SIL Safety Manual

MAGNETROL PULSAR MODEL R86

High Performance 26 GHz Pulse Burst Radar Level Transmitter

Supplied by

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PULSAR®
R86 RADAR

SIL Safety Manual for Pulsar Model R86

Software v1.x

Functional Safety Manual

Model R86

26 GHz Pulse Burst Radar

Level Transmitter

This manual complements and is intended to be used with the Pulsar® Model R86 Installation and Operating manual (Bulletin 58-603).

Benefits

The PULSAR Model R86 (HART®) Pulse Burst level transmitter can be applied in most indoor and outdoor process or storage vessels. The PULSAR Model R86 can be used in liquids or slurries to meet the safety system requirements of IEC 61508/IEC 61511-1.

Benefits

The Magnetrol® Model R86 (HART) transmitter provides the following benefits to your operation:

- Protection up to SIL2 as independently assessed (hardware assessment) by exida as per IEC 61508/ IEC 61511-1. Safe Failure Fraction:
  - 93.2% (intrinsically safe)
  - 93.0% (explosion-proof)
- Antenna designs to +750 °F (+400 °C), 2320 psig (160 bar)
- IS, XP and Non-Incendive approvals
- Quick connect / disconnect antenna coupling
- Performance not process dependent (changing specific gravity and dielectric have no effect).

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Pulsar® Model R86 Pulse Burst Radar Level Transmitter

SIL 2 Suitable

Table of Contents

1.0 Introduction

1.1 Product Description

The Pulsar® Model R86 Pulse Burst Radar Level Transmitter is a loop-powered, 24 VDC level transmitter based on Pulse Burst Radar technology. For Safety Instrumented Systems usage, it is assumed that the 4–20 mA output is used as the primary safety variable. The analog output meets NAMUR NE 43 (3.8 mA to 20.5 mA usable), and the transmitter contains self-diagnostics and can be programmed to send its output to a user-selected failure state, either low or high upon internal detection of a failure. The device can be equipped with or without an LCD display. Table 1 lists the versions of the PULSAR Model R96 that have been considered for the hardware assessment.

Table 1
Pulsar® Model Number

R86-51XX-aXX (a=0, 1, A, C or D)	**Intrinsically Safe** R86 is energy limited but not isolated from current loop.
R86-51XX-aXX (a=3 or B)	**Explosion Proof** R86 is galvanically isolated from current loop.

The R86 is classified as a Type B^2 element according to IEC 61508, having a hardware fault tolerance of 0)

1.2 Theory of Operation

Pulsar Model R86 is a top-mounted, downward-facing pulse burst radar transmitter operating at 26 GHz. Unlike true pulse devices that transmit a single, sharp (fast rise-time) waveform of wide-band energy, the Pulsar Model R86 emits short bursts of 26 GHz energy and measures the transit time of the signal reflected off the liquid surface. Distance is calculated utilizing the equation:

Distance = C × Transit time/2, then developing the Level value by factoring in application-specific configuration.

The Pulsar Model R86 is classified as a Type B device according to IEC 61508.

1.3 Determining Safety Integrity Level (SIL)

Tables 2 & 3 define the criteria for the achievable SIL against the target mode of operation in Demand Mode Operation.

Table 2 shows the relationship between the Safety Integrity Level (SIL) and the Probability of Failure on Demand Average (PFDavg).

Table 3 can be used to determine the achievable SIL as a function of the Hardware Fault Tolerance (HFT) and the Safe Failure Fraction (SFF) for the complete safety system (type B – complex components as per IEC 61508 Part 2) of which the level transmitter is one component.

Table 2
SIL vs. PFDavg

Safety Integrity Level (SIL)	Target Average probability of failure on demand (PFDavg)
4	$\geq 10^{-5}$ to $<10^{-4}$
3	$\geq 10^{-4}$ to $<10^{-3}$
2	$\geq 10^{-3}$ to $<10^{-2}$
1	$\geq 10^{-2}$ to $<10^{-1}$

Table 3
Minimum hardware fault tolerance
Type B sensors, final elements and non-PE logic solvers

SFF	Hardware Fault Tolerance (HFT)		
	0	1	2
None: <60%	Not Allowed	SIL 1	SIL 2
Low: 60% to <90%	SIL 1	SIL 2	SIL 3
Medium: 90% to <99%	SIL 2	SIL 3	
High: ≥99%	SIL 3		

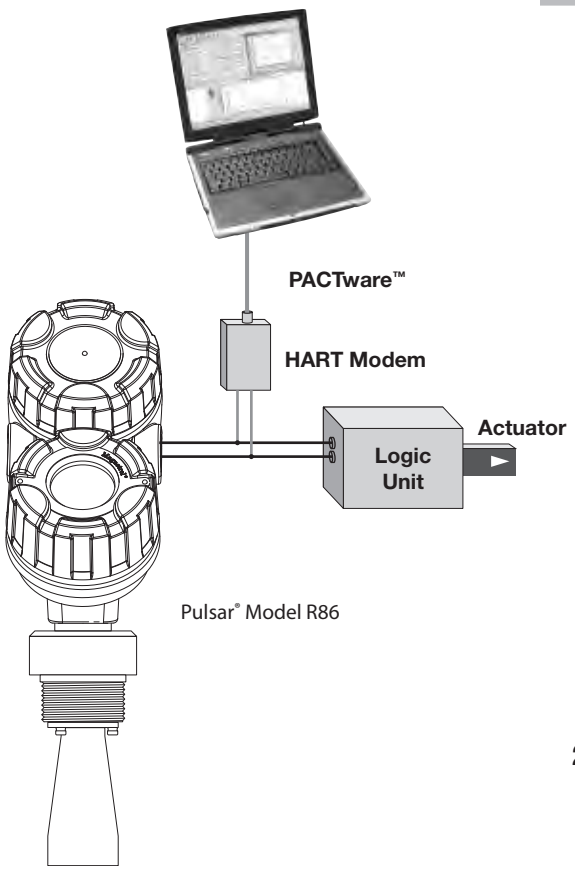


Figure 1
Typical System

2.0 Level Measuring System

The diagram shows the structure of a typical measuring system incorporating the Magnetrol Pulsar Model R86 Pulse Burst radar transmitter.

This SIL rated device is only available with an analog signal (4–20 mA) with HART digital communication. (The measurement signal used by the logic solver must be the analog 4– 20 mA signal proportional to the level generated).

For fault monitoring, the logic unit must recognize both high alarms (21.5 mA) and low alarms (3.6 mA). If the logic solver loop uses intrinsic safety barriers, caution must be taken to ensure the loop continues to operate properly under the low alarm condition.

The only unsafe mode is when the unit is reading an incorrect level within the 4–20mA range (> ±2% deviation). Magnetrol defines a safe failure as one in which the 4–20 mA current is driven out of range (i.e., less than 3.8 mA or greater than 20.5 mA).

2.0.1 FOUNDATION fieldbus™

Although the Pulsar Model R86 is available with FOUNDATION fieldbus™ output, it does not presently meet the FF-SIS standard.

2.1 Applicable Models

This manual is applicable to the following Pulsar Pulse Burst Radar transmitters:

R86-51XX-aXX (a=0, 1, 3, A, B, C or D)

2.2 Miscellaneous Electrical Considerations

Following are miscellaneous electrical issues to be considered.

2.2.1 Pollution Degree 3

The Pulsar system is designed for use in Category II, Pollution Degree 3 installations.

The typical pollution degree used for equipment being evaluated to IEC/EN 61010 is a nonconductive pollution of the sort where a temporary conductivity caused by condensation might be expected.

2.2.2 Overvoltage

The Magnetrol Model R86 has over-voltage protection per CE requirements. When considering Hi-pot, Fast Transients and Surge, this protection is to 1000 volts. Therefore, there should be no unsafe failure modes up to 1 KV.

Overvoltage Category II is a local level, covering appliances, portable equipment, etc., with smaller transient overvoltages than those characteristic of Overvoltage Category III. This category applies from the wall plug to the power-supply isolation barrier (transformer). The typical plant environment is Overvoltage Category II, so most equipment evaluated to the requirements of IEC/EN 61010 are considered to belong in that classification.

3.0 Mean Time To Repair (MTTR)

SIL determinations are based on a number of factors including the Mean Time To Repair (MTTR). The analysis for the Pulsar Model R86 is typically based on a MTTR of 24 hours.

4.0 Supplementary Documentation

The Pulsar Model R86 Installation and Operating Manual Bulletin 58-603 must be available for installation of the measuring system.

One of the following Electronic Device Description Files is also required if HART is used:

Manufacturer Code 0x0056 Model R86 1.x Device ID 0x56DD, device revision 1, DD revision 1.

For device installations in a classified area, the relevant safety instructions and electrical codes must be followed.

5.0 Instructions

5.1 Systematic Limitations

The following factors must be observed to avoid systematic failures.

5.1.1 Application

Choosing the proper Pulse Burst Radar antenna is the most important step in the application decision process. The antenna configuration establishes fundamental performance characteristics. Therefore, the horn antenna for use with the Pulsar Model R86 should be selected as appropriate for the application.

See Sections 2.3 & 2.4 of Installation and Operating Manual 58-603 for more detailed application information and limitations.

5.1.2 Environmental

See Section 3.7 of Installation and Operating Manual 58-603 for environmental limitations.

5.2 Skill Level of Personnel

Personnel following the procedures of this safety manual should have technical expertise equal to or greater than that of a qualified instrument technician.

5.3 Necessary Tools

Following are the necessary tools needed to carry out the prescribed procedures:

- Open-wrenches or adjustable wrench to fit the process connection size and type.
  - Antenna 2" (50 mm)
  - Transmitter 1½" (38 mm)
  - Torque wrench is highly desirable
- Flat-blade screwdriver
- Digital multimeter
- 24 VDC power supply, 23 mA minimum

5.4 Storage

The device should be stored in its original shipping box and not be subjected to temperatures outside the storage temperature (-50 to +80 °C) shown in the Pulsar Model R86 Installation and Operating Manual and associated specifications.

5.5 Installation

Refer to the Pulsar Model R86 Installation and Operating Manual Bulletin 58-603 for the proper installation instructions.

Section 2.6 of I/O Manual 58-603 contains information on the use, changing and resetting of the password protection function.

Section 2.6 of I/O Manual 58-603 provides menu selection items for configuration of the transmitter as a level sensing device and also contains configuration recommendations.

This SIL evaluation has assumed that the customer will be able to acknowledge an over or under current condition via the Logic Solver.

5.6 Configuration

5.6.1 General

The Magnetrol Pulsar Model R86 can be configured via the local display, or via HART compatible handheld terminal or personal computer.

Ensure the parameters have been properly configured for the application.

Special consideration should be given to the following configuration parameters:

DIELECTRIC RANGE: Enter the Dielectric Range for the material to be measured:

Above 10 (Water-based media)
3.0 to 10 (Mid-dielectric media)
1.7 to 3.0 (Most typical hydrocarbons)
Below 1.7 (Light Hydrocarbons like Propane and Butane) — (stillwell only)

PV ALARM SELECTION: Do NOT choose HOLD for this parameter as a Fault will not be annunciated on the current loop.

LOOP CURRENT MODE: ensure this is set to ENABLED.

PASSWORD: should be changed to a specific value other than Zero. See Section 5.6.2

5.6.2 Write Protecting / Locking

The Pulsar Model R86 is password protected with a numerical password between 0 and 59999 (Default=0=Password disabled).

Refer to section 2.6 of the Pulsar Model R86 Installation and Operating Manual Bulletin 58-603 for information on password protection.

5.6.3 Write Enabling / Unlocking

Refer to section 2.6 of the Pulsar Model R86 Installation and Operating Manual Bulletin 58-603 for information on password protection.

When the alterations to the system are complete, ensure the menu has been locked with the password to prevent inadvertent changes to the device.

5.7 Site Acceptance Testing

To ensure proper operation after installation and configuration a site acceptance test should be completed. This procedure is identical to the Proof Test Procedure described in Section 6.1.4.

5.8 Recording Results

Results of Site Acceptance Testing must be recorded for future reference.

5.9 Maintenance

5.9.1 Diagnostics

Internal diagnostic testing does a complete cycle approximately four times per minute. A message will appear and the Output current will be driven to 3.6 or 22 mA (customer selectable) upon detection of a Diagnostic Failure. Worst-case internal fault detection time is one minute.

5.9.2 Troubleshooting

Report all failures to Magnetrol.

Refer to Section 3.4 of the Pulsar Model R86 Installation and Operating Manual Bulletin 58-603 for troubleshooting device errors.

- As there are no moving parts in this device, the only maintenance required is the proof test.
- Firmware can only be upgraded by factory personnel.

6.0 Recurrent Function Tests

6.1 Proof Testing

6.1.1 Introduction

Following are the procedures utilized to detect Dangerous Undetected (DU) failures. The procedure will detect approximately 90% of possible DU failures in the Model R86.

6.1.2 Interval

To maintain the Safety Integrity Level of a Safety Instrumented System, it is imperative that the entire system be tested at regular time intervals (referred to as TI in the appropriate standards). The onus is on the owner/operator to select the type of inspection and the time period for these tests.

The system check must be carried out to prove that the functions meet the IEC specification and result in the desired response of the safety system as a whole.

This system check can be guaranteed when the response height is approached in the filling process; though, if this is not practical, a suitable method of simulating the level of the physical measurement must be used to make the level sensor respond as if the fill fluid were above the alarm/set point level. If the operability of the sensor/transmitter can be determined by other means that exclude all fault conditions that may impair the normal functions of the device, the check may also be completed by simulating the corresponding output signal of the device.

6.1.3 Recording results

Results of the Proof Test should be recorded for future reference.

6.1.4 Proof Test Procedure

1. Bypass the PLC or take other action to avoid a false trip.
2. Inspect the Unit in detail outside and inside for physical damage or evidence of environmental or process leaks.
   a. Inspect the exterior of the Unit housing. If there is any evidence of physical damage that may impact the integrity of the housing and the environmental protection, the unit should be repaired or replaced.
   b. Inspect the interior of the Unit. Any evidence of moisture, from process or environment, is an indication of housing damage, and the unit should be repaired or replaced.
3. Use the Unit's DIAGNOSTICS menu to observe Present Status, and review EVENT HISTORY in the Event Log. Up to 20 events are stored. The events will be date and time stamped if the internal clock is set and running. It is suggested that the internal clock be set at the time of commissioning of the unit. If the clock is set at the time of the proof test, event times are calculated.
   a. Choose the menu DIAGNOSTICS / Present Status.
      i. Present Status should be OK.
   b. Choose the menu DIAGNOSTICS / EVENT HISTORY / Event Log
      i. Any FAULT or WARNING messages must be investigated and understood.
      ii. Corrective actions should be taken for FAULT messages.
4. Use the DIAGNOSTICS menu to perform a "CURRENT LOOP TEST". Choose the menu DIAGNOSTICS / ADVANCED DIAGNOSTICS / TRANSMITTER TESTS / Analog Output Test to change the output loop current and confirm the actual current matches the value chosen.
   a. Send a HART command to the transmitter (or use the local interface) to go to the high alarm current output, 22mA, and verify that the analog current reaches that value.
      i. This step tests for compliance voltage problems such as low supply voltage or increased wiring resistance.
      ii. This also tests for current loop control circuitry and adjustment problems.
   b. Send a HART command to the transmitter (or use the local interface) to go to the low alarm current output, 3.6mA, and verify that the analog current reaches that value.

i. This step tests for high quiescent current and supply voltage problems.

ii. This also tests for current loop control circuitry and adjustment problems.

c. Exit the "Analog Output Test" and confirm that the output returns to original state, with the proper loop current as indicated and controlled by the unit.

5. Use the DIAGNOSTICS menu to observe the present Echo Curve. Confirm that the ECHO Waveform is normal. The echo curve is dependent on the type of antenna used, the installation conditions and the level of process. Comparison of the present Echo curve to one stored at the time of commissioning the unit gives additional confidence of the normal operation of the unit. Use of the DTM and digital communications is necessary for comparison of echo curves.

   a. Choose the menu DIAGNOSTICS / ECHO CURVES / View Echo Curve

      i. Observe the present Echo Curve, identify the characteristic portions of the waveform related to the Initial Launch, Process level, and other features.

      ii. Confirm that the Initial Launch appears acceptable. Confirm that Initial Launch is located where expected.

      iii. Confirm that the signal from the process level appears normal and is located as expected.

      iv. Compare to Echo curve from commissioning in the Initial Launch area.

6. Perform 2 point calibration check of the transmitter by varying level to two points in the process and compare the transmitter display reading and the current level value to a known reference measurement.

7. If the calibration is correct the proof test is complete. Proceed to step 9.

8. If the calibration is incorrect, remove the transmitter and antenna from the process. Inspect the antenna for coating. Clean the antenna, if necessary. Perform a bench calibration check by placing a metal reflector at two points in front of the antenna. Measure the distance of the two points and compare to the transmitter display and current level readings.

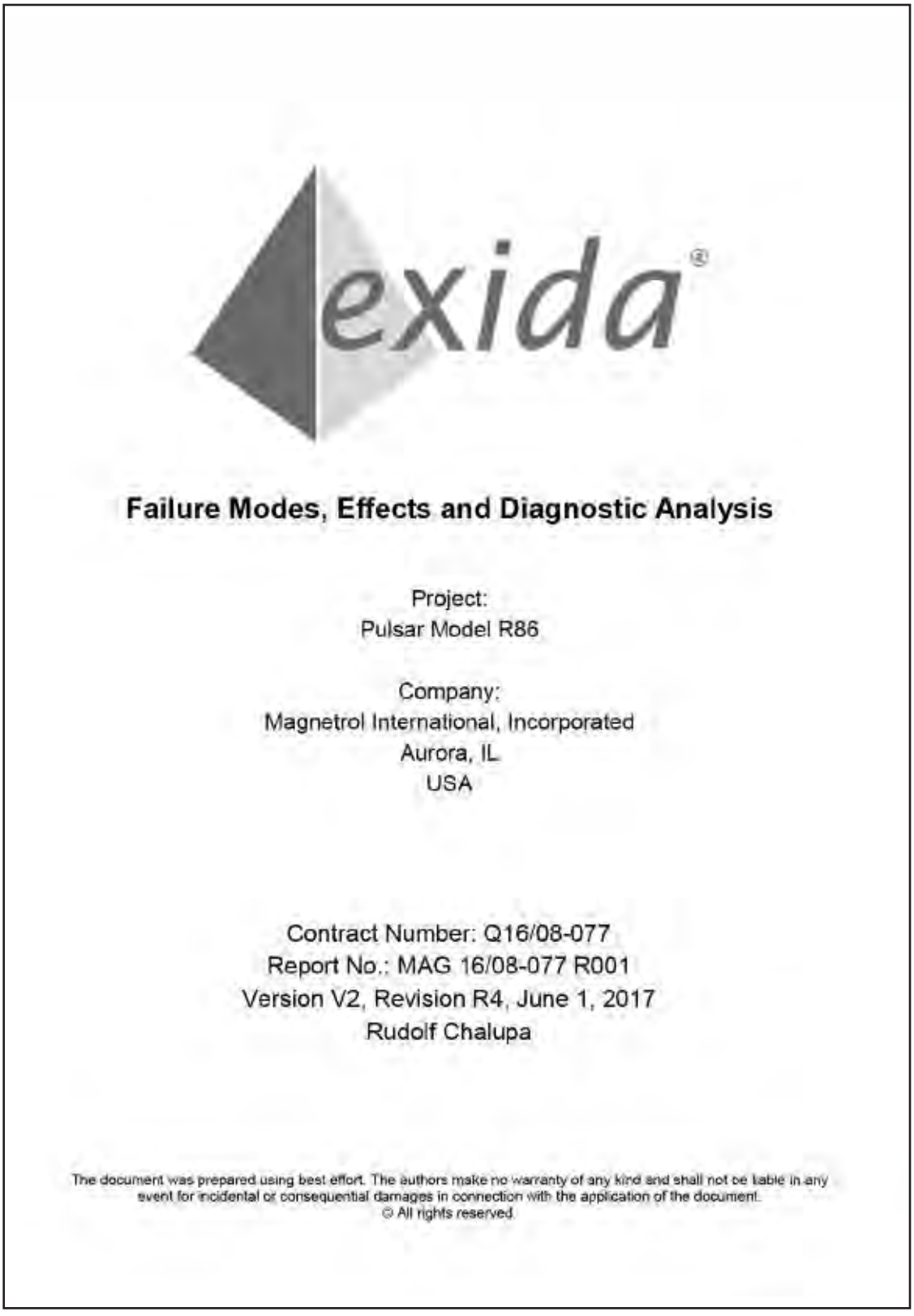
   a. If the calibration is off by more than 2%, call the factory for assistance.

   b. Re-install the antenna and transmitter.

9. Restore loop to full operation.

7.0 Appendices

7.1 FMEDA Report: Exida Management Summary



Failure Modes, Effects and Diagnostic Analysis

Project:
Pulsar Model R86

Company:
Magnetrol International, Incorporated
Aurora, IL
USA

Contract Number: Q16/08-077
Report No.: MAG 16/08-077 R001
Version V2, Revision R4, June 1, 2017
Rudolf Chalupa

Table 3 Failure rates R86-51XX-aXX (a=1 or A)

Failure Category	Failure Rate (FIT)	
Fail Safe Undetected		78
Fail Dangerous Detected		953
Fail Detected (detected by internal diagnostics)	820	
Fail High (detected by logic solver)	55	
Fail Low (detected by logic solver)	78	
Fail Dangerous Undetected		75
No Effect		452
Annunciation Undetected		5

Table 4 Failure rates R86-51XX-aXX (a=3 or B)

Failure Category	Failure Rate (FIT)	
Fail Safe Undetected		183
Fail Dangerous Detected		905
Fail Detected (detected by internal diagnostics)	820	
Fail High (detected by logic solver)	40	
Fail Low (detected by logic solver)	45	
Fail Dangerous Undetected		81
No Effect		488
Annunciation Undetected		5

These failure rates are valid for the useful lifetime of the product, see Appendix A

According to IEC 61508 the architectural constraints of an element must be determined. This can be done by following the 1_H approach according to 7.4.4.2 of IEC 61508 or the 2_H approach according to 7.4.4.3 of IEC 61508 (see Section 5.2).

The 1_H approach involves calculating the Safe Failure Fraction for the entire element.

The 2_H approach involves assessment of the reliability data for the entire element according to 7.4.4.3.3 of IEC 61508.

The analysis shows that the R86 has a Safe Failure Fraction between 90% and 99% (assuming that the logic solver is programmed to detect over-scale and under-scale currents) and therefore meets hardware architectural constraints for up to SIL 2 as a single device.

Table 5 lists the failure rates for the R86 according to IEC 61508.

Table 5 Failure rates according to IEC 61508 in FIT

Device	λ_{SD}	λ_{SU}[3]	λ_{DD}	λ_{DU}	SFF[4]
R86-51XX-aXX (a=1 or A)	0	78	953	75	93.2%
R86-51XX-aXX (a=3 or B)	0	183	905	81	93.0%

[3] It is important to realize that the No Effect failures are no longer included in the Safe Undetected failure category according to IEC 61508, ed2, 2010.
[4] Safe Failure Fraction if needed, is to be calculated on an element level

7.2 SIL Declaration of Conformity

Hardware functional safety according to Section 2.4.4 of IEC 61508-2 (Edition 2.0: 2010).

Magnetrol International, Incorporated 705 Enterprise Street, Aurora, Illinois 60504 declares as the manufacturer, that the level transmitter:

Pulse Burst Radar (4-20 mA) Model R86-511x-xxx

is suitable for use in safety-instrumented loops according to IEC 61508 on condition that "the good practice of engineering rules" as described in the IEC standards, the appropriate parts of IEC 61508/61511, and the following parameters of the instrument are applied.

Product	**Model R96-51xx-axx (a=1 or A)**	**Model R96-51xx-axx (a=3 or B)**
SIL	2	2
Proof Test Interval	1 Year	1 Year
Device Type	B	B
SFF	93.2%	93.0%
λ_{SD}	0 FIT	0 FIT
λ_{SU}	78 FIT	183 FIT
λ_{DD}	953 FIT	905 FIT
λ_{DU}	75 FIT	81 FIT

7.3 Specific Model R86 Values

Specific Model R86

Product	Pulsar R86-51XX-aXX (a=1 or A)	Pulsar R86-51XX-aXX (a=3 or B)
SIL	SIL 2	
HFT	0	
SFF	93.2%	93.0%

Refer to Section 5 and Appendix D of the Model R86 FMEDA report for PFD_{avg} information.

7.4 Report: Lifetime of Critical Components

According to section 7.4.9.5 of IEC 61508-2, a useful lifetime, based on experience, should be assumed.

Although a constant failure rate is assumed by the probabilistic estimation method, this only applies provided that the useful lifetime* of components is not exceeded. Beyond their useful lifetime the result of the probabilistic calculation method is therefore meaningless, as the probability of failure significantly increases with time. The useful lifetime is highly dependent on the subsystem itself and its operating conditions.

This assumption of a constant failure rate is based on the bathtub curve. Therefore, it is obvious that the PFD_{avg} calculation is only valid for components that have this constant domain and that the validity of the calculation is limited to the useful lifetime of each component.

It is the responsibility of the end user to maintain and operate the R86 per manufacturer's instructions. Furthermore, regular inspection should show that all components are clean and free from damage.

The R86 has an estimated useful lifetime of about 50 years.

When plant experience indicates a shorter useful lifetime than indicated in this appendix, the number based on plant experience should be used.

* Useful lifetime is a reliability engineering term that describes the operational time interval where the failure rate of a device is relatively constant. It is not a term which covers product obsolescence, warranty, or other commercial issues.

References

- ANSI/ISA-84.00.01-2004 Part 1 (IEC 61511-1Mod) "Functional Safety: Safety Instrumented Systems for the Process Industry Sector – Part 1 Hardware and Software Requirements"
- ANSI/ISA-84.00.01-2004 Part 2 (IEC 61511-2Mod) "Functional Safety: Safety Instrumented Systems for the Process Industry Sector – Part 2 Guidelines for the Application of ANSI/ISA84.00.01-2004 Part 1 (IEC 61511-1 Mod) – Informative"
- ANSI/ISA-84.00.01-2004 Part 3 (IEC 61511-3Mod) "Functional Safety: Safety Instrumented Systems for the Process Industry Sector – Part 3 Guidance for the Determination of the Required Safety Integrity Levels – Informative"
- ANSI/ISA-TR84.00.04 Part 1 (IEC 61511 Mod) "Guideline on the Implementation of ANSI/ISA-84.00.01-2004"

Disclaimer

The SIL values in this document are based on an FMEDA analysis using exida's SILVER Tool. Magnetrol accepts no liability whatsoever for the use of these numbers of for the correctness of the standards on which the general calculation methods are based.

ASSURED QUALITY & SERVICE COST LESS

Service Policy

Owners of Magnetrol controls may request the return of a control or any part of a control for complete rebuilding or replacement. They will be rebuilt or replaced promptly. Controls returned under our service policy must be returned by prepaid transportation. Magnetrol will repair or replace the control at no cost to the purchaser (or owner) other than transportation if:

1. Returned within the warranty period; and
2. The factory inspection finds the cause of the claim to be covered under the warranty.

If the trouble is the result of conditions beyond our control; or, is NOT covered by the warranty, there will be charges for labor and the parts required to rebuild or replace the equipment.

In some cases it may be expedient to ship replacement parts; or, in extreme cases a complete new control, to replace the original equipment before it is returned. If this is desired, notify the factory of both the model and serial numbers of the control to be replaced. In such cases, credit for the materials returned will be determined on the basis of the applicability of our warranty.

No claims for misapplication, labor, direct or consequential damage will be allowed.

Return Material Procedure

So that we may efficiently process any materials that are returned, it is essential that a "Return Material Authorization" (RMA) number be obtained from the factory prior to the material's return. This is available through a Magnetrol local representative or by contacting the factory. Please supply the following information:

1. Company Name
2. Description of Material
3. Serial Number
4. Reason for Return
5. Application

Any unit that was used in a process must be properly cleaned in accordance with OSHA standards, before it is returned to the factory.

A Material Safety Data Sheet (MSDS) must accompany material that was used in any media.

All shipments returned to the factory must be by prepaid transportation.

All replacements will be shipped F.O.B. factory.

MAGNETROL® / AMETEK®

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SUPERSEDES: April 2017

Operating Manual

MAGNETROL PULSAR MODEL R86

High Performance 26 GHz Pulse Burst Radar Level Transmitter

Supplied by

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PULSAR®
R86 RADAR

Pulsar® Model R86
PROFIBUS PA
Operating Manual

Software Version 1.x

High Performance

26 GHz Pulse Burst Radar

Level Transmitter

PROFI

PRESSURE EQUIPMENT DIRECTIVE 2014/68/EU

MAGNETROL® / AMETEK®

LEVEL MEASUREMENT SOLUTIONS

Read this Manual Before Installing

This manual provides information on the Pulsar® Model R86 Radar transmitter with PROFIBUS PA Output and should be used in conjunction with Pulsar I&O manual 58-603. It is important that all instructions are read and followed carefully.

Safety Messages

The PULSAR system is designed for use in Category II, Pollution Degree 2 installations. Follow all standard industry procedures for servicing electrical and computer equipment when working with or around high voltage. Always shut off the power supply before touching any components. Although high voltage is not present in this system, it may be present in other systems.

Electrical components are sensitive to electrostatic discharge. To prevent equipment damage, observe safety procedures when working with electrostatic sensitive components.

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

WARNING! Explosion hazard. Do not connect or disconnect designs rated Explosion proof or Non-incendive unless power has been switched off and/or the area is known to be non-hazardous

Low Voltage Directive

For use in Installations Category II, Pollution Degree 2. If equipment is used in a manner not specified by the manufacturer, protection provided by equipment may be impaired.

Warranty

All Magnetrol electronic level and flow controls are warranted free of defects in materials or workmanship for eighteen months from the date of original factory shipment. If returned within the warranty period; and, upon factory inspection of the control, the cause of the claim is determined to be covered under the warranty; then, Magnetrol will repair or replace the control at no cost to the purchaser (or owner) other than transportation.

Magnetrol shall not be liable for misapplication, labor claims, direct or consequential damage or expense arising from the installation or use of equipment. There are no other warranties expressed or implied, except special written warranties covering some Magnetrol products.

Quality assurance

The quality assurance system in place at Magnetrol guarantees the highest level of quality throughout the company. Magnetrol is committed to providing full customer satisfaction both in quality products and quality service.

The Magnetrol quality assurance system is registered to ISO 9001 affirming its commitment to known international quality standards providing the strongest assurance of product/service quality available.

Performance specifications are effective with date of issue and are subject to change without notice. Magnetrol® reserves the right to make changes to the product described in this manual at any time without notice. Magnetrol makes no warranty with respect to the accuracy of the information in this manual.

MAGNETROL® / AMETEK®
LEVEL MEASUREMENT SOLUTIONS

Pulsar® Model R86 Radar transmitter with PROFIBUS PA Output

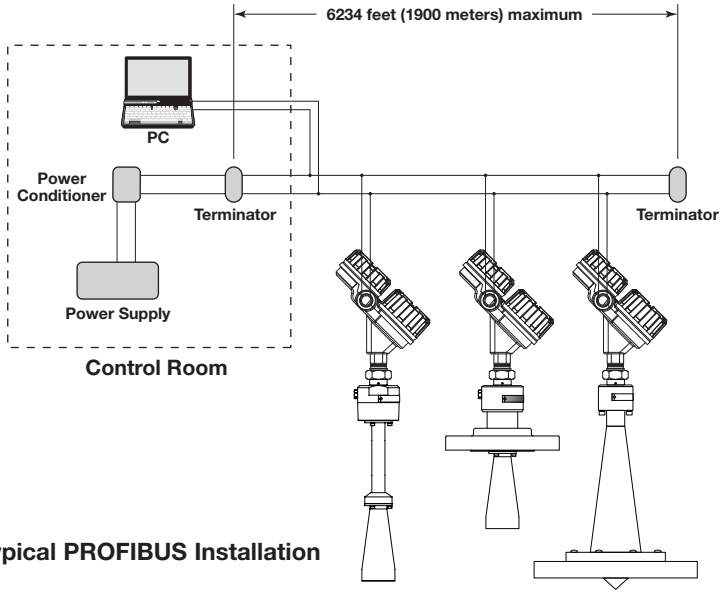
Table of Contents

1.0 PROFIBUS PA™ Overview

1.1 Description

PROFIBUS PA™ is a digital communications system that serially interconnects devices in the field. A fieldbus system is similar to a Distributed Control System (DCS) with two exceptions:

- PROFIBUS PA™ is a system that allows the user to distribute control across a network. Fieldbus devices are smart and actually maintain control over the system.



Typical PROFIBUS Installation

Unlike 4–20 mA analog installations in which the two wires carry a single variable (the varying 4–20 mA current), a digital communications scheme such as PROFIBUS PA™ considers the two wires as a network. The network can carry many process variables as well as other information. The Model R86PA transmitter is a PROFIBUS PA™ certified device that communicates with the DPV1 protocol operating at 31.25 kbits/sec. The MBP physical layer is an approved IEC 61158 standard.

An IEC61158 shielded twisted pair wire segment can be as long as 6234 feet (1900 meters) without a repeater. Up to 4 repeaters per segment can be used to extend the distance. The maximum number of devices allowed on a fieldbus segment is 32 although this depends on the current draw of the devices on any given segment.

Details regarding cable specifications, grounding, termination, and other network information can be found in IEC 61158 or the technical guideline "PROFIBUS PA™ User and Installation Guideline" at **www.profibus.com**.

1.2 Benefits

The benefits of PROFIBUS PA™ can be found throughout all phases of an installation:

1. **Design/Installation:** Connecting multiple devices to a single pair of wires means less wire and fewer I/O equipment. Initial Engineering costs are also reduced because PROFIBUS International requires interoperability, defined as "the ability to operate multiple devices in the same system, regardless of manufacturer, without a loss of functionality."

   All PROFIBUS PA™ devices must be tested for interoperability by a PI accredited, independent testing agency. Magnetrol Model R86PA device certification information can be found at **www.profibus.com**.

2. **Operation:** A PROFIBUS PA™ system allows for multiple variables to be brought back from each device to the control room for additional trending and reporting.

3. **Maintenance:** The self-diagnostics residing in the smart field devices minimizes the need to send maintenance personnel to the field.

1.3 Device Configuration

The function of a PROFIBUS PA™ device is determined by the arrangement of a system of blocks. The types of blocks used in a typical User Application are described as follows:

Physical Block describes the characteristics of the PROFIBUS PA™ device such as the device name, manufacturer, and serial number.

Function Blocks are built into the PROFIBUS PA™ devices as needed to provide the desired control system behavior. There can be numerous function blocks in a single User Application.

Transducer Blocks contain information such as calibration parameters and sensor type. They are used to connect the sensor to the input function blocks.

An important requirement of fieldbus devices is the interoperability concept mentioned earlier. Device Description (DD) technology can provide extended descriptions for each object and provides pertinent information useful for a host system.

DDs are similar to the drivers that your personal computer (PC) uses to operate peripheral devices connected to it.

General PROFIBUS Information:

- The Model R86 supports PA Profile Version 3.02
- The Ident Number issued by the PNO for Magnetrol Model R86 is 0x1035. The Ident Number is included in the name of the GSD file.
- The General Station Description (GSD) file provides information on the features and performance capabilities of a PROFIBUS device to allow easy configuration of PROFIBUS networks with devices from different manufacturers. The manufacturer-specific GSD file for the Model R86PA is MI021035.gsd. Also, a bitmap file specified in the GSD file provides a symbolic representation of the device for network configuration tools.
- The Model R86PA can also use the profile-specific GSD file PA139707.gsd. If this general GSD file is used, the "Ident number Selector" parameter in the Physical Block must be set to the profile-specific ident number. The default selection of the "Ident Number Selector" parameter is the manufacturer-specific ident number.
- A Device Description is available for configuring the device using Simatic PDM.
- The range of device bus addresses is 0 to 126. 126 is the default address and all units will ship with address 126 unless a non-default address assignment is requested by the customer. The address can be changed via the fieldbus or the local LCD interface.

Additional information can be found at **www.profibus.com**.

1.3.1 PROFIBUS DD Revision Table

Model R86PA

DD Version	Release Date	Compatible with Model R86PA	
		Firmware	Software Revision
Dev V1 DD v1	February 2019	1.0	V 3.0.2

1.4 Intrinsic Safety

The IEC 61158 physical layer supports Intrinsic Safety (IS) applications with bus-powered devices. To accomplish this, an IS barrier or galvanic isolator is placed between the power supply in the safe area and the device in the hazardous area.

IEC 61158 also supports the Fieldbus Intrinsically Safe Concept (FISCO) model which allows more field devices in a network. The FISCO model considers the capacitance and inductance of the wiring to be distributed along its entire length. Therefore, the stored energy during a fault will be less and more devices are permitted on a pair of wires. Instead of the conservative entity model, which only allows about 90 mA of current, the FISCO model allows a maximum of 110 mA for Class II C installations and 240 mA for Class II B installations.

FISCO certifying agencies have limited the maximum segment length to 1000 meters because the FISCO model does not rely on standardized ignition curves.

The Model R86 PA is available with entity IS, FISCO IS, and FNICO non-incendive approvals.

2.0 Function Blocks

2.1 Overview

The Pulsar Model R86 Non-Contact Radar Level Transmitter operates at 26 GHz. Refer to Bulletins 58-103 and 58-603 for more detailed information on the Pulsar product family.

The Pulsar Model R86PA is a Non-Contact level transmitter with twelve PROFIBUS PA™ Blocks (one Physical Block, three Transducer Blocks, and eight Analog Input blocks). The idea of Function Blocks, which a user can customize for a particular application, is a key concept of fieldbus topology. Function Blocks consist of an algorithm, inputs and outputs, and a user-defined name.

The TRANSDUCER block output is available to the network through the ANALOG INPUT blocks.

The ANALOG INPUT blocks (AI) take the TRANSDUCER block measured values and makes them available as an analog value to the network. The AI blocks have scaling conversion, filtering, and alarm functions.

2.1.1 Standard PROFIBUS Block Parameters

The following are general descriptions of the parameters common to all blocks. Additional information for a given parameter is described later in that specific block section.

BLOCK_OBJECT: Contains the characteristics of the block. This object applies to every block and is placed before the first parameter.

ST_REV A read-only parameter to track changes of static parameters in the associated block. ST_REV will be incremented each time a static parameter is changed.

TAG_DESC (tag descriptor): A user-supplied description of the block.

STRATEGY: A user-specified value that may be used in configuration or diagnostics as a key in sorting block information.

ALERT_KEY: A user-assigned value that may be used in sorting alarms or events generated by a block.

TARGET_MODE: This attribute indicates what mode of operation is desired for the block.

MODE_BLK: A structured parameter composed of the actual mode, the normal and the permitted mode(s) of a block.

The actual mode is set by the block during its execution to reflect the mode used during execution

The permitted mode shows which changes of the target mode are valid for the specific block

ALARM_SUM: This parameter summarized the status of up to 16 block alarms.

2.2 Physical Block

The Physical Block contains data specific to the Model R86PA transmitter, along with some information about the firmware.

NOTE: The Physical Block has no control function.

MODE_BLK: Actual mode must be in AUTO in order for the AI Function blocks in the transmitter to operate.

NOTE: A Physical Block in “out of service” will stop all function block execution in the transmitter.

SOFTWARE_REVISION: Revision number of the software of the field device.

HARDWARE_REVISION: Revision number of the hardware of the field device.

DEVICE_MAN_ID: Identification code of the manufacturer of the field device.

DEVICE_ID: Manufacturer specific identification of the device.

DEVICE_SER_NUM: Serial number of the device.

DIAGNOSIS: Detailed information about the device, bitwise coded.

DIAGNOSIS_EXTENSION: Additional detailed information about the device.

DIAGNOSIS_MASK: Definition of supported DIAGNOSIS information-bits.

0 = not supported

1 = supported

DIAGNOSIS_MASK_EXTENSION: Definition of supported DIAGNOSIS_EXTENSION information-bits.

0 = not supported

1 = supported

DEVICE CERTIFICATION: Pertinent certifications of the device.

WRITE_LOCKING: Software write-protection can be enabled or disabled.

FACTORY_RESET: Command for resetting the device for default values. The setting of the bus address in not affected.

- **RESTART_WITH_DEFAULTS:** As RESTART DEFAULT will set all configuration parameters to their default values. Devices need to be reconfigured following activation of this function. The bus address is not affected.
- **WARM_START:** No parameters changed
- **RESET_ADDRESS_TO_DEFAULT:** Other parameters unchanged

DESCRIPTOR: User-definable text string to describe the device within the application.

DEVICE_MESSAGE: User-definable message string used to describe the device within the application of in the plant.

DEVICE_INSTAL_DATE: Installation date of the device.

IDENT_NUMBER_SELECTOR: Selects manufacturer-specific Ident number issued by PNO or profile-specific Ident number to determine features and behavior for interacting with device.

HW_WRITE_PROTECTION: Indicates the position of a write block mechanism (e.g., hardware jumper).

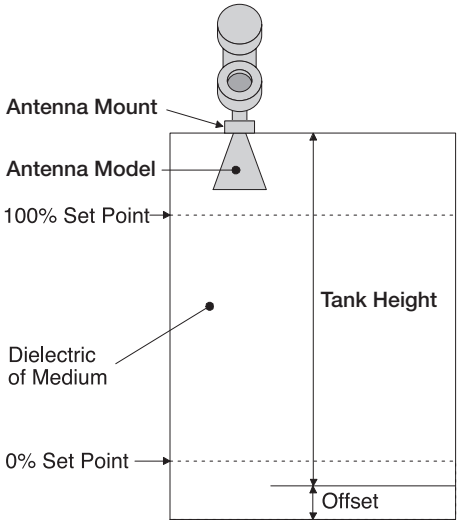
2.3 Analog Input Block

The ANALOG INPUT (AI) block takes the Transducer Block input data, selected by channel number, and makes it available to other function blocks at its output:

1. Level
2. Distance
3. Echo Strength
4. Echo Margin
5. Electronics Temperature
6. Volume
7. Flow
8. Head
9. NR Totalizer
10. R Totalizer

2.3.1 AI Block Parameters

The first eight parameters in an AI block are the standard block parameters discussed in section 2.1.1. Additional analog input function block parameters are as follows:



Scaling

BATCH: A parameter intended to be used in Batch application in line with IEC 61512 Part 1.

OUT: Contains the current measurement value in the configuration engineering unit.

PV_SCALE: High and low scale values used to convert Process Variable Configured by channel into percent.

OUT_SCALE: The high and low scale values, the engineering code, and number of digits to the right of the decimal point to be used in displaying the OUT parameters.

CHARACTERIZATION_TYPE: Selects the type of linearization. The only type supported in the AI function blocks is Linear, which means no linearization.

CHANNEL: Selects the measurement value from an active transducer block as the input to the function block.

PV_FTIME: Filter time of the Process Variable.

FSAFE_TYPE: Defines the reaction of a device, if a fault is detected and the quality of the process variable input from the transducer block is BAD.

0 = FSAFE_VALUE is used as OUT

1 = Use last stored valid OUT value

2 = OUT has incorrect calculated value; status remains “bad”.

FSAFE_VALUE: Default value for the OUT parameter, if a fault is detected, and FSAFE_TYPE is 0.

HI_LIM: Value of the upper limit of warnings.

LO_LIM: Value of the lower limit of warnings.

ALARM_HYS: Hysteresis to adjust sensitivity of alarm triggering.

HI_HI_LIM: Value of the upper limit of alarms.

HI_LIM: Value of the upper limit of warnings.

LO_LIM: Value of the lower limit of warnings.

LO_LO_LIM: Value of the lower limit of alarms.

HI_HI_ALM: State of the upper limit of alarms.

HI_ALM: State of the upper limit of warnings.

LO_ALM: State of the lower limit of warnings.

LO_LO_ALM: State of the lower limit of alarms.

SIMULATE: For commissioning and test purposes, the input value of the Transducer Block in the AI Block can be modified.

OUT_UNIT_TEXT: Allows the user to write text if a specific unit of the OUT parameter is not in the code list.

The TRANSDUCER and AI Block's actual mode in the MODE_BLK parameter must be set to AUTO to pass the PV Value through the AI to the network.

Transducer scaling, called PV_SCALE, is applied to the PV from the CHANNEL to produce the FIELD_VAL in percent. Units of PV_SCALE are the same as the units of the TRANSDUCER BLOCK process variable configured by channel.

Damping Filter is a feature of the AI Block. PV_FTIME parameter is the time constant of a single exponential filter for the PV, in seconds. This parameter can be used to dampen out fluctuation in level due to excessive turbulence.

The AI Block has multiple ALARM functions that monitor the OUT parameter for out of bound conditions.

2.3.2 Local Display of Analog Input Block

The PULSAR Model R86 PA transmitter incorporates a useful feature that allows the Analog Input (AI) block Out values to be displayed on the local LCD.

NOTE: There are many reasons that AI block Out values can deviate from the measurement value originating in the Transducer block, and because the keypad and local display will only provide access to Transducer block parameters, there is no way to change (or view) the other fieldbus configuration items affecting the AI block output using the keypad and LCD.

These screens should only be considered as measured value indicators for configured transmitters. For example:

- The screens are not used for commissioning or diagnostic/troubleshooting purposes.
- Prior to full fieldbus configuration (transmitter assigned a permanent address, AI block(s) configured and scheduled for execution, etc.), the value displayed may not reflect the transducer measurement.

LCD Screen

2.3.2.1 AI Out Display Screens

The Analog Input Block Out values can be conditionally displayed as part of the "rotating" home menu screens. A representative example is shown at left.

The screens will be formatted as shown with:

- Physical Device Tag (Selectable)
- Measured Value Status (Bad, Good, Uncertain)
- Bar Graph

For example, "AI1_Level" would be the most commonly used AI Out screen.

"AI2---" would be displayed when the channel value is 0 [uninitialized] for AI block 2.

Because the Model R86 transmitter has eight (8) Analog Input blocks, any or all of which may be used in particular applications, a Transducer block parameter controls which AI block Out values will be displayed on the LCD.

Any or all (or none) of the AI block Out values can be selected for display on the LCD.

NOTE: In the photo at left, status is shown as "Bad out of Service". This message could be shown prior to commissioning.

Device Address screen
The address can be changed to any number from 0 to 126, and changing the address does not require use of the advanced password. (Note: changing or resetting the address results in a reset of the transmitter.)

Physical Device Tag screen
The Tag can be set using the keypad and local display, or from the Profibus interface.

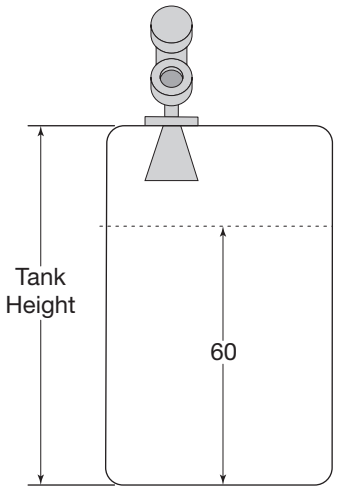
The [AI Block] PV Scale values are automatically converted to appropriate values if the units for the channel used by an AI block are changed. For example, if PV Scale Upper Value is 240 inches and Channel is Level, if Level Units is changed from inches to feet, PV Scale Upper Value will automatically change to 20 [feet].

2.3.3 AI Block Configuration

Below are examples of various typical AI Block configurations.

Example 1: standard configuration for transmitter with tank height TH inches or cm.

[setup by factory as part of final assembly procedure]

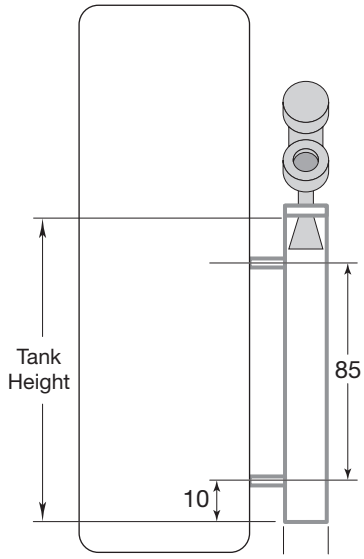


Transducer Block + LCD Level	AI Block Output [To PA segment]
60 [in / cm]	100%
Tank Height = inches or cm	
0 [in / cm]	0%

Configuration	
Tank Height	TH
Bottom Blocking Distance	0
PV Scale Lower Value	0
PV Scale Upper Value	TH
PV Scale Units	in/cm
Out Scale Lower Value	0
Out Scale Upper Value	100
Out Scale Units	%
Characterization Type	Linear

Example 2: end user desires 0 to 100% output for a subset of the measureable region

[e.g., for a chamber application]

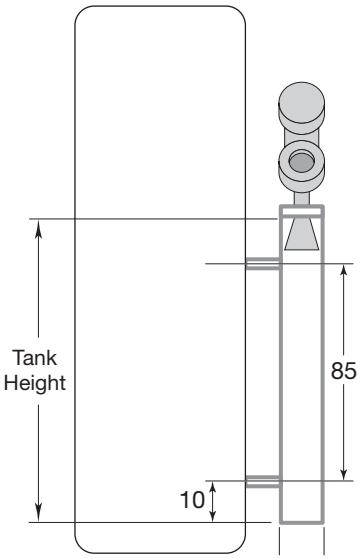


Transducer Block + LCD Level	AI Block Output [To PA segment]
85 cm	100%
0 cm	0%

Configuration	
Tank Height	TH
Bottom Blocking Distance	10
PV Scale Lower Value	10
PV Scale Upper Value	85
PV Scale Units	cm
Out Scale Lower Value	0
Out Scale Upper Value	100
Out Scale Units	%
Characterization Type	Linear

Example 3: same configuration as previous except Direct [no] scaling setup in AI block

Output to PA segment is in cm



Transducer Block + LCD Level	AI Block Output [To PA segment]
85 cm	85 cm
10 cm	10 cm

Configuration	
Tank Height	TH
Bottom Blocking Distance	10
PV Scale Lower Value	0
PV Scale Upper Value	85
PV Scale Units	cm
Out Scale Lower Value	0
Out Scale Upper Value	85
Out Scale Units	cm
Characterization Type	Linear

2.4 Radar Transducer Block

The TRANSDUCER block is a custom block containing parameters that support the Model R86PA level transmitter. It contains the radar antenna configuration, diagnostics, and calibration data, and outputs level with status information.

The TRANSDUCER block parameters are grouped in a useful configuration, and contain both read-only and read-write parameters.

- The read-only parameters report the block status and operation modes.
- The read-write parameters affect the function block basic operation, level transmitter operation, and calibration.

The Transducer Block remains in AUTO mode even when the local interface (keypad) is used to change a parameter online.

3.0 Model R86 Transmitter Configuration

Although the PULSAR Model R86 transmitter can be delivered pre-configured from the factory, it can also be easily reconfigured in the shop or at the installation using the local LCD/Keypad. Bench configuration provides a convenient and efficient way to set up the transmitter before going to the tank site to complete the installation.

NOTE: The transmitter can be configured without the antenna. Disregard diagnostic indicators that may appear.

3.1 Configuration Information

To utilize the QuickStart menu available on the PULSAR Model R86, some key information is required for configuration.

Gather the information and complete the following operating parameters table before beginning configuration.

NOTES: The QuickStart menu is available for Level Only applications.

1. These configuration steps are not necessary if the transmitter was pre-configured prior to shipment.

Display	Question	Answer
Level Units	What units of measurement will be used?	_____
Tank Height	What is the tank height?	_____
Antenna Model	What type of antenna is being used? Select first 7 digits of Model number. (See nameplate on side of antenna)	_____
Antenna Extension	What is maximum nozzle length for which the antenna can be used? Select last 3 digits of Model number. (See nameplate on side of antenna)	_____
Antenna Mount	Is the antenna mounting NPT, BSP, or flanged?	_____
Dielectric	What is the dielectric of the process medium?	_____

3.2 Menu Traversal and Data Entry

The four push buttons offer various forms of functionality for navigation and data entry.

The Model R86 user interface is hierarchical in nature, best described as a tree structure. Each level in the tree contains one or more items. Items are either menu labels or parameter names.

- Menu labels are presented in all capital letters
- Parameters are capital words

3.2.1 Navigating the Menu

⇧ **UP** moves to the previous item in the menu branch.

⇩ **DOWN** moves to the next item in the menu branch.

⇦ **BACK** moves back one level to the previous (higher) branch item.

⇨ **ENTER** enters into the lower level branch or switches to the entry mode. Holding the ENTER down on any highlighted menu name or parameter will show help text for that item.

3.2.2 Data Selection

This method is used for selecting configuration data from a specific list.

⇧ **UP** and ⇩ **DOWN** to navigate the menu and highlight the item of interest

➪ **ENTER** allows modification of that selection

⇧ **UP** and ⇩ **DOWN** to choose new data selection

➪ **ENTER** to confirm selection

Use ⇦ **BACK** (Escape) key at any time to abort the procedure and escape to previous branch item.

3.2.3 Entering Numeric Data Using Digit Entry

This method is used to input numeric data, e.g., Probe Length or level offset.

Push button		Keystroke Action
⬆	Up	Moves up to the next highest digit (0,1,2,3,....,9 or decimal point). If held down the digits scroll until the push button is released.
⬇	Down	Moves up to the next lowest digit (0,1,2,3,....,9 or decimal point). If held down the digits scroll until the push button is released.
⬅	Back	Moves the cursor to the left and deletes a digit. If the cursor is already at the leftmost position, then the screen is exited without changing the previously saved value.
➡	Enter	Moves the cursor to the right. If the cursor is located at a blank character position, the new value is saved.

All numeric values are left-justified, and new values are entered from left to right. A decimal point can be entered after the first digit is entered, such that .9 is entered as 0.9.

Some configuration parameters can have a negative value. In this case, the leftmost position is reserved for the sign (either "-" for a negative value, or "+" for a positive value).

3.2.4 Entering Numeric Data Using Increment/Decrement

Use this method to input the following data into parameters such as Failure Alarm Delay.

Push button		Keystroke Action
	Up	Increments the displayed value. If held down the digits scroll until the push button is released. Depending on which screen is being revised, the increment amount may increase by a factor of 10 after the value has been incremented 10 times.
	Down	Decrements the displayed value. If held down the digits scroll until the push button is released. Depending on which screen is being revised, the decrement amount may increase by a factor of 10 after the value has been decremented 10 times.
	Back	Returns to the previous menu without changing the original value, which is immediately redisplayed.
	Enter	Accepts the displayed value and returns to the previous menu.

3.2.5 Entering Character Data

This method is used for parameters requiring alphanumeric character entry, such as for entering tags, etc.

General Menu Notes:

Push button		Keystroke Action
	Up	Moves to the previous character (Z...Y...X...W). If held down, the characters scroll until the push button is released.
	Down	Moves to the next item character (A...B...C...D). If held down, the characters scroll until the push button is released.
	Back	Moves the cursor back to the left. If the cursor is already at the leftmost position, then the screen is exited without changing the original tag characters.
	Enter	Moves the cursor forward to the right. If the cursor is at the rightmost position, then the new tag is saved.

3.3 Password Protection

The PULSAR Model R86 transmitter has three levels of password protection to restrict access to certain portions of the menu structure that affect the operation of the system. The user password can be changed to any numerical value up to 59999. When the transmitter is programmed for password protection, a password is required whenever configuration values are changed.

User Password

The User Password allows the customer to limit access to the basic configuration parameters.

The default User Password installed in the transmitter at the factory is 0. (With a password of 0, the transmitter is no longer password protected and any value in the basic user menus can be adjusted without entering a confirming password.)

NOTE: If a User Password is not known or has been misplaced, the menu item New Password in the DEVICE SETUP/ADVANCED CONFIG menu displays an encrypted value representing the present password. Contact Technical Support with this encrypted password to retrieve the original User Password.

Advanced Password

Certain portions of the menu structure that contain more advanced parameters are further protected by an Advanced Password.

This password will be provided, when necessary, by Factory technical support.

Factory Password

Calibration-related and other factory settings are further protected by a Factory Password.

3.4 Model R86 Menu: Step-By-Step Procedure

The following tables provide a complete explanation of the software menus displayed by the PULSAR transmitter. The menu layout is similar between the local Keypad/LCD interface, the DD, and the DTM.

Use these tables as a step-by-step guide to configure the transmitter based on the desired measurement type from the following selections:

- Level Only
- Level & Volume
- Flow

Home Screen

HOME SCREEN

The Home Screen consists of a "slide show" sequence of Measured Values screens which are rotated at 2-second intervals. Each Home Measured Value screen can present up to four information items:

- **Physical Device Tag**
- **Measured Value**
  Label, Numerical Value, Units
- **Status**
  Will be displayed as text
- **Bar Graph** (shown in %)
  Bar graph is only displayed on AI_OUT screens shown in % based on PV scale configuration.

The Home Screen presentation can be customized by viewing or hiding some of these items. See DISPLAY CONFIG under the DEVICE SETUP menu in Section 3.5 — Configuration Menu.

At left is an example of a Home Screen for a Model R86 configured for a Level Only application.

MAIN MENU

Pressing any key on the Home Screen will present the Main Menu, consisting of three basic menu labels shown in all capital letters.

DEVICE SETUP

DIAGNOSTICS

MEASURED VALUES

As shown, the reverse video represents a cursor identifying the selected item, which will appear in reverse video on the LCD. The actions of the keys at this point are:

Main Menu Screen

Push button		Keystroke Action
↑	Up	No action as the cursor is already at the first item in the MAIN MENU
↓	Down	Moves the cursor to DIAGNOSTICS
←	Back	Moves back to HOME SCREEN, the level above MAIN MENU
→	Enter	Presents the selected item, DEVICE SETUP

NOTES:
1. Items and parameters that are shown in lower level menus will depend on the Measurement Type chosen. Those parameter not applicable to the present Measurement Type will be hidden.
2. Holding down the Enter key when the cursor is highlighted over a parameter or menu will provide additional information about that item.

