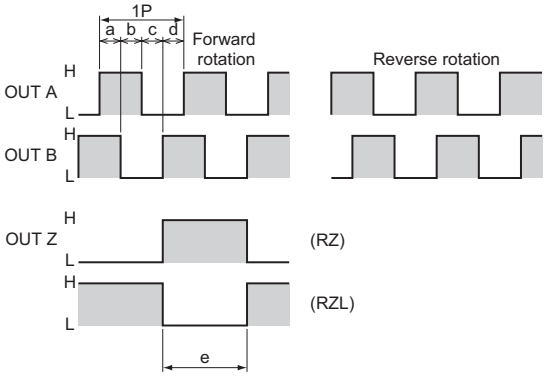

All dimensions in mm; 1 mm = 0.03937 in

***Servo mounting***

All dimensions in mm; 1 mm = 0.03937 in




## Channel timing chart




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%)

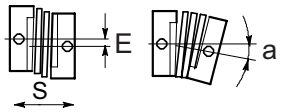
OUT Z generates home position in both directions.

# Encoder Accessories – Couplings

## Encoder Couplings

Couplings provide a connection between solid-shaft encoders and solid shafts. We offer aluminum, fiberglass, and polymer couplings for metric, S.A.E. and metric-to-S.A.E. applications.

***Misalignment compensation***




### Couplings Selection Guide and Dimensions

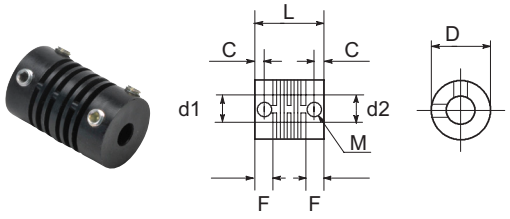
| Type | Part Number | Price | Applicable Encoders (shaft size) | Shaft Diameter | | D | L | F | C | M | a | E max | S max | Working Torque | Torsional Rigidity | Material |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | d1 | d2 | ( mm [in] ) | | | | | | ( mm [in] ) | | (N·m) | | |
| Fiberglass (metric) | GJ-4D | $0963: | TRD-MX (4mm) | 4mm | 4mm | 13 [0.51] | 21 [0.83] | 5.3 [0.21] | 3 [0.12] | M3 set screw | 5° | 0.4 [0.02] | 0.4 [0.02] | 0.6 N·m | 6 N·m/rad | Glass-fiber reinforced resin |
| | GJ-6D | $965: | TRD-S/SR (6mm) | 6mm | 6mm | 15 [0.59] | 22 [0.87] | 5.2 [0.20] | 3 [0.12] | M3 set screw | 6° | 0.5 [0.02] | 0.12 [0.005] | 0.8 N·m | 10 N·m/rad | |
| | GJ-8D | $0966: | TRD-N/NA (8mm) | 8mm | 8mm | 19 [0.75] | 24 [0.94] | 6.8 [0.27] | 3.5 [0.14] | M4 set screw | 5° | 0.5 [0.02] | 0.4 [0.016] | 1.5 N·m | 20 N·m/rad | |
| | GJ-10D | $0962: | TRD-GK (10 mm) | 10 mm | 10 mm | 22 [0.87] | 26 [1.02] | 7.1 [0.28] | 4 [0.16] | M4 set screw | 5° | 0.5 [0.02] | 0.12 [0.005] | 2.0 N·m | 32 N·m/rad | |
| Fiberglass (SAE) | GJ-635D | $0964: | TRDA-2E (0.25 in) | 0.25 in | 0.25 in | 15 [0.59] | 22 [0.87] | 5.2 [0.20] | 3 [0.12] | M3 set screw | 5° | 0.5 [0.02] | 0.12 [0.005] | 0.8 N·m | 10 N·m/rad | |
| | GJK-953D | $0967: | TRDA-20/25 (0.375 in) | 0.375 in | 0.375 in | 25 [0.98] | 32 [1.26] | 7.3 [0.29] | 3.5 [0.14] | M4 set screw | 5° | 0.5 [0.02] | 0.12 [0.005] | 2.0 N·m | 32 N·m/rad | |
| Polymer (SAE) | STP-MTRA-SC-1412 | $-096j: | TRDA-2E (0.25 in) | 0.25 in | 0.50 in | 25 [0.98] | 38 [1.50] | 9.9 [0.39] | 5.4 [0.21] | M3 cap screw | 5° | 0.3 [0.01] | 0.12 [0.005] | 3.7 N·m | 0.36 °/lb·in | Engineered polymer |
| | STP-MTRA-SC-3812 | $096k: | TRDA-20/25 (0.375 in) | 0.375 in | 0.50 in | 25 [0.98] | 38 [1.50] | 9.9 [0.39] | 5.4 [0.21] | M3 cap screw | 5° | 0.3 [0.01] | 0.12 [0.005] | 3.7 N·m | 0.36 °/lb·in | |
