



Model M1630-04C

STRAIN GAGE LOAD CELL

Installation and Operating Manual

For assistance with the operation of this product, contact:

**PCB Load & Torque, Inc.
Toll-free: 866-684-7107
24-hour SensorLine™: 716-684-0001
Fax: 248-888-8266
E-mail: LTInfo@pcbloadtorque.com
Web: www.pcbLoadTorque.com**



The information contained in this document supersedes all similar information that may be found elsewhere in this manual.

Total Customer Satisfaction – PCB Piezotronics guarantees Total Customer Satisfaction. If, at any time, for any reason, you are not completely satisfied with any PCB product, PCB will repair, replace, or exchange it at no charge. You may also choose to have your purchase price refunded in lieu of the repair, replacement, or exchange of the product.

Service – Due to the sophisticated nature of the sensors and associated instrumentation provided by PCB Piezotronics, user servicing or repair is not recommended and, if attempted, may void the factory warranty. Routine maintenance, such as the cleaning of electrical connectors, housings, and mounting surfaces with solutions and techniques that will not harm the physical material of construction, is acceptable. Caution should be observed to insure that liquids are not permitted to migrate into devices that are not hermetically sealed. Such devices should only be wiped with a dampened cloth and never submerged or have liquids poured upon them.

Repair – In the event that equipment becomes damaged or ceases to operate, arrangements should be made to return the equipment to PCB Piezotronics for repair. User servicing or repair is not recommended and, if attempted, may void the factory warranty.

Calibration – Routine calibration of sensors and associated instrumentation is

recommended as this helps build confidence in measurement accuracy and acquired data. Equipment calibration cycles are typically established by the users own quality regimen. When in doubt about a calibration cycle, a good “rule of thumb” is to recalibrate on an annual basis. It is also good practice to recalibrate after exposure to any severe temperature extreme, shock, load, or other environmental influence, or prior to any critical test.

PCB Piezotronics maintains an ISO-9001 certified metrology laboratory and offers calibration services, which are accredited by A2LA to ISO/IEC 17025, with full traceability to N.I.S.T. In addition to the normally supplied calibration, special testing is also available, such as: sensitivity at elevated or cryogenic temperatures, phase response, extended high or low frequency response, extended range, leak testing, hydrostatic pressure testing, and others. For information on standard recalibration services or special testing, contact your local PCB Piezotronics distributor, sales representative, or factory customer service representative.

Returning Equipment – *Following these procedures will insure that your returned materials are handled in the most expedient manner.* Before returning any equipment to PCB Piezotronics, contact your local distributor, sales representative, or factory customer service representative to obtain a Return

Materials Authorization (RMA) Number. This RMA number should be clearly marked on the outside of all package(s) and on the packing list(s) accompanying the shipment. A detailed account of the nature of the problem(s) being experienced with the equipment should also be included inside the package(s) containing any returned materials.

A Purchase Order, included with the returned materials, will expedite the turn-around of serviced equipment. It is recommended to include authorization on the Purchase Order for PCB to proceed with any repairs, as long as they do not exceed 50% of the replacement cost of the returned item(s). PCB will provide a price quotation or replacement recommendation for any item whose repair costs would exceed 50% of replacement cost, or any item that is not economically feasible to repair. For routine calibration services, the Purchase Order should include authorization to proceed and return at current pricing, which can be obtained from a factory customer service representative.

Warranty – All equipment and repair services provided by PCB Piezotronics, Inc. are covered by a limited warranty against defective material and workmanship for a period of one year from date of original purchase. Contact

PCB for a complete statement of our warranty. Expendable items, such as batteries and mounting hardware, are not covered by warranty. Mechanical damage to equipment due to improper use is not covered by warranty. Electronic circuitry failure caused by the introduction of unregulated or improper excitation power or electrostatic discharge is not covered by warranty.

