MTS ®

Temposonics ®

Position Sensors and Systems

Temposonics ® II
Position Sensors

Ordering Guide

3-00   550031   Revision J

GENERAL INFORMATION

MTS PHONE NUMBERS	
To place orders:	Contact your local distributor or call: 800-633-7609 or 919-677-0100
Application questions:	919-677-0100
24-Hour Technical Assistance:	800-633-7609
Service:	800-248-0532
Fax:	919-677-0200
SHIPPING ADDRESS	**HOURS**
MTS SYSTEMS CORPORATION Sensors Division 3001 Sheldon Drive Cary, North Carolina 27513	Monday - Thursday 8:00 a.m. to 6:30 p.m. EST or EDT Friday 8:00 a.m. to 5:00 p.m. EST or EDT

1. INTRODUCTION

When you specify Temposonics linear displacement transducers (LDTs) on your equipment, you get all the performance advantages you want from a position sensor, including:

- **Wide range of output options** (includes absolute analog and digital outputs).

- **Maximum up-time**, with a non-contact magnetostrictive design that performs reliably in hostile environments for years with no maintenance.

- **Precise resolution** from 0.005 inch to 0.00005 in.

- **Superior repeatability** to ± 0.001% of full stroke for excellent product consistency.

From standard to custom-built units, Temposonics sensors provide the LDT solution that meets your application requirements, no matter how challenging.

Design solutions begin with Temposonics LDTs

Thanks to the proven record of Temposonics transducers for durability, affordability, performance and compact dimensions, many equipment designers specify Temposonics sensors early in the process. Since 1975, our sensors have successfully set the industry standard in hundreds of thousands of industrial and high-tech applications. Best of all, Temposonics LDTs are so flexible, you won't need to alter your design criteria to utilize our equipment.

While many conventional position sensors may claim to be "long wearing", Temposonics LDTs are absolutely **non**-wearing. Since our non-contacting sensing elements never touch, wear is simply not an issue. Also, unlike many competitors' units, each Temposonics LDT is sealed to protect it from contamination, which can often cause costly downtime for cleaning, repair or replacement. Each unit is fully shock and vibration resistant, and built rugged to withstand the harshest industrial environments.

If you want to design low maintenance into your equipment, no maintenance Temposonics LDTs should be part of the package. And, if repeatable accuracy is a key concern for your design, Temposonics LDTs deliver it through our ability to offer high resolution and high repeatability.

* Products are covered by U.S. Patents: 3,898,555; 4,298,861; 4,721,902; 4,726,226; 4,952,873 and additional patents pending.

1.1 Specifications

Parameter	Specification
Input Voltage:	± 12 to ± 15 Vdc

Current Draw:	_Transducer Only:_
	± 15 Vdc at 100 mA maximum, 25 mA minimum
	(current draw varies with magnet position, maximum draw occurs when magnet is at 2 in. (50.6 mm) from the flange and minimum update time is being utilized)
	
	Transducer with:
	RS-422 Personality Module (RPM):
	    ± 12 to ±15 Vdc at 140 mA maximum
	Analog Personality Module (APM):
	    ± 15 Vdc (+0, -3V) at 190 mA maximum, 115 mA minimum
	Digital Personality Module (DPM):
	    + 15 Vdc at 150 mA maximum, 75 mA minimum,
	    - 15 Vdc at 100 mA maximum, 25 mA minimum
	Analog Output Module (AOM):
	    + 15 Vdc at 250 mA, - 15 Vdc at 65 mA

Displacement:	Up to 25 feet (7620 millimeters)
Dead Space:	2.5 inches (63.5 millimeters)
Electronics Enclosure:	Designed to NEMA 6 specifications _Size_: 2.13 in (54.1 mm). high x 1.75 in. (44.45 mm) dia.
Non-linearity:	< ± 0.05% of full scale or ± 0.002 inch (±0.05 mm), whichever is greater
Repeatability:	± 0.001% of full scale or ± 0.0001 inch (± 0.002 mm)), whichever is greater
Hysteresis:	0.0008 inch (0.02 mm) maximum
Frequency Response:	Stroke dependent, 200 to 50 Hz for strokes ranging from 12 to 100 inches (305 to 2540 mm). Wider response is available. For digital systems, output is updated at discreet intervals.
Temperature Coefficient: _**Transducer**_ _(length dependent):_ _**Electronics:**_	 3 ppm/°F (5.4 ppm/°C) < 0.00011 in./°F (< 0.00503 mm/°C)
Operating Temperature _**Head Electronics:**_ _**Transducer Rod:**_ _**Analog Output Module:**_	 - 40 to 150 °F (- 40 to 66 °C) - 40 to 185 °F (- 40 to 85 °C) - 40 to 180 °F (- 40 to 82 °C)
Operating Pressure:	Factory Mutual certified to 3000 psi continuous, 8000 psi static
Outputs (absolute) _**Analog:**_ _**Digital:**_	 Standard: 0 to 10 Vdc (others voltage outputs are available), Optional: 4 - 20 mA (available with AOM only) TTL level, nominal 0 and 5V, true high, parallel transmission
Output Impedance:	Temposonics II with APM: 10 KΩ Output from AOM: 5KΩ
Optional Velocity Output: _(available with AOM only)_	0 to ± 10 Vdc, polarity of output defines direction of travel _(optional 4-20 mA velocity output is available -- contact MTS for details)_
Additional Features:	Internal noise rejection circuitry, low ripple filter
Mounting Distances:	Temposonics II to Analog Output Module: 250 feet Temposonics II with RS-422 Personality Module to Rx: 500 feet Temposonics II with Digital Personality Module to Rx: 150 feet (300 ft. to CC) Temposonics II with Analog Personality Module to Rx: 150 feet

Specifications are subject to change without notice. Consult MTS for verification of specifications critical to your application.

1.2 Definitions

Below are common terms which will be used throughout this manual.

- **Asynchronous Operation/Internal Interrogation:** Defines a system which consists of a transducer, Digital Personality Module (DPM), and a Digital Counter Card or customer supplied high speed counter. The DPM generates an internal interrogation signal at a fixed frequency. The frequency is determined by the stroke length and the number of recirculations.

- **Synchronous Operation/External Interrogation:** In digital systems, synchronous operation defines a system which consists of a transducer and DPM using a customer generated or external interrogation pulse. This is a complex method of interrogation that requires special user-designed hardware and detailed knowledge of Temposonics' sensor technology.

- **Recirculations (circulations):** In digital systems, a process that improves resolution of an LDT system. The on time of the pulse duration signal is multiplied by a specified factor (2 to 127). This provides more counting time for the counter, improving resolution. The process involves retriggering an interrogation pulse a fixed number of times.

Recirculations = 1 ÷ (G x F x R)

Where:

G = Gradient (approximately 9.05 μs per inch, or 0.356 μs per millimeter)

F = Crystal frequency of the counter (27-28 MHz standard)

R = Resolution (in inches or millimeters)

- **Resolution:** The smallest increment of stroke that can be detected and indicated in an output. For digital systems, resolution is a discrete value normally stated in counts-per-inch or counts-per-millimeter. For analog outputs, resolution is limited only by sensitivity or design of the receiver electronics and external wiring.

- **Update Time:** Update time is defined as the time interval between maximum update (refresh) of the Digital Counter Card's binary output. With the Counter Card crystal frequency and the resolution fixed, the update time is proportional to the number of recirculations and the stroke length. The update time is calculated using the following formula.

Update Time (milliseconds) = (S)(R)(G)

Where:

S = Stroke Length (as defined in model number)

R = Number of Recirculations

G = Gradient (approximately 9.05 μs per inch or 0.000356 μs per millimeter)

- **Gradient:** The rate at which pulses propagate through the waveguide, this is approximately 9.05μs per inch (0.356μs per mm), but will vary slightly from transducer to transducer. The gradient for any particular transducer will be indicated on the label affixed to the transducer.
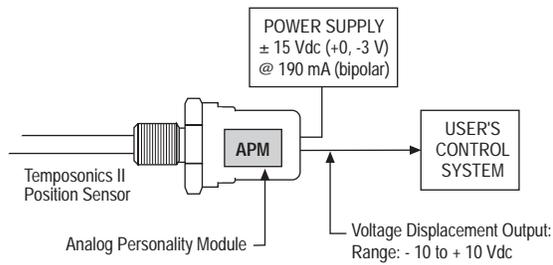
2. ANALOG SYSTEMS

Figure 2.1
*Analog System Configuration
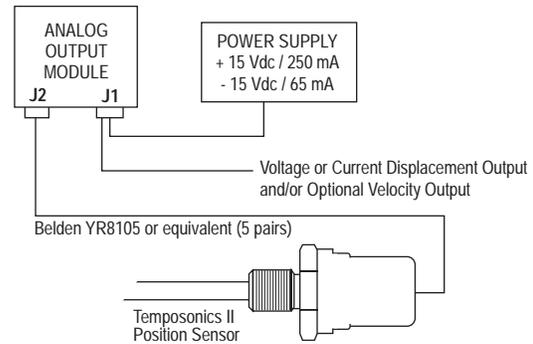with Analog Personality Module (APM)*

Figure 2.2
*Analog System Configuration
with Analog Output Module (AOM)*

2.1 Analog Personality Module (APM)

The Analog Personality Module (APM) is a microprocessor based module that generates scaled outputs from the transducer. Scaled outputs range from -10 to + 10 Vdc or +10 to -10 Vdc (or anywhere in between). The digital programming of the APM provides the capability to make full scale adjustments (i.e., 100% adjustments) to the output, both zero point and full scale (millivolt adjustments are possible).

The APM has three (3) operation modes to choose from. Each mode offers a different combination of update time and resolution. Choose the one that best meets your application requirements. Descriptions of the operation modes are as follows:

Figure 2.3
Analog Personality Module

1. Resolution Preferred Mode	This mode is limited to stroke lengths of 48 inches or less. In the Resolution Preferred Mode, the APM generates a high resolution output (approximately 0.001 in.) while sacrificing update time.
2. Balanced Mode	In this mode the APM offers a "balance" between update time and resolution. For stroke lengths up to 230 inches, the output resolution will be approximately 0.003 inches.
3. Update Preferred Mode	In this mode the APM produces the fastest possible update time while sacrificing resolution. For stroke lengths up to 300 inches, the output resolution will be approximately 0.007 inches.

The following charts illustrate the update time versus resolution comparisons for each operation mode as they relate to stroke length.

