

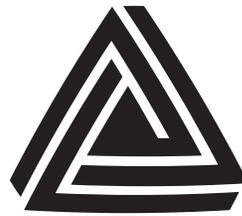
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# Instruction Manual

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ANDERSON-NEGELE

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Instrument Model Number \_\_\_\_\_

Instrument Serial Number \_\_\_\_\_

# MODEL TDL DIFFERENTIAL LEVEL TRANSMITTER

**HART**   
COMMUNICATION PROTOCOL

Form Number AIC2025  
© October 2001  
Revised: February 2015  
Supersedes: May 2014

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# **1 PRODUCT DESCRIPTION AND SPECIFICATIONS**

**QUICKSTART NOTE:**

**Section 1.0 - 5.0  
Section 6.0**

**Installation and startup TDL  
Re-configuration of existing unit**

## **1.1 Principals of Operation**

The Anderson model TDL Differential Level Transmitter is designed to measure liquid level in vessels where the condition inside the vessel is at a positive pressure, or a vacuum, when referenced to atmosphere. Vessels such as pressurized storage tanks, surge tanks, evaporators and vacuum vessels fall into this category. The TDL utilizes dual sensors, with one sensor placed at the bottom of the vessel, and the other sensor placed at the top of the vessel – out of product contact. The bottom sensor sees not only the pressure induced by the product, but also the effect of the pressure or vacuum condition on the head of the product. The top sensor does not see any effect caused by the product in the tank, but only that which is exerted on the head of the product, whether it is a positive or negative pressure condition. The signals from these two sensors, in turn, feed the Transmitter Enclosure. From here, the sensor signals allow the transmitter unit to calculate a true “level output” (Differential between the two probes) regardless of whether the product is under pressurized or vacuum conditions. The unit provides a primary 4-20 mADC output signal directly proportional to the height of the product in the vessel. In addition, a secondary 4-20 mADC signal is provided. This signal may be configured to be directly proportional to the pressure/vacuum condition present in the headspace, or alternately to represent the total tank pressure (product and headspace).

The TDL may also be specified as HART (Highway Addressable Remote Transducer) compatible. When this communications protocol is supplied, a HART compatible communication device may be placed in parallel with output loops on the device. A digital signal is superimposed on top of the standard analog output, allowing setup and configuration of the device via the handheld terminal. In addition, unique tagging and serial number information is available.

## 1.2 Specifications

### DIFFERENTIAL (LEVEL) OUTPUT

Low Range: 0-50" WC min span, 0-415" WC max span  
 Medium Range: 0-100" WC min span, 0-830" WC max span  
 High Range: 0-170" WC min span, 0-1385" WC max span

### SECONDARY OUTPUT (PRESSURE AND/OR VACUUM)

#### Low Range (HD1):

Min Span: 50" WC  
 Max Span: 775" WC  
 Min Low End: -360" WC (26.48" Hg)  
 Max Low End: 0" WC

#### Medium Range (HD2):

Min Span: 100" WC  
 Max Span: 1,190" WC  
 Min Low End: -360" WC (26.48" Hg)  
 Max Low End: 0" WC

#### High Range (HD3):

Min Span: 170" WC  
 Max Span: 1,745" WC  
 Min Low End: -360" WC (26.48" Hg)  
 Max Low End: 0" WC

### PERFORMANCE SPECIFICATIONS

Calibrated Accuracy:  $\pm 0.25\%$  of URL (1" WC for HD1, 2" WC, HD2, 3.5" WC for HD3)  
 Repeatability:  $\pm 0.08\%$  of URL  
 Stability:  $\pm 0.2\%$  of URL per 10°F  
 Resolution: Less than 0.1% of URL  
 Hysteresis:  $\pm 0.07\%$  of URL  
 Linearity:  $\pm 0.1\%$  of URL (Best Fit Straight Line)  
 Over-Range Capacity: 60 psig - low/med range, 100 - psig high range

### TEMPERATURE SPECIFICATIONS

Process Temp. Limits: 0° - 300°F (-18° -149°C)  
 Ambient Temp. Limits: (sensor only): 15° - 120°F (-9° -48°C)  
 Compensated Temp. Range: (sensor only): (Process) 0° - 250°F (-18° -120°C)  
 (Ambient) 15° - 120°F (-9° -48°C)  
 Ambient Temp. Limits (trans. enclosure): 15° to 120°F (-9° -48°C)  
 Temperature Shock (system): -1" to +4" WC per 100°F instantaneous change.  
 Within spec in five minutes.

**ELECTRICAL**

Signal Output: 4-20 mA DC for level output;  
4-20 mA DC for pressure/vacuum/total output

Transmitter Enclosure Power: External Source, 18-30 VDC, 92mA (spec where power supply utilized for Transmitter only)

Loop Power: External Source, 12-30 VDC, 25mA (req'd for each loop) (spec where power supply utilized for Output Loops only)

Common Power Supply: 18-30 VDC, 150mA (spec where power supply utilized for both Loops and Transmitter)

Cable Recommended: 18-24 AWG, 0.17" to 0.26" O.D. stranded, 2 conductor, with ground, shielded and PVC coated.

**MATERIAL AND CONSTRUCTION**

Transmitter Housing: 304 Stainless Steel

Dimensions: 7.87" H x 9.84" W x 5.91" D

Integral LCD: Liquid Crystal, 0.625" high digit

Window Material: Polycarbonate

Sensor Material: 304 and 316 SS finished to maximum  $R_a = 32$  microinches

Wetted Parts: 316L SS, electropolished to maximum  $R_a = 15$  microinches

Wetted Parts-Special: Hastelloy "C" diaphragm optional

**AGENCY APPROVALS**

Hazardous Locations: Intrinsically safe for use in Class1, Div. 1, Groups A-D (UL Listed)

Sanitary Standards: Complies with all applicable provisions of 3-A Sanitary Standards (74-00)

## **2 PRE-INSTALLATION AND MOUNTING**

### **2.1 Unpacking**

Remove the instrument from the carton, and inspect for any damage due to shipment. If damage is visible, be sure to save all packing material. Immediately report and file a claim with the carrier.

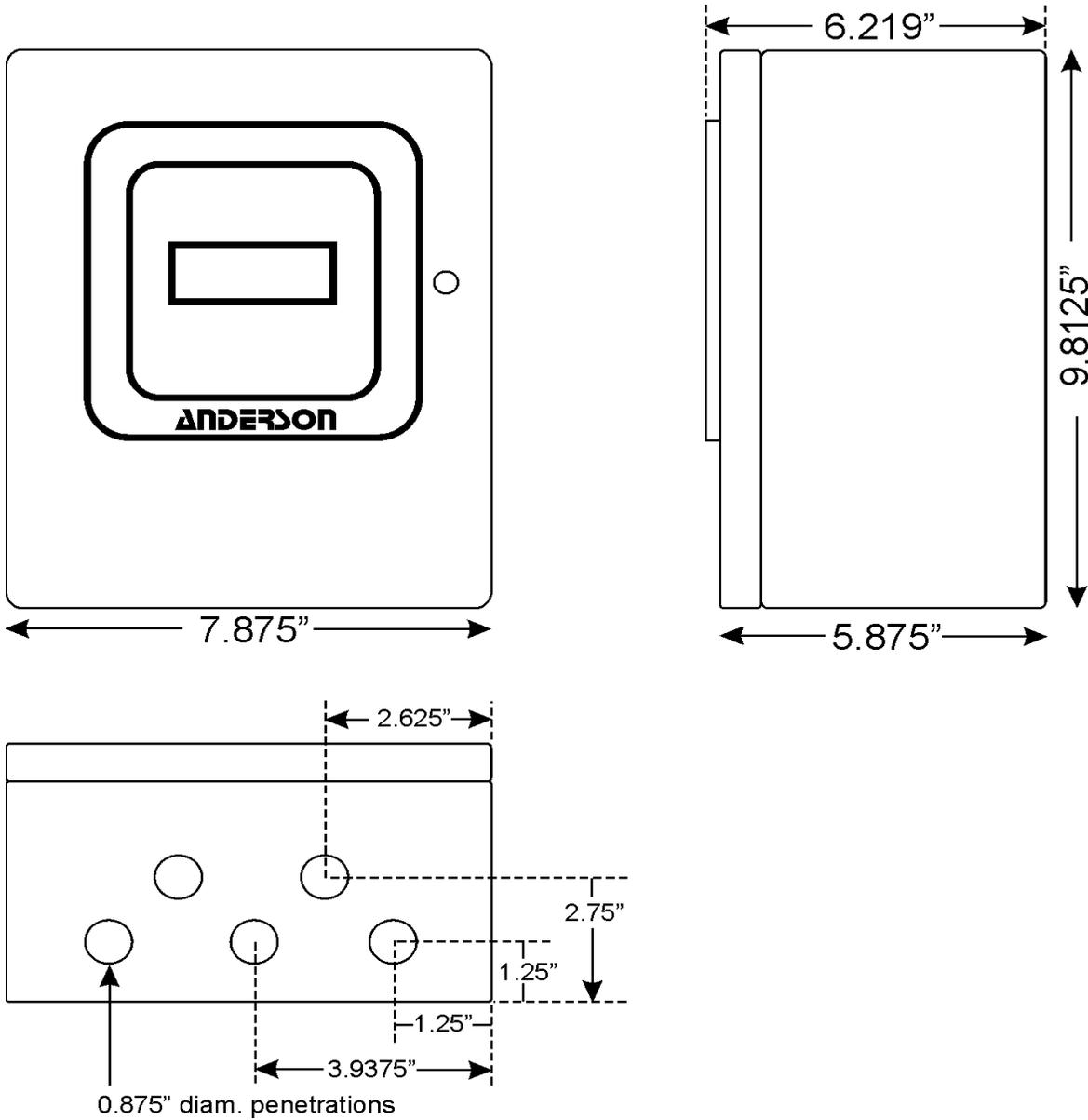
NOTE: Be sure to leave the protective caps on the ends of each of the sensors until time of final installation. Failure to do so will risk damage to the diaphragm portion of the sensor – handle with care.

### **2.2 Location**

The TDL transmitter enclosure is designed to be wall mounted locally at the vessel, or to a leg of the vessel utilizing the included Pipe Mount Kit. Refer to the specifications outlined in Section 1.2 to be sure that the selected area is acceptable. If either the sensors or the transmitter enclosure is being mounted outside, it is recommended that an enclosure be constructed around the equipment to protect it from the elements. In areas where conditions may become extremely cold, it may be necessary to insulate the enclosure, and place heat trace tape inside. Again, refer to the specifications in Section 1.2 to be sure proper temperatures are maintained.

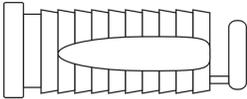
### 2.3 Case Dimensions

The following diagram illustrates the overall case dimensions of the TDL. A total of five 7/8" penetrations have been provided on the underside of the unit for cable entry.



