550664 A

WIRING - Neuter OUTPUT

Temposonics LH sensors with square wave neuter output are used for retrofitting Temposonics I sensors and Temposonics II sensors with neuter output and previously existing Temposonics accessories. Below are tables that show the wiring relationships of the original sensor to the new retrofitted Temposonics LH.

Retrofitting Temposonics I

Pin	Function	Temposonics I	AOM	Temposonics LH	
R1 & R2 Connectors		Wire Color	TB2 Connector	>12 in. (R0 cable)	≤ 12 in. (R0 cable)
A	(+) 15 Vdc	Green	TB2-A	N/C	N/C
B	DC Common	Black	TB2-B	White & Green	White & Yellow
C	Return Pulse	Brown	TB2-C	Pink	Pink
D	(-) 15 Vdc	Blue	TB2-D	N/C	N/C
E	Interrogation Pulse	White	TB2-E	Yellow	Green
F	(+) 12 Vdc	Red	TB2-F	Red	Red

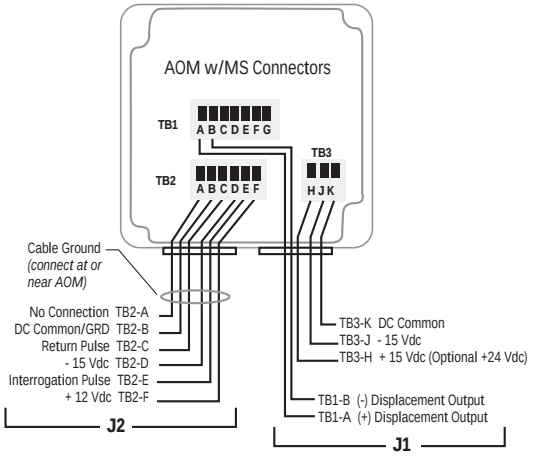
NOTE:
For pigtail connections:
Use positive (+) interrogation.when retrofitting a Tempsosonics II sensor with an AOM or a Temposonics I sensor greater than 12 inches.
Use negative (-) interrogation when retrofitting a Temposonics I less than 12 inches.

Retrofitting Temposonics II

Pin	Function	Temposonics II		AOM	Temposonics LH	
RB Connector		Wire Color	Striped	TB2 Connector	R0 Cable	RB Connector
1	DC Ground	White	White/Blue	TB2-B	White	White
2	N/C	Brown	Blue/White	N/C	N/C	N/C
3	N/C	Gray	White/Orange	N/C	N/C	N/C
4	N/C	Pink	Orange/White	N/C	N/C	N/C
5	(+) 12 Vdc	Red	White/Green	TB2-F	Red	Red
6	N/C	Blue	Green/White	N/C	N/C	N/C
7	N/C *(see note 3)*	Black	White/Brown	TB2-B	N/C	Black
8	Output Pulse	Purple	Brown/White	TB2-C	Pink	Purple
9	(+) Interrogation	Yellow	White/Gray	TB2-E *(see notes 1 & 2)*	Yellow	Yellow
10	(-) Interrogation	Green	Gray/White	TB2-E *(see notes 1 & 2)*	Green	Green

NOTES:
1. *For pigtail connections:*
   Use positive (+) interrogation.when retrofitting a Tempsosonics II sensor with an AOM or a Temposonics I sensor greater than 12 inches.
   Use negative (-) interrogation when retrofitting a Temposonics I less than 12 inches.
2. *Ground unused interrogation lead.*
3. *In some applications, Pin 7 may be used as DC ground. Consult applications for more information.*