Resolution Preferred Mode

Update Time

Resolution

Balanced Mode

Update Time

Resolution

Update Preferred Mode

Update Time

Resolution
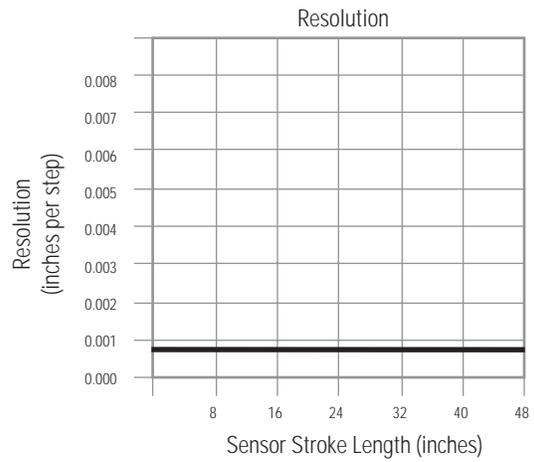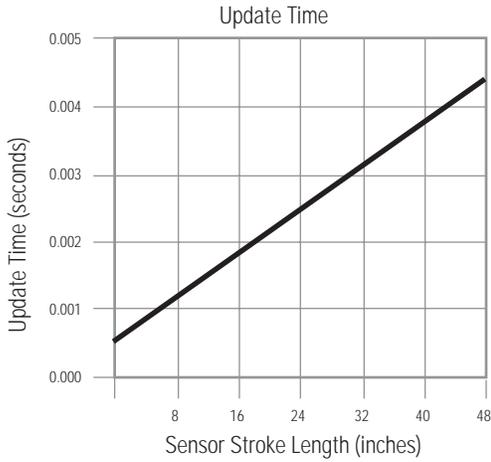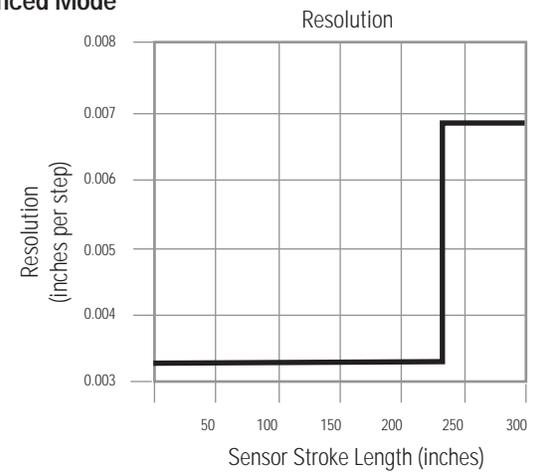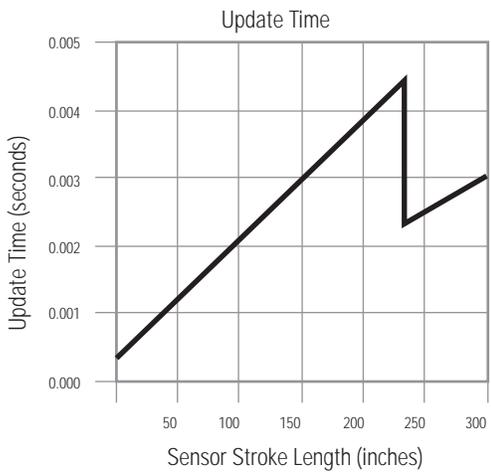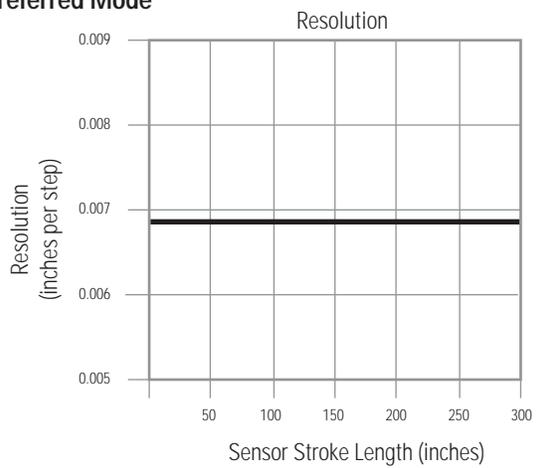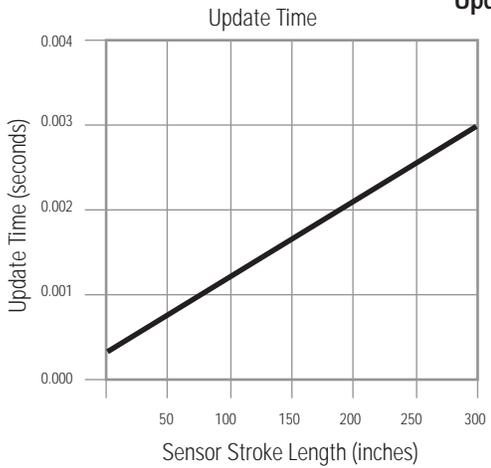
2.2a Analog Output Module

The Analog Output Module (AOM) is an interface device that is mounted separately from, but connected to the Temposonics II transducer. It contains the interrogating electronics and circuitry required for developing an absolute analog displacement signal. An optional velocity output signal is also available from the AOM.

Analog Output Module

2.2b Analog Output Card

The Analog Output Card is a plug-in type card with an edge connector; it is not equipped with an enclosure. The Analog Output Card possesses all of the features available with the AOM and can be retrofitted physically and functionally in place on the "old style" Temposonics electronics card. A card holder to mount the Analog Output Card is available (see Accessories - Section 7.4).

Analog Output Card

Analog Output Module & Analog Output Card Specifications

| Parameter	Specification
Power Requirements:	Standard: ± 15 Vdc standard; *Optional: 24 Vdc*
Connectors:	AOM: Strain relief connectors (standard); *Optional: 5 and 6 pin MS connectors*
	AOM Card: Terminal strip
Mounting Distance:	Maximum distance between transducer and AOM: 250 ft. (76.2 M)
Size:	4.35 in x 4.35 in. x 2.25 in.
Displacement Outputs:	<u>Voltage Outputs</u> -10 to +10 Vdc -10 to +10 Vdc (reverse acting) 0 to + 10 Vdc 0 to + 10 Vdc (reverse acting) 0 to - 10 Vdc 0 to - 10 Vdc (reverse acting) 0 to 5 Vdc 0 to 5 Vdc (reverse acting) - 5 to + 5 Vdc - 5 to + 5 Vdc (reverse acting) <u>Current Outputs</u> 4 to 20 mA ungrounded 4 to 20 mA ungrounded (reverse acting) 4 to 20 mA grounded 4 to 20 mA grounded (reverse acting)
Velocity Outputs:	<u>X</u> inches/second = ± 10 Vdc *(X must be specified at time of order)*
	Note: Optional 4-20 mA velocity outputs are also available.

2.3 4-20 mA Output - Grounded vs. Ungrounded

4 - 20 mA UNGROUNDED Output:	If this output is grounded, the output will fail. The negative (return) line of the output is isolated from the ± 15 Vdc common and cannot be connected to the power supply common or to the power supply positive. In many installations you will find that the receiver device input is grounded to the same earth ground that the power supply common is grounded to. This would effectively connect the return to power supply common and the units will not function.
• 4 - 20 mA GROUNDED Output:	This output uses the supply common as the return and is, therefore, "grounded" since it is recommended that the user ground the power supply common to earth ground. In general, we suspect that most users will select the grounded 4 - 20 mA output. Please note that an Analog Output Module configured for an ungrounded output cannot be converted to a grounded output, and vice versa.

Figure 2.1 illustrates the difference between a 4-20 mA grounded and 4-20 mA ungrounded output.
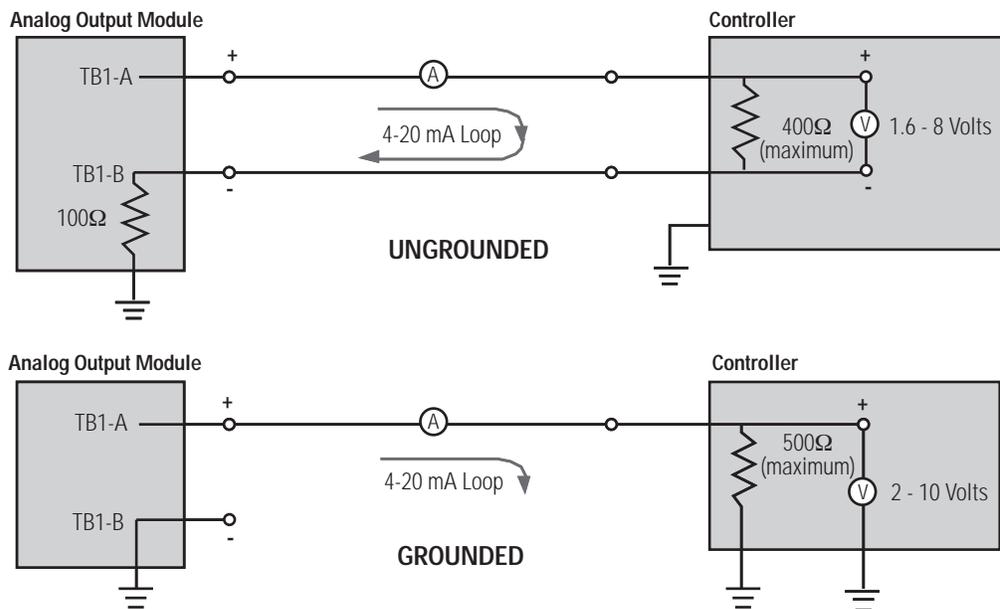
NOTES:
1. Selecting either a grounded or ungrounded 4-20 mA output is dependent on the controller interface requirements.
2. Current loop path MUST be completed for system to operate.
3. 4-20 mA ungrounded output IS NOT ISOLATED from ground. Customer provided isolators are required if isolated output is required by controller interface.

Figure 2.1
4-20 mA Output

2.4 Velocity Output Option

The analog velocity output signal is developed by differentiation of the analog displacement output signal. Velocity output is a split range output in which the polarity of the output indicates the direction of travel. For example, a forward acting velocity output would be indicated by a +10 Vdc output at full (specified maximum) velocity as the magnet travels away from the head of the transducer, -10 Vdc output at full velocity as the magnet travels towards the head. Velocity output is 0 Vdc when the magnet is stationary.

When selecting the velocity output option with the Analog Output Module, refer to Table 2-A. This table outlines the maximum and minimum velocity parameters for a given displacement output.

Table 2-A
Velocity Parameters for Analog Systems with Displacement & Velocity Outputs

| | | ± 15 Vdc Power Forward-acting Velocity | | ± 15 Vdc Power Reverse-acting Velocity | | 24 Vdc Power Velocity Options 1 & 2 | |
| | | *Velocity (inches/second)* | | *Velocity (inches/second)* | | *Velocity (inches/second)* | |
Output Code	Displacement Output	Minimum	Max. (Note 1)	Minimum	Max. (Note 1)	Minimum	Max. (Note 1)
10	0 to +10 V forward	0.0034 x stroke	58.6	0.034 x stroke	39	0.034 x stroke	39
02	0 to -10V reverse						
20	0 to +10V reverse	0.034 x stroke	39	0.0034 x stroke	58.6	0.034 x stroke	39
01	0 to -10V						
50	-10 to +10V	0.0017 x stroke	29.3	0.017 x stroke	19	0.017 x stroke	19
60	-10 to +10V reverse	0.017 x stroke	19	0.0017 x stroke	29.3	0.0017 x stroke	19
03	4 to 20 mA ungrounded	Consult MTS Sensors Division		N/A		N/A	
05	4 to 20 mA grounded						
04	4 to 20 mA ungrounded reverse	N/A		Consult MTS Sensors Division		N/A	
06	4 to 20 mA grounded reverse						

NOTES:

1. **IMPORTANT:** In the Table 2-A, maximum velocities refer to velocities with lag errors of less than 0.15% of full stroke. **Greater velocities are available** with increased lag error.