| Aluminum (metric) | ARM-075-5-4D | $;095,: | TRD-MX (4mm) | 4mm | 5mm | 19.1 [0.75] | 19.1 [0.75] | 4.6 [0.18] | 2.4 [0.09] | M3 set screw | 5° | 0.25 [0.01] | 0.25 [0.01] | 2.3 N·m | 8.2 N·m/rad | Aluminum alloy |
| | RU-075D | $096g: | TRD-S/SR (6mm) | 6mm | 6mm | 19.1 [0.75] | 19.1 [0.75] | 4.6 [0.18] | 2.4 [0.09] | M3 set screw | 5° | 0.25 [0.01] | 0.12 [0.005] | 1.0 N·m | 8.2 N·m/rad | |
| | JU-100D | $0968: | TRD-N/NA (8mm) | 8mm | 8mm | 25.4 [1.00] | 25.4 [1.00] | 6.6 [0.26] | 3.8 [0.15] | M5 set screw | 5° | 0.25 [0.01] | 0.25 [0.01] | 1.6 N·m | 14.3 N·m/rad | |
| | RU-100D | $096h: | TRD-GK (10 mm) | 10 mm | 10 mm | 25.4 [1.00] | 25.4 [1.00] | 6.6 [0.26] | 3.8 [0.15] | M5 set screw | 5° | 0.25 [0.01] | 0.12 [0.005] | 1.6 N·m | 14.3 N·m/rad | |
| Aluminum (metric-to-SAE) | ML13P-4-476D | $096e: | TRD-MX (4mm) | 4mm | 0.1875 in | 13 [0.51] | 19 [0.75] | 5.5 [0.22] | 2.5 [0.10] | M2 set screw | 5° | 0.4 [0.02] | 0.2 [0.01] | 0.25 N·m | 44 N·m/rad | Aluminum alloy (Bent plate: Polyimide) |
| | ML16P-4-635D | $;096f: | TRD-MX (4mm) TRDA-2E (0.25 in) | 4mm | 0.25 in | 16 [0.63] | 23 [0.91] | 7 [0.28] | 3 [0.12] | M3 set screw | 5° | 0.6 [0.02] | 0.3 [0.01] | 0.4 N·m | 70 N·m/rad | |
| | MCGL16-6-635 | $0969: | TRD-S/SR (6mm) TRDA-2E (0.25 in) | 6mm | 0.25 in | 16 [0.63] | 23.2 [0.91] | 7 [0.28] | 3 [0.12] | M3 set screw | 3.5° | 0.3 [0.01] | 0.3 [0.01] | 0.4 N·m | 70 N·m/rad | |
| | MCGL20-8-635 | $096a: | TRD-N/NA (8mm) TRDA-2E (0.25 in) | 8mm | 0.25 in | 20 [0.79] | 26 [1.02] | 7.5 [0.30] | 3.7 [0.15] | M3 set screw | 3.5° | 0.3 [0.01] | 0.4 [0.02] | 0.6 N·m | 130 N·m/rad | |
| | MCGL20-8-952 | $096b: | TRD-N/NA (8mm) TRDA-20/25 (0.375 in) | 8mm | 0.375 in | 20 [0.79] | 26 [1.02] | 7.5 [0.30] | 3.7 [0.15] | M3 set screw | 3.5° | 0.3 [0.01] | 0.4 [0.02] | 0.6 N·m | 130 N·m/rad | |
| | MCGL25-10-635 | $096c: | TRD-GK (10 mm) TRDA-2E (0.25 in) | 10 mm | 0.25 in | 25 [0.98] | 30.2 [1.19] | 9 [0.35] | 4 [0.16] | M4 set screw | 3.5° | 0.3 [0.01] | 0.5 [0.02] | 1.4 N·m | 240 N·m/rad | |
| | MCGL25-10-952 | $096d: | TRD-GK (10 mm) TRDA-20/25 (0.375 in) | 10 mm | 0.375 in | 25 [0.98] | 30.2 [1.19] | 9 [0.35] | 4 [0.16] | M4 set screw | 3.5° | 0.3 [0.01] | 0.5 [0.02] | 1.4 N·m | 240 N·m/rad | |
| Aluminum (SAE) | ARM-075-635-635D | $0960: | TRDA-2E (0.25 in) | 0.25 in | 0.25 in | 19.1 [0.75] | 19.1 [0.75] | 4.6 [0.18] | 2.4 [0.09] | M3 set screw | 5° | 0.25 [0.01] | 0.25 [0.01] | 1.0 N·m | 8.2 N·m/rad | Aluminum alloy |
| | ARM-100-9525-9525D | $0961: | TRDA-20/25 (0.375 in) | 0.375 in | 0.375 in | 25.4 [1.00] | 25.4 [1.00] | 6.6 [0.26] | 3.8 [0.15] | M5 set screw | 5° | 0.25 [0.01] | 0.25 [0.01] | 1.6 N·m | 14.3 N·m/rad | |

