



TDR-3000
Two-Wire Guided Wave Radar
Installation & Operation Manual



TDR-3000 Two-Wire Guided Wave Radar Installation & Operation Manual

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SAFETY SYMBOLS



WARNING:

IDENTIFIES CONDITIONS OR PROCEDURES, WHICH IF NOT FOLLOWED, COULD RESULT IN SERIOUS INJURY. RISK OF ELECTRICAL SHOCK.



CAUTION:

IDENTIFIES CONDITIONS OR PROCEDURES, WHICH IF NOT FOLLOWED, COULD RESULT IN SERIOUS DAMAGE OR FAILURE OF THE EQUIPMENT.

TDR-3000 Two-Wire Guided Wire Radar

I. HANDLING AND STORAGE

SAVE THESE INSTRUCTIONS

STUDY THE INSTRUCTIONS MANUAL CAREFULLY

Failure to do so can lead to serious damage, injuries and loss of warranty.

Store the instructions manual in an safe environment.

INSPECTION AND HANDLING

Do not dispose of the device's packaging or packaging materials during the warranty period or if the device is being stored.

Each package should be inspected upon receipt for damage that may have occurred due to mishandling during shipping. If the unit is received damaged, notify the carrier or the factory for instructions. Failure to do so may void your warranty. If you have any problems or questions, consult Customer Support at 1-800-778-9242.

DISPOSAL AND RECYCLING

This product can be recycled by specialized companies and must not be disposed of in a municipal collection site. If you do not have the means to dispose of properly, please contact Bindicator for return and disposal instructions or options.

STORAGE

If the device is not scheduled for immediate installation following delivery, the following steps should be carried out:

1. Following inspection, repackage the unit into its original packaging.
2. Select a clean dry site, free of vibration, shock and impact hazards.
3. If storage will be extended longer than 30 days, the unit must be stored at temperatures between -40° and 176° F (-40° to 80° C) in non-condensing atmosphere with humidity less than 85%.



CAUTION: DO NOT STORE A NON-POWERED UNIT OUTDOORS FOR A PROLONGED PERIOD.

II. GENERAL SAFETY

AUTHORIZED PERSONNEL

All instructions described in the document must be performed by authorized and qualified service personnel only. Before installing the unit, please read these instructions and familiarize yourself with the requirements and functions of the device. The required personal protective equipment must always be worn when servicing this device.

USE

The device is solely intended for use as described in this manual. Reliable operation is ensured only if the instrument is used according to the specifications described in this document. For safety and warranty reasons, use of accessory equipment not recommended by the manufacturer or modification of this device is explicitly forbidden. All servicing of this equipment must be performed by qualified service personnel only. This device should be mounted in locations where it will not be subject to tampering by unauthorized personnel.

MISUSE

Improper use or installation of this device may cause the following:

- Personal injury or harm
- Application specific hazards such as vessel overfill
- Damage to the device or system


SAFETY REGULATIONS FOR THE EX APPROVED UNITS

The level transmitter must be operated in intrinsically safe circuit only. The metal enclosure of the unit must be connected to the Protective Earth (PE) circuit.

If any questions or problems arise during installation of this equipment, please contact the Customer Support at 800-778-9242.

III. SPECIAL CONDITIONS FOR SAFE USE

In case of the  II 1 G Ex ia IIB T6...T4 protected equipment version with aluminum enclosure, the aluminum-content of enclosure exceeds the limit. Thus the equipment must be protected against impact and friction effects.

In case of the  II 1 D Ex ia IIIC T85°C...T110°C Da, protected equipment versions with window, the size of window exceeds the limit. Thus the equipment must be protected against effects which results electrostatic charges.

If the device is installed to a site where it can be subjected to over-voltage, the device must be equipped with over-voltage protection of at least over-voltage class III!

IV. ESSENTIAL HEALTH AND SAFETY REQUIREMENTS

Covered by “II. GENERAL SAFETY “ and “II. GENERAL SAFETY “ and “III. SPECIAL CONDITIONS FOR SAFE USE”.

All national, federal, state, municipal, and local codes, laws and applicable standards must apply!

WARNING: Among others: ENERGIZED MACHINERY, PRESSURIZED VESSELS, LIVE VALVES, WIRES, FALLING OBJECTS, SLIPPERY, SHARP SURFACES, HEIGHTS, HOT, COLD, ACIDIC, CAUSTIC, VOLATILE, TOXIC AND EXPLOSIVE MATERIALS POSE A GREAT RISK OF SERIOUS INJURY, PERMANENT DISABILITY AND DEATH!

Only trained and authorized professional is allowed to mount, set up, alter the settings or operate the device. In fit and able condition and in the required personal protective equipment.

The level transmitter instrument is not a plant safety device.

V. PRODUCT DESCRIPTION

FUNCTION

The TDR-3000 two-wire guided microwave level transmitter uses the TDR (Time Domain Reflectometry) principle. The instrument sends low power nanosecond-wide pulses along an electrically conductive probe with a known propagation speed (the speed of light). As the pulse reaches the surface of the medium or phase of two liquids (altered dielectric constant ϵ_r), a part of it is reflected back to the electronic module. The efficiency of the reflected signal depends on the dielectric constant ϵ_r difference of the mediums or layers. The reflected pulse is detected as an electrical voltage signal and processed by the electronics. Level distance is directly proportional to the time of flight of the pulse, this measured level distance then can be used up as is. Alternatively derived values can be calculated from it. Such as volume and mass. The choice will be the main output of the level transmitter: The Primary Variable (PV) which gets converted into 4-20 mA loop current in single drop mode. Transmitted loop current is also displayed on the LCD display. Numerical data transmission is a parallel option via HART messages. The TDR technology is unaffected by the other properties of the medium as well as that of the space above it.

