

GURLEY MODEL 7700 INCREMENTAL AND VIRTUAL ABSOLUTE® ENCODER

MOTION TYPE:

ROTARY

USAGE GRADE:

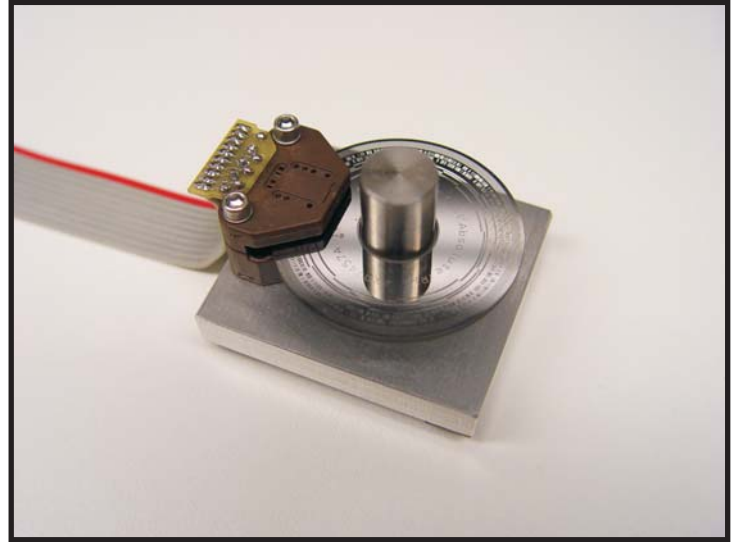
LIGHT INDUSTRIAL

OUTPUT:

INCREMENTAL A QUAD B
ABSOLUTE USB, SSI,
OR PARALLEL BUS

MAX RESOLUTION:

20,000 COUNTS/REV
OR 19 BITS (524,288)
VIRTUAL ABSOLUTE



MODULAR DESIGN - BIG PERFORMANCE

The model 7700 Incremental and *Virtual Absolute* encoder is a compact, non-contact modular encoder with superior performance. Available in many resolutions and configurations, it is easy to install and its optional commutation tracks eliminate hall effect sensors for brushless motors.

Features common to both models include:

- LED illumination for long life (>100,000 hours)
- Low power consumption
- Single phased-array optoelectronic ASIC
- Optional three-phase 2, 4, 6, or 8 pole pair motor commutation

Incremental systems (7700 encoder + disc/hub) include:

- Resolutions up to 5000 cycles/rev (20,000 counts/rev, or 0.018°/count)
- TTL/CMOS-compatible square wave output, 10mA sink
- Standard once-per-rev zero index signal

Virtual Absolute systems (7700 encoder + disc/hub + VG, VH or VJ decoder) include:

- Resolutions from 12 bits (4,096 steps) to 19 bits (524,288 steps) per turn
- True absolute position after 3.52° or 1.92° initialization, depending on disc diameter
- Compact decoder circuits provide byte-wide parallel (VG), USB (VH), or SSI serial (VJ) outputs. Please refer to individual decoder datasheets for more information
- Built-in patented pseudorandom and quadrature error detection for high reliability

ISO
9001
CERTIFIED

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ingenuity@work®

7700 READ HEAD SPECIFICATIONS

ELECTRICAL	
Input power	V _{CC} : +5VDC ±0.5 VDC @ 60 mA
Light source	Screened infra-red LED; rated life >100,000 hours
Output Signals	TTL-compatible square waves or micro-current analog waves
MECHANICAL	
Materials Encoder body Disc Hub	Molded Ryton PPS Vacuum-deposited chrome pattern on glass or plastic Aluminum (stainless steel optional)
Weight Read head	0.25 oz (7 g) max without cable
PERFORMANCE	
Frequency response	125 kHz, all channels
Endplay	0.010 inches (0.254 mm)
ENVIRONMENTAL	
Operating temperature	-40°F to +212°F (-40°C to +100°C)
Storage temperature	-40°F to +212°F (-40°C to +100°C)