** mm ÷ 25.4 = inches*

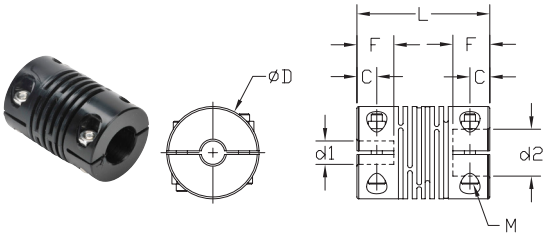
# Encoder Accessories – Couplings

## Encoder Couplings – Dimensions

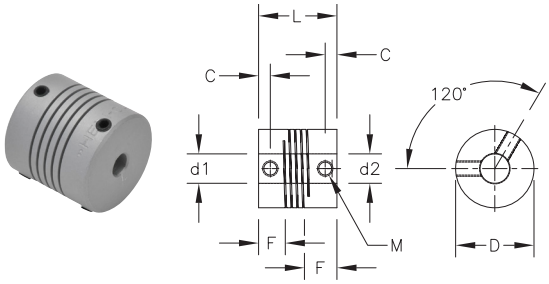
**GJ-xxD Fiberglass Couplings (metric) &**
**GJx-xxxD Fiberglass Couplings (SAE)**



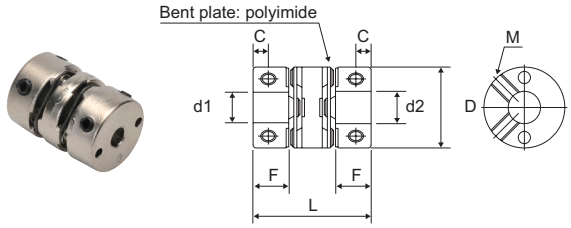

**STP-MTRA-SC-xxxx Polymer Couplings**



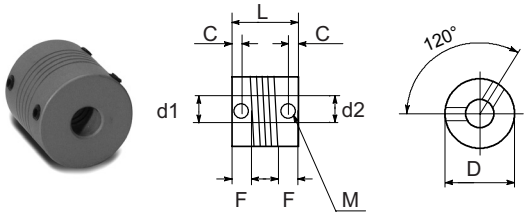

**ARM-xxxxxxD Aluminum Couplings (metric & SAE)**




**MCGLxx Aluminum Couplings &**
**ML1xP-4-xxxD Aluminum Couplings**




**RU-075D, RU-100D, and JU-100D Aluminum Couplings**



# Encoders Frequently Asked Questions

***Q: What is a differential line output?***

**A:** Differential output refers to the fact that each channel has a complement channel, i.e. Channel A and Channel A not. A differential line driver is used to help increase noise immunity. It also allows you to sink or source more current than a Totem-pole output. A differential line driver will work with either a sinking or sourcing circuit. It can also help in increasing the distance that a signal is transmitted.

***Q: What is an open collector output?***

**A:** An open collector output is an NPN transistor. An NPN transistor allows the sinking of current to common. It can be thought of as a switch that allows the circuit to be connected to common after the load. This means that a source is required for the output to work. A supply through a load must be connected to the output, otherwise the NPN transistor is simply creating a path to common, i.e. a dry contact. Therefore, if you were to measure the voltage at the output of an open collector that is not connected to a supply, you would not see a change in voltage. The voltage should be measured across the output load to determine if the open collector is working properly.