Contact Information – International customers should direct all inquiries to their local distributor or sales office. A complete list of distributors and offices can be found at www.pcb.com. Customers within the United States may contact their local sales representative or a factory customer service representative. A complete list of sales representatives can be found at www.pcb.com. Toll-free telephone numbers for a factory customer service representative, in the division responsible for this product, can be found on the title page at the front of this manual. Our ship to address and general contact numbers are:

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3425 Walden Ave.
Depew, NY 14043 USA
Toll-free: (800) 828-8840
24-hour SensorLineSM: (716) 684-0001
Website: www.pcb.com
E-mail: info@pcb.com

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1.0 INTRODUCTION

S-type load cells manufactured by PCB Load & Torque, Inc. are accurate strain gage sensors used for weighing and force measurement. Their high accuracy makes them ideally suited for critical weighing applications. S-type load cells are typically used to measure tensile loads, however, compression loads can also be measured when compression loads are guided and any resultant extraneous loads are minimized. Standard 1/4"-28 female threads facilitate ease of installation.

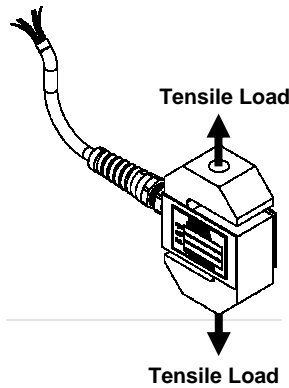


Figure 1 – S-Type Load Cell Loading

The following document explains the characteristics and installation of the S-type load cells.

2.0 SAFETY PRECAUTIONS

Failure of the load cell structure may cause personal injury and equipment damage.

The load cell can withstand loads of at least 150% of the full-scale capacity before any damage occurs to the sensing element. Be sure that the load cell and any fixturing used is properly designed, fabricated, and securely installed prior to use.

3.0 OVERVIEW

S-type load cells come in a variety of capacities to handle loads ranging from 50 lbf to 5k lbf.

Table 1 - Full-Scale Capacities

Full-Scale Capacities		
Model	(lbf)	(N)
1630-03C	50	222
1630-04C	100	445
1630-06C	250	1112
1631-01C	500	2224
1631-03C	1000	4448
1631-04C	2000	8896
1631-06C	5000	22241

3.1 Dimensions

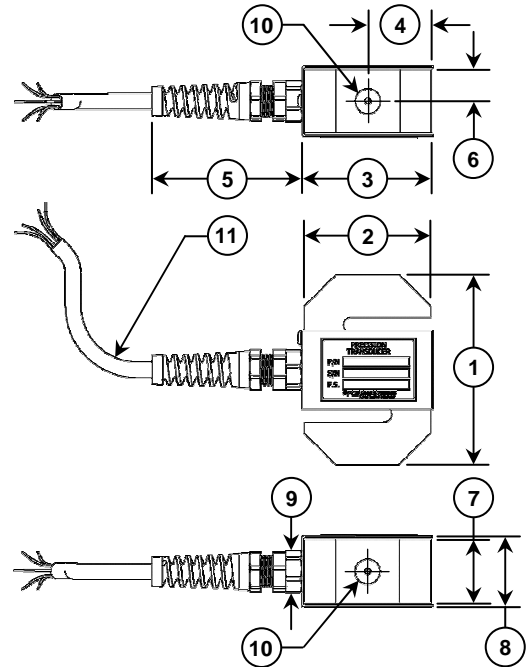


Figure 2 - Dimensions

Table 2 - Dimension Values

Dimensions (see Figure 2)	Series Number					
	1630		1631		1631-06C	
	(in)	(mm)	(in)	(in)	(in)	(mm)
1	2.50	63.5	3.00	76.2	3.50	88.9
2	2.00	50.8	2.00	50.8	2.50	63.5
3	2.05	52.1	2.05	52.1	2.55	64.8
4	1.00	25.4	1.00	25.4	1.25	31.8
5	2.00	50.8	2.00	50.8	2.00	50.8
6	0.31	7.9	0.50	12.7	0.75	19.1
7	0.63	15.9	1.00	25.4	1.50	38.1
8	0.74	18.8	1.11	28.3	1.61	41.0
9	Ø0.65	Ø16.5	Ø0.65	Ø16.5	Ø0.65	Ø16.5
10	1/4"-28 Tapped		1/4"-28 Tapped		1/4"-28 Tapped	
11	10 ft integral cable					

4.0 MECHANICAL INSTALLATION

Loads applied to S-type load cells must be even and centered. Compensation linkages (e.g. rod end bearing, alignment couplers) are recommended to help minimize load misalignment. When installing fixtures, be sure to thread the fixture to the load cell, and not the load cell to the fixture. If alignment fixtures are not used, ensure loading surfaces are flat and parallel, with loads applied in-line with the sensor.