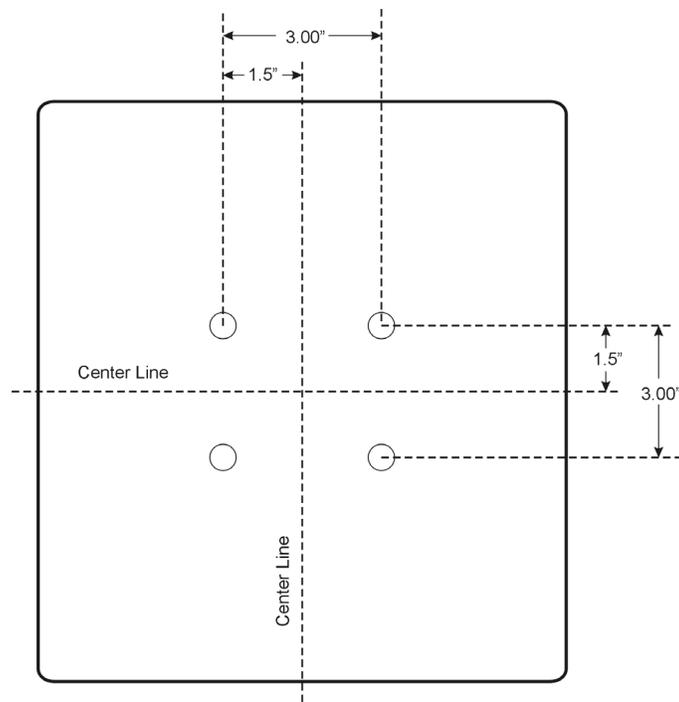
## 2.4 Wall Mounting

A hardware kit has been provided with the TDL for solid wall mounting. Within this kit, identify the following parts:

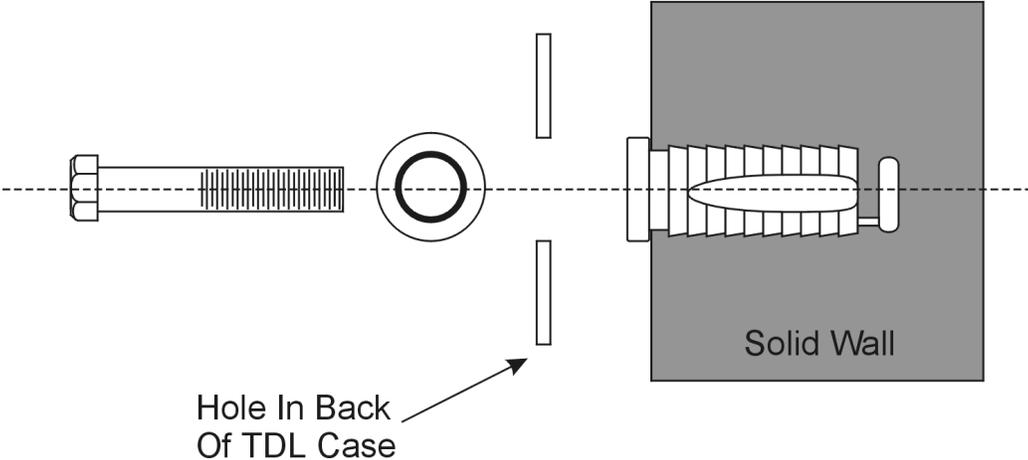
	<p>Qty = 4 Bolt</p>	<p><b>Part Number</b> 4526800000</p>
	<p>Qty = 4 Sealing Washer (Dish Shape)</p>	<p><b>Part Number</b> 44758A0003</p>
	<p>Qty = 4 Concrete Anchor (3/8" Pilot Hole Required)</p>	<p><b>Part Number</b> 4526700000</p>

**CAUTION:** If customer supplied hardware is utilized for wall mounting, care must be taken to seal all areas around the fasteners to prevent moisture entry.

The following diagram shows the locations of mounting holes that have been provided in the back of the TDL transmitter enclosure.

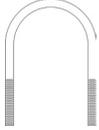
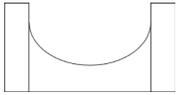
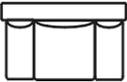


Once the Concrete Anchors have been installed in their pilot holes, the TDL enclosure will be ready for mounting. The following diagram shows the order in which the mounting hardware and the TDL enclosure are assembled:



## 2.5 Pipe Mounting

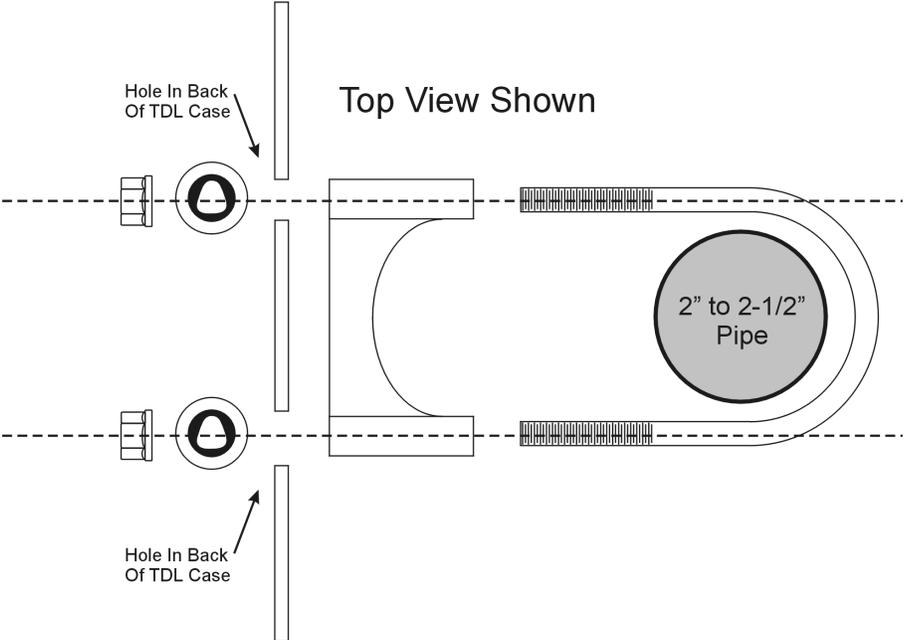
A hardware kit has been provided with the TDL for pipe mounting. Within this kit, identify the following parts:

	<p>Qty = 2 Stainless Steel U Bolt</p>	<p><b>Part Number</b> 45235A0001 (Part of kit)</p>
	<p>Qty = 2 Stainless Steel Clamp</p>	<p><b>Part Number</b> 45235A0001</p>
	<p>Qty = 4 Stainless Steel Nut</p>	<p><b>Part Number</b> 45235A0001</p>
	<p>Qty = 4 Flat Washer With Gasket</p>	<p><b>Part Number</b> 44758A0002</p>

**CAUTION:** If customer supplied hardware is utilized for pipe mounting, care must be taken to seal all areas around the fasteners to prevent moisture entry.

A location should be chosen that allows a good view of the front operating display, but keeps the unit free from heavy traffic areas, falling objects, etc.

The following diagram shows the order in which the mounting hardware and TDL enclosure are assembled:



## **3 WIRING**

Be sure to read these instructions before proceeding with wiring of the TDL. All electrical code requirements apply, and proper safety standards should be observed. Power supply wiring should be performed by a qualified electrician, followed by startup of the instrument qualified personnel.

The TDL top and bottom sensors come pre-wired to the transmitter enclosure. If sensors must be unhooked from the unit to complete installation, refer to the diagrams in this section for proper wire color codes to reinstall the sensors.

### **3.1 Pre-Wiring Precautions**

Electrical noise is a phenomenon typical of industrial environments. The following guidelines should be observed to minimize the effect of noise upon any instrumentation.

Below are some common sources for noise in the industrial environment:

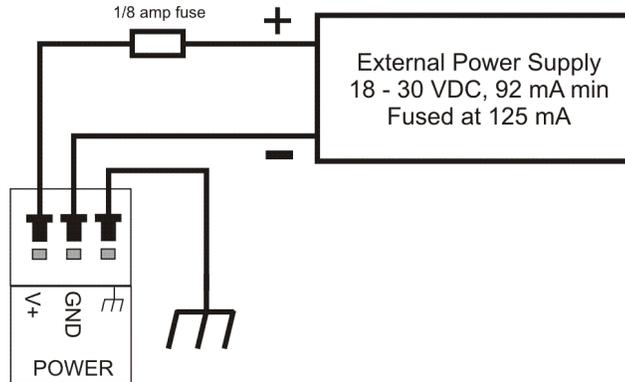
- Ignition Transformers
- Arc Welders
- Mechanical Contact Relays
- Electric Solenoids

Before using any instrument near devices listed, the following guidelines should be followed:

1. If the instrument is to be mounted in the same panel as any of the above devices, separate them by the largest distance possible.
2. If possible, eliminate mechanical contract relays and replace with solid state relays. If a mechanical relay being powered by an instrument output device cannot be replaced, a solid state relay may be used to isolate the device.
3. A separate isolation transformer to feed only instrumentation should be considered. The transformer can isolate the instrument from noise found on the AC power input.
4. If the instrument is being installed on existing equipment, the wiring should be checked to insure that good wiring practices have been followed.

### 3.2 Transmitter Enclosure Power

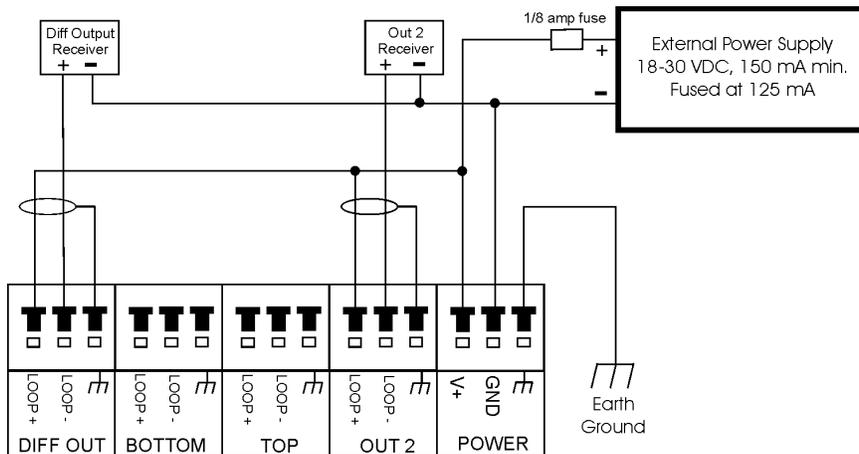
The TDL transmitter enclosure requires power from an 18-30 VDC source. Current requirement is less than 92 mA. Be sure to size the power supply accordingly. A 1/8 amp fuse should be installed in the line. The following diagram illustrates connections to the TDL System Board. Terminals are located on the bottom edge of the board.



See section 3.3 for additional wiring information. The TDL may share a common power supply for both the main power input, as well as the Differential and Secondary outputs.

### 3.3 Output Loop Wiring

The Differential Output, and if utilized, the Secondary Output, require that loop power be externally supplied. Power may originate from the supply that feeds the TDL transmitter enclosure. Wiring is as follows:

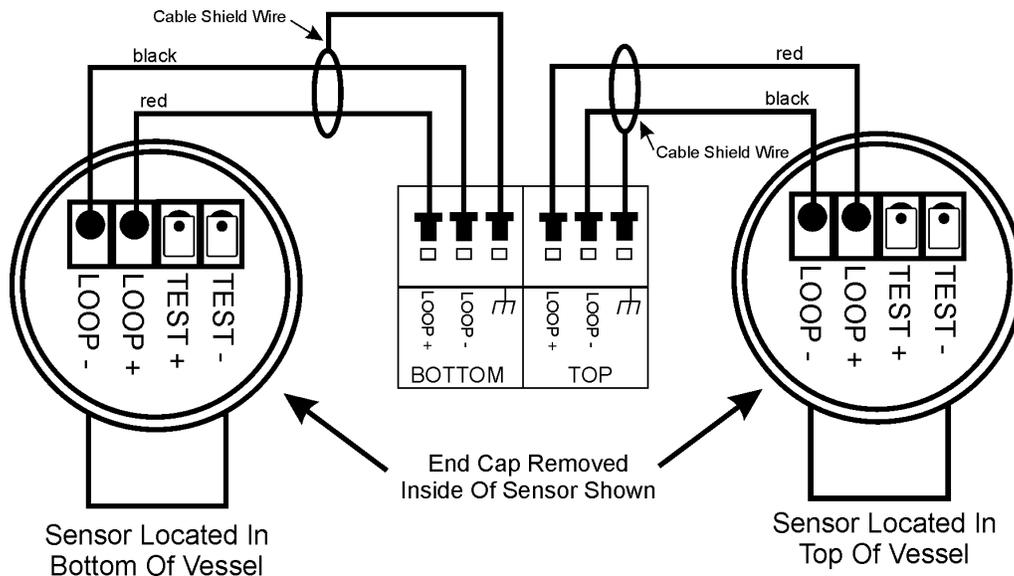


Be sure that the supply is rated at least 150 mA if wired in the above configuration. This will prevent signal drop off from occurring.

### 3.4 Sensor Wiring

Both top and bottom sensor normally ship pre-wired from the factory. During installation of the unit, it may be necessary to disconnect the wiring from the transmitter enclosure. As they are similar, be sure to properly identify the wire from the top and bottom sensor.

The electrical connections are shown below.

