ANORAD

LZ Series Linear Motors

USER MANUAL

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Anorad

Rockwell Automation

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls, publication SGI-1.1, available from your local Rockwell Automation sales office or online at http://literature.rockwellautomation.com. It describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

WARNING	Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
IMPORTANT	Identifies information critical for successful application and understanding of the product.
ATTENTION	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard and recognize the consequences.
SHOCK HAZARD	Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
BURN HAZARD	Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

Table of Contents

Preface

Read this preface to familiarize yourself with the manual.

About This Publication

This manual provides detailed installation instructions for mounting, wiring, maintaining, and troubleshooting your LZ Linear Motor.

Who Should Use This Manual

This manual is intended for engineers or technicians directly involved in the installation, wiring, and maintenance of this LZ linear motor. Any person that teaches, operates, maintains, or repairs these linear motors must be trained and demonstrate the competence to safely perform the assigned task.

If you do not understand linear motors, contact your local Anorad/Rockwell Automation sales representative for information on available training courses before using this product.

Read this entire manual before you attempt to install your LZ linear motor into your motion system. This will familiarize you with the linear motor components, their relationship to each other and the system.

After installation, check the configuration of the system parameters to be sure they are properly set for using the linear motor in your motion system.

Be sure to follow all instructions carefully and pay special attention to safety concerns.

Additional Resources

The following documents contain additional information concerning related Anorad and Allen-Bradley products.

Resource	Description
Kinetix 2000 Multi-axis Servo Drive User Manual, publication 2093-UM001	Information on wiring, configuring, operating, and troubleshooting a Kinetix 2000 drive.
Kinetix 6000 Multi-axis Servo Drive User Manual, publication 2094-UM001	Information on wiring, configuring, operating, and troubleshooting a Kinetix 6000 drive.
LZ Family of Linear Motors Brochure, publication PMC-BR001	Provide detailed specifications and ordering information for the LZ series linear motors.
Ultra3000 Installation Manual, publication 2098-IN003	Information on wiring, configuring, operating, and troubleshooting a Ultra3000 drive.

Understanding and Caring for Your Linear Motor

Introduction

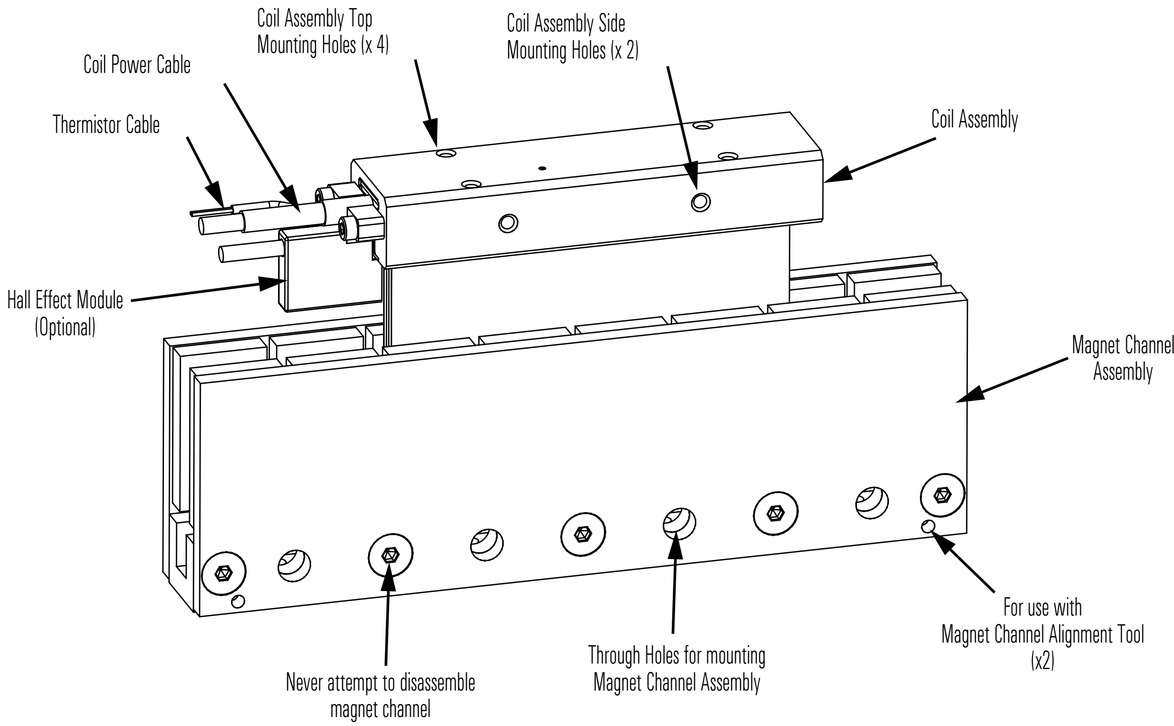
The LZ Linear Motor Series description and maintenance is given in this section. Product features are explored and the part numbering system is explained. This information will help you develop an understanding of the linear motor's basic configuration.

Product Description

The LZ Linear Motor diagram on page 8 shows the LZ linear motor major components.

Anorad's LZ Series of epoxy core linear motors are made with the latest magnetic materials and optimized by Finite Element Analysis (FEA) achieving a very high force density. The LZ Linear Motors are available in models with continuous forces from 68 N…850 N (15 lbf …191 lbf), and peak forces from 342 N…4250 N (77 lbf … 955 lbf).

LZ Linear Motor



For servo drives that require commutation feedback, an optional trapezoidal (digital) Hall effect feedback module may be attached to the front of the motor coil. The LZ linear motor may also be commutated via software. Anorad and Rockwell Automation offers a full line of compatible servo controls and drives.

Motor 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…4000 N.
- Continuous force from 70…900 N.
- Ideal for constant scanning application.

Identifying Your Linear Motor Components

Use the following key to identify your linear stage and its options coil and magnet assemblies.

LZ - *xxx* - *x* - *xxx* - *x* - *x* - *x* - *xx* - *x*

Cable Length
0 = 300 mm,
1 = 600 mm,
2 = 1000 mm

Thermal Protection
0 = None
TR = PTC Thermal Sensor

Hall Feedback
0 = No Feedback
T = Trapezoidal Hall Effect

Cooling Option
0 = No Cooling

Winding Code
D = Y Configuration
E = Y Configuration
F = Δ Configuration
G = Δ Configuration

Coil Length
120 = 120 mm
240 - 240 mm
360 = 360 mm
480 = 480 mm

Configuration
0 = Match to ’0’ Option Magnet Channel
T = Match to ‘T’ Option Magnet Channel
HT = Match to ‘HT’ Option Magnet Channel

Magnet Length
030 = 30 mm
050 = 50 mm
075 = 75 mm
100 = 100 mm

Bulletin Number

LZM - *xxx* - *x* - *xxx*

Magnet Channel Length
120 = 120mm,
180 = 180mm
240 = 240mm
480 = 480mm
600 = 600mm

Configuration
0 = Match to ’0’ Option Coil
T = Match to ’T’ Option Coil
HT = Match to ’HT’ Option Coil

Magnet Length
030 = 30 mm
050 = 50 mm
075 = 75 mm
100 = 100 mm

Bulletin Number

Maintenance

Anorad linear motors require no maintenance when operated in a relatively clean environment. For operation in harsh and dirty environments, minimal cleaning is recommended every 6 months.

Clean the metallic debris and other contaminants from the air gap. To effectively remove the metal debris use a strip of masking tape. Simply put a strip of tape in the magnet channel and then remove it.

Keeping the magnet channel clean will prevent witness marks. Witness marks are caused by metal debris being dragged across the surface of the magnet by the magnet field of the moving coil. Witness marks have no effect on the performance of the motor.

Motor Storage

Store the motor in a clean, dry, and vibration free environment it should be kept at relatively constant temperature. The coil resistance measurement checks explained in this manual should be done at time of storage. If a motor is stored on the equipment, it should be protected from the weather.

Installation

Introduction

Use the following section to guide you through installation and start-up of your LZ linear motor.

Unpacking and Inspection

Inspect motor assemblies for damage that may have occurred in shipment. Any damage or suspected damage should be immediately documented. Claims for damage due to shipment are usually made against the transportation company. Contact Anorad immediately for further advise.

ATTENTION

Linear motors contain powerful permanent magnets which require extreme caution during handling. When handing multiple magnet channels do not allow the channels to come in contact with each other. Do not disassemble the magnet channels. The forces between channels are very powerful and can cause bodily injury. Persons with pacemakers or Automatic Implantable Cardioverter Defibrillator (AICD) should maintain a minimum distance of 0.33 m (1 ft) from magnet assemblies. Additionally, unless absolutely unavoidable, a minimum distance of 1.5 m (5 ft) feet must be maintained between magnet assemblies and other magnetic or ferrous composite materials. Use only non-metallic instrumentation when verifying assembly dimension prior to installation

- Compare the purchase order with the packing slip.
- Check the quantity of magnet channels received matches your job requirements.
- Identify the options that came with your linear motor.
- Inspect the assemblies and confirm the presence of specified options.

Installing the Linear Motor

Use the following procedures to install the magnet channel and the motor coil to create a linear motor.

Mount the Magnet Channel

The required tools are:

- magnet channel alignment tool (supplied).
- aluminum straight edge.
- non-magnetic M4 or M5 hex wrench.

Use M6 SHCS for channel mounting configuration A, or M5 SHCS for channel mounting configuration B and C see diagram on page 14. See Specifications and Dimensions starting on page 31 for quantity.

Use the follow steps to safely install your magnet channel on to the mounting surface.

ATTENTION

To avoid injury or damage from unexpected motion of the channel caused by the magnetic attraction between channels, maintain a minimum distance of 1.2 m (5 ft) between the channel that are being installed and the channels awaiting installation. Leave protective cardboard and conductive metal plates in place until the installation is performed.

1. Be sure to the mounting surface is clear of any and all of foreign matter.

ATTENTION

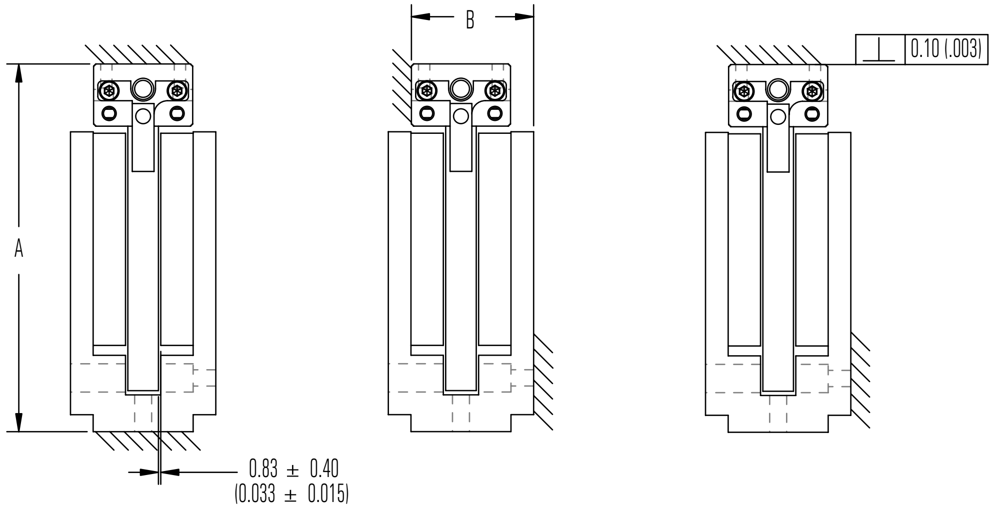
Do not use abrasives to clean the surface.

   If necessary the surface maybe stoned (acetone or methanol may be used as cleaning agent).

2. Verify the flatness of the surface to which the magnet channel is to be mounted.

   The total indicator reading (TIR) is 0.127 mm (0.005 in.) per 300 mm (12 in.). TIR or runout, correlates to an overall flatness of a surface.

3. Verify that the mounting configuration for the magnet channel and coil fits in envelope dimensions shown in diagram.



Catalog Number	A mm (in.)
LZM-030-*x-xxx-x-x-x-x-x*	80.0 (3.15)
LZM-050-*x-xxx-x-x-x-x-x*	100.0 (3.94)
LZM-075-*x-xxx-x-x-x-x-x*	130.0 (5.12)
LZM-100-*x-xxx-x-x-x-x-x*	155.0 (6.10)

Catalog Number	B mm (in.)
LZM-030-0-*xxx-x-x-x-x-x* LZM-050-0-*xxx-x-x-x-x-x*	36.4 (1.43)
LZM-030-T-*xxx-x-x-x-x-x* LZM-050-T-*xxx-x-x-x-x-x*	37.7 (1.48)
LZM-030-HT-*xxx-x-x-x-x-x* LZM-050-HT-*xxx-x-x-x-x-x*	43.15 (1.70)
LZM-075-0-*xxx-x-x-x-x-x* LZM-100-0-*xxx-x-x-x-x-x*	38.05 (1.50)
LZM-075-T-*xxx-x-x-x-x-x* LZM-100-T-*xxx-x-x-x-x-x*	39.35 (1.55)
LZM-075-HT-*xxx-x-x-x-x-x* LZM-100-HT-*xxx-x-x-x-x-x*	43.15 (1.70)

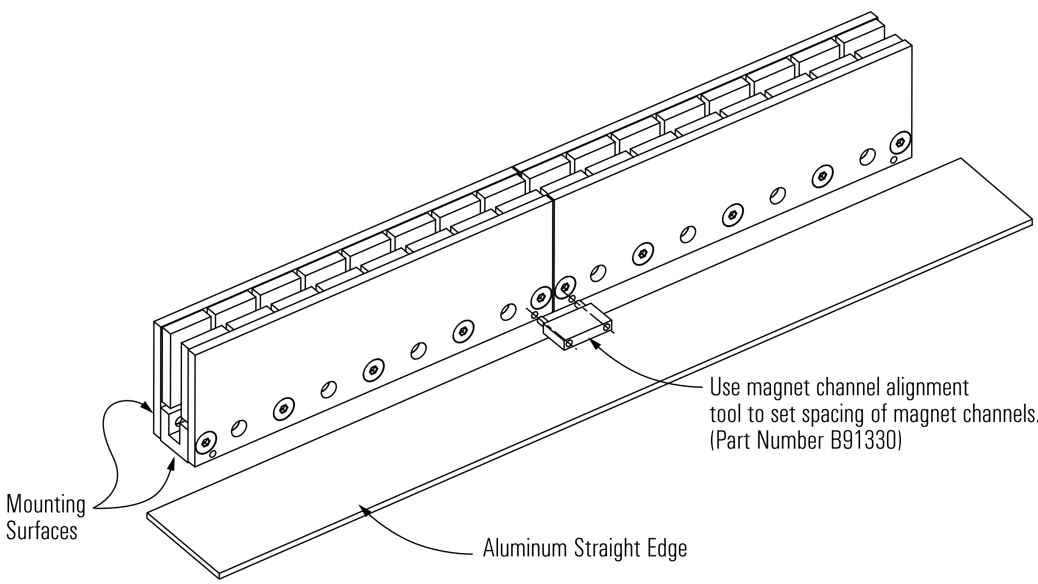
4. Install the first magnet channel using M6 SHCS for mounting configuration A, or M5 SHCS for mounting configuration B and C.

TIP Non-magnetic tools and hardware such as beryllium copper, 300 series stainless steel, and others should be used. If not available, proceed carefully since magnetic and ferrous items will be attracted to the magnet channel.