5.0 ELECTRICAL INSTALLATION

Table 4 - Electrical Connections

Electrical Connection:	Pig-tailed, 10 ft, integrated cable
------------------------	-------------------------------------

5.1 Electrical Drawing / Western Regional Std.

All load cells are wired following the Western Region Standard. All models utilize strain gages configured into a Wheatstone Bridge Circuit to produce the primary sensing element. The four-arm Wheatstone bridge configuration is shown below in Figure 3.

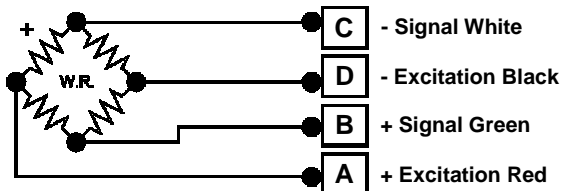


Figure 3 - Western Regional Strain Gage Committee Wiring Code

The gages are bonded to the load cell's structure. Typically, a regulated DC or AC excitation is applied between A and D of the bridge. When a force is applied to the load cell, the Wheatstone bridge becomes unbalanced, causing an output voltage between B and C, which is proportional to the applied load. This configuration allows for temperature and pressure compensation, as well as cancellation of signals caused by forces not directly applied to the axis of the applied load. Output is typically expressed in units of mV/V of excitation.

5.2 Output Polarity

The following figure describes the output polarity.

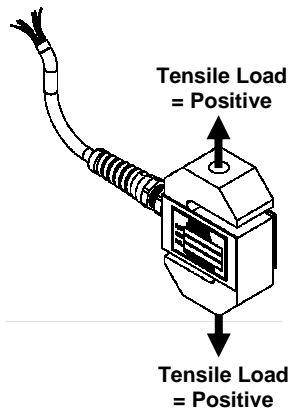


Figure 4 - Output Polarity

5.3 Cable & Grounding Considerations

Proper grounding and shielding is required to prevent electrical noise in strain gage load cell measuring systems. The cable must be shielded twisted pairs with a drain wire.

Cable shields must be grounded only at one end, for example, on the instrument or control system ground. The load cell case is grounded by mechanical attachment to the structure to which it is mounted.

The instrument or control system is grounded through its power cord. Ground loops and measuring system wiring may result in unstable or noisy signals.

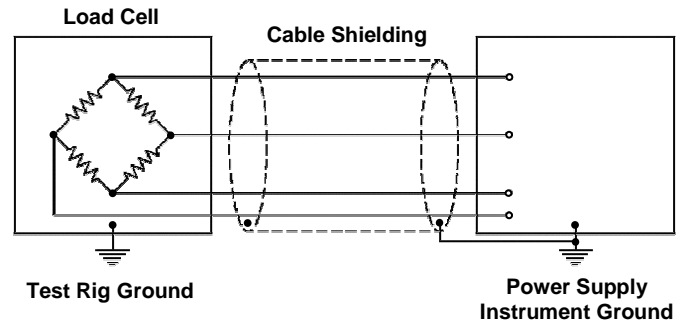


Figure 5 - Grounding

A simple test with a voltmeter connected between the power cord ground and the structure on which the load cell is mounted can confirm that the structure has been properly grounded. If the power cord ground and structure ground are not at the same potential, it may be necessary to provide a secure structure ground, perhaps by driving a copper rod and attaching a ground strap.

