

Product Specification for model TT Transducer Tester Rev. B



The Rapid Controls model TT Rev B transducer tester connects to multiple types of transducers and displays position and status information from the transducer. It is capable of testing SSI, PWM, Start/Stop, Neuter, Analog Output, CAN Open, MTS CAN bus and Profibus DP transducers. Transducer selection is accomplished via the front-panel keypad. The display is portable, housed in a plastic desktop enclosure, and optionally battery powered.

Features

- Measures Start/Stop, Start/Stop Trailing Edge, PWM, Neuter, SSI, Analog, Balluff and MTS Profibus DP, CAN Open, MTS Single and MultiMagnet CANbus sensors
- Battery powered for easy testing at any location
- 2 line x 20 character backlit LCD display for magnetostrictive transducers
- Capable of calibrating MTS SSI transducers at 1200 or 4800bps
- Programmable analog output for data logging
- Six button front panel keypad to accommodate front panel setup
- Removable 5mm Phoenix type screw terminals for connections
- 2+ hour battery life while powering a transducer
- Setup stored in non-volatile EEPROM memory

Specifications

- SSI, Start/Stop, and PWM outputs are RS422 differential
- SSI, Start/Stop, and PWM inputs drive an optoisolator
- Start/Stop single-ended (neuter) level must be at least 1.2V
- Analog output is scalable to any position range
- Switched 24V sensor power is current limited to 200mA
- Optional +/-15V sensor power
- Minimum of 2 hour battery life (while powering one transducer)
- Housed in plastic enclosure: 8 in wide, 3.6 in high, 6 in deep

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Ordering information:

Specify model: **TT-A-B**

A. Transducer Supply Voltage Options

Omit for +24VDC power only

15V -15V, +15V, and +24VDC supply

B. Power Supply Options

Omit for international wall-powered unit

BATT Internal battery provides 2+ hours runtime

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1 Tester Capabilities

1.1 Introduction

The TT Transducer Tester Rev B is capable of interrogating and displaying position from transducers with the following interfaces:

- Synchronous Serial Interface (SSI) with 24/25/26-bit binary or Gray Code output
- Differential Start/Stop with either leading-edge or trailing-edge output
- Single-ended (Neuter) Start/Stop
- Externally interrogated Pulse Width Modulated (PWM)
- Free-running (internally interrogated or interrogated by a device other than the TT) PWM
- Single- and Multi-Magnet MTS Protocol CANbus
- MTS CANopen
- Balluff Profibus DP
- MTS Profibus DP
- -10 to 10 VDC analog voltage output
- 4-20mA analog current output (0 – 20 mA can be detected)

The TT Rev B is capable of displaying position information either in counts (unaltered data from the transducer) or in operator specified engineering units. Voltage or current based analog output can be configured to represent a range of positions.

1.2 Transducer Types

The strings used to represent the transducer types supported by the TT Rev B are shown in the table below. Although several transducers can be attached simultaneously (i.e. Start/Stop and CANbus), only one transducer will be interrogated at a time.

| Displayed | Transducer Type |
|-------------|---|
| SSI-24Bin | Transducers with a SSI interface with 24 data bits, in binary format |
| SSI-25Bin | Transducers with a SSI interface with 25 data bits, in binary format |
| SSI-26Bin | Transducers with a SSI interface with 26 data bits, in binary format |
| SSI-24Gray | Transducers with a SSI interface with 24 data bits, in Gray Code format |
| SSI-25Gray | Transducers with a SSI interface with 25 data bits, in Gray Code format |
| SSI-26Gray | Transducers with a SSI interface with 26 data bits, in Gray Code format |
| StartStop | Transducers with a leading-edge differential Start/Stop interface |
| StartStopSE | Transducers with a leading-edge single-ended Start/Stop interface |
| StartStopTr | Transducers with a trailing-edge differential Start/Stop interface |
| PWM | Externally interrogated Pulse Width Modulated output transducers |
| PWMFreeRun | Internally interrogated Pulse Width Modulated output transducers |
| CAN REMFRA | Multi magnet and Single Magnet MTS protocol CANbus transducers |
| CAN BRDCST | Single magnet MTS protocol CANbus transducers |
| CANopen | MTS protocol CANopen transducers |
| AnalogVolt | Analog voltage output transducers |
| Analog Cur | Analog 4-20mA output transducers |
| BALProfiDP | Balluff Profibus DP transducers |
| MTSProfiDP | MTS Profibus DP transducers |

1.3 Analog Output

The analog output system changes the output voltage level depending on the currently displayed position. For example, if the position of magnet 4 is currently displayed, the analog output voltage will vary with the position of magnet 4.