2. Maximum ripple to be 20 mV peak with estimated random (low frequency) noise level maximum of 200 mV peak.

3. Velocity lag error to be less than 0.15% of full stroke (greater velocities are possible with increased lag error or noise).

4. For calculation purposes, stroke includes any additional null space beyond the standard 2.0 inches and any dead space greater than the standard 2.5 inches.

5. Velocity options are not available with dual outputs except on a custom basis.

6. Differential displacement output is available with a differential magnet velocity output. Consult MTS Sensors Division for ordering instructions.

7. Velocity accuracy is approximately 1 - 2% of full scale, excluding random noise. Dynamic range is limited by random low frequency noise.

3. DIGITAL SYSTEMS

There are three standard digital system configurations (see illustrations, page 11). Each system provides a different type of digital output:

• Pulse width modulation
• RS422 compatible START/STOP pulse
• Binary (BCD, natural binary, Gray Code)

Different system components are required depending on the output requirement, descriptions of each component are as follows:

3.1 Digital System Components

3.1a Digital Personality Module (DPM)

The DPM is installed in the Temposonics II transducer's head enclosure. It contains the interrogating electronics and provides a TTL-level pulse duration output

Digital Personality Module

3.1b RS422 Personality Module (RPM)

The RPM is installed in the Temposonics II transducer's head enclosure. A *customer supplied* differential RS422, 1μs wide interrogation pulse is required with the RPM to produce an RS422 Start/Stop output.

RS422 Personality Module

3.1c MK292 Digital Output Module

The Temposonics MK292 Digital Output Module provides an interface between a Temposonics position sensor and a system controller. The selection of displacement outputs from the MK292 allows almost universal compatibility; they include: BCD, Binary, and Gray Code (user-selectable outputs from 5 - 24 V).

'DATA READY' and 'ERROR' feedback, as well as logic inputs (DATA HOLD, EXTERNAL START, MASTER/SLAVE, and TRI-STATE) are standard with the MK292. If required, an optional sub-board assembly provides an analog output (range: 0 to 10 Vdc or 10 to 0 Vdc).

MK292 Digital Output Module
(Rack-mountable Card and
Insert Module Housing Version)

Two mounting configurations are available (see photograph, right). Both are designed for installation in a standard 19 inch mounting rack. The insert module housing version (left) provides a thermal shield against other electronic components and mechanical protection.

Connections to the MK292 from the position sensor and other sources are made via a 64 pin (32 pin x 2 rows) DIN edge connector (an optional 64-pin card holder is also available).

The format of the input signal from the Temposonics position sensor, and attainable system resolution, is determined by the type of position sensor selected:

1.) Temposonics LH w/Pulse Width Modulated Output (PWM)
   Resolution: 0.0002 in. (0.05 mm)

2.) Temposonics LH w/Start/Stop Output
   Resolution: 0.002 in. (0.05 mm)

3.) Temposonics II w/Digital Personality Module
   Output: Pulse Width Modulation (PWM)
   Resolution: 0.0002 in. (0.005 mm)

4.) Temposonics II w/RS422 Personality Module
   Output: Start/Stop
   Resolution: 0.002 in. (0.05 mm)

5.) Temposonics LP w/ Start/Stop Output
   Resolution: 0.002 in. (0.05 mm)

MK292 COMPATIBLE SENSORS
• Temposonics II Position Sensor with Digital Personality Module (DPM)
• Temposonics II Position Sensor with RS422 Personality Module (RPM)
• Temposonics LH Position Sensor with START/STOP Output
• Temposonics LH Position Sensors with PWM Output
• Temposonics LP Position Sensor with START/STOP Output

Power Supply 24Vdc

Temposonics II Position Sensor

DPM or RPM

Magnet

Interrogation

Sensor Output

**MK 292
Digital Output Module**

Input Levels: 5 - 36 V

Output Levels: 5 - 36 V

Start/Stop Output from RPM
Maximum Resolution: 0.002 in. (0.05 mm)

Pulse Width Modulated Output from DPM
Maximum Resolution: 0.0002 in. (0.005 mm)

Selectable BCD, Binary, or Gray Code Position Output

Optional Voltage Output: (0 to 10 Vdc or 10 to 0 Vdc)

Figure 3.1
Digital system configuration with Temposonics II position sensor,
DPM or RPM and MK292 Digital Output Module

Power Supply Requirements
• ±12 to ±15Vdc @ 140mA (bipolar)

$1\mu s$

**User's
Control
System**

Belden YR8105 or equivalent (5 pair)

RPM ◄— RS422 Personality Module

Magnet
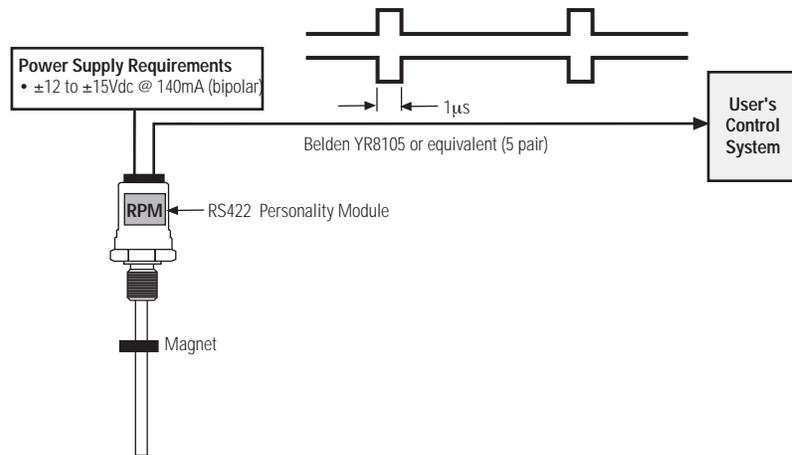
Figure 3.2
Digital system configuration with a
Temposonics II position sensor with an RPM

Power Supply Requirements
• ±12 to ±15Vdc @ 140mA (bipolar)

Pulse Width Modulated Output

(Pulse width is proportionate to displacement)

**User's
Control
System**

Belden YR8105 or equivalent (5 pair)

DPM ◄— Digital Personality Module

Magnet

Figure 3.3
Digital system configuration with a
Temposonics II position sensor with a DPM

4. INVENTORIED UNITS

The table below identifies the part numbers for inventoried products, which include:

- Temposonics II transducers
- Temposonics II transducers with integrated Digital Personality Modules (DPM)
- Temposonics II transducers with integrated RS-422 Personality Modules (RPM)
- Temposonics II transducers with integrated Analog Personality Modules (APM)

Standard delivery time for stock units is one week after receipt of order (quantities are restricted).
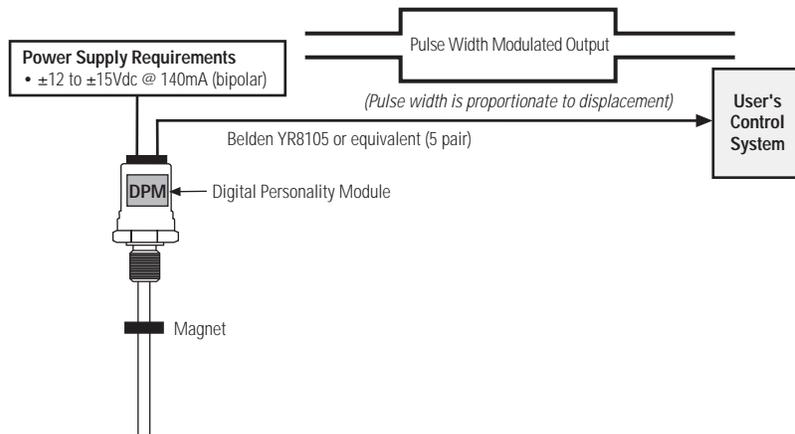
Table 4A Model Numbers for Inventoried Units

Stroke Length *(inches)*	Transducer Only	Transducer w/DPM	Transducer w/RPM	Transducer w/APM
6	TTS-RB-U-0060	TTS-RB-U-0060D-I004	TTS-RB-U-0060R	TTS-RB-U-0060AXXX
12	TTS-RB-U-0120	TTS-RB-U-0120D-I004	TTS-RB-U-0120R	TTS-RB-U-0120AXXX
18	TTS-RB-U-0180	TTS-RB-U-0180D-I004	TTS-RB-U-0180R	TTS-RB-U-0180AXXX
24	TTS-RB-U-0240	TTS-RB-U-0240D-I004	TTS-RB-U-0240R	TTS-RB-U-0240AXXX
30	TTS-RB-U-0300	TTS-RB-U-0300D-I004	TTS-RB-U-0300R	TTS-RB-U-0300AXXX
36	TTS-RB-U-0360	TTS-RB-U-0360D-I004	TTS-RB-U-0360R	TTS-RB-U-0360AXXX
42	TTS-RB-U-0420	TTS-RB-U-0420D-I004	TTS-RB-U-0420R	TTS-RB-U-0420AXXX
48	TTS-RB-U-0480	TTS-RB-U-0480D-I004	TTS-RB-U-0480R	TTS-RB-U-0480AXXX
54	TTS-RB-U-0540	TTS-RB-U-0540D-I004	TTS-RB-U-0540R	TTS-RB-U-0540AXXX
60	TTS-RB-U-0600	TTS-RB-U-0600D-I004	TTS-RB-U-0600R	TTS-RB-U-0600AXXX

Stroke Length *(millimeters)*	Transducer Only	Transducer w/DPM	Transducer w/RPM	Transducer w/APM
300	TTS-RB-M-0300	TTS-RB-M-0300D-I004	TTS-RB-M-0300R	TTS-RB-M-0300AXXX
600	TTS-RB-M-0600	TTS-RB-M-0600D-I004	TTS-RB-M-0600R	TTS-RB-M-0600AXXX
900	TTS-RB-M-0900	TTS-RB-M-0900D-I004	TTS-RB-M-0900R	TTS-RB-M-0900AXXX
1200	TTS-RB-M-1200	TTS-RB-M-1200D-I004	TTS-RB-M-1200R	TTS-RB-M-1200AXXX
1500	TTS-RB-M-1500	TTS-RB-M-1500D-I004	TTS-RB-M-1500R	TTS-RB-M-1500AXXX
	FEATURES: • NEMA 6 enclosure • 2 inch Null • 2.5 inch dead zone • 304 stainless steel rod	**FEATURES:** • 4 recirculations • Internal interrogation • Update Time: ≤ 3 ms **NOTE:** If external interrogation is required, change I004 to E004 in the part number.		Specify output —refer to S1 through S6 on page 15.