6.0 CALIBRATION

Every S-type load cell manufactured by PCB Load & Torque, Inc. has been fully calibrated per ISO/IEC 17025 procedures, and meets all published specifications. Each load cell will come with a calibration certificate designated with matching model and serial numbers. PCB Load & Torque also offers calibration services on an on-going basis.

6.1 Calibration Certificate Description

Calibration reports supplied with S-type load cells contain valuable information to assist the customer in use of the equipment. A separate calibration report is provided for tension and compression calibrations. Calibration procedures, equipment, and reports comply with ISO/IEC 17025.

6.1.1 Measured Output

The applied load starting at zero is measured in five increments to full scale. Output (mV/V) is measured at each increment. The straight-line from zero to the full scale measurement is compared to the measured readings at each increment to calculate the error at each load increment. The deviations (% Full Scale) corresponding to non-linearity at each measurement increment are then calculated.

6.1.2 Hysteresis

The difference between the ascending and descending measured readings at 40% of full scale is used to calculate the hysteresis value.

6.1.3 Best Fit Output

The best fit calibration second-order equation has been calculated from the calibration data by the method of least squares. Deviation between measured output and best-fit output is calculated and displayed in the column next to the best-fit output for each measurement increment. The deviations (% Full Scale) of measured outputs from the calculated best fit are tabulated for each measured reading.

6.1.4 Strain Gage Measurements

Table 5 – Strain Gage Measurements

Bridge Resistance:	350 Ohm Nominal
Excitation:	+P(A) to –P(D) Ohms
Signals:	+S(B) to –S(C) Ohms
Leakage to Ground:	> 5k GOhm
Bridge Unbalance:	±1.0% Full Scale
Output:	2.0 mV/V Nominal
Maximum Voltage:	20 VDC

6.1.5 Shunt Calibration Standard Resistor

All S-type load cell calibrations use a 60K Ohm (0.1%) precision resistor shunt calibration value that is supplied into the calibration report.

6.1.6 Static Error Band (SEB)

The static error band (SEB) is determined by the maximum deviations of the ascending and descending calibration points from the best fit straight line through zero output. The SEB includes the effects of nonlinearity, hysteresis, and non-return to minimum load.

7.0 SHUNT CALIBRATION DESCRIPTION

Shunt calibration is used to simulate a known tension or compression load on a load cell. The calibration certificate will indicate which leg of the bridge to apply the shunt resistor to for both tension and compression load simulation. Typically tension is simulated by inserting the shunt resistor between the +P and +S connector leads. Compression loading is simulated by inserting the shunt resistor between the +S and –P connector leads.

7.1 Resistor Value

S-type load cells have a nominal 2.0 mV/V full scale output. For a 350 ohm strain gage bridge the precision shunt resistor is, 60,000 ohms ± 0.1%, simulates an output of approximately 73% of the full scale output for the load cell. The calibration values for each bridge are found on the calibration certificates supplied with each load cell.

7.2 Shunt Calibration Process

To perform the shunt calibration, use the following procedure:

1. Stabilize all forces on the load cell. If possible, remove all loads.
2. Allow the powered sensor and signal conditioner to warm up for a minimum of 30 minutes
3. Set the load indicator display to read exactly 00.000.
4. Connect the shunt resistor to the terminals specified in the calibration certificate, and adjust the span or gain until the display reads the force value stated on the certificate.
5. Repeat steps 1-3 to verify that a valid calibration setting has been obtained.
6. If possible, apply a known load to the measurement system to further verify that the calibration has been accurately set up.

7.3 Estimating Shunt Resistor for a Given Load

The following formula can be used to estimate the approximate value of shunt resistor required to simulate a mechanical load.

$$R_{cal} = (25 * R_b) / (Output_{FS} * L_{cal})$$

Where:

R_{cal} = Shunt Resistor (K ohms)

R_b = Bridge Resistance (ohms)

$Output_{FS}$ = Full Scale output of the load cell (mV/V)

L_{cal} = Load to be simulated, % of Load Cell Capacity

8.0 MAINTENANCE

Routine maintenance of the S-type load cell should include cleaning the electrical connectors, housings, and mounting surfaces with solutions and techniques that will not harm the physical material of construction. Make sure liquids are not allowed to migrate into devices that are not hermetically sealed. Such devices should only be wiped with a damp cloth, and never be submerged or have liquids poured on them. Never use a pressure washer on the load cells.

