Gurley Model HR2A
High-resolution Interpolator

Application:

Selected GPI linear and rotary incremental encoders

Output:

Compatible with virtually all counter circuits, dedicated encoder interface cards and PLCs

Max Resolution:

Up to 80x encoder line count

High resolution - Industrial ruggedness

The Gurley **HR2A** High-Resolution Interpolator is a versatile electronics package that augments your Gurley encoder's capabilities, improving resolution by as much as 80x. The units may be used with virtually all available counter circuits, dedicated encoder interface cards and programmable logic controllers.

The HR2A interpolator can generate any number of quadrature square waves from 1 to 20 times the line count on the disc or scale, or fixed duration pulses at 1, 2, or 4 times any interger from 1 to 20.

It features an on-board low-dropout voltage regulator. Optional up/down or pulse/direction output formats are available. A zero-index (reference) signal is available in gated ½ cycle, gated ¼ cycle, or fixed duration pulse format to give you greater flexibility.

Advantages:
Gurley Precision Instruments' philosophy of using lower resolution discs or scales coupled with electronic interpolation has several distinct advantages.

- Highly accurate and stable optical signals are easy to obtain.
- Final encoder resolution and frequency response can be extended beyond the natural physical limits imposed on direct readout techniques.
- A greater variety of resolutions can be derived from existing optical masters.
- Mechanical positioning of the optical components is less critical, which enhances long-term stability and reliability with regard to vibration and temperature.

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ISO 9001 Certified

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Specifications

Input Signals	Phototransistor or buffered sinusoids
Input Power	5.0V ±0.25V or 7-15V at 125mA maximum excluding transmission line termination requirements (consult individual encoder data sheets)
Output format options	• Quadrature square waves at up to 20x the line count on disc or scale. • Direction-sensed, fixed duration pulses at up to 80x the line count.
Output device options	• EIA/RS-422 differential line driver • 7406 open collector with internal 3.3k pull-up resistor
Output Voltage Line Driver Open Collector	 TTL-compatible, regardless of input voltage Referenced to supply voltage through internal 3.3k pull-up resistor
Interpolation Factors Square wave output Pulse Output	 Any interger from 1 to 20 1, 2, or 4 times any interger from 1 to 20
Pulse Format	Output P: Two pairs of output lines: FWD pulses and REV pulses Output Q: Pulses on one pair of lines, direction on other pair, HIGH for FWD, LOW for REV
Output Pulse Width Line driver Open Collector	 80 ns ±25% 1.0 s ±25%
Index Format Options	• ½ Cycle square wave: gated with low state of Channel B • ¼ Cycle square wave: gated with high states of Channels A and B • Pulse: gated with a specific pulse of square-wave transition
Interpolation Error	± 0.1 quantum. This is the maximum interpolation error at the transitions of the output square waves. It does not include encoder error (see specific datasheet for each encoder model), nor does it include quantization error, which is ± quantum. ("Quantum" is the final output resolution after user's quadrature decode.)
*Maximum Input Frequency	50 kHz
*Maximum Output Frequency Square Waves Pulses	 1 MHz with line driver output, 125 kHz with open collector output 4 Mhz with line driver output, 500 kHz with open collector output
Temperature Operating Storage	 0°C to 70°C (32°F to 158°F) -18°C to 71°C (0°F to 160°F)
Humidity	98% rh, non-condensing
Maximum Weight	13.5 oz. (383 g)