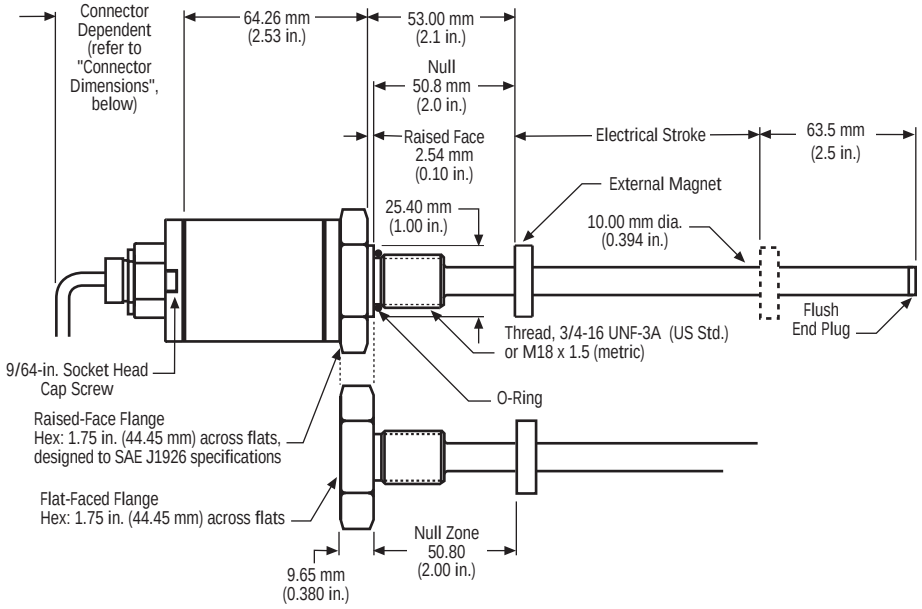
AOM Connections



NOTE:
The connections to TB3 represent wiring for a typical system configuration (i.e., ±15 Vdc power supply and strain-relief connectors). If the AOM is configured with other options (i.e., 24 Vdc power supply, velocity output, MS connectors) refer to tables 1-8 in this document for proper wiring.

Figure A
AOM J1 and J2 Connections

DIMENSIONS

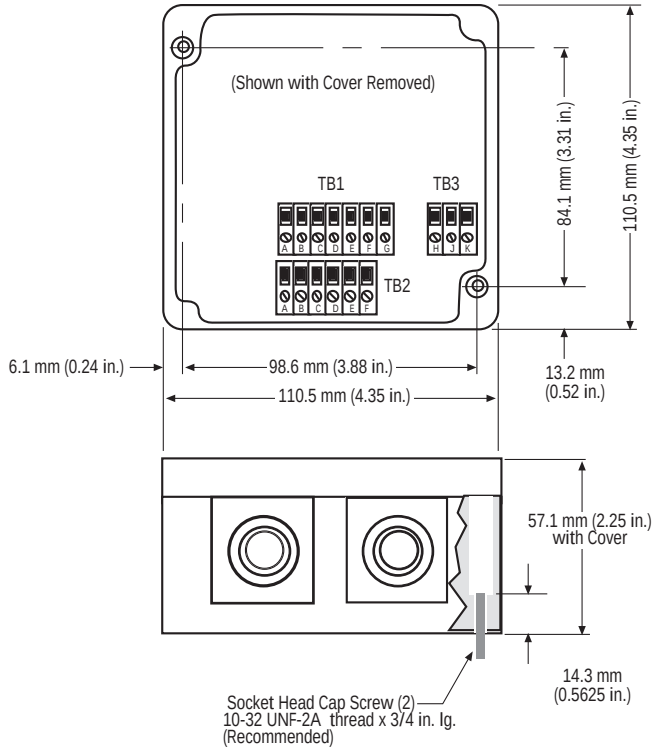


MODEL

LH

CONNECTOR DIMENSIONS (includes cable bend)

- **'RB' Connector w/ 'MT' or 'FT' Mating Connector:** 109.22 mm (4.30 in.)
- **'R' Integral Cable:** 69.85 mm (2.75 in.)



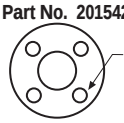
AOM

(ANALOG OUTPUT MODULE)

Part No. 251416

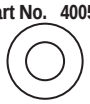
ID: 13.5 mm (0.53 in.)
OD: 32.8 mm (1.29 in.)
Thickness: 7.9 mm (0.312 in.)

Part No. 201542



ID: 13.5 mm (0.53 in.)
OD: 32.8 mm (1.29 in.)
Thickness: 7.9 mm (0.312 in.)

Part No. 400533



ID: 13.5 mm (0.53 in.)
OD: 25.4 mm (1.0 in.)
Thickness: 7.9 mm (0.312 in.)
(For use with strokes ≤ 3050 mm or 120 in.)

