AMETEK®
DREXELBROOK

Installation and Operating Instructions

Series DR1200 (TDR)
Guided Micropulse Level Instrument
for
Two-Wire Control Systems

The DR1200 level gauge is designed solely for measuring the distance, level, volume and reflection of liquids, solids and particulate materials. The DR1200 level gauge does not form part of an overfill protection system. Special codes and regulations apply to its use in hazardous areas. Responsibility as to suitability and intended use of these level gauges rests solely with the user. Improper installation and operation of our level gauges may lead to loss of warranty.

Series DR1200 (TDR)
Guided Micropulse Level Instrument
for
Two-Wire Control Systems

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**SECTION 1
INTRODUCTION**

**1.1   Product
          Description**

The DR1200 two-wire TDR system is designed to measure the distance, level, volume and reflection of liquids, slurries, solids and particulate materials. It can be operated on storage, process tanks and also on still wells.

The DR1200 measuring system consists of
• the sensor system,
• and the signal converter.

The DR1200 flange system contains
• the probe support,
• and the process connection.

The compact signal converter contains
• the Time Domain Reflectometry (TDR) measuring circuit
• and the signal processing system, including the output signal (4-20 mA HART® interface).

The signal converter can be separated from the sensor system under process conditions, without loss of pressure or escape of product.
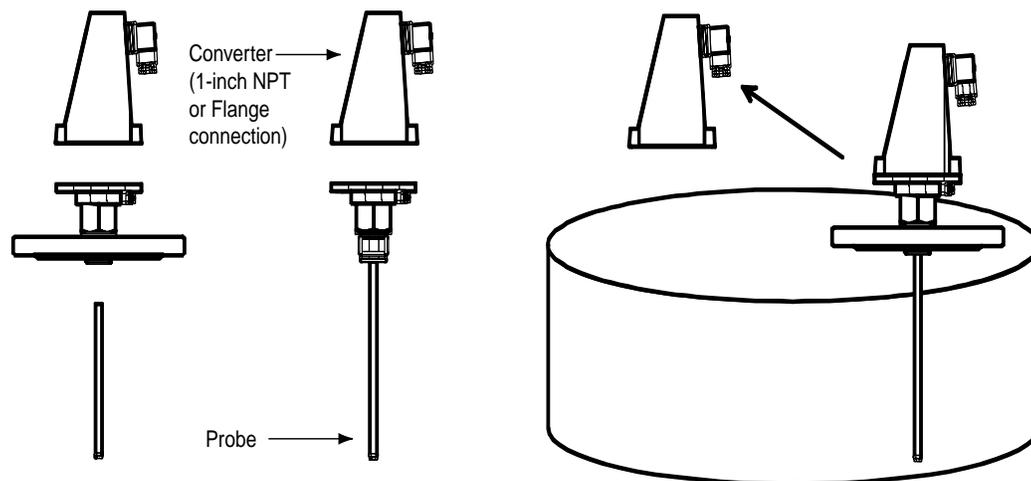
*Figure 1-1
DR1200 TDR System*

1.2   Model Number

Instrument

DR1200

Internal code
4

Probe Construction

1	Single Rod	maximum length	10'
2	Single Cable	maximum length	80' (4mm OD)
3	Coaxial	maximum length	20'
4	Twin Cable	maximum length	80'
6	Single Cable	maximum length	80' (8mm OD)

Material

1	316 SS (standard for Cable probe)
2	316L SS (standard for Rod probe)

Connection (ANSI)

2	1" NPT	**C**	3" 150#
3	1 1/2" NPT	**D**	4" 150#
A	2" 150#	**E**	6" 150#
B	2 1/2" 150#		

Length

0	0'	**5**	17'	**B**	33'	**G**	50'	**N**	66'
1	3'	**6**	20'	**C**	36'	**H**	53'	**P**	69'
2	7'	**7**	23'	**D**	40'	**K**	56'	**R**	73'
3	10'	**8**	26'	**E**	43'	**L**	59'	**S**	76'
4	13'	**A**	30'	**F**	46'	**M**	63'	**T**	80'

Incremental Length

0	0"	**5**	20"
1	4"	**6**	24"
2	8"	**7**	28"
3	12"	**8**	32"
4	16"	**A**	35"

Pressure Rating

2	232 psi (standard)
3	580 psi

Sealing

1	Viton
2	Kalrez

Counter Weight

0	Without	**3**	D 2" x L 10" (8 mm cable/solids)
1	D 1" x L 4" (standard)	**5**	Turnbuckle
2	D 2" x L 2" (Twin Cable)	**6**	Tie-down (clamps included)

Cable connection

1	DIN Connector (snap-on plastic cable gland)
2	M 16 (includes junction box)
3	1/2" NPT (includes junction box)

Application

1	Liquids
2	Solids

Approvals

0	Without	**2**	FM
1	Cenelec/Atex	**3**	CSA

Precision

1	15 mm (standard)
2	5 mm

Flange Temperature

1	194ºF (90ºC) standard
2	275ºF (135ºC)

Indicator

0	Without

DR1200	4											0	

1.3   Probe selection guide

Coax	Twin Cables	Single Cable or Rod
Recommended Applications		
Only for clean, non-viscous liquids.	For high silo or tank with liquid or granules.	For all fine powder applications.
1. Connection size is less than three inches. 2. Liquid movements, acting like stillwell. 3. Liquid or vapors spray near the probe. 4. Flow inside vessel like oil/water separators. 5. Can be heat tracing. 6. Contact with metallic part or tank wall. 7. High magnetic field around. 8. CE approval in plastic tanks. 9. Very low dielectric liquids. 10. Foam applications.	1. Same as rod, but over 20 and up to 80 feet. 2. For smaller tanks with no clearance for rigid probe. 3. For side installation with bent type DR1200 (maximum 20 feet on liquid).	1. For all fine powder applications greater than 20 feet. 2. For all very viscous liquids like liquid sugar. 3. To build a coax version with an existing stillwell (calibration required). 4. Very corrosive liquids with FEP coating. 5. Crystallizing acids with FEP coating.
Non-Recommended Applications		
1. Crystallizing liquids. 2. Severe coating. 3. Powders.	1. Small connection flange with nozzle. 2. Agitated tank without anchoring.	1. Long and small diameter nozzle installation (minimum recommended flange four inches or see item 2 below. 2. Maximum nozzle height based on its diameter. The calculation is: $h = \dfrac{(L \times d)}{4 \times a} + 140mm.$ L = Probe length (mm). d = Nozzle diameter (mm). a = Flange eccentricity from tank center (mm).
Application Examples		
1. Tanks less than 20 feet. 2. LPG, LNG, Solvent, NH3, Fuel oil, Foam, Alcohol, Oil/Water separators, displacer, open channel measurement, thread connection installation.	1. Tank farm. 2. LPG, LNG, NH3. spheres, beer, alcohol. 3. For very high temperature applications with single cable construction.	1. Cement, limestone, flyash, alumna, etc... 2. Acids. 3. Liquid sugar, honey, syrups.

SECTION 2 INSTALLATION

2.1   Unpacking

Carefully remove the contents of the shipping carton and check each item against the packing list before destroying any packing material. If there is a shortage or damage, report it to the factory immediately.

When handling the DR1200 TDR instrument avoid hard blows, jolts, impacts,

2.2   Installation Considerations

2.2.1 Measured Variable (distance, level, volume) (Input)

The primary measured variable is the distance between a reference point (e.g. tank mounting flange) and a reflecting surface (e.g.surface of the level).

Volume measurements are possible by entering a conversion table (maximum 20 points).

The strength of the reflected signal can be measured for qualitative assessment of the process material.
(Only available with HART® communication).

2.2.2 Measuring Range (0.5 to 80 feet) (Input)

Minimum tank height is 0.5 feet.
The useful range depends on the sensor type, the reflection properties of the process material, the installation position, and the presence of interfering reflections.

2.2.3 Dead Zone (Input)

The dead zone distance is the minimum measured distance between the mounting flange (reference point) and the surface of the process material.
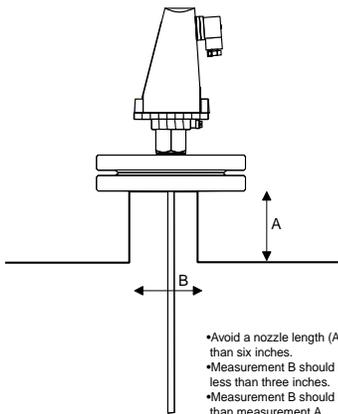
For twin probe:	K>10	12 inches.[1]
For twin probe:	K<10	6 inches.[1]
For single probe:	K<10	16 inches.[1]
For single probe:	K>10	12 inches.[1]
For coax system:	= 0	for all K.[1]

A

B

•Avoid a nozzle length (A) greater than six inches.
•Measurement B should not be less than three inches.
•Measurement B should be greater than measurement A.

[1] These are minimum values. Default value is 16 inches.

2.2.4 Out-of-range Performance
(Input)

When the level measuring range is exceeded (including flooding) the measured value remains at the dead zone.

If the measured value drops below the level range, it remains at the set lower range limit (distance = tank height).

