

GURLEY MODELS LE18, LE20, LE25, AND LE30 INCREMENTAL LINEAR ENCODERS

MOTION TYPE:

LINEAR

USAGE GRADE:

INDUSTRIAL

OUTPUT:

INCREMENTAL

MAX RESOLUTION:

0.1 TO 10 μ M



HIGH RESOLUTION - INDUSTRIAL RUGGEDNESS

The Models **LE18**, **LE20**, **LE25** and **LE35** are optical incremental linear encoders designed for long life in medium to high-performance applications. The compact **LE18** offers measuring lengths up to 1.2 m (48"); the almost-as-compact **LE20** measures up to 1.5 m (60"); and the more robust **LE25** and **LE35** have a maximum measuring length of 3.2 m (126")*. All models have a reliable internal ASIC to provide resolution as fine as 0.1 μ m after 4X quadrature decode in the user's circuitry. The output device for the quadrature square waves and index signal is an EIA/RS-422 balanced differential line driver. For users who prefer to provide their own interpolation, analog outputs are available as either 11- μ A or 1-V signals.

Precision ball bearings allow the reading head to traverse the glass scale at speeds up to 1 m/s (40 in/s). The system is protected to IP53 by an aluminum extrusion and rubber sealing flaps.

The encoders are interchangeable with several popular competitive brands.

* For applications longer than 3.2 meters (126") please consult LE50 datasheet.

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ISO
9001
CERTIFIED

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SPECIFICATIONS

	See note	LE18	LE20	LE25	LE35
Cross-section, mm (in)		18 x 46 (0.71 x 1.81)	20 x 51 (0.79 x 2.01)	25 x 52 (0.98 x 2.05)	35 x 62 (1.38 x 2.44)
Measuring length ML, mm (in)		70-1240 (3-48)	70-1540 (3-60)	70-3220 (3-126)	1140-3220 (45-126)
Overall length, mm (in)		ML + 105 (ML + 4.2)			
Weight, kg (lb)		0.08 + 0.6/m (0.18 + 0.03/in)	0.08 + 0.9/m (0.18 + 0.05/in)	0.09 + 1.55/m (0.20 + .09/in)	0.1 + 2.0/m (0.22 + 0.11/in)
Resolution, μm (after user's 4X)	1, 2	0.1, 0.2, 0.5, 1, 2, 2.5, 5 or 10 μm			
Accuracy (at 20°C)		Grade A: $\pm 3 \mu\text{m/m}$ ($\approx \pm 36 \mu\text{in/ft}$) Grade B: $\pm 5 \mu\text{m/m}$ ($\approx \pm 60 \mu\text{in/ft}$) Grade C: $\pm 10 \mu\text{m/m}$ ($\approx \pm 120 \mu\text{in/ft}$)			
Hysteresis		0.5 μm (20 μin)			
Input power		5V \pm 0.25V @ 180 mA max or 12V \pm 0.6V @ 100 mA (square waves only)			
Analog output	3	11 μApp (OUT = A) or 1 Vpp (OUT = M)			
Square wave output (OUT = L)		RS-422 line driver on all channels			
Max speed	6	1 m/s (40 in/s)			
Max acceleration		30 m/s ² (1200 in/s ²)			
Driving force	6	1.5 N (6 oz)			
Operating temperature		0° to 50°C (32° to 122°F)			
Sealing		IP53			

NOTES:

1. With resolution = 0.1 μm , maximum operating speed is 300 mm/s. With resolution = 0.2 μm , maximum operating speed is 600 mm/s.
2. With resolution = 0.1 or 0.2 μm : In order to have a system that does not miss any counts during the 4X quadrature evaluation, you must use a counter or input circuit that can detect quadrature edges as close as 40 ns, which is equivalent to a 25 MHz count rate.
3. With analog output, pitch of Channel A and Channel B signals is 20 μm (order RES = 050) or 40 μm (order RES = 100).
4. With square-wave output, the index signal is ¼-cycle wide, gated to be coincident with the high states of A and B.
5. Channel A (SIN) leads Channel B (COS) when the read head travels from left to right with respect to the scale.
6. For higher speed or lower driving force, consult factory.