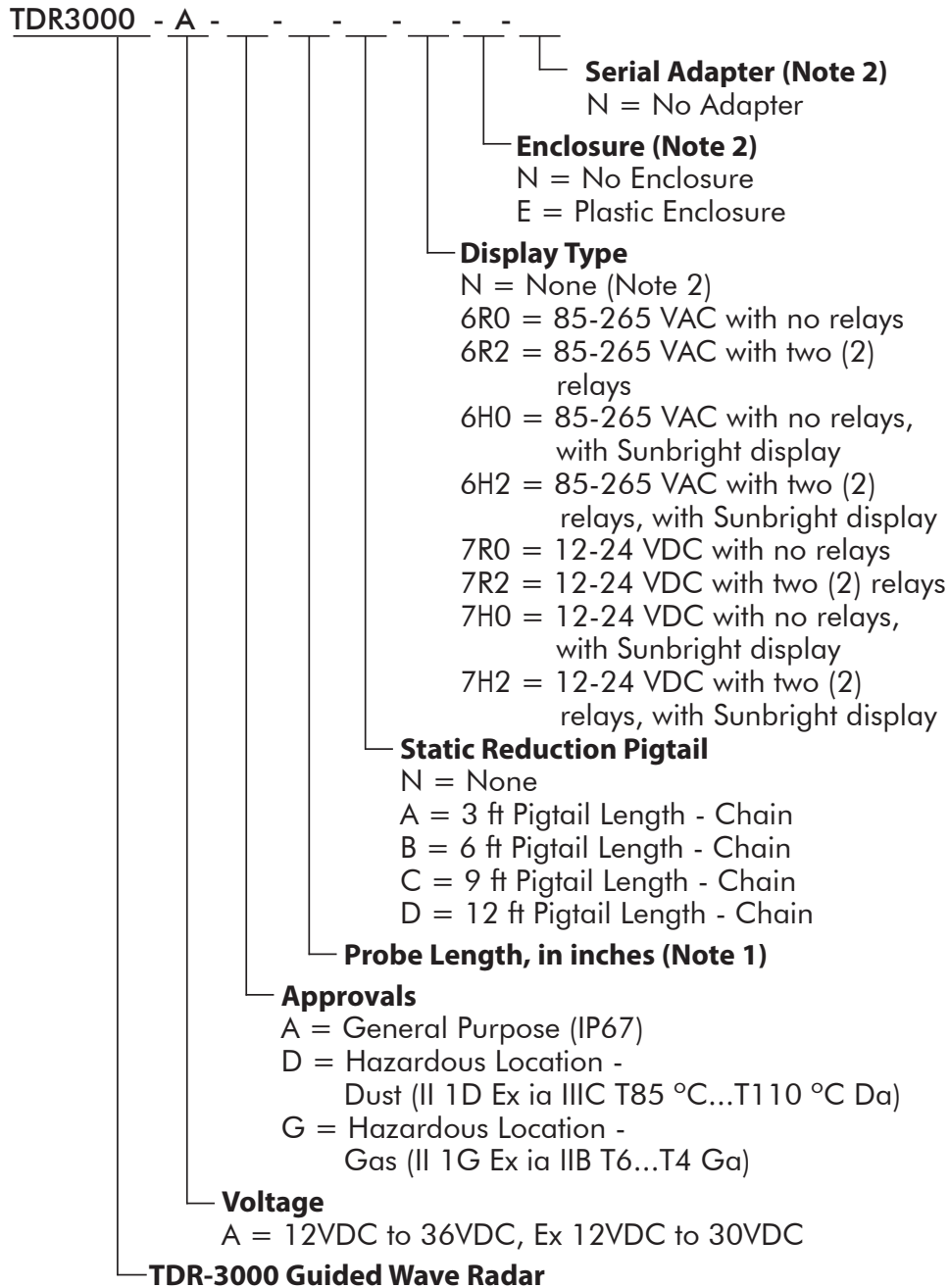
APPLICATIONS

Designed for measuring the distance, level, volume of liquids, pastes, slurries and powder products; applicable in tanks, silos, rigid pipe, reaction vessel and level reference vessel. The guided radar wave can permeate much deeper through disturbances than free space radar or ultrasonic.

FEATURES

- Simple to install in new tanks or retrofit existing tanks
- Can be installed while tank is in service
- Does not require special configuration to compensate for environmental or structural conditions
- Factory calibrated and configured
- Transmitter design minimizes maintenance requirements

HOW TO ORDER



- NOTES
1. Maximum probe length is 98.5 ft (30.0 m).
 2. If no display is required, choose Display Type and Enclosure N
 3. Consult factory for cables less than 100 in.

TECHNICAL SPECIFICATIONS

FUNCTIONAL

Operating Power	24 VDC (12 to 36 VDC) Ex Version: 24 VDC (12 to 30 VDC)
Ambient Temperature	-22° to 149° F (-30° to 65°C) -4° to 149°F (-20° to 65°C) with display
Process Temperature	-22° to 194°F (-30° to 90°C)
Operating Pressure	-14 to 232 psi (-1 to 16 bar)
Accuracy	±20 mm (±0.75"), if probe length ≥ 10 m (32 ft): ±0.2% of the probe length
Dielectric Constant	> 2.1
Output	4-20mA, Optional Relay

PERFORMANCE

Measuring Range	Flexible Probe: Max of 98.5ft (30 m)
	Deadband Top: 13.8" (35cm) if Er < 10 ; 9.84" (25cm) if Er > 10 Deadband Bottom: 14.2" (36 cm)
	Counter Weight Diameter: 1.6" (4 cm); length 10.2" (26 cm)
Resolution	0.04" (1 mm)

PHYSICAL

Process Connection	1 1/2" NPT
Ingress Protection	1P67
Conduit Connections	(2) M20 x 1.5 and (2) 1/2" NPT
Electrical Protection	Class III
Probe Materials	Flexible 316 Stainless Steel Cable
Enclosure Materials	Aluminum with white epoxy coating
Seals	FPM (Viton®), FFKM (Kalrez®), EPDM
Shipping Weight (Head Unit)	4.85 lbs (2.2 kg)

APPROVALS

ATEX MARKINGS



II 1G Ex ia IIB T6...T4 Ga

II 1D Ex ia IIIC T85°C... T110°C Da

T ambient = -30°C...+65°C



SPECIAL DATA FOR EX CERTIFIED MODELS

Ex marking (ATEX)	 II 1 G Ex ia IIB T6...T4 Ga
	 II 1 D Ex ia IIIC T85°C...T110°C Da
Intrinsically safe data (II 1 G Ex ia IIB)	$C_i \leq 25 \text{ nF}$, $L_i \leq 300 \text{ }\mu\text{H}$, $U_i = 30 \text{ V}$, $I_i = 140 \text{ mA}$, $P_i = 1 \text{ W}$
Intrinsically safe data (II 1 0 Ex ia IIIC)	$C_i \leq 25 \text{ nF}$, $L_i \leq 300 \text{ }\mu\text{H}$, $U_i = 30 \text{ V}$, $I_i = 100 \text{ mA}$, $P_i = 0.75 \text{ W}$

TEMPERATURE DATA

	EXPLOSIVE GAS ATMOSPHERE TDR-3000-A-G-_ Ex ia IIB			EXPLOSIVE DUST ATMOSPHERE TDR-3000 -A- D-_ Ex ia IIIC		
	+80°C	+90°C	+100°C	+80°C	+90°C	+100°C
Maximum permissible process temperature at the antenna	+80°C	+90°C	+100°C	+80°C	+90°C	+100°C
Maximum permissible surface temperature at the process connection	+70°C	+90°C	+100°C	+75°C	+90°C	+100°C
Temperature class	T6	T5	T4	T85°C	T100°C	T110°C

PROCESS TEMPERATURE DATA

TYPE	FLANGE TEMPERATURE
Transmitter	-30°C ... +90°C

Lower or higher temperature for non-Ex version on special request.