Yearly calibrations are recommended to ensure that the unit's outputs match the factory specifications.

9.0 TROUBLE SHOOTING

Proper performance of a load cell requires careful attention to both electrical and mechanical aspects of the measurement system. A basic understanding of the electrical and mechanical installation requirements is recommended.

9.1 Mechanical Trouble Shooting

A mechanical checklist includes:

1. Check for proper installation of fixturing.
2. Check integrity of the fixturing.

9.2 Electrical Trouble Shooting

An electrical checklist should start with:

1. Check cables for proper wiring and make sure connections are secure and proper.
2. Inspect for loose or dirty electrical connections.
3. Check for improper shield grounds.
4. Check for proper grounding of the structure that the load cell is mounted on.
5. Check the signal conditioning electronics for proper setup.
6. Check the insulation resistance of shielded conductors for short circuits.
7. Check isolation resistance, load cell flexure to conductors.
8. Check load cell bridge resistances, (A-D) excitation and (B-C) the signal leads.
9. Check bridge balance.
10. Keep a record of your observations, correct problems, or contact PCB factory for assistance.

10.0 CALIBRATION / REPAIR SERVICES

PCB Load & Torque offers calibration and repair services. The PCB Calibration Laboratory in Farmington Hills, Michigan is A2LA Accredited per ISO/IEC 17025.

Standard calibration certificates list five force points ascending and one point descending. Additional data points are available at extra cost upon request. A 60 K ohm ($\pm 0.1\%$) shunt calibration resistor is supplied with each load cell calibration.

Certificate information includes tabulated measurement variable data zero balance, bridge input/output resistance, computer nonlinearity and hysteresis, static error band (SEB) calculations and entries abilities and traceability statements.

If an initial evaluation shows that a transducer requires repair, PCB will provide the customer with an estimate prior to taking any corrective action.

10.1 RMA / Purchase Order

Please request a return material authorization (RMA) before sending a load cell back to the factory for any reason. For calibration services, if possible, a copy of the purchase order covering the requested services should be included with the returned load cell.

11.0 WARRANTY

Standard warranty on S-type load cells covers parts and workmanship. For full details, refer to the Warranty Statement supplied with each load cell.


If the load cell is defective for reasons other than overloads, return it to the factory for detailed evaluation. Factory evaluation may show that the load cell is repairable or non-repairable and if repair or replacement will be under warranty. If not under warranty, the customer will be contacted with the cost of repairs and recalibration. Once authorization to proceed is received, a delivery date will be provided.