***Q: What is a Totem-pole output?***

**A:** A Totem-pole output, sometimes referred to as a push-pull output, is a bipolar output with active devices that are controlled such that, as the resistance of one increases, the resistance of the other decreases; so that according to the relative states of the two active devices, the output voltage can swing between levels approaching the two supply voltages. The term 'totem-pole output,' as commonly used, does not include three-state outputs. A Totem-pole circuit can sink current from a voltage source or it can supply current to a sinking device (but only one configuration can be wired at one time).

## Q: What is a quadrature output?

**A:** Quadrature output refers to the use of two output channels (A and B) separated by 90 degrees of phase shift. The fact that the signals are 90 degrees out of phase allows a controller to determine the direction of rotation, i.e. if channel A leads B then the encoder is spinning one direction, if B leads A then it is spinning the other direction. Refer to the channel timing charts for a graphical view of this concept. Remember that each channel provides the rated pulses per revolution (PPR) for each encoder. For example: with a 100 PPR encoder, there are 100 pulses per revolution from channel A, and 100 pulses from channel B. This is a total of 200 pulses if your controller can count both channels (X2 logic). Some controllers can count the rising edge and the falling edge of each pulse (on both channels) thereby increasing the effective resolution by a factor of four (X4 logic), and counting 400 edges per revolution on a 100 PPR quadrature encoder. This doesn't mean that there are 400 pulses coming from a 100 PPR quadrature encoder.

***Q: Why do I need a pull-up resistor?***

**A:** A pull-up resistor is used to pull the logic high voltage level up to the level of the operating voltage. This is useful when the output of the open collector is not reaching the voltage level needed to indicate a logic high signal or when noise is present on the signal line. When a logic high signal is present, its voltage level will be approximately that of the operating voltage for an open circuit. The difference is due to the voltage drop across the pull-up resistor. This is not necessarily true if the load is referenced to ground. Pull-up resistors are also used to convert sinking devices to sourcing devices, which inverts the pulse train.

***Q: What is the difference between X2 and X4 logic?***

**A:** Some devices that are commonly interfaced to encoders (controllers, counters, displays) can detect more events per revolution than the rated PPR output of a quadrature encoder signal. Because a quadrature encoder provides two channels of pulses, a controller that counts the pulses on both channels can count twice (X2) the PPR output of a given encoder. For example, a controller with X2 logic can count 240 pulses per rev. from a 120 PPR encoder. Some controllers can count the rising edge and the falling edge of each pulse (on both channels) thereby counting four times (X4) the PPR rating of the encoder (or 480 edges per revolution in our example). It's important to remember that a quadrature encoder produces two channels of pulses at a given PPR. X2 or X4 logic refers to how the controller (or other device) interprets those pulse streams.

## Q: Is shielded cable needed?

**A:** YES. The use of shielded cable is highly recommended. This is especially true for areas in which large amounts of electrical noise exist. If you are having any noise problems, or suspect that you might, then use a shielded cable.

***Q: How do I set my calibration constant?***

**A:** The calibration constant can be simplified by selecting the correct pulses per revolution (PPR). When choosing your calibration constant, remember, the closer to 1 the better. The value of the calibration constant is your best resolution per pulse of the encoder.

***Q: How do I choose the pulses per revolution (PPR)?***

**A:** When choosing the PPR value of the encoder, you should follow a few simple rules. Make sure that you do not choose a PPR that will exceed the maximum input frequency of the controller (or whatever device the encoder is driving). To calculate the max frequency of the encoder signal (in Hz): simply multiply the speed that the encoder will spin (in revs/sec) by the PPR of the encoder (don't forget to take X2 or X4 logic into account if it applies for your application). Try to chose a PPR that is an even multiple of the value you are trying to measure or display. For example, if one revolution of the encoder equates to 12 inches of travel, you might chose a 1200 PPR encoder. This can eliminate or simplify the need for a calibration constant or scaling factor and more importantly, it eliminates the possibility of accumulating a rounding error over many cycles of the encoder. In this example you would be able to measure the travel to a resolution of 1/100 of an inch. You should also consider any 2x or 4x counting logic in your controller. If your controller can "see" pulses on both the A and B channels (2x logic), then it will count 2400 pulses for every 12 inches of travel in our example. If the controller counts both the leading edge and the trailing edge of each of the pulses on both channels (4x logic), then it will count 4800 edges per revolution and your effective resolution would increase to 1/400 of an inch per count.

