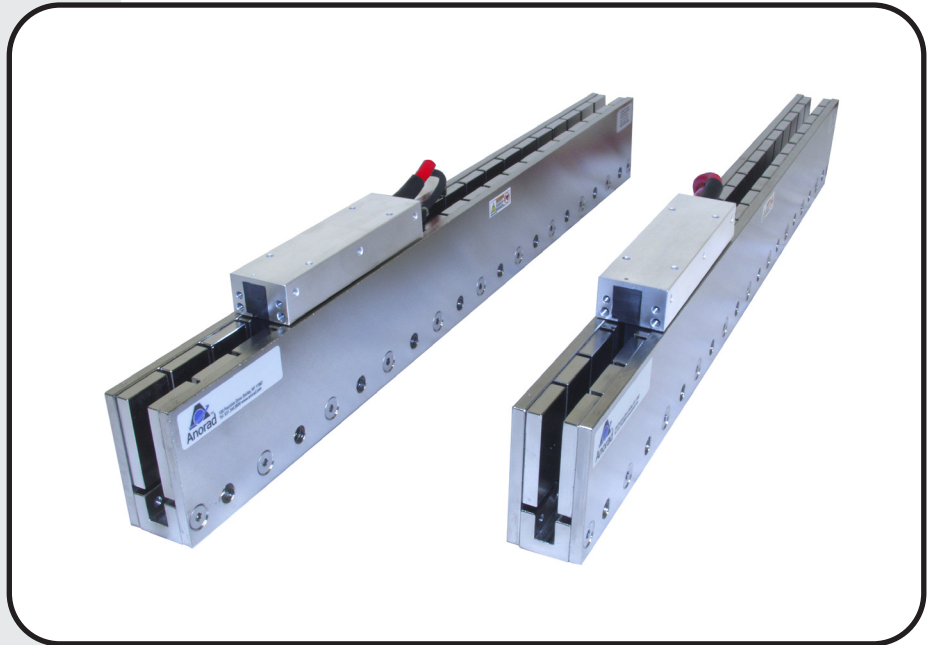




## LZ Family of Linear Motors

### Product Features

- High-performance, optimized design
- 30% higher force density as compared to standard ironless motors
- Zero-cogging
- Wide range of coil and magnet options
- Peak force range from 350 to 4000 Newtons
- Continuous force range from 70 to 900 Newtons
- Ideal for constant velocity scanning applications



LZ Family of Linear Motors

### High-Performance Ironless Linear Motors

The Anorad LZ series of ironless linear servo motors represents the most advanced linear motor technology available. The LZ series are high-performance linear motors that have been optimized for extremely high force density and low weight. The LZ motors utilize the latest magnetic materials and are optimized by Finite Element Analysis (FEA) to achieve an extremely high force density.

The LZ series has forty-eight motors comprised of four magnet lengths and four coil lengths with each coil having three coil/magnet configurations. Additionally, each motor is offered in several winding configurations to accommodate most applications. All motors are offered with optional hall effect sensors and thermal sensors.

Anorad offers a complete line of linear servo motors, linear stages, gantries, drives and controls for a complete motion solution in the most performance demanding applications.

*Product Profile*

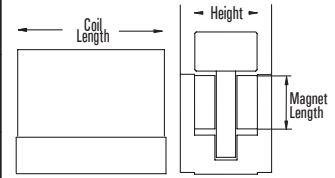
**Rockwell  
Automation**



# LZ Family Configurations

| Coil/Magnet Way Configuration Code | Description    | Height         | Active Coil Length |               |                |                | Active Magnet Length |              |              |               |
|------------------------------------|----------------|----------------|--------------------|---------------|----------------|----------------|----------------------|--------------|--------------|---------------|
|                                    |                |                | 120                | 240           | 360            | 480            | 30                   | 50           | 75           | 100           |
| O                                  | Standard Force | 37.8<br>(1.49) | 120<br>(4.72)      | 240<br>(9.45) | 360<br>(14.17) | 480<br>(18.90) | 30<br>(1.18)         | 50<br>(1.97) | 75<br>(2.95) | 100<br>(3.94) |
| T                                  | Medium Force   | 40.4<br>(1.59) | 120<br>(4.72)      | 240<br>(9.45) | 360<br>(14.17) | 480<br>(18.90) | 30<br>(1.18)         | 50<br>(1.97) | 75<br>(2.95) | 100<br>(3.94) |
| HT                                 | High Force     | 51.3<br>(2.02) | 120<br>(4.72)      | 240<br>(9.45) | 360<br>(14.17) | 480<br>(18.90) | 30<br>(1.18)         | 50<br>(1.97) | 75<br>(2.95) | 100<br>(3.94) |

Dimensions mm [in]



## Advantages of Linear Motors

### Unlimited Travel

Anorad motors do not have limitations on travel displacements. Since the stationary magnet assemblies can be easily joined together to form any length of motor, travel can be made as long as necessary. Since the same moving coil assembly could be used for any travel, there is no trade-off in performance as a function of travel. Screw driven systems, on the other hand, have critical speed limitations and higher inertia with added length. Speed limitations, high inertia, and low stiffness are major performance trade-offs with larger travels with other drive techniques.

### Velocity

Anorad linear servo motors can be used in both very low and very high velocity applications, all with very high precision. They can precisely operate at velocities ranging from less than 1  $\mu\text{m}/\text{sec}$  (0.00004"/sec) to more than 10 m/sec (400"/sec). Ball screws and lead screws have critical speed limitations. Belt drives exhibit lower stiffness. Rack-and-pinion drives typically have backlash and poor low velocity performance.

### Acceleration

Anorad linear motors have a high ratio of peak force to motor inertia (about 30:1). Therefore, almost all the motor force can be used to accelerate the moving load and perform useful work. In typical screw-driven systems, a large portion of the motor torque is lost in overcoming the rotary inertia of the motor, coupling and screw.

### Accuracy and Repeatability

With Anorad linear motors, the only limit to total system accuracy and repeatability is the sensing device and the bearings of the positioning system. In rotary driven systems there are additional factors which effect these performance variables, including backlash, hysteresis, lost motion and jitter.

### Smoothness Of Motion

Brushless linear servo motors can provide extremely smooth motion, since they have no contacting surfaces to cause jitter. Ultimate smooth motion is achieved with Anorad's sinusoidal-commutated non-ferrous motors. By contrast, ball screws are not as smooth due to the vibrating nature of the balls entering and exiting the ball nut raceways, which is easily observed in sub-micron systems. Belt and rack-and-pinion drives also have contacting mechanisms which are susceptible to friction and backlash caused vibrations.

### Stiffness

Anorad linear servo motors have very high stiffness, typically higher than a stage's bearings and structural members. With ball screws and rack-and-pinion drives, the couplings, ball nut, and pinions are the highest contributors to low stiffness of a stage. Low stiffness reduces frequency response and increases settling times.

### Maintenance and Life Expectancy

Anorad brushless linear servo motors have no contact between the two working members. Therefore, they have an extremely long, virtually maintenance-free life. The non-contact design eliminates lubrication and periodic adjustment to compensate for wear. Rotary driven mechanisms require regular lubrication and occasional replacement due to wear.

### Cleanroom and Vacuum Applications

Since the coil assembly and the magnet assembly of linear servo motors do not make contact, they are ideally suited for clean room and vacuum applications. Anorad manufactures linear motors specifically for  $10^{-7}$  torr and high vacuum applications, using special material and manufacturing processes. Anorad is the world leader in vacuum preparation, cleaning, and materials selection for these critical applications.