The analog output range is comprised of two positions in engineering units. The analog low bound is the position at which the analog output is 0VDC. The analog high bound is the position at which the analog output is 10VDC.

2 Tester operation

At power-on, the Transducer Tester displays software version information for two seconds before entering the normal display screen.

The TT Rev B has two display modes when not in the setup menu: Normal mode, and Min/Max mode. Normal mode displays the current position and status of the transducer in addition to the current transducer type and units. Min/Max mode shows the current position of the transducer and the minimum and maximum positions over a period of time. The Min/Max mode is useful for determining how noisy the position information from the transducer is.

2.1 The Normal Mode Display

An example of the normal mode display screen is shown below:

```
|           7.8719 in           |  
|XDCR OK   SSI-24Bin |
```

This screen shows the current transducer position (either in counts or engineering units) in the upper line of the display. If position information is not available due to transducer error, a line of dashes is displayed. The position information is continuously updated.

The lower left portion of the screen contains the transducer status. This field will display either “XDCR OK” if the transducer appears to be operating correctly, “NO MAGNET” if the transducer is responding, but no magnet is present, or “NO XDCR” if the transducer is not responding or no transducer is connected. A correctly responding CANbus or CANopen transducer is indicated with “OK” followed by the current CANbus baud rate.

The lower right portion of the screen contains the currently selected transducer type.

2.1.1 Keypress Actions

2.1.1.1 Shift-Enter

To enter the setup menu, press Shift-Enter. More information about the setup menu is available in section 2.3.

2.1.1.2 Clear

For transducer types other than analog voltage or analog current, pressing Clear will set the offset in order to “zero” the position. This means that the position displayed at the current position will be 0.0. This will only affect the display when engineering units are shown.

The analog voltage and analog current sensor types are zeroed separately from the other transducer types. This should be done if the shown reading is not zero volts or zero mA when the Analog Input + pin is connected to DC common. Calibration of the analog transducer types should only have to be performed once, unless the TT is reset to factory defaults.

2.1.1.3 Up Arrow and Down Arrow

Pressing the up arrow or down arrow will cycle through the transducer types.

2.1.1.4 Right Arrow (Shift-Down)

Press the right arrow to increment the currently selected magnet. Multiple magnet readings are supported for Start/Stop transducers, CANbus, and Profibus transducers. If fewer magnets than the selected magnet are present, a No Magnet error will be reported.

Pressing the right arrow when a PWM transducer is selected will change the number of recirculations that the TT is expecting the PWM transducer to be performing internally. This should be set to the number of recirculations that the transducer was ordered with. Failure to do so will cause the position readout to be incorrect.

2.1.1.5 Left Arrow (Shift-Up)

If a Start/Stop transducer type is selected, pressing the left arrow will select the null hold-off period. This is the period after transducer interrogation during which a received gate pulse is considered a glitch and not counted as a magnet. Transducers can be ordered with a smaller null distance than the default of 2 inches. The following null hold-off period settings are available: 2" null (the default setting, provides a 25us hold-off period), 1" null (provides a 17us hold-off period), and 0.85" null (provides a 12us hold-off period).

If a CANbus transducer type is selected, pressing the left arrow will display the CANbus transducer information screen. An example of this screen follows:

```
|CAN Serial: 12345678|  
|B:500k N: 0 M: 16 |
```

The top line shows the serial number (12345678 in the example) of the attached transducer. The lower line shows the Baud Rate (500kbps in the example), Node ID (0 in the example), and configured number of magnets (16 in the example). If you enter this field after changing the Node Id you will be prompted to allow changing the Node ID. See section 2.33.11 for details

2.2 The Min/Max Mode Display

The min/max display mode can be used to determine if unacceptable jitter or spurious errors are occurring. The min/max display mode can be "cleared," which resets the minimum and maximum positions to the current position, and resets the long-term error indicator to no error.

An example of the normal mode display screen is shown below:

```
| 7.6688 NoErrs 3m|  
| 7.6686to 7.6692|
```

The current position is displayed in the upper-left portion of the screen; if the transducer is in an error state, this is displayed in place of the position. In the center of the top line is an indication of whether an error has been detected since the min/max information was cleared. The upper-right portion of the screen shows how much time has elapsed since the min/max information was cleared (display will show an "s" indicator for seconds, a "m" indicator for minutes, an "h" indicator for hours, or a "d" indicator for days).

The lower line of the display shows the minimum and maximum positions encountered since the min/max information was cleared.

2.2.1 Keypress Actions

2.2.1.1 Shift-Enter

To enter the setup menu, press Shift-Enter. More information about the setup menu is available in section 2.3.