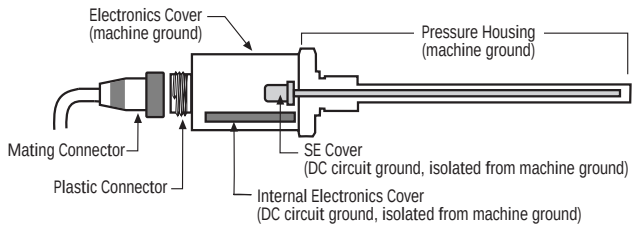
Part No. 401032

ID: 13.5 mm (0.532 in.)
OD: 17.4 mm (0.685 in.)
Thickness: 7.9 mm (0.312 in.)
(For use with strokes ≤ 1525 mm or 60 in.)

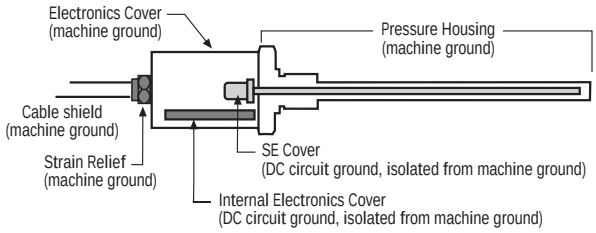
MAGNETS

G R O U N D I N G

L Series (SE-based) Sensors with Plastic Connectors



L Series (SE-based) Sensors with Integral Cables



Retrofitting Note:
When retrofitting original Temposonics II or LH sensors with L Series sensors, with 'R0' type integral cables, verify that the cable shield and the DC circuit ground are isolated from each other. Connecting the cable shield to DC ground will typically cause a ground loop when using sensors with metal connectors or integral cables.

T E M P O S O N I C S L H S P E C I F I C A T I O N S

PARAMETER	SPECIFICATION
Measured Variable:	Displacement
Resolution:	Infinite (when used with the AOM)
Non-Linearity:	± 0.02% or ± 0.05 mm (± 0.002 in.), whichever is greater 0.002 in. is the minimum absolute linearity and varies with sensor model
Repeatability:	Equal to resolution
Hysteresis:	< 0.02 mm (0.0008 in.)
Outputs:	Square Wave Neuter
Measuring Range:	25 to 3800 mm (1 to 150 in.)
Operating Voltage:	+ 11.4 to 26.4 Vdc
Power Consumption:	100 mA
Operating Temperature:	*Head Electronics:* - 40 to 70°C (- 40 to 158°F) *Sensing Element:* - 40 to 105°C (- 40 to 221°F)
Shock Rating:	100 g (single hit)/IEC standard 68-2-27 (survivability)
Vibration Rating:	5 g/10-150 Hz/IEC standard 68-2-6
Update Time:	Minimum = [Stroke (specified in inches) + 3] x 9.1 µs
Operating Pressure:	5000 psi static; 10,000 psi spike
Housing Style/Enclosure:	Aluminum die-cast head, IP 67 stainless steel rod & flange (LH flange: M18 x 1.5 or 3/4-16 UNF-3A)
Magnet Type:	Ring magnet

Temposonics LH

SENSOR MODEL
LH = Hydraulic Rod Style

HOUSING STYLE
T = US customary threads, raised-faced hex, and pressure tube
S = US customary threads, flat-faced hex, and pressure tube
M = Metric threads, flat-faced hex, and pressure tube
N = Metric threads, raised-faced hex, and pressure tube
B = Sensor cartridge only, no pressure housing (stroke lengths ≤ 72 inches)

CONNECTION TYPE
RB = 10-pin threaded connector
R0 = Integral cable, straight out exit, pigtail connection (See Price Adders, next page)
R1 = Integral cable with 6-pin connector (for retrofitting sensors with stroke lengths >12 in.)
R2 = Integral cable with 6-pin connector (for retrofitting sensors with stroke lengths ≤12 in.)

