Product Specification for Transducer Display Model TDD

The TDD displays position information from a magnetostrictive transducer or quadrature encoder. It is capable of interfacing to a SSI, PWM, start/stop or neuter transducer depending on model. Setup is accomplished via the front-panel keypad or RS-232/485 serial communications link. The unit has optional programmable limit switches and analog output. A host computer can obtain position and limit-switch information via the RS232/RS485 serial link.

Features

- Six digit, 0.57 inch high, seven segment, red LED display
- Interfaces to Start/Stop, PWM or SSI transducers
- Start/Stop-Display model interfaces to any start-stop transducer
- Optional support for multi-magnet or re-circulated start/stop transducers
- Fast 5-millisecond update rate
- Programmable decimal point, units, scale, and resolution
- Optional five-channel programmable limit switch and analog output module
- Four button front panel keypad to accommodate front panel setup
- Remote zero input
- Front panel disable input prevents unwanted changes of setup information
- RS-232 and RS-485 serial interface for host setup or position information
- Removable 3.5mm Weidmuller type screw terminals for connections
- 512 bytes of non-volatile EEPROM memory for storage of setup information

Specifications

- Capable of displaying -199999 to 999999 with a decimal point to the right of any character
- Units can be set to inches, millimeters, or centimeters
- Remote zero input contact closure; ground to zero position
- Front panel disable contact closure; ground to disable front panel
- 9600-baud RS232 and RS485 serial interface
- Optional five-channel programmable limit switch:
  - Programmable on/off points for each channel
  - Each channel capable of sinking 500 ma at 50V
- Analog output based on position, velocity, or a forced level; variable input range; output either 0-10V or +/-10V
- Input Power: 7 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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Ordering information:

Specify model: TDD-*A*-*B*-*C*-*D*-*E*

A. Transducer Interface

R	Start/Stop interface
RR	Re-circulated Start/Stop interface
S	SSI interface
P	PWM interface
N	Neuter transducer interface
NR	Neuter transducer interface with recirculations
Q	Quadrature encoder interface (See TDD-Q document for further information)
CAN	MTS Can protocol transducer
X	No transducer interface: uses serial channel to acquire displayed data

B. Digit Size and Enclosure

	Omit for standard 0.57 inch digits in a 1/8 DIN enclosure
ND	No display
LD	2-inch digits in 14-inch aluminum enclosure with power supply
LD10V	Same as LD except with a 10 volt transducer power supply
EPR	Standard TDD mounted in NEMA 12 enclosure with 24V power supply

C. Limit Switch Outputs

	Omit for no limit switch functions
LA	5 solid state DC limit switch outputs with +/- 10V or 0 to 10V 12-bit analog output
LA420	5 solid state DC limit switch outputs with 0 – 20 or 4 – 20mA 12-bit analog output
RA	5 mechanical relay limit switch outputs
A12	Dual 12-bit +/- 10V or 0 – 10V analog outputs
A16	Dual 16-bit -10 – 10V analog outputs

D. Magnet Configuration

	Omit for single magnet operation
MM15	Up to 15 magnets on a single starts top transducer. (valid with TDD-R only)

E. Other options

	Omit for normal operation without peak read support.
PKRD	Display switches between peak and current reading; selected by DC input
LIN	Linearity lookup table can be loaded. This cannot be ordered with MM2 option.
MST	MM15 master display (valid with TDD-R-MM15 only)
SLV	MM15 slave display (valid with TDD-X-MM15 only)

Notes:

- All TDD-S models are compatible with 24 or 25 bit binary or gray code SSI transducers without synchronization. 24-bit binary is recommended.
- Resolution of the PWM models is determined by the recirculations of the transducer: Resolution = 0.002 / recirculations. All TDD-P units will operate with externally interrogated PWM transducers.
- SSI transducer resolution is programmed at the factory.
- The MM2 models measure the position difference between magnet 1 and magnet 2.
- TDD-OPT is a $50 software and cable package that allows a PC to be used for setup and control of a TDD, for DOS and Windows 95/98, Windows NT, and Windows 2000.

LD Option

TDD Rear Panel


EPR Option

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Contents

1 About this manual 1
2 Model Selection Information 1
2.1 Transducer Interfaces 1
2.2 Limit Switches and Analog Output 2
2.3 TDD-MM15 Magnet Configuration 2
2.4 Other Options 2
3 Display Operation 3
3.1 Startup 3
3.2 Normal Operation 3
3.3 Front Panel 3
3.4 Digital Inputs 3
3.5 Numerical Output 3
3.6 Linearity 4
3.7 MM15 Master and Slave Displays 4
4 Display Configuration Values 5
4.1 Position Settings 5
4.2 Multiple Magnet Settings 5
4.3 Recirculation settings 6
4.4 Transducer Settings 6
4.5 Analog Settings 7
4.6 Limit Settings 7
4.7 System Settings 8
5 Setup Mode 9
5.1 Setup Considerations 11
6 Serial Communications 11
7 Connections 12
7.1 Power and Transducer Rear Connector (TDD) 12
7.2 Power and Transducer Rear Connector (TDD-LD) 12
7.3 Communications Connector 13
7.4 RS485 Termination Jumpers 13
8 Optional Solid State Limit Switch and Analog Output 15
8.1 Features 15
8.2 Mechanical Specifications 15
8.3 Limit Switch Specifications 15
8.4 Analog Output Specifications 15
8.5 Solid State Limit Switch Analog Connections 16
8.6 Solid state limit switch connections 17
8.7 Connector J1 Pin-out 17
8.8 Solid state limit switch output cautions 17
9 Optional Electromechanical Relay Limit Switch 19
9.1 Features of the electromechanical relay limit switch 19
9.2 Mechanical Specifications 19
9.3 Relay Limit Switch Specifications 19
9.4 Relay Limit Switch Connections 20
9.5 Relay Limit Switch Output Cautions: 20
10 TDD Panel Cutout 21
10.1 TDD Panel cutout Dimensions 21
11 TDD LD mounting 21

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1 About this manual

This manual covers both the TDD and the TDD-LD products. These products are packaged differently, but operate identically. Separate sections of the manual describe the electrical connections and the mounting of the different models when they differ.

Serial communications with the TDD is not covered in this manual. A separate TDD communications manual (TDD-COMM.PDF) describes the serial communications protocol in detail and is available upon request or from the Rapid Controls web site: http://www.rapidcontrols.com/.

Setup of the display may also be carried out using the free TDD-WinComm utility available on the Rapid Controls website.

2 Model Selection Information

This section contains model specific information to aid in selection of a TDD model suitable for your needs.