# Motor Definitions

## Continuous Force ( $F_{cTmax}$ )

The force produced by continuous current ( $I_{cTmax}$ ), all the phases sharing the load, provided the coil is secured through an adequate thermal heatsink as specified. This scenario produces a coil temperature equal to the  $T_{max}$  rating for the motor.

## Peak Force ( $F_p$ )

The force produced by peak current ( $I_p$ ).  $I_p$  assumes a 4% duty cycle with a maximum on time of 1 second.

## Motor Constant ( $K_m$ )

This is a figure of merit for motor efficiency. It is the ratio of the continuous force (three phases)  $F_{cTmax}$  to the square root of the motor power losses in the 3 phases.

## Thermal Resistance ( $R_{th}$ )

The equivalent thermal resistance of the motor, determined by the ratio of coil temperature rise (for example 110°C for LZ series) to the total power motor losses in the three phases. We assume the motor is mounted on a heat sink of at least the size specified in this catalog, with ambient temperature below 20°C and with a stroke of at least twice the coil length.

## Max Power Dissipation ( $P_{cTmax}$ )

The continuous power losses of the motor when the RMS current in the coil is  $I_{cTmax}$  and the ambient temperature below 20°C.

## Maximum Applied Bus Voltage ( $V_{DC}$ )

This is the maximum allowable Bus DC voltage that can be applied to the coil.

## Electrical Cycle Length ( $E_c$ )

This is the length of the electrical cycle and corresponds to twice the magnet length (North to North).

## Electrical Time Constant ( $\tau_e$ )

The time it takes for a step current input to the coil to reach 63% of its final value by overcoming the resistance and the inductance of the coil.

## Maximum Coil Temperature ( $T_{max}$ )

The maximum rated service temperature of the coil = 130°C. However, good practice is to limit the RMS current to no more than 80% of the rated continuous current ( $I_{cTmax}$ ).

## Magnetic Track Mass ( $M_m$ )

The mass of the magnetic track per unit of length.

## Force Constant ( $K_f$ )

The ratio between the motor continuous force ( $F_{cTmax}$ ) to the motor continuous current ( $I_{cTmax}$ ). For these motors, the force constant does not change as a function of current.

## Back EMF Constant p-p ( $K_e$ )

The ratio between the back emf voltage in volt peak to the motor speed.

## Peak Current ( $I_p$ )

The magnitude of the 3 phase sinusoidal currents that need to be applied to the motor to develop the motor peak force ( $F_p$ ).

## Continuous Current ( $I_{cTmax}$ )

The continuous current corresponding to the continuous Force. This is a sinusoidal current which can be expressed either in Amp 0-peak or in Amp rms.

## Resistance p-p @ 20°C ( $R_{20}$ )

This is the cold coil resistance measured phase to phase (line to line) at 20°C.

## Inductance p-p ( $L$ )

This is the coil inductance measured phase to phase (line to line).

## Magnetic Attraction ( $F_a$ )

The magnetic attraction force exerted between the coil assembly and its magnet assembly, measured at the nominal air gap.

## Coil Mass ( $M_c$ )

The mass of the coil including the standard cable length.

## Specifications LZ-030-0-XXX

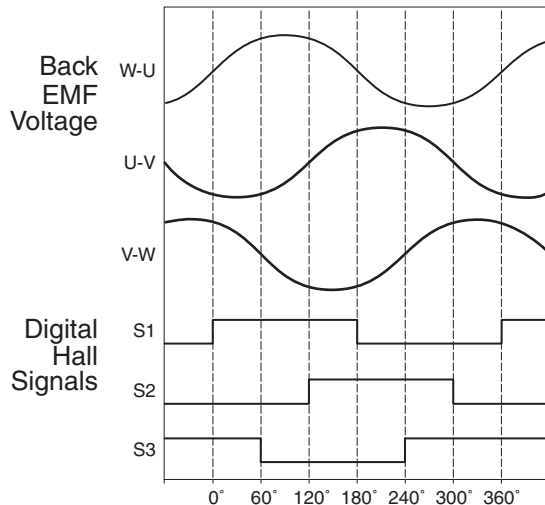


| Performance Parameters                      | Symbol      | Units                                  | LZ-030-0-120    |     |                |     | LZ-030-0-240    |                |                |                | LZ-030-0-360    |                |     |                | LZ-030-0-480    |                |     |                |
|---|-------------|--|-----------------|-----|----------------|-----|-----------------|----------------|----------------|----------------|-----------------|----------------|-----|----------------|-----------------|----------------|-----|----------------|
| Continuous Force <sup>1,5,6,7</sup>         | $F_{cTmax}$ | $\frac{N}{(lb_f)}$                     | 70<br>(16)      |     |                |     | 139<br>(31)     |                |                |                | 209<br>(47)     |                |     |                | 278<br>(63)     |                |     |                |
| Peak Force <sup>2</sup>                     | $F_p$       | $\frac{N}{(lb_f)}$                     | 348<br>(78)     |     |                |     | 695<br>(156)    |                |                |                | 1043<br>(234)   |                |     |                | 1390<br>(313)   |                |     |                |
| Motor Constant <sup>1</sup>                 | $K_M$       | $\frac{N/\sqrt{-W}}{(lb_f/\sqrt{-W})}$ | 8.7<br>(2.0)    |     |                |     | 12.3<br>(2.8)   |                |                |                | 15.1<br>(3.4)   |                |     |                | 17.4<br>(3.9)   |                |     |                |
| Thermal Resistance                          | $R_{th}$    | $^{\circ}C/W$                          | 1.73            |     |                |     | 0.86            |                |                |                | 0.58            |                |     |                | 0.43            |                |     |                |
| Max Power Dissipation                       | $P_{cTmax}$ | W                                      | 64              |     |                |     | 127             |                |                |                | 191             |                |     |                | 255             |                |     |                |
| Maximum Applied Bus Voltage <sup>8</sup>    | $V_{DC}$    | Volts                                  | 325             |     |                |     | 325             |                |                |                | 325             |                |     |                | 325             |                |     |                |
| Electrical Cycle Length                     | $E_c$       | mm                                     | 60              |     |                |     | 60              |                |                |                | 60              |                |     |                | 60              |                |     |                |
| Electrical Time Constant                    | $\tau_e$    | msec                                   | 1.6             |     |                |     | 1.6             |                |                |                | 1.6             |                |     |                | 1.6             |                |     |                |
| Maximum Coil Temperature                    | $T_{max}$   | $^{\circ}C$                            | 130             |     |                |     | 130             |                |                |                | 130             |                |     |                | 130             |                |     |                |
| Winding Type                                |             |  | D               | E   | F              | G   | D               | E              | F              | G              | D               | E              | F   | G              | D               | E              | F   | G              |
| Force Constant <sup>1</sup>                 | $K_F$       | $\frac{N/A_{pk}}{(lb_f/A_{pk})}$       | 21.0<br>(4.7)   | N/A | 12.1<br>(2.7)  | N/A | 21.0<br>(4.7)   | 42.0<br>(9.4)  | 12.1<br>(2.7)  | 24.3<br>(5.5)  | 21.0<br>(4.7)   | 63.0<br>(14.2) | N/A | 36.4<br>(8.2)  | 21.0<br>(4.7)   | 42.0<br>(9.4)  | N/A | 24.3<br>(5.5)  |
| Back EMF Constant p-p <sup>3,4</sup>        | $K_e$       | $\frac{V_p/m/s}{(V_p/in/s)}$           | 24.8<br>(0.6)   | N/A | 14.3<br>(0.4)  | N/A | 24.8<br>(0.6)   | 49.6<br>(1.3)  | 14.3<br>(0.4)  | 28.6<br>(0.7)  | 24.8<br>(0.6)   | 74.4<br>(1.9)  | N/A | 43.0<br>(1.1)  | 24.8<br>(0.6)   | 49.6<br>(1.3)  | N/A | 28.6<br>(0.7)  |
| Peak Current <sup>2,4</sup>                 | $I_p$       | $\frac{A_{pk}}{(A_{rms})}$             | 16.5<br>(11.7)  | N/A | 28.7<br>(20.3) | N/A | 33.1<br>(23.4)  | 16.5<br>(11.7) | 57.3<br>(40.5) | 28.7<br>(20.3) | 49.6<br>(35.1)  | 16.5<br>(11.7) | N/A | 28.7<br>(20.3) | 66.2<br>(46.8)  | 33.1<br>(23.4) | N/A | 57.3<br>(40.5) |
| Continuous Current <sup>1,4,5,6</sup>       | $I_{cTmax}$ | $\frac{A_{pk}}{(A_{rms})}$             | 3.3<br>(2.3)    | N/A | 5.7<br>(4.1)   | N/A | 6.6<br>(4.7)    | 3.3<br>(2.3)   | 11.5<br>(8.1)  | 5.7<br>(4.1)   | 9.9<br>(7.0)    | 3.3<br>(2.3)   | N/A | 5.7<br>(4.1)   | 13.2<br>(9.4)   | 6.6<br>(4.7)   | N/A | 11.5<br>(8.1)  |
| Resistance p-p <sup>3</sup> @20 $^{\circ}C$ | $R_{20}$    | ohm                                    | 5.41            | N/A | 1.80           | N/A | 2.70            | 10.82          | 0.90           | 3.61           | 1.80            | 16.23          | N/A | 5.41           | 1.35            | 5.41           | N/A | 1.80           |
| Inductance p-p <sup>3</sup>                 | L           | mH                                     | 8.43            | N/A | 2.81           | N/A | 4.22            | 16.86          | 1.41           | 5.62           | 2.81            | 25.29          | N/A | 8.43           | 2.11            | 8.43           | N/A | 2.81           |
| Mechanical Parameters                       |             |  |                 |     |                |     |                 |                |                |                |                 |                |     |                |                 |                |     |                |
| Magnetic Attraction                         | $F_a$       | $\frac{N}{(lb_f)}$                     | 0<br>(0)        |     |                |     | 0<br>(0)        |                |                |                | 0<br>(0)        |                |     |                | 0<br>(0)        |                |     |                |
| Coil Mass                                   | $M_c$       | $\frac{kg}{(lb_m)}$                    | 0.63<br>(1.38)  |     |                |     | 1.14<br>(2.51)  |                |                |                | 1.65<br>(3.64)  |                |     |                | 2.16<br>(4.76)  |                |     |                |
| Magnetic Channel Mass                       | $M_n$       | $\frac{kg/m}{(lb/in)}$                 | 11.49<br>(0.64) |     |                |     | 11.49<br>(0.64) |                |                |                | 11.49<br>(0.64) |                |     |                | 11.49<br>(0.64) |                |     |                |