INTEGRAL CABLE LENGTH
00 = No integral cable (i.e., sensors with integral connectors)
02 = 2 meter integral cable; standard with metric stroke lengths (i.e., millimeters)
05 = 5 ft. integral cable; standard with US stroke lengths (i.e., inches and tenths)
01 - 99 = Custom cable length 1 to 99 ft. (or 1 to 30 meters)
(Encode length in feet if using US customary stroke length, in meters if using metric stroke length)

NOTE: *MTS recommends the maximum integral cable length to be 10 meters or 33 feet. Cables greater than 10 meters in length are available, however, proper care must be taken during handling and installation.*

UNIT OF MEASURE
U = US customary (inches and tenths: xxx.x in.)
M = Metric (millimeters: xxxx mm)

LENGTH
__ __ __ . __ = Inches and tenths or __ __ __ __ millimeters
1 to 150 in. stroke lengths (25 to 3800 mm)

NOTE:
LH sensors with Neuter Output have a maximum stroke length of 150 in. (3800 mm). LH sensors with housing style 'B' have a maximum stroke length of 72 in. (1800 mm).

INPUT VOLTAGE
4 = +11.4 to 26.4 Vdc

OUTPUT
N0 = Square Wave Neuter Output (for retrofitting Temposonics I and Temposonics II sensors)

CAUTION!

Retrofitting LH Sensors:
The 'S' style housing on the original Temposonics LH sensor had a raised-face flange. The 'S' style housing on the new Temposonics L Series LH sensor has a flat-faced flange. If you want to retrofit an original LH sensor with an 'S' style housing with a new L Series LH sensor, select the 'T' style housing. Contact the factory if you have an questions.

Analog Output Module

7-digit model number code for Temposonics LH sensor

ENCLOSURE STYLE
31 = Strain relief connector (standard)
32 = 5 & 6-pin MS connectors (mating connectors sold separately)

DISPLACEMENT OUTPUT
Voltage:
10 = 0 to 10 Vdc
20 = 10 to 0 Vdc
30 = 0 to 5 Vdc
40 = 5 to 0 Vdc
50 = - 10 to + 10 Vdc
60 = +10 to - 10 Vdc
70 = - 5 to + 5 Vdc
80 = + 5 to - 5 Vdc
01 = 0 to - 10 Vdc
02 = - 10 to 0 Vdc

Current:
03 = 4 to 20 mA (ungrounded)
04 = 20 to 4 mA (ungrounded)
05 = 4 to 20 mA (grounded)
06 = 20 to 4 mA (grounded)

Special
(2 magnets required with following output selections):
09 = Dual magnet *(provides 2 separate displacement outputs)*
90 = Differential *(output reflects distance between two magnets)*

Consult MTS Applications Engineering before ordering special outputs. Also, set points for special outputs must be defined at the time order.

DC POWER SUPPLY REQUIREMENTS
0 = ± 15 Vdc (standard)
1 = 24 Vdc

VELOCITY OPTION
0 = None (standard)
Options:
1 = Forward-acting voltage output
2 = Reverse-acting voltage output
3 = Forward-acting current output (grounded)
4 = Reverse-acting current output (grounded)
5 = Forward-acting current output (ungrounded)
6 = Reverse-acting current output (ungrounded)

Consult MTS Applications Engineering before ordering velocity option.

MAXIMUM VELOCITY
__ __ __ = Velocity range: 1 to 400 inches per second or metric equivalent
(the 3-digit code represents either inches per second or meters per second depending upon the unit of measure selected above.)

CONNECTION TYPE FOR TEMPOSONICS LH SENSOR
R__
(Refer to model number guide for Temposonics LH sensors)

UNIT OF MEASURE
U = US Customary (inches and tenths: xxx.x in.)
M = Metric (millimeters: xxxx mm)

STROKE LENGTH
__ __ __ . __ = Inches and tenths or __ __ __ __ millimeters
(Encode length in 0.1 in. or 5 mm increments)
Encode as follows:
0120 = 12.00 inches or 120 mm
1200 = 120.0 inches or 1200 mm

IMPORTANT NOTES:
1.) Only two of the following options can be ordered per AOM:
- current outputs
- special outputs
- velocity outputs
- 24 Vdc input power

Contact customer service if you have questions about ordering options.

