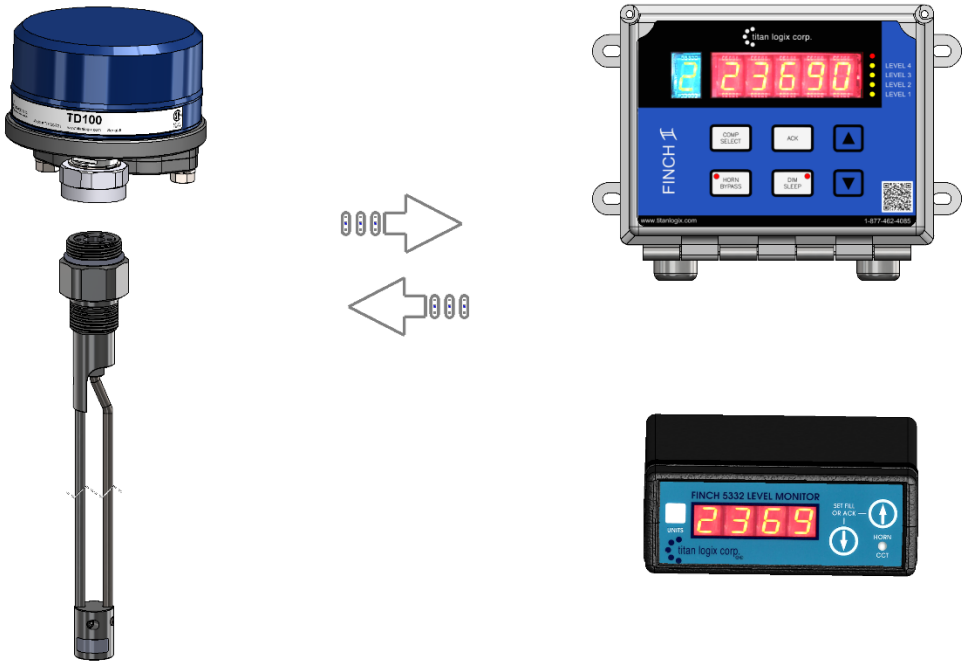
TD80 INSTALLATION & OPERATION MANUAL



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Rev 2.1

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All returns for credit are subject to a restocking fee.

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1 TD80 Introduction

1.1 About This Manual

This instruction manual provides information specific to the Titan Logix Corp. TD80™ (hereafter referred to as the TD80) Level Gauging and Overfill Prevention System. Other peripheral equipment should be supplied with its own instruction manual and that manual should be referred to for proper operation of the peripheral equipment.

It is essential that this manual be read and understood for proper installation and operation of your new TD80™ Level Gauging and Overfill Prevention System.

THIS MANUAL INCLUDES:

Introduction	Description of the key features and components of the TD80 Level Gauging and Overfill Prevention System.
Installation	Description of mounting and wiring of equipment.
Troubleshooting	Description of possible problems, their probable causes, and solutions.
Technical Reference	Technical Specification Guides.
Operation	Description of Operation and Alarms.
Programming	Description of Programming requirements and steps.

1.2 Warranty

Please see the Terms and Conditions at http://www.titanlogix.com/support for details about product warranty.

1.3 Disclaimer

The information in this document is subject to change without notice. Titan Logix Corp. makes no representations or warranties with respect to the contents hereof.

> Only qualified personnel should install this product. Please read this manual before installing this product and follow all applicable safety and electrical regulations as required.

1.4 Proprietary Information

The Information disclosed herein contains proprietary rights of Titan Logix Corp. Neither this document nor the information disclosed herein shall be reproduced or transferred to other documents, or used or disclosed to others for manufacturing purposes, or for any other purpose except as specifically authorized in writing by Titan Logix Corp.

1.5 Safety

This manual will use the following standard safety terms and conventions to indicate conditions:

	**WARNING** **Indicates a hazardous situation which, if not avoided, could result in death or serious injury.**

	**CAUTION** **Indicates a hazardous situation which, if not avoided, could result in moderate injury and/or property damage.**

!	**NOTE** **Indicates an important message not related to personal injury or property damage.**

The TD80 system must be installed and operated in accordance with details described in the Titan Logix manuals, application notes, and all other relevant publications. Only qualified personnel familiar with the installation and operation of this equipment should install, adjust, operate, or service this equipment. Failure to observe this warning could result in bodily injury or loss of life.

Do not install or repair the system where flammable gases and/or fumes may be present.

Observe all federal, state/provincial and local safety standards and industry recommended practices.

Turn vehicle power off before any installation or maintenance.

1.6 TD80 System Introduction and Description

1.6.1 About the TD80 System

The TD80 Level Transmitter is the heart of the TD80 level measurement system. The TD80 transmitter uses Guided Wave RADAR (GWR) to measure liquid level in a tank. It does not use any moving parts for level measurement.

Guided Wave RADAR is a contacting level measurement method that uses a probe as a wave guide to channel the radio frequency energy to the liquid being measured. The probe provides an efficient path for the transmitted energy and pulse reflections from the surface of the liquid.

The TD80 transmitter measures the time delay between transmitted and reflected pulses to calculate distance to the material's surface. This distance is then used to determine level of the liquid in the tank.

The calculated level is converted into common volume units and is sent to a Display such as the Finch 5332 Display. The display is also part of an optional secondary overfill prevention system. TD80 generated alarms provide the approaching overfill information to halt loading at industry standard optic controlled loading racks, on-board loading pumps or valves.

The TD80 system consists of a TD80 transmitter, dual rod or coaxial probe and a Finch Display. Optional components such as the Finch Relay Module, horns and lights are installed as required.

1.6.2 TD80 System Components

TD80 Transmitter

The TD80 transmitter generates and processes the GWR signals to determine liquid level in a tank. The TD80 is mounted on the tank top and connected to the probe, is weatherproof and rated for use in hazardous locations where explosive fumes may be present. TD80s are available in two versions, dual rod or coaxial probe for compatibility with a wide range of liquids.

The TD80 transmitter can only be used with probes supplied by Titan.

TD80 transmitters are available with an optional 4-20mA output. This option will communicate level information only (no alarms) to alternate displays.

The Finch II Display is required to display both level information and alarms/states.

Probe

The probe guides the transmitted pulse and reflection from the surface of the liquid. Probes are available in dual rod or coaxial versions and require a matching transmitter type. The probe is mounted on the tank top and is connected to the bottom of the transmitter. Dual rod probes are designed for viscous liquids. Coaxial probes are used mostly for tanks containing products like aviation fuel.

Finch 5332 Display

Finch Displays are available in weather-proof external versions, the Finch 5332E and a smaller internal version, the Finch 5332. Both provide bright LED numeric display of volume information, alarms and system error codes from the TD80 transmitter. Various alarm and error conditions are detected by the transmitter and display. These alarm states control three internal relays for alarm annunciation, overfill and low-level prevention.

1.6.3 Optional Components

P2000

The P2000 is an accessory that enables secondary overfill prevention when used with industry standard optic loading rack controllers.

MIC 10

The MIC 10 is an interface device for connecting multiple TD80s to a third party modem.

Finch Relay Module

The Finch Relay Module is an accessory that enables overfill prevention by control of an onboard pump or loading valve.

Horns and Lights

Alarm reporting is through optional vehicle mounted horns and lights.

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1.6.4 Technical Specifications

Power	**8 to 28VDC @ 125mA max.**
Accuracy	+/- 5mm
Resolution	1mm
Repeatability	1mm
Top Deadband	7.1 inch
Bottom Deadband	4.5 inch
Materials	SS316L, Hastelloy® C276
Process Pressure	14.9 PSI Maximum
Chemical Resistance	Compatible with most substances. Alternate seal materials available.
Cable Entry	1 x ½" NPT threaded entry
Ambient Temperature	-40°F (-40°C) to 185°F (75°C)
Process Temperature	-49°F (-45°C) to 248°F (120°C)
Dielectric Constant of Measured Liquid	Dual rod probe >1.8 Coax probe >1.7
Cable	3 Conductor AWG #14 Max (AWG #18 recommended) (for 4-20mA Output) 5 Conductor AWG #14 Max (AWG #18 recommended)
Enclosure Type:	Type 4/4x
Outputs	SVBus Digital Optional 4-20mA
Hazardous Area Approvals	Class I, Division 1 Groups B, C, D Class II, Groups E, F, G Class III, T5 Class I, Division 2, Groups A, B, C, D T4A

1.6.5 Theory of Operation

Overview

The TD80 system consists of a TD80 transmitter, dual rod or coaxial probe and an internal or external Finch Display. Optional components such as horns and lights are installed as required.

The TD80 continuously measures liquid level in the tank and transmits volume information with alarm states to the Finch Display. This information is presented on a large 4 digit display and to alarm controlled relays. Alarms and errors control three separate relays to signal or control external devices. These relays indicate Spill, High-High (HH) and system Fail alarms to external devices such as overfill prevention valves, lights, horns and stationary loading controls.

The HH, Spill and system Fail alarms provide information to the P2000 or Finch Relay Module and only permits loading while all conditions are safe. HH is normally the first shutdown level; Spill is a backup level slightly higher than HH, while Fail indicates failure of the TD80 system. Activation of any alarm halts loading to prevent a dangerous overfill condition or spill at the loading rack.

TD80 Transmitter and Probe

The TD80 transmits a continuous stream of radio frequency pulses into the probe. These pulses travel along the probe and part of the pulse energy is reflected back to the transmitter when encountering the surface of the liquid in a tank.

Time delay between the transmit pulse and reflected pulse is used to calculate the distance from the tank top mounted transmitter to the liquid level.

The TD80 contains a table describing the tank depth and volumetric characteristics. This table is programmed before installation and operation on the tank. Liquid level is calculated from the table using maximum depth of the tank and distance from the top to the liquid surface. The TD80 “sees” the depth of air space in the tank and calculates the loaded volume.

Physical limitations of GWR create a dead band at the bottom of the probe where the transmitted pulse interferes with the reflected echo. This region of dead band is considered to be the bottom 5.5” of the tank. Any liquid level measured at 5.5” or less is indicated by the Finch as “2 LO”, meaning “too low”. An upper dead band exists at 7.5” from the top on the dual rod and 2.5” on the coaxial probe. Level measurements within the dead bands are inaccurate and unreliable.

Calculated volume is transmitted to a Finch Display by SV Bus while a linearly scaled level is sent by the optional 4-20mA interface. The Finch is able to display up to 4 numeric digits, including a decimal point. This numeric display correctly indicates volume of loaded product in the tank. The 4-20mA output is scaled linearly for a volume of 0% at an output of 4mA and 100% volume at 20mA.

SV Bus

SV Bus is a single wire serial digital communication interface with an error checking protocol that eliminates false communication between the TD80 transmitter and Finch Display. SV Bus is one of the three wires required for TD80 operation with the Finch. The other two wires are power and ground. This bus is designed for reliable communications in stationary and transport environments.

Finch Display

The Finch Display receives a continuous stream of volume information and alarm states from the TD80 on the SV Bus. Volume, alarm states and errors are shown on the 4 digit numeric display. An additional alarm is controlled directly by the Finch. Alarms and errors control three separate relays to signal or operate external devices.

TD80 controlled relays indicate Spill, High-High and system Fail alarms to external devices such as overfill prevention valves, lights, horns and stationary loading controls. The Finch controlled alarm and relay indicates a preset, increasing Fill or decreasing Fall level to warn of an approaching operator action while loading or unloading product.

The Fill/Fall and High-High Alarms remain active until acknowledged by the operator. The Spill alarm remains active until the spill condition is cleared by unloading product below the spill alarm level while the system is powered and monitoring the changing level.

Alarms are acknowledged by button presses on the Finch or a push button connected to the Alarm Acknowledge input.

TD80 reported errors or malfunctions are indicated by the Finch showing "E xx", where xx is an error code and activating the Fail alarm.

Finch reported loss of communication with the TD80 is indicated by showing "----" and activating the Fail alarm.

Relay Module

A Finch Relay Module is available to combine the Finch Spill/Fail and High-High alarm relays with a signal from the vehicle mounted Power Take-Off (PTO) to safely control an onboard overfill prevention system. The Relay Module contains high current relays to energize a bottom loading valve or hydraulic motor bypass valve for loading control. It also contains a terminal strip for power and alarm accessory interconnections.

P2000

The P2000 is an accessory that enables secondary overfill prevention when used with industry standard optic loading rack controllers. The Finch controlled alarms provide an intrinsically safe signal to the P2000 that permits or denies loading at the rack. The loading rack connections are made through a standard 7-pin or 10-pin optic socket.

MIC 10

The MIC 10 is an interface device for connecting multiple TD80s to a third party modem. Level, alarm and error information from the TD80s is collected by the MIC 10 and forwarded to the modem. The modem is then able to wirelessly transmit data to the back office for asset management and tracking purposes.

It can be set to automatically transmit TD80 data at intervals based on a user preferred configuration, or else can send data on command from the modem. The MIC 10 features a PTO signal input to enable data transmission only when the PTO is engaged. This limits the data bandwidth required by a wireless modem.

1.6.6 The TD80 Alarm System

This description refers to TD80 transmitters and Finch 5332E/PS Display (Red Terminal Board version). See notes in parentheses for the Finch 5332E Display (Green Terminal Board version). Internal Finch 5332 description is the same as the 5332E version. Internal Displays are connected by a pigtail with labeled wires instead of a terminal board as in the external Finch versions.

The TD80 alarms are listed below. A vehicle mounted Power Take Off (PTO) unit may signal a loading or unloading event when alarms are required to be activated. A Display Enable (PTO) (or Gauge Enable (PTO) on 5332E Displays) signal to the Finch Display enables these alarms. An inactive PTO signal holds all alarms in the non-alarming state to prevent false triggering due to sloshing while driving. This PTO signal is usually a dry contact switch closed by the mechanical engagement of the PTO.

Fill/Fall Alarm

Fill and Fall alarms share one relay output. The alarm is configured as a Fill or a Fall alarm with Finch Display jumper J9. The alarm point is settable by the operator. The Fill alarm is typically used to warn the operator when the loading process is nearing maximum capacity. The Fall alarm is usually used when unloading and a minimum volume of product must be retained in the tank to prevent pump damage. Fill or Fall operation is determined when the system is installed and is configured inside the Finch Display.

The Finch Display is the source of this alarm. Fill/Fall alarms are indicated by the flashing the current level on the display and activating the Fill/Fall alarm relay.

High-High (HH) Alarm

The High-High alarm is set during transmitter programming and is normally the maximum safe volume of the tank. Dual Rod TD80 transmitters and probes are settable to a volume from 8” below the tank top and lower while the Coaxial TD80 transmitters and probes are able to be set from 3” and lower.

The TD80 transmitter is the source of this alarm. The HH alarm is activated by a measured volume equal to or exceeding the alarm level set during programming. High-High alarms are indicated by alternately flashing “HH” along with the current level on the Display and activating the HH alarm relay.

Spill Alarm

Spill is an approaching overfill condition. Dual Rod TD80 transmitters and probes are factory set at 7.5” below the tank top while Coaxial TD80 transmitters and probes are selectable in the range of 2.5” down to 15.5” from the top.

The TD80 transmitter is the source of this alarm. Spill alarms are indicated by showing “SPill” on the display and activating the spill alarm through the Spill/Fail (or Fail on the 5332E Displays) relay.

Fail Alarm

System failures such as internal transmitter errors, probe faults or loss of communications are reported by the Spill/Fail (or Fail on the 5332E Displays) relay.

The Finch Display reports communication failure. The TD80 transmitter is the source for all other system errors. Errors are displayed as “E xx”, where xx is an error code. Loss of communication between the TD80 and Finch is displayed as “----“.

Alarm Relays

1. Fill/Fall relay
2. High-High relay
3. Spill/Fail (or Fail on 5332E Displays) relay.

Devices such as horns and lights are connected to these alarm relays for operator action. The Fall, High-High and Spill/Fail relays typically operate shutdown controls including external relays, and solenoid operated valves.

1.7 Overfill Prevention System Description

The description below incorporates the recommended Finch Relay Module. See the Overfill Prevention System Installation Section 2.7 for detail.

1. Power On

The TD80 and Finch proceed through the normal start-up sequence as described below. Once completed; “OFF” will be displayed on the Finch. Level is displayed for 30 seconds by a momentary press of the Up or Down buttons.

2. PTO Engaged

The operator engages the truck mounted PTO to begin loading. The PTO signal to the Finch is controlled by an air/electric switch that causes the following to occur:

1. Finch Display to an active mode with all alarms enabled and continuous level display.
2. A Solenoid is energized to allow loading by controlling a **Normally Closed** bottom loading valve or a **Normally Open** hydraulic motor bypass valve.
3. The Green Light is on to indicate loading is permitted.
4. The Red Light and Horn are off at the start of the loading process.

Bottom Loading Valves:

The unpowered condition of a bottom loading valve is **normally closed**. The solenoid must be powered to allow loading. Any alarm condition for system errors, failures or overfill will cause the solenoid to be de-energized and halt the loading process. A disengaged PTO will also close the valve.

Hydraulic Bypass Valves.

The unpowered condition for a hydraulic motor bypass valve is **normally open**. The solenoid must be powered to allow loading by closing the bypass circuit. Any alarm condition for system errors, failures or overfill will cause the solenoid to de-energize and halt the loading process. A disengaged PTO will also open the valve.

5. Operator fills the tank

The liquid is loaded into the tank using either the on-board or a stationary pump. When the liquid reaches the Fill alarm level, the following occurs:

a. The Red light and Horn turn on to alert the operator that he is getting close to the loading limit and has to prepare to turn off the pump and close the valve.
b. The Green Light stays on to indicate continued loading is permitted.
c. The Solenoid continues to be energized to allow loading.
d. The Finch Display flashes the level indication to indicate the active Fill alarm.

The operator then presses either the Up or Down button on the Finch to silence the horn, turn off the Red light and return to a normal level display.

The operator continues to load. He will likely manually shut off the pump and close the valve before the liquid level reaches the HH alarm level. If he does not and the liquid level reaches the HH alarm level, then the following occurs:

a. Green light turns off

b. The solenoid de-energizes, closing the bottom loading valve or opening the on-board pump bypass valve. This halts the loading process.

If the tank has been loaded to the required amount, then the operator turns off the pump, closes the valve, disconnects the hoses and drives away.

If the tank has not been loaded to the required amount, then the operator clears the HH alarm on the Finch with the UP/UP/DOWN/UP button sequence. This resets the alarm response and allows further loading with the following:

a. The Green Light turns back on

b. The Solenoid is re-energized

c. The Solenoid either opens the bottom loading valve or closes the on-board pump bypass valve to allow loading to continue.

The operator is likely to stop loading before the level reaches the Spill alarm level.

If the operator continues to load and reaches the Spill alarm level, the following occurs:

a. Green Light turns off

b. The Solenoid is de-energized

c. The de-energized solenoid either closes the bottom loading valve or opens the on-board pump bypass valve to halt the loading process.

The operator cannot reset or acknowledge the Spill alarm. The liquid must be pumped out of the tank until it drops several inches below the HH alarm level. The Spill alarm then clears and enables loading through a bottom

6. PTO Disengaged

When the operator has completed the loading procedure, he turns off the PTO. This deactivates the Finch alarms, displays “OFF” and prevents the solenoid from energizing to disable loading through a bottom loading valve or a bypass valve on a hydraulic motor.

He now drives to a new location to load or unload.

7. Sequence of Events with Finch Relay Module installed

Event Sequence	Finch Display	Red Light, Horn	Green Light	Solenoid
Truck started, PTO NOT engaged	“OFF”	Pulsed, then OFF	OFF	OFF
PTOengaged	2 LO or Level	OFF	ON	ON
Liquid loaded to Fill level	Flashing Level	ON	ON	ON
Operator presses UP or DOWN button	Level	OFF	ON	ON
Liquid loaded to HH alarm level	“HH”/Level	OFF	OFF	OFF
Operator presses UP/UP/DOWN/UP	Level	OFF	ON	ON
Liquidloaded to Spill level	“SPILL”	OFF	OFF	OFF
PTO is disengaged. Operator drives tonext site.	“OFF”	OFF	OFF	OFF
Operator pumps out liquid with PTO engaged.	Level	OFF	ON	ON
All liquid is pumped out	2 LO	OFF	ON	ON
PTO is disengaged. Operator drives tonext site	“OFF”	OFF	OFF	OFF

Table 1-1: Sequence of Events with Finch Relay Module installed

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1.8 Graphical Glossary of Terms

Dual Rod Probe Truck and Trailer Installation

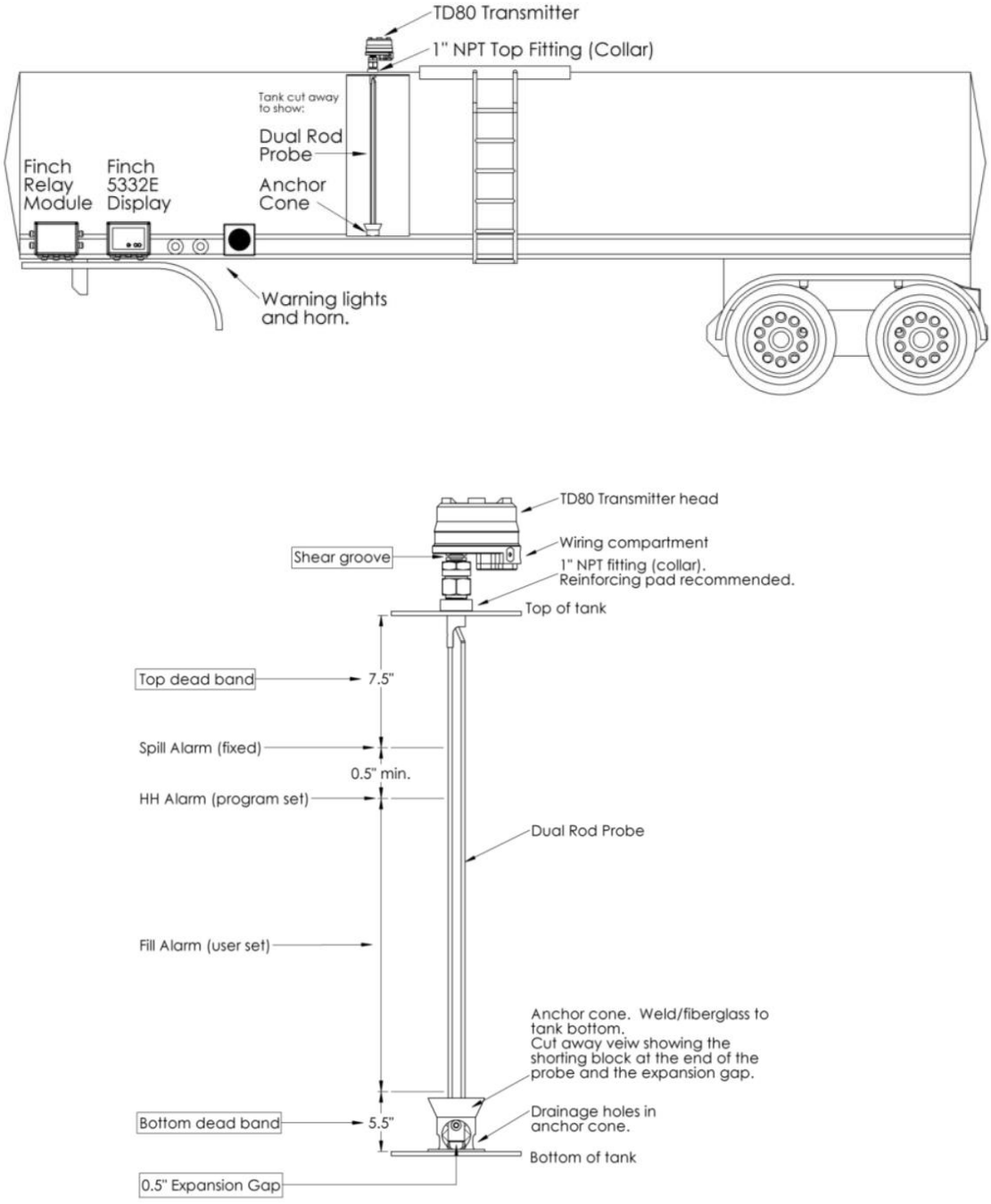

Figure 1-1: Dual Rod Probe Truck & Trailer Installation

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Coaxial Probe Truck and Trailer Installation

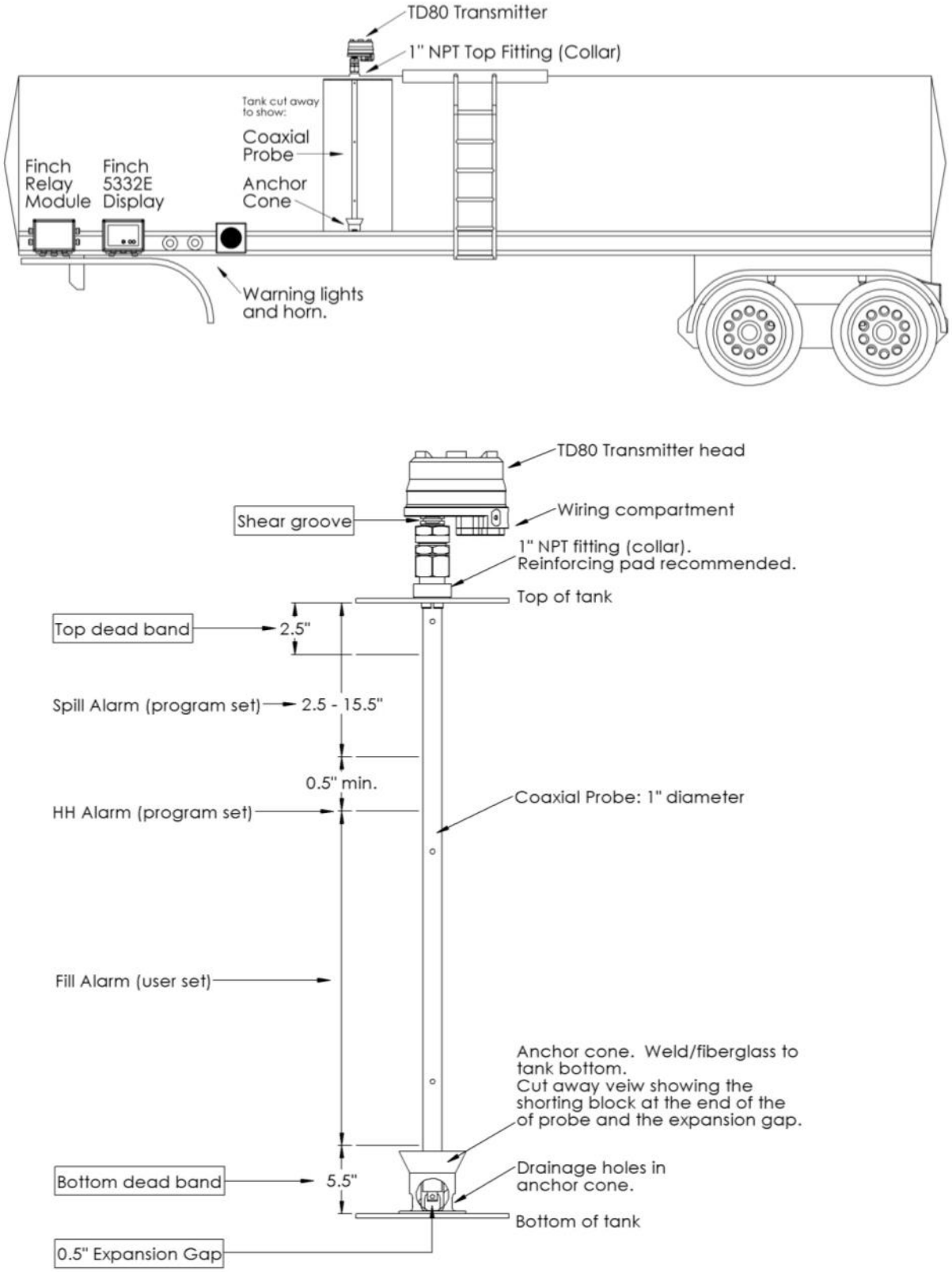

Figure 1-2: Coaxial Probe Truck & Trailer Installation

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TD80 Programming

SV Programming Kit

Figure 1-3: SV Programming Kit

PC Programming Software, Birdfeeder 2

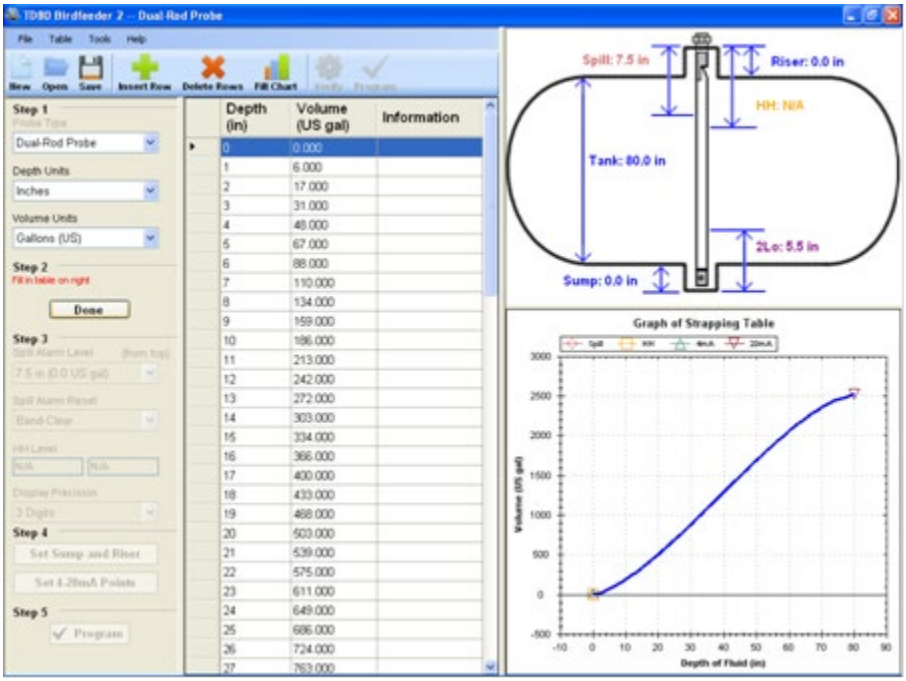

Figure 1-4: PC Programming Software Birdfeeder 2

2 TD80 Installation

2.1 TD80 Installation Steps Overview

2.1.1 Pre-Installation Requirements

⚠	**CAUTION** **Where ambient temperature conditions exceed 60°C, use cable suitable for the higher ambient temperature conditions.**

1. When choosing a location to install the TD80 components, the following guidelines must be followed:
   a. Appropriate industry, national, provincial/state and local codes
   b. Fuses and components appropriate for the area classification

2. The tank is completely drained of liquid and vapour free

3. No drilling or welding to the tank and frame without first consulting with the tank manufacturer.

4. Refer to the TD80 installation guidelines 2.1.3 for the following:
   a. Probe and Transmitter location
      i. Dual Rod
      ii. Coaxial
   b. Finch Display location
   c. Finch Relay Module location
   d. Electrical requirements

2.1.2 Installation Steps Overview

1. Program the TD80
   a. The TD80 must be programmed before use. Programming may be done at the factory when purchased, by the customer prior to installation or after installation on the vehicle when necessary.
   b. See the Programming Instructions 6.3 for detail.

2. Install the 1” NPT Top Fitting (collar)
   a. Ensure that the top fitting position allows the probe to fit vertically into the tank.
   b. Weld the top fitting to the tank top
   c. See the Mechanical Installation Instructions 2.4 for detail.

3. Install the Anchor Cone
   a. Ensure that the anchor cone is directly under the collar, within 3 degrees from vertical.
   b. Weld the anchor cone to the tank bottom
   c. See the Mechanical Installation Instructions 2.4 for detail.

4. Install the Probe
   a. Cut probe to length
   b. Install with Teflon tape or anti-seize compound
   c. The probe must fit into the anchor cone without bending, twisting or binding.
   d. See the Mechanical Installation Instructions 2.4 for detail.

5. Mount the Transmitter
   a. Do not use Teflon tape or anti-seize compound
   b. Hand-tighten the transmitter nut, and then use a wrench to secure the connection.
   c. See the Mechanical Installation Instructions 2.4 for detail.

6. Mount the Finch Display
   a. See the Mechanical Installation Instructions 2.4 for detail.

7. Mount the Relay Module (optional)
   a. See the Mechanical Installation Instructions 2.4 for detail.

8. Mount the Alarm Accessories (optional)
   a. Lights
   b. Horns
   c. Alarm Acknowledge push button
   d. See the Mechanical Installation Instructions 2.4 for detail.

9. Inspect the Mechanical Installation
   a. See the Mechanical Installation Instructions 2.4 for detail.

10. Install the Electrical Wiring

⚠	**WARNING** **All electrical grounding is to the vehicle or trailer electrical ground connection and not to the chassis.**

TRANSMITTER SPECIFIC WARNINGS

⚠	**WARNING** **Seal shall be installed within 50 mm of the enclosure.**

⚠	**WARNING** **Open circuits before removing cover.**

⚠	**WARNING** **Not including the Acidic Atmospheres-Ketones and Halogenated Hydrocarbons.**

If using conduit, use a minimum 18 AWG.

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Observe the following instructions during installation:

a. The TD80 transmitter is provided with a 50’ or 75’ cable kit (optional). It is recommended to use the kit with included sealing fitting for connection to the Finch II display. If the cable kit is not used, a cable assembly is selected that uses a sealing fitting if the transmitter is installed in a hazardous area.
b. For trailers, connect the TD80 system power and ground to the nose box electrical connector. For trucks, connect TD80 system power to a switched accessory power connection from the battery.
c. Wire splices should be made inside a weather-proof enclosure or junction box to prevent premature failure due to corrosion.
d. Secure all wires and cabling with clips or cable ties and tighten all compression fittings.
e. The TD80 transmitter terminal wiring area forms an explosion proof enclosure. Care must be taken when opening or closing the enclosure.
f. Keep the surface of the terminal cover area (where the terminal cover attaches to the base) free of scratches, dust, or dirt.

⚠	**CAUTION** **Replace the transmitter if the terminal cover or terminal cover area on the transmitter base become dented or scratched, to maintain explosion-proof protection.**

⚠	**CAUTION** **Replace the transmitter if the threads for the transmitter lid become damaged, to maintain explosion-proof protection.**

g. The transmitter lid should only be removed at Titan factory. Warranty will be void if lid is removed outside of the Titan Factory.
h. Refer to the specific installation wiring diagrams and instructions for details. See sections 2.5, 2.6, 2.7 for wiring examples.

11. Set and Verify the Finch Display Jumpers. Place the following jumpers in the positions required for the installation. See Figure 2-36 & Figure 2-37.
    a. Decimal point, J2 to J5
    b. Fill alarm relay, J1
    c. Fail/Spill relay, J10
    d. Fill/Fall alarm, J9

12. Confirm Finch 5332E/PS (red terminal board) Fuses are Installed with Correct Type (Ceramic, Sand Filled, 5x20mm) and Rating (F1, F3-F5: 2A, F2: 5A) or Finch 5332E (green terminal board) 3A Blade Fuse is installed in a non-hazardous location. See Figure 2-35.

13. Perform the TD80 Basic Operation Test
    a. See section 2.2.1.

14. Verify the TD80 Programming Information
    a. Correct depth chart and units
    b. Fill or Fall alarm level
    c. HH level
    d. Spill Level

15. Set the Fill or Fall Alarm Level Volume

16. Perform TD80 System Test and Verification
    a. See section 2.2.2

17. Perform the Offset Calibration
    a. See section 2.2.3

2.1.3 TD80 Installation Guidelines

Probe and Transmitter Location: See TD80 Probe and Transmitter Location 2.3 for details.

Finch Display Location:

a. Locate Finch 5332, internal Display
    i. Sheltered from weather and moisture
    ii. Easily visible and within reach of the operator
    iii. Must be located in a non-hazardous area

b. Locate Finch 5332E external Display
    i. Shielded from wheel spray and stones
    ii. Easily visible and within reach of the operator

c. Avoid the following locations:
    i. Direct sunlight
    ii. Temperatures less than -40C and greater than +65C
    iii. Near high voltage/current wiring, contactors, inverters and radio transmitters.

Finch Relay Module Location:

a. Must be located in a non-hazardous area.

Electrical Requirements: See the TD80 Dual Rod or Coaxial Technical Specifications for details.

2.2 TD80 Installation Test and Calibration

2.2.1 TD80 Basic Operation Tests

The following steps describe basic tests to confirm that the TD80 system is functional after installation or repair. Troubleshoot and repair all problems if the test results differ from the ones shown.

1. Inspect installation before power is applied.

2. Turn power on to the TD80 system. The Display should turn on and go through its start-up sequence (approximately 10 seconds long).
    a. Display is tested, showing numbers 0 thru 9 and then letters A thru F

3. Display will show “----” for up to several seconds, then one of the following:
    a. “2 LO” if the tank is empty or contains liquid and the depth is less than 5.5”
    b. Level if the tank contains liquid and the depth is greater than 5.5”
    c. Error message “E xx”, where xx is a number
    d. “SPill”

2.2.2 TD80 System Testing and Verification

The following steps describe tests and to be completed after mechanical and electrical installation of the TD80 system. These tests may also be used to confirm correct system operation after repair. Normal responses are indicated for each test. Proceed to troubleshooting if the test results differ from the ones shown.

1. Turn power on to the TD80 system. The Display should turn on and go through its start-up sequence (approximately 10 seconds long).
   a. Display is tested, showing numbers 0 thru 9 and then letters A thru F
   b. Fill/Fall alarm is pulsed
      i. Installed light will blink
      ii. Installed horn will briefly sound
      iii. Installed underfill prevention system will activate then deactivate
   c. Fail/Spill alarm is pulsed
      i. Installed light will blink
      ii. Installed horn will briefly sound
      iii. Installed Overfill prevention system will activate then deactivate

2. Display will show "----" for up to several seconds, then one of the following:
   a. "2 LO" if the tank is empty or contains liquid and the depth is less than 5.5"
   b. Level if the tank contains liquid and the depth is greater than 5.5"
   c. Error message "E xx", where xx is a number
   d. "SPill"

3. Test the volume display by doing the following:
   a. For dual rod probes, run your hand along the probe to check the volume display and alarm settings. If the probe is not within reach, use foil or a metal rod to short the two probe rods together.
      i. Volume displayed will increase as the hand or shorting rod moves toward the top of the compartment
      ii. Volume displayed will decrease as the hand or shorting rod moves toward the bottom of the compartment
   b. For coaxial probes, insert a small metal rod into the holes along the probe. Short the center rod to the outer tube to check the volume and alarm settings.
      i. Volume displayed will increase as the shorting rod moves toward the top of the compartment
      ii. Volume displayed will decrease as the shorting rod moves toward the bottom of the compartment

4. Set the Fill alarm according to the customer's requirements.

5. Clear all active alarms.

6. Confirm that the following occurs when the probe is shorted at selected points:
   a. "2 LO" is displayed when the tank level is less than 5.5". Volume is displayed when the level is above 5.5".

   b. Installed Fall alarm activates when the tank level decreases to or is less than the Fall alarm setting.
      i. Display flashes the volume
      ii. Installed light and horn activate
      iii. Installed underfill prevention system activates

   c. Installed Fall alarm deactivates when either the Up or Down button is pressed.
      i. Display returns to normal, not flashing
      ii. Installed light and horn deactivate
      iii. Installed underfill prevention system deactivates

d. Installed Fill alarm activates when the tank level increases to or exceeds the Fill alarm setting.
   i. Display flashes the volume
   ii. Installed light and horn activate

e. Installed Fill alarm deactivates when either the Up or Down button is pressed.
   i. Display returns to normal, not flashing
   ii. Installed light and horn deactivate

f. HH alarm activates when the tank level reaches the HH alarm setting.
   i. Display shows blinking “HH” and volume
   ii. Installed light and horn activate
   iii. Installed overfill prevention system activates

g. HH alarm deactivates when Up-Up-Down-Up button combination is pressed.
   i. Display returns to normal, not blinking
   ii. Installed light and horn deactivate
   iii. Installed overfill prevention system deactivates

h. Spill/Fail alarm activates when the tank level reaches the Spill alarm setting.
   i. Display shows flashing “SPill”
   ii. Installed light and horn activate
   iii. Installed overfill prevention system activates

i. Spill/Fail alarm deactivates when the tank level decreases more than 2” below the Spill alarm setting.
   i. Display returns to normal, not flashing “SPill”
   ii. Installed light and horn deactivate
   iii. Installed overfill prevention system deactivates

7. Test the 4-20mA output (if installed) by doing the following:
   a. Monitor the 4-20mA signal with a Digital Multimeter (DMM).
   b. Short the probe with a small metal rod at several points along the length of the probe.
   c. No short across the probe produces a signal of 4mA or slightly greater. Increasing height of the short produces an increasing current toward 20mA.

2.2.3 Offset Calibration Methods

Offset Calibration Description

Offset calibration of the TD80 transmitter is required after installation, programming or replacement of the TD80 transmitter. The calibration compensates for variations from the calibration chart provided by the tank manufacturer and probe mounting height above the tank top. It is recommended to recalibrate seasonally to maintain the rated accuracy.

Small differences in tank height, probe position on the tank and variation from the calibration chart are compensated by adjusting the displayed volume to a known amount. Large changes to the offset calibration indicate an error in programming. Review the calibration chart and mounting details, confirm that the TD80 transmitter is programmed for the compartment it is installed on and reprogram if necessary.

Offset calibration will halt if the adjusted level causes the High-High alarm setting to exceed the Spill alarm level. The High-High alarm is programmed to be no closer than ½" below the Spill alarm. This is also an indication of incorrect programming to be resolved. The adjusted level may only be lowered by the distance between the High-High and Spill alarm levels.

Methods

Methods 1 and 2 are preferred, while method 3 is acceptable as better than no calibration. The first two methods calibrate to a metered load under normal conditions. This is the most accurate compensation for mounting location and calibration chart differences. The third method compensates for mounting height only and does not have any effect on variations from the calibration chart supplied by the tank manufacturer.

1. Offset Calibration Using a Loaded and Metered Volume

a. Ensure the tank is level in all directions.
b. Fill the tank approximately 1/2 to 2/3 full. Determine the volume with a flow meter.
c. Turn the gauge power off.
d. Press and hold either the Up or Down button while turning on gauge power.
e. Continue to hold the button down until "CAL" is displayed and then release it.
f. After the normal display start-up sequence, "CAL" will be displayed flashing for several seconds and then the current volume measured by the TD80. This should be close to the actual volume.
g. Use the Up and/or Down buttons to adjust the displayed volume to the actual amount. Then release the buttons.
h. Turn the gauge power off.
i. Turn the gauge power on, without holding any buttons.
j. Verify that the display matches the actual volume.
k. Offset calibration is now complete. This procedure should be done seasonally to maintain the TD80 rated accuracy.

2. Offset Calibration Using an Unloaded and Metered Volume

See sample depth chart for the following calibration step examples.

a. Ensure the tank is level in all directions at the unloading site.
b. Note the TD80 reported volume. This must be less than the Spill alarm level.
    i. For example, the TD80 reported volume is 198.9 bbl
c. Unload at a metered site. Note the metered volume when the tank is completely empty.
    i. For example, the site metered volume is 195.4 bbl
d. Refer to the manufacturer's depth chart for the following step.
    i. Determine the distance between the TD80 reported volume and the metered amount. For example:
        1. The TD80 volume is 198.9 bbl at a depth of 70.75"
        2. The site metered unloaded volume is 195.4 bbl
        3. The depth chart shows 195.4 bbl at a depth of 69.00"
        4. 70.75" - 69.00" = 1.75"
        5. The difference is 1.75" down in depth
    ii. Note this difference as an increasing or decreasing number of inches and fractional part of an inch to adjust the TD80 reported volume.
e. At the next site, load the tank to approximately 3/4 full. Note the TD80 reported volume.
    i. For example, 168.1 bbl is loaded for the calibration as shown on the Finch Display.
f. Refer to the manufacturer's depth chart. Determine the depth at the currently loaded volume reported by the TD80.
    i. According to the sample depth chart, 168.1 bbl is at a depth of 59"
g. Add or subtract the distance calculated at step 4 to increase or decrease to the actual volume. Note the actual volume from the depth chart.
    i. For example, 59" – 1.75" = 57.25"
    ii. Actual volume is 162.5 bbl at a depth of 57.25"
    iii. 162.5 bbl will be the newly calibrated volume
h. The TD80 can now be calibrated to a metered volume.
i. Turn the gauge power off.
j. Press and hold either the Up or Down button while turning on gauge power.
k. Continue to hold the button down until "CAL" is displayed and then release it.

Sample Depth Chart,			
206bbl trailer, 81" depth			
in	**bbl**		
1	0.05		
2	0.1		
..			
55	155		
56	158.4		
56.25	159.22		
56.5	160.05		
56.75	160.87		
57	161.7		
57.25	162.5		
57.5	163.3		
57.75	164.1		
58	164.9		
59	168.1		
60	171.3		
61	174.3		
62	177.3		
63	180.2		
64	183		
65	185.7		
66	188.3		
67	190.8		
68	193.1		
69	195.4		
70	197.5		
70.25	197.97		
70.5	198.45		
70.75	198.92		
71	199.4	HH alarm level	
72	201.2		
73	202.8		
73.5	203.45	Spill alarm level	
74	204.1		
75	205.2		
76	205.7		
77	205.9		
78	206.1		
79	206.3		
80	206.5		
81	206.7		

Figure 2-1: Sample Depth Chart

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l. After the normal display start-up sequence, “CAL” will be displayed flashing for several seconds and then the current volume measured by the TD80.
m. The TD80 reports the loaded volume as 168.1 bbl
n. Use the Up and/or Down buttons to adjust the displayed volume to the actual amount determined in step 7. Then release the buttons.
    i. In this example, press the down button until 162.5 bbl is displayed.
o. Turn the gauge power off.
p. Turn the gauge power on, without holding any buttons.
q. Verify that the display matches the actual volume.
r. Offset calibration is now complete. This procedure should be done seasonally to maintain the TD80 rated accuracy.
s. Continue to complete loading.

3. Offset Calibration Using a Measured Level

See sample depth chart for the following calibration step examples.

a. Fill the tank approximately 1/2 to 2/3 full. Determine the volume by dipping and referring to a depth chart. An alternative is to place a wire short at a level 1/2 to 2/3 of the probe depth in an empty tank.
    i. For example
        1. Flat bottom tank or center of sloped bottom, 55” from the bottom
        2. Sloped bottom tank, 26” from the top (81” - 26” = 55”)
        3. Volume is 155.00 bbl
b. Turn the gauge power off.
c. Press and hold either the Up or Down button while turning on gauge power.
d. Continue to hold the button down until “CAL” is displayed and then release it.
e. After the normal display start-up sequence, “CAL” will be displayed flashing for several seconds and then the current volume measured by the TD80. This should be close to the actual volume.
f. Use the Up and/or Down buttons to adjust the displayed volume to the actual amount. Then release the buttons.
    i. For this example, the display shows 155.0 when offset calibrated
g. Turn the gauge power off.
h. Turn the gauge power on, without holding any buttons.
i. Verify that the display matches the actual volume.
j. Offset calibration is now complete. This procedure should be done seasonally to maintain the TD80 rated accuracy.

2.3 TD80 Probe and Transmitter Location

2.3.1 Locating the Probe

Before beginning the installation of the probe, consider the location carefully. The nature of Guided Wave RADAR requires a 4” minimum diameter around the dual rod probe to be free of metal. The coaxial probe does not have this restriction. The dual rod probe must be mounted at least 2” away from any internal pipes, fittings, and structural members. Infeeds, weirs, drains and agitators may cause mechanical damage to the probe. They will also create turbulence that causes incorrect level measurements. The dual rod and coaxial probes must be mounted as far as possible from turbulent areas of the tank. An anchor cone at the bottom of the probe is also required to prevent probe damage due to sloshing liquids.

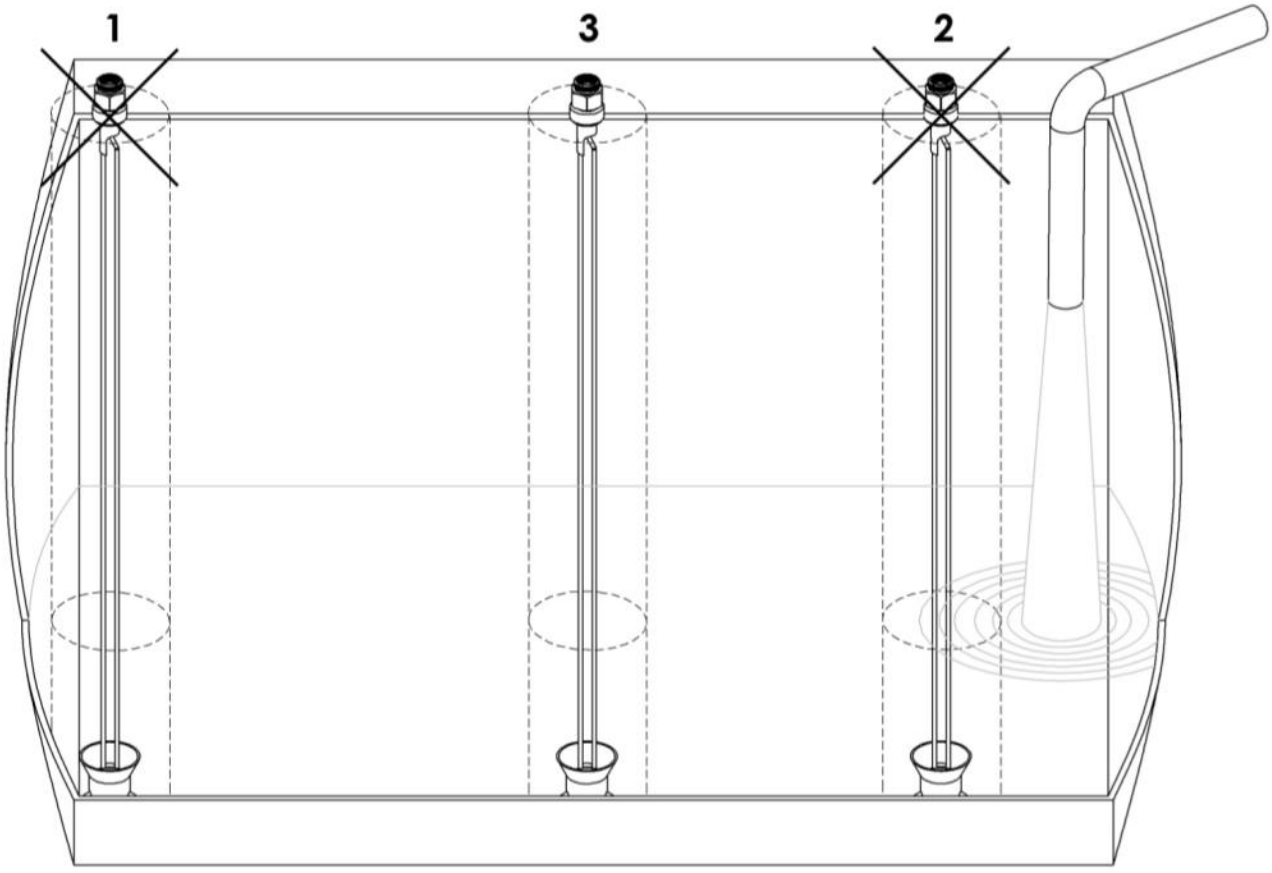

Figure 2-2: Locating the Probe

1 Probe is too close to the side of the tank (or other fittings)
2 Probe is too close to the tank infeed
3 Preferred placement. No interference within 2” of the probe

- - - - - - - - -

Indicates the 4" diameter which the probe uses to measure.

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Vehicle mounted tanks present another challenge to correct location of the probe. The preferred location is the center of the tank, both across the width and length to minimize measurement errors due to leveling of the vehicle.

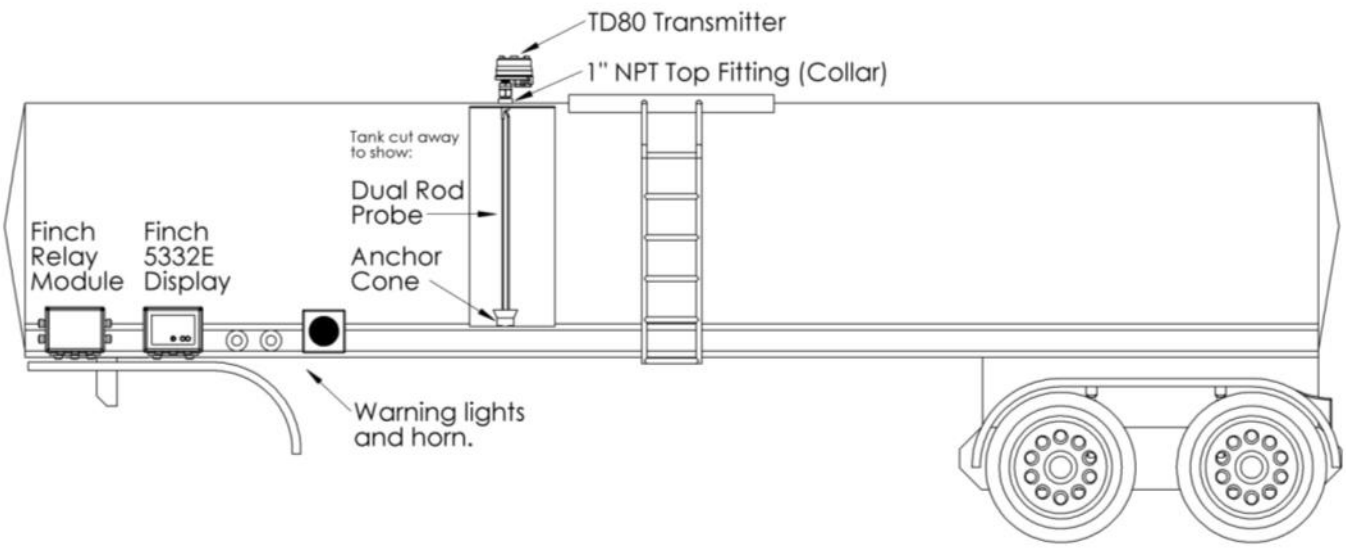

Figure 2-3: Trailer Mounted Tank

2.3.2 Locating the Transmitter

Ensure sufficient clearance between the transmitter and tank top mounted fittings, obstructions or manway. Provide at least 6” of clearance around the transmitter. Consider the installation location for clearance of the large 1 ¾” wrench required to install the probe and transmitter. These components must be sufficiently tightened for safe and reliable operation.

2.3.3 Mounting the Top Fitting

It is recommended to use the Titan supplied 1" NPT top fitting. Alternative fittings must not be longer than 1 ½". Fittings exceeding 1 ½" in length with an internal diameter of less than 4" interfere with the RADAR signal and prevent the TD80 transmitter from measuring the liquid level or cause false level alarms.

Ensure that the probe hangs vertically in the tank, within 3 degrees of vertical. Tanks with curved tops may require a leveling piece to meet the required vertical position.

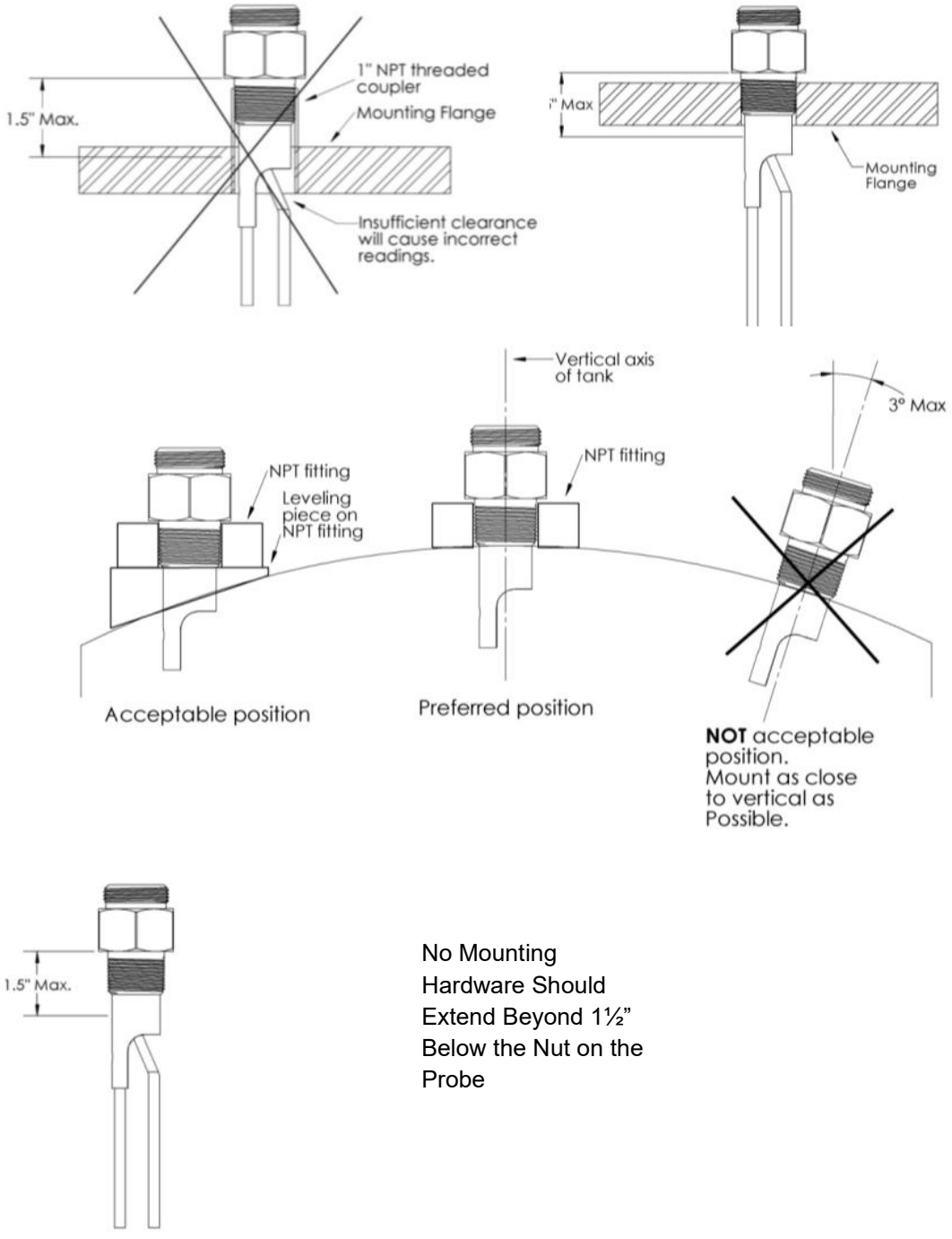

Figure 2-4: Locating the Top Fitting

2.3.4 Mounting the Anchor Cone

The anchor cone, located at the bottom of the probe, is used to prevent probe damage due to movement of liquid.