**Notes:** Motor performance specifications are with sinusoidal commutation.

- Continuous forces, motor constant and currents listed are with coils at maximum temperature 130 $^{\circ}C$ , mounted to a heat sink that is equivalent to an aluminum slide 25.4mm (1.0") thick with the following areas: 120 coil 774cm<sup>2</sup> (120in<sup>2</sup>), 240 coil 1160cm<sup>2</sup> (180in<sup>2</sup>), 360 coil 1680cm<sup>2</sup> (260 in<sup>2</sup>), 480 coil 2060cm<sup>2</sup> (320 in<sup>2</sup>).
- Calculated at 4% duty cycle with a maximum on time of 1 second.
- All winding parameters listed are measured line-to-line (phase-to-phase).
- All currents and voltages are measured 0-peak of the sine wave unless noted rms.
- Continuous force and current based on coil moving with all phases sharing the same load in sinusoidal commutation.
- For stand still conditions multiply continuous force and continuous current by 0.9.
- Coil mountings on either of the two narrow sides reduces continuous force by 10%.
- Maximum cable length 10 meters. Please consult factory concerning applications requiring longer cables  
All specifications are  $\pm 10\%$ . Phase-to-phase inductance is  $\pm 30\%$ .

## Motor Phasing Diagram



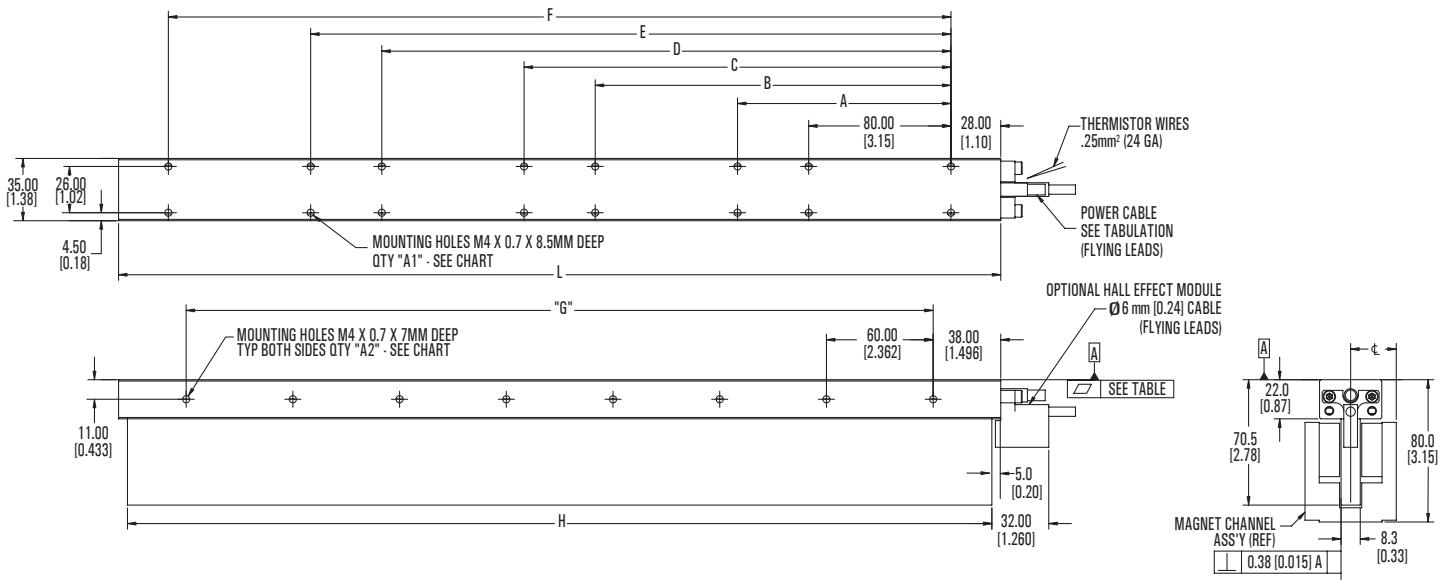
Note: Phasing direction is coil moving towards motor power cable

## Dimensions mm [in]

| Size    | Winding Code     | Power Cable Dia. | Gauge                    |
|---------|------------------|------------------|--------------------------|
| 030-120 | D<br>F           | $\phi 6.1$ (.24) | 0.75mm <sup>2</sup> (18) |
| 030-240 | D<br>E<br>F<br>G | $\phi 6.1$ (.24) | 0.75mm <sup>2</sup> (18) |
| 030-360 | D<br>E<br>G      | $\phi 6.1$ (.24) | 0.75mm <sup>2</sup> (18) |
| 030-480 | D<br>E<br>G      | $\phi 6.1$ (.24) | 0.75mm <sup>2</sup> (18) |