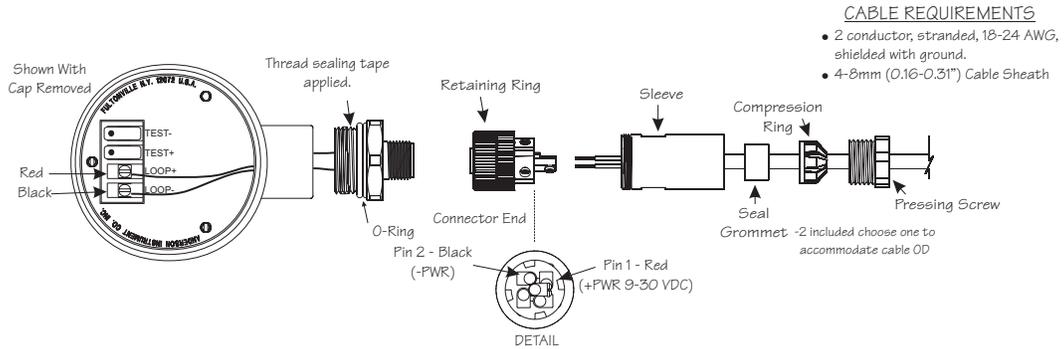


#### 3.4.1 Moisture Proof Quick-Disconnect Receptacle and Field Wireable Connector or Conduit Connector

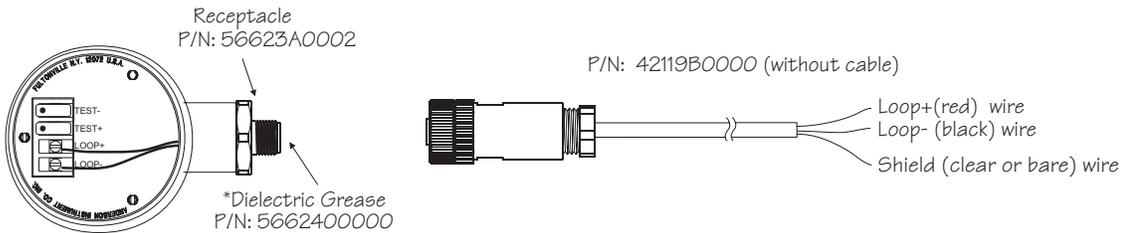
Anderson Instrument Company is pleased to offer all Liquid Level Transmitters with a NEMA 4X / IP-65 rated quick-disconnect receptacle, and a two year warranty against damage due to moisture ingress. The receptacle is installed and wired at the factory, and eliminates the possibility of moisture entering the sensor housing through the cable entry point. Two cable connector options are available from Anderson for use with the receptacle.

- Our standard connector is a NEMA 4X / IP-65 Field Wireable Connector. Upon request, Anderson will pre-wire cable in 25' increments, or customer supplied cable may be utilized and wired in the field. See Cable Requirements below for cable specifications.
- For applications where flexible conduit is utilized, Anderson offers a ½" Conduit Connector which includes 20' of cable and may be installed at the end of the installed flexible conduit. This option isolates the conduit system from the Level Transmitter, thus preventing moisture that may be present in the conduit system from migrating into the sensor housing.
- Alternatively, customers may supply a pre-molded cordset that will mate to our receptacle (Turck minifast® 3-pin). Be certain to specify shielded cable when ordering cordsets, as they may not be standard catalog items.

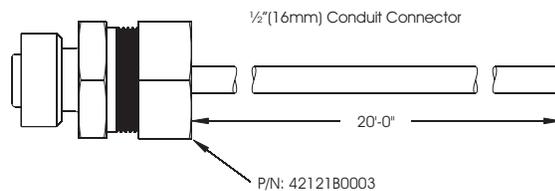
### 3.4.2 Field Wireable Connector Assembly Procedure



1. Insert cable through Pressing Screw, Compression Ring, Seal Grommet, and Sleeve.
2. Strip back 1-1/4" of outer sheathing, cut off any excess wires, shield and ground. Strip off 1/4" insulation from remaining two wires. It is not necessary or recommended to tin the wires.
3. Orient Connector end so that center pin connecting screw is horizontal facing right.
4. Wire LOOP + (red) wire to top-right terminal, and LOOP - (black) wire to top-left terminal. No connection is made to the center and bottom terminals.
5. Screw on the Sleeve. Hand-tighten only.
6. Press the Seal Grommet into the Sleeve and hand-tighten the Pressing Screw.
7. Use a wrench to tighten the Pressing Screw another 3/4 turn. Do not over-tighten!



To install connector, simply line up key, press into receptacle, and hand tighten the retaining ring.



## 4 INITIAL SYSTEM STARTUP

With all mounting, power wiring and signal cable runs complete, the following section illustrates sensor installation into the vessel, along with startup calibration procedures.

### 4.1 Sensor Physical Installation

Identify the Top and Bottom sensors, and properly locate them on the vessel. They may appear identical, but the etching identifies them as Top and Bottom.

Before installation of the sensors, flush out and wipe clean the inside surface of the weld-in shell sensor connection. Inspect with a flashlight for any debris or surface damage, especially in the area where gasket seals are made.

If utilizing the Anderson flush mount sensors, DO NOT use any lubrication on the gasket. The gasket to shell seal should be dry fit only. Hand-tighten only enough to provide proper seal. Over tightening may cause the gasket to bulge into the vessel.

On flanged connections, be sure to properly tighten all mounting hardware.

### 4.2 TDL Zero Calibration

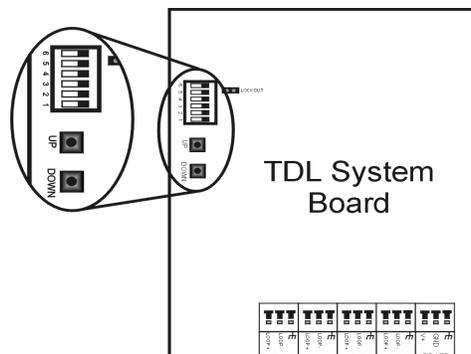
The main TDL power supply should be powered at this time. Additionally, output loop power supplies should be powered if you wish to monitor the TDL signal output.

Both the Top and Bottom sensor MUST be properly installed into the vessel at this time. No product should be present in the vessel, and it should be vented to atmosphere.

Upon initial startup, and as part of a yearly maintenance routine, zero calibration of the unit is required. This calibration compensates for shifts in the sensors output due to the position (angle) of the sensors in the vessel.

NOTE: No tools are required to perform this calibration

The following diagram shows the location of the DIP Switches SW1 through SW6, as well as the momentary contact **UP** and **DOWN** program buttons. The switches and buttons will be used to perform setup and calibration of the TDL unit.

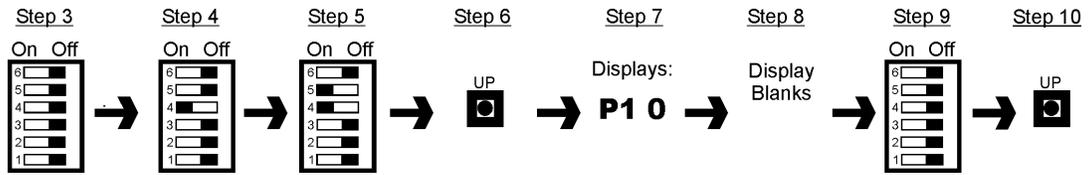


### 4.3 TDL Zero Calibration Procedure

1. Verify that both sensors are properly installed in the vessel and that it is empty and vented to atmospheric pressure.
2. Locate the DIP switch bank on the back of the TDL system board and note the normal operating positions of SW1, SW2, & SW3. Verify that the Lockout shunt is installed.
3. Move all DIP switches to the OFF position.

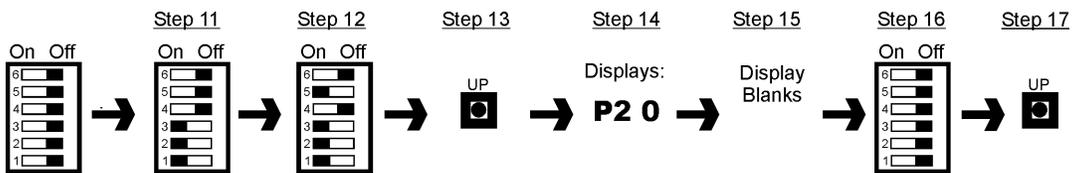
The following steps 4 – 9 will perform the Bottom Sensor Input Zero Calibration.

4. Place switch SW4 in the ON position.
5. Place SW5 in the ON position to enter the Configuration mode.
6. Momentarily press the UP key.
7. The TDL front display will indicate P1 0, and the BTM LED light is lit.
8. Wait 6 seconds for the front display to blank, and the BTM LED to extinguish.
9. Move all switches to the OFF position.
10. Momentarily press the UP key to return the TDL to normal operation.



The following steps 11 - 18 will perform the Top Sensor Input Zero Calibration.

11. Place switches SW1, SW2, & SW3 in the ON position.
12. Place SW5 in the ON position to enter the Configuration mode.
13. Momentarily press the UP key
14. The TDL front display will indicate P2 0, and the TOP LED light is lit.
15. Wait 6 seconds for the front display to blank, and the TOP LED to extinguish.
16. Move all switches to the OFF position.
17. Momentarily press the UP key to return the TDL to normal operation.
18. Move SW1, SW2, & SW3 back to the position noted in step 2.



#### 4.4 TDL Start-Up Checklist

Once the TDL unit is physically installed and wired, the following check list may be followed. It is designed to verify that the unit is working properly. It is not required, but is suggested. The vessel should be empty and vented to atmosphere.

1. Using a Digital Multi-Meter (DMM) measure the DC milliamp output of both the top and bottom sensors as shown in (Section 5.2). Readings should be as shown in Section 5.1.
2. Perform the TDL Zero Calibration (Section 4.3). The Differential output should be 4.00 +/- 0.1 mA.
3. The Secondary output value should match the calculated value for zero pressure. (Section 6.3)
4. Verify that the TDL configuration is correct. Use the worksheet in Section 10.
5. Seal the vessel and bring the pressure or vacuum within the vessel to the normal operating pressure or vacuum. The Differential output should remain at 4.00 +/- 0.1 mA.
6. The Secondary output value should increase or decrease with pressure or vacuum.
7. Vent the tank to atmosphere.
8. Add water or product to the vessel and observe the Differential output increase as the level increases.
9. The Secondary output should remain unchanged if set to TOP, or increase slightly if set to BOTTOM.
10. Drain the tank.
11. If the TDL does not perform as expected through any of these tests, see Section 13 Troubleshooting, and if necessary contact the factory for assistance.

## 5 OPERATION

Calibration of the TDL package (Transmitter, Top and Bottom sensors) is always performed at the factory prior to shipment. A data tag, located on the inside of the door, illustrates the factory-programmed range of the unit. This section provides information necessary to check programming, or make modifications to the programming of a unit already existing in the field.

### 5.1 HD Sensor Operation

HD sensors are 2-wire, 4-20 mA transmitters, and are factory calibrated to a fixed range as shown below. The sensors operate by transferring pressure/vacuum exerted on the welded stainless steel diaphragm through a liquid filled system to a strain gauge type transducer. The electrical signal generated by the transducer is then converted to a digital signal, which the internal microprocessor reads. The microprocessor also receives temperature inputs from sensors embedded in the sensor's housing. The pressure signal is scaled, linearized, and corrected for temperature offsets by the microprocessor and output as an analog 4-20 mA. Due to the liquid fill contained within the transmitter's internal capillary, the sensors exhibit sensitivity to tilting. The sensors are factory zeroed at the mounting angle specified at time of order. Corrections can be made in the TDL for changes in actual mounting angles. This correction is made by performing the TDL Zero Calibration (Section 4.3).

There are three ranges available. Using the Order Matrix in Section 12 of this document, the sensor range may be determined, and the Top sensor may be distinguished from the Bottom sensor. The word Top or Bottom will also be marked on the sensor housing.