2.2.1.2 Clear

Pressing Enter will clear the Min/Max information. This resets the timer to 0 seconds, the long-term error indicator, and the minimum and maximum positions.

2.2.1.3 Up Arrow and Down Arrow

Pressing the up arrow or down arrow will change the transducer type.

2.2.1.4 Right Arrow (Shift-Down)

Press the right arrow to increment the currently selected magnet. Multiple magnet readings are supported for Start/Stop, CANbus, and Profibus DP transducers. If fewer magnets than the selected magnet are present, a No Magnet error will be reported.

Pressing the right arrow when a PWM transducer is selected will change the number of recirculations that the TT is expecting the PWM transducer to be performing in the head. This should be set

to the number of recirculations that the transducer was ordered with. Failure to do so will cause the position readout to be incorrect.

2.2.1.5 Left Arrow (Shift-Up)

If a Start/Stop transducer type is selected, pressing the left arrow will select the null hold-off period. This is the period after transducer interrogation during which a received gate pulse is considered a glitch and not counted as a magnet. Transducers can be ordered with a smaller null distance than the default of 2 inches. The following null hold-off period settings are available: 2" null (the default setting, provides a 25us hold-off period), 1" null (provides a 17us hold-off period), and 0.85" null (provides a 12us hold-off period).

If a CANbus transducer type is selected, pressing the left arrow will display the CANbus transducer information screen. See section 2.1.1.5 for more information.

2.3 The Setup Menu

The Setup Menu is used to adjust the configuration of the TT. An example view of the menu is shown below:

```
|*Units          ↑|
| Scale          ↓|
```

The asterisk (*) indicates the currently selected setup item (in this case, the type of units that are displayed). The arrow pointing up indicates that more items can be accessed by pressing the up arrow key and the down arrow indicates that more items can be accessed by pressing the down arrow key.

Exit the menu by pressing the Clear key. If an item is being edited, the Clear key will cause changes to that item to be discarded.

2.3.1 Editing a Setup Item

To edit the selected setup item, press the Enter key. An example view of the editing screen when the Scale is being edited is shown below:

```
|Scale          |
|[0000001.0000000] in|
```

The top line indicates the setup item that is currently being edited. The bottom line shows the value of the setup item. The scale is a numeric value, and a cursor will be displayed under one of the digits. This is the currently selected digit – the digit that will be changed.

To change the currently selected digit, press the left or right arrow keys. To change the value of the digit, press the up or down arrow keys or press a numeric key. To enter a negative value, select the leftmost digit and press the down arrow key until a zero (0) is displayed. Pressing the down arrow key again will switch to a negative value. Pressing the up arrow key will then switch back to a positive value

Other setup items allow selection from a list of choices. An example of this type of editing screen is shown below:

```
|Units          |
|(Millimeters   ) ↑↓|
```

The top line shows the setup item that is being edited, and the bottom line shows the currently selected list item. The up and down arrows indicate if more choices are available by pressing the up arrow key or the down arrow key.

2.3.2 Storing a Setup Value

Press enter to store the new value of the selected setup item and begin using this value for operation of the display. Press Clear to abandon changes to the selected setup item.

2.3.3 Setup Items

All setup items available from the TT Rev B setup menu are listed below.

2.3.3.1 Display Type

The display type selects between the Normal display mode and the Min/Max display mode. See sections 2.1 and 2.2 for more information.

2.3.3.2 Display Units

The “Display Units” setup item selects whether engineering units are used to show position information. Select No to display counts; select Yes to display engineering units.

2.3.3.3 Units

The “Units” setup item selects the base engineering units that the position is displayed in. The choices are Inches, Millimeters, and Centimeters. Other units can be derived from these units by changing the scale value.

2.3.3.4 Scale

The “Scale” is multiplied by the position (before the offset is added). This can be used to adjust position output to account for linear deviation, adjust for gearing or other mechanical systems, to reverse the direction in which position increases (using a negative scale) or to display positions in engineering units other than those provided by the TT.

2.3.3.5 Resolution

The “Resolution” setup item is used in the calculation of position in engineering units for transducers other than Start/Stop and PWM. Each count is considered to be worth the value of the resolution setup item. The resolution of a Start/Stop or PWM transducer is calculated from the gradient (see section 2.3.3.7); other types of transducers store this value internally.

2.3.3.6 Offset

The “Offset” setup item is used to adjust the position output by a constant amount. It is a value in engineering units that is subtracted from the position after the scale is applied. This can be used to “zero” the displayed position at an arbitrary point.

