



Product Specification and User Manual for Transducer Display Model TDD2



The TDD2 displays position information derived from a magnetostrictive transducer with Synchronous Serial Interface (SSI), Start/Stop, Pulse Width Modulated (PWM), or CANbus output. Setup of units, offsets, and other items can be accomplished via the front-panel keypad menu or a RS-232/485 interface.

Features

- Supports SSI, Start/Stop, PWM, MTS multi-magnet CANbus and MTS single-magnet CANopen sensors
- Multiple magnets supported when using Start/Stop or CANbus sensors
- Resolution to 5 micron for Start/Stop transducers
- Capable of auto-detecting PWM, free-running PWM, and Start/Stop sensors
- Capable of supporting MTS G-Series sensors
- Programmable decimal point, units, scale, and resolution
- Optional 5-channel programmable limit switch, solid-state or mechanical
- Optional 16-bit analog output with programmable range
- Two digital inputs allow actions such as remote zero and front panel disable
- RS-232 and RS-485 serial interface for host setup and position inquiries
- Removable 3.5mm Weidmuller type screw terminals for connections
- Setup values stored in non-volatile EEPROM memory

Specifications

- Six 0.57 inch red LED digits
- Capable of displaying -199999 to 999999 with a decimal point to the right of any character
- Integral units: inches, feet, millimeters, centimeters, or meters
- SSI Interface: Clock frequency 227 kHz; External Clock 500 kHz maximum
- Update rate: 200 Hz; External update rate 4 kHz maximum
- 9600 or 19200-baud RS-232 and RS-485 serial interface
- Optional five-channel programmable limit switch with programmable on/off points for each channel
- Solid State limit switch channels each capable of sinking 500 ma at 50V
- Analog retransmission output based on position, velocity, or a forced level
 - Output ranges: 0-5V, 0-10V, -5-5V, -10-10V, -2.5-2.5V, -2.5-7V
- Chip-select output for 3 wire SSI sensors such as rotary encoders
- Input Power: 9 to 26.4 VDC (transducer power supply) Except RA option which requires 20 to 26.4 VDC
- Housed in 1/8 DIN metal enclosure: 3.78in wide, 1.89in high, 4.68in deep, panel cutout: 3.6in x 1.75in

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TDD2-LD (Large Digit)



TDD2-ND (No Display)

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Contents

1	Introduction.....	1
1.1	About This Manual.....	1
1.2	Introducing the TDD2.....	1
2	Installation.....	2
2.1	Connections.....	2
2.2	MTS Multi-Magnet CANbus sensor requirements.....	6
3	Display Operation.....	7
3.1	Startup.....	7
3.2	Normal Operation.....	7
3.3	The Front Panel.....	7
3.4	Numerical Output.....	9
4	Display Configuration Values.....	10
4.1	Display Settings.....	10
4.2	Position Settings.....	10
4.3	Transducer Settings	12
4.4	Digital Output Settings (Optional).....	13
4.5	Presets.....	14
4.6	Analog Output Settings.....	15
4.7	Digital Input Settings.....	16
4.8	Front Panel Actions.....	17
4.9	Serial Settings.....	18
5	Front Panel Menu Setup Items.....	19
5.1	Display Setup Items.....	20
5.2	Peak Read Setup Items.....	21
5.3	Position Setup Items.....	22
5.4	Transducer Setup Items.....	23
5.5	Digital Output Setup Items.....	24
5.6	Preset Setup Items.....	24
5.7	Analog Output Setup Items.....	25
5.8	Digital Input Setup Items.....	25
5.9	Front Panel Setup Items.....	26
5.10	Serial Interface Setup Items.....	26
5.11	Save to EEPROM.....	26
5.12	Reset to Factory Defaults.....	26
6	Troubleshooting.....	27
7	Serial Communications.....	28
7.1	TDD2 WinComm.....	28
7.2	Write protection.....	28
7.3	Display Settings.....	29
7.4	Position Settings.....	31
7.5	Transducer Settings.....	35
7.6	Analog Output Settings.....	39
7.7	Digital Input and Front Panel Settings.....	41
7.8	Position Queries.....	43
8	Optional Solid State Limit Switch	45
8.1	Features.....	45
8.2	Mechanical Specifications.....	45
8.3	Limit Switch Specifications.....	45
8.4	Solid state limit switch connections.....	45
8.5	Connector J1 Pin-out.....	45
8.6	Solid state limit switch output cautions.....	45
9	Optional Electromechanical Relay Limit Switch.....	47

9.1 Features of the electromechanical relay limit switch.....	47
9.2 Mechanical Specifications.....	47
9.3 Relay Limit Switch Specifications.....	47
9.4 Relay Limit Switch Connections.....	48
9.5 Relay Limit Switch Output Cautions:.....	48
10 Rear Panel Layout.....	49
11 TDD2 Panel Cutout.....	50
11.1 TDD2 Panel cutout Dimensions.....	50

1 Introduction

1.1 About This Manual

This manual explains how to install, configure, and operate the TDD2. It is divided into the following sections:

Installation	Section 2 explains how to install the TDD2.
Operation	Section 3 describes how the TDD2 operates.
Configuration	Section 4 explains the settings affecting the operation of the TDD2. Section 5 shows the front panel menu representation of the configuration items listed in section 4.
Troubleshooting	Section 6 is a troubleshooting guide.
Communications	Section 7 covers communicating with the TDD2 via the RS-232/485 interface

1.2 Introducing the TDD2

The TDD2 is a flexible transducer display capable of interfacing with magnetostrictive transducers employing Synchronous Serial Interface (SSI), Start/Stop, Pulse Width Modulated (PWM), or CANbus output. A high-speed microcontroller interrogates the sensor, performs calculations to arrive at the desired engineering units, and displays the position on the 6-digit LED display. A non-volatile EEPROM stores configuration data while the TDD2 is powered off.

The front panel of the TDD2 contains 4 keypad switches to facilitate configuration using the front panel display. These switches can also be used to control display operation when not configuring the device.

An RS-232/485 interface allows for setup and control from a host computer or PLC. Free software is available to assist with configuration from a Windows PC.

Solid State or relay type digital output modules can be installed in the TDD2 to implement limit switch type functions.

TDD2-ND models do not have a front-panel display or keypad and must be configured using the RS-232 interface.

2 Installation

Installation of the TDD2 consists of connecting the sensor to the rear connector, connecting power, and configuring the unit. Sections 3 and 4 discuss operation and configuration of the TDD2.

2.1 Connections

The TDD2 has two connectors, a power/transducer connector and a serial connector. The serial connector is an RJ-45 modular connector and provides connections to the RS-232, RS-485, and CANbus interfaces. The serial connector pinout is shown in Table 2. The power/transducer connector provides connections for input power, transducer interface as well as the digital inputs, analog output and the CANbus interface. The pinout of the transducer connector is shown in Table 1.

Pin	Description
1	+24V DC
2	Ground
3	Transducer Int+ / Clock+
4	Transducer Int- / Clock-
5	Transducer Gate+ / Data+
6	Transducer Gate- / Data-
7	Digital Input 0 (active low)
8	Digital Input 1 (active low)
9	SSI Chip Select +
10	SSI Chip Select -
11	Analog Output Common
12	Analog Output
13	Can High
14	Can Low

Table 1: Transducer Connector

Pin	Description
1	Can High
2	RS-485 TX/RX
3	RS-232 TX
4	Ground
5	Ground
6	RS-232 RX
7	RS-485 TX/RX#
8	Can Low

Table 2: RJ45 Connector

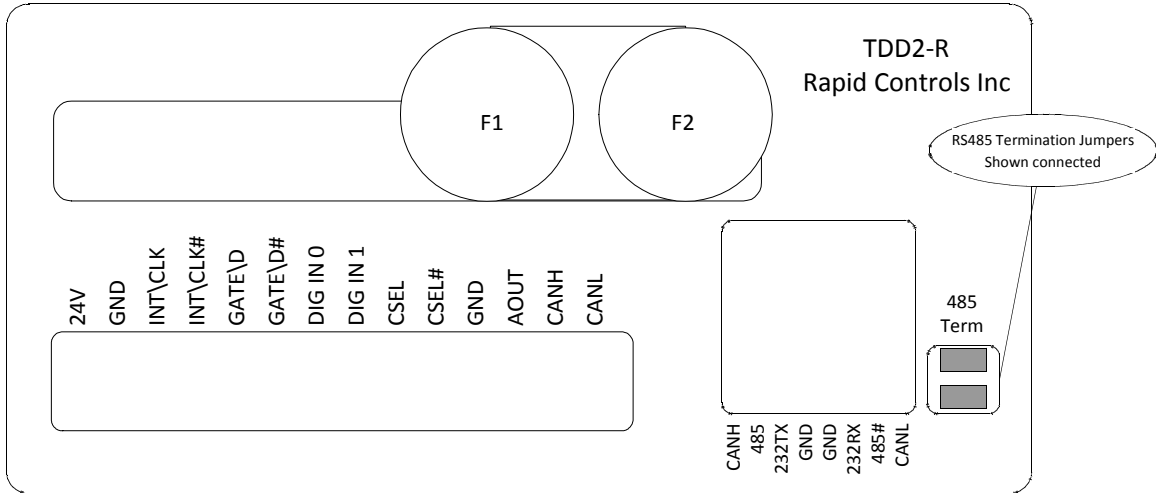
TDD2 RJ45 Connector Pin	Description	PC DB9 Serial Connector
4	Gnd	5
3	RS-232 TX	2
6	RS-232 RX	3
no connect	RTS – CTS	7 Jumper to 8
no connect	DTR – DSR	4 Jumper to 6

Table 3: TDD2 to PC Cable

2.1.1 Communication Notes

A serial cable, part # A10603, may be purchased from Rapid Controls. This cable connects a standard DB9 serial port connection to the TDD2's RJ45 serial connector to allow RS-232 communication. Part # A10884 consists of the same cable with a USB to RS-232 converter added.

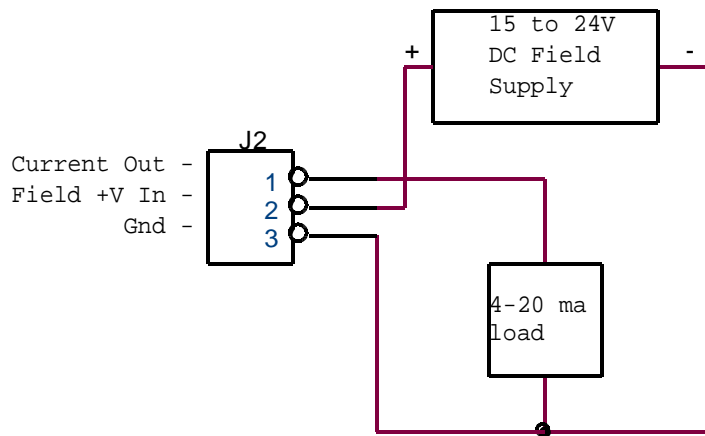
RS232 communications is not recommended for distances greater than 20 feet. It is recommended that you use RS485 for lengths greater than 20 feet. RS485 termination is required for reliable communications and is accomplished by installing shunt jumpers horizontally across the X3 terminations, as shown in the Rear Panel Layout , section 11. When using multiple TDD2 modules the termination should be removed on all but the first and the last device of the link. The TDD2 is supplied from the factory with the termination jumpers installed. The jumpers are shown installed on the figure below.