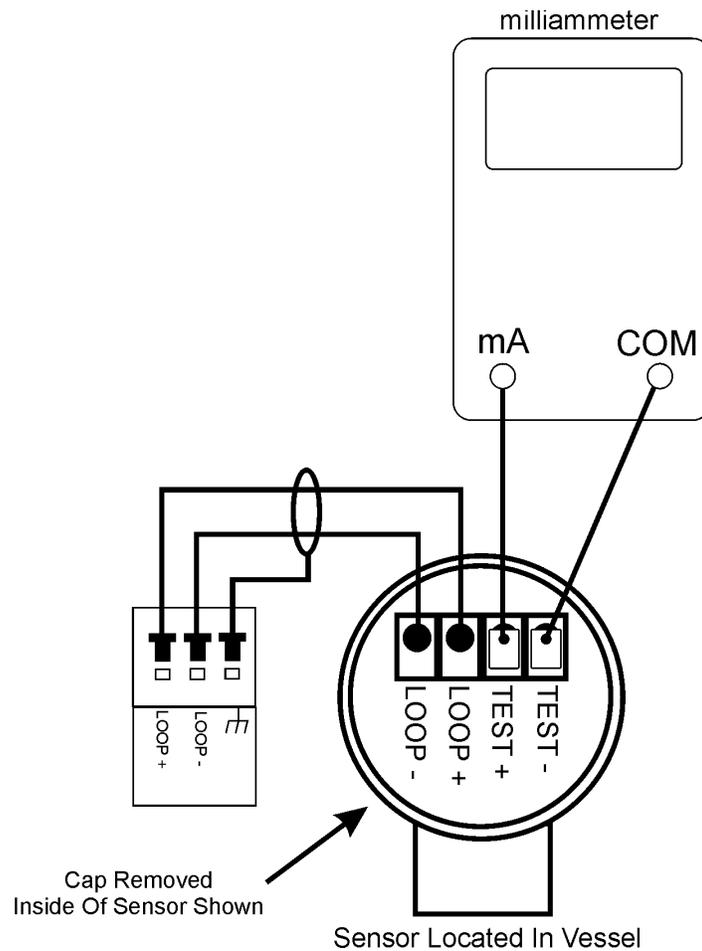
	HD1 - Low Range	HD2 - Medium Range	HD3 - High Range
LRL (Lower Range Limit) 4mA Output	-360"WC (26.48"Hg)	-360"WC (26.48"Hg)	-360"WC (26.48"Hg)
Output at Atmospheric Pressure	11.43 +/- 0.1 mA	8.84 +/- 0.1 mA	7.30 +/- 0.1 mA
URL (Upper Range Limit) 20 mA Output	415"WC (15 psig)	830"WC (30 psig)	1385"WC (50 psig)
Over-range Limit	60 psig	60 psig	100 psig

- The Bottom sensor sees the pressure developed by the product introduced into the vessel, as well as the vacuum or positive pressure placed on the head of the product.
- The Top sensor only sees the vacuum / pressure that is present within the head-space area of the vessel.
- The transmitter unit then takes the Bottom sensor signal, and subtracts the Top sensor signal from it. The result is the Differential, or true level of the product in the vessel no matter what the current condition (vacuum / pressure) may be in the head-space area.

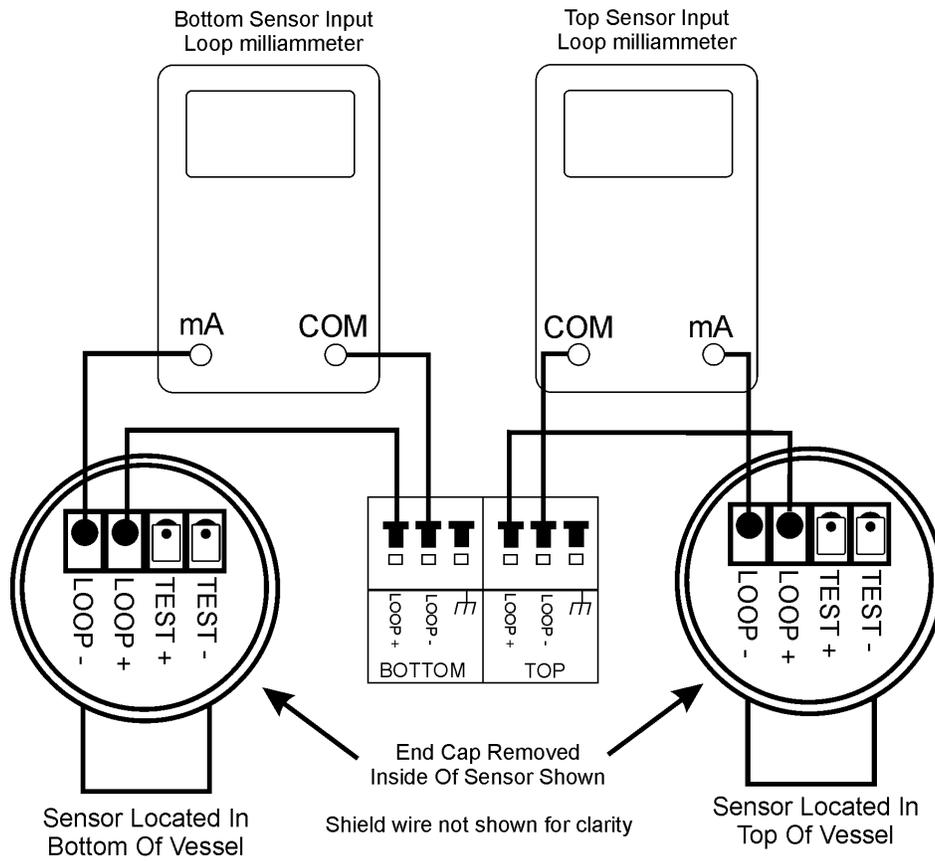
**CAUTION: Sensors are supplied as a matched set with respect to range. In other words, a system must utilize either two HD1 sensors, two HD2 sensors, or two HD3 sensors.**

## 5.2 HD Sensor Testing

To verify that an HD sensor is providing the proper milliamp output, a milliammeter can be connected across the test points within the sensor housing. Monitoring the current this way will not affect the operation of the TDL by interrupting the milliamp input circuits. To access these test points, simply unscrew the housing cap. Do not allow moisture to enter the open sensor housing. The milliammeter leads can be clipped directly to the TEST+ and TEST- test points as shown below. The proper mA output at atmospheric pressure is shown in the table in the previous section.



As an alternative method to using the sensor test points, a milliammeter may also be temporarily wired in series with the sensor input circuit at the TDL system board. However, using this method requires that the sensor input circuit be broken to install the meter, and this will cause the TDL to enter an error condition until the circuit is re-established.



### 5.3 Differential (Level) Output

The Differential output terminals of the transmitter enclosure represent a 4-20 mA signal that is based on the differential calculation performed between the top and bottom sensor signals. The resulting signal may be scaled so that the 20 mA point falls at a user defined span or level. This setting has been performed prior to shipment of the unit, and is defined on the sticker located on the door of the transmitter enclosure. Units are represented in inches of water column, or "WC. This signal represents the true level in the vessel, regardless of what headspace conditions may be present.

Example of Typical Setup:

- Maximum height, in inches, of product above the bottom sensor = 100"
- Specific gravity of the product = 1.00 (Water used for example)
- Resulting "WC =  $100 * 1.0 = 100$ "WC
- This calibration says that if the vessel were filled 100" high with product having a specific gravity of 1.0, we expect to receive 20.00 mA from the DIFF OUT terminals of the TDL.

### 5.4 Secondary Output Operation

In addition to the Differential Output, the TDL transmitter also provides a Secondary Output (OUT 2) signal. Output 2 may be configured to output a 4-20 mA signal that is proportional to either the pressure / vacuum in the headspace of the vessel as measured by the Top sensor, or the pressure / vacuum that exists below the liquid in the vessel as measured by the Bottom sensor. The Range of the Secondary Output is configurable within the range limits of the sensors.

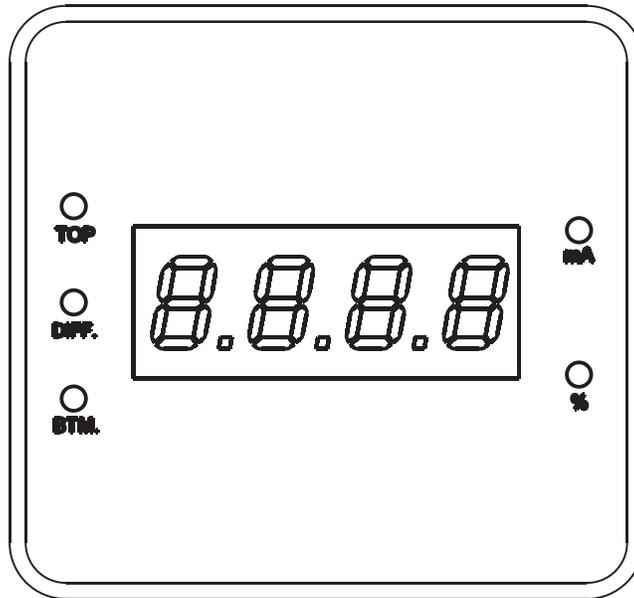
The current operating mode for the secondary output is selected via DIP switch, as shown in Section 6 - Configuration.

### 5.5 User Display Operation

The user display is visible on the front of the transmitter enclosure. It provides real time information based on the current process, and is also utilized during setup and calibration of the instrument.

LEDs located on either side of the display indicate the current operation mode, as well as provide feedback during calibration and setup. LED functions are as follows:

- mA** Indicates display units are in mA DC.
- %** Indicates display units are in percent of full scale.
- TOP** Indicates user display is showing value seen by TOP sensor alone. This value represents only the vacuum / pressure present in the headspace.
- DIFF** Indicates user display is showing value represented by differential of Top and Bottom sensors – this is the true Level of the product in the vessel.
- BTM** Indicates user display is showing value seen by BOTTOM sensor alone. This value represents the total tank (product and headspace) pressure.



## 5.6 Display Settings

The integral LCD display may be configured to indicate either the Differential, or the Secondary output value, and can readout in milliamps or percentage of output. The display can only indicate a single value at a time. It cannot be configured to scroll through the values, or indicate in volumetric or weight units. It is primarily intended to be a troubleshooting or programming tool.

The display's function is determined by the position of DIP switches SW1 and SW3 as shown in the table below.

DIP Switch	On (Switch to left)	OFF (Switch to right)
SW6 SW5 SW4	Configuration Setup Only	Normal Operating Position
SW3	Indicates Secondary Output Value	Indicates Differential Output Value [default setting]
SW2	Secondary Output will be BOTTOM sensor pressure / vacuum (TD_2)	Secondary Output will be TOP sensor pressure / vacuum(TD_1)
SW1	Displays in Percentage of Output (% LED will be lit)	Displays in DC milliamps (mA LED will be lit) [default setting]

## 6 CONFIGURATION

The TDL Differential is configured and calibrated at the factory to the specifications and ranges requested on the TDL Order Worksheet (Section 11). The following information may be used to verify the TDL configuration. Reconfiguring the TDL in the field, although not normally necessary, can be accomplished by following the instructions in this section of the manual. Modifying the TDL from its original factory configuration should only be attempted by a qualified individual, who is familiar with the principles of differential level measurement, and process instrumentation.

TDL configuration does not require any special tools except for a simple calculator. Configuration is accomplished utilizing the TDL display and the DIP switches and push buttons on the backside of the TDL system board. The TDL display does not indicate pressure or level units. It is only capable of displaying a value in milliamps, which represent a corresponding pressure. The range of the display is 4-20 mA, where the equivalent pressure range is equal to that of the sensor and therefore dependent on which range sensor is used. The formulas to calculate the milliamp reading to represent a desired pressure are included below as well as a table in Section 9. Be certain to use the correct formula for the sensor range utilized.

It is important to note that the DIP switches must be toggled in the order as instructed. Undesirable results may occur if the procedure is not properly adhered to. It helps to understand the function of the switches. Start by noting the positions of switches SW1, SW2, & SW3, and then switching them all OFF. For configuration purposes, DIP switches SW1, SW2, SW3, & SW4 are set in a particular combination to access a particular configuration parameter. Once the first four switches are set, then SW5 can be switched ON to enter the Configuration mode for the selected parameter. Next, move all five switches back to the OFF position. The milliamp value representing the selected parameter will then be displayed and can be modified using the UP and DOWN keys. Toggling SW6 ON and immediately OFF again will enter the displayed value into the TDL. SW6 must be toggled even if the value was not changed. Pressing the UP key at this point will return the TDL to normal operation. Switches SW1, SW2, & SW3 can then be returned to their original positions.

A Lockout shunt is located in the TDL system board. Removing this shunt from both pins, will prevent accidental entry to the TDL Configuration mode. The shunt must be placed over both pins to allow access to the TDL Configuration, or Calibration modes.

