

GURLEY SERIES 9X11S ROTARY INCREMENTAL ENCODER

MOTION TYPE:

ROTARY

USAGE GRADE:

LIGHT INDUSTRIAL

OUTPUT:

INCREMENTAL

MAX RESOLUTION:

7,200 COUNTS/REV
144,000 COUNTS/REV
W/EXT. ELECTRONICS



SMALL PACKAGE - BIG PERFORMANCE

The Series 9x11S is a family of optical incremental encoders designed specifically for light industrial applications that require high resolution in a small package. These features make the 911S superior to competitive encoders:

- Resolutions up to 1800 cycles/rev (7,200 counts/rev, or 0.05°/count)
- Standard zero index signal
- LED illumination for long life (>100,000 hours)
- Differential photo-detectors for signal stability
- RS-422 differential line driver output for noise immunity
- Single-board, surface-mount electronics (911S)
- Sealed ABEC 7 bearings for contamination resistance
- Grease lubrication for long trouble-free service

Two models available:

Model 911S: suitable for most applications

Model 921S: provides higher accuracy and with external customer electronics, generates up to 144,000 counts/rev

ISO
9001
CERTIFIED

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SPECIFICATIONS

	See Note	Model 9111S	Model 9211S
Max. line count on disc			1800
Max. cycles/rev (with internal electronics)			1800
Max. counts/rev (after quadrature decode by user)			7200
Max. cycles/rev (with external electronics)	5	N/A	36,000
Max. counts/rev (after quadrature decode by user)	5	N/A	144,000
Instrument error, \pm arcmin (at 20°C)	1, 2	2.5	0.8
Quadrature error, \pm electrical degrees (at 20°C)	1, 3		30
Interpolation error, quanta	1,4,5	N/A	0.1
Frequency response, kHz (1x square waves)			100
Frequency response, kHz (up to 20 x square waves)	5	N/A	1,000
Max. weight, oz (g)			2 (57)
Starting torque, in-oz (N-m) @20°C			0.02 (1.4×10^{-4})
Running torque, in-oz (N-m) @20°C			0.005 (3.5×10^{-5})
Moment of inertia, in-oz-s ² (g-cm ²)			8.6×10^{-6} (0.61)
Max. acceleration, rad/s ²			3×10^6
Operating temperature, °F (°C)		32 to 158 (0 to 70)	32 to 122 (0 to 50)
Storage temperature, °F (°C)			0 to 160 (-18 to 71)
Humidity, % rh, non-condensing			98
Shock			50 g, 11 ms
Vibration			15 g, 0-2000 Hz
Bearings			ABEC 7, grease-lubricated and sealed
Max radial shaft load, lb (N)	6		3 (13)
Bearing life (with 0.75 lb radial load)			1×10^9 revolutions

NOTES:

- Total Optical Encoder Error is the algebraic sum of Instrument Error + Quadrature Error + Interpolation Error. Typically, these error sources sum to a value less than the theoretical maximum. Error is guaranteed at 20°C and is defined at the signal transitions. It does not include quantization error, which is $\pm 1/2$ quantum. ("Quantum" is the final resolution of the encoder, after user's 4X quadrature decode.)
- Instrument Error is the sum of disc pattern errors, disc eccentricity, bearing runout and other mechanical imperfections within the encoder. This error tends to vary slowly around a revolution.
- Quadrature Error is the combined effect of phasing and duty cycle tolerances and other variables in the basic analog signals. This error applies to data taken at all four transitions within a cycle; if data are extracted from 1X square waves on a 1X basis (i.e., at only one transition per cycle), this error can be ignored.
Error in arcminutes = (60) x (error in electrical degrees) / (disc line count)
- Interpolation Error is present only when the resolution has been electronically increased to more than four data points per optical cycle. It is the sum of all the tolerances in the electronic interpolation circuitry.
Error in arcminutes = (21600) x (error in quanta) / (counts/rev)
- With external Model HR2 High Resolution Electronics. Frequency response is as stated for output signals, or 50 kHz at the disc, whichever is limiting.
- If higher load capacity is required, consult factory.