2.2.5 HART® Communication
(Output)

Figure 2-2 shows an overview of the digital communications output for the DR1200 TDR level instrument.
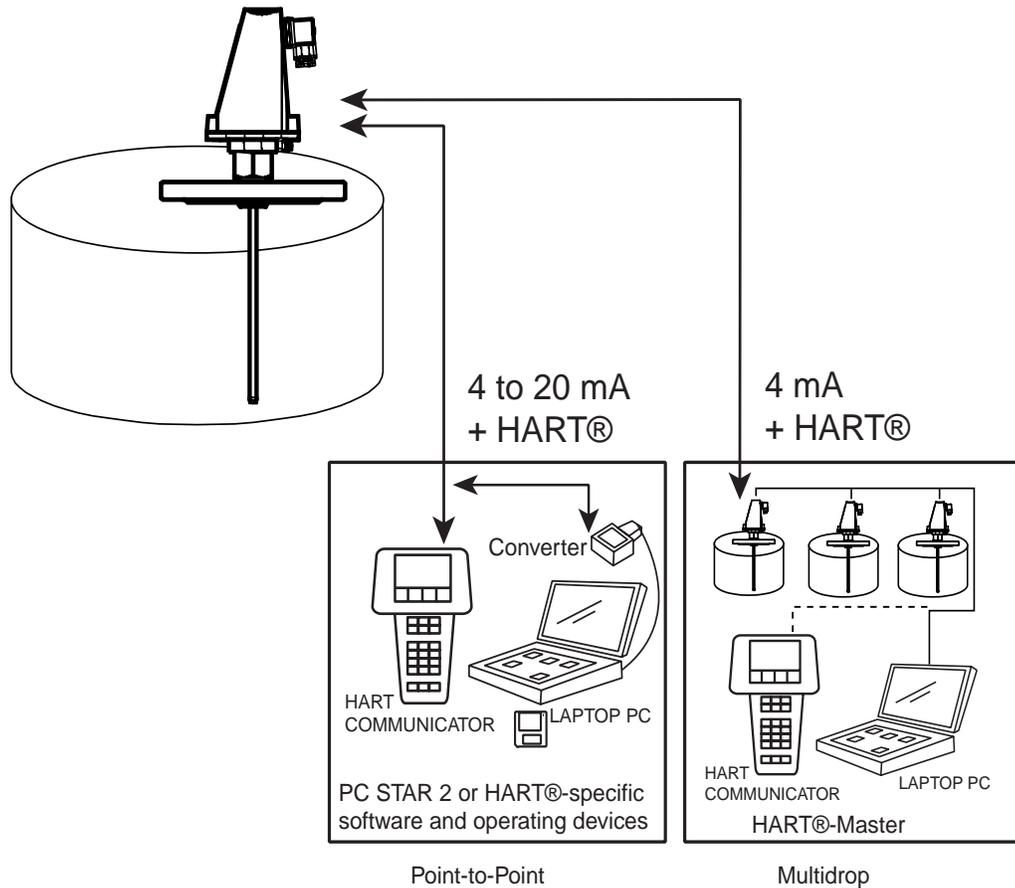
Figure 2-2
DR1200 TDR Instrument
Communications Output Options

There are two ways of using the HART® communications protocol with a DR1200 readar instrument. All versions with HART® protocol can be operated with the PC-STAR 2 PC program.

2.2.5 HART® Communication (cont.)
(Output)

a) As a point-to-point connection between the DR1200 and the HART® Master equipment.
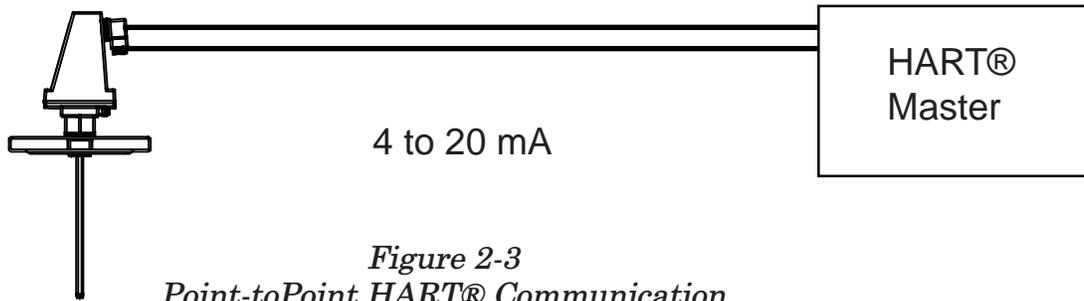
Figure 2-3
Point-toPoint HART® Communication

b) As a multipoint connection (multidrop) with up to 15 devices (DR1200 or other HART® equipment), in parallel on a 2-wire bus:
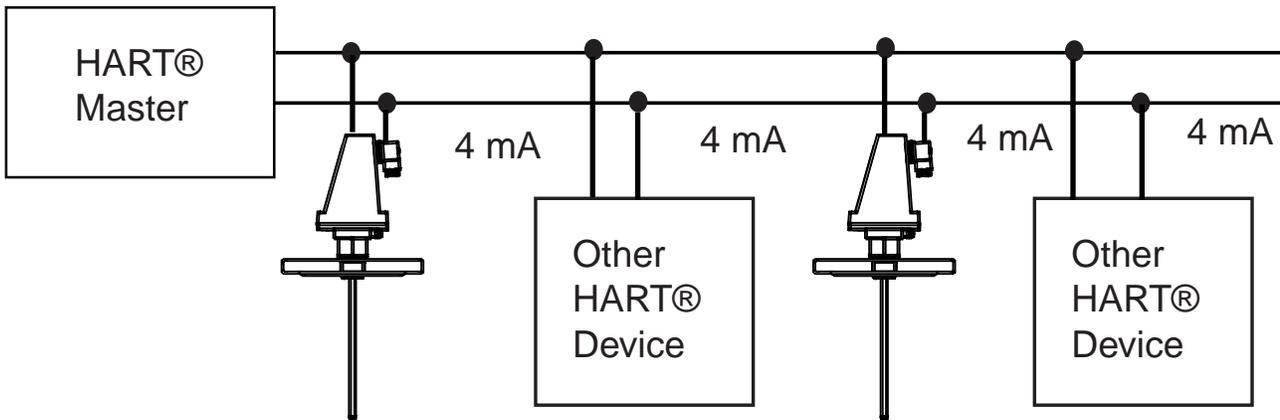
Figure 2-4
Multidrop HART® Communication

2.2.6 Service Diagnostics
(Output)

Service information can be accessed using the following:
·   Current output: error signal 22 mA.
·   Digital interfaces: interrogation of error flags.

2.3   Installation Guidelines

The DR1200 TDR instrument is designed for field mounting:

- It should be mounted in a location as free as possible from vibration, corrosive atmospheres, and any possibility of mechanical damage.
- In case of direct exposure to sunshine, a sunshade is recommended.
- For convenience at start-up, mount the instrument in a reasonably accessible location.
- Mounting: See Figure 2-5.

Twin
Rod/Cable
4 inch
minimum

Coaxial
Cable
0 inch
minimum

12 (304)

Single
Rod/Cable
12 inch
minimum

Avoid bending.

No interference
restrictions.

2.3   Installation Guidelines (cont.)

For best results, mount the DR1200 radar instrument without a nozzle and directly mounted in a 1-inch NPT welding socket.

A

B

•Avoid a nozzle length (A) greater than 6 inches.
•Measurement B should not be less than 3 inches.
•Measurement B should be greater than Measurement A.

When mounting in an agitated vessel or stilling well:
•Fix or center the end of the probe.
•Avoid touching the side vessel wall or stilling well.

2.4   Wiring

2.4.1 Electrical Connection

The electrical connection for supply power is made in the terminal compartment of the signal converter.

CAUTION
When using in a hazardous area, only certified intrinsically-safe equipment may be connected to the DR1200 instrument.

Two versions of the electrical connection are available (see Figures 2-6 & 2-7):

1. **NPT connector: ½-inch (ISO16)**

• Terminals: conductor size: 16 AWG maximum

• High Integrity Ground: U-clamp terminal
(10 AWG maximum) at "neck" of signal converter.

• Cable entries: ½-inch NPT (with standard cable gland: cable clamping area = 8 to 10 mm).

• Signal cable shielding: possible current loop cable shield can be connected to ground.

1.   Remove the four retaining screws and open the terminal compartment.
2.   Connect the current loop to the terminal block. Use ferrules to protect the cable ends. No polarity.
3.   Close the terminal compartment.

Ground is directly connected with the signal connector housing and also with the flange system of the instrument. To avoid ground loops, do not connect a cable shield at both cable ends.
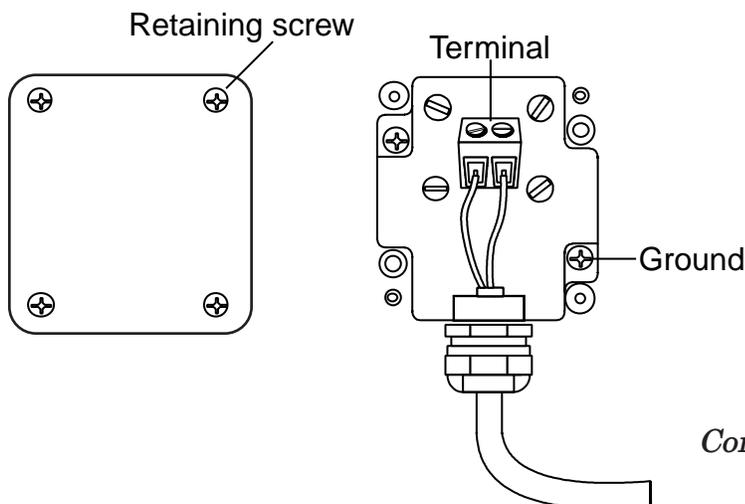
For Ex/XP applications, only the intrinsically safe 2-wire loop must be connected to the terminal 1 and 2. The ground terminal and terminal 3 are not connected.

Figure 2-6
Connector Wiring

2. **DIN Connector** (Snap-on plastic cable gland)

• Terminals: conductor size: 14 AWG maximum
1.5 mm² maximum

• "Ex" equipotential bonding: U-clamp terminal (10 AWG maximum) at "neck" of signal converter.

• Cable entries: 1x M16x1.5 (with standard cable gland: cable clamping area = 4 to 8 mm).

• Signal cable shielding: possible current loop cable shield can be connected to ground.

Power supply:

1. Remove the screw **P** and lift off the connector from the signal converter.

2. Put a screwdriver in **F** and separate **N** from **R**.

3. Connect the current loop to terminals 1 and 2 (there's no polarity to respect). Use ferrules to protect cable ends. Terminal 3 remains non-connected.

4. Re-assemble **N** and **R**.

5. Put the seal in place, connect **R** to the signal converter and screw **P** .

The earth terminal **E** is directly connected with the signal connector housing and also with the flange system of the instrument. In order to avoid earth current loops a possible cable shield must not be connected at both cable ends.