It is recommended to use the Titan supplied anchor cone. The anchor cone is required to prevent excessive probe flexing and the resulting damage to the probe or tank. It must be mounted directly in line with the top fitting to prevent bending the probe when installed. A bent or bowed probe produces inaccurate or false level measurements. Alternative anchors must have a minimum internal diameter of 1 ½" and approximately 2" high.

The following steps describe the recommended procedure for correct alignment of the top fitting and anchor cone for retrofit installations or where the positions are not accurately shown in a drawing. Materials required are a suitable length of rigid 1" tube and a bored through 1" NPT swage fitting.

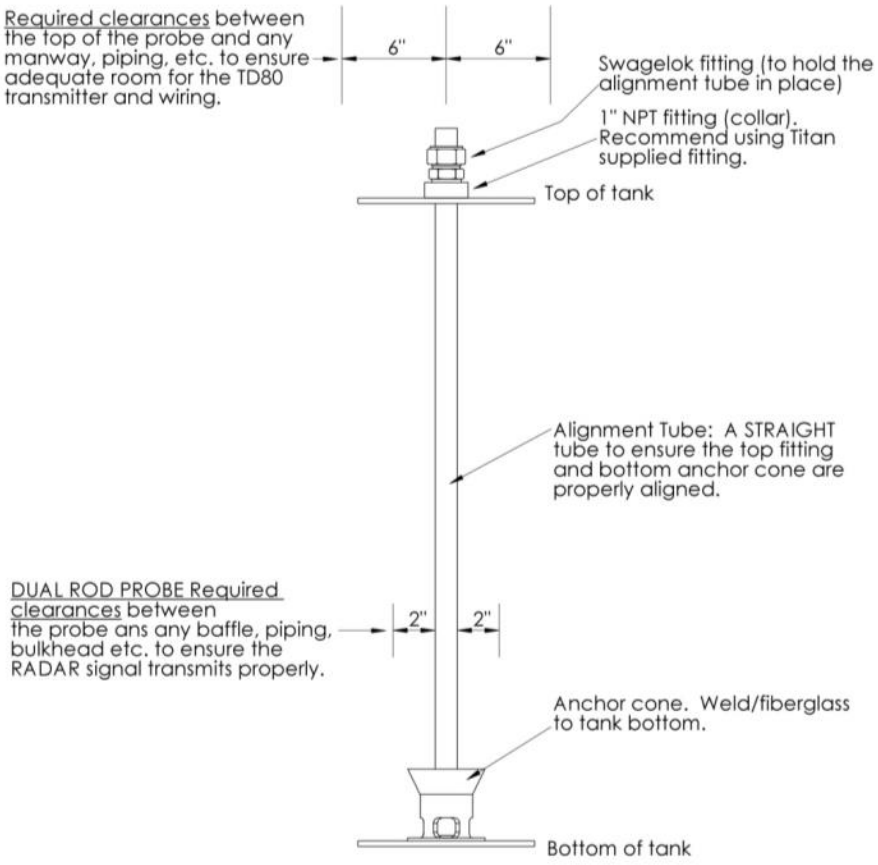

Figure 2-5: Locating the Anchor Cone

1. Locate the probe and transmitter according the recommended guidelines. Also consider location of the anchor cone for probe placement.
2. Install the top collar.
3. Screw the swage fitting into the 1" NPT top fitting.
4. Insert the tube into the swage fitting until it reaches the bottom of the tank.
5. Position the anchor cone where the tube meets the bottom of the tank.
6. Mark the anchor cone position and remove the tube.
7. Weld the anchor cone in place.

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2.4 TD80 Mechanical Installation

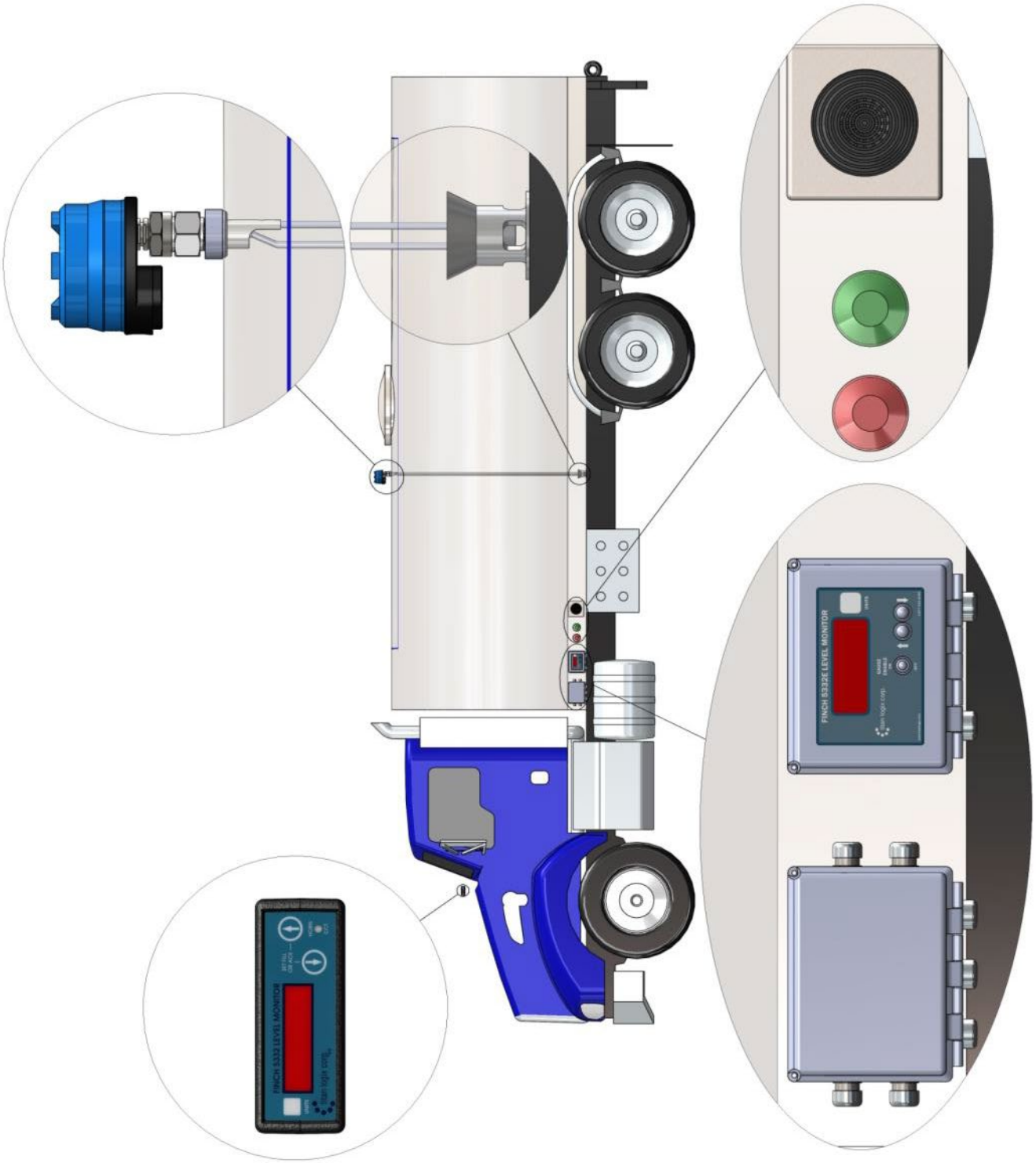

Figure 2-6: Mechanical Installation of the TD80 System

2.4.1 Overview of the Installation Procedure

Step 1: Align and Weld the Mounting Fittings

Tasks:
1. Install the 1” NPT Top Fitting
2. Install the Anchor Cone

Step 2: Cut and Install the Probe

The TD80 probe is available in two types, Dual Rod and Coaxial, for a wide variety of liquids. See the specific list of tasks at Step 2 for the probe type being installed.

Tasks:
1. Cut the Probe to Length
2. Install the Probe

Step 3: Component Mounting

Tasks:
1. Mount the Transmitter
2. Mount Finch Display
3. Mount the Finch Relay Module (optional)
4. Mount the Alarm Accessories (optional)

Step 4: Inspect the Work

2.4.2 Installation Procedure

The probe is threaded through a 1” NPT fitting at the top of the tank and sits in an anchor cone at the bottom. It is not bolted in place, but sits approximately ½” above the bottom of the tank and loosely inside the anchor cone, to allow for expansion and contraction of the tank.

Prior to installation, ensure the tank is safe to work on as per precautions recommended by the local regulations. See Section 2.1.1, Pre-Installation Requirements for details.

Step 1: Align and Weld the Mounting Fittings

1. Install the 1” NPT Top Fitting
   a. Use the Titan supplied 1” NPT top fitting.
   b. Make a hole in the top of the tank where indicated by the manufacturing or installation drawings.
   c. Ensure that the top fitting will allow the probe to hang vertically in the tank. If the tank has a curved top, a leveling piece may be required. This will prevent the probe from bending.
   d. Ensure that the top fitting is aligned within 3 degrees of vertical above where the anchor cone will be welded.
   e. Weld the top fitting to the tank top, using a leveling piece if required.
   f. Clean all debris from the threads of the top collar. This will prevent the probe from jamming during installation.

2. Install the Anchor Cone
   a. Use the Titan supplied anchor cone.
   b. The anchor cone is required to prevent excessive flexing of the probe. The anchor must be mounted directly in line with the top fitting to prevent bending or twisting during installation. Place the anchor cone at the position indicated by the manufacturing or installation drawings.

c. Ensure that the anchor cone is aligned within 3 degrees of vertical above where the top fitting is welded.
d. Weld the anchor cone in place.

Step 2: Cut and Install the Dual Rod Probe. See Coaxial probe installation instructions below.

Note: If the probe is for use in corrosive environments, ensure the Hastelloy® probe, shorting block, and set screws are used.

The probe has been cut to the proper length when it is fully threaded into the top fitting with a ½" gap between the bottom of the tank and end of the probe at the shorting block, inside the anchor cone.

Before installing the probe, ensure that the top of the probe is protected from dirt, oil and physical damage by the orange plastic cap it is shipped with. This cap must remain in place until the transmitter is mounted.

1. Cut the Dual Rod Probe to Length, See Figure 2-7 & Figure 2-8
   a. The probe is shipped longer than required to fit all installations. It is cut to length once the height of the tank is known. Measure the height from the bottom of the tank, inside the anchor cone to the top edge of the 1" NPT top fitting. Add 1 ½" to this height. This is the overall length of the probe. Temporarily remove the protective orange cap. Transfer this measurement to the probe, starting at the very top of the probe. Replace the cap before proceeding.
   b. Loosen the screws retaining the shorting block on the rods of the probe. Do not completely remove the screws .
   c. Slide the shorting block up the probe until the bottom of the block is at the overall length of the probe when it is installed.
   d. Tighten the screws on the shorting block. Ensure that the rods are not twisted and then completely tighten the screws.
   e. Use a hacksaw to cut off the rods at the bottom of the shorting block. For the Hastelloy® probe rods, a pipe cutter or die grinder is recommended.
   f. Use a flat file to remove any burrs after cutting the rods. The ends should be smooth and flush with the shorting block.

2. Install the Dual Rod Probe
   a. Inspect the probe for any bends or twists. Loosen the shorting block to readjust the rods, and then retighten once the rods are straight and parallel.
   b. Inspect the threads on the probe and top fitting for damage or debris. Do not install the probe with damaged threads.
   c. Apply Teflon tape or anti-seize compound to the 1" NPT threads that mate with the top fitting.
   d. Carefully insert the probe through the top fitting, resting the shorting block inside the anchor cone.
   e. Hand tighten the probe into the top fitting, then finish tightening with a 1 ¾" wrench.
   f. Ensure that the probe is not bent or twisted after installation.
   g. Ensure that there is approximately a ½" gap between the shorting block and the bottom of the tank.

Step 2: Cut and Install the Coaxial Probe. See Dual Rod probe installation instructions above.

The probe has been cut to the proper length when it is fully threaded into the top fitting with a ½" gap between the bottom of the tank and end of the probe at the shorting block, inside the anchor cone.

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Before installing the probe, ensure that the top of the probe is protected from dirt, oil and physical damage by the orange plastic cap it is shipped with. This cap must remain in place until the transmitter is mounted.

1. Cut the Coaxial Probe to Length, See Figure 2-10 & Figure 2-11
   a. The probe is shipped longer than required to fit all installations. It is cut to length once the height of the tank is known. Measure the height from the bottom of the tank, inside the anchor cone to the top edge of the 1" NPT top fitting. Add 1 ½" to this height. This is the length of the probe to the top of the shorting block. Temporarily remove the protective orange cap. Transfer this measurement to the probe, starting at the very top of the probe. Replace the cap before proceeding.
   b. Loosen the set screw retaining the shorting block on the center rod of the probe.
   c. Slide the shorting block off the end of the probe. The shorting block is press-fit into the coaxial tube. Clamping the end of the shorting block in a vise and then twisting while pulling the probe can make this easier to accomplish.
   d. Cut the tube at the marked length using a tube cutter. This ensures a clean and even cut around the end of the tube.
   e. Use a half round file to clean some of the burring left behind inside the cut end of the tube. The shorting block must still press-fit with some resistance when reinstalled.
   f. Reinstall the shorting block on the center rod and tap into place on the end of the tube. The shorting block must butt up evenly with the end of the tube.
   g. Tighten the set screw on the shorting block and inspect the center rod for bending or bowing. Loosen the set screw and adjust the shorting block position until the center rod is evenly spaced along the length of the tube. Retighten the set screw.
   h. Use a hacksaw to cut off the center rod at the bottom of the shorting block.
   i. Use a flat file to remove any burrs after cutting the rod. The end should be smooth and flush with the shorting block.

2. Install the Coaxial Probe
   a. Inspect the probe for any bending of the center rod. Loosen the shorting block to readjust the rod, and then retighten once the rod is straight.
   b. Inspect the threads on the probe and top fitting for damage or debris. Do not install the probe with damaged threads.
   c. Apply Teflon tape or anti-seize compound to the 1" NPT threads that mate with the top fitting.
   d. Carefully insert the probe through the top fitting, resting the shorting block inside the anchor cone.
   e. Hand tighten the probe into the top fitting, then finish tightening with a 1 ¾" wrench.
   f. Ensure that the probe is not bent or twisted after installation.
   g. Ensure that there is approximately a ½" gap between the shorting block and the bottom of the tank.

Step 3: Component Mounting

1. Mount the Transmitter
   a. Ensure that the protective orange cap remains on the probe if the transmitter will be mounted at a later time.
   b. Carefully remove the protective cap from the probe. Ensure that the threads are not damaged. Inspect the transmitter and probe for dirt, oil, moisture or debris.
   c. Warning, do not apply Teflon tape or anti-seize compound to the transmitter threads. Do not apply dielectric grease to the transmitter and probe connection. This must be a clean and bare metal-to-metal connection.
   d. Place the transmitter on top of the probe, supporting it with one hand while hand engaging the transmitter nut with the probe.
   e. Continue to support the transmitter while hand tightening the transmitter nut until it is resting on the probe O-ring seal.

f. Position the transmitter for the required cable routing. The angled sealing fitting and cable must not interfere with the tank top mounted fittings and manway.
g. Continue tightening the transmitter nut with a 1 ¾" wrench until the nut compresses the O-ring on the probe and the transmitter does not rotate on the probe when twisted by hand. The transmitter to probe connection must not have any movement to operate properly.

2. Mount the Finch Display
   a. Position the Finch Display where indicated by the manufacturing or installation drawings
   b. Bolt the Finch Display to the panel, bracket or protective box. Ensure that the bolts are not torqued to the extent that the plastic mounting tabs are crushed.

3. Mount the Finch Relay Module (optional)
   a. Position the Finch Relay Module where indicated by the manufacturing or installation drawings
   b. Bolt the Finch Relay Module to the panel, bracket or protective box. Ensure that the bolts are not torqued to the extent that the plastic mounting tabs are crushed.

4. Mount the Alarm Accessories (optional)
   a. Position the lights, horns and other alarm accessories where indicated by the manufacturing or installation drawings
   b. Bolt the accessories to the panel, bracket or protective box. Ensure that the bolts are not torqued to the extent that the plastic mounting tabs are crushed.

Step 4: Inspect the Work

This is an important step in maintaining the quality expected by the customer and providing a safe installation. The following are suggested items to check. They are not comprehensive and may be modified to suit the installer's Quality Assurance (QA) process.

1. Inspect all welding.
2. Verify that the system components are mounted in the correct locations.
3. Inspect all system components for physical damage that may have occurred during the installation.
4. Verify that all components are securely mounted with all nuts and bolts tightened.
5. Inspect for any metal debris that is left behind after the installation.

NOTE: Once the Mechanical Installation is complete, refer back to section 2.1.2, TD80 Installation Steps Overview, for clarification on the next installation step.

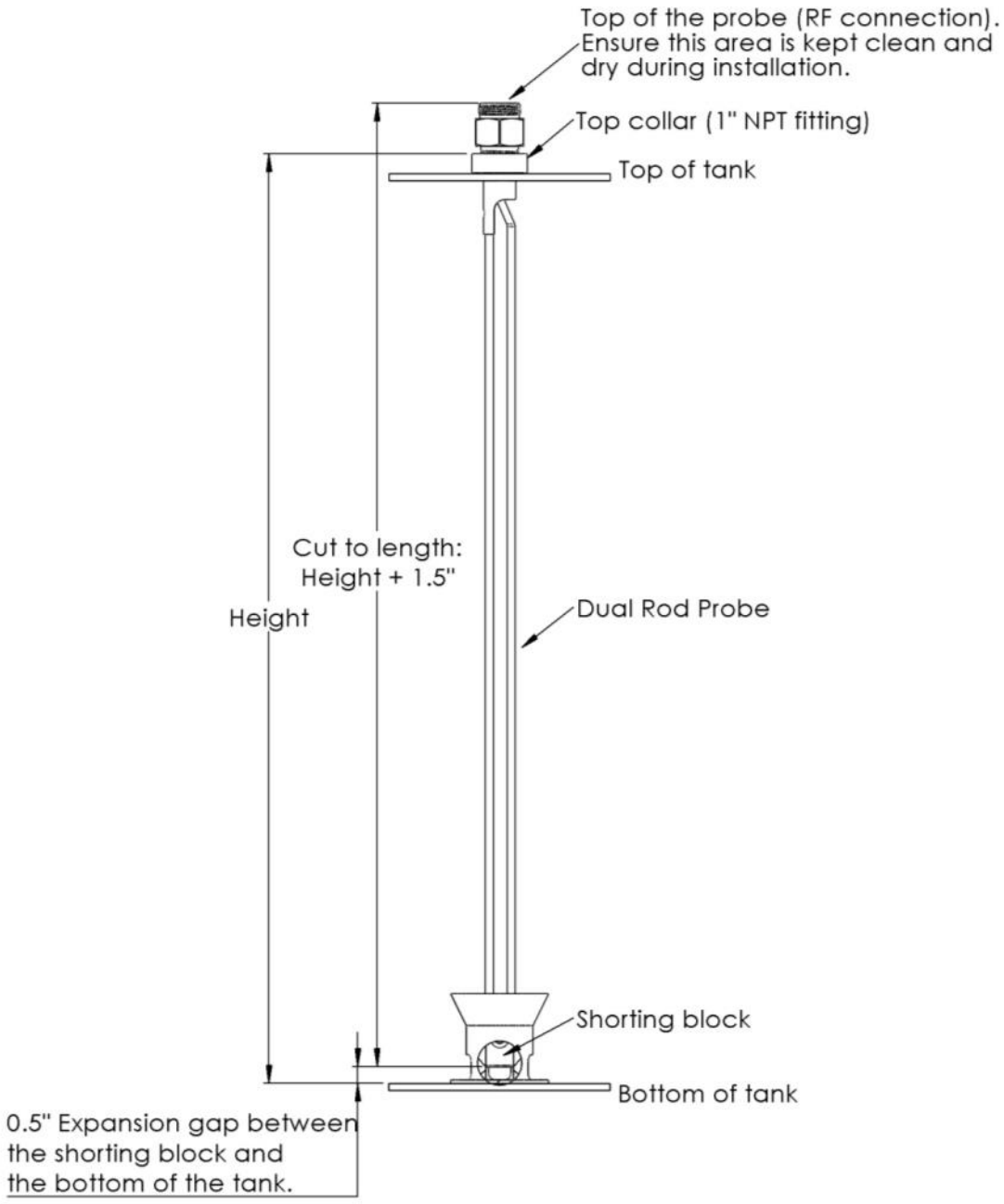

Figure 2-7: Dual Rod Probe Measurement

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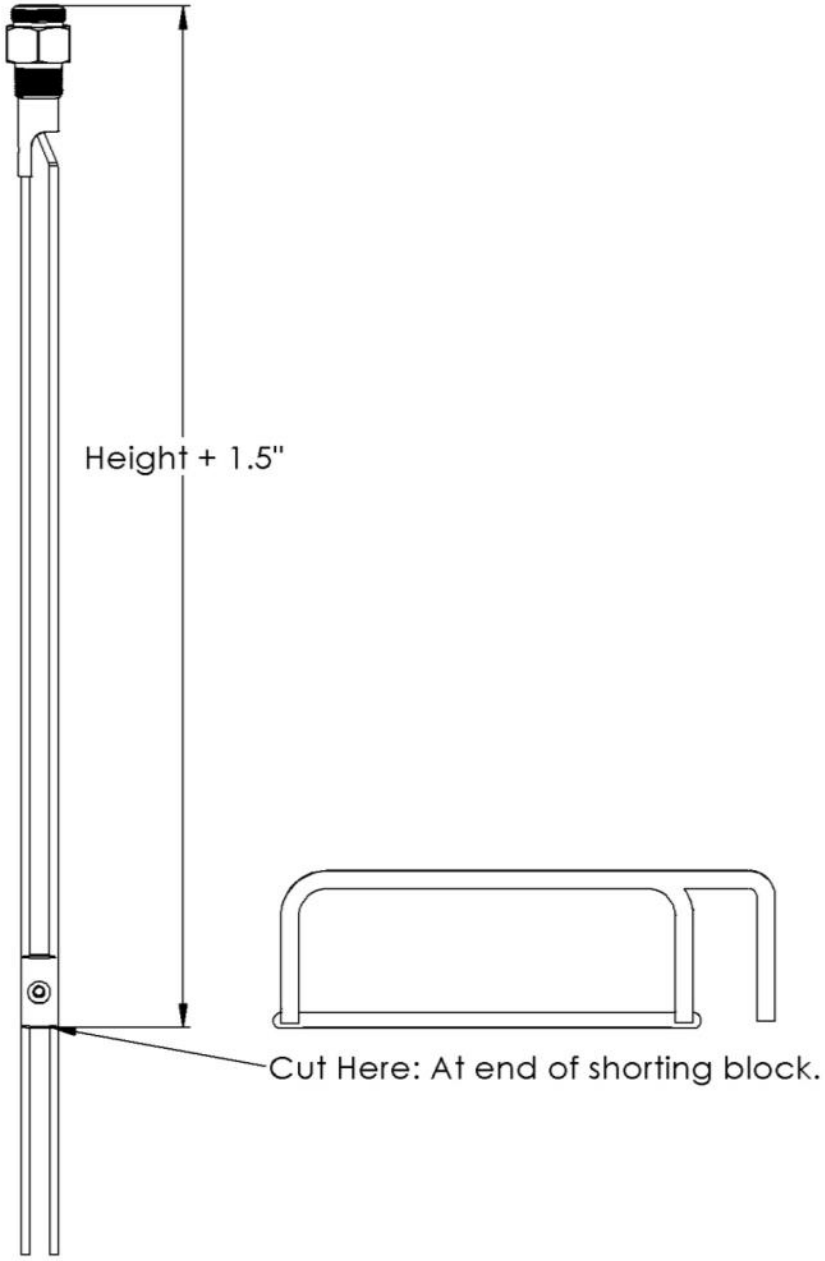

Figure 2-8: Cutting the Dual Rod Probe

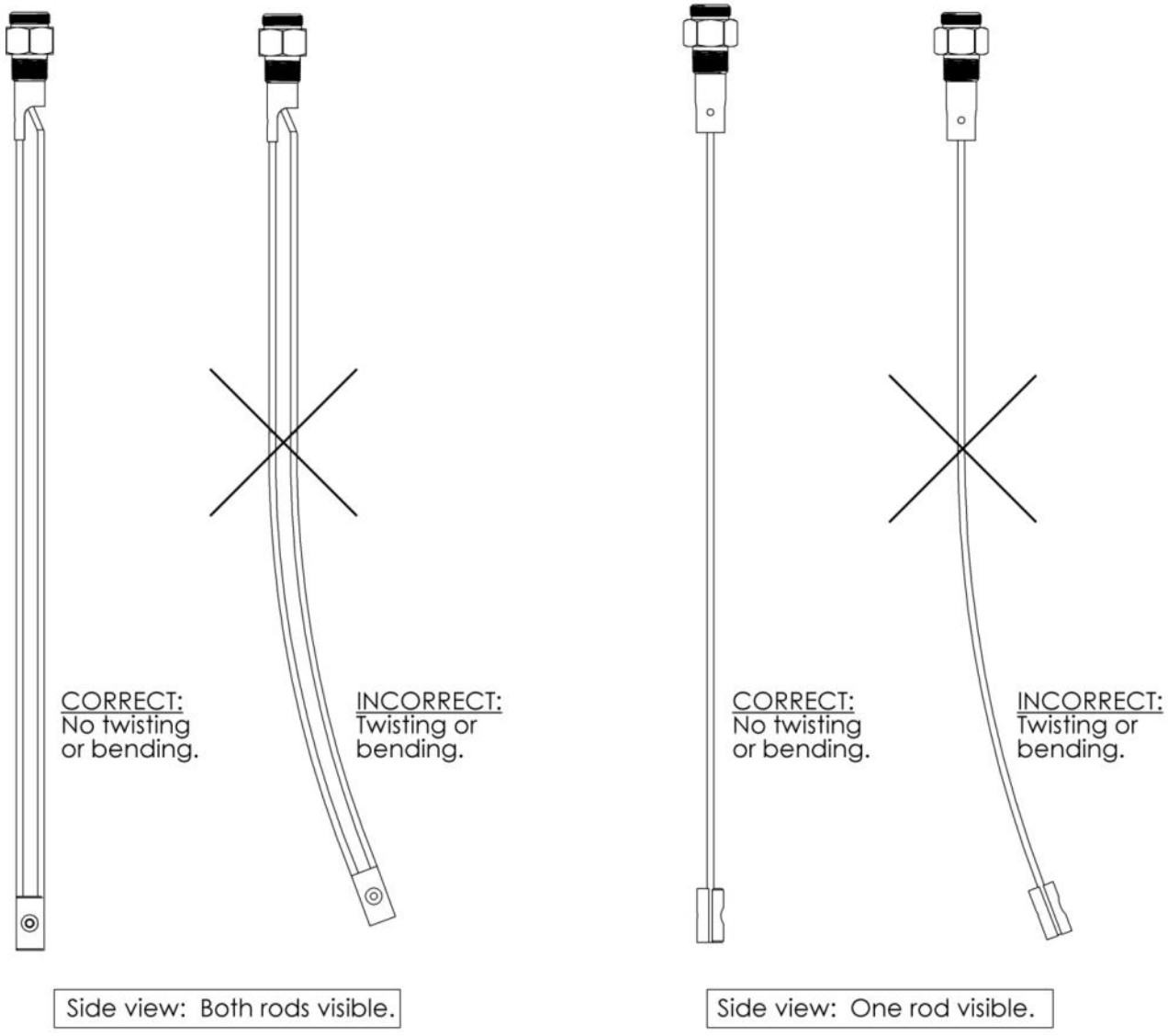

Figure 2-9: Correct Probe Installation

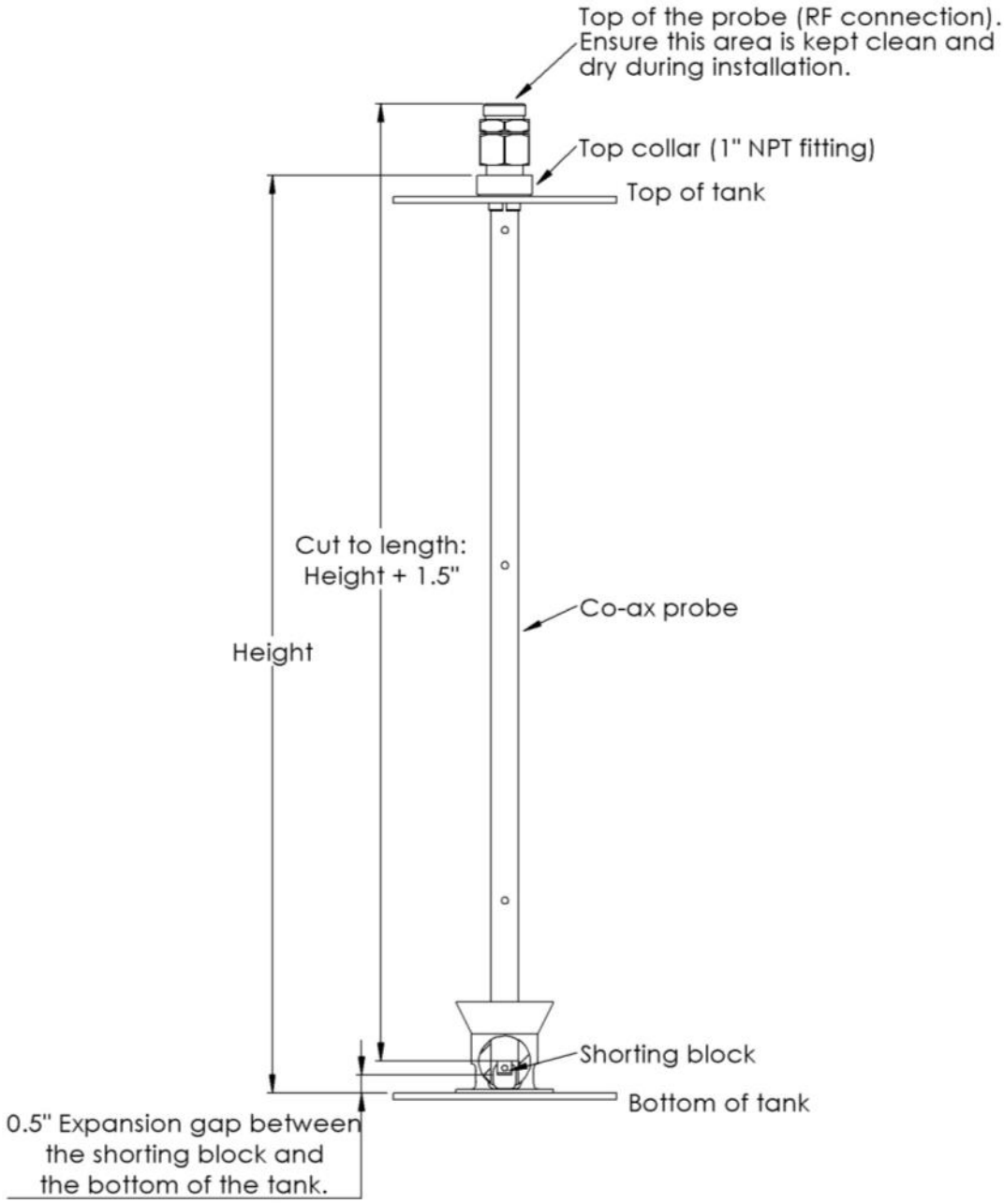

Figure 2-10: Coaxial Probe Measurement

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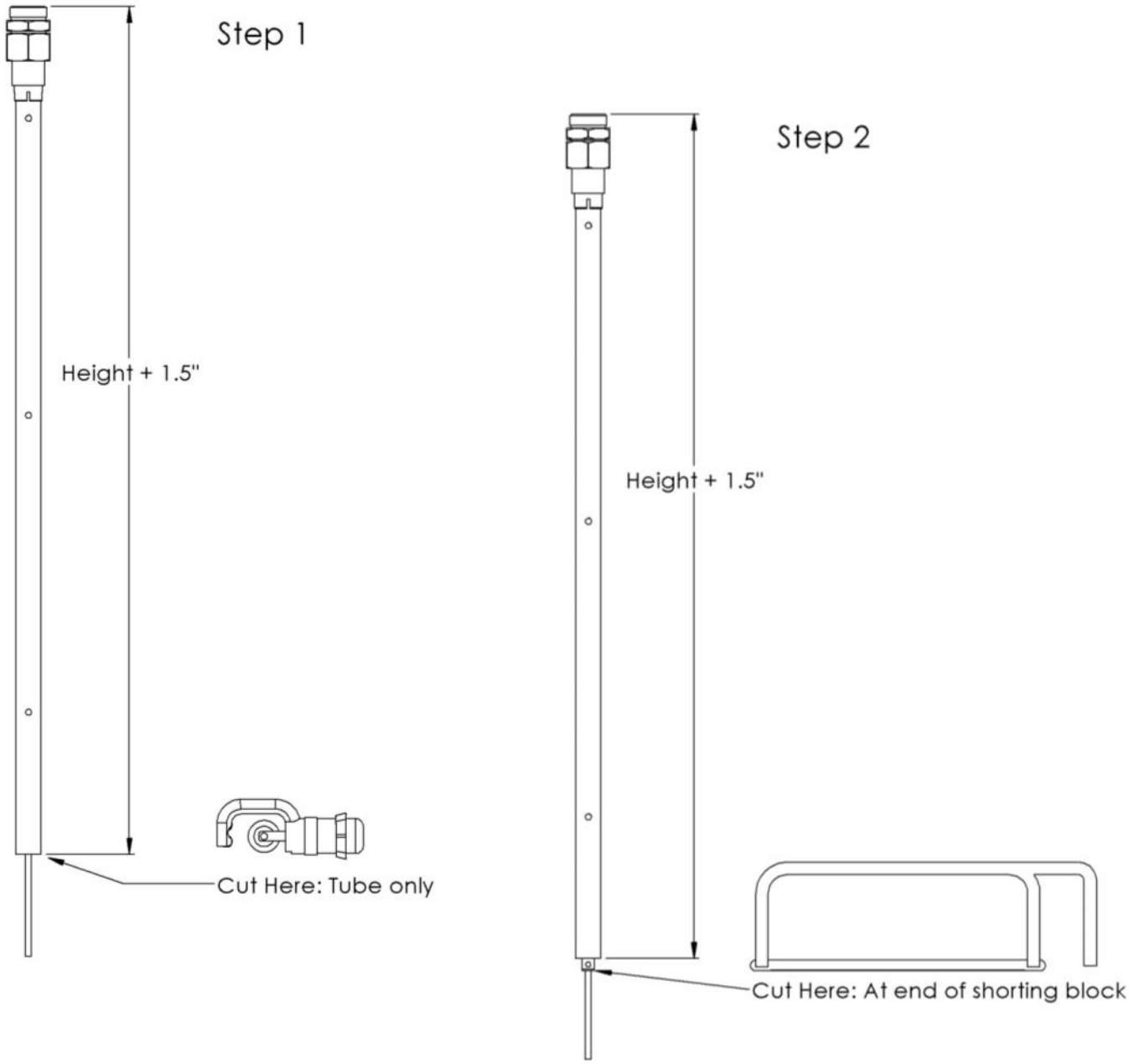


Figure 2-11: Cutting the Coaxial Probe

2.5 TD80 Basic System Installation Wiring

2.5.1 Finch 5332E/PS External Display, Red Terminal Board Wiring Instructions

Wiring steps for single TD80 and Finch Display. Refer to Figure 2-12 & Figure 2-13 for Finch 5332E/PS (red board) installation.

1. Fused Power wire from nose box socket or junction box to Finch POWER IN (25)
2. Ground wire from nose box socket or junction box to Finch GROUND IN (24)
3. TD80 Power (black wire) to Finch GAUGE POWER (4)
4. TD80 Ground (white wire) to Finch GAUGE GROUND (5)
5. TD80 SV Bus (red wire) to Finch GAUGE SV (6)
6. Finch Jumpers, see Figure 2-37
   a. J9 and Decimal Point shunt positions
      i. J9 removed for Fill alarm, installed for Fall alarm (removed when shipped from factory)
      ii. Decimal point jumper for required Display
7. Optional PTO or brake air switch to Finch DISPLAY ENABLE (PTO) (7) and Electrical Ground
   OR
8. Optional Gauge Enable toggle switch red wire to Finch DISPLAY ENABLE (PTO) (7) and black wire to Finch GROUND (9) **OR** wire Finch DISPLAY ENABLE (PTO) (7) to Finch GROUND (9) when not connected to a PTO or brake air switch
   OR
9. Optional Gauge Enable toggle switch red wire to Finch POWER ENABLE (27) and black wire to Finch GROUND (27) for power control **OR** wire Finch POWER ENABLE (27) to Finch GROUND (26)

NOTE: Once the Basic Installation Wiring is complete, refer back to section 2.1.2, TD80 Installation Steps Overview, for clarification on the next installation step.

2.5.2 Finch 5332E External Display, Green Terminal Board Wiring Instructions

Wiring steps for single TD80 and Finch Display. Refer to Figure 2-14 & Figure 2-15 for Finch 5332E (green board) installation.

1. Fused Power wire from the nose box socket or junction box through a 3A fuse to Finch 8-28 VDC POWER
2. Ground wire from nose box socket or junction box to Finch GROUND
3. TD80 Power (black wire) to Finch GAUGE POWER
4. TD80 Ground (white wire) to Finch GAUGE GND
5. TD80 SV Bus (red wire) to Finch SV BUS
6. Finch Jumpers, see Figure 2-37
   a. J9 and Decimal Point shunt positions
      i. J9 removed for Fill alarm, installed for Fall alarm (removed when shipped from factory)
      ii. Decimal point jumper for required display
7. Optional PTO or brake air switch to Finch GAUGE ENABLE (PTO) and Electrical Ground
   OR

8. Optional Gauge Enable toggle switch red wire to Finch GAUGE ENABLE (PTO) and black wire to GROUND **OR** wire Finch GAUGE ENABLE (PTO) to Finch GROUND when not connected to a PTO or brake air switch

NOTE: Once the Basic Installation Wiring is complete, refer back to section 2.1.2, TD80 Installation Steps Overview, for clarification on the next installation step.

2.5.3 Finch 5332, Internal Display Wiring Instructions

Wiring steps for single TD80 and Finch Display. Refer to Figure 2-16 for Finch 5332 internal Display installation.

1. Fused Power wire from the fuse or junction box through a 3A fuse to Finch POWER IN (red wire)
2. Ground wire from the fuse or junction box to Finch GROUND (black wire)
3. TD80 Power (black wire) to Finch GAUGE PWR (red wire)
4. TD80 Ground (white wire) to Finch GAUGE GND (black wire)
5. TD80 SV Bus (red wire) to Finch SV BUS (yellow wire)
6. Finch Jumpers, see Figure 2-36
   b. J9 and Decimal Point shunt positions
      i. J9 removed for Fill alarm, installed for Fall alarm (removed when shipped from factory)
      ii. Decimal point jumper for required display
7. Optional PTO or brake air switch to Finch PTO (orange) input **OR** wire Finch PTO (orange) input to GROUND when not connected to a PTO or brake air switch

NOTE: Once the Basic Installation Wiring is complete, refer back to section 2.1.2, TD80 Installation Steps Overview, for clarification on the next installation step.

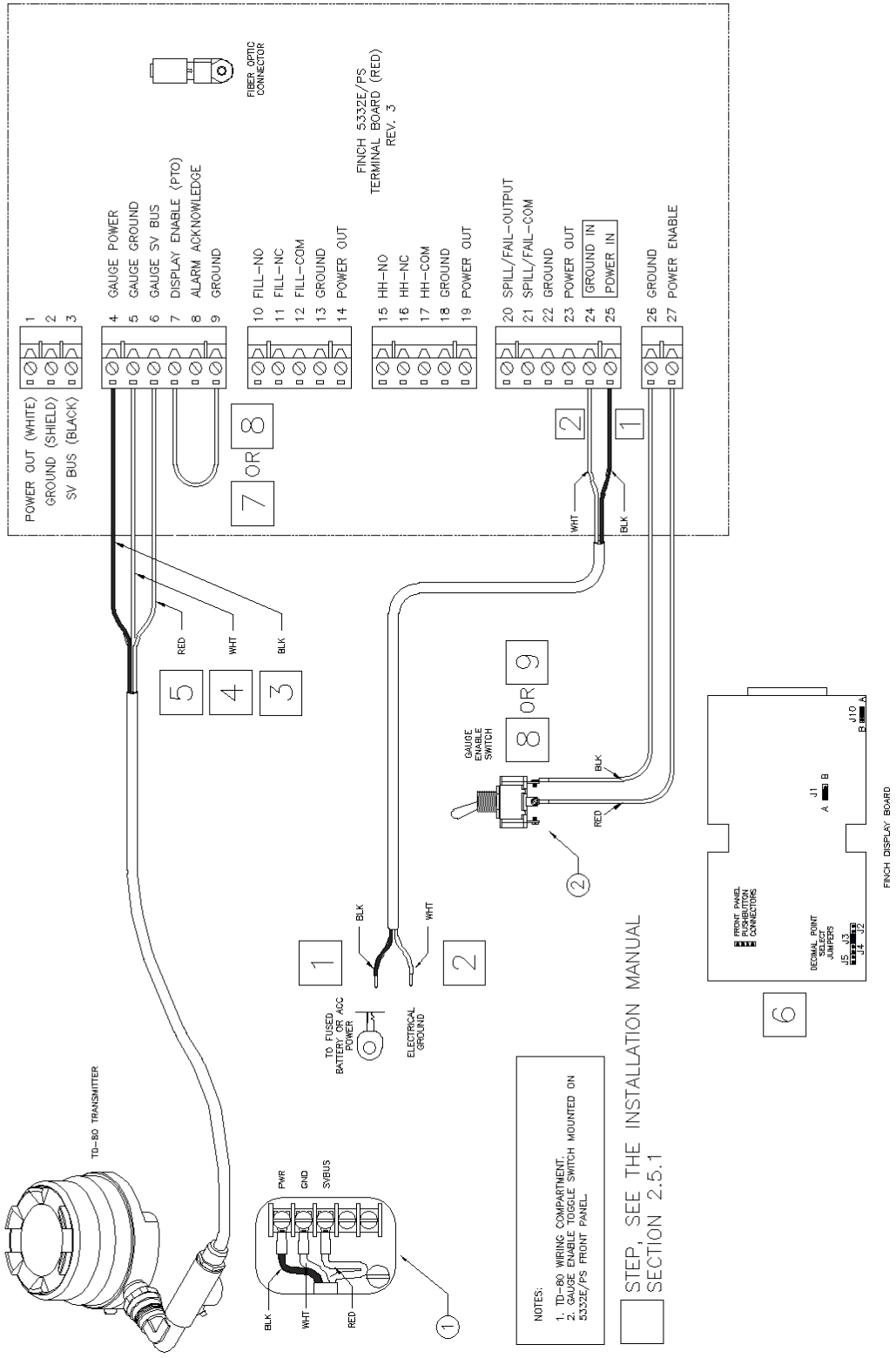


Figure 2-12: Basic System Wiring Diagram for Finch 5332E/PS External Display

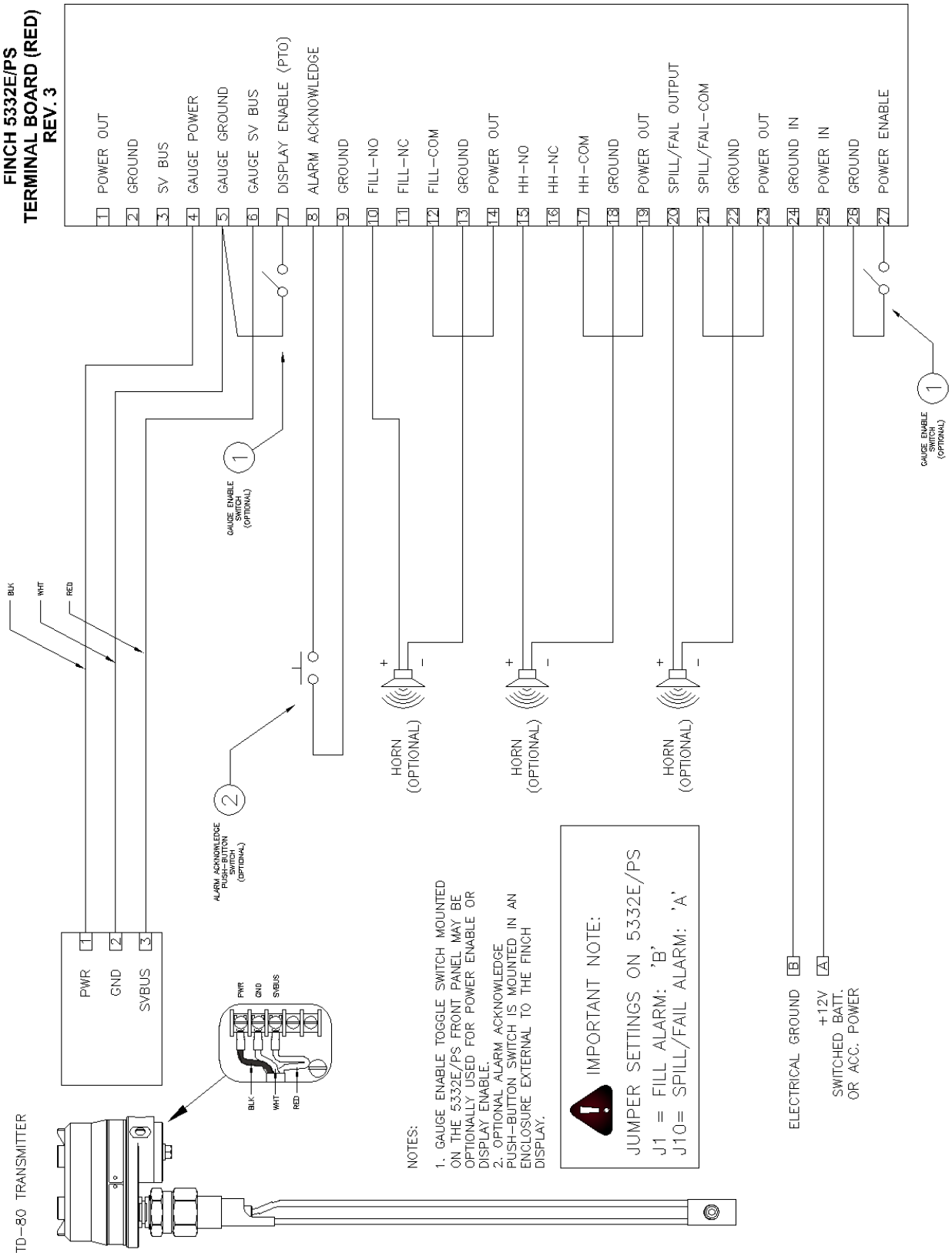


Figure 2-13: Basic System Wiring Schematic for Finch 5332E/PS External Display

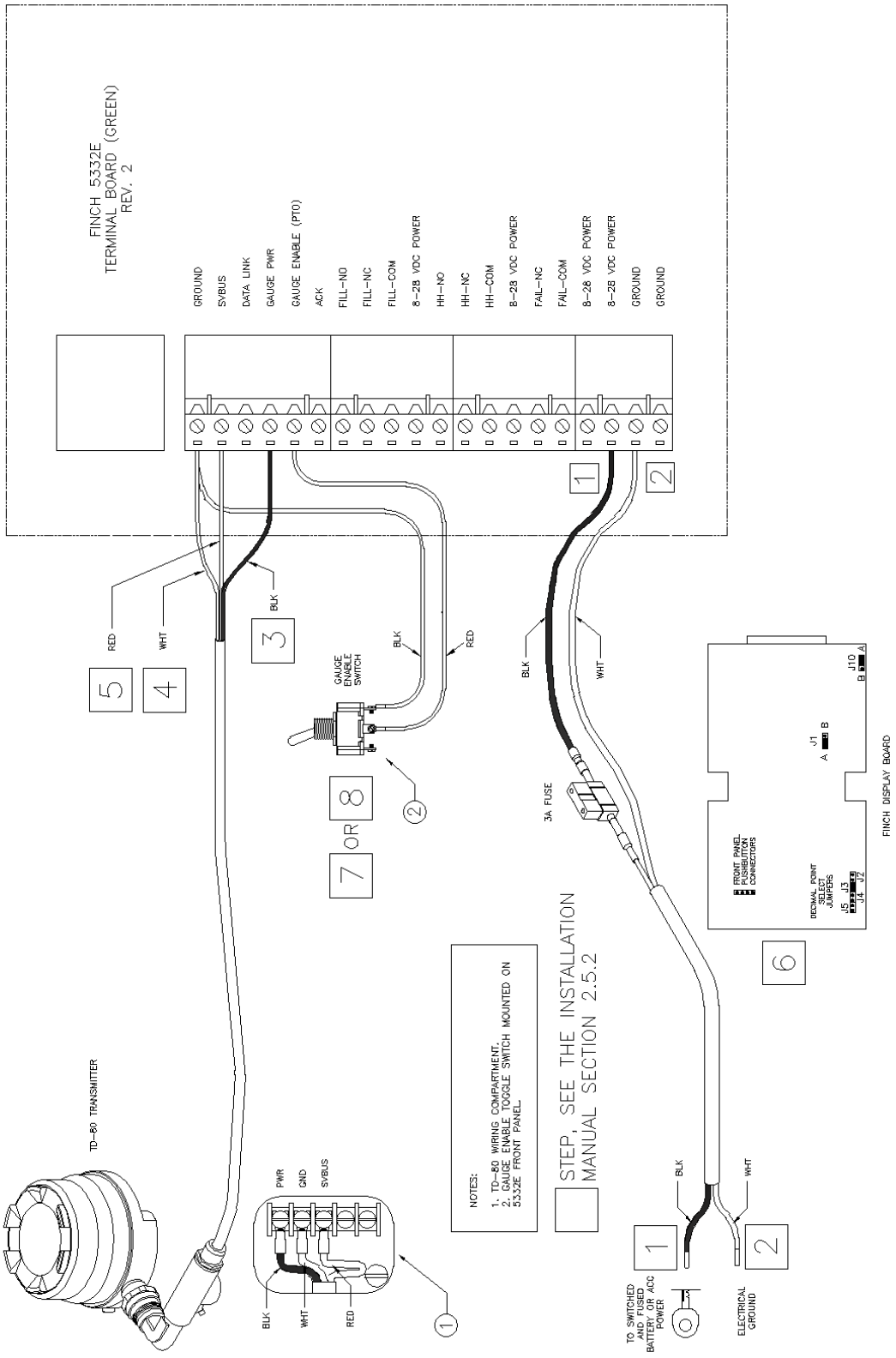


Figure 2-14: Basic System Wiring Diagram for Finch 5332E External Display

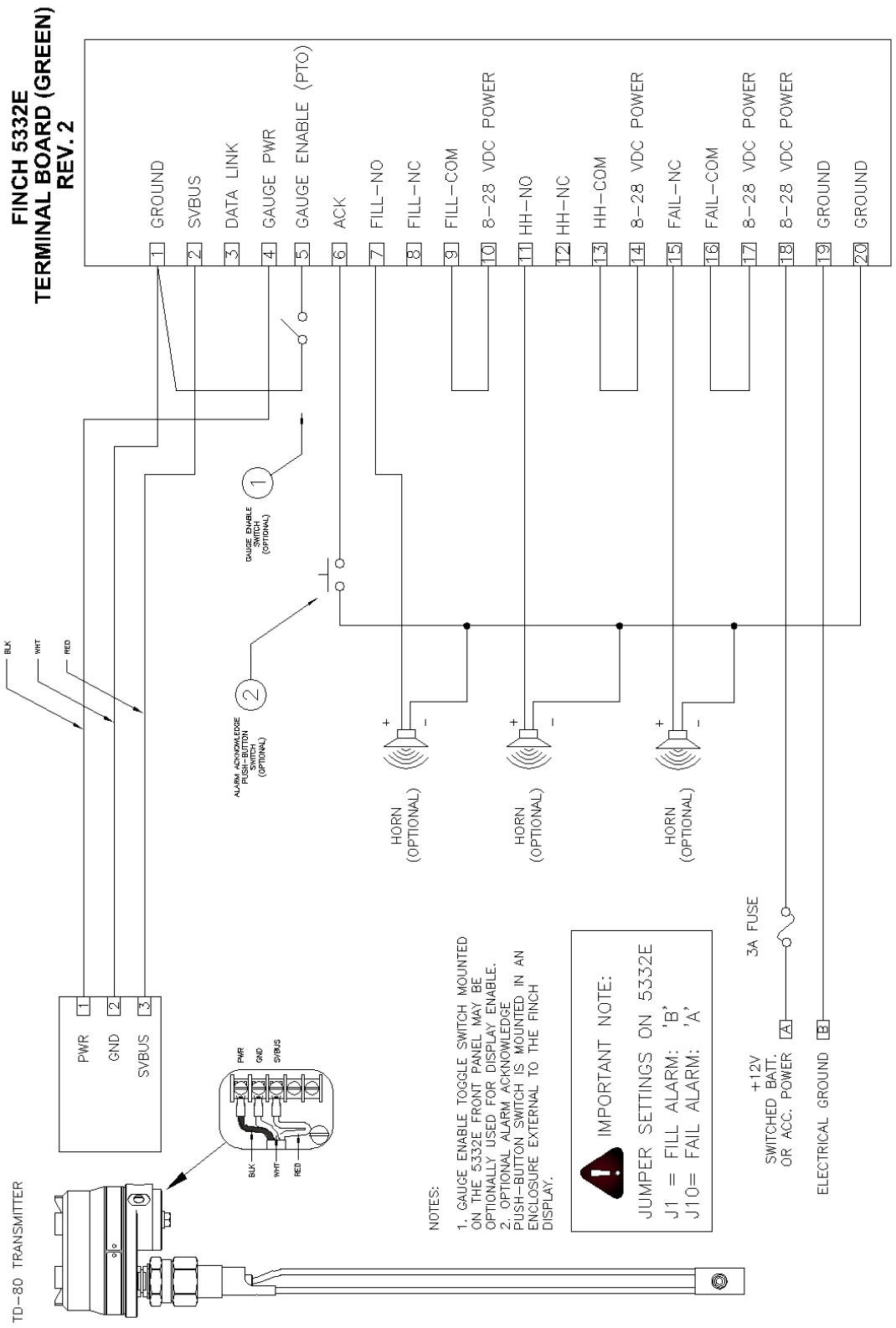


Figure 2-15: Basic System Wiring Schematic for Finch 5332E External Display

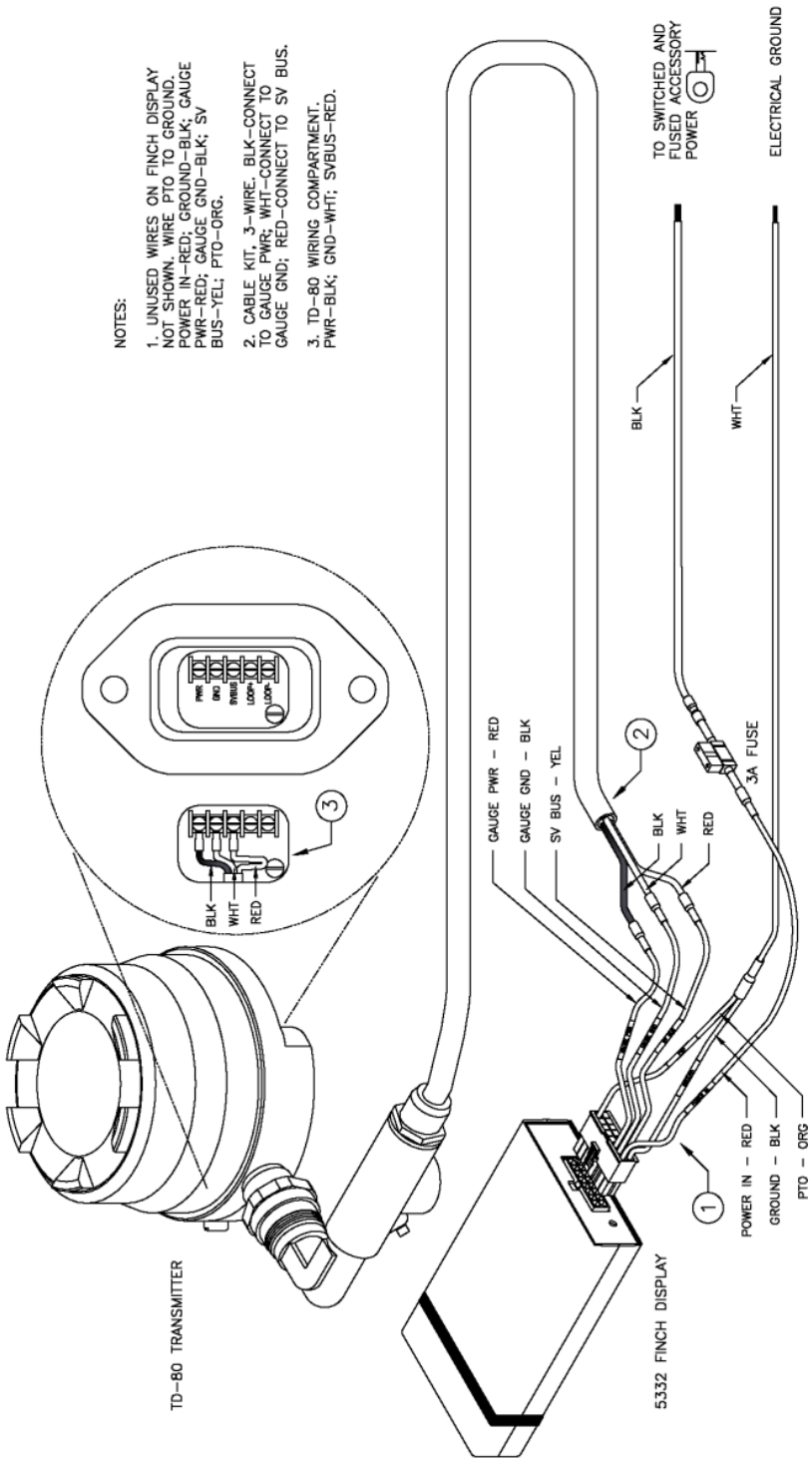


Figure 2-16: Basic System Wiring Diagram for Finch 5332 Internal Display

2.6 TD80 Basic Alarm Installation Wiring

The TD80 and Finch Display generated alarms are available for controlling a variety of lights, horns, solenoid operated valves and other devices. These alarms control three sets of dry contact relay outputs. The suggested alarm wiring below is for a basic system of lights or horns to alert an operator for further action.