2.) Only certain combinations of current outputs and velocity outputs are valid with the AOM—the chart below identifies the valid combinations:

Current Output Codes	*Velocity Output Codes*
03	5
04	6
05	3
06	4

Extension Cables

SENSORS CONNECTION TYPE
MT = (Standard) Molded connector for Style RB sensors
FT = Field installable connector for Style RB sensors

CABLE LENGTHS
__ __ __ = Cable Length (Range 5 ft. 100 ft.; Encode: 005 to 100)

CABLE TERMINATION
C1 = 6-pin female connector (P/N 370015)
[standard connection to Analog Output Module (AOM) with enclosure style '32' which includes MS-style connectors]
C2 = 6-pin female connector (P/N 370015; for use in retrofit situations only)
[for retrofitting an original Temposonics sensor system that includes an AOM with enclosure style '32' with MS-style connectors, a stroke length of ≤ 12 inches, and a negative (-) interrogation pulse]
P0 = Pigtail connection (for use with enclosure style '31')

Mating Connectors

6-Pin Female MS Connector 370015
Mates to J2 of the Analog Output Module or Digital Interface Box

5-Pin Female MS Connector 370017
Mates to J1 connector of Analog Output Module

Installing the Analog Output Module (AOM)

Dimensions of the AOM are shown below in Figure D. The mounting hole dimensions shown are also stamped on the back of the module. Mount the AOM as shown, using two socket head cap-screws.

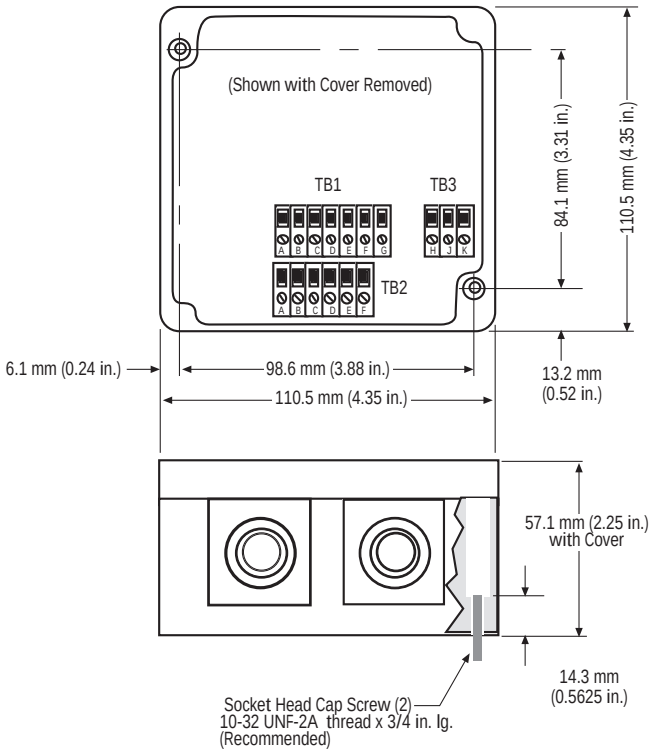


Figure D
AOM Dimensions

1. Mount the AOM in a location within reach of the sensor cable. Standard systems allow the AOM to be mounted 250 feet from the sensor.
2. Connect cable from AOM to the sensor.
3. Adjust the AOM zero and span potentiometers (as described on p.6-7) to compensate for any offsets due to mechanical installation.

Analog Output Module / Wiring Procedures

This section describes wiring procedures for analog systems that use the Analog Output Module, including:

- 0 to 10 V displacement (forward and reverse acting)
- -10 to +10 V displacement (forward and reverse acting)
- Ungrounded 4 to 20 mA displacement
- Grounded 4 to 20 mA displacement
- Velocity Outputs
- Dual Channel Outputs

Connections are made between the sensor, the AOM, the customer-supplied power supply, and the customer-supplied receiving device.

Preparing Cable for Connection to the AOM

The AOM is equipped with two strain relief or two MS (mil-spec) connectors.

A strain relief is used for an un-terminated cable. Prepare the cable as shown in Figure E. It is recommended that you tin the exposed leads to ensure a good connection. Mount the cable to the AOM, ready to make connections to the terminal boards (TB1, TB2, or TB3) inside.

