

50 mm Diameter Absolute Single-Turn Rotary Encoders (Optical)



EP50 Series PRODUCT MANUAL

For your safety, read and follow the considerations written in the instruction manual, other manuals and Autonics website.

The specifications, dimensions, etc. are subject to change without notice for product improvement. Some models may be discontinued without notice.

Features

- Ø 50 mm housing, Ø 8 mm solid shaft
- Various output code options: BCD, binary, Gray code
- Various resolutions: up to 10-bit (1024 divisions)
- Axial cable type, radial cable type models
- Oil resistant PVC cable (UL certified models only)
- Protection structure: IP65

Safety Considerations

- Observe all 'Safety Considerations' for safe and proper operation to avoid hazards.
- ⚠ symbol indicates caution due to special circumstances in which hazards may occur.

⚠ Warning Failure to follow instructions may result in serious injury or death.

- 01. Fail-safe device must be installed when using the unit with machinery that may cause serious injury or substantial economic loss. (e.g. nuclear power control, medical equipment, ships, vehicles, railways, aircraft, combustion apparatus, safety equipment, crime / disaster prevention devices, etc.)**
Failure to follow this instruction may result in personal injury, economic loss or fire.
- 02. Do not use or store the unit in the place where flammable / explosive / corrosive gas, high humidity, direct sunlight, radiant heat, vibration, impact or salinity may be present.**
Failure to follow this instruction may result in explosion or fire.
- 03. Install the device in panel to use.**
Failure to follow this instruction may result in fire.
- 04. Do not connect, repair, or inspect the unit while connected to a power source.**
Failure to follow this instruction may result in fire.
- 05. Check 'Connections' before wiring.**
Failure to follow this instruction may result in fire.
- 06. Do not disassemble or modify the unit.**
Failure to follow this instruction may result in fire.

⚠ Caution Failure to follow instructions may result in injury or product damage.

- 01. Use the unit within the rated specifications.**
Failure to follow this instruction may result in fire or product damage.
- 02. Do not short the load.**
Failure to follow this instruction may result in fire.
- 03. Do not use the unit near the place where there is the equipment which generates strong magnetic force or high frequency noise and strong alkaline, strong acidic exists.**
Failure to follow this instruction may result in product damage.

Cautions during Use

- Follow instructions in 'Cautions during Use'.
Otherwise, it may cause unexpected accidents.
- 5 VDC \equiv , 12 - 24 VDC \equiv power supply should be insulated and limited voltage / current or Class 2, SELV power supply device.
- For using the unit with the equipment which generates noise (switching regulator, inverter, servo motor, etc.), ground the shield wire to the F.G. terminal.
- Ground the shield wire to the F.G. terminal.
- When supplying power with SMPS, ground the F.G. terminal and connect the noise canceling capacitor between the 0 V and F.G. terminals.
- Wire as short as possible and keep away from high voltage lines or power lines, to prevent inductive noise.
- Check the wire type and response frequency when extending wire because of distortion of waveform or residual voltage increment etc. by line resistance or capacity between lines.
- This unit may be used in the following environments.
 - Indoors (UL Type 1 Enclosure)
 - Altitude max. 2,000 m
 - Pollution degree 2
 - Installation category II

- Install the unit correctly with the usage environment, location, and the designated specifications.
- Fix the front part with bolts.
If the front part is not fixed and only bracket is used to install, location value errors may occur.
- Do not load overweight on the shaft.
- Do not put strong impact when insert a coupling into shaft.
Failure to follow this instruction may result in product damage.
- When fixing the product or coupling with a wrench, tighten under 0.15 N·m.
- If the coupling error (parallel misalignment, angular misalignment) between the shaft increases while installation, the life cycle of the coupling and the encoder can be shorten.
- Do not apply tensile strength over 30 N to the cable.

This is only for reference, the actual product does not support all combinations.
For selecting the specified model, follow the Autonics website.

S: Shaft type

8: Ø 8 mm

Number: Refer to resolution in 'Output
Phase / Output Angle'

- 1: BCD code
- 2: Binary code
- 3: Gray code

F: Increase output when the rotating direction is clockwise base on facing the shaft
R: Increase output when the rotating direction is counter-clockwise base on facing the shaft