VI. MECHANICAL INSTALLATION



WARNING: REMOVE POWER FROM THE UNIT BEFORE INSTALLING, REMOVING, OR MAKING ADJUSTMENTS.



CAUTION: CARRY USING BOTH HANDS, LIFTING THE DEVICE CAREFULLY BY THE CONVERTER HOUSING. IF NECESSARY, USE LIFTING GEAR. NO ATTEMPT SHOULD BE MADE TO LIFT THE INSTRUMENT BY ITS PROBE. THE DEVICE WILL WEIGH BETWEEN 7 AND 25 LBS (3 - 12 KG).



CAUTION: THE PROBE IS A CRITICAL GAUGE COMPONENT. DO NOT DAMAGE. HANDLE WITH CARE.



CAUTION: FRAGILE ELECTRONICS. AVOID JOLTS, DROPPING, IMPACTS, ETC.



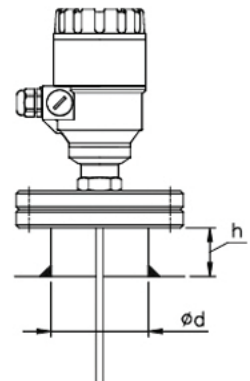
CAUTION: AVOID CABLE KINKS AND FRAYING. DO NOT COIL THE CABLE LESS THAN 16 IN (400 MM) IN DIAMETER. CABLE KINKS OR FRAYING WILL CAUSE MEASUREMENT ERRORS.



CAUTION: INSTALL A SUNSHADE IF THE UNIT IS EXPOSED TO DIRECT SUNLIGHT. LCD TECHNOLOGY IS USED FOR THE DISPLAY AND CAN BE DAMAGED IN DIRECT SUNLIGHT.

GENERAL INSTALLATION

1. Empty the vessel or at least reduce the material level below the length of the cable probe.
2. Determine location of where probe should be on the top of the tank. Consider the following:
 - a. Cable probe should be at least 12 in (30 cm) away from any metal surface.
 - b. Do not install unit close to material entry flow. Pouring the product directly onto the cable probe will give false readings and can cause excessive wear to the unit.
 - c. Install a deflector plate if it is impossible to distance gauge from the entry location.
 - d. For round, center fill, center discharging vessels, it is recommended that mounting should be located at a point approximately 1/3 of the vessel radius from the vessel wall.
 - e. For other types of vessel shapes, contact the manufacturer for assistance in determining ideal ... mounting location.
3. Add lubricant or sealant in the 1½” NPT coupling to avoid seizing.
4. Insert TDR unit, with weighted end into the silo, and mount the unit to the top of the tank using a 1½” NPT half coupling.
 - a. If direct mounting is not possible, a nozzle may need to be used.
 - b. When mounting a nozzle, the diameter of the nozzle must be great than the height. Take note of additional height due to nozzle; add as needed to the probe length.

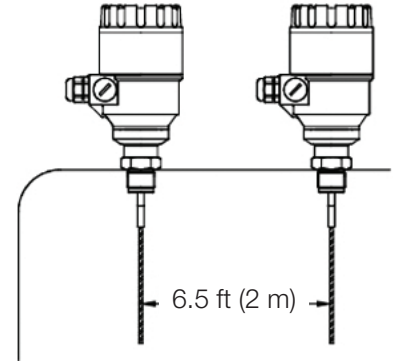


CAUTION: DO NOT USE NOZZLES THAT PENETRATE INTO THE TANK. THIS WILL DISTURB THE EMITTED RADAR PULSE.

5. Unit should hang straight down into the vessel. See Probe Alignment section for more details about non-standard situations.
6. Tighten the unit to the 1½” NPT coupling using the hex nut at the base of the head.
7. Proceed to Electrical Section for wiring instructions.

INSTALLATION OF MULTIPLE DEVICES

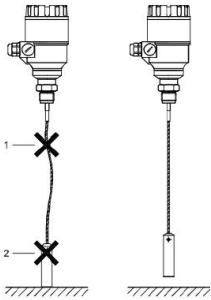
If two devices are being used in the same tank, the units should be mounted at a distance of at least 6.5 ft (2 m) away from each other. If not, interferences from the electromagnetic (EM) fields generated by both instruments may



CABLE PROBE ALIGNMENT

The cable probe should be installed in a manner that allows the cable probe to hang straight. The probe should not make direct contact with the bottom or the side of the tank. The cable probe must be at least 12 in.

(30 cm) away from side walls, wall reinforcements, mixers, etc to avoid kinks or entanglements that will influence the cable probe's electromagnetic field and the material readings.

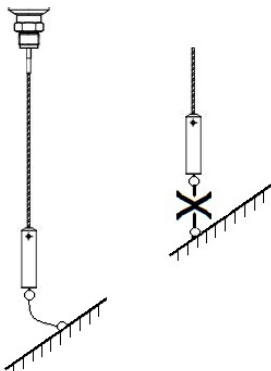


CABLE PROBE TETHERING

The cable probe should be installed so that the counterweight can be tethered to the cone of the tank; a pigtail can also be used. When tethering the cable probe it should be attached to the tank in such a manner as to allow the cable probe to move as the material level changes. Tethering of the cable probe is done to provide an electrical path for discharge of static build-up. The cable probe should not be anchored in a fashion that adds any additional load to the top of the tank.



WARNING: TETHERING OF THE CABLE PROBE IS REQUIRED TO PREVENT STATIC DISCHARGE AND ELECTRICAL SHOCK.



VII. ELECTRICAL INSTALLATION



WARNING: REMOVE POWER FROM THE UNIT BEFORE INSTALLING, REMOVING, OR MAKING ADJUSTMENTS.

GENERAL SAFETY

When using electrical equipment, you should always follow basic safety precautions, including the following:

- The installation and wiring of this product must comply with all national, federal, state, municipal, and local codes that apply.
- Properly ground the enclosure to an adequate earth ground.
- Do not modify any factory wiring. Connections should only be made to the terminals described in this section.
- All connections to the unit must use conductors with an insulation rating of 300 V minimum, rated for 105 C, a minimum flammability rating of VW-1, and be of appropriate gauge for the voltage and current required (see specifications).
- Do not allow moisture to enter the electronics enclosure. Conduit should slope downward from the unit housing. Install drip loops and seal conduit with silicone rubber product.