*Whichever is limiting

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

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HOW WE INTERPOLATE

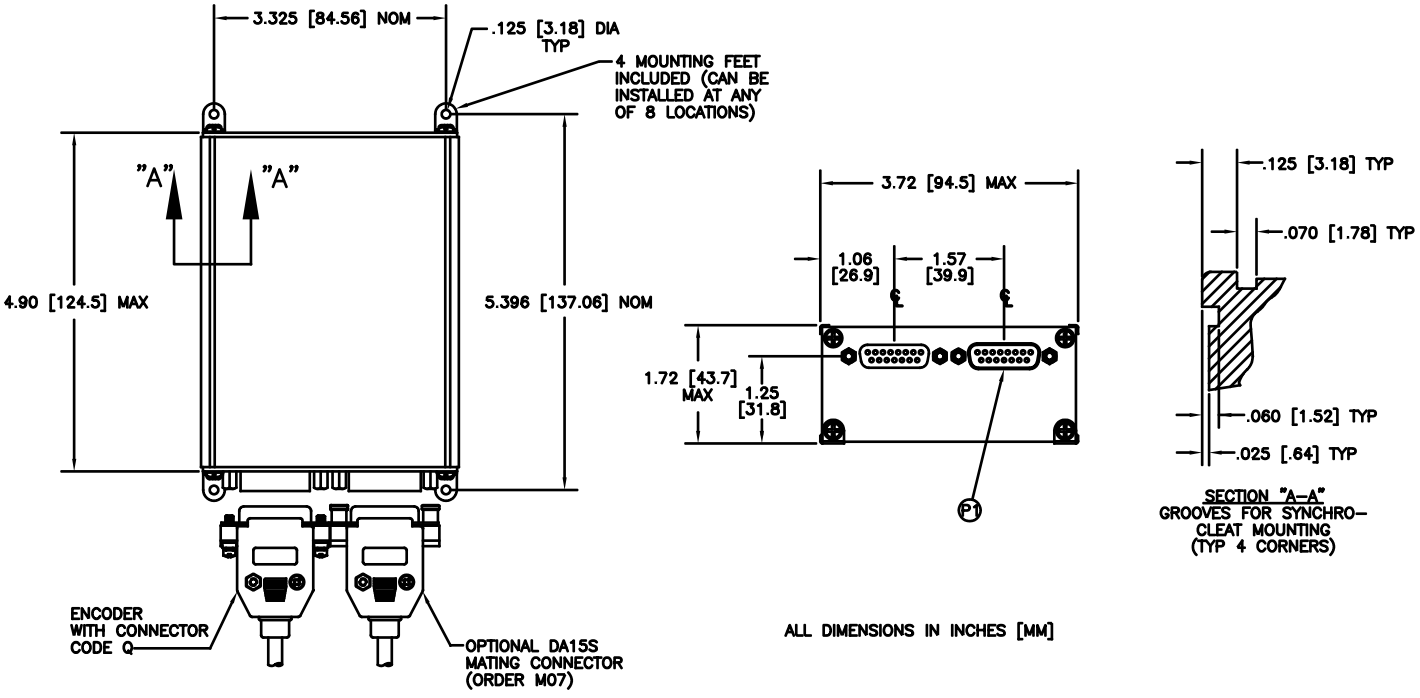
The optical reading head in the encoder generates a sine and cosine signal pair with a period corresponding to the line-pair spacing on the disc or scale. The reading head has multiple detectors and employs spatial averaging techniques to ensure high accuracy and the purity and stability of the sine/cosine signal pair.

These signals are noise-filtered and processed electronically to generate additional analog signals of intermediate (i.e. Interpolated) phase. These signals appear exactly as though they had been optically generated from the disc or scale. The zero crossings of these signals are detected and combined to yield digital square waves of extended resolution and frequency response, which are available for immediate output, or further on-board decoding and formatting.

The Gurley interpolation system provides increased output resolution exactly as though it had been read optically from a disc or scale with the corresponding line count; no information is lost if the motion is stopped or reversed. The circuitry is designed to reject the effects of supply voltage variations, ambient temperature changes, LED aging and other common mode error sources. As a result of its advanced design , the HR2A's accuracy (including noise immunity and hysteresis) is commensurate with the resolution obtained. For example, 80x interpolation with a 4,500 line rotary encoder will generate 360,000 pulses/rev, or 1 pulse every 0.001 degrees. Interpolation error will be 0.0001 degrees.

The HR2A High-Resolution Interpolator can be used with the following encoders:

Encoder Model	Encoder Ordering Information
9211, R13X, 8235H, 8435H	Output code B and connector code Q
8235S	Output code B; connector code Q, or connector code M and CAA cable assembly
9710	Connector code Q
9717	Connector code Q



