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

EPM50 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 multi-turn absolute rotary encoders
- Output interface options: Parallel, SSI (Synchronous Serial Interface)
- 23-bit (8,388,608) total resolution
  - 10-bit single-turn (1,024 divisions)
  - 13-bit multi-turn (8,192 revolutions)
- Zero-point reset with single-turn data reset and multi-turn count reset functions
- Position memory backup
- CW / CCW direction setting function
- Overflow alarm (OVF) function
- Latch function (Parallel output type only)
- IP64 protection structure (IEC standard)

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 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 on a device 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.
- 12 - 24 VDC⎓ 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 (in the environment condition rated in 'Specifications')
  - Altitude max. 2,000 m
  - Pollution degree 2
  - Installation category II

CE UK CA EAC

Cautions during Installation

- Install the unit correctly with the usage environment, location, and the designated specifications.
- 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.

Ordering Information

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

EPM50 ❶ ❷ - ❸ ❹ - ❺ - ❻ - ❼ - ❽

❶ Shaft type
S: Shaft type

❷ Shaft outer diameter
8: Ø 8 mm

❸ Single-turn resolution
10: 10 bit (1024-division)

❹ Multi-turn resolution
13: 13 bit (8192-revolution)

❺ Output code
B: Binary code

❻ Control output
PN: Parallel NPN open collector output
S: SSI Line driver output

❼ Power supply
24: 12 - 24 VDC⎓ ±5%

❽ Connection
No mark: Axial cable type
S: Radial cable type

Product Components

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

Connections

- 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.
- For Parallel NPN open collector output, it is recommended to connect +V and GND of both multi-turn count cable and single-turn data cable.
- Since exclusive driver IC is used for output circuit, be aware of short circuits when wiring each output wires.
- N·C: not connected

■ Parallel NPN open collector output

- Multi-turn count (sheath: black)

Color	Function	Refer
White	+V	Power
Black	GND	
Brown	2^0	Multi-turn count
Red	2^1	
Orange	2^2	
Yellow	2^3	
Green	2^4	
Blue	2^5	
Purple	2^6	
Gray	2^7	
Pink	2^8	
Clear	2^9	
Light brown	2^{10}	
Light yellow	2^{11}	
Light green	2^{12}	
Light blue	Overflow alarm (OVF)	
Light purple	Multi-turn count reset	
Shield	F.G.	Signal shield

- Single-turn data (sheath: gray)

Color	Function	Refer
White	+V	Power
Black	GND	
Brown	2^0	Single-turn data
Red	2^1	
Orange	2^2	
Yellow	2^3	
Green	2^4	
Blue	2^5	
Purple	2^6	
Gray	2^7	
Pink	2^8	
Clear	2^9	
Light brown	N·C	
Light yellow	Direction	
Light green	Latch	
Light blue	Clear	
Light purple	Single-turn data reset	
Shield	F.G.	Signal shield

■ SSI Line driver output

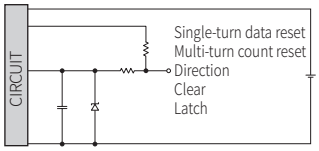
Color	Function	Refer
White	+V	Power
Black	GND	
Brown	CLOCK+	SSI
Red	CLOCK-	
Orange	DATA+	
Yellow	DATA-	
Gray	Single-turn data reset	COMMAND
Blue	Multi-turn count reset	
Purple	Clear	
Green	Direction	
Shield	F.G.	Signal shield

Inner Circuit

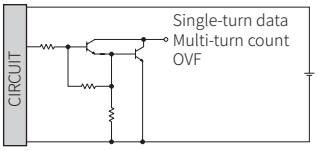
- The output circuit is identical for each output bit.
- Be aware of circuit break in case of overload or short beyond the specifications.