DEVICE SETUP

Choosing DEVICE SETUP from the MAIN MENU will result in an LCD presentation as shown at left.

The small down arrow shown at the right hand side of the screen is the indication that more items are available below and can be accessed by pressing the DOWN key.

Section 3.5 shows the entire tree menu for the Model R86 DEVICE SETUP Menu.

Device Setup Screen

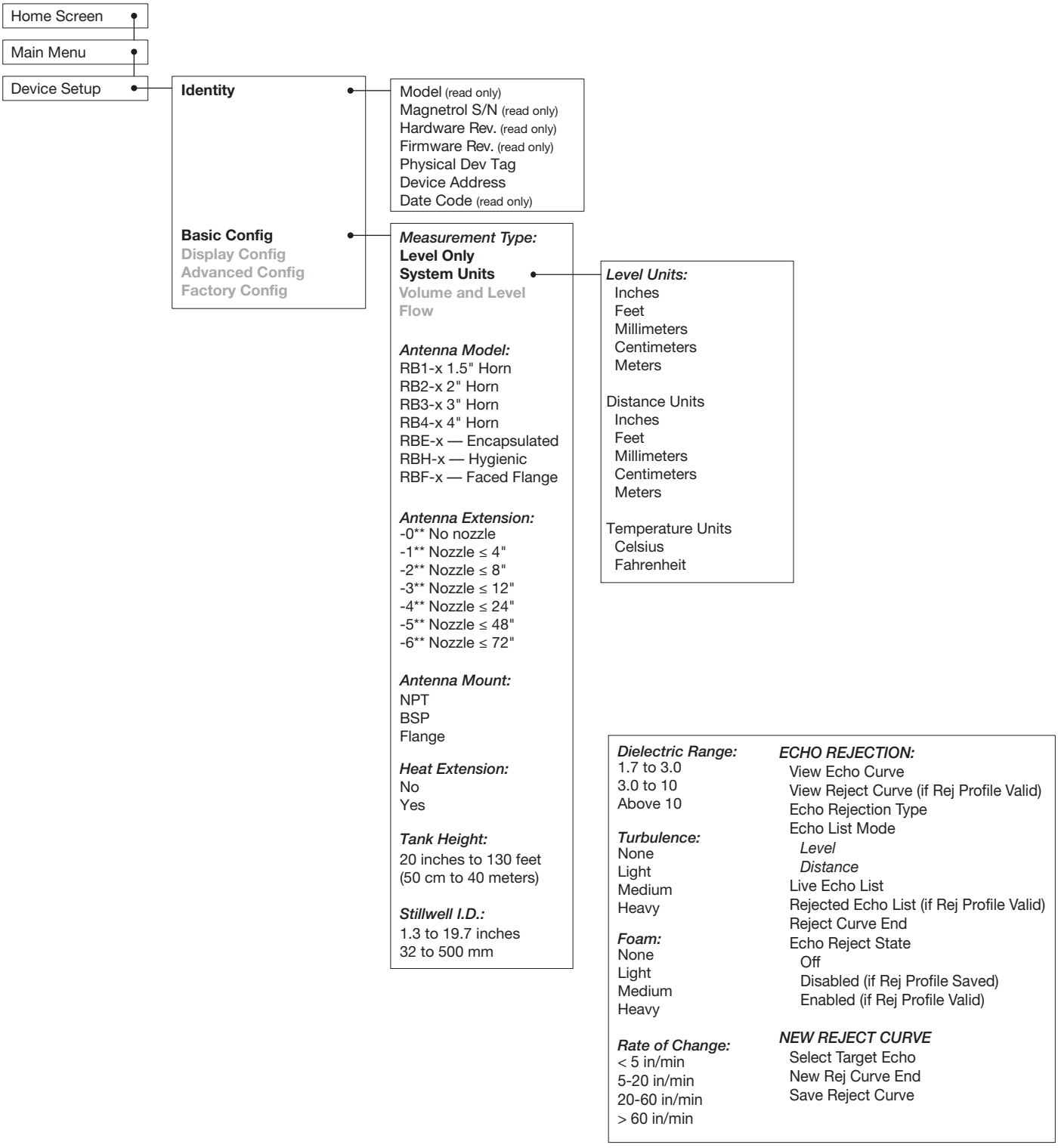
DIAGNOSTICS

Refer to Section 4.0

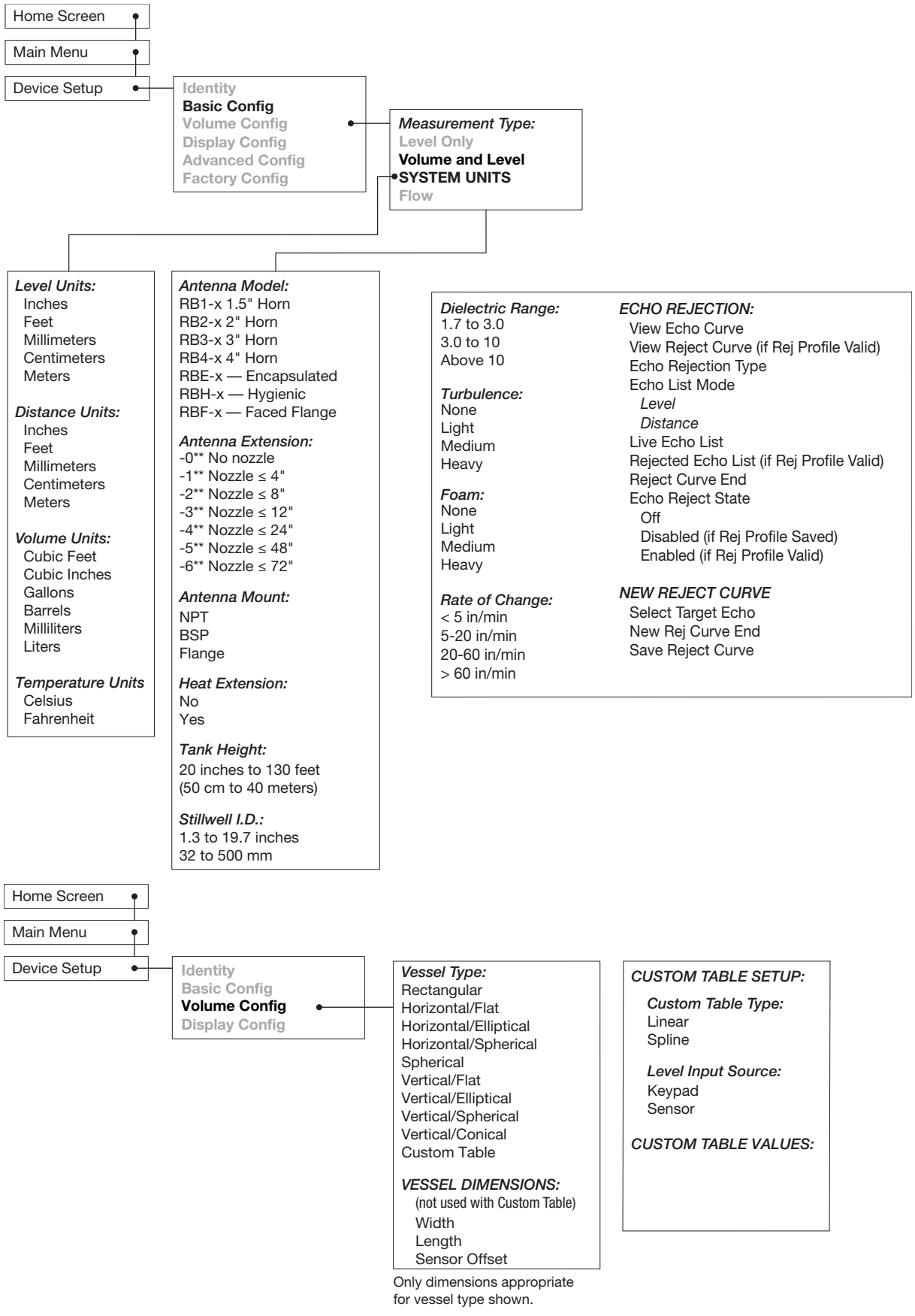
MEASURED VALUES

Allows the user to scroll through all of the available measured values for the measurement type chosen.

3.5 Model R86 Configuration Menu — Device Setup

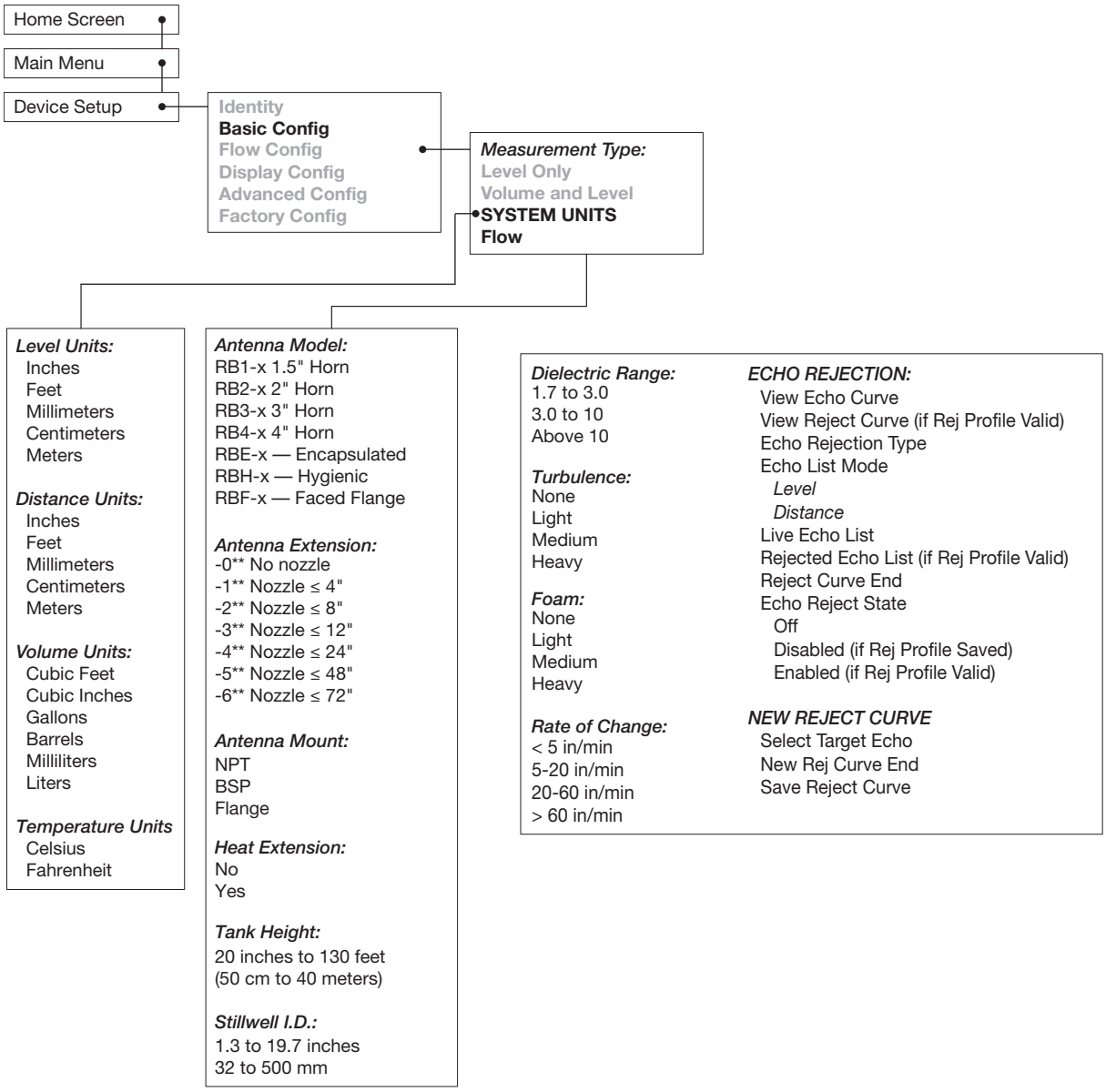


3.5 Model R86 Configuration Menu — Device Setup

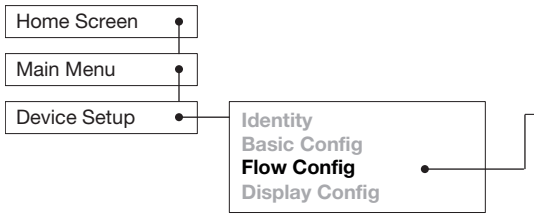


Only dimensions appropriate for vessel type shown.

3.5 Model R86 Configuration Menu — Device Setup

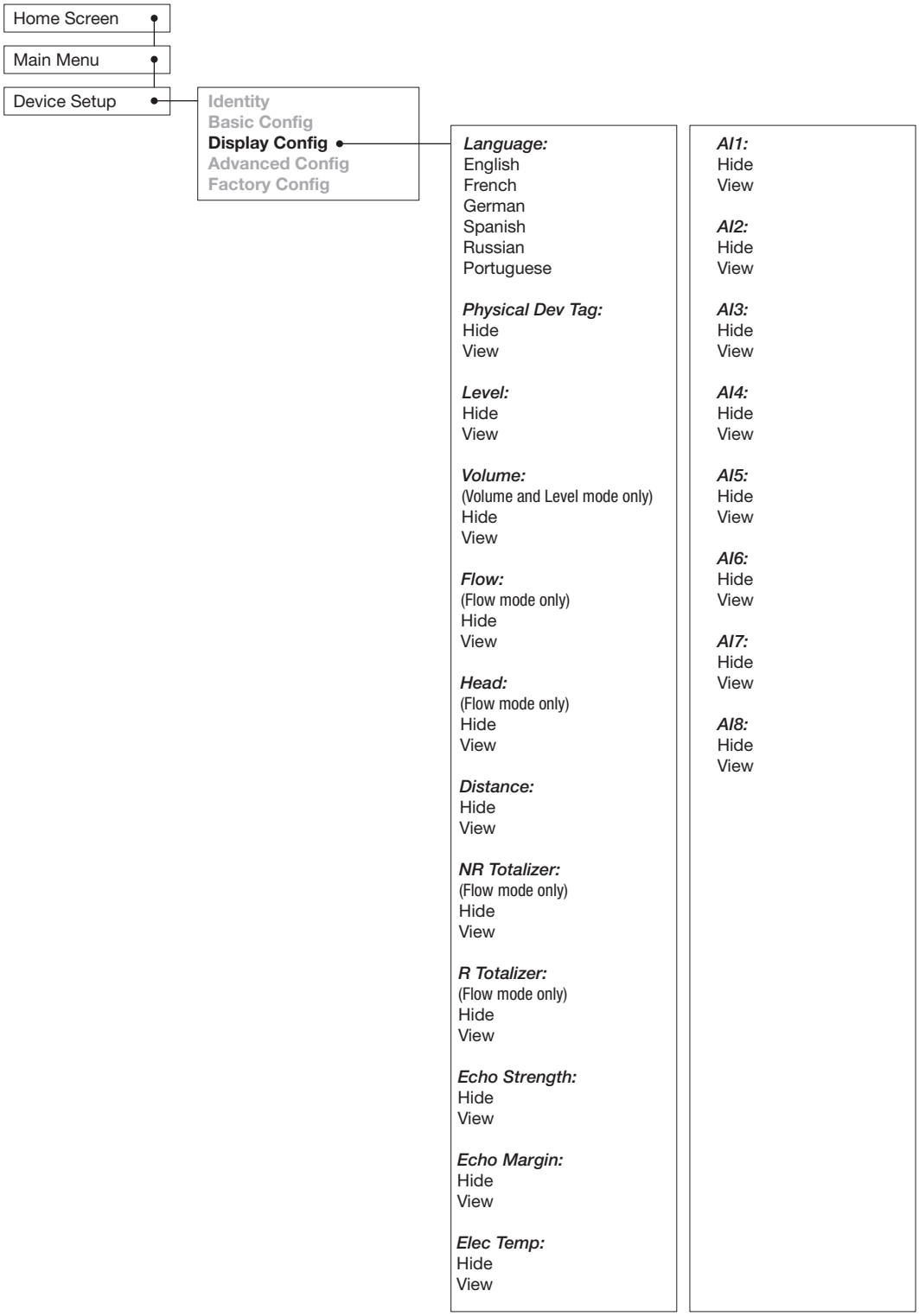


3.5 Model R86 Configuration Menu — Device Setup

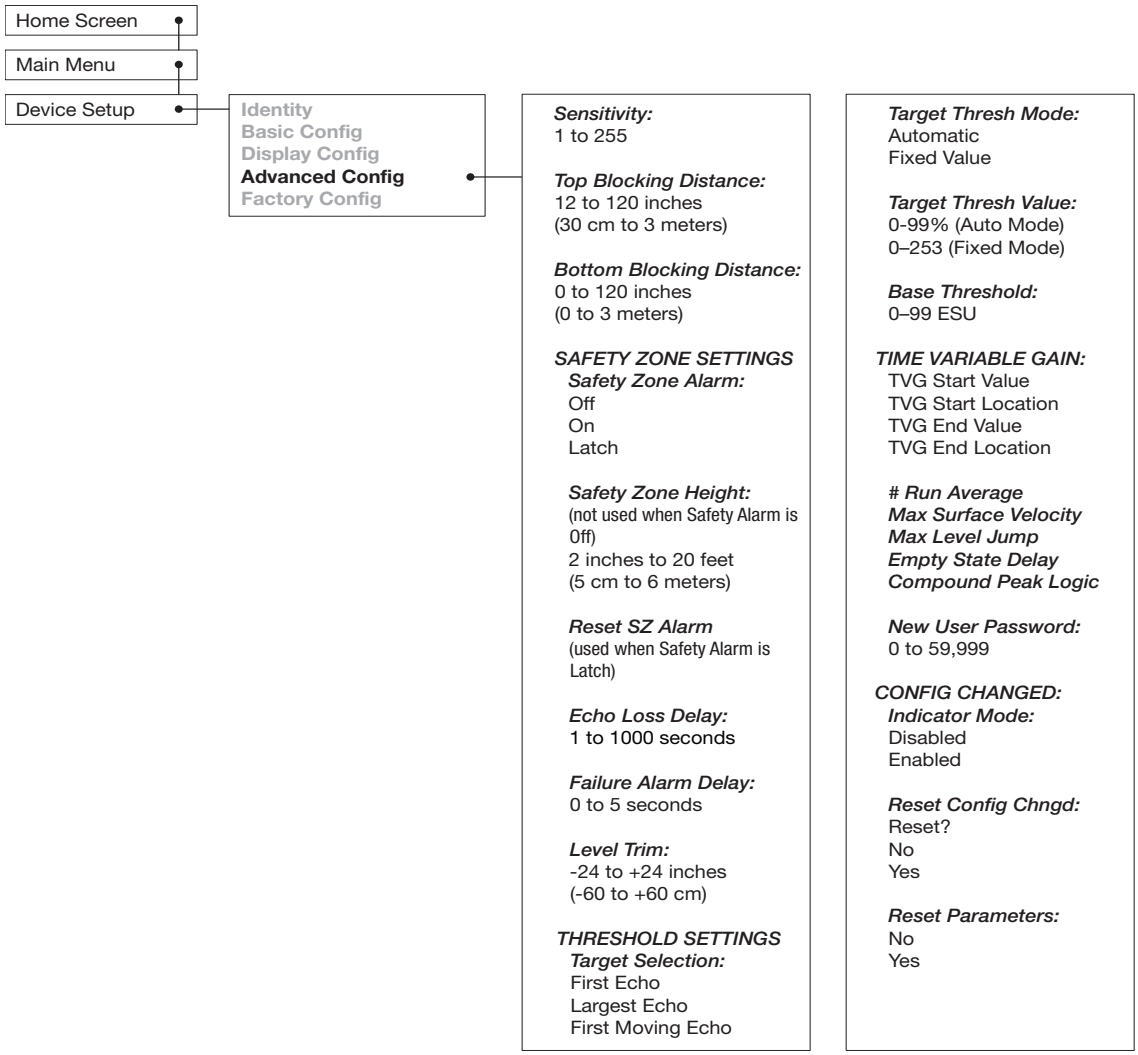


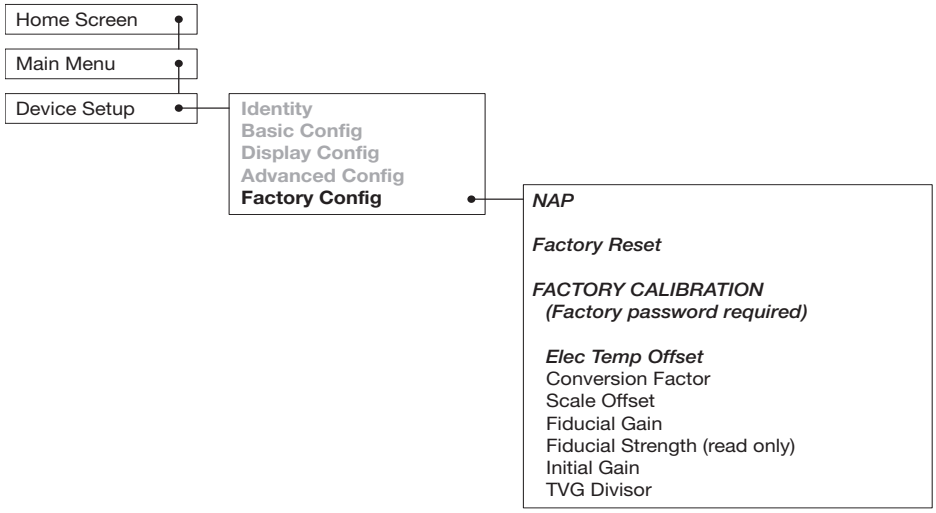
Flow Units: Cubic Ft/Second Cubic Ft/Minute Cubic Ft/Hour Gallons/Minute Gallons/Hour Mil Gallons/Day Liters/Second Liters/Minute Liters/Hour Cubic Meters/Hour ***Head Units:*** Inches Feet Millimeters Centimeters Meters ***Flow Element:*** ***Palmer-Bowlus Flume*** ***Flume Channel Width:*** 4 inches 6 inches 8 inches 10 inches 12 inches 15 inches 18 inches 21 inches 24 inches 27 inches 30 inches ***Parshall Flume*** ***Flume Channel Width:*** 1 inch 2 inches 3 inches 6 inches 9 inches 12 inches 18 inches 24 inches 36 inches 48 inches 60 inches 72 inches 96 inches 120 inches 144 inches	***V notch Weir*** ***V-notch Weir Angle:*** 22.5° 30° 45° 60° 90° 120° ***Rect Weir with Ends*** 0 to 215.0 feet (0 to 65 m) ***Rect Weir w/o Ends*** 0 to 215.0 feet (0 to 65 m) ***Cipolletti Weir*** 0 to 215.0 feet (0 to 65 m) ***Generic Equation*** K L C n ***Custom Table*** ***Custom Table Type:*** Linear Spline ***CUSTOM TABLE VALUES:*** Up to 30 Pairs of Head/Flow Data ***Reference Distance:*** 12 inches to 130 feet (30 cm to 40 m) ***Maximum Head*** (calculated, read only) ***Maximum Flow*** (calculated, read only) ***Low Flow Cutoff:*** 0 to 6 inches (0 to 15.3 cm)	***NON-RESET TOTALIZER:*** ***Units:*** Cubic Feet Gallons Mil Gallons Liters Mil Liters Cubic Meters ***Multiplier:*** 1 10 100 1,000 10,000 100,000 ***Value (read only)*** ***RunTime (read only)*** ***RESETTABLE TOTALIZER:*** ***Mode:*** Disabled Enabled ***Units:*** Cubic Feet Gallons Mil Gallons Liters Mil Liters Cubic Meters ***Multiplier:*** 1 10 100 1,000 10,000 100,000 ***Value (read only)*** ***RunTime (read only)*** ***Reset***

3.5 Model R86 Configuration Menu — Device Setup



3.5 Model R86 Configuration Menu — Device Setup





4.0 Troubleshooting and Diagnostics

The PULSAR Model R86 transmitter is designed and engineered for trouble-free operation over a wide range of operating conditions. The transmitter continuously runs a series of internal self-tests and displays helpful messages on the large graphic liquid crystal display (LCD) when attention is required.

The combination of these internal tests and diagnostics messages offer a valuable proactive method of troubleshooting. The device not only tells the user what wrong, but also, and more importantly, offers suggestions on how to solve the problem.

All of this information can be obtained directly from the transmitter on the LCD, remotely from the PROFIBUS host system, or by utilizing the PULSAR Model R86 PA DD.

The EDD implemented for the Model R86 PA makes use of enhanced DD language features to provided Echo Curve displays (including Echo History), a trend chart, etc. and to present items in a well-organized DTM-like manner (also includes a Setup Wizard).

4.1 Diagnostic Parameters

As mentioned above, the PULSAR Model R86 measurement engine runs through a series of self-tests and will detect and report fault operations. The TRANSDUCER BLOCK displays this diagnostic information in the DEVICE STATUS parameter.

Note: Within the TRANSDUCER BLOCK, BLOCK_ERROR is not used except for indicating Out of Service (OOS).

For the first few seconds after power is applied to the Model R86 transmitter, the LEVEL_STATUS/QUALITY is “Uncertain,” the SUB_STATUS is “Initial value,” and the LIMIT attribute is shown as “Constant.”

When the Model R86 is operating properly, the LEVEL_STATUS/QUALITY is shown as “GOOD,” and the SUB_STATUS is “Non-Specific.”

While changing any transmitter parameters using the local display or through a system configuration tool (with the MODE_BLK in OOS), the output might be inaccurate because of the changing parameters. When the device is set to OOS, the TRANSDUCER BLOCK will still output level but the QUALITY will be shown as “Bad” and the SUB_STATUS is “Out of Service.”

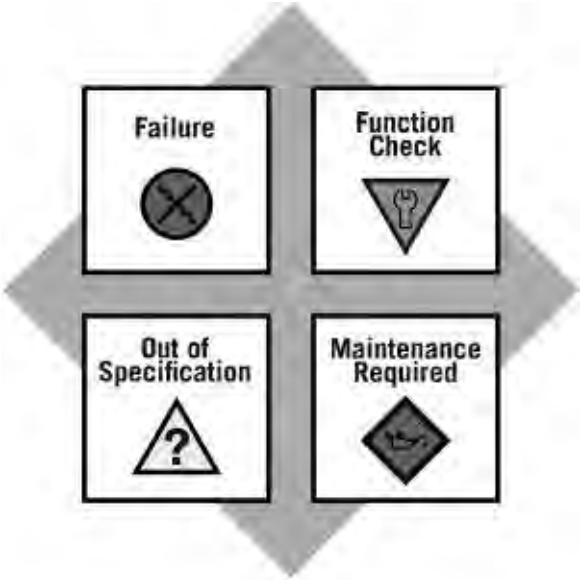
If the Model R86 fails to find a measurable level, the TRANSDUCER BLOCK maintains the last good value as the output and flags the failure. The QUALITY is “Bad,” the SUB_STATUS is “Sensor failure” for no level, and the LIMIT attribute is “Constant.”

Refer to Section 4.2 for additional information.

4.1.1 Diagnostics (Namur NE 107)

The PULSAR Model R86 transmitter includes an exhaustive list of Diagnostic Indicators which follow the NAMUR NE 107 guidelines.

NAMUR is an international user association of automation technology in process industries, whose goal is to promote the interest of the process industry by pooling experiences among its member companies. In doing so, this group promotes international standards for devices, systems, and technologies.



The objective of NAMUR NE 107 was essentially to make maintenance more efficient by standardizing diagnostic information from field devices. This was initially integrated via FOUNDATION Fieldbus, but the concept applies regardless of the communication protocol.

According to the NAMUR NE107 recommendation, "Self Monitoring and Diagnosis of Field Devices," fieldbus diagnostic results should be reliable and viewed in the context of a given application. The document recommends categorizing internal diagnostics into four standard status signals:

- Failure
- Out of Specification
- Function Check
- Maintenance required

In essence, this approach ensures that the right diagnostic information is available to the right person-at the right time. In addition, it allows diagnostics to be applied, as most appropriate, for a particular plant application (such as process control engineering or asset management maintenance). Customer specific mapping of diagnostics to these categories allows for flexible configuration depending on the user's requirements.

From an external Model R86 transmitter perspective, diagnostic information includes measurement of process conditions, in addition to detection of internal device or system anomalies.

The PROFIBUS PA version of the Model R86 transmitter was implemented according to the PROFIBUS Profile for Process Control Devices, which is consistent with the objectives of NE 107.

Refer to the table below for a complete listing of the Model R86 diagnostic indicators, along with their explanations, default categories, and recommended remedies.

NOTES: 1) The remedies shown in this table can also be seen on the transmitter LCD by viewing the present status screen when the device is in a diagnostic condition.

2) Those indicators showing “Failure” as the default result in an alarm condition.

4.1.2 Diagnostic Indication Simulation

The Model R86PA DD allows for the ability to manipulate diagnostic indicators mapped to NE-107 alarm categories in the Physical Block. Intended as a means to verify the configuration of the diagnostic parameters and connected equipment, a user can manually change any indicator in the Physical Block to and from the active state.

4.1.3 Diagnostic Indicator Table

Below is a listing of the Model R86 diagnostic indicators, showing their priority, explanations and recommended remedies. (Priority 1 is highest priority.)

Priority	Indicator Name	Default Category	Explanation	Remedy (Context Sensitive Help)
1	Software Error	Failure	Unrecoverable error occurred in stored program.	Contact MAGNETROL Technical Support.
2	RAM Error	Failure	RAM (read/write) memory failing.	
3	ADC Error	Failure	Analog-to-digital converter failure.	
4	EEPROM Error	Failure	Non-volatile parameter storage failing.	
5	Analog Board Error	Failure	Unrecoverable hardware failure.	
6	Spare Indicator 1	OK	Reserved for future use.	
7	Default Parameters		Saved parameters are set to default values.	Perform complete Device Configuration.
8	Spare Indicator 2	OK	Reserved for future use.	
9	Sweep Time Error	Failure	Analog board sweep time error	Contact MAGNETROL Technical Support.
10	Spare Indicator 3	OK	Reserved for future use.	
11	Too Many Echoes	Failure	Excessive number of possible echoes detected	Check Settings: Dielectric, Sensitivity. Check Polarization.
12	Safety Zone Alarm	Failure	Risk of echo loss if liquid rises above Blocking Distance.	Ensure that liquid cannot reach Blocking Distance.
13	Echo Lost	Failure	No signal detected.	Check settings: Dielectric Range Increase Sensitivity. View Echo Curve.
14	Spare Indicator 4	OK	Reserved for future use	
15	Config Conflict	Failure	Measurement type and primary variable selection parameters are inconsistent.	Confirm proper configuration. Check Measurement Type.
16	High Volume Alarm	Failure	Volume calculated from Level reading exceeds capacity of vessel or custom table.	Check settings: Vessel Dimensions, Custom Table entries
17	High Flow Alarm	Failure	Calculated flow exceeds maximum for flume or custom table.	Check settings: Vessel Dimensions, Custom Table entries
18	Spare Indicator 5	OK	Reserved for future use.	
19	Initializing	Function Check	Distance measurement is inaccurate while internal filters are settling.	Standard start-up message. Wait for up to 10 seconds.
20	Config Changed	Function Check	A parameter has been modified from the User Interface.	If desired, reset Config Changed indicator in ADVANCED CONFIG menu.
21	Spare Indicator 6	OK	Reserved for future use.	

4.1.3 Diagnostic Indicator Table

Priority	Indicator Name	Default Category	Explanation	Remedy
22	High Elec Temp	Out of Spec	Electronics too hot. May compromise level measurement or damage instrument.	Shield transmitter from heat source or increase air circulation. Locate transmitter remotely in a cooler area.
23	Low Elec Temp	Out of Spec	Electronics too cold. May compromise level measurement or damage instrument.	Insulate transmitter. Locate transmitter remotely in a warmer area.
24	Calibration Req'd	Out of Spec	Factory calibration has been lost. Measurement accuracy may be diminished.	Return transmitter to factory for recalibration.
25	Reject Curve Invalid	Out of Spec	Echo Rejection inoperative. May report erroneous Level readings. Upr Echo may be lost.	Save a fresh Echo Rejection Curve.
26	Spare Indicator 7	OK	Reserved for future use.	
27	Inferred Level	Out of Spec	Level inferred to have entered Blocking Region if echo lost within Max Distance Jump of Top or Bottom Blocking Region.	Verify level reading; if incorrect, check configuration.
28	Totalizer Data Lost		Totalizer data has been lost; restarted from zero.	
29	Low Supply Voltage	Out of Spec	Loop current may be incorrect at higher values. Analog output is inaccurate.	Verify loop resistance. Replace loop power supply.
30	Spare Indicator 8	OK	Reserved for future use.	
31	Max Jump Exceeded	Maintenance Required	Transmitter has jumped to an echo at location that exceeds "Max Level Jump" from previous echo location.	Check settings: Dielectric Range Sensitivity View Echo Curve.
32	Low Echo Margin	Maintenance Required	Signal Margin is less than allowable minimum.	Check settings: Dielectric Range Sensitivity View Echo Curve.
33	High Surface Velocity	Maintenance Required	Measured Surface Velocity greater than Max Surface Velocity derived from configured Rate of Change.	Confirm actual rate of change. Adjust rate of change setting, if needed.
34	Spare Indicator 9	OK	Reserved for future use.	
35	Sequence Record	OK	A Sequence Record number has been stored in Event Log.	If desired, report Sequence Record number to factory.

4.1.4 Diagnostic Help

Selecting DIAGNOSTICS from the MAIN MENU presents a list of five ITEMS from the top level of the DIAGNOSTICS tree.

When Present Status is highlighted, the highest Magnetrol priority active diagnostic indicator (numerically lowest in Table 4.1.3) is displayed on the bottom LCD line as shown above. Pressing the ENTER key moves the active diagnostic indicator to the top line outdented and presents in the lower area of the LCD a brief explanation of and possible remedies for the indicated condition. A blank line separates the explanation from the remedies. Additional active diagnostic indicators, if any, appear with their explanations in descending priority order. Each additional active indicator name-explanation pair is separated by a blank line from the one above.

If the explanation and remedy text (and additional name-explanation pairs) exceeds the available space, a ⇩ appears in the rightmost column of the last line indicating more text below. In this situation, the DOWN key scrolls the text up. Similarly, while text exists above the upper line of the text field, a ⇧ appears in the rightmost column of the top (text) line. In this situation, the UP key scrolls the text down. Otherwise the DOWN and UP keys are inoperative. In all cases the ENT or BACK key reverts to the previous screen.

When the transmitter is operating normally and the highlight cursor is positioned on Present Status, the bottom LCD line displays "OK" because no diagnostic indicators are active.

EVENT HISTORY – This menu displays the parameters related to diagnostic event logging.

ADVANCED DIAGNOSTICS – This menu displays parameters related to some of the advanced diagnostics available within the Model R86.

> **INTERNAL VALUES** – Displays read-only internal parameters.
>
> **ELEC TEMPERATURES** – Displays temperature information as measured in the potted module in degrees F or C.

ECHO CURVES – This menu allows the user to display the live Echo Curve, Echo Reference Curve, Echo History Curves, or Echo Rejection Curve on the LCD.

ECHO HISTORY SETUP – The Model R86 contains the unique and powerful feature that allows waveforms to be automatically captured based on Diagnostic Events, Time or both. This menu contains those parameters that configure that feature.

Eleven (11) waveforms can be saved directly into the transmitter.

- Nine (9) Troubleshooting Curves
- One (1) Echo Rejection Curve
- One (1) Reference Curve

TREND DATA – A 15-minute trend of the PV can be displayed on the LCD.

4.2 Diagnostic Parameters

Each detected diagnostic condition potentially affects the status of one or more of the Transducer Block output parameters.

The Process Variable Status is described by three characteristics—Quality, Sub-status and Limit.

The following table assigns the proposed values of these characteristics, in order of decreasing priority, for each of the diagnostic conditions and/or device configurations.

NOTES:
1) Only the highest priority status will be indicated for a given process variable.
2) If a process variable is not listed for a given diagnostic condition and/or device configuration, the status of that process variable is not affected and will be shown as Good::Non-specific: Not limited

Diagnostic/Condition	Process Variables	Quality	Sub-status	Limit
Level TB –> OOS	Level Distance Echo Strength Elec Temperature Echo Margin	Bad	Out of Service	Not limited
Vol TB -> OOS	Volume	Bad	Out of Service	Not limited
Analog Board Error	All PVs except Elec Temperature	Bad	Sensor Failure	Constant limited
Software Error	All PVs	Bad	Device Failure	Constant limited
RAM Error	All PVs	Bad	Device Failure	Constant limited

Diagnostic/Condition	Process Variables	Quality	Sub-status	Limit
ADC Failure	All PVs	Bad	Device Failure	Constant limited
EEPROM Error	All PVs	Bad	Device Failure	Constant limited
No Fiducial	All PVs except Elec Temperature	Bad	Device Failure	Constant limited
Too Many Echoes	All PVs except Elec Temperature	Bad	Device Failure	Constant limited
Echo Lost	All PVs except Elec Temperature	Bad	Device Failure	Constant limited
Inferred Level	Echo Strength Echo Margin	Bad	Device Failure	Constant limited
Default Parameters	ALL PVs	Bad	Config Error	Not limited
MeasType != Volume & Level	Volume	Bad	Config Error	Constant limited
High Volume Alarm	Volume	Bad	Config Error	High limited
Safety Zone Alarm	Level, Distance, Volume	Bad	Non-Specific	Not limited
Initializing	All PVs except Elec Temperature	Uncertain	Initial Value	Constant limited
Ramp Slope Error	All PVs	Good	Non-specific	Not limited
High Elec Temp	All PVs	Good	Non-specific	Not limited
Low Elec Temp	All PVs	Good	Non-specific	Not limited
Calibration Req'd	All PVs	Good	Non-specific	Not limited
Reject Curve Invalid	All PVs	Good	Non-specific	Not limited
Max Jump Exceeded	All PVs	Good	Non-specific	Not limited
Low Echo Margin	All PVs	Good	Non-specific	Not limited
High Surface Velocity	All PVs	Good	Non-specific	Not limited
TB Config Changed	All PVs	Good	Non-specific	Not limited
Sequence Record	All PVs	Good	Non-specific	Not limited.

4.3 PROFIBUS PA Segment Checklist

There can be several reasons for a PROFIBUS PA installation to be in a faulty condition. In order to ensure that communication can be established, the following requirements must be met.

- Device supply voltage must be higher than 9 VDC with a maximum of 32 VDC.
- Total current draw of a given segment cannot exceed the rating shown on the power conditioner and/or barrier.
- Two 100 Ω, 1 µF terminators must be connected to the network—one at each end of the segment.
- Cable length plus spur length must not exceed the following values:

Number of Spurs	1 Device	2 Devices	3 Devices	4 Devices
25–32	—	—	—	—
19–24	100 ft. (30 m)	—	—	—
15–18	200 ft. (60 m)	100 ft. (30 m)	—	—
13–14	300 ft. (90 m)	200 ft. (60 m)	100 ft. (30 m)	—
1–12	400 ft. (120 m)	300 ft. (90 m)	200 ft. (60 m)	100 ft. (30 m)

Pair	Shield	Twisted	Size	Length	Type
Single	Yes	Yes	AWG 18 (0.8 mm^2)	6,200 ft. (1,900 m)	A
Multi	Yes	Yes	AWG 22 (0.32 mm^2)	3,900 ft. (1,200 m)	B
Multi	No	Yes	AWG 26 (0.13 mm^2)	1,300 ft. (400 m)	C
Multi	Yes	No	AWG 16 (1.25 mm^2)	650 ft. (200 m)	D

- The cable shield is to be hard grounded only at one point close to the DCS. In addition, the cable shield can be capacitively grounded in multiple places to improve EMC protection.
- Ensure all devices are on the “live list,” and the schedule has been downloaded.
- Ensure that the Physical Block, then the Transducer Block, and lastly the Function Block(s) are in“Auto” mode rather than Out of Service (OOS).

If all of these requirements are met, stable communication should be established.

Appendix A

Level Transducer Block Table

Item	Parameter Name	Parameter Label
0	BLOCK_STRUCTURE	BLOCK STRUCT
1	ST_REV	Static Revision
2	TAG_DESC	Tag Description
3	STRATEGY	Strategy
4	ALERT_KEY	Alert Key
5	MODE_BLK	Block Mode
6	BLOCK_ERR	Block Error
7	UPDATE_EVT	Update Event
8	BLOCK_ALM	Block Alarm
9	TRANSDUCER_DIRECTORY	Transducer Directory
10	TRANSDUCER_TYPE	Transducer Type
11	XD_ERROR	Transducer Error
12	COLLECTION_DIRECTORY	Collection Directory
13	MEASUREMENT_TYPE	Measurement Type
14	LEVEL	Level
15	LEVEL_UNIT	Level Unit
16	DISTANCE	Distance
17	DISTANCE_UNIT	Distance Unit
18	ANTENNA_MODEL	Antenna Model
19	ANTENNA_EXTENSION	Antenna Extension
20	ANTENNA_MOUNT	Antenna Mount
21	TANK_HEIGHT	Tank Height
22	STILLWELL_ID	Stillwell ID
23	DIELECTRIC_RANGE	Dielectric Range
24	TURBULENCE	Turbulence
25	FOAM	Foam
26	RATE_OF_CHANGE	Rate Of Change
27	ECHO_REJECT_STATE	Echo Reject State
28	ECHO_LIST_MODE	Echo List Mode
29	SAVED_REJECT_LOCATION	Saved Reject Location
30	NEW_REJECT_LOCATION	New Reject Location
31	ECHO_REJECT_MATURITY	Echo Reject Maturity
32	ECHO_REJECT_RESPONSE	Echo Reject Response
33	SENSITIVITY	Sensitivity
34	TOP_BLOCKING_DISTANCE	Top Blocking Distance

35	BOTTOM_BLOCKING_DISTANCE	Bottom Blocking Distance
36	SAFETY_ZONE_ALARM	Safety Zone Alarm
37	SAFETY_ZONE_HEIGHT	Safety Zone Height
38	RESET_SAFETY_ZONE_LATCH	Reset SZ Latch
39	ECHO_LOSS_DELAY	Echo Loss Delay
40	ALARM_DELAY	Failure Alarm Delay
41	LEVEL_TRIM	Level Trim
42	TARGET_ALGORITHM	Target Algorithm
43	TARGET_THRESH_MODE	Target Threshold Mode
44	TARG_AUTO_THRESH_VALUE	Target Auto Threshold Value
45	TARG_FIXED_THRESH_VALUE	Target Fixed Threshold Value
46	BASE_THRESHOLD	Base Threshold
47	TVG_START_VALUE	TVG Start Value
48	TVG_END_VALUE	TVG End Value
49	TVG_START_LOCATION	TVG Start Location
50	RUN_AVERAGE_DEPTH	Run Average Depth
51	MAX_SURFACE_VELOCITY	Max Surface Velocity
52	MAX_DISTANCE_JUMP	Max Distance Jump
53	EMPTY_STATE_DELAY	Empty State Delay
54	RESET_PARAMETERS	Reset Parameters
55	FIDUCIAL_TICKS	Fiducial Ticks
56	FIDUCIAL_STRENGTH	Fiducial Strength
57	BOUNDARY_STATE	Boundary State
58	LEVEL_TICKS	Level Ticks
59	ECHO_STRENGTH	Echo Strength
60	ECHO_MARGIN	Echo Margin
61	SURFACE_VELOCITY	Surface Velocity
62	ELECTRONICS_TEMPERATURE	Electronics Temp
63	TEMPERATURE_UNIT	Temperature Unit
64	MAX_ELECTRONICS_TEMP	Max Elec Temp
65	MIN_ELECTRONICS_TEMP	Min Elec Temp
66	RESET_ELECTRONICS_TEMPS	Reset Electronic Temps
67	ENTER_PASSWORD	Enter Password
68	ELEC_TEMP_OFFSET	Elec Temp Offset
69	NAP_VALUE	NAP Value
70	FACTORY_RESET	Factory Reset
71	FIDUCIAL_GAIN	Fiducial Gain
72	WINDOW_TAR	Window

73	CONV_FACT	Conversion Factor
74	SCLE_OFFS	Scale Offset
75	TVG_DIVISOR	TVG Divisor
76	FACTORY_PARAMETER_1	Factory Parameter 1
77	FACTORY_PARAMETER_2	Factory Parameter 2
78	FACTORY_PARAMETER_3	Factory Parameter 3
79	FACTORY_PARAMETER_4	Factory Parameter 4
80	MAGNETROL_SERIAL_NUMBER	Magnetrol S/N
81	DATE_CODE	Date Code
82	CONFIG_CHANGED_MODE	TB Config Chgd Mode
83	RESET_CONFIG_CHANGED	Reset Config Changed
84	USER_PASSWORD	New User Password
85	LOCAL_DISP_MEAS_VALUES	Local Disp Meas Values
86	LOCAL_DISP_LANGUAGE	Local Disp Language
87	LOCAL_DISP_PHYS_DEV_TAG	Local Disp Phys Dev Tag
88	SOFTWARE_REV	Software Rev
89	HARDWARE_REV	Hardware Rev
90	PRESENT_STATUS	Present Status
91	STATUS_INDICATORS_1	Indicators Group 1
92	STATUS_INDICATORS_2	Indicators Group 2
93	STATUS_INDICATORS_3	Indicators Group 3
94	STATUS_INDICATORS_4	Indicators Group 4
95	STATUS_INDICATORS_5	Indicators Group 5
96	TREND_LEVEL_VALUE	Level
97	TREND_DISTANCE_VALUE	Distance
98	TREND_ECHO_STR_VALUE	Echo Strength
99	TREND_SIGNAL_MARGIN_VALUE	Signal Margin
100	DEVICE_CLOCK	Device Clock
101	HISTORY_CONTROL	History Control
102	HIST_ENTRY1	Event History 1
103	HIST_ENTRY2	Event History 2
104	HIST_ENTRY3	Event History 3
105	HIST_ENTRY4	Event History 4
106	HIST_ENTRY5	Event History 5
107	HIST_ENTRY6	Event History 6
108	HIST_ENTRY7	Event History 7
109	HIST_ENTRY8	Event History 8
110	HIST_ENTRY9	Event History 9

111	HIST_ENTRY10	Event History 10
112	RESET_HISTORY	Reset History
113	ECHO_HIST_TRIGGER_MODE	Echo Hist Trigger Mode
114	ECHO_HIST_TIME_TRIGGERS	Echo Hist Time Triggers
115	ECHO_HIST_EVENT_TRIGGERS	Echo Hist Event Triggers
116	ECHO_REJECTION_LOG	Echo Rejection
117	ECHO_REFERENCE_LOG	Echo Reference
118	ECHO_HISTORY_LOG1	Echo History 1
119	ECHO_HISTORY_LOG2	Echo History 2
120	ECHO_HISTORY_LOG3	Echo History 3
121	ECHO_HISTORY_LOG4	Echo History 4
122	ECHO_HISTORY_LOG5	Echo History 5
123	ECHO_HISTORY_LOG6	Echo History 6
124	ECHO_HISTORY_LOG7	Echo History 7
125	ECHO_HISTORY_LOG8	Echo History 8
126	ECHO_HISTORY_LOG9	Echo History 9
127	DELETE_ECHO_HISTORY	Delete Echo History
128	SAVE_ECHO_CURVE	Save Echo Curve
129	VIEW_ECHO_CURVE	View Echo Curve
130	WAVEFORM_SUMMARY	Waveform Summary
131	ECHO_CURVE_DATA	Echo Curve Data
132	ECHO_DATA_INDEX	Echo Data Index
133	DATA_LOG_SETUP	Data Log Setup
134	DATA_LOG_SUMM_READ_REQ	Log Summary Read Req
135	DATA_LOG_SUMMARY	Data Log Summary
136	DATA_LOG_INDEX	Data Log Index
137	DATA_LOG_RECORDS	Log Data
138	PD_TAG_APPL_IMAGE	PD Tag
139	ECHO_LIST_CONTROL	EchoListControl
140	ECHO_LIST_TYPE	Echo List Type
141	ECHO_LIST_LENGTH	Echo List Length
142	ECHO_LIST_ENTRY1	Echo List 1
143	ECHO_LIST_ENTRY2	Echo List 2
144	ECHO_LIST_ENTRY3	Echo List 3
145	ECHO_LIST_ENTRY4	Echo List 4
146	ECHO_LIST_ENTRY5	Echo List 5
147	ECHO_LIST_ENTRY6	Echo List 6
148	ECHO_LIST_ENTRY7	Echo List 7

149	ECHO_LIST_ENTRY8	Echo List 8
150	ECHO_LIST_ENTRY9	Echo List 9
151	ECHO_LIST_ENTRY10	Echo List 10
152	ECHO_LIST_ENTRY11	Echo List 11
153	ECHO_LIST_ENTRY12	Echo List 12
154	ECHO_LIST_ENTRY13	Echo List 13
155	ECHO_LIST_ENTRY14	Echo List 14
156	ECHO_LIST_ENTRY15	Echo List 15

Volume Transducer Block Table

Item	Parameter Name	Parameter Label
0	BLOCK_STRUCTURE	BLOCK STRUCT
1	ST_REV	Static Revision
2	TAG_DESC	Tag Description
3	STRATEGY	Strategy
4	ALERT_KEY	Alert Key
5	MODE_BLK	Block Mode
6	BLOCK_ERR	Block Error
7	UPDATE_EVT	Update Event
8	BLOCK_ALM	Block Alarm
9	TRANSDUCER_DIRECTORY	Transducer Directory
10	TRANSDUCER_TYPE	Transducer Type
11	XD_ERROR	Transducer Error
12	COLLECTION_DIRECTORY	Collection Directory
13	MEAS_TYPE	Measurement Type
14	VOLUME	Volume
15	VOLUME_UNIT	Volume Unit
16	LEVEL_VALUE	Level
17	LEVEL_UNIT	Level Unit
18	VESSEL TYPE	Vessel Type
19	VESSEL_RADIUS	Vessel Radius
20	VESSEL_ELLIPSE_DEPTH	Vessel Ellipse Depth
21	VESSEL_CONICAL_HEIGHT	Vessel Conical Height
22	VESSEL_WIDTH	Vessel Width
23	VESSEL_LENGTH	Vessel Length
24	VESSEL_SENSOR_OFFSET	Vessel Sensor Offset
25	VOLUME_TABLE_TYPE	Volume Table Type

26	LEVEL_INPUT_SOURCE	Level Input Source
27	VOLUME_TABLE_LENGTH	Volume Table Length
28	VOLUME_TABLE_PT_01	Volume Table Pt 01
29	VOLUME_TABLE_PT_02	Volume Table Pt 02
30	VOLUME_TABLE_PT_03	Volume Table Pt 03
31	VOLUME_TABLE_PT_04	Volume Table Pt 04
32	VOLUME_TABLE_PT_05	Volume Table Pt 05
33	VOLUME_TABLE_PT_06	Volume Table Pt 06
34	VOLUME_TABLE_PT_07	Volume Table Pt 07
35	VOLUME_TABLE_PT_08	Volume Table Pt 08
36	VOLUME_TABLE_PT_09	Volume Table Pt 09
37	VOLUME_TABLE_PT_10	Volume Table Pt 10
38	VOLUME_TABLE_PT_11	Volume Table Pt 11
39	VOLUME_TABLE_PT_12	Volume Table Pt 12
40	VOLUME_TABLE_PT_13	Volume Table Pt 13
41	VOLUME_TABLE_PT_14	Volume Table Pt 14
42	VOLUME_TABLE_PT_15	Volume Table Pt 15
43	VOLUME_TABLE_PT_16	Volume Table Pt 16
44	VOLUME_TABLE_PT_17	Volume Table Pt 17
45	VOLUME_TABLE_PT_18	Volume Table Pt 18
46	VOLUME_TABLE_PT_19	Volume Table Pt 19
47	VOLUME_TABLE_PT_20	Volume Table Pt 20
48	VOLUME_TABLE_PT_21	Volume Table Pt 21
49	VOLUME_TABLE_PT_22	Volume Table Pt 22
50	VOLUME_TABLE_PT_23	Volume Table Pt 23
51	VOLUME_TABLE_PT_24	Volume Table Pt 24
52	VOLUME_TABLE_PT_25	Volume Table Pt 25
53	VOLUME_TABLE_PT_26	Volume Table Pt 26
54	VOLUME_TABLE_PT_27	Volume Table Pt 27
55	VOLUME_TABLE_PT_28	Volume Table Pt 28
56	VOLUME_TABLE_PT_29	Volume Table Pt 29
57	VOLUME_TABLE_PT_30	Volume Table Pt 30
58	VOLUME_HIGH_LIMIT	Volume High Limit
59	LEVEL_LOW_LIMIT	Level Low Limit
60	LEVEL_HIGH_LIMIT	Level High Limit
61	ENTER_PASSWORD	Enter Password
62	PRESENT_STATUS	Present Status
63	STATUS_INDICATORS_1	Indicators Group 1

64	STATUS_INDICATORS _2	Indicators Group 2
65	STATUS_INDICATORS _3	Indicators Group 3
66	STATUS_INDICATORS _4	Indicators Group 4
67	STATUS_INDICATORS _5	Indicators Group 5
68	TREND_VOLUME_VALUE	Volume

NOTES

Service Policy

Owners of Magnetrol may request the return of a control or any part of a control for complete rebuilding or replacement. They will be rebuilt or replaced promptly. Controls returned under our service policy must be returned by Prepaid transportation. Magnetrol will repair or replace the control at no cost to the purchaser (or owner) other than transportation if:

1. Returned within the warranty period; and
2. The factory inspection finds the cause of the claim to be covered under the warranty.

If the trouble is the result of conditions beyond our control; or, is NOT covered by the warranty, there will be charges for labor and the parts required to rebuild or replace the equipment.

In some cases it may be expedient to ship replacement parts; or, in extreme cases a complete new control, to replace the original equipment before it is returned. If this is desired, notify the factory of both the model and serial numbers of the control to be replaced. In such cases, credit for the materials returned will be determined on the basis of the applicability of our warranty.

No claims for misapplication, labor, direct or consequential damage will be allowed.

Return Material Procedure

So that we may efficiently process any materials that are returned, it is essential that a "Return Material Authorization" (RMA) number be obtained from the factory prior to the material's return. This is available through Magnetrol local representative or by contacting the factory. Please supply the following information:

1. Company Name
2. Description of Material
3. Serial Number
4. Reason for Return
5. Application

Any unit that was used in a process must be properly cleaned in accordance with OSHA standards, before it is returned to the factory.

A Material Safety Data Sheet (MSDS) must accompany material that was used in any media.

All shipments returned to the factory must be by prepaid transportation.

All replacements will be shipped F.O.B. factory.

PULSAR Pulse Burst Radar transmitters may be protected by one or more of the following U.S. Patent Nos.:
US 6,062,095; US 6,980,174; US 7,102,584; US 7,106,248; US 7,271,646

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Installation & Maintenance Instructions

MAGNETROL PULSAR MODEL R86

High Performance 26 GHz Pulse Burst Radar Level Transmitter

Supplied by

247able.com

Call us on +44 (0)118 916 9420 | Email info@247able.com

PULSAR®
R86 RADAR

Installation and Operating Manual for Pulsar® Model R86 with HART® output

Software Version 1.x

High Performance 26 GHz Pulse Burst Radar Level Transmitter

MAGNETROL®

AMETEK®

Read this Manual Before Installing
This manual provides information on the Pulsar® Model R86 Radar transmitter. It is important that all instructions are read carefully and followed in sequence. The *QuickStart Installation* instructions are a brief guide to the sequence of steps for experienced technicians to follow when installing the equipment. Detailed instructions are included in the *Complete Installation* section of this manual.

Conventions Used in this Manual
Certain conventions are used in this manual to convey specific types of information. General technical material, support data, and safety information are presented in narrative form. The following styles are used for notes, cautions, and warnings.

NOTES
Notes contain information that augments or clarifies an operating step. Notes do not normally contain actions. They follow the procedural steps to which they refer.

Cautions
Cautions alert the technician to special conditions that could injure personnel, damage equipment, or reduce a component's mechanical integrity. Cautions are also used to alert the technician to unsafe practices or the need for special protective equipment or specific materials. In this manual, a caution box indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

WARNINGS
Warnings identify potentially dangerous situations or serious hazards. In this manual, a warning indicates an imminently hazardous situation which, if not avoided, could result in serious injury or death.

Safety Messages
The PULSAR Model R86 system is designed for use in Category II, Pollution Degree 3 installations. Follow all standard industry procedures for servicing electrical and computer equipment when working with or around high voltage. Always shut off the power supply before touching any components. Although high voltage is not present in this system, it may be present in other systems.

Electrical components are sensitive to electrostatic discharge. To prevent equipment damage, observe safety procedures when working with electrostatic sensitive components.

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

FCC ID: LPN-R86
Any unauthorized changes or modifications not expressly approved by the party responsible for compliance could void user's authority to operate this equipment.

WARNING! Explosion hazard. Do not connect or disconnect designs rated Explosion-proof or Non-incendive unless power has been switched off and/or the area is known to be non-hazardous.

Low Voltage Directive
For use in Installations Category II, Pollution Degree 3. If equipment is used in a manner not specified by the manufacturer, protection provided by equipment may be impaired.

Notice of Copyright and Limitations
Magnetrol® & Magnetrol® logotype and Pulsar® are registered trademarks of Magnetrol® International, Incorporated.

MAGNETROL reserves the right to make changes to the product described in this manual at any time without notice. MAGNETROL makes no warranty with respect to the accuracy of the information in this manual.