Termination jumpers

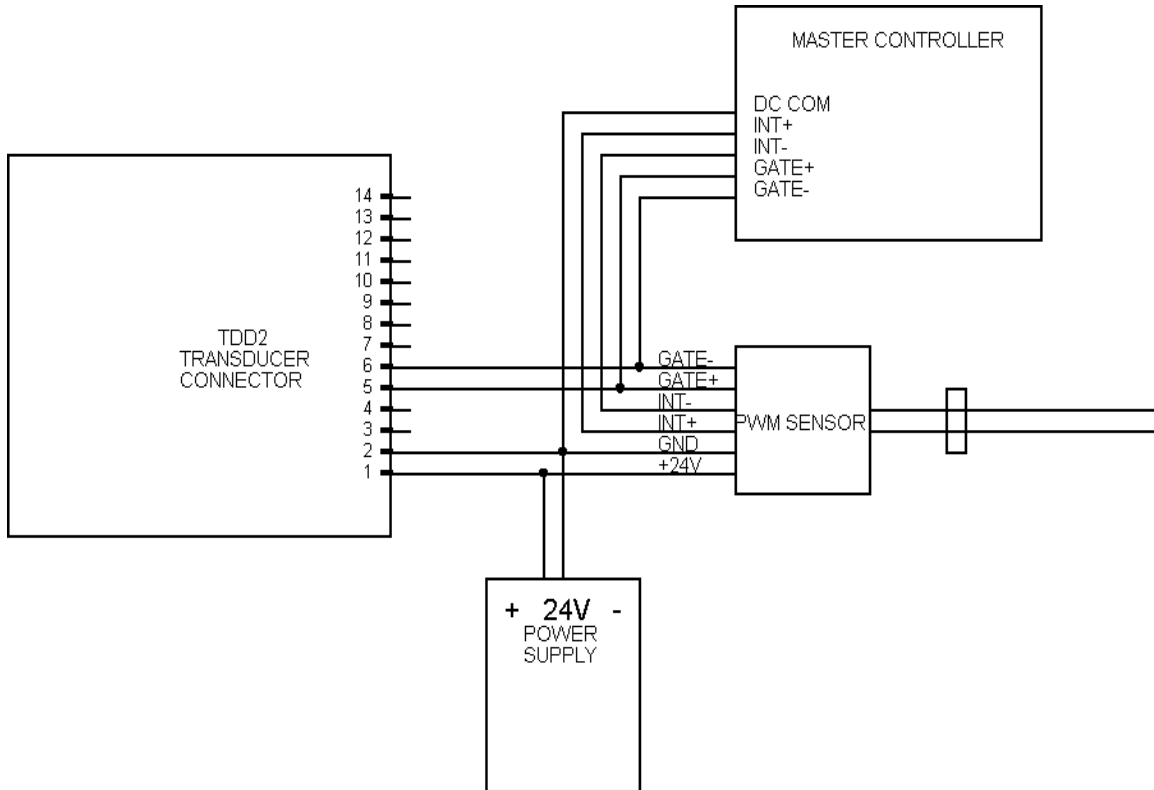
2.1.2 4-20 mA Output Option

- J2-1: Current source output
- J2-2: Field + Current source voltage (15 to 24 VDC) in current mode
- J2-3: Ground



Connections for 4-20 MA option

2.1.3 Connections for PWM Eavesdrop

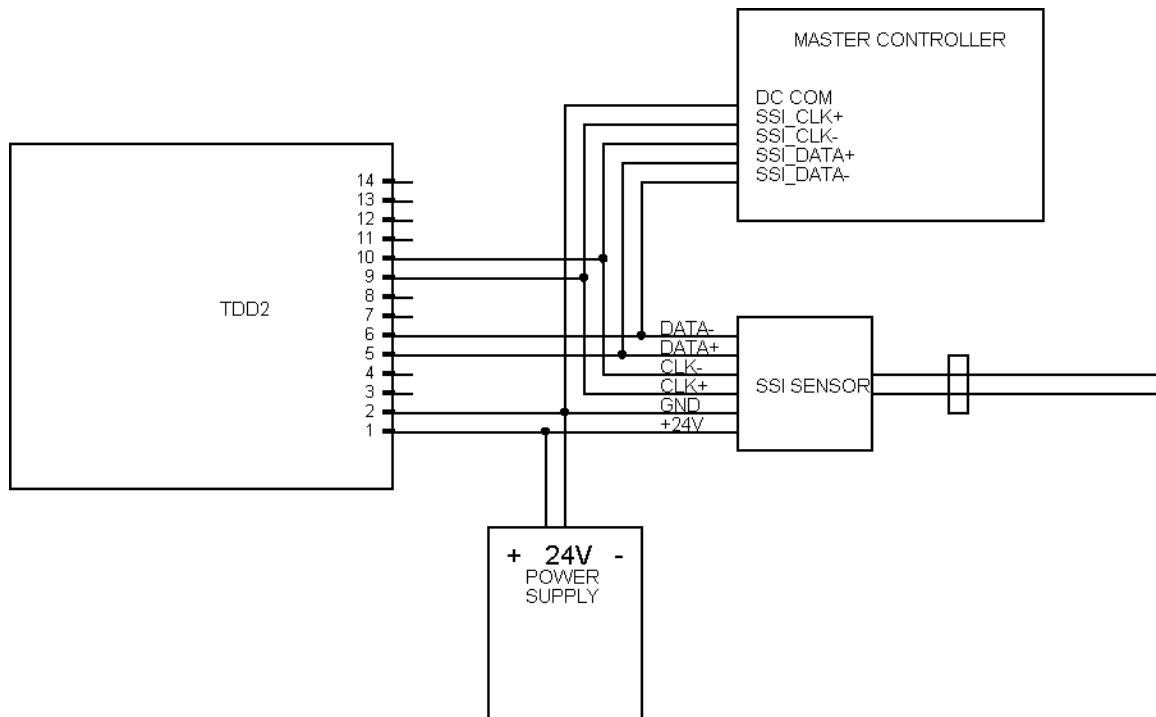


2.1.4 Connections for Externally Interrogated SSI

When using the TDD2 with an SSI sensor that is interrogated by another device, the SSI Clock signals must be connected to the SSI Chip Select pins of the transducer connector. The proper connections for an externally interrogated SSI sensor are shown below.

Pin	Description
1	+24V DC
2	Ground
3	No Connection
4	No Connection
5	SSI Data + Input
6	SSI Data - Input
7	Digital Input 0
8	Digital Input 1
9	SSI Clock + Input
10	SSI Clock - Input
11	Analog Output Common
12	Analog Output
13	Can High
14	Can Low

Table 4: Sensor Connections with Externally Interrogated SSI



2.2 MTS Multi-Magnet CANbus sensor requirements

MTS Multi-Magnet sensors that are used with the TDD2 should be ordered with the correct number of magnets so that the factory sets the magnets parameter correctly. For all TDD2's with software dated before Feb 18th of 2006 the sensor must be programmed at the factory with a Position ID of 100 and the number of magnets set to the desired value and at least 3. The serial number must be entered correctly.

For TDD2's with software dated Feb 18 2006 or later, the TDD2 will automatically work with any node id and position id and will reprogram the number of magnets parameter if it is less than the desired value (Set in the 'AGNETS' parameter in the 'TSNDCR' menu section) At power on the TDD2 scans all node id's from 0 to 100 to find the sensor. The serial number parameter is not required unless the node id is not with the range of 0 to 100

3 Display Operation

3.1 Startup

When power is applied, the unit will begin with a LED segment test, followed by the software date, which is displayed for 2 seconds. Next, saved configuration settings are loaded from the non-volatile EEPROM. By default, the TDD2 attempts to detect a MTS G-Series sensor and displays “GSErIE” if one is found (see section 4.3.1 for information on sensor auto-detection). The display then begins normal operation: interrogating the transducer and displaying the returned position on the LED display.

3.2 Normal Operation

During normal operation, the sensor is interrogated for magnet position information once every 5-milliseconds. The display is updated with new position information at the user defined display update rate.

An interactive front-panel setup menu can be entered during normal operation. Position updates continue during use of the setup menu.

3.2.1 Error Messages

If an error condition is detected during normal operation, an error message will be displayed in lieu of the position. Table 5 shows the possible error messages.

Error Condition	Displayed Error Message
No Error	Position Displayed
Working transducer, no magnet	[----]
No transducer or magnet	Err 01

Table 5: Error Messages

3.3 The Front Panel

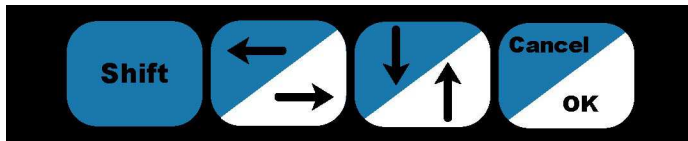


Figure 1: The Front Panel Switches

The front panel has four switches labeled (left to right): ‘Shift’, ‘Right/Left’, ‘Up/Down’, and ‘OK/Cancel’. Figure 1 shows the layout of the switches. These switches are used for operator control of the display and navigation of the front panel menu. The

Right/Left, Up/Down, and OK/Cancel switches each have two functions, depending on whether the Shift switch is pressed at the same time. Error: Reference source not found6 shows the key press resulting from pressing the switches with and without the Shift switch.

In this manual, a reference to a full switch name, such as “the OK/Cancel switch,” refers to the switch itself. A reference to a keypress, such as “the Down key,” refers to the action required to activate that key press (pressing the Shift switch and the Up/Down switch).

	Right/Left	Up/Down	OK/Cancel
Output Without Shift	Right	Up	OK
Output With Shift	Left	Down	Cancel

Table 6: Shifted Switch Output

3.3.1 Entering the Front Panel Menu

Pressing and holding the Right/Left and Up/Down switches simultaneously for 2 seconds enters the front panel menu. See section 3.3.3 for information on navigating the menu and section 4 for information on setup items available in the front panel menu.

3.3.2 Front Panel Actions

The front panel switches can be configured to perform an action when pressed. Actions can be configured to occur when the Right, Left, Up, Down, OK, or Cancel switches are pressed momentarily or held for 2 seconds. Section 4.8 lists the available actions.

3.3.3 Navigating the Front Panel Menu

The front panel menu allows setup of the configuration values listed in section 4 of this document. Press and hold the Right/Left and Up/Down switches simultaneously for 2 seconds to enter the menu.

Use the Right and Left keys to navigate the items in the menu. The OK key is used to select an item, and the Cancel key is used to go back to the previously selected item.

Most top-level items are categories containing sub-items. Pressing OK selects a category and then displays the first sub-item. These sub-items can then be navigated using the Right and Left keys. Pressing Cancel will return to the list of categories. Pressing Cancel again will exit the front panel menu.

Pressing OK when a setup item is displayed to edit the value of that item. Instructions for editing each type of item follow.

3.3.3.1 Editing List Items

After pressing OK, the current setting of the list item will be displayed. Press Up and Down to cycle through the other options available. When the desired item is displayed, press OK to keep this setting and return to the list of sub-items. Press Cancel at any time to abandon any changes made during this edit and return to the list of sub-items.

3.3.3.2 Editing Integer Items

After pressing OK, the current setting of the integer item will be displayed. One digit will be blinking – this is the active digit. Pressing Left or Right will change the current active digit. Press Up to increment the active digit and press Down to decrement the active digit.

3.3.3.3 Editing Floating Point Items

After pressing OK, the current setting of the floating point item will be displayed, with one digit blinking – the active digit. The value is formatted to have 6 digits before the decimal point and 5 digits after the decimal point. The 11 digits cannot be displayed at the same time, so only a portion of the value is shown at one time. The value 12.5 is shown in Figure 2a, where the box indicates the digits that are visible on the display. If the active digit is not the leftmost digit of the number, but is the leftmost digit of the display, and Left is pressed, the digits shown on the display will shift to the left. The transition between Figures 2a and 2b shows this shift to the left. Likewise, if the active digit is not the rightmost digit of the number, is the rightmost digit of the display, and Right is pressed, the digits on the display will shift to the right. The transition between Figures 2a and 2c show this shift to the right.

Pressing Up will increment the selected digit. Pressing Down will decrement the selected digit. If the value is decremented below 0, the value will become negative.

When the desired value is displayed, press OK to keep this setting and return to the list of sub-items. Press Cancel at any time to abandon any changes made during this edit and return to the list of sub-items.

Note: The TDD2 stores floating point values in 32-bit IEEE format. This allows for 7 decimal digits of precision. If a very large value is being edited, the smallest digits may not maintain the exact value entered.

3.3.3.4 Editing Hexadecimal Integers

The hexadecimal integers involved in configuration of the TDD2 are always 32-bits long, and take 8 digits to display. Because the 8 digits cannot be displayed at the same time, only a portion of the value is shown at one time. Shifting which digits are displayed is the same as editing a floating-point value (see

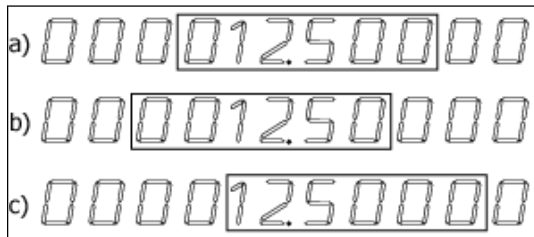


Figure 2: Editing a Floating Point Value

section 3.3.3.3), and is performed by pressing Left or Right when the active digit is the left or rightmost digit of the display.

Pressing Up will increment the selected digit and pressing Down will decrement the selected digit.

When the desired value is displayed, press OK to keep this setting and return to the list of sub-items. Press Cancel at any time to abandon any changes made during this edit and return to the list of sub-items.

3.4 Numerical Output

The position of a single magnet is determined by Equation 1. This is the formula used when the display mode is set to single. For more information on the possible display modes, see section 4.2.7, Display Mode.

$$P = C \cdot R \cdot S \cdot D - O_H - O_S - O_M$$

Equation 1: Calculation of position for a single magnet

Where:

P is the displayed position in units

C is the raw count received from the sensor

R is the resolution of one count from the sensor in units (calculated automatically from the gradient for Start/Stop and PWM sensors)

S is the scale

D is +1 if the direction sense is positive, and -1 if the direction sense is negative

O_H is the hard offset

O_S is the soft offset

And

O_M is the offset specific to the magnet

When two magnet positions are used to determine the displayed position (relative or gap mode; see section 4.2.7), the individual magnet positions are determined by Equation 1, and are combined according to Equation 2 (relative mode) and Equation 3 (gap mode).

$$P_F = P_D - P_R$$

Equation 2: Calculation of position in relative mode

$$P_F = P_{G+1} - P_G$$

Equation 3: Calculation of position in gap mode

Where

P_F is the final displayed position that is based on two magnet positions

P_D is the calculated position of the displayed magnet (as determined by Equation 1)

P_R is the calculated position of the reference magnet (as determined by Equation 1)

P_{G+1} is the calculated position of the magnet numbered one higher than the gap (see Equation 1)

P_G is the calculated position of the magnet with the same number as the gap (see Equation 1)

4 Display Configuration Values

The TDD2 stores the displays configuration values in a non-volatile EEPROM. Values that are changed via the front panel menu are not saved to the EEPROM until the user specifically requests they be saved (see section 5.11). Zeroing the display (sections 4.7 and 4.8) will save the offset values to the EEPROM immediately.