■ Parallel NPN open collector output

- COMMAND input

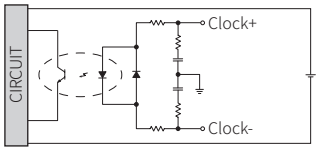


- Output

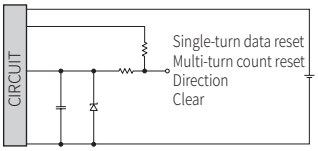


■ SSI Line driver output

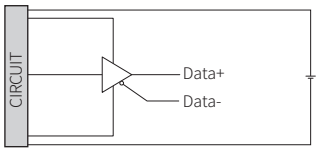
- CLOCK input



- COMMAND input



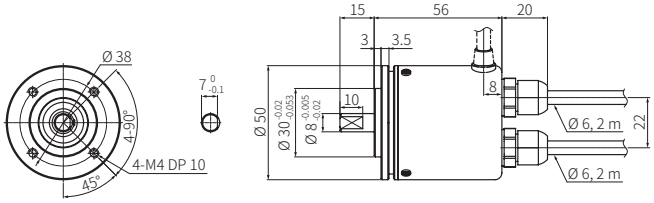
- Output



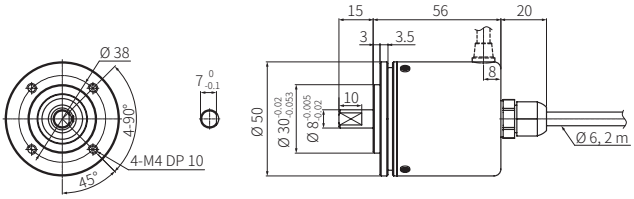
Dimensions

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

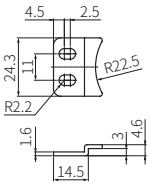
■ Parallel NPN open collector output



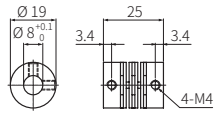
■ SSI Line driver output



■ Bracket



■ Coupling



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

Specifications

Model	EPM50S8-1013-B-PN-24-□	EPM50S8-1013-B-S-24-□
Resolution	Single-turn: 1024 division, 10 bit Multi-turn: 8192 revolution, 13 bit	
Rotation limit when power OFF 01)	± 90°	
Output code	Binary 2 code	24 bit, Binary 2 code
Output signal	Single-turn data, Multi-turn count, Overflow alarm (OVF) 02)	
Control output	Parallel NPN open collector output	SSI (Synchronous Serial Interface) Line driver output
Inflow current	≤ 32 mA	≤ 20 mA
Residual voltage	≤ 1 VDC⎓	≤ 0.5 VDC⎓
Outflow current	-	≤ -20 mA
Output voltage	-	≥ 2.5 VDC⎓
Output logic	Negative logic output	-
Response speed 03)	≤ 1 μs	-
Single-turn data reset 04) **Multi-turn count reset** 05) **Direction** **Clear**	Input level: 0 - 1 VDC⎓ Input logic: Low Active, OPEN or HIGH in common use Input time: ≥ 100 ms	
Latch	Input level: 0 - 1 VDC⎓ Input logic: Low Active, OPEN or HIGH in common use Input time: ≥ 500 μs	-
Clock	-	Input level: 5 VDC⎓ ± 5% Input frequency: 100 kHz to 1 MHz
Max. response freq.	50 kHz	-
Max. allowable revolution 06)	3,000 rpm	
Starting torque	≤ 0.0069 N m	
Inertia moment	≤ 40 g·cm² (4 × 10⁻⁶ kg·m²)	
Allowable shaft load	Radial: 10 kgf, Thrust: 2.5 kgf	
Unit weight (packaged)	≈ 475 g (≈ 560 g)	≈ 324 g (≈ 409 g)
Approval	CE UK EAC	

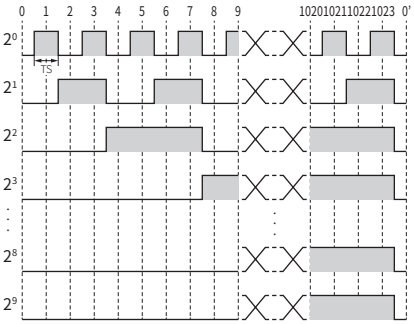
01) It calibrates the multi-turn count by comparing single-turn data before/after power off without counting multi-turn count when power off. Correct multi-torn count cannot be obtained if a rotating operation exceeding ± 90° is performed at the rotation position when power off.
02) Outputs when multi-turn count is out of counting range (0 to 8191 revolution).
03) Based on cable length: 2 m, I sink = 32 mA
04) If the single-turn data reset signal is applied, the single-turn data will be initialized to 0.
05) If the multi-turn count reset signal is applied, the multi-turn count will be initialized to 0.
06) For parallel model Select resolution to satisfy Max. allowable revolution ≥ Max. response revolution
[max. response revolution (rpm) = $\frac{\text{max. response frequency}}{\text{resolution}} \times 60$ sec]

Power supply	12 - 24 VDC⎓ ± 5% (ripple P-P: ≤ 5%)
Current consumption	Parallel NPN open collector output: ≤ 100 mA (no load) SSI Line driver output: ≤ 150 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.	-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	Axial cable type: IP64 (IEC standard), Radial cable type: IP50 (IEC standard)
Connection	Axial / Radial cable type model (cable gland)
Cable spec.	Ø 6 mm, 2 m, shield cable Parallel NPN open collector output: 17-wire × 2, SSI Line driver output: 10-wire
Wire spec.	AWG28 (0.08 mm), insulator diameter: Ø 0.8 mm Parallel NPN open collector output: 17-core, SSI Line driver output: 19-core