Warranty
All MAGNETROL electronic level and flow controls are warranted free of defects in materials or workmanship for eighteen months from the date of original factory shipment.

If returned within the warranty period; and, upon factory inspection of the control, the cause of the claim is determined to be covered under the warranty; then, MAGNETROL will repair or replace the control at no cost to the purchaser (or owner) other than transportation.

MAGNETROL shall not be liable for misapplication, labor claims, direct or consequential damage or expense arising from the installation or use of equipment. There are no other warranties expressed or implied, except special written warranties covering some MAGNETROL products.

Quality Assurance
The quality assurance system in place at MAGNETROL guarantees the highest level of quality throughout the company. MAGNETROL is committed to providing full customer satisfaction both in quality products and quality service.

The MAGNETROL quality assurance system is registered to ISO 9001 affirming its commitment to known international quality standards providing the strongest assurance of product/service quality available.

Pulsar® Model R86
Pulse Burst Radar Level Transmitter

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continued on next page

1.0 QuickStart Installation

The QuickStart Installation procedures provide an overview of the key steps for mounting, wiring, and configuring the PULSAR Model R86 radar level transmitter. These procedures are intended for experienced installers of electronic level measurement instruments.

See Section 2.0, *Complete Installation*, for detailed installation instructions.

1.1 Getting Started

Before beginning the QuickStart Installation procedures, have the correct equipment, tools, and information available.

1.1.1 Equipment and Tools

No special tools are required. The following items are recommended:

- Threaded antenna and process connection. . . . . 2 1/8" (54 mm) wrench
- Transmitter/antenna connection . . 1 1/2" (38 mm) wrench
- Torque wrench . . . . . highly desirable
- Flat-blade screwdriver
- Digital multimeter or volt/ammeter . . . . . Optional
- 24 VDC (23 mA) power supply . . . . . Optional

1.1.2 Configuration Information

A helpful SETUP WIZARD, which will guide you through the simple configuration (with parameter explanations), is available in the PULSAR Model R86. Located in the local user interface menu under MAIN MENU/WIZARDS/ SETUP WIZARD, some key information is required for configuration. The transmitter will prompt confirmation questions at the end of the Setup Wizard to verify operation.

Gather the information and complete the following operating parameters table before beginning configuration.

NOTE: These configuration steps are not necessary if the transmitter was pre-configured prior to shipment.

Display	Question	Answer
Measurement Type	What is the intended measurement type (Level, Volume, or Flow)?	_____
System Units	What units of measurement will be used?	_____
Antenna Model	What type of antenna is being used? Select first 3 digits of model number. (See nameplate on side of antenna.)	_____
Antenna Extension	What is maximum nozzle length for which the antenna can be used? Select 8th digit of antenna model number. (See nameplate on side of antenna.)	_____
Antenna Mount	Is the antenna mounting NPT, BSP, or flanged?	_____
Heat Extension	Is there a heat extension connected to the antenna?	_____
Tank Height	What is the tank height?	_____
Stillwell ID	What is the Inner Diameter (ID). Enter 0 if not applicable.	_____
Dielectric Range	What is the dielectric of the process medium?	_____
Turbulence	What amount of turbulence is expected?	_____
Foam	What amount of foam is expected?	_____
Rate of Change	What is the expected maximum rate of level change?	_____
Primary Variable	Select Level, Volume, or Flow	_____
4 mA Setpoint (LRV)	What is the 0% reference point for the 4.0 mA value?	_____
20 mA Setpoint (URV)	What is the 100% reference point for the 20.0 mA value?	_____
PV Alarm Selection	What output current is desired when a failure indicator is present?	_____
Damping	How much damping (averaging) is required? Default = 1 second	_____

1.2 QuickStart Mounting

NOTE: Confirm the configuration style and process connection (size and type) of the PULSAR Model R86 radar transmitter. Ensure it matches the requirements of the installation before continuing with the QuickStart installation.

① Confirm the model and serial numbers on the nameplates of PULSAR Model R86 electronics and antenna are identical.

1.2.1 Antenna

② Carefully place the antenna into the vessel. Mount in a location equal to 1/2 the radius of tank top. Do not mount in center of vessel nor closer than 45 cm (18") of tank wall.

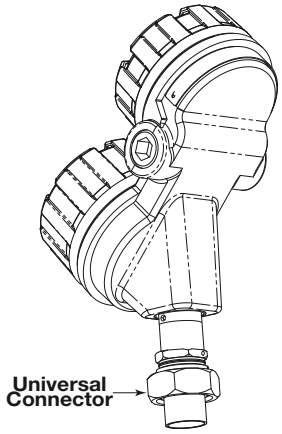
③ Secure the antenna to the vessel.

④ Leave the protective plastic cap in place until ready to install the transmitter.

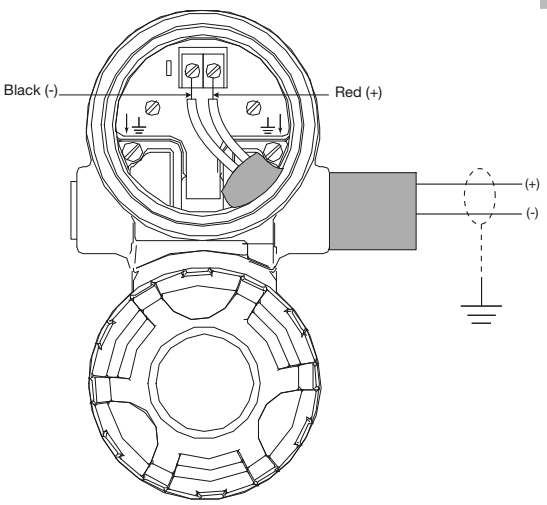
NOTE: Do not use sealing compound or TFE tape on antenna connection to transmitter. This connection is sealed by a Viton® O-ring.

1.2.2 Transmitter

1. Remove the protective plastic cap from the top of the antenna and store for future use. Make sure the bottom of the Universal connector and inside of the antenna are clean and dry. Clean with isopropyl alcohol and cotton swabs if necessary.
2. Place the transmitter onto the antenna.
3. Rotate the transmitter so that it is in the most convenient position for wiring, configuring, and viewing.
4. While keeping the housing aligned, tighten the large Universal connector Hex nut to 30 ft. lbs (40 N m) of force. A torque wrench is highly desirable.
   DO NOT LEAVE HAND TIGHT.



- Do not place insulating material around any part of the Radar transmitter including the antenna flange.



1.3 QuickStart Wiring

WARNING! Explosion hazard. Do not remove covers unless power has been switched off or the area is known to be non-hazardous.

NOTE: Ensure that the electrical wiring to the PULSAR Model R86 radar transmitter is complete and in compliance with all regulations and codes.

1. Remove the cover of the upper wiring compartment.
2. Attach a conduit fitting and mount the conduit plug in the spare opening. Pull the power supply wire through the conduit fitting.
3. If present, connect cable shield to an earth ground at the power supply.
4. Connect the positive supply wire to the (+) terminal and the negative supply wire to the (-) terminal. For Explosion Proof Installations, see *Wiring*, Section 2.5.3.
5. Replace the cover and tighten.

1.4 Setup Wizard – Configuration

If requested, the PULSAR Model R86 transmitter is shipped fully pre-configured for the application and can be installed immediately. Otherwise, the unit is shipped configured with default factory values and can be easily reconfigured in the shop. The minimum configuration instructions follow. Use the information from the operating parameters table before beginning configuration. See Section 1.1.2, *Configuration Information*.

The Setup Wizard offers a very simple step-by-step menu indicating the basic parameters required for a typical application.

1. Apply power to the transmitter.

   The graphic LCD display can be programmed to change every two seconds to show pertinent Measured Values on the Home Screen. For example: Level, %Output, and Loop current can all be displayed on a rotating screen.

   The LCD can also be programmed to always show just one of the Measured Variables at all times. For example: Level can be the only value displayed on the screen.

2. Remove the cover of the electronics compartment.

STEP 4

STEP 5

STEP 6

3. The push buttons offer multiple forms of functionality for menu navigation and data entry. (See Section 2.6 for complete explanation.)

   ⇧ **UP** moves up through the menu or increases a displayed value.

   ⇩ **DOWN** moves down through the menu or decreases a displayed value.

   ⇦ **BACK** exits a branch of the menu or exits without accepting entered value.

   ⇨ **ENTER** enters a branch of the menu or accepts a displayed entry.

NOTE: Holding down the ENTER key for two seconds when any menu or parameter is highlighted will show help text in reference to that item.

4. Press any key at the Home Screen to access the Main Menu.
5. Press ⇨ ENTER with the WIZARDS menu item highlighted.
6. Press ⇨ ENTER with the SETUP WIZARD menu item highlighted.

   The Setup Wizard shows the basic parameters, along with Help Text to guide the procedure.

   One can now quickly and easily scroll through the Setup Wizard configuration items, changing those parameters as required:

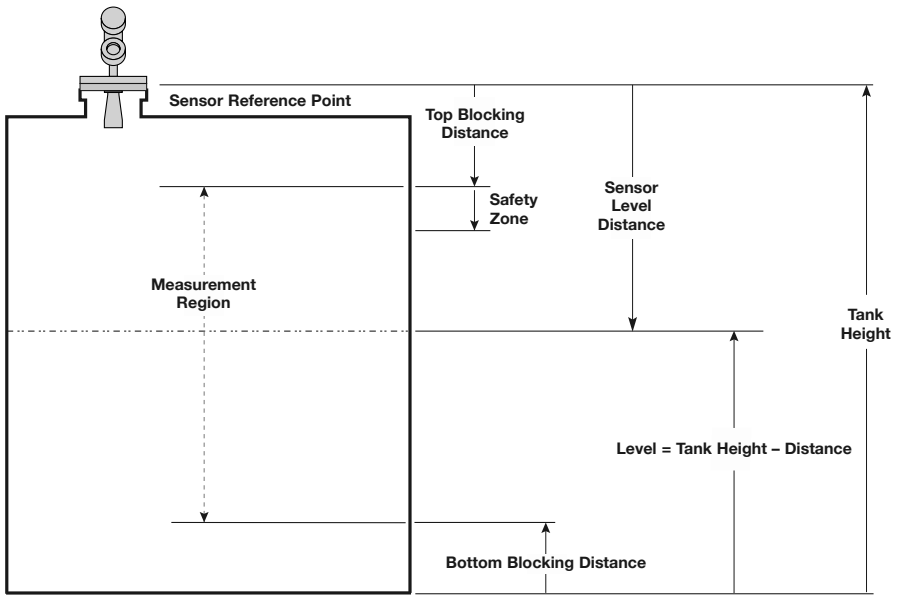
   - Press ⇨ ENTER at the highlighted parameter.
   - Scroll to the desired option, then press ⇨ ENTER.
   - Scroll to next parameter or press ⇦ BACK when finished to exit the WIZARDS menu.

   Section 1.4.1 lists and describes the nine parameters in the SETUP WIZARD menu.

7. After making all of the necessary changes in the WIZARDS menu, press the ⇦ BACK button three times to return to the Home Screen.
8. The QuickStart configuration is complete. The Model R86 transmitter should be measuring and is ready for service.

1.4.1 Setup Wizard Menu Options

Level Units		Select the Units of measurement for the level output: • Inches • Feet • Millimeters • Centimeters • Meters
Tank Height		Enter tank height (in Level Units selected)
Antenna Model		• RB1-x — 1 1/2” horn • RB2-x — 2" horn • RB3-x — 3" horn • RB4-x — 4" horn • RBE-x — Encapsulated • RBF-x — Faced Flange
Antenna Extension		0 No nozzle 1 For nozzle height ≤ 100 mm (4") 2 For nozzle height ≤ 200 mm (8") 3 For nozzle height ≤ 300 mm (12") 4 For nozzle height ≤ 600 mm (24") 5 For nozzle height ≤ 1200 mm (48") 6 For nozzle height ≤ 1800 mm (72")
Antenna Mount		Select the type of Antenna Mounting to the vessel (refer to antenna nameplate): • NPT (National Pipe Thread) • BSP (British Standard Pipe) • Flange (ASME or EN)
Dielectric Range		Enter the Dielectric Range for the material to be measured. Below 1.7 (light hydrocarbons like propane and butane; stillwell only) 1.7 to 3.0 (most typical hydrocarbons) 3.0 to 10 (varying dielectric, for example: mixing tanks) Above 10 (water-based media)
HART Only	**4 mA Set Point (LRV)**	Enter the level value (0 %-point) for the 4 mA point. Lower Range Value (LRV). Refer to Section 1.4.1.1.
	20 mA Set Point (URV)	Enter the level value (100 %-point) for the 20 mA point. Upper Range Value (URV). Refer to Section 1.4.1.1.
	PV Alarm Selection	Enter the desired output state when a Failure Indicator is active. • High (22 mA) • Low (3.6 mA) • Hold (hold last value is not recommended for standard configuration). Consult factory.



1.4.1.1 Setup Wizard Numerical Data Entry

To make numerical entry changes to Tank Height:

- **UP** moves up to the next highest digit (0,1,2,3,....,9 or the decimal point). If held down the digits scroll until the push button is released.
- **DOWN** moves up to the next lowest digit (0,1,2,3,....,9 or the decimal point). If held down the digits scroll until the push button is released.
- **BACK** moves the cursor to the left and deletes a digit. If the cursor is already at the leftmost position, then the screen is exited without changing the previously saved value.
- **ENTER** Moves the cursor to the right. If the cursor is located at a blank character position, the new value is saved.

Scrolling further in the SETUP WIZARD menu results in the remaining parameters appearing one by one, with the present highlighted value shown at the bottom of the screen.

- **BACK** returns to the previous menu without changing the original value, which is immediately redisplayed.
- **ENTER** accepts the displayed value and returns to the previous menu.

2.0 Complete Installation

This section provides detailed procedures for properly installing, wiring, configuring, and, as needed, troubleshooting the PULSAR Model R86 Radar Level Transmitter.

2.1 Unpacking

Unpack the instrument carefully. Make sure all components have been removed from the packing material. Check all contents against the packing slip and report any discrepancies to the factory.

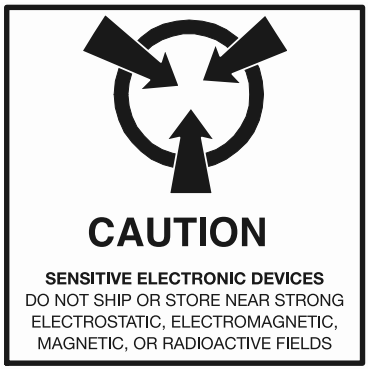
Before proceeding with the installation, do the following:

- Inspect all components for damage. Report any damage to the carrier within 24 hours.
- Make sure the nameplate model number on the antenna and transmitter agree with the packing slip and purchase order.
- To avoid moisture ingress in the housing, covers should be fully tightened at all times. For the same reason, plugs should remain properly installed in the cable entries until replaced with a cable gland
- Record the model and serial numbers for future reference when ordering parts.

Model Number

Serial Number

2.2 Electrostatic Discharge (ESD) Handling Procedure



MAGNETROL electronic instruments are manufactured to the highest quality standards. These instruments use electronic components that may be damaged by static electricity present in most work environments.

The following steps are recommended to reduce the risk of component failure due to electrostatic discharge.

- Ship and store circuit boards in anti-static bags. If an anti-static bag is not available, wrap the board in aluminum foil. Do not place boards on foam packing materials.
- Use a grounding wrist strap when installing and removing circuit boards. A grounded workstation is recommended.
- Handle circuit boards only by the edges. Do not touch components or connector pins.
- Make sure that all electrical connections are completely made and none are partial or floating. Ground all equipment to a good, earth ground

WARNING! Potential electrostatic charging hazard. Do not rub with dry cloth.

2.3 Before You Begin

2.3.1 Site Preparation

Each PULSAR Model R86 Radar transmitter/antenna is built to match the physical specifications of the required installation. Ensure that the antenna process connection is correct for the threaded or flanged mounting on the vessel where the transmitter will be placed. See Section 2.4, *Mounting*.

Ensure that all local, state, and federal regulations and guidelines are observed. See Section 2.5, *Wiring*.

Ensure that the wiring between the power supply and PULSAR Model R86 Radar transmitter is complete and correct for the type of installation. See Section 3.6, *Specifications*.

2.3.2 Equipment and Tools

No special tools are required. The following items are recommended:

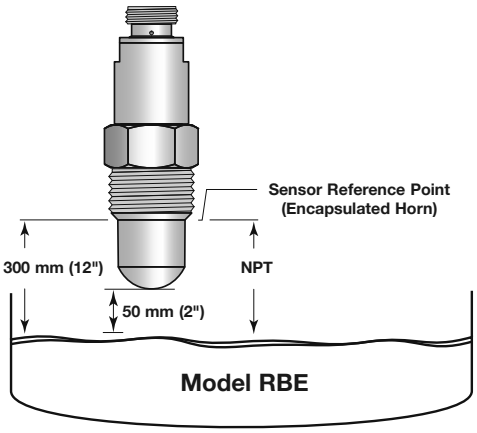
- Threaded antenna and process connection. . . . . 2 1/8" (54 mm) wrench
- Transmitter/antenna connection . . 1 1/2" (38 mm) wrench
- Torque wrench . . . . . highly desirable
- Flat-blade screwdriver
- Digital multimeter or volt/ammeter . . . . . Optional
- 24 VDC (23 mA) power supply . . . . . Optional

2.3.3 Operational Considerations

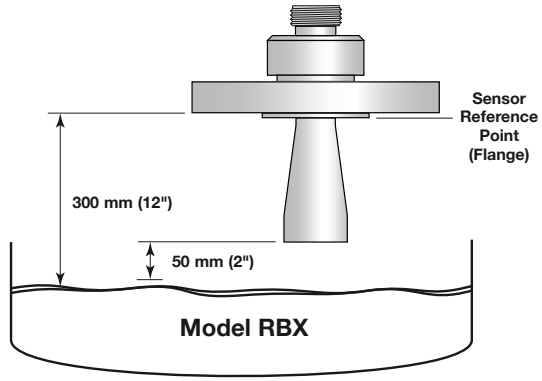
Radar applications are characterized by three basic conditions;

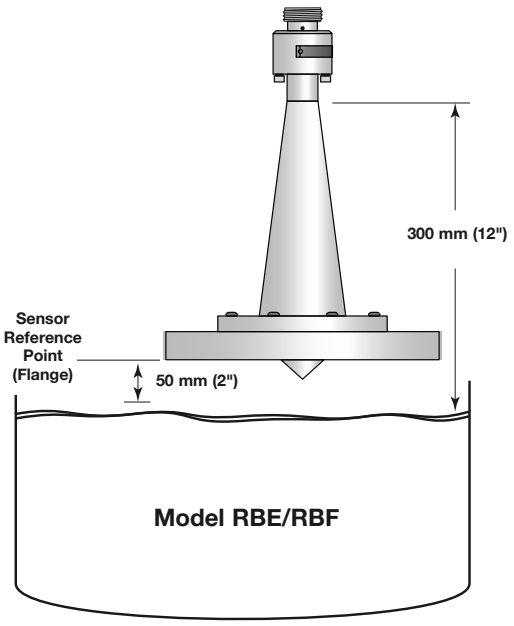
- Dielectric (process medium)
- Distance (measuring range)
- Disturbances (turbulence, foam, false targets, multiple reflections and rate of change).

The PULSAR Model R86 Radar transmitter is offered with a horn antenna configuration—Horn (1 1/2", 2", 3", 4"). Ideally, if the installation allows, the 4" horn antenna should be used to ensure the best possible performance in all operational conditions.



Encapsulated Horn RBE





Encapsulated Horn RBE/F

2.3.3.1 Maximum Distance

The chart below shows the maximum measuring range (Distance) of each antenna based on fundamental conditions of Dielectric, Distance and Turbulence. Distance is measured from the Sensor Reference Point (bottom of NPT thread, top of BSP thread or face of a flange).

R86 Maximum Recommended Measuring Range in meters (feet)							
		Turbulence None or Light			Turbulence Medium or Heavy		
	Dielectric >	1.7 – 3	3 – 10	10 – 100	1.7 – 3	3 – 10	10 – 100
Antenna Type	1½" Horn	9 (30)	12 (40)	18 (60)	3 (10)	5 (16)	8 (26)
	2" Horn	10 (33)	15 (49)	20 (66)	3 (10)	6 (20)	10 (33)
	3" Horn	15 (50)	20 (66)	30 (98)	4 (13)	9 (30)	12 (40)
	4" Horn	20 (66)	30 (98)	40 (130)	7 (23)	12 (40)	15 (50)

2.3.3.2 Minimum Distance

Liquid should not be allowed closer dan:

For Metal Antennas:

50 mm (2") from the bottom of the antenna or 300 mm (12") from the sensor reference point (whichever is greater). Refer to illustration at left.

For Encapsulated Horn Antennas:

50 mm (2") from the bottom of the antenna or 300 mm (12") from the launch point (whichever is greater). Refer to illustration at left.

2.3.3.3 Problematic Applications; GWR Alternative

Some applications can be problematic for Non-Contact Radar. For these, Guided Wave Radar is recommended:

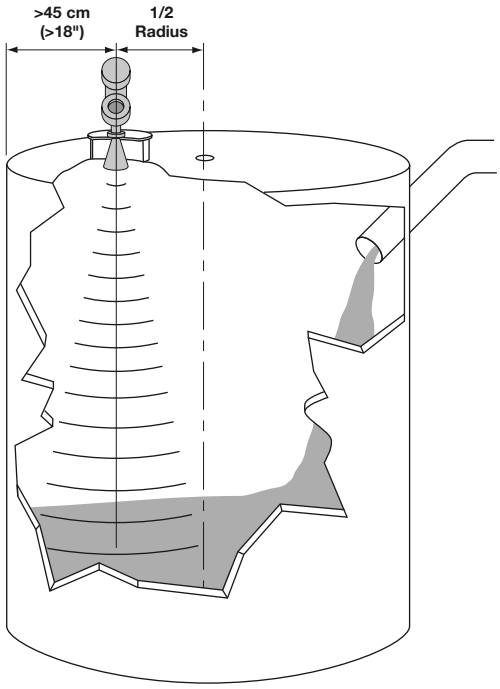
Model RBX

- Extremely low dielectric media (ε_r<1.7)
- Stillwells, standpipes, bridles, cages and bypass columns.
- Very weak reflections from the liquid surface (particularly during turbulence) can cause poor performance.
- Tanks heavily cluttered with false targets (mixers, pumps, ladders, pipes, etc.)
- During times of very low liquid levels of low dielectric media, the metal tank bottom may be detected which can deteriorate performance.
- Foam can either absorb or reflect the microwave energy depending upon the depth, dielectric, density and wall thickness of the bubbles. Due to typical variations in the amount (depth) of foam, it is impossible to quantify performance. It may be possible to receive most, some or none of the transmitted energy.
- When measurement close to flange is critical

  Extremely high liquid levels (Overflow) conditions when liquid very near the antenna can cause erroneous readings and measurement failure.
- Interface applications

Refer to Eclipse® Model 706 bulletin BE 57-106 for

2.4 Mounting

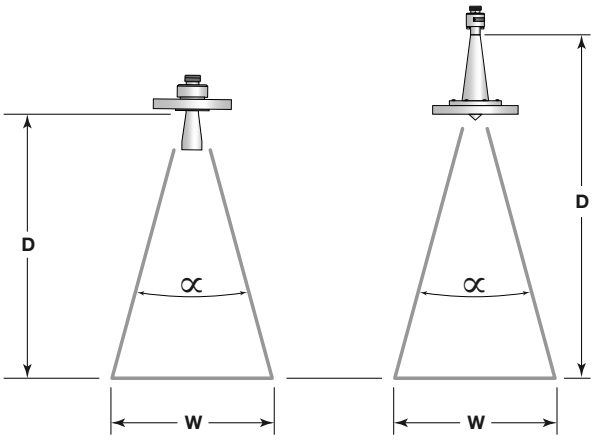


The PULSAR Model R86 Radar transmitter can be mounted to a vessel using a variety of process connections. Generally, either a threaded or flanged connection is used. For information about the sizes and types of connections available, see Section 3.8.2, *Antenna Model Numbers*.

2.4.1 Installing the Antenna

Before installing, ensure that:

- Model and Serial numbers on the nameplates of the PULSAR Model R86 transmitter and antenna are identical.
- Process temperature, pressure, dielectric, turbulence and distance are within the antenna specifications for the installation.
- Protective cap is kept on the antenna if the transmitter is to be installed at a later time.
- Antenna is being mounted in the optimal location. See following sections: *Location*, *Beam Angle*, *Obstructions* and *Nozzles* for specific information.
- If the liquid level comes in contact with the antenna, noise and media buildup drastically decrease reliable measurement. Liquid should not be allowed closer than 50 mm (2") from the bottom of the antenna or 300 mm (12") from the sensor reference point, whichever is greater.



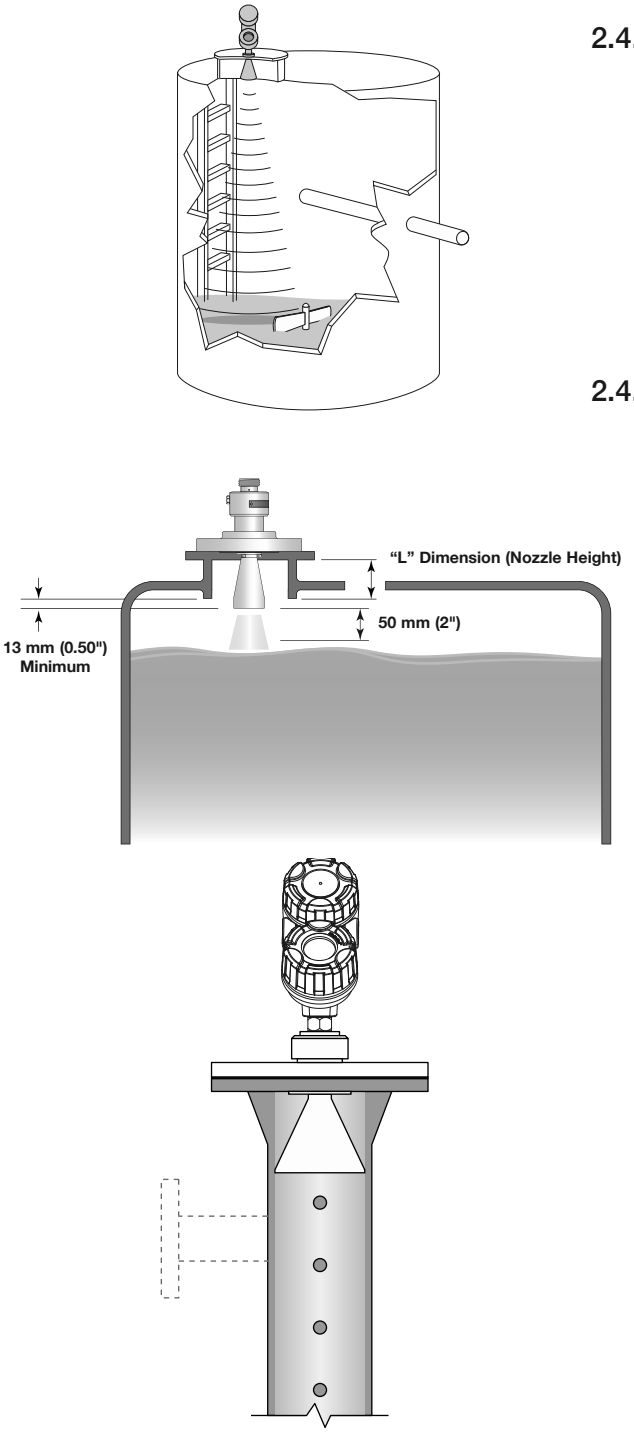
	Beam Spread, W @-3dB; m (ft)			
Antenna Beam Angle (∝)	1½" Horn 20°	2" Horn 18°	3" Horn 11°	4" Horn 9°
Distance, D ; m (ft)				
3 (10)	1,1 (3.5)	1,0 (3.2)	0,6 (1.9)	0,5 (1.6)
6 (20)	2,1 (7.1)	1,9 (6.3)	1,2 (3.9)	0,9 (3.1)
9 (30)	3,2 (10.6)	2,9 (9.5)	1,7 (5.8)	1,4 (4.7)
12 (40)	4,2 (14.1)	3,8 (12.7)	2,3 (7.7)	1,9 (6.3)
15 (50)	5,3 (17.6)	4,8 (15.8)	2,9 (9.6)	2,4 (7.9)
18 (60)	6,3 (21.2)	5,7 (19.0)	3,5 (11.6)	2,8 (9.4)
20 (65)		6,3 (20.6)	3,9 (12.5)	3,1 (10.2)
30 (98)			5,8 (18.9)	4,7 (15.4)
40 (130)				6,3 (20.5)

2.4.1.1 Location

Ideally, the Radar transmitter should be mounted providing an unobstructed signal path to the liquid surface where it should illuminate (with microwave energy) the largest, possible surface area. See Section 2.4.1.2, *Beam Angle*. Unavoidable obstacles will produce reflections that must be minimized during field configuration. See Section 3.3.3, *Echo Rejection*. Mount in a location equal to 1/2 the radius of tank top. Do not mount in center of vessel nor closer than 45 cm (18") of tank wall. Contact Magnetrol Technical Support when mounting closer than 45 cm (18") is required.

2.4.1.2 Beam Angle

The various horn antennas exhibit slightly different beam patterns. Ideally, the beam pattern should illuminate with microwave beam the maximum liquid surface with minimum contact with other objects in the vessel including the tank wall. Use the chart at left to determine the optimum installation location.



PULSAR Model R86 Mounted in Stillwell (Bridle)

2.4.1.3 Obstructions

Almost any object that falls within the beam pattern will cause reflections that may be misinterpreted as a false liquid level. Although PULSAR Model R86 has a powerful Echo Rejection routine, all possible precautions should be taken to minimize false target reflections with proper installation and orientation. Refer to Section 4.0, *Advanced Configuration/ Troubleshooting Techniques* for additional information.

2.4.1.4 Nozzles

Improper installation in a nozzle can create "ringing" that will adversely affect measurement. The antenna should always be mounted so the active section of the antenna is a minimum of 13 mm (0.5") outside the nozzle. Antenna extensions are offered to allow the PULSAR Model R86 transmitter to work reliably in nozzles up to 1,8 m (72"). See Section 3.6.7 for dimensional drawings of all antenna designs including nozzle extensions.

Be sure to include any nozzle distance extending within the vessel.

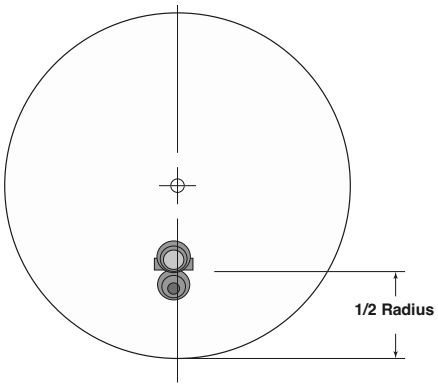
2.4.1.5 Standpipes and Stillwells

The PULSAR Model R86 can be mounted in a standpipe or stillwell but certain items must be considered:

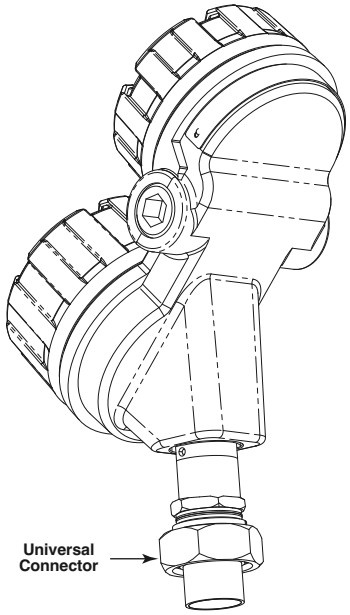
- Metal stillwells only: inside diameter 45–200 mm (1 3/4"–8").
- Diameter must be consistent throughout length; no reducers or gaps.
- Stillwell length must cover complete range of measurement (i.e., liquid must be in stillwell).
- Welds should be smooth.
- Vents: holes < 3 mm (0.125") diameter, slots < 3 mm (0.125") width.
- If an isolation valve is used, it must be a full port ball valve with an I.D. equal to the pipe diameter.
- Configuration must include a non-zero entry for PIPE I.D parameter.

2.4.2 Installing the Transmitter

- Remove the protective plastic cap from the top of antenna. Store the cap in a safe place in case the transmitter has to be removed later.
- Carefully place the transmitter on the antenna.
- Rotate the transmitter to face the most convenient direction for wiring, configuration and viewing.



Top View
Mounted 1/2 radius



NOTE: ALWAYS RUN THE ECHO REJECTION ROUTINE AFTER MAKING CHANGES TO MENU ITEMS (**Antenna Model**, **Antenna Extension**, **Antenna Mount, Tank Height, Blocking Distance, Dielectric, Turbulence, Rate of Change, Foam**).

2.4.2.1 Low Echo Margin

Echo Margin is a parameter that, when used with Echo Strength, can be a very useful troubleshooting tool. It is defined as a numeric value that is related to the strength of the target peak relative to the Level Threshold or competing waveform features, i.e., noise.

Echo Loss: If the Level signal is lost repeatedly at a specific point in the vessel, it is usually a symptom of multipath (sidewall) reflections causing cancellation by returning to the transmitter exactly 180° out of phase with the actual Level signal. This can be improved by applying the following procedure:

- Scroll to Display Config Menu under Device Setup. Scroll down to Echo Strength and Echo Margin and change the settings from Hide to View. This will allow you to view these values from the home screen.
- Bring the Level up (or down) to the exact point where the signal is repeatedly lost. Monitor the Echo Margin value as this point is being approached. The Echo Margin value will degrade to a low point before it begins to increase.
- Refer to Section 4.4 for additional information.

2.5 Wiring

Caution: HART versions of the PULSAR Model R86 transmitter operate at voltages of 11–36 VDC. FOUNDATION Fieldbus™ versions operate at 9–17.5 VDC. Higher voltages will damage the transmitter.

Wiring connections between the power supply and the PULSAR Model R86 Radar Transmitter should be made using 0.5–1 mm^2 (18–22 AWG) shielded twisted pair instrument cable. Connections are made to the terminal strip and the ground connections within the top enclosure compartment. Wiring connections are to be torqued to a minimum of 0,79 N m (7 in. lbs.) and shall not exceed 1,13 N m (10 in. lbs.).

The instructions for wiring the PULSAR Model R86 transmitter depend on the application:

- General Purpose or Division 2
- Intrinsically Safe
- Explosion Proof

WARNING! Explosion hazard. Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

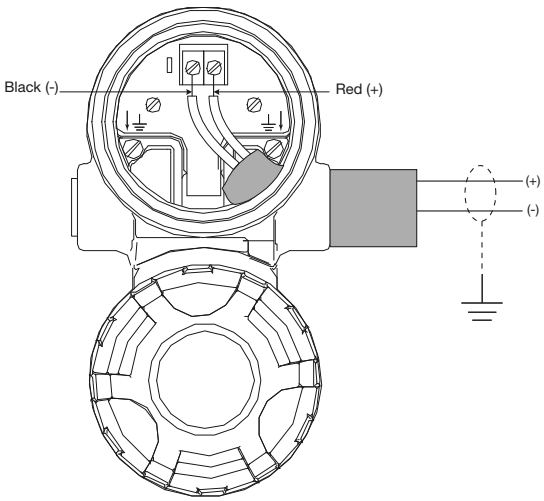
To avoid moisture ingress in the housing, covers should be fully tightened at all times. For the same reason, cable gland and plugs should be properly installed in the cable entries.

2.5.1 General Purpose or Division 2

A general purpose installation does not have flammable media present.

Areas rated Division 2 have flammable media present only under abnormal conditions.

24 VDC electrical connections are required.



Caution: If flammable media is contained in the vessel, the transmitter must be installed per Class I, Div 1 standards of area classification.

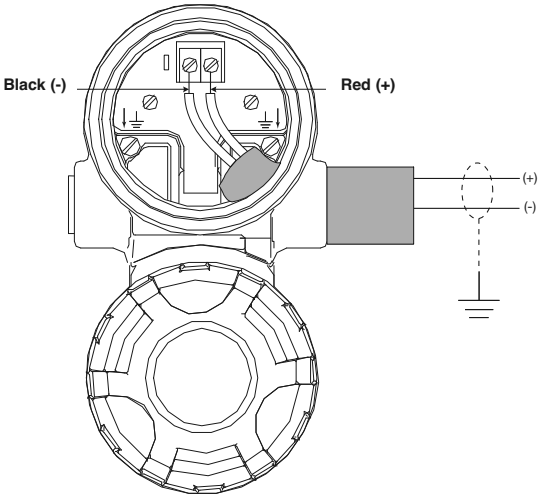
To install General Purpose or Division 2 wiring:

1. Remove the cover from the wiring compartment of the transmitter. Install the conduit plug in the unused opening and use PTFE tape/sealant to ensure a liquid-tight connection.
2. Install a conduit fitting and pull the supply wires.
3. Connect shield to an earth ground at power supply.
4. Connect an earth ground wire to the nearest green ground screw (not shown in illustration).
5. Connect the positive supply wire to the (+) terminal and the negative supply wire to the (-) terminal.
6. Replace and tighten the cover to the transmitter wiring compartment before applying power.

2.5.2 Intrinsically Safe

An Intrinsically Safe (IS) installation potentially has flammable media present. An approved IS barrier must be installed in the non-hazardous (safe) area to limit the available energy out to the hazardous area.

See *Agency Drawing – Intrinsically Safe Installation*, Section 3.5.1.



To install Intrinsically Safe wiring:

1. Ensure that the IS barrier is properly installed in the safe area (refer to local plant or facility procedures). Complete the wiring from the power supply to the barrier and from the barrier to the PULSAR Model R86 transmitter.
2. Remove the cover from the wiring compartment of the transmitter. Install the conduit plug in the unused opening and use PTFE tape/sealant to ensure a liquid-tight connection.
3. Install a conduit fitting and pull the supply wires.
4. Connect shield to an earth ground at power supply.
5. Connect an earth ground wire to the nearest green ground screw (not shown in illustration).
6. Connect the positive supply wire to the (+) terminal and the negative supply wire to the (-) terminal.
7. Replace and tighten the cover to the wiring compartment of the transmitter before applying power.

2.5.3 Explosion Proof

Explosion Proof (also referred to as XP or flameproof) is another method of designing equipment for installation into hazardous areas. A hazardous location is an area in which flammable gases or vapors are (or may be) present in the air in quantities sufficient to produce explosive or ignitable mixtures.

The wiring for the transmitter must be contained in Explosion Proof conduit extending into the safe area.

- Due to the specialized design of the PULSAR Model R86 transmitter, no Explosion Proof conduit fitting (EY seal) is required within 45 cm (18") of the transmitter.
- An Explosion Proof conduit fitting (EY seal) is required between the hazardous and safe areas. See Section 3.5, Agency Specifications.

To install an Explosion Proof transmitter:

1. Install Explosion Proof conduit from the safe area to the conduit connection of the PULSAR Model R86 transmitter (refer to local plant or facility procedures).
2. Remove the cover from the wiring compartment of the transmitter.
3. Connect shield to an earth ground at the power supply.
4. Connect an Earth ground wire to the nearest green ground screw per local electrical code (not shown in illustration).
5. Connect the positive supply wire to the (+) terminal and the negative supply wire to the (-) terminal.
6. Replace and tighten the cover to the wiring compartment of the transmitter before applying power.

2.6 Configuring the Transmitter

Although the PULSAR Model R86 transmitter can be delivered pre-configured from the factory, it can also be easily reconfigured in the shop or at the installation using the local LCD/Keypad or PACT*ware*/DTM. Bench configuration provides a convenient and efficient way to set up the transmitter before going to the tank site to complete the installation.

Before configuring any transmitter, collect all operating parameters information (refer to Section 1.1.2).

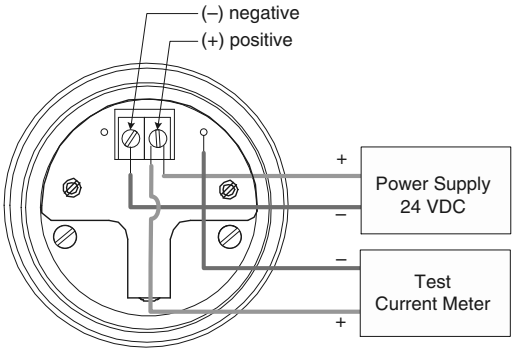
Apply power to the transmitter and follow the step-by-step procedures for the menu-driven transmitter display. Refer to Sections 2.6.2 and 2.6.4.

Information on configuring the transmitter using a HART communicator is given in Section 2.7, *Configuration Using HART*.

Refer to I/O manual BE 58-641 for information on FOUNDATION Fieldbus™ output.

2.6.1 Bench Configuration

The PULSAR Model R86 transmitter can be easily configured at a test bench by connecting a standard 24 VDC power supply directly to the transmitter terminals as shown in the accompanying diagram. An optional digital multimeter is shown in the event that mA current measurements are desired.



G.P./I.S. Model

NOTE: Current measurements taken at these test points are an approximate value. Accurate current readings should be taken with the digital multimeter directly in series with the loop.

NOTE: When using a HART communicator for configuration, a minimum 250-ohm line load resistance is required. Refer to your HART communicator manual for additional information.

NOTE: The transmitter can be configured without the antenna attached. Disregard any diagnostic indicators that may appear during that time.

2.6.2 Menu Traversal and Data Entry

The four push buttons offer various forms of functionality for navigation and data entry.

The PULSAR Model R86 user interface is hierarchical in nature, best described as a tree structure. Each level in the tree contains one or more items. Items are either menu labels or parameter names.

- Menu labels are presented in all capital letters
- Parameters are capital words

2.6.2.1 Navigating the Menu

⇧ **UP** moves to the previous item in the menu branch.

⇩ **DOWN** moves to the next item in the menu branch.

⇦ **BACK** moves back one level to the previous (higher) branch item.

⇨ **ENTER** enters into the lower level branch or switches to the entry mode. Holding the ENTER down on any highlighted menu name or parameter will show help text for that item.

2.6.2.2 Data Selection

This method is used for selecting configuration data from a specific list.

⇧ **UP** and ⇩ **DOWN** to navigate the menu and highlight the item of interest

⇨ **ENTER** allows modification of that selection

⇧ **UP** and ⇩ **DOWN** to choose new data selection

⇨ **ENTER** to confirm selection

Use ⇦ **BACK** (Escape) key at any time to abort the procedure and escape to previous branch item

2.6.2.3 Entering Numeric Data Using Digit Entry

This method is used to input numeric data, e.g., Tank Height, 4 mA setpoint and 20 mA setpoint.

Push button		Keystroke Action
	Up	Moves up to the next highest digit (0,1,2,3,....,9 or decimal point). If held down the digits scroll until the push button is released.
	Down	Moves up to the next lowest digit (0,1,2,3,....,9 or decimal point). If held down the digits scroll until the push button is released.
	Back	Moves the cursor to the left and deletes a digit. If the cursor is already at the leftmost position, then the screen is exited without changing the previously saved value.
	Enter	Moves the cursor to the right. If the cursor is located at a blank character position, the new value is saved.

All numeric values are left-justified, and new values are entered from left to right. A decimal point can be entered after the first digit is entered, such that .9 is entered as 0.9.

Some configuration parameters can have a negative value. In this case, the leftmost position is reversed for the sign (either "-" for a negative value, or "+" for a positive value).

2.6.2.4 Entering Numeric Data Using Increment/Decrement

Use this method to input the following data into parameters such as Damping and Failure Alarm.

Push button		Keystroke Action
	Up	Increments the displayed value. If held down the digits scroll until the push button is released. Depending on which screen is being revised, the increment amount may increase by a factor of 10 after the value has been incremented 10 times.
	Down	Decrements the displayed value. If held down the digits scroll until the push button is released. Depending on which screen is being revised, the decrement amount may increase by a factor of 10 after the value has been decremented 10 times.
	Back	Returns to the previous menu without changing the original value, which is immediately redisplayed.
	Enter	Accepts the displayed value and returns to the previous menu.

2.6.2.5 Entering Character Data

This method is used for parameters requiring alphanumeric character entry, such as for entering tags, etc.

General Menu Notes:

Push button		Keystroke Action
↑	Up	Moves to the previous character (Z...Y...X...W). If held down, the characters scroll until the push button is released.
↓	Down	Moves to the next item character (A...B...C...D). If held down, the characters scroll until the push button is released.
←	Back	Moves the cursor back to the left. If the cursor is already at the leftmost position, then the screen is exited without changing the original tag characters.
→	Enter	Moves the cursor forward to the right. If the cursor is at the rightmost position, then the new tag is saved.

2.6.3 Password Protection

The PULSAR Model R86 transmitter has three levels of password protection to restrict access to certain portions of the menu structure that affect the operation of the system.

User Password

The User Password allows the customer to limit access to the basic configuration parameters.

The default User Password installed in the transmitter at the factory is 0. With a password of 0, the transmitter is no longer password protected and any value in the basic user menus can be adjusted without entering a confirming password.

The user password can be changed to any numerical value up to 59999. When the transmitter is programmed for password protection, a password is required whenever configuration values are changed.

NOTE: If a User Password is not known or has been misplaced, the menu item New Password in the DEVICE SETUP/ADVANCED CONFIG menu displays an encrypted value representing the present password. Contact Technical Support with this encrypted password to retrieve the original User Password.

Advanced Password

Certain portions of the menu structure that contain more advanced parameters are further protected by an Advanced Password.

This password will be provided, when necessary, by Factory technical support.

Factory Password

Calibration-related and other factory settings are further protected by a Factory Password.

2.6.4 Model R86 Menu: Step-By-Step Procedure

NOTE: Context-sensitive HELP is available for all menu and parameter items. With the item highlighted, hold down the ➪ **ENTER** key for two seconds. Use ⇧ **UP** and ⇩ **DOWN** for navigation.

The tables in Section 2.6.5 provide a complete explanation of the software menus displayed by the PULSAR Model R86 transmitter. The menu layout is similar between the local Keypad/LCD interface, the DD, and the DTM.

Use these tables as a step-by-step guide to configure the transmitter based on the desired measurement type from the following selections:

- **Level Only**
- **Volume & Level**
- **Flow**

HOME SCREEN

The Home Screen consists of a "slide show" sequence of Measured Values screens which are rotated at 2-second intervals. Each Home Measured Value screen can present up to four information items:

- **HART® Tag**
- **Measured Value**
  Label, Numerical Value, Units
- **Status**
  Will be displayed as text or optionally with NAMUR NE 107 symbol
- **Primary Value Bar Graph** (shown in %)

The Home Screen presentation can be customized by viewing or hiding some of these items. See DISPLAY CONFIG under the DEVICE SETUP menu in Section 2.6.5, *Configuration Menu.*

At left is an example of a Home Screen for a Model R86 configured for a Level Only application.

MAIN MENU

Pressing any key on the Home Screen will present the Main Menu, consisting of three basic menu labels shown in all capital letters.

- **DEVICE SETUP**
- **DIAGNOSTICS**
- **MEASURED VALUES**
- **WIZARDS**

As shown, the reverse video represents a cursor identifying the selected item, which will appear in reverse video on the LCD. The actions of the keys at this point are:

Push button		Keystroke Action
↑	Up	No action as the cursor is already at the first item in the MAIN MENU
↓	Down	Moves the cursor to DIAGNOSTICS
←	Back	Moves back to HOME SCREEN, the level above MAIN MENU
→	Enter	Presents the selected item, DEVICE SETUP

NOTES: 1. Items and parameters that are shown in lower level menus will depend on the Measurement Type chosen. Those parameter not applicable to the present Measurement Type will be hidden.

2. Holding down the Enter key when the cursor is highlighted over a parameter or menu will provide additional information about that item.

DEVICE SETUP

Choosing DEVICE SETUP from the MAIN MENU will result in an LCD presentation as shown at left.

The small down arrow shown at the right hand side of the screen is the indication that more items are available below and can be accessed by pressing the DOWN key.

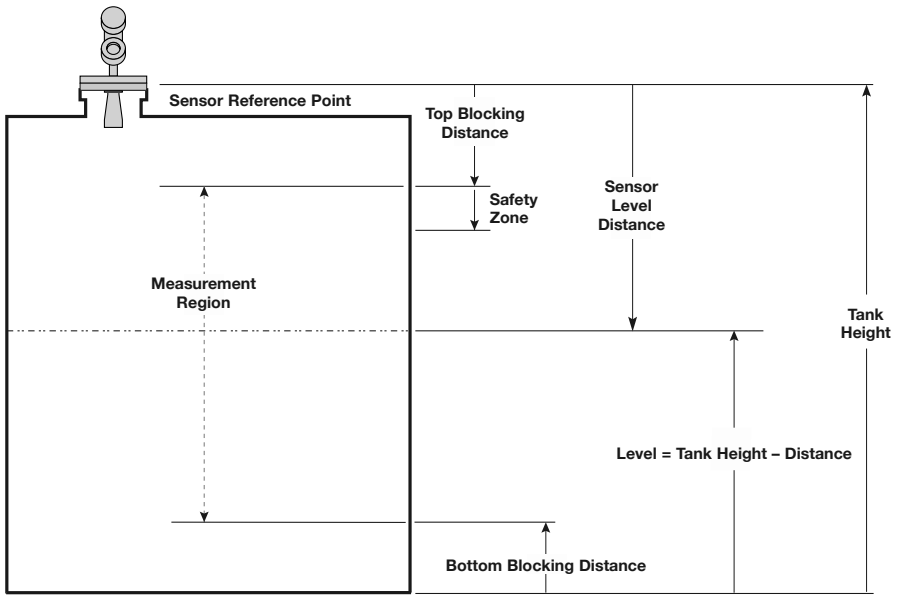
Section 2.6.5 shows the entire tree menu for the Model R86 DEVICE SETUP Menu.

DIAGNOSTICS

Refer to Section 3.4

MEASURED VALUES

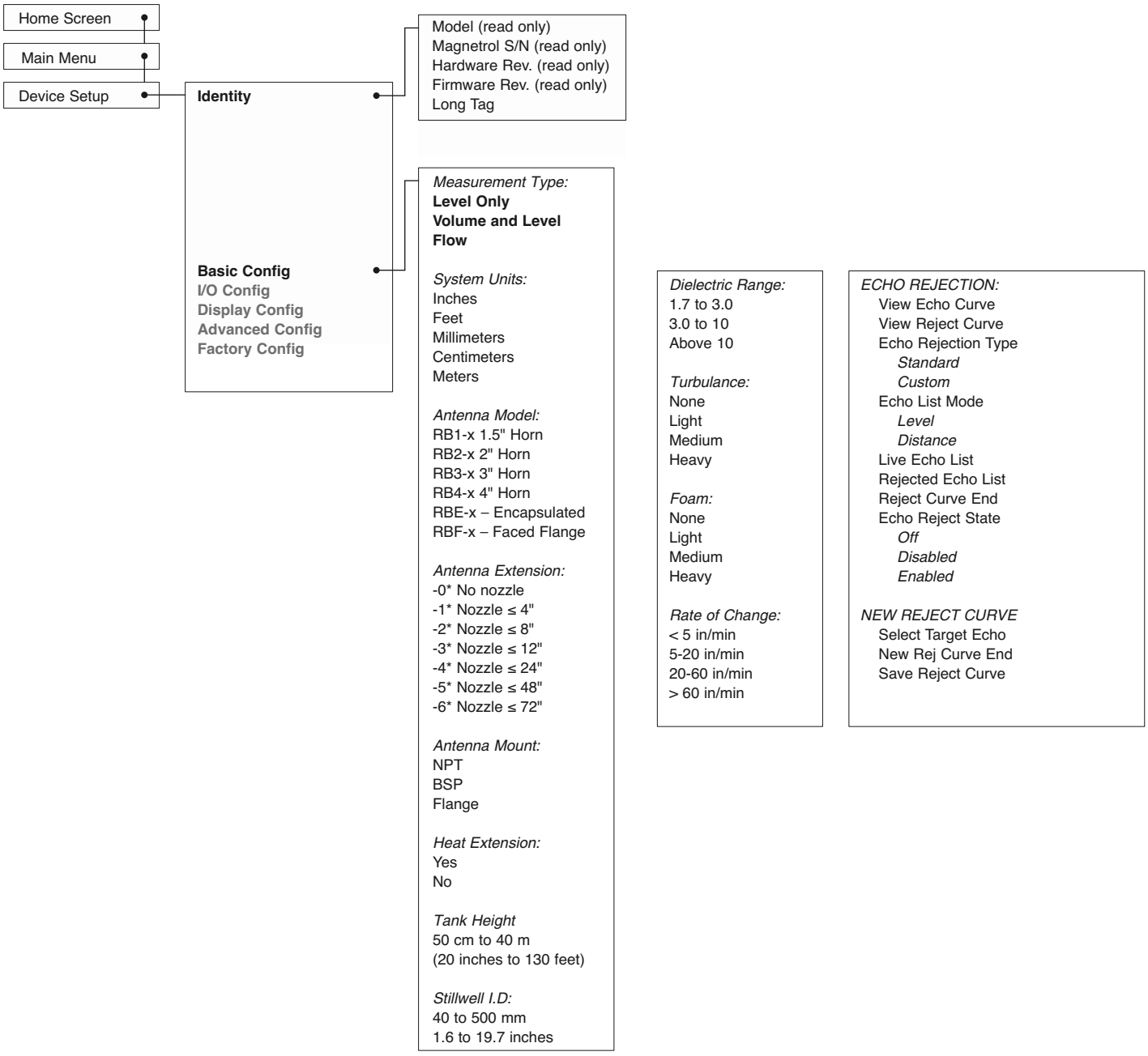
Allows the user to scroll through all of the available measured values for the measurement type chosen.



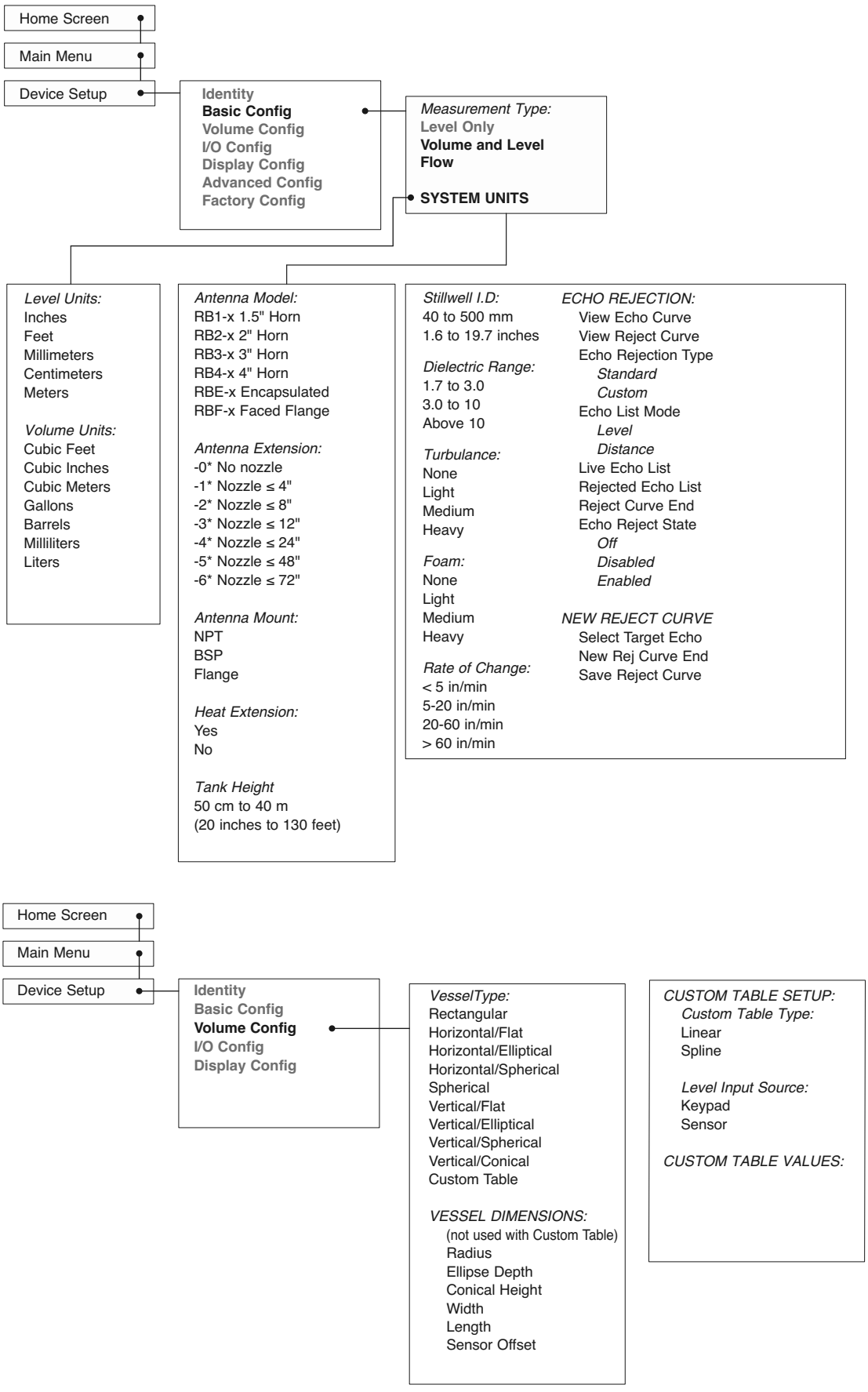
R86 Level Model

2.6.5 Model R86 Configuration Menu — Device Setup

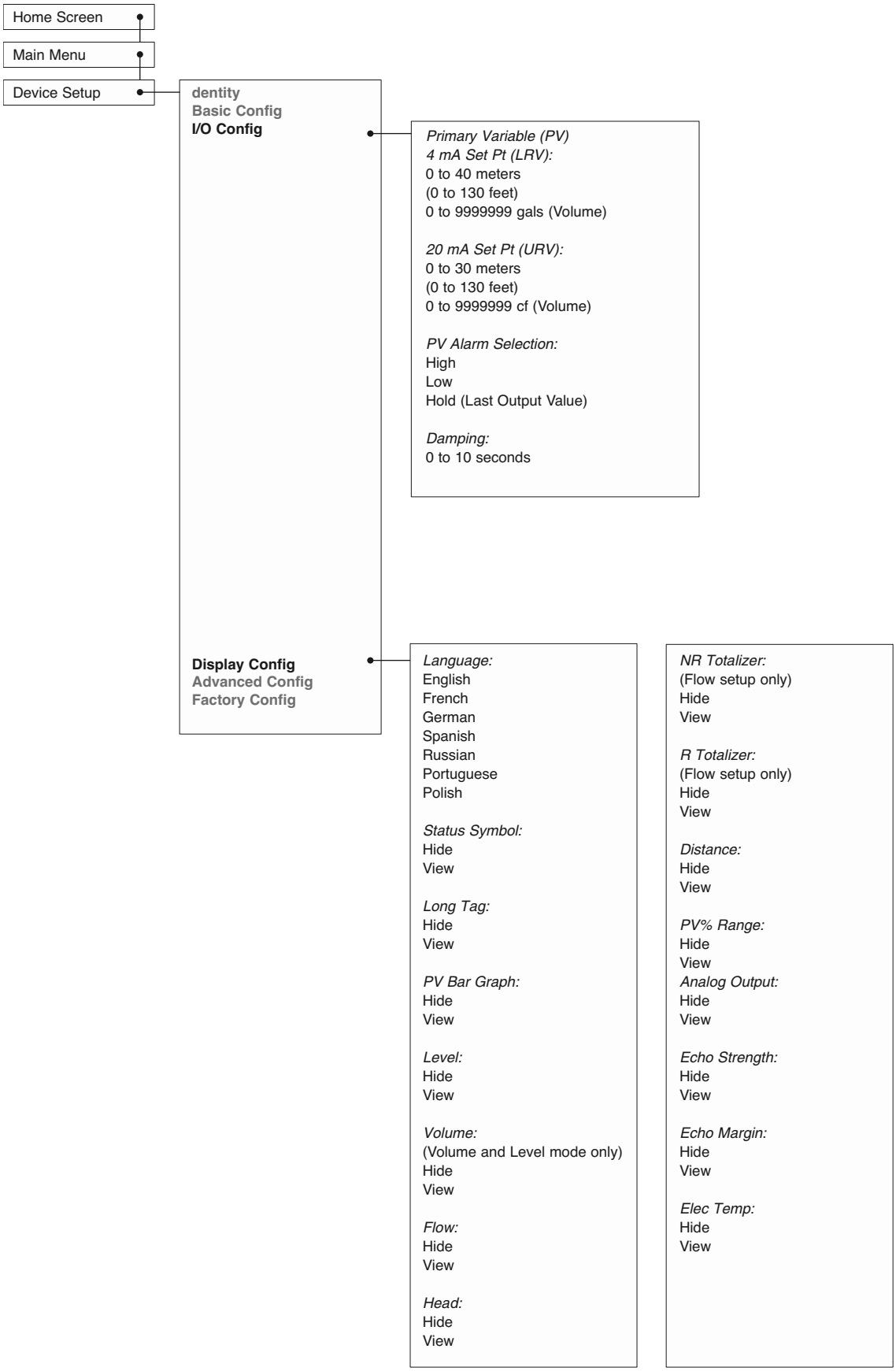
NOTE: Context-sensitive HELP is available for all menu items. With the menu item highlighted, hold down the ➪ **ENTER** key for two seconds. Use ⇧ **UP** and ⇩ **DOWN** for navigation.