Manual Number: 55947

Manual Revision: NR

Revision Date: 6/5/13

ECO Number: 41592

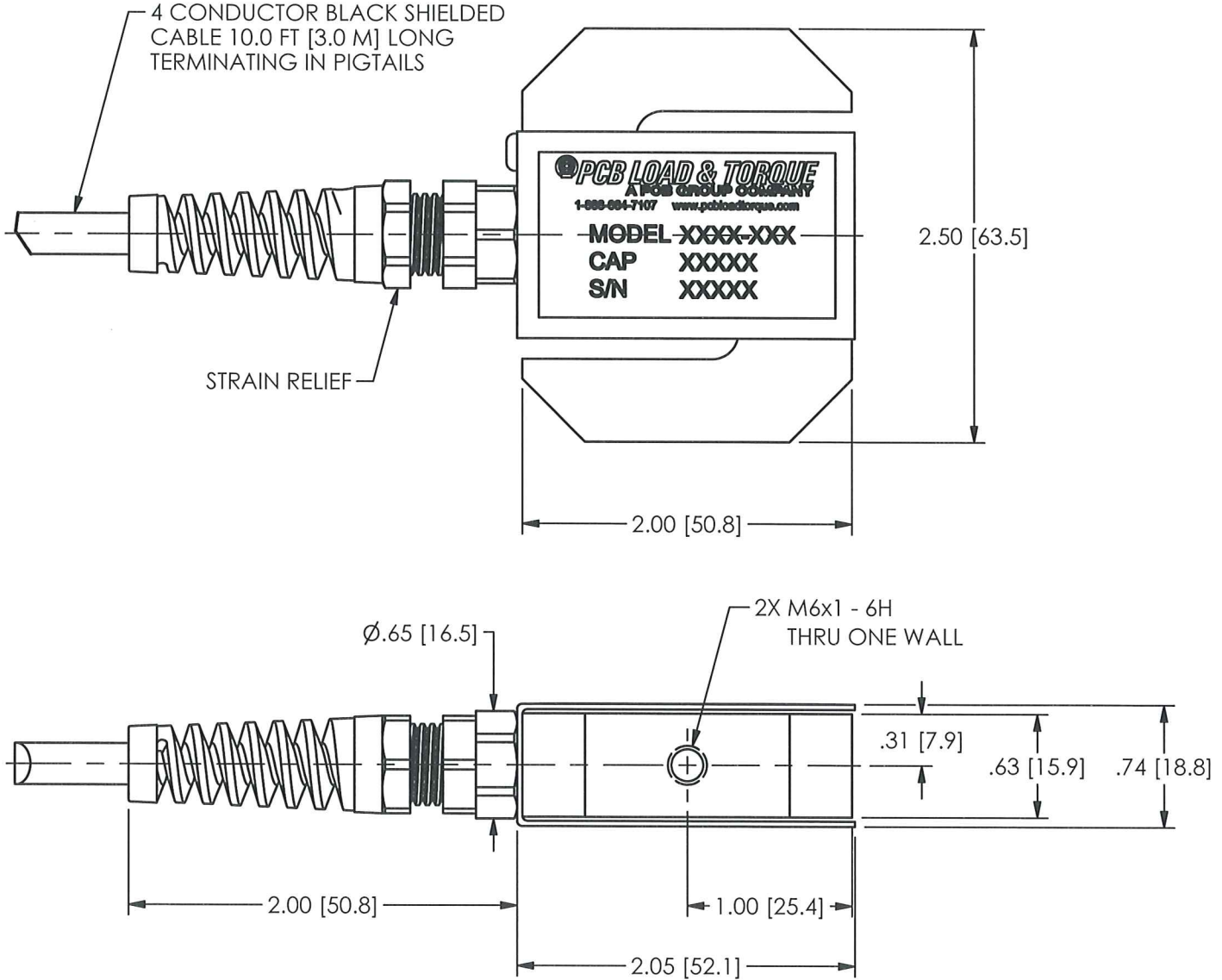
Model Number M1630-04C		STRAIN GAGE LOAD CELL			Revision: D ECN #: 43825											
Performance		ENGLISH	SI		OPTIONAL VERSIONS											
Measurement Range	112 lb	500 N	[5]	Optional versions have identical specifications and accessories as listed for the standard model except where noted below. More than one option may be used.												
Sensitivity(± 10 %)	2 mV/V	2 mV/V	[6]													
Non-Linearity	≤ 0.15 % FS	≤ 0.15 % FS														
Hysteresis	≤ 0.15 % FS	≤ 0.15 % FS														
Non-Repeatability	≤ 0.05 %RO	≤ 0.05 %RO														
Resonant Frequency	1.8 kHz	1.8 kHz														
Creep(in 20 minutes)	≤ 0.08 %	≤ 0.08 %		NOTES: [1]Nominal. [2]Calibrated at 10 VDC, usable 5 to 20 VDC or VAC RMS. [3]Singularly applied, i.e. no other extraneous loads. [4]Over compensated operating temperature range. [5]FS - Full Scale. [6]RO - Rated Output. [7]See Outline Drawing 46140 for Complete Dimensions												
Environmental																
Overload Limit	168 lb	750 N														
Load Limit(Side Force, F _X or F _Y)	11.2 lb	50 N	[3]													
Load Limit(Bending Moment, M _X or M _Y)	22.1 in-lb	2.5 Nm	[3]													
Load Limit(Axial Torque, M _Z)	22.1 in-lb	2.5 Nm	[3]													
Temperature Range(Operating)	0 to +200 °F	-18 to +93 °C														
Temperature Range(Compensated)	+75 to +150 °F	+21 to +65 °C														
Temperature Effect on Output(Maximum)	± 0.002 %Reading/°F	± 0.0036 %Reading/°C	[4]													
Temperature Effect on Zero Balance(Maximum)	± 0.0015 %FS/°F	± 0.027 %FS/°C	[4]													
Electrical				<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>Entered: AP</td> <td>Engineer: PE</td> <td>Sales: JC</td> <td>Approved: JSD</td> <td>Spec Number:</td> </tr> <tr> <td>Date: 2/16/2015</td> <td>Date: 2/16/2015</td> <td>Date: 2/16/2015</td> <td>Date: 2/16/2015</td> <td style="text-align: center;">46002</td> </tr> </table>			Entered: AP	Engineer: PE	Sales: JC	Approved: JSD	Spec Number:	Date: 2/16/2015	Date: 2/16/2015	Date: 2/16/2015	Date: 2/16/2015	46002