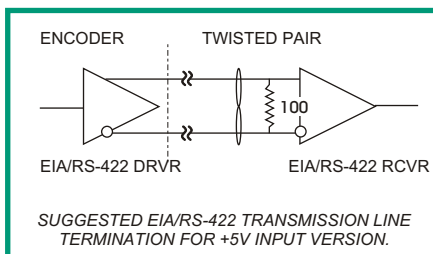
Input Power (excluding customer load)

+5 VDC @ 75 mA (150 mA for 9211S)
+12 or +15 VDC @75 mA max. (9111S only)

Output Device Options

Square Waves (output code 'L')

EIA/RS-422 balanced differential line driver on all channels, protected to survive an extended-duration short circuit across its output. May be used single-ended for TTL-compatible inputs. The encoder's complementary output voltages will typically swing to within two volts of the applied power supply input voltage rail. The high-voltage-capable line driver can sink or source up to 70 mA, and can readily interface to controllers requiring 12 or 15 volt "open collector" type signals.



As part of our continuing improvement program, these specifications are subject to change without notice.

Buffered Sinusoids (output code 'B')

9211 only

The output device is an op amp referenced to (50% \pm 3%) x Vcc. Typical signal roll-off at 100 kHz -3dB. Signal values at 1 kHz with 4.7 Ω load to ground (20°C):

- P-P signal amplitude, data channels: 1.0 \pm 0.1 V.
- Amplitude ratio, min chan to max chan: 0.90 to 1.00
- P-P signal amplitude, index channel: 0.7 \pm 0.3V.

Index

Index is standard and it is ungated with a width of 360° \pm 180° electrical.

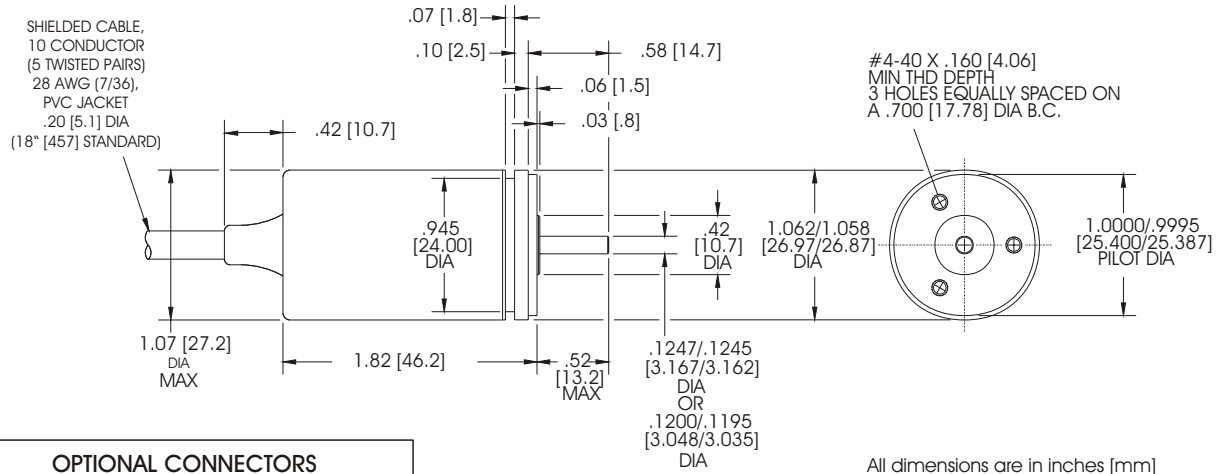
Extended Resolution

The series 911S offers resolution up to 7,200 counts/rev (3 arcmin/count) after 4X quadrature-edge detection. If finer resolution is required (up to 144,000 counts/rev, or 9 arcsec/count), the **HR2A** external electronics package can be used with the 9211S. This provides a wide range of options that ensures compatibility with virtually all commercially available counter circuits, dedicated encoder interface cards and programmable logic controllers:

- Any number of quadrature square waves from 1 to 20 times the line count on the disc.
- Fixed-duration pulses at 1, 2 or 4 times any integer from 1 to 20.
- A choice of CW/CCW or PULSE/DIRECTION output pulse format.
- A zero-index (reference) signal in either gated 1/2 cycle, gated 1/4 cycle, or fixed-duration pulse format.
- EIA/RS-422 or open-collector line drivers.
- On-board low-dropout voltage regulator.