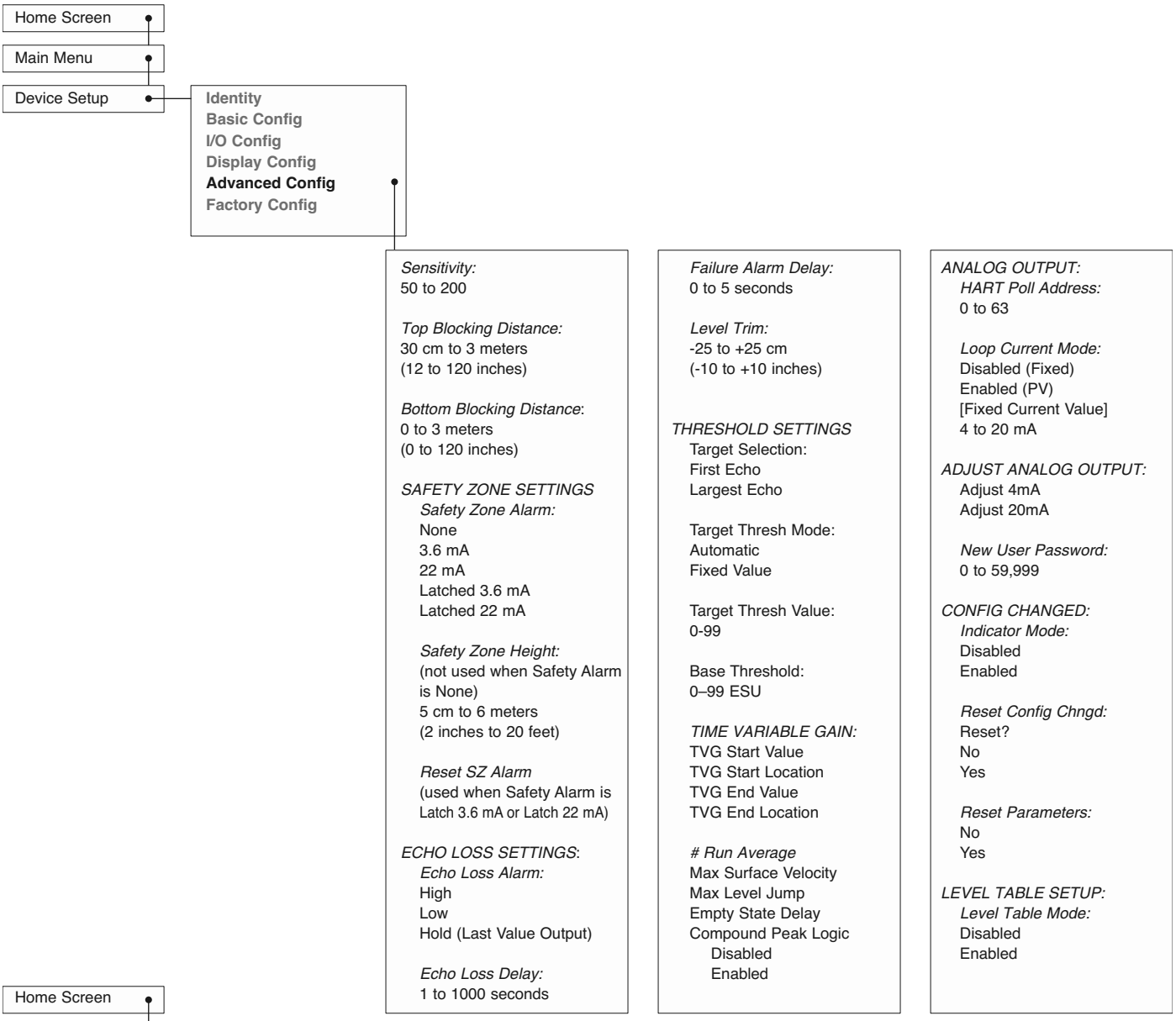
2.6.5 Model R86 Configuration Menu — Device Setup



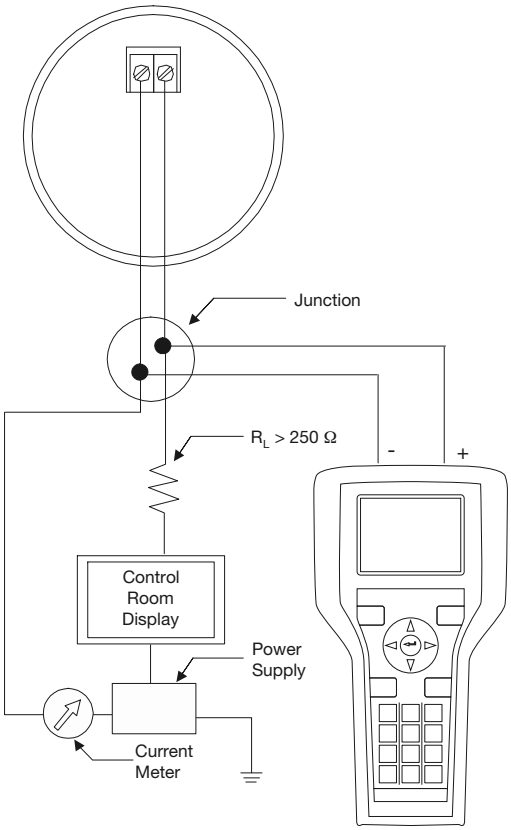
2.6.5 Model R86 Configuration Menu — Device Setup



2.6.5 Model R86 Configuration Menu — Device Setup



2.7 Configuration Using HART®



A HART (Highway Addressable Remote Transducer) remote unit, such as a HART communicator, can be used to provide a communication link to the PULSAR Model R86 transmitter. When connected to the control loop, the same system measurement readings shown on the transmitter are also shown on the communicator. The communicator can also be used to configure the transmitter.

The HART communicator may need to be updated to include the PULSAR Model R86 software (Device Descriptions). Refer to your HART Communicator Manual for update instructions.

One can also access configuration parameters using PACT*ware* and the Model R86 DTM, or using the AMS with EDDL.

2.7.1 Connections

A HART communicator can be operated from a remote location by connecting it to a remote junction or by connecting it directly to the terminal block in the electronics housing of the PULSAR Model R86 transmitter.

HART uses the Bell 202 frequency shift key technique of high-frequency digital signals. It operates on the 4–20 mA loop and requires 250 Ω load resistance. A typical connection between a communicator and the PULSAR Model R86 transmitter is illustrated.

2.7.2 Display Menu

A typical communicator display is an 8-line by 21-character LCD. When connected, the top line of each menu displays the model (Model R86) and its tag number or address. For detailed operating information, refer to the instruction manual provided with the HART communicator.

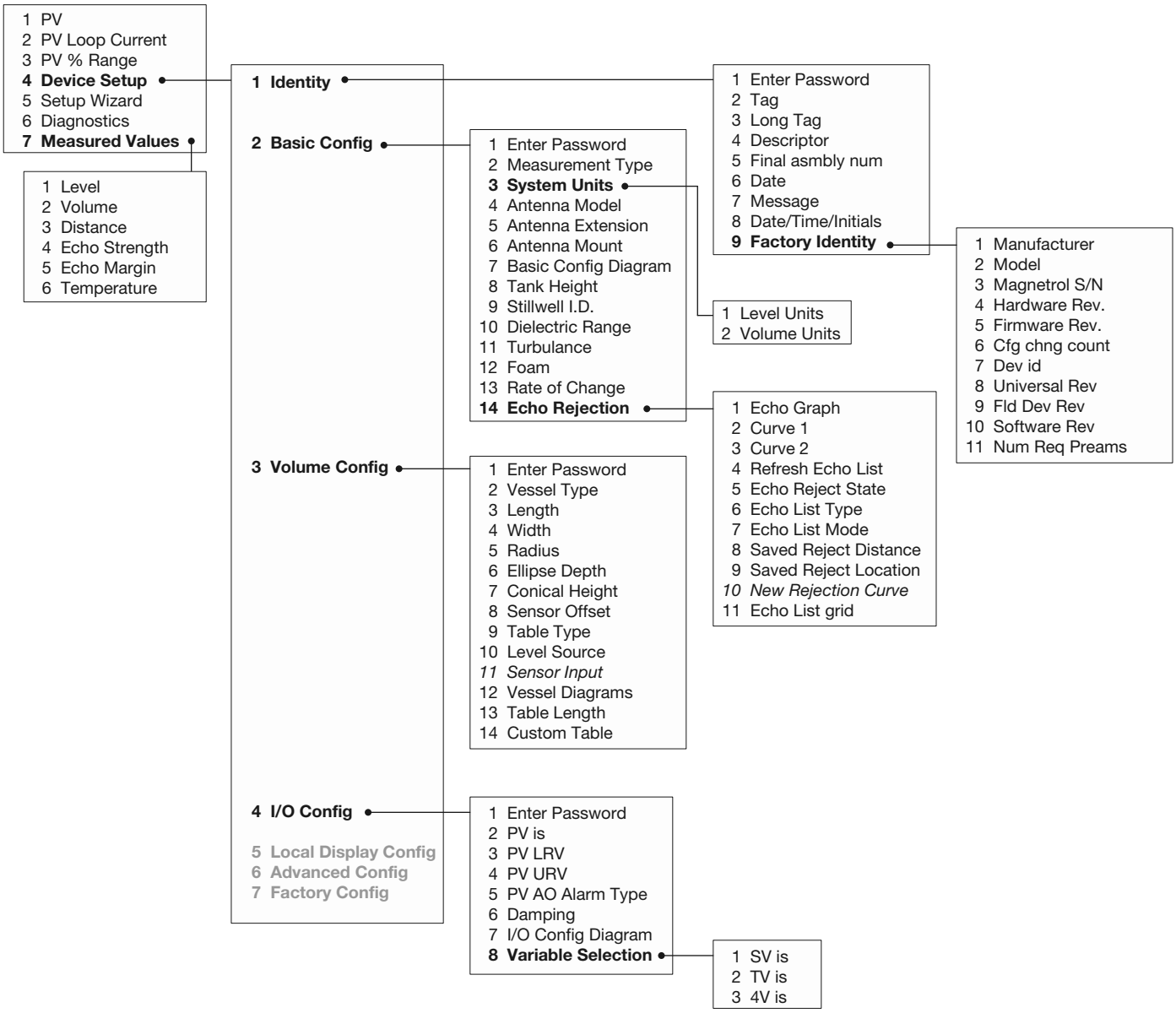
The PULSAR Model R86 transmitter online menu trees are shown in the following illustration. Open the menu by pressing the alphanumeric key 4, Device Setup, to display the second-level menu.

2.7.3 HART Revision Table

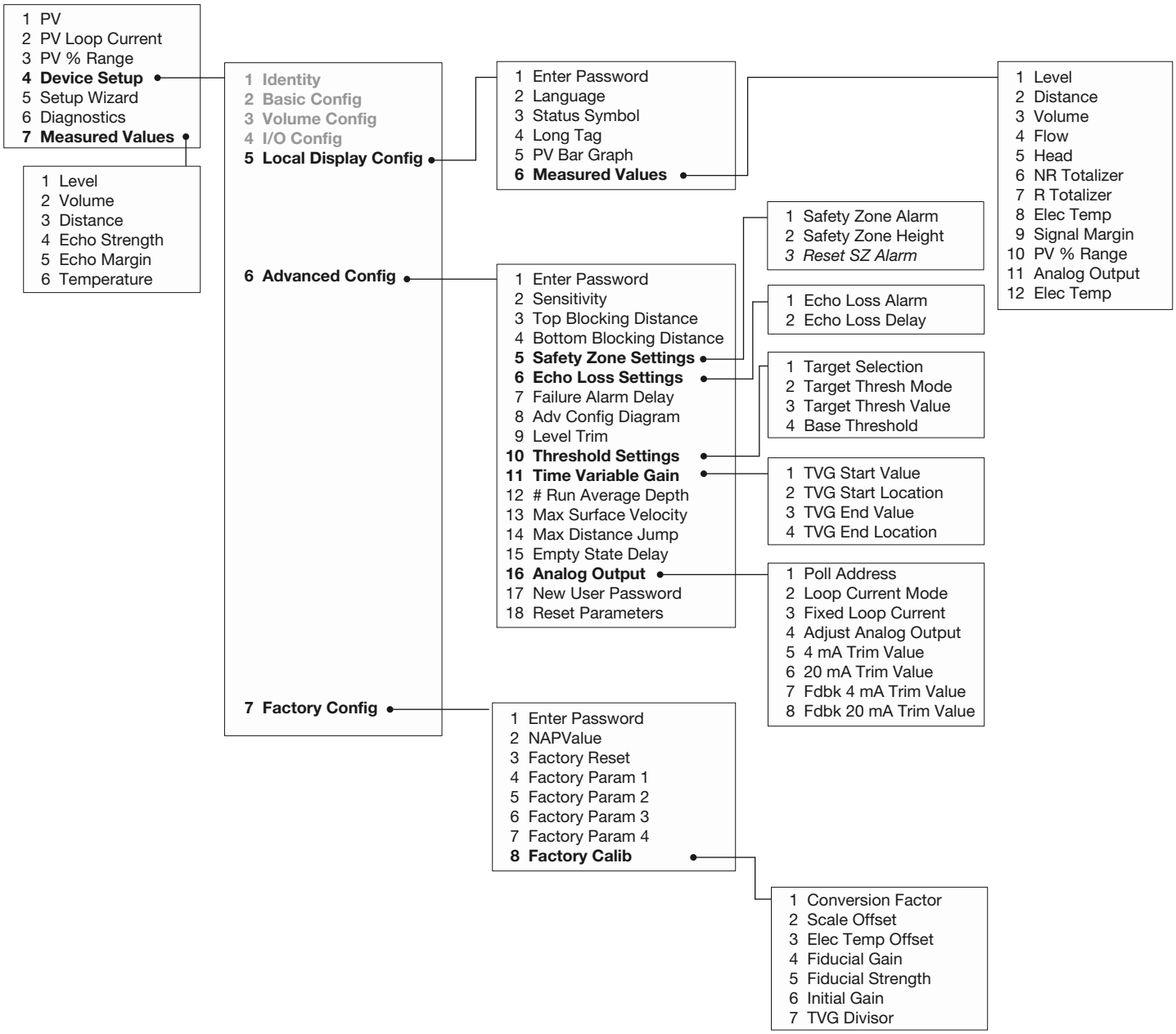
2.7.3.1 Model R86

HART Version	HCF Release Date	Compatible with R86 Software
Dev V1 DD1	April 2017	Version 1.0a and later

2.7.4 HART Menu



2.7.4 HART Menu (continued)



3.0 Reference Information

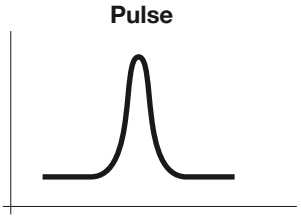
This section presents an overview of the operation of the PULSAR Model R86 Radar Level Transmitter, information on troubleshooting, common problems, listings of agency approvals, lists of replacement and recommended spare parts, and detailed physical, functional and performance specifications.

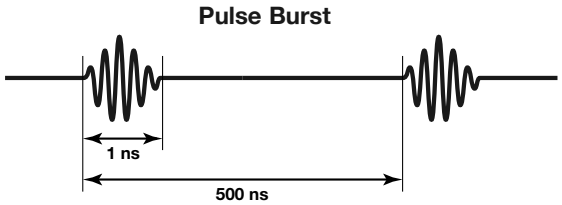
3.1 Description

The PULSAR Model R86 is a two-wire, 24 VDC, level transmitter based on the concept of pulse burst radar. The electronics are housed in an ergonomic housing comprised of two tandem compartments angled at a 20-degree angle for ease of wiring and calibration. These two compartments connect via a watertight feed-through.

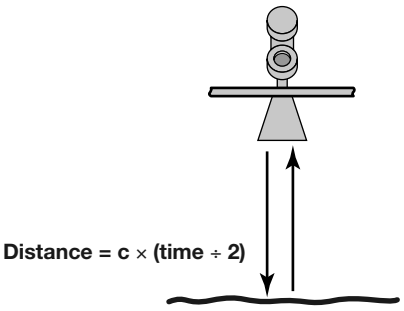
3.2 Theory of Operation

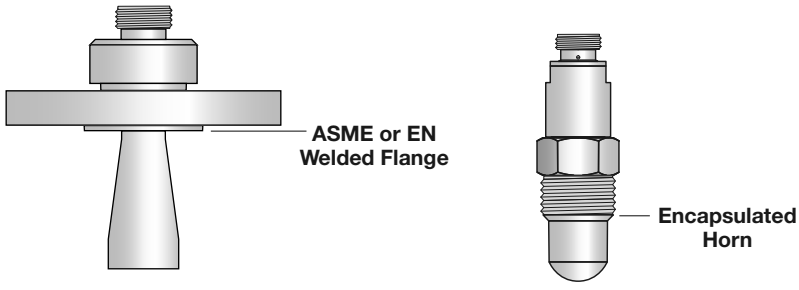
3.2.1 Pulse Burst Radar





PULSAR Model R86 is a top-mounted, downward-looking pulse burst radar operating at 26 GHz. Unlike true pulse devices (GWR, for example) that transmit a single, sharp (fast rise-time) waveform of wide-band energy, PULSAR Model R86 emits short bursts of 26 GHz energy and measures the transit time of the signal reflected off the liquid surface. Distance is calculated utilizing the equation: Distance = C (Speed of light) × Transit time/2, then developing the Level value by factoring in application-specific configuration. The exact reference point for distance and level calculations is the Sensor Reference Point—bottom of an NPT thread, top of a BSP thread or face of a flange.





Sensor Reference Point

The exact level measurement is extracted from false target reflections and other background noise via the use of sophisticated signal processing. The new PULSAR Model R86 circuitry is extremely energy efficient so no duty cycling is necessary to accomplish effective measurement.

3.2.2 Equivalent Time Sampling

ETS, or Equivalent Time Sampling, is used to measure the high speed, low power EM (electromagnetic) energy. ETS is a critical key in the application of Radar to vessel level measurement technology. The high speed electromagnetic energy (1000 ft/µs) is difficult to measure over short distances and at the resolution required in the process industry. ETS captures the EM signals in real time (nanoseconds) and reconstructs them in equivalent time (milliseconds), which is much easier to measure with today's technology.

ETS is accomplished by scanning the tank to collect thousands of samples. Approximately three scans are taken per second; each scan gathers more than 14,000 samples.

3.3 Configuration Information

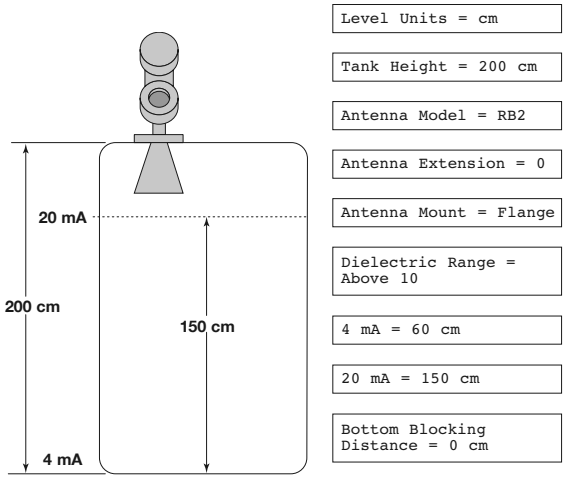
This section is intended to offer additional configuration-related details with respect to some of the parameters shown in the Menu in Section 2.6.

3.3.1 Bottom Blocking Distance Description

The parameter referred to as Bottom Blocking Distance in the PULSAR Model R86 DEVICE SETUP/ADVANCED CONFIG menu is defined as the distance from the bottom of the tank to the lowest valid level reading.

NOTE: The level reading will never be lower than the Bottom Blocking Distance or higher than the Top Blocking Distance.

The PULSAR Model R86 transmitter is shipped from the factory with Bottom Blocking Distance set to 0. With this configuration, level measurements are referenced from the bottom of the tank. See Example 1.

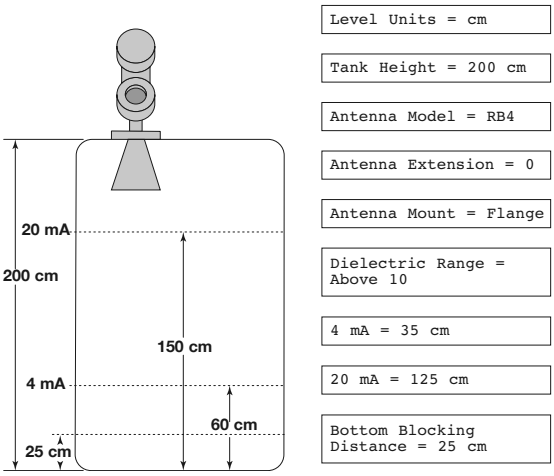


Example 1

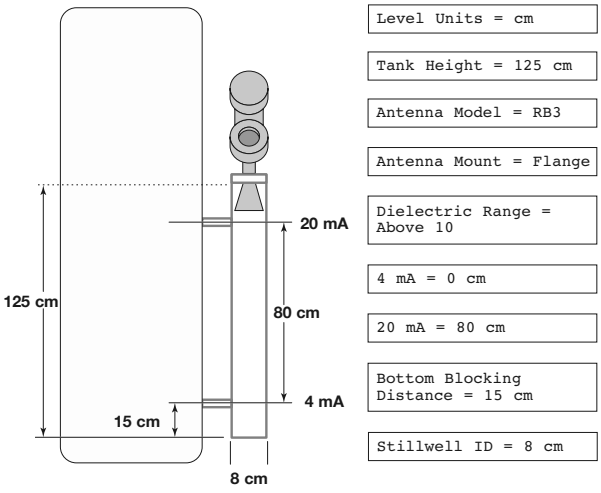
Example 1 (Bottom Blocking Distance = 0 as shipped from factory):

Application calls for a Model RB2 antenna in an 200 cm tank with a flanged process connection. The process medium is water.

The user wants the 4 mA Set Point (LRV) at 60 cm and the 20 mA Set Point (URV) at 150 cm **as referenced from the bottom of the tank**.



Example 2



Example 3

Example 2 (Bottom Blocking Distance = 25 cm):

Application calls for a Model RB4 antenna in an 200 cm tank with a flanged process connection.

The user wants the 4 mA Set Point (LRV) at 60 cm and the 20 mA Set Point (URV) at 150 cm **as referenced from the bottom of the tank**.

When the PULSAR Model R86 transmitter is mounted in a stillwell, it is usually desirable to configure the unit with the 4 mA Set Point (LRV) at the lower process connection and the 20 mA Set Point (URV) at the upper process connection. The measuring range then becomes the center-to-center dimension.

Example 3:

Application calls for a Model RB3 flanged antenna measuring water in a chamber with ID = 8 cm. The user wants the 4 mA point at the bottom process connection and the 20 mA point at the top process connection.

3.3.2 Reset Function

A parameter labeled "Reset Parameters" is located at the end of the DEVICE SETUP/ADVANCED CONFIG menu. In the event a user gets confused during configuration or advanced troubleshooting, this parameter gives the user the ability to reset the Model R86 transmitter configuration.

Unique to the Model R86 transmitter is the ability for MAGNETROL to fully "pre-configure" devices to customer requests. For that reason, the Reset function will return the device back to the state **at which it left the factory**.

It is recommended that MAGNETROL Technical Support be contacted as the Advanced User password will be required for this reset.

3.3.3 Echo Rejection

Since all Non-Contact radar transmitters are application/installation dependent, Echo Rejection (ignoring false targets) may be necessary.

The Model R86 transmitter Echo Rejection feature is located in the DEVICE SETUP/BASIC CONFIG menu, and requires the User Password to activate. It is highly recommended that this feature be used with the waveform capture capability of the Model R86 DTM and PACT*ware*™.

Refer to Section 4.0, *Advanced Configuration/ Troubleshooting Techniques* or contact MAGNETROL Technical Support for additional instructions.

3.3.4 Volumetric Capability

Selecting Measurement Type = Volume and Level allows the Model R86 transmitter to measure volume as the Primary Measured Value.

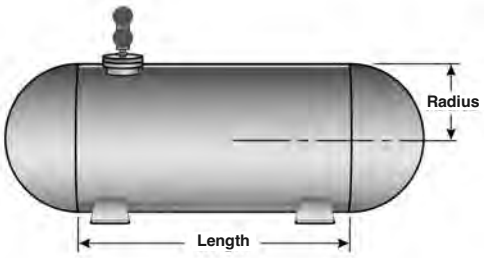
3.3.4.1 Configuration using built-in Vessel Types

The following table provides an explanation of each of the System Configuration parameters required for volume applications that use one of the nine Vessel Types.

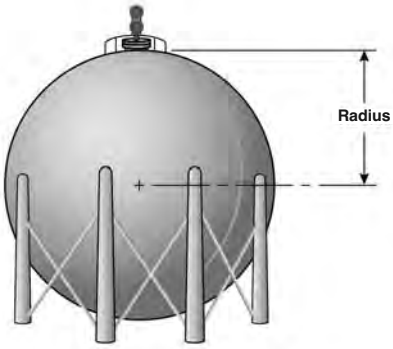
MEASUREMENT TYPE = LEVEL & VOLUME

Configuration Parameter	Explanation
System Units	A selection of Gallons, Barrels, Milliliters, Liters, Cubic Feet, or Cubic Inches, is provided. (Factory default is Cubic Feet)
Vessel Type	Select either Vertical/Flat (factory default Vessel Type), Vertical/Elliptical, Vertical/Spherical, Vertical/Conical, Rectangular, Horizontal/Flat, Horizontal/Elliptical, Horizontal/Spherical, Spherical, or Custom Table. Note: Vessel Dims is the next screen only if a specific Vessel Type was selected. If Custom Table was selected. Refer to page 44 to select the Cust Table Type and Cust Table Vals.
Vessel Dims	See the vessel drawings on the following page for relevant measuring areas.
Radius	Used for all Vessel Types with the exception of Rectangular.
Ellipse Depth	Used for Horizontal and Vertical/Elliptical vessels.
Conical Height	Used for Vertical/Conical vessels.
Width	Used for Rectangular vessels.
Length	Used for Rectangular and Horizontal vessels.

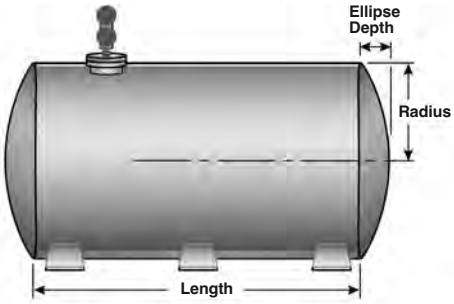
Vessel Types



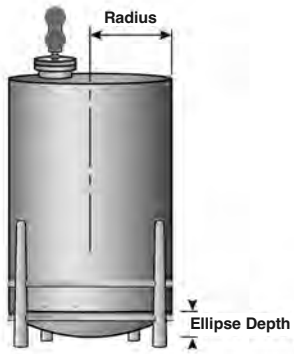
HORIZONTAL/SPHERICAL



SPHERICAL

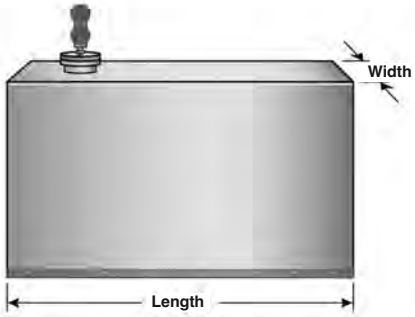


HORIZONTAL/ELLIPTICAL



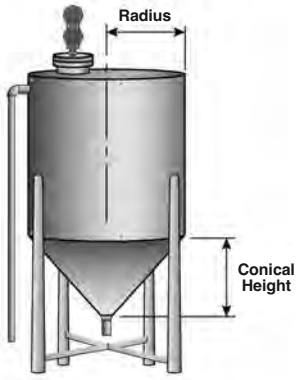
VERTICAL/ELLIPTICAL

VERTICAL/SPHERICAL

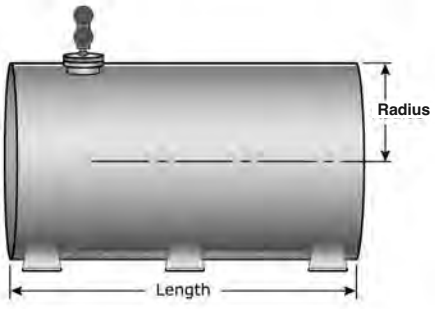


RECTANGULAR

VERTICAL/FLAT



VERTICAL/CONICAL

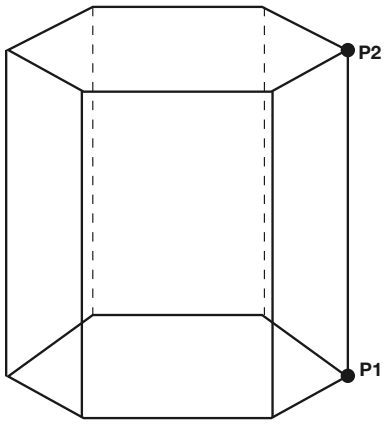


HORIZONTAL/FLAT

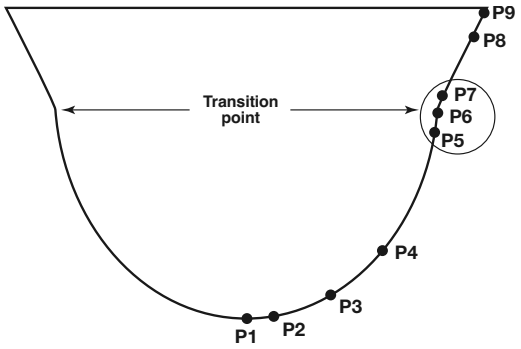
3.3.4.2 Configuration using Custom Table

If none of the nine ***Vessel Types*** shown can be used, a ***Custom Table*** can be created. A maximum of 30 points can be used to establish the level to volume relationship. The following table provides an explanation of each of the System Configuration parameters for volume applications where a Custom Table is needed.

Configuration Parameter	Explanation (Custom Volumetric Table)
Volume Units	A selection of **Gallons, Barrels, Milliliters**, **Liters**, **Cubic Feet**, **Cubic Inches**, or **Cubic Meters** is provided.
Vessel Type	Select **Custom Table** if none of the nine *Vessel Types* can be used.
Cust Table Type	The *Custom Table* points can be a **Linear** (straight line between adjacent points) or **Spline** (can be a curved line between points) relationship. See drawing below for more information.
Cust Table Vals	A maximum of 30 points can be used in building the *Custom Table*. Each pair of values will have a level (height) in the units chosen in the *Level Units* screen, and the associated volume for that level point. The values must be monotonic, i.e., each pair of values must be greater than the previous level/volume pair. The last pair of values should have the highest level value and volume value associated with the level in the vessel.



LINEAR

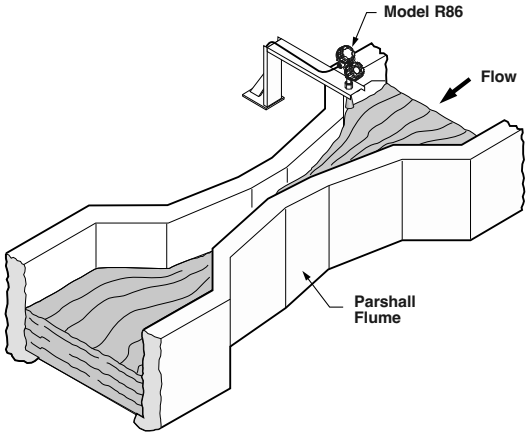


Use where walls are not perpendicular to base.

Concentrate at least two points at beginning (P1) and end (P9); and three points at either side of transition points.

SPLINE

3.3.5 Open Channel Flow Capability



Open Channel Flow Measurement
Parshall Flume

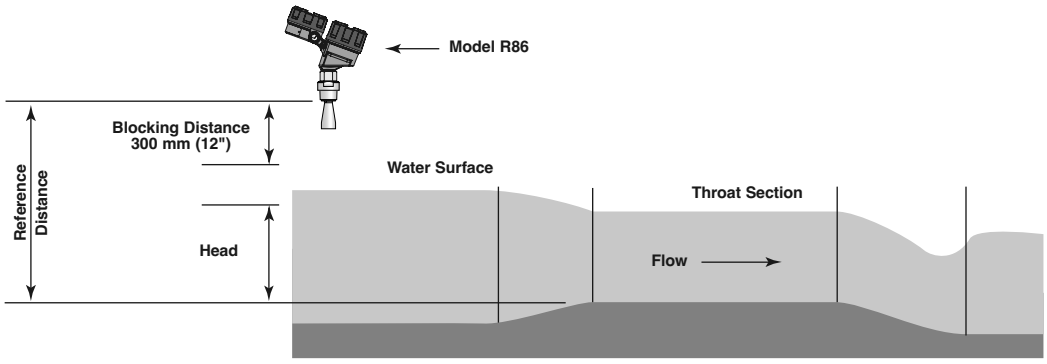
Selecting Measurement Type = Flow allows the PULSAR Model R86 transmitter to measure flow as the Primary Measured Value.

Open channel flow is performed by using the Model R86 to measure the Head in a hydraulic structure. The hydraulic structure is the primary measuring element, of which the two most common types are weirs and flumes.

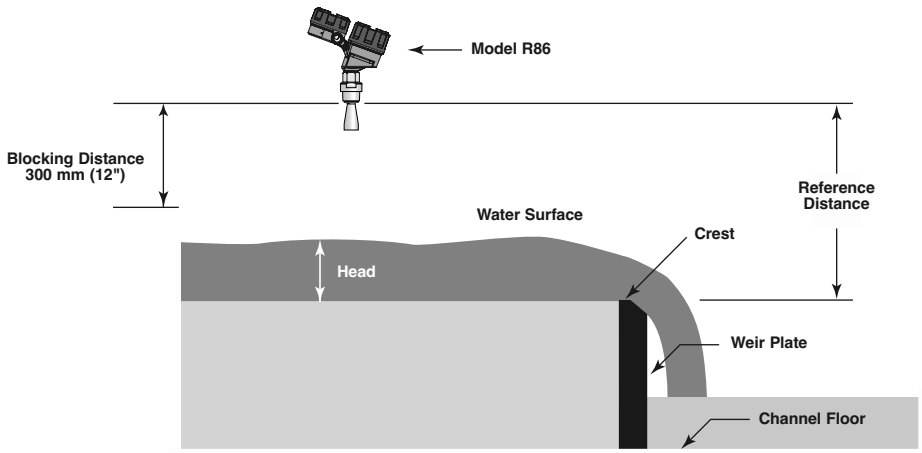
Since the primary element has a defined shape and dimensions, the rate of flow through the flume or over the weir is related to the Head at a specified measurement location.

The Model R86 is the secondary measuring device, which measures the Head of the liquid in the flume or weir. Open channel flow equations stored in the transmitter firmware convert the measured Head into units of flow (volume/time).

NOTE: Proper positioning of the Model R86 should be per the recommendation of the flume or weir manufacturer.



Flume (side view)



Weir (side view)

3.3.5.1 Configuration using Flume/Weir Equations

The following table provides an explanation of each of the System Configuration parameters required for open channel flow applications using one of the Flow Elements that are stored in the firmware.

Configuration Parameter	Explanation
Flow Units	A selection of **Gallons/Minute** (factory default *Flow Unit*), **Gallons/Hour, Mil Gallons/Day, Liters/Second, Liters/Minute, Liters/Hour, Cubic Meter/Hour, Cubic Ft/Second, Cubic Ft/Minute,** and **Cubic Ft/Hour** are provided.
Flow Element	Select one of the following primary *Flow Elements* that are stored in the firmware: **Parshall** flume sizes of **1", 2", 3", 6", 9", 12", 18", 24", 36", 48", 60", 72", 96", 120"** and **144". Palmer-Bwls** (Palmer-Bowlus) flume sizes of **4", 6", 8", 10", 12", 15", 18", 21", 24", 27"** and **30"**. **V-notch** weir sizes of **22.5°, 30°, 45°, 60°, 90° and 120°**. **Rect with Ends** (Rectangular Weir with End Contractions), **Rect w/o Ends** (Rectangular Weir without End Contractions), and **Cipoletti** weir. **Custom Table** (see page 44 can be selected if none of the stored *Flow Elements* can be used. The table can be built with a maximum of 30 points. The Model R86 also has the capability of using a **Generic Equation** (see page 42) for flow calculation.
Weir Crest Length	The *Weir Crest Length* screen only appears when the chosen *Flow Element* is Cipoletti or one of the *Rectangular* weirs. Input this length in the user-selected level units.
Flume Channel Width	Allows for entry of the width of the Palmer-Bowlus flume.
V-Notch Weir Angle	Only appears when flow element is V-Notch weir. It allows for the entry of angle of the V-Notch weir.
Reference Dist	The *Reference Distance* is measured from the sensor reference point to the point of zero flow in the weir or flume. This must be measured very accurately in the user-selected level units.
Maximum Head	*Maximum Head* is the highest liquid level (Head) value in the flume or weir before the flow equation is no longer valid. The *Maximum Head* is expressed in the user-selected *Level Units.* The Model R86 will default to the largest *Maximum Head* value that is allowed for any given flume or weir. The *Maximum Head* value can be revised depending on the value of the *Reference Distance*, or for end user preference.
Maximum Flow	*Maximum Flow* is a read-only value that represents the flow value corresponding to the *Maximum Head* value for the flume or weir.
Low Flow Cutoff	The *Low Flow Cutoff* (in user-selected level units) will force the calculated flow value to zero whenever the *Head* is below this point. This parameter will have a default and minimum value of zero.

3.3.5.2 Configuration using Generic Equation

The following table provides an explanation of each of the System Configuration parameters for Open channel flow applications using the Generic Equation.

Configuration Parameter	Explanation (Open Channel Flow — using the Generic Equation)
Flow Units	A selection of **Gallons/Minute** (factory default *Flow Unit*), **Gallons/Hour, Mil Gallons/Day, Liters/Second, Liters/Minute, Liters/Hour, Cubic Meter/Hour, Cubic Ft/Second, Cubic Ft/Minute,** and **Cubic Ft/Hour** are provided.
Flow Element	Select one of the following primary *Flow Elements* that are stored in the firmware: **Parshall** flume sizes of **1", 2", 3", 6", 9", 12", 18", 24", 36", 48", 60", 72", 96", 120"** and **144". Palmer-Bowlus** flume sizes of **4", 6", 8", 10", 12", 15", 18", 21", 24", 27"** and **30"**. **V-notch** weir sizes of **22.5°, 30°, 45°, 60°, 90° and 120°**. **Rect with Ends** (Rectangular Weir with End Contractions), **Rect w/o Ends** (Rectangular Weir without End Contractions), and **Cipoletti** weir. **Custom Table** (see page 43) can be selected if none of the stored *Flow Elements* can be used. The table can be built with a maximum of 30 points. The Model R86 also has the capability of using a **Generic Equation** (see below) for flow calculation.
Generic Eqn Factors	*Generic Equation* is a discharge flow equation in the form of $Q = K(L-CH)H^n$, where Q = flow (Cu Ft/Second), H = Head (Feet), K = a constant, and L, C and n are user input factors that depend on which *Flow Element* is being used. Make sure the flow equation is in the form of $Q = K(L-CH)H^n$, and proceed to enter the values of K,L,C,H and n. See example below. **NOTE:** The Generic Equation parameters **must be entered in Cu Ft/Second units**. The resultant flow is converted by the Model R86 into whatever Flow Units are selected above. See example below.
Reference Dist	The *Reference Distance* is measured from the sensor reference point to the point of zero flow in the weir or flume. This must be measured very accurately in the user-selected level units.
Maximum Head	*Maximum Head* is the highest liquid level (Head) value in the flume or weir before the flow equation is no longer valid. The *Maximum Head* is expressed in the user-selected level units. The Model R86 will default to the largest *Maximum Head* value that is allowed for any given flume or weir. The *Maximum Head* value can be revised depending on the value of the *Reference Distance*, or for end user preference.
Maximum Flow	*Maximum Flow* is a read-only value that represents the flow value corresponding to the *Maximum Head* value for the flume or weir.
Low Flow Cutoff	The *Low Flow Cutoff* (in user-selected level units) will force the calculated flow value to zero whenever the *Head* is below this point. This parameter will have a default and minimum value of zero.

Generic Equation Example (using equation for an 8' rectangular weir w/ end contractions)		
Q = **Cubic Ft/Second** flow rate	L = 8' (weir crest length in feet)	H = Head value
K = 3.33 for **Cubic Ft/Second** units	C = 0.2 (constant)	n = 1.5 as an exponent

$$\mathbf{Q = K(L-CH)H^n}$$

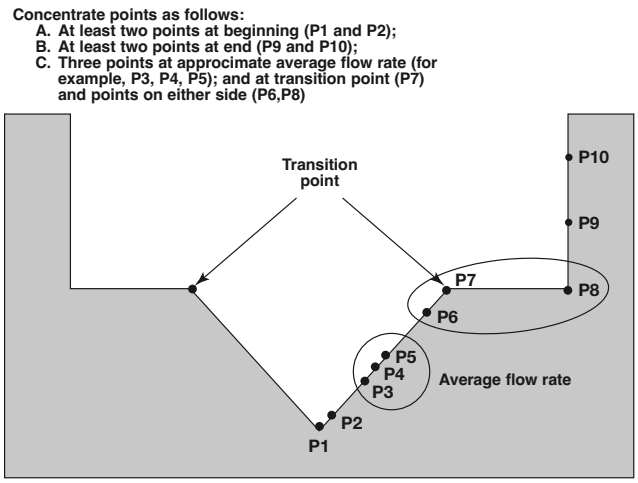
Using the factors above the equation becomes:

$Q = 3.33\ (8-0.2H)\ H^{1.5}$

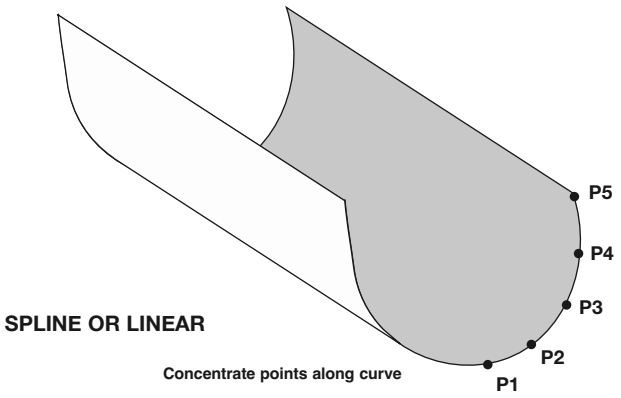
The discharge flow value for a Head value of three feet becomes 128.04 **Cubic Ft/Second**. If GPM was selected for the Flow Units, the Model R86 Measured Values screen would display this value converted to 57,490 GPM.

3.3.5.3 Configuration using Custom Table

The following table provides an explanation of each of the System Configuration parameters for open channel flow applications using the Custom Table.



SPLINE



Configuration Parameter	Explanation (Open Channel Flow — Custom Table)
Flow Units	A selection of **Gallons/Minute** (factory default *Flow Unit*), **Gallons/Hour, Mil Gallons/Day, Liters/Second, Liters/Minute, Liters/Hour, Cubic Meters/Hour, Cubic Ft/Second, Cubic Ft/Minute,** and **Cubic Ft/Hour** are provided.
Flow Element	Select one of the following primary *Flow Elements* that are stored in the firmware: **Parshall** flume sizes of **1", 2", 3", 6", 9", 12", 18", 24", 36", 48", 60", 72", 96", 120"** and **144". Palmer-Bowlus** flume sizes of **4", 6", 8", 10", 12", 15", 18", 21", 24", 27"** and **30"**. **V-notch** weir sizes of **22.5°, 30°, 45°, 60°, 90° and 120°**. **Rect with Ends** (Rectangular Weir with End Contractions), **Rect w/o Ends** (Rectangular Weir without End Contractions), and **Cipoletti** weir. **Custom Table** (see below) can be selected if none of the stored *Flow Elements* can be used. The table can be built with a maximum of 30 points. The Model R86 also has the capability of using a **Generic Equation** (see page 42) for flow calculation.
Custom Table	The *Custom Table* points can be a **Linear** (straight line between adjacent points) or **Spline** (can be a curved line between points) relationship. Refer to the drawing above for more information.
Cust Table Vals	A maximum of 30 points can be used in building the *Custom Table*. Each pair of values will have a Head (height) in the units chosen in the *Level Units* screen, and the associated flow for that Head value. The values must be monotonic, i.e., each pair of values must be greater than the previous Head/flow pair. The last pair of values should have the highest Head value (usually the *Maximum Head* value) and the flow associated with that Head value.
Reference Dist	The *Reference Distance* is measured from the sensor reference point to the point of zero flow in the weir or flume. This must be measured very accurately in the user-selected level units.
Maximum Head	*Maximum Head* is the highest liquid level (Head) value in the flume or weir before the flow equation is no longer valid. The *Maximum Head* is expressed in the user-selected *Level Units*. The Model R86 will default to the largest *Maximum Head* value that is allowed for any given flume or weir. The *Maximum Head* value can be revised depending on the value of the *Reference Distance*, or for end user preference.
Maximum Flow	*Maximum Flow* is a read-only value that represents the flow value corresponding to the *Maximum Head* value for the flume or weir.
Low Flow Cutoff	The *Low Flow Cutoff* (in user-selected level units) will force the calculated flow value to zero whenever the *Head* is below this point. This parameter will have a default and minimum value of zero.

3.4 Troubleshooting and Diagnostics

The PULSAR Model R86 transmitter is designed and engineered for trouble-free operation over a wide range of operating conditions. The transmitter continuously runs a series of internal self-tests and displays helpful messages on the large graphic liquid crystal display (LCD) when attention is required.

The combination of these internal tests and diagnostics messages offer a valuable proactive method of troubleshooting. The device not only tells the user what is wrong, but also, and more importantly, offers suggestions on how to solve the problem.

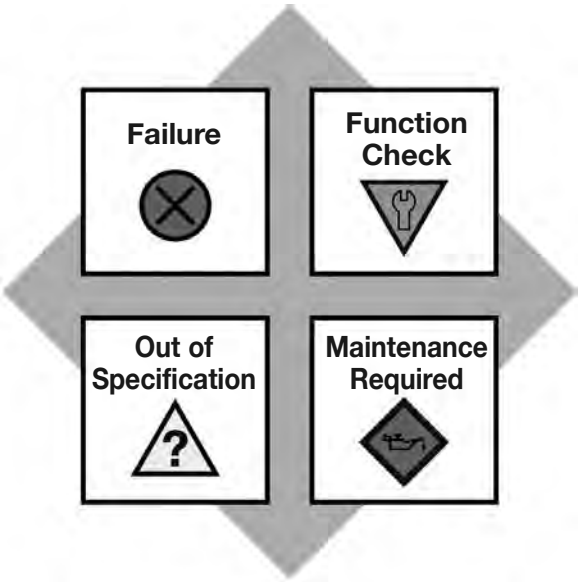
All of this information can be obtained directly from the transmitter on the LCD, or remotely by using a HART communicator or PACT*ware* and the PULSAR Model R86 DTM.

PACTware™ PC Program

The PULSAR Model R86 offers the ability to perform more advanced diagnostics such as Trending and Echo Curve analysis using a DTM with PACT*ware*. This is a powerful troubleshooting tool that can aid in the resolution of any diagnostic indicators that may appear.

Refer to Section 4.0, *Advanced Configuration/ Troubleshooting Techniques* for additional information.

3.4.1 Diagnostics (Namur NE 107)



The PULSAR Model R86 transmitter includes an exhaustive list of Diagnostic Indicators which follow the NAMUR NE 107 guidelines.

NAMUR is an international user association of automation technology in process industries, whose goal is to promote the interest of the process industry by pooling experiences among its member companies. In doing so, this group promotes international standards for devices, systems, and technologies.

The objective of NAMUR NE 107 was essentially to make maintenance more efficient by standardizing diagnostics information from field devices. This was initially integrated via FOUNDATION Fieldbus™, but the concept applies regardless of the communication protocol.

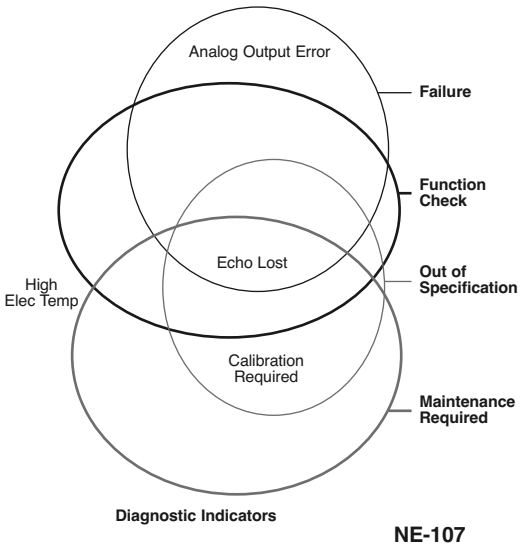
According to the NAMUR NE107 recommendation, "Self Monitoring and Diagnosis of Field Devices," fieldbus diagnostic results should be reliable and viewed in the context of a given application. The document recommends categorizing internal diagnostics into four standard status signals:

- Failure
- Function Check
- Out of Specification
- Maintenance required

These categories are shown by both symbols and colors, depending on the display capability.

In essence, this approach ensures that the correct diagnostic information is available to the correct person-at the correct time. In addition, it allows diagnostics to be applied, as most appropriate, for a particular plant application (such as process control engineering or asset management maintenance). Customer specific mapping of diagnostics to these categories allows for flexible configuration depending on the user's requirements.

From an external Model R86 transmitter perspective, diagnostic information includes measurement of process conditions, in addition to detection of internal device or system anomalies.



NE-107
Status Signals

As mentioned above, the indicators can be assignable (via the a DTM or host system) by the user to any (or none) of the NAMUR recommended Status Signal categories: Failure, Function Check, Out of Specification, and Maintenance Required.

In the FOUNDATION Fieldbus™ version of the transmitter, diagnostic indicators can be mapped to multiple categories (e.g., as shown in the diagram at left).

Indicators that are mapped to the Failure category will normally result in a current loop alarm output. The alarm state for HART transmitters is configurable as high (22 mA), Low (3.6 mA), or Hold (last value).

Users will not have the ability to unassign certain indicators from the Failure signal category as the Model R86 user interfaces will prohibit or reject such re-assignment entries. This is to ensure that current loop alarms are asserted in situations where the device is not able to provide measurements due to critical failures. (For example, if the alarm selection has not been set to Hold or a fixed current mode is in effect.)

A default mapping of all diagnostic indicators will be applied initially, and can be re-applied through use of a reset function.

Refer to the Diagnostic Indicator tables in this section for a complete listing of the Model R86 diagnostic indicators, along with their explanations, default categories, and recommended remedies.

NOTES:
1) The remedies shown in this table can also be seen on the transmitter LCD by viewing the present status screen when the device is in a diagnostic condition.
2) Those indicators showing failure as the default result in an alarm condition.

3.4.2 Diagnostic Indication Simulation

The DD and DTM allow for the ability to manipulate diagnostic indicators. Intended as a means to verify the configuration of the diagnostic parameters and connected equipment, a user can manually change any indicator to and from the active state.

3.4.3 Diagnostic Help

Selecting DIAGNOSTICS from the MAIN MENU presents a list of five ITEMS from the top level of the DIAGNOSTICS tree.

When Present Status is highlighted, the highest MAGNETROL priority active diagnostic indicator (numerically lowest in Table 3.4) is displayed on the bottom LCD line. Pressing the ENTER key moves the active diagnostic indicator to the top line outdented and presents in the lower area of the LCD a brief explanation of and possible remedies for the indicated condition. A blank line separates the explanation from the remedies. Additional active diagnostic indicators, if any, appear with their explanations in descending priority order. Each additional active indicator name-explanation pair is separated by a blank line from the one above.

If the explanation and remedy text (and additional name-explanation pairs) exceeds the available space, a ⇩ appears in the rightmost column of the last line indicating more text below. In this situation, the DN key scrolls text up one line at a time. Similarly, while text exists above the upper line of the text field, a ⇧ appears in the rightmost column of the top (text) line. In this situation, the UP key scrolls the text down one line at a time. Otherwise the DN and UP keys are inoperative. In all cases the ENT or DEL key reverts to the previous screen.

When the transmitter is operating normally and the highlight cursor is positioned on Present Status, the bottom LCD line displays "OK" because no diagnostic indicators are active.

EVENT HISTORY – This menu displays the last twenty events related to configuration and diagnostic event logging.

ADVANCED DIAGNOSTICS – This menu displays parameters related to some of the advanced diagnostics available within the Model R86.

INTERNAL VALUES – Displays read-only internal parameters.

ELEC TEMPERATURES – Displays temperature information as measured in the electronics module in degrees F or C.

TRANSMITTER TESTS – Allows the user to manually set the output current to a constant value. This is a method for the user to verify operation of the other equipment in the loop.

ECHO CURVES – This menu allows the user to display the live Echo Curve, Echo Reference Curve, Echo History Curves or Echo Rejection Curve on the LCD.

3.4.4 Diagnostic Indicator Table

Shown below and at right is a listing of the Model R86 diagnostic indicators, showing their priority, explanations and recommended remedies. (Priority 1 is highest priority.)