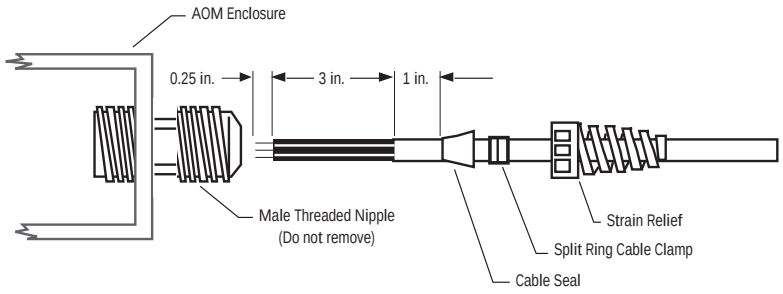


Figure E
Cable Preparation for Strain Relief

When the AOM box is used, an optional MS connector can be used with the cable. Cables are available in various lengths.

J1 Installation Wiring

The J1 cable provides the AOM voltage inputs from the DC power supply. It also provides displacement outputs to the receiving device.

Take the following steps to connect J1:

1. One of the screws securing the cover of the AOM has a raised head. Connect a ground wire from that screw head to a central earth ground or to the power supply ground (if it is grounded). Only one circuit earth ground should be used to prevent ground loops.
2. *Strain Relief Only*: Fabricate the J1 cable, and prepare the cable as described earlier. Identify the connections to TB1 and TB3. Refer to Tables 1 - 8 to determine the appropriate J1 connections.
3. *MS Connector Only*: Fabricate the J1 cable. Refer to tables 1-8 to determine the appropriate J1 connections. Solder the connections to the MS type connector (Part No. 370017). Use any cable capable of maintaining the signals for the required length. Ensure the solder connections are clean and free of excessive solder. Use heat-shrink over the solder connections to prevent the pins from shorting.
4. Identify the wires at the other end of the cable for connections to the power supplies and the receiving device. Test the cable for shorts.

> **NOTE:**
> *Make sure that the power supply can provide +15 Vdc at 250 mA and -15 Vdc at 65 mA (use a bipolar power supply). The power supply should provide less than 1% ripple with 2% regulation. The power supply should be dedicated to the transducer system to prevent noise and external loads from affecting the system performance.*

5. Make sure the power supply is off. Complete the cable connections at the power supply.

> **CAUTION:**
> *The input to the receiver electronics should be a passive, resistive device to prevent damage to the AOM.*

6. First, make sure there is no voltage present on the receiving device input connections. Then, complete the cable connections to the receiving device.

> **NOTE:**
> *Do not route the J1 cable near high voltage sources.*

7. *Strain Relief Only*: Connect the cable to the TB1 and TB3 terminals on the AOM.
8. *MS Connector Only*: Connect the cable to the J1 connector on the AOM.

J1 Connections for AOM

The AOM is provided with either a strain relief connector, which accepts a pigtailed connection directly into terminals blocks located inside the AOM enclosure, or a threaded MS connectors. Tables 1 - 8, below, indicate the appropriate connection to make for either configuration. Make sure that you follow the appropriate table for your specified options.

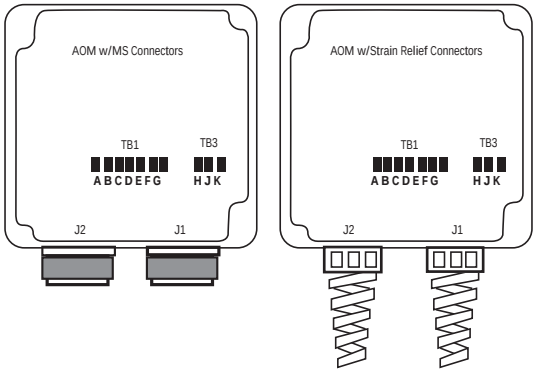
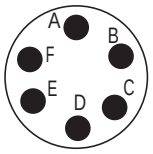


Figure F
AOM w/ Strain Relief and MS Connectors

Table 1 - Standard J1 Connections

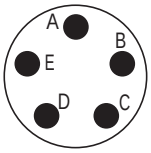
Strain Relief Connection	*MS Connector (J1) Pin Designation*	*Function*
TB1		
A	D	Displacement Output
B	E	Displacement Output Return (ground)
TB3		
H	A	+ 15 Vdc
J	B	- 15 Vdc
K	C	DC Common



J2 pin out locations for MS connector (MTS P/N 370015)