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



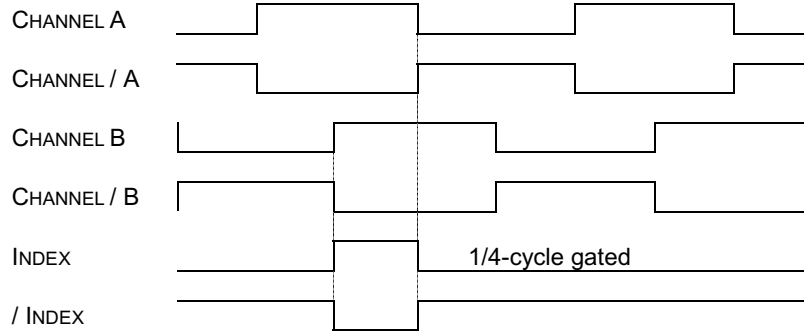
SPECIFICATIONS

INPUT POWER

+5 VDC \pm 0.25 V @100 mA max.

SQUARE WAVE OUTPUT - OUTPUT CODE L

On all channels: EIA/RS-422 balanced differential line driver, with short circuit protection, may be used single-ended for TTL-compatible inputs. Index is 1/4-cycle wide, gated with the high states of channels A and B. (With $V_{IN} = 12V$, $V_{OUT} > V_{IN} - 2.5V$)



ANALOG OUTPUT - OUTPUT CODE A

Photo-diode output. Signal roll-off at $100 \text{ kHz} \leq 3 \text{ dB}$. SIN, COS and INDEX are complemented. Signal values at 1 kHz (at 20°C):

Peak-to-peak signal amplitudes, SIN+, SIN-, COS+ and COS-:	7-16 μA (11 μA nominal)
Amplitude ratio, min channel to max channel:	0.8 to 1.0
Peak-to-peak signal amplitude, INDEX:	2- 8.5 μA
Index width at Vref:	$360^\circ \pm 180^\circ$
Phasing between SIN and COS:	$90^\circ \pm 10^\circ$
Phasing between INDEX peak and SIN:	$135^\circ \pm 60^\circ$ (nominally, where $\text{SIN+} = \text{COS+}$)

ANALOG OUTPUT - OUTPUT CODE M

The output device is an op-amp referenced to $V_{ref} = V_{cc}/2 \pm 0.25 \text{ V}$. Signal roll-off at $100 \text{ kHz} \leq 3 \text{ dB}$. SIN, COS and INDEX are complemented. Signal values at 1 kHz with 120Ω load to common (at 20°C):

Peak-to-peak signal amplitudes, SIN, /SIN, COS and /COS:	$0.9 \pm 0.3 \text{ V}$ (1 V nominal)
Amplitude ratio, min channel to max channel:	0.8 to 1.0
Peak-to-peak signal amplitude, INDEX:	$0.5 \pm 0.3 \text{ V}$
Index width at Vref:	$360^\circ \pm 180^\circ$
Phasing between SIN and COS:	$90^\circ \pm 10^\circ$
Phasing between INDEX peak and SIN:	$135^\circ \pm 60^\circ$ (nominally, where $\text{SIN} = \text{COS}$)

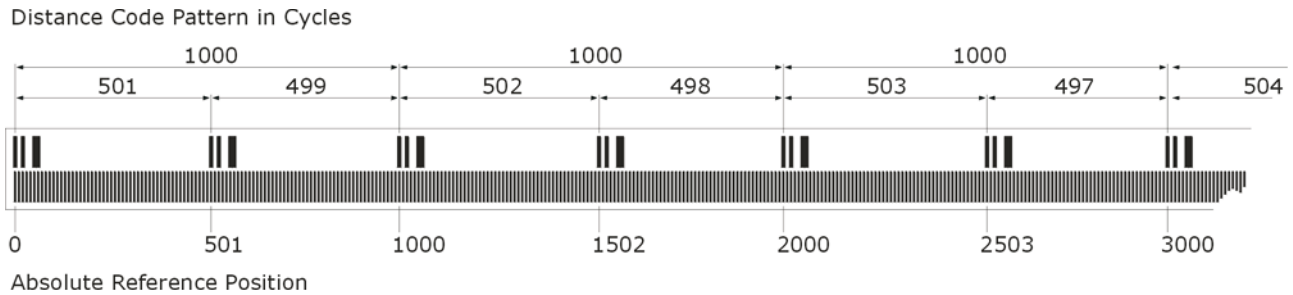
Output Function			Wire Colors Conn. Code P	Pin #, DA-15P Conn. Code Q	Pin #, DE-9P Conn. Code S
Square waves OUT = L	Analog 11 μ A OUT = A	Analog 1 V OUT = M			
A	SIN	SIN	Yellow	8	4
/ A	-SIN	/ SIN	Brown	7	8
B	COS	COS	Green	5	3
/ B	-COS	/ COS	Orange	4	7
IND	IND	IND	Blue	2	2
/ IND	-IND	/ IND	White	1	6
+V	+V	+V	Red	10	5
COMMON	COMMON	COMMON	Black	13	9
CASE	CASE	CASE	Bare (shield)	9	1