2.6.1 Finch 5332E/PS, Red Terminal Board Wiring Instructions

Wiring steps for a single TD80 and Finch Display. Refer to Figure 2-17 for Finch 5332E/PS (red board) installation. The alarm relay contacts are rated for 30VDC, 2A continuous current maximum. Each set of contacts is protected by a 2A fuse located on the terminal board.

Ensure that the power and ground are connected as described below.

1. Fused Power wire from nose box socket or junction box to Finch POWER IN (25)
2. Ground wire from nose box socket or junction box to Finch GROUND IN (24)

Fill/Fall Alarm Installation

1. Finch FILL-COM (12) to POWER OUT (14)
2. Horn or light to Finch FILL-NO (10) and Electrical Ground
3. Finch Jumpers, see Figure 2-37
   a. J1 to “B” position
   b. J9 removed for Fill alarm, installed for Fall alarm

High-High (HH) Alarm Installation

1. Finch HH-COM (17) to POWER OUT (19)
2. Horn or light to Finch HH-NO (15) and Electrical Ground

Spill/Fail Alarm Installation

1. Finch SPILL/FAIL-COM (21) to POWER OUT (23)
2. Horn or light to Finch SPILL/FAIL OUTPUT (20) and Electrical Ground
3. Finch Jumper J10 to “A” position, see Figure 2-37

NOTE: Once the Basic Alarm Installation Wiring is complete, refer back to section 2.1.2, TD80 Installation Steps Overview, for clarification on the next installation step.

2.6.2 Finch 5332E, Green Terminal Board Wiring Instructions

Wiring steps for a single TD80 and Finch Display. Refer to Figure 2-18 for Finch 5332E (green board) installation. The alarm relay contacts are rated for 30VDC, 2A continuous current maximum.

Ensure that the power and ground are connected as described below.

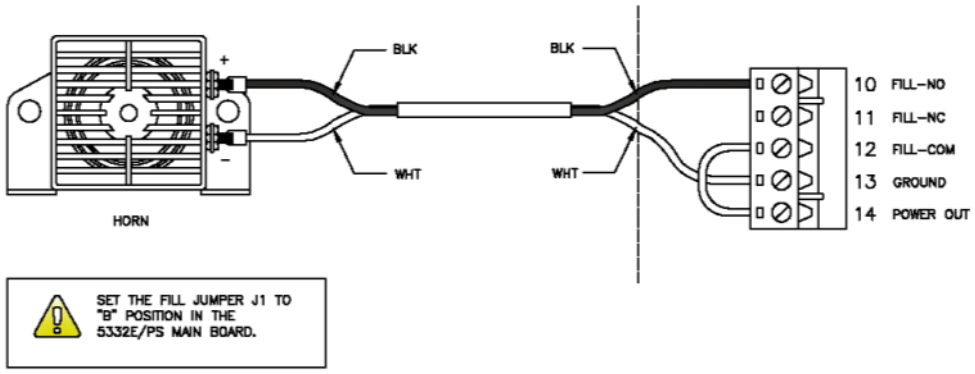
1. Fused Power wire from the nose box socket or junction box through a 3A fuse to Finch 8-28 VDC POWER
2. Ground wire from nose box socket or junction box to Finch GROUND

Fill/Fall Alarm Installation
1. Finch FILL-COM to 8-28VDC POWER
2. Horn or light to Finch FILL-NO and Electrical Ground
3. Finch Jumpers, see Figure 2-37
   a. J1 to “B” position
   b. J9 removed for Fill alarm, installed for Fall alarm

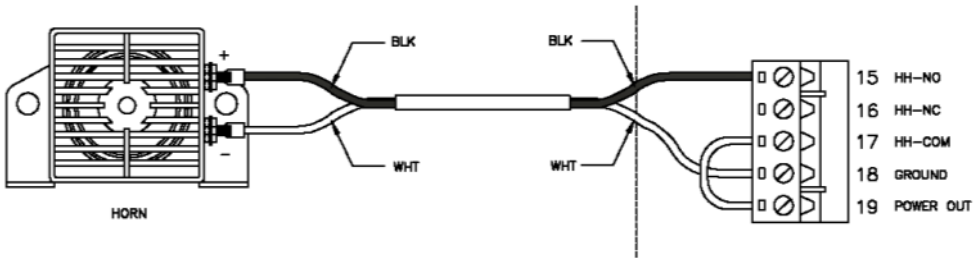
High-High (HH) Alarm Installation
1. Finch HH-COM to 8-28VDC POWER
2. Horn or light to Finch HH-NO and Electrical Ground

Spill/Fail Alarm Installation
1. Finch FAIL-COM to 8-28VDC POWER
2. Horn or light to Finch FAIL-NC and Electrical Ground
3. Finch Jumper J10 to “A” position, see Figure 2-37

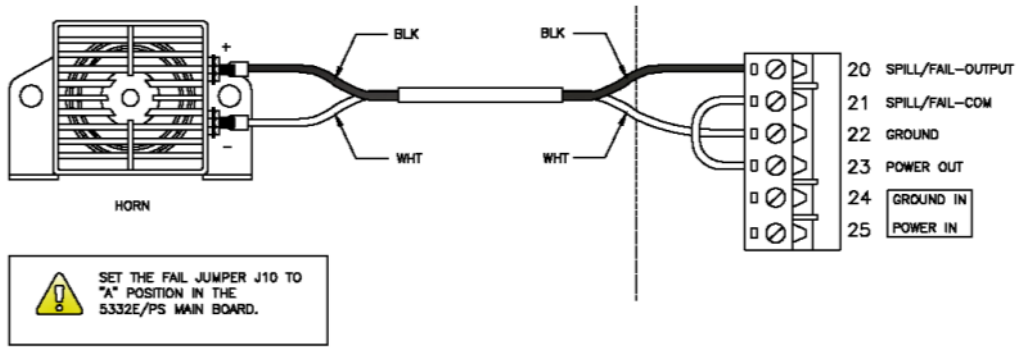
NOTE: Once the Basic Alarm Installation Wiring is complete, refer back to section 2.1.2, TD80 Installation Steps Overview, for clarification on the next installation step.



5332E/PS FILL ALARM WIRING



5332E/PS HH ALARM WIRING



5332E/PS SPILL/FAIL ALARM WIRING

Figure 2-17: Basic Alarm Wiring Diagram for Finch 5332E/PS External Display

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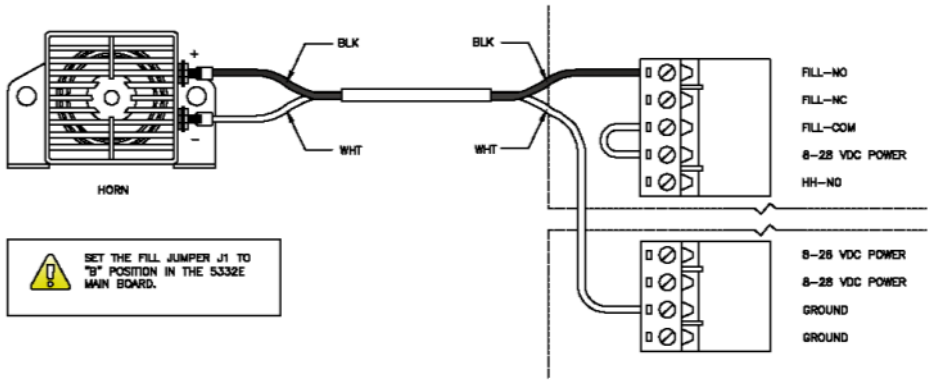
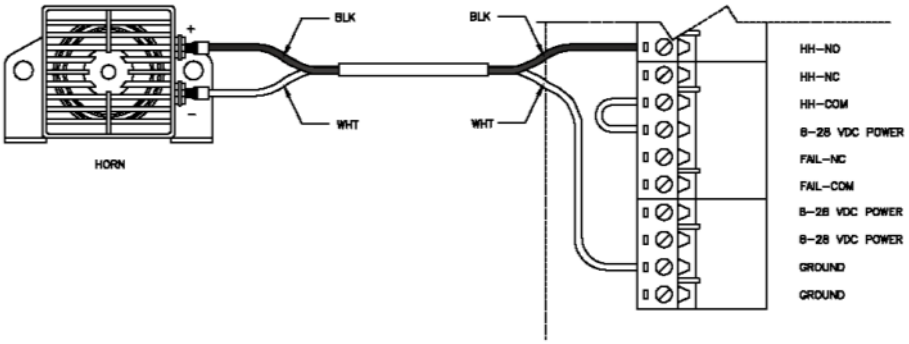
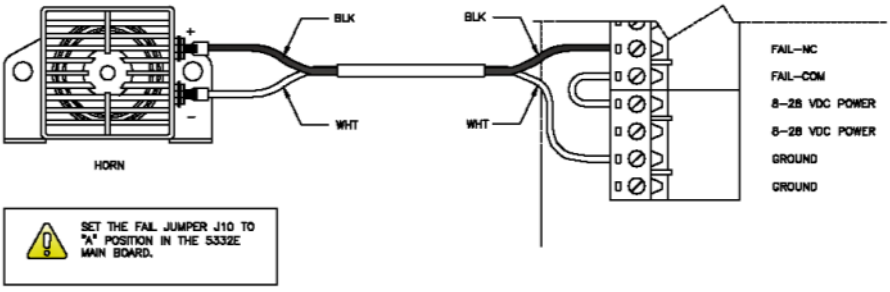


5332E FILL ALARM WIRING



5332E HH ALARM WIRING



5332E SPILL/FAIL ALARM WIRING

Figure 2-18: Basic Alarm Wiring Diagram for Finch 5332E External Display

2.7 TD80 Overfill Prevention System Installation Wiring

2.7.1 Finch Relay Module Installation Wiring

The TD80 generated alarms, through the Finch Display control the optional Finch Relay Module for onboard overfill prevention. The loading process may be controlled by a bottom loading valve or bypass of a hydraulic motor powered pump. A single, **normally open (NO),** high current relay contact powers an external device to enable loading; while removal of the power disables loading as a failsafe control method.

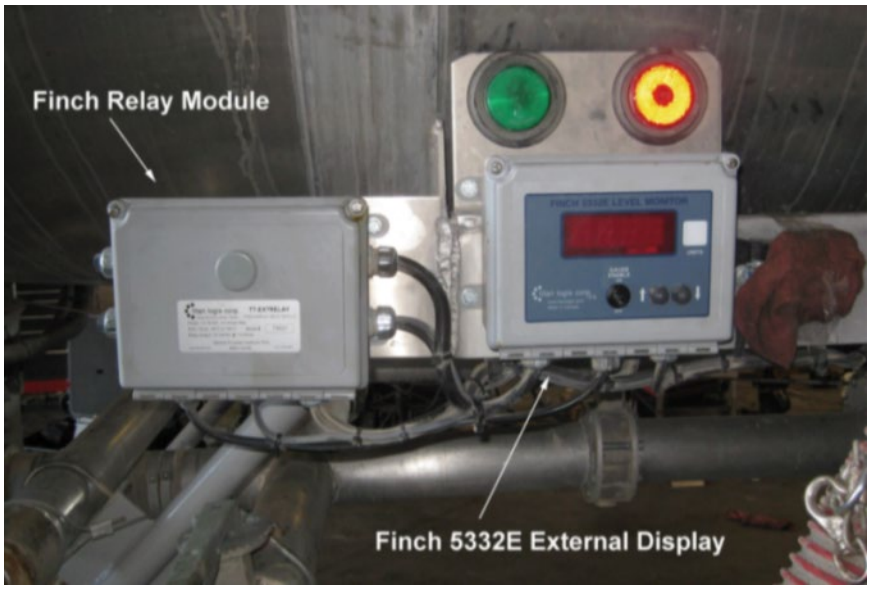


Figure 2-19: Overfill Prevention Installation Example

The wiring steps described below use the recommended TD80 transmitter, Finch Display and Finch Relay Module.

The most common control devices for overfill prevention are:

1. A **normally closed (NC)** bottom loading valve
   OR
2. A **normally open (NO)** hydraulic motor bypass valve

Install the Finch Relay Module in a Non-Hazardous location only.

Finch 5332E/PS, Red Terminal Board Wiring Instructions

Wiring steps for a single TD80, Finch Display and Relay Module. Refer to Figure 2-20, Figure 2-25 & for Finch 5332E/PS (red board) installation.

Note that the horn, red and green lights are optional accessories. The PTO signal must be connected to the Finch Display mounted Gauge Enable switch or to a switch controlled by the PTO or air brake. Power may be controlled by the optional brake air switch.

1. Fused Power and Ground wires from nose box socket or junction box through a 5A fuse to Relay Module POWER (15) and GROUND (14)
2. Optional PTO or brake air switch to Relay Module PTO (13) and Electrical Ground
3. Relay Module GAUGE GND (2) to Finch GROUND IN (24)
4. Relay Module PTO (13) to Finch DISPLAY ENABLE (PTO) (7)
5. Relay Module 12V POWER (1) to Finch POWER IN (25). 3A fuse not required.
6. TD80 Power (Black wire) to Finch GAUGE POWER (4)
7. TD80 Ground (White wire) to Finch GAUGE GROUND (5)
8. TD80 SV Bus (Red wire) to Finch GAUGE SV (6)
9. Finch Wiring and Jumpers
   a. Wire POWER ENABLE (27) to GROUND (26)
   b. Wire SPILL/FAIL Output (20) to HH-COM (17)
   c. Wire FILL-COM (12) to GROUND (13)
   d. J1, J9, J10, Decimal Point Jumper positions, see Figure 2-37

      i. J1=”A” position
      ii. J9 removed for Fill alarm, installed for Fall alarm
      iii. J10= “B” position
      iv. Decimal point jumper for required Display
10. Optional Gauge Enable toggle switch red wire to DISPLAY ENABLE (PTO) (7) and black wire to GROUND (922)
11. Finch SPILL/FAIL-COM (21) to Relay Module FAIL-COM (6)
12. Finch HH-NC (16) to Relay Module HH-NC (5)
13. Finch FILL-NC (11) to Relay Module FILL-NC (4)
14. Optional Green Light to Relay Module HH-NC (5) and POWER (15), refer to Figure 2-21 & Figure 2-22
15. Optional Red Light to Relay Module HORN/RED L (8) and POWER (15), refer to Figure 2-21 & Figure 2-22
16. Optional Horn (-) to Relay Module HORN/RED L (8), Horn (+) to Relay Module POWER (15), refer to Figure 2-21 & Figure 2-22
17. Solenoid to Relay Module SOLENOID (7) and Electrical Ground

NOTE: Once the Overfill Prevention Installation Wiring is complete, refer back to section 2.1.2, TD80 Installation Steps Overview, for clarification on the next installation step.

Finch 5332E, Green Terminal Board Wiring Instructions

Wiring steps for a single TD80, Finch Display and Relay Module. Refer to Figure 2-20 & *Figure 2-27* & Figure 2-28 for Finch 5332E (green board) installation.

Note that the horn, red and green lights are optional accessories. The PTO signal must be connected to the Finch Display mounted Gauge Enable switch or to a switch controlled by the PTO or air brake. Power may be controlled by the optional brake air switch.

1. Fused Power and Ground wires from nose box socket or junction box through a 5A fuse to Relay Module POWER (15) and GROUND (14)
2. Optional PTO or brake air switch to Relay Module PTO (13) and Electrical Ground
3. Relay Module GAUGE GND (2) to Finch GROUND
4. Relay Module 12V POWER (1) through a 3A fuse to Finch 8-28 VDC POWER
5. Relay Module PTO (13) to Finch GAUGE ENABLE (PTO)
6. TD80 Power (Black wire) to Finch GAUGE PWR POWER
7. TD80 Ground (White wire) to Finch GROUND GAUGE GND
8. TD80 SV Bus (Red wire) to Finch SV BUS

9. Finch Wiring and Jumpers, see Figure 2-37
    a. Wire FAIL-NC to HH-COM
    b. Wire FILL-COM to GROUND
    c. J1, J9, J10, Decimal Point Jumper positions
        i. J1=”A” position
        ii. J9 removed for Fill alarm, installed for Fall alarm
        iii. J10= “B” position
        iv. Decimal point jumper for required Display
10. Optional Gauge Enable toggle switch red wire to GAUGE ENABLE (PTO) and black wire to GROUND
11. Finch FAIL-COM to Relay Module FAIL-COM (6)
12. Finch HH-NO to Relay Module HH-NC (5)
13. Finch FILL-NC to Relay Module FILL-NC (4)
14. Optional Green Light to Relay Module HH-NC (5) and POWER (15), refer to Figure 2-23 & Figure 2-24
15. Optional Red Light to Relay Module HORN/RED L (8) and POWER (15), refer to Figure 2-23 & Figure 2-24
16. Optional Horn (-) to Relay Module HORN/RED L (8), Horn (+) to Relay Module POWER (15), refer to Figure 2-23 & Figure 2-24
17. Solenoid to Relay Module SOLENOID (7) and Electrical Ground

NOTE: Once the Overfill Prevention Installation Wiring is complete, refer back to section 2.1.2, TD80 Installation Steps Overview, for clarification on the next installation step.

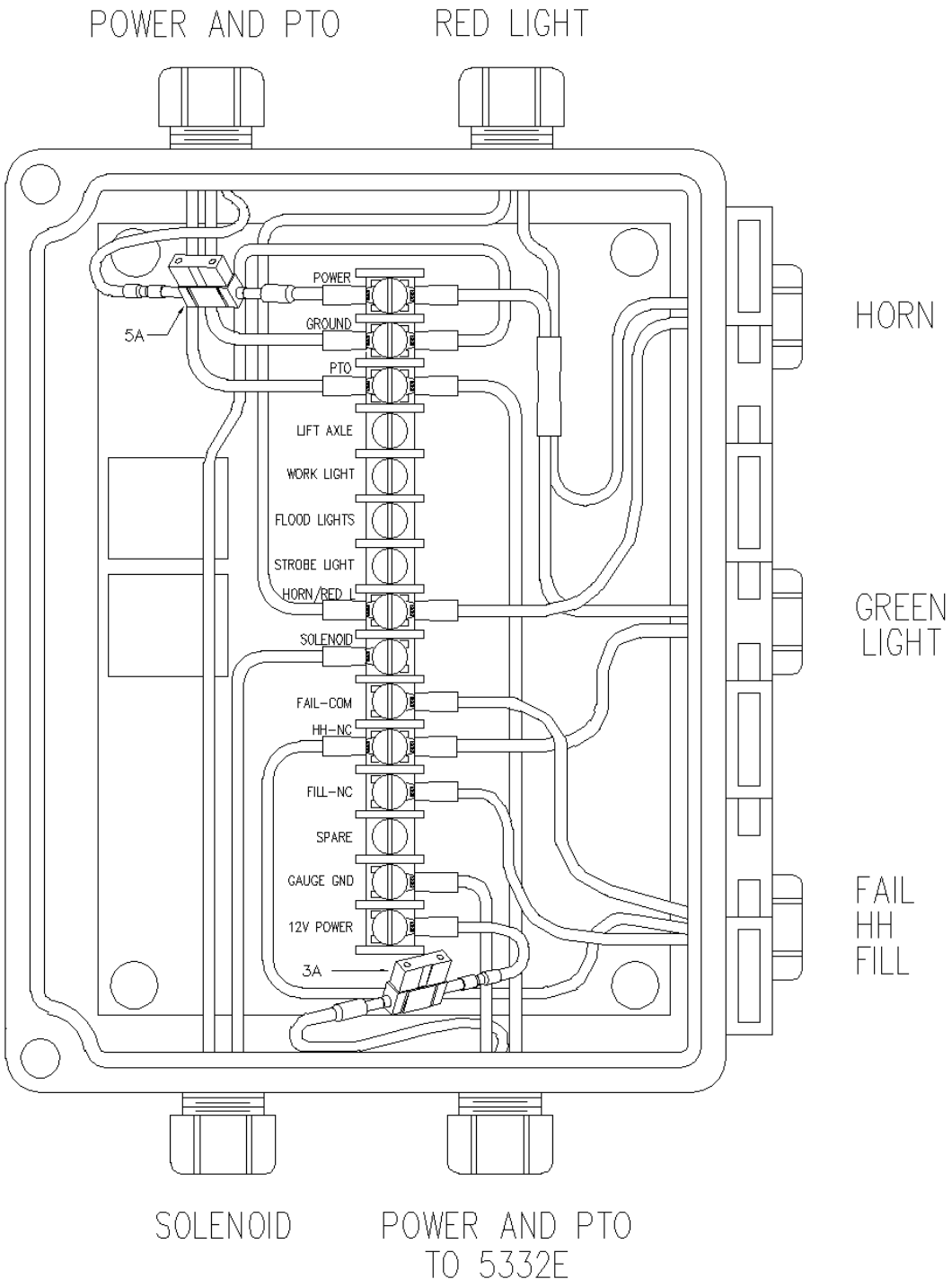


Figure 2-20: Finch Relay Module Internal Wiring Diagram

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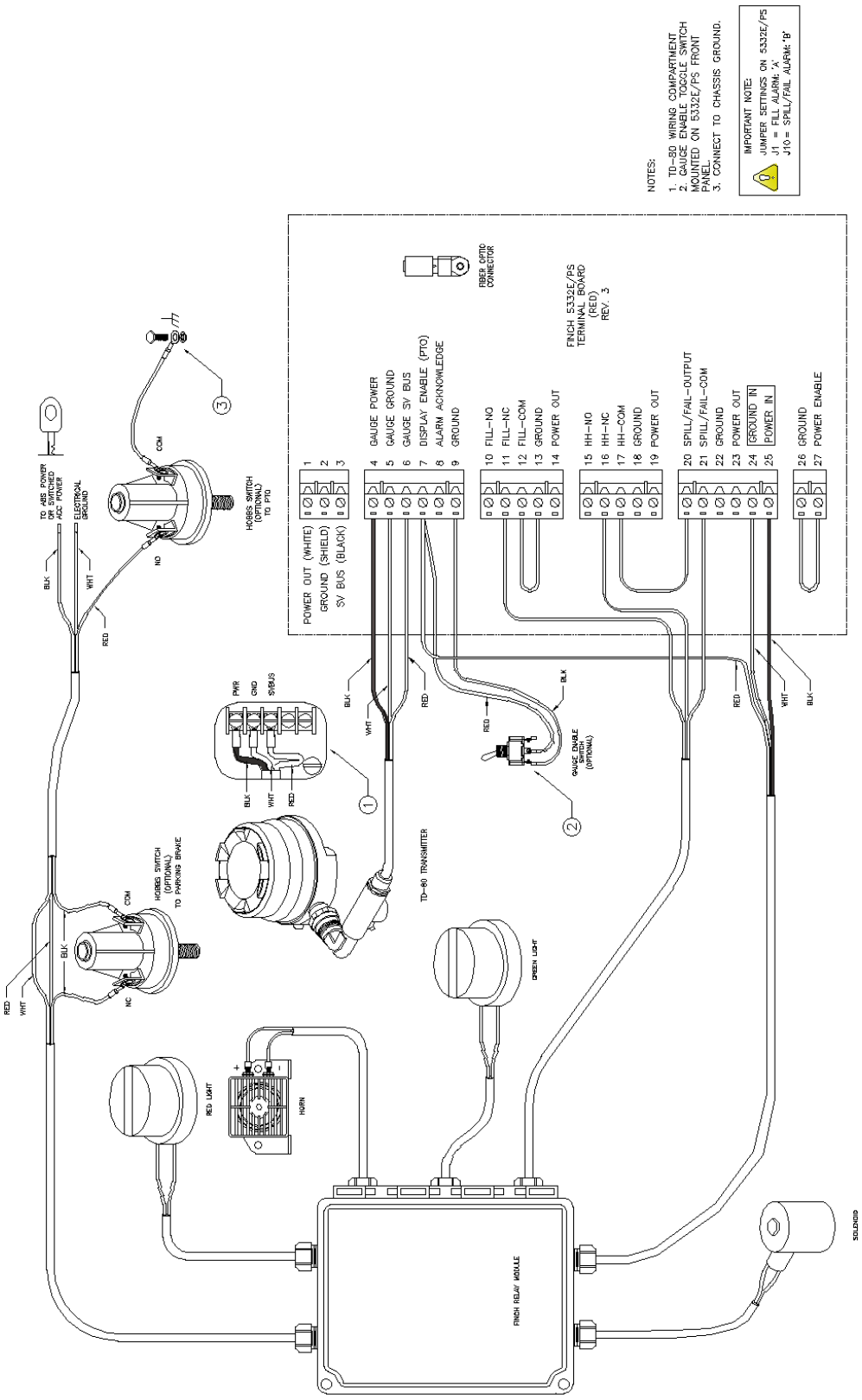

Figure 2-21: Finch Relay Module Overfill Prevention System Wiring Diagram for Finch 5332E/PS with Horns and Lights

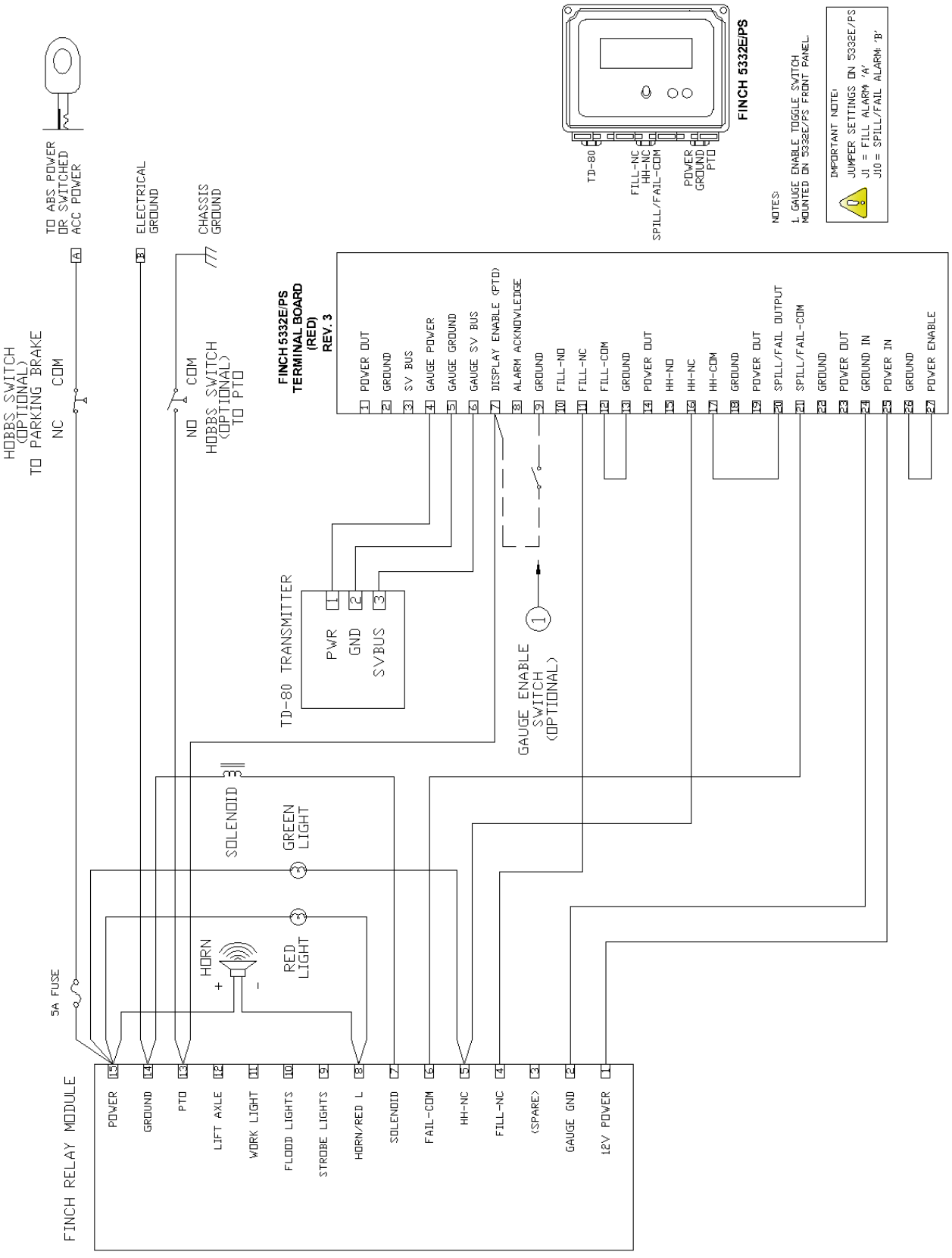

Figure 2-22: Finch Relay Module Overfill Prevention System Wiring Schematic for Finch 5332E/PS with Horns and Lights

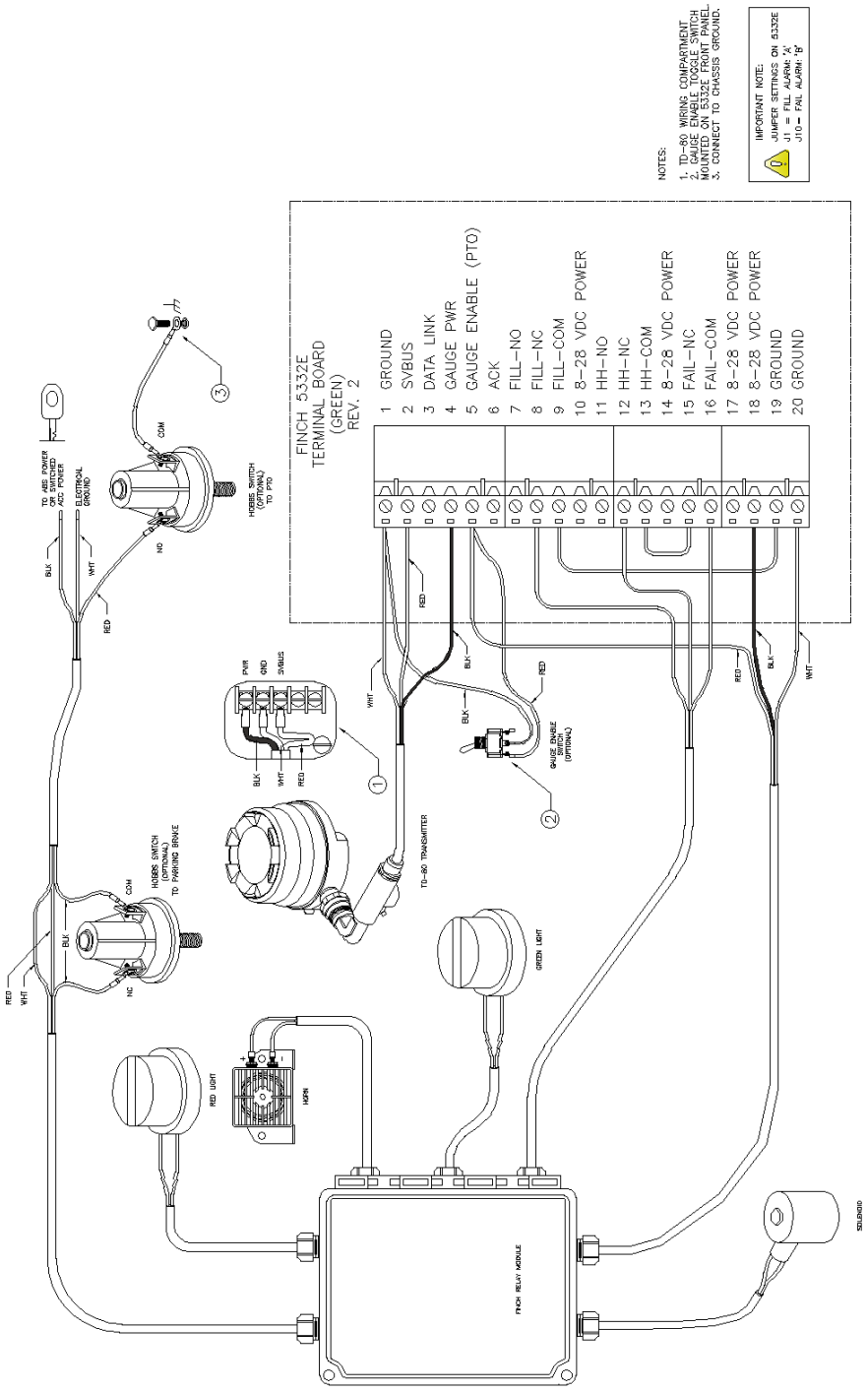

Figure 2-23: Finch Relay Module Overfill Prevention System Wiring Diagram for Finch 5332E with Horns and Lights

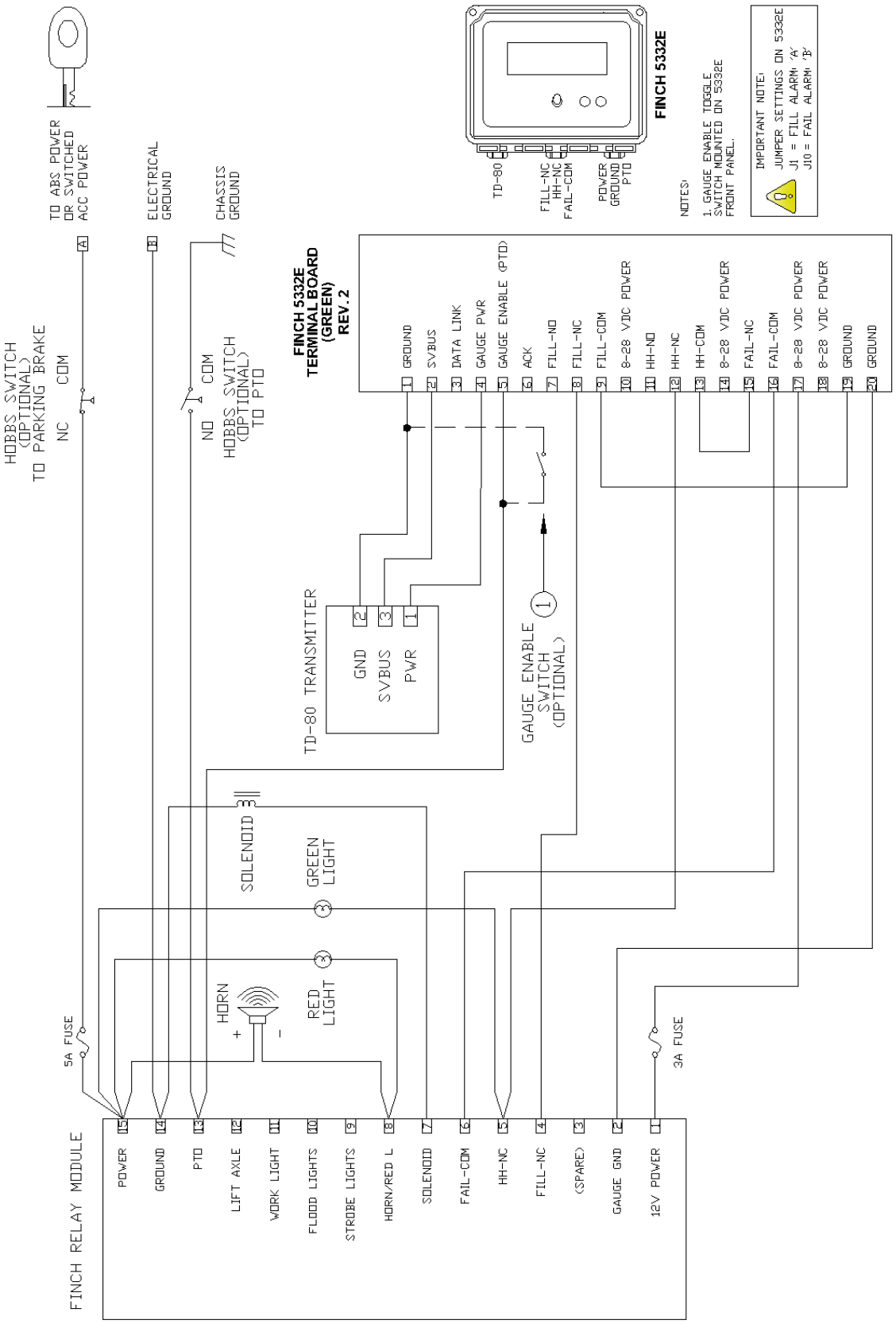

Figure 2-24: Finch Relay Module Overfill Prevention System Wiring Schematic for Finch 5332E with Horns and Lights