2.1 Transducer Interfaces

Several transducer interfaces are available on the TDD.

2.1.1 Start/Stop Interfaces (TDD-R and TDD-RR)

TDD-R and TDD-RR model displays are capable of interfacing with Start/Stop magnetostrictive transducers. TDD-R models are limited to a resolution of 0.002 inches/count. TDD-RR models can "recirculate", or reinterrogate the transducer to achieve increased resolution. A maximum resolution of 0.000125 inches/count can be achieved with 16 recirculations.

2.1.2 SSI Interfaces (TDD-S and TDD-SS)

TDD-S and TDD-SS model displays are capable of interfacing with SSI (Synchronous Serial Interface) magnetostrictive transducers and encoders. 24- and 25-bit SSI in either binary or Gray code formats are supported. If your transducer uses bit 21 as an error indicator, the TDD can support this. The resolution of a SSI transducer is determined by the transducer and is programmed at the factory.

2.1.3 PWM Interfaces (TDD-P)

TDD-P model displays interface with PWM (Pulse Width Modulated) output magnetostrictive transducers. Free running (externally interrogated) PWM transducers are supported. The resolution of a PWM transducer depends on the number of recirculations occurring in the transducer. Total resolution is 0.002 inches/count divided by the number of recirculations.

2.1.4 Neuter Interfaces (TDD-N and TDD-NR)

TDD-N and TDD-NR models interface with neuter output magnetostrictive transducers. TDD-N models are limited to a resolution of 0.002 inches/count. TDD-NR models can "recirculate", or reinterrogate the transducer to achieve increased resolution. A maximum resolution of 0.000125 inches/count can be achieved with 16 recirculations.

2.1.5 Quadrature Interfaces (TDD-Q)

TDD-Q models interface with quadrature encoders. Please see the TDD-Q specific manual for more information.

2.1.6 CANbus Interfaces (TDD-CAN)

No information available at this time.

2.1.7 No Transducer Interface (TDD-X)

TDD-X models have no transducer interface. Position information is gathered from the RS-232/485 interface.

2.2 Limit Switches and Analog Output

Analog output and limit switches are available as options for most TDD models.

2.2.1 TDD- --LA

The LA option provides 5 solid-state limit switch outputs and a 12-bit analog output which is selectable between +/-10V and 0-10V output.

2.2.2 TDD- -LA420

The LA420 option provides 5 solid-state limit switch outputs and a 12-bit current analog output, which is selectable between 0-20mA and 4-20mA output.

2.2.3 TDD- -RA

The RA option provides 5 mechanical relay limit switch outputs.

2.2.4 TDD- -A12

The A12 option provides dual 12-bit voltage analog output (position and velocity). The output is selectable between +/-10V and 0-10V.

2.2.5 TDD- -A16

The A16 option provides dual 16-bit voltage analog output (position and velocity). The output is fixed as +/-10V.

2.3 TDD-MM15 Magnet Configuration

The MM15 option allows a TDD to operate with up to 15 magnets on a Start/Stop transducer.

2.4 Other Options

Options in this category provide additional TDD features.

2.4.1 PKRD

Allows an operator selectable display of either the current position or the peak-read position.

2.4.2 LIN

The LIN option adds linearity support to the TDD, allowing for correction of non-linear transducers.

2.4.3 MST

The MST option is only available as the TDD-R-MM15-MST. As the serial master display, it provides position information to TDD-X-MM15-SLV slave displays over the RS-232/485 serial interface.

2.4.4 SLV

The SLV option is only available as the TDD-X-MM15-SLV. As the serial slave display, it receives position information over the RS-232/485 serial interface.

3 Display Operation

3.1 Startup

When power is applied, the unit will begin with a LED segment test. Saved configuration settings are loaded from the non-volatile EPROM and the software date is displayed on the LED display for 2 seconds. The display then begins normal operation: interrogating the transducer, displaying position, and controlling limit switches and analog output.

3.2 Normal Operation

During normal operation, the display interrogates the transducer for magnet position information. This information is used to update the limit switches, produce analog output, and to display position on the LED display. Settings can be changed via the RS232 serial link at any time during normal operation. An interactive setup mode can be accessed to allow setup via the front panel. Serial communications are suspended during front panel setup.

3.2.1 Error Messages

If an error condition is detected during normal operation, an error message will be displayed in place of the position. If the display cannot retrieve a valid position from the transducer, an error message is displayed. If no magnet is detected "**[----]**" is displayed. If no transducer or a bad transducer is detected, "**Err 01**" is displayed. TDD-X models will display "**.....**" if no position information is received over the serial port.

3.3 Front Panel

The front panel has four switches labeled (left to right): 'SEL', 'INC', 'DEC', and 'ENTER'. These switches are used for operator control of the display and navigation of the on-display menus. The ENTER button may be used to zero the display based on the zero operation setting configured on the display. For more information, refer to section 4.7.3.

Pressing the SEL button will enter a limit bound edit mode. This is available to allow the fast editing of one limit bound. The display will blink with the value of the limit bound. Pressing the INC or DEC buttons will change the bound by a preset amount. Press the SEL button to return to normal operation. (TDD LA models only)

When the MM15 option is installed, the INC or DEC buttons will allow changing of the *display mode* and *displayed magnet* from the front panel. Pressing either momentarily will display the current state of the multi-magnet system, in the following form: AAA BB. AAA is "GAP", "REL", or "ABS", corresponding to the current *display mode*. BB is the number of the *displayed magnet* in absolute and relative modes, and the number of the *gap* in *gap mode*. During the period when these values are displayed, pressing the INC button will change the current *display mode* and pressing the DEC button will change the current *gap number*. (TDD MM15 models only)

3.4 Digital Inputs

3.4.1 Remote Zero Input

The remote zero input can be used to zero the display remotely. It may be setup to set the user zero to the current position or to set the offset to the current position (see section 4.7.3).

3.4.2 Enable Input

The Enable input has several functions, which are selected by changing the enable flag setting.

3.5 Numerical Output

Values are internally stored as inches or derivatives of inches. Setup values entered in units are converted to inches for storage. When output of position is necessary, the position is multiplied by a scalar to convert it to the selected units. A number to be output is arrived at by the following formula:

$$\left(\left(P \cdot D \cdot S\right) - O\right) - U$$

Where:

P is the measured position, returned from the transducer, in units.
D is +1 if the direction sense is positive, and –1 if the direction sense is negative
S is the defined scale.
O is the offset in units.
and U is the user zero in units.