The display has a large set of parameters controlling its operation. The following is a comprehensive list of settings, by category. For information on changing these settings via the front panel, see section 3.34.9.1. For information on changing these settings via the RS-232/485 interface, see section 7.

4.1 Display Settings

The following setup items affect how the unit displays position values. These settings do not change the operation of the TDD2 other than the appearance of the displayed value.

4.1.1 Decimal Places

The number of digits displayed after the decimal point can be configured to a value between 0 and 5. By default, 3 digits are displayed after the decimal point.

4.1.2 Display Update Rate

The display can be configured to update at a user-configured rate. This value can vary between 1 and 60 Hz. By default, the display is updated 25 times per second.

4.1.3 Leading Zeros Flag

The display can be configured to display or hide leading zeros. This option is either ON or OFF. By default, leading zeros are not displayed.

4.1.4 Fractional Display Mode

The display can be configured to output the displayed value as a whole number and fraction instead of displaying a decimal representation. This allows the operator to monitor position change using familiar units, such as 32^{nds} of an inch. When fractional display mode is enabled, the numerator of a fraction is displayed after the decimal point. The denominator is not displayed – it is assumed to be known by the operator. Possible denominators are 2, 4, 8, 16, 32, 64, 128, 256, or 512.

The *decimal places* configuration item controls the width of the displayed numerator. By default, 3 digits are used for the numerator display.

4.1.5 Peak Read Display Mode

The display can be configured to track and display the largest or smallest value received from the sensor. This value can be reset to the current position at any time via serial command, button press, or digital input activation.

4.2 Position Settings

The following setup items affect how the TDD2 calculates the displayed position from the sensor output.

4.2.1 Units

The display provides with the following units: inches, feet, millimeters, centimeters, and meters. If another unit choice is desired, it may be derived from one of the five basic units by using a scale value.

Changing the current units setting will affect most floating-point configuration values of the TDD2. This can be used to enter values in alternate units. Simply select the alternate units, change one or more settings, and change the units back to the normally desired units setting. The configuration value changed will automatically be converted to the new units.

The default unit is inches.

4.2.2 Resolution

The resolution of the sensor is the value of one raw count (see section 3.4). Match the entered resolution with the resolution of the SSI or CANbus sensor as programmed at the factory. If the sensor resolution is given in different units than you wish to use for display, it is possible to change the units temporarily while entering the resolution – this can be helpful when entering a resolution in mm but displaying position in inches. The default resolution is 0.005 mm (0.000197 inches).

4.2.3 Scale

The position data from the sensor is multiplied by the scale before it is used (see section 3.4). This feature can be used to display position in units that are not natively supported by the TDD2, such as feet or meters. The default scale is 1.0.

4.2.4 Hard Offset

The hard offset is subtracted from the position before it is displayed (see section 3.4). This value can be used to correct a constant error in position or to “zero” the display. To “zero” the display manually, set the offset to 0.0, move the magnet to the desired zero location, and set the offset to the position displayed at that point. The same display zeroing effect can be achieved directly from the front panel (see section 4.8). The default offset is 0.0 units.

4.2.5 Soft Offset

An additional offset is subtracted from the position before it is displayed (see section 3.4). This value is never saved to the EEPROM. It is intended to allow the operator to zero the display without removing an offset that is preconfigured.

4.2.6 Direction Sense

Position information from the transducer is treated as increasing from zero if the direction sense is positive. If the direction sense is negative, position information from the transducer is treated as decreasing from zero. More information on how the direction sense mathematically effects the displayed position can be found in section 3.4.

For example, with a positive direction sense, a raw position of 5000 counts read from the transducer is interpreted as +5000; with a negative direction sense it is interpreted as –5000.

Combining a negative direction sense and an offset allows the operator to reverse the physical locations of the smallest and largest positions. For example, if the maximum position output from the transducer is 20.0 inches, setting the offset to –20.0 inches and the direction sense to negative will cause the display to read 20.0 inches where it initially read 0.0 inches, and to decrease to 0.0 inches at the point where it initially read 20.0 inches.

The default direction sense is positive.

4.2.7 Display Mode

The display mode controls what position is displayed. The simplest and default display mode is single mode. In single mode, the position of a specific magnet with respect to the head of the transducer is shown. The other two display modes, Gap and Relative, display the position between two magnets.

In Single mode, the position of the displayed magnet is displayed.

Gap mode displays the distance between to adjacent magnets, selected with the *displayed gap* configuration value. Gap 1 shows the distance from magnet 1 to magnet 2. Gap 2 shows the distance from magnet 2 to magnet 3.

Relative mode displays the distance between two magnets, the *displayed magnet* and the *reference magnet*.

See section 3.4 for information on how the displayed position is calculated.

4.2.8 Displayed Magnet

When the display mode is set to single, the position of the displayed magnet is shown. If the display mode is set to relative, the position of the reference magnet is subtracted from the displayed magnet.

4.2.9 Displayed Gap

The *displayed gap* is used when the display mode is set to *gap*, and indicates an adjacent set of magnets. Examples: Gap 1 is the distance between magnets 1 and 2, Gap 4 is the distance between magnets 4 and 5.

4.2.10 Single-Magnet Fallback

If the display mode is set to Gap or Relative, the display will normally show a no magnet error if only 1 magnet is detected. However, changing the Single-Magnet Fallback setting to 'Yes' will cause the TDD2 to act as if the display mode was set to Single when only one magnet is present.

4.2.11 Reference Magnet

The position of the reference magnet is subtracted from the position of the displayed magnet in relative mode. In any other display mode, this has no effect.

4.2.12 Per Magnet Offsets

Each magnet can have a unique offset, in addition to the shared hard and soft offsets. See section 3.4 for information on how position is calculated.

4.3 Transducer Settings

Transducer settings configure the interface to the sensor.

4.3.1 Transducer Auto-Detection

The TDD2 supports three auto-detection modes: G-Series, Standard, and Off. The G-Series auto-detection is able to detect MTS G-Series transducers. At startup, the TDD2 will automatically detect if a G-Series transducer is attached and obtain the transducer type (Start/Stop, PWM), gradient, and number of recirculations directly from the sensor. If a G-Series sensor is not detected, operation will continue as if the auto-detection mode was set to none.

The Standard auto-detection is able to detect non-G-Series PWM and Start/Stop protocol transducers. At startup or when no transducer is detected, the TDD2 will detect and change the transducer type setting to the type of transducer attached. The position will then display normally. If the TDD2 loses connection to the sensor, auto-detecting will begin again.

Setting auto-detection to Off disables the auto-detection features of the TDD2.

Parameters changed due to auto-detection are not saved automatically, and if it is desired to retain the settings (i.e. if auto-detection will be turned off), they must be saved manually. The default auto-detection mode is G-Series, but will not hinder normal operation if a G-Series transducer is not found.

4.3.2 Transducer Type

The transducer type is the type of sensor that is currently being interrogated. The TDD2 can support PWM, Start/Stop, MTS CANbus protocol, SSI Binary, SSI Gray Code, and externally interrogated SSI binary output sensors. SSI Binary transducers output position data in binary format with the most significant bit first. SSI Gray code transducers output position information using a binary reflected Gray code in which all adjacent numbers differ by only one bit. The default transducer type is SSI Binary.

4.3.3 Number of Magnets

CANbus and Start/Stop transducers can return position information for more than one magnet. For these types of sensors, the number of magnets configuration value determines the expected number of magnets on the transducer. For other types of sensors, this value should be set to 1. The default number of magnets is 1.

4.3.4 SSI Word Length

If a SSI sensor is selected, the number of bits of data transferred from the sensor can be configured. Most magnetostrictive transducers provide 24 or 25 bits of position information, but values from 8 to 32 bits are supported by the TDD2. If this number is not set correctly, the apparent resolution of the sensor will be halved for each bit that is ignored; the resolution will appear to double for each bit that is interpreted by the TDD2 but not output by the sensor. The default word length is 24 bits.

4.3.5 SSI Error Value and Error Mask

SSI sensors from different manufacturers can have different ways of indicating an error condition (usually a “no magnet” error). Because only one type of data (the position) can be returned from a SSI sensors, the sensor indicates an error by varying some aspect of the position data it returns.

The SSI Error Value and Error Mask combine to provide versatile SSI error condition detection. The raw position data retrieved from the sensor is bit-wise ANDed with the SSI Error Mask and compared to the SSI Error Value. If the masked position is equal to the Error Value, a missing magnet condition is reported (see section 3.2.1). Only least-significant bits of the SSI Error Value are used for this comparison. The number of bits defined by the SSI Word Length (section 4.3.4) are compared to the SSI Error Value; the remaining bits of the SSI Error Value are ignored.

Examples:

The most common value for SSI sensors to output in the event of an error is 0. To detect this value, the error output mask is set to FFFFFFFFh, and the error output is set to 00000000h. This setting will report an error only when a position of 0 is returned from the sensor. This is the default setting for the SSI Error Value and Error Mask.

Another common error condition output is to set a certain bit of the position output active when an error occurs. If a sensor sets bit 21 (the 22nd bit) active when an error occurs, both the error output mask and the error output value are set to 00200000h. This setting will report an error anytime bit 21 is active, regardless of the state of the other data bits.

4.3.6 Gradient

When using a PWM or Start/Stop transducer, the gradient must be programmed into the TDD. The gradient is a measurement of the speed of the sonic pulse within the transducer waveguide and is printed on the can of the transducer. Failure to enter this value will cause incorrect position display.

4.3.7 Start/Stop Holdoff Period

A Start/Stop transducer returns one pulse per magnet installed on the transducer. The minimum time that must elapse before the first pulse is received can be configured. If you are working with a non-standard null and are seeing a “No Magnet” error when the magnet is moved close to the head of the transducer, lower this value. The default holdoff period is 20ms.

4.3.8 CANbus Baud Rate

The CANbus interface can be configured to operate at 125, 250, 500 or 1000 kb/s. The default baud rate is 500kbps.

4.3.9 CANbus Transducer Serial Number

A CANbus transducer’s serial number is used to identify the transducer. This number must be entered before a CANbus transducer can be communicated with.

4.3.10 Plausibility Filtering

Plausibility filtering will detect values far outside the normal range of valid positions and hide them. This allows the TDD2 to display stable positions from sensors that occasionally return bad data. A setting of zero will disable plausibility filtering. For values greater than zero, a position is considered invalid if it is more than 100 times the setting different than the previous reading. For example, a setting of 100 will cause readings more than 10,000 counts different than the previous reading to be considered invalid. The default plausibility filter level is 50.

4.3.11 SSI Shift Right ($Ln5dCr \rightarrow SSI\ 5Hr$)

The output data word can be shifted right before it is used. This can be used to isolate the sensor data if the least significant bits of the SSI data word are flags or other undesired information. By default the data word is shifted by 0 bits (no shifting occurs). Shifting right by n bits is equivalent to dividing the data word by 2^n and truncating the result to be an integer.

4.3.12 SSI Clock Frequency (EN5dCr → 55i 5Pd)

The TDD2 will output an SSI clock with a frequency of 178kHz by default. This speed is slow enough to accommodate most cabling situations, but when using a very long cable it may be necessary to use a slower SSI clock. The SSI clock speed can be reduced to 100kHz, 75kHz, 50kHz, or 40kHz.

4.4 Digital Output Settings (Optional)

The Digital Outputs menu item (di 90Ue) will only appear if a 1- or 5-channel limit switch daughter board is installed in the TDD2. When this menu appears, the digital outputs (limit switch outputs) of the TDD2 can be configured to turn on and off based on the displayed position or one of the magnets in a multi-magnet system. Each of the five outputs is configured independently. Each output has a low position bound and a high position bound, which delineate the position range where the output is active. Each output can be configured to be active when the selected position source is inside the bounds or when the selected position source is outside the bounds.

A position is considered inside the position bounds when the position is equal to or greater than the smaller position bound and less than or equal to the larger position bound. A position is considered to be outside the bounds when the position is less than the smaller position bound or greater than the larger position bound.

4.4.1 Digital Output Lower Bound (one per digital output)

Each digital output has a lower bound that defines one side of the range of positions where the output will be active. The “Lower” bound is the smaller position of the two bounds. A position that is greater than or equal to the lower bound and less than or equal to the upper bound will be considered inside the position range for the digital output.

4.4.2 Digital Output Upper Bound (one per digital output)

Each digital output has an upper bound that defines one side of the range of positions where the output will be active. The “Upper” bound is the larger position of the two bounds. A position that is less than or equal to the upper bound and greater than or equal to the lower bound will be considered inside the position range for the digital output.