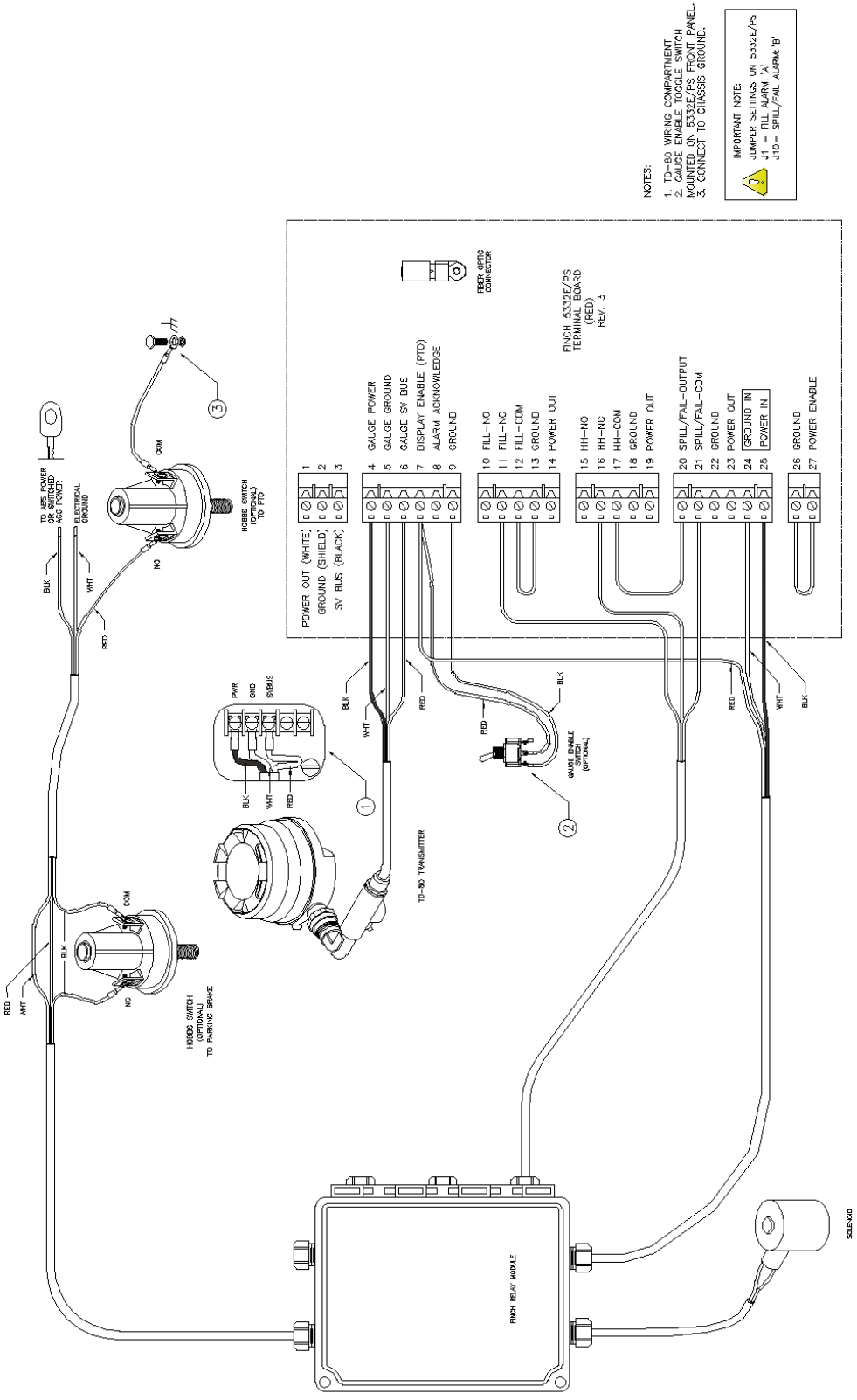

Figure 2-25: Basic Shutdown Wiring Diagram for Finch 5332E/PS External Display

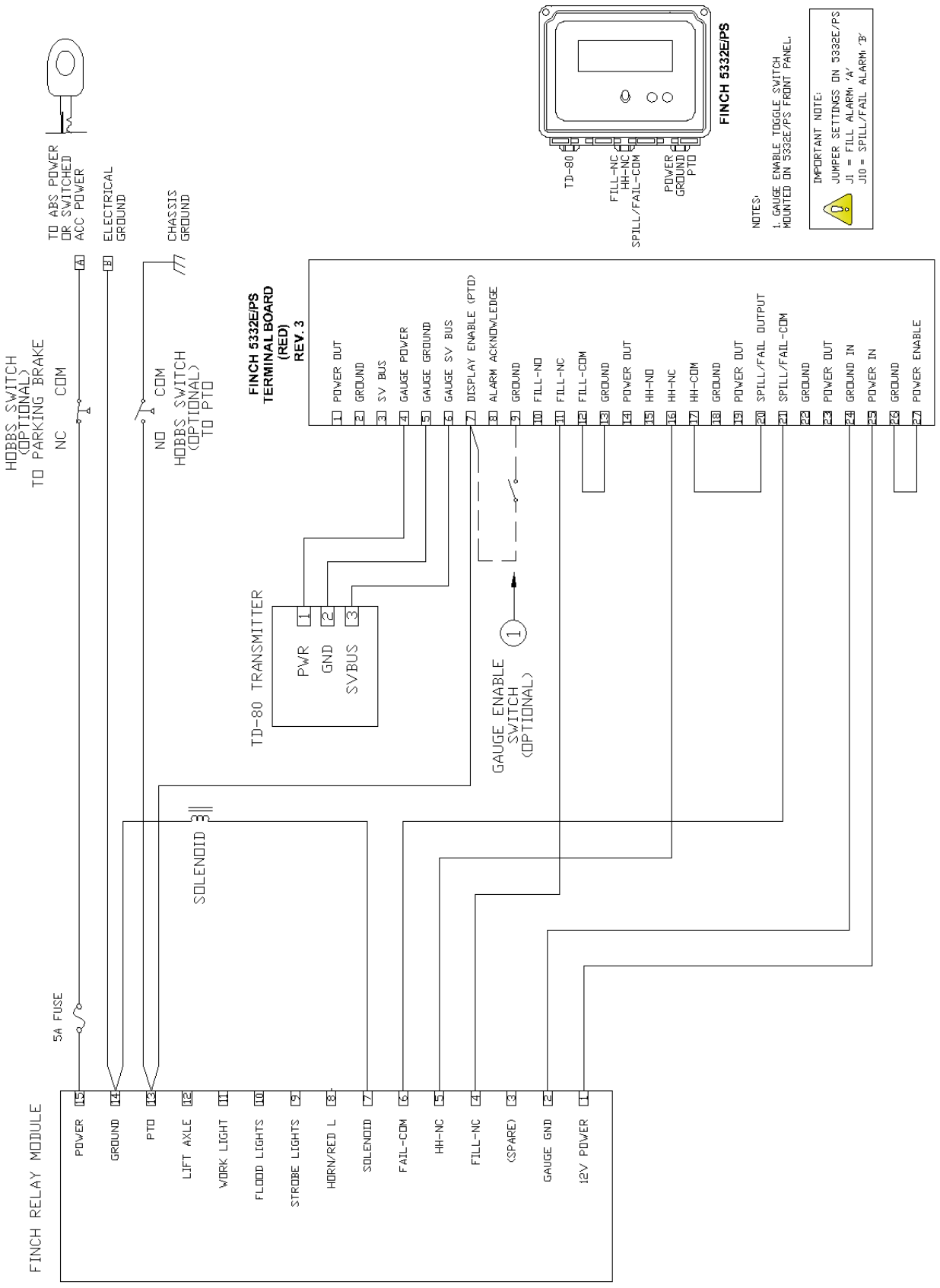

Figure 2-26: Basic Shutdown Wiring Schematic for Finch 5332E/PS External Display

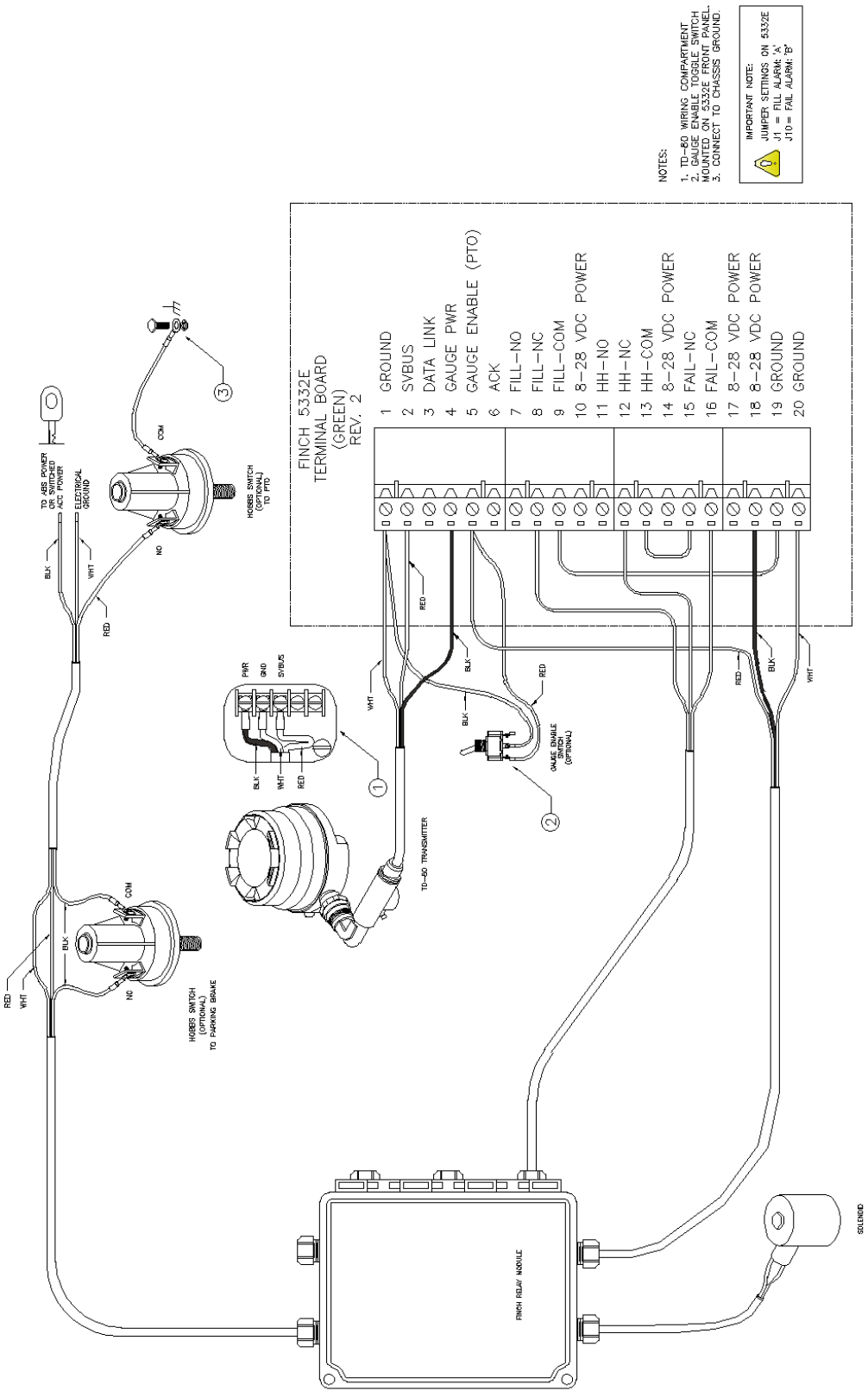

Figure 2-27: Basic Shutdown Wiring Diagram for Finch 5332E External Display

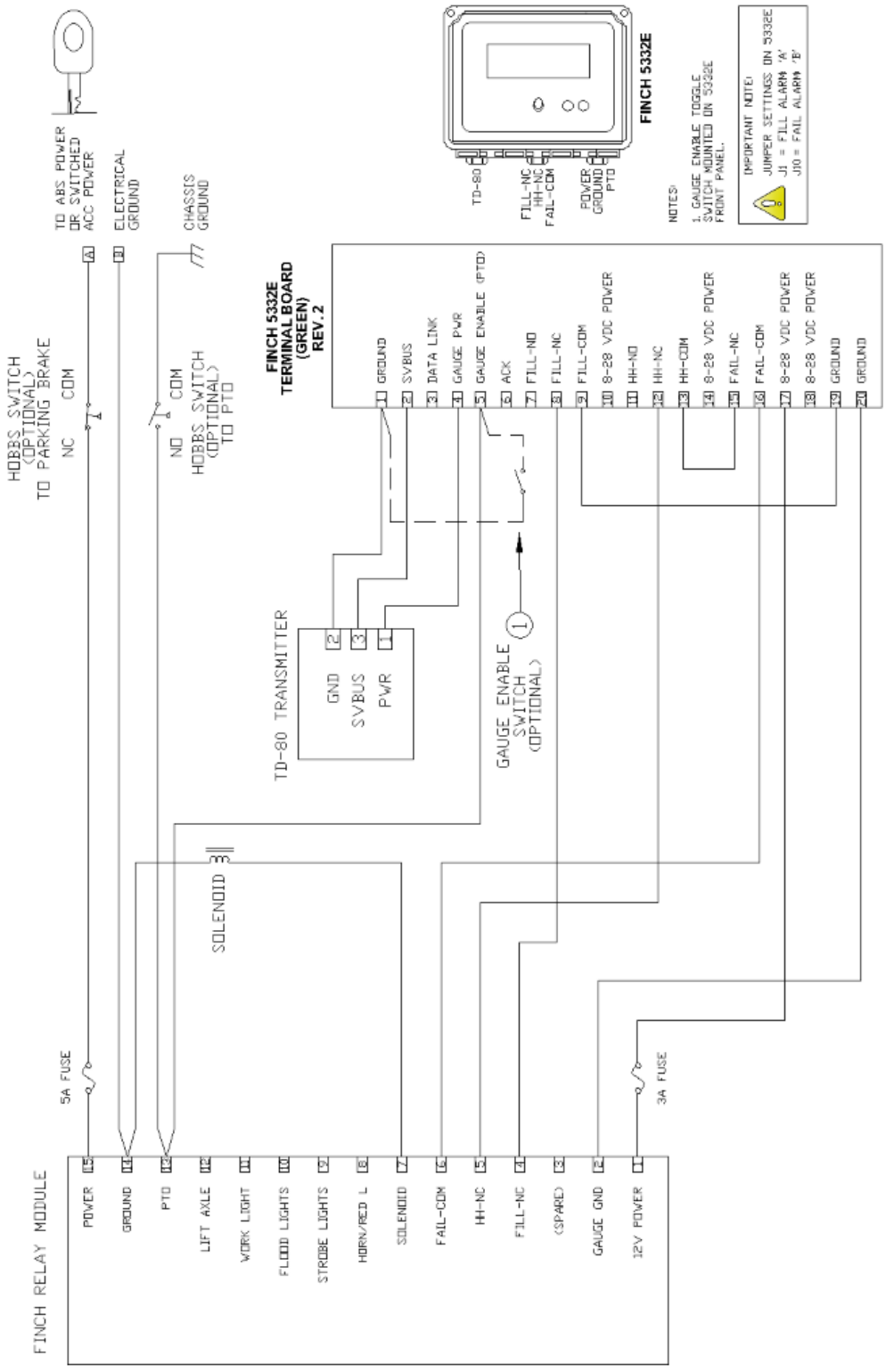

Figure 2-28: Basic Shutdown Wiring Schematic for Finch 5332E External

2.7.2 P2000 Overfill Prevention System

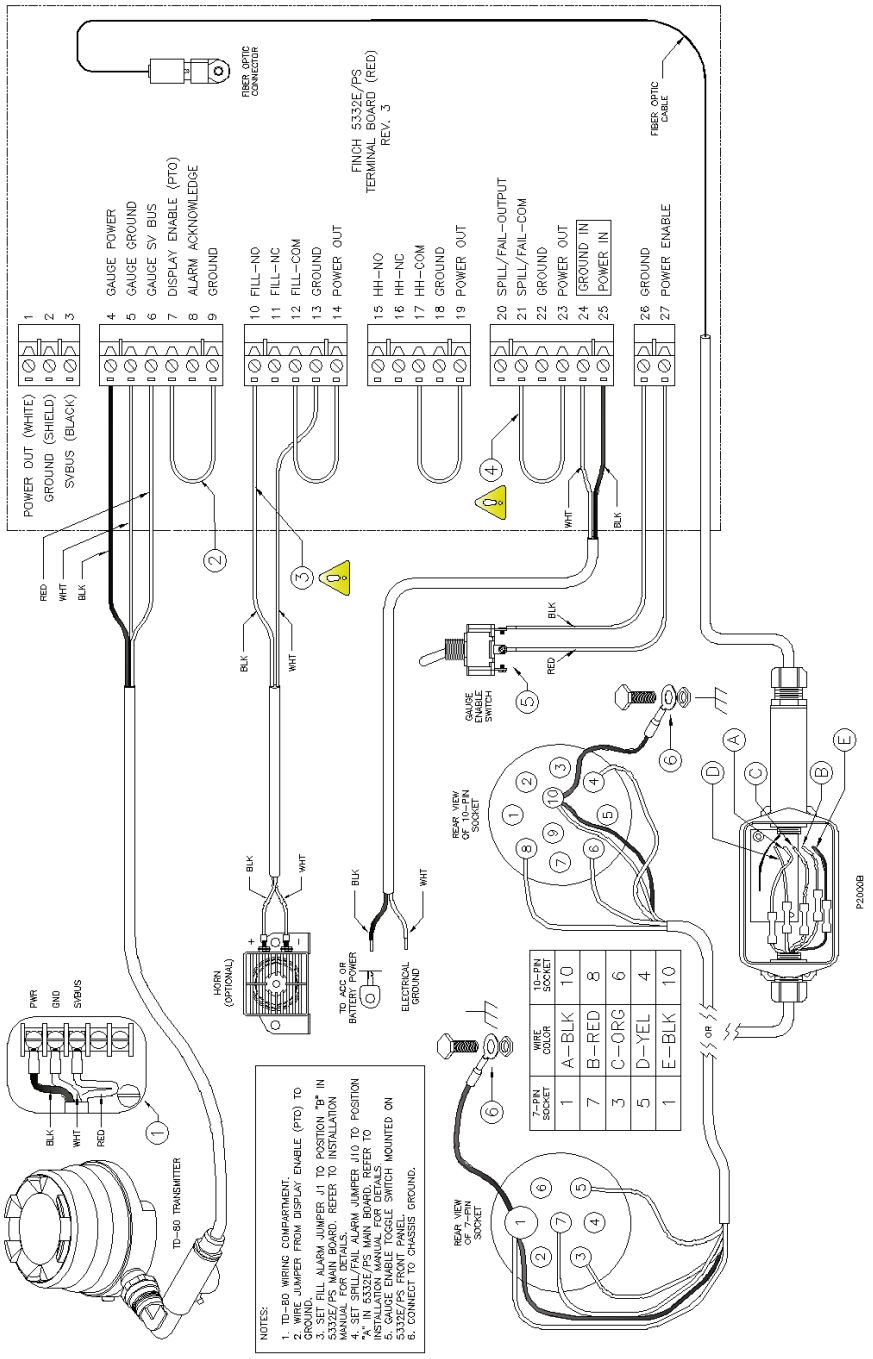

Figure 2-29: Single P2000 Overfill Prevention System Wiring Diagram

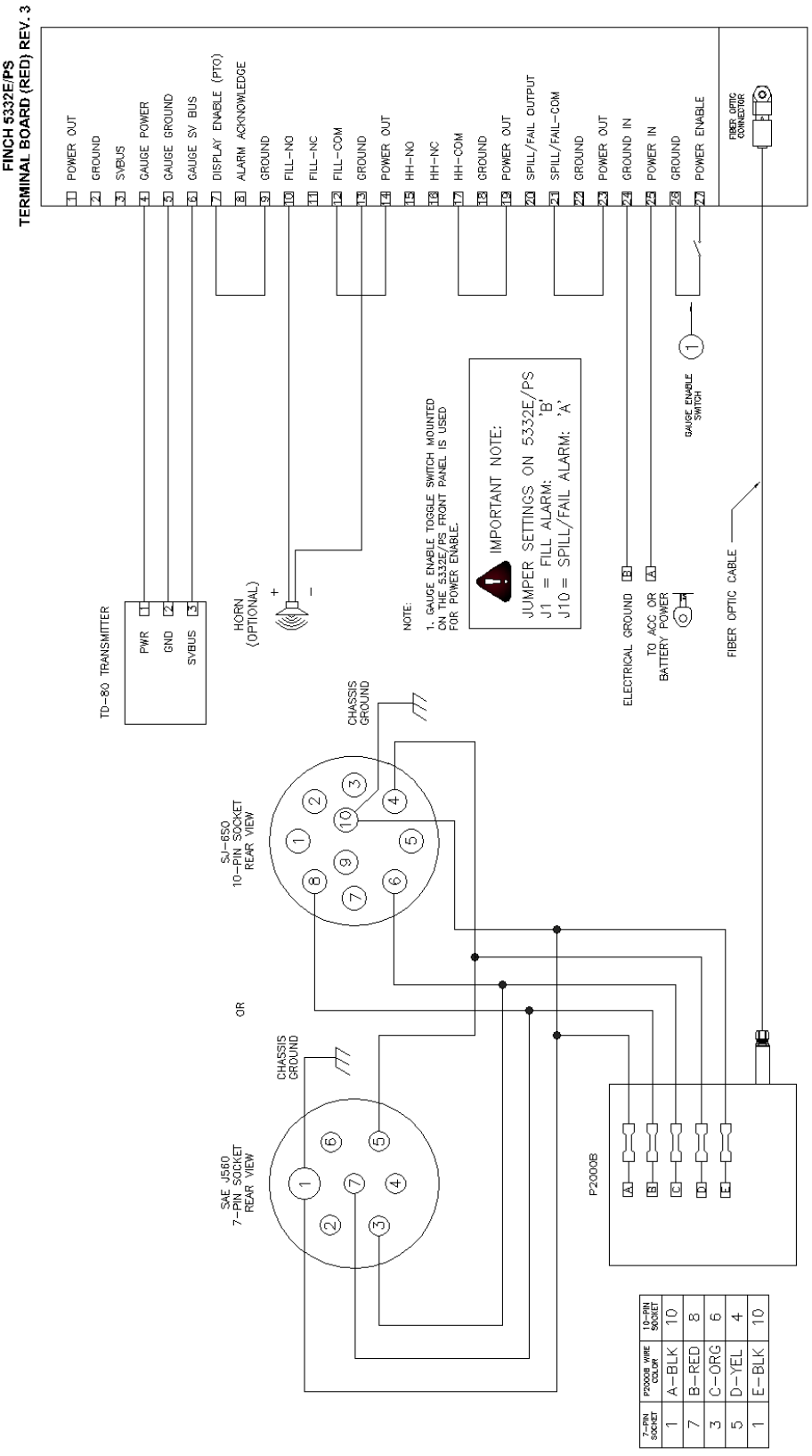

Figure 2-30: Single P2000 Overfill Prevention System Wiring Schematic

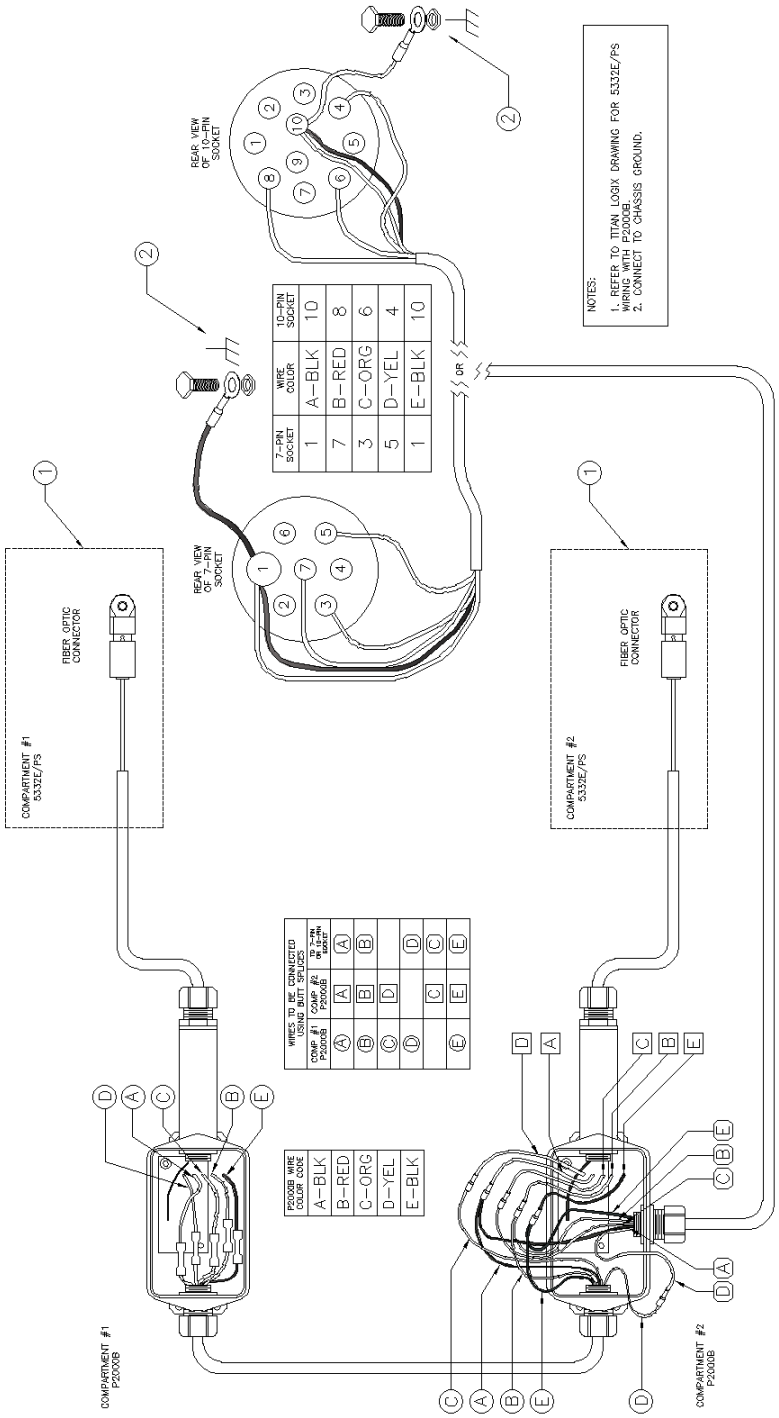

Figure 2-31: Dual P2000 Overfill Prevention System Wiring Diagram

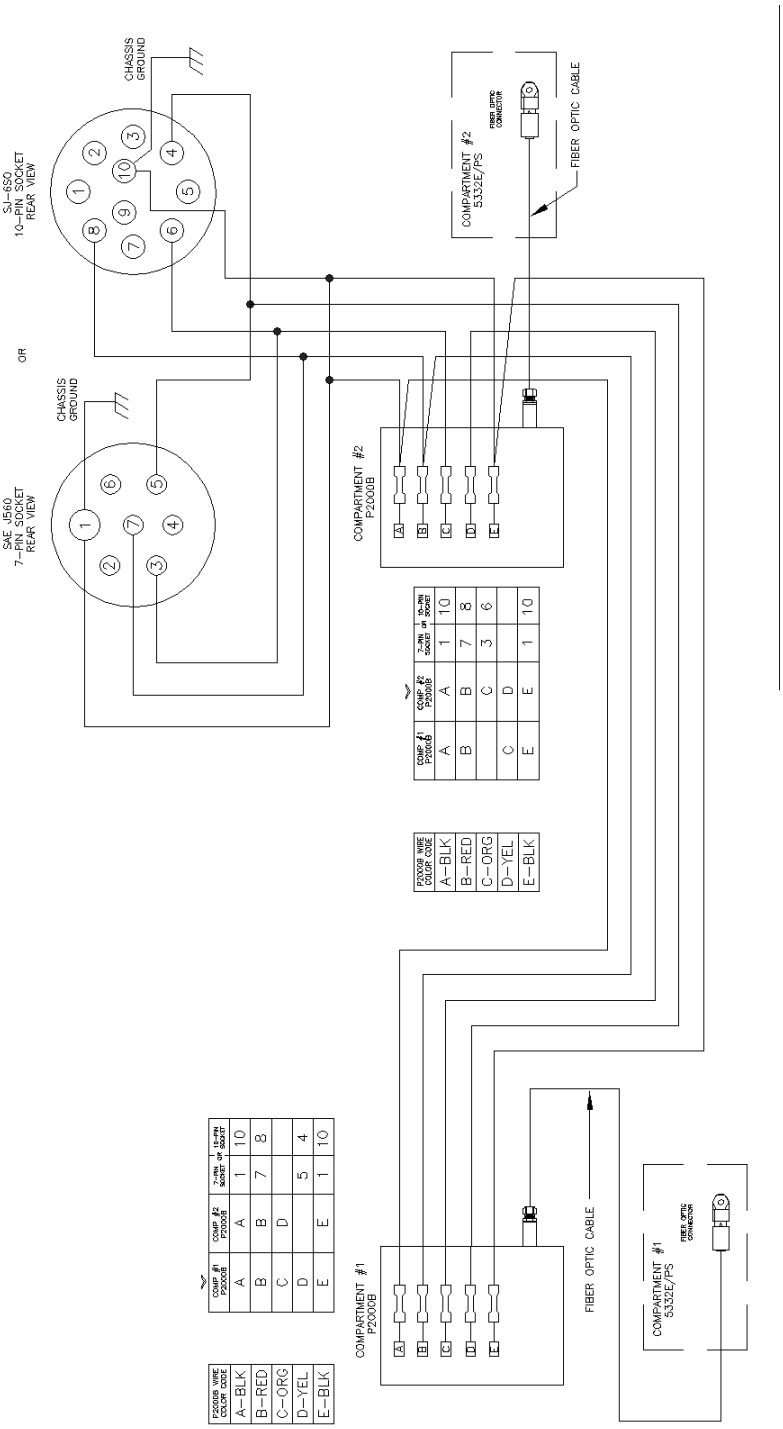

Figure 2-32: Dual P2000 Overfill Prevention System Wiring Schematic

2.7.3 ABS Power Supply Wiring Example

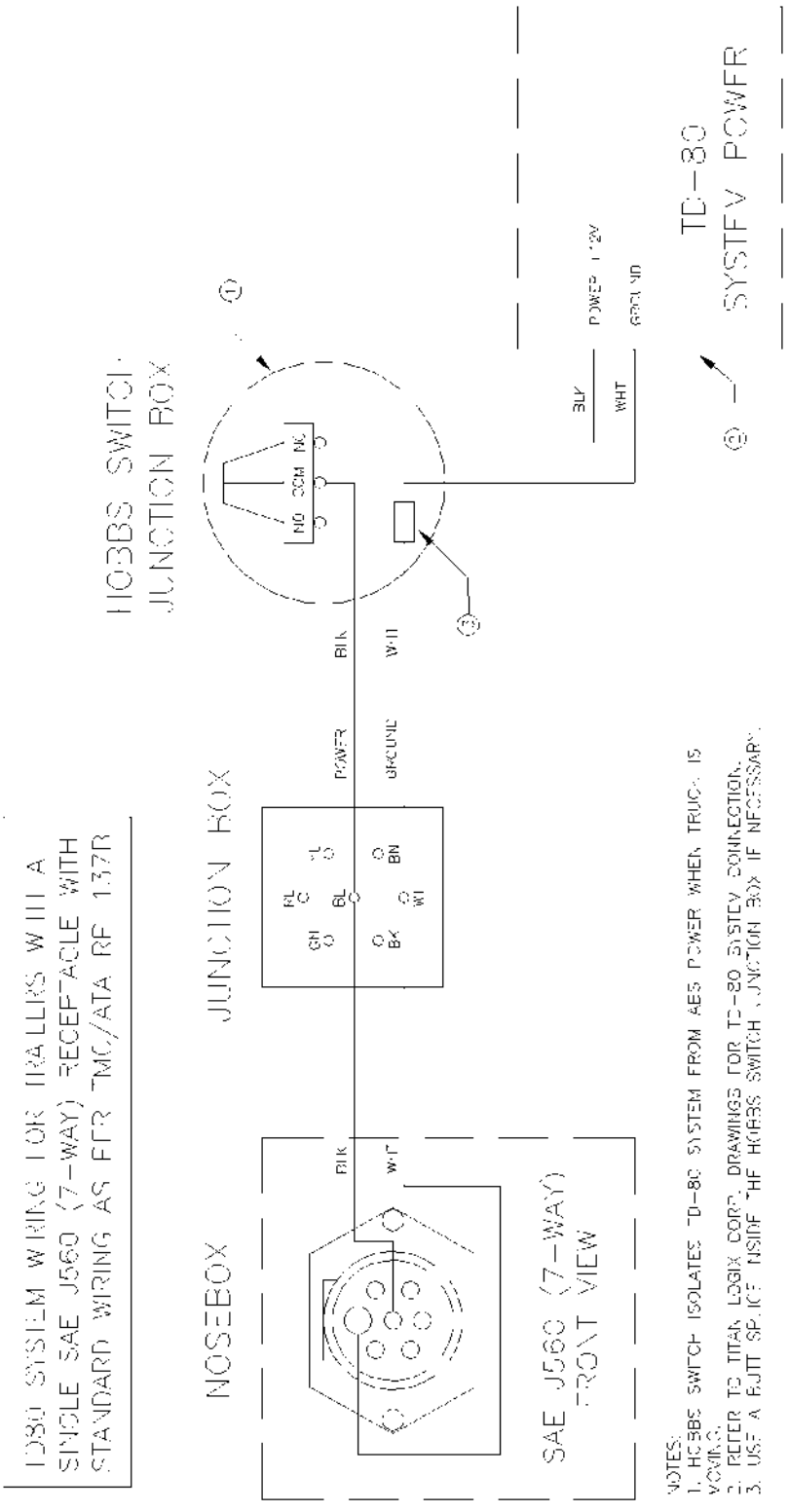

Figure 2-33: ABS Power Supply Wiring Example Schematic

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2.8 Finch Display Terminal and Jumper Locations

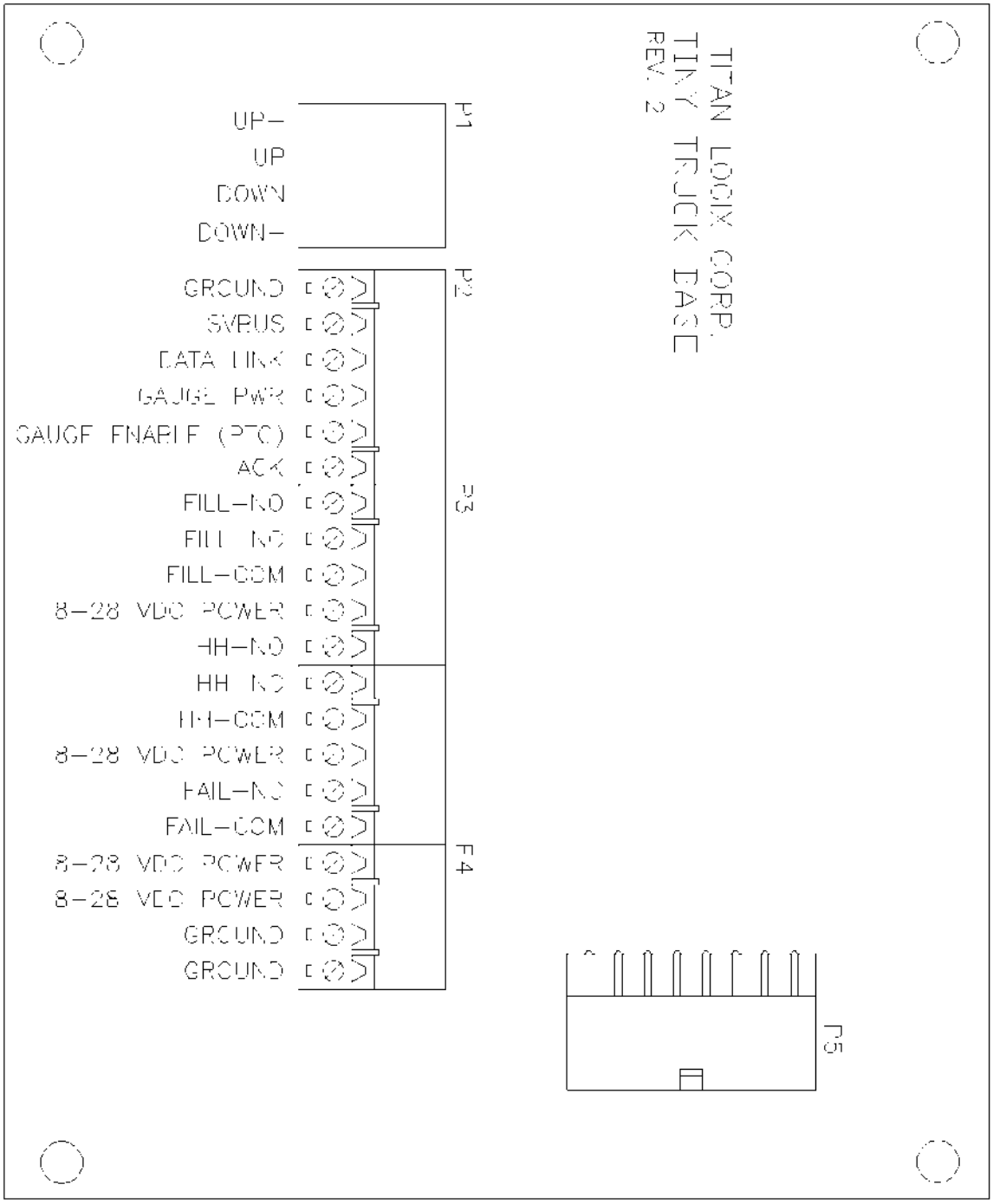

Figure 2-34: Finch 5332E External Display Terminal Board

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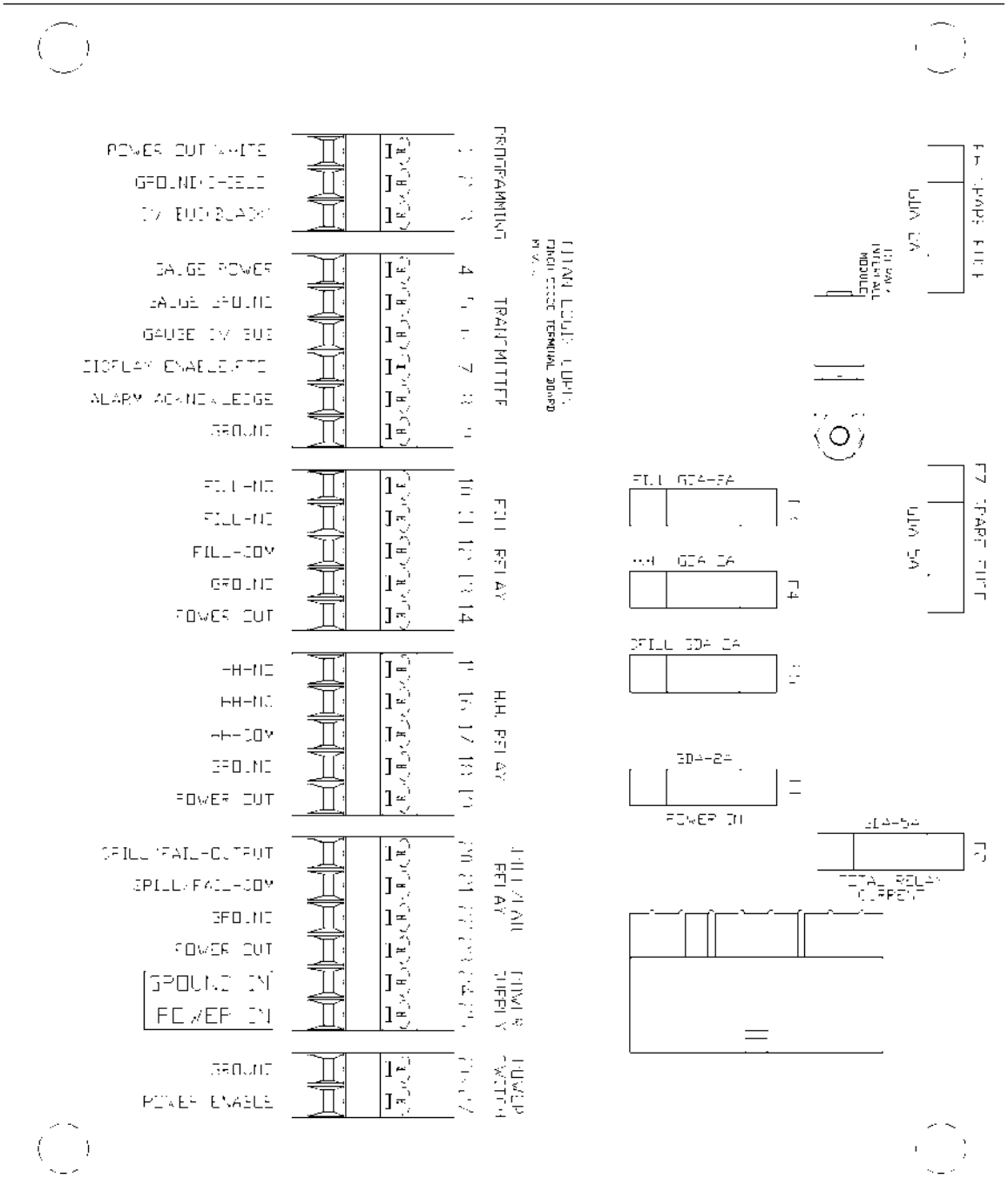

Figure 2-35: Finch 5332E/PS External Display Terminal Board

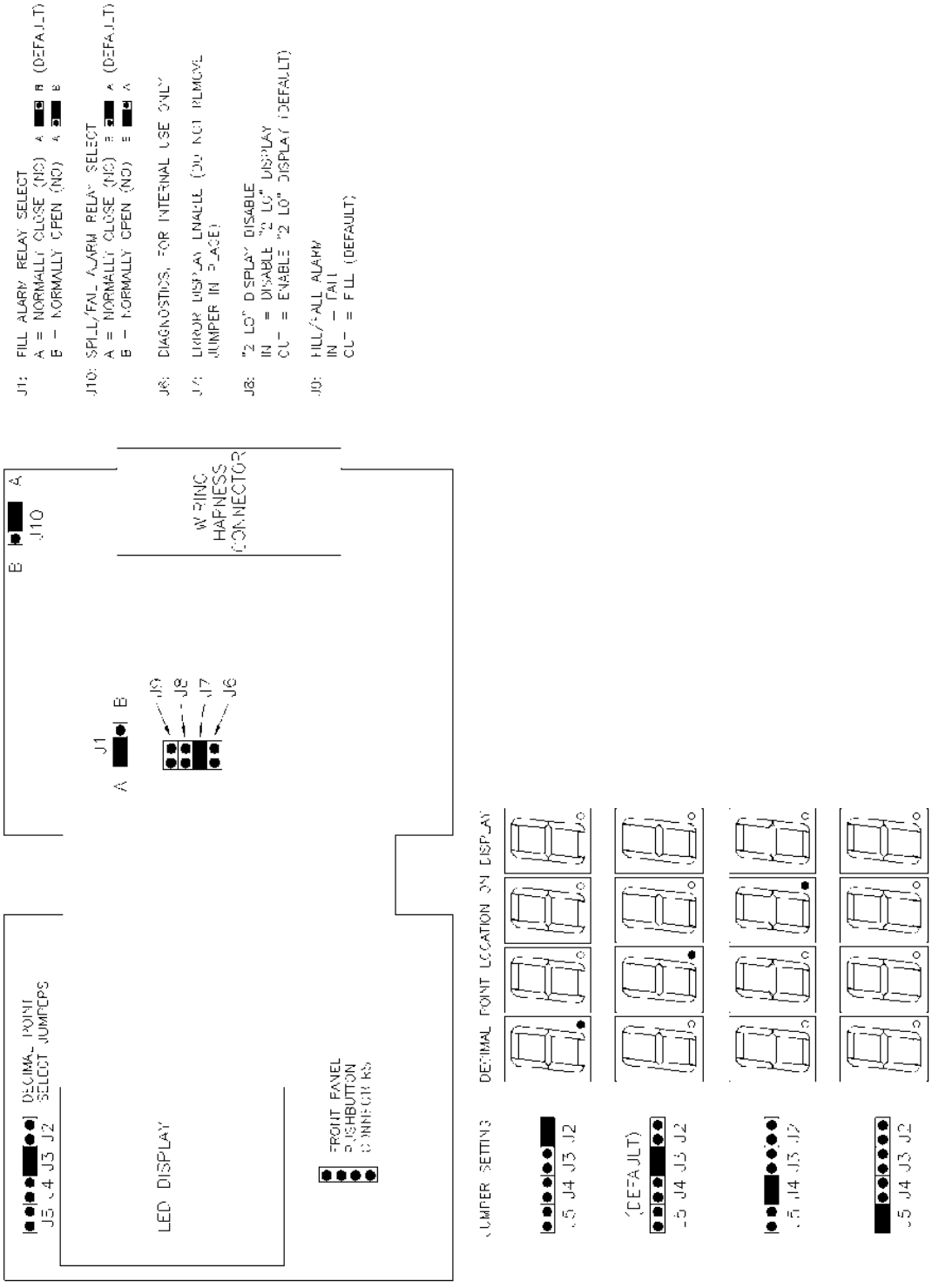

Figure 2-36: Finch 5332 Internal Display Jumper Settings

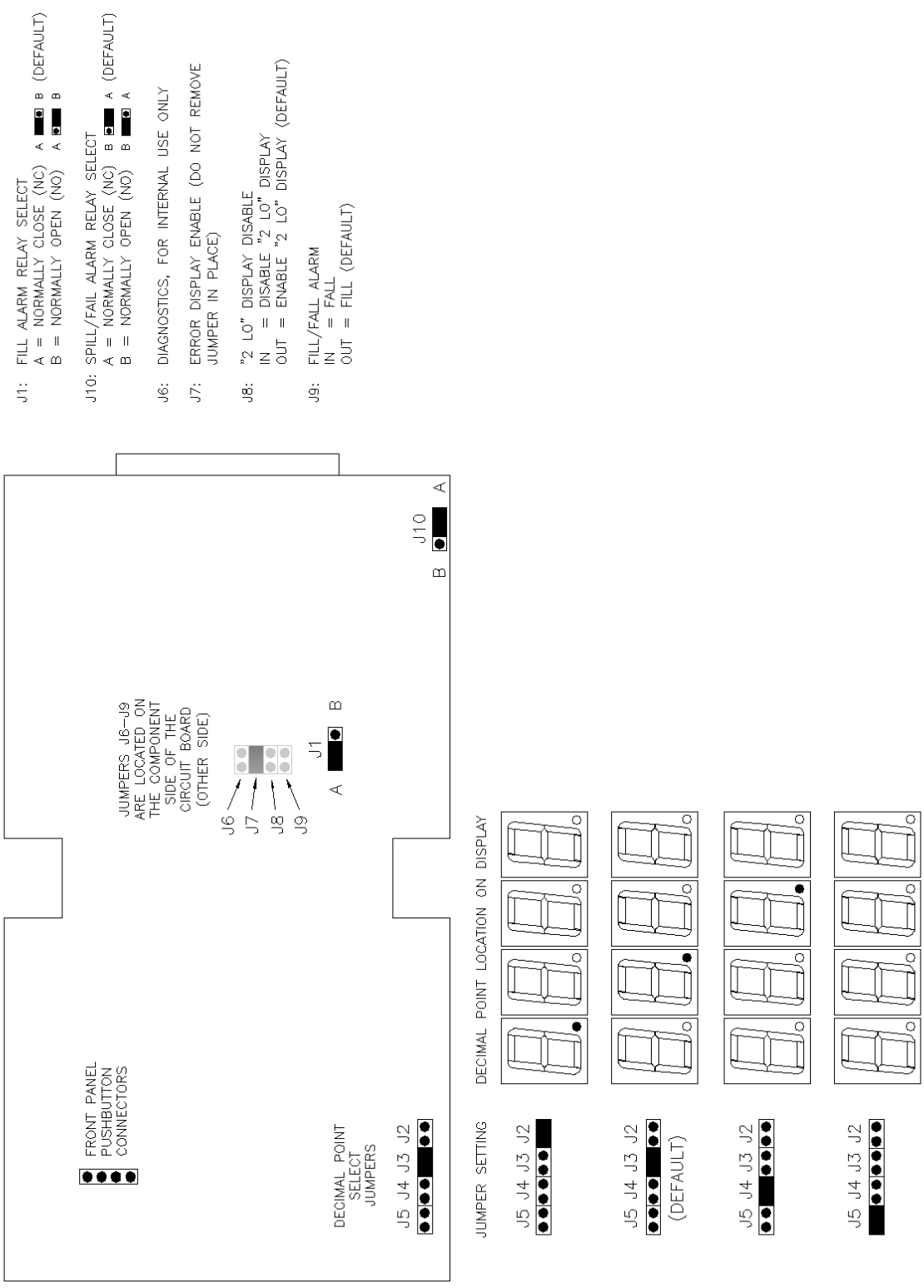

Figure 2-37: Finch 5332E(/PS) External Display Jumper Settings

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2.9 TD80 Installation Checklist

Checked	Step
	1. Program the TD80
	2. Install the 1” NPT Top Fitting
	3. Install the Anchor Cone
	4. Install the Probe
	5. Mount the Transmitter
	6. Mount the Finch Display
	7. Mount the Relay Module (optional)
	8. Mount the Alarm Accessories (optional)
	9. Inspect the Mechanical Installation
	10. Install the Electrical Wiring
	11. Set and Verify the Finch Display Jumpers
	12. Confirm Fuses Installed with Correct Type and Rating
	13. Perform the TD80 Basic Operation Test
	14. Verify TD80 Transmitter Programming
	15. Set the Fill or Fall Alarm Level
	16. Perform the TD80 System Test and Verification
	17. Perform the Offset Calibration

Table 2-1: TD80 Installation Checklist

3 TD80 and Overfill Prevention System Troubleshooting

Equipment Required:
1. Automotive Test light, 6VDC to 24VDC
2. Short length of wire bare at both ends or with alligator clips.

Optional Equipment:
1. Digital Multimeter (DMM)
2. Scully Universal Truck Tester for P2000 installations.

3.1 Overview and General Techniques

The test light is a multi-purpose tool for checking the presence of power or ground in an automotive electrical circuit. The tip is usually pointed and sharp enough to pierce the insulation of a wire for circuit testing. Most test lights have a low resistance path due to the cold resistance of the light bulb. This makes it useful to apply either power or ground to a part of the circuit. Short circuit current is limited by the light bulb to several hundred milliamps in a typical automotive circuit. Care must be taken because even this low current may damage some low power electronic devices. The value of a test light is its inexpensiveness, ruggedness, ease of use and indications are readily apparent at a glance.

1. Check presence of battery power

    1. Test light clip is connected to power common or ground/return to battery power. This is usually the chassis of the vehicle.
    2. Probe with test light tip in all circuit points that are energized by battery power.
        a. Dim or dark light indicates low or no voltage due to a high resistance connection or open circuit.

2. Check presence of circuit ground or power return

    1. Test light clip is connected to battery power.
    2. Probe with test light tip in all circuit points that are connected to circuit ground.
        a. Dim or dark light indicates a high resistance connection or open circuit.

Varying brightness of the light bulb indicates an intermittent connection. This could be from any combination of faults listed below:

1. Corroded connector pin/socket, terminal or crimp
2. Loose screw on terminal
3. Corroded wire or splice
4. Pinched wire shorting to power, ground or another signal
5. Poor solder joint
6. Defective electrical component such as connector, switch, plug, socket, terminal strip or junction box

3. Confirm presence of an open circuit in wiring

An open circuit in wiring may be confirmed after testing by temporarily bridging the break with a short length of wire bared at both ends or a jumper with alligator clips. Care must be taken to ensure that only the open circuit is bridged and not any other part of the circuit. Confirm normal circuit operation with the wire in place. Repair the wiring as necessary.

The test light may also be used to bridge a wire break. It is current limited and will indicate current flow in the circuit. The internal resistance of the light bulb will allow some circuit components to operate such as horns, relays and lights. It will not provide operating power for a full system and indicates low current with a dim light.

4. Short circuit isolation

This can be done by disconnecting the devices from the affected wire or signal, then testing at each circuit point until the short circuit or defective component is isolated.

1. Short circuit to ground isolation.
   a. Disconnect the shorted wire at each component to isolate the short circuit.
   b. Clip on battery power; probe each component at the shorted terminal and disconnected wire. A short circuit to ground is indicated by the light partially or fully illuminating.

2. Short Circuit to power isolation.
   a. Disconnect the shorted wire at each component to isolate the short circuit.
   b. Clip on ground; probe each component at the shorted terminal and disconnected wire. A short circuit to power is indicated by the light partially or fully illuminating.

3.2 TD80 System Specific Troubleshooting

Specific parts of the TD80 and Overfill Prevention System are tested using a combination of voltage checking and power/ground applied with the test light. The test light does not precisely measure the circuit voltage and is not a completely short circuit for applying voltage or ground. This must be kept in-mind during the troubleshooting process.

Troubleshooting a TD80 system is as uncomplicated as looking for circuit power and grounds. A circuit point is either properly connected to battery power or ground through wiring or devices controlled by the TD80; or not. Finding the defective component is troubleshooting or sometimes described as fault isolation. Once the defective component is determined, it is replaced or repaired and the system is fully tested to confirm correct operation. It is common for more than one defective component to cause a system failure.

3.2.1 Common System Wiring and Component Failures Overview:

1. Loss of power. No system operation, Finch Display is blank.
2. Finch Display shows “OFF” when the PTO is engaged or Gauge Enable is on.
3. Loss of SV Bus Communication, Finch Display shows “----”.
4. Finch Display shows only a decimal point, no numbers.
5. Finch Display shows “8888” or flickers between “8888” and other numbers.
6. Finch Display restarts at erratic intervals. The digit test begins and then displays a level for some time, then restarts with the digit test.
7. Fill Alarm remains inactive.
8. Fill Alarm continuously active.
9. Overfill Prevention System fails to allow loading.
10. Overfill Prevention System fails to stop loading on high level alarms.
11. Overfill Prevention System fails to stop loading when PTO signal is off.
12. Finch Display shows an Error Code (E xx)
13. Finch Display continuously shows “2 LO”.
14. Finch Display shows erratic level measurements or “2 LO”.
15. Spill alarm is on continuously, unable to clear the alarm by unloading while the TD80 is turned on or by entering Calibration mode.
16. Unable to offset calibrate the TD80.

3.2.2 Common Installation Wiring and Component Problems Overview:

1. Unable to offset calibrate the TD80.
2. Fuses keep blowing
3. Spill alarm stuck on.
4. Finch Display continuously shows “2 LO”.
5. Finch Display continuously shows a level in an empty tank.
6. Finch Display shows incorrect volume.
7. Finch Display continuously shows “OFF” until a Display push button is pressed.
8. Finch Display shows erratic level measurements.
9. Relay Module Shutdown system does not permit loading.
10. P2000 Shutdown system does not permit loading.
11. Fill alarm horn continuously sounds when power is turned on.

3.2.1 Common System Wiring and Component Failures

The following troubleshooting steps are organized by system or circuit function and symptoms. These are some of the most common system wiring and component failures along with suggested troubleshooting and repair steps.

1. Loss of power. No system operation, Finch Display is blank.		
WHAT TO DO:	**DETAILS:**	**REMEDY:**
a. Check fuses, cable connections, wiring and power switches. See the following examples and suggestions.	i. Turn on the power/key switch	
	ii. Replace all blown fuses	
	iii. Repair all defective wiring	
	iv. Replace all defective components	
b. Check the power supply for adequate operating voltage.	Provide power from a well charged battery or DC power source, 8VDC to 28VDC, steady output. Confirm this voltage using a Digital Multi Meter. Do not use a battery charger.	
c. Use a test light to test points for battery voltage in the following sequence.	i. Check all points from the Finch Display back to the battery	
	ii. Inspect all junction boxes, plugs and sockets for broken wires and corrosion	
d. If power is at all points, use a test light to check for grounds at points in the following sequence.	i. Check all points from the Finch Display back to the battery	
	ii. Inspect all junction boxes, plugs and sockets for broken wires and corrosion	
e. If fuses keep blowing:	i. Verify that the type and rating of the fuse is appropriate for the application	
	ii. Continue by disconnecting power to system components to isolate the short circuit. Clip on battery power; probe each component at the power terminal. A short circuit to ground is indicated by the light fully illuminating.	Repair or replace the defective component as necessary

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2. Finch Display shows “OFF” when the PTO is engaged or Gauge Enable is on.			
WHAT TO DO:	**DETAILS:**	**WHAT TO CHECK:**	**REMEDY:**
Manually enable the PTO signal with the Gauge Enable switch on the Finch 5332E Display if it is available. If the system activates, then check for an open circuit in the PTO signal as follows:	i. Clip the test light to ground and probe tip to the PTO signal at all points in the circuit. The test light will complete a path to ground and activate the PTO signal. Probe all points from the 5332(E) PTO signal input back to the source. This will isolate a broken wire or defective switch.	Inspect for broken or corroded wiring where the test light fails to activate the PTO signal and repair as necessary	
	ii. An alternative method is to clip the test light to battery power and confirm the PTO signal is grounded at all circuit points until the light does not illuminate. This will isolate the wire break or defective switch.	a. Inspect for broken or corroded wiring where the test light fails to illuminate and repair as necessary	
		b. If the Gauge Enable switch or PTO signal ground at the 5332(E) does not activate the system, then the 5332(E) PTO signal input is defective.	Finch Display is faulty, replace the unit

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3. Loss of SV Bus Communication, Finch Display shows "----".			
WHAT TO DO:	**DETAILS:**		**REMEDY:**
a. "----" displayed on the 5332(E) indicates loss of SV Bus communication with the TD80 transmitter. Any other Display such as "2 LO", "E 20", Spill or level confirms proper communication with the transmitter.			
b. If multiple compartments are displayed on one 5332(E), check all compartment positions on the selector switch	i. If all positions are inactive, check the wiring from the switch to the SV Bus input on the 5332(E) and common power supply wiring to the TD80 transmitters.		Inspect for broken or corroded wiring and repair as necessary.
	ii. If one or more compartments; but not all are inactive, then troubleshoot the Transmitter and wiring to the selector switch.		Inspect for broken or corroded wiring and repair as necessary.
c. Check the SV Bus LED on the 5332(E) for activity. Blinking fully on and fully off indicates normal bus voltages. The LED will blink in bursts every second as the level information is transmitted to the Display.	i. Partially on or off indicates a defective TD80 system component, loss of power to a TD80 system component or an SV Bus short circuit to either power or ground.	a. Use the test light to check for power and ground to the TD80 system components on the SV Bus. Check at the power and ground terminals as well as any intermediate connections such as junction boxes, plugs and sockets.	Inspect for broken or corroded wiring where the test light fails to illuminate and repair as necessary.
		b. SV Bus LED partially on indicates short circuit to power	Troubleshoot SV Bus and repair or replace as necessary
		c. SV Bus LED partially off indicates a short circuit to ground.	Troubleshoot SV Bus and repair or replace as necessary
		d. If the SV Bus LED is off continuously	i. Check for power and ground to the TD80 Transmitter ii. Clip the test light to ground and probe the SV Bus signal wire. Tap the probe tip on an SV Bus terminal and the LED will blink with each tap to indicate continuity through the wiring and SV Bus receiver in the 5332(E). Probe at each SV Bus circuit point until the open circuit or defective component is isolated.

3. Loss of SV Bus Communication, Finch Display shows "----".		
		e. If the SV Bus LED is on continuously, check for a short circuit to ground on the SV Bus. This can be done by disconnecting the devices from the SV Bus, clip the test light to battery power and probe for ground on the SV Bus at each circuit point until the short circuit or defective component is isolated.

4. Finch Display shows only a decimal point, no numbers.	
WHAT TO DO:	**DETAILS:**
a. Check the power supply for adequate operating voltage.	Provide power from a well charged battery or DC power source, 8VDC to 28VDC, steady output. Confirm this voltage using a DMM. Do not use a battery charger.
b. Use a test light or DMM to test terminals for battery voltage and ground in a logical sequence.	i. Check all terminals from the Finch Display back to the battery ii. Inspect all junction boxes, plugs and sockets for broken wires and corrosion
c. Possibly faulty Finch Display, replace the unit	

5. Finch Display shows "8888" or flickers between "8888" and other numbers.	
WHAT DO TO:	**DETAILS:**
a. Check that the system is not powered by a battery charger	Disconnect from the charger and power from a well charged battery or DC power source, 8VDC to 28VDC, steady output
b. Check power supply wiring for intermittent or corroded connections	
c. Ensure that the battery voltage is at least 8VDC and steady	Provide power from a well charged battery or DC power source, 8VDC to 28VDC, steady output
d. Finch Display may be faulty, replace the unit	

6. Finch Display restarts at erratic intervals. The digit test begins and then displays a level for some time, then restarts with the digit test.	
WHAT TO DO:	**DETAILS:**
a. Check power supply wiring for intermittent or corroded connections	
b. Ensure that the battery voltage is at least 8VDC and steady	Provide power from a well charged battery or DC power source, 8VDC to 28VDC, steady output
c. Finch Display may be faulty, replace the unit	

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7. Fill Alarm remains inactive.			
WHAT TO DO:	**DETAILS:**	**WHAT TO CHECK:**	**REMEDY:**
a. Check Fill alarm setting on 5332(E). Confirm that the 5332(E) is flashing the level to indicate an active alarm.	i. Confirm that the PTO signal is active by either a switch operation or permanently enabled through wiring.	Activate the PTO signal	If the PTO signal does activate, then troubleshoot the PTO signal wiring and components.
	ii. If the 5332(E) does not flash at the desired fill level	Confirm and reset the Fill alarm setting. If this does not fix the problem, then the Finch Display may be faulty, replace the unit.	
	iii. If the Finch Display flashes at the alarm setting then troubleshoot the Fill alarm wiring and components.		
b. Confirm that the J1 shorting jumper is installed correctly.			
c. Confirm that the J9 Fill/Fall jumper is installed correctly.			
d. For Fill alarms energized by a ground from the 5332(E)	i. Check for power at the Red light and/or Horn.		
	ii. Clip the test light to ground and probe all Fill alarm circuit points to activate the Red light and/or Horn. Circuit points to confirm are as follows:	a. At the 5332(E) FILL-COM, FILL-NO or FILL-NC	
		b. At any external wiring junctions	
		c. Red light and/or Horn	
	iii. Check for a blown fuse (if installed) and replace as necessary		
	iv. Inspect for broken or corroded wiring and repair as necessary		
	v. Inspect for broken or defective horn or light and repair as necessary		
e. For Fill alarms energized by power from the 5332(E)	i. Check for ground at the Red light and/or Horn		
	ii. Clip the test light to power and probe all Fill alarm circuit points to activate the Red light and/or Horn. Circuit points are as described above.		
	iii. Check for a blown fuse (if installed) and replace as necessary		
	iv. Inspect for broken or corroded wiring and repair as necessary		
	v. Inspect for broken or defective horn or light and repair as necessary		

8. Fill Alarm continuously active.		
WHAT TO DO:	**DETAILS:**	**REMEDY:**
a. Check Fill alarm setting on 5332(E). Confirm that the 5332(E) is not flashing the level to indicate an active alarm.	i. If the 5332(E) is flashing level, confirm and reset the Fill alarm setting. If this does not fix the problem, then the 5332(E) is defective.	
	ii. If the Display is not flashing, then troubleshoot the Fill alarm wiring and components.	
b. Confirm that the J1 shorting jumper is installed correctly.		
c. For Fill alarms energized by a ground from the 5332(E)	Clip the test light to power and troubleshoot the Fill alarm circuit points for a short circuit to ground. Circuit points to confirm are as follows: 1. At the 5332(E) FILL-COM, FILL-NO or FILL-NC 2. At any external wiring junctions 3. Red light and/or Horn	
d. For Fill alarms energized by power from the 5332(E)	Clip the test light to ground and troubleshoot the Fill alarm circuit points for a short circuit to power. Circuit points are as described above.	

<table>
<tr><th colspan="4">9. Overfill Prevention System fails to allow loading.</th></tr>
<tr><th>WHAT TO DO:</th><th colspan="2">DETAILS:</th><th>WHAT TO CHECK:</th></tr>
<tr><td colspan="4">a. Relay Module</td></tr>
<tr><td colspan="4">i. Ensure that HH and Spill/Fail alarms are inactive, TD80 system is operating normally.</td></tr>
<tr><td colspan="4">ii. Check for a blown HH or SPILL/FAIL fuse (if installed) and replace as necessary</td></tr>
<tr><td rowspan="6">iii. Check for power at Relay Module Solenoid terminal</td><td colspan="3">1. If power is present, check wiring and power to solenoid</td></tr>
<tr><td colspan="3">2. Energize and de-energize solenoid by moving J10 jumper to check for solenoid and valve operation.</td></tr>
<tr><td rowspan="4">3. If no power present at solenoid terminal, check the following:</td><td>a. Check ground signal through HH and FAIL relays in 5332E</td><td>Clip test light to ground, probe at 5332E, HH-NC and FAIL-COM (or SPILL/FAIL – COM on 5332E/PS Display) to apply ground for loading enable.</td></tr>
<tr><td>b. Check ground at HH-NC and FAIL-COM in Relay Module.</td><td>Clip test light to ground, probe at Relay Box, HH-NC and FAIL-COM to apply ground for loading enable.</td></tr>
<tr><td colspan="2">c. Check J10 shorting jumper is in “B” position.</td></tr>
<tr><td>d. Check PTO signal at Relay Module.</td><td>Clip test light to ground, probe at Relay Box, PTO to apply ground for loading enable.</td></tr>
<tr><td colspan="3">4. Inspect for broken or corroded wiring and repair as necessary.</td></tr>
<tr><td colspan="4">b. P2000</td></tr>
<tr><td colspan="4">i. Ensure that HH and Spill/Fail alarms are inactive, TD80 system is operating normally.</td></tr>
<tr><td colspan="4">ii. Check for a blown HH or SPILL/FAIL fuse and replace as necessary</td></tr>
<tr><td colspan="4">iii. Check J10 shorting jumper is in “A” position for 5332E/PS (red terminal board Display) or “B” position for 5332E (green terminal board display).</td></tr>
<tr><td colspan="4">iv. Check that the LED to fiber optic cable is illuminated.</td></tr>
<tr><td colspan="4">v. If the LED is OFF, then troubleshoot the 5332E for HH and FAIL relay fault or open wiring.</td></tr>
<tr><td colspan="4">vi. If the LED is ON, then troubleshoot the fiber optic cable, P2000 and wiring to Scully socket.</td></tr>
<tr><td colspan="4">vii. Inspect for broken or corroded wiring and repair as necessary.</td></tr>
</table>

10. Overfill Prevention System fails to stop loading on high level alarms.	
WHAT TO DO:	**DETAILS:**
a. Relay Module	
i. Ensure that HH and Spill/Fail alarms activate, TD80 system is operating normally.	
ii. Deactivate/reset the alarms for further troubleshooting.	
iii. Check for power at Relay Module Solenoid terminal	1. If power is present, check wiring to solenoid for a short circuit to power. 2. If power is not present, check solenoid valve. 3. Energize and de-energize solenoid by moving J10 jumper to check for solenoid and valve operation. This also checks for a shorted 5332E FAIL-NC (or SPILL/FAIL-NC on 5332E/PS Display) to FAIL-COM (or SPILL/FAIL-COM on 5332E/PS Display) connection.
iv. Check for short circuit to ground at Relay Module HH-NC.	
v. Check for short circuit to ground at 5332E HH-NC, HH-COM and FAIL-NC (or SPILL/FAIL-NC on 5332E/PS Display).	
vi. Inspect for defective, incorrect or corroded wiring and repair as necessary	
b. P2000	
i. Ensure that HH and Spill/Fail alarms activate, TD80 system is operating normally.	
ii. Deactivate/reset the alarms for further troubleshooting.	
iii. Check that the LED to fiber optic cable is OFF	
iv. If the LED is OFF, then troubleshoot the P2000	
v. If the LED is ON, then troubleshoot the 5332E HH and FAIL relay fault or shorted wiring.	
vi. Inspect for defective, incorrect or corroded wiring and repair as necessary	

11. Overfill Prevention System fails to stop loading when PTO signal is off.	
WHAT TO DO:	**DETAILS:**
a. Relay Module	
i. Ensure that HH and Spill/Fail alarms activate, TD80 system is operating normally.	
ii. Deactivate/reset the alarms for further troubleshooting.	
iii. Energize and de-energize solenoid by moving J10 jumper to check for solenoid and valve operation.	
iv. Ensure that the 5332E Displays “OFF” when the PTO signal is disengaged.	
v. If the 5332E displays level when PTO signal is disengaged, test for short circuit to ground on PTO signal.	
vi. If the 5332E displays “OFF” when PTO signal is engaged/on, test for an open circuit between 5332E PTO input and Relay Module PTO terminal.	
vii. Check for power at Relay Module Solenoid terminal	1. If power is present, check wiring to solenoid for a short circuit to power. 2. If power is not present, check solenoid valve.
viii. Inspect for defective, incorrect or corroded wiring and repair as necessary.	
b. P2000	
i. If the 5332E displays level when PTO signal is disengaged, test for short circuit to ground on PTO signal.	
ii. Energize and de-energize the LED by moving J10 jumper to check for normal operation.	
iii. Inspect for defective, incorrect or corroded wiring and repair as necessary.	

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12. Finch Display shows an Error Code (E xx)

The transmitter constantly checks the system for errors. Detected errors are shown on the Finch Display as an error code, E and a 2 digit number. This error code assists in diagnosing and repairing the problem.

E 80 through E 84 indicate an error caused by an incorrect strapping table or internal transmitter malfunction. For these errors, review the programming information, correct if necessary and reprogram the transmitter. If the malfunction persists, then replace the transmitter and ensure it is programmed correctly.

The error codes and possible solution are listed below.

E 00	Can't Autorange (could not measure level)	- possibly bent or damaged probe - move the probe location to a less turbulent area of the tank - possibly defective transmitter
E 01	Too many samples rejected (too much turbulence)	- move the probe to a less turbulent area of the tank - possibly defective transmitter
E 02	Internal transmitter error, Wrap around on Timer1	- defective transmitter
E 04	Internal transmitter error, Timer1 count is too large	- defective transmitter
E 10	Internal transmitter error, timeout between captures	- defective transmitter
E 20	No fiducial detected	- possibly defective transmitter - possibly damaged or defective probe - possible turbulence in the tank - possible disconnection of transmitter and probe - possible liquid or grease contamination of transmitter to probe connection
E 40	Internal transmitter error, Watchdog reset	- defective transmitter
E 80	Internal strapping table error, HH alarm level set too close to Spill alarm level	- incorrect strapping table, reprogram the transmitter with a correct table
E 81	Internal strapping table error, Alarms set, No strapping table	- program the transmitter with a strapping table - possibly defective transmitter
E 82	Internal strapping table error	- reprogram the transmitter - possibly defective transmitter
E 83	Internal strapping table error, error detected in strapping table during operation	- restart the transmitter, if problem persists then reprogram the transmitter - possibly defective transmitter
E 84	Internal strapping table error, error detected in strapping table during operation	- restart the transmitter, if problem persists then reprogram the transmitter - possibly defective transmitter

Error codes 01, 02, 04, 10, 20 and 40 can be combined if there is more than one error code at a time, for example E 26 is E 02 + E 04 + E 20. E 80 to E 84 will not be combined with any other error codes.

13. Finch Display continuously shows “2 LO”.		
WHAT TO DO:	**DETAILS:**	**REMEDY:**
a. Check the probe for physical damage, defects, corrosion or product build up.	i. Probe may be faulty.	Replace the probe.
	ii. Probe may be bent or twisted.	Repair or replace the probe.
	iii. Inspect the probe for product buildup.	Clean the probe with a solvent compatible with the product.
b. The TD80 transmitter may be defective.	Replace the TD80 transmitter with a serviceable unit that has been programmed with same information as the one it is replacing.	
c. Check the probe to TD80 transmitter connection for contamination.	Clean out any contamination such as water, oil, grease or dirt. The connectors must be clean and make a solid mechanical connection. Retighten the connectors and test the system.	
d. Check installation of the coaxial probe if installed	The transmitter must be securely fastened to the probe	Hand tighten the transmitter nut until it is at the o-ring, then fully tighten with a wrench.

14. Finch Display shows erratic level measurements or “2 LO”.		
WHAT TO DO:	**DETAILS:**	**REMEDY:**
a. Finch Display shows erratic level measurements while a mobile radio is keyed or other radio equipment transmits.	Physically separate all TD80 system components and wiring from the radio devices.	
b. Finch Display shows erratic level measurements or “2 LO” while loading or unloading product.	i. Check the probe for physical damage, defects, corrosion or product build up.	1. Probe may be faulty, replace the probe. 2. Probe may be bent or twisted, repair or replace the probe. 3. Probe may be corroded, replace the probe. 4. The shorting block may be loose or missing, repair or replace the shorting block. 5. Inspect the probe for product buildup. Clean the probe with a solvent compatible with the product.
	ii. The TD80 transmitter may be defective.	Replace the TD80 transmitter with a serviceable unit that has been programmed with same information as the one it is replacing.
	iii. Check the probe to TD80 transmitter connection for contamination.	Clean out any contamination such as water, oil, grease or dirt. The connectors must be clean and make a solid mechanical connection. Retighten the connectors and test the system.
c. Check installation of the coaxial probe if installed	The transmitter must be securely fastened to the probe	Hand tighten the transmitter nut until it is at the o-ring, then fully tighten with a wrench.

15. Spill alarm is on continuously, unable to clear the alarm by unloading while the TD80 is turned on or by entering Calibration mode.		
WHAT TO DO:	**DETAILS:**	**REMEDY:**
a. Check installation of the dual rod probe if installed.	i. The tank mounting collar or fitting must not extend more than 1.5” below the 1 3/4” nut on the probe.	The mounting fitting height must be reduced to 1.5” or less.
	ii. A 4” minimum diameter around the probe must be free of any metal objects.	The probe must be relocated to an area that has at least 4” diameter around it free from metal objects.
	iii. The transmitter must be securely fastened to the probe	Hand tighten the transmitter nut until it is at the o-ring, then fully tighten with a wrench.
b. Check installation of the coaxial probe if installed.	Inspect the inside of the probe near the top for any metal foreign objects.	Shake or flush out any foreign objects inside the coaxial probe.
c. Check probe for buildup of product at or near the top of the probe.	Clean the probe with a solvent compatible with the product	The probe may require removal for thorough inspection and cleaning

16. Unable to offset calibrate the TD80.			
WHAT TO DO:	**DETAILS:**	**REMEDY:**	
a. Finch Display shows “2 LO” after flashing “CAL”.	i. The tank may be empty or the level is less than 5 ½” from the bottom of the tank.	Fill the tank above 5 ½” and Calibrate.	
b. Finch Display continues to flash “CAL” without showing current volume.	i. Possibly defective Finch Display	Replace Finch Display	
	ii. possibly defective TD80 transmitter	Replace TD80 transmitter	
	iii. TD80 transmitter power may be independent from the Finch Display power. Power must be cycled to the Finch Display and TD80 at the same time for offset calibration.		
c. Finch Display shows a level after flashing “CAL”, unable to set the Display to the actual volume.	i. The TD80 transmitter may be defective.	Replace the TD80 transmitter with a serviceable unit that has been programmed with same information as the one it is replacing.	
	ii. The TD80 transmitter may be incorrectly programmed.	Reprogram the transmitter with correct information.	
	iii. Finch Display button presses do not change the setting in one or both directions	Inspect the push button wiring inside Finch Display for a loose or removed connector(s)	Reinstall push button connector(s) if disconnected or replace the defective Finch Display.

3.2.2 Common Installation Wiring and Component Problems

The following troubleshooting steps are organized by problems commonly experienced after installation. They may be encountered after a new installation, retrofit or repair of an in-service vehicle. These are some of the most common frequent system wiring and component installation errors along with suggested troubleshooting and repair steps. The problems may also be the result of a normal breakdown or component malfunction.

1. Unable to offset calibrate the TD80.			
WHAT TO DO:	**DETAILS:**	**REMEDY:**	
a. Finch Display shows “2 LO” after flashing “CAL”.	The tank may be empty or the level is less than 5 ½” from the bottom of the tank.	Fill the tank above 5 ½” and Calibrate.	
b. Finch Display continues to flash “CAL” without showing current volume.	i. Possibly defective Finch Display	Replace Finch Display	
	ii. possibly defective TD80 transmitter	Replace TD80 transmitter	
	iii. TD80 transmitter power may be independent from the Finch Display power. Power must be cycled to the Finch and TD80 at the same time for offset calibration.	Possibly incorrect power wiring to the Finch Display and TD80 transmitter.	
c. Finch Display shows a level after flashing “CAL”, unable to set the Display to the actual volume.	i. The TD80 transmitter may be defective.	Replace the TD80 transmitter with a serviceable unit that has been programmed with same information as the one it is replacing.	
	ii. Finch Display button presses allow changes in both directions, halts when lowering the actual volume before the calibrated volume is reached	The TD80 transmitter is incorrectly programmed.	Reprogram the transmitter with correct information.
	iii. Finch Display button presses do not change the setting in one or both directions	Inspect the push button wiring inside Finch Display for a loose or removed connector(s)	Reinstall push button connector(s) if disconnected or replace the defective Finch Display.