Priority	Indicator Name	Default Category	Explanation	Remedy (Context Sensitive Help)
1	Software Error	Failure	Unrecoverable error occurred in stored program.	Contact MAGNETROL Technical Support.
2	RAM Error	Failure	RAM (read/write) memory failing.	
3	ADC Error	Failure	Analog-to-digital converter failure.	
4	EEPROM Error	Failure	Non-volatile parameter storage failing.	
5	Analog Board Error	Failure	Unrecoverable hardware failure.	
6	Analog Output Error	Failure	Actual loop current deviates from commanded value. Analog output is inaccurate.	Perform Adjust Analog Output maintenance procedure.
7	Spare Indicator 1	OK	Reserved for future use.	
8	Default Parameters		Saved parameters are set to default values.	Perform complete Device Configuration.
9	Spare Indicator 2	OK	Reserved for future use.	
10	Sweep Time Error	Failure	Analog board sweep time error	Contact MAGNETROL Technical Support.
11	Spare Indicator 3	OK	Reserved for future use.	
12	Too Many Echoes	Failure	Excessive number of possible echoes detected	Check Settings: Dielectric, Sensitivity. Check Polarization.
13	Safety Zone Alarm	Failure	Risk of echo loss if liquid rises above Blocking Distance.	Ensure that liquid cannot reach Blocking Distance.
14	No Echoes	Failure	No signal detected.	Check settings: Dielectric Range Increase Sensitivity. View Echo Curve.
15	Spare Indicator 4	OK	Reserved for future use	
16	Config Conflict	Failure	Measurement type and primary variable selection parameters are inconsistent.	Confirm proper configuration. Check Measurement Type.
17	High Volume Alarm	Failure	Volume calculated from Level reading exceeds capacity of vessel or custom table.	Check settings: Vessel Dimensions, Custom Table entries
18	High Flow Alarm	Failure	Calculated flow exceeds maximum for flume or custom table.	Check settings: Vessel Dimensions, Custom Table entries
19	Spare Indicator 5	OK	Reserved for future use.	
20	Initializing	Function Check	Distance measurement is inaccurate while internal filters are settling.	Standard start-up message. Wait for up to 10 seconds.

Priority	Indicator Name	Default Category	Explanation	Remedy
21	Config Changed	Function Check	A parameter has been modified from the User Interface.	If desired, reset Config Changed indicator in ADVANCED CONFIG menu.
22	Spare Indicator 6	OK	Reserved for future use.	
23	High Elec Temp	Out of Spec	Electronics too hot. May compromise level measurement or damage instrument.	Shield transmitter from heat source or increase air circulation. Locate transmitter remotely in a cooler area.
24	Low Elec Temp	Out of Spec	Electronics too cold. May compromise level measurement or damage instrument.	Insulate transmitter. Locate transmitter remotely in a warmer area.
25	Calibration Req'd	Out of Spec	Factory calibration has been lost. Measurement accuracy may be diminished.	Return transmitter to factory for recalibration.
26	Echo Reject Invalid	Out of Spec	Echo Rejection inoperative. May report erroneous Level readings. Upr Echo may be lost.	Save a fresh Echo Rejection Curve.
27	Spare Indicator 7	OK	Reserved for future use.	
28	Inferred Level	Out of Spec	Level inferred to have entered Blocking Region if echo lost within Max Distance Jump of Top or Bottom Blocking Region.	Verify level reading; if incorrect, check configuration.
29	Adjust Analog Out	Out of Spec	Loop current is inaccurate.	Perform Adjust Analog Output maintenance procedure.
30	Totalizer Data Lost		Totalizer data has been lost; restarted from zero.	
31	Low Supply Voltage	Out of Spec	Loop current may be incorrect at higher values. Analog output is inaccurate.	Verify loop resistance. Replace loop power supply.
32	Spare Indicator 8	OK	Reserved for future use.	
33	Max Jump Exceeded	Maintenance Required	Transmitter has jumped to an echo at location that exceeds "Max Level Jump" from previous echo location.	Check settings: Dielectric Range Sensitivity View Echo Curve.
34	Low Echo Margin	Maintenance Required	Signal Margin is less than allowable minimum.	Check settings: Dielectric Range Sensitivity View Echo Curve.
35	High Surface Velocity	Maintenance Required	Measured Surface Velocity greater than Max Surface Velocity derived from configured Rate of Change.	Confirm actual rate of change. Adjust rate of change setting, if needed.
36	Spare Indicator 9	OK	Reserved for future use.	
37	Sequence Record	OK	A Sequence Record number has been stored in Event Log.	If desired, report Sequence Record number to factory.

3.4.5 Additional Diagnostic/Trouble Shooting Capabilities

3.4.5.1 Echo History Setup

The Model R86 contains the unique and powerful feature that allows waveforms to be automatically captured based on Diagnostic Events, Time or both. This menu contains those parameters that configure that feature.

Eleven (11) waveforms can be saved directly into the transmitter.

- Nine (9) Troubleshooting Curves
- One (1) Echo Rejection Curve
- One (1) Reference Curve

3.4.5.2 Event History

As a means for improved troubleshooting capability, a record of significant diagnostic events is stored with time and date stamps. A real-time on-board clock (which must be set by the operator), will maintain the current time.

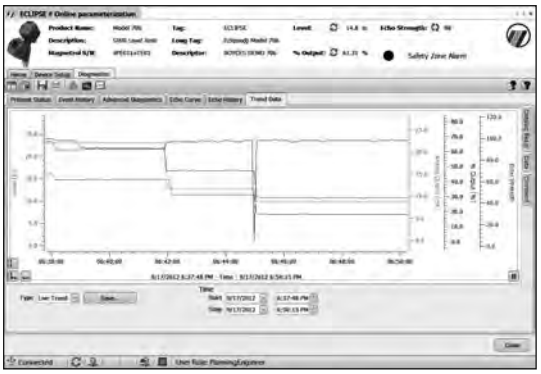
3.4.5.3 Context-sensitive Help

NOTE: Context-sensitive HELP is available for all menu items. With the menu item highlighted, hold down the ➪ **ENTER** key for two seconds. Use ⇧ **UP** and ⇩ **DOWN** for navigation.

Descriptive information relevant to the highlighted parameter in the menu will be accessible via the local display and remote host interfaces. This will most often be a parameter-related screen, but could also be information about menus, actions (for example, Loop [Analog Output] Test, resets of various types), diagnostic indicators, etc.

For example: Dielectric Range — Selects the range bounding the dielectric constant of the medium in vessel. Some ranges may not be selectable depending on the antenna model.

3.4.5.4 Trend Data



Another feature of the Model R86 is the ability to log several measured values (selectable from any of the primary, secondary, or supplemental measured values) at a configurable rate (for example, once every five minutes) for a period ranging from several hours to a number of days (depending on the configured sample rate and number of values to be recorded). The data will be stored in non-volatile memory in the transmitter with date and time information for subsequent retrieval and visualization using the associated Model R86 DTM.

TREND DATA – A 15-minute trend of the PV can be displayed on the LCD.

3.5 Agency Approvals


These devices are in compliance with the RED-directive 2014/53/EU, the PED-directive 2014/68/EU, the ATEX directive 2014/34/EU and RoHS directive 2011/65/EU.

Explosion Proof
US/Canada:
FM17US0108X / FM17CA0055X
Class I, Div 1, Group B, C, D, T4...T1
Class I, Zone 0/1 AEx/Ex ia/db IIB i + H2 T4...T1 ga/Gb
Class I, Zone 1 AEx/Ex db ia IIB + H2 T4...T3 Gb
Ta = -40 ºC to +70 ºC
Type 4X, IP67

Flame Proof
ATEX – FM17ATEX0027X
II 1/2 G Ex ia/db IIB + H2 T4…T1 Ga/Gb
II 2 G Ex db ia IIB + H2 T4…T3 Gb
Ta = -40 ºC to +70 ºC
IP67

IEC- IECEx FMG 17.0012X
Ex ia/db IIB + H2 T4…T1 Ga/Gb
Ex db IIB + H2 T4…T3 Gb
Ta = -40 ºC to +70 ºC
IP67

Non- Incendive
US/Canada:
FM17US0108X / FM17CA0055X
Class I, II, III, Div 2, Group A, B, C, D, E, F, G, T4...T1
Class I, Zone 2 AEx nA ia IIC T4...T1
Class I, Zone 2 Ex nA ia IIC T4...T1
Ta = -15 ºC to +70 ºC
Type 4X, IP67

ATEX - FM17ATEX0028X
II 3 G Ex nA IIC Gc T4...T1
Ta = -15 ºC to +70 ºC
IP67

IEC – IECEx FMG 17.0012X
Ex nA IIC Gc T4...T1
Ta = -15 ºC to + 70 ºC
IP67

Intrinsically Safe
US/Canada:
FM17US0108X / FM17CA0055X
Class I, II, III, Div 1, Group A, B, C, D, E, F, G, T4...T1
Class I, Zone 0 AEx ia IIC T4...T1
Class I, Zone 0 Ex ia IIC T4...T1 Ga
Ta =-40 ºC to +70 ºC
Type 4X, IP67

ATEX – FM17ATEX0027X:
II 1 G Ex ia IIC T4...T1 Ga
Ta = -40 ºC to +70 ºC
IP67

IEC – IECEx FMG 17.0012X:
Ex ia IIC T4...T1 Ga
Ta = -40 ºC to +70 ºC
IP67

Dust Ignition Proof
US/Canada:
FM17US0108X / FM17CA0055X
Class II, III, Div 1, Group E, F, and G, T4...T1
Ta = -15 ºC to +70 ºC
Type 4X, IP67

ATEX – FM17ATEX0027X:
II 2 D Ex ia tb IIIC T100 ºC Db
Ta = -15 ºC to +70 ºC
IP67

IEC – IECEx FMG 17.0012X:
Ex ia tb IIIC T100 ºC Db
Ta = -15 ºC to +70 ºC
IP67

Telecommunications Approvals

Agency	In-Tank	Out of Tank
FCC	47 CFR, Part 15, Subpart C, Section 15.209 Unintentional Radiators	47 CFR, Part 15, Subpart C, Section 15.256
ISED	RSS-211	RSS-211
ETSI	EN 302 372 V2.1.1 (2016-12)	EN 302 729 V2.1.1 (2016-12)

FM3600:2011, FM3610:2010, FM3611:2004, FM3615:2006, FM3616:2011, FM3810:2005, ANSI/ISA60079-0:2013, ANSI/ISA 60079-1:2015, ANSI/ISA 60079-11:2013, ANSI/ISA 60079-15:2012, ANSI/ISA 60079-26:2011, NEMA 250:2003, ANSI/IEC 60529:2004, C22.2 No. 0.4:2009, C22.2 No. 0.5:2008, C22.2 No. 30:2007, C22.2 No. 94:2001, C22.2 No. 213:2012, C22.2 No. 1010.1:2009, CAN/CSA 60079-0:2011, CAN/CSA 60079-1:2011, CAN/CSA 60079-11:2014, CAN/CSA 60079-15:2012, C22.2 No. 60529:2005, EN60079-0:2012+A11:2013, EN60079-1:2014, EN60079-11:2012, EN60079-15:2010, EN60079-26:2015, EN60079-31:2014, EN60529+A1:2000+A2:2013, IEC60079-0:2011, IEC60079-1:2014, IEC60079-11:2011, IEC60079-15:2010, IEC60079-26:2006, IEC60079-31:2008

“This equipment with chargeable non-conductive parts, e.g. enclosure’s paint and antenna use PTFE, Co-polymer Polypropylene or Noryl En265, is provided with a warning label referring to the safety measures that must be taken if there is electrostatic charging during operation. For use in hazardous area, the equipment and side to be installed, e.g. tank, must be connected to earth and be attention to not only the measuring object, e.g. liquids, gases, powders and etc., but also the related conditions, e.g. tank container, vessel and etc. (According to IEC 60079- 32-1).”

SPECIAL CONDITIONS OF USE:

1. The enclosure contains aluminum and is considered to present a potential risk of ignition by impact or friction. Care must be taken during installation and use to prevent impact or friction.
2. Provisions shall be made to provide transient overvoltage protection to a level not to exceed 119 VDC.
3. To maintain the T4 temperature code, care shall be taken to ensure the 'enclosure temperature' does not exceed 70 °C.
4. For installation with ambient temperature of 60 °C, refer to manufacturer's instructions for guidance on proper selection of conductors.
5. The risk of electrostatic discharge shall be minimized at installation, following the direction given in this instruction manual.
6. The Pulsar R86 includes flamepath joints. Consult Magnetrol if repair of flamepath joints is necessary.
7. Temperature class for the process temperature ranges is defined by the following table when digit 10 (seal option) is "N".

Process Temperature Range	Temperature Code
From 0 °C to 130 °C	T4
From 130 °C to 195 °C	T3
From 195 °C to 295 °C	T2
From 295 °C to 400 °C	T1

8. Temperature class for the process temperature ranges is defined by the following table when digit 10 (seal option) is "0".

Process Temperature Range	Temperature Code
From 0 °C to 130 °C	T4
From 130 °C to 180 °C	T3

Process temperature ranges for seal options is defined by the following table

Seal option	Process Temperature Range
10th digit = 0	-40 °C to +180 °C
10th digit = N	-40 °C to +400 °C

9. Temperature class for the process temperature ranges is defined by the following table when digit 10 (seal option) is "2", "8" or "A".

Process Temperature Range	Temperature Code
From 0 to 130 °C	T4
From 130 to 195 °C	T3
From 195 to 295 °C	T2

The seal for option "2", "8" or "A" is limited for use where process temperature range is from -7 °C to +200 °C.

FCC (ID# LPN-R86) Compliance Statement:

§15.209 The 1 1/2" and 2" horns can only be used for installations directly into tanks.

§15.105 Information to the user.

(b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

—Reorient or relocate the receiving antenna.

—Increase the separation between the equipment and receiver.

—Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

—Consult the dealer or an experienced radio/TV technician for help.

(i) The installation of the LPR/TLPR device shall be done by trained installers, in strict compliance with the manufacturer's instructions.

(ii) The use of this device is on a "no-interference, no-protection" basis. That is, the user shall accept operations of high-powered radar in the same frequency band which may interfere with or damage this device. However, devices found to interfere with primary licensing operations will be required to be removed at the user's expense.

ISED Certification Number 2331A–R86 Statement:

This device shall be installed and operated in a completely enclosed container to prevent RF emissions, which can otherwise interfere with aeronautical navigation.

This device complies with Industry Canada's licence-exempt RSSs. Operation is subject to the following two conditions:

(1) This device may not cause interference; and

(2) This device must accept any interference, including interference that may cause undesired operation of the device

3.5.1 Agency Drawing and Entity Parameters

HAZARDOUS LOCATION

PULSAR R86 LEVEL TRANSMITTER
INTRINSICALLY SAFE FOR:
CL I,II,III DIV 1 GRP A,B,C,D,E,F,G
CL I, ZONE 0 AEx ia IIC
CL I, ZONE 0 Ex ia IIC
II 1 G Ex ia IIC
Ex ia IIC

ENTITY

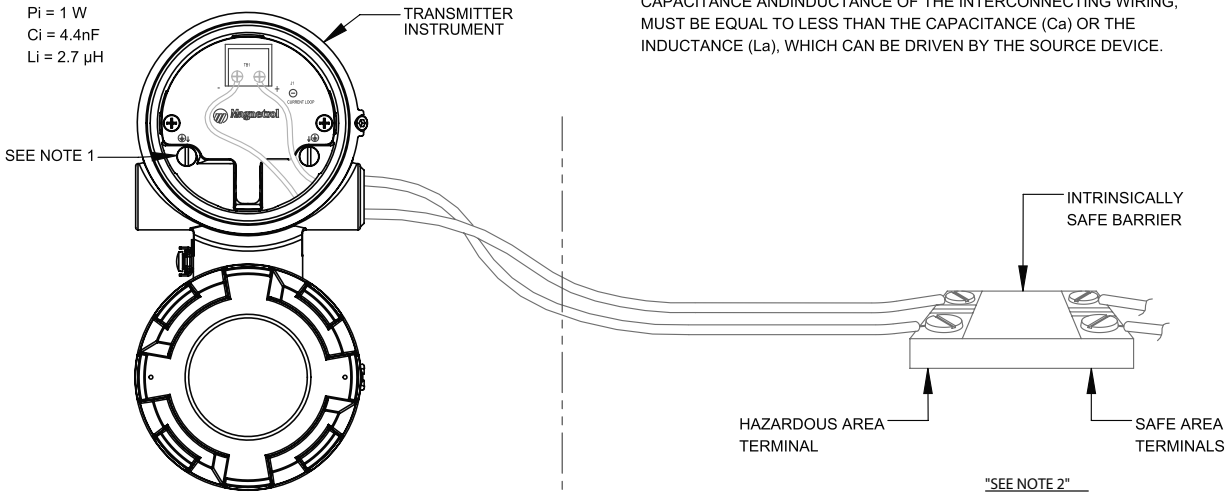
Ui (Vmax) = 28.6 V
Ii (Imax) = 140 mA
Pi = 1 W
Ci = 4.4nF
Li = 2.7 µH

NON-HAZARDOUS LOCATION

LIMITING VALUES

Voc <= 28.6V Ca >= 4.4 nF
Isc <= 140 mA La >= 2.7µH

THE VOLTAGE (V max) AND CURRENT (I max), WHICH THE TRANSMITTER CAN RECEIVE MUST BE EQUAL TO OR GREATER THAN THE MAXIMUM OPEN CIRCUIT VOLTAGE (Voc OR V+) AND THE MAXIMUM SHORT CIRCUIT CURRENT (Isc OR IE), WHICH CAN BE DELIVERED BY THE SOURCE DEVICE. IN ADDITION, THE MAXIMUM CAPACITANCE (Ci) AND INDUCTANCE (Li) OF THE LOAD AND THE CAPACITANCE ANDINDUCTANCE OF THE INTERCONNECTING WIRING, MUST BE EQUAL TO LESS THAN THE CAPACITANCE (Ca) OR THE INDUCTANCE (La), WHICH CAN BE DRIVEN BY THE SOURCE DEVICE.



PULSAR R86-51XX-XXX

SPECIAL CONDITIONS OF USE:

1. THE ENCLOSURE CONTAINS ALUMINUM AND IS CONSIDERED TO PRESENT A POTENTIAL RISK OF IGNITION BY IMPACT OR FRICTION. CARE MUST BE TAKEN DURING INSTALLATION AND USE TO PREVENT IMPACT OR FRICTION.
2. PROVISIONS SHALL BE MADE TO PROVIDE TRANSIENT OVERVOLTAGE PROTECTION TO A LEVEL NOT TO EXCEED 119VDC.
3. TO MAINTAIN THE T4 TEMPERATURE CODE CARE SHALL BE TAKEN TO ENSURE THE "ENCLOSURE TEMPERATURE" DOES NOT EXCEED 70ºC.
4. FOR INSTALLATION WITH AMBIENT TEMPERATURE OF 60ºC, REFER TO THE MANUFACTURER'S INSTRUCTIONS FOR GUIDANCE ON PROPER SELECTION OF CONDUCTORS.
5. THE RISK OF ELECTROSTATIC DISCHARGE SHALL BE MINIMIZED AT INSTALLATION, FOLLOWING THE DIRECTION GIVEN IN THE INSTRUCTION MANUAL.
6. THE PULSAR R86 INCLUDES FLAMPATH JOINTS, CONSULT MAGNETROL IF REPAIR OF FLAMEPATH JOINTS IS NECESSARY.
7. TEMPERATURE CLASS FOR THE PROCESS TEMPERATURE RANGES IS DEFINED BY THE FOLLOWING TABLE.

PROCESS TEMPERATURE RANGE	TEMPERATURE CODE
FROM 0°C TO 130°C	T4
FROM 130°C TO 190°C	T3
FROM 195°C TO 295°C	T2
FROM 295°C TO 400°C	T1

G

NOTES:

1. FOR EXPLOSION PROOF INSTALLATIONS THE I.S. GROUND TERMINAL SHALL BE CONNECTED TO APPROPRIATE INTRINSICALLY SAFE GROUND IN ACCORDANCE WITH THE CANADIAN ELECTRICAL CODE (CEC) OR THE NATIONAL ELECTRICAL CODE (NEC). FOR INTRINSICALLY SAFE INSTALLATIONS THE I.S. GROUND TERMINAL DOES NOT REQUIRE GROUNDING.
2. MANUFACTURER'S INSTALLATION INSTRUCTIONS SUPPLIED WITH THE PROTECTIVE BARRIER AND THE CEC OR THE NEC MUST BE FOLLOWED WHEN INSTALLING THIS EQUIPMENT. BARRIER MUST BE CERTIFIED FOR CANADIAN & U.S. INSTALLATION.
3. CONTROL EQUIPMENT CONNECTED TO PROTECTIVE BARRIERS MUST NOT USE OR GENERATE MORE THAN 250 VDC OR VRMS.
4. AGENCY APPROVED DUST TIGHT SEALS MUST BE USED WHEN TRANSMITTER IS INSTALLED IN CLASS II & III ENVIRONMENTS.
5. FOR SUPPLY CONNECTIONS, USE WIRE SUITABLE FOR THE OPERATING TEMPERATURE.
6. FM APPROVED BARRIERS WITH LINEAR OUTPUT CHARACTERISTICS MUST BE USED.

AGENCY
LISTED DRAWING

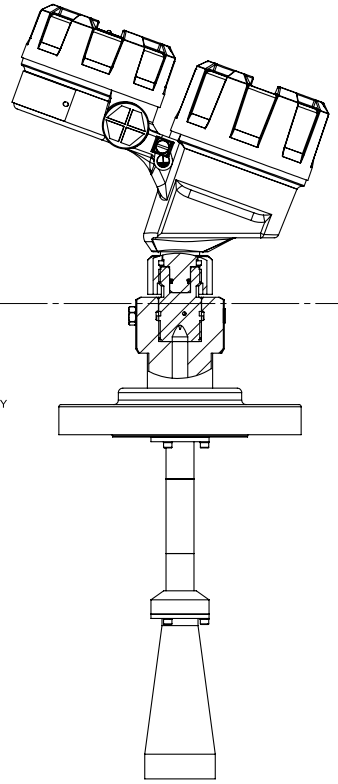
ALL REVISIONS
TO THIS DRAWING
REQUIRE QA APPROVAL

099-5077-001-G

SHEET 2 OF 7

HAZARDOUS LOCATION
PULSAR R86 LEVEL TRANSMITTER
EXPLOSION PROOF FOR:
CL I DIV 1 GRP B,C,D
CL I ZONE 0/1 AEx ia/db IIB+H2
ZONE 0/1 Ex ia/db IIB+H2
II 1/2 G Ex ia/db IIB+H2
Ex ia/db IIB+H2

ENTITY
Um = 36Vdc



G **RBX-XXXX-XXN-XXX**
N = QUARTZ BRAZED ONLY
0 = VITON VX065
8 = AEGIS PF 128 (NACE)

PULSAR R86-51XX-3XX
(SEE SHEET-4 FOR NOTES)

AGENCY
LISTED DRAWING
ALL REVISIONS
TO THIS DRAWING
REQUIRE QA APPROVAL

099-5077-001-G

SHEET 3 OF 7

SPECIAL CONDITIONS OF USE:

1. THE ENCLOSURE CONTAINS ALUMINUM AND IS CONSIDERED TO PRESENT A POTENTIAL RISK OF IGNITION BY IMPACT OR FRICTION. CARE MUST BE TAKEN DURING INSTALLATION AND USE TO PREVENT IMPACT OR FRICTION.
2. PROVISIONS SHALL BE MADE TO PROVIDE TRANSIENT OVERVOLTAGE PROTECTION TO A LEVEL NOT TO EXCEED 119VDC.
3. TO MAINTAIN THE T4 TEMPERATURE CODE CARE SHALL BE TAKEN TO ENSURE THE “ENCLOSURE TEMPERATURE” DOES NOT EXCEED 70ºC.
4. FOR INSTALLATION WITH AMBIENT TEMPERATURE OF 60ºC, REFER TO THE MANUFACTURER’S INSTRUCTIONS FOR GUIDANCE ON PROPER SELECTION OF CONDUCTORS.
5. THE RISK OF ELECTROSTATIC DISCHARGE SHALL BE MINIMIZED AT INSTALLATION, FOLLOWING THE DIRECTION GIVEN IN THE INSTRUCTION MANUAL.
6. THE PULSAR R86 INCLUDES FLAMEPATH JOINTS, CONSULT MAGNETROL IF REPAIR OF FLAMEPATH JOINTS IS NECESSARY.
7. G TEMPERATURE CLASS FOR THE PROCESS TEMPERATURE RANGES IS DEFINED BY THE FOLLOWING TABLE WHEN SEAL OPTION IS "N".

PROCESS TEMPERATURE RANGE	TEMPERATURE CODE
FROM 0°C TO 130°C	T4
FROM 130°C TO 195°C	T3
FROM 195°C TO 295°C	T2
FROM 295°C TO 400°C	T1

8. G TEMPERATURE CLASS FOR THE PROCESS TEMPERATURE RANGE IS DEFINED BY THE FOLLOWING TABLE WHEN SEAL OPTION IS "0"

PROCESS TEMPERATURE RANGE	TEMPERATURE CODE
FROM 0°C TO 130°C	T4
FROM 130°C TO 180°C	T3

9. G TEMPERATURE CLASS FOR THE PROCESS TEMPERATURE RANGE IS DEFINED BY THE FOLLOWING TABLE WHEN SEAL OPTION IS "8"

PROCESS TEMPERATURE RANGE	TEMPERATURE CODE
FROM 0°C TO 130°C	T4
FROM 130°C TO 195°C	T3
FROM 195°C TO 200°C	T2

10. G PROCESS TEMPERATURE RANGE FOR THE SEAL OPTIONS IS DEFINED BY THE FOLLOWING TABLE: (DO NOT HIGHLIGHT THE TABLE)

SEAL OPTION	PROCESS TEMPERATURE RANGE
0	-40°C TO 180°C
N	-40°C TO 400°C
8	-7°C TO 200°C

NOTES:

11. AGENCY APPROVED DUST TIGHT SEALS MUST BE USED WHEN TRANSMITTER IS INSTALLED IN CLASS II & III ENVIRONMENTS.
12. FOR SUPPLY CONNECTIONS, USE WIRE SUITABLE FOR THE OPERATING TEMPERATURE.
13. TOP WIRING COMPARTMENT HAS EXPLOSION PROOF APPROVAL. BOTTOM COMPARTMENT IS INTRINSICALLY SAFE ONLY.
14. POWER SUPPLY/CONTROL EQUIPMENT CONNECTED TOTHE PULSAR R86 MUST NOT USE OR GENERATE MORE THAN 36VDC.

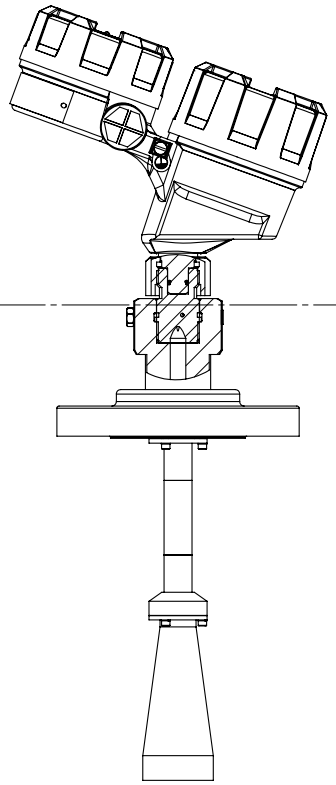
AGENCY
LISTED DRAWING
ALL REVISIONS
TO THIS DRAWING
REQUIRE QA APPROVAL

099-5077-001-G

SHEET 4 OF 7

HAZARDOUS LOCATION
PULSAR R86 LEVEL TRANSMITTER
EXPLOSION PROOF FOR:
CL I DIV 1 GRP B,C,D
CL I ZONE 1 AEx db ia IIB+H2
ZONE 1 Ex db ia IIB+H2
II 2 G Ex db ia IIB+H2
Ex db ia IIB+H2

ENTITY
Um = 36Vdc



RBX-XXXX-XXA-XXX

"A" CAN EQUAL:
2 = KALREZ 4079
A = KALREZ 6375

G

PULSAR R86-51XX-3XX
(SEE SHEET-6 FOR NOTES)

AGENCY
LISTED DRAWING
ALL REVISIONS
TO THIS DRAWING
REQUIRE QA APPROVAL

099-5077-001-G

SHEET 5 OF 7

SPECIAL CONDITIONS OF USE:

1. THE ENCLOSURE CONTAINS ALUMINUM AND IS CONSIDERED TO PRESENT A POTENTIAL RISK OF IGNITION BY IMPACT OR FRICTION. CARE MUST BE TAKEN DURING INSTALLATION AND USE TO PREVENT IMPACT OR FRICTION.
2. PROVISIONS SHALL BE MADE TO PROVIDE TRANSIENT OVERVOLTAGE PROTECTION TO A LEVEL NOT TO EXCEED 119VDC.
3. TO MAINTAIN THE T4 TEMPERATURE CODE CARE SHALL BE TAKEN TO ENSURE THE "ENCLOSURE TEMPERATURE" DOES NOT EXCEED 70ºC.
4. FOR INSTALLATION WITH AMBIENT TEMPERATURE OF 60ºC, REFER TO THE MANUFACTURER'S INSTRUCTIONS FOR GUIDANCE ON PROPER SELECTION OF CONDUCTORS.
5. THE RISK OF ELECTROSTATIC DISCHARGE SHALL BE MINIMIZED AT INSTALLATION, FOLLOWING THE DIRECTION GIVEN IN THE INSTRUCTION MANUAL.
6. THE PULSAR R86 INCLUDES FLAMEPATH JOINTS, CONSULT MAGNETROL IF REPAIR OF FLAMEPATH JOINTS IS NECESSARY.
7. TEMPERATURE CLASS FOR THE PROCESS TEMPERATURE RANGES IS DEFINED BY THE FOLLOWING TABLE.

G

PROCESS TEMPERATURE RANGE	TEMPERATURE CODE
FROM 0°C TO 130°C	T4
FROM 130°C TO 195°C	T3

G 8. THE SEALS ARE LIMITED FOR USE WHERE PROCESS TEMPERATURE RANGE IS - 7 TO +200°C.

NOTES:

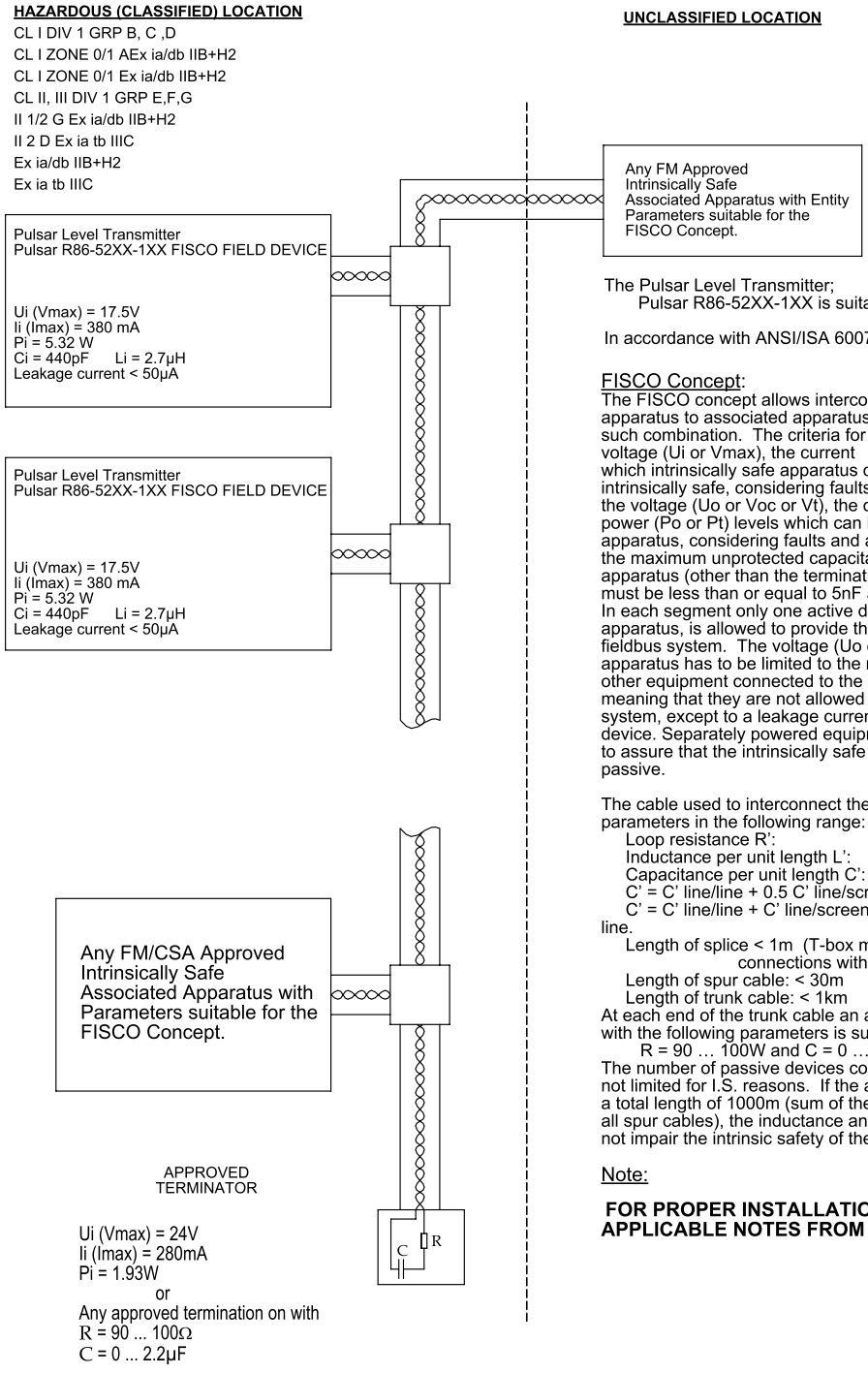
9. AGENCY APPROVED DUST TIGHT SEALS MUST BE USED WHEN TRANSMITTER IS INSTALLED IN CLASS II & III ENVIRONMENTS.
10. FOR SUPPLY CONNECTIONS, USE WIRE SUITABLE FOR THE OPERATING TEMPERATURE.
11. TOP WIRING COMPARTMENT HAS EXPLOSION PROOF APPROVAL. BOTTOM COMPARTMENT IS INTRINSICALLY SAFE ONLY.
12. POWER SUPPLY/CONTROL EQUIPMENT CONNECTED TOTHE PULSAR R86 MUST NOT USE OR GENERATE MORE THAN 36VDC.

AGENCY
LISTED DRAWING
ALL REVISIONS
TO THIS DRAWING
REQUIRE QA APPROVAL

099-5077-001-G

SHEET 6 OF 7

3.5.1 Agency Drawing and Entity Parameters



The Pulsar Level Transmitter;
Pulsar R86-52XX-1XX is suitable for use in a FISCO system

In accordance with ANSI/ISA 60079-27:2006.

FISCO Concept:
The FISCO concept allows interconnection of intrinsically safe apparatus to associated apparatus not specifically examined in such combination. The criteria for the interconnection is that the voltage (Ui or Vmax), the current (Ii or Imax) and the power (Pi) which intrinsically safe apparatus can receive and remain intrinsically safe, considering faults, must be equal or greater than the voltage (Uo or Voc or Vt), the current (Io or Isc or It) and the power (Po or Pt) levels which can be delivered by the associated apparatus, considering faults and applicable factors. In addition, the maximum unprotected capacitance (Ci) and (Li) of each apparatus (other than the termination) connected to the fieldbus must be less than or equal to 5nF and 10µH respectively.
In each segment only one active device, normally the associated apparatus, is allowed to provide the necessary energy for the fieldbus system. The voltage (Uo or Voc or Vt), of the associated apparatus has to be limited to the range of 14V to 24V d.c. All other equipment connected to the bus cable has to be passive, meaning that they are not allowed to provide energy to the system, except to a leakage current of 50µA for each connected device. Separately powered equipment needs a galvanic isolation to assure that the intrinsically safe fieldbus circuit remains passive.

The cable used to interconnect the devices needs to have the parameters in the following range:
- Loop resistance R': 15 … 150W/km
- Inductance per unit length L': 0.4 … 1mH/km
- Capacitance per unit length C': 80 … 200nF/km
- C' = C' line/line + 0.5 C' line/screen, if both lines are floating or
- C' = C' line/line + C' line/screen, if screen is connected to one line.
- Length of splice < 1m (T-box must only contain terminal connections with no energy storage capability)
- Length of spur cable: < 30m
- Length of trunk cable: < 1km

At each end of the trunk cable an approved infallible termination with the following parameters is suitable:
R = 90 … 100W and C = 0 … 2.2µF
The number of passive devices connected to the bus segment is not limited for I.S. reasons. If the above rules are followed, up to a total length of 1000m (sum of the length of the trunk cable and all spur cables), the inductance and capacitance of the cable will not impair the intrinsic safety of the installation.

Note:

FOR PROPER INSTALLATION REFERENCE ALL APPLICABLE NOTES FROM PAGE 2 - 099-5077-001

099-5077-001-G

AGENCY LISTED DRAWING

ALL REVISIONS TO THIS DRAWING REQUIRE QA APPROVAL

SHEET 7 OF 7

3.6 Specifications

3.6.1 Functional – Transmitter

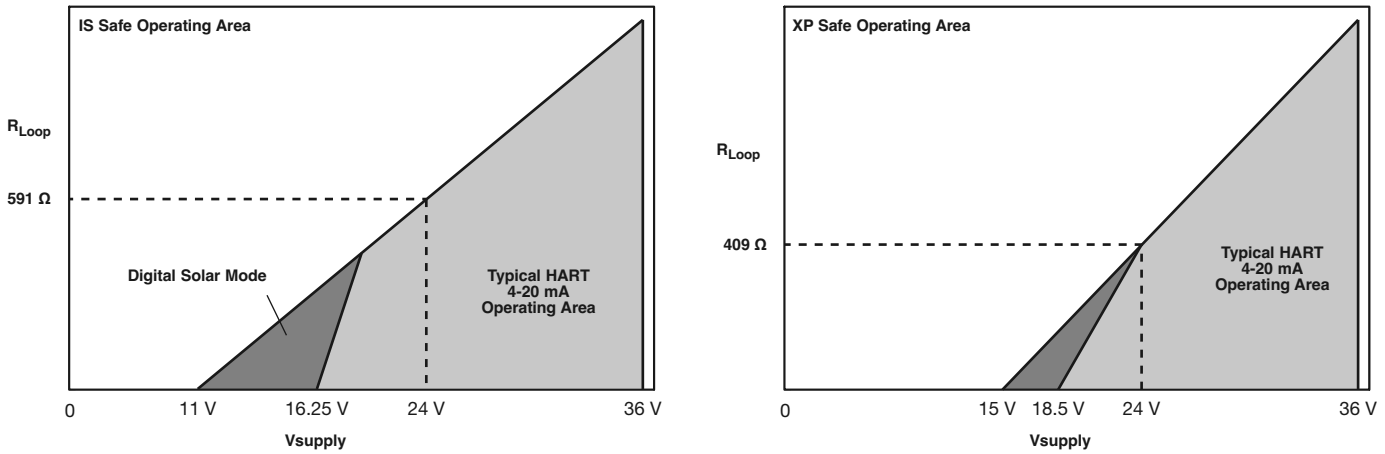
System Design		
Measurement Principle		Pulse burst radar 26 GHz
Input		
Measured Variable		Level, determined by the time-of-flight of radar pulse reflections
Span		0,2 to 40 m (0.5' to 130')
Output		
Type		4 to 20 mA with HARD: 3.8 mA to 20.5 mA useable (per NAMUR NE43)
		FOUNDATION Fieldbus™: H1 (ITK Ver. 6.2.0)
Resolution	Analog:	.003 mA
	Digital Display:	1 mm
Loop Resistance	GP/IS:	591 ohms @ 24 VDC and 22 mA
	XP/Flameproof:	500 ohms @ 24 VDC and 22 mA
Diagnostic Alarm		Selectable: 3.6 mA, 22 mA (meets requirements of NAMUR NE 43), or HOLD last output
Diagnostic Indication		Meets requirements of NAMUR NE107
Damping		Adjustable 0-10
User Interface		
Keypad		4-button menu-driven data entry
Display		Graphic Liquid Crystal Display
Digital Communication		HART Version 7–with Field Communicator, FOUNDATION Fieldbus™, AMS, or FDT
		DTM (PACT*ware*™), EDDL
Menu Languages	Transmitter LCD:	English, French, German, Spanish, Russian, Portuguese, Polish
	HART DD:	English, French, German, Spanish, Russian, Chinese, Portuguese, Polish
Host System	FOUNDATION Fieldbus™	English
	PROFIBUS PA:	English
Voltage (Measured at instrument terminals)		HART: General Purpose (Weather proof)/Intrinsically Safe/Explosion-proof:
		11 VDC minimum at terminals under certain conditions
		FOUNDATION Fieldbus™ and PROFIBUS PA: 9 to 17.5 VDC
		FISCO, FNICO, General Purpose (Weatherproof)
Housing		
Material		IP67/die-cast aluminum A413 (<0.6% copper); optional stainless steel
Net/Gross Weight	Aluminum:	2,0 kg (4.5 lbs.)
	Stainless Steel:	4,5 kg (10.0 lbs.)
Overall Dimensions		See section 3.6.7
Cable Entry		1/2" NPT or M20
SIL 2 Hardware (Safety Integrity Level)		Safe Failure Fraction = 93.2 % (HART only)
		Functional Safety to SIL 2 as 1oo1 in accordance with IEC 61508
		(Full FMEDA report available upon request)

3.6 Specifications

3.6.2 Functional – Environment

Operating Temperature		General purpose: -40 °C to +80 °C (-40 °F to +175 °F); Agency approved: -40 °C to +70 °C (-40 °F to +160 °F); LCD viewable -20 °C to +70 °C (-5 °F to +160 °F)
Storage Temperature		-45 °C to +85 °C (-50 °F to +185 °F)
Humidity		0–99 %, non-condensing
Electromagnetic Compatibility		Meets CE requirement (EN 61326) and NAMUR NE 21
Surge Protection		Meets CE EN 61326 (1000V)
Shock/Vibration		ANSI/ISA-S71.03 Class SA1 (Shock); ANSI/ISA-S71.03 Class VC2 (Vibration)
Reference Conditions		Reflection from ideal reflector at +20 °C (+70 °F)
Linearity		±3 mm (0.1") or 0.1 % of tank height (whichever is greater)
Measured Error		±3 mm (0.1") or 0.1 % of tank height (whichever is greater) (Performance will degrade slightly within 1.5 m (60") of antenna)
Resolution		1mm or 0.1"
Repeatability		±3 mm (0.1") or 0.05 % of tank height (whichever is greater)
Response Time		<2 seconds (configuration dependent)
Initialization Time		< 30 seconds (configuration dependent)
Ambient Temperature Effect	Digital	Average 3 mm (0.12") / 10 K, max of ±10 mm (0.4") over the entire temperature range -40 °C to +80 °C (-40 °F to +175 °F)
	Analog	Current Output (additional error with reference to 16 mA span) Average 0.03 % / 10 K. max 0.45 % over entire temperature range -40 °C to +80 °C (-40 °F to +175 °F)
Maximum Rate of Change		450 cm (180")/minute
FOUNDATION Fieldbus™ :	ITK Version	6.2.0
	H1 Device Class	Link Master (LAS)—selectable ON/OFF
	H1 Profile Class	31PS, 32L
	Function Blocks	(8) AI, (3) Transducer, (1) Resource, (2) PID (1) Arithmetic, (1) Signal Characterizer, (1) Input Selector, (1) Integrator
	Quiescent Current	17 mA
	Execution Time	10 ms (15 ms PID Block)
	Device Revision	01
	DD Version	0x01
PROFIBUS	see bulletin	

3.6.2.1 Safe Operating Areas



3.6.2.2 Transmitter Terminal Voltage

Operational Mode	Current Consumption	Vmin	Vmax
HART			
General Purpose	4mA 20mA	16.25V 11V	36V 36V
Intrinsically Safe	4mA 20mA	16.25V 11V	28.6V 28.6V
Explosion Proof	4mA 20mA	18.5V 15V	36V 36V
Fixed Current-Solar Power Operation (PV transmitter via HART)			
General Purpose	10mA①	11V	36V
Intrinsically Safe	10mA①	11V	28.6V
HART Multi-Drop Mode (Fixed Current)			
Standard	4mA①	16.25V	36V
Intrinsically Safe	4mA①	16.25V	28.6V
FOUNDATION Fieldbus™			
Supply Voltage	9V to 17.5V	9V to 17.5V	9V to 17.5V

① Start-up current 12 mA minimum

3.6.3 O-ring (seal) Selection Chart

Material	Code	Maximum Temperature	Maximum Pressure	Min. Temp.	Recommended For Use In	Not Recommended For Use In
Viton® VX065	0	② +180 °C @ 16 bar (+356 °F @ 232 psi)	51.7 bar @ +20 °C (750 psi @ +70 °F)	-40 °C (-40 °F)	General purpose, ethylene	Ketones (MEK, acetone), skydrol fluids, amines, anhydrous ammonia, low molecular weight esters and ethers, hot hydrofluoric or chlorosulfuric acids, sour HCs
Kalrez® 4079	2	+200 °C @ 16 bar (+400 °F @ 232 psi)	51.7 bar @ +20 °C (750 psi @ +70 °F)	-40 °C (-40 °F)	Inorganic and organic acids (including HF and nitric), aldehydes, ethylene, glycols, organic oils, silicone oils, vinegar, sour HCs	Black liquor, hot water/steam, hot aliphatic amines, ethylene oxide,propylene oxide, molten sodium, molten potassium
③ Simriz SZ485 (formerly Aegis PF128)	8	+200 °C @ 16 bar (+400 °F @ 232 psi)	51.7 bar @ +20 °C (750 psi @ +70 °F)	-20 °C (-4 °F)	Inorganic and organic acids (including HF and nitric), aldehydes, ethylene, glycols, organic oils, silicone oils, vinegar, sour HCs, steam, amines, ethylene oxide, propylene oxide, NACE applications	Black liquor, Freon 43, Freon 75, Galden, KEL-F liquid, molten sodium, molten potassium
Kalrez® 6375	A	+200 °C @ 16 bar (+400 °F @ 232 psi)	51.7 bar @ +20 °C (750 psi @ +70 °F)	-40 °C (-40 °F)	Inorganic and organic acids (including hydro fluids and nitric), aldehydes, ethylene, organic oils, glycols, silicone oils, vinegar, sour HCs	Hot water/steam, hot aliphatic amines, ethylene oxide, propylene oxide
Quartz	N	+400 °C @ 94.8 bar (+750 °F @ 1375 psi)	160 bar @ +20 °C (2320 psi @ +70 °F)	-70 °C (-100 °F)	General high temperature/high pressure applications, hydrocarbons, full vacuum (hermetic), ammonia, chlorine	Hot alkaline solutions HF acid, media with ph>12, direct exposure to saturated steam

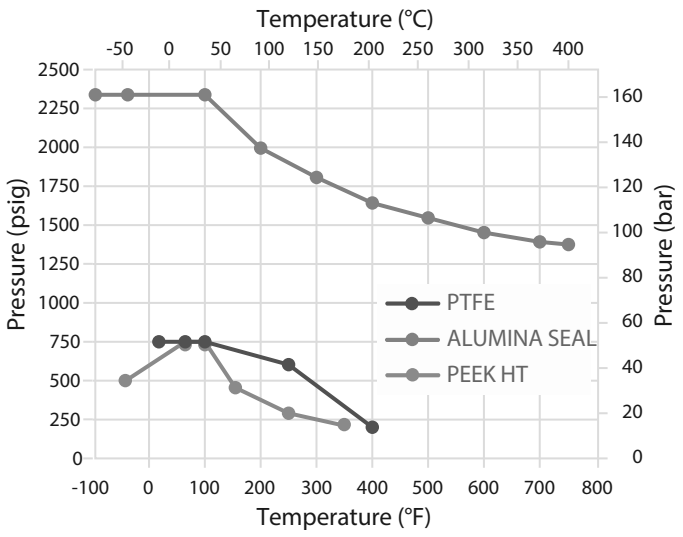
② +180 °C (+350 °F) for options with hazardous locations approvals.
③ Maximum +150 °C (+300 °F) for use on steam.

3.6.4 Functional – Antenna

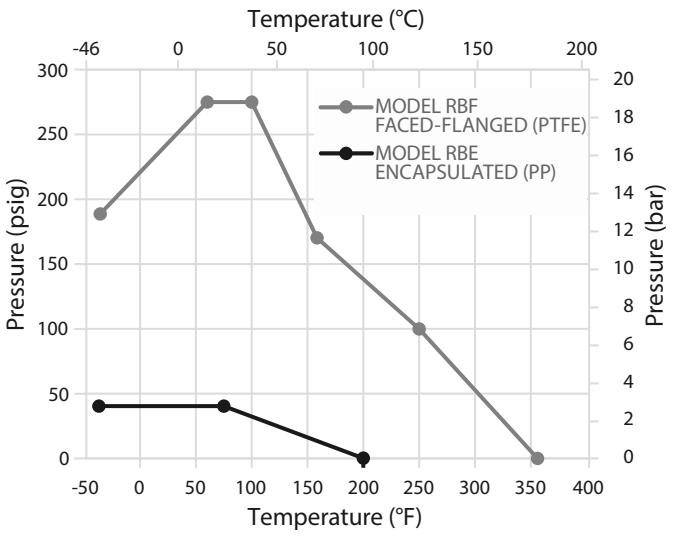
Antenna Material	316 SS, Hastelloy C, Polypropylene or PTFE
Process Seal Material	PEEK, PTFE with O-rings or Alumina
Maximum Process Temperature	+400 °C @ 94,8 bar (+750 °F @ 1375 psi)
Maximum Process Pressure	-1,0 to 160 bar @ +20 °C (-14.7 to 2320 psi @ +70 °F)
Vacuum Service	Hermeticity to $<5 \times 10^{-7}$ cc/sec helium
Minimum Dielectric (application dependent)	1,7 (1,4 with stillwells)

3.6.5 Antenna Pressure / Temperature Ratings

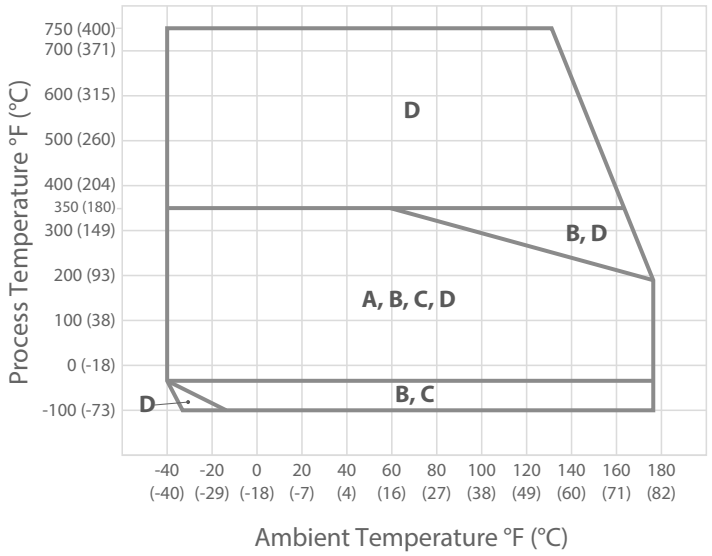
Pressure Ratings – Standard Horn Antennas



Pressure Ratings – Isolation Antennas



3.6.6 Operating Temperature Range



Safe Operating Regions

A: Standard PTFE Seal

B: Standard PTFE Seal with Extension (P/N 032-6922-001)

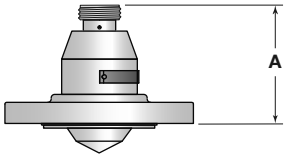
C: HTHP Alumina Seal

D: HTHP Alumina Seal with Extension (P/N 032-6922-001)

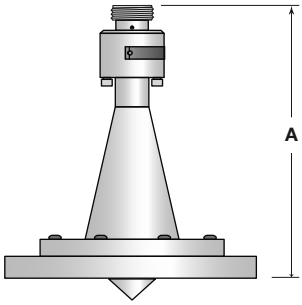
Model R86 T-codes	No Temperature Extension			With Temperature Extention Part No. 032-6922-001		
	Max. Temp. of Process	Max. Ambient Temp.	T-code	Max. Temp. of Process	Max. Ambient Temp.	T-code
Standard Seal 10th digit = 0, 2, 8 or A	+70 °C	+70 °C	T4	+70 °C	+70 °C	T4
	+130 °C	+42 °C		+135 °C	+67 °C	
	—	—	—	+195 °C	+64 °C	T3
HTHP Seal 10th digit = N	+70 °C	+70 °C	T4	+70 °C	+70 °C	T4
	+130 °C	+42 °C		+135 °C	+67 °C	
	—	—	—	+180 °C	+64 °C	T3
	—	—	—	+295 °C	+60 °C	T2
	—	—	—	+400 °C	+55 °C	T1

3.6.7 Physical – mm (inches)

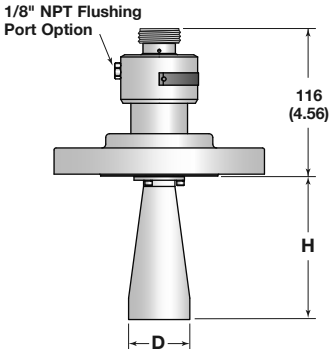
Flange Connection



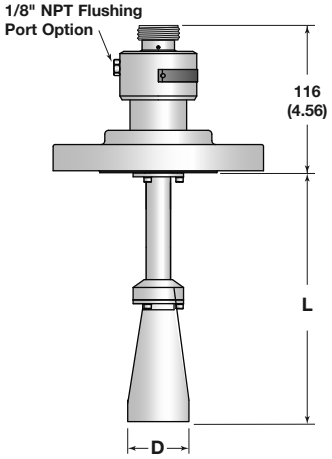
Model RBE/RBF



Model RBE



Model RBX



Model RBX

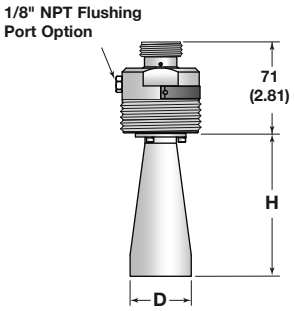
POLYPROPYLENE AND PTFE FACED-FLANGE ANTENNA

	Model Nr 3th Digit	Process Connection	Horn Size 1 1/2"	2"	3"
Dim. A	E Encapsulated Polypropylene Horn	1 1/2" NPT	122 (4.79)	—	—
		2" 150#	—	100 (3.94)	—
		3" 150#	—	—	268 (10.56)
		4" 150#	—	—	289 (11.39)
		6" 150#	—	—	291 (11.45)
Dim. A	F Faced Flange PTFE Horn	2" 150#	—	100 (3.94)	—
		3" 150#	—	—	119 (4.69)

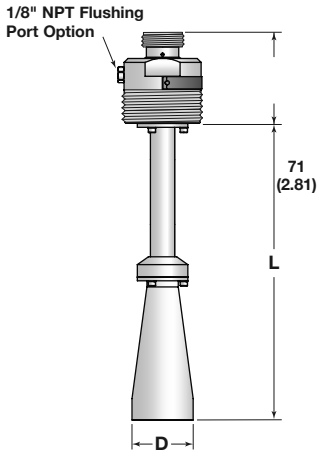
HORN ANTENNA FLANGE CONNECTION

	Model Nr 11th Digit (Extension)	3rd Digit (Horn Size) 1 (1 1/2")	2 (2")	3 (3")	4 (4")
Dim. H	0 (None)	81 (3.2)	114 (4.5)	216 (8.5)	292 (11.5)
Dim. L	1 (4")	152 (6)	—	—	—
	2 (8")	203 (8)	211 (8.3)	—	—
	3 (12")	305 (12)	305 (12)	315 (12.4)	366 (14.4)
	4 (24")	610 (24)	610 (24)	610 (24)	610 (24)
	5 (48")	1219 (48)	1219 (48)	1219 (48)	1219 (48)
	6 (72")	1829 (72)	1829 (72)	1829 (72)	1829 (72)
Dim. D		40 (1.56)	48 (1.89)	75 (2.95)	95 (3.74)

NPT Connection

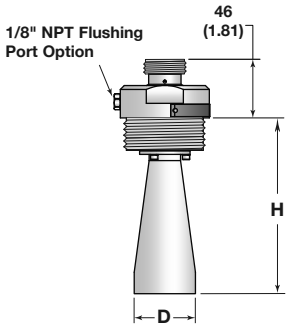


Model RBX

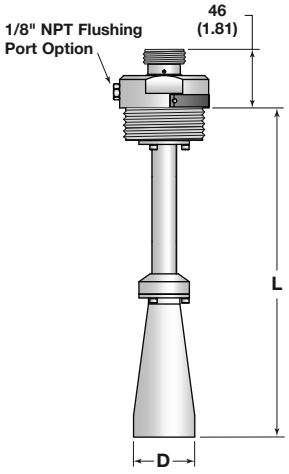


Model RBX

BSP Connection



Model RBX



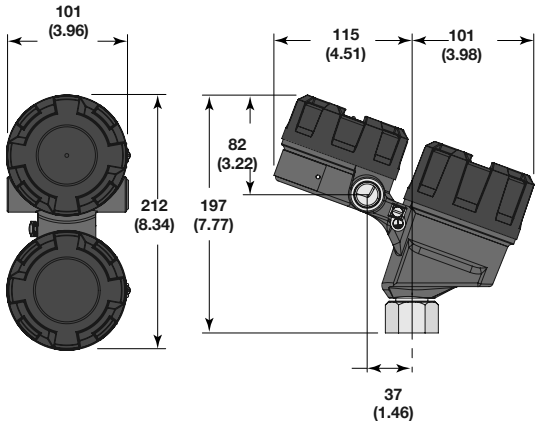
Model RBX

HORN ANTENNA SCREWED CONNECTION

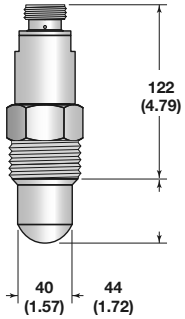
	Model Nr 11th Digit (Extension)	Model Code Digit 4 & 5 1 (1 1/2") NPT	BSP	2 (2") NPT	BSP	3 (3") NPT	BSP	4 (4") NPT	BSP
Dim. H	0 (None)	81 (3.2)	106 (4.2)	114 (4.5)	139 (5.5)	—	—	—	—
Dim. L	1 (4")	152 (6)	177 (7)	—	—	—	—	—	—
	2 (8")	203 (8)	228 (9)	211 (8.3)	236 (9.3)	—	—	—	—
	3 (12")	305 (12)	330 (13)	305 (12)	330 (13)	315 (12.4)	340 (13.4)	366 (14.4)	391 (15.4)
	4 (24")	610 (24)	635 (25)	610 (24)	635 (25)	610 (24)	635 (25)	610 (24)	635 (25)
	5 (48")	1219 (48)	1244 (49)	1219 (48)	1244 (49)	1219 (48)	1244 (49)	1219 (48)	1244 (49)
	6 (72")	1829 (72)	1854 (73)	1829 (72)	1854 (73)	1829 (72)	1854 (73)	1829 (72)	1854 (73)
Dim. D		40 (1.56)		48 (1.89)		75 (2.95)		95 (3.74)	

3.6.7 Physical – mm (inches)

TRANSMITTER



NPT Connection



Model RBE

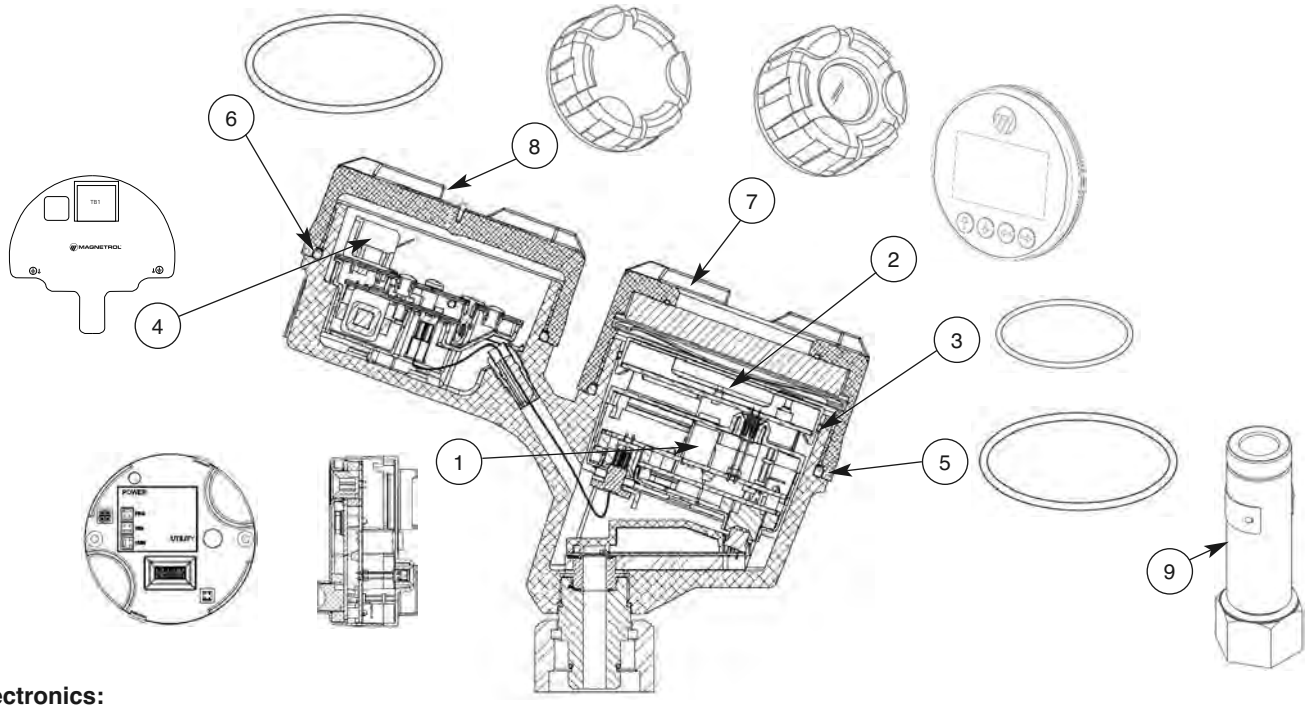
3.7 Parts

3.7.1 Replacement Parts

All replacement parts are for standard models only. Consult factory for replacement parts on modified units (model number preceded by an X).