5. Do not tighten bolts at this time. Install additional magnet channels by placing them on the mounting surface at a distance from the previously installed magnet channel, and then slide it towards its final location.

6. The final alignment of the magnet channels is done with an aluminum straight edge and the alignment tool.

   Place the alignment tool in the alignment holes on each of the channels as shown in diagram. Align the edges of the channel with the aluminum straight edge and tighten the bolts.



Motor Coil Mounting Hardware Requirements

Select M4 x 0.7 bolts with a length that extends through your machine slide by 5 mm minimum, but not more then 7 mm.

Mount the Motor Coil

Follow these procedures to mount the motor coil to your machine slide.

1. Be sure the motor coil mounting face is clean and free of burrs.

2. Position the slide at the end of travel where the cable is to exit.

3. Using M4 x 0.7 bolts with a length as defined by previously in Motor Coil Mounting Hardware Requirements. Lightly tighten bolts.

4. Using plastic shim stock measure the gap between the motor and magnet. The gap should be 0.83 ± 0.4 (0.033 ± 0.15).

5. Torque all bolts to values listed on the tables in Appendix B. When considering torque values for mounting hardware, take into account the magnet channel mounting surface material and mounting hardware. Secure assemblies in place using all mounting holes.

Motor Power and Feedback Cable Signal Names

The following tables show the motor power and feedback cable signal names. These cables are not suitable for continuous flexing operation and should be terminated and connected to flex type cables for any continuous flex operation.

IMPORTANT Improper wiring can lead to the motor not responding to commutation commands, run away conditions, or the motor performing at about half its specified force.

Motor Power Cable Signals

Color from Motor	Designation	Comments
Red	Motor Phase U (A)	• Observe maximum applied voltage specification. • Consult drive manual or supplier for specific wiring instructions to the drive. Wiring is phase-commutation sensitive.
White	Motor Phase V (B)	
Black	Motor Phase W (C)	
Green/Yellow	Motor Ground	• Terminate per drive manual instructions. • Shield is not connected to the motor frame.
Shield	Cable Shield	

ATTENTION

Disconnect the input power supply before installing or servicing the motor.

The motor lead connections can short and cause damage or injury if not well secured and insulated.

Insulate the connections, equal to or better than the insulation on the supply conductors.

Properly ground the motor per the selected drive manual.

Feedback Cable Signals

Signal Type	Color from Module	Signal Designation	Comment
Trapezoidal Hall Effect Circuit	Red	+V	5-24Vdc Hall Supply, 20 mA.
	Black	VRTN	Hall signal common.
	White	S1	• Trapezoidal Hall Signals, 120° Spacing, Open Collector Transistor (24Vmax) Outputs (Pull-up Resistor External). • Consult the drive manual or supplier for specific wiring instructions to the drive. Wiring is phase-commutation sensitive.
	Blue	S2	
	Orange	S3	
Shield	Silver Brad	Cable Shield	Terminate at the drive end per the drive manual instructions.
Thermistor	Black Black	TR+ TR-	Positive Temperature Coefficient (PTC) thermistor.

Motor-Hall Phasing and Sequence

The LZ linear motor family is compatible with off-the-shelf brushless motor servo drives. The servo drive will see them as a two-pole motor with a full electrical cycle of 60 millimeters (360 degrees equivalent rotary motion).

The brushless motor drives and controls must have two control functions for suitable commutation of a linear motor.

- Upon power-up, the servo drive must be able learn where the motor electrical coil phases are with respect to the north and south magnetic fields, and align its three phase drive current accordingly.
- The servo drive must be able to control the direction and magnitude of current through the three phases of the coil as it moves across the magnetic field.

Linear motors with Hall sensors (LZ -*xxx-x xxx-x-x*-T-*x-x*) can be used for Hall commutation feedback with brushless motor servo drives. See the relationship of the digital Hall signals to the back EMF of the motor coils in the diagram on page 18. These signals can be used in two ways:

- When using Hall-start-up, upon power-up, the brushless servo drive reads the state of the three digital Hall signals to approximate the motor coil location with respect to the magnetic field. The drive then switches to a fine sinusoidal commutation based on a the high resolution linear encoder feedback. A high resolution in encoder must be install in your system to use this feature.
- Some drives will perform trapezoidal commutation based solely on the feedback from the digital Hall signals.

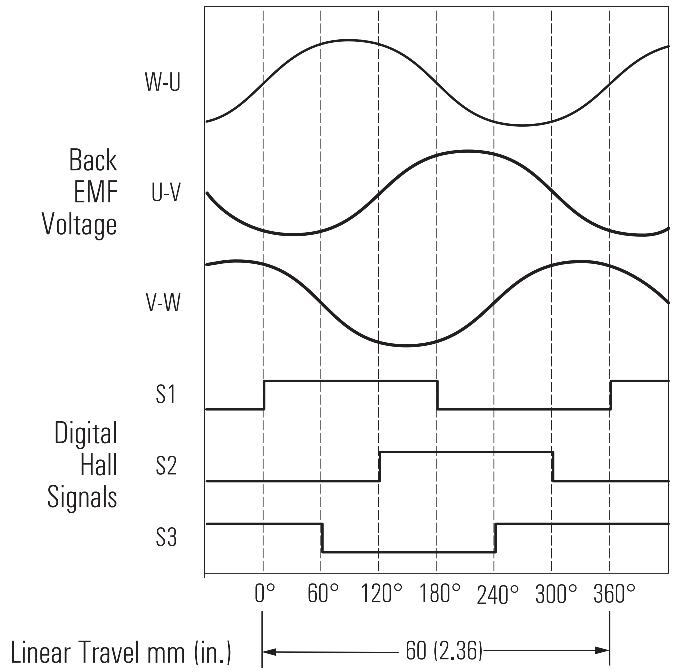
IMPORTANT For optimal commutation and force generation, the selected brushless servo motor drive must be compatible with the LZ series phasing, and be wired to the motor coil correctly.

As shown in the phasing diagram:
S1 is in phase with W-U back EMF
S2 is in phase with U-V back EMF
S3 is in phase with V-W back EMF
Phase sequence = S1 leads S2 leads S3. Spacing is 120 degrees.

ATTENTION Incorrect motor and Hall wiring can cause runaway conditions.

IMPORTANT Phasing direction = the coil toward the motor power cable or the magnet assembly away from the power cable.

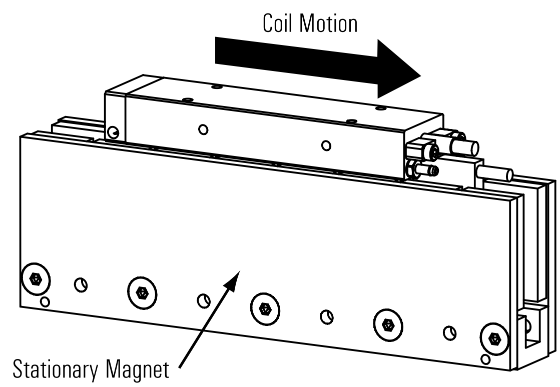
Motor Phasing Diagram
Back EMF Voltage vs. Hall Signals



Phasing direction = the coil toward motor power cable for moving coil configuration as shown in Positive Motor Direction or the magnet assembly away from power cable for moving magnet configuration.

Positive Motor Direction

When properly wired this is considered the positive direction.



Motor Coil Thermal Protection

ATTENTION

LZ linear motors with the thermal protection option will supply a signal that indicates the motor temperature limit condition. This signal should be used by the motor control or drive system to immediately shut down the motor power on an open condition. Since linear motors are generally not repairable, and typically highly integrated into the mechanical structure, redundant motor thermal protection is strongly recommended.

- Typical digital drives have “RMS” current protection and I^2T or estimated temperature vs. time software protection schemes. These available features should be activated and set according to the motor model ratings for there application.
- The selected drive should have ± peak current magnitude limits that should be set according to the motor’s peak current rating, as a maximum.
- For drives without adjustable or available motor protection features, motor fuses (current rating not to exceed motor continuous RMS) should be installed per the Local and National Electrical Code. The fuses should be time-delay type and rated for the drive PWM output voltage.
- Design control circuit to trip at 130°C as necessary.

Temperature °C (°F)	Resistance in Ohms
Up to 25 (77)	≤ 300
Up to 125 (257)	≤ 1500
Up to 135 (275)	≥ 4000

Operational Guidelines

After installing the motor and before powering up your system for the first time, performed the Motor Coil Electrical Test on page 23 to verify motor condition.

ATTENTION

Moving parts can injure. Before running the motor, make sure all components are secure and the magnet mounting hardware is below magnet surface. Remove all unused parts from the motor travel assembly to prevent them from jamming in the motor air gap and damaging the coil or flying off and causing bodily injury.

Run away condition: incorrect motor-hall (commutation) wiring and position feedback (position encoder) to servo control can cause uncontrolled speeding.

Keep away from the line of motor travel at all times.

High Voltage can kill. Do not operate with protective covers removed. Do not go near electrically live parts.

Maximum Safe Speed: Linear motors are capable of very high forces, accelerations and speeds. The maximum obtainable acceleration and speed is based on the drive output (bus voltage and current settings). The allowable maximum speed is application specific and partly based on the linear motion mechanics supplied by others.

IMPORTANT

You are responsible for ensuring the servo control system safely controls the linear motor with regards to maximum safe force, acceleration and speed, including runaway conditions.

Chapter **3**

Troubleshooting

Introduction

Use this section to diagnose the health of motor coil and the Hall effect module.

Hall Effect Module

Use the following procedures to troubleshoot the Hall effect module.

ATTENTION

Even with the motor power disabled and leads disconnected, permanent magnet motors can generate high back EMF voltage when moving due to external forces.

Hall Effect Circuit - Hall Signals Test

1. Turn the drive power OFF.
2. Verify the Hall circuit is connected to the drive per interface wiring specifications.
3. Disconnect the motor leads from the drive.
4. Turn the Hall power supply ON (driver power ON).
5. Using an oscilloscope, while referring to the Motor Phasing Diagram, check the waveforms at S1, S2 and S3 while slowly and steadily moving the motor by hand in the specified phasing direction.

6. Check for the proper logic levels (approximately 0V = low, +V = high) and the sequence: S1 leads S2 leads S3 with approximately 120 electrical degree spacing in between.

TIP Connect the probe common to the Hall signal common.

Hall to Back EMF Phasing

1. Turn the drive power OFF.
2. Verify the Hall circuit is connected to the drive per interface wiring specifications.
3. Disconnect the motor leads from the drive.
4. Turn the Hall power supply ON (driver power ON).
5. While slowly and steadily moving the motor by hand, perform the Hall Signal Test except this time check the motor phases are in-phase with the specific Hall signal per the Motor Phasing Diagram. The phase error between the Hall signal and the in-phase Back EMF should be within ± 5 electrical degrees.

IMPORTANT Observe the Back EMF phase polarity.
Back EMF U-V means:
Probe tip on U phase and probe common on V phase

PTC Thermal Signal

At ambient room temperature, approximately 25 °C (77 °F), the resistance measurement between PTC Temp+ and Common should be ≤ 300 Ω

The table lists the increase in resistance at higher temperatures outside the normal operating temperature envelope.

PTC Thermistor Signal Characteristics

Temperature °C (°F)	Resistance in Ohms
Up to 25 (77)	≤ 300
Up to 125 (257)	≤ 1500
Up to 135 (275)	≥ 4000

Motor Coil Electrical Test

Perform this test after installation and when a coil electrical fault is suspected.

ATTENTION

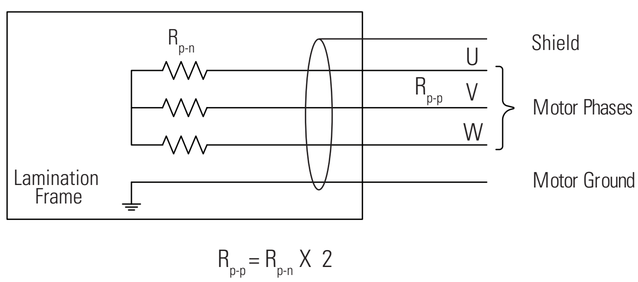
Dangerous voltages, forces and energy levels exist in servo controlled systems. Extreme care must be exercised when operating, maintaining or servicing the linear motor to prevent harm to personnel or equipment

1. Ensure the coil is at room temperature, approximately 25 °C (77 °F).

2. Turn the drive power OFF.

3. Ensure all the motor leads (phases and ground) are disconnected from the drive.

4. Referring to the diagram, measure the phase to phase (p-p) resistance of the three phase combinations and record the values. The three readings should be approximately equal to each other.



5. Measure the phase to ground resistance for each phase.

   The resistance to ground should be in excess of 100 megohms. A lower reading may indicate an electrical problem.

6. Disconnect the field cable at the coil assembly interface and repeat procedure.

   If any reading is still below 100 megohms, consult Anorad, as the motor may have an internal electrical problem.

7. Compare the phase resistance readings to the cold resistance specification of the specific coil model.

   The three reading should be about the same and comparable to the cold resistance specified for your model. When the coil is hot the resistance reading should still be balanced and but may be as mush as 30 … 40% higher than the cold resistance. To rule out the cable resistance, disconnect the field cable at the coil assembly interface and repeat the procedures at the coil.

IMPORTANT	Do not perform coil or insulation electrical stress tests (Megger or Hi-Pot test) without first consulting with Anorad technical support or engineering.

Motor Back EMF Tests

When the LZ motor phases are internally connected in a Y configuration (LZ-xxx-x-xxx-D/E-x-x-x-x). The neutral of the Y is not accessible without the use of a resistor star network. This is why all measurements are performed phase-to-phase.

Each phase can consist of single windings (coils) or multiple sets in series or parallel. Performing a back EMF voltage magnitude and phase sequence test is a good indicator of correct internal wiring.

Back EMF Wave Comparison Test

ATTENTION	Even with the motor power disabled and the leads disconnected, permanent magnet motors can generate high back EMF voltage when moving due to external forces.

1. See the Motor Phasing Diagram on page 18. Certain measurements in this test will be inverted.
2. Turn the drive power OFF.
3. Disconnect the motor leads from the drive.
4. With a 2 channel oscilloscope, compare U-V to W-V voltage by connecting the leads, and slowly and steadily moving the motor by hand, in the phasing direction specified in Motor-Hall Phasing and Sequence. W-V should lead U-V by 60°. The shapes and peak voltages should be approximately the same. Note that probe common = V.

5. Repeat step 4 comparing V-W to U-W. In this case U-W should lead V-W by 60^{o}. The shapes and peak voltages should be approximately the same. Note that probe common = W. Be sure to use the same phasing direction as in step 4.

Check Measured Back EMF to Specification

By comparing your measured and calculated Back EMF constant to the motor's specified back EMF constant, you can verify the correct installation and general health of the magnets and coil. The force constant has a direct relationship to the back EMF constant, so this test also checks the force constant. The calculation is based on the analysis of one motor electromechanical cycle. Problems can occur at any point along the motor travel, so check that the Back EMF waveshape is consistent throughout the whole travel.

1. Turn the drive power OFF.

2. Disconnect the motor leads from the drive.

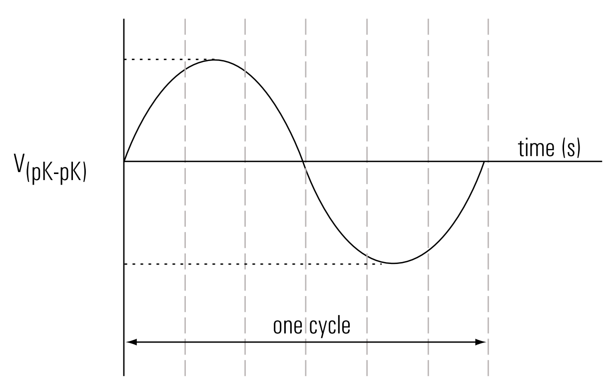
ATTENTION

Even with motor power disabled and leads disconnected, permanent magnet motors can generate high back EMF voltage when moving due to external forces.