DISCONNECT REQUIREMENTS FOR PERMANENTLY INSTALLED EQUIPMENT

A dedicated disconnecting device (circuit breaker) must be provided for the proper installation of the unit. If independent circuits are used for power input and main relay outputs, if applicable, individual disconnects are required. Disconnects must meet the following requirements:

- Located in close proximity to the device
- Easily accessible to the operator
- Appropriately marked as the disconnect for the device and associated circuit
- Sized appropriately to the requirements of the protected circuit (See specifications)

CONDUIT CABLE CONNECTION

- Two (2) M20 x 1.5 and two (2) 1/2" NPT female conduit openings are provided in the housing for input and output wiring. When only one conduit opening is used for installation, the unused opens must be sealed with a suitable type of plug.

POWER SUPPLY REQUIREMENTS

- 12 to 36 VDC

WIRING TDR TO POWER SUPPLY

1. Turn off all power to unit.
2. Detach the cover of the unit.
3. Guide the cable into the housing through the cable gland
4. Remove a 0.16 in (4 mm) length of insulation from the wires and cut away the free part of the shielding.
5. Connect the wires of the current loop to terminals 2 and 3 (any polarity). See Figure 1.
6. Pull back the cable until 0.39 in (10 mm) of length remains in the housing behind the cable gland.
7. Tighten the cable gland using a wrench.
8. Check the connection of wires and the tightness of the cable gland.
9. Properly ground the unit. Screw type terminal on the housing, maximum cable cross-section: 0.006 in² (4 mm²). Grounding resistance $R < 1$ ohm. The shielding of the signal cable should be grounded at the control room. Avoid coupling of electromagnetic noises and place the signal cable away from power-current cables.



WARNING: UNIT HOUSING MUST BE GROUNDED FOR PROPER FUNCTION.

10. Return power to the unit.
11. If unit has been programmed by the company, it is now ready to begin taking readings. If unit needs to be reprogrammed for the vessel, proceed to the Set Up Section.

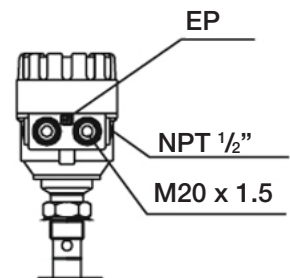


Figure 1: Basic 24 V Wiring – TDR to Power Supply

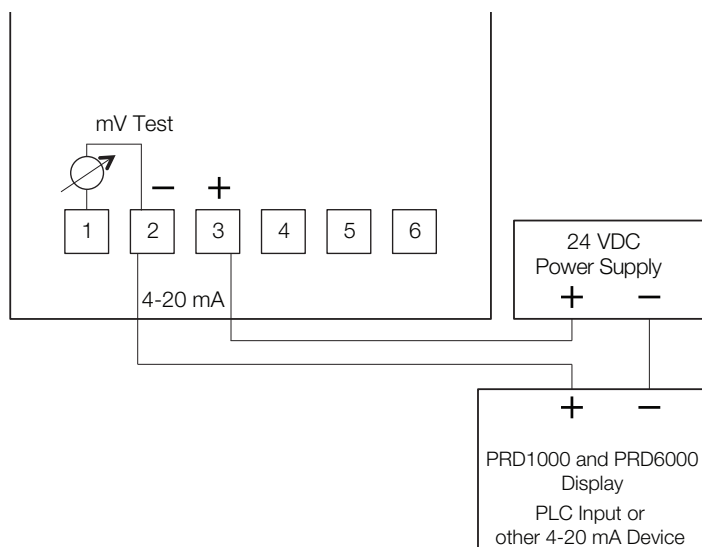
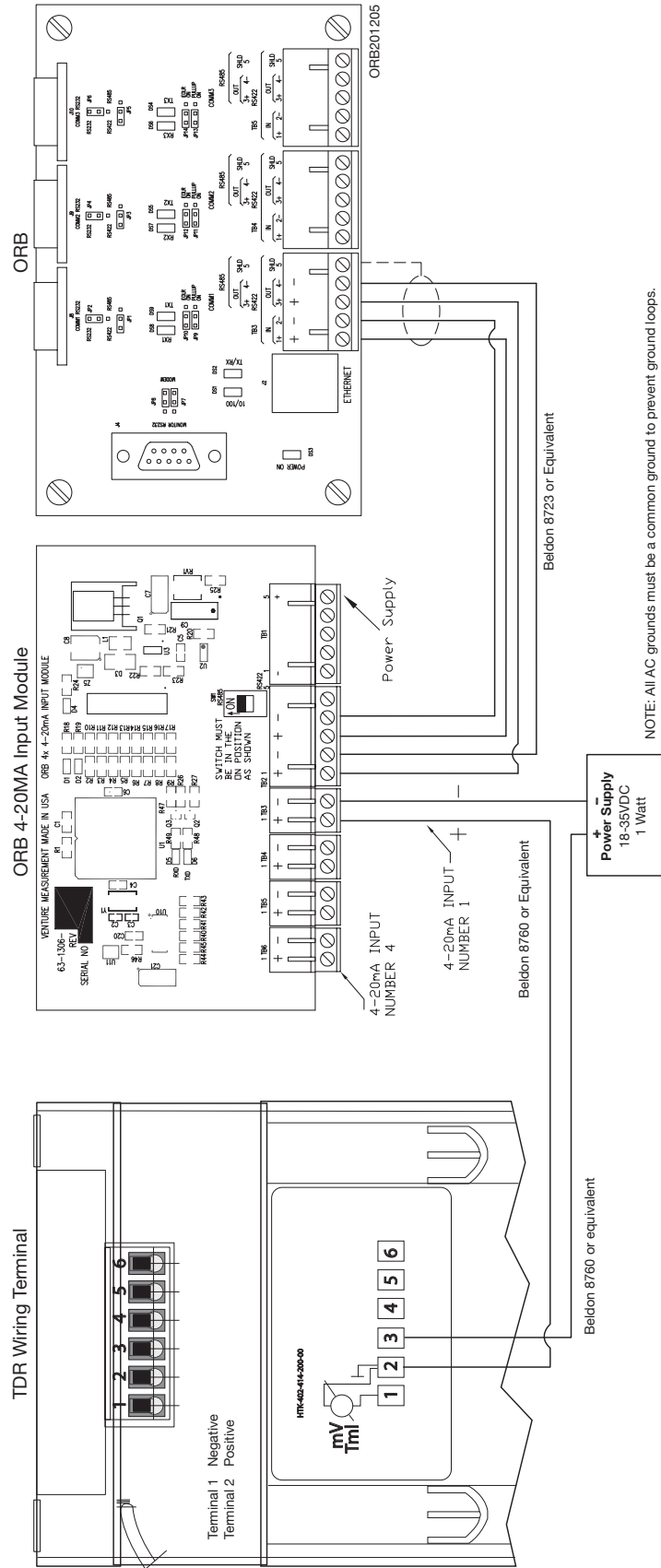
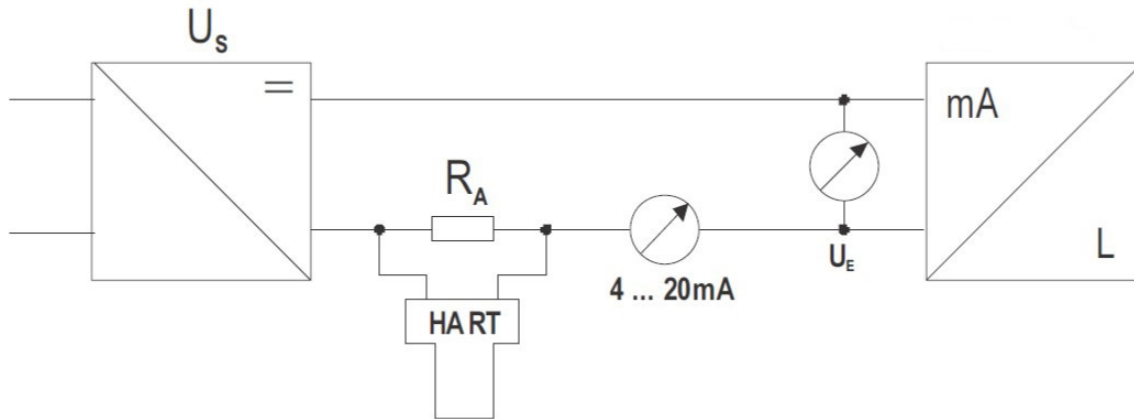