2.3.3.7 Gradient

The “Gradient” setup item is used to calculate the resolution of a position count when using a Start/Stop or PWM transducer. The gradient is always entered in uS/in, and is printed on the head of the transducer. If your sensor shows the gradient in m/s, this value must be converted to uS/in manually before entry. This setup item must be changed to the correct value of the transducer for engineering unit output to be accurate. A value of 9.00 uS/in can be used as a nominal value if perfect accuracy is not needed (i.e. when testing many sensors quickly).

2.3.3.8 Ana Sensor Span

The “Ana Sensor Span” is the distance between the location of the magnet at minimum output and the location of the magnet at maximum output. For a 0-10V sensor, 0V is the point of minimum output and 10V is the point of maximum output. For a 4-20mA sensor, 4mA is the point of minimum output and 20mA output is the point of maximum output. This value is used to calculate positions in engineering units for analog output sensors.

2.3.3.9 Analog Low Bound

The “Analog Low Bound” setup item sets the position representing minimum output of the analog output system. Any position lower than this position will result in an output of 0VDC.

2.3.3.10 Analog High Bound

The “Analog High Bound” setup item sets the position representing maximum output of the analog output system. Any position higher than this position will result in an output of 10VDC.

2.3.3.11 CANbus XDCR Info

Select the “CANbus XDCR Info” setup item to display information about the CANbus transducer. This screen is identical to the screen accessed by pressing the left arrow key when not in the setup menu. If a new Node ID has been entered using the Change XDCR Node ID “ setup item you will be prompted for permission to Change the XDCR Node ID. If you press the ENTER key in response the Node Id will be changed. Pressing any other key bypasses the change.

The display will show SN:01234567 followed by the baud rate. The bottom line will show M: number of magnets, N: Node Id, P: Position ID, B: Broadcast ID or S: Status ID.

2.3.3.12 Change XDCR Node ID

For CANBus only! Select the “Change XDCR Node ID” setup item to enter a new Node ID, which will be downloaded to the sensor the next time the “CANbus XDCR Info” item is selected. The value entered has no effect until the “CANBus XDCR Info” setup item is executed when you will be prompted to allow changing the Node ID.

2.3.3.13 Send/Rcv CAN Msgs

For CANBus sensors only! Select the “Send/Rcv CAN Msgs” setup item to send and receive standard frame messages directly to the Can Bus sensor. This function is not available unless a CAN sensor type is selected. The sensor should be responding in the display section before messages can be sent reliably. Messages to be sent are shown and entered on the upper line of the display, preceded by an ‘S:’. All characters are entered in hexadecimal format. The message is sent when the Enter key is pressed. The return response message from the sensor is displayed on the lower line. The message returned from the sensor will be displayed on the lower line preceded by ‘R:’.

Use the left and right arrows (2nd Up Arrow and 2nd Down Arrow) to choose which character of the message to change. The blinking cursor will show which character is selected. Enter the new value for that character by pressing the number and letter keys ‘A-F’. Press the Clear key to clear from the cursor position to the end of the line. Messages must be at least 4 characters in length or the response shown will be “—“. When the message to be sent is correct then press the Enter key and the message will be sent. The response from the sensor will then appear on the lower line. The response message “***” indicates no response from the sensor.

The keys G and H are preprogrammed to broadcast a Start and Stop message respectively to the attached sensor. If this sensor is an MTS single magnet sensor it will start sending its position and status information at the programmed rate. These messages are displayed on the Receive line until stopped. The Stop message is broadcast upon entering the Send/Rcv Msgs menu.

To return to the main menu press the 2nd and Enter keys.

2.3.3.14 Send/Rcv SSI Msgs

For SSI sensors only! Select the “Send/Rcv SSI Msgs” setup item to send and receive messages directly to the SSI sensor. This function is not available unless an SSI sensor type is selected. The sensor should be responding in the display section before messages can be sent reliably. Choose between 1200 and 4800 baud from the menu presented. Once you choose the sensor power will be cycled and the tester will attempt to place the sensor in the Cal mode.

Messages to be sent are shown and entered on the upper line of the display, preceded by an ‘S:’ and terminated by a Carriage Return. (Note that the CR symbol is the empty battery symbol). All characters are entered in ASCII format. The message is sent when the Enter key is pressed. Use the left and right arrows (2nd Up Arrow and 2nd Down Arrow) to choose which character of the send message to change. The blinking cursor will show which character is selected. Enter the new value for that character by pressing the number and letter keys ‘A-J’ or by adjusting the existing character using the Up and Down arrows. Press the Clear key to clear from the cursor position to the end of the line. Messages must be at least 3 characters in length, including the Carriage Return, or the response shown will be “—“. When the message to be sent is correct then press the Enter key and the message will be sent to the sensor..