3. Using a storage oscilloscope, connect one channel across any two phase leads.

4. Move the motor at a very steady and constant speed in either direction by hand. This is the motor's phase-phase back EMF.

5. Capture and analyze one electrical cycle.



Mechanical displacement of one electrical cycle = motor magnetic pitch (180^o) in inches multiplied by two. Note that the published specification may already be in "cycles." In this case do not multiply by two.

Use the following equation to calculate back EMF constant:

$$\frac{\text{mechanical displacement of one cycle (in)}}{\text{cycle time (s)}} = \text{velocity}\left[\frac{in}{s}\right]$$

$$V_{ptz} = V_{(pK\text{-}pK)} \text{ x } 0.5 \text{ (V)}$$

$$\frac{V_{ptz}}{\text{Velocity}\left[\frac{in}{s}\right]} = \text{Back EMF constant}\left[\frac{\text{Volts}_{ptz}[ptp]}{\frac{in}{s}}\right]$$

Note: $$\frac{\text{Volts}_{ptz}[ptp]}{\frac{in}{s}} \times 0.707 = \text{Back EMF constant}\left[\frac{\text{VoltsRMS}[ptp]}{\frac{in}{s}}\right]$$

Where:

ptz = peak to zero or peak of sinewave
ptp = phase to phase

When comparing to the published motor back EMF constant, make sure you convert the units as necessary.

If values do not match verify that you have installed the correct magnetic channel and coil assemblies and they have the correct air gap.

Checking the Magnet Channel Butting Polarity

The magnetic channels must be butted such that the magnet polarity sequence is alternating (north-south) throughout the whole travel. It is difficult to use the back EMF method to check this on motor coils with multiple sets. Analyzing the trapezoidal Hall effect signal over the whole travel is the best method of evaluating proper magnet channel polarity.

1. Refer to the Motor Phasing Diagram for the expected Hall waveshape.
2. With the drive power OFF, verify that the Hall circuit is connected to the drive per the interface wiring specifications.
3. Disconnect the motor leads from the drive.
4. Turn the Hall power supply ON (driver power ON).

5. Using an oscilloscope, connect one channel between any Hall signal (output) and the Hall signal common.

6. Slowly and steadily move the motor by hand in one direction over the whole travel. Monitor the waveshape as you are doing this.

   The Hall signal should alternate between a high and low DC level of equal duty cycle (squarewave), as the Hall module passes over the alternating polarity magnets. Especially at the magnet channel joints, ensure the squarewave shape is consistent. Any changes or irregularities in the squarewave duty cycle shape may indicate a magnet polarity problem. Note which magnet channel where the problem occurs. If a problem is suspected, first check to see if the channel alignment tool holes are all on the same side. If correct, contact Anorad Technical Support for further advice.

Hall Effect Module Removal and Replacement

Introduction

Use this section to change the Hall effect module.

Hall Effect Module

If a problem is detected with a Hall effect module use the following procedures to remove and replace the unit.

The following procedures require a 3 mm hex key, non-magnetic preferred, and cardboard to fit in magnet channel.

Replacement Hall Effect Modules

Coil Catalog No.	Winding Type	Hall Effect Module Part Number
LZ-xxx-x-xxx-D-x-x-xx-x	Y	B91860
LZ-xxx-x-xxx-E-x-x-xx-x		
LZ-xxx-x-xxx-F-x-x-xx-x	Delta	B91860-Delta
LZ-xxx-x-xxx-G-x-x-xx-x		

Remove the Hall Effect Module

1. Disconnect the Hall cable from the drive.

1. Place the cardboard in the magnet channel to prevent tools from damaging the magnets by limiting the attractive forces.

2. Remove the two M4 SHCS using a 3 mm hex key.

Install the Hall Effect Module

1. Place the cardboard in the magnet channel to prevent tools from damaging the magnets by limiting the attractive forces.

2. Place the module at the end of the motor with the sensor blade inserted in the magnet channel.

3. Install the two M4 SHCS using a 3 mm hex key. Do not over tighten.

4. Remove the cardboard from the magnet channel.

5. Connect the Hall cable connector.

Specifications and Dimensions

Introduction

Anorad/Rockwell Automation publication listed in Additional Resources on page 5 may supersede the information in this appendix.

Trapezoidal Hall Effect Circuit

Description	Specifications
Input Power	5…24V dc, 20 mA max.
Output	NPN, open collector, 10 mA max.
Hall signal common	• Trapezoidal Hall Signals, 120^{o} Spacing, Open Collector Transistor (24V max.) Outputs (Pull-up Resistor External) • Consult the drive manual or supplier for specific wiring instructions to the drive. Wiring is phase-commutation sensitive.

Positive Temperature Coefficient (PTC) Thermistor

Temperature °C (°F)	Resistance in Ohms
Up to 25 (77)	≤ 300
Up to 125 (257)	≤ 1500
Up to 135 (275)	≥ 4000

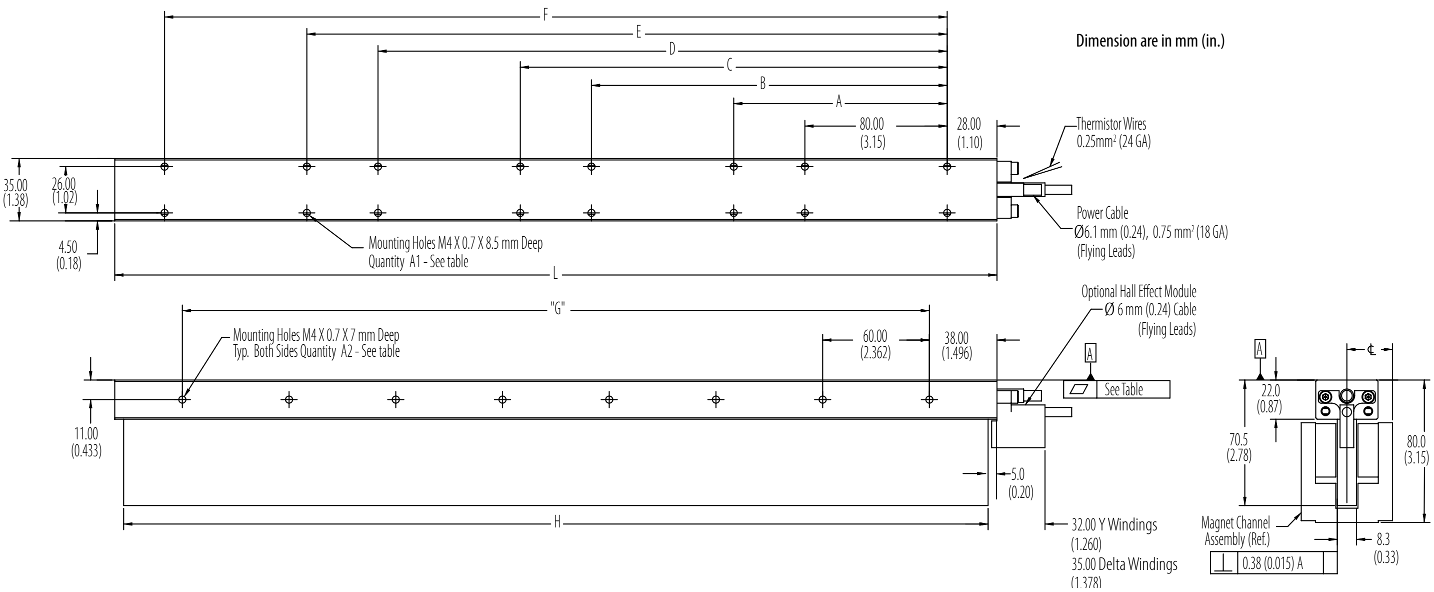
Environmental Specifications for LZ Linear Motors

Attribute	Value
Ambient temperature	0…40 °C (32…104 °F)
Storage temperature	-30…70 °C (-22…158 °F)
Relative humidity	5%…95% non-condensing

LZ Series Linear Motor Dimensions

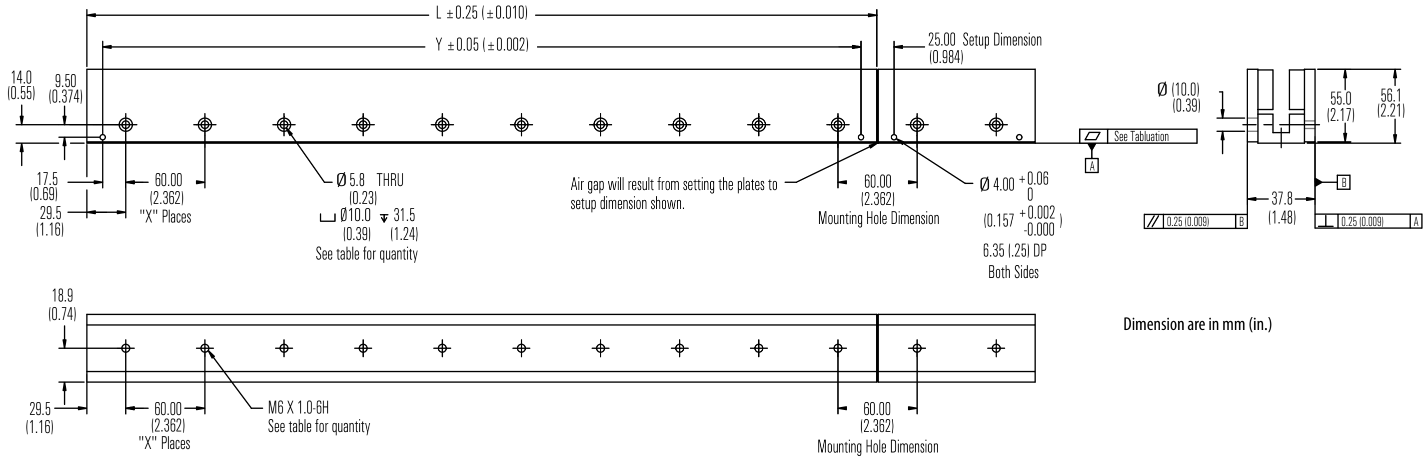
Linear motors are designed to metric dimensions. Inch dimensions are conversions from millimeters. Untolereated dimensions are for reference.

LZ Series Linear Motor Coil (Catalog Number LZ-030-0-*xxx*-*x*-0-*x*-*x*-*x*)



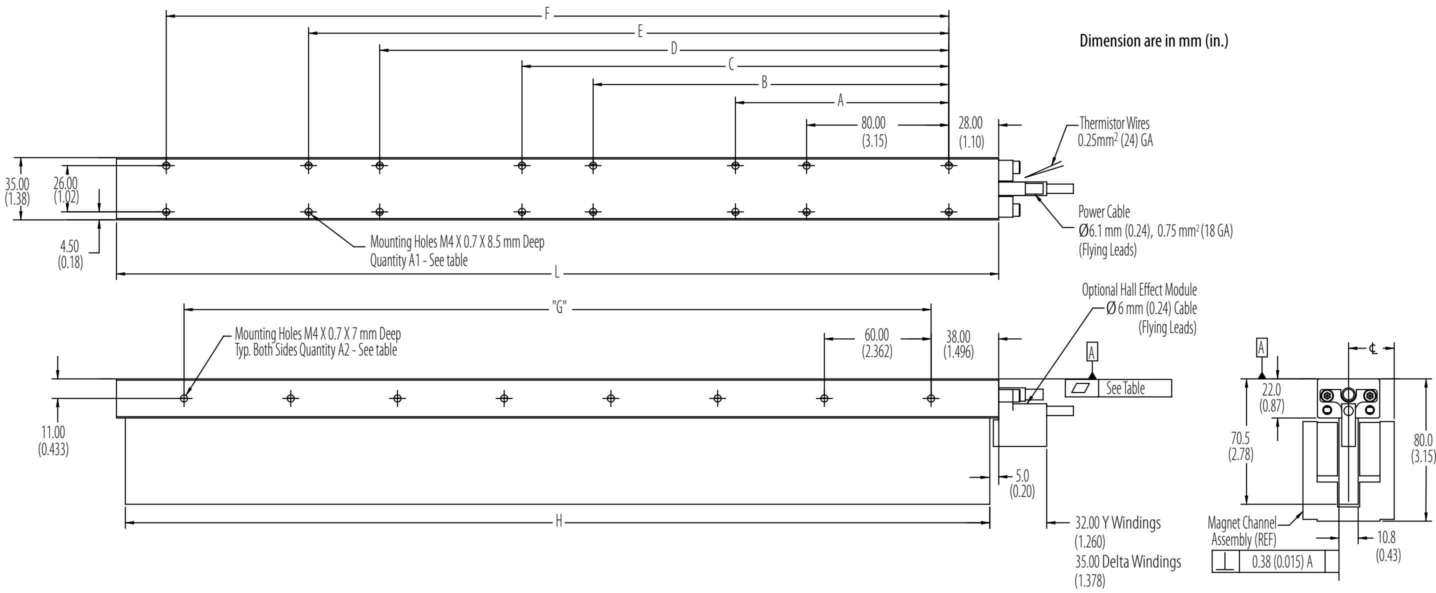
Coil Cat. No.	L mm (in.)	A mm (in.)	B mm (in.)	C mm (in.)	D mm (in.)	E mm (in.)	F mm (in.)	G mm (in.)	H mm (in.)	A1 QTY	A2 QTY	Flatness -A- mm (in.)
LZ-030-T-120-*x*-0-*x*-*x*-*x*	136.00 (5.35)							60.00 (2.362)	126.0 (4.96)	4	2	0.25 (0.010)
LZ-030-T-240-*x*-0-*x*-*x*-*x*	256.00 (10.08)	120.00 (4.724)	200.00 (7.874)					180.00 (7.087)	246.0 (9.69)	8	4	0.25 (0.010)
LZ-030-T-360-*x*-0-*x*-*x*-*x*	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	6	0.38 (0.015)
LZ-030-T-420-*x*-0-*x*-*x*-*x*	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	8	0.64 (0.025)

LZ Linear Motor Magnet Channel (Catalog Number LZM-030-0-*xxx*)