EXPEDITE SHIP PLAN (ESP)

Several parts are available for quick shipment, within max. 1 week after factory receipt of purchase order, through the Expedite Ship Plan (ESP).
Parts covered by ESP service are conveniently grey coded in the selection tables.



Electronics:

Partn°: R 8 6 — — — — — — — —

Digit in partn°: X 1 2 3 — 4 5 6 7 — 8 9 10

X = product with a specific customer requirement

Serial n°: — — — — — — — — — — —

See nameplate, always provide complete part number and serial number when ordering spares.

Consult factory to obtain the correct replacement part numbers for items not listed in the tables below.

(1) Electronic module		
Digit 5	**Digit 6**	**Replacement part**
1	1, B	Z31-2864-001
2	0, A	Z31-2864-002
3	0, A	Z31-2873-001

(2) Display module	
Digit 7	**Replacement part**
0	not applicable
A	Z31-2850-001

(3) Display "O"-ring	
Digit 7	**Replacement part**
0	not applicable
A	012-2016-001

	Replacement part
(5) O-ring	012-2601-237
(6) O-ring	012-2601-237
(9) Temperature extension	032-6922-001

(4) Wiring PC board			
Digit 5	**Digit 6**	**Digit 8**	**Replacement part**
1	1, B	0, 1, A, D	Z30-9180-001
		3, B	Z31-2865-001
		C	Z30-9180-002
2, 3	0, A	0, 1, A, D	Z30-9166-003
		C	Z30-9166-004

(7) Housing cover		
Digit 7	**Digit 9**	**Replacement part**
0	1	004-9225-002
	2	004-9225-003
A	1	036-4413-013
	2	036-4413-016

(8) Housing cover	
Digit 9	**Replacement part**
1	004-9225-002
2	004-9225-003

3.8 Model Numbers

3.8.1 PULSAR Model R86 Radar Transmitter

1–3 | MEASUREMENT SYSTEM

R 8 6	Through-Air Radar Level Transmitter - 26 GHz Pulse Burst Radar

4 | POWER

5	24 VDC, Two Wire

5 | SIGNAL OUTPUT

1	4-20 mA with HART
2	FOUNDATION Fieldbus™ H1 (not available with 8th digit 3 or B)
3	PROFIBUS PA (not available with 8th digit 3 or B)

6 | SAFETY OPTIONS

0	None (FOUNDATION Fieldbus™ and PROFIBUS only, 5th digit = 2 or 3)
1	SIL 2 Hardware - HART only (5th digit = 1)
A	None (FOUNDATION Fieldbus™ and PROFIBUS only, 5th digit = 2 or 3) – ETSI ①
B	SIL 2 Hardware - HART only (5th digit = 1) – ETSI ①

① Must be used with 3-inch or 4-inch horn

7 | ACCESSORIES/MOUNTING

0	No Digital Display and Keypad - Integral
A	Digital Display and Keypad - Integral

8 | CLASSIFICATION

0	General Purpose, Weatherproof (IP 67)
1	Intrinsically Safe (FM & CSA)
3	Explosion-proof (FM & CSA)
A	Intrinsically Safe (ATEX/IEC)
B	Flame-proof (ATEX/IEC) Zone 0 requires antenna 10th digit = 0, 8 or N
C	Non-sparking (ATEX)
D	Dust Ex (ATEX)

9 | HOUSING

1	Die-cast Aluminum, Dual Compartment, 20-degree
2	Investment Cast, 316ss, Dual Compartment, 20-degree

10 | CONDUIT CONNECTION

0	1/2" NPT
1	M20
2	1/2" NPT with sunshade
3	M20 with sunshade

R	8	6	—	5				—			
1	2	3		4	5	6	7		8	9	10

3.8.2 PULSAR Model R86 Radar Antenna

1–2 | TECHNOLOGY

R B	PULSAR Radar Antennas - 26 GHz

3 | CONFIGURATION/STYLE

1	1 1/2" Horn
2	2" Horn
3	3" Horn (not available when digit 4 = 3, 4 or D and digit 11 = 0)
4	4" Horn (not available when digit 4 = 3, 4, 5, D or E and digit 11 = 0)
E	Encapsulated – Polypropylene (available only when 4th and 5th digits = 31, 43, 53, 63, 73, DA, EA, FA, GA)
F	Faced Flange – PTFE Coated Wetted Surfaces (available only when 4th and 5th digits = 43, 53, DA, EA)

4–5 | PROCESS CONNECTION - SIZE/TYPE

31	1 1/2" NPT thread	41	2" NPT Thread
32	1 1/2" BSP (G 1 1/2") thread	42	2" BSP (G 2") Thread

ASME Flanges		EN Flanges		
43	2" 150# ASME raised face flange	DA	DN 50, PN 16	EN 1092-1 Type A
44	2" 300# ASME raised face flange	DB	DN 50, PN 25/40	EN 1092-1 Type A
45	2" 600# ASME raised face flange	DD	DN 50, PN 63	EN 1092-1 Type B2
53	3" 150# ASME raised face flange	EA	DN 80, PN 16	EN 1092-1 Type A
54	3" 300# ASME raised face flange	EB	DN 80, PN 25/40	EN 1092-1 Type A
55	3" 600# ASME raised face flange	ED	DN 80, PN 63	EN 1092-1 Type B2
63	4" 150# ASME raised face flange	FA	DN 100, PN 16	EN 1092-1 Type A
64	4" 300# ASME rased face flange	FB	DN 100, PN 25/40	EN 1092-1 Type A
65	4" 600# ASME raised face flange	FD	DN 100, PN 63	EN 1092-1 Type B2
73	6" 150# ASME raised face flange	GA	DN 150, PN 16	EN 1092-1 Type A
74	6" 300# ASME raised face flange	GB	DN 150, PN 25/40	EN 1092-1 Type A
75	6" 600# ASME raised face flange	GD	DN 150, PN 63	EN 1092-1 Type B2

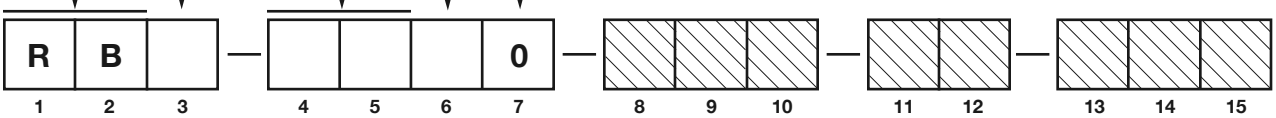
① 3" RBE are Raised Face Lap Joint Flange

6 | CONSTRUCTION CODES

0	Industrial
K	ASME B31.1
L	ASME B31.3
M	ASME B31.3 & NACE MR0175 / MR0103
N	NACE MR0175 / MR0103

7 | FLANGE OPTIONS

0	None



3.8.2 PULSAR Model R86 Radar Antenna

8 | MATERIAL OF CONSTRUCTION

A	316SS/316L SS
B	Hastelloy C
R	316SS/316L SS with Carbon Steel Flange
S	Hastelloy C with Carbon Steel Flange

9 | FUTURE

0	None

10 | O-RING MATERIALS/SEAL OPTIONS ①

0	Viton VX065
2	Kalrez 4079 - not suitable for ATEX/IEC flameproof Zone 0
8	Simriz SZ485 (formerly Aegis PF128) — NACE
A	Kalrez 6375 - not suitable for ATEX/IEC flameproof Zone 0
N	None - Alumina seal

① Refer to pages 5 and 6 for temperature extension information

11 | ANTENNA EXTENSIONS

0	None
1	For nozzle height ≤ 100 mm (4") - only available when 3rd digit = 1 ②
2	For nozzle height ≤ 200 mm (8") - not available when 3rd digit = 3 or 4 ②
3	For nozzle height ≤ 300 mm (12") ②
4	For nozzle height ≤ 600 mm (24") ②
5	For nozzle height ≤ 1200 mm (48") ②
6	For nozzle height ≤ 1800 mm (72") ②

② Not available for RBE and RBF antenna.

12 | SPECIAL OPTIONS

0	None
1	1/8" NPT Flushing Connection

13-15 | FUTURE

000	None

R	B							0					0	0	0
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	

4.0 Advanced Configuration/Troubleshooting Techniques

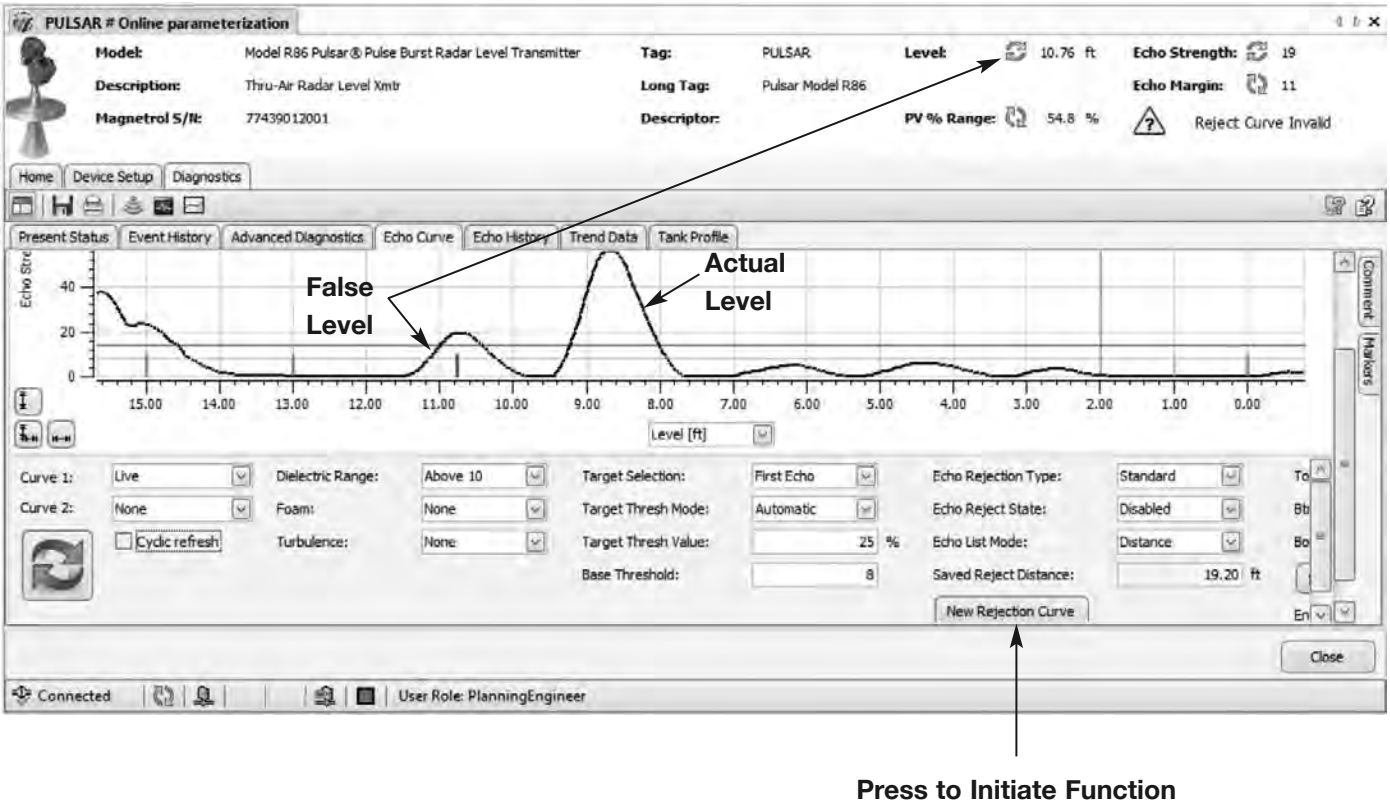
This section contains information regarding some of the advanced configuration and troubleshooting capability contained within the Model R86 transmitter. Some of these diagnostic options are best suited for use with PACTware and the Model R86 DTM, and should be implemented only after contacting Magnetrol Technical Support.

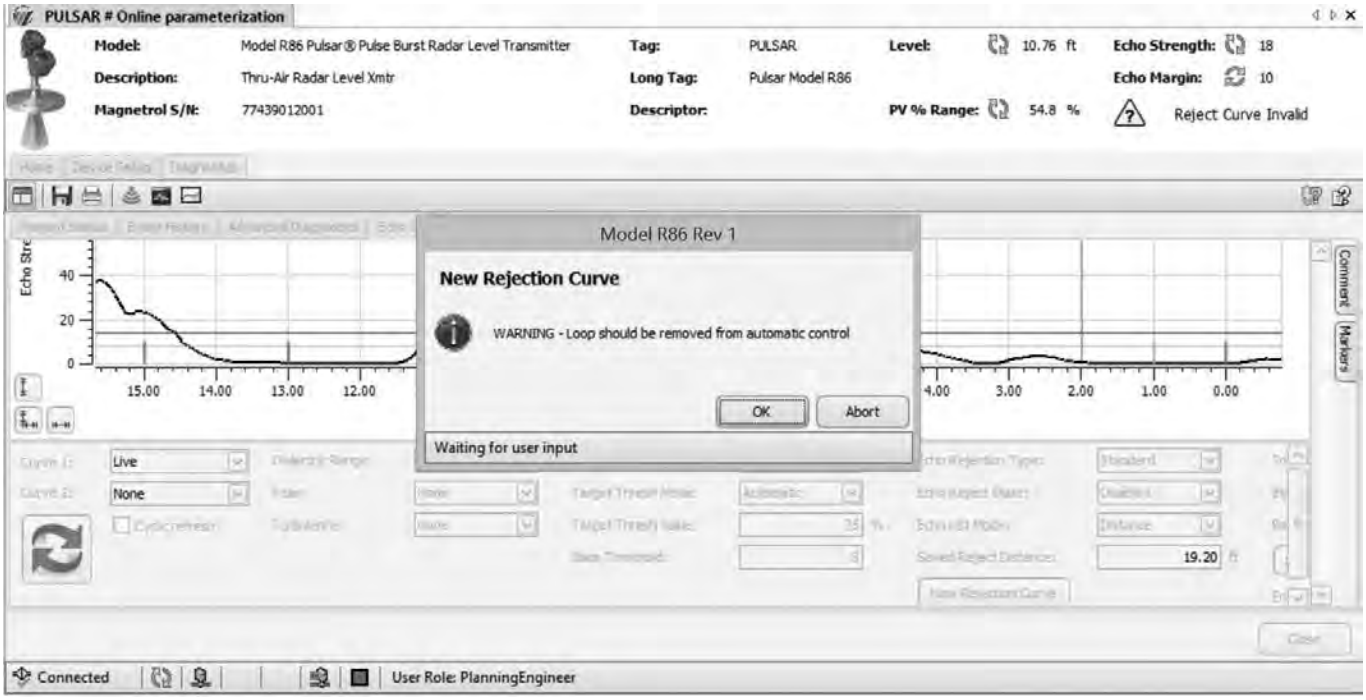
4.1 Echo Rejection

After choosing a proper mounting location, another way to ignore unwanted signals within the measuring range is by utilizing the Echo Rejection feature.

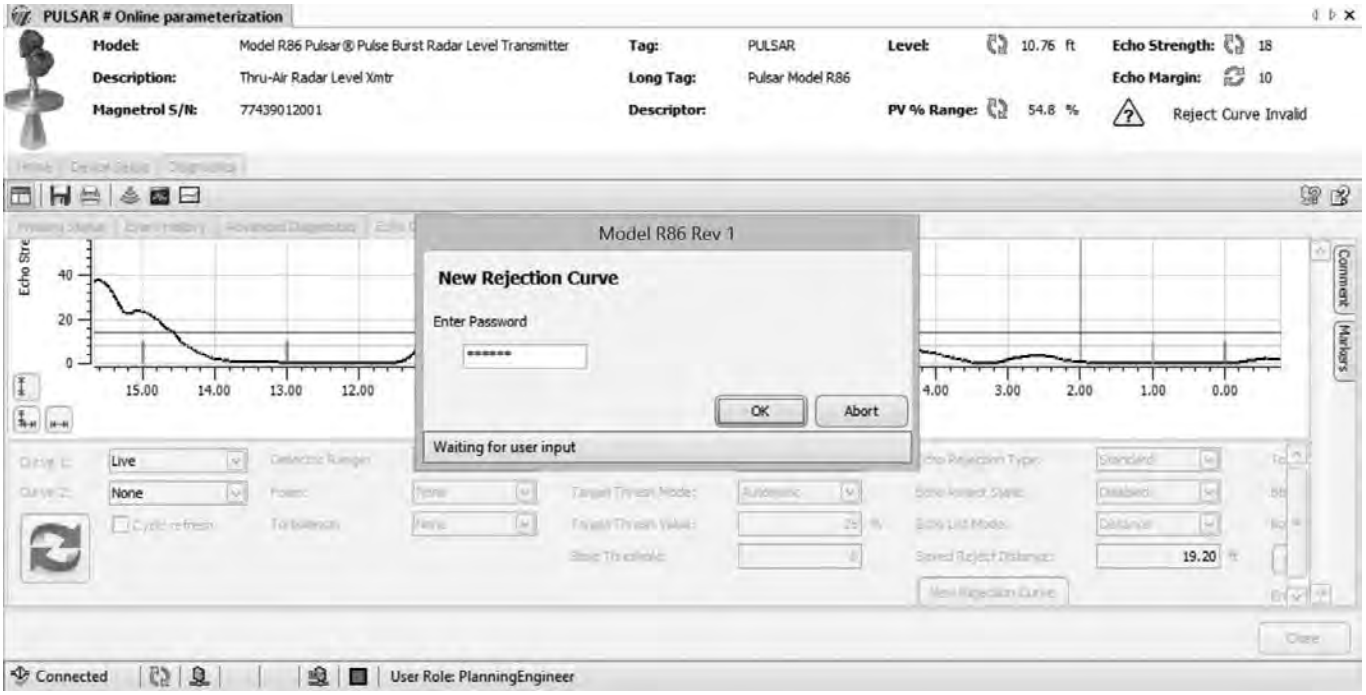
Setup using DTM/PACTware™

Select the Diagnostics tab and then the Echo Curve tab. After refreshing the waveform, click on the New Rejection Curve button.

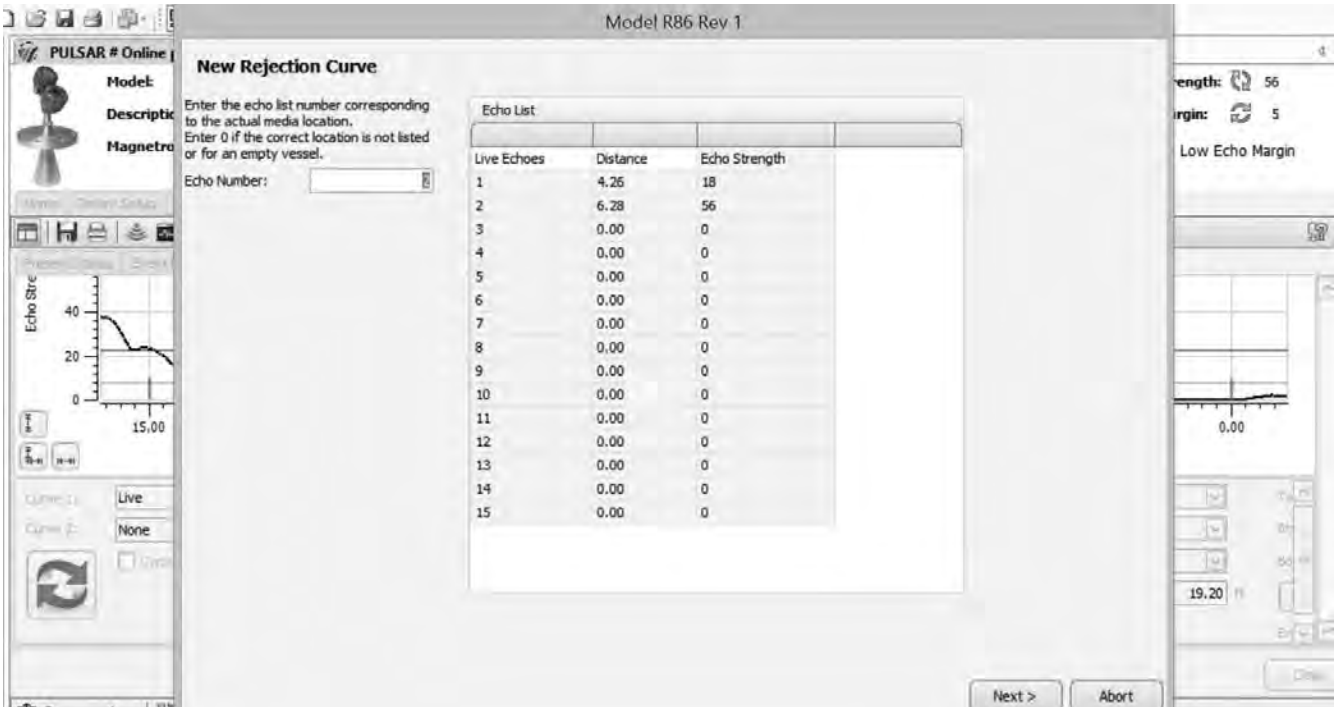




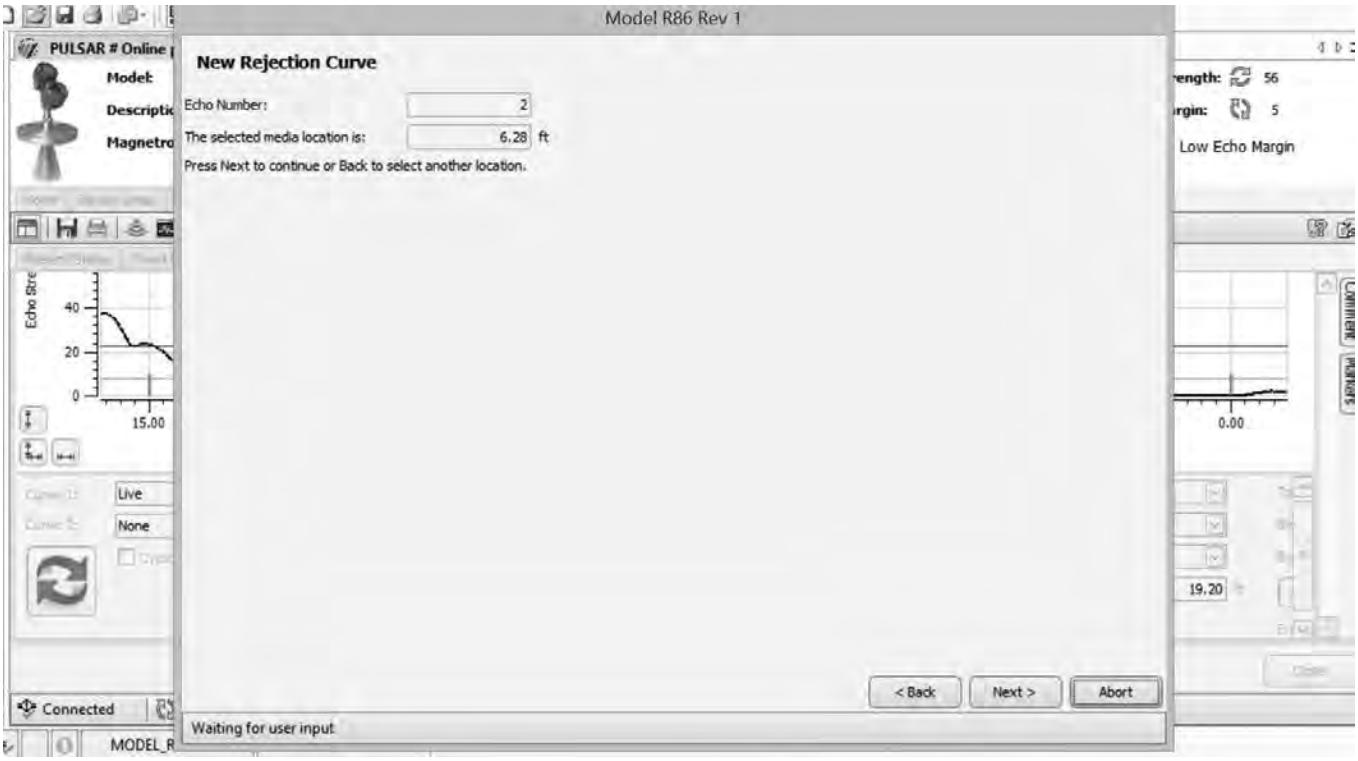
Click on NEXT at the loop warning message.



A password window will then appear. Click OK. The system calculates the curve, and then saves it. Click OK to confirm.

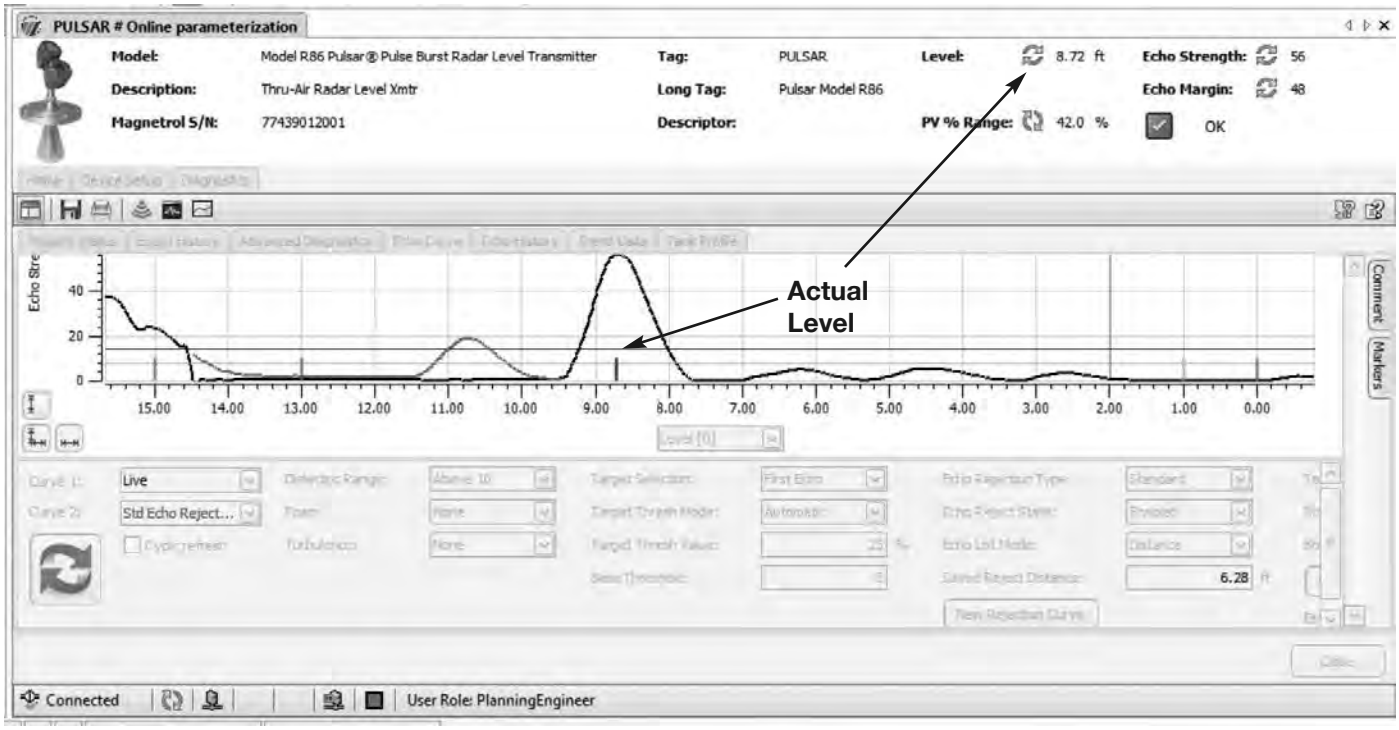


On the next screen, enter the actual location of the level to be measured. Press ENTER and then click on NEXT.

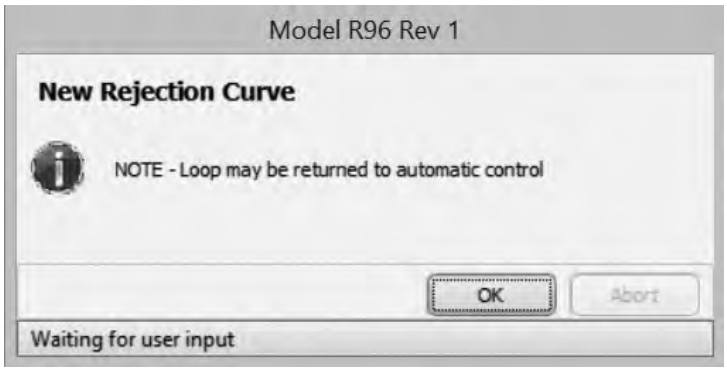


Press NEXT to confirm.

The Live Curve and Rejection Curve will then be displayed as shown in the screenshot below.



A warning screen is shown that the loop can be returned to automatic control.



4.2 Custom Echo Rejection

INTRODUCTION

The Pulsar Model R86 has a very unique feature that allows for a user to modify a Standard Echo Rejection curve.

Custom Echo Rejection is a feature intended to allow a user to manually adjust the curve to account for undesirable waveform features (noise, disturbances, etc.) that may not have been captured by the initial Standard Echo Rejection curve.

For example, undesirable signals may occur if the original echo rejection curve was taken at a time when mixing blades were stopped in a particular location. If the blades then later stop in a different location, a false echo from the blade could then appear in the live echo curve. Custom Echo Rejection can then be used to modify the Standard Echo Rejection curve in order to ensure that all "false echoes" are cancelled out of the waveform.

The Custom Echo Rejection curve is offered in addition to the Standard Echo Rejection curve. Once a Custom Echo Rejection curve has been created, either curve is available for use by the user to reject unwanted echo echoes. The user has the ability to select which curve (or no curve) will be used for echo rejection.

Since the local display does not have the ability to concurrently display the live and rejection echo curves, the manipulation of the echo rejection curve will be done in the DD and DTM only. The ability to view the two curves graphed together is essential in determining how the rejection curve should be modified to provide the desired outcome.

When the Custom Echo Rejection curve is selected for use, the "New Rejection Curve" button will change to "Modify Rejection Curve". Clicking on this button will guide a user through:

- modifying an existing echo in the custom curve
- copying an echo from the live curve to the custom rejection curve
- resetting a Custom Echo Rejection curve back to the original form from which it was taken (Standard Echo Rejection curve).

OPERATION

BEFORE STARTING: Note that changes to certain parameters cause the Echo Rejection profile to become invalid. Those parameter changes will invalidate both the Standard and the Custom rejection curves simultaneously, regardless of which echo rejection curve option is selected at the time. For example, making any changes to Gain parameters (Dielectric, Turbulence, Foam and Sensitivity) or Tank Height parameter will invalidate all Echo Rejection Curves whether Standard or Custom.

The Custom Echo Rejection curve can be modified in three ways:

1. Modify existing Echo

   Changing the amplitude or width of an existing echo in the Custom Rejection Curve is the most typical use of this method. For example, it can be used to account for the variations in mixing blade operation. If mixing blades are stopped when the initial curve was created, the next time the blades stop they may be in a slightly different position. The new blade position can result in a slightly different position of its echo. Echoes from the blade will appear in the echo curve as slightly shifted to the left or right compared to the echo in the original curve. The amplitude may also be somewhat different. In that case, expanding the width of the existing echo, or changing its amplitude would create an echo rejection curve that encompasses both the original echo and the new echo locations.

2. Add an Echo

   This is used to copy an echo from the live curve to the Custom Rejection Curve. This would be done in the event that a new echo was found in the live curve after the initial echo rejection curve had been saved.

NOTE: In the case where the level at the time was higher in the tank, saving a new entire echo rejection curve would result in a lower portion of the rejection curve being lost. Therefore, it is beneficial in that circumstance to be able to add the echo to the existing custom curve so that the lower portion of the curve is retained.

3. Reset Custom Curve

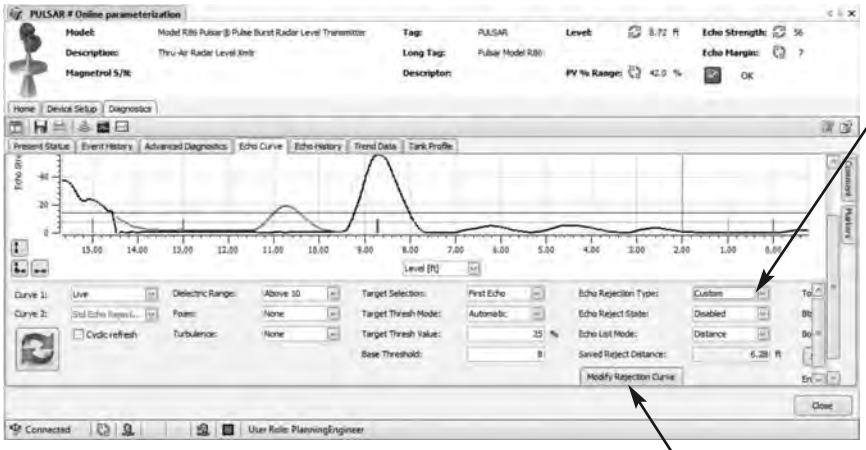
   If the need arises to eliminate changes made during any of the previous modification procedures, Reset Custom Curve is used to reset the Custom Rejection Curve back to its original values.

PROCEDURES

Changing the widths and amplitude of an existing echo:

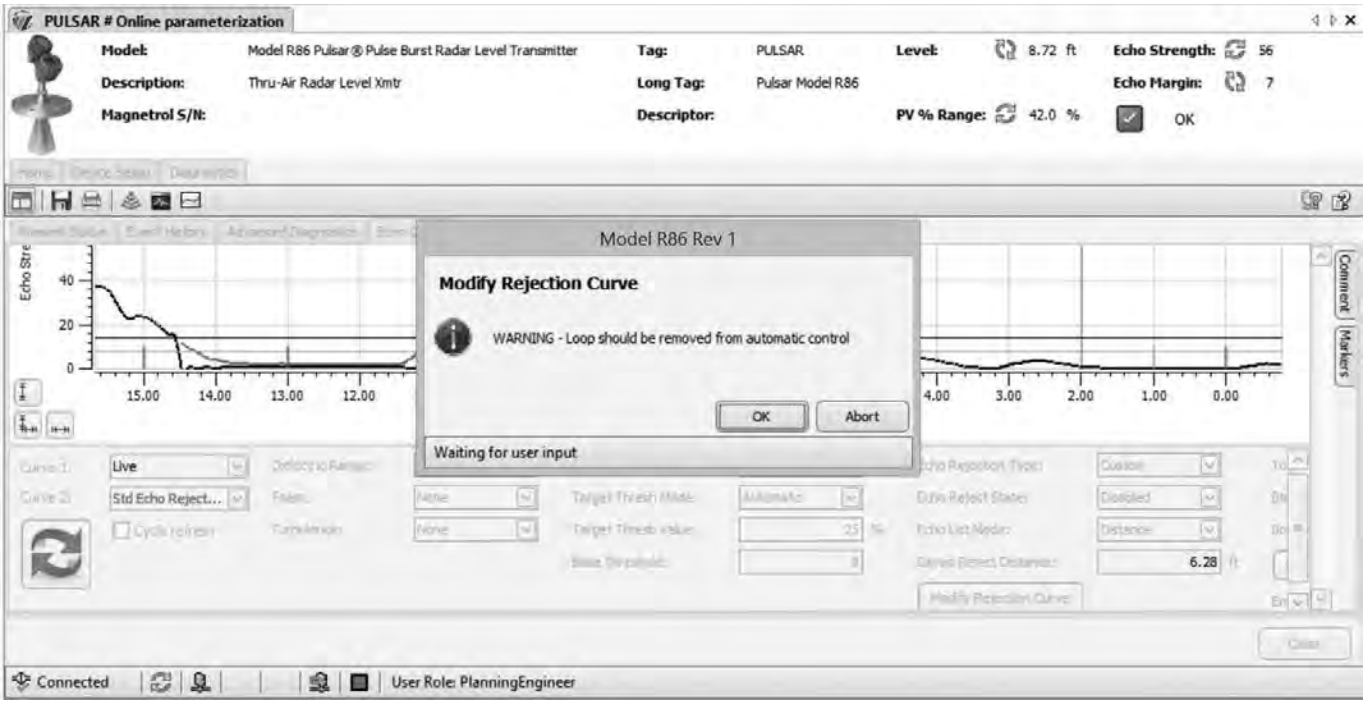
Modifying an existing echo in the custom rejection echo curve consists of the user identifying the desired echo and defining the changes to be made to that echo. The user begins the Customize Rejection Curve method in the DTM at Diagnostics/Echo Curve.

1. Ensure a Standard Echo Rejection has been captured before continuing (Standard Echo Rejection will appear as red curve on graph)

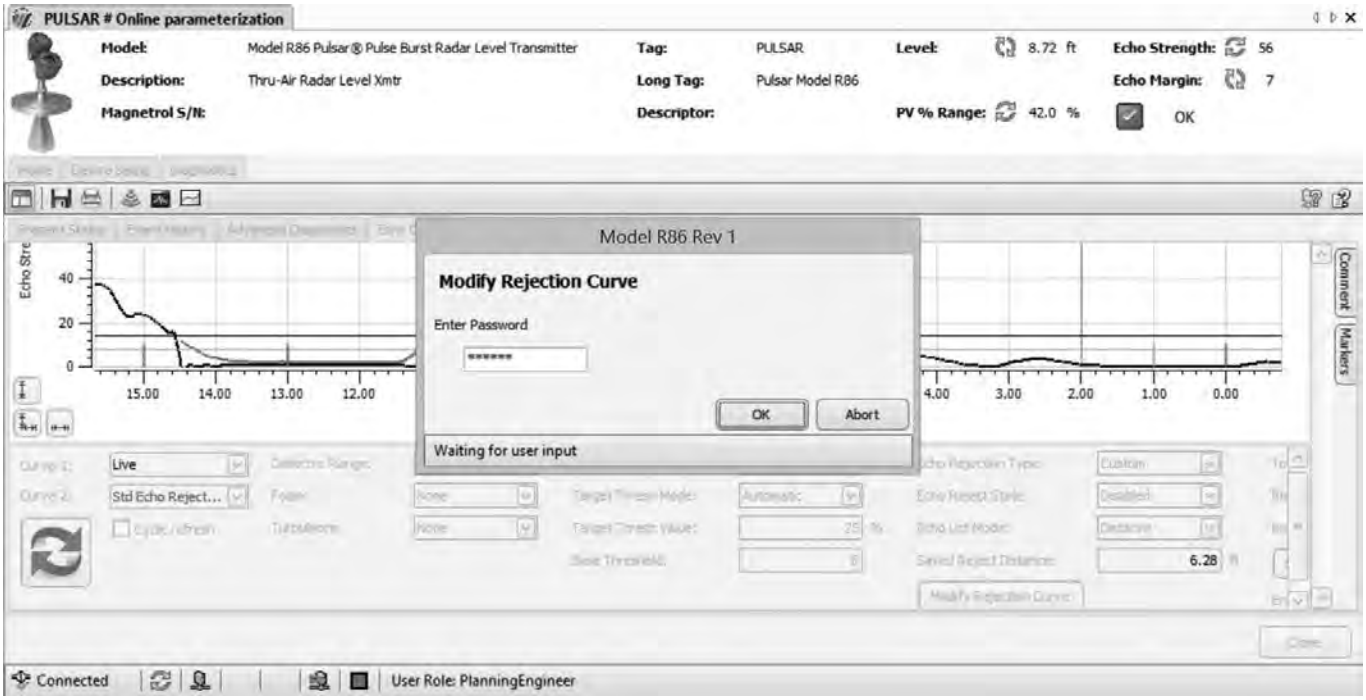


Change "Echo Rejection Type" from "Standard" to "Custom"

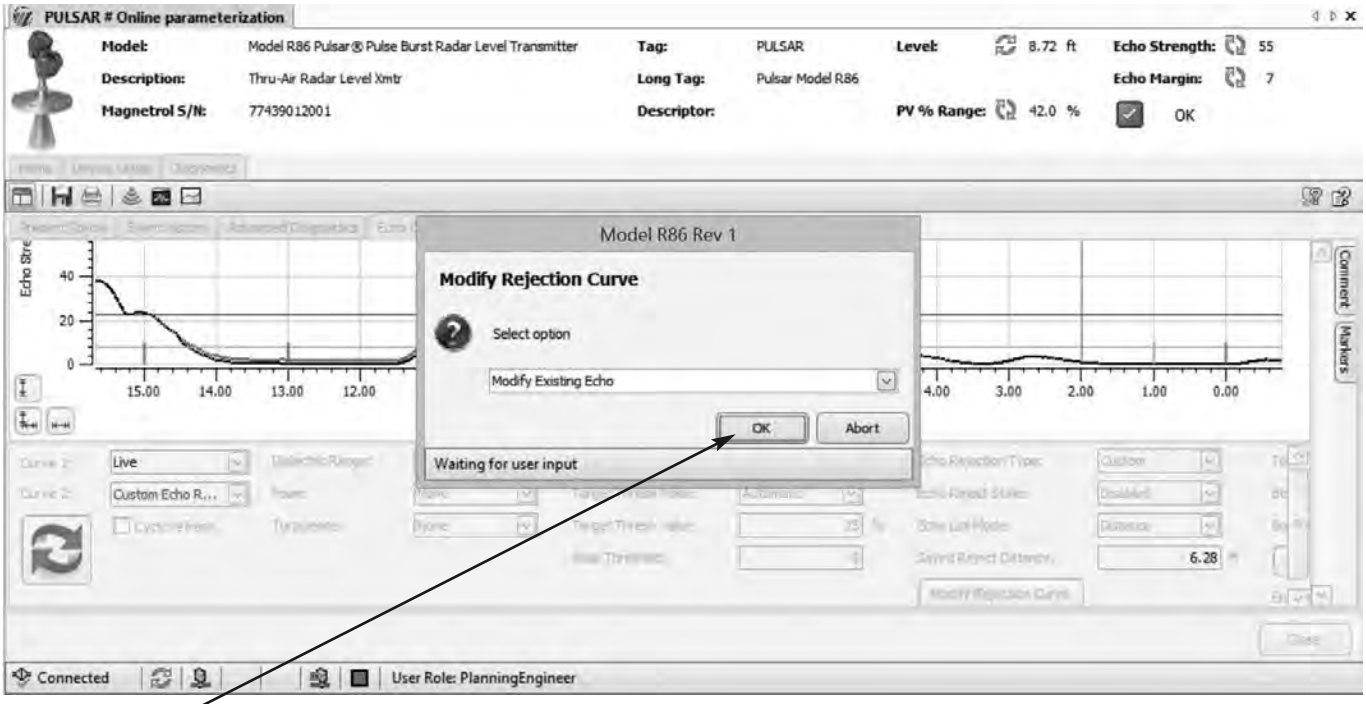
The "New Rejection Curve" button changes to "Modify Rejection Curve"; press button



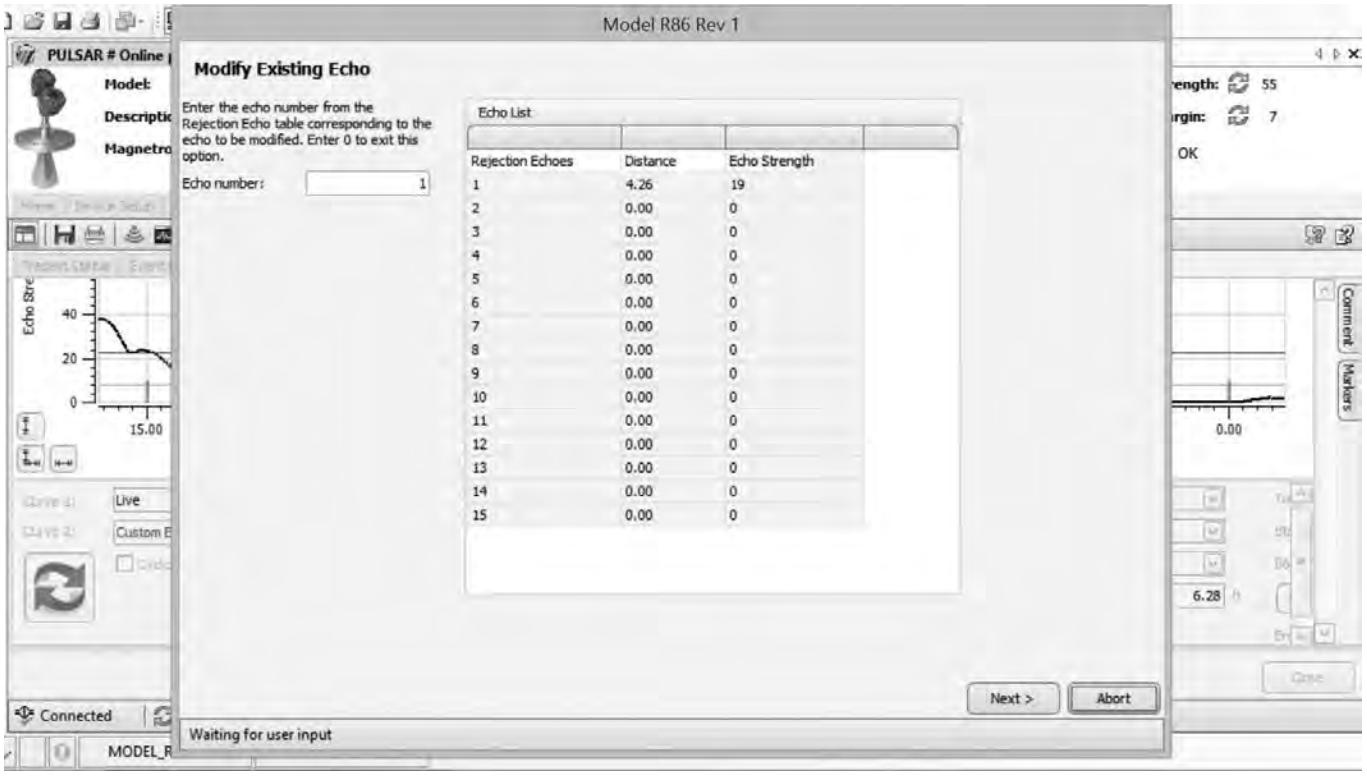
Click on NEXT at the loop warning message.



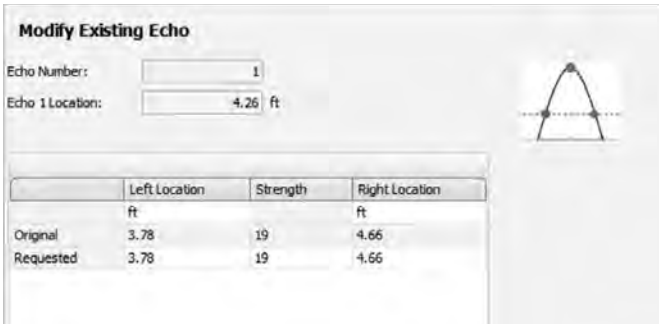
A password window will then appear. Click OK.

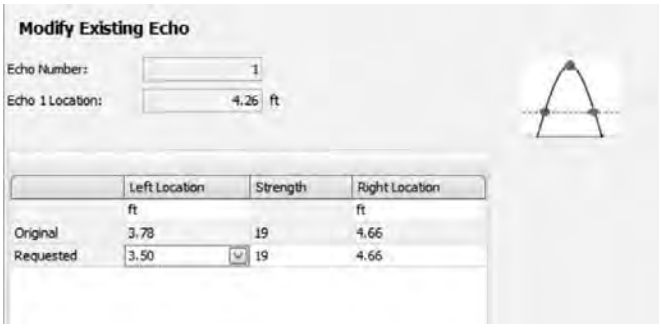


Click OK.

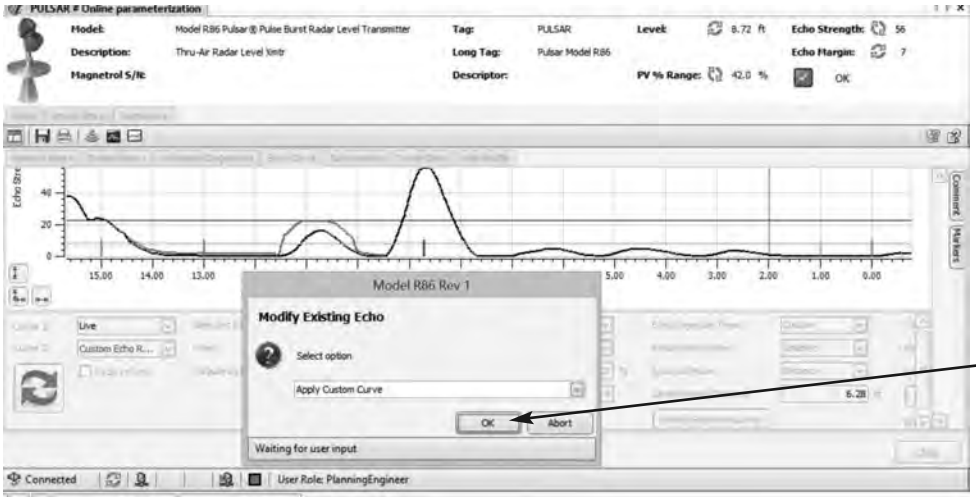


Upon presentation of the Rejection echo list (including the echo amplitudes), along with a display of the present level, select the desired false echo to be modified. (The distance to the echo must be smaller than the distance to the level echo).

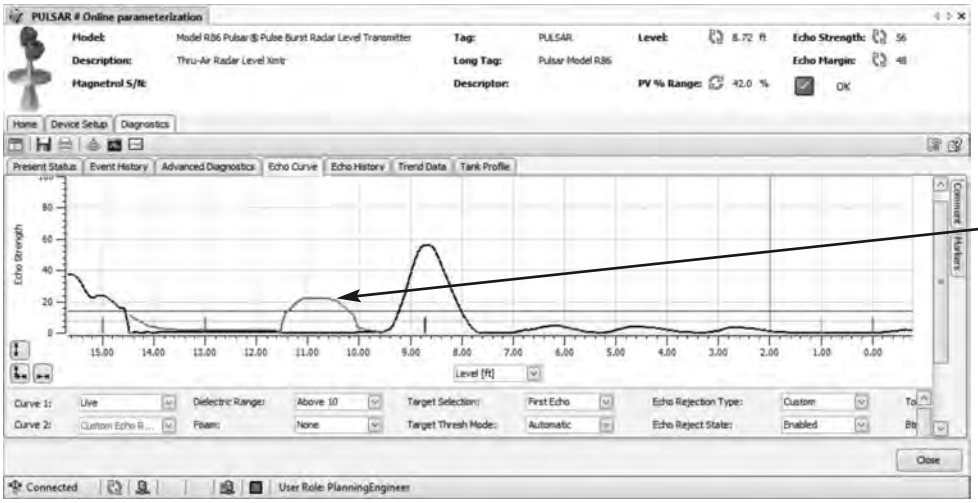




Revise left location and press ENTER. (Right location and/or strength can also be revised.)



Click OK.



New Rejected Area

4.3 Tank Profile

Introduction

Non-Contact radar transmitters are typically configured and commissioned with a static liquid level. Ideally, the installer will generate some level change after commissioning to verify proper operation, but rarely can one witness a complete fill and empty cycle of the vessel. Therefore, the transmitter configuration may not initially be optimized for the entire range of operation.

Although previous versions of Magnetrol transmitters contain troubleshooting options for recording and saving diagnostic information such as Data Log, Event History, and Echo History, none contains a way for the device to automatically capture pertinent information ***for an entire fill and empty cycle***. As this complete cycle could take hours, days or even weeks to complete, having this information will confirm proper operation for a given configuration or can provide precious information about the transmitter performance at troublesome levels in the tank.

The information is stored in the transmitter, retrieved at a later time and evaluated by a qualified individual who will decide the next steps to take.

A few items to note:

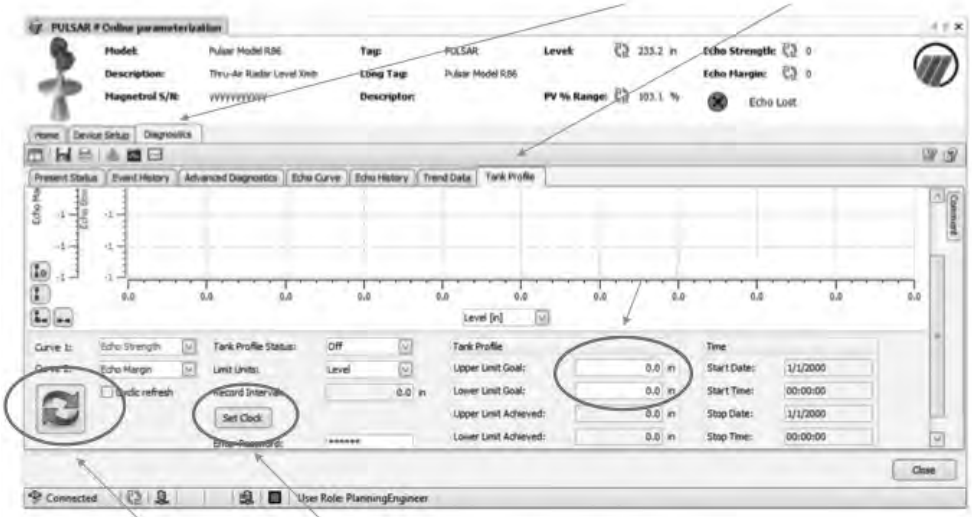
1. The Tank Profile feature must be manually initiated. It is not an automatic feature.
2. The Tank Profile feature may be manually stopped at any time.
3. Before the feature starts capturing information, the transmitter configuration should be manually saved. This is not necessary for the operation of the feature but provides useful data for determining what configuration change may be warranted.
4. Although the ability to set up and run this feature will be available in all user interfaces (HART and FF LUI, DD and DTM), the results can only be graphically viewed in the corresponding DTM. For DD-based hosts, there is a DD method that will sequentially display the readings one level at a time.
5. The feature can be set to cover a smaller range than the entire tank. For example, some processes may only operate in a smaller range.
6. The increments can be set as a percentage of the Start/Stop range (Increment by %) or in Level/Distance units (Increment by Unit).
7. The information captured at each increment will be:
   a. Time
   b. Level
   c. Distance
   d. Echo Strength
   e. Echo Margin
   f. Loop Current (HART only)
   g. Target Threshold
   h. Level Ticks
   i. BCSM state
8. The saved minimum and maximum Echo Strength and Echo Margin readings can be viewed in a graph in the Tank Profile menu.