The tester waits up to 1.5 seconds for a response from the sensor. The message returned from the sensor will be displayed on the lower line preceded by ‘R:’. A good response from the sensor will appear on the lower line terminated by the Carriage Return symbol. The response message “***” indicates no response from the sensor.

To return to the main menu press the 2nd and Enter keys.

2.3.3.15 Cal GSeriesDigital

For G-Series digital sensors only. This function allows setup of the G-Series Digital sensors using configuration software from MTS Sensors. The TT-TESTER acts as a RS232 to RS422 converter in this mode. Press the CLR button to cycle the power to the sensor – this must be done while the setup software is attempting to communicate with the sensor to enter the sensor's setup mode. Press the Enter button to return to the menu. While in this mode the characters sent to the sensor are displayed in Hex format on the screen.

2.3.3.16 Cal GSeriesAnalog

For G-Series analog sensors only. This function allows setup of the G-Series Analog sensors using configuration software from MTS Sensors. The TT-TESTER acts as a RS232 to RS485 converter. Press the CLR button to cycle the power to the sensor – this must be done while the setup software is attempting to communicate with the sensor to enter the sensor's setup mode. Press the Enter button to exit to the menu. While in this mode the characters sent to the sensor are displayed in Hex format on the screen.

Communications for programming a G-Series Analog-output sensor happens on a pair of RS-485 lines, not the analog output. This means that the sensor must be connected to the “StartStop/PWM/SSI” connector:

- Pin 1 (Int+/Clk+) is connected to both Pin 3 (Gate+/Data+) **and** sensor RS-485+ (yellow)
- Pin 2 (Int-/Clk-) is connected to both Pin 4 (Gate-/Data-) **and** sensor RS-485- (green)
- Pin 8 (24VDC) is connected to sensor Supply Voltage (red or brown)
- Pin 6 (DC Common) is connected to sensor DC Ground (white)

2.3.3.17 Cal RSeries SSI

For R-Series SSI sensors only. This function allows setup of R-Series SSI sensors using configuration software from MTS Sensors. The TT-TESTER acts as the RS232 to RS422 converter. Press the CLR button to cycle the power to the sensor – this must be done while the setup software is attempting to communicate with the sensor to enter the sensor's setup mode. Press the Enter button to exit to the menu.

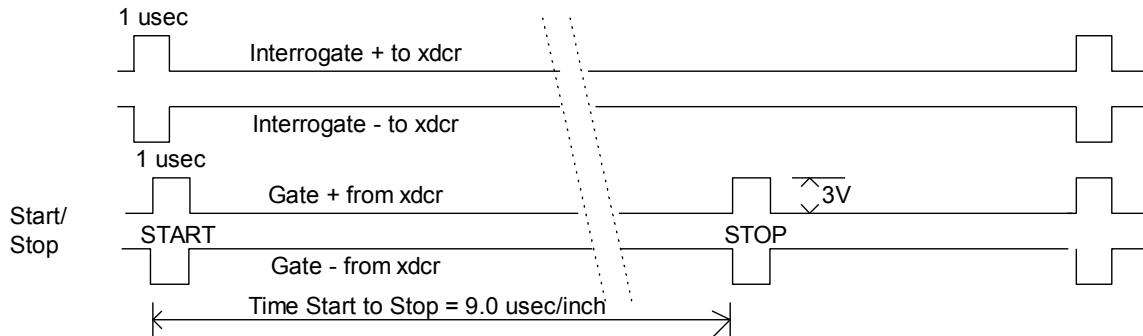
2.3.3.18 Factory Reset

This menu item will reset the TT Rev B's settings to the defaults.

3 Transducer Waveforms

The following sections describe the data exchanges between the TT and various transducer types. These are made available to assist with advanced troubleshooting of a sensor. An oscilloscope may be used to verify that the transducer is responding correctly to the queries from the TT.