# Coil Assembly LZ-030-0-XXX

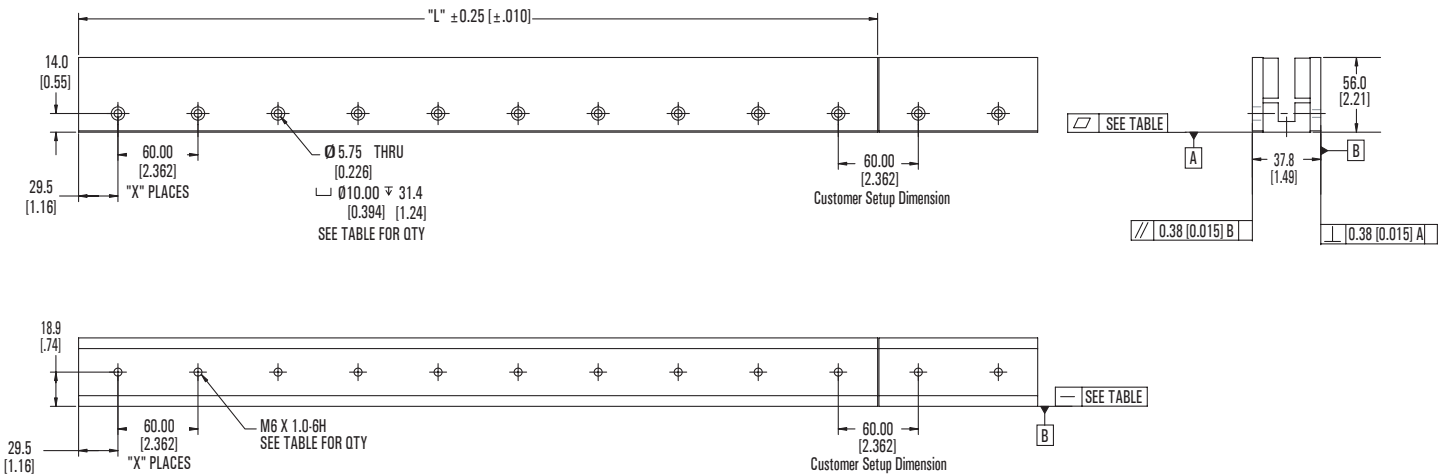
Dimensions mm [in]



| Coil    |                |                |                |                |                 |                 |                 |                 |               |        |        |             |
|---------|----------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|-----------------|---------------|--------|--------|-------------|
| Size    | L              | A              | B              | C              | D               | E               | F               | G               | H             | A1 QTY | A2 QTY | Flatness A  |
| 030-120 | 136.00 (5.35)  | ---            | ---            | ---            | ---             | ---             | ---             | 60.00 (2.362)   | 126.0 (4.96)  | 4      | 3      | 0.25 (.010) |
| 030-240 | 256.00 (10.08) | 120.00 (4.724) | 200.00 (7.874) | ---            | ---             | ---             | ---             | 180.00 (7.087)  | 246.0 (9.69)  | 8      | 5      | 0.25 (.010) |
| 030-360 | 376.00 (14.80) | 120.00 (4.724) | 200.00 (7.874) | 240.00 (9.449) | 320.00 (12.598) | ---             | ---             | 300.00 (11.811) | 366.0 (14.41) | 12     | 7      | 0.38 (.015) |
| 030-480 | 496.00 (19.53) | 120.00 (4.724) | 200.00 (7.874) | 240.00 (9.449) | 320.00 (12.598) | 360.00 (14.173) | 440.00 (17.323) | 420.00 (16.535) | 486.0 (19.13) | 16     | 9      | 0.64 (.025) |

| Magnet Channel |               |   |          |             |             |
|----------------|---------------|---|----------|-------------|-------------|
| Size           | L             | X | Hole Qty | —           | ▱           |
| -120           | 119.0 (4.69)  | 1 | 2        | 0.13 (.005) | 0.13 (.005) |
| -180           | 179.0 (7.05)  | 2 | 3        | 0.13 (.005) | 0.13 (.005) |
| -240           | 239.0 (9.41)  | 3 | 4        | 0.13 (.005) | 0.13 (.005) |
| -480           | 479.0 (18.86) | 7 | 8        | 0.26 (.010) | 0.26 (.010) |
| -600           | 599.0 (23.58) | 9 | 10       | 0.26 (.010) | 0.26 (.010) |

# Magnet Channel LZM-030-0-XXX



Tolerances

| Metric    | English       |
|-----------|---------------|
| .x ± .25  | [.xx] ± .01   |
| .xx ± .13 | [.xxx] ± .005 |