3.5.1 Position Adjustment

The position returned by the display may differ slightly from what is expected. The scale can be used to correct position output. If the position is greater than expected, a scale of less than 1.0 should be used. If the position is less than expected, a scale of greater than 1.0 should be used. The use of a scale is required when a PWM transducer with more than 1 recirculation performed in the head. In this case, enter a scale of 1/recirculations.

Note: Correct constant position errors with the offset, and linear position errors with the scale.

3.6 Linearity

TDD LIN models support linearization of positions from the transducer using a set of correction points (breakpoints) stored in non-volatile EEPROM memory. Each breakpoint contains a raw position and a corrected position. The raw position is the position read from the transducer. The corrected position is the position desired from this expected position. Breakpoints can be added through the serial interface.

During operation with linearization enabled, raw positions are corrected to a linear interpolation of the nearest breakpoints. This action is transparent once breakpoints have been configured.

A new table of linearity data is entered using the following steps:

1. Disable linearity (Serial command **St**)
2. Add breakpoints in increasing order (Serial command **SB**)
3. Save table (Serial command **Sb**)
4. Enable linearity (Serial command **Sl**)

3.7 MM15 Master and Slave Displays

The MM15 display is also available as a set of displays consisting of one master and a number of slaves. The master interrogates a transducer to retrieve position information for all magnets. This position information is sent over a RS-485 serial link, where it is received by the slave displays. The slave displays use the position information exactly as if the position information had been interrogated directly from a local transducer.

The master/slave configuration allows the simultaneous display of multiple magnet positions. All displays (master and slaves) can display in the MM15 absolute, relative, and gap modes. Each display has independent configuration settings, allowing different kerf settings for each display. Note that this means you must make sure each slave display has been configured correctly for the transducer.

4 Display Configuration Values

The display has a large set of parameters controlling its operation. The following is a comprehensive list of settings, by category. Most settings can be changed through either the front panel or the RS-232 serial link.

4.1 Position Settings

The following affect the displayed position that is returned from the transducer.

4.1.1 Units

The display is able to operate with the following units: inches, millimeters, and centimeters. If another unit choice is desired, it may be derived from one of the three basic units by using a scale value. All position output and setup values reflect the units setting, with the exception of the resolution setting. The default unit is inches.

3.1.2 Direction sense

The display can return the position with either a positive or negative direction sense. A positive direction sense returns increasing position values as the magnet moves away from the head of the transducer. A negative direction sense returns decreasing position values as the magnet moves away from the head. Positive is the default direction sense.

4.1.2 Scale

Before position is compared to the limit switches, output through the analog output, or displayed on the display, it is multiplied by a scale value. A value of zero would make position be always zero. A scale of 1.000 is default. The use of a scale is required when a PWM transducer with more than 1 recirculation performed in the head. In this case, enter a scale of 1/recirculations.

4.1.3 Offset

The offset is subtracted from the raw magnet position immediately after it is scaled. The offset is defined as a position in units. The offset can be used to “zero” the display at a certain point by setting the offset to the raw magnet position returned at that point. The default offset is zero units.

4.1.4 User Zero

The user zero is an additional offset that is subtracted from the position. Unlike the offset, the user zero is never saved to the EEPROM. It is cleared each time power is reset. The user offset can only be set from the front panel (See section 4.7.3).

4.2 Multiple Magnet Settings

The following items are only available on TDD MM15 models.

4.2.1 Display Mode

The display mode determines how magnets are selected to be used to determine the displayed position. Three modes are available: absolute, relative, and gap. Absolute mode displays the absolute position of the *displayed magnet*. Relative mode displays the difference in position between the *displayed magnet* and the *reference magnet*. Gap mode displays the difference between two adjacent magnets, selected with the *gap number*.

4.2.2 Reference Magnet

The position of the reference magnet is subtracted from the *displayed magnet* in relative mode.

4.2.3 Displayed Magnet

The position of the displayed magnet is displayed in absolute mode and the position from which the *reference magnet* is subtracted in relative mode.

4.2.4 Gap Number

The gap number is used in gap mode, and indicates a set of consecutive magnets. For example, the distance between the first and second magnets (from the head of the transducer) is referred to as gap 1. The second and third magnets are gap three, and so on.

4.2.5 Number of Magnets

The number of magnets limits the number of magnets selectable from the front panel. The effect of this setting is intended only to make selection of a magnet from the front panel easier, and has no effect otherwise.

4.2.6 Kerf

The kerf is an offset in units that is subtracted from the displayed position in either relative mode or gap mode.

4.3 Recirculation settings

The following items are only available on TDD RR and NR models.

4.3.1 Recirculations

Recirculation of the transducer is a technique to increase position data resolution by interrogating the transducer multiple times in quick succession. The resolution of a transducer is approximately (0.002 / number of recirculations) inches. The formula for finding the exact resolution is:

1 / 60.0 / gradient / number_of_recirculations inches,

where number_of_recirculations can range from 1 to 16.

Note: The TDD with recirculations is setup for a standard null of 3 inches or more. If a shorter Null is planned notify Rapid Controls and the null time can be reduced.

4.4 Transducer Settings

The following affect the transducer interface. These settings are dependent on the model of display used.

4.4.1 Resolution

The resolution setting is available only on SSI-Display models. It is the worth of one bit of position returned from the transducer. This value can be decoded from the model number written on the head of the transducer. The resolution setting of the display is in units. The default resolution of the TDD is 0.0005 microns per count.

The display has only six digits so it is difficult to enter the precision required for the resolution. Since the display automatically converts metric setup values to inches it is recommended that you change to metric units and then enter the resolution in metric units and then change the display units back to inches. The value saved internally will have the required resolution although the displayed value is rounded down. To verify this, change the units back to metric and view the resolution.

4.4.2 Transducer Type

The transducer type setting is only available on SSI-Display models. SSI transducers are available in both 24 and 25 bit versions. This setting allows the Display to accommodate both. The default is 24 bits.

4.4.3 Error bit 21

Some SSI transducers may specify bit 21 of the data as an error bit which signals a transducer error when set. When the TDD Error bit 21 flag is set ‘ON’ the display will read “**[----]**”, missing magnet, if the 22nd bit is set. If the Error bit 21 flag is set ‘OFF’ bit 21 is treated as part of the data word. Devices that use Error Bit 21 to signal a transducer error are limited to 21 bits of position information. The default setting is ‘OFF’.

4.4.4 Gradient

The gradient setting is available only on Start/Stop and PWM Display models. The gradient of a transducer is the number of microseconds required for a pulse to propagate one inch of the transducer. The gradient of the transducer is stamped on the head. This setting is not affected by the units setting. 9.00 microseconds per inch is default.