For Ex applications only the intrinsically safe 2-wire loop must be connected to terminals 1 and 2. The earth terminal **E** as well as terminal 3 remains non-connected.
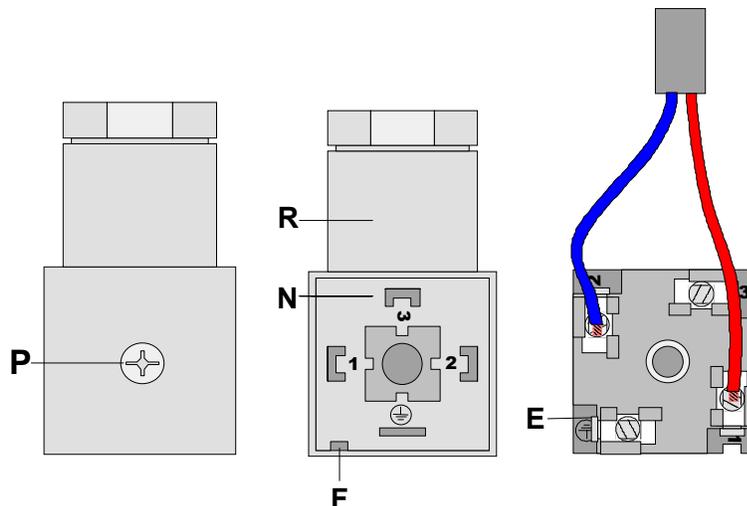
Figure 2-7
DIN Connector Wiring

**SECTION 3
OPERATION**

3.1   Start-up

After the DR1200 TDR instrument has been switched on, the current output is fixed to 22 mA during 13 seconds. The current output is then driven to probe length until the level has been found. Finally, the current output approaches the measured value. Full measuring accuracy is obtained after 46 seconds operating time with default parameters (time constant=10 seconds).

3.2   Calculation of the Measured Value

Refer to Figure 3-1. The DR1200 instrument measures time between reflections and converts it to a distance or a level information with the following formulas:

Delta T: Time between Initial Pulse and Level Pulse (mS).

Calspeeds   (Electronic Calspeed) x (Mechanic Calspeed) (mS/mm).

Offset   Distance between Initial pulse and bottom sur face of the flange (mm).

Epsilon R   Dielectric constant of first medium under the flange, normally 1.00.

$$\text{Distance} = \frac{\dfrac{\text{Delta T}}{\text{Calspeeds}}}{\sqrt{\text{Epsilon R}}} - \text{Offset}$$

$$\text{Level} = \text{Tank Height} - \text{Distance}$$
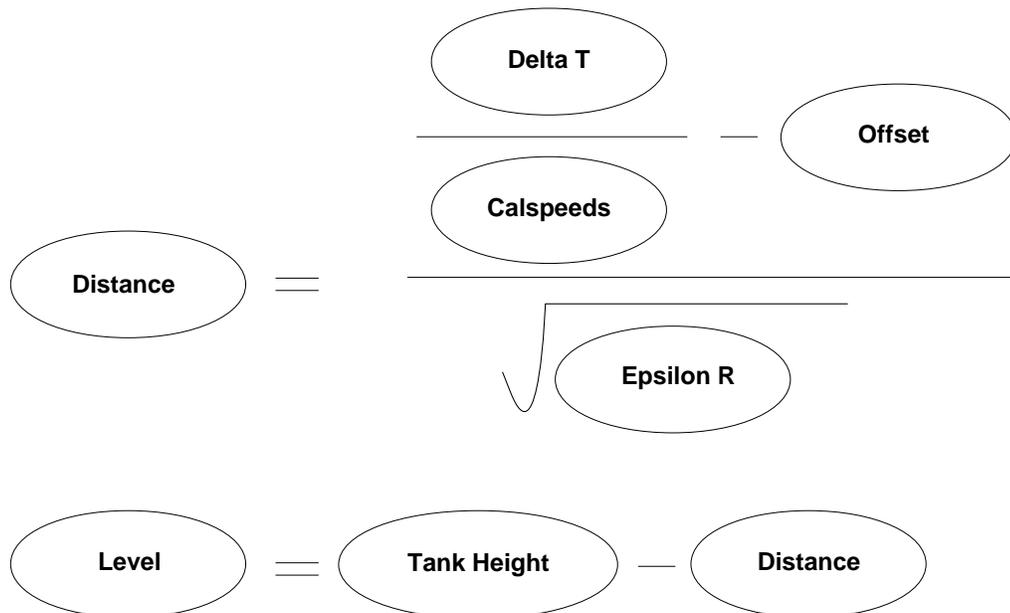
*Figure 3-1
Calculation of the Measured Value*

3.2   Calculation of the Measured Value (cont.)

The measured time between the initial pulse and the level pulse is translated in millimeters by the Calspeed setting. This primary distance is corrected by the offset and then standardized to the reference point (= flange). This primary distance is divided by the Epsilon R square root (if there is only one product in the tank, the Epsilon R is 1.00 [air]). The level is calculated as the difference between tank height and distance. All parameters (excepted Delta T) are accessible via the digital communication menus.

3.3   Warning Messages during Measurement

Status Message	Definition of Message
Configuration Changed	Configuration parameter was changed.
More Status Available	Command 48 must be executed to empty the status. (refer to *Watch Status*).
Primary Variable Analog Output Fixed	•Device is set in Multidrop Mode, (Polling Address ≠ 0). •Fixed Current Mode is entered, (during Loop Test and DAC Trim).
Analog Output Saturated	During normal operation, the maximum value for the analog output is 20mA. The analog output saturation error flag is set in case the measurement exceeds the signal current output range.
First Start	This message appears only when the serial number is 0 or 16777215.
Tank Full	The DR1200 indicates that the level is in the Dead Zone. The tank is full.
Tank Empty	The DR1200 indicates that the level is below the probe end. The DR1200 makes a measure only to the end of the probe--not to the bottom of the tank.
Level Lost	The DR1200 loses the level signal. Message is displayed when there is no signal with an amplitude higher than the threshold value. Measuring values are frozen. If the mode 4-20mA/ error 22mA is selected then the current output is fixed to 22mA after the selected delay time.

3.4 Error Messages during Measurement

The following table lists the error meassages that can trigger the current ouput to be set to 22 mA if the mode 4-20/Error22 is selected. Measuring values are then frozen. Consult Factory Service.

Status Message	Definition of Message
EEPROM Error	Start-up error. Problem with non-volatile memory.
RAM Error	Start-up Error. Problem with internal microcontroller memory.
ROM Error	Start-up Error. Problem with internal microcontoller memory.
Checksum Error Bank Customer 0	Start-up Error. Problem with the EEPROM or with the parameter that recalls the saved EEPROM. Parameters are saved in a non-volatile memory (EEPROM). There are 4 banks, two for each type of parameters (customer or factory). If there is a problem with the first bank (0), then the DR1200 gets the parameters values from the second bank (1). If the DR1200 indicates only a problem with the first bank, then it has succeeded to get all the parameters from the second bank. In this case, the device can measure.
Check sum Error Bank Factory 0	Start-up Error. Problem with the EEPROM or with the parameter that recalls the saved EEPROM. Parameters are saved in a non-volatile memory (EEPROM). There are 4 banks, two for each type of parameters (customer or factory). If there is a problem with the first bank (0), then the DR1200 gets the parameters values from the second bank (1). If the DR1200 indicates only a problem with the first bank, then it has succeeded to get all the parameters from the second bank. In this case, the device can measure.
Check sum Error Bank 1	Start-up Error. Refer to Bank 0. Restart the device several times.
Check sum Error Factory 1	Start-up Error. Refer to Bank 0. Restart the device several times
Digitizing Error	Sampling audio signal error. The electronics is not getting a valid image of the audio signal. The measurement could be incorrect.
Gain Error	Hardware problems with the signal front end amplifier. One of the four amplifications is not working correctly.

3.4   Error Messages during Start-up or Measurement Cont.

Status Message	Definition of Message
Offset Error	Problem with the electronic offset of the signal.
Positive Voltage Error	+3 Volts power supply is out of limit.
Negative Voltage Error	-3 Volts power supply is out of limit.
VCO1 Voltage Error	Problem with the time base.
VCO2 Voltage Error	Problem with the time base.
Delay Out of Limits	Problem with the time base.
Reference Not Found	Problem with the time base.
Flange Not Found	Problem with the time base. Mechanical problem (bad contact) between the converters electronic block and the flange connection.
Update Failure	The DR1200 is not able to measure.

3.5   Symptoms/Faults during Start-up or Measurement

Symptom/Fault	Cause	Corrective Action
Current Output Value < 4mA	Calibration of the current output is incorrect	Executes the calibration with the specialist rights or contact Factory Service.
	Connection of the device is incorrect.	Check the connection between the device and the power supply.
	No power supply.	
Current Output reads 22 mA	An error has occurred.	The range 4-20mA/error 22mA is selected. Check the status by selecting F8 (PC software) or enter the Status menu for the HART® Calibrator.
Current ouput reads 22 mA (cont.)	Device isn't in start-up phase.	Wait 50 seconds. If the current If the current value drops to a value between 4 and 20 mA, and goes immediately back to 22mA, call Factory Service.

3.5   Symptoms/Faults during Start-up or Measurement (cont.)

Symptom/Fault	Cause	Corrective Action
Value at the current output does not correspond to the value at the display.	Settings of the current output are incorrect.	Configure output as described in *Analog Output* parameter.
Data communication via digital interface is not working.	Communication parameters of the computer are set incorrectly.	Check computer setting (polling address).
	Bad connection to the interface. Current output value is < 4mA Current output value is = 22mA	Check connection. Consult Factory Service. Device isn't in start-up phase, wait 50 seconds and try again. If the problem persists, contact Factory Service.
DR1200 indicates an incorrect level value.	DR1200 measures a non-valid signal.	•Increase the Detection Delay and Dead Zone with the same ratio or increase the Threshold level if the full measurement range is essential. •Threshold level must be adjusted so that it masks the disturbances but also to give enough head room for 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 (see *2.3 Installation Guidelines*).
The tank is empty, and the DR1200 indicates a level.	A valid pulse was found.	Check the probe for disturbances such as heating tubes or product build-up (clogging). Adjust the Threshold (dynamic configuration menu).
The tank is full, and the DR1200 indicates a level or empty tank.	Threshold is not adjusted.	Adjust Threshold.
The tank is not empty or not full, and the DR1200 indicates an empty or full tank.	Threshold is not adjusted.	Adjust Threshold.

SECTION 4
COMMUNICATION

4.1   Loop Requirements

- nominal power supply voltage V_{input} : 24 Vdc
- maximum V_{input} :   35 Vdc
- minimum V_{input} :   see graph in Figure 4-1.

Input voltages above 35 Vdc or below the specified voltage may damage the instrument; cause a fault measurement or trigger the instrument to reset.

loop resistance R_{loop}:	$R_{HART®}$ + R_{cable} + R_{meter}
minimum R_{loop}:	0 ohms
maximum $R_{loop:}$	750 ohms
HART® Communication	250 ohms
resistor $R_{HART®:}$	(recommended)

The graph in Figure 4-1 specifies the minimum voltage at the terminals of the DR1200 instrument. The voltage drop over the total loop resistance (Ampere-meter resistance R_{meter} plus wiring resistance R_{cable} plus HART® communication resistance $R_{HART®}$) should be considered for the calculation of the minimum power supply voltage.