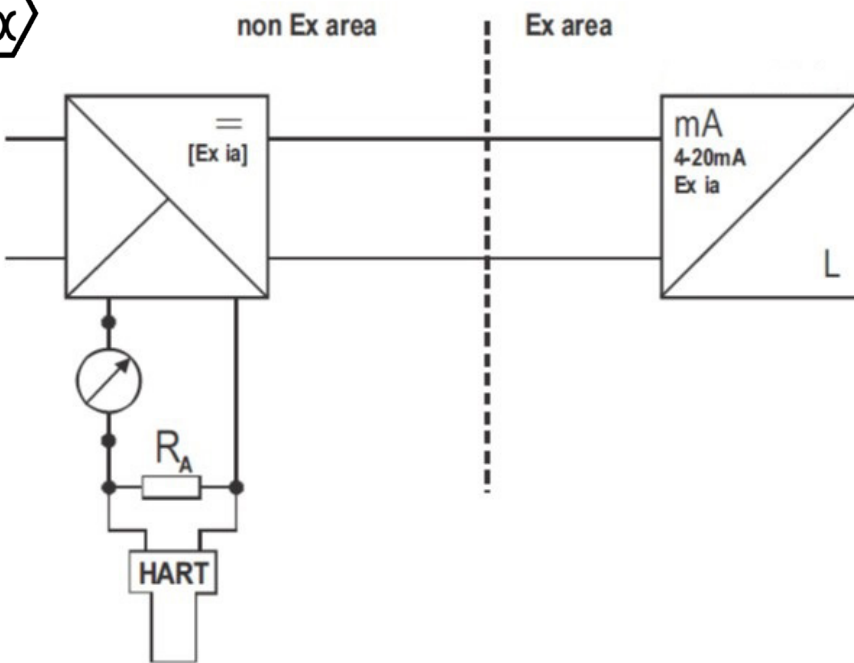
Figure 2: TDR to ORB Wiring Diagram



Non-Hazardous Duty Version



Hazardous Duty Version



VIII. SET- UP

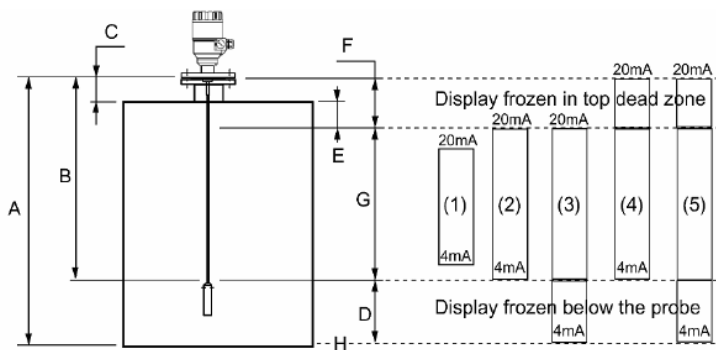
PROGRAMMING

Units shipping directly from the factory have been programmed according to the customer requirements on the Application Data Sheet (ADS). If no changes to the tank have occurred, unit will be ready for use after installation and no additional programming is required.

Changes to the unit, such as adjusting the 4-20mA range may require changes to set-up

VALUES FOR SETTING UP THE UNIT

Figure 3. Measurement Set-up Guide



- A = Tank Height
- B = Probe Length
- C = Detection Delay
- D = Non-Measurable Zone
- E = Minimum distance between non-measurable zone and dead zone
- F = Upper Dead Zone
- G = Measuring Range
- H = Reference Point at Tank Bottom

1	The "current output" range is smaller than the maximum possible measuring range	
2	The "current output" range is equal to the measuring range	Scale Min: 4 mA = Tank Height (A) – Probe Length (B) + Reference Point (H) Scale Max: 20 mA = Tank Height (A) – Dead Zone (F)
3	The "current output" range is greater than the measuring range	Scale Min: 4 mA = 0.0 Scale Max: 20 mA = Tank Height (A) – Dead Zone (F)
4	The "current output" range is greater than the measuring range	Scale Min: 4 mA = Tank Height (A) – Probe Length (B) + Reference Point (H) Scale Max: 20 mA = Tank Height (A)
5	The "current output" range is greater than the measuring range	Scale Min: 4 mA = 0.0 Scale Max: 20 mA = Tank Height (A)

PROGRAMMING WITH THE DISPLAY

PROGRAMMING WITH THE DISPLAY UNIT

The most important parameters can be set with the display unit.

By default, the display shows the primary measurement result (from which the output current is calculated).