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2. Fuses keep blowing		
WHAT TO DO:	**DETAILS:**	**REMEDY:**
a. Verify that the type and rating of the fuse is appropriate for the application	Install fuse with the correct type and rating.	
b. Verify that the system components are installed and wired correctly.	i. Inspect all wiring for installation errors.	
	ii. Continue by disconnecting power to system components to isolate the short circuit. Clip on battery power; probe each component at the power terminal. A short circuit to ground is indicated by the light fully illuminating.	Repair or replace the defective component as necessary

3. Spill alarm stuck on.		
WHAT TO DO:	**DETAILS:**	**REMEDY:**
a. Check installation of the dual rod probe if installed.	i. The tank mounting collar or fitting must not extend more that 1.5” below the 1 3/4” nut on the probe.	The mounting fitting height must be reduced to 1.5” or less.
	ii. A 4” minimum diameter around the probe must be free of any metal objects.	The probe must be relocated to an area that has at least 4” diameter around it free from metal objects.
	iii. The transmitter must be securely fastened to the probe	Hand tighten the transmitter nut until it is at the o-ring, then fully tighten with a wrench.
b. Check installation of the coaxial probe if installed.	Inspect the inside of the probe near the top for any metal foreign objects.	Shake or flush out any foreign objects inside the coaxial probe.

4. Finch Display continuously shows “2 LO”.		
WHAT TO DO:	**DETAILS:**	
Check installation of the coaxial probe if installed	The transmitter must be securely fastened to the probe	Hand tighten the transmitter nut until it is at the o-ring, then fully tighten with a wrench.

5. Finch Display continuously shows a level in an empty tank.		
WHAT TO DO:	**DETAILS:**	**REMEDY:**
a. Check the probe for physical damage, defects or product build up.	i. Probe may be bent or twisted	Repair or replace the probe.
	ii. Inspect the probe for heavy product buildup bridging the rods.	Clean the probe with a solvent compatible with the product.
b. The TD80 transmitter may be defective.		Replace the TD80 transmitter with a serviceable unit that has been programmed with same information as the one it is replacing.
c. The TD80 transmitter may be incorrectly programmed.		Reprogram the transmitter with correct information.

6. Finch Display shows incorrect volume.	
WHAT TO DO:	**DETAILS:**
a. The TD80 transmitter may be defective.	Replace the TD80 transmitter with a serviceable unit that has been programmed with same information as the one it is replacing.
b. The TD80 transmitter may be incorrectly programmed.	Reprogram the transmitter with correct information.
c. Offset calibration may be required.	Perform the offset calibration.

7. Finch Display continuously shows “OFF” until a Display push button is pressed.	
WHAT TO DO:	**DETAILS:**
a. Verify that the PTO signal is wired according to the installation diagram	i. Inspect the wiring for correct installation
	ii. Inspect for loose or broken wiring
	iii. Correct all wiring errors and continue to verify system operation.
b. Test the PTO or air brake controlled switch for correct operation	Repair or replace the switch as necessary.

8. Finch Display shows erratic level measurements.		
WHAT TO DO:	**DETAILS:**	**REMEDY:**
a. Finch Display shows erratic level measurements while a mobile radio is keyed or other radio equipment transmits	Physically separate all TD80 system components and wiring from the radio devices.	
b. Finch Display shows erratic level measurements or “2 LO” while loading product.	Check placement of the probe near inlet or agitator	The probe must be relocated to an area of the tank away from turbulence while loading or normal operation.

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9. Relay Module Shutdown system does not permit loading.		
WHAT TO DO:	**DETAILS:**	**REMEDY:**
a. Check the position of the Finch Display J10 jumper. This jumper is located internally on the Display circuit board.	Verify jumper J10-“B” position, place in “B” position if necessary	
b. Check for a blown HH or SPILL/FAIL fuse and replace as necessary		
c. Check installation of wiring inside Finch Display	Confirm wire is installed for the following	1. Finch 5332E/PS, red terminal board, wire between SPILL/FAIL OUTPUT (20) and HH-COM (17) 2. Finch 5332E, green terminal board, wire between Fail-NC and HH-COM

10. P2000 Shutdown system does not permit loading.	
WHAT TO DO:	**DETAILS:**
a. Check the position of the Finch Display J10 jumper. This jumper is located internally on the Display circuit board.	Verify jumper J10-“A” position, place in “A” position if necessary
b. Check for a blown HH or SPILL/FAIL fuse and replace as necessary	
c. Check installation of wiring inside Finch Display	
d. Check installation of optical cable inside Finch Display	

11. Fill alarm horn continuously sounds when power is turned on.	
WHAT TO DO:	**DETAILS:**
a. Check the position of the Finch Display J1 jumper. This jumper is located internally on the Display circuit board.	i. FILL-NC contact controlling the horn, J1-“A” position
	ii. FILL-NO contact controlling the horn, J1-“B” position
b. Check for wiring shorts to power or ground	Correct all wiring errors and continue to verify system operation.
c. Check the Fill alarm level	The Fill alarm may be incorrectly set too low. Confirm and enter the correct alarm setting.

3.3 Alternate TD80 System Troubleshooting

Sometimes it is easier and less complicated to isolate a system problem by disconnecting all the components and then rewiring them back in a logical sequence. This method is described below.

Checked	Step	Description
	1.	Ensure that the power is off and disconnect all external wiring to the Finch Display.
	2.	Connect the two wires providing power and ground.
	3.	Turn on the power and verify that the Finch Display powers up normally, then displays "----". It may then display "OFF" or continue to display "----" if the PTO is permanently wired to ground or the gauge enable switch is on. Resolve all problems at this point before continuing.
	4.	Turn the power off.
	5.	Install the PTO wiring if applicable. Turn power on, verify that the Finch displays "----" continuously with the PTO signal active, then "OFF" with the PTO inactive. Resolve all problems at this point before continuing.
	6.	Turn power off.
	7.	Install the three wires from the TD80 transmitter to the Finch Display. Turn power on, verify that the Finch displays something other than "----". If it displays "OFF", press a button and verify that something other than "----" is displayed. Resolve all problems at this point before continuing.
	8.	Turn power off. At this point, the TD80 system is functioning and reporting level, an alarm condition or an error code.
	9.	Resolve all problems until the TD80 is functioning normally with a level display and inactive alarms.
	10.	Turn power off.
	11.	Continue to wire accessory components one at a time and verify correct system operation. Ensure power is off before connecting or disconnecting any wiring.

3.4 TD80 System Tests

The following tests are used to determine correct operation of optional alarm accessories such as horns, lights and overfill prevention system. They do not verify correct operation of the TD80 level transmitter, probe or display. The purpose is to exercise the optional components for troubleshooting or repair tests.

1. Fill Alarm Test

1. Verify normal TD80 system operation. Resolve all problems at this point before continuing.
2. Turn on power to the TD80 system.
3. Ensure all alarms are inactive and reset as necessary.
4. Change J1 jumper to the opposite position and verify that the Fill alarm horn sounds and if installed, the light illuminates.

5. Place the J1 jumper back to the original position and verify that the Fill alarm horn silences and if installed, the light goes out.

2. Finch Relay Module Shutdown System Test

1. Verify normal TD80 system operation. Resolve all problems at this point before continuing.
2. Turn on power and activate the PTO signal.
3. Ensure all alarms are inactive and reset as necessary.
4. Confirm J10 jumper is in “B” position. Change from “B” to “A” position and verify that the solenoid or voltage to the solenoid changes with the jumper position.

a. Voltage to the solenoid and loading enabled in “B” position.
b. No voltage to the solenoid and loading disabled in “A” position.
c. Confirm normal operation or resolve all problems at this point before continuing.

5. Activate each alarm in turn and verify normal shutdown operation. Resolve all problems before continuing.
6. Test all system functions and verify correct operation.

3. P2000 Optic Shutdown System Test

1. Verify normal TD80 system operation. Resolve all problems at this point before continuing.
2. Turn power on and activate the PTO signal.
3. Ensure all alarms are inactive and reset as necessary.

4. Confirm Finch 5332E/PS Display J10 jumper is in correct position (“A”) and verify that the fiber optic LED changes with the jumper position.
   a. Fiber optic LED on and loading enabled in “A” position.
   b. Fiber optic LED off and loading disabled in “B” position.
   c. Confirm normal operation or resolve all problems at this point before continuing.
      i. The fiber optic LED will be illuminated in a normal or non-alarming condition.
      ii. The fiber optic LED will be off in any Spill, HH or Error alarming condition.
      iii. Ensure that the wire jumpers at Spill/Fail and HH alarm relays are wired correctly.
      iv. Check Finch Display terminal board fuses F1 power, F5 Spill and F4 H.H.

5. Test at Scully optic socket with the Universal Truck Tester (UTT). This unit provides all signals and monitors response identically to the Scully Optic Rack. Resolve all problems at this point before continuing. Check for corroded or broken wiring between the Scully Optic socket and the P2000. Visually inspect the fiber optic cable. Isolate each P2000 if installed on a multi-compartment truck/trailer and test separately.

6. Test all system functions and verify correct operation.

The following diagrams and schematics are for reference during troubleshooting techniques and are the same as previously shown in section 2: TD80 Installation.

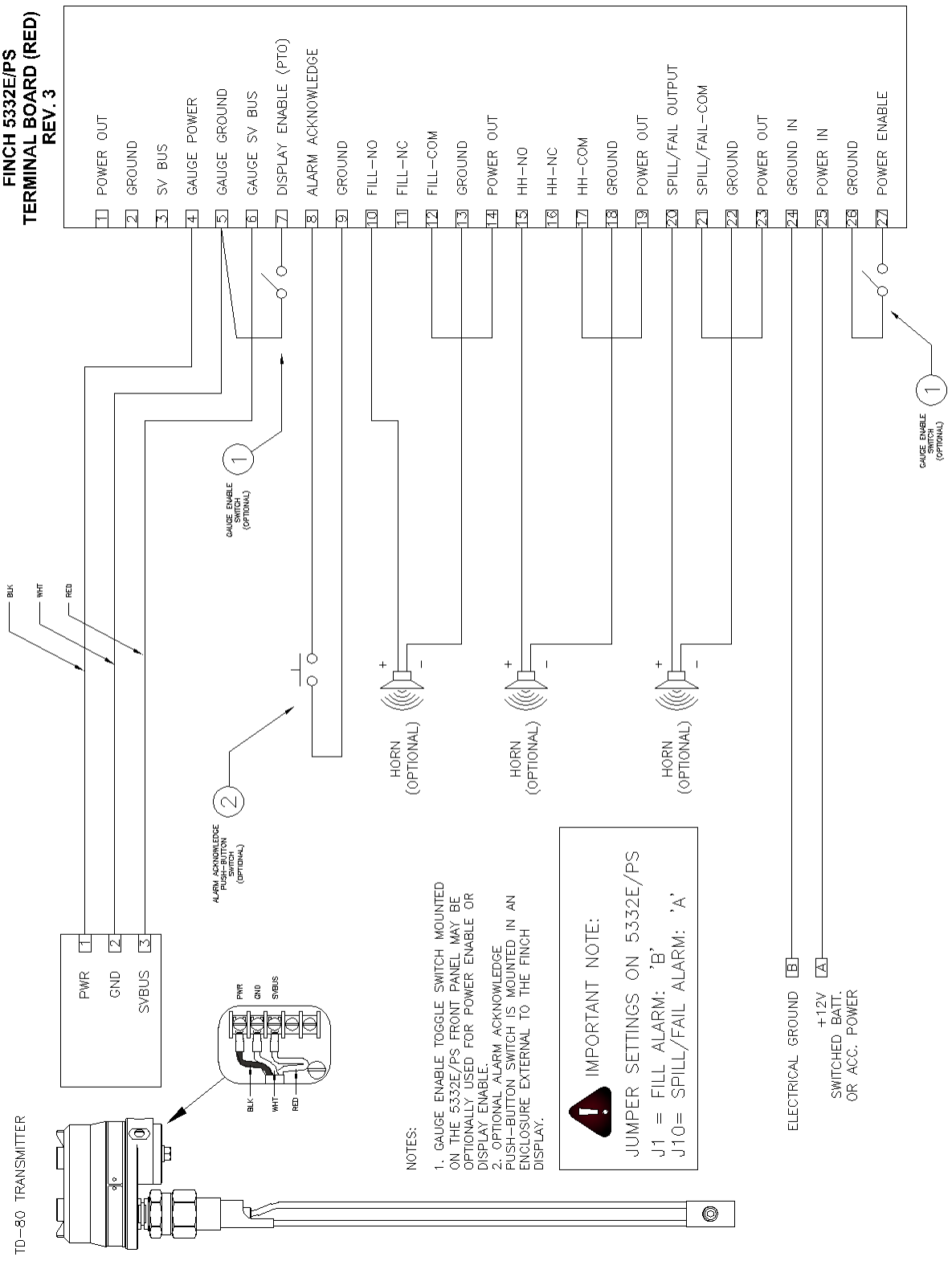

Figure 3-1: Basic System Wiring Schematic for Finch 5332E/PS External Display

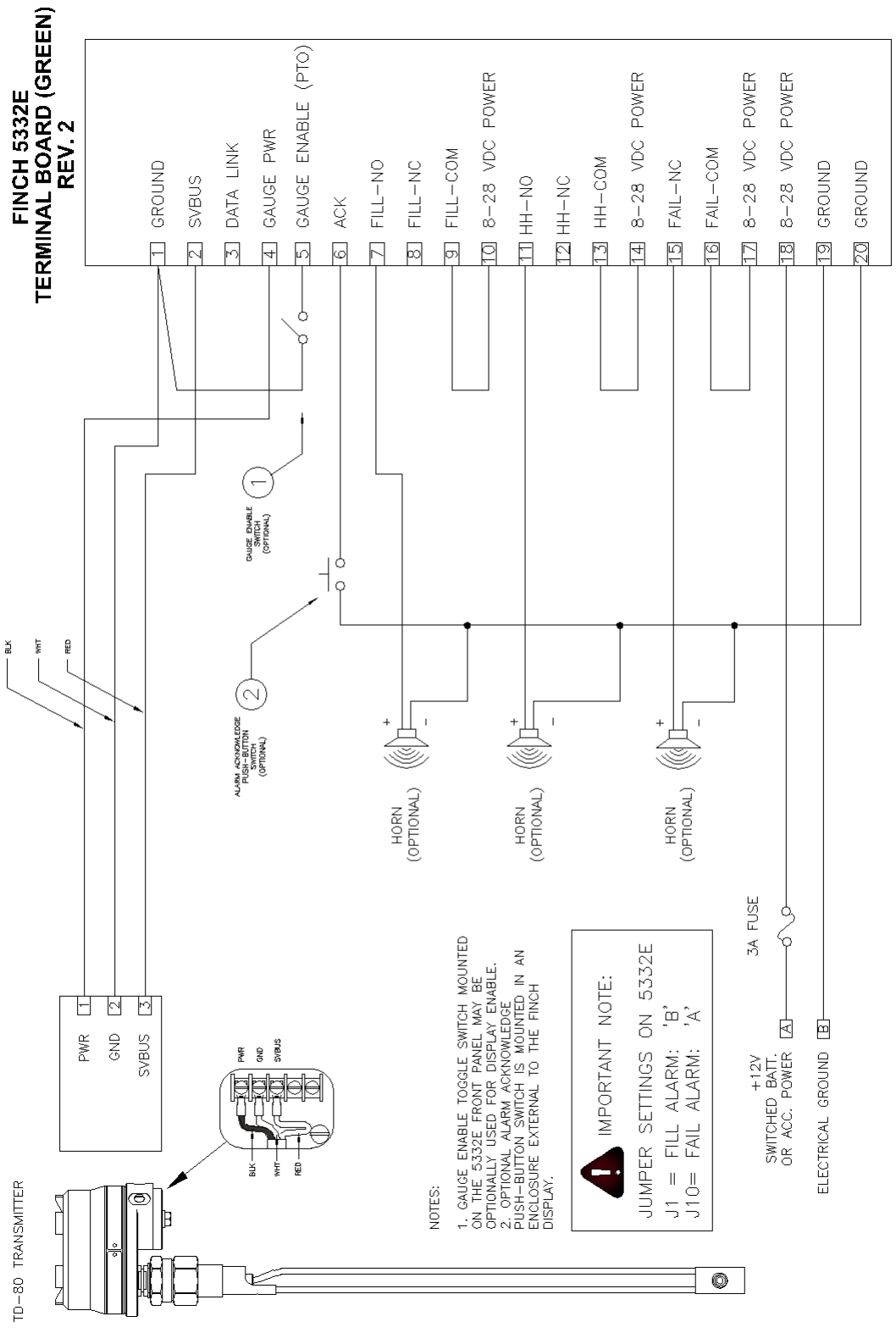

Figure 3-2: Basic System Wiring Schematic for Finch 5332E External Display

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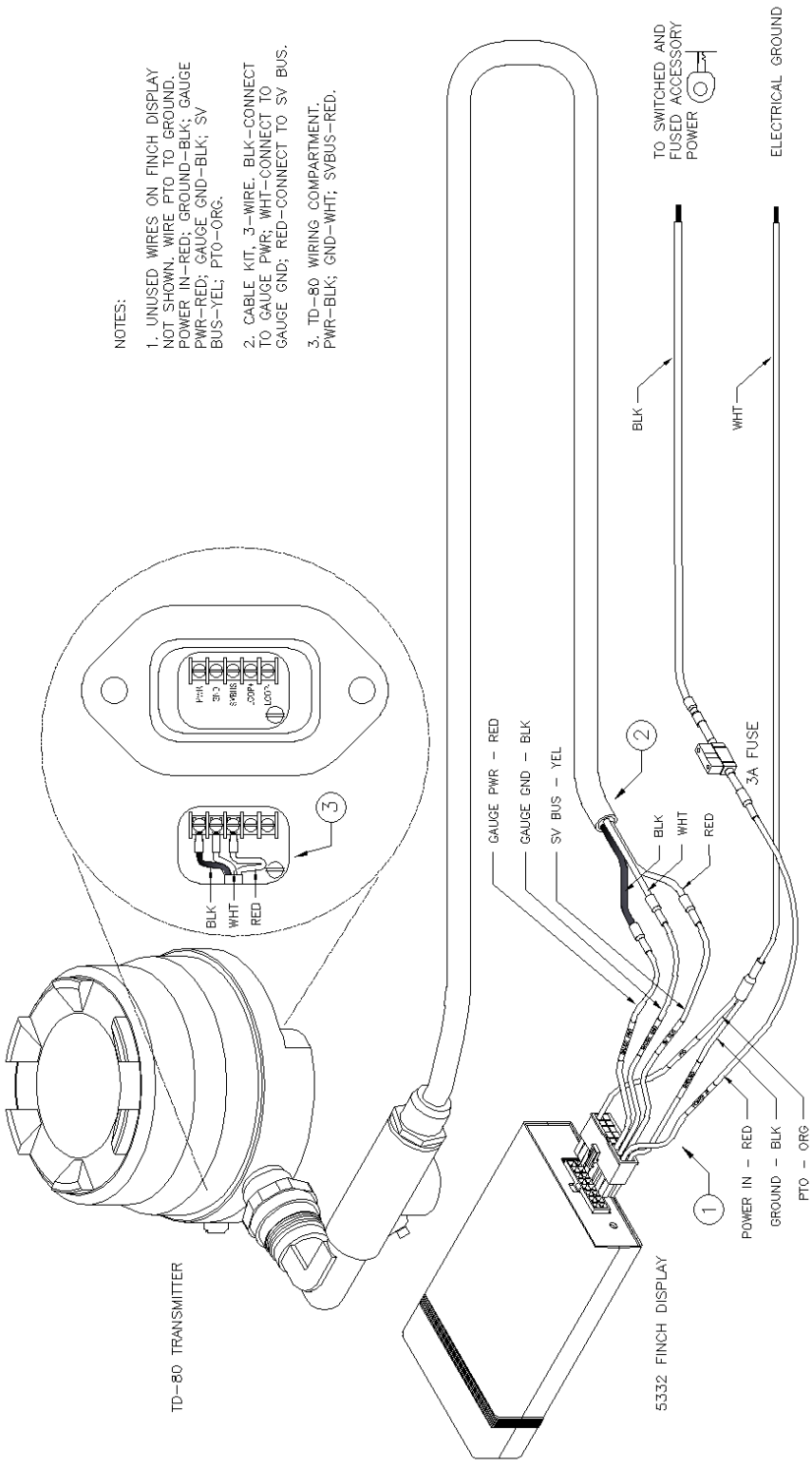

Figure 3-3: Basic System Wiring Diagram for Finch 5332 Internal Display

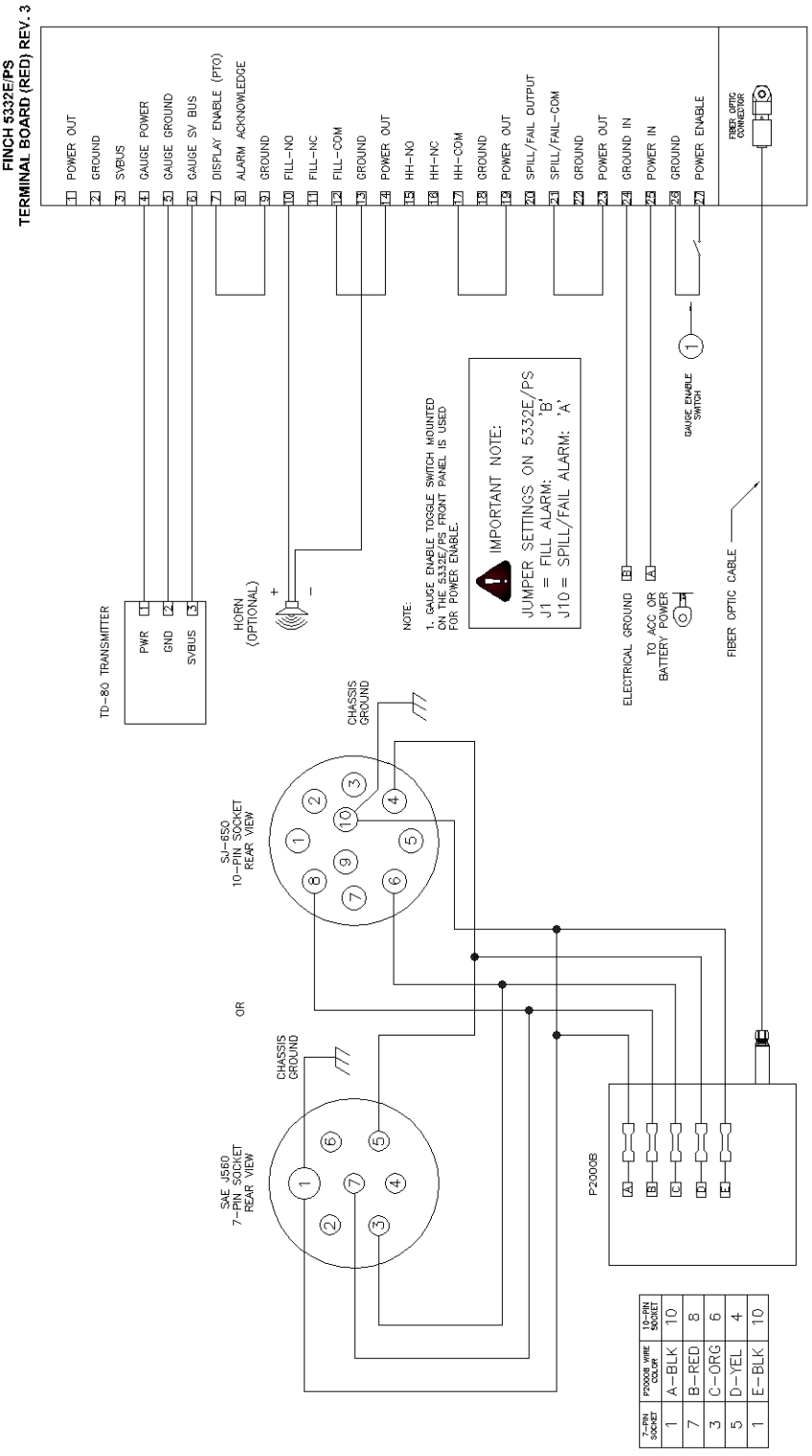

Figure 3-4: Single P2000 Overfill Prevention System Wiring Schematic

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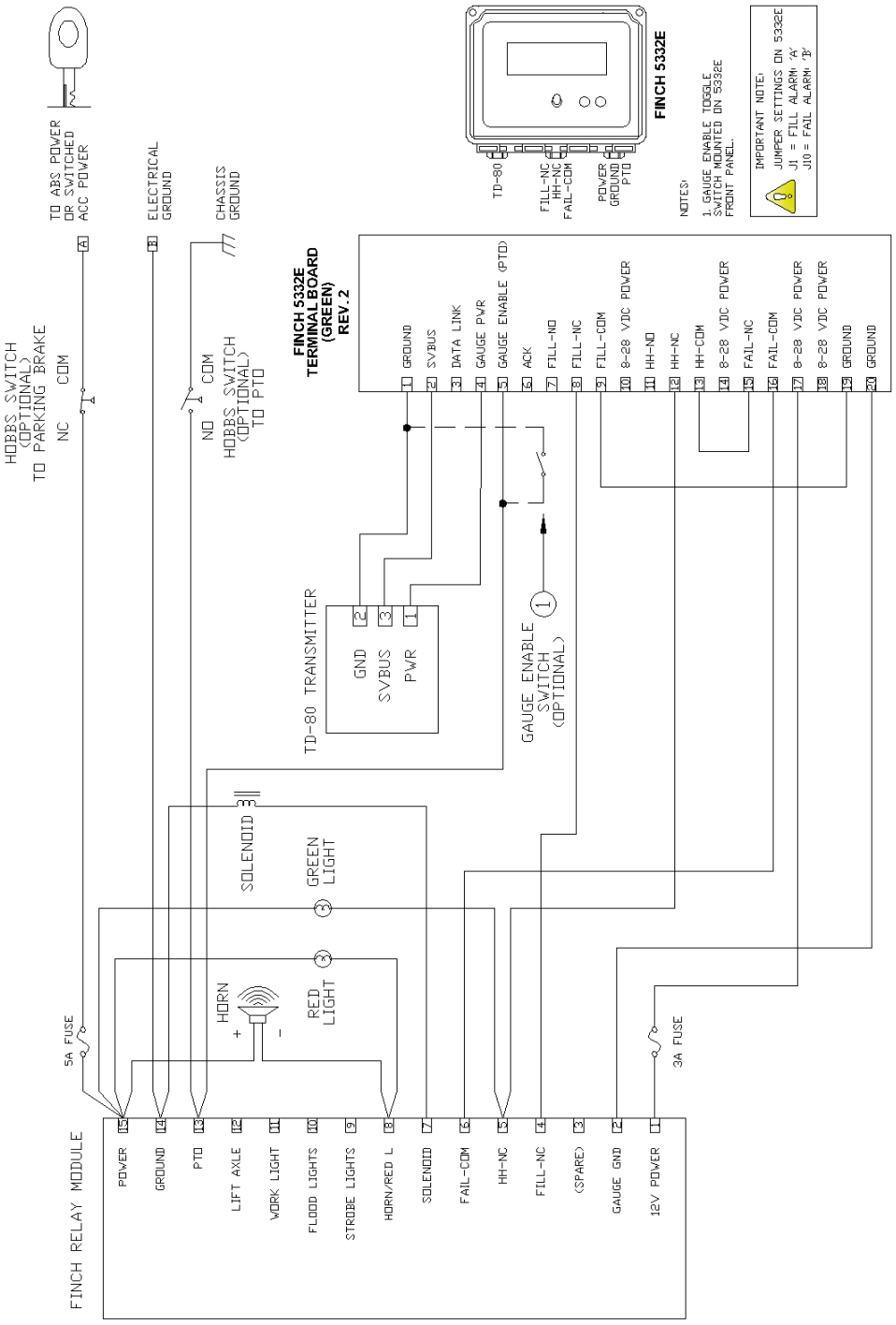

Figure 3-5: Finch Relay Module Overfill Prevention System Wiring Schematic for Finch 5332E with Horns and Lights

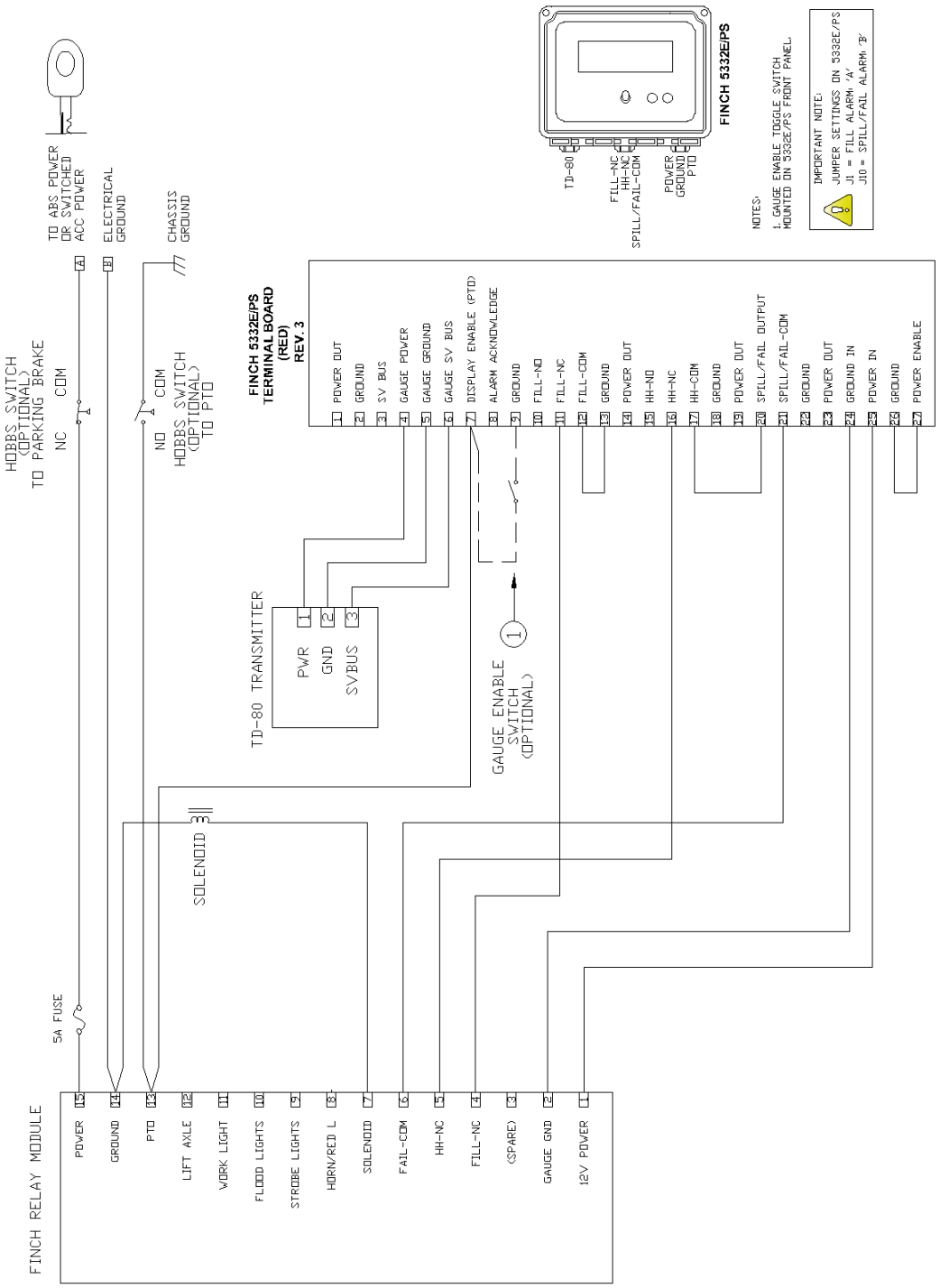

Figure 3-6: Basic Shutdown Wiring for Finch 5332E/PS External Display

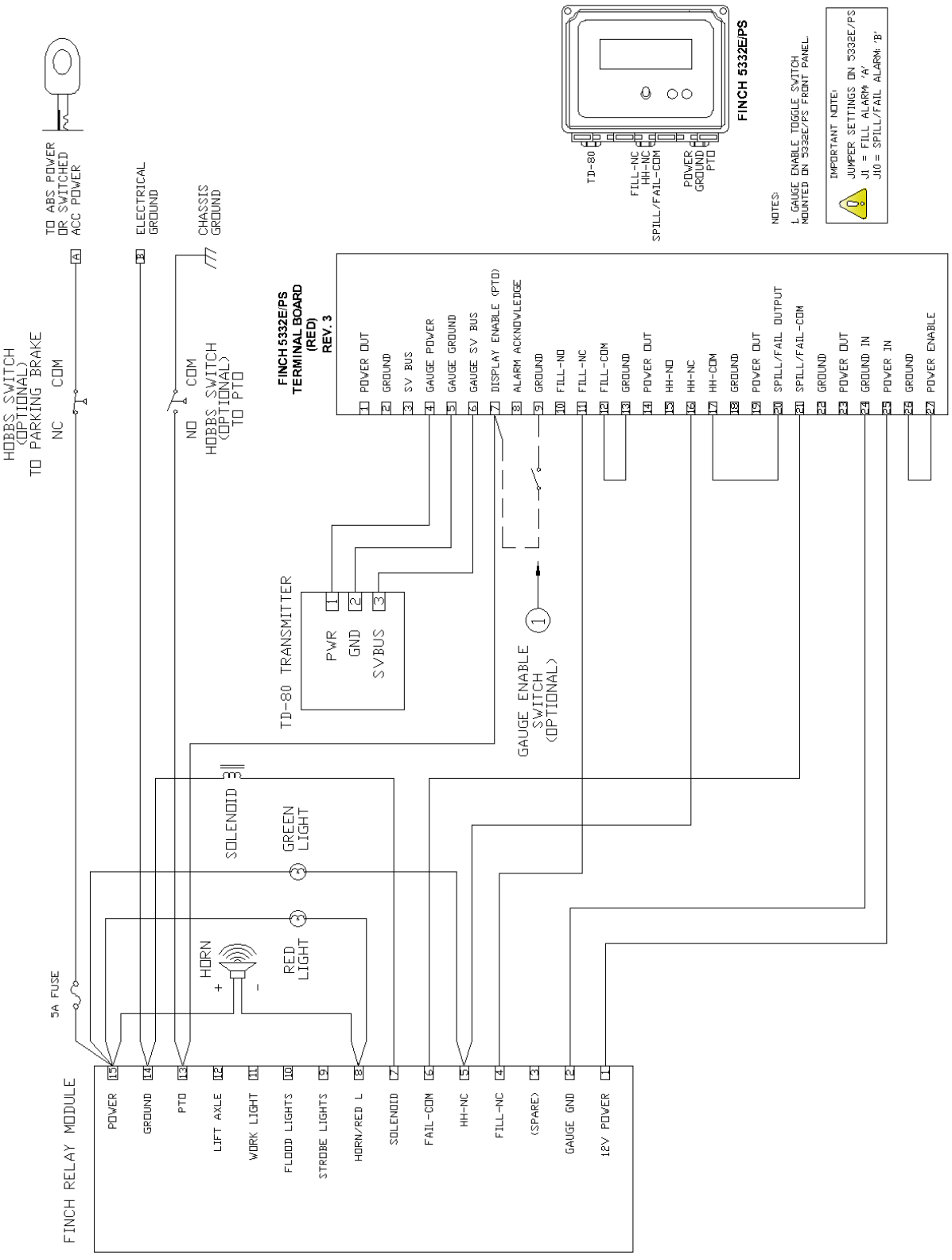

Figure 3-7: Finch Relay Module Overfill Prevention System for Finch 5332E/PS with Horns and Lights

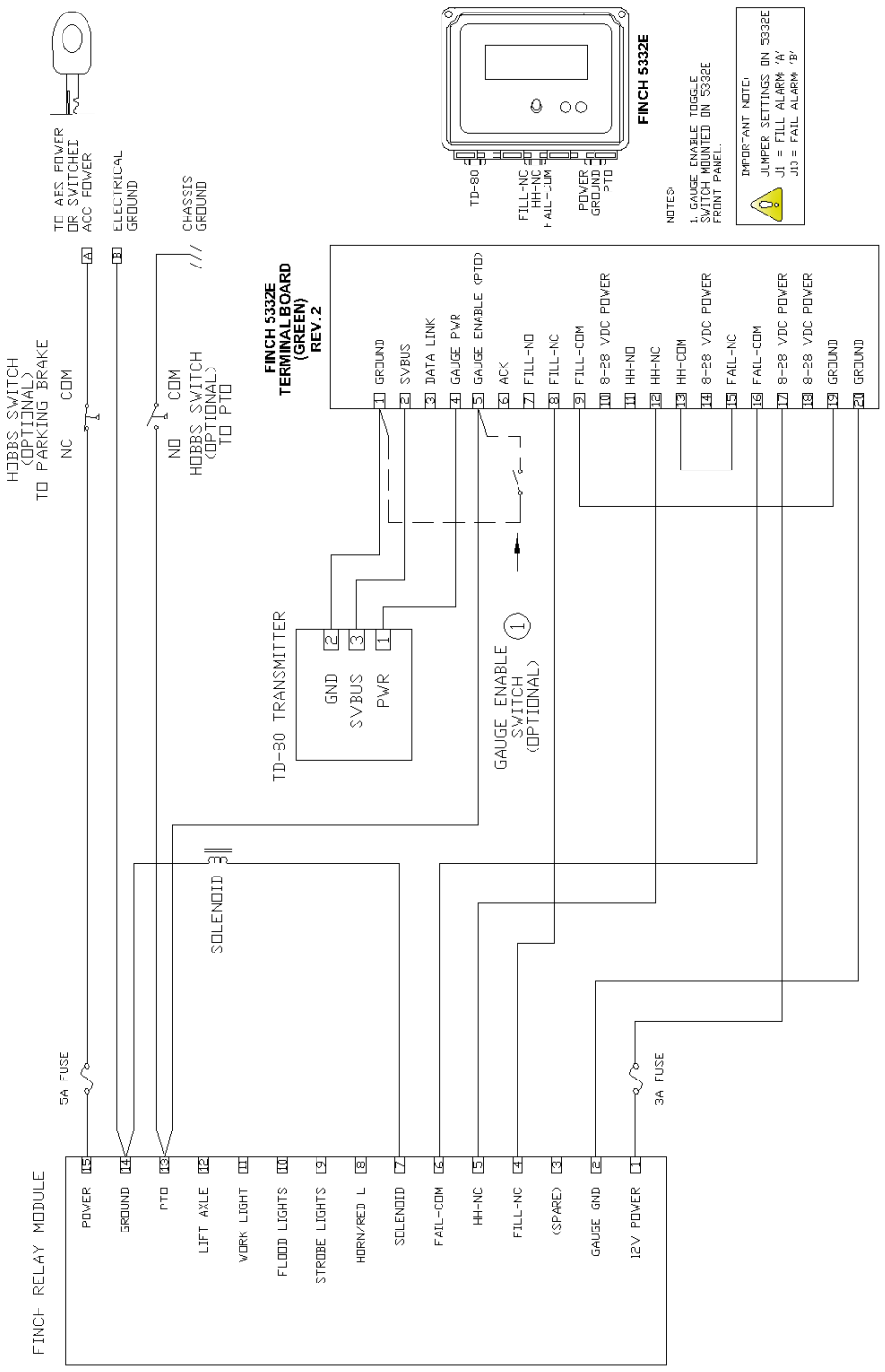

Figure 3-8: Basic Shutdown Wiring Schematic for Finch 5332E External Display

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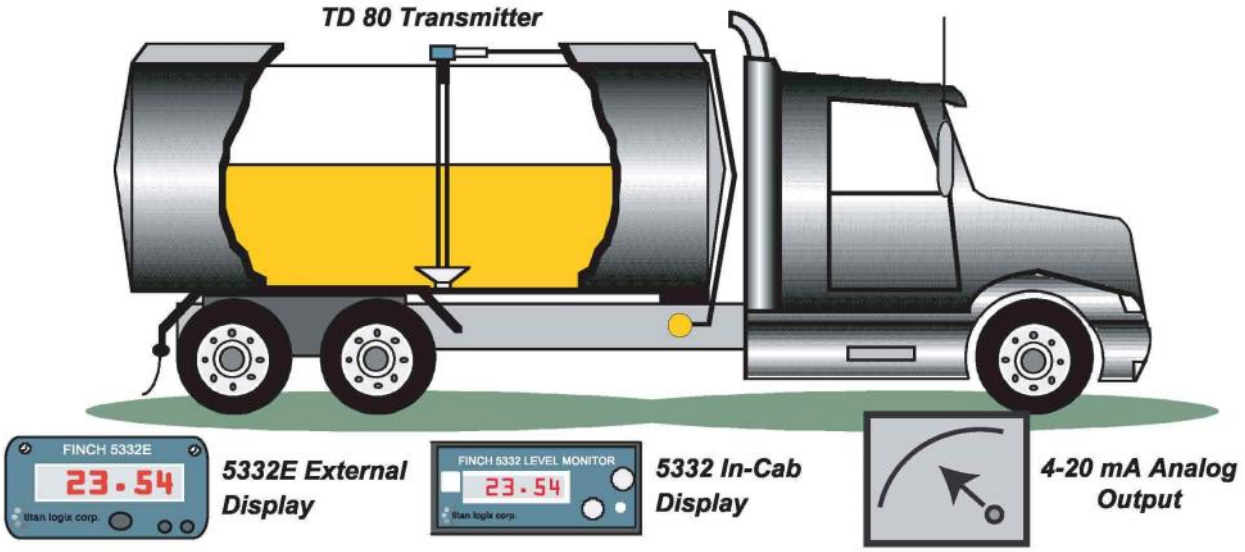
4 TD80 Technical Reference

4.1 Technical Specification Guide for Dual Rod Probes

titan logix corp.

TD80: Radar Liquid Level Measurement and Overfill Protection for Transport Tankers/Vessels

Technical Specification Guide (Dual Rod Probe)



Titan Logix Corp.'s TD80 is a revolutionary state-of-the-art patented liquid level measurement system for transportation applications based on the principle of Guided Wave Radar (GWR): A high-speed digital pulse is launched from the TD80 radar circuitry in the transmitter head, travels down the probe, reflects off the surface of the liquid and returns back up the probe to the electronics, where the total "flight" time of the pulse (to the liquid and back) is determined and thus the level is measured. This measurement is converted into a digital signal transmitted via the SV Bus communication wires from the transmitter to the display(s) or into a 4-20 mA signal. Liquid level may be displayed in volume or linear units. Three built-in alarm points are available to alert the operator of Fill, High-High, or Spill conditions. The 4-20 mA output option can be connected to PLCs and other devices with analog inputs. Using no moving parts, this revolutionary technology provides exceptionally safe, reliable, and accurate level measurement and spill protection in a wide variety of liquids and applications.

A. TD80 Level Transmitter (Features & Benefits)

Feature	Benefit
No Float or Moving Parts	Reliable long lasting system -- No float to stick due to product build up, to sink due to pin holes, to be stuck on the tank bottom due to ice or sand, to bounce around causing mechanical damage, to be in the way of internal piping/baffles, or to be removed/secured if service is required; no magnetic reed switches; no gears; etc.
High Accuracy Level Measurement	Accurate inventory records -- Standard 0.2" (5mm) accuracy: excellent for a truck based liquid level measurement system.
Straightforward Installation	Can be installed with no special tools -- Probe is available to a maximum length of 92 inches and cut to proper tank depth with a hacksaw. End block is bolted in place. No loctite or other glues required.
Highest Quality Electronics	Exceptional performance in rugged, hostile environments -- Both the transmitter and the display use modern, proven PIC Chip microprocessors and surface mount technology.

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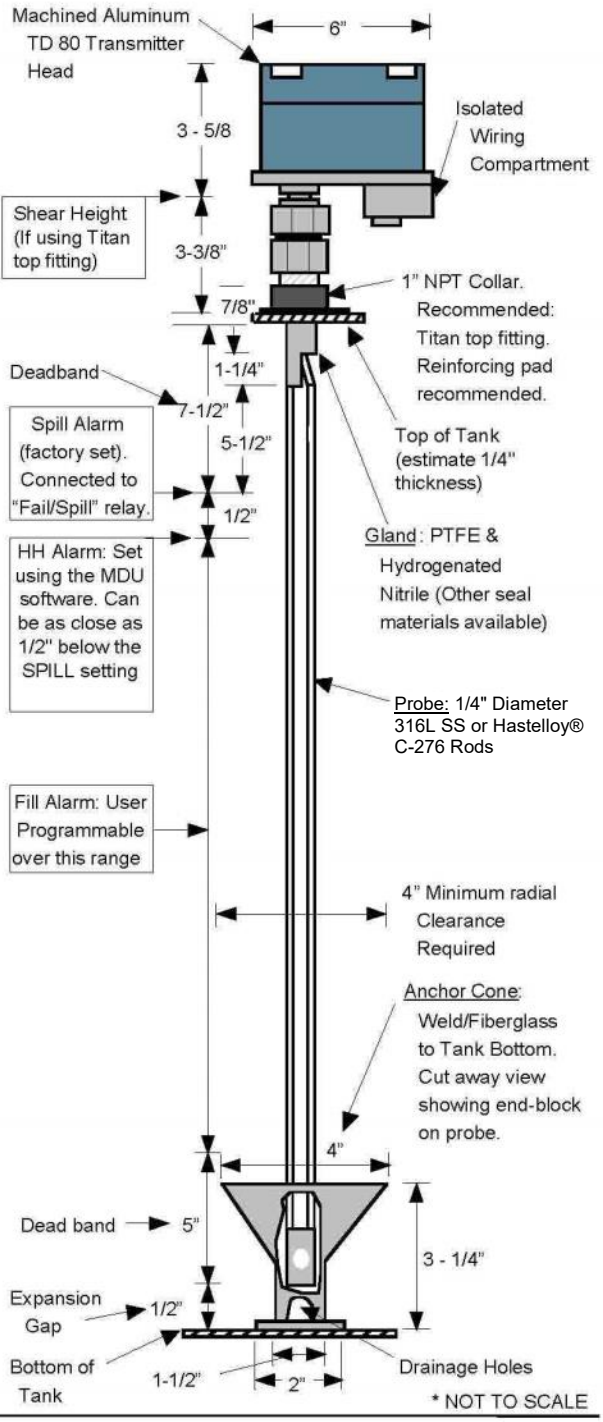
TD80: Radar Liquid Level Measurement for Transport Tankers/Vessels (Dual Rod)

TD 80 Transmitter

The TD80 Level Transmitter is the heart of the TD80 level measurement system. The Transmitter is mounted in the tank in a 1" NPT fitting at the top and cone anchor at the bottom. It uses radar to measure the liquid level, then converts this measurement into useable units and sends the information to a display or monitoring unit (4-20 mA output also available).

Power	8 to 28 VDC @ 50 mA max
Probe Length (below top fitting)	93 inches (can be cut to length in the field)
Measurement Range	13.5 inch (minimum) to 81 inch (maximum active length)
Accuracy	0.2 inch (5 mm)
Resolution	0.0312 inch (0.8 mm)
Repeatability	0.0312 inch (0.8 mm)
Top Dead Band	7.5 inch
Bottom Dead Band	5.5 inch
Shear Height	3.375 inches above tank top
Temperature Drift	[(200 ppm) x (Total Probe Length)] per degree Celcius
Materials	316L SS, PTFE, PEEK, HNBR (O-rings), Hastelloy® C-276
Process Pressure	14.9 PSI Maximum
Chemical Resistance	Compatible with most substances; Alternate o-ring materials available.
Ambient Temperature	-40 F (-40 C) to 185 F (85 C)
Process Temperature	-49 F (-45 C) to 248 F (120 C)
Dielectric Constant (Er) of Measured Liquid	> 1.8 (contact factory to confirm application)
Relative Humidity	5 to 95% (non-condensing); No frost on probe
Cable/Separation	3 Conductor AWG #14 Max
Outputs	SV Bus Digital. Optional 4-20 mA (0.1%).
Hazardous Area Approvals	CSA and NRTL/C Class I Division 1 Grps B, C, D
FCC Approval	Part 15 Class B, Verified



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TD80: Radar Liquid Level Measurement for Transport Tankers/Vessels (Dual Rod)

Highest Quality, Rugged, Modular Design	Easy to service -- Component requiring service can be isolated from the rest of the system (user can replace faulty component in the field). Reduced cost of service as only the faulty component is serviced. The probe can be removed & reinstalled without opening the man cover (ie: steaming or cleaning or hazardous entry of the tank is NOT required). The TD80 transmitter head can be removed from the probe for servicing.
Approved for Hazardous Areas	Safe to use in explosive environments -- Operator can use gauge with assurance a certified testing body has approved the TD80 to be safe, especially in hazardous areas.
Wide Range Corrosion Resistance	Ideal for sour services and harsh chemicals – Probe is constructed of two 1/4" diameter 316L stainless steel or Hastelloy® C-276 rods, PEEK (high corrosion resistance plastic), PTFE and Hydrogenated Nitrile (other seal materials available).
Environmentally Sealed Transmitter Enclosure	Excellent Protection of Electronics from moisture, including rain, humidity, condensation, power washing, etc. -- The TD80 transmitter head is O-Ring sealed to keep the elements out of the electronics compartment.
Power Supplied by Truck Battery	Reliable, Continuous power source -- The low power requirements of the gauge are readily supplied by the truck battery.
Not affected by Changes in Liquid Density	Accurate reading regardless of liquid density -- Changes in the density / specific gravity of the liquid have no effect on the performance of the transmitter, as compared to the varying readings obtained by float-based gauges. Also, the TD80 provides accurate measurements in very low density liquids, whereas float systems may not work at all due to dramatically reduced buoyancy.
Rollover Protection	Enhanced Safety – In the event of a tanker rollover, the TD80 transmitter head is designed to shear off, saving the tank from puncture and product release due to the probe.
Installs in Some Existing Fittings	Reduced Installation Costs -- The TD80 can be installed in some existing tank gauge fittings. Please consult your TD80 Representative for details regarding retrofit installations.
PC Based Programming of Display Values (Depth Chart)	Special Programmer not required -- Programming of depth/volume chart or calibration table (eg: cubic metres, barrels, liters, inches, millimeters, etc.) is performed on a personal computer, with a progamming adapter and software, and is easily modified. Table values can be imported, eliminating the need to retype them into a programmer. Built-in error checking enables the operator to ensure the values are correct.
Depth Chart stored in Non-Volatile Memory	Reliable Storage of Depth Chart Data -- The depth chart is stored in the TD80 transmitter in Non Volatile memory. Data is retained without requiring a battery.
Probe Is Electrically Grounded	Static Electricity Protection -- The probe of the TD80 transmitter is electrically grounded to prevent static build-up on the probe.
Multiple Displays with One Transmitter	Can view liquid level in-cab or outside at the same time -- Two displays can be connected to 1 transmitter, allowing an In-Cab & External, 2 Externals, or 2 In-Cab displays to show the level from the same transmitter.
Multiple TD80s with One Display	Save the cost and space for additional displays -- One display can be used for multiple transmitters, thus saving the cost of dedicated displays for each TD80.

TD80: Radar Liquid Level Measurement for Transport Tankers/Vessels (Dual Rod)

B. Finch 5332 & 5332E Digital Displays (Features & Benefits)

The Finch 5332 Level Monitor receives information from the TD80 Level Transmitter and displays it in an easy to read form. The Finch is available in two forms: the Finch 5332 is a compact in-cab display while the Finch 5332E is a larger external display with a NEMA 4X enclosure. Both units operate in the same manner with a 4 digit display, 3 output relays, PTO input, and acknowledge input.

Built-In Programmable Alarm Point (FILL)	Provide an audible Spill Prevention Warning -- User adjustable "Fill" relay and factory set "High-High" and "Fail" (Spill alarm) relays can be wired to horns, lights, etc. to assist in safe loading procedures. High-High and Spill alarms are factory programmed in the TD80 transmitter.
Troubleshooting / Error Codes	Quick Diagnosis of problems -- Error codes appear on the display to help in determining whether a problem exists in the display, TD80 transmitter head, the probe, or the wiring.
Modular Design	Ease of Service -- Electronic display module can be removed and replaced without difficult removal of wiring connections.
Digital Communications	Reliable Signal Transmission -- Liquid level and probe status information is transmitted from the TD80 to the 5332 or 5332E display in a digital protocol to maximize data accuracy and reliablity.

C. System Configuration: Typical Examples

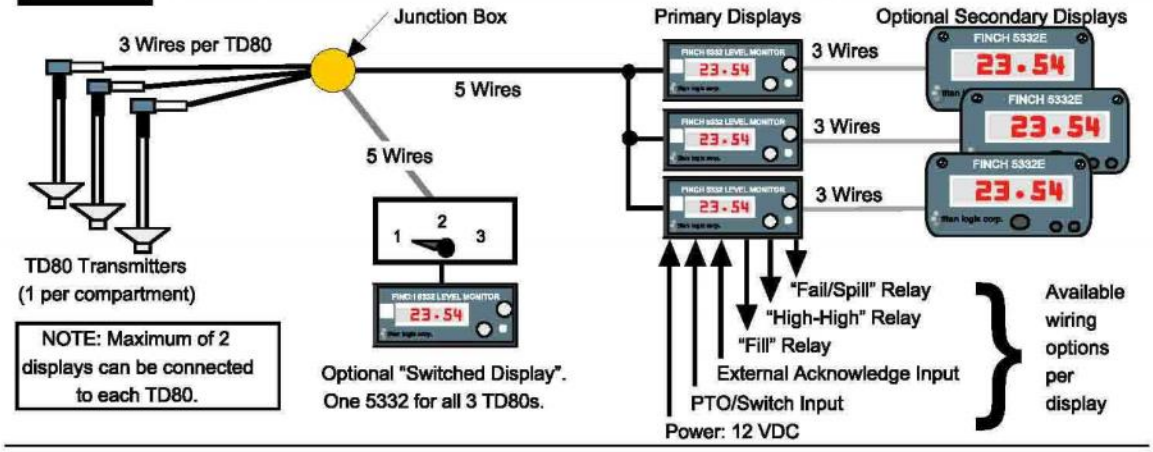
The TD80 level measurement system is ideal for a variety of transport tanker applications. Using the 5332 in-cab display, an operator can view the liquid level from inside the truck cab. Or, using the 5332E external display, the operator can view the liquid level while outside the truck, thus being able to be close to the hoses, valves, etc. For example, if the tanker is a Super-B, with perhaps a 2 compartment lead and 1 compartment pup, there can be:

- three (3) dedicated 5332 displays in the cab or a multi-tank switched display to select between the 3 x TD80s, **or**
- the 5332E external display(s) could be installed at the side of the lead and pup tanks to be able to view the liquid level while outside the cab, **or**
- for a maximum of flexibility, the operator could also have the option of displays in the cab and at the side of the tank at the same time

For further explanation, please refer to the diagram below.

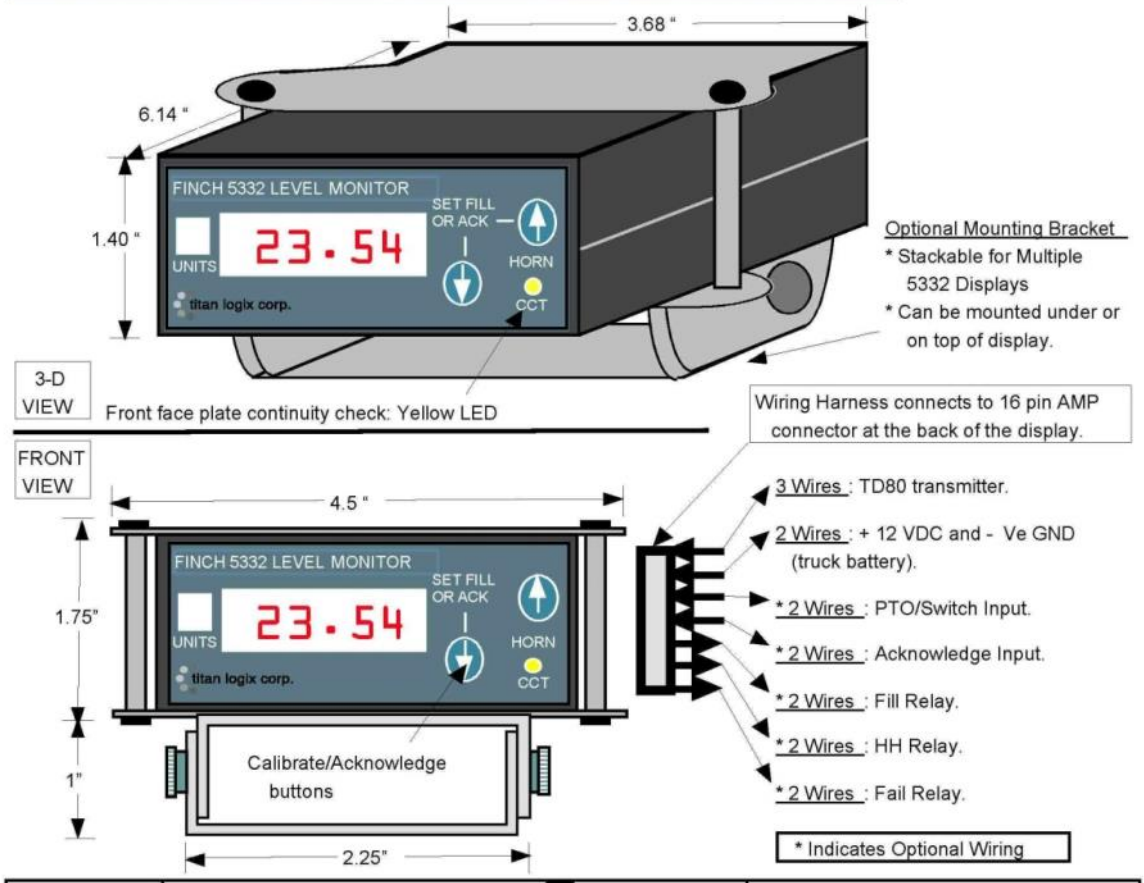
NOTE: When connecting multiple TD80 transmitters to the optional "Switched Display" the Fill, High-High, Fail/Spill relays activate only for the particular TD80 which the display is switched to. Consult your TD80 Representative for more details.

4-20 mA Analog Output (Internal Card)
An isolated analog output card is available, installed in the TD80 transmitter enclosure. The 4-20 mA output is not strapped and will be calibrated at the factory to give full span over the active probe length to deliver 4 mA at the bottom of the tank and 20 mA at the top of the tank. Alternatively, the 4 mA level and 20 mA level can also be programmed at customer required heights.