The voltage of the power supply has to be at a loop current of at least 20 mA:

$$V_{supply\ min20} = 20\ mA \times 250\ ohms + V_{input\ min20} = 5\ V + 10\ V = 15\ V$$

In order to cover the full current range of 4 to 22 mA the voltage drop at 4 mA has to be verified.

$$V_{supply\ min4} = 4\ mA \times 250\ ohms + V_{input\ min4} = 1\ V + 18\ V = 19\ V$$

With a loop resistance of 250 ohms, a power supply voltage of 19 V is sufficient to supply the 4 to 20 mA range of the instrument.

Safety Barriers

Use the graph in Figure 4-1 to determine which safety barrier can be used with the DR1200 instrument. Most of the barriers are specified to deliver a minimum output voltage at 20 mA loop current $V_{out\ min20}$. The output voltage at 4 mA must also be specified or it can be calculated with the value of the internal series barrier resistance.

Use only converters with HART® barriers. The PCSTAR 2 software or the HART® communication tools will not operate if the converter is not equipped with this option.

NON HAZARDOUS

Nominal 24VDC supply

R_{HART}

250 ohm

PC Star 2 Software (included)

IBM compatible

HART Modem 401-700-21

Optional Intrinsic Safety Barrier

377-4-16 smart
377-4-15 non-smart

OR

HAZARDOUS

R_{Load}

Power/Signal Terminals Not Polarity Sensitive

Entity Parameters:
Vmax = 30V
Imax = 150mA
Pmax = 1W
Ci = 10.5 nF
Li = 10uH

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Loop Resistance: Minimum 0 ohms,
Maximum 750 ohms

Voltage Requirements: Maximum 35 Vdc
Minumum - see chart

Calculate required voltage:
Minimum Voltage @ 20mA:
0.02A X Loop resistance + 10V = Voltage required at 20mA
(Example: 0.02 X 250 ohms +10V (from chart) = 15V

Maximum Voltage @ 4mA:
.004A X Loop resistance +18V = Voltage required at 4mA
(Example: 0.004 X 250 ohms +18V (from chart) = 19V

minimum input voltage V
(measured at DR1200 terminals)
with 0 ohms loop resistance
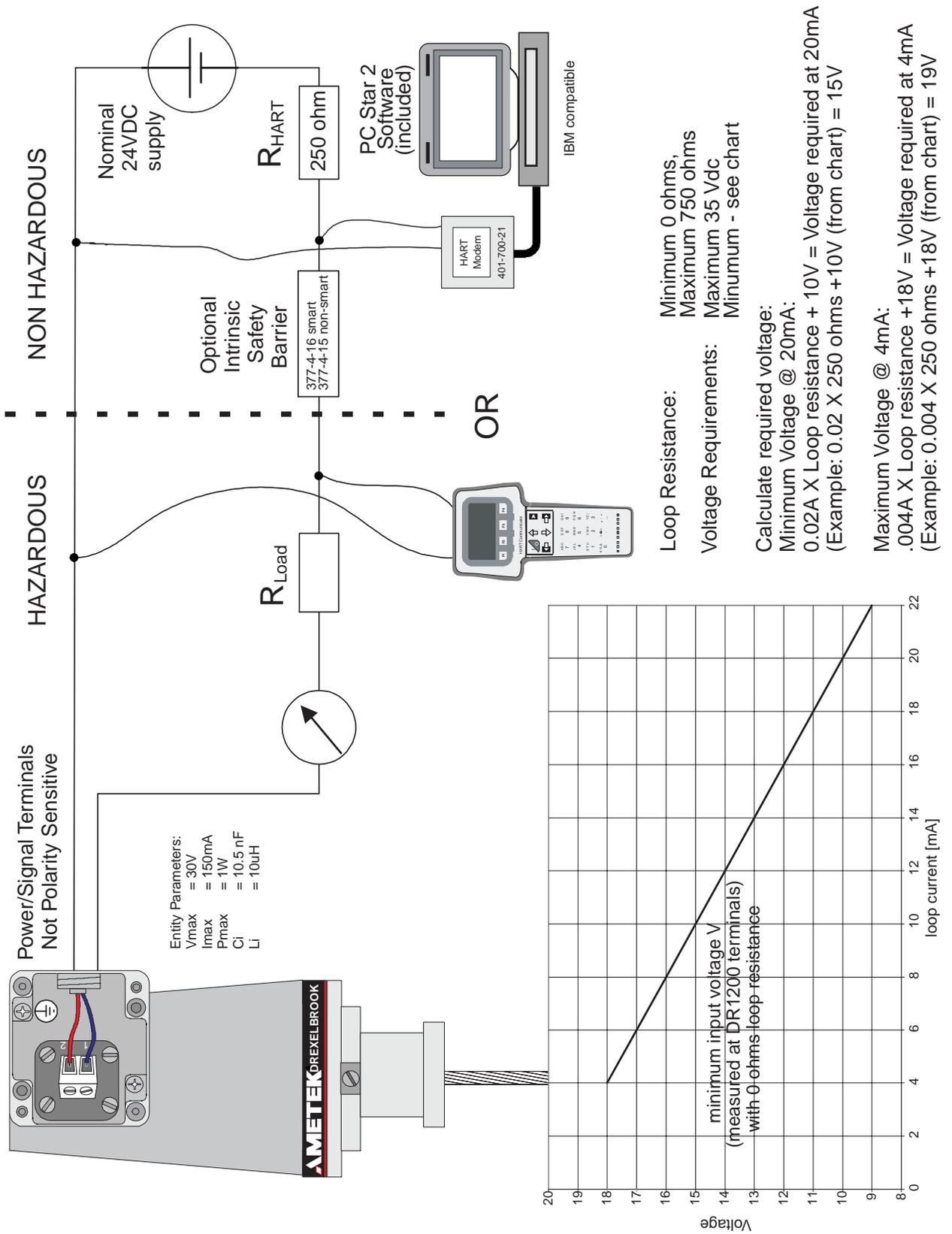
loop current [mA]

Voltage

Figure 4-1
Loop Requirements

4.1.1 Interface Adapter

The Smart Converter and the black Viator modem are powered from the serial interface on the computer, which must be able to supply the appropriate operating current with an adequate voltage level.

For the Smart Converter:
- The serial interface must be capable of supplying a current of approxiamately 10 mA.
- The power is taken from one or several of the following terminals: RTS, TXD, DTR.
- The voltage to GND at at least one of these terminals must be a minimum of +4.8 V in operation.
- PC-CAT must be used with the setting *RTS not inverted*.

For the black Viator RS232 Interface to HART:
- The serial interface must be capable of supplying a current of minimum 1.5 mA.
- The power is taken from one or both of the following terminals: DTR, RTS.
- The voltage to GND at at least one of these terminals must be a minimum of +4 V in operation.
- The RS232 output of the PC (DTR and RTS) must be current-limited to +/- 10 mA.
- PC-CAT must be used with the setting *RTS inverted*.

Pin assignment of above terminals:

	9-pin	25-pin
GND	= 5	= 7
RTS	= 7	= 4
TXD	= 3	= 2
DTR	= 4	= 20

4.1.2 Load Resistance

To successfully communicate between a PC and level instrument via the current output, an appropriate resistance in the 4-20 mA loop is necessary.

The current is modulated directly, in accordance with the HART® conventions. The signal amplitude is proportional to the resistance and with an open loop (or a too high load) the signal breaks down. A resistance of **minimum 120 ohms** is necessary for PC communication. The HART® conventions define a load of nominal 250 ohms, minimum 220 ohms.

4.1.3 Multidrop Communication

The DR1200 instrument can be configured in a multidrop connection with up to 5 devices (DR1200 or other HART equipment) in parallel on a 2-wire bus. (HART Foundation allows up to 15 devices to be connected.)

**4.1.3 Multidrop
   Communication
        (cont.)**

All instruments in multidrop mode must have previously
been configured with addresses different from each other
(address must not be "0" because "0" is an address used only
for point-to-point mode, where 4-20mA output is valid).

In mulitdrop mode, only digital information is used (4-20mA
output is not valid in this case, the current output of each
instrument is set to 4mA).

1. Configure each instrument in point-to-point mode. Set
    the address of the device (do not use "0").
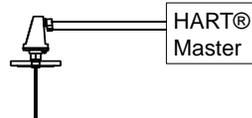
2. Multidrop the connection of up to 5 devices (DR1200 or
    other HART® equipment), in parallel on a two-wire bus.
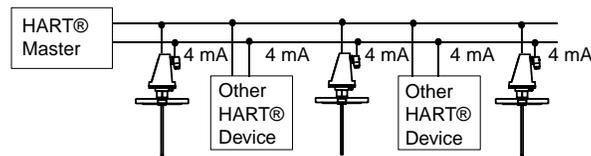
During start-up in a multidrop configuration, each DR1200
instrument draws a current of 22mA for 25 seconds, then the
instrument drops to a fixed value of 4mA.

Looking at an example of the start-up and assuming that five
DR1200 instruments are connected, there would be a current
draw of (5 x 22mA = 110mA) for 25 seconds.

Adding the 250 ohm resistor to the equation and the constant
power supply voltage (24V) voltage drop across the resistor:
110mA x 250 ohms = 27.5V.

Because the laws of electricity limits the the current draw to
96 mA (24V/250 ohms), Drexelbrook recommends starting
each DR1200 instrument individually, one at a time, or short
circuiting the resistor during start-up in order to successfully
start up in a multidrop configuration.
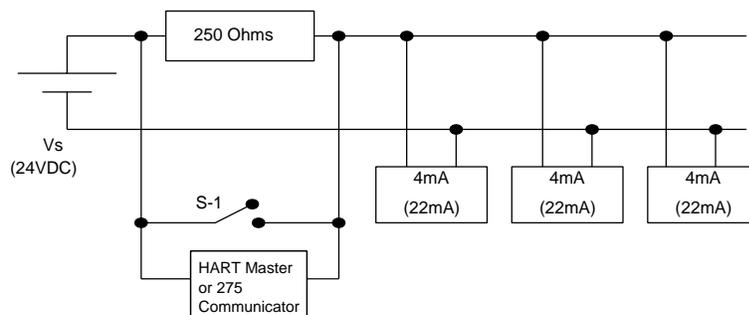
4.2   PC SOFTWARE

4.2.1   Software Installation

Refer to 4.1 Loop Requirements.