Cable: $\Phi 0.2''$ ($\Phi 5 \mu\text{m}$) shielded, 10 conductors (5 twisted pairs), 28 AWG (40/44), gray PVC jacket.

DISTANCE-CODED REFERENCE MARKS

The LExx encoders include an index signal, which can be located anywhere along the measuring length; its position is specified at the time of order. Once the encoder is installed, the index becomes fixed with respect to the user's machine. This feature allows the user to return to a known starting point.

Since the index signal occurs only once, it may take a while to find. One way to decrease the homing time is with DISTANCE-CODED REFERENCE MARKS (DCRM). Instead of being at a single location, many index marks are placed all along the scale so that the distance between any two adjacent marks is unique. Thus, the distance between any two marks, coupled with knowledge of the direction of travel, provides all the information necessary to determine the absolute position of an index mark. The maximum travel required to determine position is 1000 optical cycles, or 20 mm with a scale pitch of 20 μm . For the mathematics behind DCRM, see the document *Using Distance-Coded Reference Marks On LExx Series Linear Encoders*. (DCRM not available with 2- μm or 10- μm resolution.)



Another way to minimize homing time is to use Gurley's unique *Virtual Absolute*® technology. This reduces the initialization distance from 20 mm to 0.480 mm and provides these additional benefits:

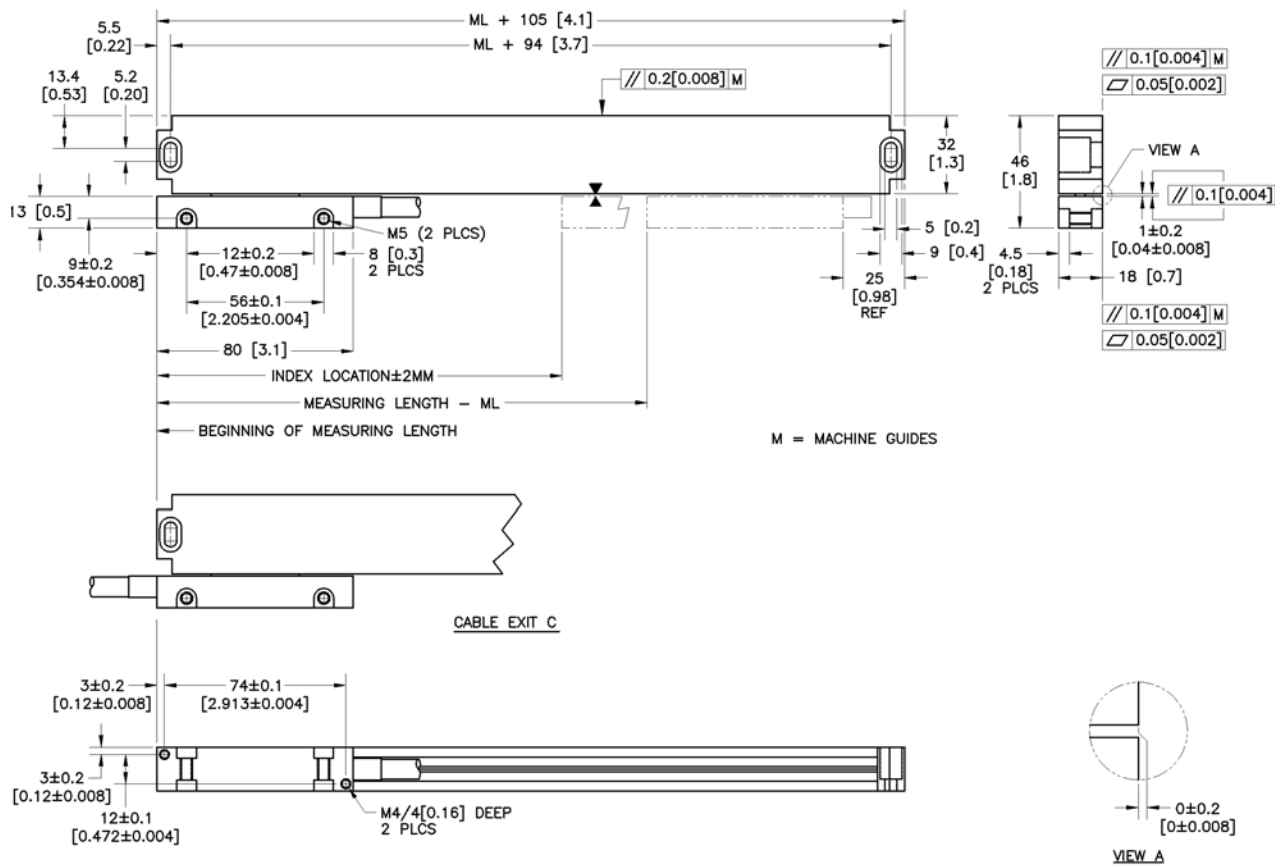
- True absolute position, not just for one index mark, but for all position data.
- Built-in-testing to confirm the validity of all position information.
- Greatly increased system reliability compared to either an incremental or a conventional absolute encoder.