Table 2 - J1 Connections w/Velocity Output Option

Strain Relief Connection	*MS Connector (J1) Pin Designation*	*Function*
TB1		
A	D	Displacement Output
B	-	Displacement Output Return (ground)
C	E	Velocity Output
D	-	Velocity Output Return (ground)
TB3		
H	A	+ 15 Vdc
J	B	- 15 Vdc
K	C	DC Common



J1 pin out locations for MS connector (MTS P/N 370017)

Table 3 - J1 Connections w/24 V Power Supply Option

Strain Relief Connection	*MS Connector (J1) Pin Designation*	*Function*
TB1		
A	D	(+) Displacement Output
B	E	(-) Displacement Output
TB3		
H	A	24 Vdc
J	No Connection	N/A
K	C	DC Common

Table 4 - J1 Connections w/ 24 V Power Supply & Velocity Output Options

Strain Relief Connection	*MS Connector (J1) Pin Designation*	*Function*
TB1		
A	D	(+) Displacement Output
B	-	(-) Displacement Output
C	E	(+) Velocity Output
D	-	(-) Velocity Output
TB3		
H	A	24 Vdc
J	No Connection	N/A
K	C	DC Common

Table 5 - AOM J1 Connections w/Dual Channel Option

Strain Relief Connection	*MS Connector (J1) Pin Designation*	*Function*
TB1		
A	D	Channel 1 (+) Displacement Output
E	E	Channel 2 (+) Displacement Output
TB3		
H	A	+ 15 Vdc
J	B	- 15 Vdc
K	C	DC Common

Table 6 - J1 Connections w/Dual Channel & 24 V Power Supply Options

Strain Relief Connection	*MS Connector (J1) Pin Designation*	*Function*
TB1		
A	D	Channel 1 (+) Displacement Output
B	E	Channel 2 (+) Displacement Output
TB3		
H	A	24 Vdc
J	No Connection	N/A
K	C	DC Common

J1 Connection to AOM with MS Connectors

Table 7 - Grounded 4-20 mA Current Output

Strain Relief Connection	*MS Connector (J1) Pin Designation*	*Function*
TB1		
H	A	+ 15 Vdc
J	B	- 15 Vdc
K	C	DC Common and (-) Current (return) *
TB3		
A	D	Current (source)
	E	Not connected

** Maximum load resistance: 500Ω*

Table 8 - Ungrounded 4-20 mA Current Output

Strain Relief Connection	*MS Connector (J1) Pin Designation*	*Function*
TB1		
H	A	+ 15 Vdc
J	B	- 15 Vdc
K	C	DC Common
TB3		
A	D	Current Output (source) *
B	E	Current Output (return)

J2 Connections

The J2 cable provides connections between the AOM and the sensor.

Cables up to 250 feet (76 meters) can be fabricated with any high quality multi-conductor cable with an overall shield (Belden equivalent).

Take the following steps to connect J2:

1. It is recommended that you apply an earth ground to the transducer rod. This is typically accomplished by mounting the transducer head to a bracket or machine.
2. *Strain Relief Only*: If necessary, fabricate the J2 cable, and prepare the cable as described earlier. Identify the connections to TB2. Refer to Table 9, below for the J2 connections.

> **NOTE:**
> *Ensure the solder connections are clean and free of excessive solder. Use heat-shrink over the solder connections to prevent the pins from shorting.*

3. *MS Connector Only*: If necessary, fabricate the J2 cable. Be sure to use the recommended cable for the required length. The color code refers to cables supplied with the system. Solder the connections to the MS connector supplied with the AOM. Use any cable capable of maintaining the signals for the required length. Ensure the solder connections are clean and free of excessive solder. Use heat-shrink over the solder connections to prevent the pins from shorting.

Table 9 - AOM J2 Connections (see figure A or D for pin outs)

J2 Connection (TB 2 A - F)

MS connector	*Strain relief Connection*	*Function*
A	TB2-A	+ 13.5 to + 14.5 Vdc
B	TB2-B	DC Common/GND Frame
C	TB2-C	Return Pulse
D	TB2-D	- 15 Vdc (- 13.5 to - 14.5 Vdc)
E	TB2-E	Interrogation Pulse
F	TB2-F	12 Vdc

4. *Strain Relief Only*: Connect the cable to the TB2 terminals on the AOM and to the transducer.
5. *MS Connector Only*: Connect the cable to the J2 connector on the AOM, and to the transducer.
6. Apply power and check the displacement readings at the system electronics.

