HIGH-PULSE
LASER ROTARY ENCODER

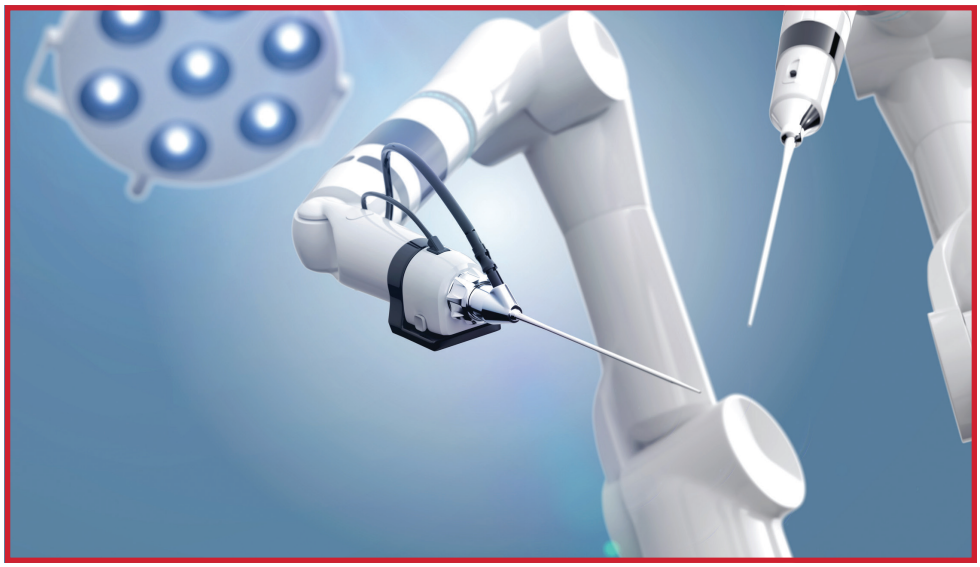
Canon

Positional Angle Mastery in a Tiny Package 81,000 Pulse Revolution at Ø36mm

The use of high-pulse optical-digital laser rotary encoders benefits applications where sensing or controlling the rotation and position of a mechanical system with high accuracy and exceptional resolution is required.

Canon's High-Pulse Laser Rotary Encoders (LREs), pumping out 81,000 pulses per revolution (ppr) without the assistance of an interpolator, can achieve resolution equal to 4 arc seconds for each pulse.

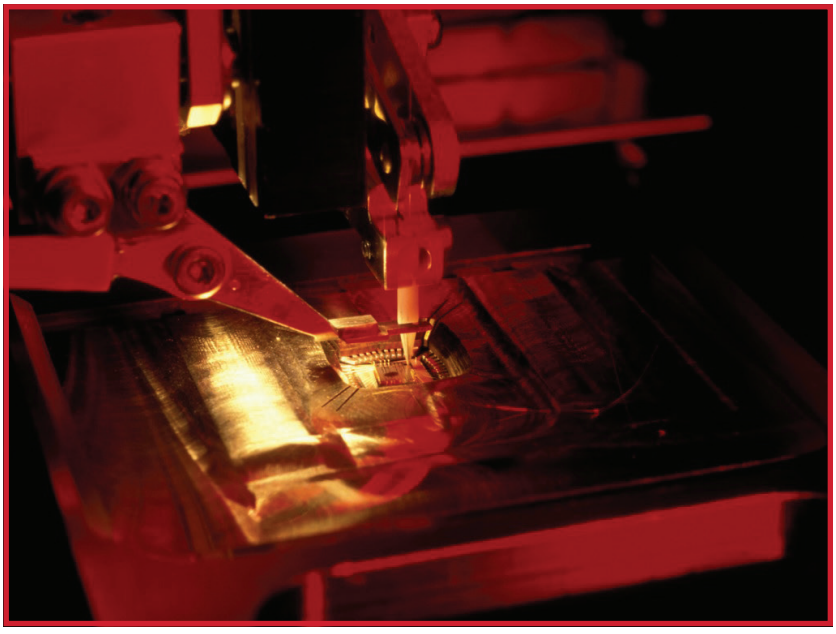
They serve in a number of applications that require razor edge precision — most prominently in robotic engineering, where they are used to control a machine's "arm" angle. High-pulse LREs also serve as sensors for numerical control (NC) and computer numerical control (CNC) machines, where they handle stage position control. They are also used to act as angle sensors for measuring instruments, such as spectrum analyzers.