In addition to the measured value displayed in large numbers, a bar graph representing the value of the output current is also shown on the right.

Programming is done using a text menu. You can use the E / / / buttons to navigate the menu.

Display Unit

Display

64 × 128 dot matrix LCD, signs, units and bar graph

Ambient temperature

–20...+65 °C (–4...+149 °F)

Housing material

PBT fiberglass, plastic (DuPont®)

Warning!

Display uses an LCD, do not expose to prolonged exposure to strong heat or sunlight as the display may be damaged.

If the display cannot be protected against solar radiation or it is used outside the operating temperature range remove the display during operation.

If you do not exit the menu, the device will automatically return to the measurement display state after 30 minutes. In this case, any changes made in the menu will be ignored.

If the display is removed, the TDR3000 will automatically exit the menu and ignore any changes made in the menu.

The Behavior of the TDR while Programmed Manually

By default, the TDR displays the main measurement data on the display (hereafter referred to as display).

Enter the programming menu by pressing the E button. Use the / buttons to navigate through the menu items.

Enter the selected menu item with the E button. Return to the previous menu level with the key.

The buttons only work if the display is present!

The device continues measuring while the menu is accessed. Changes made in the menu take effect when you exit the menu.

If you do not exit the TDR menu, the device will automatically return to the measurement display state after 30 minutes. In this case, any changes made in the menu will be ignored.

If the display is pulled out of the TDR, the TDR will automatically exit the menu and ignore any changes made in the menu.

Manual Programming

Press the E button to modify the parameter under the cursor in the submenu.

There are two modes:

Text list: Navigated is same as in the menu. The E button executes the selection, and the button cancels it.

Editable number field: Serves to edit numeric values. Editing is aided by an (inverted) cursor. The number under the cursor can be changed with the / buttons (no overflow). The cursor can be moved left with the arrow (max. 9 character-positions, including the decimal point). When the end of the field is reached, the cursor returns to the first position on the right. Editing is concluded by pressing the E button. In this case, display will check the entered value and if it is not correct, "WRONG VALUE!" is displayed in the bottom row.

WARNING: All TDR-3000s are built to the specifications provided by the user. Any modifications made without Anderson-Negele may result in a voided warranty.

PROGRAMMING

– Programming with the display unit

Name (number), function	Adjustable value range	Description
	Default value	
Zero-level distance (P04), Set container height	0...60 m (0...200 ft)	It provides the basis for level measurement calculations. The distance between the plane of the lower sealing surface of the mechanical connector (the lower plane of the flange in the case of a flanged version) and the reference point at the bottom of the tank. Its value must be set in a distance unit (Unit - P00b). Note: If measured distance is between this distance and dead zone, then this distance will be held. MAIN MENU / CALCULATION / ZERO-LEVEL DISTANCE
	As per order	
Minimum measuring distance (P05), Signal echoes found within the dead zone are not processed. Warning! Critical parameter!	Minimum measuring distance... probe length (P03)	The dead zone is the distance between the plane of the lower sealing surface of the mechanical connection (the lower plane of the flange in the case of the flanged version) and the highest level in the tank. Signals generated within the dead zone are not processed. The current loop output does not follow the dead zone level signal. Its value must be set in distance units (Length unit – P00b). Note: If the measurement exceeds this distance then this distance will be held. MAIN MENU / MEASUREMENT CONFIG / MIN. MEAS. DIST.
	“Minimum measuring distance” according to the Probe data table	
Tank full limit (P29)	Limits are 0 to Probe length (P03).	Echoes between this and P05 are processed. However if the measurement distance is in this range then the “Tank full limit distance” is returned or used up for calculations.
	Factory value minimum measurement distance according to the probe type.	

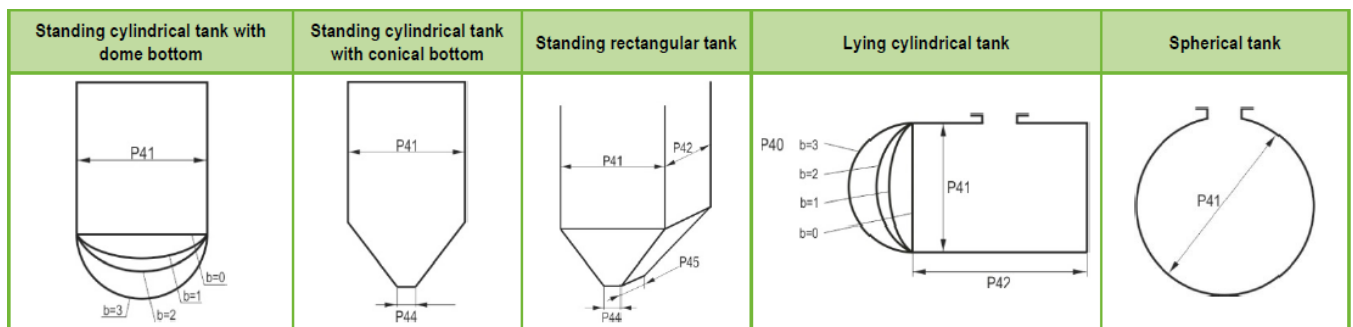
Name (number), function	Adjustable value range	Description
	Default value	
Maximum measurement range limit (P06), Remote blocking	0 (limiter off) or the minimum measuring distance. The distance between (P05) +5 cm and the probe length (P03)	The maximum value of the measuring range of the device can be limited with this parameter. Signals received beyond the set distance will not be processed. Its value is calculated from the plane of the lower sealing surface of the mechanical connector (in the case of a flanged version, from the lower plane of the flange). Remote blocking can be turned off by setting the parameter to 0. In this case, the device will give a valid result along the entire length of the sensor. MAIN MENU / MEASUREMENT CONFIG / MAX. MEAS. DIST.
	0 (off)	
Damping time (P20) Time constant	0...999 sec	The "Damping time" is used to reduce undesired fluctuations (e.g.: rippling) in the display of the measured data. If the level changes abruptly, the new value will be set to within 1% accuracy (exponential setting). Unit of measure: seconds. MAIN MENU / MEAS. OPTIMIZATION / DAMPING TIME
	10 sec	
Probe length (P03)	0.1...30 m (0.33...100 ft)	When the current output is set to "Fixed" mode (P12b = 1), the constant current set here is set. The PV current transmission does not work, and at the same time, it overrides any current output fault indication. MAIN MENU / OUTPUT SETUP / ANALOG OUTPUT / MANUAL VALUE
	This distance plus an additional 0.66 ft (0.2 m). It is the hard limit of the measurement. (Excess is used up for probe end detection and pollution of the probe.)	
Fixed output current (P08), Setting constant output current	3.8...22 mA	When the current output is set to "Fixed" mode (P12b = 1), the constant current set here is set. The PV current transmission does not work, and at the same time, it overrides any current output fault indication. MAIN MENU / OUTPUT SETUP / ANALOG OUTPUT / MANUAL VALUE
	4	
System of measurement units, units of measurement:		Path of parameters: "Settings" / Application" tab