4.4.3 Digital Output Position Source (one per digital output)

Each digital output has a position source setting that defines the source of the positions that will be compared with the position bounds. The position source can either be the displayed position (however the currently displayed position is determined), or the position from a particular magnet in a multiple-magnet configuration. The position source setting can be set to an integer from 0 to 15. A value of 0 indicates that this digital output will be based on the displayed position. A value of 1 to 15 causes the digital output to be controlled by the position of magnet 1 to 15. All applicable offsets and scaling is performed for any position used for the digital output calculations.

PS Value	Controlling position
0	Displayed position
1	Magnet 1
2	Magnet 2
3	Magnet 3
4	Magnet 4
5	Magnet 5
6	Magnet 6
7	Magnet 7
8	Magnet 8
9	Magnet 9
10	Magnet 10
11	Magnet 11
12	Magnet 12
13	Magnet 13

14	Magnet 14
15	Magnet 15

4.4.4 Digital Output Active Flag

Each digital output can be configured to be active when the position is inside the bounds or outside the bounds. If the active flag is set to 'INSIDE', the output will be active when positions are inside the bounds. If the active flag is set to 'OUTSIDE', the output will be active when positions are outside the bounds.

4.5 Presets

Four Preset registers are provided, that can be accessed by special functions of the TDD2 display. Each preset is a floating point value with units. The Preset registers can be loaded or read depending on the action. Internal functions can perform math on the presets or use the presets as inputs to mathematical functions. See sections 4.7 and 4.8 for more information.

4.6 Analog Output Settings

The analog output of the TDD2 can be configured to follow the velocity or position. It can also be forced to a desired level. Analog options are only available on TDD2 models containing analog output hardware.

4.6.1 Voltage Range

The TDD2 can be set to output analog voltages in several ranges: 0 to 5V, 0 to 10V, -5 to 5V, -10 to 10V, -2.5 to 2.5V, and -2.5 to 7V. The default range is 0 to 10V.

4.6.2 Analog Source Data

The analog output subsystem can be controlled by several sources of data. The output can be forced to a certain level, the output can be based on the current displayed position, or the output can be based on the current velocity.

When position is used as the source data, the analog output voltage will be based on the displayed position within a range (see section 4.6.4), beginning at the analog start position (see section 4.6.3).

If the analog source data is velocity, the output voltage is 50% of maximum when the velocity is 0 units/second. The output voltage will be at maximum when the velocity is equal to the analog range (see section 4.6.4), and the voltage will be at the minimum then the velocity equal to minus analog range.

4.6.3 Analog Start

When the analog output is controlled by position information, this value is the position where analog voltage will be the minimum. Any position smaller than this value will also result in minimum analog voltage.

When the analog output is controlled by velocity information, this value is the velocity where analog voltage will be at the midpoint between the minimum and maximum.

This setting has no effect when the analog source is forced.

4.6.4 Analog Range

The analog range controls the range the analog output spans. It is valid when the analog output data source is position or velocity, although the meaning is slightly different.

When the analog source data is position, the analog range is the number of units between the analog start and the position causing maximum analog output. For example, if the analog output voltage range is 0-10V, analog start is 5 inches, and analog range is 10 inches, then a position of 5 inches would cause an output of 0V, a position of 10 inches would cause an output of 5V, and a position of 15 inches would cause an output of 10V.

When the analog source data is velocity, the analog range is the number of units per second of velocity that causes the minimum or maximum voltage to be output (recall that 0.0 units/second results in 50% of maximum voltage). For example, if the analog range is 20 and the voltage range is -10 to 10V, a velocity of -10 units/second would result in a voltage of -5V and a velocity of 15 units/second would result in a voltage of 7.5V.

This setting has no effect when the analog source data is forced.

4.6.5 Force Percentage

When the analog source data is set to forced, the analog output voltage is controlled by the force percentage configuration value. It indicates the percentage of analog full scale to output. For example, if the analog output range is -10 to 10V , a force percentage of 35.4 will cause an output voltage of -2.92V .

This setting has no effect when the analog source data is position or velocity.

4.7 Digital Input Actions

The two digital inputs (Digital In 0 and Digital In 1) can be configured take a specific action when activated. An input action can be set for each input. The input action is a number corresponding to the action performed by the TDD2. Table 7 shows the available actions.

Action Number	Action Performed
0	No Action (Input disabled) Factory Default
1	Increment displayed magnet
2	Decrement displayed magnet
3	Increment gap
4	Decrement gap
5	Increment reference magnet
6	Decrement reference magnet
7	Zero the position by setting the hard offset
8	Zero the position by setting the soft offset
9	Send the current position over the RS-232/485 interface
10	Stop display updates and "hold" the current position.
11	Disable access to the front panel menu
12	Increment the current transducer type
13	Decrement the current transducer type
14	Increment Hard Offset by Preset 1 amount
15	Increment Hard Offset by Preset 2 amount
16	Increment Hard Offset by Preset 3 amount
17	Increment Hard Offset by Preset 4 amount
18	Increment Soft Offset by Preset 1 amount
19	Increment Soft Offset by Preset 2 amount
20	Increment Soft Offset by Preset 3 amount
21	Increment Soft Offset by Preset 4 amount
22	Change hard offset in order to "zero" position to preset 1
23	Change hard offset in order to "zero" position to preset 2
24	Change hard offset in order to "zero" position to preset 3
25	Change hard offset in order to "zero" position to preset 4
26	Change soft offset in order to "zero" position to preset 1
27	Change soft offset in order to "zero" position to preset 2
28	Change soft offset in order to "zero" position to preset 3
29	Change soft offset in order to "zero" position to preset 4
30	Set hard offset to value of Preset 1
31	Set hard offset to value of Preset 2
32	Set hard offset to value of Preset 3
33	Set hard offset to value of Preset 4
34	Set soft offset to value of Preset 1
35	Set soft offset to value of Preset 2
36	Set soft offset to value of Preset 3
37	Set soft offset to value of Preset 4
38	Set Preset 1 to the displayed position value
39	Set Preset 2 to the displayed position value
40	Set Preset 3 to the displayed position value
41	Set Preset 4 to the displayed position value
42	Increment multi-magnet display mode
43	Set magnet offset 1 to preset 1 and magnet offset 3 to preset 2

44	Set magnet offset 1 to preset 3 and magnet offset 3 to preset 4
45	Enable peak display mode
46	Disable peak display mode
47	Toggle peak display mode
48	Clear peak reading
49	Toggle peak display mode and clear peak reading when toggled to enable
50	Enable peak display mode and clear peak reading
51	When in gap mode, zeroes the current gap by clearing all per-magnet offsets and setting the per-magnet offset for the 2nd magnet in the gap.

Table 7: Digital Input Actions

4.8 Front Panel Actions

The front panel switches can be programmed to perform actions when they are pressed (Tap) or held for 2 seconds. These are similar to the input actions defined in 4.7. Front panel actions may be used even if the front panel menu has been disabled.

Action Number	Action Performed
0	No Action (Input disabled)
1	Increment displayed magnet
2	Decrement displayed magnet
3	Increment gap
4	Decrement gap
5	Increment reference magnet
6	Decrement reference magnet
7	Zero the position by setting the hard offset
8	Zero the position by setting the soft offset
9	Send the current position over the RS-232/485 interface
10	Stop display updates and "hold" the current position.
11	Increment the current transducer type
12	Decrement the current transducer type
13	Increment Hard Offset by Preset 1 amount
14	Increment Hard Offset by Preset 2 amount
15	Increment Hard Offset by Preset 3 amount
16	Increment Hard Offset by Preset 4 amount
17	Increment Soft Offset by Preset 1 amount
18	Increment Soft Offset by Preset 2 amount
19	Increment Soft Offset by Preset 3 amount
20	Increment Soft Offset by Preset 4 amount
21	Change hard offset in order to "zero" position to preset 1
22	Change hard offset in order to "zero" position to preset 2
23	Change hard offset in order to "zero" position to preset 3
24	Change hard offset in order to "zero" position to preset 4
25	Change soft offset in order to "zero" position to preset 1
26	Change soft offset in order to "zero" position to preset 2
27	Change soft offset in order to "zero" position to preset 3
28	Change soft offset in order to "zero" position to preset 4
29	Set hard offset to value of Preset 1
30	Set hard offset to value of Preset 2
31	Set hard offset to value of Preset 3
32	Set hard offset to value of Preset 4
33	Set soft offset to value of Preset 1

34	Set soft offset to value of Preset 2
35	Set soft offset to value of Preset 3
36	Set soft offset to value of Preset 4
37	Set Preset 1 to the displayed position value
38	Set Preset 2 to the displayed position value
39	Set Preset 3 to the displayed position value
40	Set Preset 4 to the displayed position value
41	Increment multi-magnet display mode
42	Set magnet offset 1 to preset 1 and magnet offset 3 to preset 2
43	Set magnet offset 1 to preset 3 and magnet offset 3 to preset 4
44	Enable peak display mode
45	Disable peak display mode
46	Toggle peak display mode
47	Clear peak reading
48	Toggle peak display mode and clear peak reading when toggled to enable
49	Enable peak display mode and clear peak reading
50	When in gap mode, zeroes the current gap by clearing all per-magnet offsets and setting the per-magnet offset for the 2nd magnet in the gap.

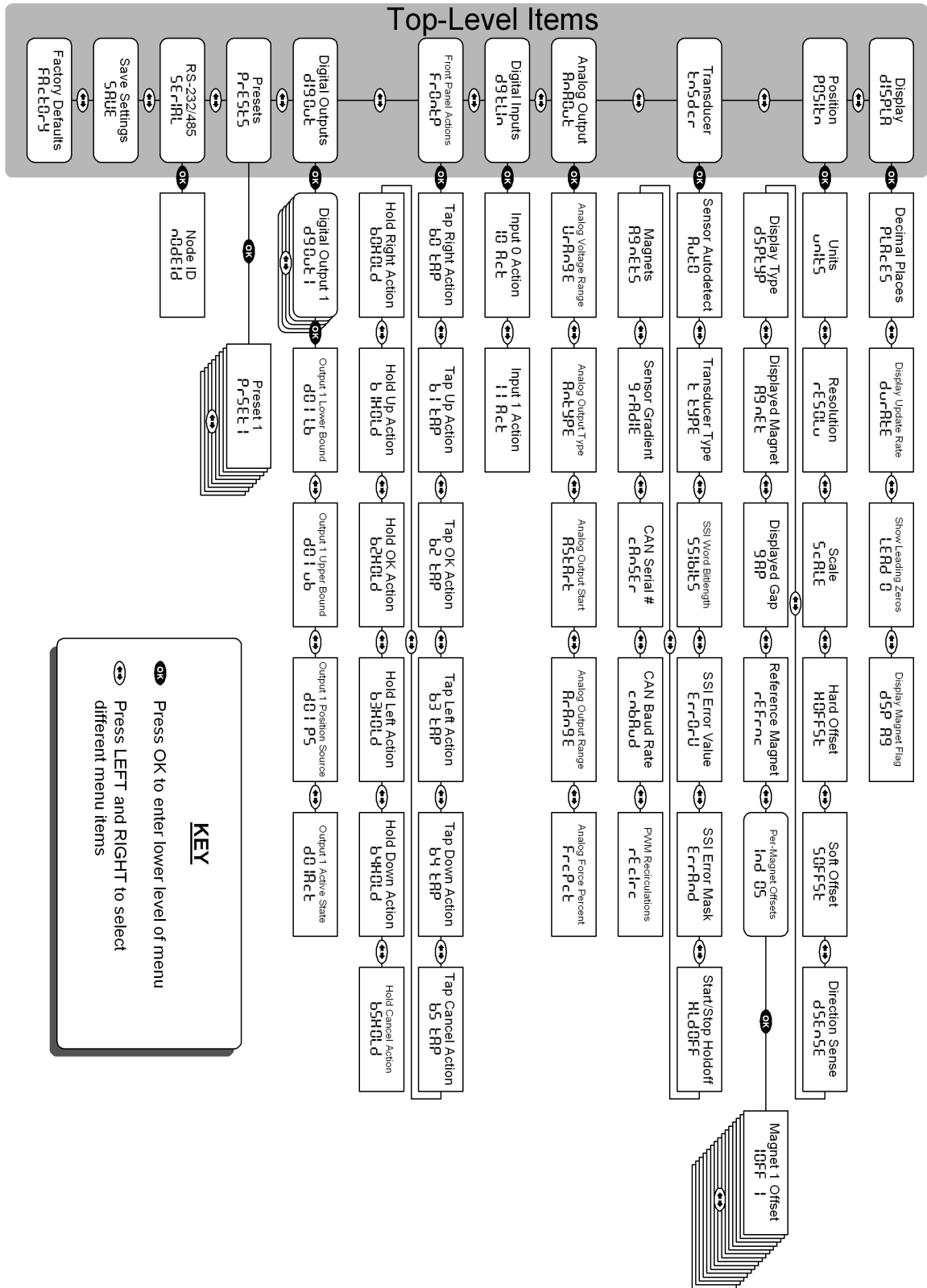
Table 8: Front Panel Switch Actions

4.9 Serial Settings

4.9.1 Node ID

The Node ID of the TDD2 is an identifier used to differentiate between multiple TDD2s. This only becomes an issue when RS-485 is used, and more than one TDD2 can be on the same serial link. The node ID can range from 1 to 9, and all TDD2s will respond to the node ID 0.