**Please do not proceed into the Configuration section until you have read and understand Section 5 - Operation.**

## 6.1 Differential Output Calculations

### Differential Output Range Limits

Sensor:	HD1 - Low Range	HD2 - Medium Range	HD3 – High Range
Minimum URV	50"WC	100"WC	170"WC
Maximum URV	415"WC	830"WC	1385"WC
Max. Pressure	15 psig	30 psig	50 psig

1. Determine the desired Differential Output (Level) span in inches of water column ("WC). This is accomplished by multiplying the maximum level height above the sensor in inches by the specific gravity of the product in the tank.
2. Determine if you are using Low (HD1), Medium (HD2), or High (HD3) Range series sensors (See sticker located on door).
3. Verify that the desired Differential Output (Level) span is within the Range Limits noted in the table above. If the desired range is below the minimum span, you must either utilize a lower range sensor, or configure the transmitter to the minimum allowable span. Do not attempt to configure the transmitter to a Diff URV below the minimum, because an unstable output will result.
4. Translate the Diff URV in "WC to mA using the following formulas, or the table in Section 9:

If using an HD1 – Low Range sensors, perform the following calculation:

$$[["WC / 775] \times 16] + 4 = \text{Diff URV mA Translation}$$

If using an HD2 – Medium Range sensors, perform the following calculation:

$$[["WC / 1190] \times 16] + 4 = \text{Diff URV mA Translation}$$

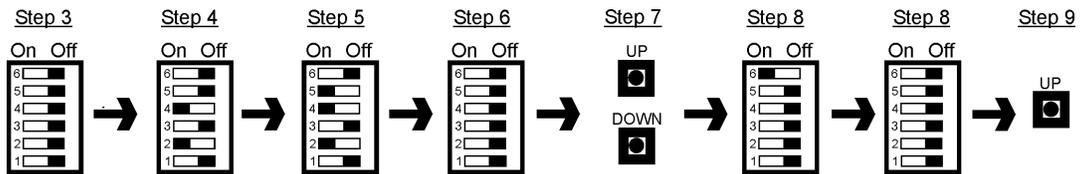
If using an HD3 – High Range sensors, perform the following calculation:

$$[["WC / 1745] \times 16] + 4 = \text{Diff URV mA Translation}$$

Examples of the above calculations can be found in Section 9.

### 6.2 Differential Output Configuration Procedure

1. Perform the Diff URV translation as described above.
2. Locate the DIP switch bank on the back of the TDL system board and note the normal operating positions of SW1, SW2, & SW3. Verify that the Lockout shunt is installed.
3. Move all DIP switches to the OFF position.
4. Place SW2 & SW4 in the ON position.
5. Place SW5 in the ON position to enter the Configuration mode.
6. Return all switches to the OFF position, and view the existing Diff URV value.
7. Use the UP and DOWN keys to modify the value.
8. Once the desired value is displayed, toggle SW6 ON and immediately OFF again to enter the value into the TDL.  
Note: SW6 must be toggled even if the value was not modified.
9. Press the UP key to return to Run mode.
10. Return switches SW1, SW2, and SW3 to the positions noted in step 2.



### 6.3 Secondary Output Calculations

#### Output 2 Range Limits

Sensor:	HD1 - Low Range	HD2 - Medium Range	HD3 - High Range
Minimum LRV	-360"WC (26.5"Hg)	-360"WC (26.5"Hg)	-360"WC (26.5"Hg)
Maximum URV	415"WC (15 psig)	830"WC (30 psig)	1385"wc (50 psig)
Minimum Span	50"WC	100"WC	170"WC

1. Determine if you are using Low (HD1), Medium (HD2), or High (HD3) Range series sensors (See sticker located on door).
2. Verify that the desired Output 2 Range Values are within the Range Limits noted in the table above.
3. A Table is provided in Section 9 which lists common engineering unit conversions, and mA LRV and URV translations for some common ranges. For ranges not shown on the table, use the formulas below.
4. If using HD1 – Low Range sensors, perform the following calculation:

$$[[["WC + 360] / 775] \times 16] + 4 = \text{Out 2 mA Translation}$$

If using HD2 – Medium Range sensors, perform the following calculation:

$$[[["WC + 360] / 1190] \times 16] + 4 = \text{Out 2 mA Translation}$$

If using HD3 – High Range sensors, perform the following calculation:

$$[[["WC + 360] / 1745] \times 16] + 4 = \text{Out 2 mA Translation}$$

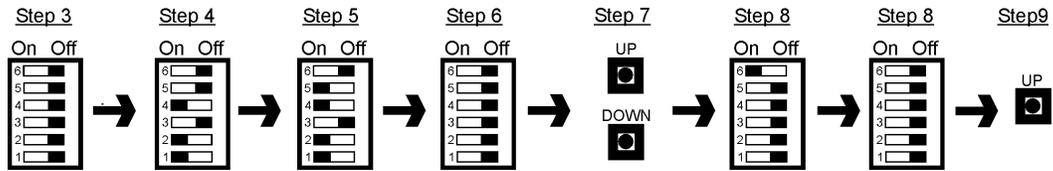
Examples of the above calculations can be found in Section 9.

## 6.4 Secondary Output Configuration Procedure

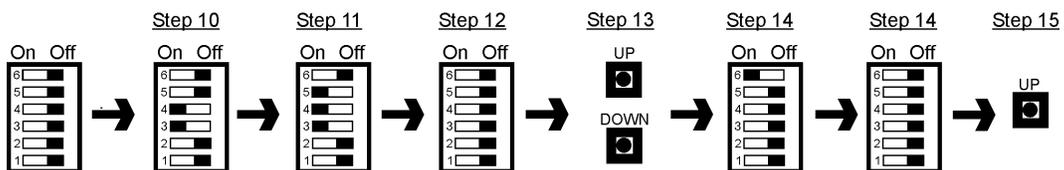
The Secondary Output Top and Bottom output ranges are configured independently. Only the signal which is selected by DIP switch SW2 will be available on the Output 2 terminals. It is only necessary to configure the Output 2 range that is actually being used. By default, the Output 2 range is set to match the range limits.

### 6.4.1 Secondary Output Proportional to TOP Sensor Pressure (TD\_1) (Top URV and LRV Parameter Configuration)

1. Perform the TDL mA translation as described above for both the Upper and Lower Range Values.
2. Locate the DIP switch bank on the back of the TDL system board and note the normal operating positions of SW1, SW2, & SW3. Verify that the Lockout shunt is installed.
3. Move all DIP switches to the OFF position.
4. To set the Top LRV, place SW1, SW2 & SW4 in the ON position.
5. Place SW5 in the ON position to enter the Configuration mode.
6. Return all switches to the OFF position, and view the existing Top LRV value.
7. Use the UP and DOWN keys to modify the value.
8. Once the desired value is displayed, toggle SW6 ON and immediately OFF again to enter the value into the TDL.  
Note: SW6 must be toggled even if the value was not modified.
9. Press the UP key to return to Run mode.

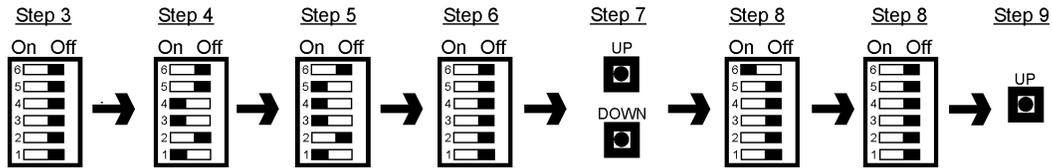


10. To set the Top URV, place SW3 & SW4 in the ON position.
11. Place SW5 in the ON position to enter the Configuration mode.
12. Return all switches to the OFF position, and view the existing Top URV value.
13. Use the UP and DOWN keys to modify the value.
14. Once the desired value is displayed, toggle SW6 ON and immediately OFF again to enter the value into the TDL.  
Note: SW6 must be toggled even if the value was not modified.
15. Press the UP key to return to Run mode.
16. Return switches SW1, SW2, and SW3 to the positions noted in step 2.

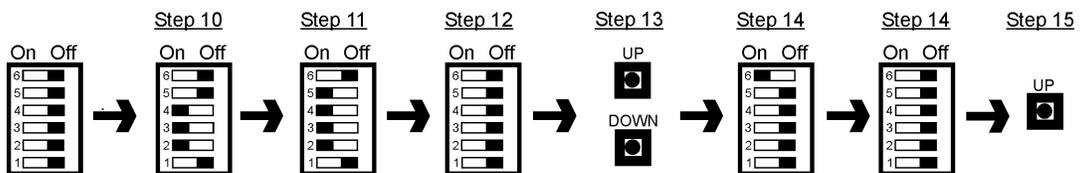


### 6.4.2 Secondary Output Proportional to BOTTOM Sensor Pressure (TD\_2) (Bottom URV and LRV Parameter Configuration)

1. Perform the TDL mA translation as described above for both the Upper and Lower Range Values.
2. Locate the DIP switch bank on the back of the TDL system board and note the normal operating positions of SW1, SW2, & SW3.  
Verify that the Lockout shunt is installed.
3. Move all DIP switches to the OFF position.
4. To set the Bottom LRV, place SW1, SW3, & SW4 in the ON position.
5. Place SW5 in the ON position to enter the Configuration mode.
6. Return all switches to the OFF position, and view the existing Bottom LRV value.
7. Use the UP and DOWN keys to modify the value.
8. Once the desired value is displayed, toggle SW6 ON and immediately OFF again to enter the value into the TDL.  
Note: SW6 must be toggled even if the value was not modified.
9. Press the UP key to return to Run mode.



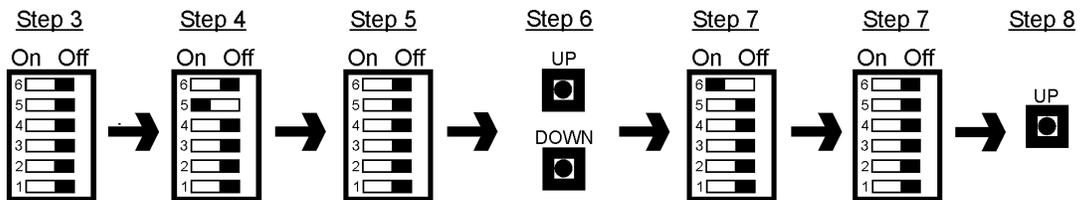
10. To set the Bottom URV, place SW2, SW3, & SW4 in the ON position.
11. Place SW5 in the ON position to enter the Configuration mode.
12. Return all switches to the OFF position, and view the existing Bottom URV value.
13. Use the UP and DOWN keys to modify the value.
14. Once the desired value is displayed, toggle SW6 ON and immediately OFF again to enter the value into the TDL.  
Note: SW6 must be toggled even if the value was not modified.
15. Press the UP key to return to Run mode.
16. Return switches SW1, SW2, and SW3 to the positions noted in step 2.