4.5 Analog Settings

Analog output can be set to unipolar (0-10V) or bipolar (±10V) by changing jumper X1 on the analog daughter board. Both position and velocity output will work with either setting. In bipolar mode, position will begin at -10 volts; velocity will center at 0 volts. In unipolar mode, position output will begin at 0 volts; velocity centers at 5 volts.

4.5.1 Analog Type

The analog output has three possible settings. These are the ability to output a fixed value, or to output based on position or velocity. If the analog output type is fixed, the output will be a percentage of maximum analog output as defined in the analog range. Position is the default output type.

If the analog output type is position, the analog output will be based on the position of the magnet within a range (defined by the analog range), and will begin at the start point defined by the analog start. For example, if the analog range is 5.0, the analog start is 20.0, and the magnet position 23.4, the analog output will be ((23.4 – 20.0) / 5.0) * 100 or 68 percent of maximum output.

If the analog output type is velocity, the output is calculated from the delta position over a time base of 10 milliseconds. Output will be 50% of maximum when the velocity is 0.0 units per second. The output will be at maximum when the velocity is the analog range. The output will be at minimum when the velocity is negative analog range.

4.5.2 Analog Range

The analog range is the maximum input to the analog output system in velocity and position modes. Anything not in range is saturated to either minimum or maximum output. The analog range is the percentage of output in the forced modes. The default analog range is 5.00 inches.

4.5.3 Analog Start

In position mode, the analog start is the beginning of the range for analog output. The analog start is in units. The default analog start is zero inches.

4.5.4 Analog Update

The analog update is the number of milliseconds between each analog update. This is rounded up to the nearest 5-millisecond period. This setting can be used to optimize velocity based analog output. The following equation will find the minimum update period in milliseconds to maintain full usage of the analog output range, given resolution in inches and maximum speed in inches per second:

update_time = (resolution * 2048 / maximum_speed) / 1000

Note that this is valid only for 12-bit analog output. The update time for 16-bit velocity analog output can be calculated with the folowing equation:

update_time = (resolution * 32768 / maximum_speed) / 1000

4.6 Limit Settings

The five limit switches each have a lower and upper bound. When the position is greater than or equal to the lower bound and less than or equal to the upper bound, the limit switch output will be on. All limit switches default to a lower and upper bound of 0.000.

The states of the hardware limit switch outputs can be inverted by setting the Limit Invert flag to ON.

4.7 System Settings

The following items affect miscellaneous portions of display operation.

4.7.1 Decimal Places

The display will format the position output to a specified number of decimal places, from 0 to 5. If the integer portion of the position is larger than can be accommodated by the remaining digits of the display, fewer fractional digits will be shown. Note that increasing or decreasing the number of displayed decimal places does not change the precision of the internally represented position. Three places are displayed by default.

4.7.2 Remote Zero Flag

The ability to zero the display (set the offset to the raw magnet position) through an input can be enabled or disabled. The remote zero flag can have one of three values: disabled, offset, or user zero. The remote zero input will have no action if the remote zero flag is disabled. If the remote zero is set to 'offset', when the input is triggered, the offset will be set to the current position and the user zero cleared. If the remote zero flag is set to 'user zero', when the input is triggered, the user zero will be set to the current position. The zero set flag is set to 'offset' by default.

4.7.3 Zero Operation

The effect of the 'ENTER' button during normal operation can be controlled using the 'zero operation' setting. The setting changes the operation of the 'ENTER' button according to the following table. The ENTER button will perform an action when touched momentarily, and when held for 2 seconds.

Setting	Action of the ENTER button when touched momentarily	Action of the ENTER button when held for 2 seconds
0	None	None
1	None	Sets the user zero to the current position. Does not require the front panel to be enabled.
2	None	Clears the user zero and sets the offset to the current position and saves the value in the EEPROM. Requires the front panel to be enabled.
3	Sets the user zero to the current position. Does not require the front panel to be enabled.	Clears the user zero and sets the offset to the current position and saves the value in the EEPROM. Requires the front panel to be enabled.
4	Sets the user zero to the current position. Does not require the front panel to be enabled.	Clears the user zero. Does not require the front panel to be enabled.
5	Clears the user zero. Does not require the front panel to be enabled.	Sets the user zero to the current position. Does not require the front panel to be enabled.

4.7.4 Enable Input and Enable Flag

The effect of the Enable Input can be switched via the Enable Flag. There are five possible uses for the Enable Input:

Mode A: The front panel setup of the display can be enabled/disabled via the Enable Input. The front panel can be disabled in order to prevent accidental changes in setup. If the front panel is disabled, all menu items are disabled except the limit settings. The ability to set the offset via the front panel is removed. The INC/DEC buttons can still change the display mode and displayed magnet settings if the display is a MM15 model.

Mode B: The Enable Input can act as a “display hold” feature. When the Enable Input is active the display will not update but will hold the value last displayed before the input was activated.

Mode C: The Enable Input changes the displayed magnet. (MM15 models only)

Mode D: The Enable Input changes the displayed magnet. The front panel is disabled unless the Enable Input is active during startup. (MM15 models only)

Mode E: The Enable Input causes the TDD to output the current position followed by a carriage return over the serial port when it is activated. The position is output once each time the input is activated.

Mode F: The front panel setup of the display can be enabled/disabled via the Enable Input. The front panel can be disabled in order to prevent accidental changes in setup. If the front panel is disabled, all menu items are disabled except the limit settings. The ability to set the offset via the front panel is removed. The INC/DEC buttons no longer change the display mode and displayed magnet settings. (MM15 models only)

Mode G: The current position is printed over the RS232 port each time Enable Input goes from low(connected to DC common) to high (disconnected).

Mode H: The units are switched from MM or INCH depending on the Enable Input. If the Enable Input is low(connected to DC common) the display will read in MM. If the Enable Input is high (disconnected) the display will read in Inches.

Note: Models with software revisions earlier than 12-01-2000 refer to Mode A as ‘Panel’ and Mode B as ‘Display’. Early TDD-RR and TDD-NR models also use this convention.

4.7.5 Limit Edit Number

One of the limit bounds can be edited from the front panel. This is the number of the bound to edit. If this number is zero, no limit will be available for editing. 1 is the first limit’s lower bound, 2 is the first limit’s upper bound, and so on to 10. The default limit bound to edit is 1 (limit 1 lower bound).

4.7.6 Limit Edit Increment

This is the amount that the limit is incremented or decremented when edited from the front panel. The default increment amount is 1.0000 inches.