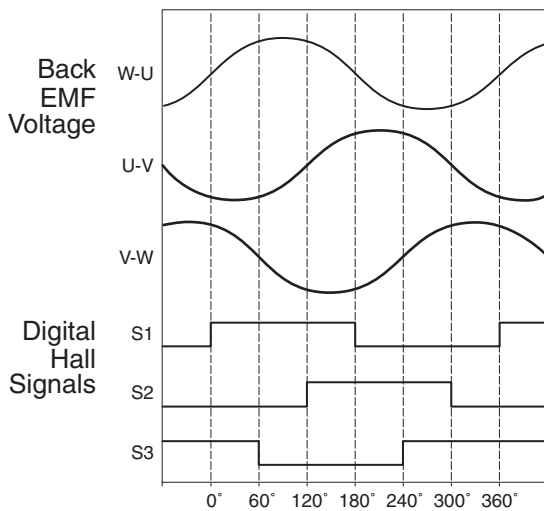
## Specifications LZ-030-T-XXX

| Performance Parameters                   | Symbol      | Units  | LZ-030-T-120    |     |                |     | LZ-030-T-240    |                |                |                | LZ-030-T-360    |                |     |                | LZ-030-T-480    |                |     |                |
|--|-------------|--|-----------------|-----|----------------|-----|-----------------|----------------|----------------|----------------|-----------------|----------------|-----|----------------|-----------------|----------------|-----|----------------|
| Continuous Force <sup>1,5,6,7</sup>      | $F_{cTmax}$ | N<br>(lbf)   | 80<br>(18)      |     |                |     | 160<br>(36)     |                |                |                | 239<br>(54)     |                |     |                | 319<br>(72)     |                |     |                |
| Peak Force <sup>2</sup>                  | $F_p$       | N<br>(lbf)   | 399<br>(90)     |     |                |     | 798<br>(179)    |                |                |                | 1197<br>(269)   |                |     |                | 1595<br>(359)   |                |     |                |
| Motor Constant <sup>1</sup>              | $K_M$       | $\frac{N}{\sqrt{W}}$<br>( $\frac{lbf}{\sqrt{W}}$ ) | 8.7<br>(2.0)    |     |                |     | 12.3<br>(2.8)   |                |                |                | 15.1<br>(3.4)   |                |     |                | 17.4<br>(3.9)   |                |     |                |
| Thermal Resistance                       | $R_{th}$    | °C/W   | 1.31            |     |                |     | 0.65            |                |                |                | 0.44            |                |     |                | 0.33            |                |     |                |
| Max Power Dissipation                    | $P_{cTmax}$ | W  | 84              |     |                |     | 168             |                |                |                | 252             |                |     |                | 336             |                |     |                |
| Maximum Applied Bus Voltage <sup>8</sup> | $V_{DC}$    | Volts  | 325             |     |                |     | 325             |                |                |                | 325             |                |     |                | 325             |                |     |                |
| Electrical Cycle Length                  | $E_c$       | mm   | 60              |     |                |     | 60              |                |                |                | 60              |                |     |                | 60              |                |     |                |
| Electrical Time Constant                 | $\tau_e$    | msec   | 1.9             |     |                |     | 1.9             |                |                |                | 1.9             |                |     |                | 1.9             |                |     |                |
| Maximum Coil Temperature                 | $T_{max}$   | °C   | 130             |     |                |     | 130             |                |                |                | 130             |                |     |                | 130             |                |     |                |
| Winding Type                             |             |  | D               | E   | F              | G   | D               | E              | F              | G              | D               | E              | F   | G              | D               | E              | F   | G              |
| Force Constant <sup>1</sup>              | $K_F$       | $\frac{N/A_{pk}}{(lbf/A_{pk})}$                    | 24.1<br>(5.4)   | N/A | 13.9<br>(3.1)  | N/A | 24.1<br>(5.4)   | 48.2<br>(10.8) | 13.9<br>(3.1)  | 27.8<br>(6.3)  | 24.1<br>(5.4)   | 72.3<br>(16.3) | N/A | 41.8<br>(9.4)  | 24.1<br>(5.4)   | 48.2<br>(10.8) | N/A | 27.8<br>(6.3)  |
| Back EMF Constant p-p <sup>3,4</sup>     | $K_e$       | $\frac{V_p/m/s}{(V_p/in/s)}$                       | 28.5<br>(0.7)   | N/A | 16.4<br>(0.4)  | N/A | 28.5<br>(0.7)   | 56.9<br>(1.4)  | 16.4<br>(0.4)  | 32.9<br>(0.8)  | 28.5<br>(0.7)   | 85.4<br>(2.2)  | N/A | 49.3<br>(1.3)  | 28.5<br>(0.7)   | 56.9<br>(1.4)  | N/A | 32.9<br>(0.8)  |
| Peak Current <sup>2,4</sup>              | $I_p$       | $A_{pk}$<br>( $A_{rms}$ )                          | 16.5<br>(11.7)  | N/A | 28.7<br>(20.3) | N/A | 33.1<br>(23.4)  | 16.5<br>(11.7) | 57.3<br>(40.5) | 28.7<br>(20.3) | 49.6<br>(35.1)  | 16.5<br>(11.7) | N/A | 28.7<br>(20.3) | 66.2<br>(46.8)  | 33.1<br>(23.4) | N/A | 57.3<br>(40.5) |
| Continuous Current <sup>1,4,5,6</sup>    | $I_{cTmax}$ | $A_{pk}$<br>( $A_{rms}$ )                          | 3.3<br>(2.3)    | N/A | 5.7<br>(4.1)   | N/A | 6.6<br>(4.7)    | 3.3<br>(2.3)   | 11.5<br>(8.1)  | 5.7<br>(4.1)   | 9.9<br>(7.0)    | 3.3<br>(2.3)   | N/A | 5.7<br>(4.1)   | 13.2<br>(9.4)   | 6.6<br>(4.7)   | N/A | 11.5<br>(8.1)  |
| Resistance p-p <sup>3</sup> @20°C        | $R_{20}$    | ohm  | 7.15            | N/A | 2.38           | N/A | 3.57            | 14.29          | 1.19           | 4.76           | 2.38            | 21.44          | N/A | 7.15           | 1.79            | 7.15           | N/A | 2.38           |
| Inductance p-p <sup>3</sup>              | $L$         | mH   | 13.40           | N/A | 4.47           | N/A | 6.70            | 26.80          | 2.23           | 8.93           | 4.47            | 40.20          | N/A | 13.40          | 3.35            | 13.40          | N/A | 4.47           |
| <b>Mechanical Parameters</b>             |             |  |                 |     |                |     |                 |                |                |                |                 |                |     |                |                 |                |     |                |
| Magnetic Attraction                      | $F_a$       | N<br>(lbf)   | 0<br>(0)        |     |                |     | 0<br>(0)        |                |                |                | 0<br>(0)        |                |     |                | 0<br>(0)        |                |     |                |
| Coil Mass                                | $M_c$       | kg<br>(lbf <sub>m</sub> )                          | 0.74<br>(1.64)  |     |                |     | 1.37<br>(3.02)  |                |                |                | 2.00<br>(4.41)  |                |     |                | 2.63<br>(5.79)  |                |     |                |
| Magnetic Channel Mass                    | $M_n$       | kg/m<br>(lbf/in)                                   | 11.66<br>(0.65) |     |                |     | 11.66<br>(0.65) |                |                |                | 11.66<br>(0.65) |                |     |                | 11.66<br>(0.65) |                |     |                |

**Notes:** Motor performance specifications are with sinusoidal commutation.

- Continuous forces, motor constant and currents listed are with coils at maximum temperature 130°C, mounted to a heat sink that is equivalent to an aluminum slide 25.4mm (1.0") thick with the following areas: 120 coil 774cm<sup>2</sup> (120in<sup>2</sup>), 240 coil 1160cm<sup>2</sup> (180in<sup>2</sup>), 360 coil 1680cm<sup>2</sup> (260 in<sup>2</sup>), 480 coil 2060cm<sup>2</sup> (320 in<sup>2</sup>).
  - Calculated at 4% duty cycle with a maximum on time of 1 second.
  - All winding parameters listed are measured line-to-line (phase-to-phase).
  - All currents and voltages are measured 0-peak of the sine wave unless noted rms.
  - Continuous force and current based on coil moving with all phases sharing the same load in sinusoidal commutation.
  - For stand still conditions multiply continuous force and continuous current by 0.9.
  - Coil mountings on either of the two narrow sides reduces continuous force by 10%.
  - Maximum cable length 10 meters. Please consult factory concerning applications requiring longer cables
- All specifications are ±10%. Phase-to-phase inductance is ±30%.

### Motor Phasing Diagram



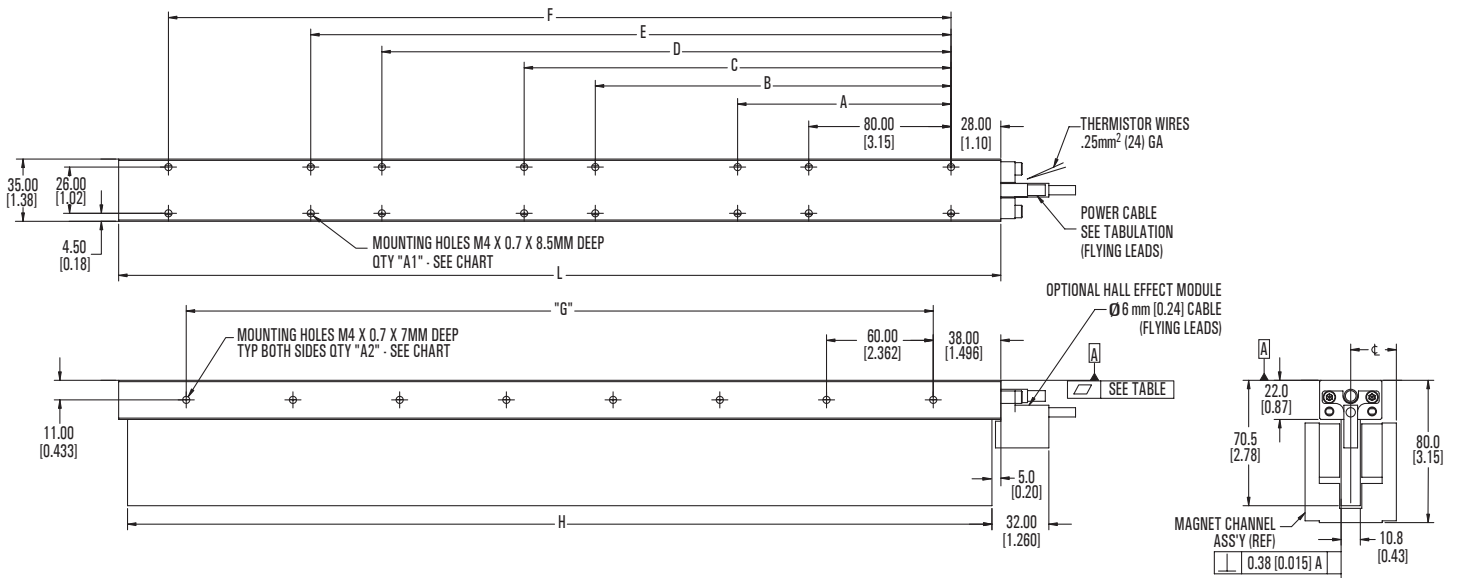
Note: Phasing direction is coil moving towards motor power cable