5 Front Panel Menu Setup Items



The front panel menu can be entered by pressing and holding the Right/Left and Up/Down switches simultaneously (see section 3.3.1). It consists of several top-level categories and configurable

setup items within those categories. Because the display of the TDD2 is limited, many of the setup items are abbreviated for display. A representation of the setup item as it appears on the TDD2 display is shown to the left of each setup item. Setup items that are selected from a list have the displayed representation shown in parenthesis in the “Possible Values” column.

Each section below contains information on a top-level item in the menu. The top-level categories are the display setup items, position setup items, and transducer setup items. The items to save the configuration data to the EEPROM and to reset the configuration data to factory defaults are also in the top-level of the menu.

Note that TDD2-ND models are not equipped with a keypad or display and cannot be configured using the front panel. You will need to use the serial interface to configure these displays.

5.1 Display Setup Items

di SPLA

These setup items affect the way the TDD2 displays position data. The available display setup items are discussed in section 4.1.

Displayed As	Item Name	Manual Section	Item Type	Possible Values	Default Setting
PLACES	Decimal Places	4.1.1	Integer	0 – 6 digits	3
dUrAtE	Display Update Rate	4.1.2	Integer	1 – 60 Hz	25
LEAd 0	Show Leading Zeros	4.1.3	List	No, Yes	No
dSP Ag	Display Magnet Number		List	No, Yes	No
FrCdSP	Fractional Display Enable	4.1.4	List	No, Yes	No
di ul 50	Fractional Display Divisor	4.1.4	List	2, 4, 8, 16, 32, 64, 128, 256, 512	16
PEA rd	Peak Read Submenu	4.1.5	Subitem List	N/A	N/A

Table 9: Display Setup Items

5.2 Peak Read Setup Items

PEA rd

These setup items affect the peak read system in the TDD2. This allows the display of the largest or smallest value received from the sensor since the peak reading was last cleared.

Displayed As	Item Name	Manual Section	Item Type	Possible Values	Default Setting
P TYPE	Peak Read Type	4.1.1	Integer	Positive(POS), Negative(NEG), Absolute(ABS)	Positive
ENABLE	Peak Read Enable Flag	4.1.2	List	No, Yes	No
CLEAR	Clear Peak Reading	4.1.3	Function	None	N/A

Table 10: Display Setup Items

5.3 Position Setup Items

POSITION

Position setup items affect how the TDD2 calculates a scaled and offset position value from the raw position read from the sensor. The available position setup items are listed in Table 10 and discussed in section 4.2.

Displayed As	Item Name	Manual Section	Item Type	Possible Values	Default Setting
Units	Position Units	4.2.1	List	Inches(INCHES), Feet (FEET), Millimeters(MILLI), Centimeters(CENTIMETERS), Meters(METERS)	Inches
RESOLUTION	Sensor Resolution	4.2.2	Floating Point	0.00001 – 1.000 units	0.005 mm
SCALE	Position Scale	4.2.3	Floating Point	0.00001 – 9.99999	1.00000
HDOFFSET	Hard Position Offset	4.2.4	Floating Point	-99999.99999 – 99999.99999	0.00000
SDOFFSET	Soft Position Offset	4.2.5	Floating Point	-99999.99999 – 99999.99999	0.00000
DSENSE	Direction Sense	4.2.6	List	Positive(POSITIVE), Negative(NEGATIVE)	Positive
DISPLAY	Display Mode	4.2.7	List	Single(SINGLE), Gap(GAP), Relative(RELATIVE)	Single
MAGNET	Displayed Magnet	4.2.8	Integer	1 – 15	1
GAP	Displayed Gap	4.2.9	Integer	1 – 14	1
FALLBACK	Single-Magnet Fallback	4.2.10	List	No, Yes	No
REFERENCE	Reference Magnet	4.2.11	Integer	1-15	1
1 OFF 1 through 1 OFF 15	Per Magnet Offsets	4.2.12	Floating Point	-99999.99999 – 99999.99999	0.00000

Table 11: Position Setup Items

5.4 Transducer Setup Items

Transducer

Transducer setup items configure the TDD2 to correctly interface with the transducer connected to it. The available transducer setup items are listed in Table 12 and discussed in section 4.3.

Displayed As	Item Name	Manual Section	Item Type	Possible Values	Default Setting
AUTO	Transducer Autodetect	4.3.1	List	Off (OFF), Standard (Standard), G-Series (G-Series)	G-Series
TYPE	Transducer Type	4.3.1	List	SSI Binary (SSI Binary), SSI Graycode (SSI Graycode), Start/Stop (Start/Stop), PWM (PWM), CANbus (CANbus)	SSI Binary
MAGNETS	Number of Magnets	4.3.3	Integer	1 – 15	1
SSI BITS	SSI Word Length	4.3.4	Floating Point	8 – 32 bits	24 bits
ERROR	SSI Error Value	4.3.5	Hexadecimal Integer	00000000 – FFFFFFFF	00000000
ERRMASK	SSI Error Mask	4.3.5	Hexadecimal Integer	00000000 – FFFFFFFF	FFFFFFFF
GRADIENT	Gradient	4.3.6	Floating Point	0.00001 – 99999.99999	9.00000
HLDOFF	Start/Stop Holdoff	4.3.7	Integer	1 – 250	20
CANBAUD	CANbus Baud	4.3.8	List	125kbps (125), 250kbps (250), 500kbps (500), 1000kbps (1000)	500 kbps
CANSERIAL	CANbus Serial #	4.3.9	Hexadecimal Integer	00000000 – FFFFFFFF	00000000
SSI SHIFTR	SSI Shift Right	4.3.11	Integer	0 – 31	0
SSI SPD	SSI Clock Frequency	4.3.11	List	178kHz (178H), 100kHz (100H), 75kHz (75H), 50kHz (50H), 40kHz (40H)	178kHz

Table 12: Transducer Setup Items

5.5 Digital Output Setup Items

dI 9OUT

Digital output setup items configure the Digital Limit Switch outputs. This menu item only appears if one of the optional limit switch daughter boards is mounted in the TDD2. Digital outputs are discussed in section 4.4.

Displayed As	Item Name	Manual Section	Item Type	Possible Values	Default Setting
d9OUT 1 through d9OUT 5	Each digital output has several options to be configured. Select this item to access the subitems.	4.4	Subitem List	N/A	None
dO 1 LB through dO 5 LB	Digital Output Lower Bound	4.4	Floating Point	-99999.99999 – 99999.99999	0.00000
dO 1 UB through dO 5 UB	Digital Output Upper Bound	4.4	Floating Point	-99999.99999 – 99999.99999	0.00000
dO 1 PS through dO 5 PS	Digital Output Position Source	4.4	Integer	0 through 15	0
dO IACT through dO 5 IACT	Digital Output Active Flag	4.4	List	Inside (INSIDE) or Outside (OUTSID)	Inside

Table 13: Digital Output Setup Items

5.6 Preset Setup Items

Displayed As	Item Name	Manual Section	Item Type	Possible Values	Default Setting
P-EST 1	Preset 1	4.5	Floating Point	-99999.99999 – 99999.99999	0.00000
P-EST 2	Preset 2	4.5	Floating Point	-99999.99999 – 99999.99999	0.00000
P-EST 3	Preset 3	4.5	Floating Point	-99999.99999 – 99999.99999	0.00000
P-EST 4	Preset 4	4.5	Floating Point	-99999.99999 – 99999.99999	0.00000

Table 14: Preset Setup Items

5.7 Analog Output Setup Items

AnAOut

Analog output setup items configure the TDD2's analog output system. The available setup items are discussed in section 4.6.

Displayed As	Item Name	Manual Section	Item Type	Possible Values	Default Setting
UrAnGE	Voltage Range	4.6.1	List	0 to 5V(Unl 5), 0 to 10V(Unl 10), -5 to 5V(bl 5), -10 to 10V(bl 10), -2.5 to 2.5V(bl 25), -2.5 to 7V(-25 7)	0 to 10V
AnType	Analog Source Data	4.6.2	List	Forced(FORCED), Position(POSITION), Velocity(VELOCITY)	Forced
AStArt	Analog Start	4.6.3	Floating Point	-99999.99999 – 99999.99999	0.00000
ArAnGE	Analog Range	4.6.4	Floating Point	-99999.99999 – 99999.99999	10.00000
FrCPct	Force Percentage	4.6.5	Floating Point	0.00 – 100.00	0.00

Table 15: Analog Output Setup Items

5.8 Digital Input Setup Items

dgTLIn

The digital input setup items are used to configure the actions performed when the digital inputs are active. See section 4.7 for a list of the possible actions.

Displayed As	Item Name	Manual Section	Item Type	Possible Values	Default Setting
I0 Act	Input 0 Action	4.7	Integer	See Section 4.7	0
I1 Act	Input 1 Action	4.7	Integer	See Section 4.7	0

Table 16: Digital Input Setup Items

5.9 Front Panel Setup Items

FRONT P

The front panel setup items are used to configure the actions performed when the front panel switches are pressed or held for two seconds. See section 4.8 for a list of possible actions.

Displayed As	Item Name	Manual Section	Item Type	Possible Actions	Default Setting
b0 TAP	Tap Right Action	4.8	Integer	See Section 4.8	0
b1 TAP	Tap Up Action	4.8	Integer	See Section 4.8	0
b2 TAP	Tap OK Action	4.8	Integer	See Section 4.8	0
b3 TAP	Tap Left Action	4.8	Integer	See Section 4.8	0
b4 TAP	Tap Down Action	4.8	Integer	See Section 4.8	0
b5 TAP	Tap Cancel Action	4.8	Integer	See Section 4.8	0
b0HOLD	Hold Right Action	4.8	Integer	See Section 4.8	0
b1HOLD	Hold Up Action	4.8	Integer	See Section 4.8	0
b2HOLD	Hold OK Action	4.8	Integer	See Section 4.8	0
b3HOLD	Hold Left Action	4.8	Integer	See Section 4.8	0
b4HOLD	Hold Down Action	4.8	Integer	See Section 4.8	0
b5HOLD	Hold Cancel Action	4.8	Integer	See Section 4.8	0

Table 17: Front Panel Setup Items

5.10 Serial Interface Setup Items

SERIAL

The serial setup items are used to configure the RS-232/485 interface. See section 4.9 for details on these settings.

Displayed As	Item Name	Manual Section	Item Type	Possible Values	Default Setting
nODEID	Node ID	4.9.1	Integer	1 – 9	1

Table 18: Serial Interface Setup Items

5.11 Save to EEPROM

SAVE

The Save to EEPROM menu item saves all TDD2 setup items to the nonvolatile EEPROM. Press OK while this item is displayed to save the configuration data.

5.12 Reset to Factory Defaults

FACTORY

The Reset to Factory Defaults menu item returns all TDD2 setup items to the default values. The settings are not stored in EEPROM until the Save to EEPROM menu item is activated (see section 5.11). Press OK while this item is displayed to reset the configuration data. See above for tables containing the default settings.

6 Troubleshooting

If you encounter a problem during the operation of the TDD2, consult Table 19 for information on the possible cause and solution. If you cannot solve the problem, please contact Rapid Controls for technical support.

Symptom	Possible Cause
Nothing is displayed	<p>Check that the display is powered correctly, as shown in section 2, Installation.</p> <p>If the TDD2 still does not display anything, contact Rapid Controls for further help.</p>
Err 0 is displayed	<p>Check that the correct transducer type is selected. See section 4.3.1.</p> <p>No transducer is connected or the transducer is wired incorrectly. Check that the transducer is connected as shown in section 2.1.</p>
[----] is displayed	<p>Check that the correct transducer type is selected. See section 4.3.1.</p> <p>Less magnets are installed than the selected displayed or reference magnet.</p> <p>The magnet is not close enough to the sensor or two magnets are too close together, or the magnet is on the null of the transducer.</p> <p>The SSI Error Value or SSI Error Mask are set incorrectly, causing the TDD2 to incorrectly detect a no magnet condition. Check that the SSI Error Value and SSI Error Mask (section 4.3.5) are set correctly.</p>
The position displayed is incorrect	<p>The Scale is set to the wrong value. Check that the Scale (section 4.2.3) is set correctly.</p> <p>One of the offsets (Hard Offset, Soft Offset, or Per-Magnet Offset) is set to the wrong value. Check that the Offset (section 4.2.4) is set correctly.</p> <p>The Units setting is incorrect. Check that the Units setting (section 4.2.1) is set to the desired engineering units.</p> <p>The Direction Sense is incorrect. Check that the Direction Sense (section 4.2.6) is set to positive if you do not wish to reverse the direction position increases.</p> <p>Please see below for more information on sensor-type specific problems.</p>
The position displayed for a SSI sensor is incorrect	<p>The SSI Word Length is wrong, causing the transducer to display a position a power of 2 smaller or larger than the correct position. Check that the SSI Word Length (section 4.3.4) is set to the same number of bits as the sensor.</p> <p>The Transducer Type is set to SSI gray code instead of SSI binary, or vice versa. Check that the Transducer Type (section 4.3.1) is set correctly.</p> <p>The resolution (section 4.2.2) is set incorrectly.</p>
The position displayed for a Start/Stop sensor is incorrect	<p>Check that the gradient (section 4.3.6) and number of magnets (section 4.3.3) have been set correctly.</p>
The position displayed for a PWM sensor is incorrect	<p>Check that the gradient (section 4.3.6) has been set correctly.</p> <p>If the transducer performs recirculation in the head, you must correct for this</p> $\frac{1}{\text{recirculations}}$ <p>by setting the scale to <i>recirculations</i>.</p>

Table 19: Troubleshooting

7 Serial Communications

The TDD2 can communicate with any device capable of RS-232 or RS-485 communications at 9600 or 19200 bps with 8-bit words, no parity bit, and 1 stop bit. A simple ASCII communications protocol is used.