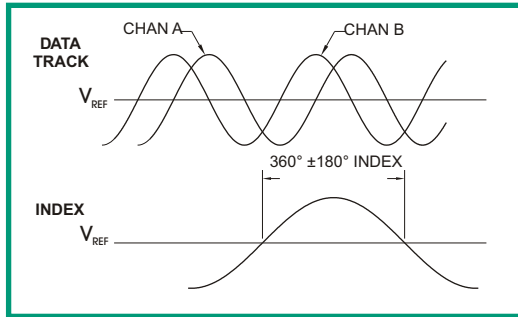
Refer to the HR2A data sheet for full details.

911S DIMENSIONS

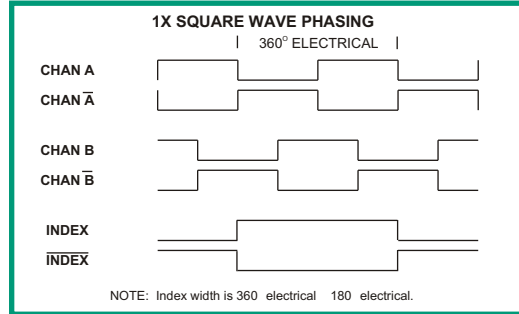


OPTIONAL CONNECTORS		
ORDER CODE	TYPE	OPTIONAL MATING CONNECTOR
Q	DA - 15P	M01
S	DE - 9P	M06

Sinusoidal Output



Square Wave Output



Wiring Colors

Conn Code P	Square Wave Output	Buffered Sinusoid
Yellow	A	SIN
Brown	/A	
Green	B	COS
Orange	/B	
Blue	INDEX	INDEX
White	/INDEX	
Gray		
Violet		
Red	+V	+V
Black	Common	Common
Bare	Case	Case

Channel B (COS) leads Channel A (SIN) for CW shaft rotation, viewed from the shaft end

* Connector Code S is not available with Buffered Sinusoid output

Pinouts

DA-15P Connector Code Q	Square Wave Output	*Buffered Sinusoid Output
1	/INDEX	
2	INDEX	
3		
4	/B	+V
5	B	INDEX
6		
7	/A	
8	A	Case
9	Case	SIN
10	+V	
11		COS
12		
13	Common	
14		
15		Common

DA-9P Connector Code S	Square Wave Output
6	/INDEX
2	INDEX
7	/B
3	B
8	/A
4	A
1	Case
5	+V
9	Common

ORDERING INFORMATION

MODEL	LINES	IND	V	OUT	INT	BASE	CAB	EXIT	CONN	DIA	SPEC

MODEL -

9111S Standard
9211S High accuracy

LINES - Disc line count

00360 00500 00512 00600 00720 00900
01000 01024 01250 01800

Consult factory for other line counts.

INDEX

F Full cycle

V - Input voltage

5 5 volts dc
C 12 volts dc (9111S only)
F 15 volts dc (9111S only)

OUT - Output format

L RS-422 line driver
B Buffered sinusoids (9211S only)

INTERPOLATION

01 Standard

BASE

A Standard

CABLE - Cable length, inches (04-99)

18 Standard

CABLE EXIT

T Standard

CONN - Connector

P Pigtails (no connector)
Q DA-15P
S DE-9P

DIA - Shaft diameter

02E 0.1250" dia (standard)
AAE 0.1200" dia

SPEC - Special code

X To define non-standard features
N No special features

ACCESSORIES (order separately)

M01 Mating connector for DA-15P
M06 Mating connector for DE-9P
AX06399 Synchro mounting cleats
ISC3N Interface card for PC

SPECIAL CAPABILITIES

For special situations, we can optimize catalog encoders to provide higher frequency response, greater accuracy, wider temperature range, reduced torque, non-standard line counts, or other modified characteristics. In addition, we regularly design and manufacture custom encoders for user-specific requirements. These range from high-volume, low-cost, limited-performance commercial applications to encoders for military, aerospace and similar high-performance, high-reliability conditions. We would welcome the opportunity to help you with your encoder needs.

WARRANTY

Gurley Precision Instruments offers a limited warranty against defects in material and workmanship for a period of one year from the date of shipment.



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