3.1 Start/Stop transducer waveforms



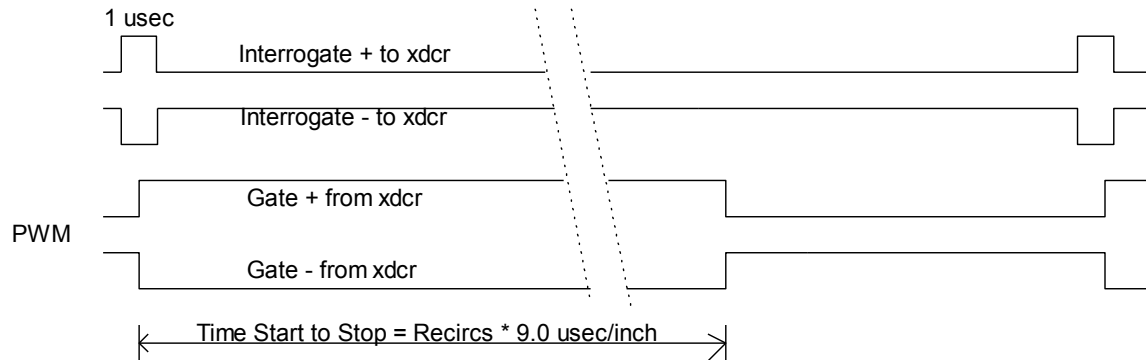
The tester issues one microsecond long interrogate+ and interrogate- pulses to the sensor. A good sensor will respond with the Start+ and Start- signals. These are usually around 1 microsecond in length. A good sensor with magnet will follow the Start pulse with a Stop pulse. The time from the leading edge of the Start Pulse to the leading edge of the Stop pulse will be approximately 9 microseconds for each inch the magnet is from the head of the sensor ($9 * \text{magnet dist}$). If a Stop pulse doesn't arrive before the next interrogate pulse the tester assumes that there is not a magnet on the transducer.

Trailing Edge type sensors use the trailing edge of the Start and Stop pulses.

Start Stop single ended transducers do not have a differential output but instead output only the Gate signal. Select the Start/Stop Single ended mode for this type of transducer.

Neuter transducers can be tested using the Start/Stop Single Ended mode. Connect the Neuter output pulse to the Gate + input.

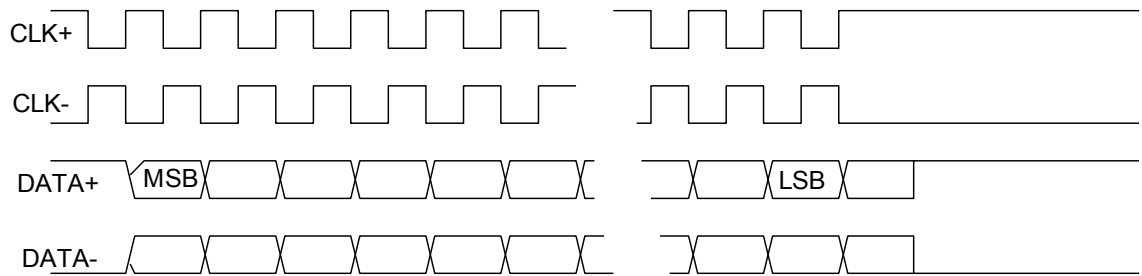
3.2 PWM transducer waveforms



The tester issues one microsecond long interrogate+ and interrogate- pulses to the sensor. A good sensor will respond by changing the Gate + to high and the Gate - to low. The time from the leading edge of the PWM Gate+ signal until the trailing edge of the PWM Gate+ will be approximately 9 microseconds for each inch the magnet is from the head of the sensor times the number of recirculations programmed in the sensor. ($9 * \text{magnet distance} * \text{recirculations}$).

The PWM sensor may be internally interrogated in which case the sensor doesn't wait for the tester to issue the interrogate pulse. Instead it has its own time base and will independently issue the Gate+ and - pulse on this time base. The tester synchronizes to this time base and issues an interrogate pulse even though it isn't used. Select the PWM Free Running transducer type to use this type of sensor.

3.3 SSI transducer waveforms



The tester issues 24, 25 or 26 clock pulses and a good transducer will respond by issuing the correct data bits during the correct clock time. The most significant bit is issued first and the least significant data bit is issued last. If the 25 bit mode is used for a 24 bit transducer the data will be shifted left by one bit resulting in double the value. If the 24 bit mode is used for a 25 bit transducer the least significant data bit will not be output by the transducer resulting in a value of $\frac{1}{2}$ the correct amount.

4 Testing Specific Transducer Types

4.1 Start/Stop Transducers

Use the front panel connector to connect the Start/Stop transducer. Using the front panel keys to select Start/stop or Start/stop Trailing Edge. The count value printed on the display should be equal to the magnet position in inches * 9 * 28. This value should change by 252 counts for each inch of travel.

4.2 PWM Transducers

Use the front panel connector to connect the PWM transducer. Using the front panel keys to select PWM. The count value printed on the display should be equal to the (magnet position in inches * 9 * 28 * Number of Recirculations). This value should change by (252 * Number of Recirculations) counts for each inch of travel. When viewing position in engineering units, adjust the configured number of recirculations (by pressing Right) to match the number of recirculations being performed by the sensor.