Entered: AP	Engineer: PE	Sales: JC	Approved: JSD	Spec Number:												
Date: 2/16/2015	Date: 2/16/2015	Date: 2/16/2015	Date: 2/16/2015	46002												
Bridge Resistance	350 Ohm	350 Ohm	[1]													
Excitation Voltage(Recommended)	10 VDC	10 VDC	[2]													
Insulation Resistance	>5x10 ⁹ Ohm	>5x10 ⁹ Ohm														
Zero Balance	≤ 1 % FS	≤ 1 % FS														
Output Polarity	+Tension	+Tension														
Physical				 <p>PCB Load & Torque, Inc. 24350 Indoplex Circle Farmington Hills, MI 48335 UNITED STATES Phone: 866-684-7107 Fax: 716-684-0987 E-Mail: linfo@pcbloadtorque.com Web site: http://www.pcbloadtorque.com</p>												
Size (Length x Height x Width)	2.00 in x 2.50 in x 0.625 in	51 mm x 64 mm x 16 mm	[7]													
Weight	0.23 lb	104 g														
Housing Material	Aluminum	Aluminum														
Sensing Element	Strain Gage	Strain Gage														
Deflection at Full Scale Capacity	0.002 in	0.05 mm														
Electrical Connector	10 ft - Integrated Cable	10 ft - Integrated Cable														
Electrical Connection Position	Side	Side														
<i>All specifications are at room temperature unless otherwise specified. In the interest of constant product improvement, we reserve the right to change specifications without notice.</i>																

PCB Load & Torque Inc. claims proprietary rights in the information disclosed hereon. Neither it nor any reproduction thereof will be disclosed to others without the written consent of PCB Load and Torque Inc.

REVISIONS

REV	DESCRIPTION	ECO
NR	RELEASED TO DRAFTING	36164

46140



UNLESS OTHERWISE SPECIFIED TOLERANCES ARE:

DRAWN	CHECKED	ENGINEER
<i>8/23/11</i>	<i>6/28/11</i>	JAM 6/28/11

PCB LOAD & TORQUE
A PCB GROUP COMPANY

DIMENSIONS IN INCHES

DIMENSIONS IN MILLIMETERS [IN BRACKETS]

DECIMALS XX ±.01
XXX ±.005

DECIMALS X ± 0.3
XX ± 0.13

ANGLES ± .5 DEGREES

ANGLES ± .5 DEGREES

FILLETS AND RADII
.015 MAX

FILLETS AND RADII
0.38 MAX

TITLE
OUTLINE DRAWING
MODEL M1 630 SERIES
S-CELL

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(716) 684-0001 E-MAIL: liinfo@pcbloadtorque.com

DWG. NO.
46140

SCALE: FULL SHEET 1 OF 1