4.7.7 Node Identifier

The node ID allows a specific TDD to be communicated with individually using the RS485 serial link. All TDDs will respond to messages sent with a node ID of 0, and messages sent with their specific node ID. Each TDD can be set with a node ID from 1 to 9.

5 Setup Mode

Pressing and holding the ‘INC’ and ‘DEC’ switches simultaneously for 2 seconds will cause the unit to enter the *setup mode*. While in the setup mode the unit will continue transducer interrogation, but RS232 queries will be ignored. The setup procedure involves selecting a value to change, changing the value and then saving the change. The list of setup values may be cycled through by pressing the ‘SEL’ switch. When the name of the desired item to change is displayed, pressing the ‘ENTER’ switch will cause the value of the selected item to be displayed. The item value may now be edited. Pressing ‘ENTER’ at this time will keep the value and return the user to the selection process.

When editing most values, ‘INC’ and ‘DEC’ are used to change the value. If a blinking digit is present, ‘SEL’ is used to change the blinking (active) digit. The value will increment or decrement once each time ‘INC’ or ‘DEC’ is pressed and released. Holding ‘INC’ or ‘DEC’ will cause the value to increase or decrease rapidly.

When editing a value that can be negative, decrementing the first digit while it is zero will cause the value to become negative. You will lose one digit of resolution when editing a negative number. The value will shift right one place on the screen when the ‘-‘ sign appears.

Note: The limit switch setup has a submenu. When it is selected, a choice of the limit switch to edit is presented. ‘LIM 1L’ means Limit 1 Lower; ‘LIM 2U’ means Limit 2 Upper, et al. If ‘ENTER’ is pressed, the limit may be edited normally. Select ‘END LI’ from the sub menu to return to the setup menu.

Items to be modified via the front panel:

Item	Description	Models	
		R	S
UNITS*	The units to use with the display. Choose between inches, mm (SI 1000), and cm (SI 100).	✓	✓
PLACES*	The number of decimal places to be displayed.	✓	✓
DSENSE*	The direction sense, expressed as 'POSITV' or 'NEGATV'.	✓	✓
SCALE*	The scale value.	✓	✓
RECIRC*	Set the number of recirculations. (TDD-RR and TDD-NR models only)	✓	
REFRNC*	Set the reference magnet. (TDD MM15 models only)	✓	
HERF*	Set the kerf. (TDD MM15 models only)	✓	
AGNETS*	Set the number of expected magnets. (TDD MM15 models only)	✓	
GRADIE*	The gradient of the transducer: the number of microseconds per inch the transducer is calibrated to.	✓	
RESOLU*	The resolution of the transducer: the number of units per count returned by the transducer.		✓
T TYPE*	The type of transducer in use.		✓
b21Err*	Whether bit 21 is used as an error bit.		✓
NOdEId	The node identifier of the display.	✓	✓
A TYPE*	The mode of the analog output.	✓	✓
A RANG*	The range of position or velocity the analog output represents. If the analog mode is Position, this value is in units; if the analog mode is Velocity, this value is in units per second.	✓	✓
A STRT*	The start of the analog output range in units. This value only applies to position-based analog output.	✓	✓
A UPDT*	The length of the analog output update period in milliseconds.	✓	✓
OFFSET*	The number to be added to the position in units.	✓	✓
SET LI	Enters the limit switch submenu. (see above)	✓	✓
LI INC*	The amount the limits will be incremented by when edited from the front panel	✓	✓
LI NR*	The number of the limit bound to edit via the front panel. Selecting zero will prevent a limit from being edited.	✓	✓
INV LI*	The limit invert flag.	✓	✓
0 SET*	The remote zero flag is expressed as 'OFF' (disabled), 'USEr 0' (user zero), or 'OFFSEt'	✓	✓
0 OPEr*	The zero operation, expressed as a number indicating the effect of pressing the 'enter' button during normal operation. (see table in section 4.7.3)	✓	✓
EnAbLE	The enable flag.	✓	✓
SAVE	Pressing the 'enter' button saves the values to the EEPROM.	✓	✓
FACTRY*	Pressing the 'enter' button retrieves the factory defaults.	✓	✓
END	Pressing the 'enter' button returns the unit to the Run Mode using the current values (not necessarily saved to EEPROM).	✓	✓

*Available only when front panel is enabled.

5.1 Setup Considerations

The display has only six digits so it is difficult to enter the precision required in some cases, especially when you have a metric resolution on an SSI transducer and you want to use inches as your displayed units. Since the display internally converts metric setup values to inches it is recommended that you enter the resolution value using metric units and then change the units setting to inches. The value saved will have the required resolution although the displayed value is rounded to fit the display. This can be verified by viewing the resolution with the units setting switched back to a metric mode or by viewing the resolution using the serial link.

Another way to achieve higher resolution in the setup values is to se the values via the serial link using the serial commands. The values downloaded to the unit can have more significant digits than the 6-digit display allows.

6 Serial Communications

The TDD supports an extensive communications protocol via the serial port. All setup values can be read and set as well as position and limit switch values. The communication protocol is described in detail in the document TDD-COMM.PDF available by request or from the Rapid Controls web site http://www.rapidcontrols.com/.

TDD MST and SLV models require that the SEL and ENT buttons be held down when the display is powered on to allow serial based setup. If you are attempting to setup a slave display with an active master on the RS-485 network, both the master and slave must have the SEL and ENT buttons held down at startup.

7 Connections

7.1 Power and Transducer Rear Connector (TDD)

Weidmüller type

1 +15 or +24 VDC power to the TDD (RA Option requires 20 to 26.4 VDC)
2 Ground
3 Interrogate + / Clk +
4 Interrogate- / Clk –
5 Gate + / Data +
6 Gate - / Data –
7 Enable input. (Connect to ground to disable either the front panel or the display depending on mode)
8 Zero input (Connect to ground to cause zero)

7.2 Power and Transducer Rear Connector (TDD-LD) Weidmüller type

Pin	Start/Stop or PWM	SSI	Neuter
1	+24V (+15V for TII) (Red)	+24V (Red)	+24V (+15V for TII) (Red)
2	Ground (Wht)	Ground (Wht)	Ground (Wht)
3	Interrogate + (Yel)	Clk + (Yel)	Interrogate + (Yel)
4	Interrogate – (Grn)	Clk – (Grn)	Interrogate – (Grn)
5	Gate + (Pnk)	Data + (Pnk)	Neuter Pulse (Vio)
6	Gate – (Gra)	Data – (Gra)	No Connect
7	Enable Input	Enable Input	Enable Input
8	Zero Input	Zero Input	Zero Input