Communications are always half duplex meaning that only one device, master or slave, transmits at a time. The master always sends a command and then the slave (TDD2) responds. The master must wait for the response before transmitting the next command.

All messages to the TDD2 must start with '\$' and the node ID of the TDD2. All good responses from the display start with '*'. All messages are terminated with a single carriage return – ASCII 13 (indicated by '<CR>' in the text). All commands are case sensitive.

The node ID of the display defaults to 1. This can be changed via the serial link or the front panel. All displays will respond to a node ID of 0 regardless of their own Node ID setting. When the TDD2 is used in a multi-drop serial configuration each TDD must have a unique Node ID from 1 to 9.

When setting configuration items that accept a string response (i.e. the transducer type), only enough of the string to differentiate it from all other acceptable choices needs to be sent.

7.1 TDD2 WinComm

The TDD2 WinComm software package is available to assist configuration of the TDD2 from a Windows PC. TDD2 WinComm communicates with a TDD2 via the serial interface and is able to set and read all of the setup items listed in this manual. Display configuration can also be saved to a file for later use. A copy of TDD2 WinComm may be downloaded free of charge from the Rapid Controls website: www.rapidcontrols.com.

A CD version of TDD2 WinComm is also available: contact Rapid Controls for information on purchasing TDD2 WinComm on CD with an accompanying serial cable.

7.2 Write protection

7.2.1 Write Enable

Turns off the write protection so that changes may be made. This command is required before most of the setup values can be changed. The write protection will remain off until power is cycled or the write protect command is issued.

Write Syntax:

`$<id>WE<CR>`

where:

id is the node id of the TDD2

7.2.2 Write Protect

Turns on the write protection so that any further changes are blocked.

Write Syntax:

`$<id>WP<CR>`

where:

id is the node id of the TDD2

7.3 Display Settings

7.3.1 Decimal Places

Reads or sets the number of displayed decimal places. See section 4.1.1 for information on this setting.

Read Syntax:

$\$<id>\mathbf{RdP}<CR>$

Write Syntax:

$\$<id>\mathbf{SdP}<d><CR>$

where:

id is the node id of the TDD2

and *d* is the number of decimal places

Examples:

To read the number of decimal places from a TDD2 with node id 1 send:

$\$1\mathbf{RdP}<CR>$

To set the number of displayed decimal places to 3 using a TDD2 with node id 4 send:

$\$4\mathbf{SdP}3<CR>$

7.3.2 Display Update Rate

Reads or sets the update rate of the display. See section 4.1.2 for information on this setting.

Read Syntax:

$\$<id>\mathbf{RdU}<CR>$

Write Syntax:

$\$<id>\mathbf{SdU}<r><CR>$

where:

id is the node id of the TDD2

and *r* is the update rate in Hz

Examples:

To read the display update rate from a TDD2 with unknown node id send:

$\$0\mathbf{RdU}<CR>$

To set the display update rate to 20 Hz using a TDD2 with node id 2 send:

$\$2\mathbf{SdU}20<CR>$

7.3.3 Leading Zeros Flag

Reads or sets the leading zeros flag. See section 4.1.3 for information on this setting.

Read Syntax:

$\$<id>\mathbf{RdZ}<CR>$

Write Syntax:

$\$<id>\mathbf{SdZ}<f><CR>$

where:

id is the node id of the TDD2
and *f* is the value of the flag, either “YES” or “NO”

Examples:

To read the state of the leading zeros flag from a TDD2 with node id 1 send:
\$1RdZ<CR>

To set the TDD2 to not display leading zeroes using node id 4 send:
\$4SdZNO<CR>

7.3.4 Enable Peak Display Flag

Reads or sets the enable peak display flag. Setting this flag to YES causes the display to show the peak position in place of the normally displayed position.

Read Syntax:

\$<*id*>RKE<CR>

Write Syntax:

\$<*id*>SKE<*f*><CR>

where:

id is the node id of the TDD2
and *f* is the value of the flag, either “YES” or “NO”

Examples:

To read the state of the enable peak display flag from a TDD2 with node id 1 send:
\$1RKE<CR>

To set the TDD2 to display the peak position using node id 4 send:
\$4SKEYES<CR>

7.3.5 Peak Display Mode

Reads or sets the mode used for peak position detection. The mode may be set to positive, negative, or absolute.

Read Syntax:

\$<*id*>RKM<CR>

Write Syntax:

\$<*id*>SKM<*m*><CR>

where:

id is the node id of the TDD2
and *m* is the desired mode, “POS”, “NEG”, “ABS”

Examples:

To read the currently used peak display mode from a TDD2 with node id 1 send:
\$1RKM<CR>

To set the peak display mode to positive using a TDD2 with node id 3 send:
\$3SKMPOS<CR>

7.3.6 Clear Peak Reading

Clears the current peak reading by setting the peak reading to the current position.

Write Syntax:

`$<id>SKC<CR>`

where:

id is the node id of the TDD2

7.4 Position Settings

7.4.1 Units

Reads or sets the unit used for display. See section 4.2.1 for information on this setting.

Read Syntax:

`$<id>RPU<CR>`

Write Syntax:

`$<id>SPU<u><CR>`

where:

id is the node id of the TDD2

and *u* is the desired units, “INCHES”, “FEET”, “MM”, “CM”, “METERS”

Examples:

To read the currently used units from a TDD2 with node id 1 send:

`$1RPU<CR>`

To set the displayed units to METERS using a TDD2 with node id 3 send:

`$3SPUMETERS<CR>`

7.4.2 Resolution

Reads or sets the resolution of the sensor. See section 4.2.2 for information on this setting.

Read Syntax:

`$<id>RPR<CR>`

Write Syntax:

`$<id>SPR<r><CR>`

where:

id is the node id of the TDD2

and *r* is the resolution in units

Examples:

To read the current resolution from a TDD2 with node id 7 send:

`$7RPR<CR>`

To set the resolution to 0.00001 units using a TDD2 with node id 1 send:

`$1SPR0.00001<CR>`

7.4.3 Scale

Reads or sets the scale. See section 4.2.3 for information on this setting.

Read Syntax:

$\$<id>\mathbf{RPS}<CR>$

Write Syntax:

$\$<id>\mathbf{SPS}<s><CR>$

where:

id is the node id of the TDD2

and *s* is the scale

Examples:

To read the scale from a TDD2 with unknown node id send:

$\$0\mathbf{RPS}<CR>$

To set the scale to 1.0 using a TDD2 with node id 6 send:

$\$6\mathbf{SPS}1<CR>$

7.4.4 Hard Offset

Reads or sets the hard offset. See section 4.2.4 for information on this setting.

Read Syntax:

$\$<id>\mathbf{RPO}<CR>$

Write Syntax:

$\$<id>\mathbf{SPO}<o><CR>$

where:

id is the node id of the TDD2

and *o* is the offset in units

Examples:

To read the hard offset from a TDD2 with node id 9 send:

$\$9\mathbf{RPO}<CR>$

To set the hard offset to 4.56 units using a TDD2 with node id 4 send:

$\$4\mathbf{SPO}4.56<CR>$

7.4.5 Soft Offset

Reads or sets the soft offset. See section 4.2.5 for information on this setting.

Read Syntax:

$\$<id>\mathbf{RPo}<CR>$

Write Syntax:

$\$<id>\mathbf{SPo}<o><CR>$

where:

id is the node id of the TDD2

and *o* is the soft offset in units

Examples:

To read the soft offset from a TDD2 with node id 5 send:

```
$5RPO<CR>
```

To set the soft offset to 2.335 units using a TDD2 with node id 7 send:

```
$7SPo2.335<CR>
```

7.4.6 Direction Sense

Reads or sets the number of displayed decimal places. See section 4.1.1 for information on this setting.

Read Syntax:

```
$<id>RPD<CR>
```

Write Syntax:

```
$<id>SPD<d><CR>
```

where:

id is the node id of the TDD2

and *d* is the direction sense, "POSITIVE" or "NEGATIVE"

Examples:

To read the direction sense from a TDD2 with unknown node id send:

```
$0RPD<CR>
```

To set the direction sense to positive using a TDD2 with node id 1 send:

```
$1SPDPOS<CR>
```

7.4.7 Display Mode

Reads or sets the display mode. See section 4.2.7 for information on this setting.

Read Syntax:

$\$<id>\mathbf{RXt}<CR>$

Write Syntax:

$\$<id>\mathbf{SXt}<m><CR>$

where:

id is the node id of the TDD2

and *m* is the display mode, “SINGLE”, “GAP”, or “RELATIVE”

Examples:

To read the display mode from a TDD2 with node id 2 send:

$\$2\mathbf{RXt}<CR>$

To set the display mode to gap using a TDD2 with node id 1 send:

$\$1\mathbf{SXtGAP}<CR>$

7.4.8 Displayed Magnet

Reads or sets the displayed magnet. See section 4.2.8 for information on this setting.

Read Syntax:

$\$<id>\mathbf{RXm}<CR>$

Write Syntax:

$\$<id>\mathbf{SXm}<m><CR>$

where:

id is the node id of the TDD2

and *m* is the displayed magnet

Examples:

To read the displayed magnet from a TDD2 with node id 1 send:

$\$1\mathbf{RXm}<CR>$

To set the displayed magnet to 6 using a TDD2 with node id 5 send:

$\$5\mathbf{SXm6}<CR>$

7.4.9 Displayed Gap

Reads or sets the displayed gap. See section 4.2.9 for information on this setting.

Read Syntax:

$\$<id>\mathbf{RXg}<CR>$

Write Syntax:

$\$<id>\mathbf{SXg}<g><CR>$

where:

id is the node id of the TDD2

and *g* is the displayed gap

Examples:

To read the displayed gap from a TDD2 with unknown node id send:

```
$0RXg<CR>
```

To set the displayed gap to 2 using a TDD2 with node id 3 send:

```
$3SXg2<CR>
```

7.4.10 Single-magnet Fallback

Controls the display if only one magnet is present and the display mode is set to Gap or Relative. If set to 'No', a missing magnet error will be reported. If set to 'Yes', position of the magnet will be displayed as if the TDD2 was configured for Single-Magnet mode. See section 4.2.10 for information on this setting.

Read Syntax:

```
$<id>RXf<CR>
```

Write Syntax:

```
$<id>SXf<g><CR>
```

where:

id is the node id of the TDD2

and *g* is "YES" or "NO"

Examples:

To read the current single-magnet fallback setting from a TDD2 with node id 1 send:

```
$1RXf<CR>
```

To enable single-magnet fallback using a TDD2 with node id 3 send:

```
$3SXfYES<CR>
```

7.4.11 Reference Magnet

Reads or sets the reference magnet. See section 4.2.11 for information on this setting.

Read Syntax:

```
$<id>RXr<CR>
```

Write Syntax:

```
$<id>SXr<r><CR>
```

where:

id is the node id of the TDD2

and *r* is the reference magnet

Examples:

To read the reference magnet from a TDD2 with node id 3 send:

```
$3RXr<CR>
```

To set the reference magnet to 1 using a TDD2 with node id 2 send:

```
$2SXr1<CR>
```

7.4.12 Per Magnet Offsets

Reads or sets a per magnet offset. See section 4.2.12 for information on this setting.

Read Syntax:

$\$<id>\mathbf{RPm}<n><CR>$

Write Syntax:

$\$<id>\mathbf{SPm}<n><o><CR>$

where:

id is the node id of the TDD2

n is the number of the magnet the offset corresponds to

and *o* is the offset in units

Examples:

To read the offset for magnet 3 from a TDD2 with node id 4 send:

$\$4\mathbf{RPm}3<CR>$

To set the offset for magnet 2 to 5.0 units using a TDD2 with node id 1 send:

$\$1\mathbf{SPm}25.0<CR>$

7.5 Transducer Settings

7.5.1 Transducer Auto Detection

Reads or sets the sensor auto-detection flag. If set to G-Series or Standard, the TDD2 will attempt to determine the type of sensor that is currently connected. See section 4.3.1 for information on this setting.

Read Syntax:

$\$<id>\mathbf{RXA}<CR>$

Write Syntax:

$\$<id>\mathbf{SXA}<f><CR>$

where:

id is the node id of the TDD2

and *f* is the value of the flag, either “OFF”, “STANDARD”, or “GSERIES”

Examples:

To read the state of the leading zeros flag from a TDD2 with node id 1 send:

$\$1\mathbf{RXA}<CR>$

To set the TDD2 to not display leading zeroes using node id 1 send:

$\$1\mathbf{SXAOFF}<CR>$

7.5.2 Transducer Type

Reads or sets the transducer type. See section 4.3.1 for information on this setting.