The PC STAR software is contained on one floppy disk.

It is compatible with Windows® 95 or 98.

4.2.2   Table of configuration parameters of PC STAR 2 (Version 1.00)

Configuration Parameter		Parameter Range	Default Value	Description
1.0.0	*Operation*			
1.1.0	*Base Parameter*			
1.1.1	Tank Height	Min value : Probe Length Max value : 196.850 feet	1000 feet	Distance between the bottom of the tank and lower flange surface.
1.1.2	Dead Zone	Min value : 0 feet Max value : Probe length	based on probe length	Prevents measurements near the flange.Measurement may not be precise in an area less than the recommended value.
1.1.3	Time Constant	Min value : 1 second Max value : 100 seconds	5 seconds	Filters possible signal fluctuations when the product surface is turbulent.
1.1.6	Probe Length	Min value : 0 feet Max value : Tank height and < 88.6 feet		This value has to be equal to the exact length of the probe. Change this value only if the probe length changes.
1.2.0	*Display*			
1.2.4	Length Unit	m, cm, mm, inch, feet, optional unit	feet	Level/distance unit. The selected unit is only valid for the length values. The optional unit allows the user to define a new unit (name and factor), see *Optional Unit* menu.
1.2.5	Volume Unit	m3 liter US gal ft3 bbl ton US ton m3/h ft3/h	m3	Unit for conversion values. The selected unit is only used to display the conversion value.

4.2.2 Table of configuration parameters of PC STAR 2 (Version 1.00)

Configuration Parameter	Parameter Range	Default Value	Description
1.2.6 *Define New Unit*			
1.2.6.1 Unit Name	4 ASCII characters	unit	Optional unit name. Enter unit name before using it in the menu.
1.2.6.2 Unit Factor	Min. value: > 0.0 Max. value:100000	1.0	Optional unit factor. Enter the unit factor before using it in the menu.
1.3.0 *Current Output I*			
1.3.1 Current 1	Level Distance Volume Ullage Volume	Level	Current output function (measured value to be displayed)
1.3.2 Range 1	4-20 mA 4-20 mA + 22mA if Error	4-20 mA	Current output range. In error mode the current output is frozen except if 4-20 mA + is selected, then the current output is fixed at 22mA.
1.3.3 Scale I min	Min value : 0 Max value : Scale I max	0	Input the lower range value for output to the current output. (Input is dependent on the selected function of the current output. The values for level and distance include the tank bottom and reference offset, respectively.).
1.3.4 Scale I max	Min value : Scale I min Max value : tank height	10,000 feet	Input of the full-scale range for output to the current output. (Input is dependent on the selected function of the current output. The values for level and distance include the tank bottom and reference offset, respectively.)
1.4.0 *User Data*			
1.4.3 Checksum			Read only menu. Software version of device.
1.4.4 Device Number	number of characters	default	Tag number of device.
1.4.5 Serial Number			Read only menu.Unique serial number of the device. The device ID (HART® protocol) of the instrument is equivalent to this number. Each device its individual address.

4.2.2 Table of configuration parameters of PC STAR 2 (Version 1.00)

| Configuration Parameter	Parameter Range	Default Value	Description
1.4.6 Commission Number			Read only menu. Factory set.
1.4.7 Commission Number			Read only menu. Factory set.
1.4.8 Option			16 bytes of ASCII characters
1.4.9 Probe Type	Rod Cable Cable and bottom weight Twin Cable Twin Cable and bottom weights Coax Special 1 Special 2 Special 3	Rod	Read only menu. Probe type attached to the flange.
1.5.0 Application			
1.5.1 Detection Delay			Forces the DR1200 instrument not to analyze reflections in a zone directly below the flange. The entered value of the detection delay must be less the *Dead Zone* value.
1.6.0 Serial I/O			
1.6.2 Poll Address	0 to 15		Sets the address of the device. For an address different of 0, the device is set to multidrop mode. In this mode the current output is fixed to 4mA.
1.7.0 Volume Table			
1.7.2 Input Table	From 0 to 20 points	0 point No table	Defines the strapping table. The 4 mA current output in volume is the first value in the table. Each subsequent value must be greater than the previous one. The length and volume units can be changed later without affecting the settings in the table. Calculations are done automatically in the instrument. Put the cursor to the level edit box in and press CTRL + INSERT in order to add a new point". CTRL + Delete to remove a point from the strapping table. Press F6 to save the volume table.To add or remove additional data points to the strapping table, position the cursor on the last data point edit field, then press CTRL+Insert (or CTRL+Delete to remove). This allows up to 20 points.
F11 Dynamic Configuration (no function numbers displayed)			
Threshold Level Pulse Distance			Read only value. Dynamic value Distance of the level pulse.

4.2.2 Table of configuration parameters of PC STAR 2 (Version 1.00)

Configuration Parameter	Parameter Range	Default Value	Description
Level Pulse Gain			Read only value. Dynamic value. Amplification of level pulse (gain 0,1,2, or 3) .
Level Pulse Amp			Read only value. Dynamic value. Amplitude of level pulse in millivolts.
Display and Set Threshold Value		200 mV gain factor	Threshold of the level pulse (in millivolts). The threshold is set with the same gain factor as the actual level pulse gain. If the level pulse gain factor is 2, then the threshold will be *x* mV gain factor 2. If the level pulse amplification changes, the threshold automatically changes the gain setting.

<div align="center">

CAUTION
Changing the *Distance Input* parameter is not recommended. Consult Factory.

</div>

Configuration Parameter	Parameter Range	Default Value	Description
Input Distance			Forces the DR1200 instrument to search for the product surface in a particular zone. If there is no level signal, enter an estimated value. If you are sure of what your indication should be, and there is still no reading, contact the factory about decreasing the *Threshold* value.
Search Probe End			Automatically measures the probe length.
Add Point to Volume Table (to insert a new point, set the cursor on the previous point and simultaneously press Ctrl+Insert.)	0-20 points	0 point	Defines the strap table. The 4 mA current output in volume is the first value in the table. Each subsequent value must be greater than the previous one. The length and volume units can be changed later without affecting the settings in the table. Calculations are done automatically in the instrument.
Delete Point to the Volume Table (to delete a point, set the cursor on the previous point and simultaneously press Ctrl+Delete.)			Deletes the strap table. The number of points are reset.
Test Output	4mA 12mA 20mA Other		Tests the current output. For test purposes, the output can be set to one of the listed values. With a reference ammeter, the calibration of the current output can be verified.
Reset DR1200	Ctrl+Alt+Delete		Restarts the software.

4.2.3 Software Configuration Examples

—Example 1

The measurements correspond to the menu parameters in the PC STAR 2 software.
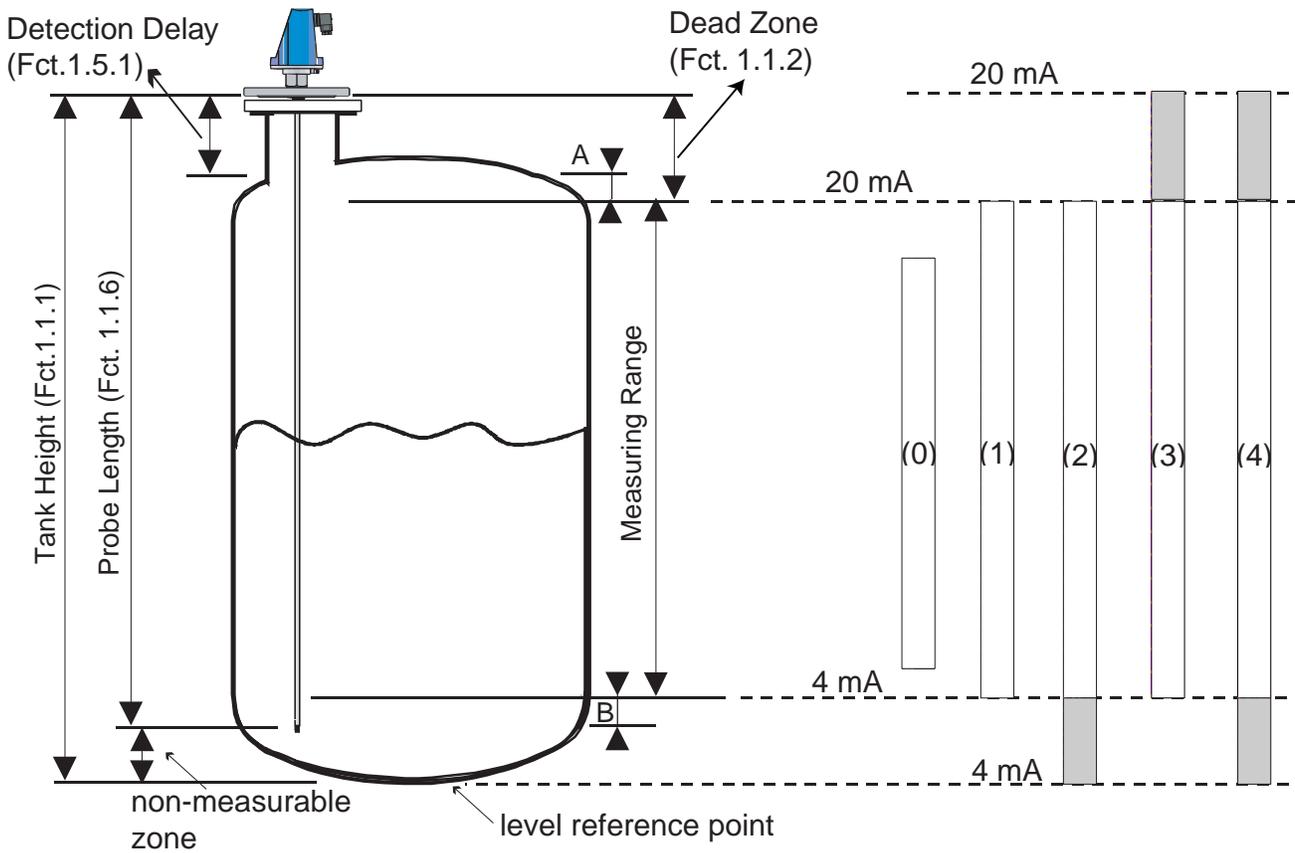
A= Minimum recommended distance between *Detection Delay* (Funct.1.5.1) and *Dead Zone* (Fct.1.1.2) (6 inches).