### Dimensions mm [in]

| Size    | Winding Code     | Power Cable Dia. | Gauge                    |
|---------|------------------|------------------|--------------------------|
| 030-120 | D<br>F           | φ6.1 (.24)       | 0.75mm <sup>2</sup> (18) |
| 030-240 | D<br>E<br>F<br>G | φ6.1 (.24)       | 0.75mm <sup>2</sup> (18) |
| 030-360 | D<br>E<br>G      | φ6.1 (.24)       | 0.75mm <sup>2</sup> (18) |
| 030-480 | D<br>E<br>G      | φ6.1 (.24)       | 0.75mm <sup>2</sup> (18) |

# Coil Assembly LZ-030-T-XXX

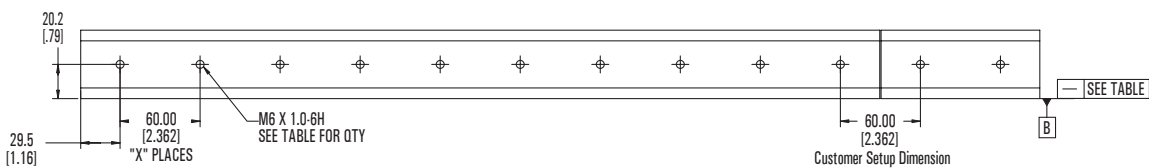
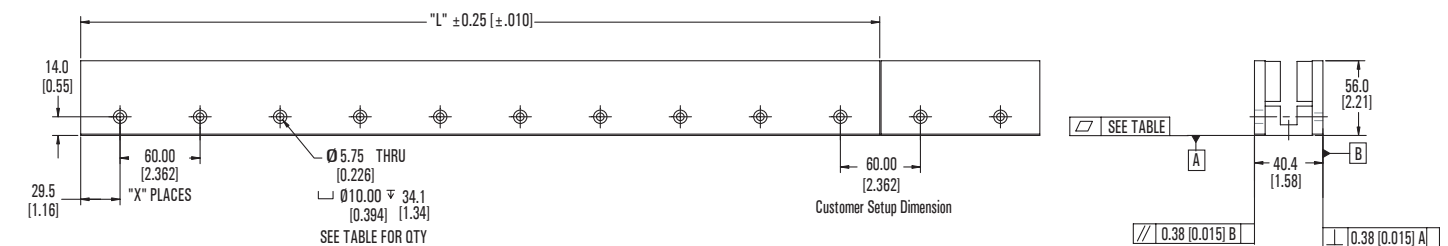
Dimensions mm [in]



| Coil    |                |                |                |                |                 |                 |                 |                 |               |        |        |             |
|---------|----------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|-----------------|---------------|--------|--------|-------------|
| Size    | L              | A              | B              | C              | D               | E               | F               | G               | H             | A1 QTY | A2 QTY | Flatness A  |
| 030-120 | 136.00 (5.35)  | ---            | ---            | ---            | ---             | ---             | ---             | 60.00 (2.362)   | 126.0 (4.96)  | 4      | 3      | 0.25 (.010) |
| 030-240 | 256.00 (10.08) | 120.00 (4.724) | 200.00 (7.874) | ---            | ---             | ---             | ---             | 180.00 (7.087)  | 246.0 (9.69)  | 8      | 5      | 0.25 (.010) |
| 030-360 | 376.00 (14.80) | 120.00 (4.724) | 200.00 (7.874) | 240.00 (9.449) | 320.00 (12.598) | ---             | ---             | 300.00 (11.811) | 366.0 (14.41) | 12     | 7      | 0.38 (.015) |
| 030-480 | 496.00 (19.53) | 120.00 (4.724) | 200.00 (7.874) | 240.00 (9.449) | 320.00 (12.598) | 360.00 (14.173) | 440.00 (17.323) | 420.00 (16.535) | 486.0 (19.13) | 16     | 9      | 0.64 (.025) |

| Magnet Channel |               |   |          |             |             |
|----------------|---------------|---|----------|-------------|-------------|
| Size           | L             | X | Hole Qty | —           | ▤           |
| -120           | 119.0 (4.69)  | 1 | 2        | 0.13 (.005) | 0.13 (.005) |
| -180           | 179.0 (7.05)  | 2 | 3        | 0.13 (.005) | 0.13 (.005) |
| -240           | 239.0 (9.41)  | 3 | 4        | 0.13 (.005) | 0.13 (.005) |
| -480           | 479.0 (18.86) | 7 | 8        | 0.26 (.010) | 0.26 (.010) |
| -600           | 599.0 (23.58) | 9 | 10       | 0.26 (.010) | 0.26 (.010) |

# Magnet Channel LZM-030-T-XXX



Tolerances

| Metric    | English       |
|-----------|---------------|
| .x ± .25  | [.xx] ± .01   |
| .xx ± .13 | [.xxx] ± .005 |