See the **VL18** data sheet for further information on this exciting new encoder.



MODEL LE18 LINEAR ENCODERS

MODEL LE18 LINEAR ENCODER



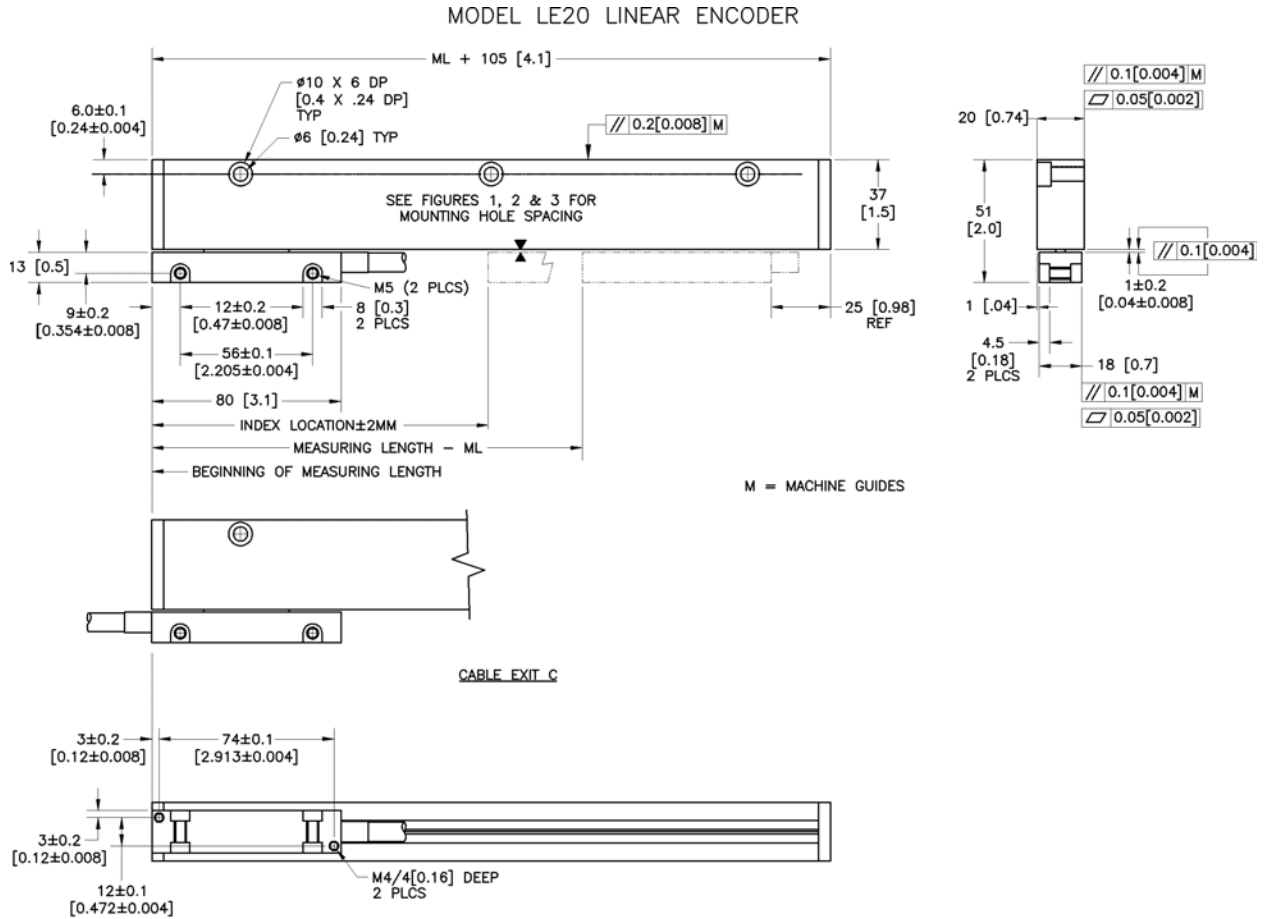
NOTES:

- ALL DIMENSIONS IN MM [IN].
- STANDARD MEASURING LENGTHS:

MM	70	120	170	220	270	320	370	420	470	520	570	620	720	820	920	1020	1140	1240
IN	2.8	4.7	6.7	8.7	10.6	12.6	14.6	16.5	18.5	20.5	22.4	24.4	28.3	32.3	36.2	40.2	44.9	48.8
CABLE, INCHES	60												120					

- READING HEAD HAS 2MM [0.08] MINIMUM OVERTRAVEL AT EACH END.
- FOR CABLE EXIT TO THE LEFT, ORDER EXIT OPTION C.

MODEL LE20 LINEAR ENCODER



NOTES:

1. ALL DIMENSIONS IN MM [IN].

2. STANDARD MEASURING LENGTHS:

MM	70	120	170	220	270	320	370	420	470	520	570
IN	2.8	4.7	6.7	8.7	10.6	12.6	14.6	16.5	18.5	20.5	22.4
CABLE, INCHES	60										

MM	620	720	820	920	1020	1140	1240	1340	1440	1540
IN	24.4	28.3	32.3	36.2	40.2	44.9	48.8	52.8	56.7	60.6
CABLE, INCHES	120					80				

3. READING HEAD HAS 8.5MM [0.33] OVERTRAVEL AT EACH END.

LEXX

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V3.1

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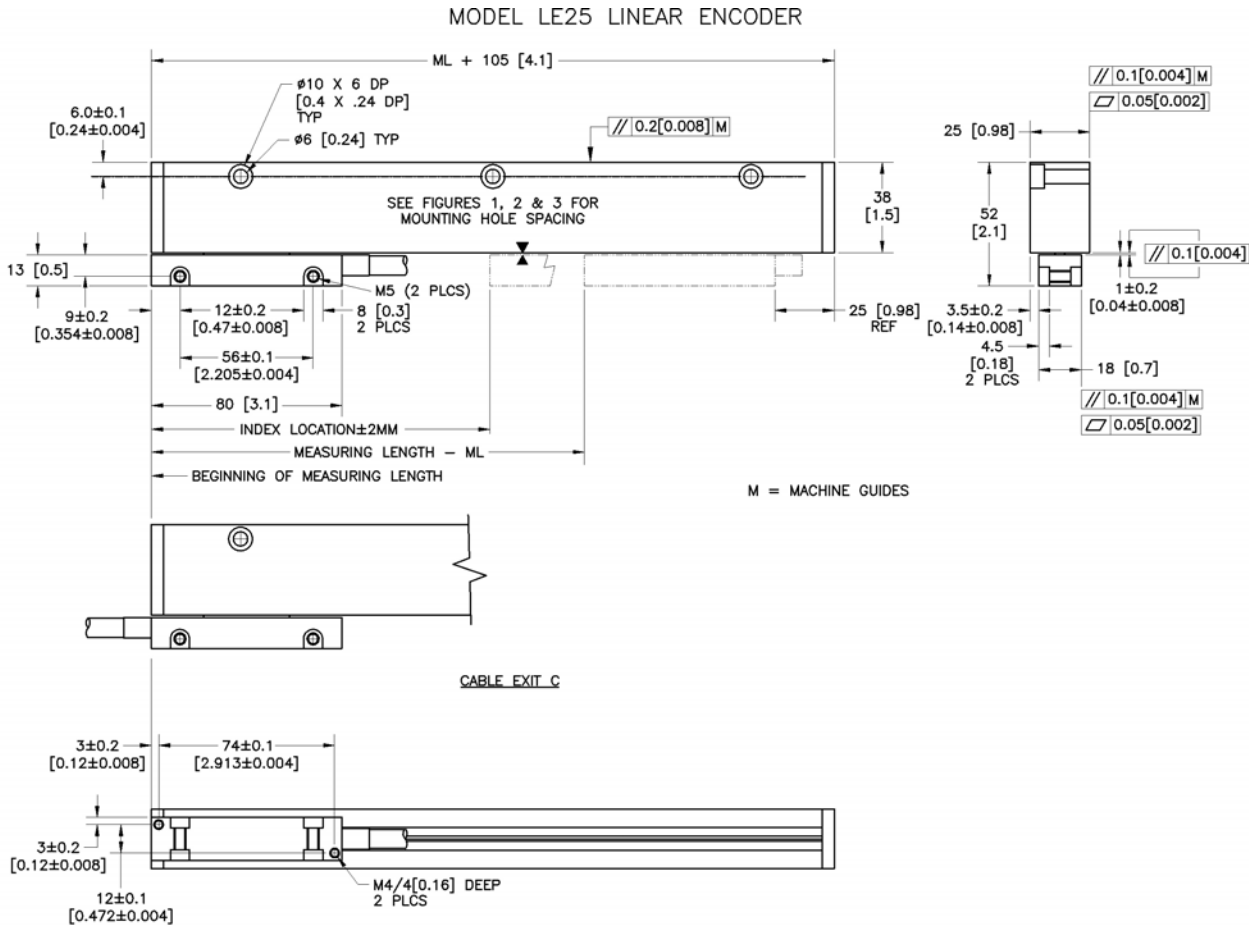
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MODEL LE25 LINEAR ENCODER