B = *Dead Zone (Fct.1.1.2)* at the end of the probe (4 inches).

Current output measuring range

Non measurable zone

Level Configuration Example:

Fct.1.3.1 = Level

(0) Current output range is smaller than the measuring range.

(1) Current output range is equal to the measuring range.
   Min Scale 4mA = tank height – probe length + 4 inches.
   Max Scale 20mA = tank height – dead zone.

(2) Current output range is bigger than the measuring range
   Min scale 4mA = 0.0.
   Max scale 20mA = tank height – dead zone.

(3) Current output range is bigger than the measuring range.
   Min scale 4mA = tank height – probe length + 4 inches.
   Max scale 20mA = tank height.

(4) Current output range is bigger than the measuring range.
   Min scale 4mA = 0.0.
   Max scale 20mA = tank height.

NOTE

For distance measurement, the reference point is the bottom surface of the flange.

4.2.3 Software Configuration Examples (cont.)

—Example 2

·In order to be able to measure volume with the DR1200 instrument, a conversion table (volume table) needs to be entered with the PC-STAR 2 software or HART® Calibrator.
·Using the volume table, various levels are allocated to specific volumes previously calculated or measured.
·In the case of non-symmetrical tanks, e.g. tanks with dished bottom, the accuracy of volume measurement depends on the number of entered level/volume pairs. The maximum number of pairs (points) that can be set is 20; the volume is linearly determined (interpolated) between 2 points.
·The table is generally used for volume, but can also be used for mass or volume flow.
·To insert a new point into the volume table, set the cursor on the previous point and simultaneously press Ctrl + Insert.
·To delete a point into the volume table, set the cursor on the point and simultaneously press Ctrl + Delete.

Volume table

Unit volume (Funct. 1.2.5): m^3

Input table (PC STAR 2):	Point	Level	Volume
	1	0.20 ft	0.5 m³
	2	0.75 ft	1.0 m³
	3	1.00 ft	1.5 m³
	4	5.60 ft	16.80 m³

Tank Height (Fct 1.1.1):   6.00 ft

Probe Length (Fct 1.1.6):   5.80 ft

Dead Zone (Fct 1.1.2):   0.40 ft

Maximum measurable level = 5.40 ft, equivalent to a volume of 16.30 m³
= tank height – dead zone – (tank height – probe length)
=   6.00 ft   –   0.40 ft – (6.00 ft   – 5.80 ft)

Note: The real level can be measured between 0.20 ft to 5.60 ft. When the level of the product is lower than the probe end, the DR1200 indicates *tank empty*. The DR1200 gives a level value between 0 ft and 5.60 ft, but it can really give a measuring value between 0.2 ft to 5.60 ft. The accuracy of the first 0.2 ft of the measurement (0 ft to 0.2 ft), depends on the installation and probe type of the DR1200.

Current output I

Function I (Fct 1.3.1):   VOLUME
Range I (Fct.1.3.2):   4 - 20 mA
Scaling 4mA (Fct. 1.3.3):   0.50 m³ corresponds to 4mA
Scaling 20mA (Fct. 1.3.4):   16.80 m³ corresponds to 20mA

Display

Unit conversion (Fct. 1.2.5):   m³ (cubic meter)

4.2.4   Software Parameter Descriptions

Choice of Units

Level/Distance Units
Select Tank Height (Fct.1.1.1):
• m.
• cm.
• mm.
• inch.
• ft.
• optional unit.

The selected unit is also valid for display purposes and calculation of the following measurement parameters:
Dead Zone (Fct 1.1.2).
Probe Length (Fct 1.1.6).
Scaling 4mA value, current output (Fct 1.3.3).
Scaling 20mA value, current output (Fct 1.3.4).

The optional unit can only be used as a length unit. Before selecting this unit enter the new unit parameters:
• The name of the unit (4 characters).
• The factor of the unit.

Conversion Units
The conversion unit is used to convert the level measurement into a different unit (usually volume). It is possible to use a non-linear function as a factor of the level.

Select Volume Unit (Fct 1.2.5):
• m3
• liter
• US gal
• ft3
• bbl (petroleum barrels)
• kg
• ton
• US ton
• Kg
• m3/h
• ft3/h

4.2.4 Software Parameter Descriptions

Choice of Units (cont.)

Conversion Units (cont.)
The selected unit is also valid for the following parameters:
Scaling 4mA value, current output.
Scaling 20mA value, current output.

Conversion measurement requires a conversion table entered with the PC-Star 2 software or HART® Calibrator. Using this table, a conversion value is allocated to each level value (level/ conversion pairs). The values are linearly interpolated between 2 points.

Tank Height (Fct 1.1.1)

The entered value is a fundamental variable for the calcula-tion of level measurement and it is equivalent current value.

Tank height is the distance between the bottom of the tank and lower flange surface. The value must be greater than the probe length parameter setting. The minimum and maxi-mum values are 0.000 to 196.850 respectively. Factory de-fault value is per the sales order.The DR1200 instrument does not measure beyond its probe length.

For tank height, select the following:
• Unit.
• Setting ranges.
• The tank height setting is the upper limit of the setting range for the following parameter:
Scale I Max (Fct. 1.3.4).
• The tank height must be greater or equal to the probe length.

Dead Zone (Fct 1.1.2)

Measurements near the flange may not be precise or reliable. Dead zone prevents measurements in this area.
The minimum value is equal to that shown in the following table. Measurement may not be precise in an area less than this recommended value.
• Unit and setting range: same as selected for *Tank Height (Fct. 1.1.1).*

4.2.4   Software Parameter Descriptions

Dead Zone (Fct. 1.1.2) (cont.)

Probe type	Dead zone minimum value	
Rod	16 in.	400 mm
Cable	16 in.	400 mm
Twin cable	12 in.	300 mm
Coax	0 in.	0 mm

Probe Length (Fct 1.1.6)

This value has to equal to the exact length of the probe. This parameter is changed only if if the probe length is changed.
• Unit and setting range: same as selected for Tank Height.
• Setting range for probe length is:
    0.000 to 10.000 feet.
The probe length (set at this point in the configuration) is the upper limit of the setting range for the following parameter:
    Dead Zone (Fct. 1.1.2).
The probe length (set at this point in the configuration) is the lower limit of the setting ranges for the following parameter:
    Tank Height (Fct. 1.1.1).

NOTE
An automatic calculation of the probe length can
be performed in the dynamic configuration menu.

Time Constant (Fct 1.1.3)

The measurement is filtered with the time constant to avoid abrupt changes in measured values and also in the current output value.

The setting range is 001 to 100 seconds. Default value and recommended setting is 5 seconds.

Current Output I (Fct. 1.3.0)

Current 1 item (Fct 1.3.1)
Use this parameter to select the measured variable.
Settings for Parameter 1 are:
    Off.   (The output sinks a constant current of 4 mA.
Analog output parameters cannot be selected. Go to *User Data*.)
    Level.
    Distance.
    Volume.
    Volume Unit.

4.2.4 Software Parameter Descriptions (cont.)

Current Output I (Fct. 1.3.0) (cont.)

Current 1 range (Fct 1.3.2)
Use this parameter to define the current output value during an error condition (E=error at 22 mA). Settings for Range 1 are:
4-20 mA (hold last measured value when error occurs).
4-20 mA/E=22 mA.

Error Delay (Fct 1.3.5)
This parameter is available on the HART® Calibrator when 4-20 mA/E=22 mA is chosen. It sets a delay before switching the current output to 22 mA. After the problem occurs and before the end of the delay, the measurement value (and also the current value) is frozen.

Scale 4 mA (Fct 1.3.3)
This parameter is used for I_{min} = 4 mA to define the lower value for level or volume (scaling 4mA). For distance or ullage volume measurement, the reference point is from the bottom surface of the flange. Scale 4 mA is the upper value.
• When configuring level, this value must be less than Scale 20 mA parameter value.
• When configuring volume, this value must be less than the maximum value in the conversion table and smaller than the Scale 20 mA parameter value.

Scale 20 mA (Fct 1.3.4)
This parameter is used for I_{max} = 20 mA to define the upper value for level or volume. For distance or ullage volume measurement, the reference point is from the bottom surface of the flange. Scale 20 mA is the lower value.
• When configuring level, this value must not be greater than or equal to tank height.
• When configuring volume, this value must be greater than or equal to the maximum value in the conversion table and smaller than the Scale 4 mA parameter value.
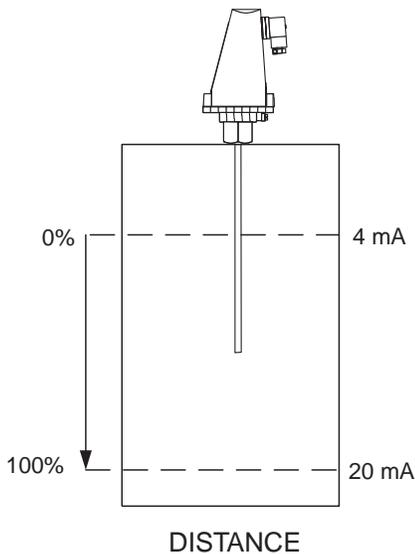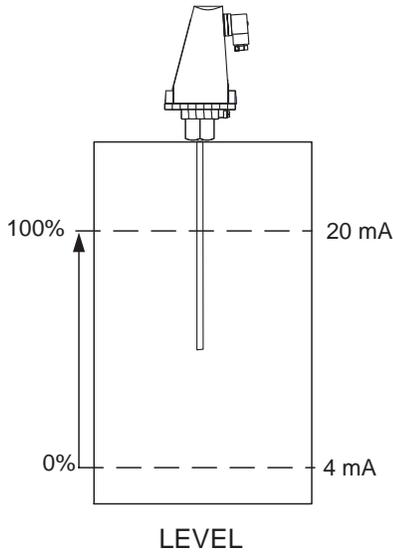
User Data (Fct. 1.4.0)

Device Number (Fct 1.4.4)
Tag name of the device can be displayed using eight ASCII characters.

NOTE
Not all the characters can be used. Tag name, Descriptor, and Message are recorded in a special format (Packed ASCII).

4.2.4   Software Parameter Descriptions (cont.)

User Data (Fct. 1.4.0) (cont.)

Serial Number (Fct 1.4.5)
Identification of each DR1200 instrument. Serial number cannot be changed. This number defines the Device ID of the HART® Long Address.