1) +24 VDC power to the transducer
2) Ground
3) Interrogate + / Clk +
4) Interrogate- / Clk –
5) Gate + / Data +/ Neuter Pulse
6) Gate - / Data –/No connect
7) Enable input. (Connect to ground to disable either the front panel or the display depending on mode)
8) Zero input (Connect to ground to cause zero)

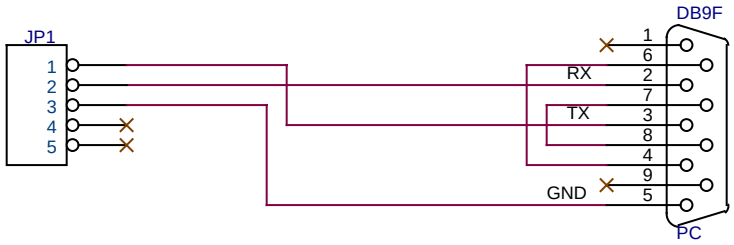
Notes: For Tempo II sensors the –15V power supply is not connected to the TDD but is connected directly from the power supply to the sensor (Blu).

7.3 **Communications Connector** Weidmüller type

1. RS232 Receive
2. RS232 Transmit
3. Ground
4. RS485 +
5. RS485 –

7.4 RS485 Termination Jumpers

Jumpers X6 and X7 can be installed to provide a 120 ohm termination of the RS485 interface. They are installed when the unit is shipped from the factory and must be installed for the RS232 interface to work correctly. If more than 1 TDD is connected using RS485 then the jumpers should be removed from all but the last TDD.



TDD TO PC RS232

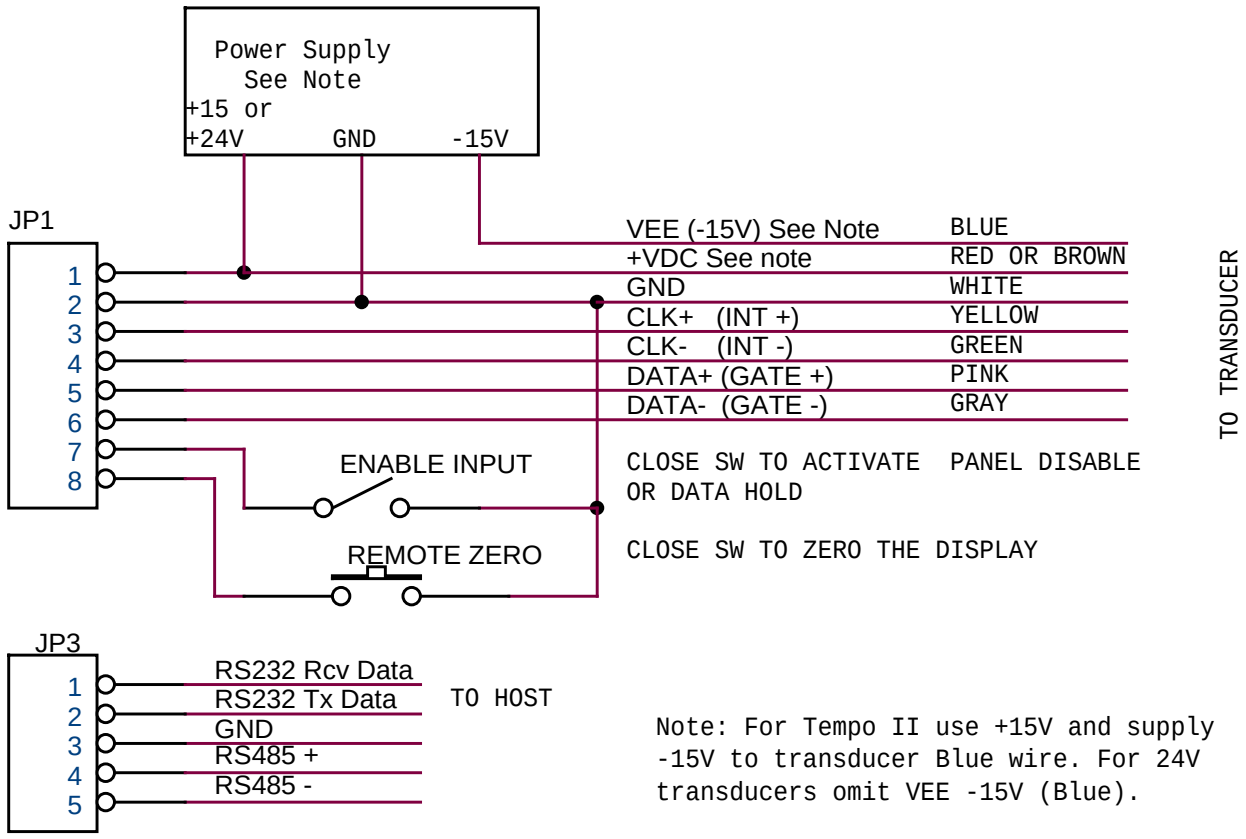


Figure 1: TDD Connections

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8 Optional Solid State Limit Switch and Analog Output

The optional limit switch and analog output 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. It also provides an analog output voltage based on position or velocity.

8.1 Features

- Five channels of Darlington transistor limit switch outputs
- 12 Bit analog voltage output representing Position or Velocity
- Analog output range of 0 to 10V, ±10V or 0 to 20 ma
- Board mounts inside the 1/8 din display module
- Integrated output transient protection
- Removable screw terminals