NOTE

To order items not listed above, refer to next page "Temposonics II Build-to-Order Units".

5. TEMPOSONICS II BUILD-TO-ORDER UNITS

5.1 How to Order Temposonics II Position Sensors

T	T	S	☐	☐	☐	☐	☐	☐	☐

Temposonics II Transducer, Standard _____

Style _____

RB = STANDARD, 3/8 in. SST rod, screw on integral connector
RC = 3/8 in. SST rod, quarter turn integral connector
RO = 3/8 in. SST rod, 5 ft. integral cable, pigtail connection

The following styles (R1 - R3) are deivations of Style RO. Each style includes a 6 or 10 pin connector instead of pigtails, which provide the capability to either retrofit an original Temposonics transducer design with a Temposonics II or to connect directly to an interface module.

R1 = Style RO with 6 pin connector (P/N 370015) instead of pigtails
STANDARD for Temposonics II transducers with integral cable and connected to an Analog Output Module with MS connectors.
[Also for retrofitting original Temposonics transducer with a greater than 12 inch stroke length (+ interrogation pulse) and connected to an Analog Output Module]

R2 = Style RO with 6 pin integral connector (P/N 370015) instead of pigtails
Used in retrofit situations ONLY.
[For retrofitting original Temposonics transducer with a less than 12 inch stroke length (- interrogation pulse) and connected to an Analog Output Module]

R3 = Style RO with 10 pin connector (P/N 370160) instead of pigtails
(A*vailable for use with Personality Modules* **ONLY***)*

Stroke Length Units _____

U = Inches (U.S. Customary)
M = Millimeters (Metric), av*ailable in 5 mm increments*

Stroke Length _____

Th*e value to enter depends on stroke length units indicated above.*
For example:
0120 = 12.0 inches or 120 mm
1200 = 120.0 inches or 1200 mm

NOTES:

1. All Temposonics II transducers have a positive interrogation pulse.
The original Temposonics transducer had a negative interrogation pulse for stroke length of 12 inches or less and a positive interrogation pulse for stroke lengths of 12.1 inches or longer. In retrofit situations, the extension cable can be configured for a direct replacement. Contact an MTS Applications Engineer for additional details.

2. Temposonics II transducers have a 2.5 inch dead zone at the tip. Previous versions of the Temposonics transducer had either a 5 inch or a 7 inch dead zone; please consider the overall length requirement in your application.

3. Build-to-order units range from 1 to 300 inches, in 1/10th inch increments.

Temposonics II Style RB (STANDARD)

Flange to Tip

Dead Zone

Stroke
(length specified by customer)

Null Space

5.0 in.
(127 mm)

2.5 in.
(63.5 mm)

0.38 in. dia. (9.65 mm)

3/4-16 UNF - 3A

Hex 1.75 in. (44.45 mm) accross flats

Metal Threaded Locking Ring

Mating Connector
(*NOT INCLUDED*, must be ordered separately)

Temposonics II Style RC

5.0 in.
(127 mm)

Plastic 1/4-Turn Locking Ring

Mating Connector
(NOT INCLUDED, must be ordered separately)

Temposonics II Style RO

4.0 in.
(101.6 mm)
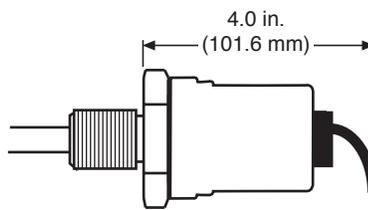
Figure 5-1
Temposonics II Dimensions

5.2 How to Order Temposonics II Transducer with APM

| T | T | S | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | A | ☐ | ☐ | ☐ |

Temposonics II Transducer

Style
(See "How to Order Temposonics II Transducer")

Stroke Length Units
 U = Inches (U.S. Customary)
 M = Millimeters (Metric), *available in 5 mm increments*

Stroke Length
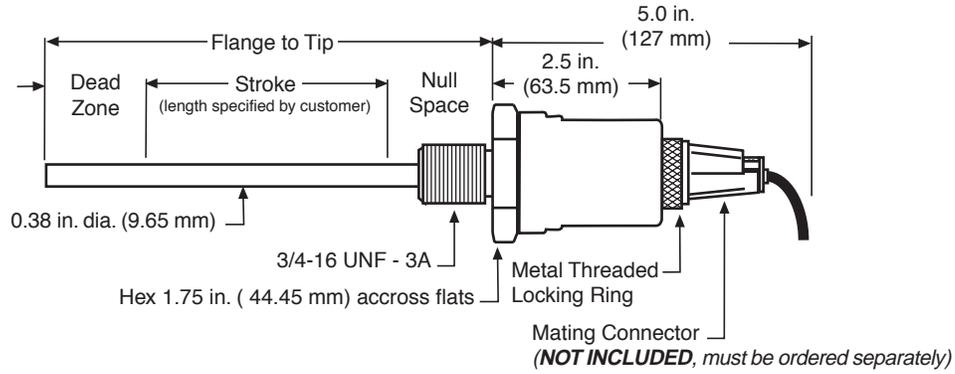*The value to enter depends on stroke length units indicated above.*
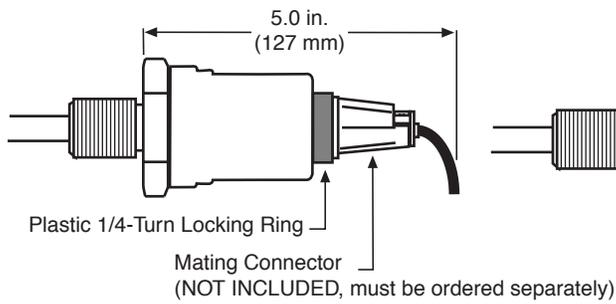*For example:*
 0120 = 12.0 inches or 120 mm
 1200 = 120.0 inches or 1200 mm

A = **Analog Personality Module**

Output
 S1 = 0 to +10 Vdc   **S4** = 0 to +10 Vdc, reverse acting
 S2 = -10 to +10 Vdc   **S5** = -10 to +10 Vdc, reverse acting
 S3 = 0 to -10 Vdc   **S6** = 0 to -10 Vdc, reverse acting
 C0 = Build-to-Order, customized set points
     Set Points must be defined by customer, see below.

Performance Mode
 R = Resolution Preferred Mode (0.001 in. resoluion, limited to maximum stroke length of 48 inches)
 B = Balanced Mode (0.003 in. resolution)
 U = Update Preferred Mode (optimum update time, 0.007 in. resolution)

NOTES:

1. **Standard Set Points:** Null (zero) is set at 2 inches from flange; Full Scale Set Point is at 2.5 inches from tip of the transducer.

In addition to the model number, zero and full scale set points must also be provided at time of order if a customized sensing range is required See example below for details on how to define set points.

How To Define Customized Set Points

Given:
  Stroke Length: 10 inches
  Output: 0 to + 10 Vdc
  Set Point #1: 2 inches from the flange (standard Null) = 0.000V
  Set Point #2: 12 inches from the flange = +10.000V
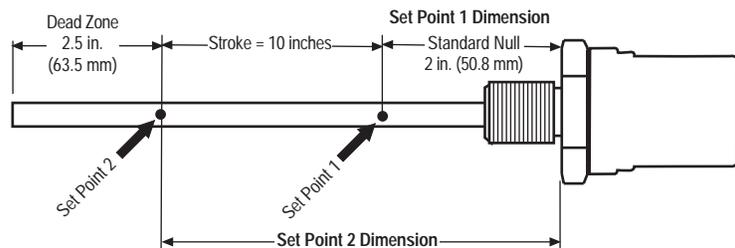
NOTES:
1. Express Set Point in inches or millimeters from face of transducer's flange.
    • If Stroke Length Units are expressed in inches, define Set Point in inches and tenths (XXX.X in.)
    • If Stroke Length Units are expressed in millimeters, define Set Point in millimeters (XXXX mm)
2. Define polarity of voltage at each Set Point
3. Define Set Point voltage (range: 0 to 10 Vdc). Express to 0.001 V

5.3 How to Order Temposonics II Transducer with DPM

```
         T  T  S  □  □  □  □  □  □  D  □  □  □  □
```

Temposonics II Transducer

Style
(See "How to Order Temposonics II Transducer")

Stroke Length Units
   U = Inches (U.S. Customary)
   M = Millimeters (Metric), *available in 5 mm increments*

Stroke Length
The value to enter depends on stroke length units indicated above.
For example:
0120 = 12.0 inches or 120 mm
1200 = 120.0 inches or 1200 mm

D = **Digital Personality Module**

Interrogation
   I = Internal Interrogation
   E = External Interrogation

Number of Recirculations
   Range: 1 to 127 recirculations
Example:
   2 recirculations = 002
   32 recirculations = 032
127 recirculations = 127 (maximum)

5.4 How to Order Temposonics II Transducer with RPM

```
         T  T  S  □  □  □  □  □  □  R
```

Temposonics II Transducer

Style
(See "How to Order Temposonics II Transducer")

Stroke Length Units
   U = Inches (U.S. Customary)
   M = Millimeters (Metric), *available in 5 mm increments*

Stroke Length
The value to enter depends on stroke length units indicated above.
For example:
0120 = 12.0 inches or 120 mm
1200 = 120.0 inches or 1200 mm

R = **RS422 Personality Module**

5.5 How to Order MK292 Digital Output Module

| M | K | 2 | 9 | 2 | | | | |

Hardware
- **10** = Standard, Rack-mountable Counter Card
- **11** = Rack-mountable Counter Card with Integral Analog Module
  (Analog Output: 0 to 10 Vdc, or 10 to 0 Vdc)
- **50** = Insert Module
- **51** = Insert Module w/Analog Sub-board (AK294/0-10 Vdc or 10-0 Vdc)
  (Analog Output: 0 to 10 Vdc, or 10 to 0 Vdc)

Software
- **01** = Standard (Temposonics II / LP)