NOTES:

1. ALL DIMENSIONS IN MM [IN].
2. STANDARD MEASURING LENGTHS:

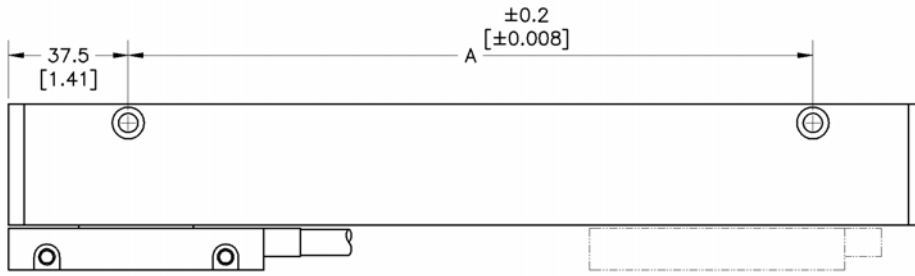
MM	70	120	170	220	270	320	370	420	470	520	570	620	720	820	920
IN	2.8	4.7	6.7	8.7	10.6	12.6	14.6	16.5	18.5	20.5	22.4	24.4	28.3	32.3	36.2
CABLE, INCHES	60											120			

MM	1020	1140	1240	1340	1440	1540	1640	1740	1840	1940	2040	2240	2440	2640	2840	3040	3220
IN	40.2	44.9	48.8	52.8	56.7	60.6	64.6	68.5	72.4	76.4	80.3	88.2	96.1	103.9	111.8	119.7	126.8
CABLE, INCHES	120			180									240				