Read Syntax:

$\$<id>\mathbf{RXT}<CR>$

Write Syntax:

$\$<id>\mathbf{SXT}<t><CR>$

where:

id is the node id of the TDD2
 and *t* is the transducer type: “SSIBIN”, “SSIGRAY”, “STARTSTOP”, “PWM”, or
 “CANBUS”

Examples:

To read the transducer type from a TDD2 with node id 2 send:

\$2RXT<CR>

To set the transducer type to SSI Binary using a TDD2 with node id 1 send:

\$1SXTSSIBIN<CR>

7.5.3 Number of Magnets

Reads or sets the number of magnets. See section 4.3.3 for information on this setting.

Read Syntax:

\$<*id*>RXM<CR>

Write Syntax:

\$<*id*>SXM<*m*><CR>

where:

id is the node id of the TDD2

and *m* is the number of magnets

Examples:

To read the number of magnets from a TDD2 with node id 8 send:

\$8RXM<CR>

To set the number of displayed magnets to 12 using a TDD2 with node id 5 send:

\$5SXM12<CR>

7.5.4 SSI Word Length

Reads or sets the SSI word length. See section 4.3.4 for information on this setting.

Read Syntax:

\$<*id*>RXB<CR>

Write Syntax:

\$<*id*>SXB<*b*><CR>

where:

id is the node id of the TDD2

and *b* is the word length in bits

Examples:

To read the SSI word length from a TDD2 with node id 4 send:

\$4RXB<CR>

To set the SSI word length to 25 bits using a TDD2 with node id 2 send:

\$2SXB25<CR>

7.5.5 SSI Error Value

Reads or sets the SSI error value. See section 4.3.5 for information on this setting.

Read Syntax:

$\$<id>\mathbf{RXE}<CR>$

Write Syntax:

$\$<id>\mathbf{SXE}<e><CR>$

where:

id is the node id of the TDD2

and *e* is the SSI error value in hexadecimal

Examples:

To read the SSI error value from a TDD2 with node id 1 send:

$\$1\mathbf{RXE}<CR>$

To set the SSI error value to 0 using a TDD2 with node id 4 send:

$\$4\mathbf{SXE}00000000<CR>$

7.5.6 SSI Error Mask

Reads or sets the SSI error mask. See section 4.3.5 for information on this setting.

Read Syntax:

$\$<id>\mathbf{RXe}<CR>$

Write Syntax:

$\$<id>\mathbf{SXe}<m><CR>$

where:

id is the node id of the TDD2

and *m* is the SSI error mask

Examples:

To read the SSI error mask from a TDD2 with node id 5 send:

$\$5\mathbf{RXe}<CR>$

To set the SSI error mask to 0xFFFFFFFF using a TDD2 with node id 1 send:

$\$1\mathbf{SXe}FFFFFFFF<CR>$

7.5.7 Gradient

Reads or sets the gradient. See section 4.3.6 for information on this setting.

Read Syntax:

$\$<id>\mathbf{RXG}<CR>$

Write Syntax:

$\$<id>\mathbf{SXG}<g><CR>$

where:

id is the node id of the TDD2

and *g* is the gradient in microseconds per inch

Examples:

To read the gradient from a TDD2 with node id 3 send:

```
$3RXG<CR>
```

To set the gradient to 9.0101 uS/in using a TDD2 with node id 9 send:

```
$9SXG9.0101<CR>
```

7.5.8 Start/Stop Holdoff Period

Reads or sets the start/stop holdoff period. See section 4.3.7 for information on this setting.

Read Syntax:

```
$<id>RXH<CR>
```

Write Syntax:

```
$<id>SXH<p><CR>
```

where:

id is the node id of the TDD2

and *p* is the holdoff period in microseconds

Examples:

To read the holdoff period from a TDD2 with node id 2 send:

```
$2RXH<CR>
```

To set the holdoff period to 10 uS using a TDD2 with node id 2 send:

```
$2SXH10<CR>
```

7.5.9 CANbus Baud Rate

Reads or sets the CANbus baud rate. See section 4.3.8 for information on this setting.

Read Syntax:

```
$<id>RXb<CR>
```

Write Syntax:

```
$<id>SXb<r><CR>
```

where:

id is the node id of the TDD2

and *r* is the baud rate in kilobits per second: “125”, “250”, “500”, or “1000”

Examples:

To read the CAN baud rate from a TDD2 with node id 4 send:

```
$4RXb<CR>
```

To set the CAN baud rate to 500 kbps using a TDD2 with node id 5 send:

```
$5SXb500<CR>
```

7.5.10 CANbus Transducer Serial Number

Reads or sets the CANbus transducer serial number. See section 4.3.9 for information on this setting.

Read Syntax:

```
$<id>RCS<CR>
```

Write Syntax:

$\$<id>\mathbf{SCS}<s><CR>$

where:

id is the node id of the TDD2

and *s* is the serial number in hexadecimal

Examples:

To read the serial number from a TDD2 with node id 1 send:

$\$1\mathbf{RCS}<CR>$

To set the serial number to 0x12345678 using a TDD2 with node id 2 send:

$\$2\mathbf{SCS}12345678<CR>$

7.6 Analog Output Settings

7.6.1 Voltage Range

Reads or sets the voltage output range of the analog output. See section 4.6.1 for information on this setting.

Read Syntax:

$\$<id>\mathbf{RAV}<CR>$

Write Syntax:

$\$<id>\mathbf{SAV}<r><CR>$

where:

id is the node id of the TDD2

and *r* is the voltage range: “0-5V”, “0-10V”, “-5-5V”, “-10-10V”, “-2.5-2.5V”, “-2.5-7.5V”

Examples:

To read the voltage range from a TDD2 with node id 6 send:

$\$6\mathbf{RAV}<CR>$

To set the holdoff period to 0 to 5 VDC using a TDD2 with node id 1 send:

$\$1\mathbf{SAV}0-5\mathbf{V}<CR>$

7.6.2 Analog Source Data

Reads or sets the analog source data. See section 4.6.2 for information on this setting.

Read Syntax:

$\$<id>\mathbf{RAT}<CR>$

Write Syntax:

$\$<id>\mathbf{SAT}<s><CR>$

where:

id is the node id of the TDD2

and *s* is the data source: “FORCED”, “POSITION”, or “VELOCITY”

Examples:

To read the source from a TDD2 with an unknown node id send:
\$0RAT<CR>

To set the source to velocity using a TDD2 with node id 9 send:
\$9SATVELOCITY<CR>

7.6.3 Analog Start

Reads or sets the analog start position or velocity. See section 4.6.3 for information on this setting.

Read Syntax:

\$<id>RAS<CR>

Write Syntax:

\$<id>SAS<p><CR>

where:

id is the node id of the TDD2

and *p* is the start position in units

Examples:

To read the analog start position from a TDD2 with node id 8 send:
\$8RAS<CR>

To set the start position to –2.50 units using a TDD2 with node id 4 send:
\$4SAS-2.50<CR>

7.6.4 Analog Range

Reads or sets the analog range. See section 4.3.9 for information on this setting.

Read Syntax:

\$<id>RAR<CR>

Write Syntax:

\$<id>SAR<r><CR>

where:

id is the node id of the TDD2

and *r* is the range in units (source is position) or units/second (source is velocity)

Examples:

To read the analog range from a TDD2 with node id 5 send:
\$5RAR<CR>

To set the analog range to 10.0 units using a TDD2 with node id 6 send:
\$6SAR10<CR>

7.6.5 Force Percentage

Reads or sets the analog force percentage. See section 4.6.5 for information on this setting.

Read Syntax:

$\$<id>\mathbf{RAP}<CR>$

Write Syntax:

$\$<id>\mathbf{SAP}<p><CR>$

where:

id is the node id of the TDD2

and *p* is the percentage of full analog scale to output

Examples:

To read the force percentage from a TDD2 with node id 6 send:

$\$6\mathbf{RAP}<CR>$

To set the force percentage to 67.3 percent using a TDD2 with node id 5 send:

$\$5\mathbf{SAP}67.3<CR>$

7.7 Digital Input and Front Panel Settings

7.7.1 Digital Input Actions

Reads or sets the action performed when a digital input is activated. See section 4.7 for information on this setting.

Read Syntax:

$\$<id>\mathbf{RI}<i><CR>$

Write Syntax:

$\$<id>\mathbf{SI}<i><a><CR>$

where:

id is the node id of the TDD2

i is the input to read/set: “A” for input 0 or “B” for input 1

and *a* is the action to perform when the is activated

Examples:

To read the action for input 1 from a TDD2 with node id 2 send:

$\$2\mathbf{RIB}<CR>$

To set the action for input 0 to none using a TDD2 with node id 1 send:

$\$1\mathbf{SIA}0<CR>$

7.7.2 Front Panel Actions

Reads or sets the action performed when a front panel switch is pressed. See section 4.8 for information on this setting.

Read Syntax:

$\$<id>\mathbf{RA}<k><CR>$

Write Syntax:

$\$<id>\mathbf{SA}<k><a><CR>$

where:

id is the node id of the TDD2

k is the code of the switch to read/set the action of (see Table 20 for a list of codes)

and *a* is action to perform

Switch Pressed	Switch Code
Press Right Momentarily	a
Press Up Momentarily	b
Press OK Momentarily	c
Press Left Momentarily	d
Press Down Momentarily	e
Press Cancel Momentarily	f
Hold Right	A
Hold Up	B
Hold OK	C
Hold Left	D
Hold Down	E
Hold Cancel	F

Table 20: Switch codes for setting front panel actions

Examples:

To read the action performed when OK is held for two seconds from a TDD2 with node id 4 send:

$\$4\mathbf{RAC}<CR>$

To set the action performed when Cancel is pressed momentarily to action 4 using a TDD2 with node id 7 send:

$\$7\mathbf{SAf4}<CR>$

7.8 Position Queries

The following allow a host controller to query the TDD2 for position information.

7.8.1 Displayed Position Query

Reads the currently displayed position. This position is calculated in the same manner as the displayed position, and takes into account the configured display mode (absolute, gap, or relative). If a position error is detected, either “0NOXDCCR” (no transducer detected) or “0NOMAG” (no magnet detected) is returned. Otherwise, the position is returned.

Read Syntax:

`$<id>RD<CR>`

where:

id is the node id of the TDD2

Example:

To read the currently displayed position from a TDD2 with node id 2 send:

`$2RD<CR>`

7.8.2 Magnet Position Query

Reads the position of a particular magnet, regardless of the displayed magnet. If a position error is detected, either "0NOXDCR" (no transducer detected) or "0NOMAG" (no magnet detected) is returned. Otherwise, the position is returned.

Read Syntax:

`$<id>Rd<i><CR>`

where:

id is the node id of the TDD2

and *i* is the magnet to read in hexadecimal (1-9 or a-f)

Example:

To read the position of magnet 12 from a TDD2 with node id 1 send:

`$1Rdc<CR>`

7.8.3 Peak Position Query

Reads the current peak position. This position is calculated in the same manner as the displayed position. The current peak position can be clear with the Clear Peak Position serial command or menu item.

Read Syntax:

`$<id>RK<CR>`

where:

id is the node id of the TDD2

Example:

To read the currently displayed position from a TDD2 with node id 1 send:

`$1RK<CR>`

8 Optional Solid State Limit Switch

The optional limit switch for the transducer display provides 5 open collector Darlington outputs which are switched on and off based on the position of the magnet on the transducer and the entered setup parameters.

8.1 Features

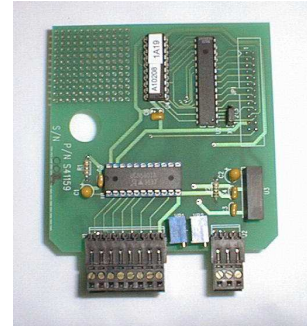
- Five channels of Darlington transistor limit switch outputs
- Integrated output transient protection
- Removable screw terminals

8.2 Mechanical Specifications

- Mounts internal to the 1/8 din transducer display module.

8.3 Limit Switch Specifications

- Five channels of Darlington transistor outputs with maximum of 50 VDC load
- Maximum continuous collector current of 200 milliamps per channel
- Peak collector current of 500 milliamps per channel
- Maximum power dissipation for 5 channels of 1.5 watts at 70 degrees F
- 8 pin removable screw terminal



8.4 Solid state limit switch connections

Connections to the limit-switch output module are made through an 8 pin removable screw terminal to connector J1. Connections to the analog output are made through connector J2.