NOTE

*Temposonics II position sensors with a DPM
must be configured for external interrogation to
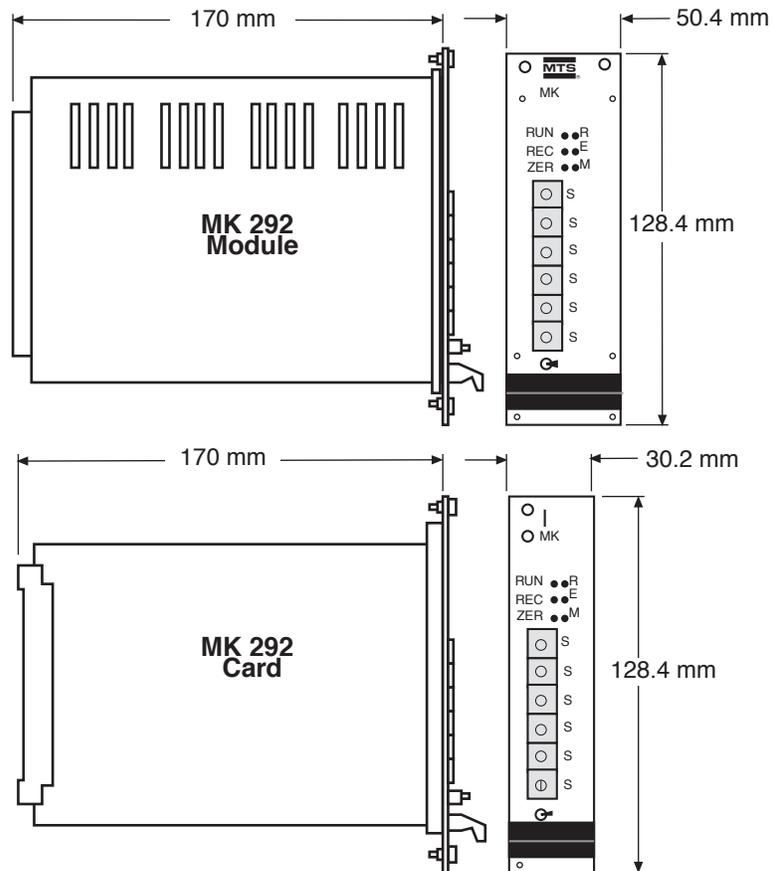function with the MK292 module.*

Figure 5-2
MK292 Dimensions

5.6 How to Order Analog Output Module

	AOM Options Code							Temposonics II Code			

Enclosure Style
- **31** = Strain relief connectors (standard)
- **32** = 5 and 6 pin MS connectors
  (mating connectors required, order separately)
- **35** = Plug-in card, can mount in rack
  (to mount, use 15-pin edge connector: P/N 370034, or edge card holder: P/N 370170)

Displacement Output

(Standard, select one)
- **10** = 0 to 10 Vdc
- **20** = 0 to 10 Vdc, reverse acting
- **30** = 0 to 5 Vdc
- **40** = 0 to 5 Vdc, reverse acting
- **50** = - 10 Vdc to + 10 Vdc
- **60** = - 10 Vdc to + 10 Vdc, reverse acting
- **70** = - 5 to + 5 Vdc
- **80** = - 5 Vdc to + 5 Vdc, reverse acting
- **01** = 0 to - 10 Vdc
- **02** = 0 to - 10 Vdc, reverse acting

(Options)
- **03** = 4 to 20 mA ungrounded
- **04** = 4 to 20 mA ungrounded, reverse acting
- **05** = 4 to 20 mA grounded
- **06** = 4 to 20 mA grounded, reverse acting

DC Power Supply Requirement Options
- **0** = ± 15 Vdc **(Standard)**
- **1** = 24 Vdc **(Option)**

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)

Maximum Velocity
- **___ ___ ___** = Maximum Velocity (range 1 to 400 inches/second or 0.01 to 9.99 meters/second)

This three digit velocity code represents either inches per second or meters per second.
The code corresponds to the 'Unit of Measurement' selected.

> **Consult Applications Engineering**
> **when ordering velocity output options**

Style
- (Refer to pages 13 and 14 for description of choices: RB, RC, RO, R1, R2, R3)

Unit of Measurement
- **U** = Inches (U. S. Customary)
- **M** = Millimeters (Metric), lengths available in 5 mm increments

Stroke Length
- **___ ___ ___ ___** = Length
Range: 1 to 300.0 in. in 0.1 in. increments or 25 to 7620 mm in 5 mm increments.

For example:
0120 = 12.0 inches or 120 mm
0600 = 60.0 inches or 600 mm

Mating Connectors for Enclosure Style '32'
- 6-pin MS connector (female): 370015
- 5-pin MS connector (female): 370017

NOTE: *AOM Options*

Only two (2) options may be selected per AOM.

Valid Output Combinations (Displacement. & Velocity)
The chart below indicates what combinations of
current output and velocity output are valid.

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

(Shown withCover Removed)

TB1   TB3

TB2

3.31 in.(84.1 mm)

4.35 in.(110.5 mm)

0.24 in.
(6.1 mm)

3.88 in.(98.6 mm)

4.35 in.(110.5 mm)

0.52 in.
(13.2 mm)

2.25 in.
(57.1 mm)

Socket Head Cap Screw (2)

0.5625 in.
(14.3 mm)
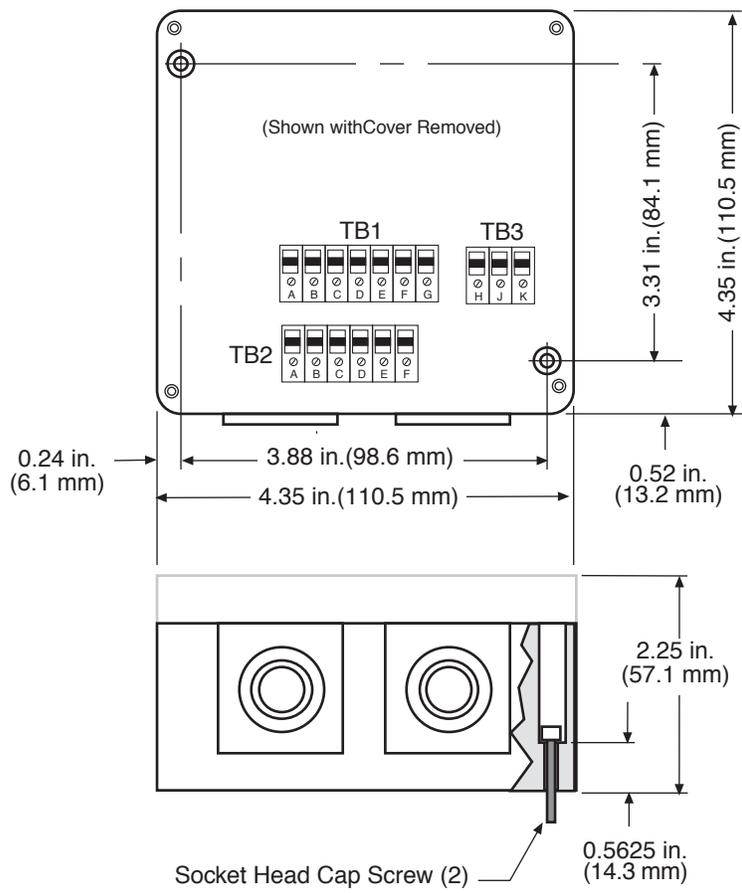
Figure 5-3
Analog Output Module Dimensions

4.5 in.
(114.3 mm)

3.8 in.
(96.52 mm)

R20 R24

5.375 in.
(136.52) mm)

5.0 in.
(127 mm)

1.008 in.
(25.603 mm)

2.484 in.
(63.09 mm)

1.008 in.
(25.603 mm)
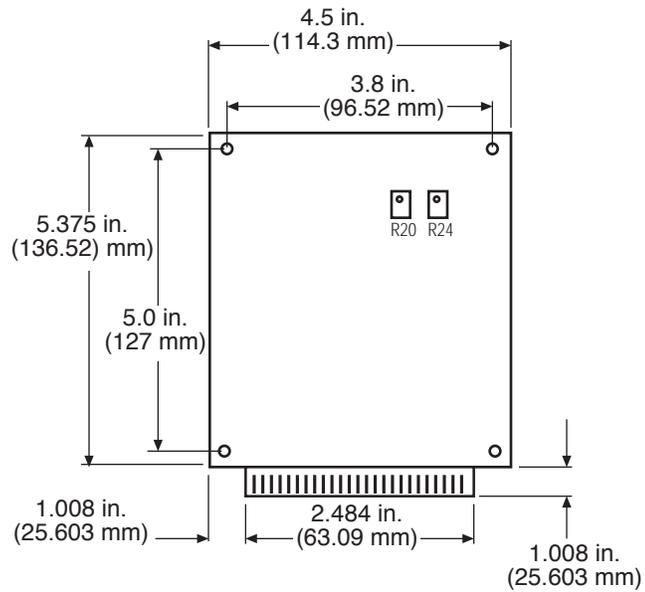
Figure 5-4
Analog output Card Dimensions

6. ENGINEERED PRODUCTS

Introducing MTS Emerging Markets and Modified Products Groups...
proven Temposonics position sensing technology with maximum design flexibility.

Modified Products Group

CHARACTERISTICS:
Product modifications are minor in nature and are almost exclusively mechanical.

Examples:
• Special connectors or cables
• Flanges or pressure tubes
• Formed sensors
• Special enclosures

Emerging Markets Group

CHARACTERISTICS:
• High level of engineering required
• High level of coordination with customers is required

Examples:
• Remote electronic sensor for mobile hydraulic markets
• Embedded sensor for small bore cylinders
• Custom electronic modules
• Custom pressure housings

For more information please call: 1-800-633-7609

7. ACCESSORIES

7.1 Extension Cables for Temposonics II Transducers

☐ ☐ ☐ ☐ ☐ ☐ ☐

Transducer Mating Connector —— *1 or 2 characters* ——
  MT = Molded (STANDARD)
      (For use with Style RB transducers)
  M = Molded
      (For use with Style RC transducers)
  FT = Field Installable
      (For use with Style RB transducers)
  F = Field Installable
      (For use with Style RC transducers)

Cable Lengths
  005 = 5 ft.
  015 = 15 ft.
  025 = 25 ft.   *(Available from stock, with molded connectors only)*
  050 = 50 ft
  100 = 100 ft
  __ __ __ = Custom Length *(Must use Field Installable Connector, Style FT or F)*