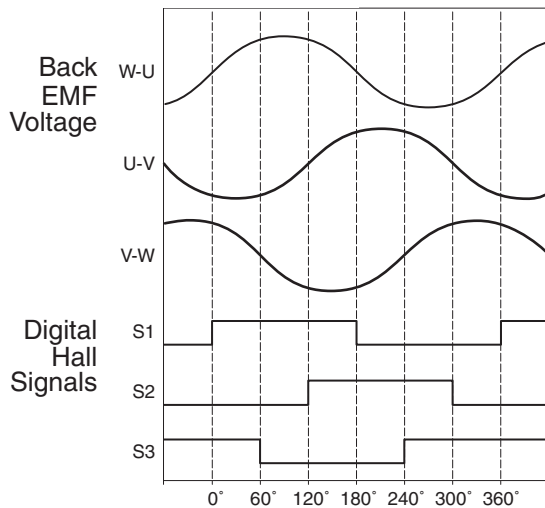
## Specifications LZ-030-HT-XXX

| Performance Parameters                   | Symbol      | Units  | LZ-030-HT-120   |     |                |     | LZ-030-HT-240   |                |                |                | LZ-030-HT-360   |                |     |                | LZ-030-HT-480   |                |     |                |
|--|-------------|--|-----------------|-----|----------------|-----|-----------------|----------------|----------------|----------------|-----------------|----------------|-----|----------------|-----------------|----------------|-----|----------------|
| Continuous Force <sup>1,5,6,7</sup>      | $F_{cTmax}$ | N<br>(lbf)   | 88<br>(20)      |     |                |     | 175<br>(39)     |                |                |                | 263<br>(59)     |                |     |                | 351<br>(79)     |                |     |                |
| Peak Force <sup>2</sup>                  | $F_p$       | N<br>(lbf)   | 439<br>(99)     |     |                |     | 877<br>(197)    |                |                |                | 1247<br>(280)   |                |     |                | 1755<br>(395)   |                |     |                |
| Motor Constant <sup>1</sup>              | $K_M$       | $\frac{N}{\sqrt{W}}$<br>( $\frac{lbf}{\sqrt{W}}$ ) | 9.6<br>(2.2)    |     |                |     | 13.5<br>(3.0)   |                |                |                | 16.6<br>(3.7)   |                |     |                | 19.1<br>(4.3)   |                |     |                |
| Thermal Resistance                       | $R_{th}$    | °C/W   | 1.31            |     |                |     | 0.65            |                |                |                | 0.44            |                |     |                | 0.33            |                |     |                |
| Max Power Dissipation                    | $P_{cTmax}$ | W  | 84              |     |                |     | 168             |                |                |                | 252             |                |     |                | 336             |                |     |                |
| Maximum Applied Bus Voltage <sup>8</sup> | $V_{DC}$    | Volts  | 325             |     |                |     | 325             |                |                |                | 325             |                |     |                | 325             |                |     |                |
| Electrical Cycle Length                  | $E_c$       | mm   | 60              |     |                |     | 60              |                |                |                | 60              |                |     |                | 60              |                |     |                |
| Electrical Time Constant                 | $\tau_e$    | msec   | 1.9             |     |                |     | 1.9             |                |                |                | 1.9             |                |     |                | 1.9             |                |     |                |
| Maximum Coil Temperature                 | $T_{max}$   | °C   | 130             |     |                |     | 130             |                |                |                | 130             |                |     |                | 130             |                |     |                |
| Winding Type                             |             |  | D               | E   | F              | G   | D               | E              | F              | G              | D               | E              | F   | G              | D               | E              | F   | G              |
| Force Constant <sup>1</sup>              | $K_F$       | $\frac{N}{A_{pk}}$<br>( $\frac{lbf}{A_{pk}}$ )     | 26.5<br>(6.0)   | N/A | 15.3<br>(3.4)  | N/A | 26.5<br>(6.0)   | 53.0<br>(11.9) | 15.3<br>(3.4)  | 30.6<br>(6.9)  | 26.5<br>(6.0)   | 79.5<br>(17.9) | N/A | 45.9<br>(10.3) | 26.5<br>(6.0)   | 53.0<br>(11.9) | N/A | 30.6<br>(6.9)  |
| Back EMF Constant p-p <sup>3,4</sup>     | $K_e$       | $\frac{V_p}{m/s}$<br>( $\frac{V_p}{in/s}$ )        | 31.3<br>(0.8)   | N/A | 18.1<br>(0.5)  | N/A | 31.3<br>(0.8)   | 62.6<br>(1.6)  | 18.1<br>(0.5)  | 36.2<br>(0.9)  | 31.3<br>(0.8)   | 93.9<br>(2.4)  | N/A | 54.2<br>(1.4)  | 31.3<br>(0.8)   | 62.6<br>(1.6)  | N/A | 36.2<br>(0.9)  |
| Peak Current <sup>2,4</sup>              | $I_p$       | $A_{pk}$<br>( $A_{rms}$ )                          | 16.5<br>(11.7)  | N/A | 28.7<br>(20.3) | N/A | 33.1<br>(23.4)  | 16.5<br>(11.7) | 57.3<br>(40.5) | 28.7<br>(20.3) | 47.0<br>(33.2)  | 15.7<br>(11.1) | N/A | 27.1<br>(19.2) | 66.2<br>(46.8)  | 33.1<br>(23.4) | N/A | 57.3<br>(40.5) |
| Continuous Current <sup>1,4,5,6</sup>    | $I_{cTmax}$ | $A_{pk}$<br>( $A_{rms}$ )                          | 3.3<br>(2.3)    | N/A | 5.7<br>(4.1)   | N/A | 6.6<br>(4.7)    | 3.3<br>(2.3)   | 11.5<br>(8.1)  | 5.7<br>(4.1)   | 9.9<br>(7.0)    | 3.3<br>(2.3)   | N/A | 5.7<br>(4.1)   | 13.2<br>(9.4)   | 6.6<br>(4.7)   | N/A | 11.5<br>(8.1)  |
| Resistance p-p <sup>3</sup> @20°C        | $R_{20}$    | ohm  | 7.15            | N/A | 2.38           | N/A | 3.57            | 14.29          | 1.19           | 4.76           | 2.38            | 21.44          | N/A | 7.15           | 1.79            | 7.15           | N/A | 2.38           |
| Inductance p-p <sup>3</sup>              | $L$         | mH   | 13.40           | N/A | 4.47           | N/A | 6.70            | 26.80          | 2.23           | 8.93           | 4.47            | 40.20          | N/A | 13.40          | 3.35            | 13.40          | N/A | 4.47           |
| <b>Mechanical Parameters</b>             |             |  |                 |     |                |     |                 |                |                |                |                 |                |     |                |                 |                |     |                |
| Magnetic Attraction                      | $F_a$       | N<br>(lbf)   | 0<br>(0)        |     |                |     | 0<br>(0)        |                |                |                | 0<br>(0)        |                |     |                | 0<br>(0)        |                |     |                |
| Coil Mass                                | $M_c$       | kg<br>(lbf <sub>m</sub> )                          | 0.74<br>(1.64)  |     |                |     | 1.37<br>(3.02)  |                |                |                | 2.00<br>(4.41)  |                |     |                | 2.63<br>(5.79)  |                |     |                |
| Magnetic Channel Mass                    | $M_n$       | kg/m<br>(lbf/in)                                   | 15.85<br>(0.89) |     |                |     | 15.85<br>(0.89) |                |                |                | 15.85<br>(0.89) |                |     |                | 15.85<br>(0.89) |                |     |                |

**Notes:** Motor performance specifications are with sinusoidal commutation.

- Continuous forces, motor constant and currents listed are with coils at maximum temperature 130°C, mounted to a heat sink that is equivalent to an aluminum slide 25.4mm (1.0") thick with the following areas: 120 coil 774cm<sup>2</sup> (120in<sup>2</sup>), 240 coil 1160cm<sup>2</sup> (180in<sup>2</sup>), 360 coil 1680cm<sup>2</sup> (260 in<sup>2</sup>), 480 coil 2060cm<sup>2</sup> (320 in<sup>2</sup>).
- Calculated at 4% duty cycle with a maximum on time of 1 second.
- All winding parameters listed are measured line-to-line (phase-to-phase).
- All currents and voltages are measured 0-peak of the sine wave unless noted rms.
- Continuous force and current based on coil moving with all phases sharing the same load in sinusoidal commutation.
- For stand still conditions multiply continuous force and continuous current by 0.9.
- Coil mountings on either of the two narrow sides reduces continuous force by 10%.
- Maximum cable length 10 meters. Please consult factory concerning applications requiring longer cables  
All specifications are ±10%. Phase-to-phase inductance is ±30%.