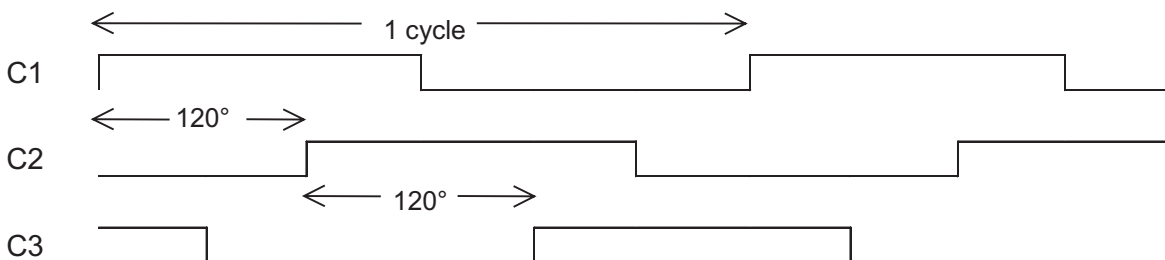
Virtual Absolute (VA) Encoders

VA discs and scales are similar to incremental discs and scales in that they contain a cyclic track and an index track. In an incremental encoder, the index occurs at one place in the full travel, but in a VA encoder, the index track is a continuous serial code similar to a bar code. You don't know position immediately upon start-up, as you do in a conventional absolute, but after a very short travel, *in either direction and starting from anywhere*, you know exactly where you are. With a 1024-line disc, this initialization angle is 3.52°; with a 2048-line disc, it's 1.92°. From then on, the encoder output is truly absolute.

Gurley offers several different interpolating decoders depending on the final resolution and output format desired. Please refer to the **VG** (Parallel), **VH** (USB) or **VJ** (SSI) datasheets for detailed information. Each model contains a patented high-speed absolute position decoder for the pseudorandom index track, and adds from 2 to 8 bits of resolution beyond the optical resolution (10 or 11 bits) of the disc. In addition to the final natural binary position output, a **status** bit tells when the encoder is initialized. This bit is at a logic high whenever the initializing motion is not yet complete, or when some other problem such as damage or fouling of the disc, supply voltage interruption, or electrical noise disrupts the proper code sequence from the index track. When these self-tests are all satisfied, the **status** bit is low, indicating the position output is valid.

Commutation Tracks

If your motor has P poles, you need a disc with N cycles/rev commutation tracks, where $N = P/2$. The three commutation signals are phase-shifted 120° electrical from each other within each cycle.

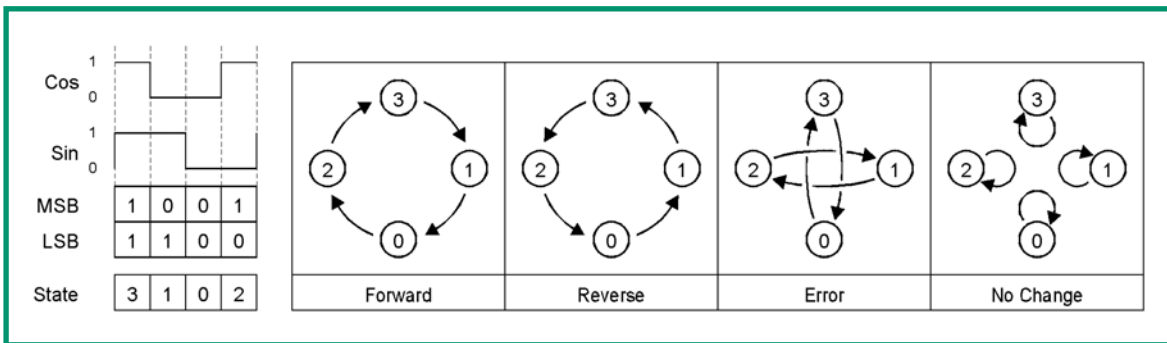


As part of our continuing improvement program, these specifications are subject to change without notice.