Cable Termination
  C1 = 6 pin female, P/N 370015
      STANDARD connection to Analog Output Module with MS connectors.
      *[For retrofitting an original Temposonics transducer system with AOM and stroke
       length > 12 inches (+ interrogation pulse)]*
  C2 = 6 pin female, P/N 370015
       Use in retrofit situations ONLY.
      *[For retrofitting an original Temposonics transducer system with AOM
      and stroke length ≤ 12 inches (- interrogation pulse)]*
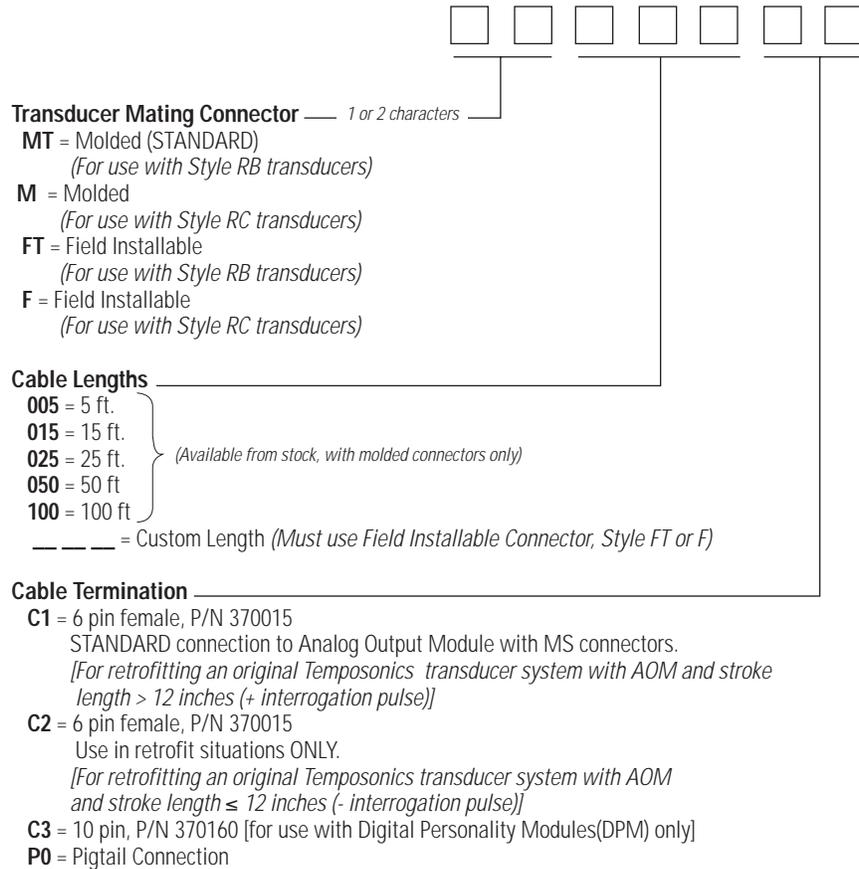 **C3** = 10 pin, P/N 370160 [for use with Digital Personality Modules(DPM) only]
  P0 = Pigtail Connection

7.2 Transducer Accessories

Part	Description	Part Number
Replacement Viton O-Ring	Seals Temposonics transducers in hydraulic cylinders. For use on 3/4-16 thread.	560315
Hex Nut Jam	3/4-16, 303 stainless steel thin hex lock w/nylon insert	500015
Magnet Spacer	Non-ferrous aluminum spacer, 1/8 in. thickness, use with standard magnet (P/N 201542)	400633
Magnet Mounting Screws	Stainless steel #6-32 x 7/8 in. SS Phillips HD screw	560357
Connector Kit	Field Installable 10 pin female connector *(For use with Style RB and RC transducers)*	400755-3
Connector	Environmental, 10 pin male MS connector	370160
Cable	Low capacitance, 5 twisted pair, 24 AWG w/overall shield and drain wire	530018

7.3 Magnets

A magnet is required for a transducer system. A variety of magnets are available to fit your application requirements. Illustrated below are the magnet styles typically provided. Consult MTS Sensors Division if a custom magnet style is required.

Transducer Stroke Length	Standard Magnet	Recommended Alternative
Up to 192 inches	201542	Any shown
Over 192 inches	201554	201553

Part No. 201554

1 of 4 Holes
each 0.182 in. dia. (4.6 mm)
on 1.625 in. dia. (41.3 mm)

I.D.: 0.75 in. (19.05 mm)
O.D.: 2.49 in. (63.25 mm)
Thickness: 0.375 in. (9.5 mm)

Part No. 201553

1 of 2 Holes
0.177 in. dia. (4.5 mm)
120° apart
on 1.625 in. dia. (41.3 mm)

0.44 in (11.2 mm) opening

90° Cut-out

I.D.: 0.625 in. (15.9 mm)
O.D.: 2.49 in. (63.25 mm)
Thickness: 0.375 in. (9.5 mm)

Part No. 201552

1 of 2 Holes
0.15 in. dia. (3.9 mm)
120° apart
on 0.94 in. dia. (23.9 mm)

90° Cut-out

I.D.: 0.53 in. (13.5 mm)
O.D.: 1.29 in. (32.8 mm)
Thickness: 0.312 in. (7.9 mm)

Part No. 201542

4 Holes
each 0.15 in. dia. (3.9 mm)
on 0.94 in. dia. (23.9 mm)

I.D.: 0.53 in. (13.5 mm)
O.D.: 1.29 in. (32.8 mm)
Thickness: 0.312 in. (7.9 mm)

Part No. 400533

I.D.: 0.53 in. (13.5 mm)
O.D.: 1.0 in. (25.4 mm)
Thickness: 0.312 in. (7.9 mm)

Part No. 401032

I.D.: 0.532 in. (13.5 mm)
O.D.: 0.685 in. (17.4 mm)
Thickness: 0.312 in. (7.9 mm)

Part No. 251298

1.1 in. Ref.

0.300 in. Max.

0.750 in. Ref.

S

N

Aluminum Plate (bonded to magnet)

0.520 in. Ref.

0.800 in. Ref.

Figure 7-1
Magnet Dimensions

7.4 System Accessories

Part	Description	Part No.	
Dual Power Supply I	Dual Output: ± 15 Vdc @ 0.8 A (supports 2 analog systems)	380017	
Dual Power Supply II (for MK292 Digital Output Module)	Dual Output: + 24 Vdc + 5 Vdc	TBD *(contact MTS)*	
15 Pin Edge Connector	15 pin solder contacts, for use with Analog Plug-in Card	370034	
AOM Adapter Plate	Gives the Analog Output Module an identical mounting footprint as the discontinued DCTM Box, for retrofit situations.	400317	
AOM Edge Card Holder	Used to mount Analog Plug-in Card, provides 15 pin screw terminal blocks	370170	

8. DISPLAY UNITS

8.1 Temposonics Display Unit / Model Number: TDU-100

The TDU Display accepts a START/STOP output from a Temposonics LH, Temposonics II (RS422 Personality Module required), or a Temposonics LP position sensor and indicates position with a 5 1/4 digit LED display. In addition, the TDU Display supplies the required power and interrogating electronics for operation of the Temposonics sensors.
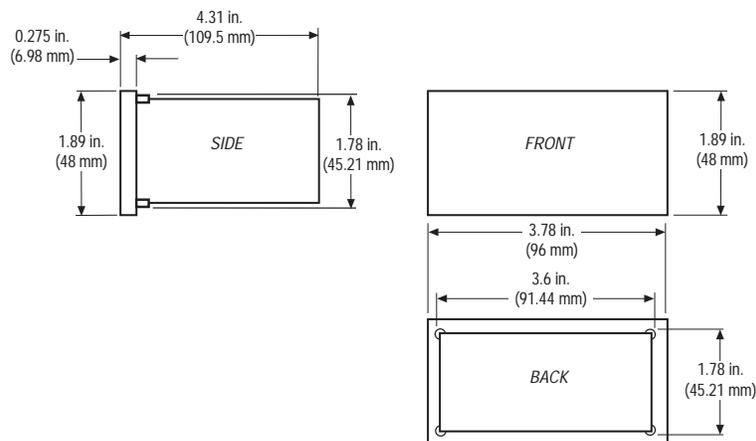
Temposonics Display Unit (TDU)

Figure 8-1
TDU Dimensions

An optional NEMA 4 enclosure (P/N 251188) is available for the TDU if required.

TDU Specifications

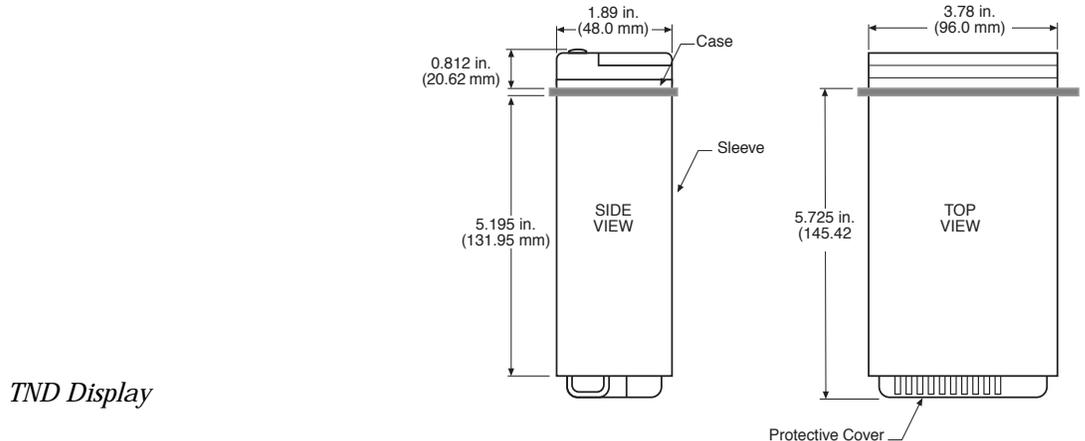| Parameter	Specification
Output:	5 1/4 digit LED display
Examples	
SPAN	RESOLUTION
Inches: 199.995	0.005 in. (optional 0.001 in. resolution is available)
Millimeters: 5080.00	0.1 mm
Centimeters: 508.00	0.01 cm
Meters: 5.0800	0.0001 M
Input:	Start/Stop
Supply Voltage:	• w/Temposonics II: ±15 Vdc (bipolar, ±10%, 250 mA)
	• w/Temposonics LP: +15 Vdc (±10%, 250 mA) or 24 Vdc (250 mA)
	• w/Temposonics LH: +15 Vdc (±10%, 250 mA) or 24 Vdc (250 mA)
Power Requirements:	24 Vdc, ± 10% at 200 mA
Operating Temperature:	32 to 158°F (0 to 70°C)
Enclosure:	NEMA 12 *Optional NEMA 4 enclosure is available (price adder applies)*
Operation:	Powers and interrogates the sensor
Size:	3.78 in. x 1.89 in. x 4.31 in.

Specifications are subject to change without notice. Contact MTS for verification of specifications critical to your requirements.

8.2 TND Series Display

The TND Display accepts the output from the following position sensors:

• Temposonics II with an RS422 Personality Module (RPM),
• Temposonics LP with a START/STOP output
• Temposonics LH with a START/STOP output

Using the output from one of these sensors, the TDU indicates position with a full 6 digit LED display. The TND also provides a choice of either three (3) open-collector outputs, dual 8 amp relay outputs or a selectable analog output. The power requirement for the TND Display is 115 Vac; the display then provides the ±15 Vdc and interrogating electronics necessary for operation of the Temposonics position sensors.