SETUP

The Tank Profile can be initiated in the DTM in the following manner:

1. Use SET CLOCK button to ensure transmitter clock is set properly
2. Choose LIMIT UNITS of “Level” or “ % Range”
3. Choose INTERVAL, LIMITS and TIMES applicable to your needs.
4. TANK PROFILE STATUS will display “Off”, “Running” or “Completed”
5. Once computer is used to configure transmitter it does not have to stay connected.
6. Connect computer at later date to download captured data for analysis.

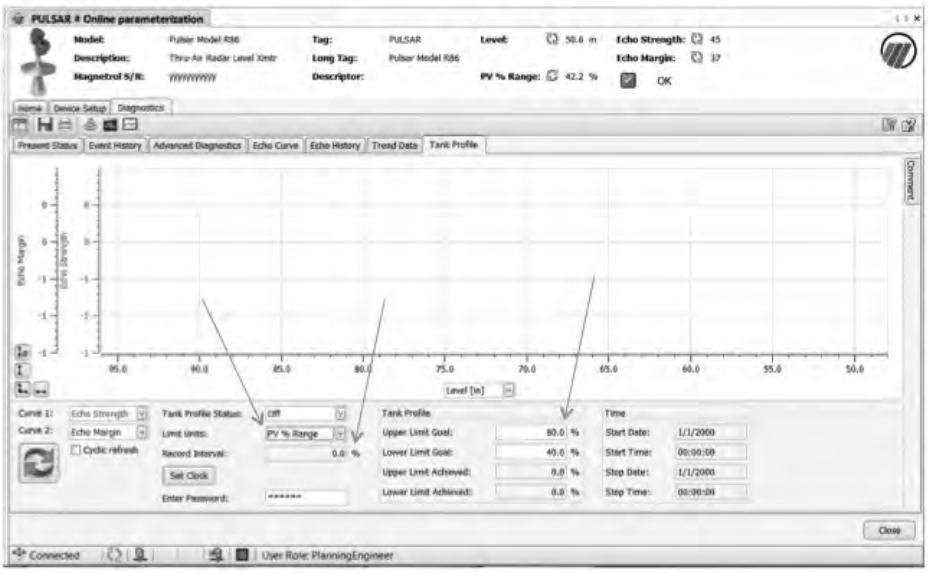
From the DTM, Tank Profile is accessed from the Diagnostics/Tank Profile tabs

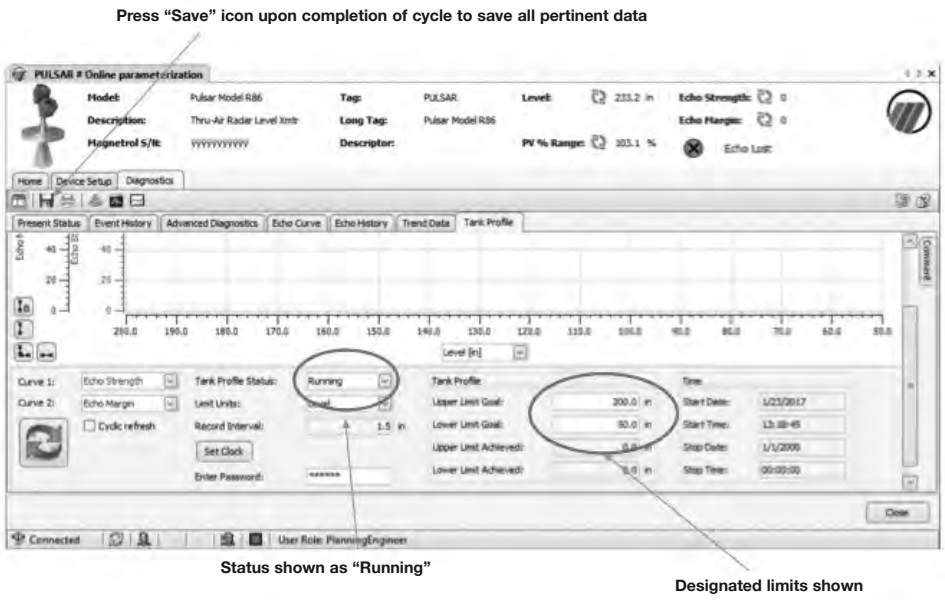


Hit Refresh to begin

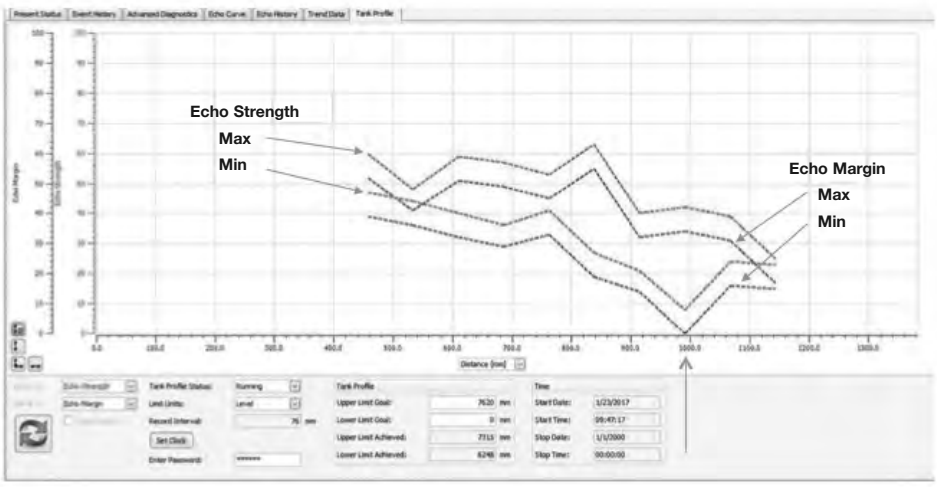
Set clock, if desired

Limit Units = PV % Range.....Record Interval and Tank Profile units switch to “%”





Progress can be conveniently viewed using the DTM



4.4 Echo Margin

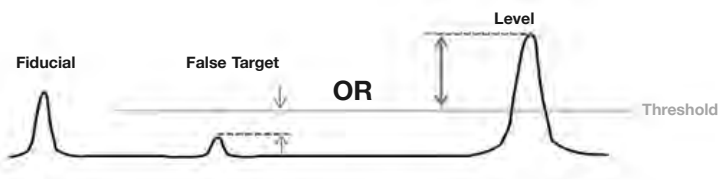
Echo Margin is a unique parameter that, when used along with Echo Strength can be a very useful troubleshooting tool. Echo Strength is taken from the standard Signal-to-Noise calculation and is simply defined as:

“The amplitude of the Level echo in Echo Strength units (0-100)”

Echo Margin is defined as:

“A numeric value that is related to the strength of the target peak relative to the Level Threshold or competing waveform features, i.e. "noise.”

The Echo Margin value (for the typical First Echo mode) is calculated as the difference of the False target-to-Threshold OR the Level target-to-Threshold whichever is SMALLER.



By reporting the SMALLER value, Echo Margin does a better job of reporting which issue is most likely to become a problem:

- False Target- if this echo becomes large enough to rise above the Threshold it will be mistakenly reported as the Level.
- Level Echo- if this echo becomes small enough to fall below the Threshold the transmitter will report Loss of Echo.

Always examine both Echo Strength and Echo Margin values. Increasing a Gain parameter (Dielectric, Turbulence, Foam or Sensitivity) will increase the amplitude of all echoes in the radar scene. If, after increasing a Gain parameter, the Echo Strength increases but the Echo Margin decreases a False Target is reaching closer to the Threshold (see drawing above). If the False Target reaches above the Threshold it will be detected as a valid Level echo and will be incorrectly reported as Level. In this case running Echo Rejection will eliminate the False Target and increase the Echo Margin value. Echo Margin values >20 are a good goal.

4.5 Automated Echo Capture

Unattended Echo Capture

One of the ways the Model R86 simplifies an often complex technology like Radar, is to improve the speed at which a user can turn around a problem and get the device back online. Minimizing down time is the ultimate goal of any device.

One of the most important tools used to troubleshoot a Radar application or optimize a transmitter configuration is the echo curve. This graphical representation of a Radar echo speaks volumes to those trained to interpret them. It is like a snapshot in time of the health of the transmitter. It is actually like seeing inside of the tank. However, the challenge with echo curves is acquiring them in a timely fashion. Unfortunately, most problems develop when there is a skeleton crew and no one watching this particular vessel. By the time an instrument technician can investigate, the alarm has cleared and no one understands why it occurred or, more importantly, when it will happen again. Since an echo curve is so important in troubleshooting the device, it is critical to capture the curve at the instant a problem occurs. Too often this means connecting a laptop and gathering information AFTER the first signs of the problem, which is obviously not ideal.

The advanced Pulsar Model R86 design is very effective at addressing this issue. This advanced design allows the transmitter to automatically capture an Echo Curve based on an Event (such as Loss of Echo) or Time (using the on-board clock).

It is shipped from the factory so an echo curve is automatically captured based on key Events. The transmitter has the ability to store a number of echo curves in its on-board memory. These echo curves can then be downloaded to a laptop running software such as PACTware and reviewed in Diagnostics/Echo History tab. If necessary, the user can email this information to the factory for expert assistance in troubleshooting. This enables the problem to be resolved much more quickly, minimizing possible down time.

A number of points should be made in this example:

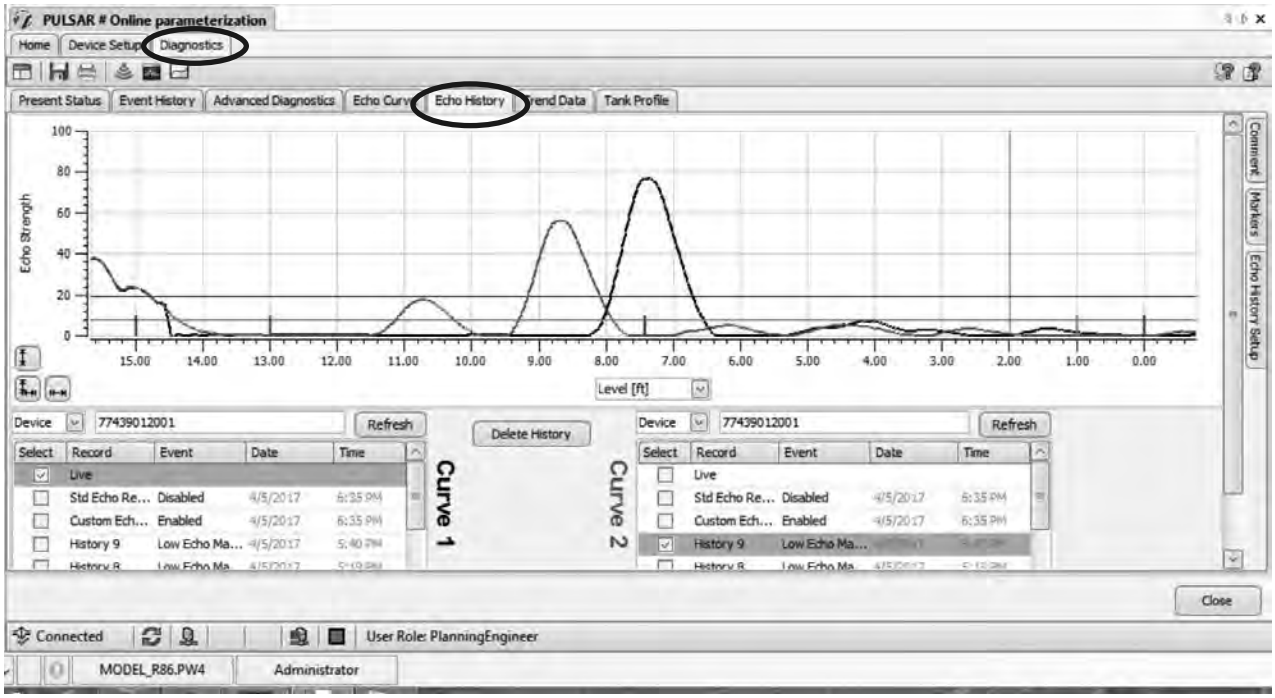
- Curve 1 is showing the current Live echo
- Curve 2 is showing "History 9"— the 9th echo stored in memory which was automatically captured at 5:40 p.m. on 4/5/2017
  - This echo capture was triggered by the "Low Echo Margin" diagnostic

SETUP

NOTE: The transmitter is shipped from the factory configured to automatically capture Echo Curves based on "Events" with ALL Events being enabled.

Automated Echo Capture is configured in the DTM in the following manner:

Open DTM to Diagnostics/Echo History



4.6 Event History

Although Event History has been included (and found to be very useful) in other Magnetol devices, it has been improved in the Model R86.

Event History becomes the main repository of all key Diagnostic and Configuration data. It now displays a history of the 20 most recent diagnostic indicators and configuration changes. For each event, the time when the event occurred and the duration of the event are shown. The table of history indicators displays the most recent indicator at the top with preceding indicators in descending order.

NOTE: A "+" suffix denotes the event remains active

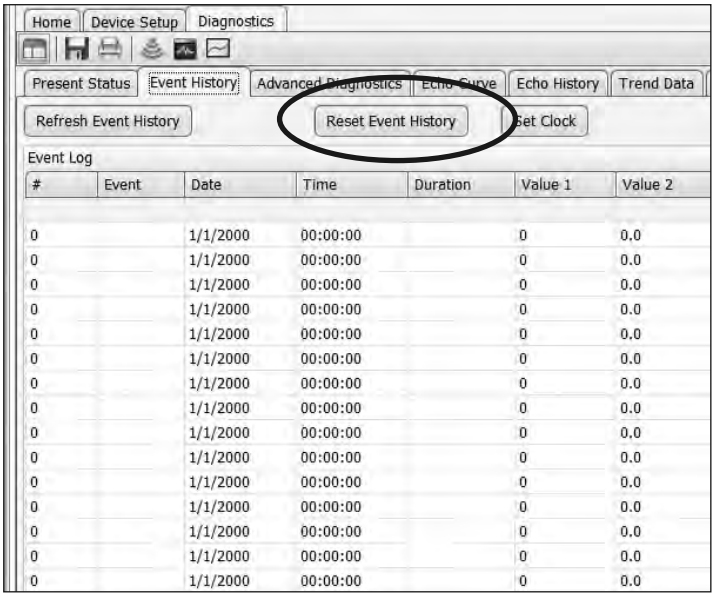
Key Features:

- 20 lines of Event information
- All Diagnostic and Configuration info
- Now 7 columns of data
- Item #
- Event name
- Date
- Time
- Duration
- Value1
- Value2

Value1 and Value2 entries have various meanings depending on the Event. (A comprehensive explanation of these entries is included in this section.) It is highly recommended to Set Clock (in transmitter) if actual Dates and Times are not shown.

(Although Event History can be viewed via the Local User Interface, the DTM offers a more complete view of the information.)

Press "Refresh Event History" upon opening the screen.



+ indicates event is active

#	Event	Date	Time	Duration	Value1	Value2
20	BC Level	2017-01-18	13:05:21	022:34:12+	12	18.0
19	Echo Reject State	2017-01-15	11:14:01	000:00:00	0	2.0
18	Std. Echo Rejection	2017-01-15	11:10:59	000:00:00	0	24.1
17	Foam	2017-01-15	11:08:39	000:00:00	1	35.0
16	Echo Curve	2017-01-15	09:41:45	000:00:00	2	83.2
15	Echo Lost	2017-01-15	09:41:15	000:87:45	0	83.2
14	Foam	2017-01-15	09:40:13	000:00:00	0	9.0
13	Max. Jump Exceeded	2017-01-12	01:26:41	000:00:49	32	118.5
12	Echo Reject State	2017-01-12	01:25:23	070:02:13	20	27.4
11	Foam	2017-01-12	01:25:23	000:00:00	2	88.0
10	BC Level	2017-01-08	15:51:20	000:17:49	1	33.1
9	Echo Reject State	2017-01-08	15:51:05	000:00:00	0	2.0
8	Echo Curve	2017-01-08	15:32:46	000:00:00	7	29.5
7	Low Echo Margin	2017-01-08	15:32:16	000:00:00	5	29.5
6	BC Level	2017-01-08	15:31:10	028:35:45	01	42.1

7 LOW ECHO MARGIN

Value 1 - EM value when captured
Value 2 - Level value when captured

Event History – Value1/Value2 Look-up Table

Event	Value1	Value2
ALL DIAGNOSTIC INDICATORS (unless otherwise noted below)	0 = No value (unused)	Level value when capturead
Analog Board Error	Error Code	0 = No value (unused)
Analog Output Error	Measured current	Expected current
Boundary Condition State (BCS) changes, Echo Lost and Inferred Level	XX- 2-digit value 1st digit = Beginning state 2nd digit = Ending state Based on following codes: 0 = Initialization 1 = Level (normal) 2 = Empty 3 = Full 4 = Echo Missing 5 = Echo Lost 6 = No Fiducial 7 = Restart	Level value when captured
Echo Curve (automated capture)	Capture based on: 12 - Too Many Echoes 14 - Echo Lost 17 - High Volume Alarm 18 - High Flow Alarm 28 - Inferred Level 33 - Max Jump Exceeded 34 - Low Echo Margin	Level value when captured
Echo Lost	See BCS changes	
High Electrical Temp	0 = No value (unused)	Temp when activated
High Surface Velocity	Value when activated	Level value when captured
Inferred Level	See BCS changes	
Low Echo Margin	Value when activated	Level value when captured
Low Electrical Temp	0 = No value (unused)	Temp when activated
Low Supply Voltage	Extrapolated terminal Lower voltage	Extrapolated terminal Upper voltage
Max. Jump Exceeded	Beginning Level value	Ending Level value
Reject Curve Invalid	0 = No value (unused)	0 = No value (unused)
Reset Max/Min Temperatures	Max Temp before reset	Min Temp before reset
Sweep Time Error	DAC setting	Sweep width
Too Many Echoes	Number of Echoes found	Level value when captured

Configuration Parameters

Event	Value1	Value2
# Run Average	Old value	New Value
4mA (LRV)	Old value	New value
20mA (URV)	Old value	New value
Base Threshold	Old value	New value
Bottom Blocking Distance	Old value	New value
Custom Echo Rejection	0 = No value (unused)	Level value when captured
Dielectric	0 = 1.4–1.7 1 = 1.7–3.0 2 = 3.0–10 3 = >10	Corresponding Echo Strength

Configuration Parameters (continued)

Event	Value1	Value2
Echo Rejection Type 2 = Standard Echo Rejection 3 = Custom Echo Rejection	Old value	New Value
Echo Reject State	Old Value 0 = Off 1 = Disabled 2 = Enabled	New Value
FME Distance Threshold	Old value	New Value
Foam	0 = None 1 = Light 2 = Medium 3 = Heavy	Corresponding Echo Strength
HART Poll address	Old value	New value
Level Trim	Old value	New value
Max Level Jump	Old value	New value
Max Surface Velocity	Old value	New value
Passwords (Date/Time only)	0 = No value (unused)	0 = No value (unused)
Rate of Change	Old value 0 = <5 in/min (<130mm/min) 1 = 5–20 in/min (130-500mm/min) 2 = 20–60 in/min (500–1500mm/min) 3 = >60 in/min (>1500mm/min)	New value
Sensitivity	Value	Corresponding Echo Strength
Standard Echo Rejection	0 = No value (unused)	Level value when captured
Stillwell ID	Old value	New value
Tank Height	Old value	New value
Target Selection	Old value 1 = First Echo 2 = Largest Echo 3 = First Moving Echo	New value
Target Threshold Mode	Old value 1 = Automatic 2= Fixed	New value
Target Threshold Value	Old value Automatic = % of Peak Max Fixed = Value in Eng. Units	New value
Top Blocking Distance	Old value	New value
Turbulence	0 = None 1 = Light 2 = Medium 3 = Heavy	Corresponding Echo Strength
TVG End Location	Old value	New value
TVG End Value	Old value	New value
TVG Start Location	Old value	New value
TVG Start Value	Old value	New value

Complete Listing of Diagnostic Indicators including Analog Board Errors

Error Code	Diagnostic	Explanation
0	OK	
1	Software Error	Instruction execution traversed an incorrect path
2	RAM Error	run-time volatile memory test failed
3	ADC Error	Run-time analog-to-digital converter test failed
4	EEPROM Error	Unrecoverable checksum error in non-volatile memory
5	Analog Board Error	Delay-locked loop malfunction
6	Analog Output Error	Measured loop current differs from commanded value
7	Spare	
8	Default Params	All parameters reset to default values
9	Spare	
10	Sweep Time Error	Analog Board sweep time error
11	Spare	
12	Too Many Echoes	Excessive number of waveform features are possible echoes
13	Safe Zone Alarm	Level is above Safe Zone end
14	No Echoes	Echo from upper surface missing for longer than Echo Loss Delay
15	Spare	
16	Config Conflict	Configuration conflict caused by incompatible parameter selections
17	High Volume Error	Calculated Volume exceeds maximum for vessel or custom table
18	High Flow Error	Calculated Flow exceeds maximum for flume or custom table
19	Spare	
20	Initializing	System warming up, distance measurement not yet valid
21	Config Changed	A parameter(s) has recently been modified from the User Interface
22	Spare	
23	High Electrical Temp	Present electronics temperature above maximum
24	Low Electric Temp	Present electronics temperature below minimum
25	Calibration Required	Distance calibration parameters are at default values
26	Echo Rejection Invalid	Previously stored Echo Rejection Curve invalidated by parameter change
27	Spare	
28	Inferred Level	Typically this is caused when the Level target has been lost or has entered either the Top or Bottom Blocking Distance zones. If in the Top or Bottom Blocking Distance zones the transmitter will read Full (Top) or Empty (Bottom). The Level reading (and mA value) will never be higher than the value related to the Top Blocking Distance or lower than the value related to the Bottom Blocking Distance.
29	Adjust Analog Output	Loop trim parameters are at default values
30	Totalizer Data Lost	Totalizer data has been lost, restarted from zero
31	Low Supply Voltage	Power supply voltage inadequate to prevent brownout or reset
32	Spare	
33	Max Jump Exceeded	Transmitter has jumped to an echo that exceeds the Max Distance Jump value from the previous echo.
34	Marginal Echo	Signal Margin is less than allowable minimum
35	High Surface Velocity	The measured Surface Velocity is greater than the Max Surface Velocity value derived from the Rate of Change parameter.
36	Spare	
37	Seq Record	Instruction execution traversed a correct but unexpected path (formerly System Warning)

Notes

Notes

IMPORTANT

The Model R86 transmitter is not serviceable in the field. Return to the factory for repair or replacement.

SERVICE POLICY

Owners of Magnetrol products may request the return of a control; or, any part of a control for complete rebuilding or replacement. They will be rebuilt or replaced promptly. Magnetrol International will repair or replace the control, at no cost to the purchaser, (or owner) ***other than transportation cost*** if:

a. Returned within the warranty period; and,
b. The factory inspection finds the cause of the malfunction to be defective material or workmanship.

If the trouble is the result of conditions beyond our control; or, is **NOT** covered by the warranty, there will be charges for labour and the parts required to rebuild or replace the equipment.
In some cases, it may be expedient to ship replacement parts; or, in extreme cases a complete new control, to replace the original equipment before it is returned. If this is desired, notify the factory of both the model and serial numbers of the control to be replaced. In such cases, credit for the materials returned, will be determined on the basis of the applicability of our warranty.
No claims for misapplication, labour, direct or consequential damage will be allowed.

RETURNED MATERIAL PROCEDURE

So that we may efficiently process any materials that are returned, it is essential that a “Return Material Authorisation” (RMA) form will be obtained from the factory. It is mandatory that this form will be attached to each material returned. This form is available through Magnetrol’s local representative or by contacting the factory. Please supply the following information:

1. Purchaser Name
2. Description of Material
3. Serial Number and Ref Number
4. Desired Action
5. Reason for Return
6. Process details

Any unit that was used in a process must be properly cleaned in accordance with the proper health and safety standards applicable by the owner, before it is returned to the factory.
A material Safety Data Sheet (MSDS) must be attached at the outside of the transport crate or box.
All shipments returned to the factory must be by prepaid transportation. Magnetrol ***will not accept*** collect shipments.
All replacements will be shipped Ex Works.

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MAGNETROL®

AMETEK®

Foundation Fieldbus™ Operating Manual

MAGNETROL PULSAR MODEL R86

High Performance 26 GHz Pulse Burst Radar Level Transmitter

PULSAR®
R86 RADAR

Pulsar® Model R86
FOUNDATION Fieldbus™
Operating Manual

Software Version 1.x

High Performance
26 GHz Pulse Burst Radar
Level Transmitter

FOUNDATION

Use in conjunction with
I&O manual BE 58-603

MAGNETROL®

AMETEK®

Pulsar® Model R86 Pulse Burst Radar Transmitter with FOUNDATION Fieldbus™ Output

Table of Contents

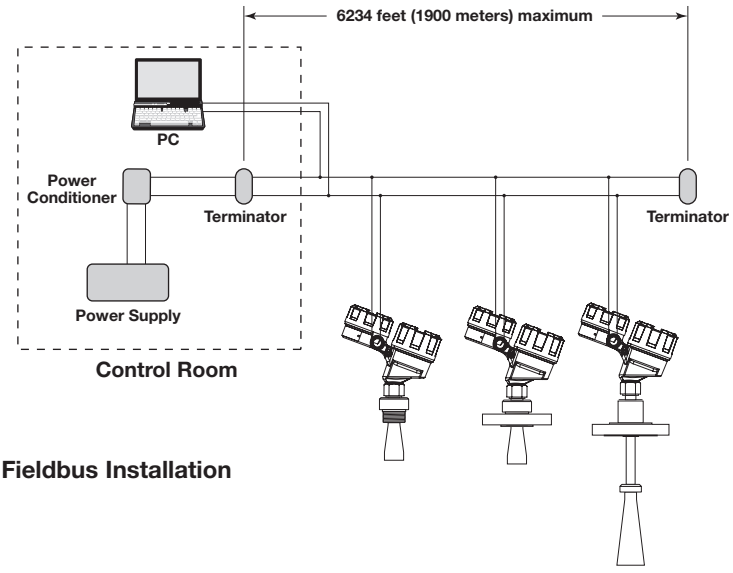
1.0 FOUNDATION Fieldbus™

1.1 Overview

FOUNDATION Fieldbus™ is a digital communications system that serially interconnects devices in the field. A Fieldbus system is similar to a Distributed Control System (DCS) with two exceptions:

- Although a FOUNDATION Fieldbus™ system can use the same physical wiring as 4–20 mA device, Fieldbus devices are not connected point to point, but rather are multidropped and wired in parallel on a single pair of wires (referred to as a segment).
- FOUNDATION Fieldbus™ is a system that allows the user to distribute control across a network. Fieldbus devices are smart and can actually maintain control over the system.

Unlike 4–20 mA analog installations in which the two wires carry a single variable (the varying 4–20 mA current), a digital communications scheme such as FOUNDATION Fieldbus™ considers the two wires as a network. The network can carry many process variables as well as other information. The PULSAR Model R86 FF transmitter is a FOUNDATION Fieldbus™ registered device that communicates with the H1 FOUNDATION Fieldbus™ protocol operating at 31.25 kbits/sec. The H1 physical layer is an approved IEC 61158 standard.



Typical Fieldbus Installation

Details regarding cable specifications, grounding, termination, and other physical layer network information can be found in IEC 61158 or the wiring installation application guide AG-140 at **www.fieldcommgroup.org**.

1.2 Device Description (DD)

An important requirement of Fieldbus devices is the concept of interoperability, defined as "the ability to operate multiple devices in the same system, regardless of manufacturer, without loss of functionality."

Device Description (DD) technology is used to achieve this interoperability. The DD provides extended descriptions for each object and provides pertinent information needed by the host system. DDs are similar to the drivers that your personal computer (PC) uses to operate peripheral devices connected to it. Any Fieldbus host system can operate with a device if it has the proper DD and Common File Format (CFF) for that device.

The most recent DD and CFF files can be found on the FOUNDATION Fieldbus™ web site at www.fieldcommgroup.org.

NOTE: Consult your host system vendor for any host-specific files that may be needed.

1.2.1 FOUNDATION Fieldbus™ DD Revision Table

FOUNDATION Fieldbus™ Version	FOUNDATION Fieldbus™ Release Date	Compatible with Model R86 Software
Dev V1 DD V1	April 2017	Version 1.0a or later

1.3 Link Active Scheduler (LAS)

The default operating class of the PULSAR Model R86 FF with FOUNDATION Fieldbus™ is a Basic device. However, it is capable of being configured as a Link Active Scheduler (LAS).

The LAS controls all communication on a FOUNDATION Fieldbus™ segment. It maintains the "Live List" of all devices on a segment and coordinates both the cyclic and acyclic timing.

The primary LAS is usually maintained in the host system, but in the event of a failure, all associated control can be transferred to a backup LAS in a field device such as the PULSAR Model R86 FF transmitter.

NOTES:

1) The PULSAR Model R86 is normally shipped from the factory with Device Class set to Basic.

2) The operating class can be changed from Basic to LAS using a FOUNDATION Fieldbus™ configuration tool.

1.4 Intrinsic Safety

The H1 physical layer supports Intrinsic Safety (IS) applications with bus-powered devices. To accomplish this, an Intrinsically Safe barrier or galvanic isolator is placed between the power supply in the safe area and the device in the hazardous area.

H1 also supports the Fieldbus Intrinsically Safe Concept (FISCO) model which allows more field devices in a network. The FISCO model considers the capacitance and inductance of the wiring to be distributed along its entire length. Therefore, the stored energy during a fault will be less and more devices are permitted on a pair of wires. Instead of the conservative entity model, which only allows about 90 mA of current, the FISCO model allows a maximum of 110 mA for Class II C installations and 240 mA for Class II B installations.

FISCO certifying agencies have limited the maximum segment length to 1000 meters because the FISCO model does not rely on standardized ignition curves.

The PULSAR Model R86 FF is available with entity IS, FISCO IS, FNICO and non-incendive approvals (explosion proof–future).

2.0 Standard Function Blocks

2.1 Overview

The function of a FOUNDATION Fieldbus™ device is determined by the arrangement of a system of blocks defined by the Fieldbus foundation. The types of blocks used in a typical User Application are described as either Standard or Advanced.

Function Blocks are built into the FOUNDATION Fieldbus™ devices as needed to provide the desired control system behavior. The input and output parameters of function blocks can be linked over the Fieldbus and there can be numerous function blocks in a single User Application.

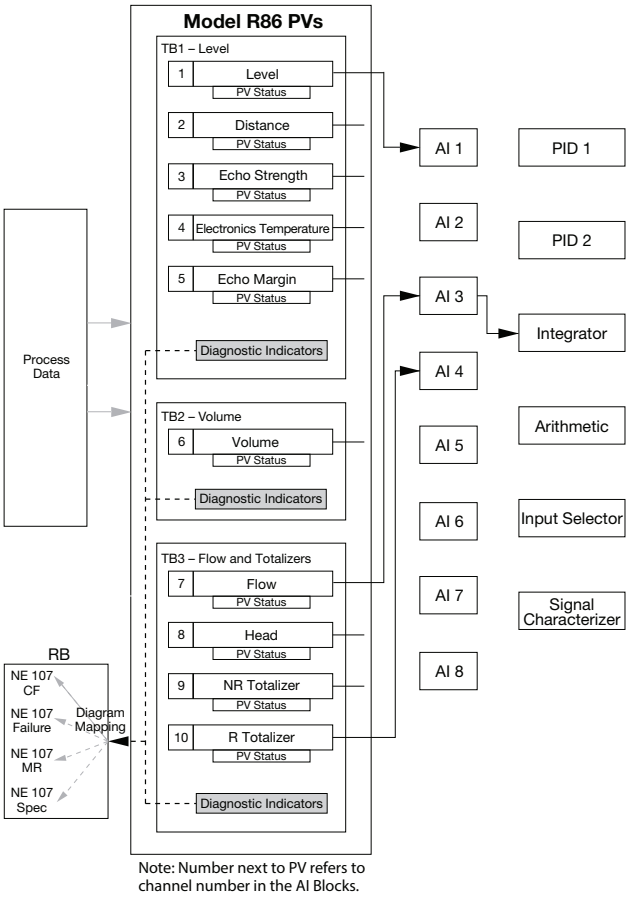
The PULSAR Model R86 FF is a Pulse Burst Radar level transmitter with the following standard FOUNDATION Fieldbus™ Function Blocks:

- One (1) Resource Block (RB)
- Three (3) Custom Transducer Blocks (TB)
- Eight (8) Analog Input Function Blocks (AI)
- Two (2) PID Blocks (PID)

With Advanced Function Blocks:

- One (1) Arithmetic Block (AR)
- One (1) Input Selector Block (IS)
- One (1) Signal Characterizer Block (SC)
- One (1) Integrator Block (IT)

Model R86 – Transducer Block



Note: Number next to PV refers to channel number in the AI Blocks.

The idea of Function Blocks, which a user can customize for a particular application, is a key concept of Fieldbus topology. Function Blocks consist of an algorithm, inputs and outputs, and a user-defined Block Tag.

The Transducer Block (TB) output is available to the network through the Analog Input (AI) blocks. Refer to Section 2.3 for additional information on the Transducer Blocks.

The AI blocks take the TB values and make them available as an analog value to other function blocks. The AI blocks have scaling conversion, filtering, and alarm functions.

Refer to Section 2.4 for additional information on the Analog Input Blocks.

As shown in the diagram at left, the end user typically configures the Process Variable value as an Analog Input to their Fieldbus network.

2.1.1 Universal Fieldbus Block Parameters

The following are general descriptions of the parameters common to all function blocks. Additional information for a given parameter may be described later in a section that describes the specific block.

ST_REV: a read-only parameter that gives the revision level of the static data associated with the block. This parameter will be incremented each time a static parameter attribute value is written and is a vehicle for tracking changes in static parameter attributes.

TAG_DESC: a user assigned parameter that describes the intended application of any given block.

STRATEGY: a user assigned parameter that identifies groupings of blocks associated with a given network connection or control scheme.

ALERT_KEY: a user-assigned parameter which may be used in sorting alarms or events generated by a block.

MODE_BLK: a structured parameter composed of the actual mode, the target mode, the permitted mode(s), and the normal mode of operation of a block.

- Target: The mode to "go to"
- Actual: The mode the "block is currently in"
- Permitted: Allowed modes that target may take on
- Normal: Most common mode for target

NOTES:

1) It may be required to change the MODE_BLK target parameter to OOS (out of service) to change configuration parameters in that specific function block. (When in OOS, the normal algorithm is no longer executed and any outstanding alarms are cleared.)

2) All blocks must be in an operating mode for the device to operate. This requires the Resource Block and the Transducer Block to be in "AUTO" before the specific function block can be placed in a mode other than OOS (out of service).

BLOCK_ERR: a parameter that reflects the error status of hardware or software components associated with, and directly affecting, the correct operation of a block.

NOTE: A BLOCK_ERR of "Simulation Active" in the Resource Block does not mean simulation is active—it merely indicates that the simulation (hardware) enabling jumper is present. (See page 21 and refer to Section 2.4.5 for additional information).

3) Function Block Execution Times:
- 10 msec (AI, IT. IS, AR, SC)
- 15 msec (PID)

2.2 Resource Block

The RESOURCE BLOCK describes the characteristics of the FOUNDATION Fieldbus™ device such as the device name, manufacturer, and serial number. As it only contains data specific to the PULSAR Model R86 FF transmitter, it has no control function.

2.2.1 Resource Block Parameters

MODE_BLK: Must be in AUTO in order for the remaining function blocks in the transmitter to operate.

NOTE: A Resource Block in "out of service" mode will stop all function block execution in the transmitter.

RS_STATE: Identifies the state of the RESOURCE block state machine. Under normal operating conditions, it should be "On-Line."

DD_RESOURCE: A string identifying the tag of the resource that contains the Device Description for this device.

MANUFAC_ID: Contains Magnetrol International's FOUNDATION Fieldbus™ manufacturer's ID number, which is 0x000156.

DEV_TYPE: The model number of the PULSAR Model R86 FF transmitter (0x0008). It is used by the Host System and other Fieldbus interface devices to locate the Device Descriptor (DD) file.

DEV_REV: Contains the device revision of the PULSAR Model R86 FF transmitter and is used by the Host System and other Fieldbus interface devices to correctly select the associated DD.

DD_REV: Contains the revision of the DD associated with the device revision of the PULSAR Model R86 FF transmitter. It is used by the Host System and other Fieldbus interface devices to correctly select the associated DD.

GRANT_DENY: Options for controlling access of host computer and local control panels to operating, tuning and alarm parameters of the block.

HARD_TYPES: The types of hardware available as channel numbers.

RESTART: Default and Processor are the available selections. Default will reset the Model R86 to the default function block configuration.

NOTE: As RESTART DEFAULT will set most function block configuration parameters to their default values. Devices need to be reconfigured following activation of this function.

FEATURES: A list of the features available in the transmitter, such as Reports and Soft Write Lock.

FEATURES_SEL: Allows the user to turn Features on or off.

CYCLE_TYPE: Identifies the block execution methods that are available.

CYCLE_SEL: Allows the user to select the block execution method.

MIN_CYCLE_T: The time duration of the shortest cycle interval. It puts a lower limit on the scheduling of the resource.

MEMORY_SIZE: Available configuration memory in the empty resource.

NV_CYCLE_T: The minimum time interval between copies of non-volatile (NV) parameters to NV memory. NV memory is only updated if there has been a significant change in the dynamic value and the last value saved will be available for the restart procedure.

NOTE: After completing a download, allow several seconds before removing power from the PULSAR Model R86 FF transmitter to ensure that all data has been saved.

FREE_SPACE: Shows the amount of available memory for further configuration. The value is zero percent in a preconfigured device.

FREE_TIME: The amount of the block processing time that is free to process additional blocks.

SHED_RCAS: The time duration at which to give up computer writes to function block RCas locations.

SHED_ROUT: The time duration at which to give up computer writes to function block ROut locations.

FAULT_STATE, SET_FSTATE, CLR_FSTATE: These only apply to output function blocks. (The Model R86 FF has no output function blocks).

MAX_NOTIFY: The maximum number of alert reports that the transmitter can send without getting a confirmation.

LIM_NOTIFY: the maximum numbers of unconfirmed alert notify messages allowed. No alerts are reported if set to zero.

CONFIRM_TIME: the time that the transmitter will wait for confirmation of receipt of a report before trying again. Retry will not occur if CONFIRM_TIME = 0.

WRITE_LOCK: When set to LOCKED, will prevent any external change to the static or non-volatile data base in the Function Block Application of the transmitter. Block connections and calculation results will proceed normally, but the configuration will be locked.

UPDATE_EVT (**Update Event**): Is an alert generated by a write to the static data in the block.

BLOCK_ALM (**Block Alarm**): Is used for configuration, hardware, connection, or system problems in the block. The cause of any specific alert is entered in the subcode field.

ALARM_SUM (**Alarm Summary**): Contains the current alert status, the unacknowledged states, the unreported states, and the disabled states of the alarms associated with the block.

ACK_OPTION (**Acknowledge Option**): Selects whether alarms associated with the block will be automatically acknowledged.

WRITE_PRI (**Write Priority**): The priority of the alarm generated by clearing the write lock.

WRITE ALM (**Write Alarm**): The alert generated if the write lock parameter is cleared.

ITK_VER (**ITK Version**): Contains the version of the Interoperability Test Kit (ITK) used by the FieldComm Group during their interoperability testing.

2.2.2 Additional Resource Block Parameters

Additional parameters are available within the resource block for use with NE-107 to aid in communicating device conditions to the user.

FD_VER: Major version of the Field Diagnostic specification to which this device conforms.

FD_FAIL_ACTIVE: For error conditions that have been selected for the FAIL alarm category, this parameter reflects those that have been detected as active.

FD_OFFSPEC_ACTIVE: For error conditions that have been selected for the OFFSPEC alarm category, this parameter reflects those that have been detected as active.

FD_MAINT_ACTIVE: For error conditions that have been selected for the MAINT alarm category, this parameter reflects those that have been detected as active.

FD_CHECK_ACTIVE: For error conditions that have been selected for the CHECK alarm category, this parameter reflects those that have been detected as active.

FD_FAIL_MAP: Maps conditions to be detected as active for the FAIL alarm category.

FD_OFFSPEC_MAP: Maps conditions to be detected as active for the OFFSPEC alarm category.

FD_MAINT_MAP: Maps conditions to be detected as active for the MAINT alarm category.

FD_CHECK_MAP: Maps conditions to be detected as active for the CHECK alarm category.

FD_FAIL_MASK: Used to suppress an alarm from being broadcast for single or multiple conditions that are active in the FAIL alarm category.

FD_OFFSPEC_MASK: Used to suppress an alarm from being broadcast for single or multiple conditions that are active in the OFFSPEC alarm category.

FD_MAINT_MASK: Used to suppress an alarm from being broadcast for single or multiple conditions that are active in the MAINT alarm category.

FD_CHECK_MASK: Used to suppress an alarm from being broadcast for single or multiple conditions that are active in the CHECK alarm category.

FD_FAIL_ALM: Used to broadcast a change in the associated active conditions, which are not masked, for the FAIL alarm category.

FD_OFFSPEC_ALM: Used to broadcast a change in the associated active conditions, which are not masked, for the OFFSPEC alarm category.

FD_MAINT_ALM: Used to broadcast a change in the associated active conditions, which are not masked, for the MAINT alarm category.

FD_CHECK_ALM: Used to broadcast a change in the associated active conditions, which are not masked, for the CHECK alarm category.

FD_FAIL_PRI: Specifies the priority of the FAIL alarm category.

FD_OFFSPEC_PRI: Specifies the priority of the OFF-SPEC alarm category.

FD_MAINT_PRI: Specifies the priority of the MAINT alarm category.

FD_CHECK_PRI: Specifies the priority of the CHECK alarm category.

FD_SIMULATE: Diagnostic conditions can be manually supplied when simulation is enabled.

FD_RECOMMEN_ACT: Describes what actions can be taken to address an active diagnostic condition.

FD_EXTENDED_ACTIVE_1: For error conditions that have been selected in the Extended_Map_1 parameter, this parameter reflects those that have been detected as active.

FD_EXTENDED_MAP_1: Allows the user finer control in selecting multiple conditions contributing to a single condition that may be mapped for the various alarm categories.

SERIAL_NUMBER: Manufacturer specific read-only parameter that corresponds to "Magnetrol Serial Number" in the Transducer Block.

SOFTWARE_REV: Read-only parameter that corresponds to "Firmware Version" in the Transducer Block.

HARDWARE_REV: Read-only parameter that corresponds to "Hardware Version" in the Transducer Block.

COMPATIBILITY_REV: Read-only parameter that is optionally used when replacing field devices. The correct usage of this parameter presumes that the DEV_REV value of the replaced device is equal or lower that the COMPATIBILITY_REV value of the replacing device.

2.3 Transducer Block

The three TRANSDUCER blocks (TB) contained within the PULSAR Model R86 FF transmitter are custom blocks containing parameters pertinent to the transmitter itself.

TRANSDUCER Block 1 (used for level only operation) contains information such as the Configuration, Diagnostics, Calibration data, output level and Status information.

TRANSDUCER Block 2 contains parameters for volume measurement configuration.

TRANSDUCER Block 3 contains parameters for flow measurement calculations.

The read-only parameters and read-write parameters within the TB are grouped in a useful configuration.

- The read-only parameters report the block status and operation modes.
- The read-write parameters affect both the operation of the function block and the transmitter itself.

NOTE: The Transducer Block will automatically be changed to "Out of Service" when the local interface (keypad) is used to change a static parameter online. The Transducer Block must be manually placed back in service from the Host System to resume operation.

2.3.1 Transducer Block Parameters

The first six parameters in the TRANSDUCER Block are the universal parameters discussed in section 2.1.1. After the universal parameters, six additional parameters are required for Transducer Blocks. The most notable of these parameters are **UPDATE_EVT** and **BLOCK_ALM**. It should be noted that these six additional parameters must exist but do not have to be implemented.

An important device-specific parameter found later in the TRANSDUCER Block list is **PRESENT_STATUS**, which displays the status of the device. If more than one message exists, then the messages are displayed in priority order.

If **PRESENT_STATUS** indicates a problem, refer to Section 5.2, Troubleshooting.

For a complete list of Transducer Block Parameters, refer to table in the Appendix.

NOTE: The user should compare the DD file and revision number of the device with the HOST system to ensure they are at the same revision level.

Refer to the DD Revision Table Section 1.2.1.

Refer to Appendix B for a complete list of the three Transducer Block parameter sets.

2.3.2 Password Parameters

To change a parameter at the local user interface, host, or Fieldbus interface, a value matching the user password must be entered (Default = 0). If a static parameter is changed from the local user interface, the Associated Transducer Block goes Out of Service (OOS).

Refer to the Section 4.3 for additional information regarding passwords.

After five minutes with no keypad activity, the entered password expires. However, the device must be placed back in service from the Host System.

2.3.3 PULSAR Model R86 FF Configuration Parameters

One of the main advantages of the PULSAR Model R86 FF Pulse Burst Radar transmitter is that the device can be delivered pre-configured to the user.

In addition, FOUNDATION Fieldbus™ provides the ability to monitor changes and make adjustments to a transmitter. The Fieldbus™ concept allows a user to make adjustments if deemed necessary.

2.3.4 PULSAR Model R86 FF Device-Specific Configuration Parameters

Refer to PULSAR Model R86 I/O Manual BE 58-603 for detailed information on the Model R86 device-specific configuration parameters.

2.4 Analog Input Block

The ANALOG INPUT (AI) block takes the PULSAR Model R86 FF input data, selected by channel number, and makes it available to other function blocks at its output.

The channel selections are:

Transducer Blocks	Process Variable	Channel Parameter Value (AI Blocks)
TB1 – Level	Level	1
	Distance	2
	Echo Strength	3
	Echo Margin	4
	Electronics Temperature	5
TB2 – Volume	Volume	6
TB3 – Flow and Totalizers	Flow	7
	Head	8
	NR Totalizer	9
	R Totalizer	10

2.4.1 AI Block Parameters

ST_REV: : a read-only parameter that gives the revision level of the static data associated with the block. This parameter will be incremented each time a static parameter attribute value is written and is a vehicle for tracking changes in static parameter attributes.

TAG_DESC: a user assigned parameter that describes the intended application of any given block.

STRATEGY: a user assigned parameter that identifies groupings of blocks associated with a given network connection or control scheme.

ALERT_KEY: a user-assigned parameter which may be used in sorting alarms or events generated by a block.

MODE_BLK: a structured parameter composed of the actual mode, the target mode, the permitted mode(s), and the normal mode of operation of a block.

- Target: The mode to "go to"
- Actual: The mode the "block is currently in"
- Permitted: Allowed modes that target may take on
- Normal: Most common mode for target

BLOCK_ERR: This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string so that multiple errors may be shown.

PV: Either the primary analog value for use in executing the function, or a process value associated with it.

OUT: The primary analog value calculated as a result of executing the function block.

SIMULATE: Allows the transducer analog input or output to the block to be manually supplied when simulate is enabled. When simulate is disabled, the simulate value and status track the actual value and status. Refer to Section 2.4.5 for additional information.

XD_SCALE: The high and low scale values, Engineering Units, and number of digits to the right of the decimal point used with the value obtained from the transducer for a specified channel.

OUT_SCALE: The high and low scale values, Engineering Units, and number of digits to the right of the decimal point to be used in displaying the OUT parameter.

GRANT_DENY: Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block.

IO_OPTS: Option which the user may select to alter input and output block processing.

STATUS_OPTS: Options which the user may select in the block processing of status.

CHANNEL: The number of the logical hardware channel that is connected to this I/O block. (This information defines the transducer to be used going to or from the physical world).

L_TYPE: Determines if the values passed by the transducer block to the AI block may be used directly (Direct), or if the value is in different units and must be converted linearly (Indirect), using the input range defined for the transducer and the associated output range.

LOW_CUT: Limit used in square root processing.

PV_FTIME: Time constant of a single exponential filter for the PV, in seconds.

FIELD_VAL: Raw value of the field device in % of PV range, with a status reflecting the Transducer condition before signal characterization (L_TYPE) or filtering (PV_FTIME).

UPDATE_EVT: This alert is generated by any change to the static data.

BLOCK_ALM: The block alarm is used for all configuration, hardware, or system problems in the block.

ALARM_SUM: The current alert status, unacknowledged states, unreported states, and disabled states of the alarms associated with the function block.

ACK_OPTION: Selection of whether alarms associated with the function block will be automatically acknowledged.

ALARM_HYS: Amount the PV must return within the alarm limits before the alarm condition clears. Alarm hysteresis expressed as a percent of the span of the PV.

HI_HI_PRI: Priority of the high-high alarm.

HI_HI_LIM: The setting for high-high alarm in engineering units.

HI_PRI: Priority of the high alarm.

HI_LIM: The setting for high alarm in engineering units

LO_PRI: Priority of the low alarm.

LO_LIM: The setting for low alarm in engineering units.

LO_LO_PRI: Priority of the low-low alarm.

LO_LO_LIM: The setting for low-low alarm in engineering units.

HI_HI_ALM: The status for high-high alarm and its associated time stamp.

HI_ALM: Status for high alarm and associated time stamp.

LO_ALM: Status for low alarm and associated time stamp.

LO_LO_ALM: The status for low-low alarm and its associated time stamp.

BLOCK_ERR_DESC: Reports more specific details regarding some errors reported through BLOCK_ERR.

The MODE_BLK parameter (within both the TB and AI Blocks) must be set to AUTO to pass the PV Value through the AI to the network.

Transducer scaling, called XD_SCALE is applied to the PV from the CHANNEL to produce the FIELD_VAL in percent.

- Valid XD_SCALE engineering units depend on the Channel Type.

2.4.2 AI Block Diagnostics

The AI blocks can display a BLOCK_ERR diagnostic when:

1. The Channel is not set correctly.
2. XD_SCALE does not have suitable engineering units.
3. The SIMULATE parameter is active.
4. AI block MODE is O/S (out of service).

NOTE: This can be caused by the Resource Block being OOS or the AI Block not scheduled for execution.

5. L-TYPE not set or set to Direct with improper OUT_SCALE.

The AI block uses the STATUS_OPTS setting and the "LIMIT" ALARM PARAMETERS value to modify the AI PV and OUT QUALITY.

A Damping Filter is a feature of the AI block. The PV_FTIME parameter is a time constant of a single exponential filter for the PV, in seconds. This parameter can be used to dampen out fluctuation in level due to excessive turbulence.

The AI block also has multiple ALARM functions that monitor the OUT parameter for out of bound conditions.

2.4.3 Local Display of Analog Input

The PULSAR Model R86 FF transmitter incorporates a useful feature that allows the Analog Input (AI) block Out values to be displayed on the local LCD.

NOTE: There are many reasons that AI block Out values can deviate from the measurement value originating in the Transducer block, and because the keypad and local display will only provide access to Transducer block parameters, there is no way to change (or view) the other Fieldbus configuration items affecting the AI block output using the keypad and LCD.

In other words, these screens should only be considered as measured value indicators for configured transmitters. For example:

- The screens are not used for commissioning or diagnostic/troubleshooting purposes.
- Prior to full Fieldbus configuration (transmitter assigned a permanent address, AI block(s) configured and scheduled for execution, etc.), the value displayed will be 0 with "BAD: OUT OF SERVICE" indicated. It will not reflect the transducer measurement.

2.4.3.1 AI Out Display Screens

The Analog Input Block Out values can be conditionally displayed as part of the "rotating" home menu screens. A representative example is shown at left.

LCD Home Screen

The screens will be formatted as shown with:

- Physical Device Tag (Selectable)
- Measured Value Status (Bad, Good, Uncertain)
- Bar Graph

For example, "AI1_Level" would be the most commonly used AI Out screen.

"AI2---" would be displayed when the channel value is 0 [uninitialized] for AI block 2.

Because the Model R86 transmitter has eight (8) Analog Input blocks, any or all of which may be used in particular applications, a Transducer block parameter controls which AI block Out values will be displayed on the LCD.

Any or all (or none) of the AI block Out values can be selected for display on the rotating home menu.

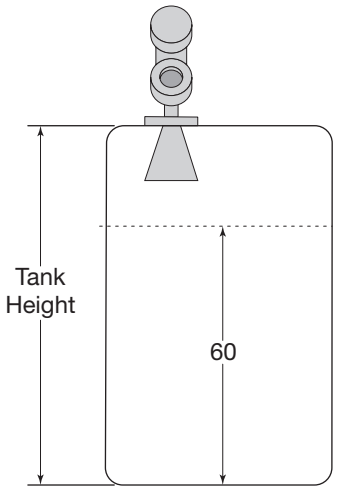
NOTE: In the photo at left, status is shown as "Bad: Out of Service". This message would be shown prior to commissioning.

2.4.4 AI Block Configuration

Below are examples of various typical AI Block configurations.

Example 1: standard configuration for transmitter with tank height TH inches or cm.

[setup by factory as part of final assembly procedure]



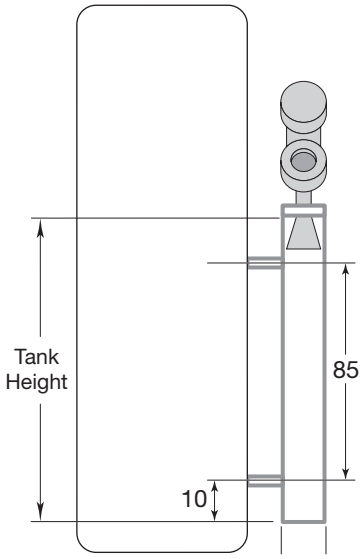
Transducer Block + LCD Level	AI Block Output [To FF segment]
60 [in / cm]	100%
0 [in / cm]	0%

Tank Height = inches or cm

Configuration	
Tank Height	TH
Bottom Blocking Distance	0
XD Scale EU at 0%	0
XD Scale EU at 100%	60
XD Scale Units	in/cm
Out Scale EU at 0%	0
Out Scale EU at 100%	100
Out Scale Units	%
L Type	Indirect

Example 2: end user desires 0 to 100% output for a subset of the measureable region

[e.g., for a chamber application]

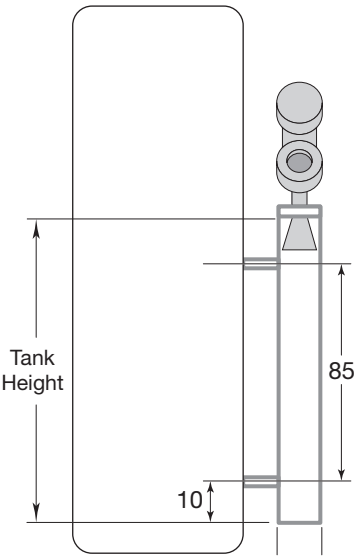


Transducer Block + LCD Level	AI Block Output [To FF segment]
85 cm	100%
0 cm	0%

Configuration	
Tank Height	TH
Bottom Blocking Distance	10
XD Scale EU at 0%	10
XD Scale EU at 100%	95
XD Scale Units	cm
Out Scale EU at 0%	0
Out Scale EU at 100%	100
Out Scale Units	%
L Type	Indirect

Example 3: same configuration as previous except Direct [no] scaling setup in AI block

Output to FF segment is in cm



Transducer Block + LCD Level	AI Block Output [To FF segment]
85 cm	85 cm
0 cm	0 cm

Configuration	
Tank Height	TH
Bottom Blocking Distance	10
XD Scale EU at 0%	10
XD Scale EU at 100%	95
XD Scale Units	cm
Out Scale EU at 0%	10
Out Scale EU at 100%	95
Out Scale Units	cm
L Type	Direct

2.4.5 Simulation Feature

The PULSAR Model R86 with FOUNDATION Fieldbus™ supports the Simulate feature in the Analog Input block. The Simulate feature is typically used to exercise the operation of an AI block by simulating a TRANSDUCER block input.

This feature cannot be activated without the placement of a hardware jumper. A jumper is provided in the "Run" position of the PULSAR Model R86, and is placed under the display module. To enable the simulation feature, remove display module and move the jumper to the "SIM" position. Refer to figure at left for jumper location.

NOTE: A BLOCK_ERR of "Simulation Active" in the Resource Block does not mean simulation is active—it merely indicates that the simulation (hardware) enabling jumper is present.

- The jumper may be removed to eliminate the BLOCK_ERR and placed back in the "Run" position.

Place jumper in the "SIM" position to enable simulation.

2.5 PID Block

The PID Function Block contains the logic necessary to perform Proportional/Integral/Derivative (PID) control. The block provides filtering, set point and rate limits, feed-forward support, output limits, error alarms, and mode shedding.

Although most other function blocks perform functions specific to the associated device, the PID block may reside in any device on the network. This includes a valve, a transmitter, or the host itself.

The PULSAR Model R86 FF PID Block implementation follows the specifications documented by the FieldComm Group.

2.5.1 PID Block Parameters

ACK_OPTION: Used to set auto acknowledgement of alarms.