Built-in Error Detection (*Virtual Absolute* options only)

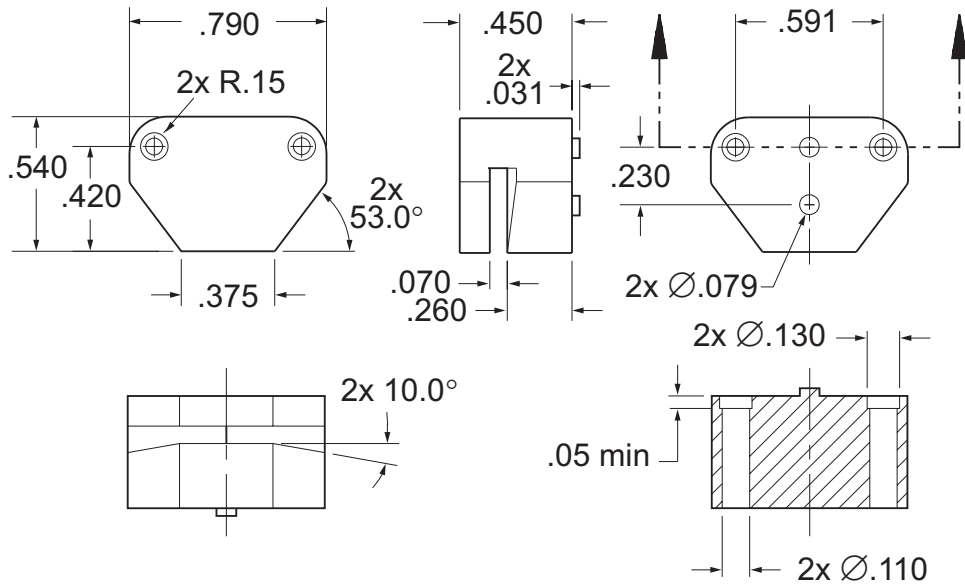
With the addition of a patented Gurley *Virtual Absolute* pseudorandom tag decoder, the encoding system continuously monitors signal integrity in two important ways to improve system reliability. The first way is actually a well-known test that can be applied to any incremental encoder, where the timing track signals from the encoder are inspected for disallowed quadrature sequence. If a quadrature sequence fault is detected, the tag decoder will immediately be reset into Wait mode, the **status** bit will be set to a logic high indicating "data not valid", and the electronics package will automatically start accumulating a new code tag with any further motion of the disk or scale.

Quadrature square waves are two square waves that are phase shifted with respect to each other by 90 electrical or one quarter of the optical cycle. The quadrature pair may be thought of as being a series of two-digit binary numbers, also given decimal state names for convenience below. Four groups of state transitions are possible depending on the direction of encoder motion. The figure below shows the digital quadrature square waves, binary representations, and state diagrams for each of the four quadrature state transition groups. The state diagrams show how a rapidly sampled pair of square waves is perceived to change from state to state by the decoder. "Forward" and "Reverse" motion are self-explanatory. The "No Change" group shows how the states are perceived not to have changed within a sampling period. The "Error" group illustrates illegal state transitions: those with simultaneous edges, or edges close enough to fall within the same sampling period. This signifies a loss of quadrature, which in turn makes it impossible to determine proper direction sensing and renders the serial data sampled from the pseudorandom *Virtual Absolute* code track untrustworthy. Possible causes of an illegal quadrature sequence include incorrect or shorted wiring from the encoder read head, damaged disk or scale, or overwhelming noise interference. The decoder's quadrature state transition test helps guarantee position data integrity at all times.



The pseudorandom serial position data may be corrupted from causes other than quadrature error. Gurley's unique decoder architecture (US Pat. No. 6127948) tests the pseudorandom data for the correct sequence, even as it is decoding it into a usable natural binary output. If a sequence error occurs due to electrical noise, broken or intermittent wires, interruption of the power supply, or various optical defects such as cracks, chips, or contamination of the code disc, the decoder resets itself the same as described above for quadrature errors. These built-in self tests are a major improvement of *Virtual Absolute* encoding technology over conventional incremental and absolute encoders, which do not detect their own malfunctions.