Name (number), function	Adjustable value range	Description
	Default value	
Unit system (P00c), Unit system settings	Selectable values: – Metric (EU), European unit system – Imperial (US), US unit system	The units that can actually be used (length, volume, weight) change according to the unit system set according to this parameter. When setting or changing units, the unit system must be selected first and only then can the actual unit to be used be set (according to the previously narrowed list). MAIN MENU / BASIC SETUP / UNITS / ENGINEERING SYSTEM
	Metric (EU)	
Distance unit (P00b), Length unit	Selectable values Metric (EU): – m – cm – mm – custom unit Imperial (US): – inch	The unit of measurement for the transmitter when the distance and level are set. If “custom unit” is selected, the unit uses the unit of length as the distance unit based on the value specified in “User Unit.” MAIN MENU / BASIC SETUP / UNITS / ENGINEERING UNITS / DISTANCE UNITS
	m	
Output unit, volume (P02b) Volume unit	Selectable values Metric (EU): – liter – hl – m3 – million liters Imperial (US): – gallon – ft3 – barrel – million gallons	The unit of the transmitted number when set to volume measurement. The device converts the measured level into volume by calculation. It is done by using a level-dependent (non-linear) function. It also gives the unit of measure for the “Output” column in the VM table (OC). MAIN MENU / BASIC SETUP / UNITS / ENGINEERING UNITS / VOLUME UNITS IT IS ONLY DISPLAYED IF THE PV IS VOLUME!
	liter	
Output unit, Weight (P02a) Weight unit	Selectable values Metric (EU): – kg – ton – US ton Imperial (US): – lb – US ton – metric ton	The unit of the transmitter number if the device is set for weight measurement. The device converts the measured level into weight. It is done by using a level-dependent (non-linear) function. It also gives the unit of measure for the “Output” column in the VM table (OC). MAIN MENU / BASIC SETUP / UNITS / ENGINEERING UNITS / MASS UNITS IT IS ONLY DISPLAYED IF THE PV IS WEIGHT!
	kg	

Name (number), function	Adjustable value range	Description
	Default value	
Operating mode (P00a), Measured medium property	Selectable values: – Liquid – Granular solid – Two interfacing liquids	The basic characteristic of the measured medium is set here. The measuring capabilities of the device vary significantly depending on this characteristic of the medium (see specification).
	Liquid Medium	MAIN MENU / BASIC SETUP / APPLICATION
Unit system (P00d), Temperature unit	Selectable values: – °C – °F	The unit of temperature measurement is selected here.
	°C	MAIN MENU / BASIC SETUP / UNITS / ENGINEERING UNITS / TEMPERATURE UNITS
Output function (P01ab), Application mode	Selectable values Metric (EU): – Distance – Level – Volume – Mass – Ullage volume	Set the physical quantity for the transmitted meter. The device measures distance. The other quantities are calculated based on the specified tank parameters and material characteristics.
	LEVEL	MAIN MENU / MEASUREMENT CONFIG / PV. MODE
Current output, current output signal settings:		Selects the current loop output mode when transmitting current. In “Auto” mode, the output current changes proportionally to the PV (4... 20 mA). In the case of “Manual,” the constant current set in the parameter P08 is forced to the current output mainly for testing purposes.
		MAIN MENU / OUTPUT SETUP / ANALOG OUTPUT / CURRENT MODE
Echo Selection(P25)	Selectable values: – Highest amplitude – First – Second – Last	In problematic cases, it is possible to choose between the echoes created during the measurement in order to ensure a stable measurement and transmission.
	Highest amplitude	SAP-300: no adjustment available
Filling speed (P26)	0.1...900 m/h (0.33...2950 ft/h)	The maximum rate of rise in the tank during filling. Entering it correctly increases the reliability of the measurement during charging.
	200 m/h (656 ft)	SAP-300: no adjustment available

Name (number), function	Adjustable value range	Description
	Default value	
Emptying speed (P27)	0.1...900 m/h (0.33...2950 ft/h)	The maximum rate of dropping in the tank during emptying. Entering it correctly makes the measurement more reliable during emptying. SAP-300: no adjustment available
	200 m/h (656 ft)	
Current loop output (P12a), Value of output current if there is an error (error current)	Selectable values: – Hold – 3.8 mA – 22 mA	This parameter determines the state that the current loop output draws in the event of a fault. For “Hold,” it keeps the last measured value (4...20 mA), for “3.8 mA” and “22 mA” it keeps the indicated value until the fault is present. Display: MAIN MENU / OUTPUT SETUP / ANALOG OUTPUT / ERROR MODE
	Hold	
Value assigned to 4 mA (P10)	Selectable values: In accordance with the PV adjustment range, usually minimum value	PV value assigned to 4 mA in current transmission mode (usually the lower limit of the measuring range for level measurement). Display: MAIN MENU / OUTPUT SETUP / ANALOG OUTPUT / 4mA VALUE
	0.000 m (0.000 ft)	
Value assigned to 20 mA (P11)	Selectable values: In accordance with the PV adjustment range, usually maximum value	PV value assigned to 20 mA in current transmission mode (usually the upper limit of the measuring range for level measurement). Display: MAIN MENU / OUTPUT SETUP / ANALOG OUTPUT / 22mA VALUE
HART® short address (P19), Device address	0...15	Unique device address based on which the device can be identified and managed via the HART® BUS. • 0: analog output active (current loop transmission active, 4...20 mA) • 1...15: analog output inactive (no current loop transmission, constant 4 mA), Multidrop Display: MAIN MENU / OUTPUT SETUP / SERIAL OUTPUT / ADDRESS
	0	