Analog Output Module Adjustments

This section explains how to adjust and calibrate an AOM when used with a Temposonics LH sensor. The AOM includes adjustments for zero (null), and span (scale). The adjustments compensate for the following:

- Differences between transducer gradients.
- Small offsets in the magnet position due to mounting.
- Wear in the moving parts of the mechanical system to which the magnet is attached.

In cases where a coupler device is used for adjusting the magnet, the coupler is used for coarse adjustments of both zero and span, while the AOM is used for fine adjustments.

Nominal Range of Adjustment

Zero:	*Minimum:* ± 3/8 in. *Maximum:* Up to 10% of total stroke or ±2 inches, whichever is smaller
Span:	± 2% of total stroke

Figure B, below, shows the location of position adjustments and terminal boards on the AOM.

> **NOTE:**
> *Zero adjustment has an overall effect on total span adjustment. However, span adjustment has no effect on zero adjustment.*

Zero and Span Adjustments

The following procedures calibrate the zero position and the span position to the required output levels. Refer to Figure B for the adjustment locations.

> **NOTE:**
> *The following procedure assumes the standard span 0 to 10 Vdc output is supplied. When other output signals are supplied, use the appropriate signal levels and test equipment for the following adjustments.*

1. Disconnect all power from the system. Loosen the four screws securing the AOM cover, and remove the cover.
2. Note the location of terminal board TB1 on the AOM (Refer to Figure B). Connect a DVM (digital voltmeter) across pins A and B of terminal board TB1 to monitor the displacement signal. Apply power to the system.

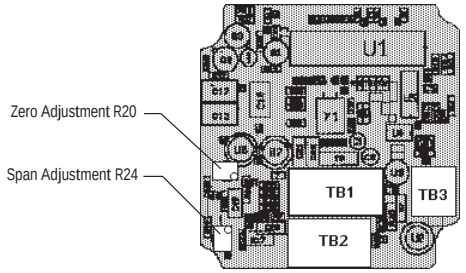


Figure B
Location of Zero & Span Adjustments and Terminal Boards on the AOM.

3. Position the permanent magnet at the specified zero position. The zero position is specified when the sensor is ordered (typically 2 inches from the transducer head).
4. Use a screwdriver to adjust the zero potentiometer (R20) to increase or decrease the value, until you obtain a DVM reading of 0.000 Vdc.
5. Position the permanent magnet for span position (typically 2 inches from the end of the sensor).
6. Use a screwdriver to adjust the span potentiometer (R24) to increase or decrease the value, until you obtain a DVM reading of +10.000 Vdc.
7. Repeat steps 3 to 6 to check the zero and span settings. Readjust as necessary.
8. Disconnect the DVM and check overall system operation. If no more adjustments are necessary, replace the AOM cover.

Optional Velocity Feature

The AOM can be provided with an optional velocity output. For those units, velocity zero and span adjustments are provided. The velocity zero and velocity span adjustments are factory set and should not require readjustment. A velocity output signal of 0 (zero) volts represents a static displacement (no motion). A velocity output of 10 volts represents a dynamic displacement or a customer-specified maximum velocity (maximum velocity must be specified at time of order). The direction of motion is indicated by the polarity of the velocity signal; a positive output signal typically indicates that the permanent magnet is moving away from the transducer head (unless otherwise specified for this system). A negative output signal typically indicates that the permanent magnet is moving towards the transducer head.

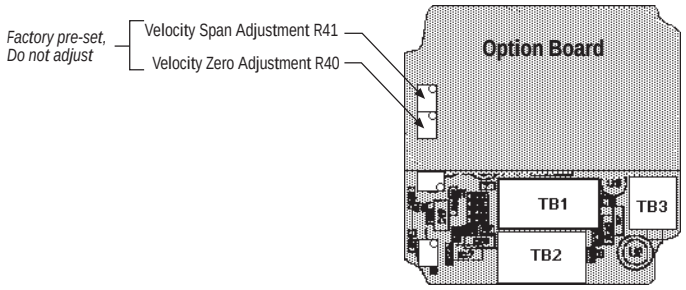


Figure C
Optional Velocity Board

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