### Motor Phasing Diagram



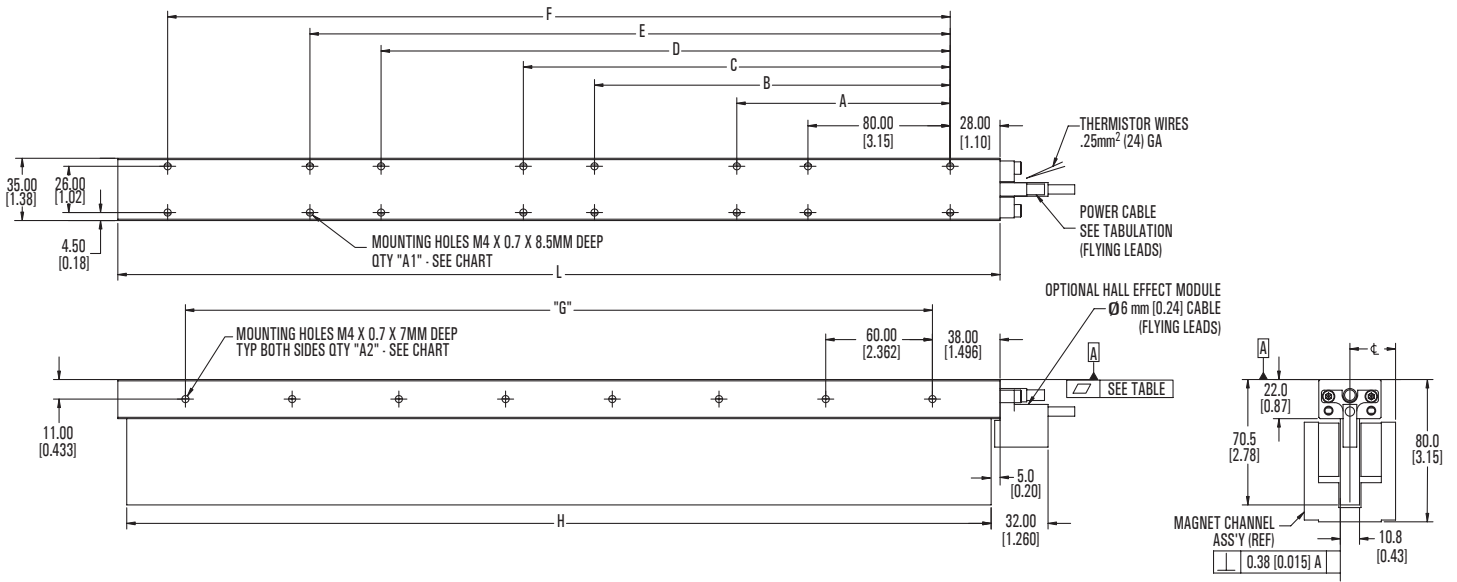
Note: Phasing direction is coil moving towards motor power cable

### Dimensions mm [in]

| Size    | Winding Code     | Power Cable Dia. | Gauge                    |
|---------|------------------|------------------|--------------------------|
| 030-120 | D<br>F           | φ6.1 (.24)       | 0.75mm <sup>2</sup> (18) |
| 030-240 | D<br>E<br>F<br>G | φ6.1 (.24)       | 0.75mm <sup>2</sup> (18) |
| 030-360 | D<br>E<br>G      | φ6.1 (.24)       | 0.75mm <sup>2</sup> (18) |
| 030-480 | D<br>E<br>G      | φ6.1 (.24)       | 0.75mm <sup>2</sup> (18) |

# Coil Assembly LZ-030-HT-XXX

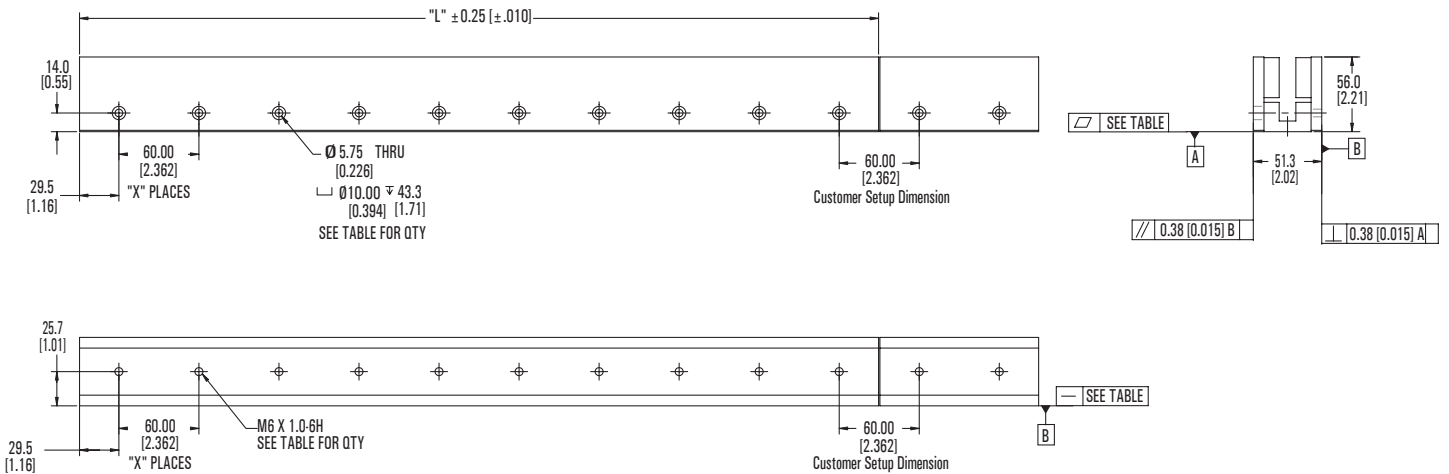
Dimensions mm [in]



| Coil    |                |                |                |                |                 |                 |                 |                 |               |        |        |             |
|---------|----------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|-----------------|---------------|--------|--------|-------------|
| Size    | L              | A              | B              | C              | D               | E               | F               | G               | H             | A1 QTY | A2 QTY | Flatness A  |
| 030-120 | 136.00 (5.35)  | ---            | ---            | ---            | ---             | ---             | ---             | 60.00 (2.362)   | 126.0 (4.96)  | 4      | 3      | 0.25 (.010) |
| 030-240 | 256.00 (10.08) | 120.00 (4.724) | 200.00 (7.874) | ---            | ---             | ---             | ---             | 180.00 (7.087)  | 246.0 (9.69)  | 8      | 5      | 0.25 (.010) |
| 030-360 | 376.00 (14.80) | 120.00 (4.724) | 200.00 (7.874) | 240.00 (9.449) | 320.00 (12.598) | ---             | ---             | 300.00 (11.811) | 366.0 (14.41) | 12     | 7      | 0.38 (.015) |
| 030-480 | 496.00 (19.53) | 120.00 (4.724) | 200.00 (7.874) | 240.00 (9.449) | 320.00 (12.598) | 360.00 (14.173) | 440.00 (17.323) | 420.00 (16.535) | 486.0 (19.13) | 16     | 9      | 0.64 (.025) |

| Magnet Channel |               |   |          |             |             |
|----------------|---------------|---|----------|-------------|-------------|
| Size           | L             | X | Hole Qty | —           | ▭           |
| -120           | 119.0 (4.69)  | 1 | 2        | 0.13 (.005) | 0.13 (.005) |
| -180           | 179.0 (7.05)  | 2 | 3        | 0.13 (.005) | 0.13 (.005) |
| -240           | 239.0 (9.41)  | 3 | 4        | 0.13 (.005) | 0.13 (.005) |
| -480           | 479.0 (18.86) | 7 | 8        | 0.26 (.010) | 0.26 (.010) |
| -600           | 599.0 (23.58) | 9 | 10       | 0.26 (.010) | 0.26 (.010) |

# Magnet Channel LZM-030-HT-XXX



Tolerances

| Metric    | English       |
|-----------|---------------|
| .x ± .25  | [.xxx] ± .01  |
| .xx ± .13 | [.xxx] ± .005 |





