8.5 Connector J1 Pin-out

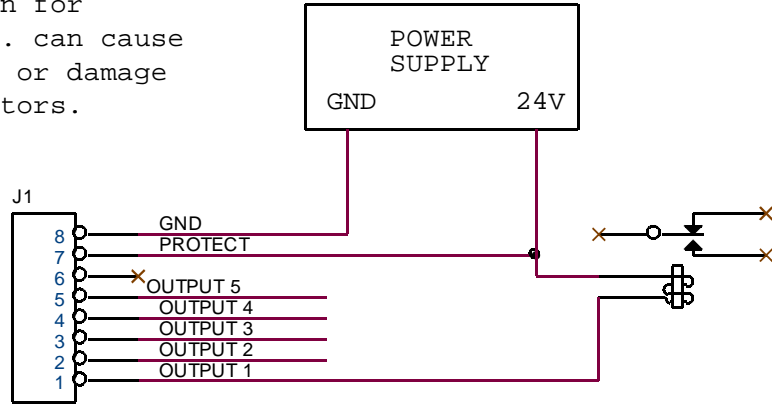
J1-1: Limit Switch output 1
 J1-2: Limit Switch output 2
 J1-3: Limit Switch output 3
 J1-4: Limit Switch output 4
 J1-5: Limit Switch output 5
 J1-6: Reserved
 J1-7: Output transient protection voltage input
 J1-8: Output common

8.6 Solid state limit switch output cautions

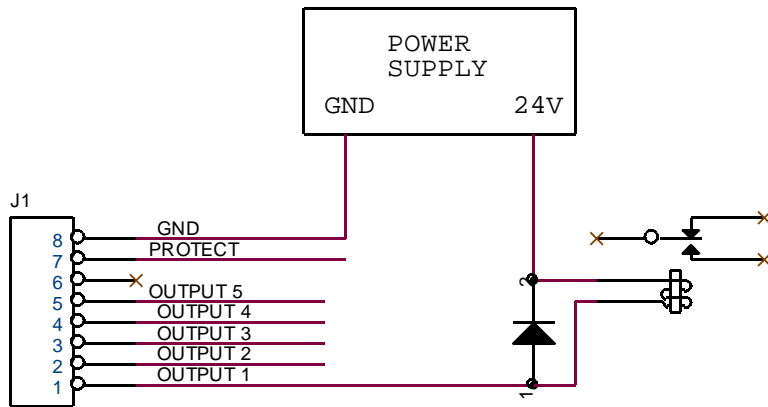
The Output transient protection voltage input (J1-7) should be connected to the relay or solenoid supply voltage if relay coils or solenoids or other inductive devices are driven by the output. This input takes the place of connecting a diode across the coil. In addition arc filters should be placed across the contacts to suppress noise that can cause random problems with the display.

OPTIONAL LIMIT SWITCH and
ANALOG BOARD INDUCTIVE KICK
BACK Protection.

Failure to provide adequate
kickback protection for
relays, motors etc. can cause
the TDD to lock up or damage
the output transistors.



If you use the TDD internal kickback protection you must connect the + Power supply to J1 Pin 7 of the TDD.



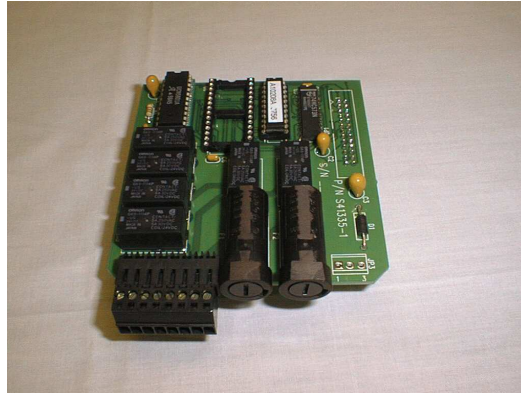
If you do not use the TDD internal kickback protection you must provide kickback suppression externally as above.

Figure 3: Solid State Limit switch inductive kickback protection

9 Optional Electromechanical Relay Limit Switch

***Note that this option requires TDD2 power supply between 20 and 26.4 VDC**

The optional relay limit switch for the transducer display provides 5 normally open mechanical relay contacts which are switched on and off based on the position of the magnet on the transducer and the entered setup parameters.



9.1 Features of the electromechanical relay limit switch

- Five normally open mechanical relay contacts
- Two separate groups of commons for the outputs, allows simultaneous DC and AC operation
- Two fuses, one for each group
- Board mounts inside the 1/8 din display module
- Removable screw terminals

9.2 Mechanical Specifications

- Mounts internal to the 1/8 din transducer display module.

9.3 Relay Limit Switch Specifications

- Five normally open relay contacts
- Maximum current of 4 amps per channel at 250 VAC or 30 VDC
- Maximum group current of 4 amps
- 8 pin removable screw terminal
- Fuses are 4 amp 250 VAC 20 mm

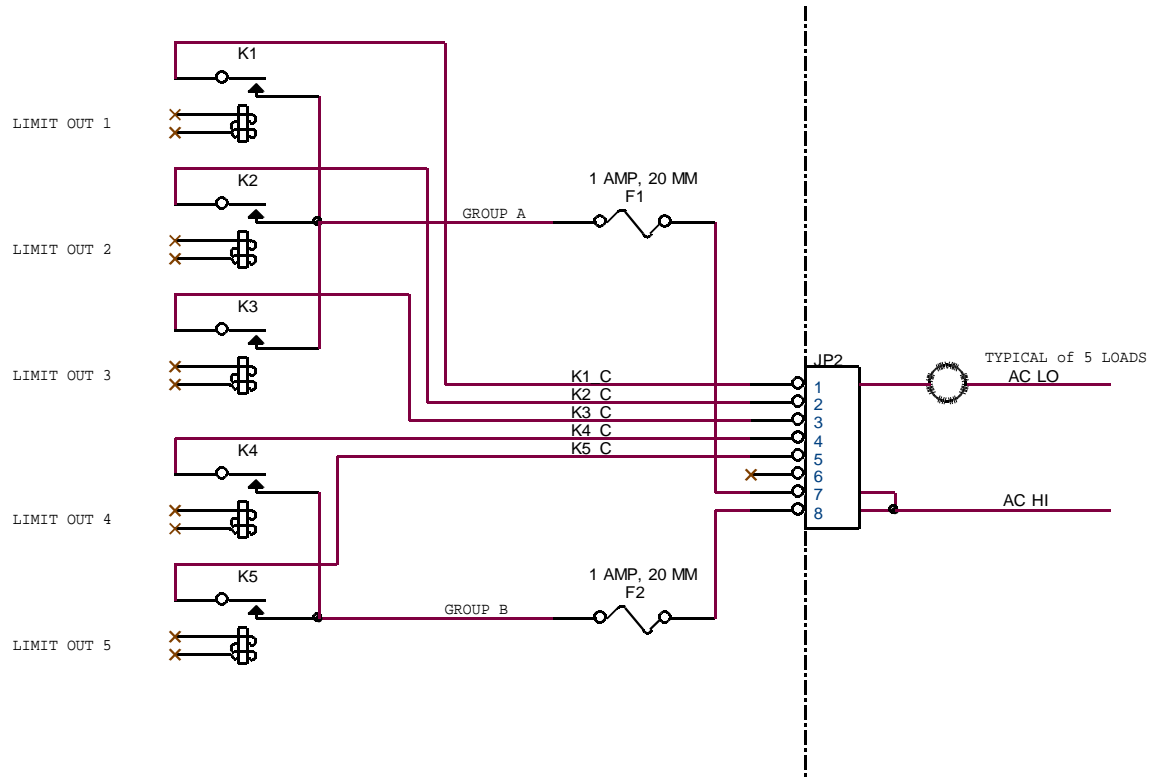


Figure 4 - Example Relay Limit Switch Connections

9.4 Relay Limit Switch Connections

Connections to the limit-switch output module are made through an 8 pin removable screw terminal to connector J1.

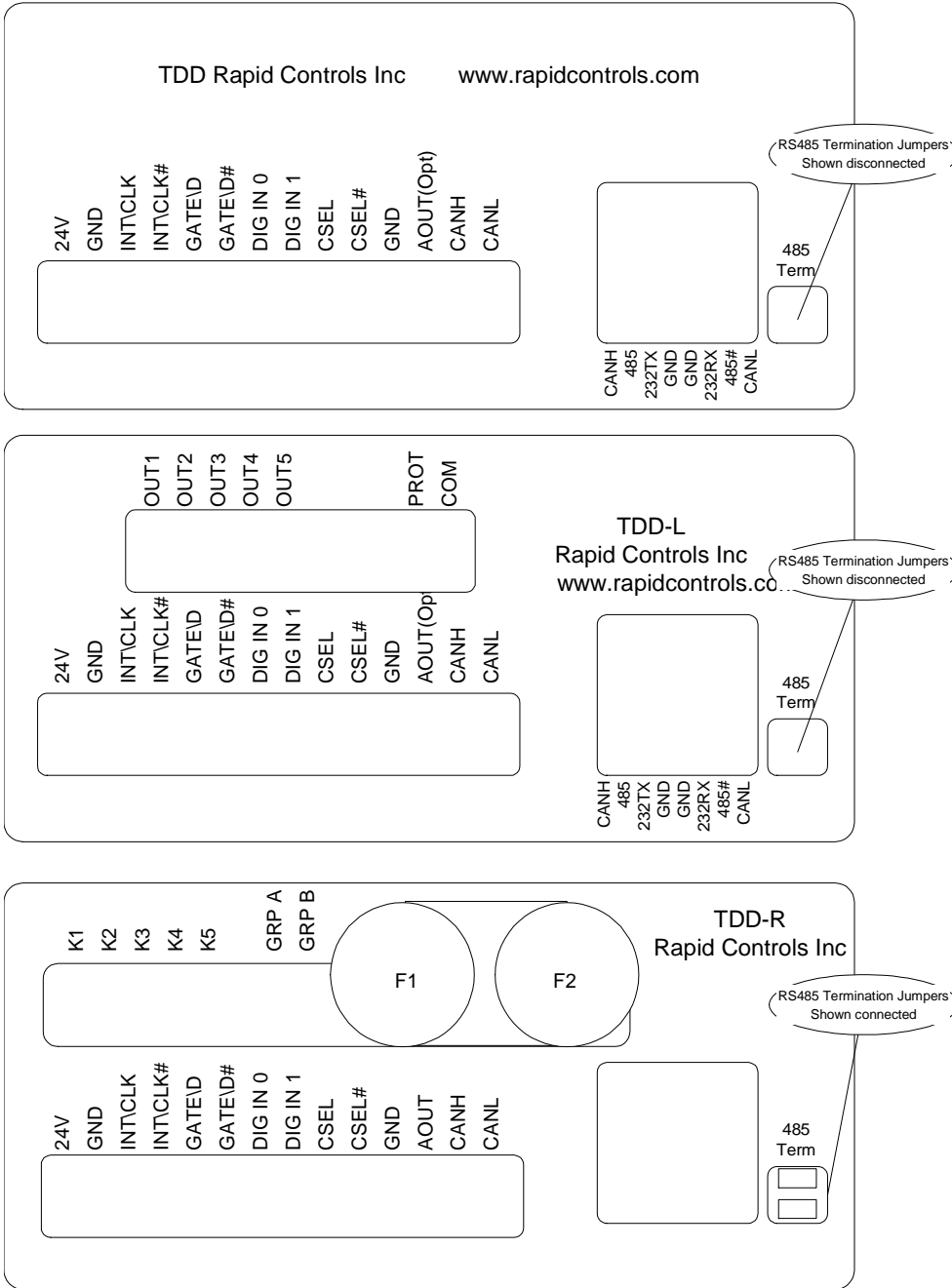
Connector J1 Pin-out

JP2-1: Limit Switch output contact 1	Used with Group A
JP2-2: Limit Switch output contact 2	Used with Group A
JP2-3: Limit Switch output contact 3	Used with Group A
JP2-4: Limit Switch output contact 4	Used with Group B
JP2-5: Limit Switch output contact 5	Used with Group B
JP2-6: Reserved	
JP2-7: Group A common	
JP2-8: Group B common	

9.5 Relay Limit Switch Output Cautions:

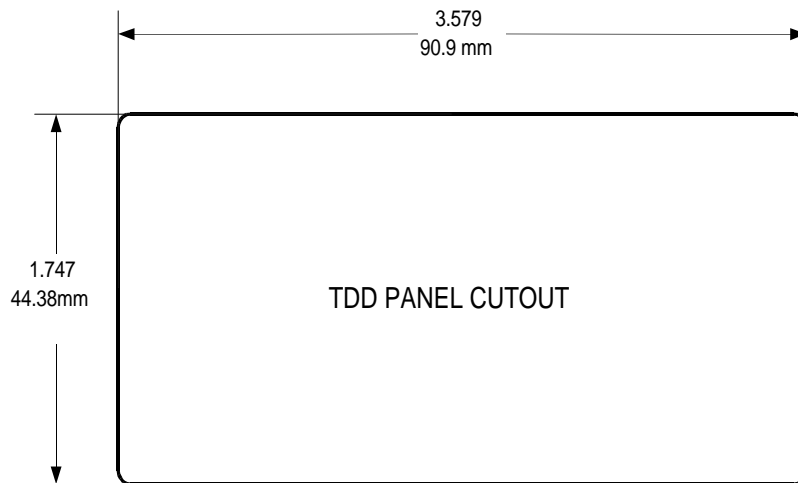
The maximum current switched by the relay contacts in a group must be limited to 4 amperes. If the TDD2 supply voltage is switched then arc suppression must be installed to limit noise on the power supply.

10 Rear Panel Layout



11 TDD2 Panel Cutout

11.1 TDD2 Panel cutout Dimensions



The TDD2 mounts into a panel and requires an 1/8 DIN panel space. It is approximately 5 inches deep from the panel including the connector.