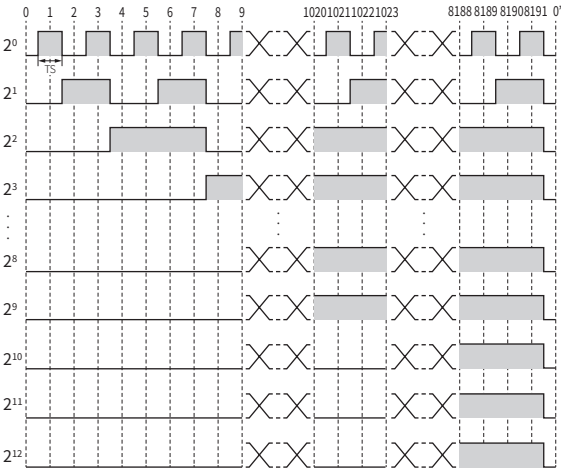
Output Waveform

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

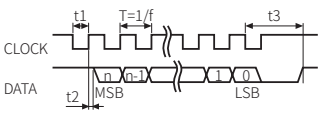
■ Parallel open collector output type single-turn data (1024 division)



■ Parallel open collector output type multi-turn count (8192 revolution)

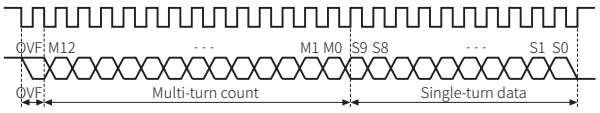


■ SSI Line driver output timing chart



Clock Frequency f	100 kHz to 1 MHz
T	T: 1 to 10 μs
	0.5 μs < t1 < 5 μs
Time lag t2	t2 < 0.3 μs
Monoflop Time t3	15 μs < t3 < 30 μs

■ SSI Line driver output type data output



Clock input bit	Data output	Data output bit
1	OVF error	0 bit
2	Multi-turn count	12 bit (MSB)
3		11 bit
4		10 bit
5		9 bit
6		8 bit
7		7 bit
8		6 bit
9		5 bit
10		4 bit
11		3 bit
12		2 bit
13		1 bit
14		0 bit (LSB)

Clock input bit	Data output	Data output bit
15	Single-turn data	9 bit (MSB)
16		8 bit
17		7 bit
18		6 bit
19		5 bit
20		4 bit
21		3 bit
22		2 bit
23		1 bit
24		0 bit (LSB)

Functions

■ Single-turn data reset
The single-turn data will be initialized to 0 when 0 - 1 VDC⎓ (min. 100 ms) is applied to single-turn data reset cable.
Connect the line to OPEN or +V in case of not using single-turn data reset cable.

■ Multi-turn count reset
The multi-turn count will be initialized to 0 when 0 - 1 VDC⎓ (min. 100 ms) is applied to multi-turn count reset cable.
Connect the line to OPEN or +V in case of not using multi-turn count reset cable.
If Overflow alarm (OVF) occurs, Overflow alarm (OVF) will be initialized when multi-turn count reset is applied.

■ Direction
If the power is ON after connecting the direction cable to OPEN or +V, the output increases when rotating direction is CW based on facing the shaft, and if the power is ON after connecting to 0 - 1 VDC⎓ (min. 100 ms), the output increases when rotating direction is CCW based on facing the shaft.
Since the direction setting is initial setting which is set with power ON, if the setting value is changed, both single-turn data and multi-turn count will be initialized to 0.

■ Clear
Both single-turn data and multi-turn count will be initialized to 0 when 0 - 1 VDC⎓ (min. 100 ms) is applied to Clear cable.
Connect the line to OPEN or +V in case of not using Clear cable.
If Overflow alarm (OVF) occurs, Overflow alarm (OVF) will be initialized when Clear is applied.

■ Latch
- Parallel NPN open collector output model only

The single-turn data, multi-turn count and overflow output will be remains its value at latch point when 0 - 1 VDC⎓ (min. 100 ms) is applied to Latch cable.
If Latch cable is connected to OPEN or +V, output will return to operating encoder output.

■ Overflow alarm (OVF)
Occurs when multi-turn count is out of counting range (0 to 8191 revolution).
If the direction setting is changed or multi-turn count reset, clear is applied, the overflow alarm will be initialized.