TD80: Radar Liquid Level Measurement for Transport Tankers / Vessels (Dual Rod)

Finch 5332 In-Cab Mount Level Monitor Display/Controller



Accuracy	1 digit, 1 / 9999 counts.	Communication	SV BUS, proprietary open drain bus, @1200 bps, 30 mA current limited, length 150 ft max.
Wire/Cable	AWG #14, SOW -40 F (-40 C) to 194 F (90 C).	Outputs	All 3 alarm relays: dry contact, rated 30 VDC, 2A continuous FILL Relay: SPDT, Jumper Selectable between Failsafe or normal operation from COM to NO and NC contacts. HIGH-HIGH Relay: SPDT, COM to NO and NC contacts. FAIL/SPILL Relay: Failsafe operation. From COM to jumper selectable NO or NC contacts.
Power	8 - 28 VDC @ 0.3 A max. current limited.		
Display	4 digit, red LED display with 4 decimal places (configurable). Digit height: 0.3 inch.		
Temperature	-40 F (-40 C) to 149 F (65 C).		
Enclosure	Flame retardant ABS.		

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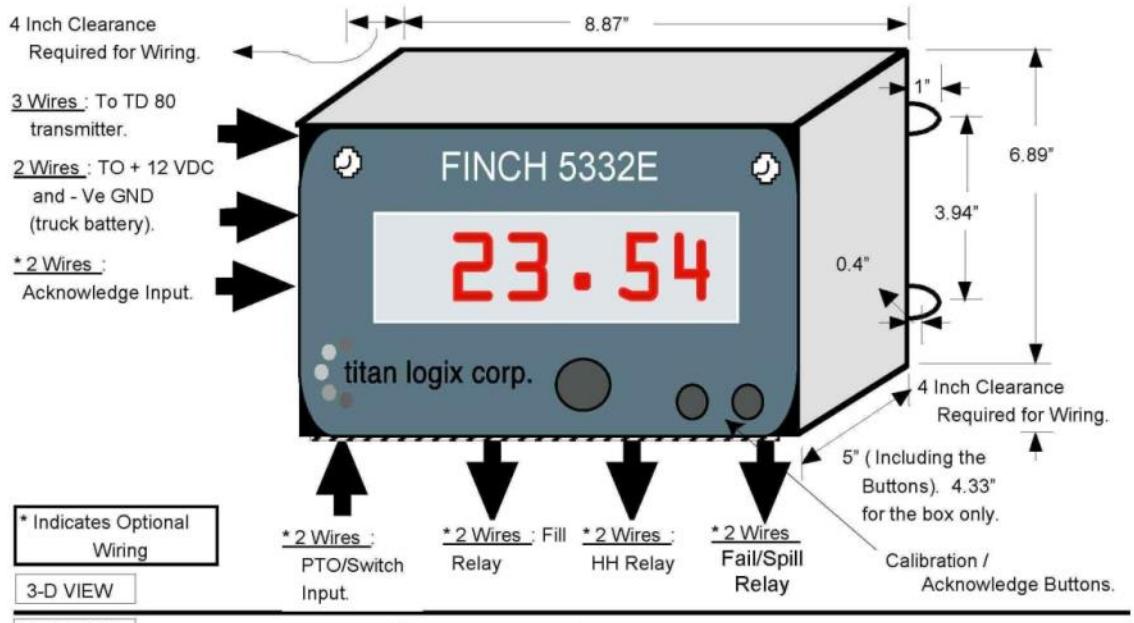
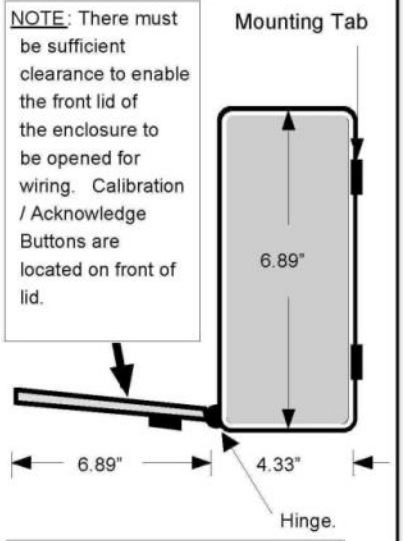
TD80: Radar Liquid Level Measurement for Transport Tankers / Vessels (Dual Rod)

Finch 5332E External Mount Level Monitor Display / Controller



SIDE VIEW



NOTE: There must be sufficient clearance to enable the front lid of the enclosure to be opened for wiring. Calibration / Acknowledge Buttons are located on front of lid.

NOTE: If 5332E will be in direct contact with road debris (i.e. rocks) it should be protected in a metal enclosure.

Accuracy	1 digit, 1 / 9999 counts.
Wire/Cable	AWG #14, SOW. -40 C to +90 C.
Power	8 - 28 VDC @ 0.3 A max. current limited.
Approvals	CSA Class 1 Div 2.
Display	4 digit, red LED display with 4 decimal places (configurable). Digit height: 0.8 inch.
Temperature	-40 F (-40 C) to 149 F (65 C).
Enclosure	Flame retardant fiberglass. Type 4X rating (weatherproof).
Communication	SV BUS, proprietary open drain bus, @1200 bps, 30 mA current limited, length 150 ft max.
Outputs	All 3 alarm relays: dry contact, rated 30 VDC, 2A continuous FILL Relay: SPDT, Jumper selectable between Failsafe or normal operation from COM to NO and NC contacts. HIGH-HIGH Relay: SPDT, COM to NO and NC contacts. FAIL/SPILL Relay: Failsafe operation. From COM to jumper slectable NO or NC contacts.

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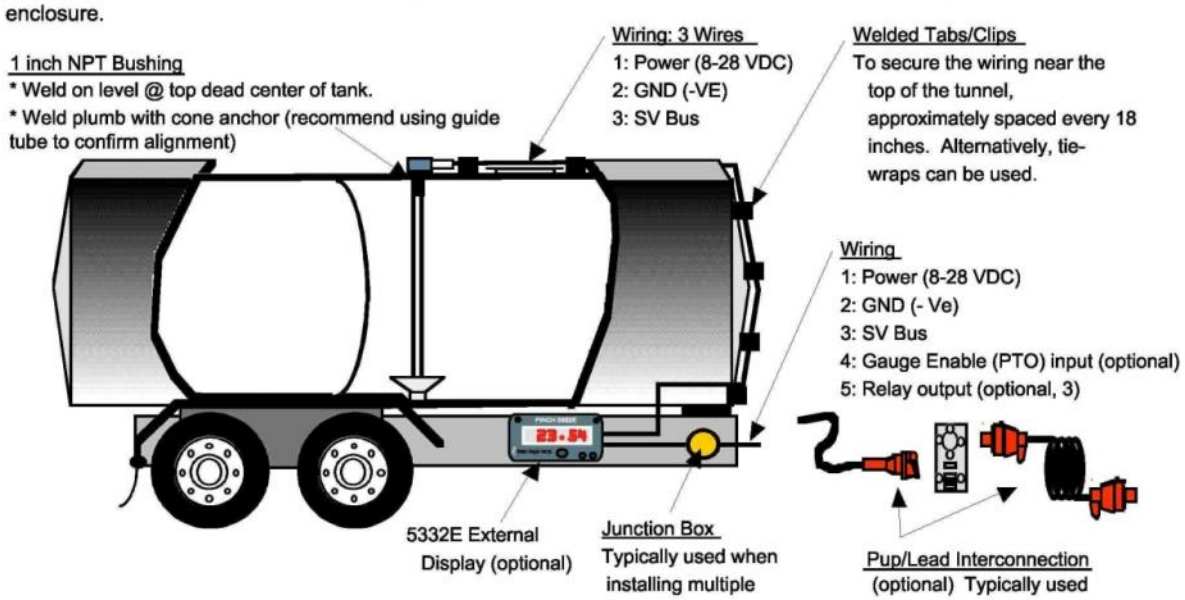
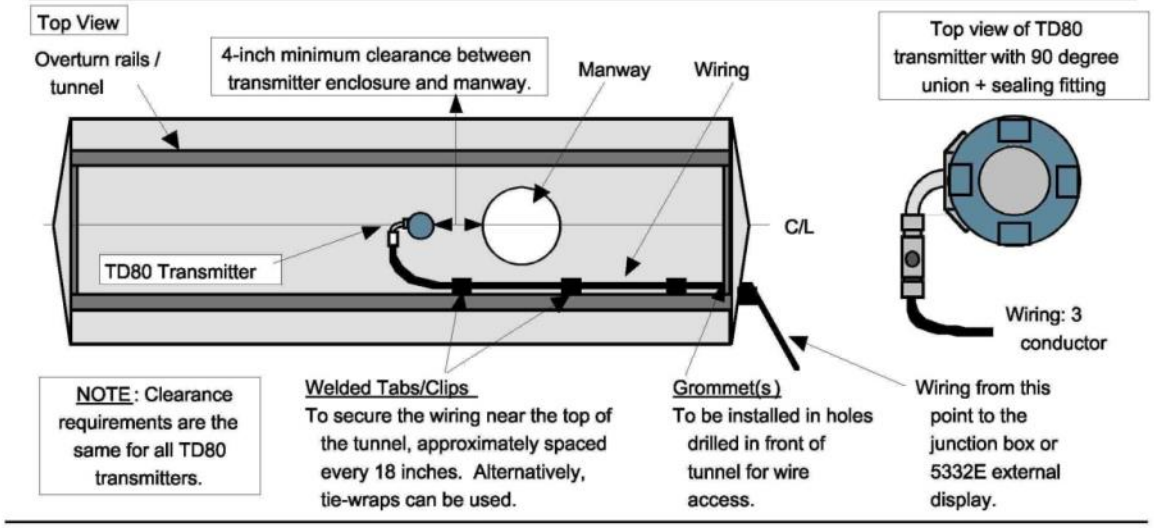
TD80: Radar Liquid Level Measurement for Transport Tankers / Vessels (Dual Rod)

D. Installation Overview

In most cases the TD80 is installed according to the diagrams below. Some points to note:

1. If mounting the 5332 In-Cab Display in the truck cab, it is recommended for the wires to go from the TD80 into the Junction Box and from there into the cab.
2. If mounting the 5332E External Display on the side of the tank, it may not be necessary to install the Junction Box.
3. If installing the 5332E External Display, it should be protected from road debris by installing in a protective metal enclosure.





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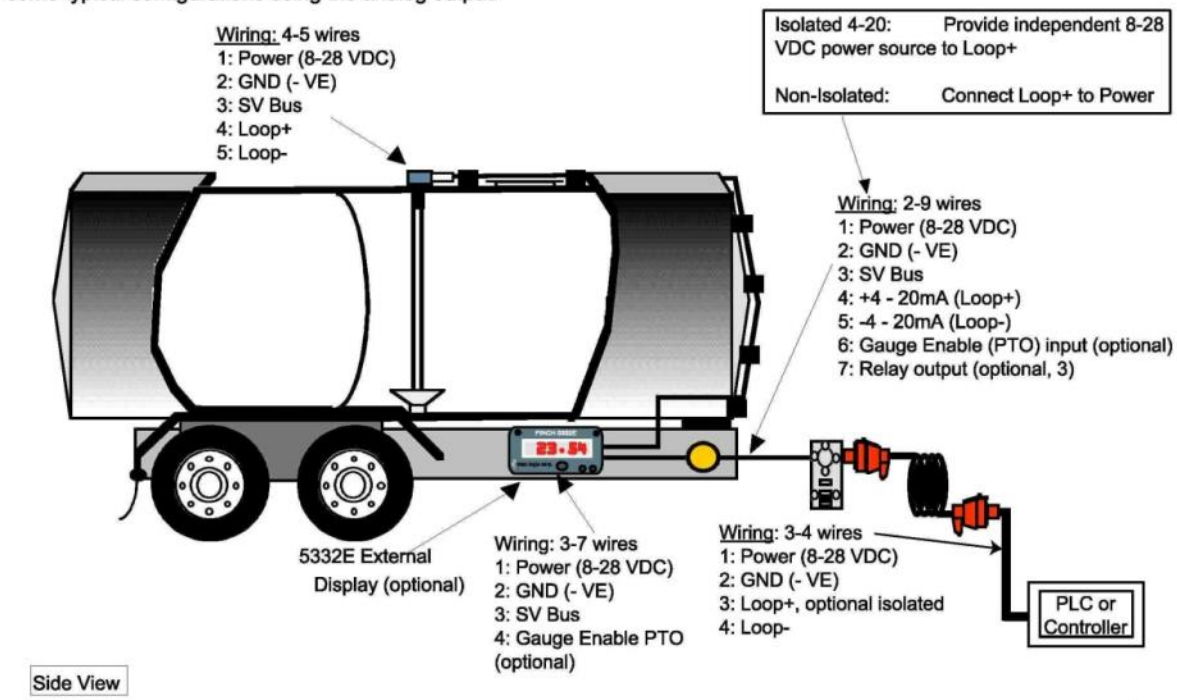
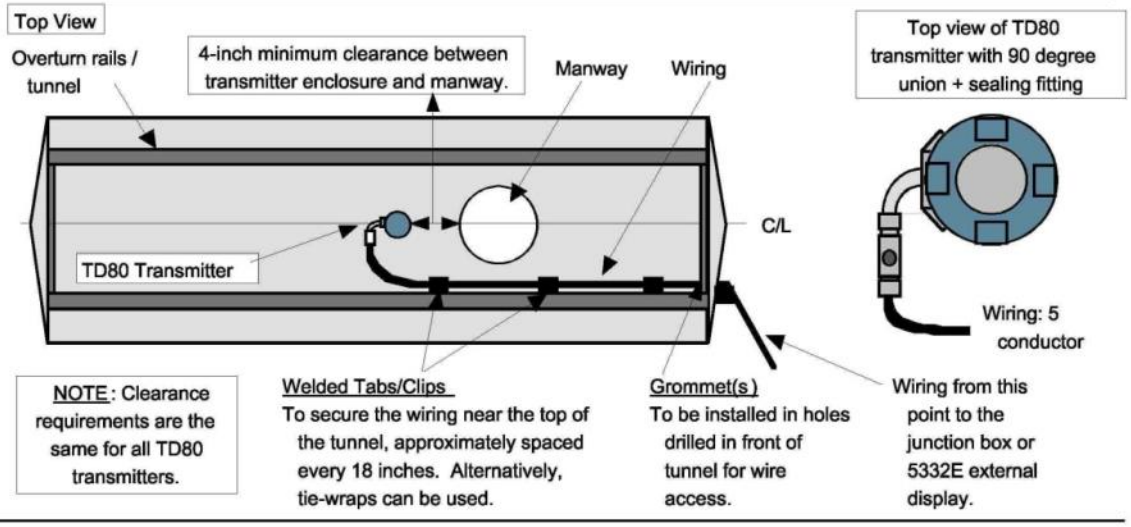
TD80: Radar Liquid Level Measurement for Transport Tankers / Vessels (Dual Rod)

E. 4-20 mA Output

The 4-20 mA analog output is an optional circuit board mounted in the TD80 transmitter at the time of manufacturing. The SV Bus signal is still available for connection to the 5332/E display(s) when the analog card is installed. The SV Bus is also required for programming the 4.00 and 20.00 mA levels. The card provides a linear output (ie: NOT strapped to the volume of the tank), and is optically isolated from the other circuits in the TD80 transmitter in case your application requires the use of a separate ground for the analog output. The following are some typical configurations using the analog output.





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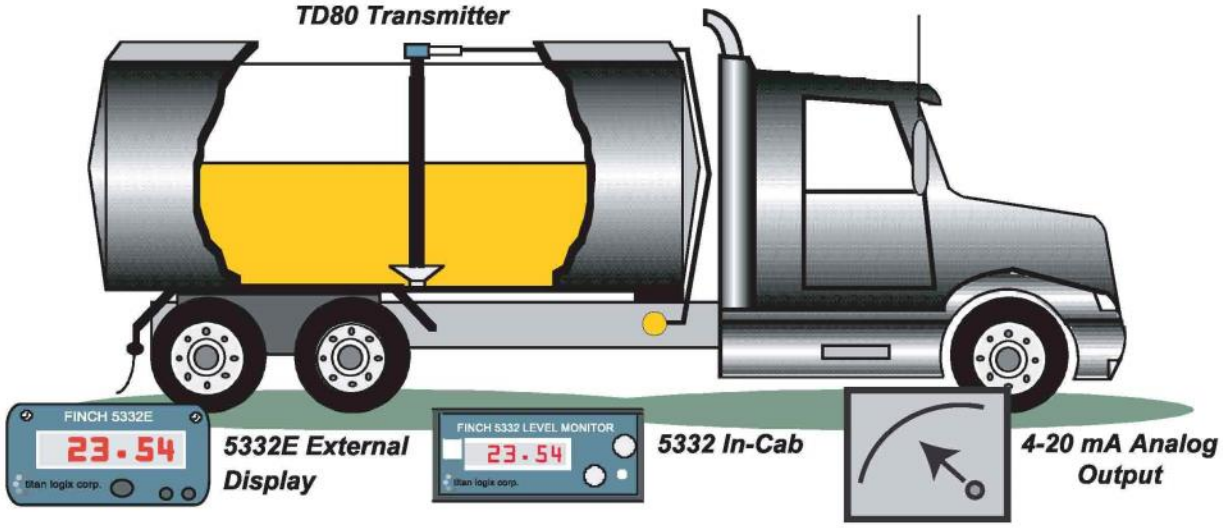
4.2 Technical Specification Guide for Coaxial Probes

titan logix corp.

TD80: Radar Liquid Level Measurement and Overfill Prevention for Transport Tankers/Vessels

Technical Specification Guide (Coaxial Probe)



Titan Logix Corp.'s TD80 is a revolutionary state-of-the-art patented liquid level measurement system for transportation applications based on the principle of Guided Wave Radar (GWR): A high-speed digital pulse is launched from the TD80 radar circuitry in the transmitter head, travels down the probe, reflects off the surface of the liquid and returns back up the probe to the electronics, where the total "flight" time of the pulse (to the liquid and back) is determined and thus the level is measured. This measurement is converted into a digital signal transmitted via the SV Bus communication wires from the transmitter to the display(s) or into a 4-20 mA signal. Liquid level may be displayed in volume or linear units. Three built-in alarm points are available to alert the operator of Fill, High-High, or Spill conditions. The 4-20 mA output option can be connected to PLCs and other devices with analog inputs. Using no moving parts, this revolutionary technology provides exceptionally safe, reliable, and accurate level measurement and spill protection in a wide variety of liquids and applications.

A. TD80 Level Transmitter (Features & Benefits)

Feature	Benefit
No Float or Moving Parts	Reliable long lasting system -- No float to stick due to product build up, to sink due to pin holes, to be stuck on the tank bottom due to ice or sand, to bounce around causing mechanical damage, to be in the way of internal piping/baffles, or to be removed/secured if service is required; no magnetic reed switches; no gears; etc.
High Accuracy Level Measurement	Accurate inventory records -- Standard 0.2" (5mm) accuracy: excellent for a truck based liquid level measurement system.
Straightforward Installation	Can be installed with no special tools -- Probe is available to a maximum length of 92 inches and cut to proper tank depth with a hacksaw. End block is bolted in place. No loctite or other glues required.
Highest Quality Electronics	Exceptional performance in rugged, hostile environments -- Both the transmitter and the display use modern, proven PIC Chip microprocessors and surface mount technology.

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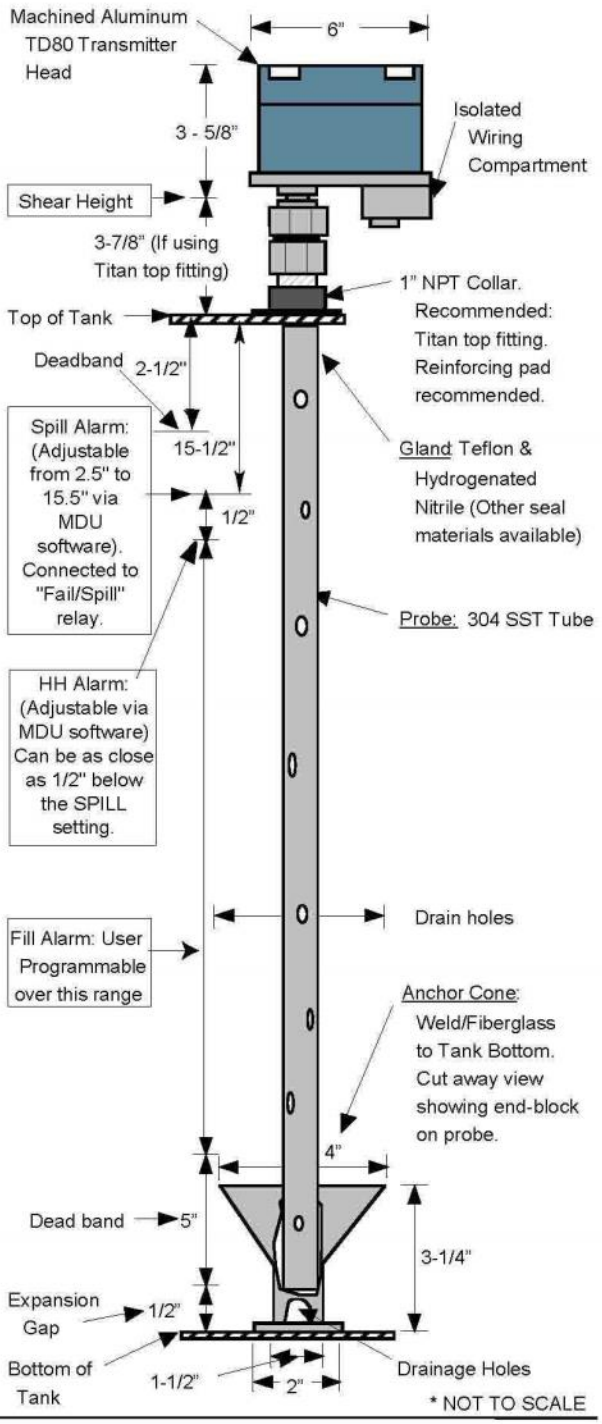
TD80: Radar Liquid Level Measurement for Transport Tankers / Vessels (Coaxial Probe)

TD80 Transmitter

The TD80 Level Transmitter is the heart of the TD80 level measurement system. The Transmitter is mounted in the tank in a 1" NPT fitting at the top and cone anchor at the bottom. It uses radar to measure the liquid level, then converts this measurement into useable units and sends the information to a display or monitoring unit (4-20 mA output also available).

Power	8 to 28 V DC @ 50 mA max
Probe Length (below top fitting)	93 inch (can be cut to length in the field)
Measurement Range	8.5 inch (minimum) to 81 inch (maximum active length)
Accuracy	0.2 inch (5 mm)
Resolution	0.0312 inch (0.8 mm)
Repeatability	0.0312 inch (0.8 mm)
Top Dead Band	2.5 inch
Bottom Dead Band	5.5 inch
Shear Height	3.875 inches above tank top
Temperature Drift	[(200 ppm) x (Total Probe Length)] per degree Celcius
Materials	SS316, PTFE, PEEK, Hydrogenated Nitrile (o-rings)
Process Pressure	14.9 PSI Maximum
Chemical Resistance	Compatible with most substances; Alternate o-ring materials available.
Ambient Temperature	-40 F (-40 C) to 185 F (85 C)
Process Temperature	-49 F (-45 C) to 248 F (120 C)
Dielectric Constant (Er) of Measured Liquid	>=1.6 (contact factory to confirm application)
Relative Humidity	5 to 95% (non-condensing); No frost on probe
Cable/Separation	3 Conductor AWG #14 Max
Outputs	SV Bus Digital. Optional 4-20 mA (0.1%).
Hazardous Area Approvals	CSA and NRTL/C Class I Division 1 Grps B, C, D
FCC Approval	Part 15 Class B, Verified



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TD80: Radar Liquid Level Measurement for Transport Tankers / Vessels (Coaxial Probe)

Highest Quality, Rugged, Modular Design	Easy to service -- Component requiring service can be isolated from the rest of the system (user can replace faulty component in the field). Reduced cost of service as only the faulty component is serviced. The probe can be removed & reinstalled without opening the man cover (ie: steaming or cleaning or hazardous entry of the tank is NOT required). The TD80 transmitter head can be removed from the probe for servicing.
Approved for Hazardous Areas	Safe to use in explosive environments -- Operator can use gauge with assurance a certified testing body has approved the TD80 to be safe, especially in hazardous areas.
Wide Range Corrosion Resistance	Ideal for sour service and some harsh chemicals -- Probe is constructed of 1" diameter 316 stainless steel tube, PEEK (high corrosion resistance plastic), PTFE and Hydrgenated Nitrile (other seal materials available).
Environmentally Sealed Transmitter Enclosure	Excellent Protection of Electronics from moisture, including rain, humidity, condensation, power washing, etc. -- The TD80 transmitter head is O-Ring sealed to keep the elements out of the electronics compartment.
Power Supplied by Truck Battery	Reliable, Continuous power source -- The low power requirements of the gauge are readily supplied by the truck battery.
Not affected by Changes in Liquid Density	Accurate reading regardless of liquid density -- Changes in the density / specific gravity of the liquid have no effect on the performance of the transmitter, as compared to the varying readings obtained by float-based gauges. Also, the TD80 provides accurate measurements in very low density liquids, whereas float systems may not work at all due to dramatically reduced buoyancy.
Rollover Protection	Enhanced Safety -- In the event of a tanker rollover, the TD80 transmitter head is designed to shear off, saving the tank from puncture and product release due to the probe.
Installs in Some Existing Fittings	Reduced Installation Costs -- The TD80 can be installed in some existing tank gauge fittings. Please consult your TD80 Representative for details regarding retrofit installations.
PC Based Programming of Display Values (Depth Chart)	Special Programmer not required -- Programming of depth/volume chart or calibration table (eg: cubic metres, barrels, liters, inches, millimeters, etc.) is performed on a personal computer, with a progamming adapter and software, and is easily modified. Table values can be imported, eliminating the need to retype them into a programmer. Built-in error checking enables the operator to ensure the values are correct.
Depth Chart stored in Non-Volatile Memory	Reliable Storage of Depth Chart Data -- The depth chart is stored in the TD80 transmitter in Non Volatile memory. Data is retained without requiring a battery.
Probe Is Electrically Grounded	Static Electricity Protection -- The probe of the TD80 transmitter is electrically grounded to prevent static build-up on the probe.
Multiple Displays with One Transmitter	Can view liquid level in-cab or outside at the same time -- Two displays can be connected to 1 transmitter, allowing an In-Cab & External, 2 Externals, or 2 In-Cab displays to show the level from the same transmitter.
Multiple TD80s with One Display	Save the cost and space for additional displays -- One display can be used for multiple transmitters, thus saving the cost of dedicated displays for each TD80.

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TD80: Radar Liquid Level Measurement for Transport Tankers/Vessels (Coaxial Probe)

B. Finch 5332 & 5332E Digital Displays (Features & Benefits)

The Finch 5332 Level Monitor receives information from the TD80 Level Transmitter and displays it in an easy to read form. The Finch is available in two forms: the Finch 5332 is a compact in-cab display while the Finch 5332E is a larger external display with a NEMA 4X enclosure. Both units operate in the same manner with a 4 digit display, 3 output relays, PTO input, and acknowledge input.

Built-In Programmable Alarm Point (FILL)	Provide an audible Spill Prevention Warning -- User adjustable "Fill" relay and factory set "High-High" and "Fail" (Spill alarm) relays can be wired to horns, lights, etc. to assist in safe loading procedures. High-High and Spill alarms are factory programmed in the TD80 transmitter.
Troubleshooting / Error Codes	Quick Diagnosis of problems -- Error codes appear on the display to help in determining whether a problem exists in the display, TD80 transmitter head, the probe, or the wiring.
Modular Design	Ease of Service -- Electronic display module can be removed and replaced without difficult removal of wiring connections.
Digital Communications	Reliable Signal Transmission -- Liquid level and probe status information is transmitted from the TD80 to the 5332 or 5332E display in a digital protocol to maximize data accuracy and reliablity.

C. System Configuration: Typical Examples

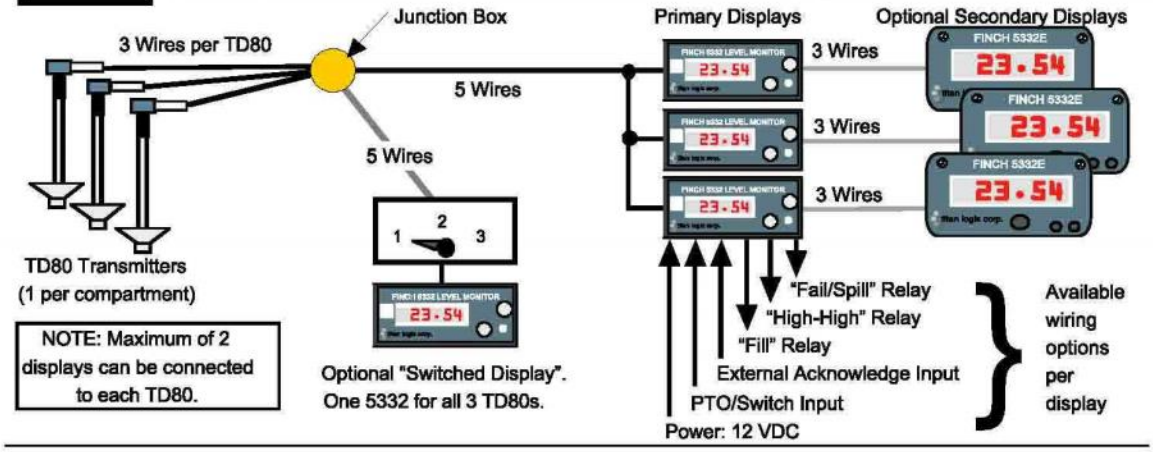
The TD80 level measurement system is ideal for a variety of transport tanker applications. Using the 5332 in-cab display, an operator can view the liquid level from inside the truck cab. Or, using the 5332E external display, the operator can view the liquid level while outside the truck, thus being able to be close to the hoses, valves, etc. For example, if the tanker is a Super-B, with perhaps a 2 compartment lead and 1 compartment pup, there can be:

- three (3) dedicated 5332 displays in the cab or a multi-tank switched display to select between the 3 x TD80s, **or**
- the 5332E external display(s) could be installed at the side of the lead and pup tanks to be able to view the liquid level while outside the cab, **or**
- for a maximum of flexibility, the operator could also have the option of displays in the cab and at the side of the tank at the same time

For further explanation, please refer to the diagram below.

NOTE: When connecting multiple TD80 transmitters to the optional "Switched Display" the Fill, High-High, Fail/Spill relays activate only for the particular TD80 which the display is switched to. Consult your TD80 Representative for more details.

4-20 mA Analog Output (Internal Card)
An isolated analog output card is available, installed in the TD80 transmitter enclosure. The 4-20 mA output is not strapped and will be calibrated at the factory to give full span over the active probe length to deliver 4 mA at the bottom of the tank and 20 mA at the top often tank. Alternatively, the 4 mA level and 20 mA level can also be programmed at customer required heights.



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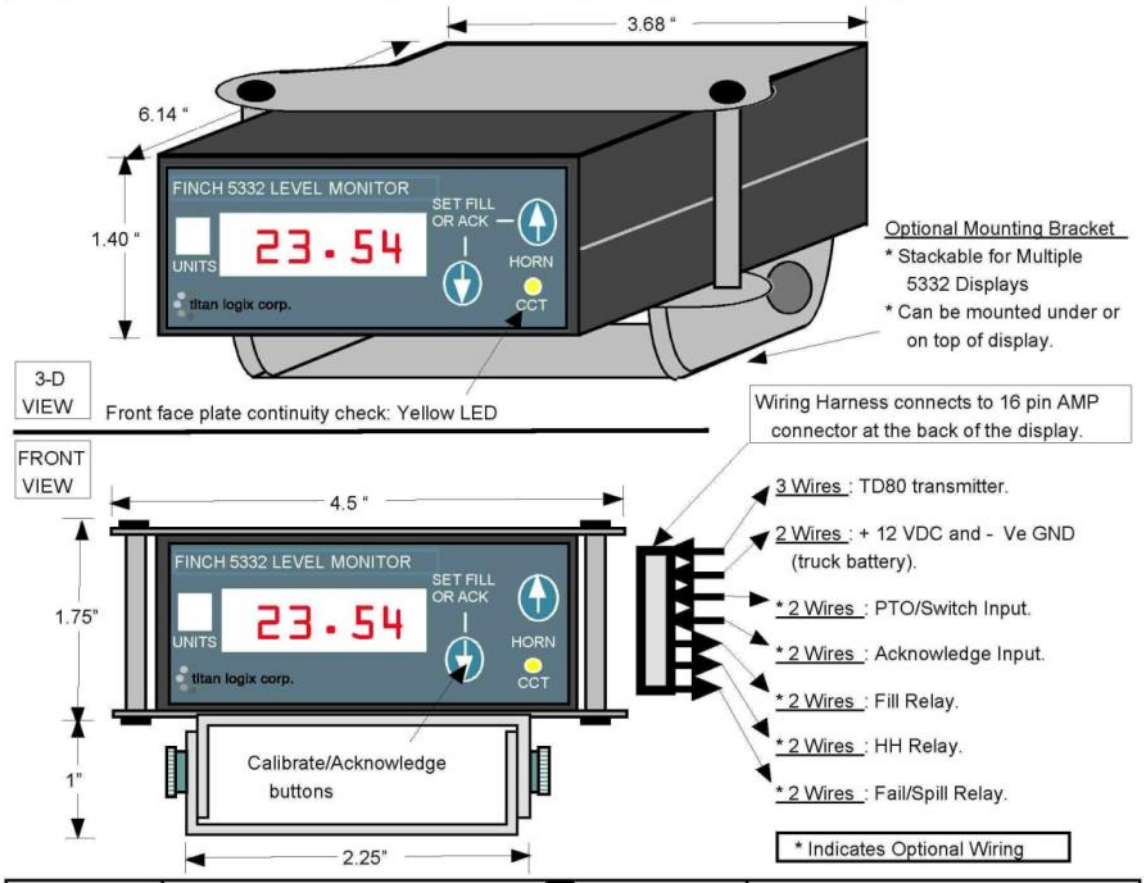
TD80: Radar Liquid Level Measurement for Transport Tankers / Vessels (Coaxial Probe)

Finch 5332 In-Cab Mount Level Monitor Display/Controller



Accuracy	1 digit, 1 / 9999 counts.	Communication	SV BUS, proprietary open drain bus, @1200 bps, 30 mA current limited, length 150 ft max.
Wire/Cable	AWG #14, SOW -40 F (-40 C) to 194 F (90 C).	Outputs	All 3 alarm relays: dry contact, rated 30 VDC, 2A continuous FILL Relay: SPDT, Jumper Selectable between Failsafe or normal operation from COM to NO and NC contacts. HIGH-HIGH Relay: SPDT, COM to NO and NC contacts. FAIL/SPILL Relay: Failsafe operation. From COM to jumper selectable NO or NC contacts.
Power	8 - 28 VDC @ 0.3 A max. current limited.		
Display	4 digit, red LED display with 4 decimal places (configurable). Digit height: 0.3 inch.		
Temperature	-40 F (-40 C) to 149 F (65 C).		
Enclosure	Flame retardant ABS.		

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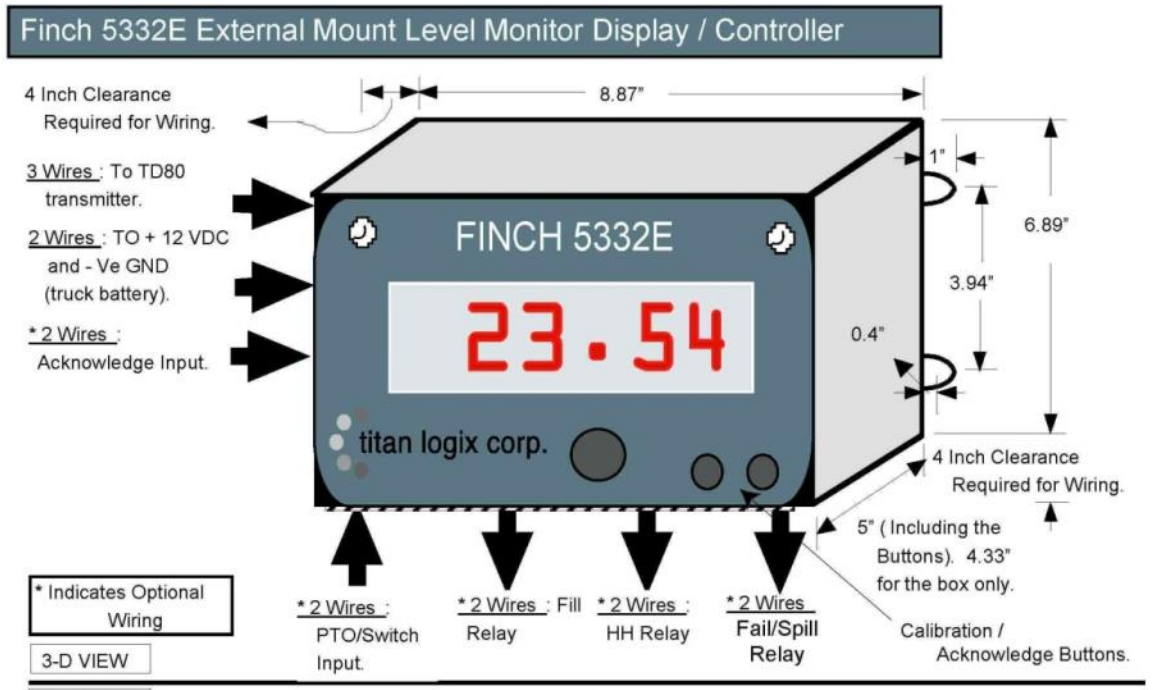
TD80: Radar Liquid Level Measurement for Transport Tankers / Vessels (Coaxial Probe)



Accuracy	1 digit, 1 / 9999 counts.
Wire/Cable	AWG #14, SOW. -40 C to +90 C.
Power	8 - 28 VDC @ 0.3 A max. current limited.
Approvals	CSA Class 1 Div 2.
Display	4 digit, red LED display with 4 decimal places (configurable). Digit height: 0.8 inch.
Temperature	-40 F (-40 C) to 149 F (65 C).
Enclosure	Flame retardant fiberglass. Type 4X rating (weatherproof).
Communication	SV BUS, proprietary open drain bus, @1200 bps, 30 mA current limited, length 150 ft max.
Outputs	All 3 alarm relays: dry contact, rated 30 VDC, 2A continuous FILL Relay: SPDT, Jumper selectable between Failsafe or normal operation from COM to NO and NC contacts. HIGH-HIGH Relay: SPDT, COM to NO and NC contacts. FAIL/SPILL Relay: Failsafe operation. From COM to jumper slectable NO or NC contacts.

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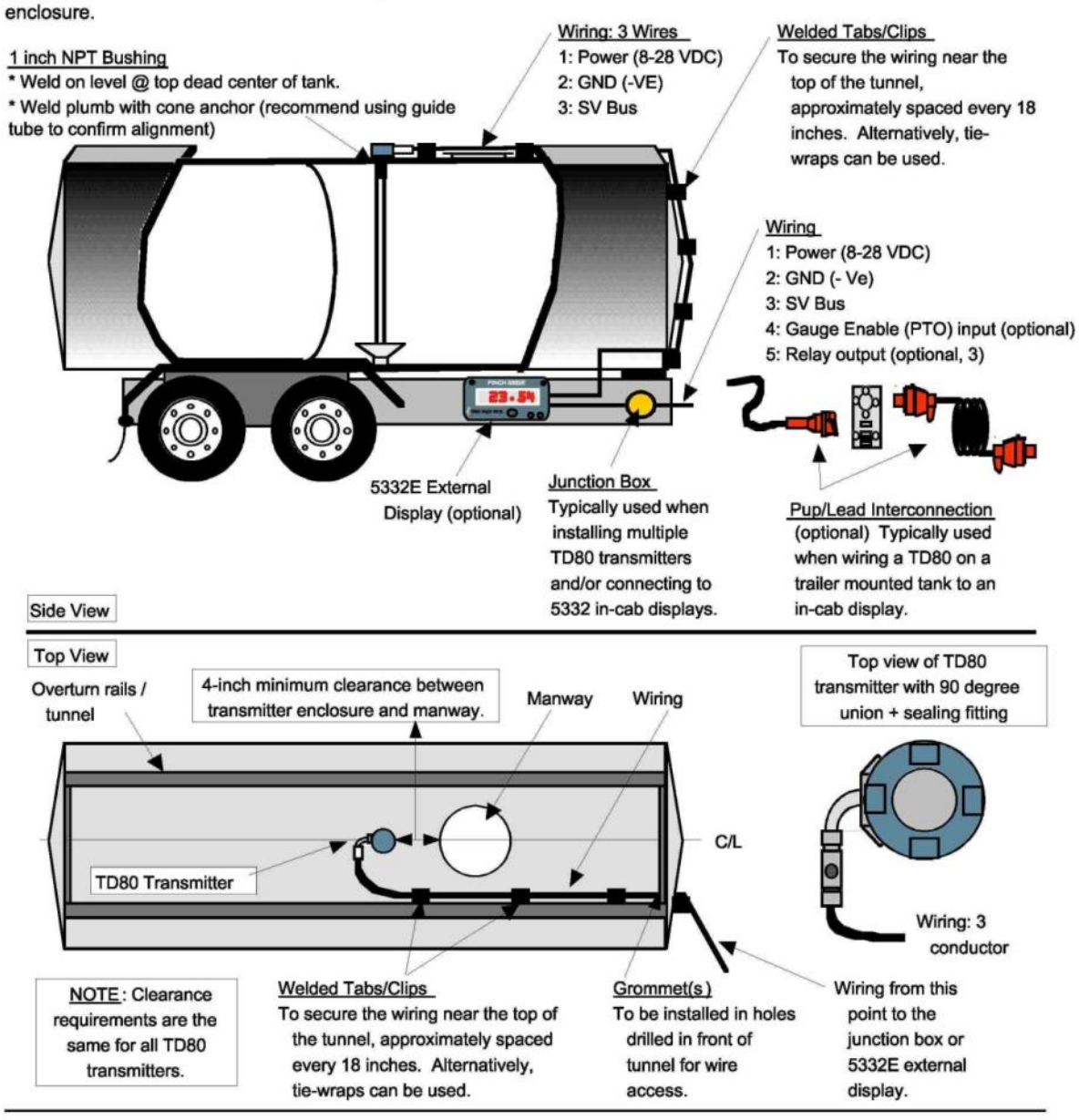
TD80: Radar Liquid Level Measurement for Transport Tankers / Vessels (Coaxial Probe)

D. Installation Overview

In most cases the TD80 is installed according to the diagrams below. Some points to note:

1. If mounting the 5332 In-Cab Display in the truck cab, it is recommended for the wires to go from the TD80 into the Junction Box and from there into the cab.
2. If mounting the 5332E External Display on the side of the tank, it may not be necessary to install the Junction Box.
3. If installing the 5332E External Display, it should be protected from road debris by installing in a protective metal enclosure.



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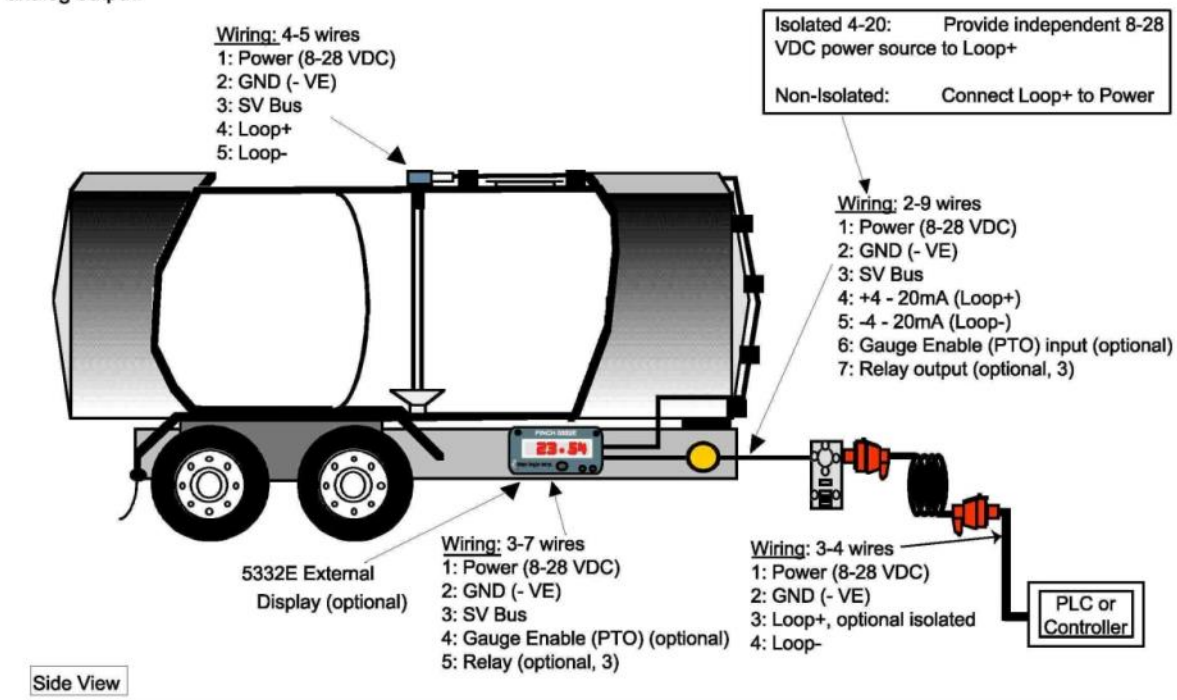
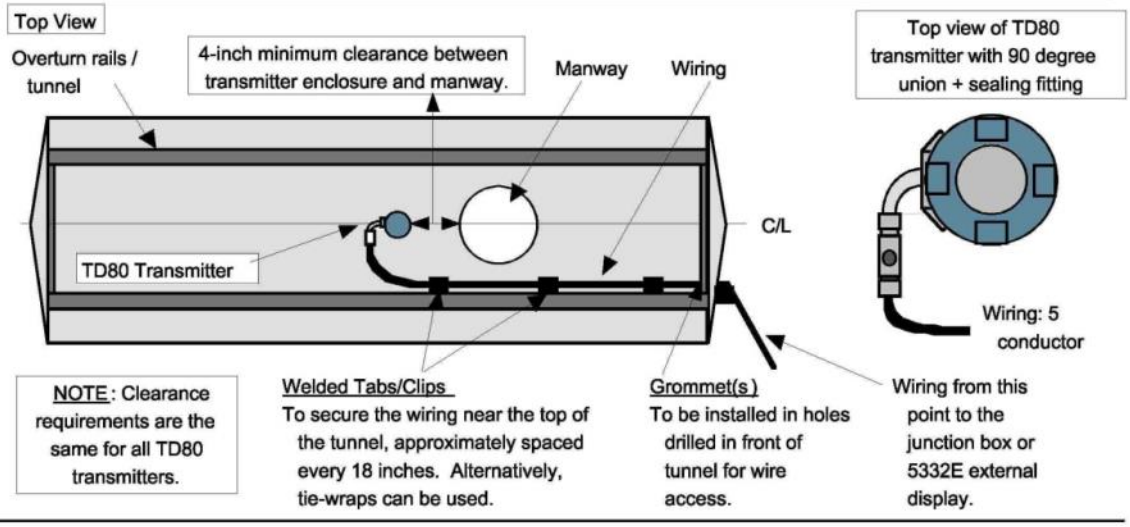
TD80: Radar Liquid Level Measurement for Transport Tankers / Vessels (Coaxial Probe)

E. 4-20 mA Output

The 4-20 mA analog output is an optional circuit board mounted in the TD80 transmitter at the time of manufacturing. The SV Bus signal is still available for connection to the 5332/E display(s) when the analog card is installed. The SV Bus is also required for programming the 4.00 and 20.00 mA levels. The card provides a linear output (ie: NOT strapped to the volume of the tank), and is optically isolated from the other circuits in the TD80 transmitter in case your application requires the use of a separate ground for the analog output. The following are some typical configurations using the analog output.





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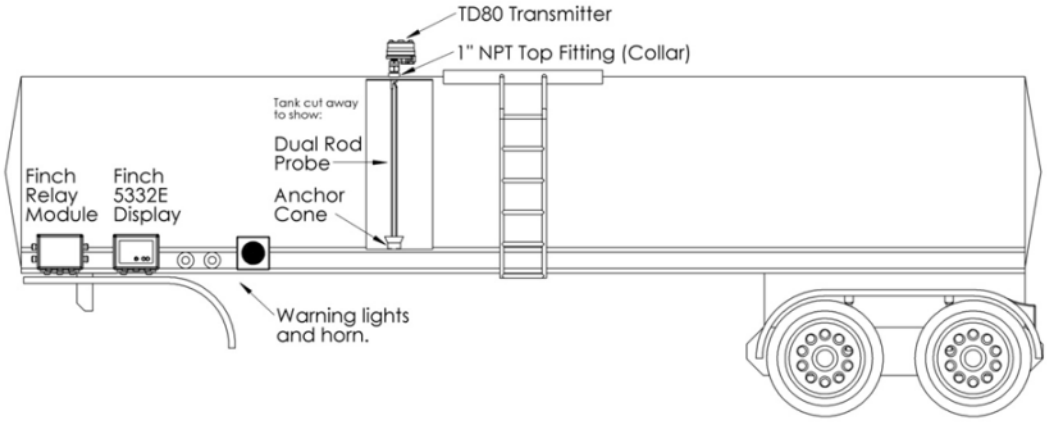
5 TD80 Operation

Graphical Glossary of Terms for Dual Rod Probe Truck and Trailer Installation



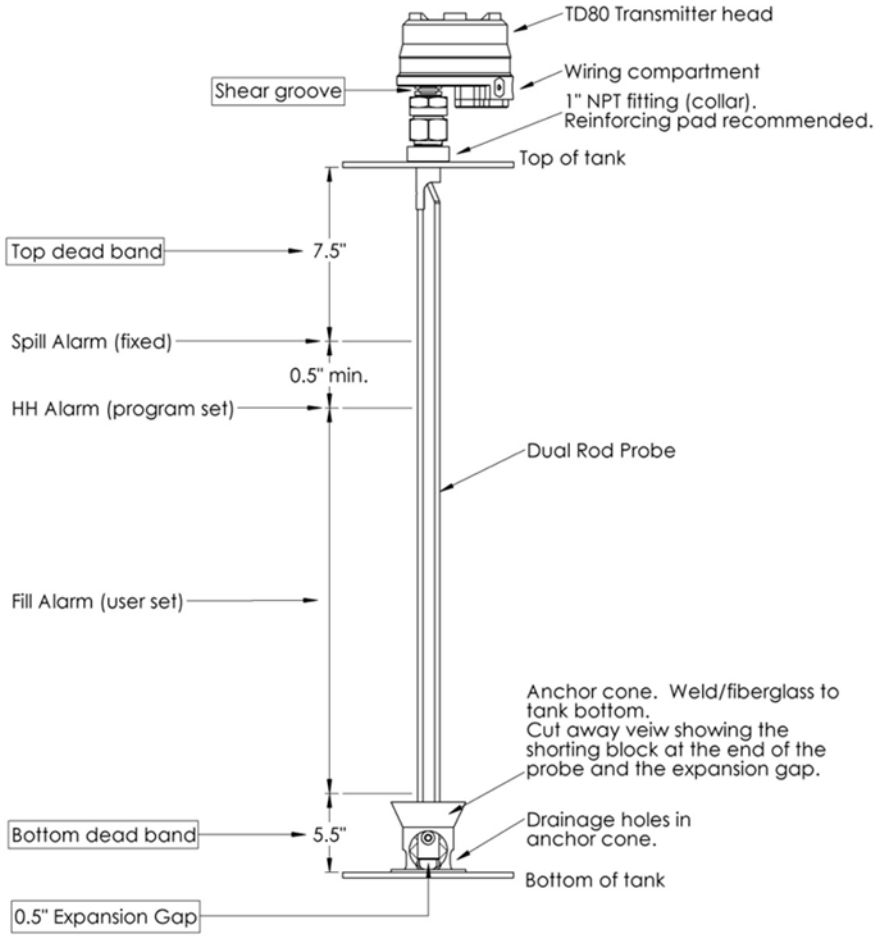


Figure 5-1: Dual Rod Probe Truck & Trailer Installation

Graphical Glossary of Terms for Coaxial Probe Truck and Trailer Installation

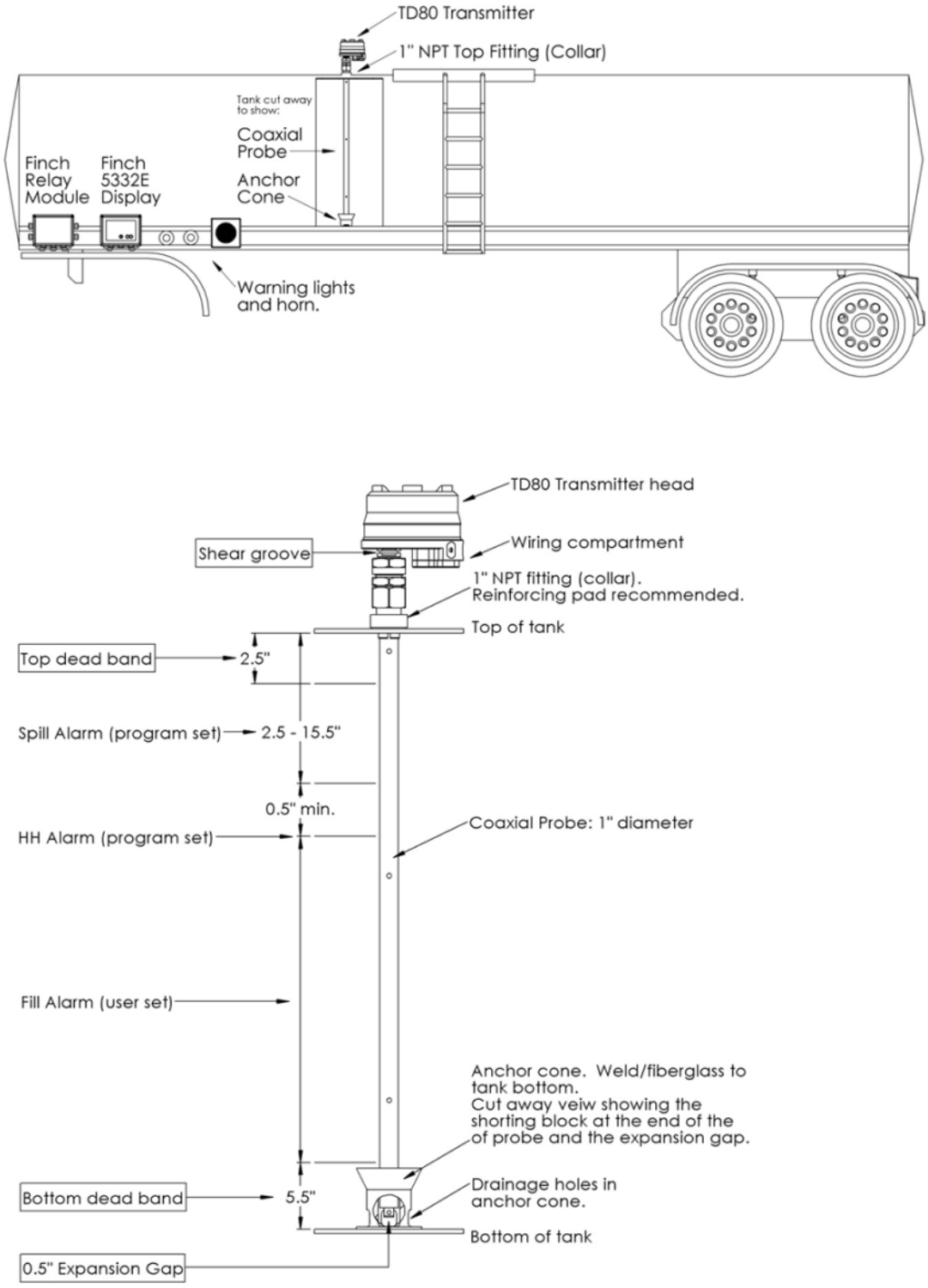


Figure 5-2: Coaxial Probe Truck & Trailer Installation

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5.1 TD80 System Components

TD80 Transmitter

The TD80 transmitter generates and processes the Guided Wave Radar signals to determine liquid level in a tank. The TD80 is mounted on the tank top and connected to the probe, is weatherproof and rated for use in hazardous locations where explosive fumes may be present. TD80s are available in two versions, dual rod or coaxial probe for compatibility with a wide range of liquids.

Probe

The probe guides the transmitted pulse and reflection from the surface of the liquid. Probes are available in dual rod or coaxial versions and require a matching transmitter type. The probe is mounted on the tank top and is connected to the bottom of the transmitter. Dual rod probes are designed for viscous liquids. Coaxial probes are used mostly for tanks containing products like aviation fuel.

Finch 5332 Display

Finch Displays are available in weather-proof external versions, the Finch 5332E and a smaller internal version, the Finch 5332. Both provide bright LED numeric display of volume information, alarms and system error codes from the TD80 transmitter. Various alarm and error conditions are detected by the transmitter and display. These alarm states control three internal relays for alarm annunciation, overfill and low level prevention.

Start Up

When power is applied to the Finch display and TD80 transmitter, the TD80 will run through a 10 second, warm-up cycle. During the TD80's warm-up cycle the Finch Display will run its own tests, during which the Finch display will show the current software revision number, followed by a display test consisting of all four digits showing the values from 0 to 9 and A to F. At the same time as the display test, the unit will test the Fill and Spill/Fail relays. The unit will wait 2 seconds, pulse the Fill relay for 1 second, wait for 2 seconds, and pulse the Spill/Fail relay for 1 second.

The operator can set the unit into calibration mode, by pressing and holding either of the front panel buttons while turning the power on. If no button is pressed the unit will enter its normal mode of operation (either Monitor Mode or Off Mode depending on the Gauge or Display Enable signal controlled by the PTO).