N: NPN open collector output
P: PNP open collector output

24: 12 - 24 VDC $\pm 5\%$

No mark: Axial cable type
S: Radial cable type

No mark: [Axial cable type] CE, UKCA, EAC
U: CE, UKCA, UL Listed

- Product
- Instruction manual
- Bolt × 8
- Coupling × 1
- Bracket × 2

- Unused wires must be insulated.
- The metal case and shield cable of encoders must be grounded (F.G.).
- F.G. (Frame Ground) must be grounded separately.
- Since exclusive driver IC is used for output circuit, be aware of short circuits when wiring each output wires.
- N·C: not connected

| Color | Function | Refer |
|----------------|-------------------|------------------------------|
| White | +V | Power |
| Black | GND | |
| Brown | 2^0 | |
| Red | 2^1 | |
| Orange | 2^2 | |
| Yellow | 2^3 | |
| Blue | $2^0 \times 10$ | |
| Purple | $2^1 \times 10$ | |
| Gray | $2^2 \times 10$ | |
| White / Brown | $2^3 \times 10$ | TP1 (≤ 40 division) |
| White / Red | $2^0 \times 10^2$ | TP2 (≤ 40 division) |
| White / Orange | $2^1 \times 10^2$ | EP (≤ 40 division) |
| White / Yellow | $2^2 \times 10^2$ | |
| White / Blue | $2^3 \times 10^2$ | |
| White / Purple | $2^0 \times 10^3$ | |
| Shield | F.G. | Signal shield |

| Color | Function | Refer |
|----------------|----------------|------------------------|
| White | +V | Power |
| Black | GND | |
| Brown | 2 ⁰ | |
| Red | 2 ¹ | |
| Orange | 2 ² | |
| Yellow | 2 ³ | |
| Blue | 2 ⁴ | |
| Purple | 2 ⁵ | |
| Gray | 2 ⁶ | |
| White / Brown | 2 ⁷ | TP1 (≤ 40 division) |
| White / Red | 2 ⁸ | TP2 (≤ 40 division) |
| White / Orange | 2 ⁹ | EP (≤ 40 division) |
| White / Yellow | N · C | |
| White / Blue | N · C | |
| White / Purple | N · C | |
| Shield | F.G. | Signal shield |

- The output circuit is identical for each output bit.
- Be aware of circuit break in case of overload or short beyond the specifications.

Circuit diagram of a PNP transistor switch. The emitter is connected to ground. The base is connected to a 5V source through a 10k resistor. The collector is connected to a 5V source through a 1k resistor and to a load through a 10k resistor. The load is connected to ground. The current through the load is labeled as Max. 32 mA.

A circuit diagram showing a load connected to a circuit. The load is labeled "LOAD" and the current is labeled "Max. 32 mA". The circuit includes a switch and a diode.

- Following waveform is based on the positive logic.
(In case of negative logic, the waveform is opposite to corresponding waveform.)

[illegible]

| Model | EP50S8-□-□□-N-□-□-□ | EP50S8-□-□□-P-□-□-□ |
|---|--|-----------------------------|
| Resolution ⁽⁰¹⁾ | ≤ 1024 division | |
| Output code | BCD / Binary / Gray code model | |
| Control output | NPN open collector output | PNP open collector output |
| Inflow current | ≤ 32 mA | - |
| Residual voltage | ≤ 1 VDC ≡ | - |
| Outflow current | - | ≤ 32 mA |
| Output voltage | - | ≥ (power supply -1.5) VDC ≡ |
| Response speed ⁽⁰²⁾ | $T_{on} \leq 800 \text{ nsec}$, $T_{off} \leq 800 \text{ nsec}$ | |
| Max. response freq. | 35 kHz | |
| Max. allowable revolution ⁽⁰³⁾ | 3,000 rpm | |
| Starting torque | ≤ 0.0069 N m | |
| Inertia moment | ≤ 40 g·cm ² (4×10^{-6} kg·m ²) | |
| Allowable shaft load | Radial: 10 kgf, Thrust: 2.5 kgf | |
| Unit weight (packaged) | ≈ 398 g (≈ 482 g) | |

01) Refer to resolution in 'Output Phase / Output Angle'

02) Based on cable length: 2 m, $I_{\text{sink}} = 32 \text{ mA}$

03) Select resolution to satisfy Max. allowable revolution \geq Max. response revolution

$$[\text{max. response revolution (rpm)}] = \frac{\text{max. response frequency}}{\text{resolution}} \times 60 \text{ sec}]$$

| Model | EP50S8-□-□ □□-□□ | EP50S8-□-□ □□-□□-U | EP50S8-□-□□-□-□-S-U |
|----------------------|--|--------------------------------------|---|
| Connection | Axial cable type (cable gland) | | Radial cable type |
| Cable spec. | Ø 7 mm, 15-wire, 2m, shield cable | | Ø 6 mm, 15-wire, 2m, shield cable |
| | PVC | Oil resistant PVC | Oil resistant PVC |
| Wire spec. | AWG28 (0.08 mm, 40-core), insulator diameter: Ø 0.8 mm | | AWG28 (0.08 mm, 15-core), insulator diameter: Ø 0.82 mm |
| Certification | CE UL ENEC | CE UL ENEC LISTED | CE UL ENEC LISTED |