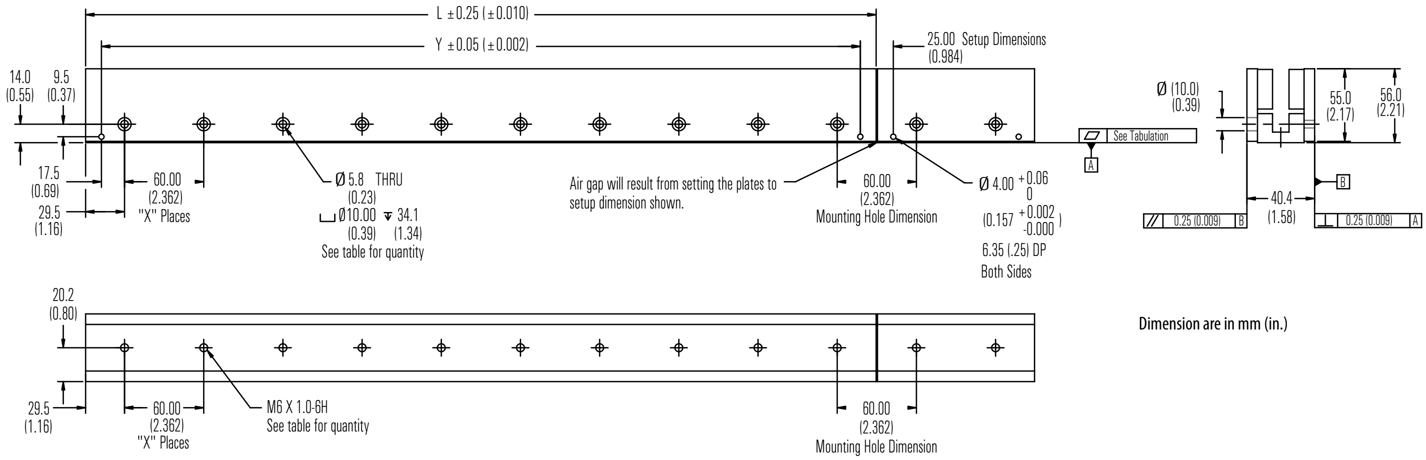
Magnet Channel Cat. No.	**L** mm (in.)	**X**	**Hole Quantity**	**Y** mm (in.)	**Flatness -A-** mm (in.)
LZM-030-0-120	119.0 (4.69)	1	2	95.0 (3.74)	0.13 (0.005)
LZM-030-0-180	179.0 (7.05)	2	3	155.0 (6.10)	0.13 (0.005)
LZM-030-0-240	239.0 (9.41)	3	4	215.0 (8.47)	0.13 (0.005)
LZM-030-0-480	479.0 (18.86)	7	8	455.0 (17.91)	0.26 (0.010)
LZM-030-0-600	599.0 (23.58)	9	10	575.0 (22.64)	0.26 (0.010)

LZ Series Linear Motor Coil (Catalog Number LZ-030-T-*xxx*-*x*-0-*x*-*x*-*x*)



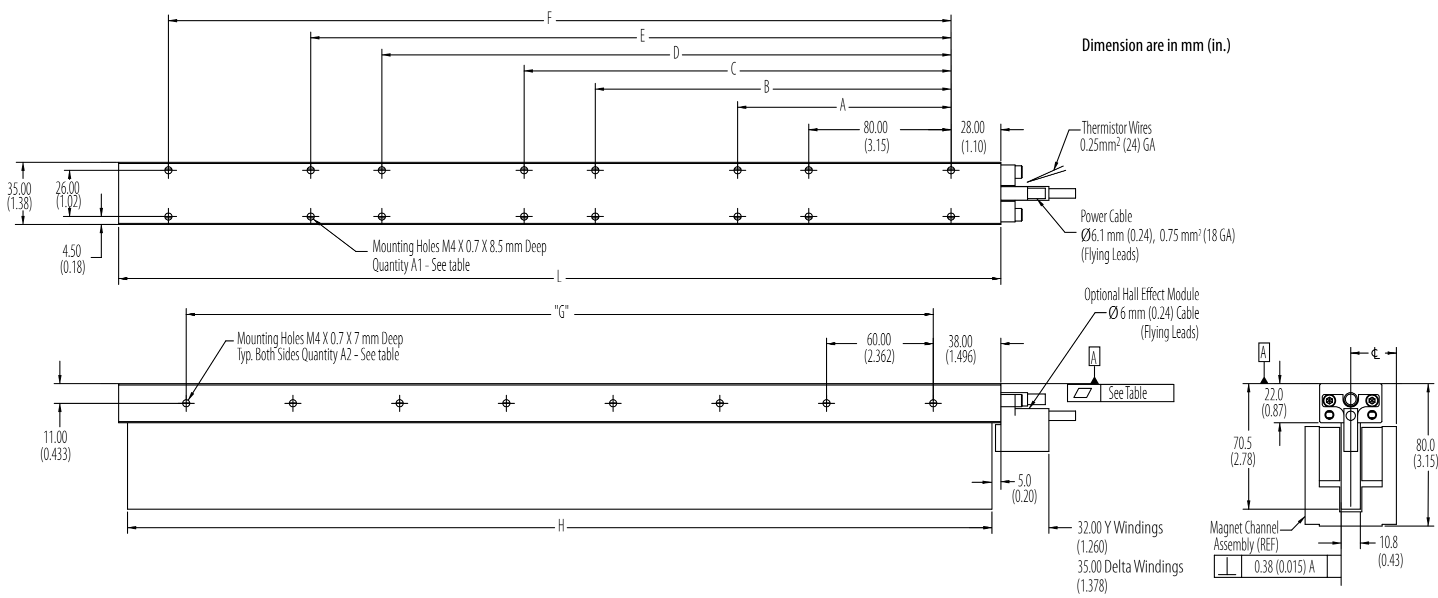
Coil Cat. No.	L mm (in.)	A mm (in.)	B mm (in.)	C mm (in.)	D mm (in.)	E mm (in.)	F mm (in.)	G mm (in.)	H mm (in.)	A1 QTY	A2 QTY	Flatness -A- mm (in.)
LZ-030-T-120-*x*-0-*x*-*x*-*x*	136.00 (5.35)							60.00 (2.362)	126.0 (4.96)	4	2	0.25 (0.010)
LZ-030-T-240-*x*-0-*x*-*x*-*x*	256.00 (10.08)	120.00 (4.724)	200.00 (7.874)					180.00 (7.087)	246.0 (9.69)	8	4	0.25 (0.010)
LZ-030-T-360-*x*-0-*x*-*x*-*x*	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	6	0.38 (0.015)
LZ-030-T-480-*x*-0-*x*-*x*-*x*	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	8	0.64 (0.025)

Magnet Channel Layout (Catalog Number LZM-030-T-*xxx*)



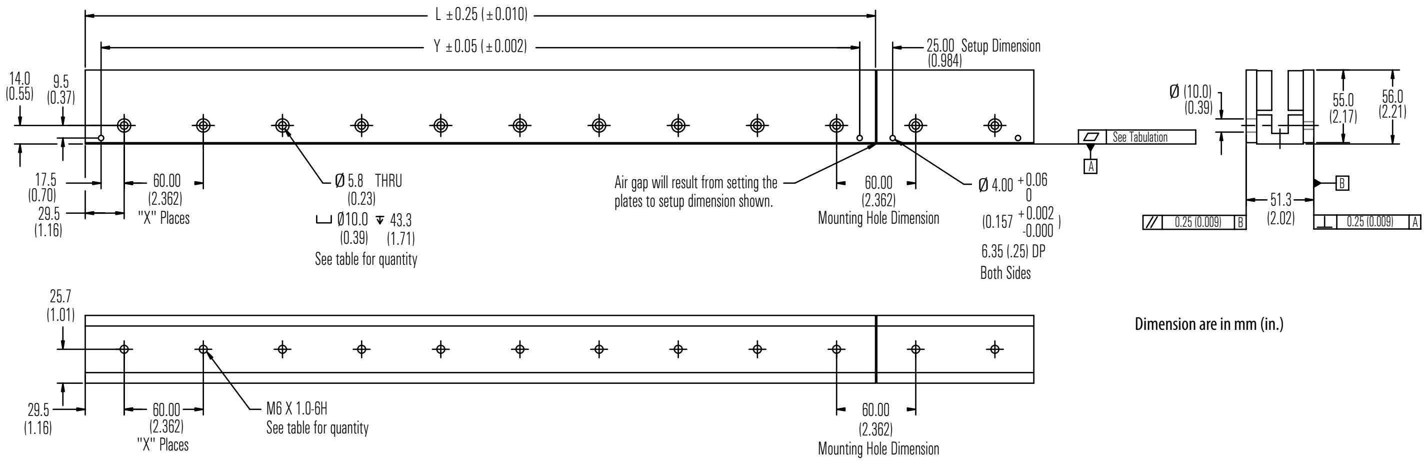
Magnet Channel Cat. No.	**L** mm (in.)	**X**	**Hole Quantity**	**Y** mm (in.)	**Flatness** mm (in.)
LZM-030-T-120	119.0 (4.69)	1	2	95.0 (3.74)	0.13 (0.005)
LZM-030-T-180	179.0 (7.05)	2	3	155.0 (6.10)	0.13 (0.005)
LZM-030-T-240	239.0 (9.41)	3	4	215.0 (8.47)	0.13 (0.005)
LZM-030-T-480	479.0 (18.86)	7	8	455.0 (17.91)	0.26 (0.010)
LZM-030-T-600	599.0 (23.58)	9	10	575.0 (22.64)	0.26 (0.010)

LZ Series Linear Motor Coil (Catalog Number LZ-030-HT-*xxx*-*x*-0-*x*-*x*-*x*)



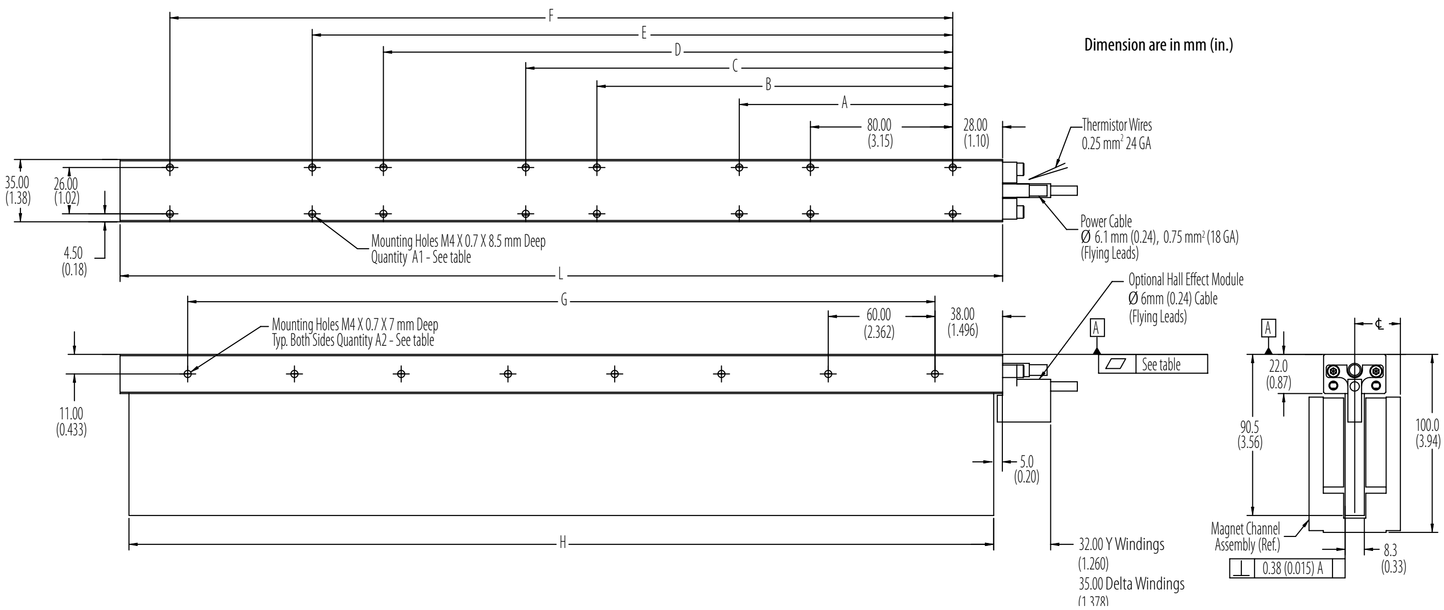
Coil Cat. No.	L mm (in.)	A mm (in.)	B mm (in.)	C mm (in.)	D mm (in.)	E mm (in.)	F mm (in.)	G mm (in.)	H mm (in.)	A1 QTY	A2 QTY	Flatness-A- mm (in.)
LZ-030-HT-120-*x*-0-*x*-*x*-*x*	136.00 (5.35)							60.00 (2.362)	126.0 (4.96)	4	2	0.25 (0.010)
LZ-030-HT-240-*x*-0-*x*-*x*-*x*	256.00 (10.08)	120.00 (4.724)	200.00 (7.874)					180.00 (7.087)	246.0 (9.69)	8	4	0.25 (0.010)
LZ-030-HT-360-*x*-0-*x*-*x*-*x*	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	6	0.38 (0.015)
LZ-030-HT-480-*x*-0-*x*-*x*-*x*	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	8	0.64 (0.025)

Magnet Channel Layout Drawing (Catalog Number LZM-030-HT-*xxx*)



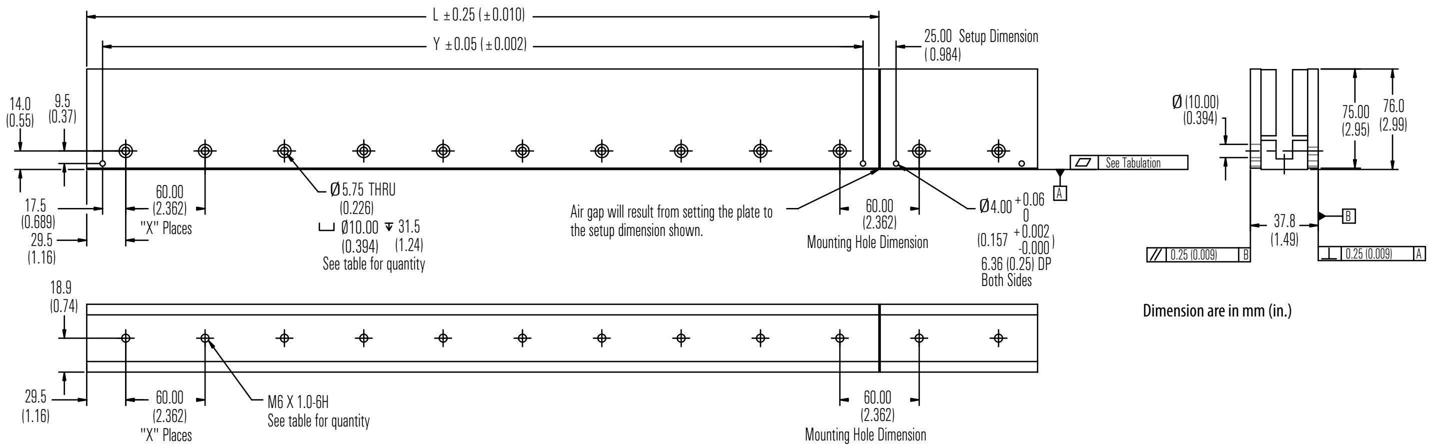
Magnet Channel Cat. No.	L mm (in.)	X	Hole Quantity	Y mm (in.)	Flatness -A- mm (in.)
LZM-030-HT-120	119.0 (4.69)	1	2	95.0 (3.74)	0.13 (0.005)
LZM-030-HT-180	179.0 (7.05)	2	3	155.0 (6.10)	0.13 (0.005)
LZM-030-HT-240	239.0 (9.41)	3	4	215.0 (8.47)	0.13 (0.005)
LZM-030-HT-480	479.0 (18.86)	7	8	455.0 (17.91)	0.26 (0.010)
LZM-030-HT-600	599.0 (23.58)	9	10	575.0 (22.64)	0.26 (0.010)

LZ Series Linear Motor Coil (Catalog Number LZ-050-0-*xxx*-*x*-0-*x*-*x*-*x*)