8.2 Mechanical Specifications

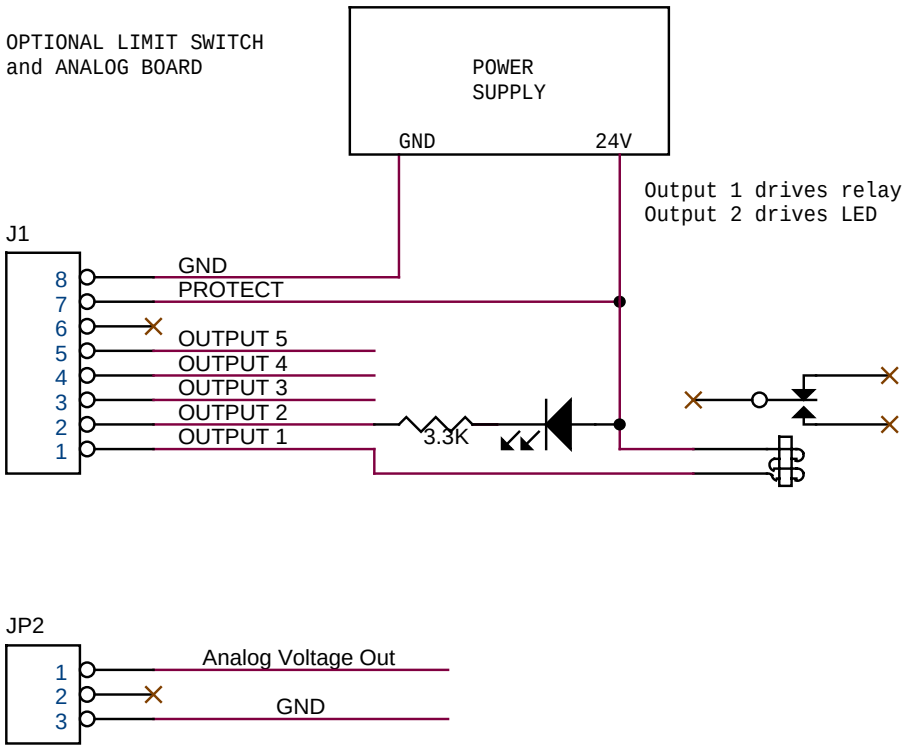
- Mounts internal to the 1/8 din transducer display module.

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

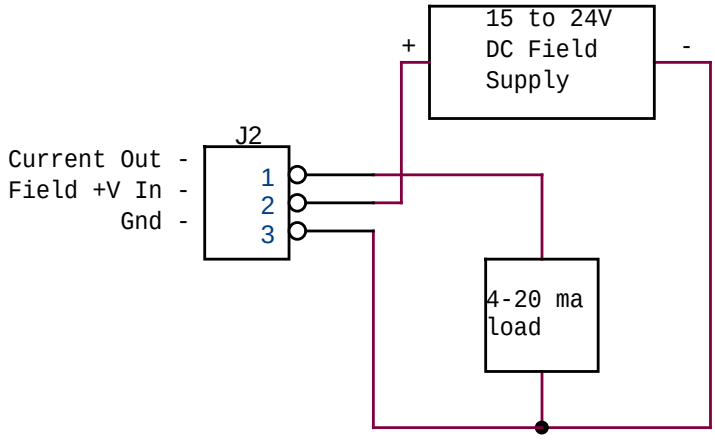
8.4 Analog Output Specifications

- 12-bit resolution (1 part in 4096)
- Maximum load current of 5 milliamps
- +/- 10V Bipolar Output range: Jumper X1 1-2 and 3-4
- 0 to 10V Unipolar Output range: Jumper X1 3-4 and 5-6
- Optional 4 to 20 ma current



8.5 Solid State Limit Switch Analog Connections

J2-1: Analog output: Voltage or Current source
J2-2: No Connect in Voltage mode. Field + Current source voltage (15 to 24 VDC) in current mode
J2-3: Ground



Connections for 4-20 MA option

8.6 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.

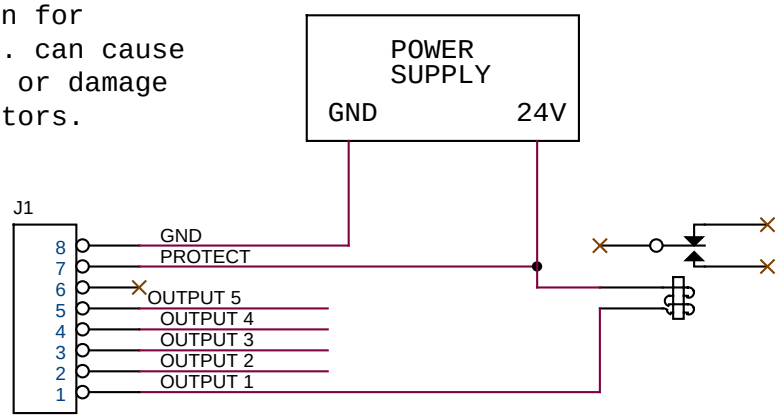
8.7 Connector J1 Pin-out

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

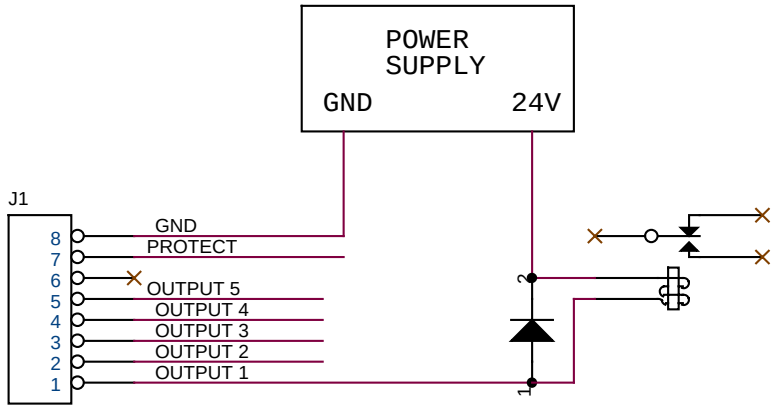
8.8 Solid state limit switch output cautions

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.



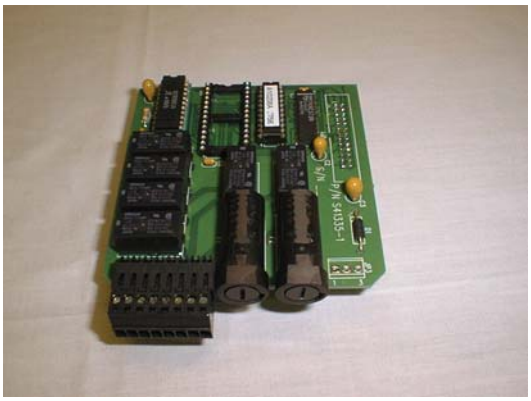
If you do not use the TDD internal kickback protection you must provide kickback suppression externally as above.