| | |
|-------------------------------------|--|
| Power supply | 5VDC= ± 5% (ripple P-P: ≤ 5%) / 12 - 24 VDC = ± 5% (ripple P-P: ≤ 5%) model |
| Current consumption | ≤ 100 mA (no load) |
| Insulation resistance | ≥ 100 MΩ (500 VDC= megger) |
| Dielectric strength | Between the charging part and the case: 750 VAC~ 50 / 60 Hz for 1 min. |
| Vibration | 1 mm double amplitude at frequency 10 to 55 Hz in each X, Y, Z direction for 2 hours |
| Shock | ≤ 50 G |
| Ambient temp. ⁰¹⁾ | -10 to 70 °C, storage: -25 to 85 °C (no freezing or condensation) |
| Ambient humi. | 35 to 85%RH, storage: 35 to 90%RH (no freezing or condensation) |
| Protection rating | IP65 (IEC standard) |

01) UL approved ambient temperature: 65 °C

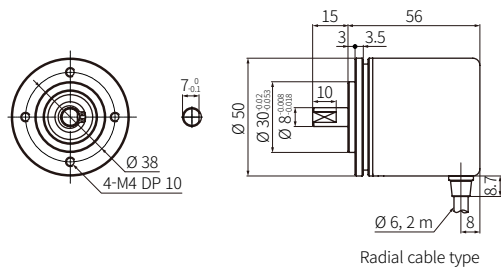
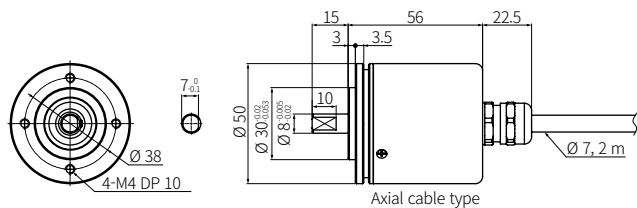
Output Phase / Output Angle