Module Outline Dimensions



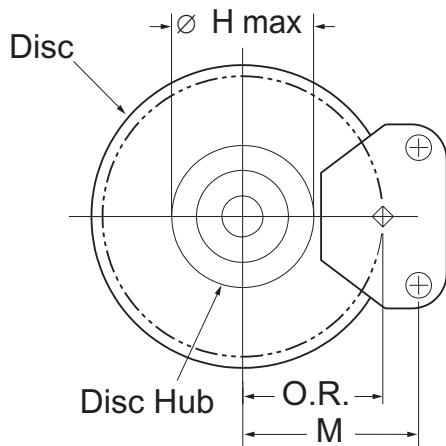
Module Interface

Module 0130

O.R. - Optical Radius0.602 in
M - Mounting dimension0.756 in
H - Hub Maximum O.D.0.61 in

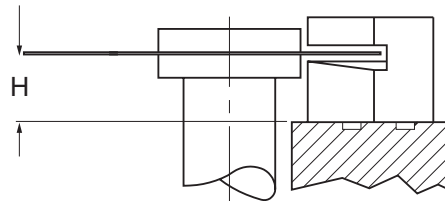
Module 0175

O.R. - Optical Radius0.832 in
M - Mounting dimension . . .0.986 in
H - Hub maximum O.D.1.07 in



DISC MOUNTING

same for rotary disc or linear scale



Disc Material	H \pm .005
Glass 0.04" [1 mm] thick (standard)	0.280
Plastic 0.02" [0.5 mm]	0.300

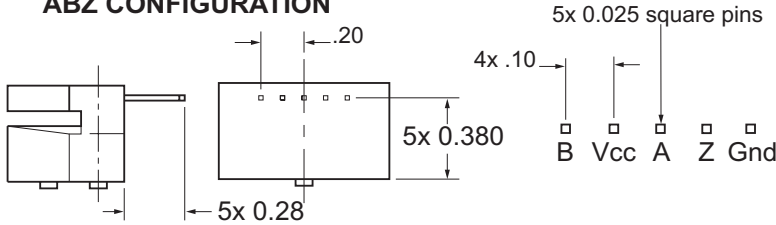
7700 DIMENSIONS

Side Pin Layout

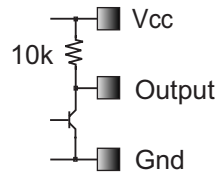
Output Format

The Optical Encoder Module with side exit pins comes standard with A, B and Z (Index) channels.

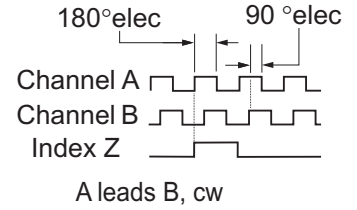
ABZ CONFIGURATION



OUTPUT STAGE



WAVEFORMS

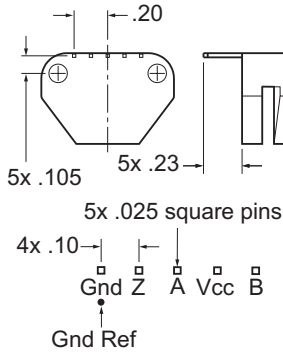


Top Pin Layouts

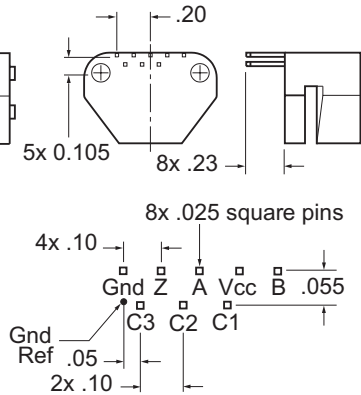
Disc and Hub Dimensions

The Optical Encoder Module with top exit pins comes standard with A, B, and Index channels. Commutation channels are optional.

ABZ CONFIGURATION



ABZ + COMS CONFIGURATION



Module 130 Disc and Hub

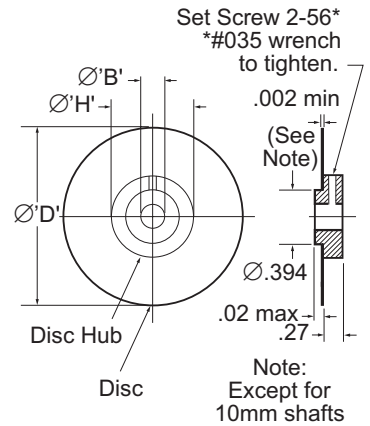
D - Disc O.D. 1.30 in.
H - Hub O.D. 0.61 in.