### 6.5 Sensor Type Configuration

If the TDL is provided with the HART communications option (TD2\_), part of the configuration is to select which sensor range is being utilized. This allows the TDL to communicate in actual pressure units with the HART host device. The procedure to configure the sensor type follows:

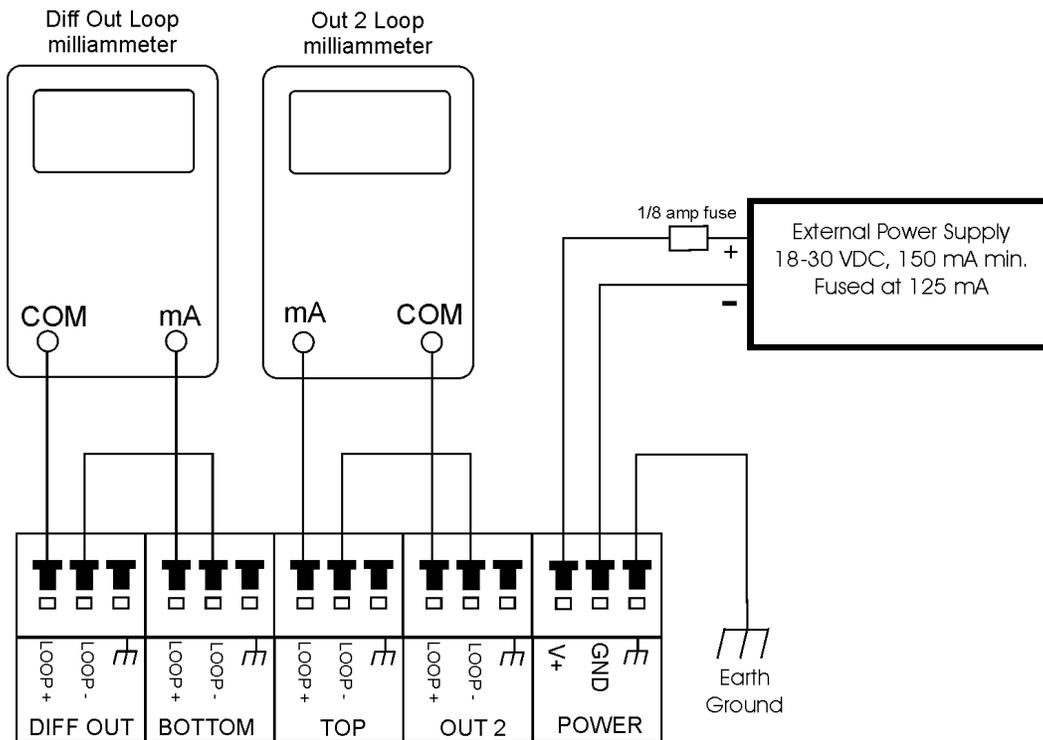
1. Determine if you are using Low (HD1), Medium (HD2), or High (HD3) Range series sensors (See sticker located on door).
2. Locate the DIP switch bank on the back of the TDL system board and note the normal operating positions of SW1, SW2, & SW3. Verify that the Lockout shunt is installed.
3. Move all DIP switches to the OFF position.
4. Place SW5 in the ON position to enter the Configuration mode.
5. Return SW5 to the OFF position, and view the existing Sensor Type value.
6. Use the UP and DOWN keys to modify the value.  
The value will change after a short delay once the key is released.  
(The display will indicate: 41.5- for HD1, 83.0- for HD2, or 13.85 for HD3)
7. Once the desired value is displayed, toggle SW6 ON and immediately OFF again to enter the value into the TDL.  
Note: SW6 must be toggled even if the value was not modified.
8. Press the UP key to return to Run mode.
9. Return switches SW1, SW2, and SW3 to the positions noted in step 2.



## 7 CALIBRATION

The TDL Differential Level transmitter contains a calibration routine to digitally calibrate the two analog inputs and the two analog outputs. The sensors are disconnected from the TDL system board for this routine. The Output Loop routine requires that a digital milliammeter be connected across the output terminals as the reference. The Input Loop routine requires that the outputs be wired back into the inputs. Performing the Input and Output Loop calibrations will not affect the TDL configuration.

For any of the calibration procedures, the TDL system board should be wired as shown below:



## 7.1 Output Loop Calibration

1. Remove supply power from the TDL system board.
2. Locate the DIP switch bank on the back of the TDL system board and note the normal operating positions of SW1, SW2, & SW3.  
Verify that the Lockout shunt is installed.
3. Wire the TDL as shown in the diagram above. Place with your milliammeter in the Diff Out loop as shown. Reapply supply power.  
The display will flash LO.OP until the calibration mode is entered.
4. Move all DIP switches to the OFF position.
5. To calibrate the 4 mA Diff Out, place SW1 in the ON position.
6. Place SW5 in the ON position to enter the Configuration mode.
7. The display will indicate LP1. L.
8. Observe the mA output as displayed on the milliammeter.
9. Use the UP and DOWN keys to modify the value until it is 4.00 mA.
10. Toggle SW6 ON and immediately OFF again to enter the value into the TDL.  
Note: SW6 must be toggled even if the value was not modified.
11. Return all switches to the OFF position.
12. Press the UP key to return to Run mode.  
The display will again flash LO.OP.
13. To calibrate the 20 mA Diff Out, place SW2 in the ON position.
14. Place SW5 in the ON position to enter the Configuration mode.
15. The display will indicate LP.1H.
16. Observe the mA output as displayed on the milliammeter.
17. Use the UP and DOWN keys to modify the value until it is 20.00 mA.
18. Toggle SW6 ON and immediately OFF again to enter the value into the TDL.  
Note: SW6 must be toggled even if the value was not modified.
19. Return all switches to the OFF position.
20. Press the UP key to return to Run mode.  
The display will again flash LO.OP.
21. Place your milliammeter in the Out 2 loop as shown.
22. To calibrate the 4 mA Out 2, place SW1 & SW2 in the ON position.
23. Place SW5 in the ON position to enter the Configuration mode.
24. The display will indicate LP2.L.
25. Observe the mA output as displayed on the milliammeter.
26. Use the UP and DOWN keys to modify the value until it is 4.00 mA.
27. Toggle SW6 ON and immediately OFF again to enter the value into the TDL.  
Note: SW6 must be toggled even if the value was not modified.
28. Return all switches to the OFF position.
29. Press the UP key to return to Run mode.  
The display will again flash LO.OP.
30. To calibrate the 20 mA Out 2, place SW3 in the ON position.
31. Place SW5 in the ON position to enter the Configuration mode.
32. The display will indicate LP.2H.
33. Observe the mA output as displayed on the milliammeter.
34. Use the UP and DOWN keys to modify the value until it is 20.00 mA.
35. Toggle SW6 ON and immediately OFF again to enter the value into the TDL.  
Note: SW6 must be toggled even if the value was not modified.
36. Return all switches to the OFF position.
37. Press the UP key to return to Run mode.  
The display will again flash LO.OP.
38. Return switches SW1, SW2, and SW3 to the positions noted in step 2.
39. It is suggested to proceed from here directly to the Input Loop Calibration.

## 7.2 Input Loop Calibration

1. The Input Loop calibration utilizes the TDL outputs to simulate TDL sensor inputs, therefore the TDL Output Loop Calibration MUST be performed prior to the TDL Input Loop Calibration
2. Locate the DIP switch bank on the back of the TDL system board and note the normal operating positions of SW1, SW2, & SW3. Verify that the Lockout shunt is installed.
3. Wire the TDL as shown in the diagram above. Place with your milliammeter in the Diff Out loop as shown. Display will flash LO.OP
4. Move all DIP switches to the OFF position.
5. To calibrate the Bottom Sensor Input loop, place SW2 & SW3 in the ON position.
6. Place SW5 in the ON position to enter the Configuration mode.
7. Momentarily press the UP key. P1.-L will be displayed and the BTM LED will be lit. A 4.00 mA output will be displayed on the milliammeter.
8. Within about 6 seconds the display will read P1.-H and 20.00 mA will be displayed on the milliammeter.
9. Wait 8 seconds for the front display to blank, and the BTM LED to extinguish.
10. Move all switches to the OFF position.
11. Momentarily press the UP key to return the TDL to normal operation.

The following steps 12-20 will calibrate the Top Sensor Input

12. Move the milliammeter to the Out 2 loop as shown.
13. To calibrate the Top Sensor Input loop, place SW1 & SW3 in the ON position.
14. Place SW5 in the ON position to enter the Configuration mode.
15. Momentarily press the UP key. P2.-L will be displayed and the TOP LED will be lit. A 4.00 mA output will be displayed on the milliammeter.
16. Within 6 seconds the display will read P2.-H and 20.00 mA will be displayed on the milliammeter.
17. Wait 8 seconds for the front display to blank, and the TOP LED to extinguish.
18. Move all switches to the OFF position.
19. Momentarily press the UP key to return the TDL to normal operation.
20. Return switches SW1, SW2, and SW3 to the positions noted in step 2.
21. Reconnect the sensors and perform the TDL Zero Calibration (Section 4.3) procedure.

## **8 HART COMMUNICATION OPERATION**

The model TDL Differential Level is available with HART Communication as an option. HART stands for Highway Addressable Remote Transducer, and is a digital signal that is superimposed over the 4-20 mA analog output signals coming from the TDL. The sticker located in the door of the unit will indicate if the HART option is present. In addition, you may use the Order Matrix in Section 12 of this document to define the digits of the transmitter model number. This will determine if the unit has the HART option installed.

### **8.1 Communications Using HART**

Communication is accomplished via a “HART” Hand Held Terminal (HHT). You may contact Anderson regarding information on where to obtain a unit. Optionally, many third party packages are available that run on a personal computer.

### **8.2 Connecting to the TDL for Communication**

Connection to Differential Output

Allows setup of Differential output scaling parameters

Connection to Output 2 – Mode set to Top Sensor Out

Allows setup of Output 2 – Top scaling parameters.

Connection to Output 2 – Mode set to Bottom Sensor Out

Allows setup of Output 2 – Bottom scaling parameters.

### **8.3 Communication Details**

Complete isolation exists between the Digital HART signal and the Analog 4-20 mA signals coming from the TDL. The 4-20 mA signal remains intact while HART communication is taking place – no changes or loss of signal will occur.

## 9 ENGINEERING UNITS CONVERSION & TDL MA TRANSLATION

The following table includes many common calibration values and their mA translations. The table also includes commonly used engineering units other than "WC. This table may be used instead of calculating TDL mA translations.

<u>Value</u>		<u>Differential mA Translation</u>			<u>Out 2 mA Translation</u>		
<u>PSI</u>	<u>"WC</u>	<u>HD1</u>	<u>HD2</u>	<u>HD3</u>	<u>HD1</u>	<u>HD2</u>	<u>HD3</u>
-13.0	-360.0				4.00	4.00	4.00
-10.0	-277.0				5.71	5.12	4.76
-5.0	-138.5				8.57	6.98	6.03
0.0	0.0	4.00	4.00	4.00	11.43	8.84	7.30
1.8	50.0	5.03			12.46	9.51	7.76
3.6	100.0	6.06	5.34		13.50	10.18	8.22
5.0	138.5	6.86	5.86		14.29	10.70	8.57
6.1	170.0	7.51	6.29	5.56	14.94	11.13	8.86
10.0	277.0	9.72	7.72	6.54	17.15	12.56	9.84
15.0	415.0	12.57	9.58	7.81	20.00	14.42	11.11
30.0	830.0		15.16	11.61		20.00	14.91
40.0	1108.0		18.90	14.16			17.46
50.0	1385.0			16.70			20.00
<u>"Hg vac</u>	<u>"WC</u>	<u>HD1</u>	<u>HD2</u>	<u>HD3</u>	<u>HD1</u>	<u>HD2</u>	<u>HD3</u>
26.5	-360.0				4.00	4.00	4.00
20	-271.7				5.82	5.19	4.81
10	-135.8				8.63	7.01	6.06
<u>mmWC</u>	<u>"WC</u>	<u>HD1</u>	<u>HD2</u>	<u>HD3</u>	<u>HD1</u>	<u>HD2</u>	<u>HD3</u>
1300	51.2	5.06			12.49	9.53	7.77
3000	118.1	6.44	5.59		13.87	10.43	8.38
4400	173.2	7.58	6.33	5.59	15.01	11.17	8.89
10000	393.7	12.13	9.29	7.61	19.56	14.13	10.91
<u>BAR</u>	<u>"WC</u>	<u>HD1</u>	<u>HD2</u>	<u>HD3</u>	<u>HD1</u>	<u>HD2</u>	<u>HD3</u>
-0.8	-321.3				4.80	4.52	4.35
-0.5	-200.8				7.29	6.14	5.46
0	0.0	4.00	4.00	4.00	11.43	8.84	7.30
0.5	200.8	8.15	6.70	5.84	15.58	11.54	9.14
1	401.7	12.29	9.40	7.68	19.72	14.24	10.98
1.5	602.5	16.44	12.10	9.52		16.94	12.82
2	803.3		14.80	11.37		19.64	14.67
2.5	1004.1		17.50	13.21			16.51
3	1205.0			15.05			18.35
3.4	1365.6			16.52			19.82

## 10 TDL SYSTEM QUICK SETUP GUIDE

This sheet is intended to be a single page resource for trouble shooting and installing the TDL by an individual who is already familiar with how the TDL operates and configures. Always begin with all switches in the OFF position, and verify that the Lockout shunt is installed.

### 10.1 Display & Output 2 Operating Mode

DIP Switch	ON	OFF
SW3	Out 2 Displayed	Diff Out Displayed
SW2	Out 2 - BOTTOM	Out 2 - TOP
SW1	% Display	mA Display

### 10.2 TDL Zero Calibration

Vessel must be empty & vented to atmosphere.

TDL Parameter	Switch to ON First:	Then Switch ON:	Press:	TDL Displays:	After Display Blanks:	Press:
Bottom Input Zero	SW4	SW5	UP Key	P1 0	All Switches OFF	UP Key
Top Input Zero	SW1, SW2 & SW3			P2 0		

### 10.3 TDL Configuration

This sheet may be used to record the TDL configuration values, and their mA translations, all in one convenient location. Once you are familiar with the TDL configuration procedures, this sheet may be all that is required to verify the configuration of the TDL.