Figure 3: Solid State Limit switch inductive kickback protection

9 Optional Electromechanical Relay Limit Switch

***Note that this option requires TDD power supply between 20 and 26.4 VD**

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

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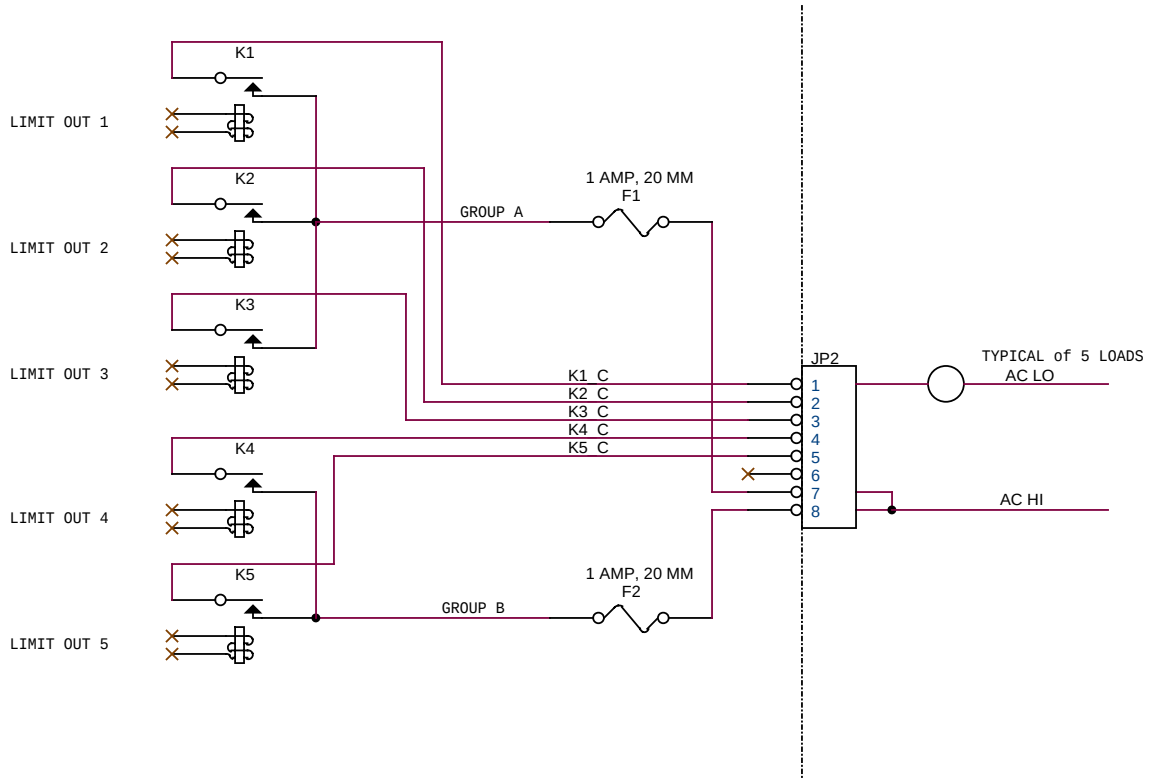


Figure 4 - Example Relay Limit Switch Connections

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. Connections to the analog output are made through connector J2.

Connector J1 Pin-out

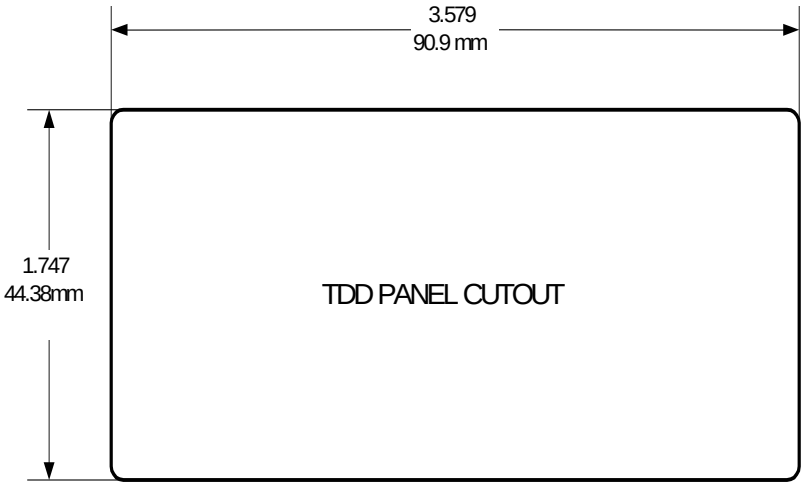
JP2-1: Limit Switch output contact 1	Used with Group A
JP2-2: Limit Switch output contact 2	Used with Group A
JP2-3: Limit Switch output contact 3	Used with Group A
JP2-4: Limit Switch output contact 4	Used with Group B
JP2-5: Limit Switch output contact 5	Used with Group B
JP2-6: Reserved	
JP2-7: Group 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 TDD supply voltage is switched then arc suppression must be installed to limit noise on the power supply.

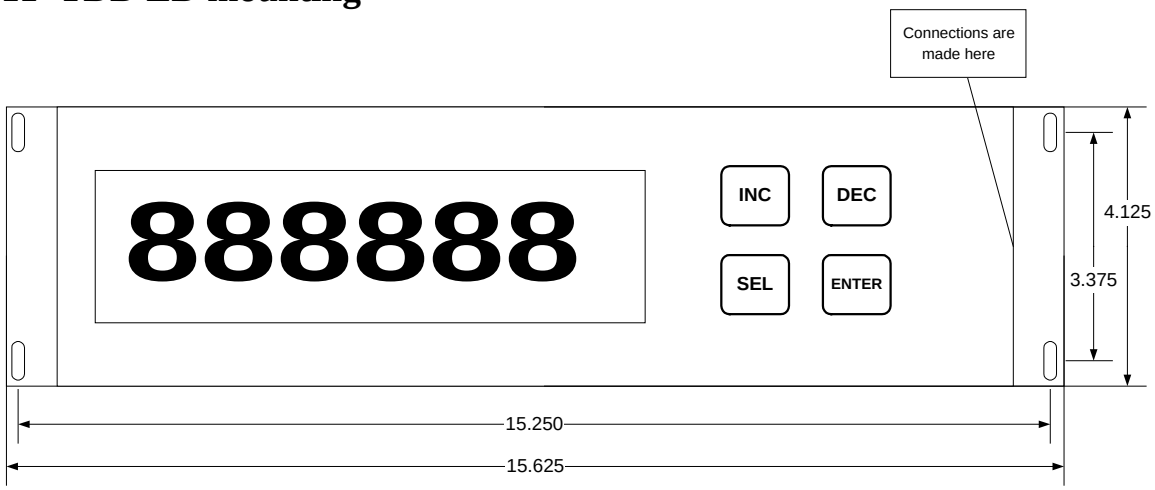
10 TDD Panel Cutout

10.1 TDD Panel cutout Dimensions



The TDD mounts into a panel and requires an 1/8 DIN panel space.

11 TDD LD mounting



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