Module 175 Disc and Hub

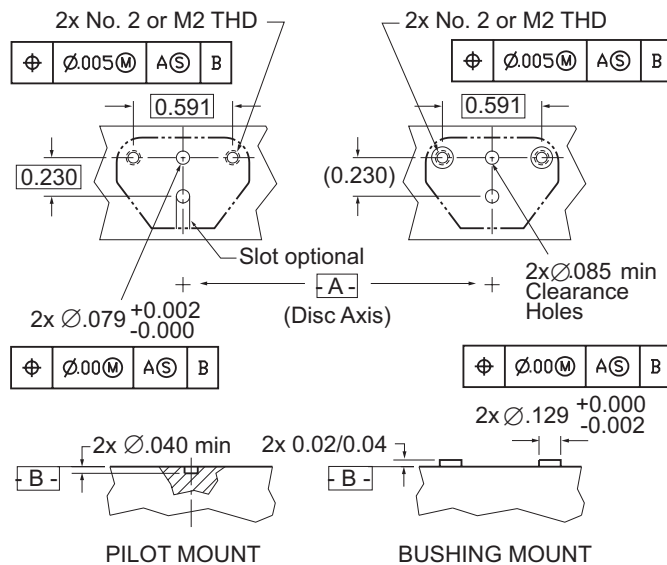
D - Disc O.D. 1.75 in.
H - Hub O.D. 1.00 in.

Shaft Size Hub Bore Sizes

Shaft Size	Hub Bore Sizes	Ø B in.	Ø B mm
1/4 in.	.2500	+0.005 -0.000	6.350
3/8 in.	.3750		9.525
6 mm	.2362		6.000
8 mm	.3150		8.000
10 mm	.3937		10.000



Recommended Mounting Configurations



ORDERING INFORMATION

ENCODER MODULE

MDL	OUT	RES	TYPE	CABLE	CONN	DIA	SF
7700			R				N

OUT # T = TTL-compatible square waves, C = TTL with commutation, D = TTL with internal doubler circuit, A = analog micro-currents for VH and VJ decoders

RES ##### 5-digit resolution code, see resolution list and notes below

TYPE R Rotary - consult factory for Linear versions

CABLE ## 00 for Top or Side pins, 01-99" allowed with 12" cable standard

CONN T, S, V, U Top pins, Side pins, V mates with VG decoder, U mates with VH or VJ

DIA ##### Use with 0130 = 1.30" or 0175 = 1.75" disc

SF # No special features - other letter codes for special customer requirements issued at time of order

Resolutions at 1.30" **00100, 00200, 00250, 00256, 00300, 00360, 00500, 00512, 00600, 00720, 01000, 01024, 01200, 01250, 01440, 02000, 02048, 02500, 02540, 03600**

Resolutions at 1.75" **01000, 01024, 02000, 02048, 03600, 04096, 05000**

TTL resolutions above 1024 for either disc size are obtained by doubler. VG decoder requires 1.30" disc at 512 lines (comm tracks optional) or 1024 lines, or 1.75" disc at 1024 lines (comms optional). VH and VJ decoders require 1.30" at 1024 or 1.75" at 2048. Consult factory for special line counts.

DISC/HUB ASSEMBLY

MDL	LINES	DIA	IND	MATL	COMM	ID	SF
DH							N

LINES ##### 5-digit line count code

DIA ##### 0130 = 1.30" or 0175 = 1.75" disc

IND # Standard once-per-rev index, Virtual Absolute index

MATL # Glass at 0.040" [1 mm] thick (standard), Plastic at 0.020" [0.5 mm]

COMM # 0 (none), or 2, 4, 6, 8 motor pole pairs (commutation cycles) available with 1.30" discs at 500 or 512 lines, and 1.75" discs at 1000 or 1024 lines

ID (hub) ### 04E = 0.250", 06E = 0.375", 06M = 6 mm, 08M = 8 mm, 10M = 10 mm

SF # No special features - other letter codes for special customer requirements issued at time of order

To order the VG, VH or VJ Virtual Absolute decoder, please refer to individual datasheets.

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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