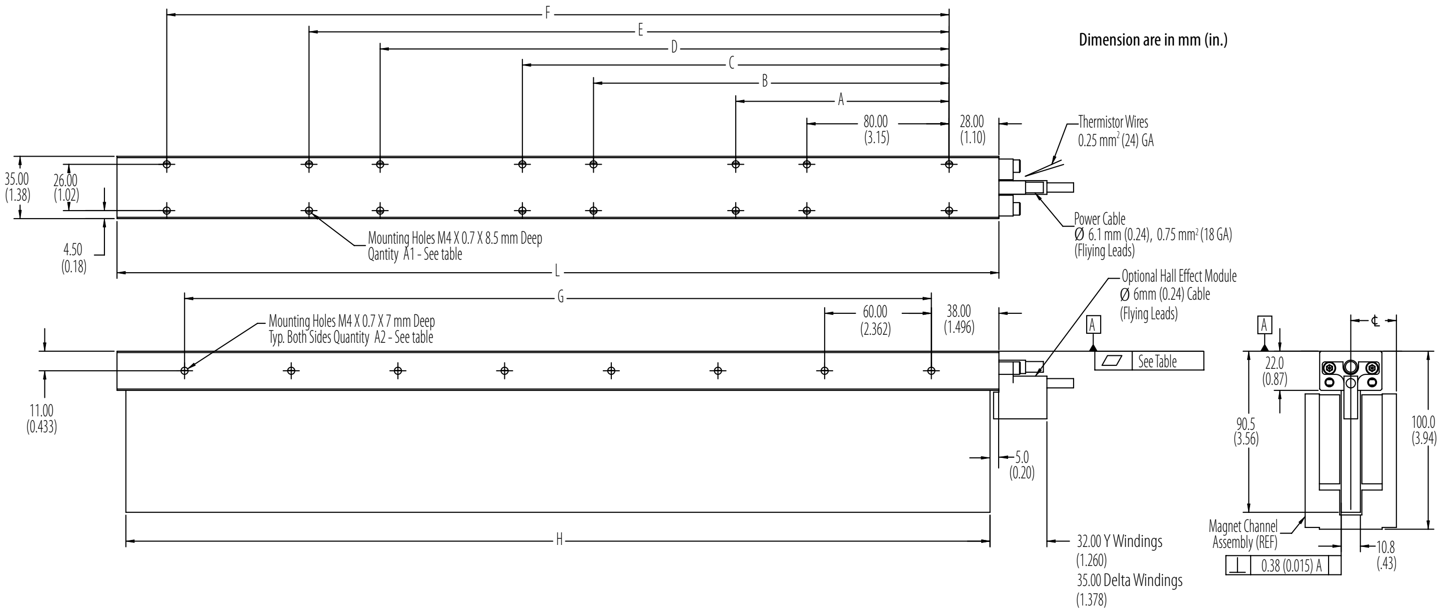
Coil Cat. No.	L mm (in.)	A mm (in.)	B mm (in.)	C mm (in.)	D mm (in.)	E mm (in.)	F mm (in.)	G mm (in.)	H mm (in.)	A1 QTY	A2 QTY	Flatness -A- mm (in.)
LZ-050-0-120-*x*-0-*x*-*x*-*x*	136.00 (5.35)							60.00 (2.362)	126.0 (4.96)	4	2	0.25 (0.010)
LZ-050-0-240-*x*-0-*x*-*x*-*x*	256.00 (10.08)	120.00 (4.724)	200.00 (7.874)					180.00 (7.087)	246.0 (9.69)	8	4	0.25 (0.010)
LZ-050-0-360-*x*-0-*x*-*x*-*x*	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	6	0.38 (0.015)
LZ-050-0-480-*x*-0-*x*-*x*-*x*	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	8	0.64 (0.025)

Magnet Channel Layout (Catalog Number LZM-050-0-*xxx*)



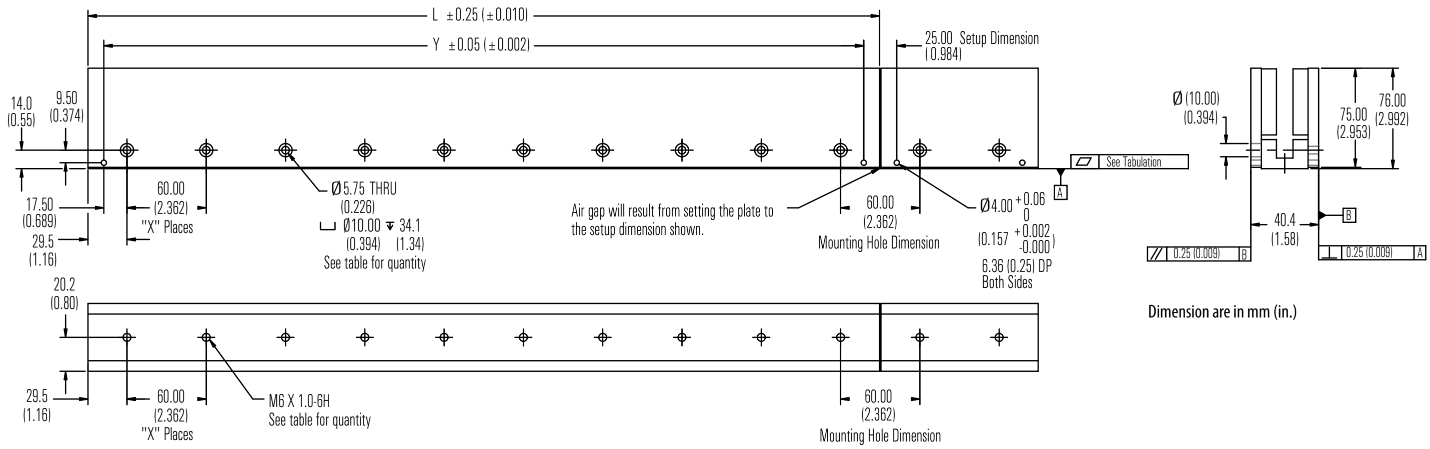
Magnet Channel Cat. No.	L mm (in.)	X	Hole Quantity	Y mm (in.)	Flatness -A- mm (in.)
LZM-050-0-120	119.0 (4.69)	1	2	95.0 (3.74)	0.13 (0.005)
LZM-050-0--180	179.0 (7.05)	2	3	155.0 (6.10)	0.13 (0.005)
LZM-050-0--240	239.0 (9.41)	3	4	215.0 (8.47)	0.13 (0.005)
LZM-050-0--480	479.0 (18.86)	7	8	455.0 (17.91)	0.26 (0.010)
LZM-050-0--600	599.0 (23.58)	9	10	575.0 (22.64)	0.26 (0.010)

LZ Series Linear Motor Coil (Catalog Number LZ-050-T-*xxx*-*x*-0-*x*-*x*-*x*)



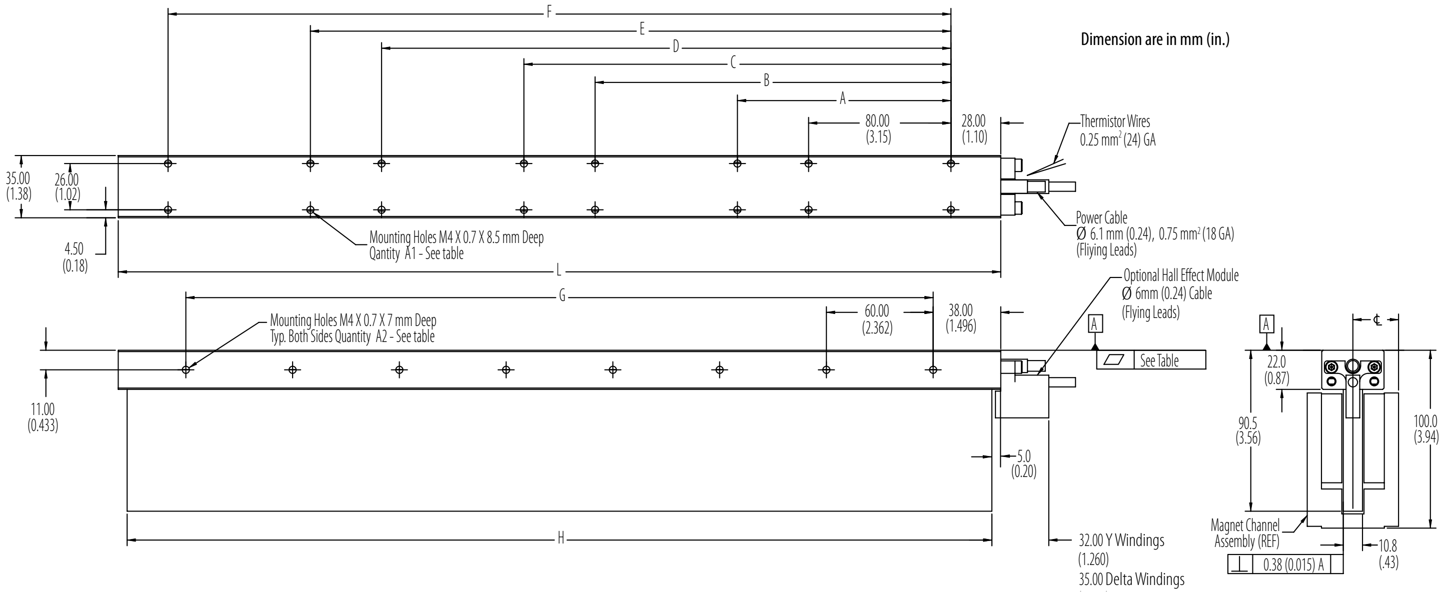
Coil Cat. No.	L mm (in.)	A mm (in.)	B mm (in.)	C mm (in.)	D mm (in.)	E mm (in.)	F mm (in.)	G mm (in.)	H mm (in.)	A1 QTY	A2 QTY	Flatness -A- mm (in.)
LZ-050-T-120-*x*-0-*x*-*x*-*x*	136.00 (5.35)							60.00 (2.362)	126.0 (4.96)	4	2	0.25 (0.010)
LZ-050-T-240-*x*-0-*x*-*x*-*x*	256.00 (10.08)	120.00 (4.724)	200.00 (7.874)					180.00 (7.087)	246.0 (9.69)	8	4	0.25 (0.010)
LZ-050-T-360-*x*-0-*x*-*x*-*x*	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	6	0.38 (0.015)
LZ-050-T-480-*x*-0-*x*-*x*-*x*	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	8	0.64 (0.025)

Magnet Channel Layout (Catalog Number LZM-050-T-*xxx*)



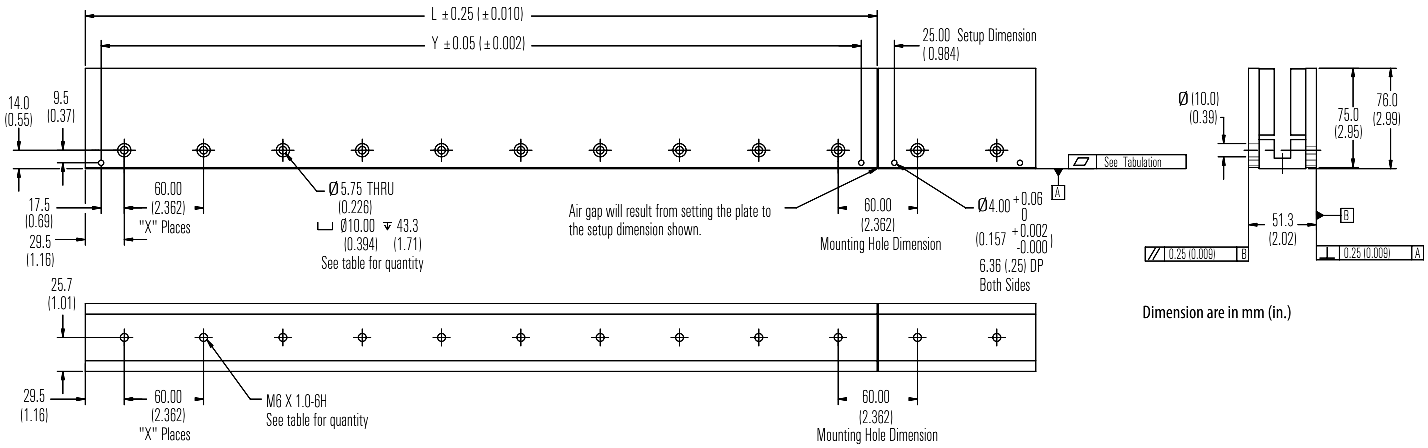
Magnet Channel Cat. No.	L mm (in.)	X	Hole Quantity	Y mm (in.)	Flatness -A- mm (in.)
LZM-050-T-120	119.0 (4.69)	1	2	95.0 (3.74)	0.13 (0.005)
LZM-050-T-180	179.0 (7.05)	2	3	155.0 (6.10)	0.13 (0.005)
LZM-050-T-240	239.0 (9.41)	3	4	215.0 (8.47)	0.13 (0.005)
LZM-050-T-480	479.0 (18.86)	7	8	455.0 (17.91)	0.26 (0.010)
LZM-050-T-600	599.0 (23.58)	9	10	575.0 (22.64)	0.26 (0.010)

LZ Series Linear Motor Coil (Catalog Number LZ-050-HT-*xxx*-*x*-0-*x*-*x*-*x*)



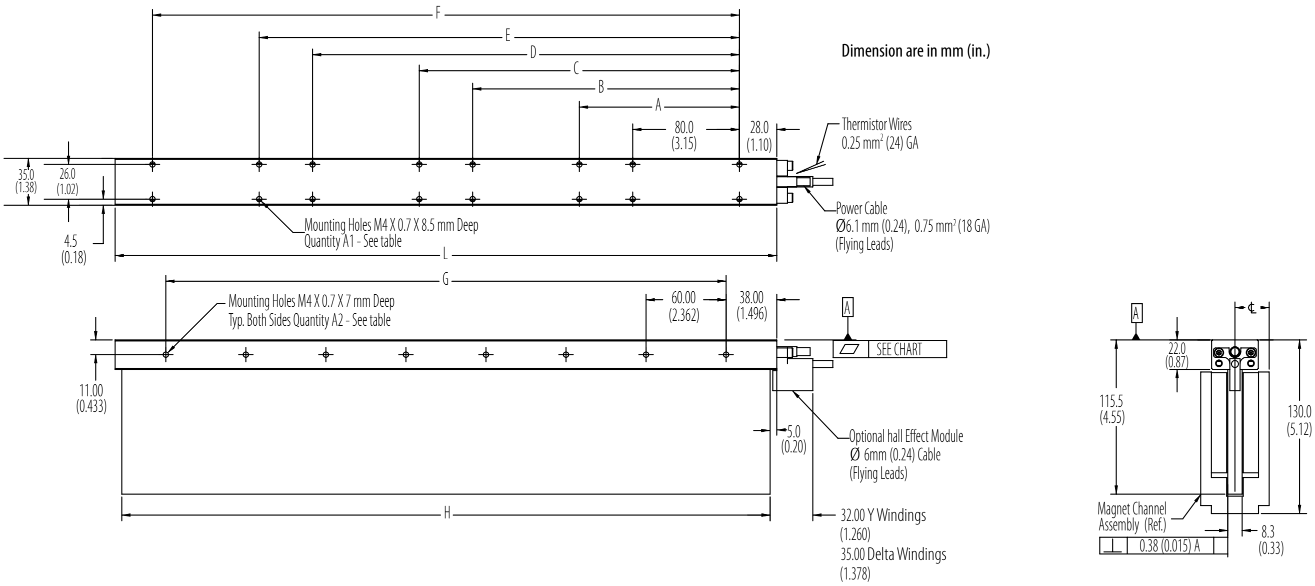
Coil Cat. No.	L mm (in.)	A mm (in.)	B mm (in.)	C mm (in.)	D mm (in.)	E mm (in.)	F mm (in.)	G mm (in.)	H mm (in.)	A1 QTY	A2 QTY	Flatness -A- mm (in.)
LZ-050-HT-120-*x*-0-*x*-*x*-*x*	136.00 (5.35)							60.00 (2.362)	126.0 (4.96)	4	2	0.25 (0.010)
LZ-050-HT-240-*x*-0-*x*-*x*-*x*	256.00 (10.08)	120.00 (4.724)	200.00 (7.874)					180.00 (7.087)	246.0 (9.69)	8	4	0.25 (0.010)
LZ-050-HT-360-*x*-0-*x*-*x*-*x*	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	6	0.38 (0.015)
LZ-050-HT-480-*x*-0-*x*-*x*-*x*	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	8	0.64 (0.025)