- TP = Timing Pulse
- TS = Signal Pulse
- EP = Even Parity

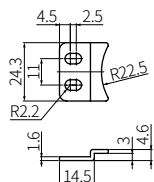
| Resolution | BCD code | Binary code | Gray code |
|------------|--|--|---|
| 1024 | TS: 0.3515° ± 15' (13 bit) | TS: 0.3515° ± 15' (10 bit) | TS: 0.703° ± 15' (10 bit) |
| 720 | TS: 0.5° ± 25' (11 bit) | TS: 0.5° ± 25' (10 bit) | TS: 1° ± 25' (10 bit) |
| 512 | TS: 0.703° ± 15' (11 bit) | TS: 0.703° ± 15' (9 bit) | TS: 1.406° ± 15' (9 bit) |
| 360 | TS: 1° ± 25' (10 bit) | TS: 1° ± 25' (9 bit) | TS: 2° ± 25' (9 bit) |
| 256 | TS: 1.406° ± 15' (10 bit) | TS: 1.406° ± 15' (8 bit) | TS: 2.8125° ± 15' (8 bit) |
| 180 | TS: 2° ± 25' (9 bit) | TS: 2° ± 25' (8 bit) | TS: 4° ± 25' (8 bit) |
| 128 | TS: 2.8125° ± 15' (9 bit) | TS: 2.8125° ± 15' (7 bit) | TS: 5.625° ± 15' (7 bit) |
| 90 | TS: 4° ± 25' (8 bit) | TS: 4° ± 25' (7 bit) | TS: 8° ± 25' (7 bit) |
| 64 | TS: 5.625° ± 15' (7 bit) | TS: 5.625° ± 15' (6 bit) | TS: 11.25° ± 15' (6 bit) |
| 48 | TS: 7.5° ± 25' (7 bit) | TS: 7.5° ± 25' (6 bit) | TS: 15° ± 25' (6 bit) |
| 45 | TS: 8° ± 25' (7 bit) | TS: 8° ± 25' (6 bit) | TS: 16° ± 25' (6 bit) |
| 40 | TP1: 5° ± 60' (1 bit) TP2: 2° ± 60' (1 bit) TS: 9° ± 60' (6 bit) EP: 9° ± 60' (1 bit) | TP1: 5° ± 60' (1 bit) TP2: 2° ± 60' (1 bit) TS: 9° ± 60' (6 bit) EP: 9° ± 60' (1 bit) | TP1: 5° ± 60' (1 bit) TP2: 2° ± 60' (1 bit) TS: 18° ± 60' (6 bit) EP: 9° ± 60' (1 bit) |
| 32 | TP1: 7° ± 60' (1 bit) TP2: 2° ± 60' (1 bit) TS: 11.25° ± 60' (6 bit) EP: 11.25° ± 60' (1 bit) | TP1: 7° ± 60' (1 bit) TP2: 2° ± 60' (1 bit) TS: 11.25° ± 60' (5 bit) EP: 11.25° ± 60' (1 bit) | TP1: 7° ± 60' (1 bit) TP2: 2° ± 60' (1 bit) TS: 22.5° ± 60' (5 bit) EP: 11.25° ± 60' (1 bit) |
| 24 | TP1: 8° ± 60' (1 bit) TP2: 3° ± 60' (1 bit) TS: 15° ± 60' (6 bit) EP: 15° ± 60' (1 bit) | TP1: 8° ± 60' (1 bit) TP2: 3° ± 60' (1 bit) TS: 15° ± 60' (5 bit) EP: 15° ± 60' (1 bit) | TP1: 8° ± 60' (1 bit) TP2: 3° ± 60' (1 bit) TS: 30° ± 60' (5 bit) EP: 15° ± 60' (1 bit) |
| 20 | TP1: 12° ± 60' (1 bit) TP2: 2° ± 60' (1 bit) TS: 18° ± 60' (5 bit) EP: 18° ± 60' (1 bit) | TP1: 12° ± 60' (1 bit) TP2: 2° ± 60' (1 bit) TS: 18° ± 60' (5 bit) EP: 18° ± 60' (1 bit) | TP1: 12° ± 60' (1 bit) TP2: 2° ± 60' (1 bit) TS: 36° ± 60' (5 bit) EP: 18° ± 60' (1 bit) |
| 16 | TP1: 15° ± 60' (1 bit) TP2: 2° ± 60' (1 bit) TS: 22.5° ± 60' (5 bit) EP: 22.5° ± 60' (1 bit) | TP1: 15° ± 60' (1 bit) TP2: 2° ± 60' (1 bit) TS: 22.5° ± 60' (4 bit) EP: 22.5° ± 60' (1 bit) | TP1: 15° ± 60' (1 bit) TP2: 2° ± 60' (1 bit) TS: 45° ± 60' (4 bit) EP: 22.5° ± 60' (1 bit) |
| 12 | TP1: 15° ± 60' (1 bit) TP2: 3° ± 60' (1 bit) TS: 30° ± 60' (5 bit) EP: 30° ± 60' (1 bit) | TP1: 15° ± 60' (1 bit) TP2: 3° ± 60' (1 bit) TS: 30° ± 60' (4 bit) EP: 30° ± 60' (1 bit) | TP1: 15° ± 60' (1 bit) TP2: 3° ± 60' (1 bit) TS: 60° ± 60' (4 bit) EP: 30° ± 60' (1 bit) |
| 10 | TP1: 30° ± 60' (1 bit) TP2: 12° ± 60' (1 bit) TS: 36° ± 60' (4 bit) EP: 36° ± 60' (1 bit) | TP1: 30° ± 60' (1 bit) TP2: 12° ± 60' (1 bit) TS: 36° ± 60' (4 bit) EP: 36° ± 60' (1 bit) | TP1: 30° ± 60' (1 bit) TP2: 12° ± 60' (1 bit) TS: 72° ± 60' (4 bit) EP: 36° ± 60' (1 bit) |
| 8 | TP1: 39° ± 60' (1 bit) TP2: 15° ± 60' (1 bit) TS: 45° ± 60' (3 bit) EP: 45° ± 60' (1 bit) | TP1: 39° ± 60' (1 bit) TP2: 15° ± 60' (1 bit) TS: 45° ± 60' (3 bit) EP: 45° ± 60' (1 bit) | TP1: 39° ± 60' (1 bit) TP2: 15° ± 60' (1 bit) TS: 90° ± 60' (3 bit) EP: 45° ± 60' (1 bit) |
| 6 | TP1: 53° ± 60' (1 bit) TP2: 15° ± 60' (1 bit) TS: 60° ± 60' (3 bit) EP: 60° ± 60' (1 bit) | TP1: 53° ± 60' (1 bit) TP2: 15° ± 60' (1 bit) TS: 60° ± 60' (3 bit) EP: 60° ± 60' (1 bit) | TP1: 53° ± 60' (1 bit) TP2: 15° ± 60' (1 bit) TS: 120° ± 60' (3 bit) EP: 60° ± 60' (1 bit) |

Dimensions

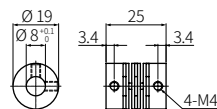
- Unit: mm, For the detailed drawings, follow the Autonics website.



■ Bracket



■ Coupling



- Parallel misalignment: ≤ 0.25 mm
- Angular misalignment: ≤ 5°
- End-play: ≤ 0.5 mm