Emerging and prospective applications for high-pulse LREs include medical robotic arms, which require the utmost precision and reliability to ensure patient safety. Robot-assisted procedures already span multiple therapy areas, and indications for robot-assisted systems continue to expand.

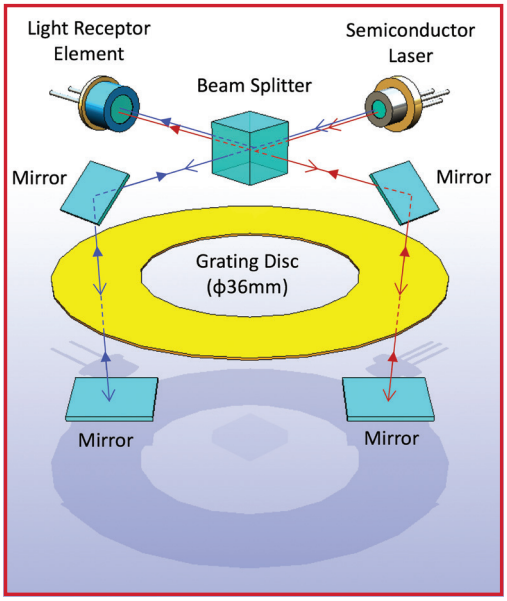
APPLICATION EXAMPLES

- Robotic Engineering
- Sensor for NC Machine
- Stage position control
- Direct motor control
- Angle sensor for measuring instruments



THEORY

Canon's High-Pulse LREs combine pinpoint accuracy — within 1/900 of a degree (i.e., 4 arc seconds) — with an unprecedented diminutive package: just 36 mm in diameter. A conventional encoder may be twice this size. A more compact package means more room to work (or pack in more components, or dissipate heat), whether the job entails replacing components in an existing system, where available space is pre-determined, or designing a new system, where a compact form factor is likely to be paramount.



Detection Principle behind Canon LREs

Our LREs accomplish this high performance in a small package through their use of the laser diffraction interference method. Conventional encoders cause diffraction phenomenon — a slight bending of the light as it passes around the edge of the disk — when the pitch (interval) of the grating disc is narrowed to increase the number of pulses, resulting in poor high-pulse encoding.

Canon LREs use this same diffraction and interference to achieve high pulse and high accuracy: two laser beams are irradiated simultaneously onto two locations that are symmetrical with respect to the rotational center of the grating disc. This configuration compensates for the disc's eccentricity, which often causes measurement error.

Laser beams are applied to two points equidistant from the grating disc's center of revolution. One diffraction beam is positive first order (+1) and the other is negative first order (-1). For each 1 pitch that the grating disc revolves, the ±1 diffraction light will change each phase by ±2π. Reflecting the ±1 diffraction light into respective mirrors and then reapplying it to the grating disc changes the phase by ±4π. In this way, each time the grating disc revolves 1 pitch, the brightness interference signals for four cycles can be obtained, making highly accurate angle sensing possible.

PRODUCT LINEUP

R-1SO

81,000 ppr in a compact housing
Open collector output

- Compact and lightweight
- High resolution 81,000 ppr equal to 4 arc second for each pulse (without interpolator)
- Open collector output
- Maximum frequency response of 500kHz

R-1SL

81,000 square wave ppr in a compact housing
Line driver output

- Compact and lightweight
- High resolution 81,000 ppr equal to 1 arc second with interpolator CI16-2. (1,296,000 ppr)
- Maximum frequency response of 500kHz (360rpm)

K-1

81,000 sine wave ppr

- Compact and lightweight
- High resolution 81,000 ppr
- Maximum frequency response of 500kHz (360rpm)

M-1S

2MHz (2,400rpm) high frequency response

- Heavy duty for factory environment
- Maximum frequency response of 2MHz
- Balanced line driver output circuit enables long distance signal transmission

KP-1Z

Module type rotary encoder
81,000 sine wave ppr

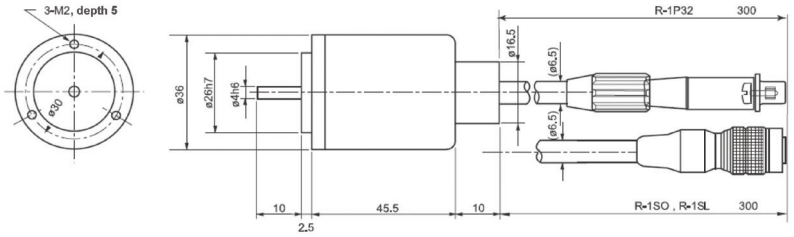
- Module type rotary encoder with Canon's original interference optics
- Low influence from disk eccentricity
- Maximum frequency response of 250kHz