Magnet Channel Layout (Catalog Number LZM-050-HT-*xxx*)



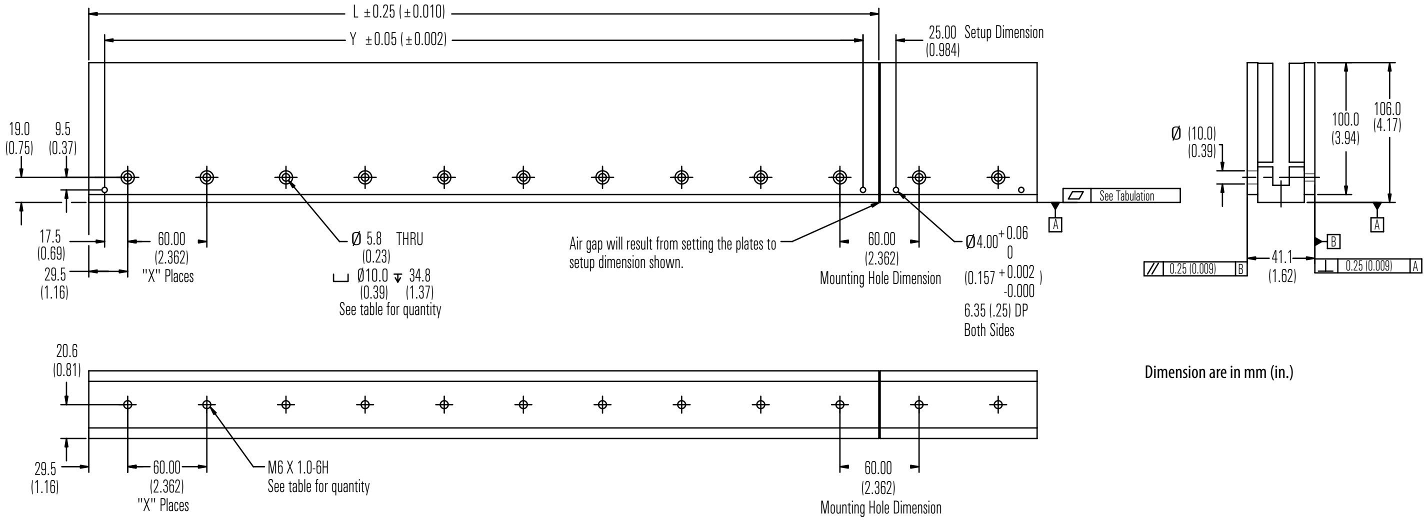
Magnet Channel Cat. No.	L mm (in.)	X	Hole Quantity	Y mm (in.)	Flatness -A- mm (in.)
LZM-050-HT-120	119.0 (4.69)	1	2	95.0 (3.74)	0.13 (0.005)
LZM-050-HT-180	179.0 (7.05)	2	3	155.0 (6.10)	0.13 (0.005)
LZM-050-HT-240	239.0 (9.41)	3	4	215.0 (8.47)	0.13 (0.005)
LZM-050-HT480	479.0 (18.86)	7	8	455.0 (17.91)	0.26 (0.010)
LZM-050-HT-600	599.0 (23.58)	9	10	575.0 (22.64)	0.26 (0.010)

LZ Series Linear Motor Coil (Catalog Number LZ-075-0-*xxx*-*x*-0-*x*-*x*-*x*)



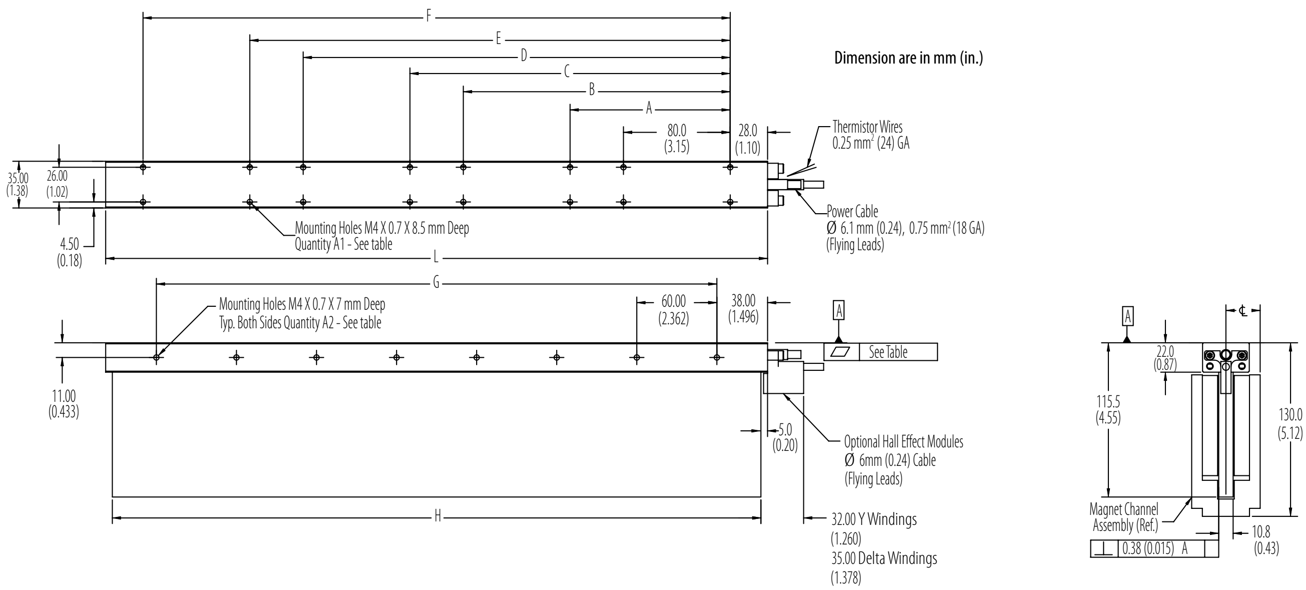
Coil Cat. No.	L mm (in.)	A mm (in.)	B mm (in.)	C mm (in.)	D mm (in.)	E mm (in.)	F mm (in.)	G mm (in.)	H mm (in.)	A1 QTY	A2 QTY	Flatness -A- mm (in.)
LZ-075-0-120-*x*-0-*x*-*x*-*x*	136.00 (5.35)							60.00 (2.362)	126.0 (4.96)	4	2	0.25 (0.010)
LZ-075-0-240-*x*-0-*x*-*x*-*x*	256.00 (10.08)	120.00 (4.724)	200.00 (7.874)					180.00 (7.087)	246.0 (9.69)	8	4	0.25 (0.010)
LZ-075-0-360-*x*-0-*x*-*x*-*x*	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	6	0.38 (0.015)
LZ-075-0-480-*x*-0-*x*-*x*-*x*	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	8	0.64 (0.025)

Magnet Channel Layout Drawing (Catalog Number LZM-075-0-*xxx*)



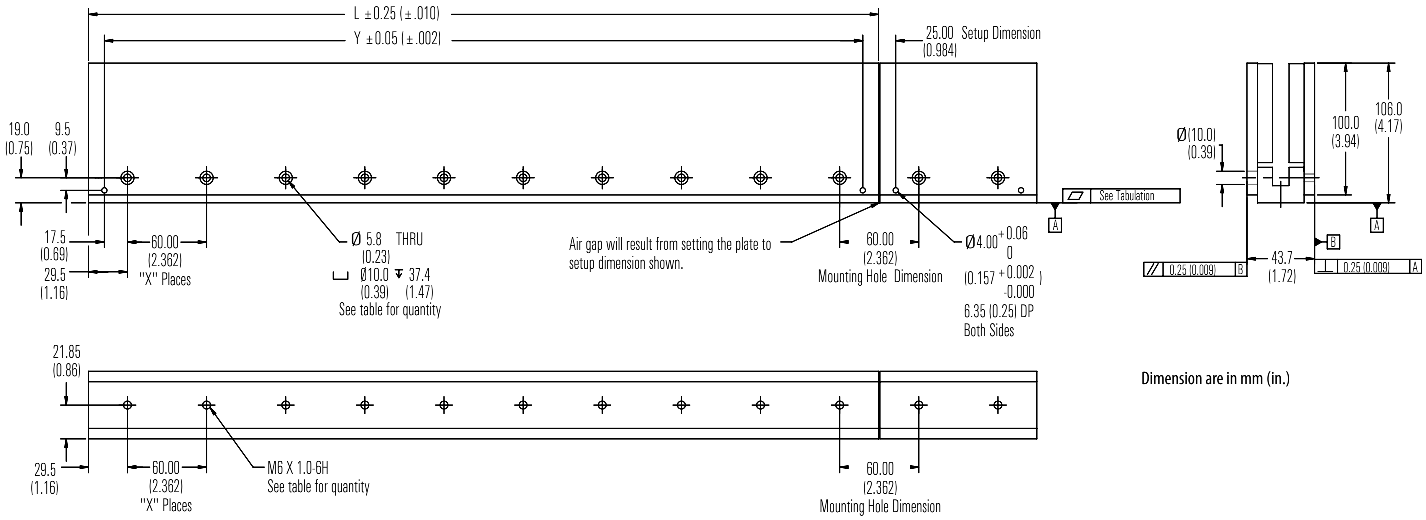
Magnet Channel Cat. No.	L mm (in.)	X	Hole Quantity	Y mm (in.)	Flatness -A- mm (in.)
LZM-075-0-120	119.0 (4.69)	1	2	95.0 (3.74)	0.13 (0.005)
LZM-075-0-180	179.0 (7.05)	2	3	155.0 (6.10)	0.13 (0.005)
LZM-075-0-240	239.0 (9.41)	3	4	215.0 (8.47)	0.13 (0.005)
LZM-075-0-480	479.0 (18.86)	7	8	455.0 (17.91)	0.26 (0.010)
LZM-075-0-600	599.0 (23.58)	9	10	575.0 (22.64)	0.26 (0.010)

LZ Series Linear Motor Coil (Catalog Number LZ-075-T-*xxx*-*x*-0-*x*-*x*-*x*)



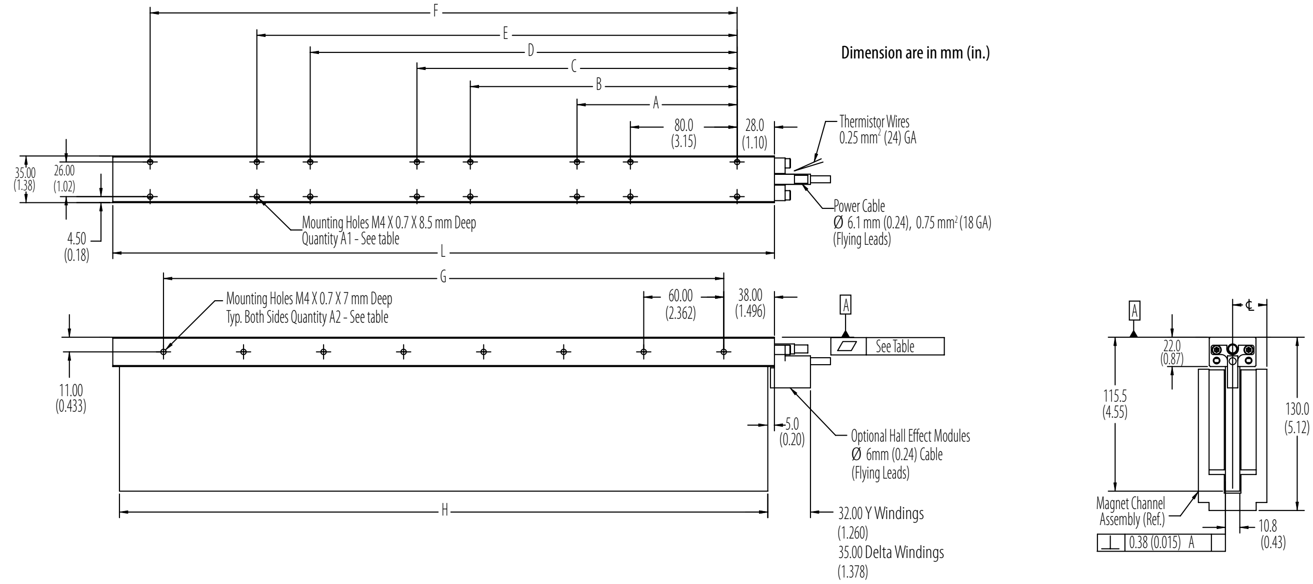
Coil Cat. No.	L mm (in.)	A mm (in.)	B mm (in.)	C mm (in.)	D mm (in.)	E mm (in.)	F mm (in.)	G mm (in.)	H mm (in.)	A1 QTY	A2 OTY	Flatness -A- mm (in.)
LZ-075-T-120-*x*-0-*x*-*x*-*x*	136.00 (5.35)							60.00 (2.362)	126.0 (4.96)	4	2	0.25 (0.010)
LZ-075-T-240-*x*-0-*x*-*x*-*x*	256.00 (10.08)	120.00 (4.724)	200.00 (7.874)					180.00 (7.087)	246.0 (9.69)	8	4	0.25 (0.010)
LZ-075-T-360-*x*-0-*x*-*x*-*x*	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	6	0.38 (0.015)
LZ-075-T-480-*x*-0-*x*-*x*-*x*	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	8	0.64 (0.025)

Magnet Channel Layout (Catalog Number LZM-075-T-*xxx*)