Note: If the display test is completed before the transmitter warm-up; the unit will display four dashes (----) for a few seconds while the transmitter warm-up completes.

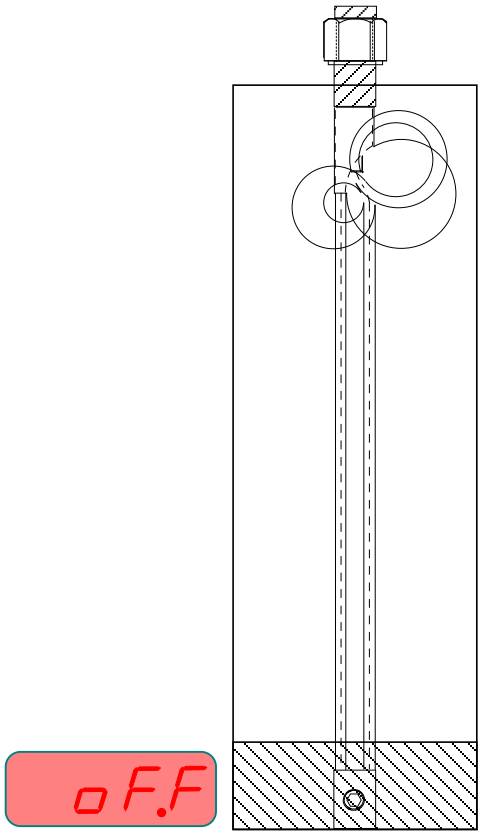
5.2 Introduction to Operation

The TD80 continuously measures liquid level in the tank and transmits volume information with alarm states to the Finch display. This information is presented on a large 4 digit display and is transmitted to alarm controlled relays. The alarms and any errors are clearly displayed for operator intervention as flashing messages on the Finch display. Alarms and errors also control three separate relays that signal or control external devices.

5.3 TD80 Operation

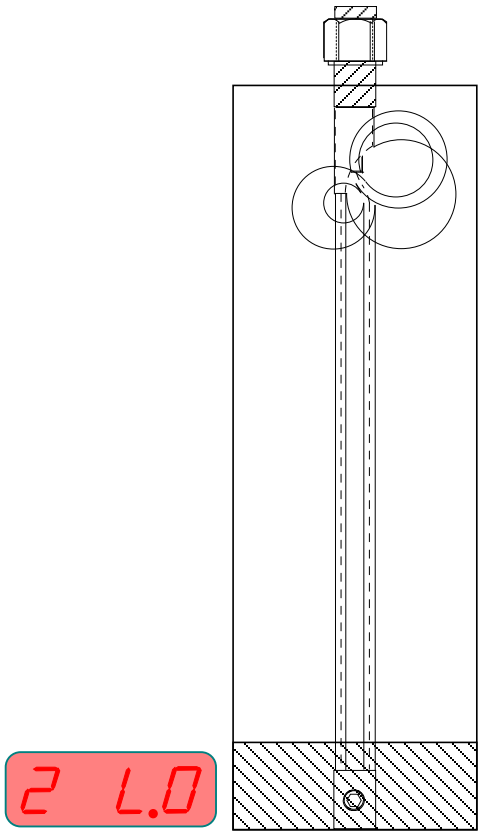
5.3.1 OFF

- When the PTO is disengaged or the Gauge Enable toggle switch is off
- All Alarms are disabled
- The Finch Display shows “OFF”
- Volume is displayed for 30 seconds by momentarily pressing the Up or Down button
-



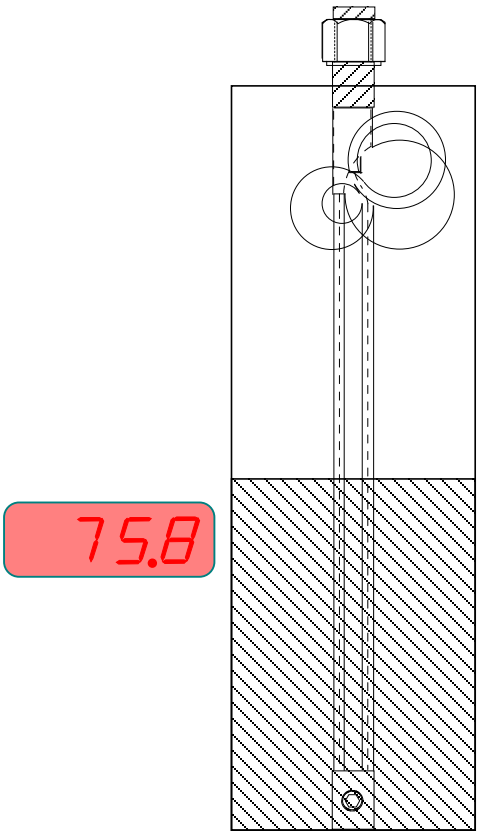
5.3.2 2 Lo

- When the tank level is below 5.5”, the Finch Display shows “2 LO”



5.3.3 Liquid Level

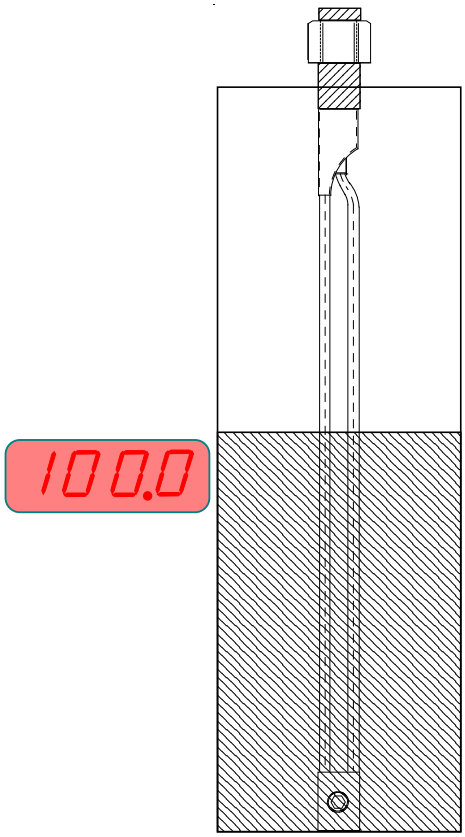
- As the tank is being filled, the Finch display indicates the liquid level



5.3.4 FILL Alarm

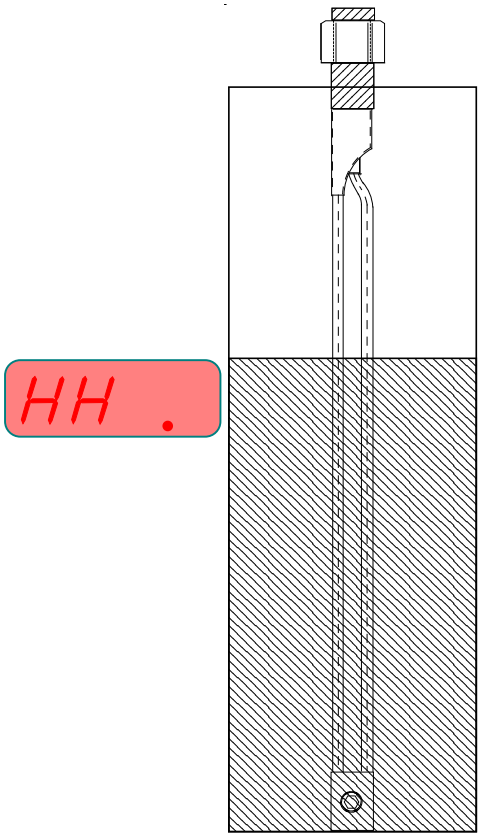
- When the liquid level rises to the user set FILL Alarm, the display flashes the current level

- To acknowledge the alarm, momentarily press the Up or Down button on the display, or an external alarm acknowledge button if it is installed



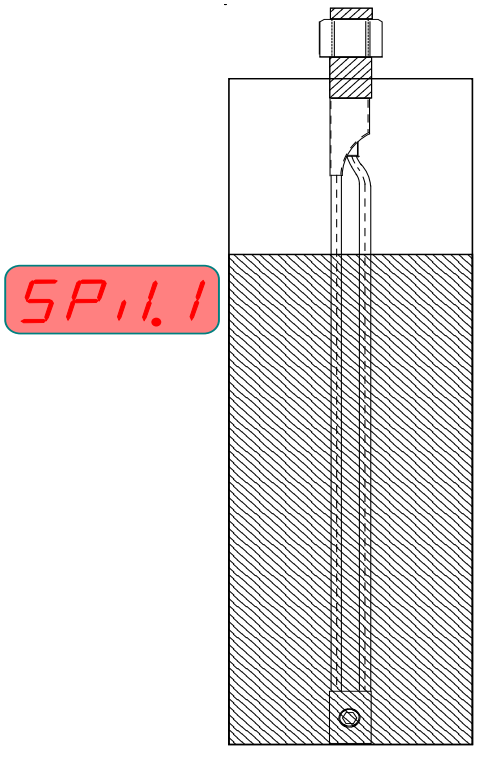
5.3.5 HH Alarm

- Once the liquid level reaches the programmed “High High” Alarm, the display alternately flashes “HH” and current level
- To acknowledge the alarm, press the sequence of buttons Up-Up-Down-Up on the display, or press an external alarm acknowledge button if it is installed



5.3.6 SPILL Alarm

- When the liquid level reaches the programmed SPILL alarm level, the display flashes “SPILL”
- To acknowledge the alarm, fluid must be removed from the tank while the TD80 and Finch Display are turned on



5.4 Modes of Operation

5.4.1 Alarm Disable Mode

The Finch display has a feature that allows the user to disable all of the alarms on the unit, while still displaying the level of liquid in the tank. While in this mode the display will show “oFF”, notifying the operator that the alarm functions are disabled. To view the current level of liquid while in this mode, the operator can press either button on the front panel to enter display mode.

5.4.2 Display Mode

In this mode the Finch display shows the current tank level, as well as any errors received from the TD80 transmitter. The unit remains in Display Mode for 30 seconds before returning to Off Mode.

If the Finch Display does not receive any information from the TD80 transmitter for 6 seconds, the unit displays four dashes (----) to indicate a communications failure.

5.4.3 Monitor Mode

In this mode the Finch Display shows the current level, error messages, and alarm information sent by the TD80 transmitter. The unit responds to all alarms and errors. To enter Monitor Mode, the PTO signal must be active or the Gauge Enable switch, if installed, is ON. From Monitor Mode the Fill/Fall Alarm is set by momentarily pressing either front panel button.

The Finch Display shows the current level and when the level is below 5 ½” the unit will display “2 LO”. (If the display does not receive any information from the TD80 transmitter for 6 seconds, the display will show four dashes (----) and triggers the Fail Alarm).

The Spill Alarm, Fill/Fall Alarm and the HH Alarm are all active in this mode and will respond if the conditions are reached. For more information on the alarms, please see the Alarms section of this manual.

5.4.4 Set Fill / Fall Mode

Fill/Fall alarm setting can be done from either Display Mode or Monitor Mode by momentarily pressing either of the buttons on the front panel. Fill or Fall alarm is determined during installation by inserting or removing the Fill/Fall jumper inside the Finch Display. If the Fill/Fall Jumper is removed, the display will blink “FILL”.

If the Fill/Fall Jumper is installed, the display will blink “FALL”. After a few seconds the display will show the current Fill or Fall setting. The current setting can then be adjusted up or down by pressing the appropriate button on the front panel. Each button press changes the level by one unit while holding the button down will change the level by tens of units. The fill level is prevented from exceeding the HH Level. After 5 seconds of inactivity the Finch Display will revert to either Display Mode or Monitor Mode depending of the state of the PTO or Gauge Enable Switch.

5.5 Alarms

When the Finch Display is in Monitor Mode, the unit responds to all alarms and errors. There are four alarm states associated with three relays. The Spill and HH Alarms are controlled by the TD80 transmitter only. The Fail alarm is controlled by the TD80 transmitter primarily; but may be set by the Finch Display if communications are lost. The Fill/Fall alarm is controlled by the Finch Display only.

5.5.1 Spill Alarm

The level for the Spill alarm is set when programming the TD80 transmitter. This level is set to 7½” from the top of the tank for the Dual Rod and 2 ½”-15 ½” for the Coaxial Probe. This alarm is reported through the Spill/Fail Relay. When the Spill Alarm level is reached, the Finch Display flashes “Spill”.

The only way to reset the Spill alarm is to either pump out liquid until the level is below the Spill alarm level, or to put the unit into calibration mode (see section **Error! Reference source not found.**, Offset Calibration), and cycle the power. The Finch Display and TD80 transmitter must remain on while the liquid is pumped out to reset the Spill alarm. The Spill alarm will be stuck if power is turned OFF while unloading from Spill alarm level. Put the unit into calibration mode and cycle the power to clear alarm.

Note: The Finch Display will not allow the user to switch operating modes until all alarms have been acknowledged.

5.5.2 Fill / Fall Alarm

The Fill/Fall alarm level is an operator set value for use in filling or draining the tank to a predetermined level. This alarm is associated with the Fill Alarm Relay. The Fill Alarm Relay is intended for use with a horn or visible indicator. When the Fill/Fall level is reached the alarm is triggered and the relay is activated. The Fill/Fall Alarm continues until it is acknowledged. To acknowledge the alarm, momentarily press one of the buttons on the front of the Finch Display or the External Alarm Acknowledge button (if installed).

5.5.3 High High Alarm

The High High alarm (HH) level is set when programming the TD80 transmitter. This level is set to a volume of a minimum ½" below the Spill Level. This alarm is associated with the HH alarm relay. When the HH alarm is triggered, the HH alarm relay is activated, the display alternately flashes the current level and "HH".

To acknowledge this alarm the operator must either press the External Alarm Acknowledge button (if installed) or press the buttons on the front panel in the following order: up - up - down - up.

If the Fill/Fall alarm and the High High alarm are triggered at the same time, they can both be acknowledged at the same time by pressing the External Alarm Acknowledge button or the front panel button sequence.

5.5.4 Fail Alarm

The Fail alarm reports when a system error has occurred. This alarm is associated with the Spill/Fail alarm relay. This alarm will activate the relay when an error message is received from the TD80 transmitter or the Finch Display does not receive any communications for over 6 seconds.

This alarm is self resetting, when the cause of the alarm is removed, the alarm resets. No acknowledgment is required for this alarm. For example if the unit does not receive any communications for 6 seconds the alarm will be set, but if communication is received 1 second later, the alarm will reset.

5.5.5 Disabling the 2 LO Message

The Finch Display can be set to show the level within the bottom dead band by inserting the 2 LO Disable jumper during installation. This will prevent the 2 LO message from appearing on the display. When installed, this jumper will enable the Finch to display the tank level all the way to the top of the shorting block (2 ½" minimum from the bottom of the tank).

Note: It is not recommended that the unit be operated in this state. The readings within the bottom dead band are inaccurate and unreliable.

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5.6 Alarms Settings

5.6.1 Fill/Fall Alarm

User Settable from Zero inches to HH Alarm

5.6.2 HH Alarm

Set by programming to a volume of 1/2” below the Spill Alarm or lower

5.6.3 Spill/Fail Alarm

Set by programming
7.5” for Dual Rod Probes from the top of the tank
2.5” to 15.5” for Coaxial Probes from the top of tank
Also connected to error codes and loss of communication

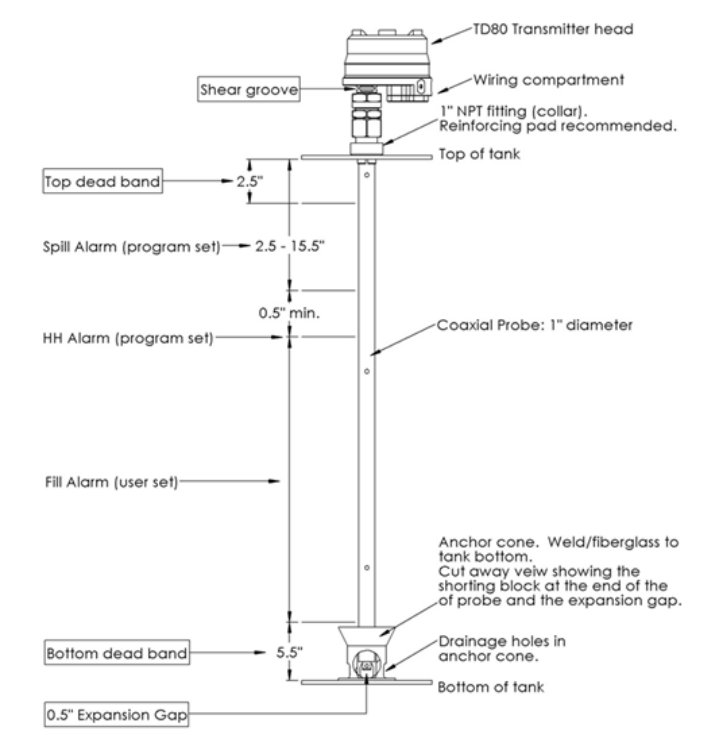

Figure 5-3: Coaxial Probe Alarm Settings

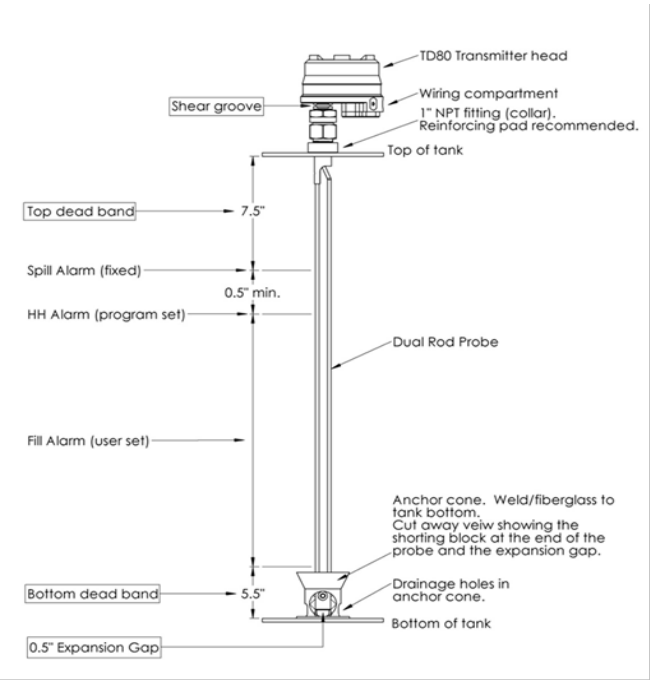

Figure 5-4: Dual Rob Probe Alarm Settings

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5.7 Offset Calibration

In order to perform an offset calibration on the system, a known amount of liquid must be in the tank. This level must be greater than 6 inches. It is recommended to calibrate the system seasonally.

To enter calibration mode; while powering up the unit, the operator must press and hold down either of the buttons on the front of the display. While continuing to hold down either of the buttons, the operator must apply power and continue to hold down the button throughout the display's test cycle. Once the cycle is complete, the display will flash "CAL". Release the button when "CAL" is displayed

The unit will flash CAL for a few seconds to indicate that it has entered calibration mode, and it will then show the current level of liquid in the tank. If the current measurement displayed is not valid for what is in the tank, the operator may change the reading at this time by pressing the up or down arrow until the displayed value is correct. All alarms in the transmitter are cleared at this time.

If there is not enough liquid in the tank, the display will flash "2 LO". More liquid will need to be added to the tank for calibration. Calibration adjusts the strapping table offset in the TD80 transmitter. The transmitter also ensures that the HH alarm volume level does not exceed the Spill alarm level. If this point is reached the unit will not allow the operator to continue adjusting in that direction; if this condition is reached, the strapping table will need to be corrected. Correcting the strapping table requires the following steps:

1. Review the tank or compartment depth chart for correct information
2. Confirm probe mounting details such as tank depth, probe mounting height, riser height, or sump depth.
3. Program the transmitter with the corrected information
4. Repeat the offset calibration

Once the display is reading accurately, the unit must be turned off and restarted for normal operation.

5.8 Normal Operation Troubleshooting

See the troubleshooting chapter for detailed instructions to resolve the problem.

The TD80 transmitter constantly performs error checking. Any detected errors are coded and sent to the display, and shown in the form of E xx (where xx is the two digit error code).

Error codes 01, 02, 04, 10, 20 and 40 can be combined if there is more than one error code at a time, for example E 26 is E 02 + E 04 + E 20. E 80 to E 84 will not be combined with any other error codes.

Problem	Possible Solution
Faint beeping coming from horn.	1. Check the horn for loose, corroded or disconnected wiring 2. Ensure that a 150ohm to 500ohm, 2W resistor is connected across the horn 3. Replace the horn with a less sensitive one
Display does not turn on.	1. Check for a blown power fuse 2. Check for loose, corroded or disconnected wires on the power or ground wiring 3. Possibly faulty display 4. Battery voltage is less than 8VDC
Only the decimal point appears on the display.	1. Possibly faulty display 2. Check for loose or corroded wires on the power and ground wiring 3. Battery voltage is less than 8VDC
Display shows only ”- - - -“	Communication between the level transmitter and the display has been interrupted. 1. Check the wiring between the display and transmitter 2. Possibly faulty level transmitter 3. Possibly faulty display
Large level offset or error.	Level transmitter may be faulty or programming is incorrect
Display shows “2 LO” during calibration	Power down the system, add more liquid to the tank and recalibrate. (see Calibration section of this manual)

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Display shows “SPill”	The tank has been over filled. Pump out excess liquid while power is applied until the Finch Display is indicating liquid.
Display shows an error code Exx, where xx is a 2 digit code	E 00 Can’t Auto range, can’t measure level E 01 Too many samples rejected, too much turbulence E 02 Internal transmitter error E 04 Internal transmitter error E 10 Internal transmitter error E 20 Level detection error E 40 Internal transmitter error E 80 Internal strapping table error E 81 Internal strapping table error E 82 Internal strapping table error E 83 Internal strapping table error E 84 Internal strapping table error

Table 5-1: Normal Operation Troubleshooting

5.9 Maintenance

WARNING
Do not remove the transmitter cover in the field. If the transmitter is damaged or is not functioning, contact Titan.

WARNING
Clean the transmitter with a damp cloth to prevent static charge.

CAUTION
Replace the transmitter if the terminal cover or terminal cover area on the transmitter base become dented or scratched, to maintain explosion-proof protection.

CAUTION
Replace the transmitter if the threads for the transmitter lid become damaged, to maintain explosion-proof protection.

The TD80 Transmitter has no serviceable parts. Return to Titan for repair if required. It is not recommended to field repair any damaged components or cabling. Temporary or emergency field repair of damaged cables or cut wiring is acceptable. Replace the cable at the earliest opportunity.

Visually inspect the TD80 system (mechanical and electrical components) periodically, ensuring that:

- mounting brackets and fittings are secure
- connecting cables to all system components are secure
- cables are not damaged or frayed
- Finch II status lights are displaying correctly
- all TD80 system components and peripheral equipment are free of any obstructions or debris

6 TD80 Programming

6.1 TD80 Transmitter and Probe Description

The TD80 transmits a continuous stream of radio frequency pulses into the probe. These pulses travel along the probe and part of the pulse energy is reflected back to the transmitter when encountering the surface of the liquid in a tank. Time delay between the transmit pulse and reflected pulse is used to calculate the distance from the tank top mounted transmitter to the liquid level.

The TD80 contains a table describing the tank depth and volumetric characteristics. This table is programmed before installation and operation on the tank. Liquid level is calculated from the table using maximum depth of the tank and distance from the top to the liquid surface. The TD80 “sees” the depth of air space in the tank and calculates the loaded volume. This table is known as a Depth Chart.

Physical limitations of Guide Wave Radar creates a dead band at the bottom of the probe where the transmitted pulse interferes with the reflected echo. This region of dead band is considered to be the bottom 5.5” of the tank. Any liquid level measured at 5.5” or less is indicated by the Finch as “2 LO”, meaning “too low”. An upper dead band exists at 7.5” from the top on the dual rod and 2.5” on the coaxial probe. Level measurements within the dead bands are inaccurate and unreliable.

Calculated volume is transmitted to a Finch display by SV Bus while a linearly scaled level is sent by the optional 4-20mA interface. The Finch is able to display up to 4 numeric digits, including a decimal point. This numeric display correctly indicates volume of loaded product in the tank. The 4-20mA output is scaled linearly for a volume of 0% at an output of 4mA and 100% volume at 20mA.

6.2 Programming the TD80

The TD80 must be programmed before use.

Programming may be done at the factory when purchased, by the customer prior to installation or after installation on the vehicle when necessary. If the TD80 is not programmed to the specific parameters of the tank it is measuring; it will not provide useable and accurate readings.

The TD80 transmitter is most conveniently programmed on a workbench close to a computer, AC power and a setup to test the transmitter for correct operation.

The TD80 can also be programmed in place on the vehicle. Battery power from the truck or the AC power adapter supplied with the programming adapter may be used. The AC adapter easily powers the TD80 transmitter and Finch display.

Programming through the Finch 5332E (green terminal board) requires vehicle battery power to be disconnected at the display terminal board when using the AC adapter. Vehicle power and accessories are disconnected by removing the wired plugs from the terminal board mounted sockets. The Finch 5332E/PS (red terminal board) has a dedicated programming connector that isolates AC adapter power from the rest of the vehicle and accessories such as horns and lights.

Do not use a battery charger for programming or test power. Though it is acceptable for testing trailer lights, the charger produces pulsed voltage that prevents TD80 and Finch operation.

Ensure that the truck battery is sufficiently charged to power the programming adapter, TD80, Finch display and accessories. A dead battery will still produce 12VDC until it is loaded, then the voltage drops below the 8VDC minimum required for the TD80 and Finch.

To program the TD80 in the shop on a table or workbench, use the attached cable kit wiring, or by connecting directly to the TD80 terminals using alligator clips. See Section 6.3.5.1 for connection details.

To program the TD80 on the vehicle after installation or repair, use the truck battery power or an AC adapter. Connect to the external Finch Display for programming. See sections 6.3.5.2 and 6.5.3.3 for connection details.

6.3 Birdfeeder 2 Programming Steps

6.3.1 Introduction

Programming the TD80 transmitter for correct operation in the intended tank or compartment consists of a several steps that must be done in the correct order. Testing the programming result is recommended as a final step.

TD80 transmitters may be programmed in a shop, on a workbench top and when necessary; after installation or repair connected to a vehicle. The order of the steps remains the same.

6.3.2 Programming Procedure

Description

There are four basic steps to programming. The first is to gather all information regarding the installation. The second step is to enter the information and create a programming file using Birdfeeder 2. The third step is to program the transmitter followed by testing the programming before installation for correct operation and alarm response.

Programming Procedure Summary

Step 1, Gather all the programming information
Step 2, Create the programming file for Birdfeeder if needed
Step 3, Program the TD80
- a. Connect the programming adapter to the TD80
- b. Run Birdfeeder
- c. Open the programming file
- d. Program the TD80

Step 4, Test the programming result

Step 1, Gather all the programming information

The following information is required.

1. Type of transmitter and probe
   i. Dual rod
   ii. Coaxial
2. Calibration or depth chart for the tank or compartment.
   i. Tank or compartment depth units
   ii. Tank or compartment volume units
   iii. Chart of inches or centimeters of liquid depth and corresponding volume.
3. Display precision required of whole or fractional volume units.
4. Transmitter mounting options such as riser or sump modifications to compensate for dead band areas of the probe.
   i. Riser height above tank top
   ii. Sump depth below tank bottom
5. Spill alarm distance from the tank top
6. Spill alarm reset option
7. High-High alarm volume
8. Optional 4-20mA offset adjustments

Step 2, Create a programming file with Birdfeeder 2

Run the Birdfeeder program by double-clicking the desktop icon or selecting from the list of programs. Normal programming steps are shown in order on the left side of the window, Steps 1 through 5.

Birdfeeder Step 1

1. Open a Birdfeeder 2 file (ending with .stb) or manually enter the programming information as follows:
   a. Select the probe or transmitter type.
   b. Select the depth and volume units.
   c. Enter the depth and volume information directly into the table from a tank calibration chart.

Birdfeeder Step 2

1. Click the Done button.
2. Convert or confirm the depth and volume units for the table.

Information entered in steps 1 and 2 above may be changed at any time by clicking on the Edit button, changing the table or settings and clicking on Done to continue. Changes to the following steps 3, 4 and 5 may be completed up to the time that the Program button is clicked. Programming can be cancelled at any time.

Birdfeeder Step 3

1. Select or confirm the correct Spill alarm level if available.
2. Select or confirm the correct Spill alarm reset option if available.
3. Enter or confirm the correct HH alarm level.
4. Select or confirm the number of decimal places to display.

Birdfeeder Step 4

1. Set or confirm the optional sump and riser distances.
2. Set or confirm the optional 4mA and 20mA offset points.

Birdfeeder Step 5

1. Confirm all values and settings by viewing the information presented on the screen.
2. Save the file before programming if it was entered manually or any changes made to the .stb file.

Step 3, Program the TD80 transmitter

Run Birdfeeder and select the correct programming file if not continuing from Step 2 above.

1. Select the appropriate connection instructions in section 6.3.5 for shop or onboard programming. The TD80 transmitter, Finch display and programming adapter may be powered by the vehicle battery or the supplied AC power adapter for convenience.
2. See the programming instructions in section 6.3.3 and 6.3.4 for step-by-step details.

Step 4, **Test the programming for correct operation and alarm response**

The following steps describe tests to be completed after programming the TD80 transmitter. Normal responses are indicated for each test. Review the programming information, electrical connections and correct as required if the test results differ from the ones shown.

1. Verify that the vehicle mounted TD80 transmitter and Finch display are installed correctly and working normally. Birdfeeder 2 Live Connection or a Finch display may be used to monitor the TD80 after programming on the workbench. A short dual rod or coaxial probe may be used for convenience. 2 LO response can't be verified if the probe length is shorter than the programmed compartment depth.
2. Turn power on to the TD80 system. The display should turn on and go through its start-up sequence (approximately 10 seconds long).
3. Display is tested, showing numbers 0 thru 9 and then letters A thru F
4. Display will show "----" for up to several seconds, then one of the following:
    a. 2 LO
    b. Level
    c. Error message E xx, where xx is a number
    d. Spill
5. Test the volume display by doing the following:
    a. For dual rod probes, run your hand along the probe to check the volume display and alarm settings. If the probe is not within reach, use foil or a metal rod to short the two probe rods together.
        i. Volume displayed will increase as the hand or shorting rod moves toward the top of the compartment
        ii. Volume displayed will decrease as the hand or shorting rod moves toward the bottom of the compartment
    b. For coaxial probes, insert a small metal rod into the holes along the probe. Short the center rod to the outer tube to check the volume and alarm settings.
        i. Volume displayed will increase as the shorting rod moves toward the top of the compartment
        ii. Volume displayed will decrease as the shorting rod moves toward the bottom of the compartment
6. Clear all active alarms.
7. Confirm that the following occurs when the probe is shorted at selected points:
    a. "2 LO" is displayed when the level is less than 5.5". Volume is displayed when the level is above 5.5".
    b. Run your hand along the dual rod probe toward the transmitter or place a small metal rod in the coaxial probe drain holes.

i. Select several positions along the probe to confirm volume programming. The finch display shows correct volume and units for positions such as ¼, ½ and ¾ full compartment levels on the probe.

c. HH alarm activates when the level reaches the HH alarm setting.
   i. Display shows blinking “HH” and volume
d. HH alarm deactivates when Up-Up-Down-Up button combination is pressed.
   i. Display returns to normal, not blinking
e. Spill alarm activates when the level reaches the Spill alarm setting.
   i. Display shows flashing “SPill”
f. Spill alarm deactivates when the level decreases more than 2” below the Spill alarm setting.
   i. Display returns to normal, not flashing “SPill”

8. Test the 4-20mA output (if installed) by doing the following:
   a. Monitor the 4-20mA signal with a digital Multimeter (DMM).
   b. Short the probe with a finger or small metal rod at several points along the length of the probe.
   c. No short across the probe produces a signal of 4mA or slightly greater. Increasing level of the short produces an increasing current toward 20mA.

6.3.3 TD80 Birdfeeder 2 Detailed Programming Instructions

Requirements

1. TD80 transmitter
2. 12-24VDC power supply, battery or AC adapter
3. SV Bus to RS232 Converter (SV converter)
4. Birdfeeder 2 software
5. PC with Windows XP or above with a serial port or USB to serial adapter
6. Strapping table (calibration chart) for the compartment including required and optional settings such as:
   a. Probe type
   b. Spill and HH levels
   c. Volume units and number of decimal places to display
   d. Spill alarm clearing option
   e. Riser height
   f. Sump depth
   g. 4mA and 20mA output offsets

Wiring Connections

Using the original SV-RS232 Converter

1. Ensure that the power supply or battery voltage is turned off. Unplug the AC power adapter from the outlet if it is being used for programming.
2. Verify that the area is free of explosive fumes
3. Plug the AC power adapter into the SV converter **OR**
   Ensure that the battery is well charged, measures at least 8VDC and attach the following wires:
   a. Power supply or battery positive to SV converter White wire
   b. Power supply or battery negative to SV converter bare Shield wire
4. Connect the TD80 as follows:
   a. SV converter White wire to TD80 Gauge Power
   b. SV converter bare Shield wire to TD80 Gauge Ground
   c. SV converter Black wire to TD80 SV Bus

Using the new programming cable SVRS232 to USB Converter

1. Ensure that the power supply or battery voltage is turned off. Unplug the AC power adapter from the outlet if it is being used for programming.
2. Verify that the area is free of explosive fumes
3. Plug the AC power adapter into the SV converter **OR**
   Ensure that the truck battery is well charged and measures at least 8VDC.
4. Connect the programming adapter according to the instructions in section 6.3.5.

Programming Steps

Run the Birdfeeder 2 software. The birdfeeder programming steps are listed below and on the left hand side of the window as a guide.

Step 1:

Open a file for programming or the following:

1. Select the probe or transmitter type for programming
2. Select the depth and volume units
3. Enter the depth and volume information directly into the table

Step 2:

1. Click the Done button if the table in Step 1 was entered manually.
2. Convert or confirm the depth and volume units for the table

Step 3:

1. Select or confirm the correct Spill alarm level
2. Select or confirm the correct Spill alarm reset option
3. Enter or confirm the correct HH alarm level
4. Select or confirm the number of decimal places to display

Step 4:

1. Set or confirm the optional Sump and Riser distances
2. Set or confirm the optional 4-20mA offset points

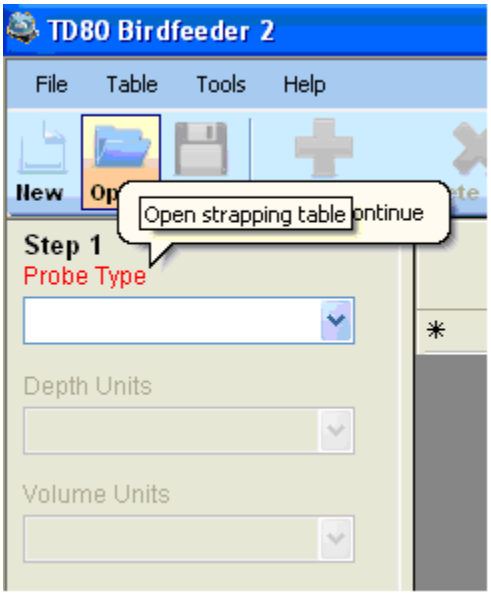
Step 5:

1. Confirm all values and settings by viewing the data presented on the screen
2. Click on the Program button
3. Save the file if necessary
4. Apply power to the TD80 transmitter when prompted
5. Click on the Continue button
6. A window will appear indicating success or failure of the programming operation

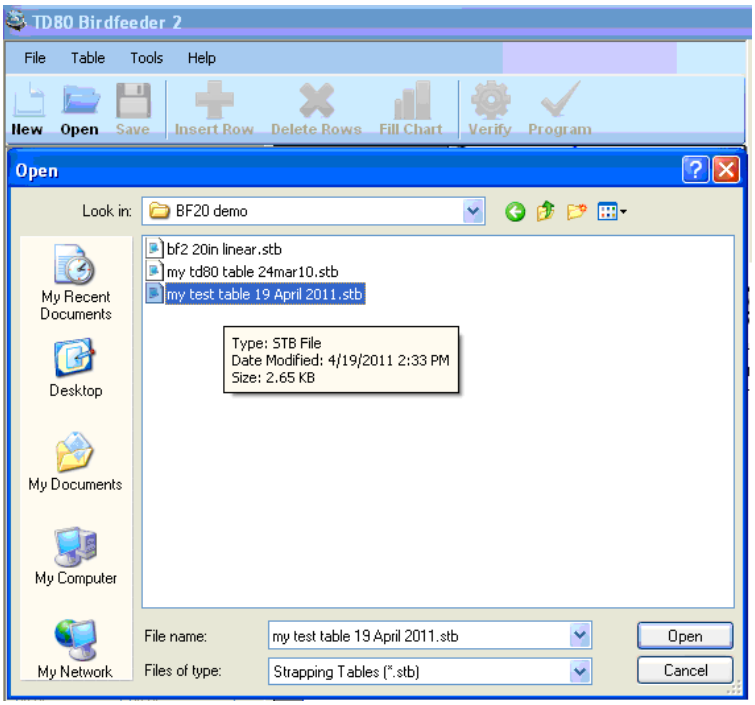
6.3.4 Graphical TD80 Programming Instructions using Birdfeeder 2

Step 1, open a Birdfeeder 2 file OR enter the information manually.

Click on the Open icon.

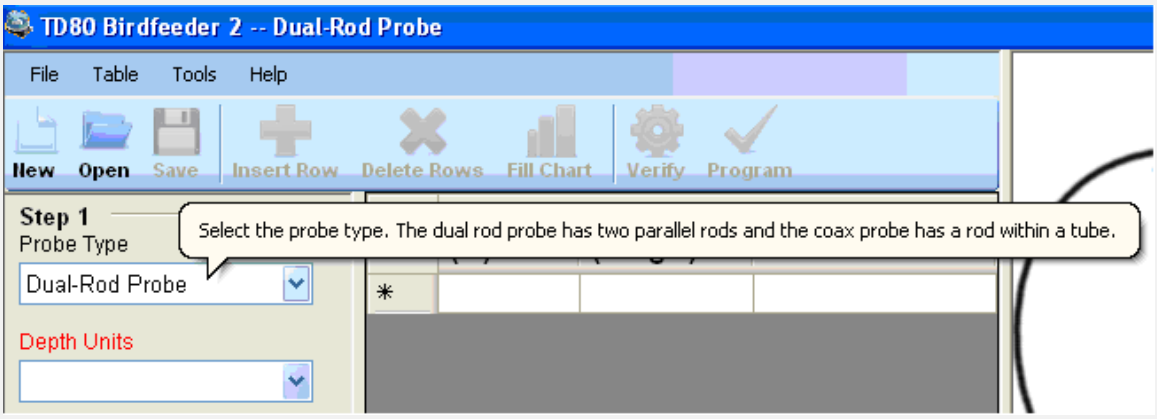


Select the file to open and double-click or click Open

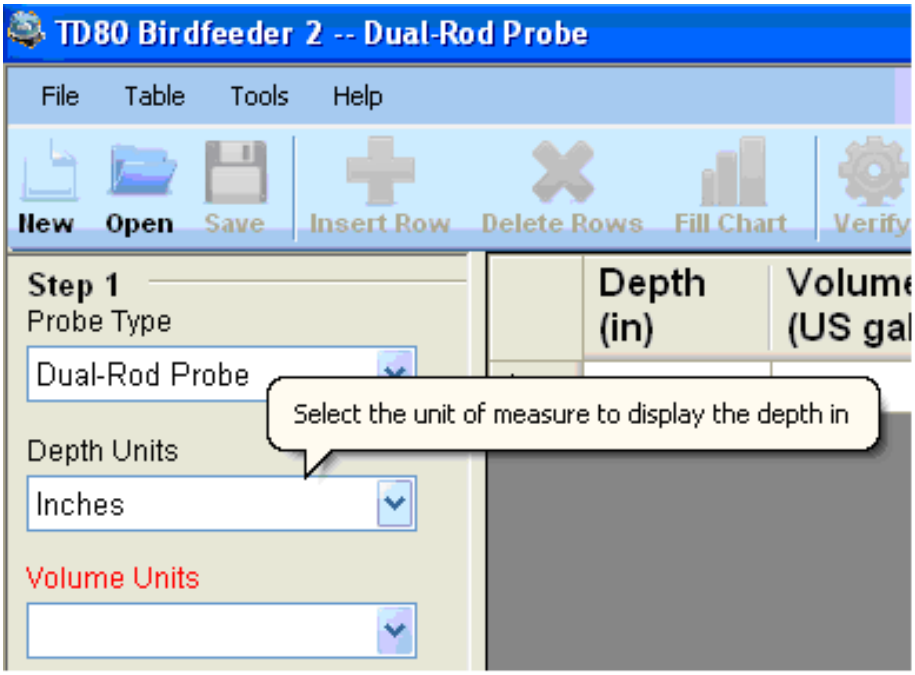


Or, enter the information manually.

Select probe type.



Select depth units.



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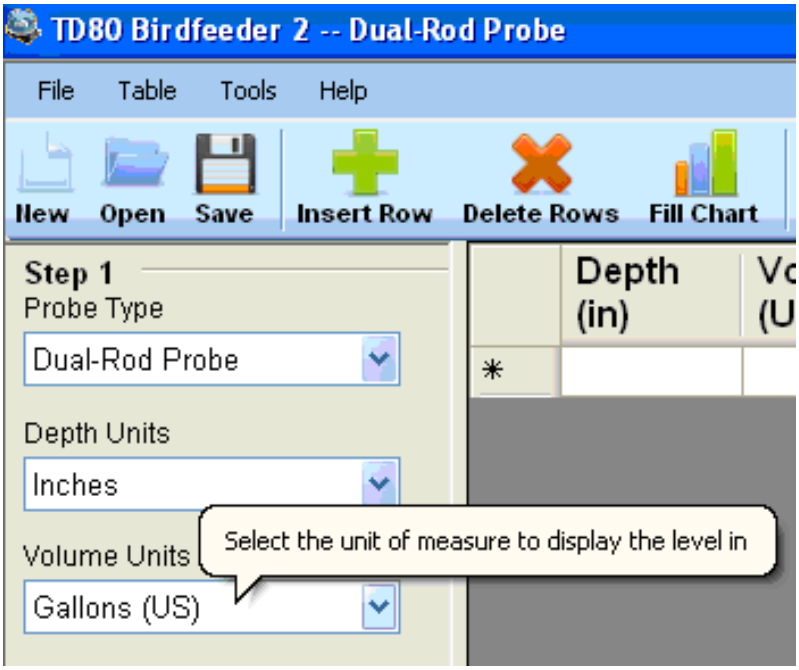
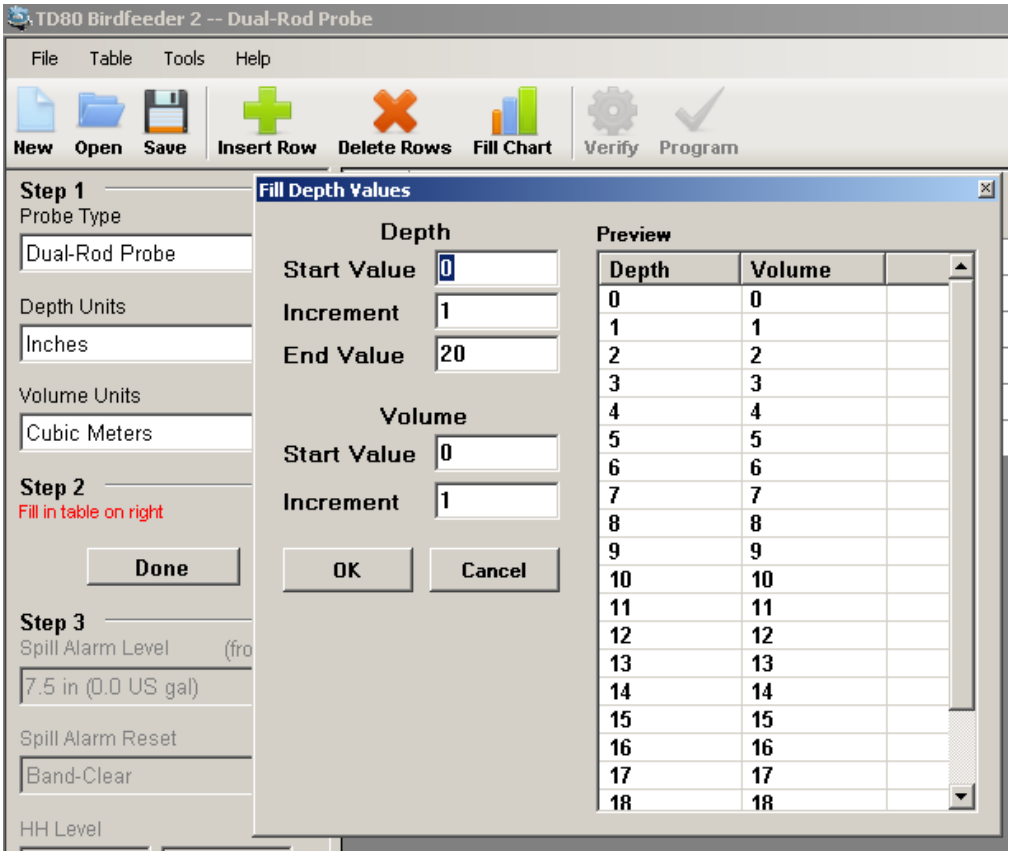
Select volume units.



Enter the depth and volume information from the customer supplied depth chart into the table. Go to Step 2.



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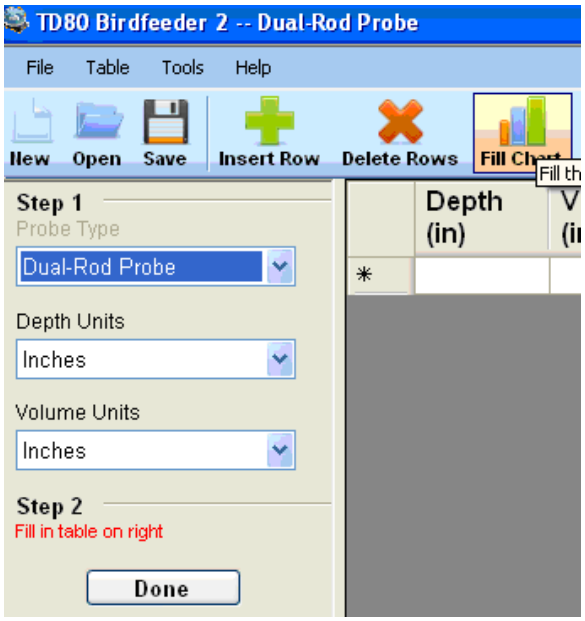
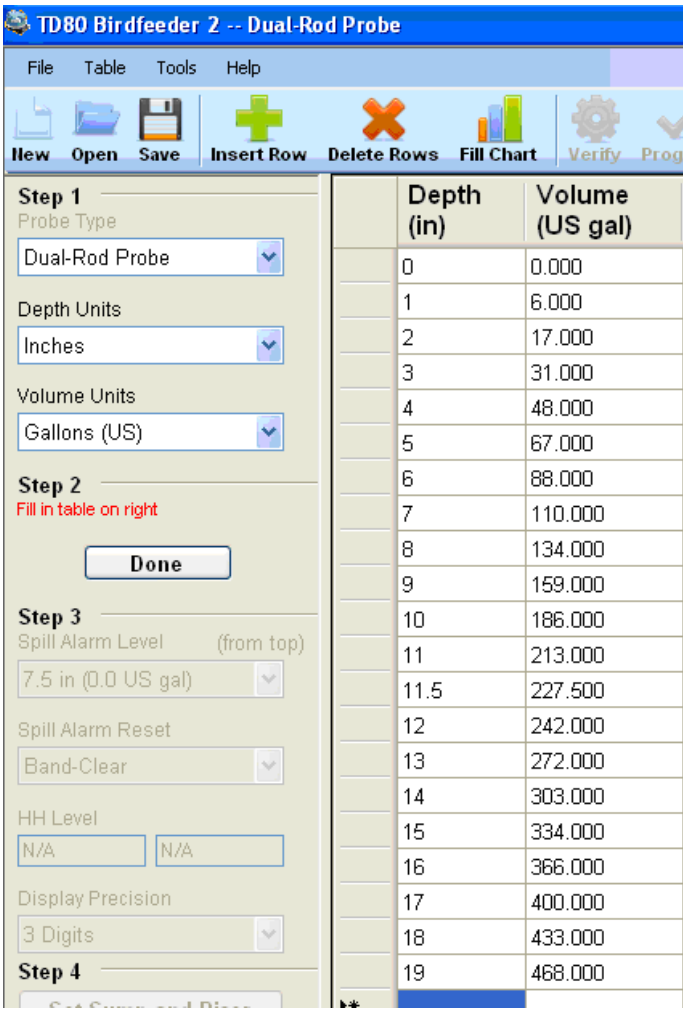
A table may automatically be filled with linear values by clicking the Fill Chart icon.

See the ***examples below***. A table with depth of 0 to 20 inches and a volume display corresponding to the depth is automatically generated. This is useful for testing a TD80 and display or for applications where depth output is required.

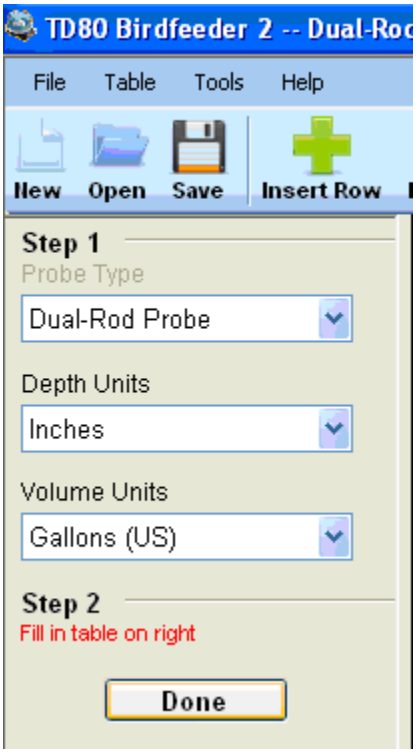


Select probe type, depth and volume units, and then click on the Fill Chart icon.

Start value, increment and end values are entered for depth. Volume is entered by starting value and increment for each depth entry.



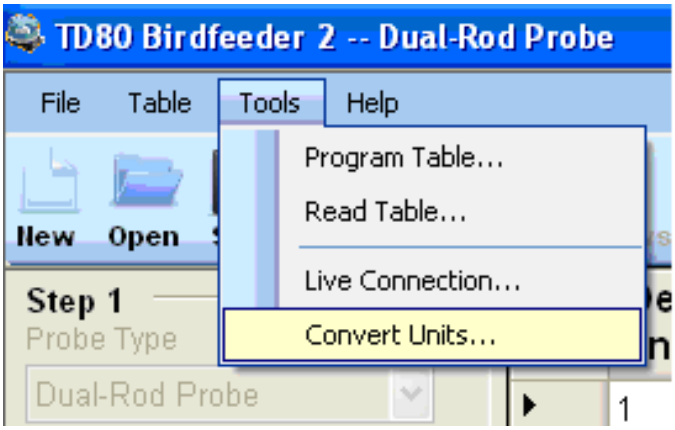
Click the Done button when the table is complete. This newly created table may be saved and the used to program a TD80 immediately or at a later time.



Step 2, click the Done button if the table was entered manually in Step 1.

Convert or confirm the depth and volume units for the table. See the examples below for volume conversion.

Click on the menu bar Tools >Convert Units…



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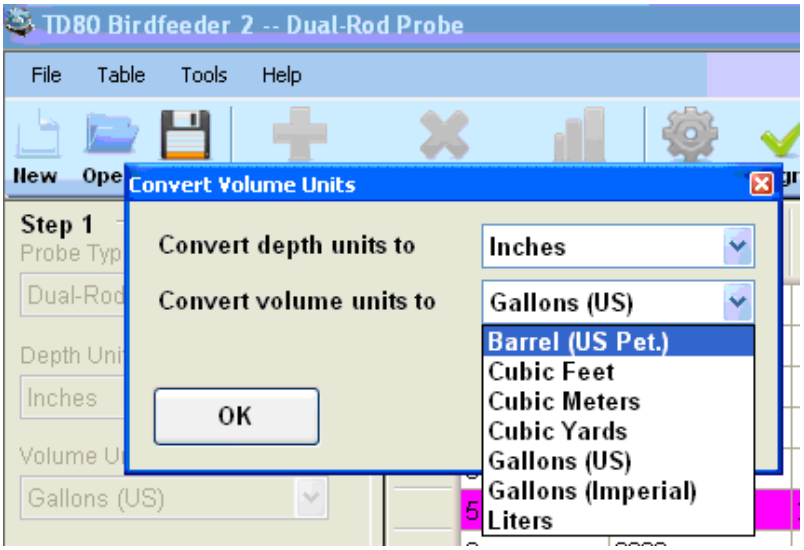
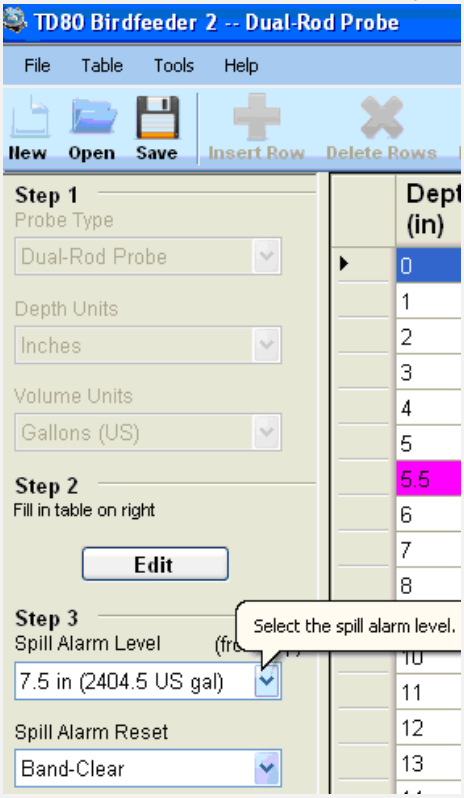
Select the unit to convert and click OK.

Verify that the unit was converted correctly.



Step 3, select Spill level and reset option, HH alarm level and display decimal places.

Select the Spill alarm level, specified by the customer in distance from the tank top.



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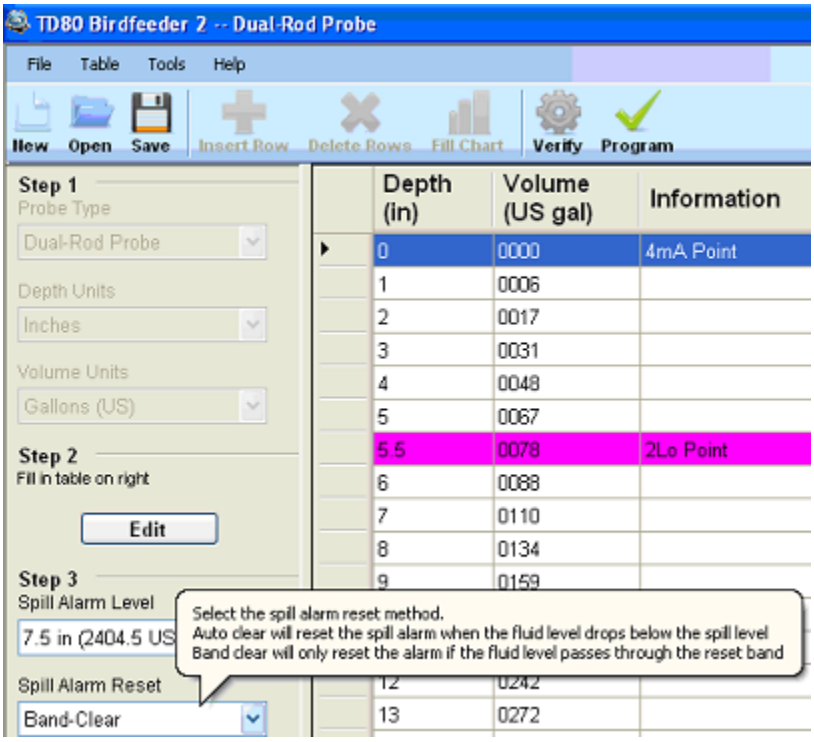
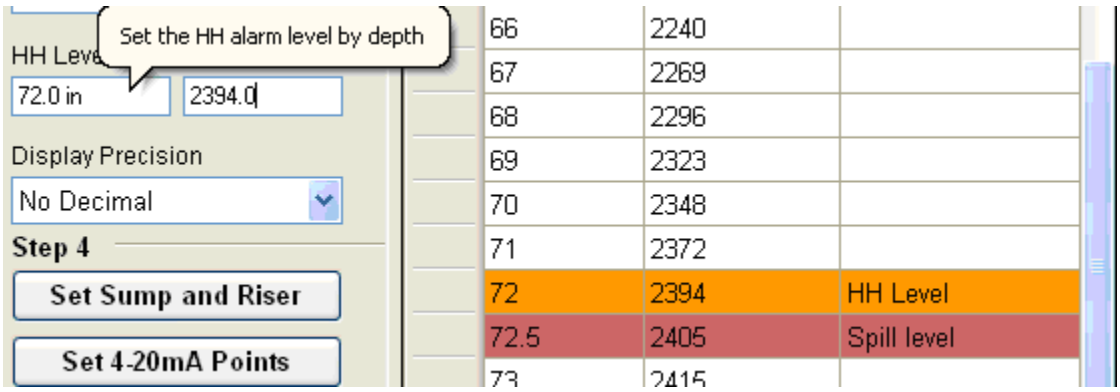
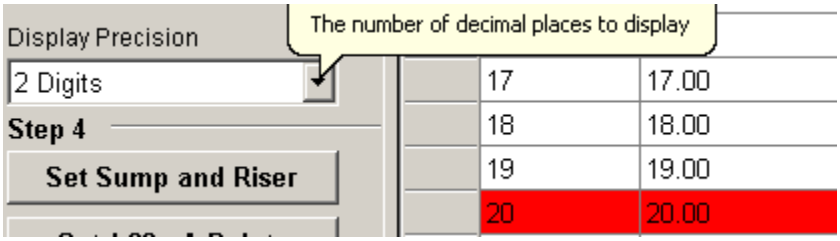
Select the optional Spill alarm reset setting.