SPECIFICATION

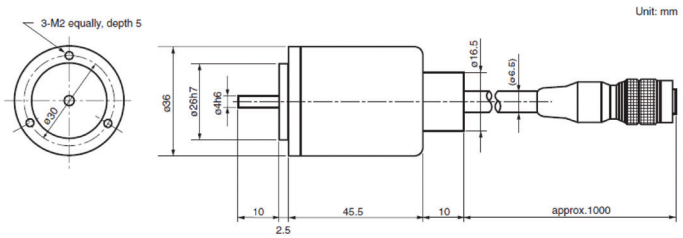
*1 : Z phase signal is not synchronized with either A phase or B phase signal.
*2: delta between A phase pulse and B phase pulse

	R-1SO	R-1SL	K-1	M-1S	KP-1Z
LIGHT SOURCE	Semiconductor Laser 780nm, 5mW max.				
Pulse/rev (without external interpolation)	81,000			50,000	81,000
Resolution*2	4 arc-sec.			6.48arc-sec.	4 arc-sec.
Max Response	500kHz(360rpm)			2MHz(2400rpm)	250kHz(185rpm)
OUTPUT SIGNAL					
A/B Phase	2 phase rectangle wave incremental signal Open Collector	2 phase rectangle wave incremental signal Line driver	2 phase sine wave incremental signal	2 phase rectangle wave incremental signal Line driver	2 phase sine wave incremental signal
Z Phase*1	Rectangle wave signal Open Collector	Rectangle wave signal Line driver	Rectangle wave reference signal	Rectangle wave signal Line driver	TTL
Permissible rotating speed	max 5,000rpm				—
Starting torque	max 9gf·cm			max 50gf·cm	—
Rotor inertial moment (GD^2)	8gf·cm²			40gf·cm²	—
Permissible load	Radial : 0.4Kgf Thrust : 1.0Kgf			Radial : 1.5Kgf Thrust : 2.0Kgf	—
POWER SUPPLY					
Voltage	DC +/- 5.00V +/- 5%				
Current (without output load)	+5V 200mA max -5V 100mA max	+5V 250mA max -5V 100mA max	+5V 200mA max -5V 100mA max	+5V 280mA max -5V 100mA max	+5V 200mA max -5V 100mA max
Outer diameter	Ø36mm			Ø56mm	
Weight (without cable)	80g	80g	80g	260g	160g (detection unit)
WORKING ENVIRONMENT					
Operating temperature	0°C ~ 50°C				
Storage temperature	-30°C ~ 80°C				-10°C ~ 60°C
Humidity	90%RH or less (No condensation)				
Vibration	10G, 500Hz or less			10G, 500Hz or less	5G, 200Hz or less
Impact	30G, 11msec or less			60G, 11msec or less	30G, 11msec or less

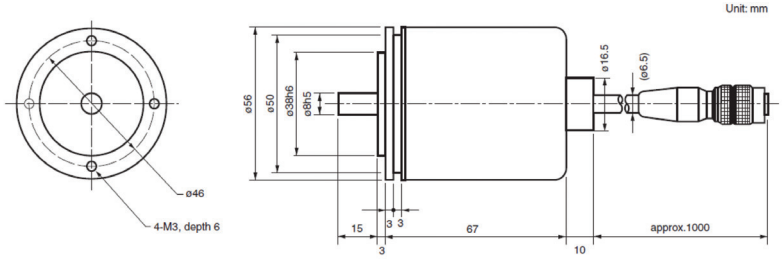
EXTERNAL DIMENSIONS



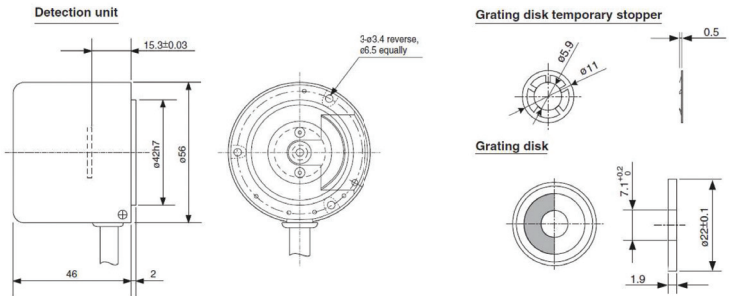
R-1SO / R-1SL



K-1



M-1S



KP-1Z

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01/2020