TDL Parameter	Set to ON DIP Switch:	Value		Conversion		
		mA	"WC	psi	mmWC	bar
Diff LRV	SW1 & SW4	4.00	0.0	0.0	0	0.00
Diff URV	SW2 & SW4					
Top LRV	SW1, SW2 & SW4					
Top URV	SW3 & SW4					
Bot LRV	SW1, SW3, & SW4					
Bot URV	SW2, SW3, & SW4					

1. Place DIP switches in ON position as shown in table above for selected parameter.
2. Place switch SW5 in the ON position to enter the Configuration mode.
3. Move all switches back to the OFF position.
4. View and/or modify mA value on TDL display.
5. Toggle SW6 ON and then immediately to the OFF position.
6. Press the UP key to return to the Run mode.

11 ORDERING WORKSHEET



Anderson Instrument Co., Inc.  
156 Auriesville Rd.  
Fultonville N.Y. 12072

Phone: 518-922-5315 or 800-833-0081  
Fax: 518-922-8997 or 800-726-6733

# Technical Bulletin

## TDL Differential Level Transmitter

### Order Worksheet

**Section 1 - Output Signal**

- 1 Analog (4-20 mA) only     2 Analog w/HART

Distributor: \_\_\_\_\_  
Reference PO#: \_\_\_\_\_  
Tank Name: \_\_\_\_\_

**Section 2 - Product Density (Specific Gravity)**

A. Known SP GR = \_\_\_\_\_ B. SP GR = [ \_\_\_\_\_ (kg/lit) / 1 ] C. SP GR = [ \_\_\_\_\_ (lbs/gal) / 8.345 ]  
(Note: If multiple products in vessel, provide data for heaviest only)

**Section 3 - Vessel Height - Output #1 (Differential)**

A. Determine working height above center line of sensor = \_\_\_\_\_ inches (nearest tenth)

B. Differential Level Calculation = A x Specific Gravity (Section 2)

C. Differential Output Span Calibration (URV) 20 mA at \_\_\_\_\_ inches water column

(If unable to determine working height, please submit complete vessel print)

**Section 4 - Secondary Output**

- 1 Top Sensor (vacuum / pressure)     2 Bottom Sensor (total system pressure)

Output #2 Full Scale Calibration (URV) 20.00 mA at Maximum working pressure = \_\_\_\_\_ inches water column  
(13.56"wc = 1"Hg 27.7"wc = 1 psig 0.03937"wc = 1 mmwc 4.02"wc = 1 kPa 0.402"wc = 1 mBar)

Output #2 Zero Calibration (LRV) 4.00 mA at Minimum working pressure / maximum vacuum = [ - \_\_\_\_\_ ] inches water column  
(Factory default is -360 inches water column)

(Conversion Examples: -360.0"wc = 26.5"Hg 138.5"wc = 5 psig 415.0"wc = 15 psig 830.0"wc = 30 psig 1385.0"wc = 50 psig)

**Section 5 - Sensors**

Select Range:     HD1 Low Range     HD2 Medium Range     HD3 High Range  
Minimum Differential Output    50.0" water column    100.0" water column    170.0" water column  
Maximum Pressure    15 psig (415.0"wc)    30 psig (830.0"wc)    50 psig (1385.0"wc)

**1 Bottom (Total System Pressure)**

**Bottom Sensor Fitting**

- 089 Anderson Flush Mount Long (71060-A3, A5, A7, A9)
- 088 Anderson Flush Mount Short (71060-A4, A6, A8)
- 004 1-1/2" Tri-Clamp
- 005 2" Tri-Clamp
- 141 Rosemount / Foxboro Sanitary Spud - Short
- 142 Rosemount / Foxboro Sanitary Spud - Long
- 150 3" ANSI 150 Flange - Flush
- 151 3" ANSI 150 Flange - 2" extension
- 152 3" ANSI 150 Flange - 4" extension
- 153 3" ANSI 150 Flange - 6" extension

**2 Top (Vacuum / Pressure)**

**Top Sensor Fitting**

- 089 Anderson Flush Mount Long (71060-A3, A5, A7, A9)
- 088 Anderson Flush Mount Short (71060-A4, A6, A8)
- 004 1-1/2" Tri-Clamp
- 005 2" Tri-Clamp
- 141 Rosemount / Foxboro Sanitary Spud - Short
- 142 Rosemount / Foxboro Sanitary Spud - Long
- 150 3" ANSI 150 Flange - Flush
- 151 3" ANSI 150 Flange - 2" extension
- 152 3" ANSI 150 Flange - 4" extension
- 153 3" ANSI 150 Flange - 6" extension

**Diaphragm**

- 1 - SS 316L (Standard)     2 - Hastelloy "C"

**Diaphragm**

- 1 - SS 316L (Standard)     2 - Hastelloy "C"

**Mounting Angle of Diaphragm**

- 0- ←     1- ↑     2- ↗

**Mounting Angle of Diaphragm**

- 0- ←     3- ↓     2- ↘

**Sensor Wiring (see Order Matrix for details)**

- 02 - 10'     05 - 25'     10 - 50'     Other \_\_\_\_\_

**Sensor Wiring (see Order Matrix for details)**

- 02 - 10'     05 - 25'     10 - 50'     Other \_\_\_\_\_



## 13 TROUBLESHOOTING

Troubleshooting assistance is available from the Anderson Distributor that this unit was purchased through, or directly from Anderson at the following numbers:

518-922-5315 or 800-833-0081 between 8:00 am to 5:00 pm Eastern

**After hours for emergency service only**

www.anderson-negele.com

Problem	Solution
TDL display blank, no lights lit	<ul style="list-style-type: none"> <li>Verify operation of main TDL power supply – TDL will not function without this power – you may test at supply, or directly at V+ and GND terminal on the TDL system board (Sect. 3.2)</li> <li>Voltage should be the same as what is designated on the power supply in use – verify what supply is being used (Eg. 24 VDC, 30 VDC)</li> </ul>
TDL Flashing “LOOP” and Top LED	<ul style="list-style-type: none"> <li>Top sensor loop wiring is not intact. Verify proper loop wiring. (Sect. 3.4)</li> </ul>
TDL Flashing “LOOP” and Btm LED	<ul style="list-style-type: none"> <li>Bottom sensor loop wiring is not intact. Verify proper loop wiring. (Sect 3.4)</li> </ul>
TDL Flashing “LOOP”, but loop wiring is confirmed intact.	<ul style="list-style-type: none"> <li>Measure sensor loop current with a milliamp meter. If present, TDL board is damaged. Replace with new board. and be sure to properly fuse. (Sect. 5.2)</li> </ul>
TDL Diff Output stuck at 2.5 mA	<ul style="list-style-type: none"> <li>TDL seeing negative level condition.</li> <li>Verify proper sensor placement. (Sect 4.1)</li> <li>Perform TDL Zero calibration. (Sect 4.2)</li> <li>Verify proper sensor input signals. (Sect 5.2)</li> <li>Verify proper Diff Out configuration. (Sect. 6.2)</li> <li>Perform Input / Output calibration. (Sect. 7)</li> </ul>
TDL Differential Output stuck at 21 mA	<ul style="list-style-type: none"> <li>TDL seeing excess level condition.</li> <li>Verify proper sensor input signals. (Sect. 5.2)</li> <li>Verify proper Diff Out configuration. (Sect. 6.2)</li> <li>Perform Input / Output calibration. (Sect. 7)</li> </ul>
TDL Differential Output not stable	<ul style="list-style-type: none"> <li>Verify good wiring practices. (Sect. 3.1)</li> <li>Diff URV set too low. Observe minimum Diff URV limitations. (Sect. 6.1)</li> </ul>
Differential Output not as expected	<ul style="list-style-type: none"> <li>Perform TDL Zero calibration. (Sect. 4.3)</li> <li>Verify proper sensor input signals. (Sect. 5.2)</li> <li>Verify proper Diff Out configuration. (Sect. 6.2)</li> <li>Perform Input / Output calibration. (Sect. 7)</li> </ul>
Output 2 value not as expected	<ul style="list-style-type: none"> <li>Perform TDL Zero calibration. (Sect. 4.3)</li> <li>Verify proper sensor input signals. (Sect. 5.2)</li> <li>Verify proper Out 2 configuration. (Sect. 6.4)</li> <li>Perform Input / Output calibration. (Sect. 7)</li> </ul>
TDL requires frequent Zero calibrations	<ul style="list-style-type: none"> <li>Verify that the vessel is completely empty and vented to atmosphere during Zero calibration.</li> <li>Verify proper sensor input signals. (Sect. 5.2)</li> </ul>
TDL outputs do not respond to changes in level and/or pressure	<ul style="list-style-type: none"> <li>Verify proper sensor input signals (Sect. 5.2)</li> <li>Verify that sensor input signals change with changes in level and/or pressure. (Sect. 5.2)</li> </ul>
TDL Differential output does not output 20 mA at full vessel condition	<ul style="list-style-type: none"> <li>Density of product may be less that the maximum specific gravity the unit was configured for. (Sect. 6.1)</li> <li>Height of vessel may be less than minimum URV limitation. (Sect. 6.1)</li> <li>Verify proper Diff Out configuration. (Sect. 6.2)</li> <li>Verify that DC power supply is capable of providing enough current. (Sect. 3.2)</li> </ul>
Modifications to the ZERO, DIFF calibration or Secondary Output calibration cannot be made	<ul style="list-style-type: none"> <li>The LOCK shunt, located near the DIP switch bank, must have a shunt over BOTH pins to allow programming. (Sect. 5)</li> </ul>

## **14 PARTS AND ACCESSORIES**

Parts and accessories may be obtained through your authorized Anderson Distributor, or directly from Anderson Instrument Customer Service. You may call directly at:

518-922-5315 or 800-833-0081 between 8:00 am to 5:00 pm Eastern

### **Replacement Motherboard**

(Calibration information must be provided)

Motherboard – Standard Analog (TD1_)	79999TD001
Motherboard – With HART Communications (TD2_)	79999TD002

### **Replacement Sensor Gaskets**

Anderson Fitting – Silicone Rubber (Short 088 or Long 089)	44348A0001
Anderson Fitting – Teflon (Short 088 or Long 089)	44348B0001
Rosemount/Foxboro Sanitary Tank Spud	36240E2341

### **Weld-In Tank Shells**

Note: Insulated styles accept Anderson 089 – Long Sensor Style  
Un-insulated styles accept Anderson 088 – Short Sensor Style

Insulated Vessel – Standard Flange – 316L	71060A0003
Un-insulated Vessel – Standard Flange – 316L	71060A0004
Insulated Vessel – Pressure Vessel Flange – 316L	71060A0005
Un-insulated Vessel – Pressure Vessel Flange – 316L	71060A0006
Insulated Vessel – Standard Flange – Hastelloy	71060A0007
Un-insulated Vessel – Standard Flange – Hastelloy	71060A0008
Insulated Vessel – Heavy Duty Pressure Vessel Flange – 316L	71060A0009

## **15 CONTROL DRAWINGS**

The control drawings shown on the following two pages illustrate how to complete the wiring for the TDL if an Intrinsically Safe installation is required.

Anderson does not provide the required signal barrier strips. Guidelines for selection are provided on the control drawings. Components may be obtained from an electrical equipment supplier.