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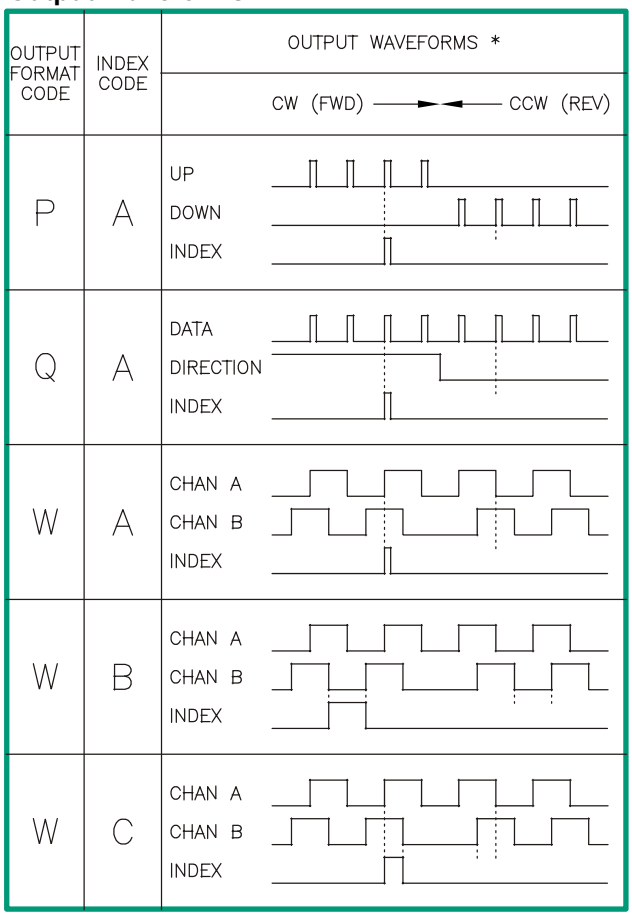
Output Diagrams

Output Waveforms

OUTPUT FORMAT CODE	INDEX CODE	OUTPUT WAVEFORMS *
		CW (FWD) ◄ ► CCW (REV)
P	A	UP, DOWN, INDEX
Q	A	DATA, DIRECTION, INDEX
W	A	CHAN A, CHAN B, INDEX
W	B	CHAN A, CHAN B, INDEX
W	C	CHAN A, CHAN B, INDEX



* DIFFERENTIAL SIGNALS OMITTED FOR CLARITY

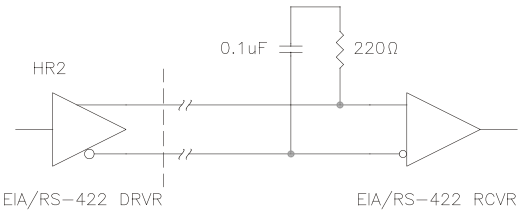
Output Pin Connections at P1

Pin No.	Square Wave Output	Pulse Output Option P	Pulse Output Option Q
1	$\overline{\text{Index}}$	$\overline{\text{Index}}$	$\overline{\text{Index}}$
2	Index	Index	Index
3	5V or 7-15V	5V or 7-15V	5V or 7-15V
4	Chan $\overline{\text{B}}$	$\overline{\text{Up}}$*	$\overline{\text{Data}}$
5	Chan B	Up*	Data
6	Common	Common	Common
7	Chan $\overline{\text{A}}$	$\overline{\text{Down}}$*	$\overline{\text{Direction}}$
8	Chan A	Down	Direction
9	Case	Case	Case
10	5V or 7-15V	5V or 7-15V	5V or 7-15V
11	5V or 7-15V	5V or 7-15V	5V or 7-15V
12	Spare	Spare	Spare
13	Common	Common	Common
14	Common	Common	Common
15	Spare	Spare	Spare

*Up=CW or FWD Down= CCW or REV

Multiple supply and return pins simplify the use of parallel conductors to reduce IR voltage drops and the implementation of remote sensing to improve voltage regulation. This feature is especially helpful when using mass-terminated connectors.

Transmission Line Diagram



Suggested EIA/RS-422 transmission line termination for reduced current consumption.

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ORDERING INFORMATION

	INT	OUT	IND	ENC	INPUT	DEV	SPEC
HR2A							

INT - Interpolation Factor

See Note 1

OUT- Output Format

P Pulse output (Up and Down)
Q Pulse output (Data and Direction)
W Quadrature square waves

See Notes 2 and 3

IND - INDEX

N No index
A Pulse Index
B Square Wave ½ cycle (gated w/ B)
C Square Wave ¼ cycle (gated w/ A&B)

See Notes 2 and 3

ENC - Encoder Output

A Phototransistor (9710)
B Buffered Sine (enclosed rotary)
L Phototransistor (9717)

INPUT - Power Input

R 5V Input
S 7-15V Input

DEV - Output Device

D EIA/RS-422 Line Driver
E Open collector

SPEC - Special Code

X To define non-standard features
N No special features

NOTES:

1. With square wave output, INTERPOLATION FACTOR can be any interger from 01 to 20. With pulse output, INTERPOLATION FACTOR can be 01, 02, or 04 times 1-20.
2. SQUARE WAVE INDEX not available with PULSE OUTPUT.
3. See OUTPUT WAVEFORMS.
4. If the HR2A electronics is not ordered with the encoder, some potentiometer adjustments will be required to achieve optimum performance; instruction will be provided. Adjustment will also be required with a modular encoder, such as the 9710 or 9717.

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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