3. READING HEAD HAS 8.5MM [0.33] OVERTRAVEL AT EACH END.

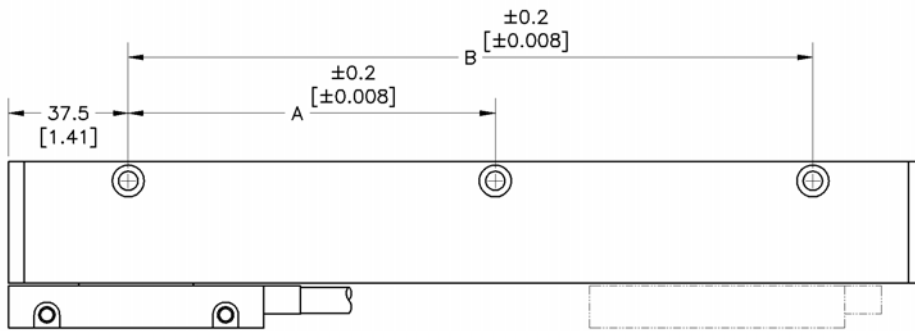
MOUNTING HOLES FOR LE20, LE25, AND LE35

FIGURE 1
70 ≤ ML ≤ 570



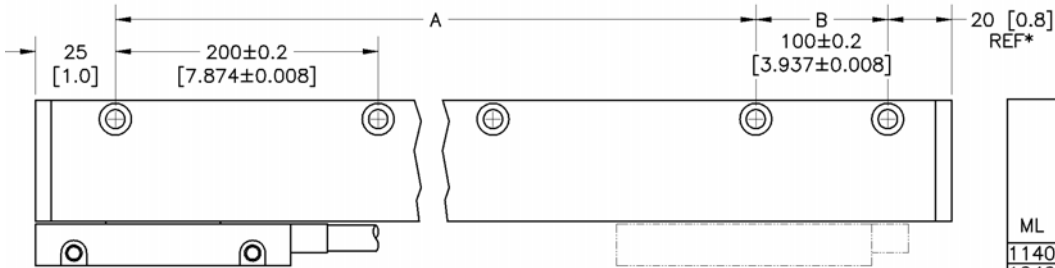
ML	A
70	100
120	150
170	200
220	250
270	300
320	350
370	400
420	450
470	500
520	550
570	600

FIGURE 2
620 ≤ ML ≤ 1020



ML	A	B
620	350	650
720	400	750
820	450	850
920	500	950
1020	550	1050

FIGURE 3
1140 ≤ ML ≤ 3220



ML	NO. OF HOLES	A	B
		# SPACES @ 200 MM	# SPACES @ 100 MM
1140	7	6	0
1240	8	6	1
1340	8	7	0
1440	9	7	1
1540	9	8	0
1640	10	8	1
1740	10	9	0
1840	11	9	1
1940	11	10	0
2040	12	10	1
2240	13	11	1
2440	14	12	1
2640	15	13	1
2840	16	14	1
3040	17	15	1
3220	17	16	0

* WITH ML=3220, THIS REF DIM=100 [3.9]

ORDERING INFORMATION

MODEL	RES	ACC	IN	OUT	ML	EXIT	IND	TYPE	CABLE	CONN	SPEC

MODEL

- LE18** 18 x 46 μm **cross-section**
- LE25** 25 x 52 μm
- LE20** 20 x 52 μm
- LE35** 35 x 62 μm

RES - Resolution after user's 4X

- 001** 0.1 μm (\approx 4 μin)
- 002** 0.2 μm (\approx 8 μin)
- 005** 0.5 μm (\approx 20 μin)
- 010** 1 μm (\approx 40 μin)
- 020** 2 μm (\approx 80 μin)
- 025** 2.5 μm (\approx 100 μin)
- 050** 5 μm (\approx 200 μin)
- 100** 10 μm (\approx 400 μin)

ACC - Accuracy

- A** $\pm 3 \mu\text{m/m}$
- B** $\pm 5 \mu\text{m/m}$
- C** $\pm 10 \mu\text{m/m}$

IN - Input voltage

- 5** +5Vdc
- C** +12Vdc (**OUT** = L)

OUT - Output waveforms

- A** Analog (11 μA); RES = 050 or 100
- M** Analog (1V); RES = 050 or 100
- L** Square waves, RS-422

ML - Measuring Length*

- xxxx** mm

EXIT -

- A** Cable exits to the right
- C** Cable exits to the left

IND - Index location

- xxxx** Distance from left end of scale housing to left side of read head, mm
- 0000 None required
- 9999 Distance-coded reference marks

TYPE - Of Cable

- A** Armored
- S** Shielded

CABLE - **xxx** Cable length, inches

- 060** Standard for $ML \leq 570$
- 120** Standard for $570 < ML \leq 1240$
- 180** Standard for $1240 < ML \leq 2040$
- 240** Standard for $2040 < ML$

CONN

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

SPEC - Special Code

- #** Issued at the time of order to cover special customer requirements
- N** No special features

ACCESSORIES (order separately)

- MO1** Mating Connector for DA-15P
- M06** Mating connector for DE-9P

* For applications longer than 3.2 meters (126") please consult LE50 datasheet.

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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