Enter the HH alarm level, specified by the customer in either distance from the tank bottom or volume. Volume is the actual HH alarm level, while distance is provided as a convenient measure.

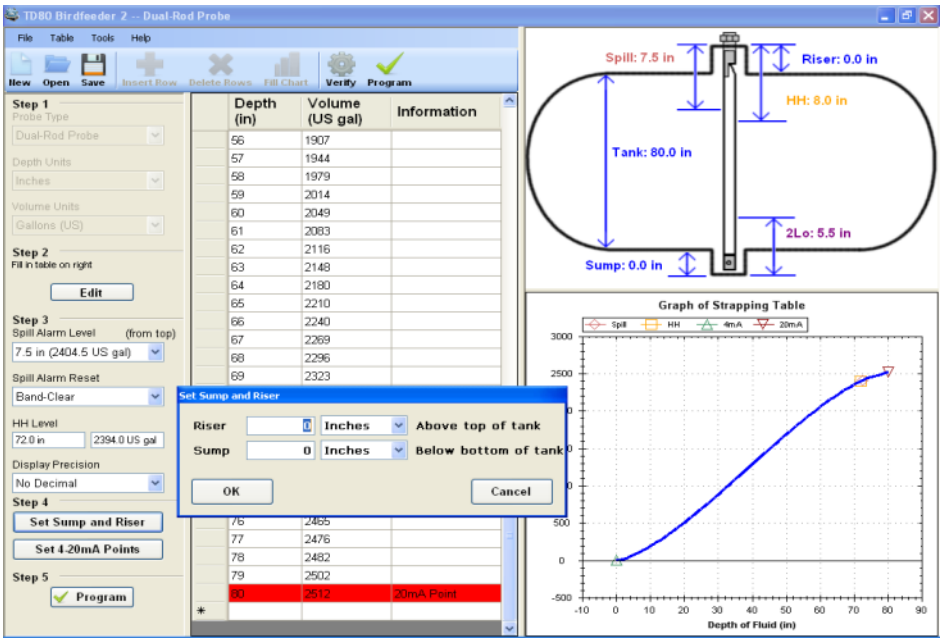


Select the number of decimal places to display. The Finch display shows a maximum of four digits. The greatest number of decimal places is usually selected for the best resolution.

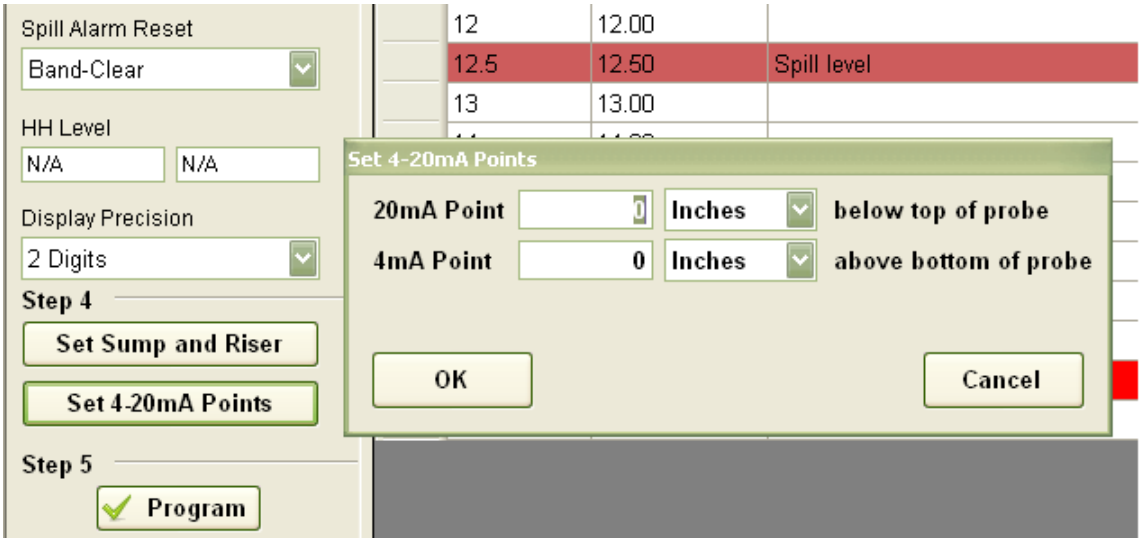


Step 4, enter the optional sump and riser distance and 4-20mA settings.

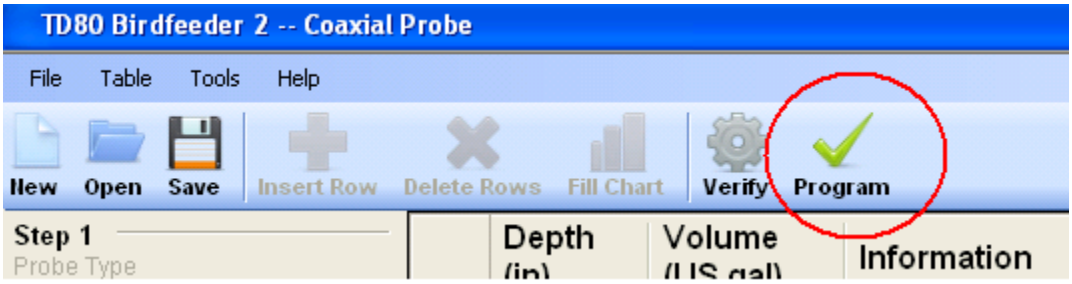
Enter the sump and riser distance. These measurements are provided by the customer or installer.



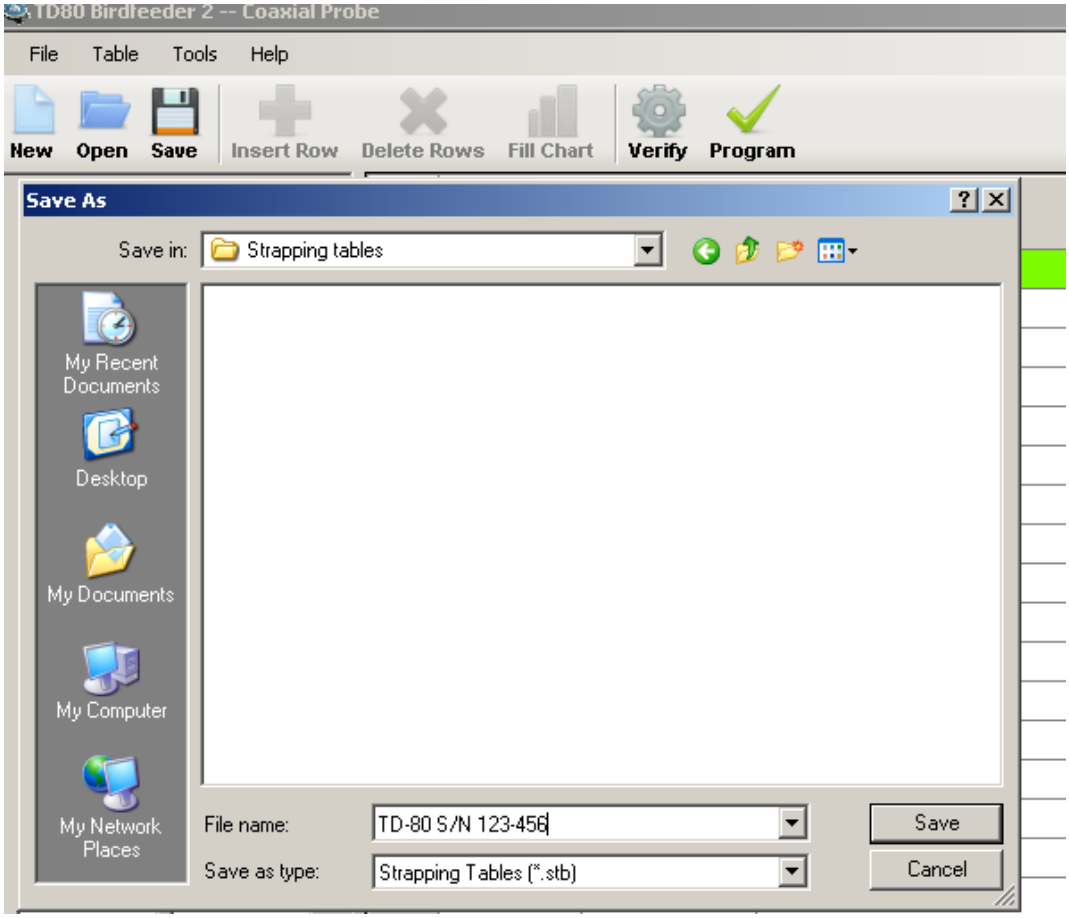
Enter the optional 4mA and 20mA settings for the 4-20mA current loop output. The usual settings are 0" from the top and bottom.



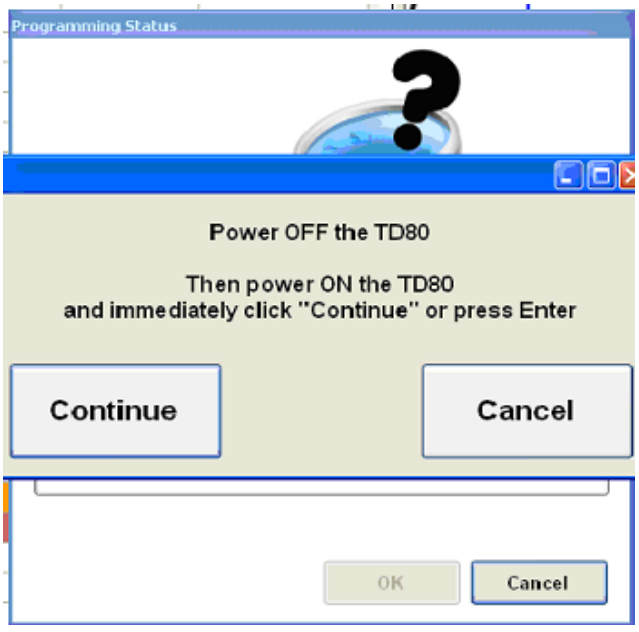
Step 5, verify that all information is correct and click the Program button.



Save the information in a file for later use if required.



Cycle the TD80 power off and then back on. Click the Continue button or press Enter.



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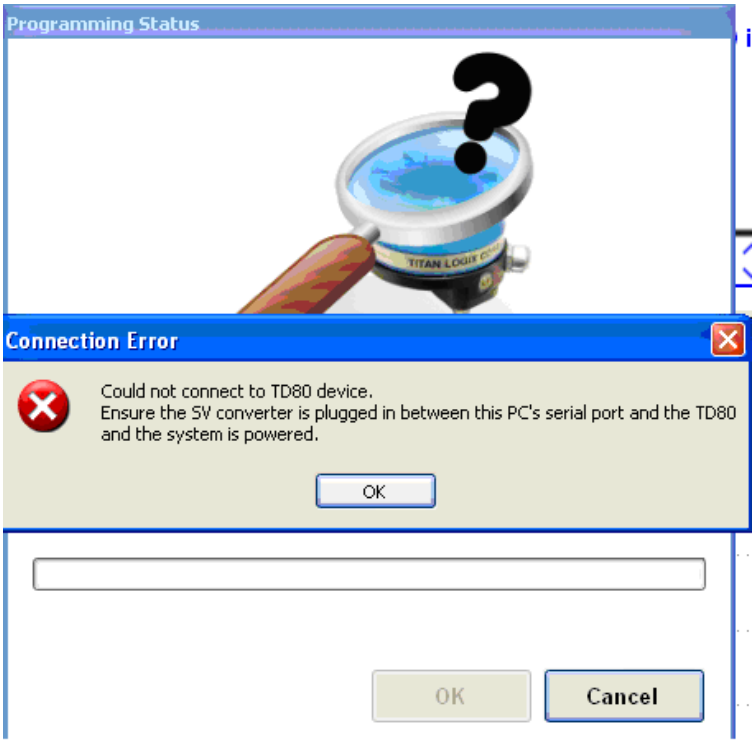
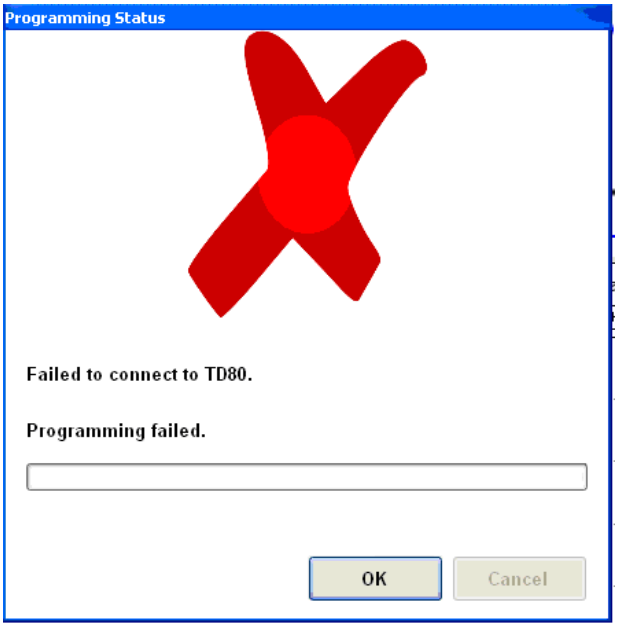
Birdfeeder 2 will search for the serial port connected to the TD80 for programming.

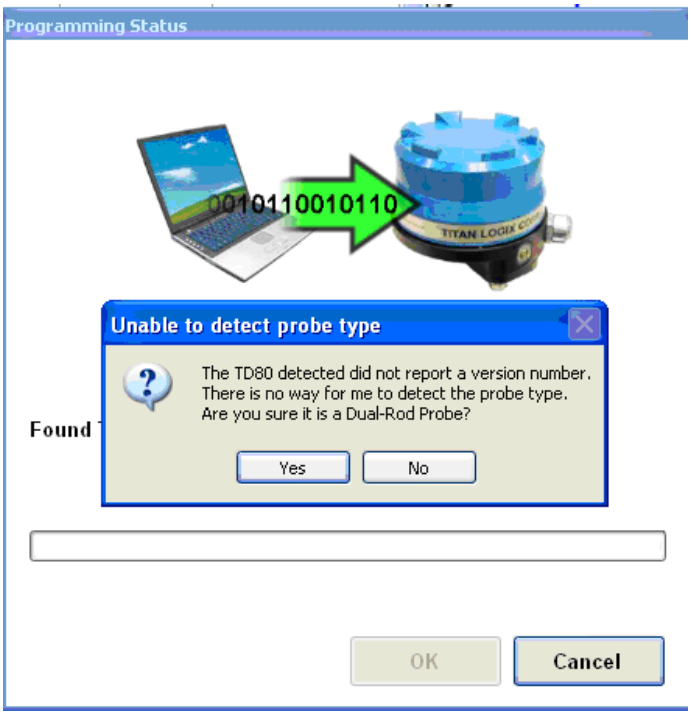
Birdfeeder 2 will report an error if the TD80 is not connected properly for programming or the power was not cycled.



The error below indicates a programming failure. Check all connections, power supply and try again after clicking on OK.



Confirm that the correct dual rod or coaxial TD80 is connected for programming. Future versions of TD80 will report the type; dual rod or coaxial.



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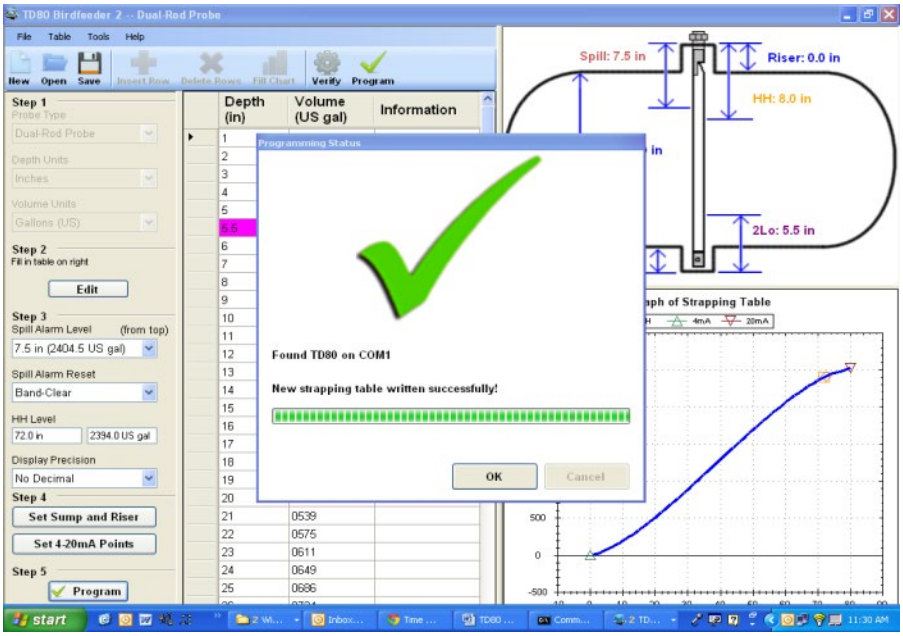
Birdfeeder 2 indicates programming progress with a bar and row count. Programming may be canceled at any time by clicking the Cancel button.

Successful programming is indicated below. Click the OK button to continue. Power may be removed from the TD80 and SV converter disconnected at this time.



6.3.5 Connecting the TD80 for Programming Using the SVRS232 to USB Converter

6.3.5.1 Connecting the TD80 for Programming in the Shop

See Figure 6-1 and Figure 6-2 for details.

1. Connect port “A” to the SVBus Converter.

2. Connect contact “B” to contact “C”.

3. Clip the SVBus Converter alligator clips to the transmitter terminals or to the same colour wires of the attached TD80 cable kit. See the wiring compartment cover diagram for the terminal locations.

   a. Black clip to PWR(BLK) terminal

   b. White clip to GND(WHT) terminal

   c. Red clip to SV(RED/GRN) terminal

4. Connect the SVBus converter to the PC USB port.

5. Connect the AC power adapter to the SVBus converter. Caution, do not connect the AC power adapter if using a battery or other source of power.

6. Apply operating power when prompted by the Birdfeeder program.

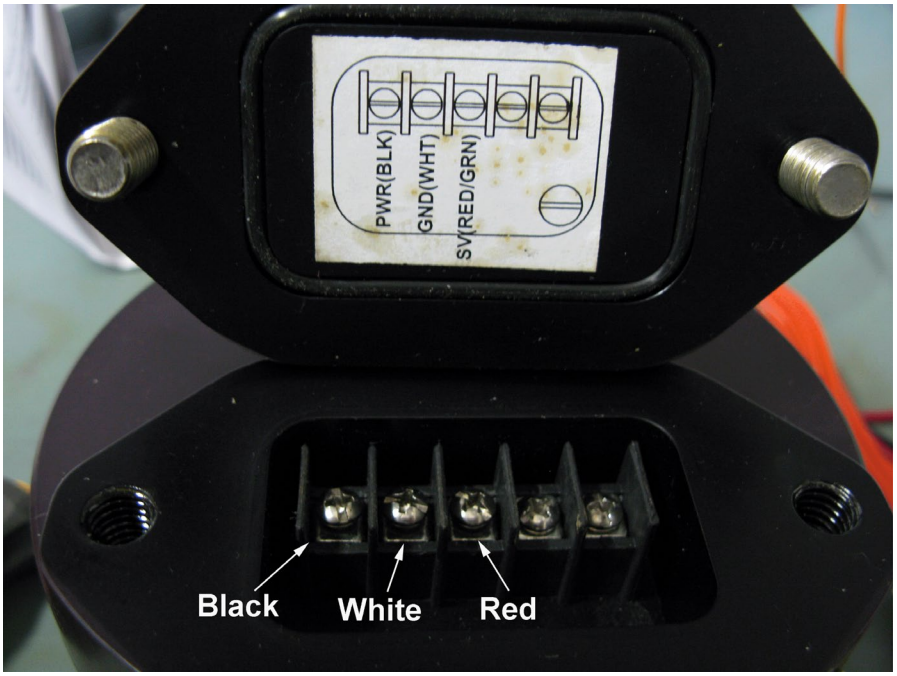


Figure 6-1: Connecting the TD80 for Programming in the Shop

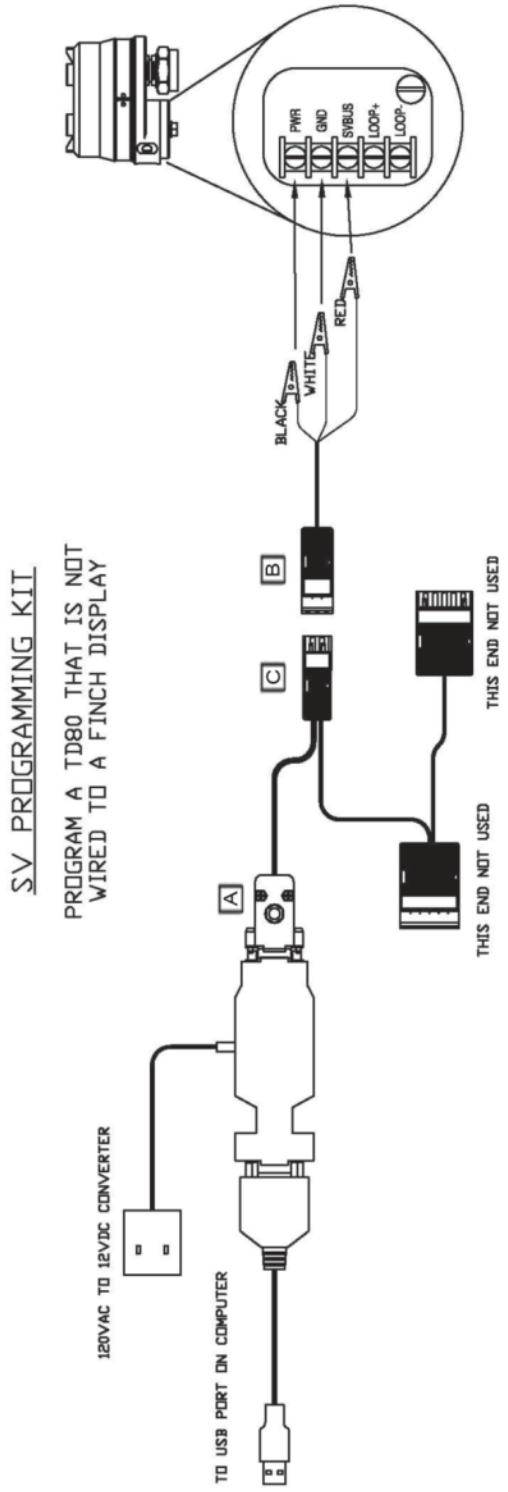


Figure 6-2: Connecting the TD80 for Programming in the Shop Drawing

6.3.5.2 Connecting the TD80 for Programming on a vehicle with a Finch 5332E Display (green board)

Connection Instructions:

See Figure 6-3 and Figure 6-4 for details.

Ensure that the power supply or battery voltage is turned off. Unplug the AC power adapter from the outlet if it is being used for programming.

Verify that the area is free of explosive fumes

1. Connect port “A” to the SVBus Converter.
2. The alligator clips are not needed. If they are still connected, remove them by disconnecting contact “B”
3. Remove contact “F”, also labeled P2 on the terminal board.
4. Connect contact “F” to contact “E” (contact “E” has two wires)
5. Connect contact “D” to the original location of contact “F” on the green terminal board.
6. If using the AC power adapter, remove the following terminals before proceeding.
    i. Remove the terminal board power connector at the far right hand side of the terminal board, labeled P4
    ii. Remove any terminals with wiring to accessories such as horns and lights.
    iii. Ensure that the terminals are reconnected when programming is complete and the AC power adapter is disconnected
7. Connect the SVBus converter to the PC USB port.
8. Connect the AC power adapter to the SVBus converter if required. Caution, do not connect the AC power adapter if using a battery or other source of power.
9. Apply operating power when prompted by the Birdfeeder program.

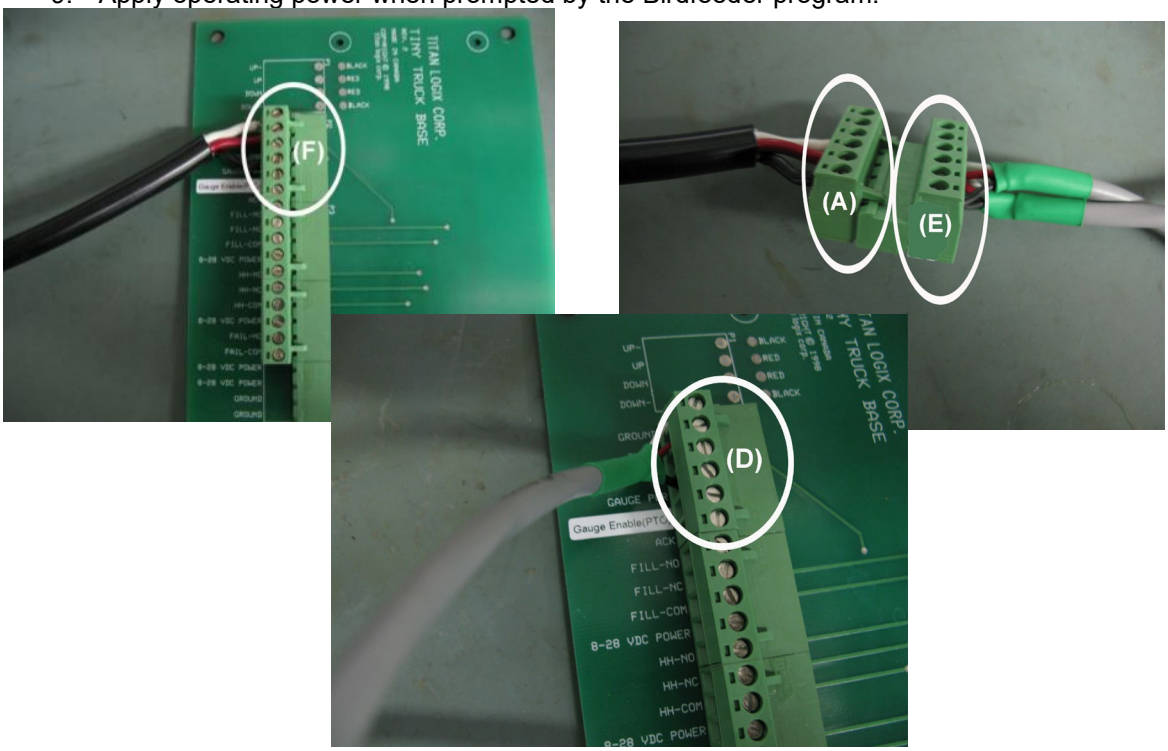


Figure 6-3: Connecting the TD80 for Programming on a vehicle with a Finch 5332E Display (green board)

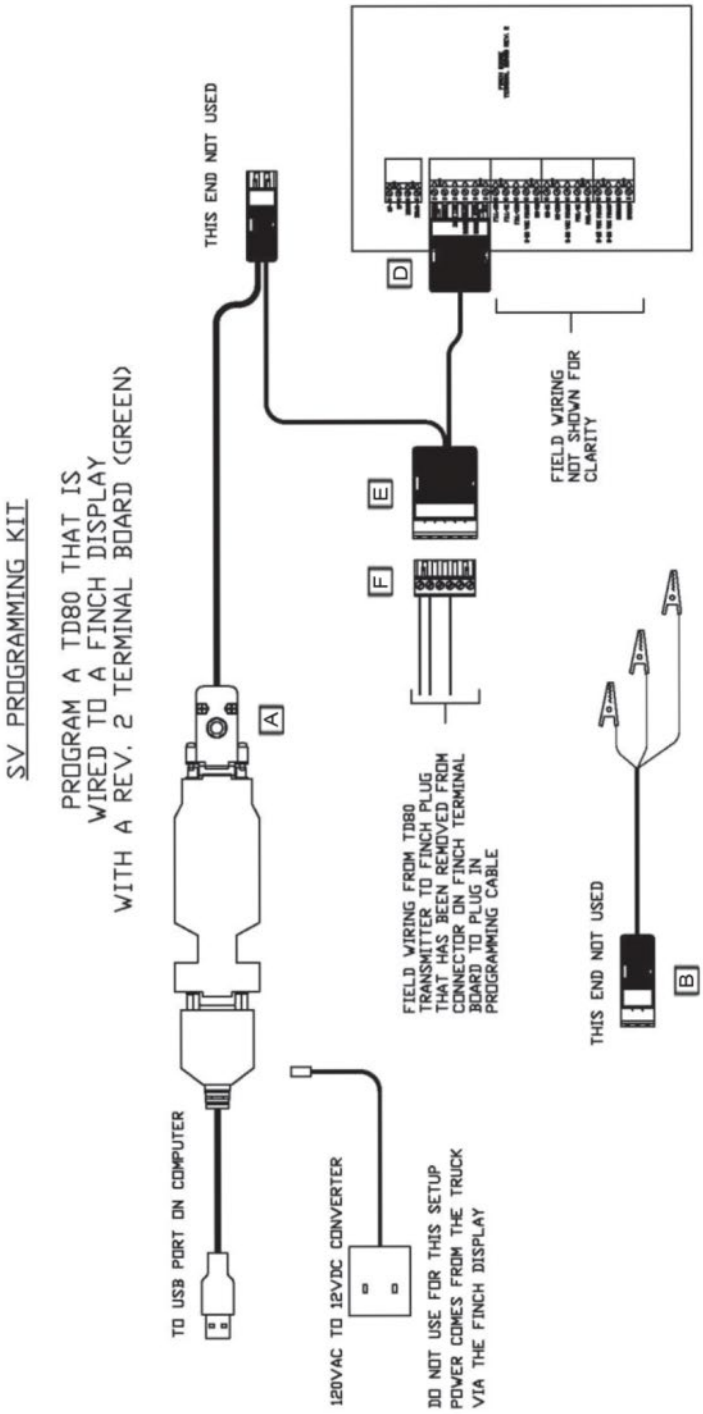


Figure 6-4: Connecting the TD80 for Programming on a vehicle with a Finch 5332E Display (green board) Drawing

6.3.5.3 Connecting the TD80 for Programming on a vehicle with a Finch 5332E/PS Display (red board)

Connection Instructions:

See Figure 6-5 and

Figure 6-6 for details.

Ensure that the power supply or battery voltage is turned off. Unplug the AC power adapter from the outlet if it is being used for programming.

Verify that the area is free of explosive fumes

1. Connect port “A” to the SVBus Converter.
2. The alligator clips are not needed. If they are still connected, remove them by disconnecting contact “B”
3. Remove the far left hand side terminal block (programming) from the red terminal board.
4. Connect contact “C” to the programming block on the red terminal board.
5. Connect the SVBus converter to the PC USB port.
6. Connect the AC power adapter to the SVBus converter if required. Caution, do not connect the AC power adapter if using a battery or other source of power.
7. Apply operating power when prompted by the Birdfeeder program.

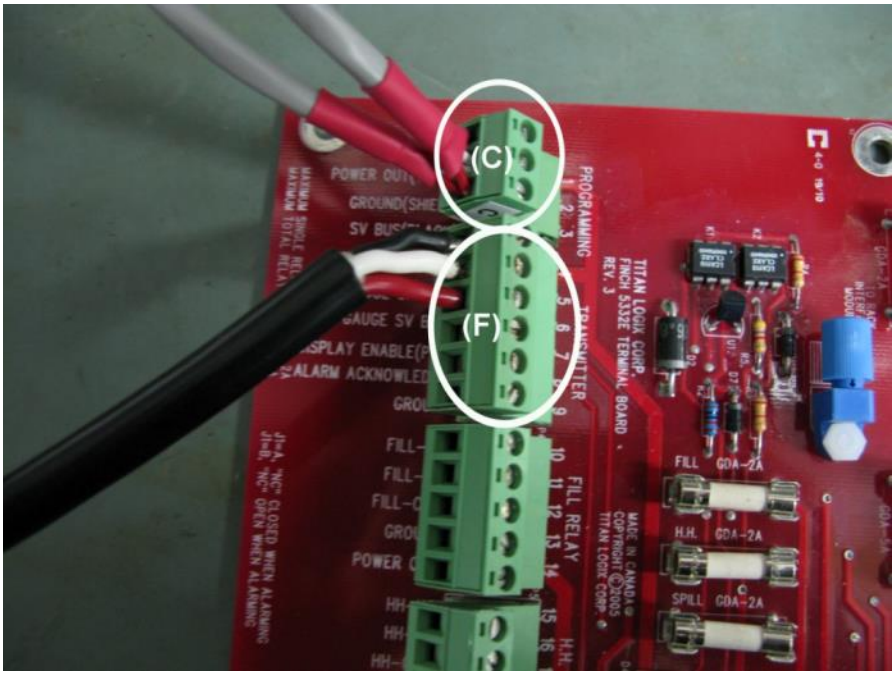


Figure 6-5: Connecting the TD80 for Programming on a vehicle with a Finch 5332E/PS Display (red board)

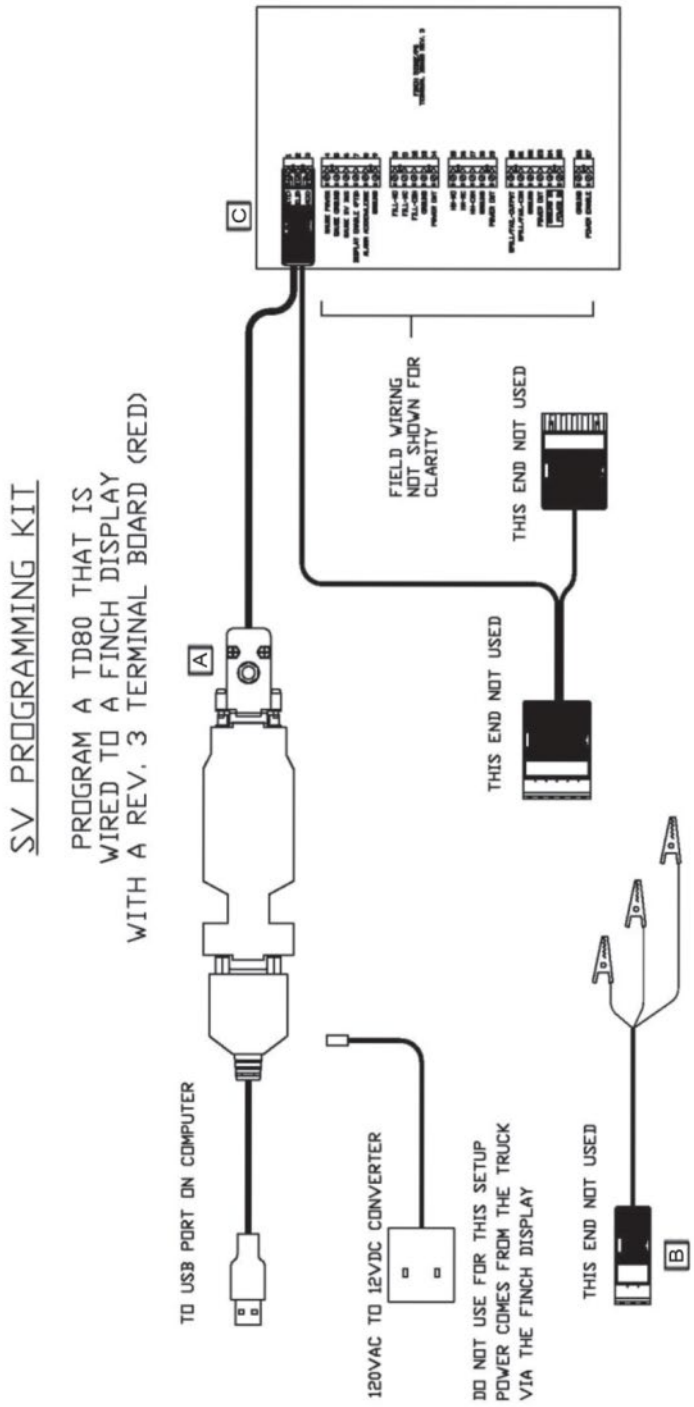


Figure 6-6: Connecting the TD80 for Programming on a vehicle with a Finch 5332E/PS Display (red board) Drawing

6.3.6 Advanced Birdfeeder 2 Programming Operations

6.3.6.1 Using MDU (Birdfeeder) files in Birdfeeder 2

Overview

The following instructions are provided to allow the use of older MDU (Birdfeeder) files with the newer Birdfeeder 2 for the following operations.

1. Extract Programming Information from Birdfeeder text files
2. Programming using Birdfeeder Text and Hex files
    a. Converting Birdfeeder Text files to Birdfeeder 2 format
    b. Converting Birdfeeder Hex files to Birdfeeder 2 format
    c. Programming directly from Birdfeeder Hex files

Programming information for the TD80 comes from the type of TD80 transmitter to be programmed, a manufacturer supplied depth or calibration chart, customer specified alarm levels and installation details. These details are recorded in a Text file by MDU and used to compile the Hex file for programming the transmitter.

MDU Text files are readable as ordinary text files with Windows NotePad. Most of the information needed to convert these to Birdfeeder 2 format comes from the Text file header where the lines begin with a semicolon.

MDU Hex files are also readable with NotePad, but the information is encoded for programming use and does not provide any useful details for file conversion. They are used to directly program a transmitter when the type, dual rod or coaxial is known or determined by customer supplied records.

MDU Text File Format

Refer to the following Text file sample below.

;updated on=Nov 23/2006 08:42:54
;deviceid=1
;units=BBL
;depth units=in
;Max value=234.9
;Min value=0.01
;HH limit=231.0
;Fill/Fall Max=231.0
;hysteresis=10
;data spacing=16.0 per inch
;display precision=1
;Spill Level=8
0 0.01
1.0 0.43
2.0 0.83
3.0 1.26
4.0 1.98
5.0 2.74
6.0 3.76
7.0 5.10
..
77.0 229.1
78.0 231.0
79.0 232.2
80.0 233.3
81.0 233.7
82.0 234.3
83.0 234.5
84.0 234.6
85.0 234.7
86.0 234.8
87.0 234.9
<EOF>

Figure 6-7: MDU Text file sample

See the lines below for the significant information that can be extracted from the sample text file.

Line:

1. **;updated on=Nov 23/2006 08:42:54**
The file header information was last updated (changed) on Nov 23/2006

2. **;units=BBL**
The displayed liquid volume is in barrels (BBL)

3. **;depth units=in**
The liquid depth is measured in inches (in)

4. **;HH limit=231.0**
The High-High (HH) alarm is set at 231.0 bbl or a liquid depth of 78” by the depth chart

5. **;display precision=1**
One decimal place of displayed volume precision XXX.X BBL

6. **;Spill Level=8**
The Spill alarm level is set at 8” from the tank top or a liquid depth of 79” by the depth chart. This value is rounded up to the nearest full inch from the 7.5” of actual Spill alarm distance for Dual Rod transmitters only.

7. **78.0 231.0**
HH alarm level of 231.0 BBL

8. **79.0 232.2**
Spill alarm level rounded to the next full inch by MDU, 79.0”

Text File Interpretation

Information from line 1 indicates the date this file was created or last modified.

Lines 2 to 6 provide information to Birdfeeder 2 for Volume Units, Depth Units, High-High Level, Display Precision and Spill Alarm Level.

The example above indicates:

1. The programming file was created on 23 November, 2006 at 8:42 am.
2. The transmitter is programmed to display barrels (BBL).
3. The depth units used for the chart is inches (in).
4. The High-High (HH) alarm is programmed for 231.0 BBL (see line 7 above) at a depth of 78”
5. The Finch display is set for one decimal place of precision.
6. The Spill alarm is set at a distance of 8” from the tank top or a depth of 79” (see line 8 above) and a volume of 232.2 BBL. The actual Spill level is 7.5” or 79.5” and a volume of 232.75 BBL. Spill Level=8 is an indication that this table was created for a dual rod transmitter. Any other Spill Alarm level of 2.5” to 15.5” indicates a coaxial transmitter.

Additional information is needed to complete the programming in Birdfeeder 2. Customer records are required to determine the coaxial transmitter Spill Alarm Reset. The most common setting is Auto-Clear. Mechanical details such as riser or sump installation may be required to convert to a Birdfeeder 2 formatted file (.STB). These details and the optional 4-20mA settings may be supplied by the customer.

MDU Format Text File Conversion

The following steps describe how to convert an MDU formatted text file for use with Birdfeeder 2. A typical installation is with a dual rod probe, no sump or riser to compensate for the top and bottom dead bands and no 4-20mA option installed.

1. Run the Birdfeeder 2 program.
2. At the Menu Bar, click File>Import Table…
3. Select the text file for conversion and click the Open button
4. Confirm the following settings and correct as necessary. All required settings are determined by the text file header.
    a. Probe Type
    b. Depth Units
    c. Volume Units
    d. Spill Alarm Level
    e. Optional Spill Alarm Reset
    f. HH level
    g. Display precision
5. Ensure that sump and riser height is 0”.
6. Ensure that the 4mA and 20mA set points are 0” or at the customer specified settings.
7. Click on the Verify icon to scan the chart for errors. Correct any identified errors and continue.
8. Save the newly created file by clicking on the Save icon and following the prompts. The new file is saved with the .STB extension to indicate it is a Birdfeeder 2 format.

Programming may continue by clicking the Program button.

MDU Hex File Conversion

Hex files are the actual files used to program the TD80 transmitter. Previous knowledge of the settings or customer supplied records is required to successfully convert these file to Birdfeeder 2 format. A typical installation is with a dual rod probe, no sump or riser to compensate for the top and bottom dead bands and no 4-20mA option installed.

1. Run the Birdfeeder 2 program.
2. At the Menu Bar, click File>Import Hex File…
3. Select the hex file for conversion and click the Open button
4. Confirm the following settings and correct as necessary. All settings are required for a correctly formatted file.
    a. Probe Type
    b. Depth Units
    c. Volume Units
    d. Spill Alarm Level
    e. Optional Spill Alarm Reset
    f. HH level
    g. Display precision
5. Ensure that sump and riser height is 0”.
6. Ensure that the 4mA and 20mA set points are 0” or at the customer specified settings.
7. Click on the Verify icon to scan the chart for errors. Correct any identified errors and continue.
8. Save the newly created file by clicking on the Save icon and following the prompts. The new file is saved with the .STB extension to indicate it is a Birdfeeder 2 format.

Programming may continue by clicking the Program button

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Program Directly From an MDU Hex File

TD80 transmitters may be programmed directly from an MDU created Hex file with a minimum of required information. Essential information is probe type, and Spill Alarm Reset for coaxial transmitters. 4-20mA settings are not recorded in the hex file and must be supplied by the customer. A typical installation is with a dual rod probe, no sump or riser to compensate for the top and bottom dead bands and no 4-20mA option installed.

1. Run the Birdfeeder 2 program.
2. At the Menu Bar, click File>Import Hex File…
3. Select the hex file for conversion and click the Open button
4. Confirm the following settings and correct as necessary.
    a. Probe Type
    b. Spill Alarm Level
    c. Optional Spill Alarm Reset
    d. HH level
    e. Display precision is none
5. Ensure that sump and riser height is 0”.
6. Ensure that the 4mA and 20mA set points are 0” or at the customer specified settings.
7. Click on the Verify icon to scan the chart for errors. Correct any identified errors and continue.
8. Program by clicking the Program button

6.3.6.2 Transmitter File Transfer Using Birdfeeder 2

The programmed TD80 transmitter information may be read by Birdfeeder 2. It is then saved as a Hex file or used immediately to program another TD80 transmitter. The process begins with Birdfeeder reading the entire contents of the TD80 program. The result is similar to opening a Hex file.

Step 1, Read the strapping table

1. Connect the first TD80 transmitter for programming. See section 6.5.3 for details.
2. Download the TD80 strapping table from the first transmitter using the Read Table feature.

The following information is extracted from the program and used to automatically set Birdfeeder. Confirm that these settings are correct from customer records and correct if necessary.

1. Spill Alarm Level
2. Spill Alarm Reset
3. HH Level
4. 4-20mA set points
5. Depth and Volume table

Step 2, Complete the programming information

1. Transmitter and probe type are determined by customer supplied records or from the TD80 transmitter model number. TD80-T11 and TD80-T12 are dual rod while TD80-T16 and TD80-T17 are coaxial transmitters. Set the correct probe type

2. Offset calibration is not read by Birdfeeder 2 and must be done at the earliest opportunity after transmitter programming to maintain an acceptable level measurement accuracy.

3. Depth and Volume units are not significant when the programming information is simply transferred from one transmitter to another without saving the file for later use. If the information will be saved for use later, determine the correct Depth and Volume units from customer supplied records. Change the depth units, volume units and decimal precision to the required settings. Decimal precision usually remains at none.

4. Confirm that the sump and riser heights are 0". Correct these settings before proceeding.

Step 3, Save the strapping table

1. Click on the Save icon, then save the new file with a meaningful file name.

Step 4, Program the second TD80 transmitter

1. Disconnect the first TD80 transmitter from the programming adapter.

2. Connect the second TD80 transmitter for programming.

3. Load the programming file created in step 3 if required.

4. Program the second TD80 transmitter.

5. Test the newly programmed transmitter for correct operation.

6.3.6.3 Offset Calibration and Programming Considerations

The TD80 offset calibration is designed to halt compensation if the HH alarm level exceeds the currently selected Spill alarm level. Continued Finch display button presses to adjust the calibrated volume measurement above the Spill level are ignored by the TD80 transmitter. This is a safety measure to ensure that the HH alarm activates before the Spill alarm when loading. The expected alarm sequence is first Fill alarm, then HH alarm, followed by Spill alarm.

The HH alarm is set to a predetermined volume and is activated when the measured level is equal to or exceeds that volume. Offset calibration shifts the strapping table up or down by 1/16" increments to match the displayed volume with the actual loaded volume. A specific volume measurement changes position up or down the probe as measured from the top of the tank. Spill alarm setting is by a fixed distance from the tank top. It is not affected by offset calibration.

Large offset calibration distances are the result of incorrect programming information. Errors in compartment height, riser height above the tank and depth chart inaccuracies contribute to programming that prevents accurate level measurements. Attempts at using the offset calibration to compensate for the inaccuracy may cause the HH alarm level to be above the fixed Spill alarm level. This condition is prevented by the TD80.

Inability to accurately calibrate the TD80 is an indication that the programming is inaccurate. Review all of the programming information, including physical measurements of the installation. The solution is then to reprogram the TD80 with corrected information and continue the calibration process.

6.3.6.4 Depth Chart Construction

A depth chart for any compartment may be built using a metered amount of liquid and a dipstick or measuring tape. The procedure is to start with an empty tank, load slowly through a flow meter and record the volume loaded at each inch from the bottom to the top of the tank.

The recorded chart is then entered into Birdfeeder and used to program the TD80 transmitter. Volume at fractional inches is not required. Birdfeeder will calculate the increments between whole inches.

The TD80 needs to be programmed to report inches if it is already installed and operating. This is also a method to use for measuring depth of hazardous products such as jet fuel.

Programming the TD80 as a Dipstick

Birdfeeder is used to create a strapping table to display inches with a resolution of 1/16”. The TD80 programmed with this table becomes a dipstick for creating the depth chart.

1. Measure or determine the height of the compartment. This is the total height inside, from the bottom of the tank to the highest point where the TD80 probe is mounted.
2. Select the Probe Type of the TD80 installed
3. Select Depth and Volume units of Inches
4. Fill the Chart with the information below. This creates a linear strapping table.
    a. Start value=0
    b. Increment=1
    c. End Value= height of compartment
5. Manually enter any remaining fractional part of the height at the end of the chart.
6. A linear depth chart is now built to act as a dipstick calibrated in inches with a resolution of 1/16”.
7. Select the smallest spill level for the transmitter being programmed
    a. 7.5” for dual rod
    b. 2.5” for coaxial
8. Select a HH level 0.5” below Spill
9. Select 2 digits for Display Precision
10. Sump and Riser at 0”
11. Program the TD80
12. The TD80 is now a dipstick with measurement of inches and a resolution of 0.0625” (1/16”).

Construct the Depth Chart

1. Set the Finch display Fill alarm to the highest level. This is the HH alarm setting.
2. Begin with an empty compartment, Finch displays 2 LO.
3. Slowly begin filling the compartment and monitor the flow meter.
4. Finch begins to display level at 5.56”, record the volume from the flow meter.
5. Continue recording volume at whole inch values 6, 7, 8, … until the HH alarm.
6. Acknowledge the HH alarm and continue recording level and volume until the Spill alarm activates or the maximum safe volume of the compartment is reached.
7. Stop loading
8. Manually fill in the volume values between 0” and 5.56” (where 2 LO ended) with small increments of volume. Begin with 0” and 0 volume and blend the values to the volume at 5.56”.

9. Manually fill in the volume values from where loading stopped to the top of the compartment with small increments of volume. Begin with the volume at 2.5” from the top for the coaxial, 7.5” for the dual rod probe or where the loading stopped and blend the volume up to the maximum depth and volume of the compartment.

Programming the TD80

1. Build a new strapping table in Birdfeeder using the newly created depth chart.
    a. Replace the original linear strapping table inch values in the volume column with the recorded volume at each inch.
    b. Set the Spill alarm level and reset option according to customer requirements
    c. Set the HH alarm level according to customer requirements
    d. Riser and sump values are 0”
    e. Set the 4-20mA adjustments according to customer requirements, if installed.
2. Save the strapping table
3. Program the TD80
4. Ensure that the Fill alarm is set to customer requirements while testing the programming results.

Blank Depth Chart Form

The following form can be used when creating a depth chart for a particular tank or compartment. Enter the liquid volume (e.g.: M3, BBL's, Gallons etc.) at each inch. This can then be entered into the Birdfeeder software for programming the TD80 Transmitter.

Note: The maximum length of the TD80 probe is 92 inches.

Depth Units: (inches) Volume Units: (M3, Liters, BBL's)

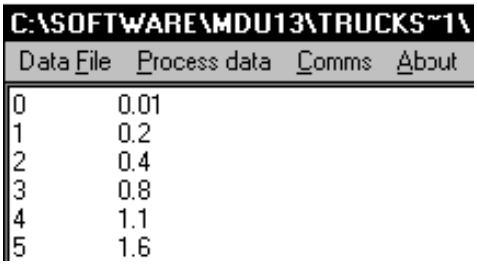
DEPTH	VOLUME	DEPTH	VOLUME	DEPTH	VOLUME
0		33		66	
1		34		67	
2		35		68	
3		36		69	
4		37		70	
5		38		71	
6		39		72	
7		40		73	
8		41		74	
9		42		75	
10		43		76	
11		44		77	
12		45		78	
13		46		79	
14		47		80	
15		48		81	
16		49		82	
17		50		83	
18		51		84	
19		52		85	
20		53		86	
21		54		87	
22		55		88	
23		56		89	
24		57		90	
25		58		91	
26		59		92	
27		60			
28		61			
29		62			
30		63			
31		64			
32		65			

Figure 6-8: Blank Depth Chart Form

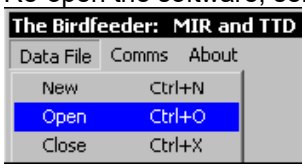
6.3.7 MDU (Birdfeeder) Programming

NOTE: The Birdfeeder 2 is the current and recommended software.

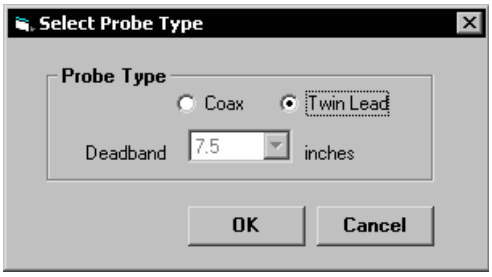
Open the MDU software program and select **New** from the Data **File** menu.

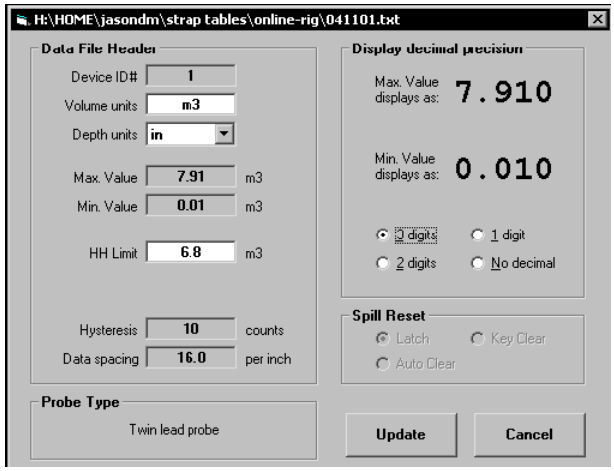


1. Once selected, blank screen will appear in which the strap table can be entered. To enter the strap table, enter in the **Inch** values in the left side of the screen (always starting at 0), tab once and enter the corresponding Volume (always starting at 0.01), then press enter to continue the next values. (Strap tables must be entered in inches.)
2. If a sump or a riser in installed in the tank, the height of both must be accounted for in the strap table. (e.g. If there is a 3" riser in the tank, 3" must be added to the top of the strap table. If there is a 3" sump in the tank, 3" must be added to the bottom of the strap table.)
3. When the strap table has been completed, save the file according to the serial number of tank or unit number and name of the customer for ease of future service and exit the program.
4. Re-open the software, select **Open** and choose the strap table just created.



5. Select the type of probe being installed and press OK. If choosing a Coax probe, select the Dead band desired.
6. Select **Edit Header** from the **Process Data** menu. If the software detects any points of the strap table that are inconsistent, an error window will pop up and display the point of error to be corrected. When the strap table is correct, two warning windows





will appear, one after the other, explaining the HH and H level alarms. Select OK on both of these and a screen will show up as follows.

- Device ID # remains 1.
- Type in the volume units where asked.
- Select **inches** for Depth Units.
- Max Value, and Min Value remain same.
- HH Level and H Level remain same.
- Hysteresis and Data Spacing remain same.
- Select digits for decimal precision. (Choose to show 4-digits. e.g. 35.00)
- Click Update.

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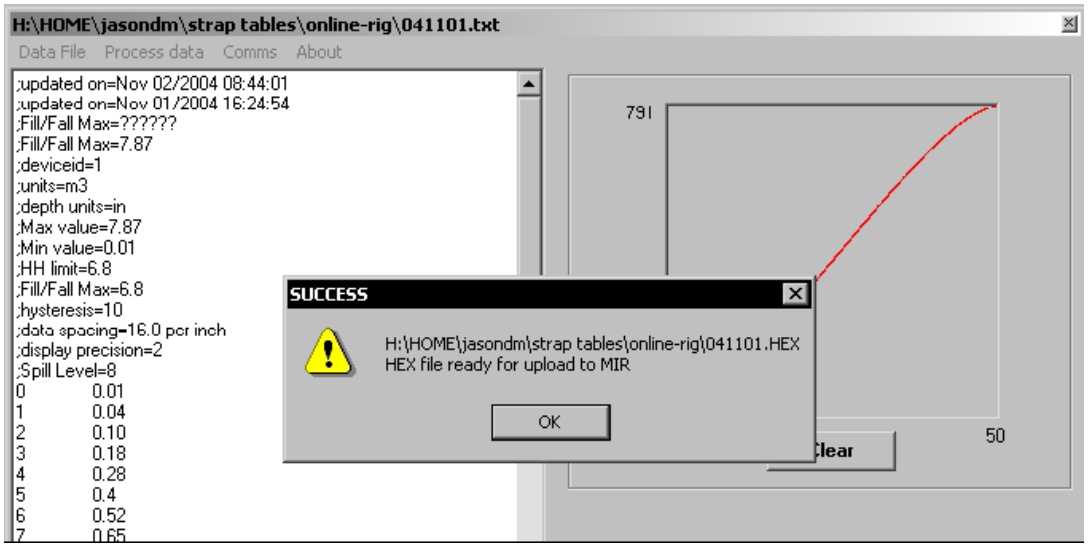
7. When the strap table re-appears with a list of information above it, select **Compile data** from the **Process data** menu. When it is finished a **SUCCESS** window should appear.



8. In the **Comms** menu, select the correct com port for the computer. (Most computers will be COM1.)

9. Select **Terminal** from the **Comms** menu. Turn power to the gauge **off**. Apply power to the gauge and click on the **Connect** button within 5 seconds of applying power. If an error message appears, turn the power supply off, check all of the wiring and COM port settings of the computer (COM 1, COM 2 etc.) and try to reconnect to the gauge applying power again. If the problem persists, a new SV Converter may be needed, or the configuration of the COM port being used on the computer may be incorrect.
10. When the **MIR DETECTED** message appears click on the **Send File** button and the strap table just produced will appear in the file box highlighted. If not, choose the **Hex** file wanted and press OK. The strap table will take approximately 1 – 2 minutes to load and a Success window should appear. If this does not finish or an error occurs during download, start over from step 10 and repeat.

6.3.8 Programming Checklist

Checked	Step
	1. Gather all the programming information
	a. Transmitter and probe type
	b. Depth chart for the tank or compartment
	c. Display precision required for the Finch display
	d. Transmitter riser and sump options
	e. Spill alarm distance
	f. Spill alarm reset option
	g. High-High alarm volume
	h. Optional 4-20mA offset adjustments
	2. Create the programming file, if required
	a. Confirm all settings with the information above
	b. Save the file with a meaningful name
	3. Program the TD80
	a. Verify all programming settings with the information above.
	b. Program the TD80
	4. Test the programming result
	a. TD80 operates normally
	b. Volume is displayed according to the depth chart
	c. Alarms activate at the programmed levels
	d. Optional Spill alarm reset clears the alarm
	e. Optional 4-20mA outputs according to programmed offsets

Table 6-1: Programming Checklist

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