TND Display

Figure 8-2
TND Dimensions

TND Specifications

Parameter	Specification
Resolution:	±0.001 in.
Display:	6 digit
Input:	Start/Stop
Outputs:	*Style:* **001:** 3 open-collector outputs **002:** Dual 8 amp relays **003:** Adjustable 4-20 mA, 0-20 mA or 0-10 V
Scale:	Selectable engineering units (i.e., mm, inches...)
Power Requirements:	115 Vac, ± 10%, 40 to 440 Hz
Operating Temperature:	32 to 140°F (0 to 60°C)
Enclosure:	NEMA 4 (front panel)

Specifications are subject to change without notice. Contact MTS for verification of specifications critical to your requirements.

How to Order TND Display

TND ☐ ☐ ☐

Style
001 = Standard, 115 V ac power, three open-collector outputs
002 = 115 V ac power, dual 8 amp relays
003 = 115 V ac power, analog output

9. TEMPOSONICS PROGRAMMABLE LIMIT SWITCH (TLS SERIES)
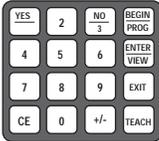
9.1 TLS with Universal Software (TLS U-Series)

The TLS is a reliable and cost effective single-axis programmable limit switch. A Temposonics LDT together with the TLS provides a system that is an ideal replacement for mechanical limit switches in a variety of applications, such as:

- Stamping & forming operations
- Pulp & paper processing
- Tool & die machinery
- Tool indexing & positioning
- Injection molding process

- Woodworking machine set-up
- Material handling or cutting
- Press brakes
- Press controls
- Hydraulic cylinder positioning

The time proven performance of Temposonics LDTs ensures accurate position data. The TLS, with its fourteen solid-state output channels and up to 155 independently assigned ON/OFF set-points, provides the versatility to program your specific set-up requirements and control functions.
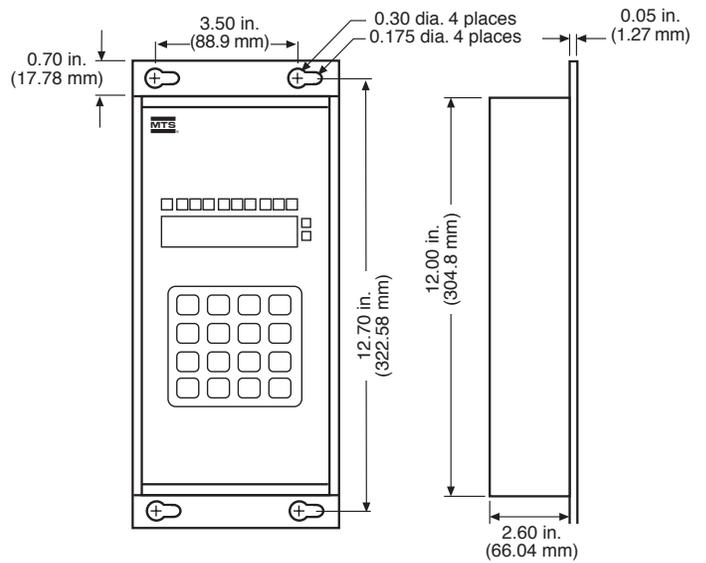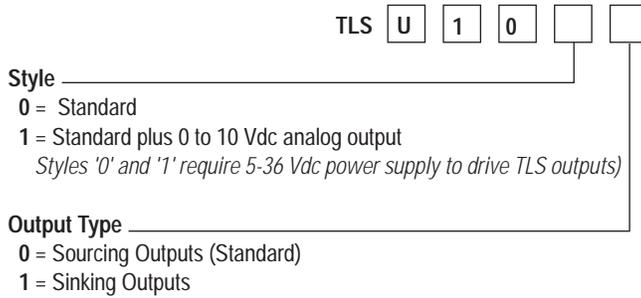
The TLS operates as an independent controller or it can interface with any PLC. An optional 4-20 mA or 0-10 Vdc output is also available.

9.2 TLS U-Series Specifications

Parameter	Specification
Housing:	Extruded aluminum, 13.50 in. x 4.75 in. x 2.63 in.
Power Supply:	115V-60Hz (230V-50Hz optional)
Inputs accepted:	RS422 START/STOP *Provided by:* • *Temposonics II position sensor with RS422 Personality Module (RPM)* • *Temposonics LH with Start/Stop Output* • *Temposonics LP with Start/Stop output*
Display:	OPTREX MCD-1266 back-lit display (yellow/green), 5 x 7 dots, 16 character, 2-line dot matrix LCD module with LCD driver and controller, capable of generating 168 alpha-numeric characters.
Programming Keypad: *(16 keys)*	The programming keypad is located on the front plate of the TLS U-Series, below the liquid crystal display.
Keypad Functions: *(Operator Accessible)*	• Set points • Subroutine in use accessible through password • Engineering units (inch/mm) • Resolution (normal/enhanced) • Scale factor (μsec/inch or m/sec) • Count increase direction • Zero point • Analog output • Output voltage • HI/LO outputs • Number of sub-routines (1 - 5) • Operator accessible outputs • Output type (ON/OFF/DWELL) • Dwells per output • Directionality
Programmable Outputs: Number of Outputs: Analog Outputs:	Total: 16 14 Solid-State outputs, programmable as ON, OFF or Multi-Dwell Set Points 0 - 10 Vdc and 4 - 20 mA (DAC, 16 bits, 0.001 in. resolution representing magnet position as indicated on display)
Connectors : Sensor cable connector: Programmable outputs: 115 Vac/230 Vac power:	 D-Shell, 15 pins, female (external) D-Shell, 25 pins, female (external) 3-terminal connector, located inside the TLS U100 housing beneath lower cover (internal)
Maximum Sensor Stroke:	99 inches

Specifications are subject to change without notice. Contact MTS for verification of specifications critical to your requirements.

9.3 How to Order TLS

TLS | U | 1 | 0 | | |

Style
- **0** = Standard
- **1** = Standard plus 0 to 10 Vdc analog output
  Styles '0' and '1' require 5-36 Vdc power supply to drive TLS outputs)

Output Type
- **0** = Sourcing Outputs (Standard)
- **1** = Sinking Outputs

*Temposonics
Programmable Limit Switch*

Figure 9.2
TLS Dimension

TLS Cables

TLS INTERFACE CABLES	
(From Temposonics II or LH to TLS, 10 conductor cables)	
Description	**Part No.**
5 ft. cable (RB and DB15 connectors)	401036-5
15 ft. cable (RB and DB15 connectors)	401036-15
25 ft. cable (RB and DB15 connectors)	401036-25

TLS INTERFACE CABLES	
(From Temposonics LP to TLS, 6 conductor cables)	
Description	**Part No.**
5 ft. cable (LP and DB15 connectors)	401037-5
15 ft. cable (LP and DB15 connectors)	401037-15
25 ft. cable (LP and DB15 connectors)	401037-25
NOTE: *For mating connectors to pigtail cables, refer to the Temposonics LP, LH, or II accessories.*	

TLS OUTPUT CABLES	
(TLS, 25 conductor input/output cables)	
Description	**Part No.**
5 ft. cable (DB25 connector & pigtails)	401038-5
15 ft. cable (DB25 connector & pigtails)	401038-15
25 ft. cable (DB25 connector & pigtails)	401038-25

10. TEMPOSONICS MULTIPLE TRANSDUCER INTERFACE MODULES (TMX)

10.1a TMX-S Series (Serial)

Features:

- Supports up to 8 transducer channels, each with a single magnet and multiple recirculations
- Outputs used as direct output, alarms or motion indicators
- 28 MHz crystal oscillator provides 0.001 inch resolution with 4 recirculations or 0.0005 inch resolution with 8 recirculations
- Recirculation values are user selectable (up to 127 channels)
- 13 optically isolated inputs read by host
- 16 optically isolated outputs can be used as 8 Hi-Lo limit channels, 8 motion indication channels, or as digital outputs
- Host interface: RS-232, RS-484, or RS-422
- Up to 8 TMX-S100 modules may reside on a single RS-485 network
- Supports a single magnet on each transducer

10.1b TMX-P Series (Parallel)

Features:

- Supports up to 8 transducer channels, each with a single magnet and multiple recirculations
- 28 MHz crystal oscillator provides 0.001 inch resolution with 4 recirculations or 0.0005 inch resolution with 8 recirculations
- 20 bit Natural Binary or 5 digit BCD host interface
- Up to 8 TMX-P100 modules may be paralleled using open collector outputs
- Supports a single magnet on each transducer
- A recirculation value is selectable with a single dip switch for all 8 channels (all channels use same value)
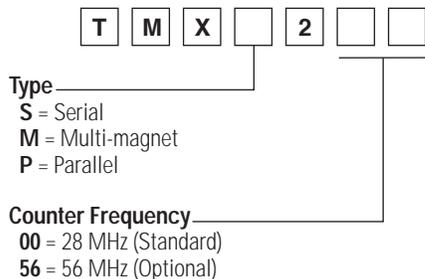
10.1c TMX-M Series (Multi-magnet)

Features:

- Supports up to 8 transducer channels, each with up to 32 magnets (1 recirculation)
- Outputs used as direct output, alarms or motion indicators
- 28 MHz crystal oscillator provides 0.004 inch resolution with a single recirculation
- Position information may be read relative to user provided offset value or relative to another magnet on same channel
- 13 optically isolated inputs read by host
- RS-232, RS-484, RS-422 host interface
- Up to 8 TMX-S100 modules may reside on a single RS-485 network
- Supports up to 32 magnets on each transducer

> **IMPORTANT NOTE:**
> *System accuracy is dependent upon the non-linearity of the position sensor:*
> **< ± 0.05% of stroke length**

10.2 How to Order TMX

| T | M | X | | 2 | | |

Type
S = Serial
M = Multi-magnet
P = Parallel

Counter Frequency
00 = 28 MHz (Standard)
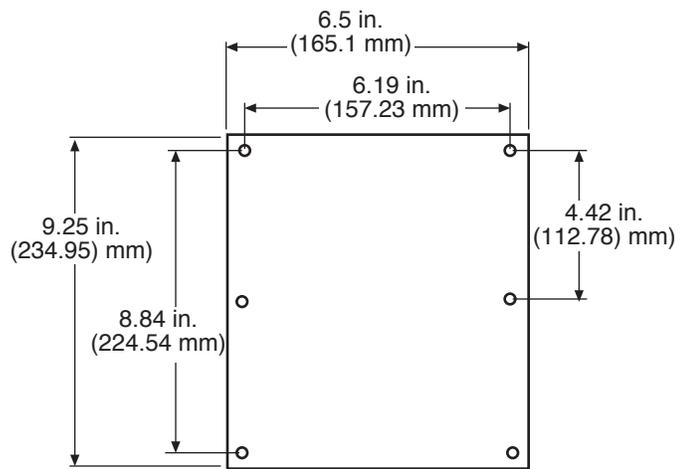**56** = 56 MHz (Optional)

Figure 10.1
TMX Dimension

APPENDIX A: Wiring Charts for Temposonics II Transducers

The following charts indicate how to wire a Temposonics II transducer in a variety of system configurations. Please read the important notes, below, and verify the appropriate system configuration for your installation before proceeding.