Name (number), function	Adjustable value range	Description
	Default value	
Tank type (P40a), Tank shapes for volume measurement	Selectable values: – Output Conversion table (OCT) – Standing cylindrical tank with dome bottom – Standing cylindrical tank with conical bottom – Standing rectangular tank with or without chute – Lying cylindrical tank – Spherical tank	Selecting a typical basic container shape for volume measurement. The tank dimensions can be set using parameters P41... P45 (see figures below). If OCT is set, the tank shape must be specified in tabular form. Display: MAIN MENU / CALCULATION / TANK SHAPE
	Standing cylindrical tank with dome bottom	IT IS ONLY DISPLAYED IF THE PV IS VOLUME
Tank type (P40a), Tank shapes for volume measurement	Selectable values: – Output Conversion table (OCT) – Standing cylindrical tank with dome bottom – Standing cylindrical tank with conical bottom – Standing rectangular tank with or without chute – Lying cylindrical tank – Spherical tank	Selecting a typical basic container shape for volume measurement. The tank dimensions can be set using parameters P41... P45 (see figures below). If OCT is set, the tank shape must be specified in tabular form. SAP-300: MAIN MENU / CALCULATION / TANK SHAPE
	Standing cylindrical tank with dome bottom	IT IS ONLY DISPLAYED IF THE PV IS VOLUME!
Tank type (P40b), Tank properties for volume measurement, tank bottom shape	Selectable values: – 0 (flat) – 1 – 2 – 3	
	0 (flat)	



Name (number), function	Adjustable value range	Description
	Default value	
Tank dimensions (P41...P45), for volume measurement	0...999 999	Typical dimensions in units of length for the tank type set in parameter P40 for volume calculation. SAP-300: no adjustment available
	0	
Specific gravity (P32), for weight measurement	0.01...100	If the device is set to weight measurement, the specific gravity of the material (medium) stored in the tank must be entered here for weight calculation. The value to be set is the ratio (without unit) to the density of the water. SAP-300: no adjustment available
Threshold offset (P34), interference sensitivity setting	-4095...+4095	Modifies the acceptance threshold set on the echo chart. It can be used it to increase (positive value) or decrease (negative value) the device's ability to suppress the interference signal relative to the default setting. When set to 0, there is no change from the original setting. SAP-300: MAIN MENU / MEAS. OPTIMIZATION / THRESHOLD OFFSET
	0	
Gross tank volume (P47)	0...999 999	Adjusts the transmitted quantity by distance. If the value measured by the device differs from the value under real conditions, this multiplier can be used to adjust the result. The output value is multiplied by the number set here. The default multiplier is 1, which does not change the output. SAP-300: no adjustment available
	0	

IX. MAINTENANCE

The TDR-3000 does not require maintenance on a regular basis. In some very rare instances, however, the probe may need a cleaning from deposited material. This must be carried out gently, without damaging the probe. Repairs during or after the warranty period are carried out exclusively at the manufacturing facility. The equipment sent back for repairs should be cleaned or neutralized (disinfected) by the user.

X. TROUBLESHOOTING

Problem	Fault	Solution
GENERAL OPERATION		
"Delay out of limits" status marker on, reading is frozen	The emitted pulse has not been detected. The gauge will not work until it has been found.	The signal converter may need replacing. Please contact Bindicator.
"Negative voltage error"	Occurs when there is a problem with the time base on the HF board.	Contact Bindicator for the corrective procedure
"VC01 voltage error"		
"VC02 voltage error"		
"Reprogramming FPGA"		
Instrument is not accurate with a product that has a high dielectric constant. A constant offset is observed when taking measurements.	Tank height is not correct	Check current output and tank height parameters. If the signal converter has been replaced, verify that factory calibration parameters are still the same. Ask for the Bindicator factory calibration sheet (if not supplied) and the password for access to the factory menu.
The TDR-3000 2-wire indicates an incorrect level value	The TDR-3000 measures a non-valid reflection	Check the tank for obstructions and verify that the probe is clean. In the case the indicated level is close to the nozzle, increase the detection delay and the dead zone with the same ratio or increase the threshold level if the full measurement range is essential. The threshold level must be adjusted so that it masks the disturbances; it also gives enough margin for detection of the level pulse. Very large pulses along the measurement signal (same amplitude as the initial pulse) can be caused by a probe which is touching the nozzle or the tank side. Ensure that no contact is possible.
Instrument is not accurate when there are two or more phases in the tank.	The instrument may be incorrectly configured for this type of application; it is measuring the interface instead of the level	Contact Bindicator for the corrective procedure. May also check that there is a layer of more than 4 in (100 mm) of top product above the bottom product.

Problem	Fault	Solution
ERROR MESSAGES		
"Tank full" status marker on, reading frozen at max or min value	No fault. The level has reached (and possibly risen above) the top configured measurement limit and is either displaying the maximum (when measuring level) or minimum (when measuring distance) output.	None. Measurements should be normal once the level is in the configured measurement range.
"Tank empty" status marker on, reading frozen at max or min value	No fault. The level has entered the gauge's bottom dead zone and can no longer detect a return signal. Either the maximum (when measuring distance) or minimum (when measuring level) output is displayed.	None. Measurements should be normal once the level is in the configured measurement range.
"Tank full" and "Level lost" status marker on, reading frozen at max or min value	No fault. The level has entered the gauge's top dead zone and can no longer detect a return signal.	Empty the tank below the top measurement range limit and check the measurement.
"Level lost" status marker on, reading is frozen	The instrument has lost the level signal, has searched but not yet found the return pulse. This may occur if the pulse has dropped below the threshold. Parasite signals from the flange or obstructions in the tank may render the gauge unable to identify the correct signal.	Ensure that tank is emptied below maximum level and check the measurement. If the signal is not detected then modify the control threshold manually.
"Reference not found" status marker on	Occurs when there is a problem with the time base on the HF board.	Contact Bindicator for corrective procedure.
"Level lost" and "Reference not found" status markers on, reading frozen	The probe has received an electrostatic discharge.	The gauge will search for the level again and resume readings. If reading remains frozen then signal converter may have been damaged by ESD and may need replacing. Please contact Bindicator.
ELECTRICAL CONNECTIONS AND COMMUNICATION OUTPUT		
Current Output value < 4 mA	No power supply.	Check the power supply.
	Connection of the device is incorrect.	Check the connection between the device and the power supply.
	The calibration of the current output is incorrect.	Execute the calibration if you have authorized access or contact Bindicator Customer Support.
Reads 22 mA	An error has occurred.	This happens in case the range 4-20 mA/ error 22 mA is selected. Check the status of the device by selecting the marker window.
	The device is in its start-up phase.	Wait 50 seconds. If the current value drops to a value between 4 and 20 mA and goes immediately back to 22 mA, contact Bindicator
The value at the current output does not correspond to the value at the display	The current output settings are incorrect.	Check the current loop and the connections.
Data communication via the digital interface is not working. The TDR-3000 is in its start-up phase, wait 50 seconds and try again	The communication parameters of the computer are set incorrectly.	Check computer setting (address/device number).
	Bad connection to the interface.	Check connection.
	Current output value is < 4 mA.	If problem persists then contact Bindicator.
	Current output value is = 22 mA.	



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