4.3 SSI Transducers

Use the front panel connector to connect the SSI transducer. Using the front panel keys select SSI. The relationship between the count value printed on the display and the position of the magnet is determined by the resolution of the transducer. Set the resolution setting to the resolution of the sensor to achieve accurate output in engineering units.

4.4 Analog Transducers

Use the front panel connector to connect an analog Output transducer. Select either the Analog Vol or Analog Cur transducer type. Apply a voltage from -10V to +10V to the Analog Input for the Analog Voltage setting. To measure a current apply a voltage to the analog input to cause the desired current to flow across the 600 ohm impedance presented by the tester.

4.5 MTS CANbus Single Magnet protocol Transducers

Use the front panel connector to connect the CANbus transducer.

Select the either CAN REMFRA type or CAN BRDCST type. A Single Magnet Protocol sensor will operate correctly using either the Remote Frame Request or the Broadcast methods

The TT will automatically search for the Node ID of the transducer at baud rates of 125kbps, 250kbps, 500kbps, and 1Mbps. The transducer status will indicate the baud rate the TT is currently searching when no transducer has been found.

A 120ohm termination resistor is installed inside the TT; adding an additional resistor may cause the CANbus network to fail.

Set the resolution setting to the resolution of the sensor to achieve accurate output in engineering units.

4.6 MTS CANbus Multi-Magnet protocol Transducers

Use the front panel connector to connect the CANbus transducer.

Select the CAN REMFRA type meaning that the tester uses a Remote Frame request to acquire the position information. A multi-magnet sensor will only work in the REMFRA type. Information from multiple magnets can be discerned (see section 2.1.1.4).

The TT will automatically search for the Node ID of the transducer at baud rates of 125kbps, 250kbps, 500kbps, and 1Mbps. The transducer status will indicate the baud rate the TT is currently searching when no transducer has been found.

A 120ohm termination resistor is installed inside the TT; adding an additional resistor may cause the CANbus network to fail.

Set the resolution setting to the resolution of the sensor to achieve accurate output in engineering units.

4.7 CANopen Transducers

Use the front panel connector to connect the CANbus transducer.

Select the CANOpen type from the menu

The TT will automatically search for the Node ID of the transducer at baud rates of 125kbps, 250kbps, 500kbps, and 1Mbps. The transducer status will indicate the baud rate the TT is currently searching when no transducer has been found.

A 120ohm termination resistor is installed inside the TT; adding an additional resistor may cause the CANbus network to fail.

Set the resolution setting to the resolution of the sensor to achieve accurate output in engineering units.

4.8 Profibus DP Transducers

Use the front panel DB9 connector to connect the Profibus DP transducer. The TT will automatically search for the Node ID of the transducer. When no transducer has been found, the transducer status will indicate the node ID that the TT is currently searching for.

Set the resolution setting to the resolution of the sensor to achieve accurate output in engineering units.

5 SSI Transducer Calibration

The TT Rev B is able to control the transducer power, and uses this ability to allow calibration of MTS SSI transducers. Use a serial terminal or terminal emulation program on a PC to connect to the TT Rev B. The TT expects to communicate at 9600bps, with 8-bit data words, no parity, 1 stop bit.

The command "\$1COBAUD<cr>" must be sent to the TT over the RS-232 interface to enter calibration mode. *BAUD* should be replaced by 1200 or 4800, the baud rate of the transducer. Most modern transducers should be 4800bps. When the TT receives this command, the TT performs the following actions:

1. Turn the transducer power OFF
2. Wait 1.5 seconds
3. Turn the transducer power ON
4. For 1 second send the string "PROG"<CR> to the transducer as fast as possible.
5. Send "*"<CR> to the host
6. Enter calibration mode and remain in calibration mode until the host sends "\$1CO" indicating the end of the CAL mode
7. Upon receipt of the \$1CO command, turn the transducer power off.
8. Wait 1.5 seconds
9. Turn the transducer power on
10. Send a '*' CR to the host
11. Enter the normal operation and display mode.

While in calibration mode the TT will send CR terminated strings that it receives from the host to the transducer at the baud rate specified in the CO command. After the TT sends the string to the transducer it will wait 250mS for a response and then send the CR terminated response string back to the host. If there is no response from the transducer the TT will respond with the CR only.

6 Connections

Transducers are connected to the connectors located on the front panel of the TT.