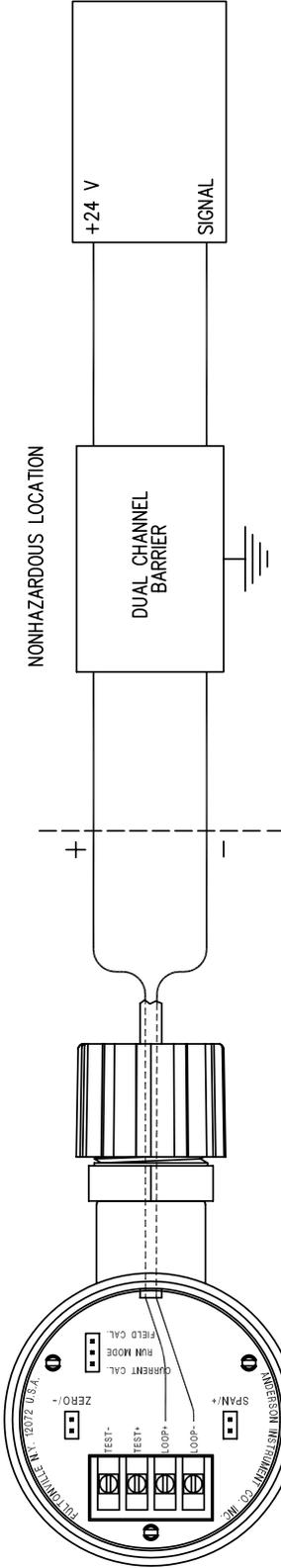
**CAUTION: If an intrinsically safe installation is required, you MUST follow the guidelines shown on the control drawings. Failure to do so will result in the application not meeting code. Proper wiring is the responsibility of the system installer.**

HAZARDOUS AREA  
CLASS I  
GROUPS A, B, C, D

REVISIONS

44-5061.0001

CHANGE NO.	DESCRIPTION	BY	DATE
A 99-022	RELEASED	TJG	3/25/99
B 01-016	REVERSED +24V AND SIGNAL, MOVE HAZARDOUS AREA	TJG	2/13/01
C 02-058	ADDED "3" TO MODEL # 1ST DIGIT, HIGH RANGE	TJG	5/1/02



NOTES:

V max = 40 VDC  
I max = 165 mA  
Ci = 0 uf  
Li = 0 uh  
Cc = Cable Capacitance  
Lc = Cable Inductance

MODEL NUMBERS  
HD - 1 - 1 - 004 - 1 - 0 - 00  
2 OR THRU OR THRU  
3 2 153 2 2 24

- SEE OPERATING INSTRUCTIONS.
- ASSOCIATED APPARATUS MUST NOT BE CONNECTED IN PARALLEL UNLESS PERMITTED BY THE ASSOCIATED APPARATUS APPROVAL.
- WARNING - SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY.
- CAPACITANCE AND INDUCTANCE OF FIELD WIRING FROM THE TRANSMITTER TO THE BARRIER SHOULD BE CALCULATED AS (Cc = 60pf/FT AND Lc = 0.2uh/FT) AND SHOULD BE INCLUDED IN THE SYSTEM CALCULATIONS.

NOTES ON BARRIERS

- MAY BE IN A DIVISION 2 LOCATION IF SO APPROVED.
- OUTPUT CURRENT MUST BE LIMITED BY A RESISTOR SUCH THAT THE OUTPUT VOLTAGE-CURRENT PLOT IS A STRAIGHT LINE DRAWN BETWEEN OPEN CIRCUIT VOLTAGE AND SHORT CIRCUIT CURRENT.
- CABLE CAPACITANCE PLUS INTRINSICALLY SAFE EQUIPMENT CAPACITANCE MUST BE LESS THAN THE MARKED CAPACITANCE (Co) SHOWN ON ANY BARRIER USED. THE SAME APPLIES FOR INDUCTANCE.
- SELECTED BARRIERS MUST BE THIRD PARTY APPROVED AND HAVE Vcc OR Vt NOT EXCEEDING Vmax AND Isc OR IT NOT EXCEEDING Imax AS SHOWN FOR EACH TYPE OF BARRIER IN THE TABLE BELOW.

NOTES ON CONTROL

- MAINS POWER MUST NOT EXCEED 250 VOLTS WITH RESPECT TO EARTH.

EQUIPMENT

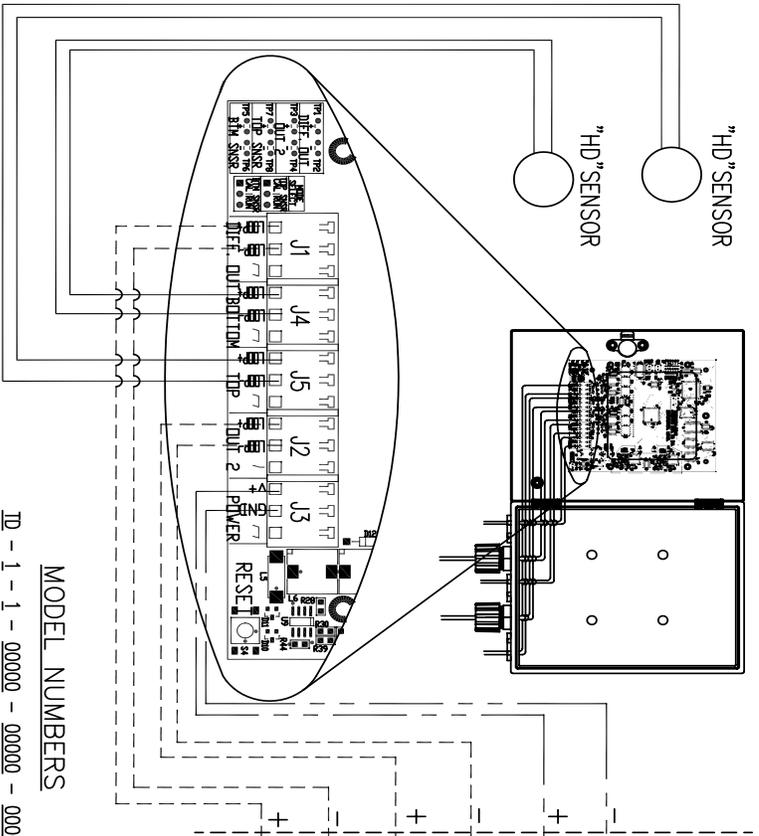
Equipment	Barrier
V max	≥ Voc
I max	≥ Isc
Ci+Cc	≤ Co
Li+Lc	≤ Lo

PROPRIETARY INFORMATION

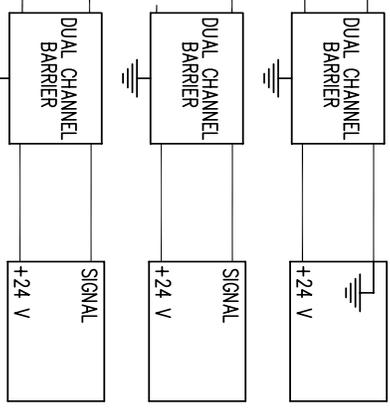
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NEXT ASSY: -N/A-	DRAWN BY: TJG	11/22/00
SCALE: NONE	CHECKED BY:	
MATERIAL: -N/A-	FINISH: -N/A-	
*** UNLESS OTHERWISE SPECIFIED ***		
ALL DIMS ARE IN INCHES BREAK CORNERS .015 MAX.		
ALL SURFACES REMOVE ALL BURRS		
Tolerances on:	3 P.L.C. DEC. ±.004	FRACTIONS ±1/64
	2 P.L.C. DEC. ±.010	ANGLES ±1°
Sheet No. DWG. 445061.0001		REV. C
T. OF J. NO.		R & D DWG. NO.

HAZARDOUS AREA - CLASS 1, GROUPS A, B, C, D



NONHAZARDOUS AREA



NOTES ON BARRIERS

1. MAY BE IN A DIVISION 2 LOCATION IF SO APPROVED.
2. OUTPUT CURRENT MUST BE LIMITED BY A RESISTOR SUCH THAT THE OUTPUT VOLTAGE-CURRENT PLOT IS A STRAIGHT LINE DRAWN BETWEEN OPEN CIRCUIT VOLTAGE AND SHORT CIRCUIT CURRENT.
3. CABLE CAPACITANCE PLUS INTRINSICALLY SAFE EQUIPMENT CAPACITANCE MUST BE LESS THAN THE MARKED CAPACITANCE (Co) SHOWN ON ANY BARRIER USED. THE SAME APPLIES FOR INDUCTANCE.
4. SELECTED BARRIERS MUST BE THIRD PARTY APPROVED AND HAVE Voc OR Vc NOT EXCEEDING Vmax AND Isc OR It NOT EXCEEDING Imax AS SHOWN FOR EACH TYPE OF BARRIER IN THE TABLE ABOVE.

ENTRY PARAMETERS FOR TERMINALS J1, J2, J3

- V max = 30 VDC
- I max = 165 mA
- Ci = 0 uF
- Li = 374 uH
- Cc = Cable Capacitance
- Lc = Cable Inductance

Equipment	Barrier
V max	Voc
I max	Isc
Ci+Cc	Ca
Li+Lc	La

MODEL NUMBERS

ID - 1 - 1 - 00000 - 00000 - 0000	OR THRU	OR THRU	OR THRU
2	2	13900	17500
			3600

1. SEE OPERATING INSTRUCTIONS.
2. ASSOCIATED APPARATUS MUST NOT BE CONNECTED IN PARALLEL UNLESS PERMITTED BY THE ASSOCIATED APPARATUS APPROVAL.
3. WARNING - SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY.
4. IF UNKNOWN, CAPACITANCE AND INDUCTANCE OF FIELD WIRING FROM THE TRANSMITTER TO THE BARRIER AND FROM THE TRANSMITTER TO THE SENSORS SHOULD BE CALCULATED AS (Cc = 60pF/FT AND Lc = 0.2uH/FT) AND SHOULD BE INCLUDED IN THE SYSTEM CALCULATIONS.
5. SENSOR CABLE LENGTH MUST BE ADDED TO BARRIER CABLE LENGTH FOR SYSTEM CALCULATIONS.
6. MAXIMUM CABLE LENGTH FOR TRANSMITTER TO SENSORS IS 200 FT.

NOTES ON CONTROL EQUIPMENT

1. MAINS POWER MUST NOT EXCEED 250 VOLTS WITH RESPECT TO EARTH.

REVISIONS

REV	CHANGE NO.	DESCRIPTION	BY	DATE
A	01-017	RELEASED	TUG	2/12/01
B	01-024	ADD TERM ID, CHG NOTE 4, ADD NOTES 5&6	TUG	2/20/01
C	02-058	ADD DIS TO DO#1 & OUT2'S & ADD OUT2 ZERO	TUG	5/1/02

44506-M1

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PROPERTY INFORMATION

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CONTROL DRAWING DIFFERENTIAL PRESSURE TRANSMITTER

44506-M1

REV. C

3 P.L.C. DEL. ±10% 2 P.L.C. DEL. ±10%

1 OF 1

REV. C

## **16 WARRANTY AND RETURN STATEMENT**

These products are sold by The Anderson Instrument Company (Anderson) under the warranties set forth in the following paragraphs. Such warranties are extended only with respect to a purchase of these products, as new merchandise, directly from Anderson or from an Anderson distributor, representative or reseller, and are extended only to the first buyer thereof who purchases them other than for the purpose of resale.

### **Warranty**

These products are warranted to be free from functional defects in materials and workmanship at the time the products leave the Anderson factory and to conform at that time to the specifications set forth in the relevant Anderson instruction manual or manuals, sheet or sheets, for such products for a period of one year (Enclosure) and two years (Sensors).

THERE ARE NO EXPRESSED OR IMPLIED WARRANTIES WHICH EXTEND BEYOND THE WARRANTIES HEREIN AND ABOVE SET FORTH. ANDERSON MAKES NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE PRODUCTS.

### **Limitations**

Anderson shall not be liable for any incidental damages, consequential damages, special damages, or any other damages, costs or expenses excepting only the cost or expense of repairs or replacement as described above.

Products must be installed and maintained in accordance with Anderson instructions. Users are responsible for the suitability of the products to their application. There is no warranty against damage resulting from corrosion, misapplication, improper specifications or other operating condition beyond our control. Claims against carriers for damage in transit must be filed by the buyer.

This warranty is void if the purchaser uses non-factory approved replacement parts and supplies or if the purchaser attempts to repair the product themselves or through a third party without Anderson authorization.

### **Returns**

Anderson's sole and exclusive obligation and buyer's sole and exclusive remedy under the above warranty is limited to repairing or replacing (at Anderson's option), free of charge, the products which are reported in writing to Anderson at its main office indicated below.

Anderson is to be advised of return requests during normal business hours and such returns are to include a statement of the observed deficiency. The buyer shall pre-pay shipping charges for products returned and Anderson or its representative shall pay for the return of the products to the buyer.

An RMA (Return Merchandise Authorization) must be obtained from Anderson Customer Service before returning merchandise.

Approved returns should be sent to:

Anderson Instrument Co., Inc.  
156 Auriesville Rd.  
Fultonville, NY 12072

ATTN: Repairs  
Write RMA number on outside of package