Release Number
Release Number of the device (Software and Hardware versions).

Probe Type (Fct 1.4.9)
Probe type attached to the flange.

Checksum (Fct 1.4.10)
ROM Checksum. Detect problems with the microcontroller. A test of this checksum is performed at each start-up.

Application (Fct. 1.5.0)

Detection Delay (Fct.1.5.1)
Detection Delay defines a zone below the flange signal in order to mask noise. This value has to be smaller or equal to the value of the dead zone. Detection delay is useful for eliminating reflections due to the nozzle.

F11   Dynamic Configuration

The amplitude and the amplification of the level pulse give an indication whether the device is following the correct pulse. For a product with an Epsilon R > 80, the amplification factor should be 0 or 1 (depending on the probe type). For an Epsilon R < 10 the amplification factor should be 2 or 3 (gain 2 or 3).

Factory setting is recommended. Some applications where reflections occur due to nozzles, etc, might require a higher threshold setting.

NOTE
If possible, do not have a full tank when setting the Threshold.

4.2.4 Software Parameter Descriptions (cont.)
Dynamic Configuration (cont.)

Threshold
Threshold masks non-valid signal reflections (e.g., heating tube). The DR1200 measures only those pulses with an amplitude above the threshold. The amplitude of the signals is linked to the dielectric constant of the product.
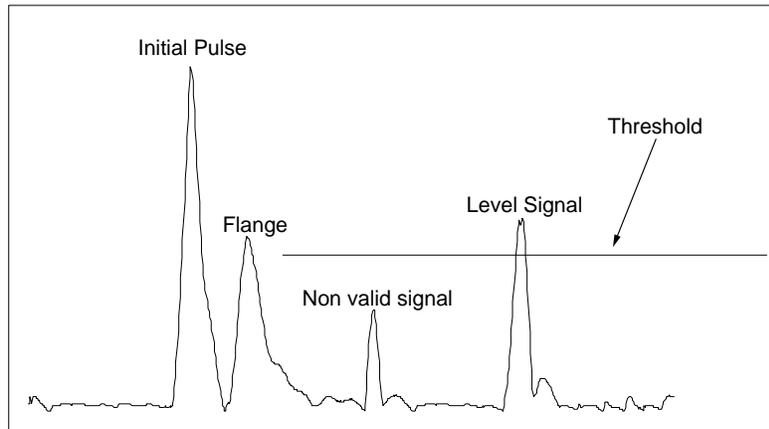
To set the threshold correctly, it is necessary to know (approximately) the amplitude of all signals along the probe (level signal and also non-valid signals) using an oscilloscope.

Default value for threshold is 200 mV Gain 3.
The minimum threshold is 50 mV Gain 3.
The maximum threshold is 2500 mV Gain 0.

Gain	Amplification
0	1.05
1	2.10
2	4.37
3	8.93

The signal level is amplified according to the amplitude of the signal.   With Gain 0, the signal is not amplified.
With Gain 3, the signal is amplified (almost by 9).

The DR1200 automatically changes the gain factor. It tries to keep the good amplitude of the level signal constant, in order to track the pulse.

The threshold is recorded with the same amplification factor as the signal level. If the signal level gain is 1, the threshold is recorded with gain 1 also. If the threshold is set to 500 mV, the DR1200 records the values 500 mV and Gain 1. If the signal level is getting smaller, the DR1200 changes the gain to 2 and the signal is amplified.

4.2.4   Software Parameter Descriptions (cont.)
Threshold (cont.)
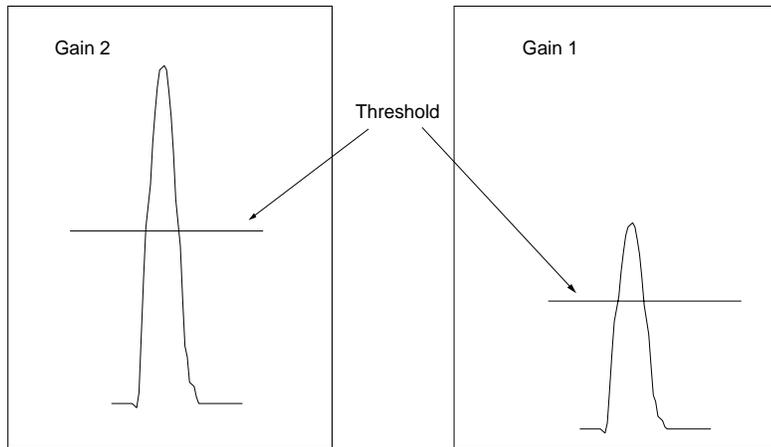
When the signal level gain changes, the threshold remains in both rises approximately at a level of 50% signal amplitude.

As the distance between the flange and the product surface rises, the amplitude of the reflected pulse gets smaller. The threshold adapts automatically.

Input Distance
It is not recommended to change this parameter.

Input Distance forces the pulse to be found in a certain zone. It is used only if the DR1200 instrument doesn't find the surface after entering a reliable value.

Search End of Probe
The probe length can be measured automatically if the probe has been modified or cut. If the DR1200 instrument cannot find the probe length then:
1.   The threshold is not set correctly. Set it to a smaller value.
2.   The electronic offset is incorrect (Service menu).
3.   The probe type selected is incorrect (Service menu).
4.   The tank is not empty?

Consult Factory.

Serial I/O (Fct. 1.6.0)

Address (Fct 1.6.2)
This parameter is used for entering valid addresses from 1 to 15 (HART® protocol). If several devices are operated on one digital bus or via HART®-Multidrop, each device must be set to an individual address under which it can then be addressed on the bus. The default value is the address "0".

4.2.5 General Status Messages

Status Message	Definition of Mesasge
Configuration Changed	Set whenever any configuration parameter is changed.
More Status Available	Set when command 48 should be used to read more status.
Primary Variable	
Current Output Fixed	Set when: ·Device is set in Multidrop Mode. (Polling Address does not equal 0). ·Fixed Current Mode is entered. (during Loop Test and DAC Trim).
Current Output Saturated	During normal operation the maximum value for current output is 20mA. While Process Value (PV) will work up to the Sensor Limits, the analog output and its digital value is saturated at 20mA and the flag is set.

4.2.6 Transmitter-specific Status Messages

Status Message	Definition of Message
Invalid selection	Bad item.
Passed parameter too large	Value too large for the parameter.
Passed parameter too small	Value too small for the parameter.
Too few data bytes	Insufficient byte transmitted.
In write protect mode	Protection against writing.
Lower range value too high	The value of the range is incorrect.
Applied process too high	PV range values are incorrect (method Apply values).
Not in proper current mode	Current output is not fixed when DAC Trim is executed.
Cannot change active password	Password is incorrect.
Table non monotonous	Volume table is not monotonous.
Lower range value too low	The value of the range is incorrect.
Applied process too low	PV range values are incorrect (method Apply values)
Upper range value too high	The value of the range is incorrect.
Multidrop mode	Cannot fix a value on the current output in the multidrop mode.
Illegal password symbol	The characters of the passed password are incorrect. Valid characters are 'E', 'R' or 'U'.
Upper range value too low	The value of the range is incorrect.
Invalid units code	The unit is not supported by the DR1200 instrument.
Invalid function	The result of the function is incorrect.
Invalid password	Cannot enter Specialist menu. Password is incorrect.
Access restricted	If customer password is set, parameter cannot be modified.
Invalid range units code	Range unit is incorrect
Device busy	Device is busy. Normally it appears when the device is in research mode or if it is executing a function.
Not implemented	Command sent to the device is not implemented in the device.

4.2.6 Transmitter-specific Status Messages (cont.)

Status Message	Definition of Message
First Parameter too high (first member of the pair too high)	Some parameters are handled in pairs. The two members are updated at the same time. When one of the following messages appears, one of the members is
First Parameter too low (first member of the pair too low)	incorrect. The parameter pairs are: •Tank height / Probe length. ´ Dead zone / Detection delay.
Second Parameter too high (second member of the pair too high)	•Threshold value / Threshold distance. •Optional unit name / Optional unit factor. •Offset of measure / Period of measure.
Second Parameter too low (second parameter of the pair too low)	•Electronics Calspeed / Mechanical calspeed. •Epsilon R / "Set value" of Electronic offset.

**SECTION 5
MAINTENANCE**

5.1 Identifying a Problem

·Use the Error/Warning Message Tables and the Fault/ Symptom Table in Sections 3 and 4 to help find and correct a problem if it occurs.
·It is important to be methodical when tracking down a problem.
·If you have questions about the DR1200 TDR Level instrument,call Drexelbrook Factory Service at 1-800-527-6297 or e-mail at *service@drexelbrook.com* .Additional service information can be found at *www.drexelbrook.com* .
·Be prepared to provide the Service Engineer with the model number,application requirement,and the materials being measured.

In standard applications, maintenance is not necessary. However, if the sensor is strongly contaminated, or coating on the sensor is heavy, the DR1200 instrument might produce an erroneous output or can fail. Consult factory.

5.2   Replacement of the Signal Converter

WARNING
Always disconnect power before removing the signal converter.

Before replacing the signal converter in a hazardous location, ensure that there is no danger of explosion.

1. Disconnect all cables from the instrument.

WARNING
On pressurized tanks, **do not** (in any case) remove the four flange screws connecting the DR1200 flanges with the tank.

2. Remove the four Allen screws shown in Figure 5-1. (Allen key size 4 mm) and lift off the signal converter. The flange unit will remain tight, even on pressurized tanks.

5.2   Replacement of the Signal Converter (cont.)
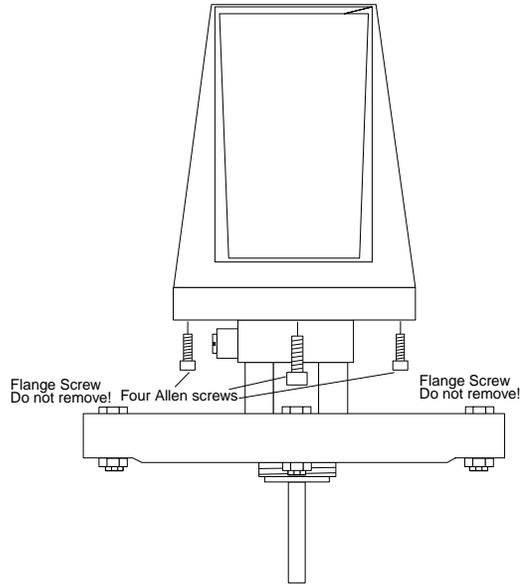
Figure 5-1
Replacing Signal Converter

3. Install the new DR1200 signal converter. Handle the signal tip with care.

4. Screw the four Allen screws (Figure 5-1) to tighten the signal converter. (Allen key size 4 mm).

5. Check power voltage.

6. Reconnect all cables in the terminal compartment.

7. Ensure that the seal of the signal converter is well greased.

5.3   Telephone Assistance

If you are have a question about your Drexelbrook equipment, call your local Drexelbrook representative, or the factory toll free 1-800-527-6297.