If you have any questions, contact MTS at 1-800-633-7609

IMPORTANT NOTES:

1. Your Temposonics II transducer may have a cable with striped leads or with solid color leads. Both cables are identified in the wiring charts and have identical performance specifications. Solid color leads are the standard as of February, 1994.

2. When installing Temposonics II transducers connected to an Analog Output Module, the green or gray/white stripe wire MUST be connected to DC ground to ensure proper operation.

   Retro-fit Installations: When a Temposonics II transducer is installed to replace an original Temposonics transducer with a stroke length of 12 inches or less and connected to an existing AOM, the yellow or white/gray stripe wire must be connected to DC ground and the green or gray/white stripe wire must be connected to TB2-E or Pin E on the AOM.

3. The AOM is provided with either strain relief connectors or MS style connectors.

   • "TB2-X" indicates the wiring connections to terminal blocks in the AOM (for AOM with strain relief connectors).

   • "Pin-X" indicates the pin connections to the 6 pin MS connector.

Temposonics II Transducer with Analog Personality Module (APM) (P/N TTS**R**XXXXX**A**XXX)

Pin No.	Cable w/Striped Leads	Cable w/Solid Leads	Functional Description
1	White/Blue Stripes	White	DC Ground
2	Blue/White Stripes	Brown	Frame
3	White/Orange Stripes	Gray	Analog (GRD)
4	Orange/White Stripes	Pink	Analog Out
5	White/Green Stripes	Red	+ 15 Vdc
6	Green/White Stripes	Blue	- 15 Vdc
7	White/Brown Stripes	Black	No Connection
8	Brown/White Stripes	Violet	No Connection
9	White Gray Stripes	Yellow	No Connection
10	Gray/White Stripes	Green	No Connection

Temposonics II Transducer with Analog Output Module (AOM) (P/N TTSRXXXXX) neuter transducer - no personality module

Pin No.	Cable w/Striped Leads	Cable w/Solid Leads	AOM Connections [2]
1	White/Blue Stripes	White	TB2-B or Pin B
2	Blue/White Stripes	Brown	TB2-B or Pin B
3	White/Orange Stripes	Gray	No Connection
4	Orange/White Stripes	Pink	No Connection
5	White/Green Stripes	Red	TB2-F or Pin F
6	Green/White Stripes	Blue	TB2-D or Pin D
7	White/Brown Stripes	Black	TB2-B or Pin B
8	Brown/White Stripes	Violet	TB2-C or Pin C
9	White Gray Stripes	Yellow	TB2-E or Pin E
10	Gray/White Stripes	Green	TB2-B or Pin B

Temposonics II Transducer with Digital Personality Module (DPM) *INTERNAL Interrogation ONLY* (P/N TTS**R**XXXXXX**DI**XXX)

Pin No.	Cable w/Striped Leads	Cable w/Solid Leads	Functional Description
1	White/Blue Stripes	White	DC Ground
2	Blue/White Stripes	Brown	Frame
3	White/Orange Stripes	Gray	(-) Gate Output
4	Orange/White Stripes	Pink	(+) Gate Output
5	White/Green Stripes	Red	+ 15 Vdc
6	Green/White Stripes	Blue	- 15 Vdc
7	White/Brown Stripes	Black	No Connection
8	Brown/White Stripes	Violet	No Connection
9	White Gray Stripes	Yellow	No Connection
10	Gray/White Stripes	Green	No Connection

Temposonics II Transducer with Digital Personality Module (DPM) *EXTERNAL Interrogation ONLY* (P/N TTS**R**XXXXXX**DE**XXX)

Pin No.	Cable w/Striped Leads	Cable w/Solid Leads	Functional Description
1	White/Blue Stripes	White	DC Ground
2	Blue/White Stripes	Brown	Frame
3	White/Orange Stripes	Gray	(-) Gate Output
4	Orange/White Stripes	Pink	(+) Gate Output
5	White/Green Stripes	Red	+ 15 Vdc
6	Green/White Stripes	Blue	- 15 Vdc
7	White/Brown Stripes	Black	No Connection
8	Brown/White Stripes	Violet	No Connection
9	White Gray Stripes	Yellow	(+) 1 μs Int. Pulse
10	Gray/White Stripes	Green	(-) 1 μs Int. Pulse

	Temposonics II Transducer with RS-422 Personality Module (RPM) (P/N TTS**R**XXXXXXX**R**)		
Pin No.	Cable Striped Leads	Cable Solid Leads	Functional Description
1	White/Blue Stripes	White	DC Ground
2	Blue/White Stripes	Brown	Frame
3	White/Orange Stripes	Gray	(-) 1 μs Pulse
4	Orange/White Stripes	Pink	(+) 1 μs Pulse
5	White/Green Stripes	Red	+ 15 Vdc
6	Green/White Stripes	Blue	- 15 Vdc
7	White/Brown Stripes	Black	No Connection
8	Brown/White Stripes	Violet	No Connection
9	White Gray Stripes	Yellow	(+) 1 μs Int. Pulse
10	Gray/White Stripes	Green	(-) 1 μs Int. Pulse

	Temposonics II Transducer with DPM and 10-Pin MS Connector Termination *INTERNAL Interrogation ONLY* (P/N TTS**R3**XXXXX**DI**XXX)		
Pin No.	Cable Striped Leads	Cable Solid Leads	Pin No. (P/N 370160)
1	White/Blue Stripes	White	A
2	Blue/White Stripes	Brown	J
3	White/Orange Stripes	Gray	K
4	Orange/White Stripes	Pink	G
5	White/Green Stripes	Red	H
6	Green/White Stripes	Blue	B
7	White/Brown Stripes	Black	No Connection
8	Brown/White Stripes	Violet	No Connection
9	White Gray Stripes	Yellow	No Connection
10	Gray/White Stripes	Green	No Connection

|	Temposonics II Transducer with DPM and 10-Pin MS Connector Termination *EXTERNAL Interrogation ONLY* (P/N TTS**R3**XXXXX**DE**XXX)		
Pin No.	Cable Striped Leads	Cable Solid Leads	Pin No. (P/N 370160)
1	White/Blue Stripes	White	A
2	Blue/White Stripes	Brown	J
3	White/Orange Stripes	Gray	K
4	Orange/White Stripes	Pink	G
5	White/Green Stripes	Red	H
6	Green/White Stripes	Blue	B
7	White/Brown Stripes	Black	No Connection
8	Brown/White Stripes	Violet	No Connection
9	White Gray Stripes	Yellow	E
10	Gray/White Stripes	Green	D
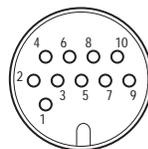
Figure A.1
10-Pin 'RB' AND 'RC' Style Connector Pin Diagram

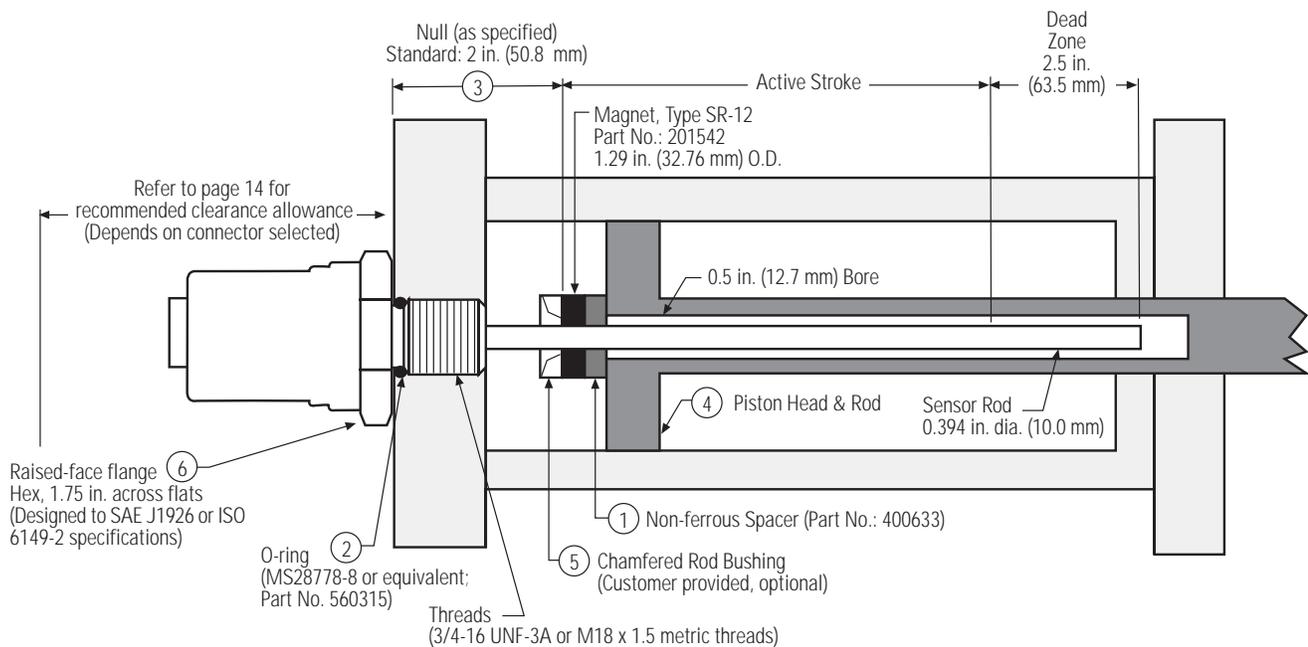## APPENDIX B: Typical Cylinder Installation

Figure B-1
Typical Cylinder Installation

> **NOTE:** *Cylinder Installation*
> *Figure B-1 (above) illustrates a **typical** cylinder installation. Some cylinder manufacturers may make alternate recommendations.*

Figure B-1 shows a typical cylinder installation. Review the following before proceeding with this type of installation.

- Use a non-ferrous (plastic, brass, Teflon®, etc.) spacer [1] to provide 1/8 inch (3.2 mm) minimum space between the magnet and the piston.

- An O-ring groove [2] is provided at the base of the 1.75 in. hex [6] for pressure sealing. MTS uses mil-standard MS33514 for the O-ring groove. Refer to mil-standard MS33649 or SAE J1926 for machining of mating surfaces.

- The null space [3] is specified according to the installation design and cylinder dimensions. Make sure that the magnet can be mounted at the proper null position.

- The piston head [4] shown is typical. For some installations, depending on the clearances, it may be desired to countersink the magnet.

- A chamfered rod bushing [5] should be considered for strokes of 60 inches or 1500 mm to prevent wear on the magnet as the piston retracts. The bushing should be made from Teflon or similar material.

- The recommended bore for the cylinder rod is 1/2 inch (12.7 mm). Use standard industry practices for machining and mounting of all components. Consult the cylinder manufacturer for applicable SAE or military specifications.