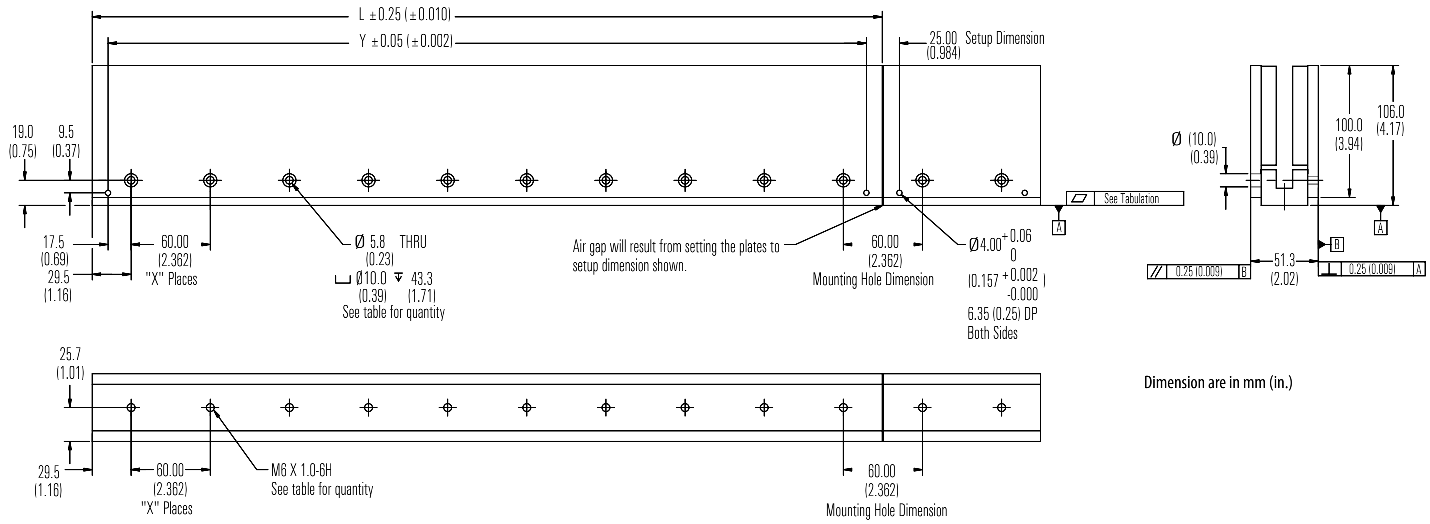
Magnet Channel Cat. No.	L mm (in.)	X mm (in.)	Hole Quantity	Y mm (in.)	Flatness -A- mm (in.)
LZM-075-T-120	119.0 (4.69)	1	2	95.0 (3.74)	0.13 (0.005)
LZM-075-T-180	179.0 (7.05)	2	3	155.0 (6.10)	0.13 (0.005)
LZM-075-T-240	239.0 (9.41)	3	4	215.0 (8.47)	0.13 (0.005)
LZM-075-T-480	479.0 (18.86)	7	8	455.0 (17.91)	0.26 (0.010)
LZM-075-T-600	599.0 (23.58)	9	10	575.0 (22.64)	0.26 (0.010)

LZ Series Linear Motor Coil (Catalog Number LZ-075-HT-*xxx*-*x*-0-*x*-*x*-*x*)



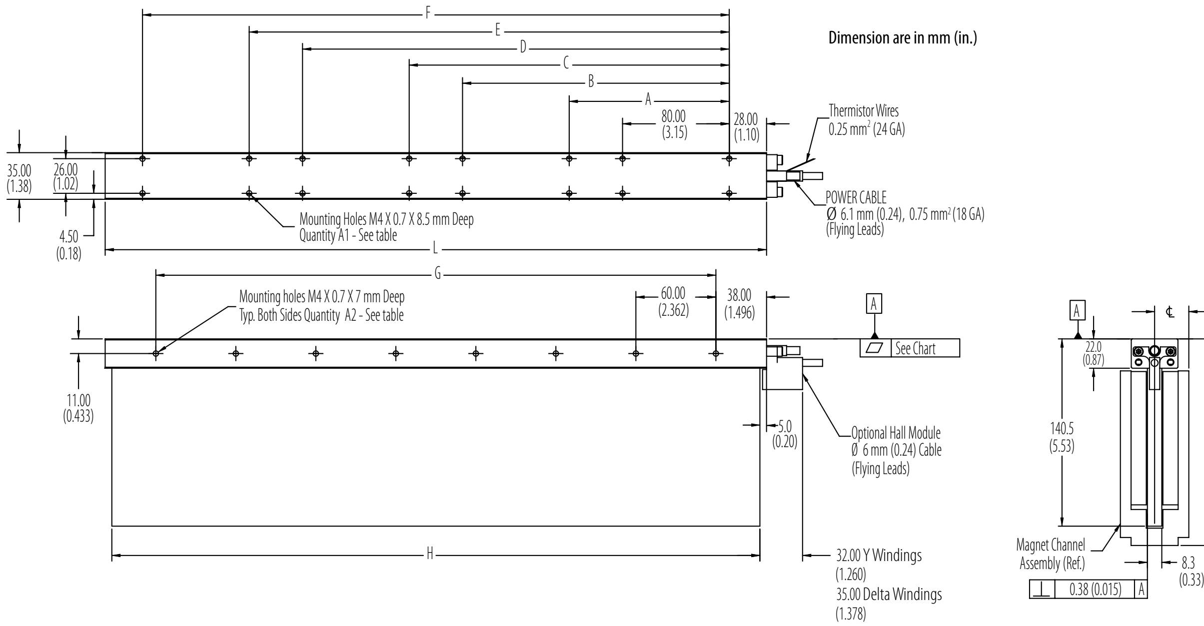
Coil Cat. No.	**L** mm (in.)	**A** mm (in.)	**B** mm (in.)	**C** mm (in.)	**D** mm (in.)	**E** mm (in.)	**F** mm (in.)	**G** mm (in.)	**H** mm (in.)	**A1 QTY**	**A2 QTY**	**Flatness -A-** mm (in.)
LZ-075-HT-120-*x*-0-*x*-*x*-*x*	136.00 (5.35)							60.00 (2.362)	126.0 (4.96)	4	2	0.25 (0.010)
LZ-075-HT-240-*x*-0-*x*-*x*-*x*	256.00 (10.08)	120.00 (4.724)	200.00 (7.874)					180.00 (7.087)	246.0 (9.69)	8	4	0.25 (0.010)
LZ-075-HT-360-*x*-0-*x*-*x*-*x*	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	6	0.38 (0.015)
LZ-075-HT-480-*x*-0-*x*-*x*-*x*	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	8	0.64 (0.025)

Magnet Channel Layout (Catalog Number LZM-075-HT-*xxx*)



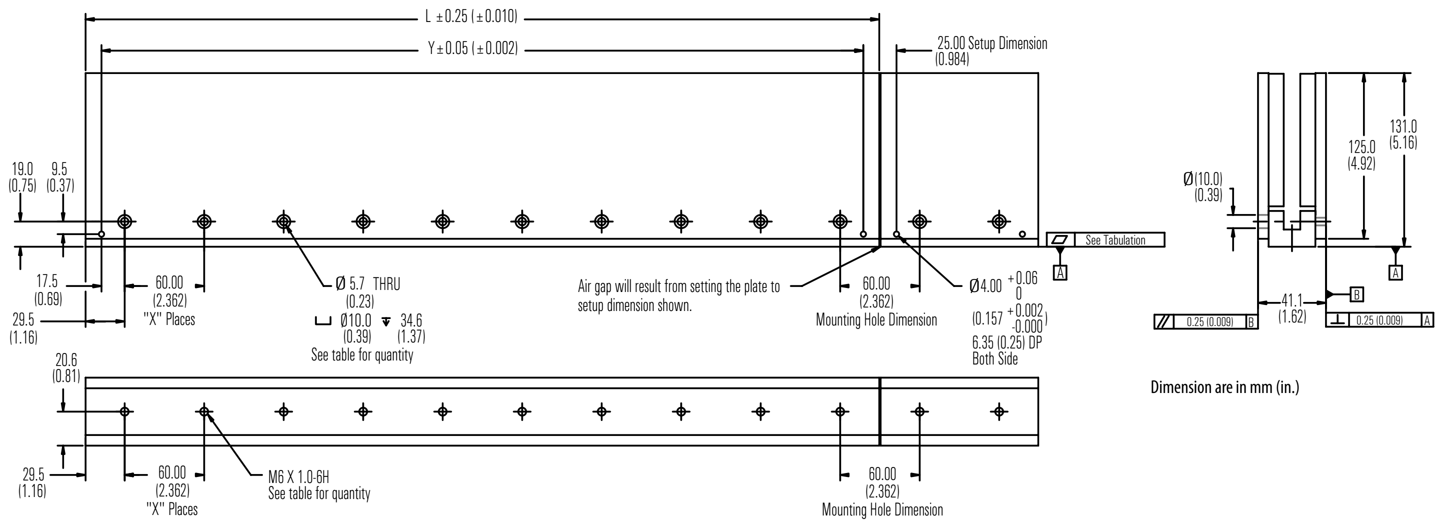
Magnet Channel Cat. No.	L mm (in.)	X	Hole Quantity	Y mm (in.)	Flatness -A- mm (in.)
LZM-075-HT-120	119.0 (4.69)	1	2	95.0 (3.74)	0.13 (0.005)
LZM-075-HT--180	179.0 (7.05)	2	3	155.0 (6.10)	0.13 (0.005)
LZM-075-HT--240	239.0 (9.41)	3	4	215.0 (8.47)	0.13 (0.005)
LZM-075-HT--480	479.0 (18.86)	7	8	455.0 (17.91)	0.26 (0.010)
LZM-075-HT--600	599.0 (23.58)	9	10	575.0 (22.64)	0.26 (0.010)

LZ Series Linear Motor Coil (Catalog Number LZ-100-0-*xxx*-*x*-0-*x*-*x*-*x*)



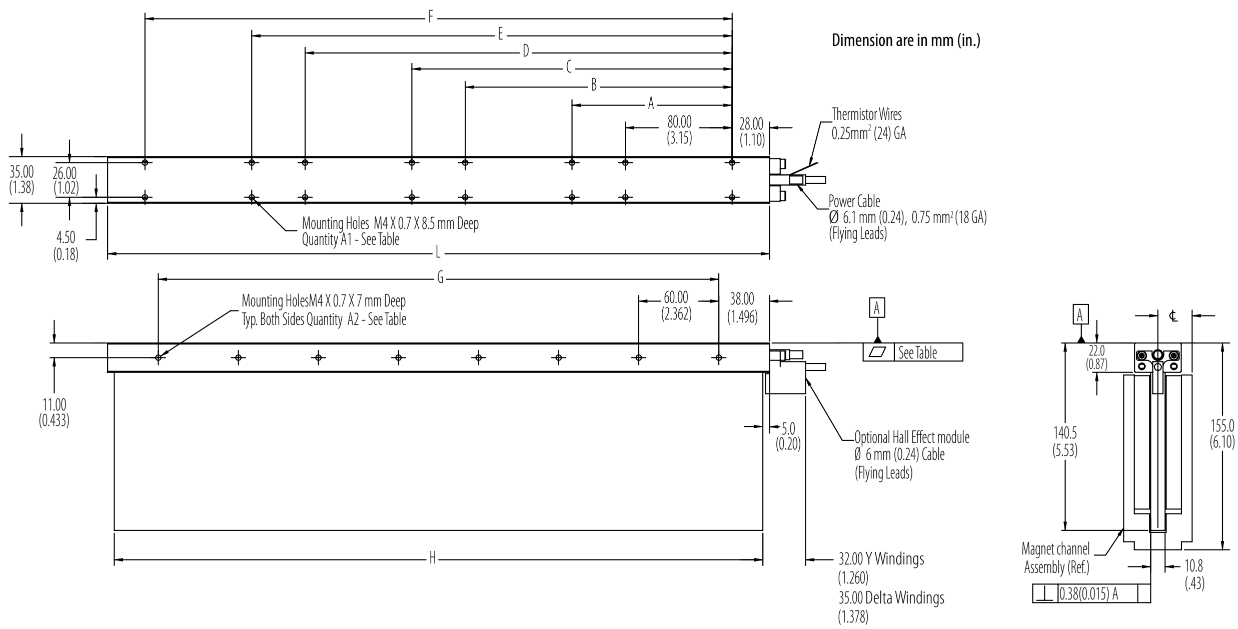
Coil Cat. No.s	L mm (in.)	A mm (in.)	B mm (in.)	C mm (in.)	D mm (in.)	E mm (in.)	F mm (in.)	G mm (in.)	H mm (in.)	A1 QTY	A2 QTY	Flatness-A- mm (in.)
LZ-100-0-120-*x*-0-*x*-*x*-*x*	136.00 (5.35)							60.00 (2.362)	126.0 (4.96)	4	2	0.25 (0.010)
LZ-100-0-240-*x*-0-*x*-*x*-*x*	256.00 (10.08)	120.00 (4.724)	200.00 (7.874)					180.00 (7.087)	246.0 (9.69)	8	4	0.25 (0.010)
LZ-100-0-360-*x*-0-*x*-*x*-*x*	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	6	0.38 (0.015)
LZ-100-0-480-*x*-0-*x*-*x*-*x*	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	8	0.64 (0.025)

Magnet Channel Layout (Catalog Number LZM-100-0-*xxx*)



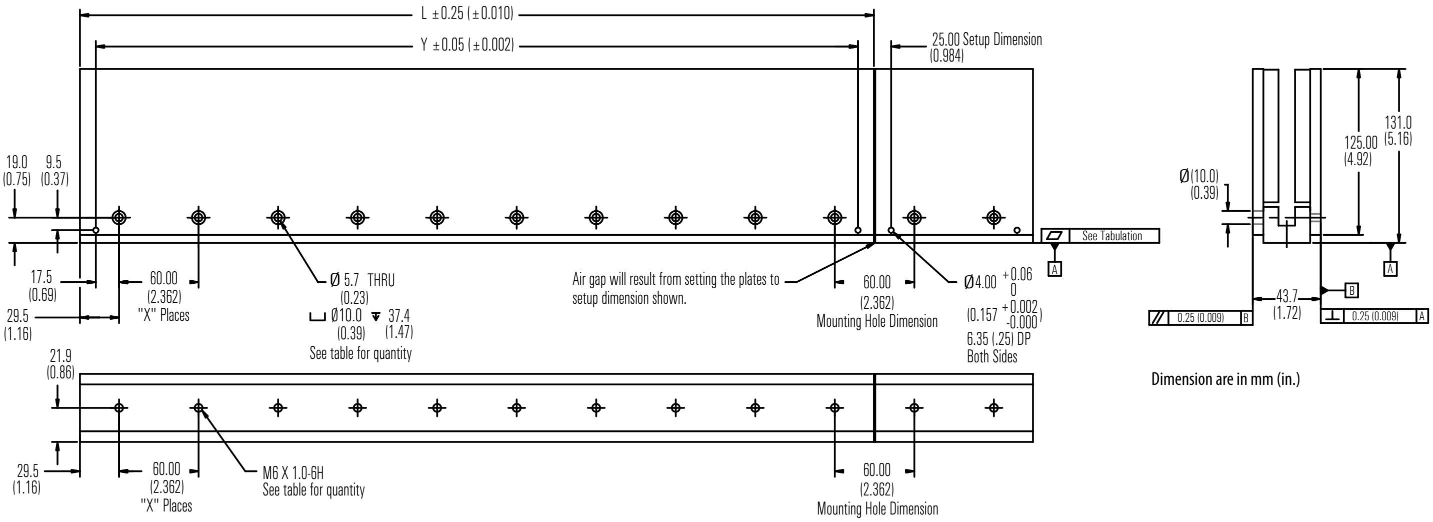
Magnet Channel Cat. No.	L mm (in.)	X	Hole Quantity	Y mm (in.)	Flatness -A- mm (in.)
LZM-100-0-120	119.0 (4.69)	1	2	95.0 (3.74)	0.13 (0.005)
LZM-100-0-180	179.0 (7.05)	2	3	155.0 (6.10)	0.13 (0.005)
LZM-100-0-240	239.0 (9.41)	3	4	215.0 (8.47)	0.13 (0.005)
LZ-M100-0-480	479.0 (18.86)	7	8	455.0 (17.91)	0.26 (0.010)
LZM-100-0-600	599.0 (23.58)	9	10	575.0 (22.64)	0.26 (0.010)

LZ Series Linear Motor Coil (Catalog Number LZ-100-T-*xxx*-*x*-0-*x*-*x*-*x*)