Please have as much of the following information as possible when you call:
Instrument Model # _____
P.O. #_____
Date_____
Insertion Length_____
Application_____

5.3 Telephone Assistance (cont.)

Material being measured_____
Temperature_____
Pressure_____
Agitation_____
Brief description of the problem _____
Checkout procedures that failed _____

5.4 Equipment Return

In many applications, sensing elements are exposed to hazardous materials.
• OSHA mandates that our employees be informed and protected from hazardous chemicals.
• Material Safety Data Sheets (MSDS) listing the hazardous materials that the sensing element has been exposed to <u>must</u> accompany any repair.
• It is your responsibility to fully disclose all chemicals and decontaminate the sensing element.

To obtain a return authorization (RA#), contact the Service department at 1-800-527-6297 (US and Canada) or 1-215-674-1234 (International). Please provide the following information:

Model Number of Return Equipment _____
Serial Number_____
Original Purchase Order Number _____
Process Materials that equipment has been exposed to_____
MSDS sheets for any hazardous materials.
Billing Address _____
_____
Shipping Address _____
_____
Purchase Order Number for Repairs _____

Please include a purchase order even if the repair is under warranty. If repair is covered under warranty, you will not be charged.

Ship equipment freight prepaid to:
AMETEK Drexelbrook
205 Keith Valley Road Horsham, PA 19044
COD shipments will not be accepted.

SECTION 6
SPECIFICATIONS

Application:

Distance, Level, Volume, and Reflection measurement of liquids, slurries, solids and particulate material on storage and process tanks or containers made of metal or concrete, and also still wells.

Mode of Operation:

Micropulse TDR with digital signal processing.

System Structure:

Compact device. Modular Design.

Input:

Measured variable: Primary variables are distance, reflection. Derived variables are level, volume.

Measuring range: Minimum tank height is 6 inches. Maximum measuring range is 78.7 feet.

Rate of change in level: $\leq$ 10/min

Output:

Ex-i current output HART®.
Type: passive (current sink).
Current Range: 4-20 mA (error 22 mA).
                    4 mA constant for HART® multidrop.
Temperarture drift: $\leq$ to 100 ppm/K (typically 40 ppm/K).
Accuracy/linearity: 0.05% (rel. 20 mA; 25°C)
Supply voltage: 20-30 V
Load impedance: 0-750 ohms

Reference conditions:

Temperature: 68°F.
Pressure: 14.7 psi (atmospheric)
Air humidity: 65%.
Tank diameter: > 3 feet.
Highly reflecting product (e.g. water) with calm surface.
Mounted at least 12 inches away from tank wall.
Mounted flat on the tank.

Current output accuracy:

The accuracy of the 4-20mA output is 0.01%.

6.0   Specifications (cont.)

Repeatability

Repeatability is equal to half the value for the error of measurement.

Ambient temperature of signal converter and process temperature:

For the DR1200 the maximum and minimum temperature of the converter and the product are linked.

Process	-30°C to 90°C
Converter	-22° to 55°C

Minimum converter temperature-22°C
Minimum product temperature -30°C
Maximum converter temperature+55°C
Maximum flange temperature +90°C

Storage temperature:

-30 °C < T< 55 °C.

Environmental class:

Installation in free air level DI according EN60654-1.

Reference conditions:

· Temperature = 68°F.
· Pressure = 14.7 psi (atmospheric)
· Air humidity = 65%.
· Highly reflecting product (e.g. water) with calm surface.
· Tank diameter > 3 feet.
· Mounted at least 12 inches away from tank wall.
· Mounted flat on the tank.

Measured Value Resolution:

1 mm / 0.04".

Transient Recovery Time:

The transient recovery time is determined by the parameter *Time Constant* (1 to 100 seconds). The transient recovery time relative to 1% deviation from the steady-state value is approximately 4.6 times the time constant. However, in the case of unusual rapid changes in level, the transient recovery time may deviate from this specification.

Turn-on characteristics/turn-on drift:

After the DR1200 has been switched on, the current output is fixed to 22 mA during 13 seconds.
The current output is then driven to probe length until the level has been found.
Finally, the current output approaches the measured value. Full measuring accuracy is obtained after 46 seconds operating time with default parameters (time constant = 10 seconds).

Specifications (cont.)

Effect of ambient temperature:

Temperature coefficient, signal output:

Current output with HART® signal:
< 100 ppm/°C (typically: 30 ppm/°C)
(<0.01%/°C) (typically: 0.003%/°C)

The temperature has no effect on the measured value as the device carries out a regular self-calibration. The effect of temperature of the atmosphere above the liquid product results theoretically in - 1ppm/°C (0.0001%/°C) for air.

Note: Liquids generally have a high coefficient of cubic expansion (organic liquids: typically 0.15 %/°C).

Protection category:

IP65.

Shock resistance:

Resist to shocks according EN61010 §8.2 0.5 J.

Vibration endurance limit:

IEC 68-2-6 and pr EN50178 (10-57 Hz: 0.075 mm/57-150 Hz: 1G).

EMC:

The devices satisfy the requirements of EN 50081-1, EN 50082-2.

Physical Properties:

Physical properties (such as density, viscosity, conductivity, relative permittivity,
magnetic properties, etc.) have no effect on measurement results. The relative permittivity is required to have a minimum value in order to ensure reliable measurements

Relative Permittivity:

The (relative) permittivity of the product determines the strength of the reflected signal. Measurement results are not affected as long as the reflected signal is strong enough, but reliability and the maximum measuring range are dependent upon the relative permittivity. Minimum permittivity (depending on the type of probe being used) is:

Single: ≥ 2.3.
Twin: ≥ 1.8.
Coax   ≥ 1.5.

Specifications (cont.)

Maximum Operating Pressure:

The maximum allowable operating pressure for the standard version is 58 psig (580 psig optional).

Weight:

Sensor Type	Signal Converter plus 3.28 feet probe (approximate)	Extra Weight per 3.28 feet
Single Rod	4.5 lbs.	0.5 lbs.
Single Cable	4.5 lbs.	0.25 lbs.
Twin Cable	4.5 lbs.	0.5 lbs.
Coax	6.5 lbs.	0.28 lbs.

Materials of construction:

Signal Converter Housing:
Aluminum with electrostatic powder coating to DIN 55990-3.

Flange:
1-inch NPT standard; all other flanges on request.

Materials in contact with the product:
- Stainless steel 316 for the cable (Hastelloy optional).
- Stainless steel 316 L standard for all the process connections (consult fa ctory for options).
- PTFE.
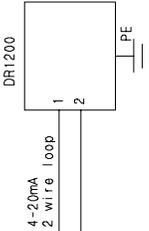- Viton O-Ring (Kalrez optional).

FM Control Drawing

NO. 420-0004-126   SHT 1 OF 1

APPROVED DRAWING
CHANGES TO THIS DRAWING
REQUIRE AGENCY APPROVAL
PER 440-0015-003
☒FM ☒CSA ☐KEMA
☐ ____ ☐ ____
420-0004-132   420-0004-153

Hazardous (classified) location
Class I, II, III Division I
Groups A, B, C, D, E, F, G

DR1200

4-20mA
2 wire loop

1
2

PE

Non-hazardous location
Or hazardous location

Any FMRC or CSA
approved apparatus
with entity concept
parameters. See
note 4.

Maximum signal current output parameters (terminal 1 and 2)

Groups	max. input voltage Vmax (V)	max. input current Imax (mA)	max input power Pmax (W)	internal capacitance Ci (nF)	internal inductance Li (uH)
A to G	30	150	1	10.5	10

NOTES:
1. Installation should be in accordance with ANSI/ISA RP 12.6, "Installation of Intrinsically Safe Systems for Hazardous (classified) locations" and the National Electric Code ANSI/NFPA 70. For CSA approved instruments, the installation must be in accordance with the Canadian Electrical Code, section 18.
2. No revision to drawing without prior agency approval.
3. Resistance between intrinsically safe ground and earth ground must be less than 1 ohm.
4. To determine proper matching of IS, Equipment and the maximum cable length, use the following entity parameter matching formulas:
   Uo or Voc ≤ Ui or Vmax
   Io or Isc ≤ Ii or Imax
   Ca ≥ Σ Ci + Ccable
   La ≥ Σ Li + Lcable
5. For Class II and Class III installations where rigid metal conduit is not used, seal cable entries against dust and fibers using a NRTL listed cable gland fitting.
6. Temperature Classes as a function of ambient temperature, process temperature and the height of the transmitter extension tube:

TEMPERATURE CLASS	AMBIENT TEMPERATURE	FLANGE TEMPERATURE	EXTENSION TUBE
T6	≤ 60ºC	≤ 80ºC	
T5	≤ 60ºC	≤ 100ºC	
T4	≤ 60ºC	≤ 135ºC	
T3	≤ 55ºC	≤ 200ºC	50mm
T3	≤ 60ºC	≤ 200ºC	100mm

7. For use in a potentially explosive atmosphere caused by dust or fibers (Class II, Group E, F or G and Class III), at a maximum process temperature of 200ºC and with a dust or fiber layer of maximum 5mm, the maximum surface temperature of the enclosure is 100ºC.

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PRIOR WRITTEN APPROVAL SEE 440-0015-021

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SCALE   NONE
UNLESS OTHERWISE STATED
ALL DIMENSIONS IN INCHES (mm)

TOLERANCES
UNLESS OTHERWISE STATED
DECIMAL   .XX±.010
          .XXX±.005
FRACTIONS ±1/64
ANGLE   ±1/2º

DR.   JJS 10-9-01
CK.   ◇ LAST REVISION

AMETEK®
DREXELBROOK

FM/CSA CONTROL DRAWING
FOR DR1200

B   420-0004-126   SHT 1 OF 1   ISS 2

ISS.	EDO/DSR NO.	APP'D	DATE
2	7-01-202	THP	3-30-01
1	2-01-336		

AMETEK®

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