6.1 Start/Stop, PWM, and SSI Transducer connector

The front panel connector contains connections for transducers.

| Pin | Connection | Notes |
|-----|-------------|--|
| 1 | Int+/Clk+ | The positive signal to the transducer. (Interrogate + or Clk +) |
| 2 | Int-/Clk- | The negative signal from the transducer. (Interrogate - or Clk -) |
| 3 | Gate+/Data+ | The positive return from the transducer. (Gate+ or Data+) |
| 4 | Gate-/Data- | The negative return from the transducer. (Gate- or Data-) |
| 5 | +15VDC | Use to power older +/-15V transducers. |
| 6 | DC Common | |
| 7 | -15VDC | Use to power older +/-15V transducers. |
| 8 | +24V | This must be used to power the transducer for SSI calibration to work correctly. |

6.2 Analog Transducer connector

| Pin | Connection | Notes |
|-----|------------|--|
| 1 | Ana Vin | The analog voltage to be measured (-10V to +10V) |
| 2 | Ana I in | The 4-20 ma current input to be measured (Jumper to Pin 1 for Current) |
| 3 | DC Common | DC Common |
| 4 | +24V DC | +24V transducer power |
| 5 | DC Common | DC Common |

6.3 Can Bus Connector

| Pin | Connection | Notes |
|-----|------------|------------------------------------|
| 1 | Com | DC Common |
| 2 | CAN L | CAN Low signal |
| 3 | Shield | Cable shield may be connected here |
| 4 | CAN H | CAN High signal |
| 5 | +24VDC | +24V power to the sensor |

6.4 Profibus Connector

| Pin | Connection | Notes |
|-----|------------|-------------------|
| 1 | Shield | |
| 2 | 24V Common | |
| 3 | P | Profibus P signal |
| 4 | N/C | No Connection |
| 5 | 5V Common | |
| 6 | +5V DC | |
| 7 | +24V DC | |
| 8 | N | Profibus N signal |
| 9 | N/C | No Connection |

6.5 Analog Output BNC Connector

| Pin | Connection | Notes |
|-----|-------------|---|
| 1 | Voltage Out | The analog voltage output. Output ranges from 0 to 10VDC. |
| 2 | Ground | Provides the voltage reference for the voltage analog output. |

6.6 Serial Communications Connector

The serial communications connector is used to calibrate SSI transducer and for upgrading the TT software.

| Pin | Function |
|-----|---------------|
| 1 | RS232 Rx Data |
| 2 | RS232 Tx Data |
| 3 | DC Common |
| 4 | RS485- |
| 5 | RS485+ |

6.7 AC Power/Battery Charge Connector

When AC power is applied to a TT with a battery option, the battery will be charged regardless of whether the TT is switched on. This AC power is used to directly power the TT on TT models without a battery option. The included battery charger should be able to charge a dead battery in about 1 hour.

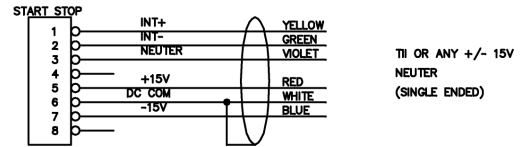
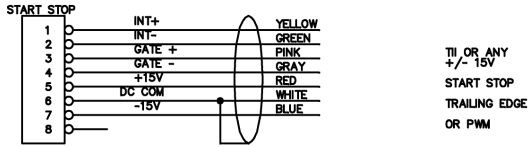
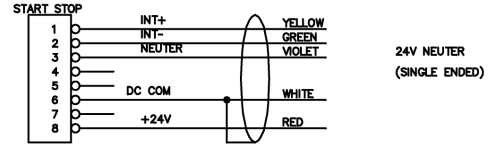
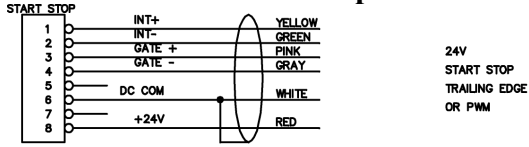
6.8 Fuse

Install a 1-ampere fuse in the fuse holder.

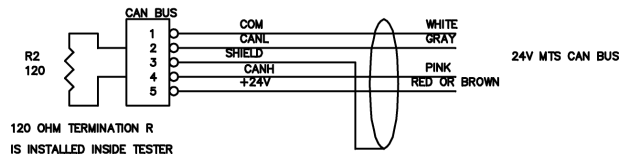
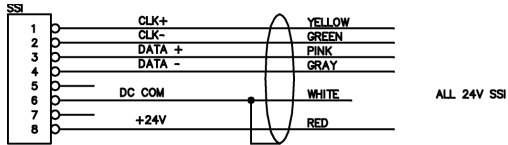
7 Sensor Connection Diagrams

Note: Colors listed in this section follow MTS color codes. Other sensor manufacturer's wire colors will vary.

7.1 PWM and Start/Stop



7.2 SSI



7.3 Current in