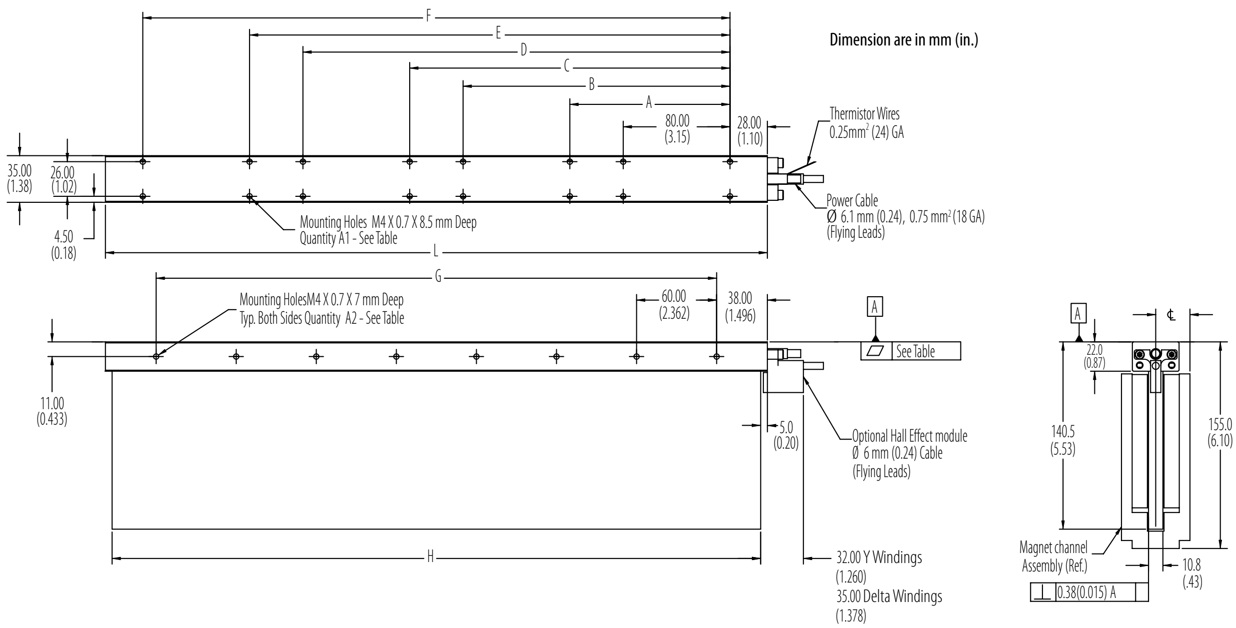
Coil Cat. No.	L mm (in.)	A mm (in.)	B mm (in.)	C mm (in.)	D mm (in.)	E mm (in.)	F mm (in.)	G mm (in.)	H mm (in.)	A1 QTY	A2 QTY	Flatness -A- mm (in.)
LZ-100-T-120-*x*-0-*x*-*x*-*x*	136.00 (5.35)	---	---	---	---	---	---	60.00 (2.362)	126.0 (4.96)	4	2	0.25 (0.010)
LZ-100-T-240-*x*-0-*x*-*x*-*x*	256.00 (10.08)	120.00 (4.724)	200.00 (7.874)	---	---	---	---	180.00 (7.087)	246.0 (9.69)	8	4	0.25 (0.010)
LZ-100-T-360-*x*-0-*x*-*x*-*x*	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	6	0.38 (0.015)
LZ-100-T-480-*x*-0-*x*-*x*-*x*	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	8	0.64 (0.025)

Magnet Channel Layout (Catalog Number LZM-100-T-*xxx*)



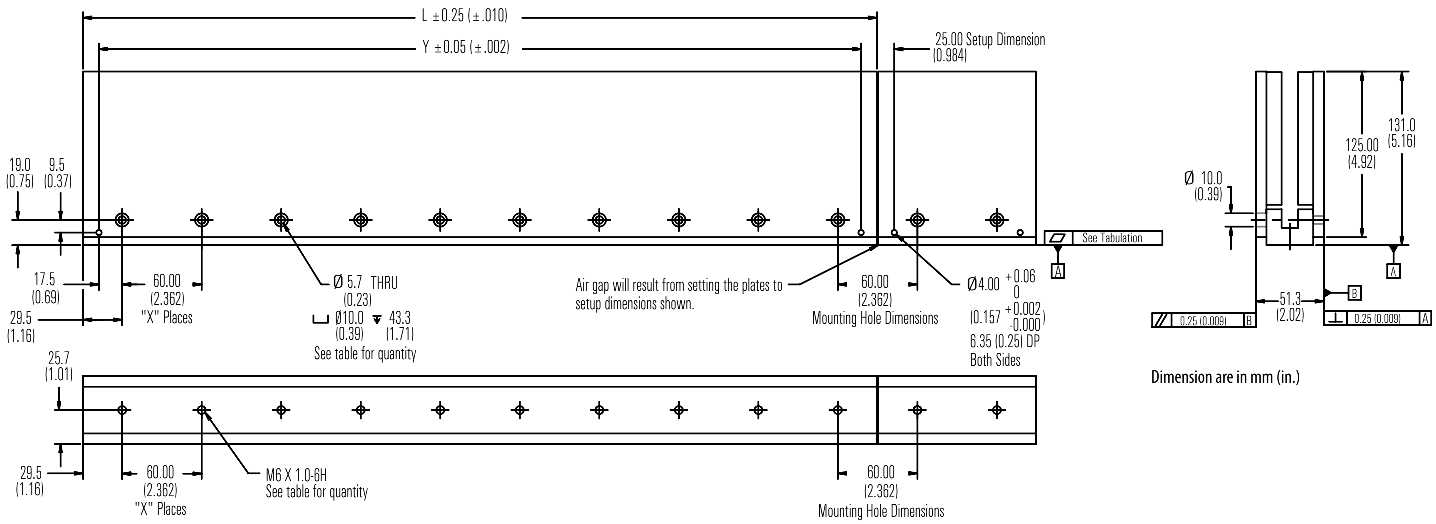
Magnet Channel Cat. No.	L mm (in.)	X	Hole Quantity	Y mm (in.)	Flatness -A- mm (in.)
LZM-100-T-120	119.0 (4.69)	1	2	95.0 (3.74)	0.13 (0.005)
LZM-100-T-180	179.0 (7.05)	2	3	155.0 (6.10)	0.13 (0.005)
LZM-100-T-240	239.0 (9.41)	3	4	215.0 (8.47)	0.13 (0.005)
LZM-100-T-480	479.0 (18.86)	7	8	455.0 (17.91)	0.26 (0.010)
LZM-100-T-600	599.0 (23.58)	9	10	575.0 (22.64)	0.26 (0.010)

LZ Series Linear Motor Coil (Catalog Number LZ-100-HT-*xxx*-*x*-0-*x*-*x*-*x*)



Coil Cat. No.	L mm (in.)	A mm (in.)	B mm (in.)	C mm (in.)	D mm (in.)	E mm (in.)	F mm (in.)	G mm (in.)	H mm (in.)	A1 QTY	A2 QTY	Flatness -A- mm (in.)
LZ-100-HT-120-*x*-0-*x*-*x*-*x*	136.00 (5.35)							60.00 (2.362)	126.0 (4.96)	4	2	0.25 (0.010)
LZ-100-HT-240-*x*-0-*x*-*x*-*x*	256.00 (10.08)	120.00 (4.724)	200.00 (7.874)					180.00 (7.087)	246.0 (9.69)	8	4	0.25 (0.010)
LZ-100-HT-360-*x*-0-*x*-*x*-*x*	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	6	0.38 (0.015)
LZ-100-HT-480-*x*-0-*x*-*x*-*x*	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	8	0.64 (0.025)

Magnet Channel Layout (Catalog Number LZM-100-HT-*xxx*)



Magnet Channel Cat. No.	L mm (in.)	X	Hole Quantity	Y mm (in.)	Flatness -A- mm (in.)
LZM-100-HT-120	119.0 (4.69)	1	2	95.0 (3.74)	0.13 (0.005)
LZM-100-HT-180	179.0 (7.05)	2	3	155.0 (6.10)	0.13 (0.005)
LZM-100-HT-240	239.0 (9.41)	3	4	215.0 (8.47)	0.13 (0.005)
LZM-100-HT-480	479.0 (18.86)	7	8	455.0 (17.91)	0.26 (0.010)
LZM-100-HT-600	599.0 (23.58)	9	10	575.0 (22.64)	0.26 (0.010)

Mounting Bolts and Torque Values

Introduction

This appendix provides typical torque values for standard and metric bolts.

Recommended Seating Torque for Metric Bolts

Bolt Size (metric) [1]	Pitch	Plain	Cadmium Plated	Zinc
		Nm (in-lb)	Nm (in-lb)	Nm (in-lb)
M1.6 [2]	0.35	0.29 (2.6)	0.22 (1.95)	0.41(3.64)
M2 [2]	0.40	0.60 (5.3)	0.45 (3.98)	0.84 (7.42)
M2.5 [2]	0.45	1.24 (11)	0.93 (8.25)	1.74 (15.4)
M3	0.5	2.15 (19)	1.61 (14.25)	3.00 (26.6)
M4	0.7	4.6 (41)	3.47 (30.75)	6.48 (57.4)
M5	0.8	9.6 (85)	7.20 (63.75)	13.4 (119)
M6	1.0	15.8 (140)	11.9 (105)	22.1 (196)
M8	1.25	39.5 (350)	29.7 (262.5)	55.4 (490)
M10	1.5	76.8 (680)	57.6 (510)	115.2 (1020)

(1) Mounting hardware is ISO 898/1 socket head cap bolt that meets or exceeds ANSI B113M, ISO 261, ISO 262 (coarse series only).

(2) Microsize bolt.

Recommended Seating Torque for Mild Steel Rb 87 or Cast Iron Rb 83

Bolt Size [1], [2]	UNC		UNF	
	Plain	Cadmium Plated	Plain	Cadmium Plated
	Nm (in-lb)	Nm (in-lb)	Nm (in-lb)	Nm (in-lb)
#0	–	–	0.24 (2.1) [3]	0.18 (1.6) [3]
#1	0.44 (3.89) [3]	0.53 (4.7) [3]	0.46 (4.1) [3]	0.34 (3.0) [3]
#2	0.71 (6.3) [3]	0.53 (4.7) [3]	0.76 (6.8) [3]	0.58 (5.1) [3]
#3	1.08 (9.6) [3]	0.81 (7.2) [3]	1.16 (10.3) [3]	0.87 (7.7) [3]
#4	1.52 (13.5) [3]	1.13 (10) [3]	1.67 (14.8) [3]	1.2 (11) [3]
#5	2.3 (20) [3]	1.7 (15) [3]	2.37 (21) [3]	1.8 (16) [3]
#6	2.8 (25) [3]	2.1 (19) [3]	3.2 (28) [3]	2.4 (21) [3]
#8	5.2 (46) [3]	3.8 (34) [3]	5.4 (48) [3]	4.1 (36) [3]
#10	7.6 (67) [3]	5.6 (50) [3]	8.6 (76) [3]	6.4 (57) [3]
1/4	17.8 (158) [3]	13.4 (119) [3]	20.3 (180) [3]	15.4 (136) [3]
5/16	36.8 (326) [3]	27.7 (245) [3]	40.7 (360) [3]	30.5 (270) [3]
3/8	65.5 (580) [3]	49.1 (435)	71.7 (635)	53.7 (476)
7/16	105 (930) [3]	78.9 (698) [3]	117.5 (1040) [3]	88.1 (780) [3]
1/2	160 (1420) [3]	172.8 (1530) [3]	254.2 (2250)	190.9 (1690) [3]

(1) Mounting hardware is 1960-series socket head cap bolt that meets or exceeds ANSI B18.3.

(2) Torque is based on 80,000 psi bearing stress under the head of the bolt.

(3) Denotes torque based on 100,000 psi tensile stress, with both threads up to one inch in diameter.

Recommended Seating Torque for Brass Rb 72

Bolt Size [1], [2]	UNC		UNF	
	Plain	**Cadmium Plated**	**Plain**	**Cadmium Plated**
	Nm (in-lb)	Nm (in-lb)	Nm (in-lb)	Nm (in-lb)
#0	–	–	0.24 (2.1) [3]	0.18 (1.6) [3]
#1	0.43(3.8) [3]	0.33 (2.9) [3]	0.46 (4.1)	0.34 (3.0) [3]
#2	0.71 (6.3) [3]	0.53 (4.7) [3]	0.77 (6.8) [3]	0.58 (5.1) [3]
#3	1.08 (9.6) [3]	0.81 (7.2) [3]	1.16 (10.3) [3]	0.87 (7.7) [3]
#4	1.52 (13.5) [3]	1.1 (10) [3]	1.67 (14.8) [3]	1.24 (11) [3]
#5	2.2 (20) [3]	1.7 (15) [3]	2.4 (21) [3]	1.8 (16) [3]
#6	2.8 (25) [3]	2.1 (19) [3]	3.2 (28) [3]	2.4 (21) [3]
#8	5.2 (46) [3]	3.8 (34)	5.4 (48) [3]	4.1 (36) [3]
#10	7.6 (67) [3]	5.6 (50) [3]	8.6 (76) [3]	6.4 (57) [3]
1/4	15.3 (136)	11.5 (102)	15.4 (136)	11.5 (102)
5/16	25.8 (228)	19.3 (171)	25.8 (228)	19.3 (171)
3/8	53.7 (476)	40.3 (357)	53.7 (476)	40.3 (357)
7/16	76.8 (680)	57.6 (510)	76.8 (680)	57.6 (510)

(1) Mounting hardware is 1960-series socket head cap bolt that meets or exceeds ANSI B18.3.

(2) Torque is based on 60,000 psi bearing stress under the head of the bolt.

(3) Denotes torques based on 100,000 psi tensile stress with both threads up to one inch in diameter.

Recommended Seating Torque for Aluminum Rb 72 (2024-T_4)

Bolt Size [1], [2]	UNC		UNF	
	Plain	**Cadmium Plated**	**Plain**	**Cadmium Plated**
	Nm (in-lb)	Nm (in-lb)	Nm (in-lb)	Nm (in-lb)
#0	-	-	0.24 (2.1) [3]	0.18 (1.6) [3]
#1	0.44 (3.8) [3]	0.33 (2.9) [3]	0.46 (4.1) [3]	0.34 3.0v
#2	0.71 (6.3) [3]	0.53 (4.7) [3]	0.77 (6.8) [3]	0.58 (5.1) [3]
#3	1.08 (9.6) [3]	0.81 (7.2) [3]	1.16 (10.3) [3]	0.87 (7.7) [3]
#4	1.52 (13.5) [3]	1.1 (10) [3]	1.67 (14.8) [3]	1.24 (11) [3]
#5	2.3 (20) [3]	1.7 (15) [3]	2.37 (21) [3]	1.8 (16) [3]
#6	2.8 (25) [3]	2.1 (19) [3]	3.2 (28) [3]	2.37 (21) [3]
#8	5.2 (46) [3]	3.8 (34) [3]	3.2 (48) [3]	4.1 (36) [3]
#10	7.6 (67) [3]	5.6 (50) [3]	8. 6 (76) [3]	6.4 (57) [3]
1/4	12.8 (113)	9.6 (85)	12.8 (113)	9.6 (85)
5/16	21.5 (190)	16.1 (143)	21.5 (190)	16.1 (143)
3/8	44.8 (397)	33.6 (298)	44.8 (397)	33.7 (298)
7/16	64.4 (570)	48.0 (425)	64.4 (570)	48.0 (425)
1/2	159.3 (1410)	119.8 (1060)	159.3 (1410)	119.8 (1060)

(1) Mounting hardware is 1960-series socket head cap bolt that meets or exceeds ANSI B18.3.

(2) Torque is based on 50,000 psi bearing stress under the head of the bolt.

(3) Denotes torques based on 100,000 psi tensile stress with both threads up to one inch in diameter.

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