*( FAQs continued on next page )*

***Q: How accurate will an encoder be in my application?***

**A:** Encoders can provide a very accurate indication of rotational position, but it's impossible to say how accurate a given encoder will be in a real-world application. Mechanical inaccuracies and electrical issues such as noise, or lost counts can affect the accuracy of any system. A good rule of thumb is to design the system to measure from 2 to 5 times more resolution than your desired accuracy. For example: if you wish to accurately measure movement of 1/100th of an inch, you should select an encoder that can deliver at least 200 counts per inch of resolution. In a rotary application - if you need accuracy within 6 degrees, select an encoder that can deliver at least 120 counts per revolution ( a resolution of 3 degrees) to your controller.

# Encoders Frequently Asked Questions

***Q: How far away can I place my encoder from my system?***

**A:** There is no set answer to this question. Many factors play a role in determining the maximum length of cable that can be used to connect the units together. The largest problem with running long lengths of cable is that the cable becomes more susceptible to noise. This is due to the capacitance of the cable, the cable acting as an antenna, and the loss of power through the cable. The maximum distance of cable can be achieved by following some basic wiring principles. Do not run the cable near objects that create a lot of electrical noise. This includes AC motors, arc welders, AC power lines, and transformers. Use twisted pair cabling when using the signal and its compliment, and shielded cabling when running any type of signal. Use the highest voltage available for the output voltage. For example, if the encoder will output 5 to 24 volts, then use 24 volts. Use an open collector or differential line driver output with a differential receiver so that the maximum amount of current can be sink/sourced. If you are using the encoder as an input to more than one controller, use a signal amplifier. This is also a good way to help increase the distance a signal can travel. Typical maximum distances for a differential line driver are around 100 feet or more when using a differential input. For an open collector the distance is around 35 feet.

***Q: Why use an absolute encoder?***

**A:** An absolute encoder has each position of the revolution uniquely numbered. This means that instead of an output of pulses, you get an output that is a specific value in a binary format. This is very useful when exact positioning is a must. If the power should be lost, the actual value of the position will be known when power is restored, since each location in an absolute encoder's revolution is a unique binary value. The exact position will be known even if the controller loses power and the process is moved.

***Q: What is Gray code?***

**A:** Gray code is a form of binary. The difference between Gray code and binary is the method of incrementing to the next number. In Gray code, only one digit may change states for every increment. This means the count sequence would look something like this: 0, 1, 3, 2, 6, and 7. This is different than standard binary, where the sequence would be 0, 1, 2, 3, 4, and 5. Gray code is used to prevent errors as transitions to the next state occur. An example of how an error could occur would be when both values in the sequence were true. This can occur due to the timing sequence and the capacitance of the cable. The transition from 0011 to 0100 could cause 0111 to be generated for a couple of microseconds. With gray code this is not possible since only one bit changes state at any given time.

***Q: How do I convert Gray code to binary?***

**A:** The conversion from Gray code to binary is simple.

Step 1: Write the number down and copy the left most digit under itself.

Step 2: Add the highlighted binary digit to the Gray code immediately up and to the right of it. So, 1 plus 1 is 0 dropping the carried digit. Write the result next to the binary digit just added. Drop all of the carried digits.

Step 3: Repeat Step 2 until the number is completed. Fortunately, many PLCs have easy-to-use Gray code conversion instructions available.

***Q: What is a sinking or sourcing Input?***

**A:** The terms sinking and sourcing inputs simply refer to the current flow in a transistor. This means that the inputs require a voltage (current) and a load to operate.

Sinking inputs:

- Require the external circuit to supply voltage/current.
- "Sink" the supplied voltage (current).
- Will be OFF when there is 0V on the terminal.
- Will be ON when there is +VDC on the terminal.

Sourcing inputs:

- Require the external circuit to provide a path to 0V.
- "Source" voltage (current) into the external circuit.
- Will be OFF when there is +VDC on the terminal (no current is flowing from the input).
- Will be ON when there is 0V on the terminal (current is flowing from the input).

A pushbutton (with a set of N.O. contacts) can be wired for use with either sinking or sourcing inputs. If used with a sinking input, one side of the pushbutton would be wired to +VDC and the other side wired to the sinking input. If used with a sourcing input, one side of the pushbutton would be wired to 0V and the other side wired to the sourcing input.