ALARM_HYS: The amount the alarm value must return to before the associated active alarm condition clears.

ALARM_SUM: The summary alarm is used for all process alarms in the block.

ALERT_KEY: The identification number of the plant unit.

BAL_TIME: The specified time for the internal working value of bias to return to the operator set bias.

BKCAL_IN: The analog input value and status for another blocks BKCAL_OUT output.

BKCAL_HYS: The amount the output must change away from its output limit before the limit status is turned off, expressed as a percent of the span of the output.

BKCAL_OUT: The value and status required by the BKCAL_IN input for another block.

BLOCK_ALM: Used for all configuration, hardware, or system problems in the block.

BLOCK_ERR: Reflects the error status associated with the hardware or software components associated with a block.

BYPASS: Used to override the calculation of the block.

CAS_IN: The remote set point value from another block.

CONTROL_OPTS: Allows one to specify control strategy options.

DV_HI_ALM: The DV HI alarm data.

DV_HI_LIM: The setting for the alarm limit used to detect the deviation high alarm condition.

DV_HI_PRI: The priority of the deviation high alarm.

DV_LO_ALM: The DV LO alarm data.

DV_LO_LIM: The setting for the alarm limit used to detect the deviation low alarm condition.

DV_LO_PRI: The priority of the deviation low alarm.

FF_GAIN: The feedforward gain value.

FF_SCALE: The high and low scale values associated with FF_VAL.

FF_VAL: The feedforward control input value and status.

GAIN: The proportional gain value. This value cannot equal zero.

GRANT_DENY: Options for controlling access of host computers to alarm parameters of the block.

HI_ALM: The HI alarm data.

HI_HI_ALM: The HI HI alarm data.

HI_HI_LIM: The setting for the alarm limit used to detect the HI HI alarm condition.

HI_HI_PRI: The priority of the HI HI Alarm.

HI_LIM: The setting for the alarm limit used to detect the HI alarm condition.

HI_PRI: The priority of the HI alarm.

IN: The connection for the PV input from another block.

LO_ALM: The LO alarm data.

LO_LIM: The setting for the alarm limit used to detect the LO alarm condition.

LO_LO_ALM: The LO _LO alarm data.

LO_LO_LIM: The setting for the alarm limit used to detect the LO_LO alarm condition.

LO_LO_PRI: The priority of the LO_LO alarm.

LO_PRI: The priority of the LO alarm.

MODE_BLK: The actual, target, permitted, and normal modes of the block.

OUT: The block input value and status.

OUT_HI_LIM: The maximum output value allowed.

OUT_LO_LIM: The minimum output value allowed.

OUT_SCALE: The high and low scale values associated with OUT.

PV: The process variable use in block execution.

PV_FTIME: The time constant of the first order PV filter.

PV_SCALE: The high and low scale values associated with PV.

RATE: The derivative action time constant.

RCAS_IN: Target set point and status that is provided by a supervisory host.

RCAS_OUT: Block set point and status that is provided to a supervisory host.

RESET: The integral action time constant.

ROUT_IN: Block output that is provided by a supervisory host.

ROUT_OUT: Block output that is provided to a supervisory host.

SHED_OPT: Defines action to be taken on remote control device timeout.

SP: The target block set point value.

SP_HI_LIM: The highest SP value allowed.

SP_LO_LIM: The lowest SP value allowed.

SP_RATE_DN: Ramp rate for downward SP changes.

SP_RATE_UP: Ramp rate for upward SP changes.

STATUS_OPTS: Allows one to select options for status handling and processing.

STRATEGY: Can be used to identify grouping of blocks.

ST_REV: The revision level of the static data associated with the function block.

TAG_DESC: The user description of the intended application of the block.

TRK_IN_D: Discrete input that initiates external tracking.

TRK_SCALE: The high and low scale values associated with TRK_VAL.

TRK_VAL: The value applied to OUT in LO mode.

UPDATE_EVT: This alert is generated by any changes to the static data.

BLOCK-ERR-DESC: Reports more specific details regarding some errors reported through BLOCK_ERR.

3.0 Advanced Function Blocks

3.1 Integrator Block (IT)

The Integrator (IT) function block integrates one or two variables over time. The block compares the integrated or accumulated value to pre-trip and trip limits and generates discrete output signals when the limits are reached.

ST_REV: The revision level of the static data associated with the function block.

TAG_DESC: The user description of the intended application of the block.

STRATEGY: The strategy field can be used to identify grouping of blocks.

ALERT_KEY: The identification number of the plant unit. This information may be used in the host for sorting alarms.

MODE_BLK: The actual, target, permitted, and normal modes of the block.

- Target: The mode to “go to”
- Actual: The mode the “block is currently in”
- Permitted: Allowed modes that target may take on
- Normal: Most common mode for target

BLOCK_ERR: The summary of active error conditions associated with the block. The block error for the Integrator function block is Out of service.

TOTAL_SP: The set point for a batch totalization.

OUT: The block output value and status.

OUT_RANGE: The high and low scale values, engineering units code, and number of digits to the right of the decimal point associated with OUT.

GRAND_DENY: Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block (not used by the device).

STATUS_OPTS: Allows you to select option for status handling and processing. The supported status option for the Integrator block is: "Uncertain if Manual mode."

IN_1: The block input value and status.

IN_2: The block input value and status.

OUT_TRIP: The first discrete output.

OUT_PTRIP: The second discrete output.

TIME_UNIT1: Converts the rate time, units in seconds.

TIME_UNIT2: Converts the rate time, units in seconds.

UNIT_CONV: Factor to convert the engineering units of IN_2 into the engineering units of IN_1.

PULSE_VAL1: Determines the mass, volume or energy per pulse.

PULSE_VAL2: Determines the mass, volume or energy per pulse.

REV_FLOW1: Indicates reverse flow when "true"; 0- Forward, 1- Reverse

REV_FLOW2: Indicates reverse flow when "true"; 0- Forward, 1- Reverse

RESET_IN: Resets the totalizers

STOTAL: Indicates the snapshot of OUT just before a reset.

RTOTAL: Indicates the totalization of "bad" or "bad" and "uncertain" inputs, according to INTEG_OPTIONS.

SRTOTAL: The snapshot of RTOTAL just before a reset

SSP: The snapshot of TOTAL_SP

INTEG_TYPE: Defines the type of counting (up or down) and the type of resetting (demand or periodic)

INTEG_OPTIONS : A bit string to configure the type of input (rate or accumulative) used in each input, the flow direction to be considered in the totalization, the status to be considered in TOTAL and if the totalization residue should be used in the next batch (only when INTEG_TYPE=UP_AUTO or DN_AUTO).

CLOCK_PER: Establishes the period for periodic reset, in hours.

PRE_TRIP: Adjusts the amount of mass, volume or energy that should set OUT_PTRIP when the integration reaches (TOTAL_SP-PRE_TRIP) when counting up of PRE_TRIP when counting down.

N_RESET: Counts the number of resets. It cannot be written or reset.

PCT_INC: Indicates the percentage of inputs with "good" status compared to the ones with "bad" or "uncertain" and "bad" status.

GOOD_LIMIT: Sets the limit for PCT_INC. OUT. Receives the status "Good" is PCT_INCL ≥ GOOD_LIM.

UNCERTAIN_LIMIT: Sets the limit for PCT_INC. OUT receives the status "uncertain" if PECT_INC ≥ UNCERT.LIM.

OP_CMD_INT: Operator command RESET Resets the totalizer

OUTAGE_LIMIT: The maximum tolerated duration for power failure

RESET_CONFIRM: Momentary discrete value with can be written by a host to enable further resets, if the option "Confirm reset" in INTEG_OPTIONS is chosen.

UPDATE_EVT: This alert is generated by any changes to the static data.

BLOCK_ALM: Used for all configuration, hardware, connection failure, or system problems in the block.

BLOCK_ERR_DESC: Reports more specific details regarding some errors reported through BLOCK_ERR.

3.2 Arithmetic Block (AR)

The Arithmetic function block provides the ability to configure a range extension function for a primary input and applies the nine different arithmetic types as compensation to or augmentation of the range extended input.

The nine arithmetic functions are:

- Flow Compensation Linear
- Flow Compensation Square Root
- Flow Compensation Approximate
- Btu Flow
- Traditional Multiply and Divide

- Average
- Summer
- Fourth Order Polynomial
- Simple HTG Compensate Level

ST_REV: The revision level of the static data associated with the function block. The revision value will increment each time a static parameter value in the block is changed.

TAG_DESC: The user description of the intended application of the block.

STRATEGY: The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.

ALERT_KEY: The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.

MODE_BLK: The actual, target, permitted, and normal modes of the block.

- Target: The mode to "go to"
- Actual: The mode the "block is currently in"
- Permitted: Allowed modes that target may take on
- Normal: Most common mode for target

BLOCK_ERR: This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string so that multiple errors may be shown.

PV: The primary analog value for use in executing the function, or a process value associate with it.

OUT: The analog output value and status.

PRE_OUT: Displays what would be the OUT value if the mode was "Auto" or lower.

PV_SCALE: Associated with the PV.

OUT_RANGE: The high and low scale values, engineering units code, and number of digits to the right of the decimal point associated with OUT.

GRANT_DENY: Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block.

INPUT_OPTIONS: Option bit string for handling the status of the auxiliary inputs.

IN: The block input value and status.

IN_LO: Input of the low range transmitter, in a range extension application.

IN–1, IN–2, IN–3: Inputs combined with the PV in a section of four term math functions.

RANGE_HI: Constant value above which the range extension has switch to the high range transmitter.

RANGE_LO: Constant value below which the range extension has switch to the high range transmitter.

BIAS_IN_1: The bias value for IN_1.

GAIN_IN_1: The proportional gain (multiplier) value for IN_1.

BIAS_IN_2: The bias value for IN_2.

GAIN_IN_2: The proportional gain (multiplier) value for IN_2.

BIAS_IN_3: The bias value for IN_3.

GAIN_IN_3: The proportional gain (multiplier) value for IN_3.

COMP_HI_LIM: Determines the high limit of the compensation input.

COMP_LO_LIM: Determines the low limit of the compensation input.

ARITH_TYPE: The set of nine arithmetic functions applied as compensation to or augmentation of the range extended input.

BAL_TIME: Specifies the time for a block value to match an input, output, or calculated value or the time for dissipation of the internal balancing bias.

BIAS: The bias value is used to calculate the output.

GAIN: The gain value is used to calculate the output.

OUT_HI_LIM: The maximum output value allowed.

OUT_LO_LIM: The minimum output value allowed.

UPDATE_EVT: This alert is generated by any changes to the static data.

BLOCK_ALM: Used for all configuration, hardware, connection failure, or system problem in the block.

BLOCK_ERR_DESC: Reports more specific details regarding some errors reported through BLOCK_ERR.

3.3 Input Selector Block (IS)

The Input Selector (IS) function block can be used to select the first good, maximum, minimum, or average of as many as four input values and place it at the output. The block supports signal status propagation. (There is no process alarm detection in the Input Selector function block.)

ST_REV: The revision level of the static data associated with the function block. The revision value will be incremented each time a static parameter value in the block is changed.

TAG_DESC: The user description of the intended application of the block.

STRATEGY: The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.

ALERT_KEY: The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.

MODE_BLK : The actual, target, permitted, and normal modes of the block.

- Target: The mode to "go to"
- Actual: The mode the "block is currently in"
- Permitted: Allowed modes that target may take on
- Normal: Most common mode for target

BLOCK_ERR: This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.

OUT: The block output value and status.

OUT_RANGE: High and low scale values, engineering units code, and number of digits to the right of the decimal point associated with OUT

GRANT_DENY: Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block.

STATUS_OPTIONS : Allows you to select options for status handling and processing. The supported status options for the input selector block are: "Use Uncertain as Good", "Uncertain if Man mode."

IN_1: The block input value and status.

IN_2: The block input value and status.

IN_3: The block input value and status.

IN_4: The block input value and status.

DISABLE_1: Parameter to switch off the input from being used 0- Use, 1 - Disable.

DISABLE_2: Parameter to switch off the input from being used 0- Use, 1 - Disable.

DISABLE_3: Parameter to switch off the input from being used 0- Use, 1 - Disable.

DISABLE_4: Parameter to switch off the input from being used 0- Use, 1 - Disable.

SELECT_TYPE: Determines the selector action; First good, Minimum, Maximum, Middle, Average.

MIN_GOOD: The minimum number of inputs which are "good" is less than the value of MIN_GOOD then set the OUT status to "bad".

SELECTED: The integer indicating the selected input number.

OP_SELECT: An operator settable parameter to force a given input to be used.

UPDATE_EVT: This alert is generated by any change to the static data.

BLOCK_ALM: The block alarm is used for all configuration, hardware, connection failure, or system problems in the block.

BLOCK_ERR_DESC: Reports more specific details regarding some errors reported through BLOCK_ERR.

3.4 Signal Characterizer Block (SC)

The Signal Characterizer (SC) function block characterizes or approximates any function that defines an input/output relationship. The function is defined by configuring as many as 21 X, Y coordinates. The block interpolates an output value for a given input value using the curve defined by the configured coordinates. Two separate analog input signals can be processed simultaneously to give two corresponding separate output values using the same defined curve.

ST_REV: The revision level of the static data associated with the function block. The revision value will be incremented in each time a static parameter value in the block is changed.

TAG_DESC: The user description of the intended application of the block.

STRATEGY: The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.

ALERT_KEY: The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.

MODE_BLK: The actual, target, permitted, and normal modes of the block.

- Target: The mode to "go to"
- Actual: The mode the "block is currently in"
- Permitted: Allowed modes that target may take on
- Normal: Most common mode for target

BLOCK_ERR: This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string so that multiple errors may be shown.

OUT1: The block output value and status.

OUT2: The block output value and status.

X_RANGE: The display scaling of the variable corresponding to the x-axis for display. It has no effect on the block.

Y_RANGE: The display scaling of the variable corresponding to the y-axis for display. It has no effect on the block.

GRANT_DENY: Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block.

IN1: The block input value and status.

IN2: The block input value and status.

SWAP_2: Changes the algorithm in such a way that IN_2 corresponds to "y" and OUT _2 to "x".

CURVE_X : Curve input points. The "x" points of the curve are defined by an array of 21 points.

CURVE_Y: Curve input points. The "y" points of the curve are defined by an array of 21 points.

UPDATE_EVT: This alert is generated by any changes to the static data.

BLOCK_ALM: The block alarm is used for all configuration, hardware, connection failure, or system problems in the block.

BLOCK_ERR_DESC: Reports more specific details regarding some errors reported through BLOCK_ERR.

4.0 Model R86 Transmitter Configuration

Although the PULSAR Model R86 transmitter can be delivered pre-configured from the factory, it can also be easily reconfigured in the shop or at the installation using the local LCD/Keypad. Bench configuration provides a convenient and efficient way to set up the transmitter before going to the tank site to complete the installation.

NOTE: The transmitter can be configured without the antenna connected. Disregard any diagnostic indicators that may appear.

4.1 Configuration Information

To utilize the DEVICE SETUP/BASIC CONFIG menu available on the PULSAR Model R86, some key information is required for configuration.

Gather the information and complete the following operating parameters table before beginning configuration.

NOTE: These configuration steps are not necessary if the transmitter was pre-configured prior to shipment.

Display	Question	Answer
Measurement Type	What is the intended measurement type (Level, Volume, or Flow)?	_____
System Units	What units of measurement will be used?	_____
Antenna Model	What type of antenna is being used? Select first 3 digits of model number. (See nameplate on side of antenna.)	_____
Antenna Extension	What is maximum nozzle length for which the antenna can be used? Select 11th digit of antenna model number. (See nameplate on side of antenna.)	_____
Antenna Mount	Is the antenna mounting NPT, BSP, or flanged?	_____
Heat Extension	Is there a heat extension connected to the antenna?	_____
Tank Height	What is the tank height?	_____
Stillwell ID	What is the Inner Diameter (ID). Enter 0 if not applicable.	_____
Dielectric Range	What is the dielectric of the process medium?	_____
Turbulence	What amount of turbulence is expected?	_____
Foam	What amount of foam is expected?	_____
Rate of Change	What is the expected maximum rate of level change?	_____

4.2 Menu Traversal and Data Entry

The four push buttons offer various forms of functionality for navigation and data entry.

The Model R86 user interface is hierarchical in nature, best described as a tree structure. Each level in the tree contains one or more items. Items are either menu labels or parameter names.

- Menu labels are presented in all CAPITAL LETTERS
- Parameters are Capital Words

4.2.1 Navigating the Menu

⇧ **UP** moves to the previous item in the menu branch.

⇩ **DOWN** moves to the next item in the menu branch.

⇦ **BACK** moves back one level to the previous (higher) branch item.

⇨ **ENTER** enters into the lower level branch or switches to the entry mode. Holding the ENTER down on any highlighted menu name or parameter will show help text for that item.

4.2.2 Data Selection

This method is used for selecting configuration data from a specific list.

⇧ **UP** and ⇩ **DOWN** to navigate the menu and highlight the item of interest

⇨ **ENTER** allows modification of that selection

⇧ **UP** and ⇩ **DOWN** to choose new data selection

⇨ **ENTER** to confirm selection

Use ⇦ **BACK** (Escape) key at any time to abort the procedure and escape to previous branch item.

4.2.3 Entering Numeric Data Using Digit Entry

This method is used to input numeric data, e.g., Tank Height.

Push button		Keystroke Action
	Up	Moves up to the next highest digit (0,1,2,3,....,9 or decimal point). If held down the digits scroll until the push button is released.
	Down	Moves up to the next lowest digit (0,1,2,3,....,9 or decimal point). If held down the digits scroll until the push button is released.
	Back	Moves the cursor to the left and deletes a digit. If the cursor is already at the leftmost position, then the screen is exited without changing the previously saved value.
	Enter	Moves the cursor to the right. If the cursor is located at a blank character position, the new value is saved.

All numeric values are left-justified, and new values are entered from left to right. A decimal point can be entered after the first digit is entered, such that .9 is entered as 0.9.

Some configuration parameters can have a negative value. In this case, the leftmost position is reserved for the sign (either "-" for a negative value, or "+" for a positive value).

4.2.4 Entering Numeric Data Using Increment/Decrement

Use this method to input the following data into parameters such as Failure Alarm Delay.

Push button		Keystroke Action
	Up	Increments the displayed value. If held down the digits scroll until the push button is released. Depending on which screen is being revised, the increment amount may increase by a factor of 10 after the value has been incremented 10 times.
	Down	Decrements the displayed value. If held down the digits scroll until the push button is released. Depending on which screen is being revised, the decrement amount may increase by a factor of 10 after the value has been decremented 10 times.
	Back	Returns to the previous menu without changing the original value, which is immediately redis-played.
	Enter	Accepts the displayed value and returns to the previous menu.

4.2.5 Entering Character Data

This method is used for parameters requiring alphanumeric character entry, such as for entering tags, etc.

General Menu Notes:

Push button		Keystroke Action
↑	Up	Moves to the previous character (Z...Y...X...W). If held down, the characters scroll until the push button is released.
↓	Down	Moves to the next item character (A...B...C...D). If held down, the characters scroll until the push button is released.
←	Back	Moves the cursor back to the left. If the cursor is already at the leftmost position, then the screen is exited without changing the original tag characters.
→	Enter	Moves the cursor forward to the right. If the cursor is at the rightmost position, then the new tag is saved.

4.3 Password Protection

The PULSAR Model R86 transmitter has three levels of password protection to restrict access to certain portions of the menu structure that affect the operation of the system. The user password can be changed to any numerical value up to 59999. When the transmitter is programmed for password protection, a password is required whenever configuration values are changed.

User Password

The User Password allows the customer to limit access to the basic configuration parameters from both the local and Fieldbus interfaces.

The default User Password installed in the transmitter at the factory is 0. (With a password of 0, the transmitter is not password protected and any value in the basic user menus can be adjusted without entering a confirming password.)

NOTE: If a User Password is not known or has been misplaced, the menu item New Password in the DEVICE SETUP/ADVANCED CONFIG menu displays an encrypted value representing the present password. Contact Technical Support with this encrypted password to retrieve the original User Password.

Advanced Password

Certain portions of the menu structure that contain more advanced parameters are further protected by an Advanced Password.

This password will be provided, when necessary, by Factory technical support.

Factory Password

Calibration-related and other factory settings are further protected by a Factory Password.

4.4 Model R86 Menu: Step-By-Step Procedure

The following tables provide a complete explanation of the software menus displayed by the PULSAR transmitter. The menu layout is similar between the local Keypad/LCD interface, the DD, and the DTM.

Use these tables as a step-by-step guide to configure the transmitter based on the desired measurement type from the following selections:

- Level Only
- Volume & Level
- Flow

Home Screen

HOME SCREEN

The Home Screen consists of a "slide show" sequence of Measured Values screens which are rotated at 2-second intervals. Each Home Measured Value screen can present up to four information items:

- **physical device tag**
- **measured value**
  Label, Numerical Value, Units
- **present status**
  Will be displayed as text
- **bar graph** (shown in %)
  Bar graph is only displayed on AI_OUT screens shown in % based on XD scale configuration.

The Home Screen presentation can be customized by viewing or hiding some of these items.

At left is an example of a Home Screen for a Model R86 configured for a Level Only application.

MAIN MENU

Pressing any key on the Home Screen will present the Main Menu, consisting of three basic menu labels shown in all capital letters.

DEVICE SETUP

DIAGNOSTICS

MEASURED VALUES

As shown, the reverse video represents a cursor identifying the selected item, which will appear in reverse video on the LCD. The actions of the keys at this point are:

Main Menu Screen

Push button		Keystroke Action
↑	Up	No action as the cursor is already at the first item in the MAIN MENU
↓	Down	Moves the cursor to DIAGNOSTICS
←	Back	Moves back to HOME SCREEN, the level above MAIN MENU
→	Enter	Presents the selected item, DEVICE SETUP

NOTES:
1. Items and parameters that are shown in lower level menus will depend on the Measurement Type chosen. Those parameter not applicable to the present Measurement Type will be hidden.
2. Holding down the Enter key when the cursor is highlighted over a parameter or menu will provide additional information about that item.

DEVICE SETUP

Choosing DEVICE SETUP from the MAIN MENU will result in an LCD presentation as shown at left.

The small down arrow shown at the right hand side of the screen is the indication that more items are available below and can be accessed by pressing the DOWN key.

Section 4.5 shows the entire tree menu for the Model R86 DEVICE SETUP Menu.

Device Setup Screen

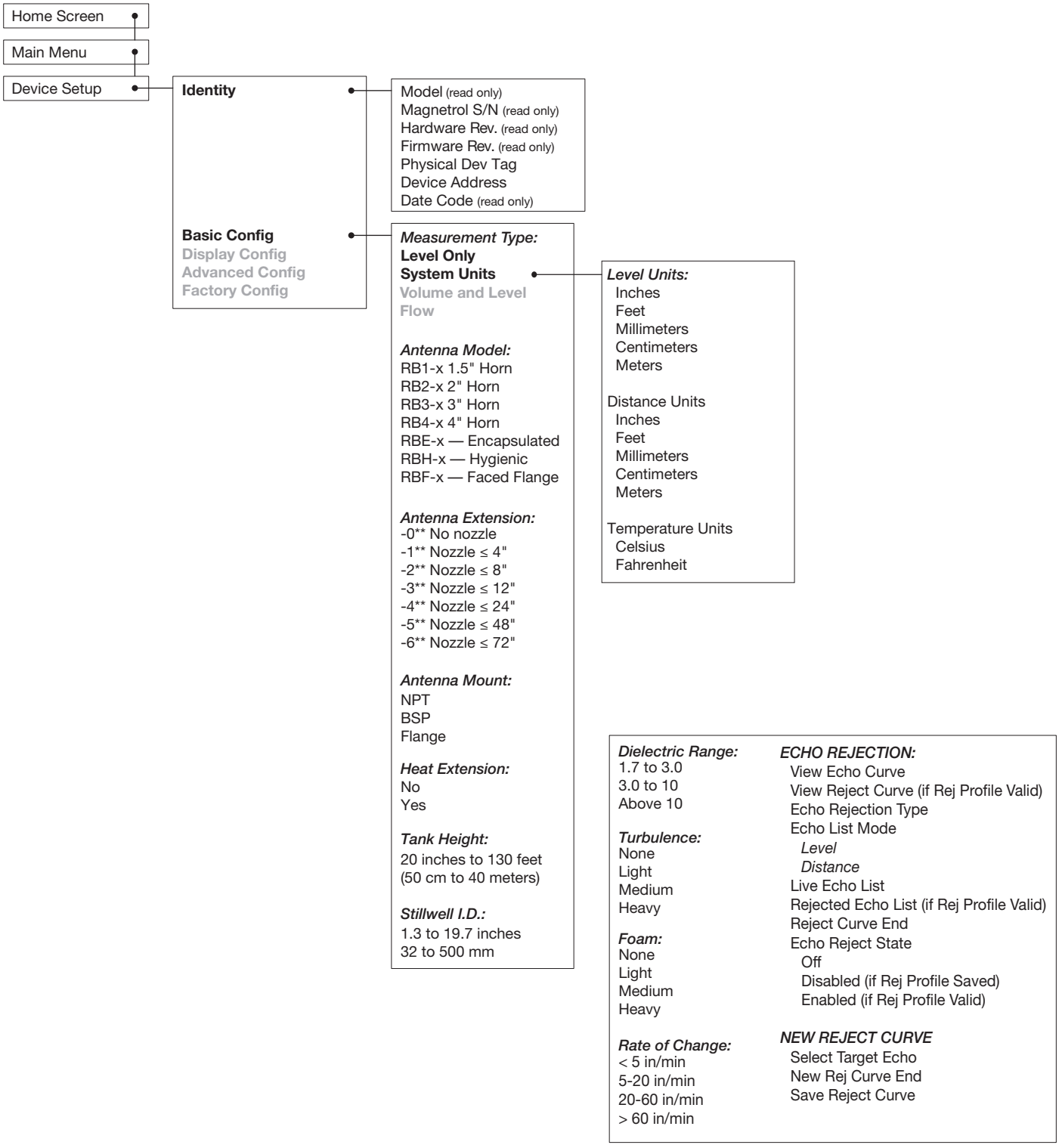
DIAGNOSTICS

Refer to Section 5.0.

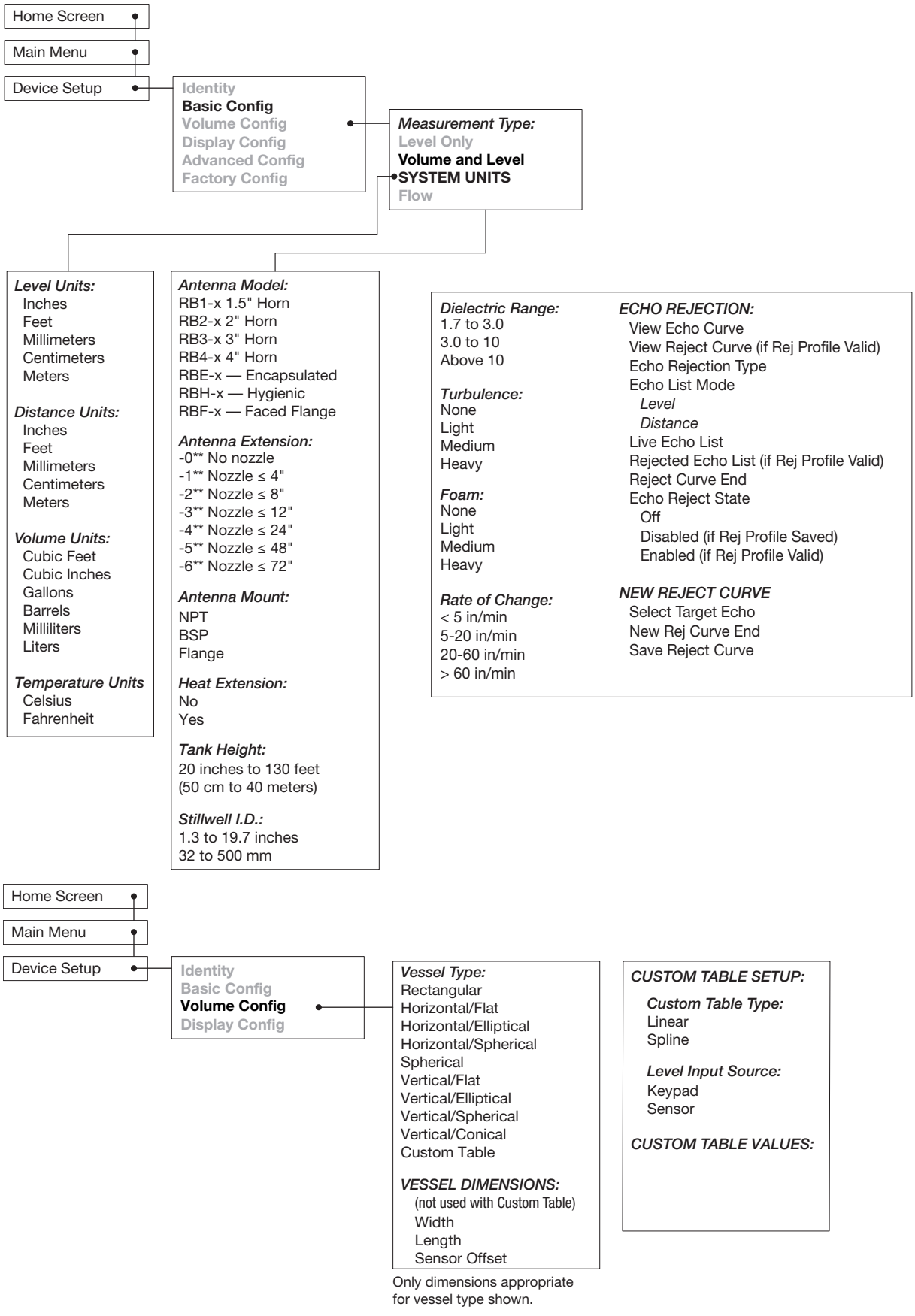
MEASURED VALUES

Allows the user to scroll through all of the available measured values for the measurement type chosen.

4.5 Model R86 Configuration Menu — Level Only

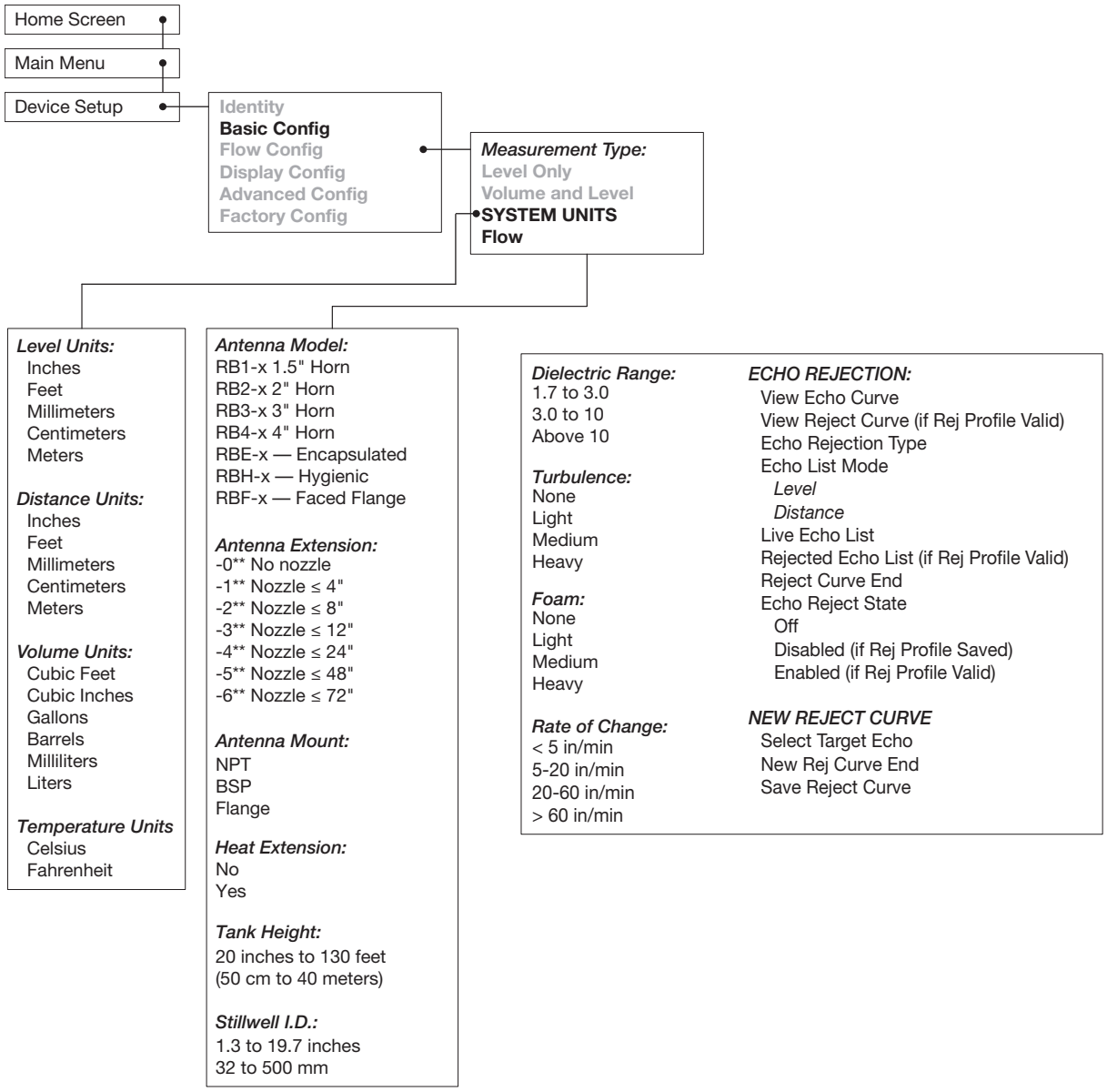


4.6 Model R86 Configuration Menu — Volume and Level

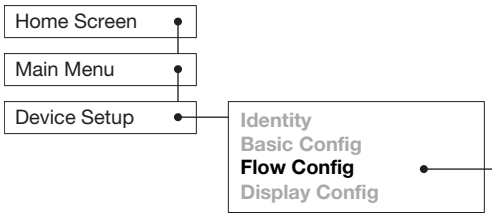


Only dimensions appropriate for vessel type shown.

4.7 Model R86 Configuration Menu — Flow



4.7 Model R86 Configuration Menu — Flow



Flow Units:
Cubic Ft/Second
Cubic Ft/Minute
Cubic Ft/Hour
Gallons/Minute
Gallons/Hour
Mil Gallons/Day
Liters/Second
Liters/Minute
Liters/Hour
Cubic Meters/Hour

Head Units:
Inches
Feet
Millimeters
Centimeters
Meters

Flow Element:
Palmer-Bowlus Flume
Flume Channel Width:
4 inches
6 inches
8 inches
10 inches
12 inches
15 inches
18 inches
21 inches
24 inches
27 inches
30 inches

Parshall Flume
Flume Channel Width:
1 inch
2 inches
3 inches
6 inches
9 inches
12 inches
18 inches
24 inches
36 inches
48 inches
60 inches
72 inches
96 inches
120 inches
144 inches

V notch Weir
V-notch Weir Angle:
22.5°
30°
45°
60°
90°
120°

Rect Weir with Ends
0 to 215.0 feet
(0 to 65 m)

Rect Weir w/o Ends
0 to 215.0 feet
(0 to 65 m)

Cipolletti Weir
0 to 215.0 feet
(0 to 65 m)

Generic Equation
K
L
C
n

Custom Table
Custom Table Type:
Linear
Spline

CUSTOM TABLE VALUES:
Up to 30 Pairs of
Head/Flow Data

Reference Distance:
12 inches to 130 feet
(30 cm to 40 m)

Maximum Head
(calculated, read only)

Maximum Flow
(calculated, read only)

Low Flow Cutoff:
0 to 6 inches (0 to 15.3 cm)

NON-RESET TOTALIZER:
Units:
Cubic Feet
Gallons
Mil Gallons
Liters
Mil Liters
Cubic Meters

Multiplier:
1
10
100
1,000
10,000
100,000

Value (read only)
RunTime (read only)

RESETTABLE TOTALIZER:
Mode:
Disabled
Enabled

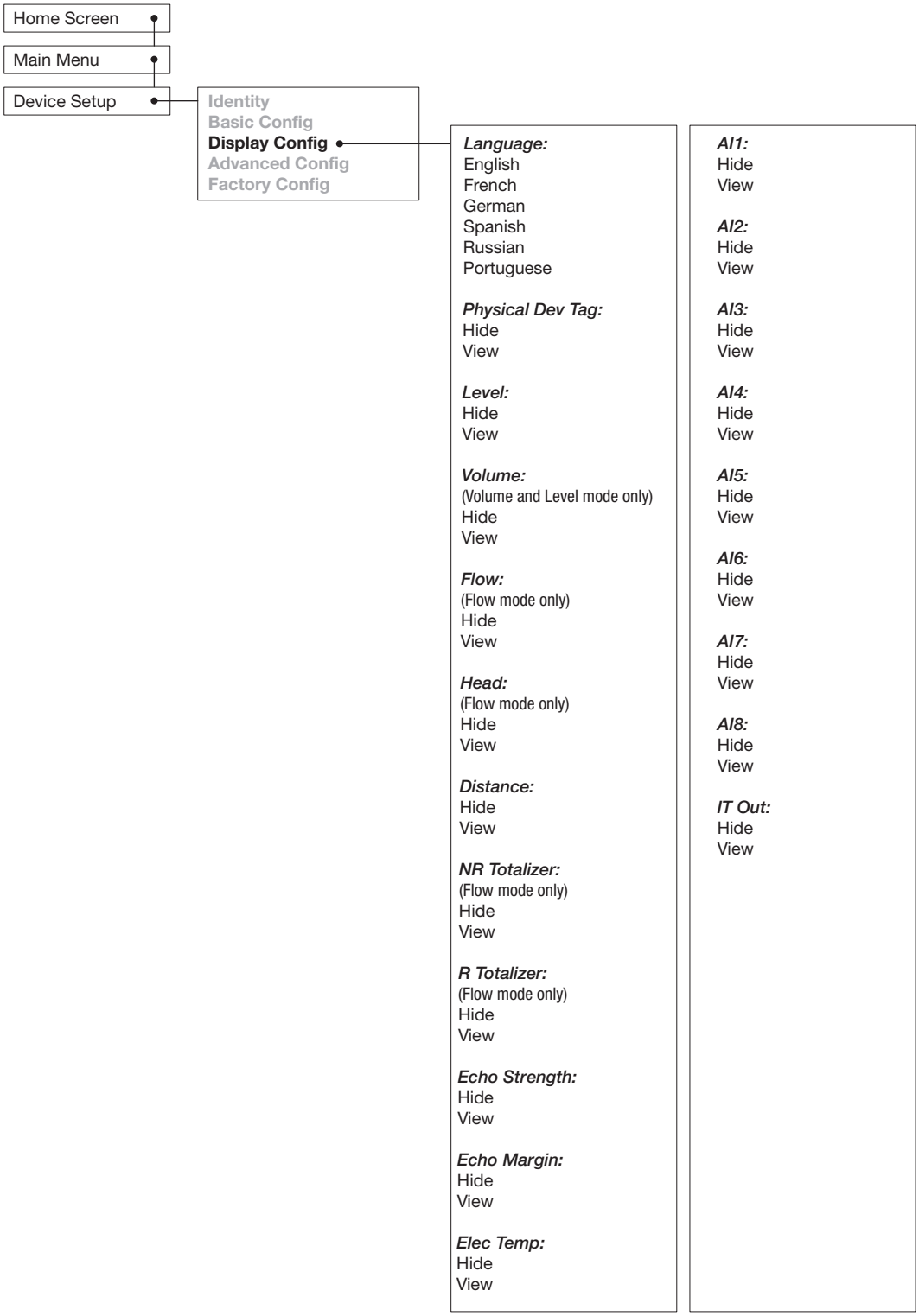
Units:
Cubic Feet
Gallons
Mil Gallons
Liters
Mil Liters
Cubic Meters

Multiplier:
1
10
100
1,000
10,000
100,000

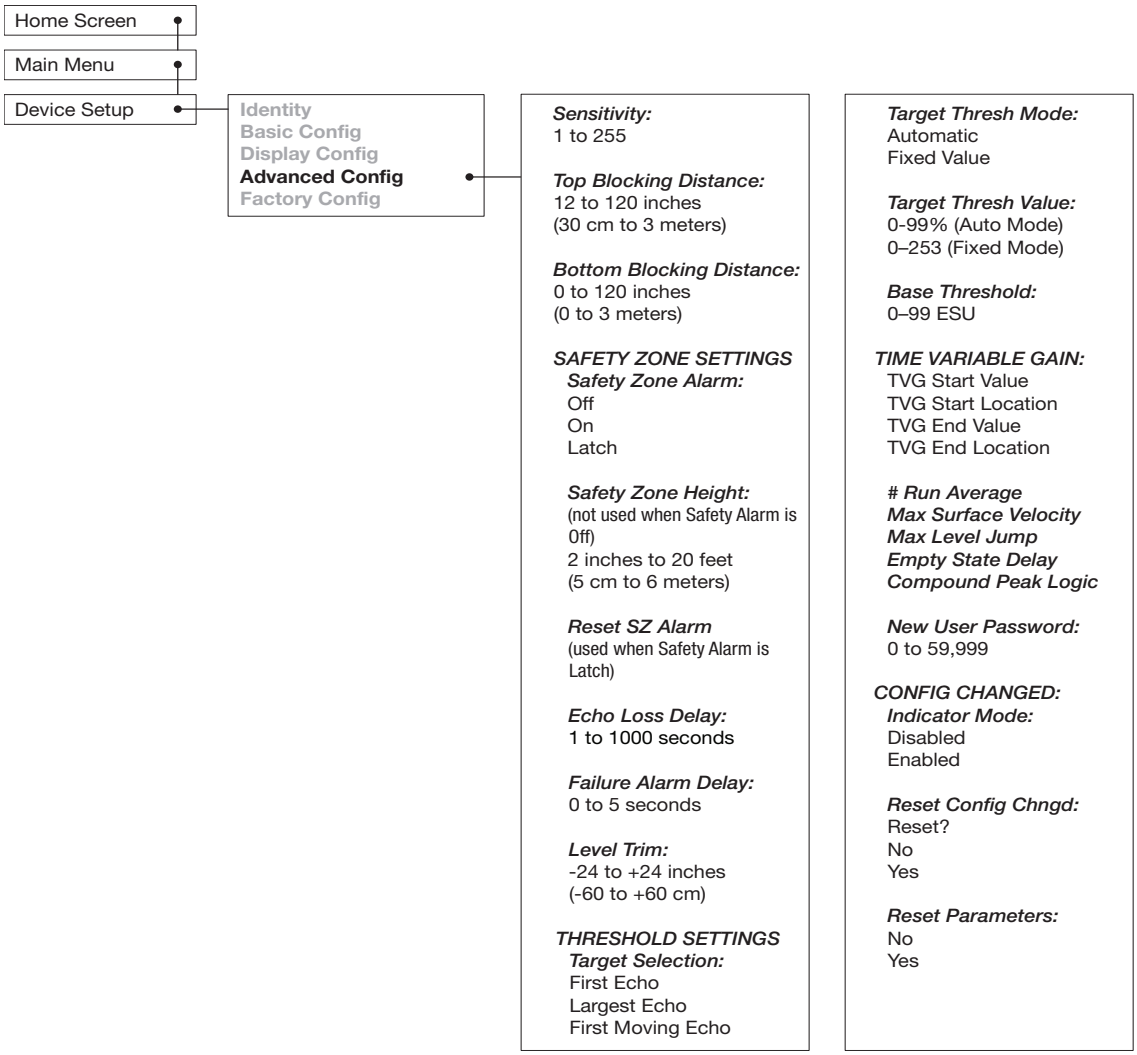
Value (read only)
RunTime (read only)

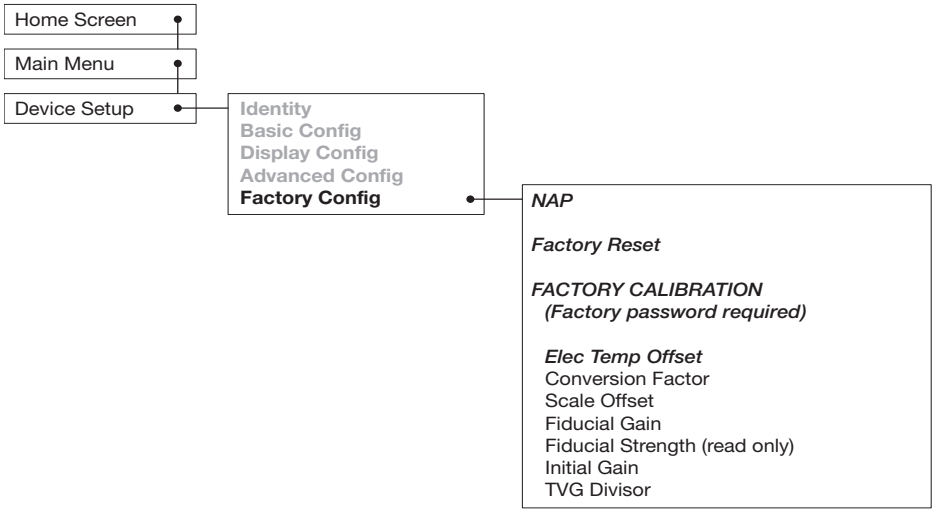
Reset

4.8 Model R86 Configuration Menu — Display Configuration



4.9 Model R86 Configuration Menu — Advanced/Factory Configuration





5.0 Troubleshooting and Diagnostics

The PULSAR Model R86 transmitter is designed and engineered for trouble-free operation over a wide range of operating conditions. The transmitter continuously runs a series of internal self-tests and displays helpful messages on the large graphic liquid crystal display (LCD) when attention is required.

The combination of these internal tests and diagnostics messages offer a valuable proactive method of troubleshooting. The device not only tells the user what is wrong, but also, and more importantly, offers suggestions on how to solve the problem.

All of this information can be obtained directly from the transmitter on the LCD, remotely from the Fieldbus host system, or by utilizing PACT*ware* and the PULSAR Model R86 DTM.

PACT*ware*™ PC Program

The PULSAR Model R86 offers the ability to perform more advanced diagnostics such as Trending and Echo Curve analysis using a PACT*ware* DTM. This is a powerful troubleshooting tool that can aid in the resolution of any diagnostic indicators that may appear.

5.1 Diagnostic Parameters

As mentioned above, the PULSAR Model R86 measurement engine runs through a series of self-tests and will detect and report faulty operation. The TRANSDUCER BLOCK displays this diagnostic information in the STATUS INDICATOR parameter. Refer to Section 5.1.3 for more information on specific diagnostic indicators.

Note: Within the TRANSDUCER BLOCK, BLOCK_ERROR is not used except for indicating Out of Service (OOS).

For the first few seconds after power is applied to the Model R86 transmitter, the LEVEL_STATUS/QUALITY is "Uncertain," the SUB_STATUS is "Initial value," and the LIMIT attribute is shown as "Constant."

When the Model R86 is operating properly, the LEVEL_STATUS/QUALITY is shown as "GOOD," and the SUB_STATUS is "Non-Specific."

While changing any transmitter parameters using the local display or through a system configuration tool (with the MODE_BLK in OOS), the output might be inaccurate because of the changing parameters. When the device is set to OOS, the TRANSDUCER BLOCK will still output level but the QUALITY will be shown as “Bad” and the SUB_STATUS is “Out of Service.”

If the Model R86 fails to find a measurable level, the TRANSDUCER BLOCK maintains the last good value as the output and flags the failure. The QUALITY is “Bad,” the SUB_STATUS is “Device failure” for no level, and the LIMIT attribute is “Constant.”

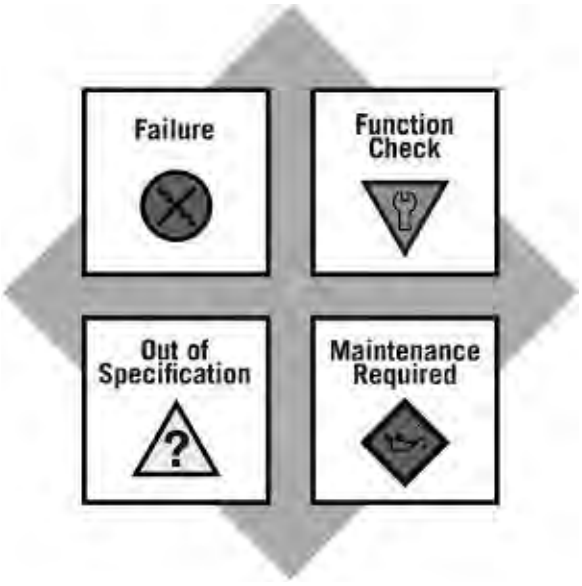
Refer to Section 5.2 for additional information.

5.1.1 Diagnostics (Namur NE 107)

The PULSAR Model R86 transmitter includes an exhaustive list of Diagnostic Indicators which follow the NAMUR NE 107 guidelines.

NAMUR is an international user association of automation technology in process industries, whose goal is to promote the interest of the process industry by pooling experiences among its member companies. In doing so, this group promotes international standards for devices, systems, and technologies.

The objective of NAMUR NE 107 was essentially to make maintenance more efficient by standardizing diagnostics information from field devices. This was initially integrated via FOUNDATION Fieldbus™, but the concept applies regardless of the communication protocol.



According to the NAMUR NE107 recommendation, "Self Monitoring and Diagnosis of Field Devices," Fieldbus diagnostic results should be reliable and viewed in the context of a given application. The document recommends categorizing internal diagnostics into four standard status signals:

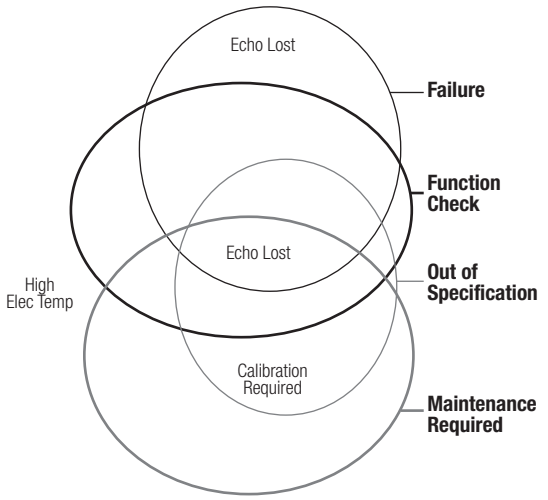
- Failure
- Function Check
- Out of Specification
- Maintenance required

In essence, this approach ensures that the correct diagnostic information is available to the correct person-at the correct time. In addition, it allows diagnostics to be applied, as most appropriate, for a particular plant application (such as process control engineering or asset management maintenance). Customer specific mapping of diagnostics to these categories allows for flexible configuration depending on the user's requirements.

From an external Model R86 transmitter perspective, diagnostic information includes measurement of process conditions, in addition to detection of internal device or system anomalies.

As mentioned above, the indicators can be assignable (via the DTM or host system) by the user to any (or none) of the NAMUR recommended Status Signal categories: Failure, Function Check, Out of Specification, and Maintenance Required.

The FOUNDATION Fieldbus™ version of the Model R86 transmitter was implemented according to the Field Diagnostics Profile, which is consistent with the objectives of NE 107.



In the FOUNDATION Fieldbus™ version, diagnostic indicators can be mapped to multiple categories, an example is shown in the diagram at left.

In this example, “Calibration Required” is mapped to both the Out of Specification and Maintenance Required status signals, and the diagnostic indicator named “High Electronic Temperature” is mapped to none of the signals.

Indicators that are mapped to the Failure category will normally result in a bad status indication.

A default mapping of all diagnostic indicators will be applied initially, and can be re-applied through use of a restart with defaults operation.

Refer to the table below for a complete listing of the Model R86 diagnostic indicators, along with their explanations, default categories, and recommended remedies.

NOTES: 1. The remedies shown in this table can also be seen on the transmitter LCD by viewing the present status screen when the device is in a diagnostic condition.

2. Those indicators showing failure as the default result in an alarm condition.

5.1.2 Diagnostic Indication Simulation

The DD and DTM allow for the ability to manipulate diagnostic indicators mapped to NE-107 alarm categories in the Resource Block. Intended as a means to verify the configuration of the diagnostic parameters and connected equipment, a user can manually change any indicator in the Resource Block to and from the active state.

5.1.3 Diagnostic Indicator Table

Below is a listing of the Model R86 diagnostic indicators, showing their priority, explanations and recommended remedies. (Priority 1 is highest priority.)

Priority	Indicator Name	Default Category	Explanation	Remedy (Context Sensitive Help)
1	Software Error	Failure	Unrecoverable error occurred in stored program	Contact MAGNETROL Technical Support
2	RAM Error	Failure	RAM (read/write) memory failing	
3	ADC Error	Failure	Analog-to-digital converter failing	
4	EEPROM Error	Failure	Non-volatile parameter storage failing	
5	Analog Board Error	Failure	Unrecoverable hardware failure	
6	Spare Indicator 10	OK	Reserved for future use	
7	Spare Indicator 1	OK	Reserved for future use	
8	Default Parameters	Failure	All saved parameters are set to default values	Perform complete Device Setup
9	Spare Indicator 2	OK	Reserved for future use	

Priority	Indicator Name	Default Category	Explanation	Remedy
10	Sweep Time Error	Failure	Internal Timing Error	Contact Magnetrol Technical Support
11	Spare Indicator 3	OK	Reserved for future use	
12	Too Many Echoes	Failure	Excessive number of possible echoes detected	Check settings: Dielectric Range Sensitivity Polarization Direction View Echo Curve.
13	Safety Zone Alarm	Failure	Risk of echo loss if liquid rises above Top Blocking Distance	Ensure that liquid cannot reach Blocking Distance
14	Echo Lost	Failure	No detectable level signal identified within the configured range	Check settings: Dielectric Range Sensitivity Tank Height View Echo Curve
15	Spare Indicator 4	OK	Reserved for future use	
16	Spare Indicator 11	OK	Reserved for future use	
17	High Volume Alarm	Failure	Volume calculated from Level reading exceeds capacity of vessel or custom table	Check settings: Vessel Dimensions, Custom Table entries
18	High Flow Alarm	Failure	Flow calculated from Distance reading exceeds capacity of flow element or custom table	Check settings: Flow Element, Reference Distance Gen Eqn Factors Custom Table entries
19	Spare Indicator 5	OK	Reserved for future use	
20	Initializing	Function Check	Distance measurement is inaccurate while internal filters are settling	Wait for up to 10 seconds
21	TB Config Changed	Function Check	A parameter has been modified from the User Interface	If desired, reset Config Changed indicator in ADVANCED CONFIG
22	Spare Indicator 6	OK	Reserved for future use	
23	High Elec Temp	Out of Spec	Electronics too hot. May compromise Distance measurement or damage instrument	Shield transmitter from heat source or increase air circulation
24	Low Elec Temp	Out of Spec	Electronics too cold. May compromise Distance measurement or damage instrument	Insulate transmitter or locate remotely in a warmer area

Priority	Indicator Name	Default Category	Explanation	Remedy
25	Calibration Required	Out of Spec	Factory calibration has been lost. Measurement accuracy is diminished	Return transmitter to factory for recalibration
26	Reject Curve Invalid	Out of Spec	Echo Rejection invalid. May report erroneous Level readings	Save a fresh Echo Rejection Curve
27	Spare Indicator 7	OK	Reserved for future use	
28	Inferred Level	Out of Spec	The target has been lost within the Max Distance Jump distance from the Top or Bottom Blocking Distance locations. As a result, the transmitter has inferred that the level has moved into one of those blocking regions, and will report level measurement corresponding to full or empty along with the Inferred Level diagnostic	Verify level reading. If incorrect the configuration may need to be adjusted. Contact MAGNETROL Technical Support
29	Spare Indicator 12	OK	Reserved for future use	
30	Totalizer Data Lost	Out of Spec	Non-volatile Totalizer Data storage failing	Contact Magnetrol Technical Support
31	Spare Indicator 13	OK	Reserved for future use	
32	Spare Indicator 8	OK	Reserved for future use	
33	Max Jump Exceeded	Maintenance Required	A potential valid level target has been detected which is further away from the last known valid level target than the “Max Distance Jump” parameter value derived from the selected rate of change	Check settings: Dielectric Range Sensitivity View Echo Curve
34	Low Echo Margin	Maintenance Required	Target echo has low Echo Margin rating	Check settings: Dielectric Range Sensitivity View Echo Curve
35	High Surface Velocity	Maintenance Required	The measured Surface Velocity is greater than the Max Surface Velocity value derived from the rate of change parameter	Confirm actual tank rate of change. Adjust (increase) Rate of Change parameter accordingly
36	Spare Indicator 9	OK	Reserved for future use	
37	Sequence Record	OK	A Sequence Record number has been stored in Event Log	If desired, report Sequence Record number to MAGNETROL Technical Support

The PULSAR Model R86 offers the ability to do Trending and Echo Curve analysis via the local graphical LCD or by using PACT*ware* and the Model R86 DTM. The Model R86 DTM is an advanced troubleshooting tool that can aid in the resolution of some of the Diagnostic Indicators shown above.

5.1.4 Diagnostic Help

Selecting DIAGNOSTICS from the MAIN MENU presents a list of five ITEMS from the top level of the DIAGNOSTICS tree.

When Present Status is highlighted, the highest MAGNETROL priority active diagnostic indicator (numerically lowest in Table 5.1.3) is displayed on the bottom LCD line as shown above. Pressing the ENTER key moves the active diagnostic indicator to the top line outdented and presents in the lower area of the LCD a brief explanation of and possible remedies for the indicated condition. A blank line separates the explanation from the remedies. Additional active diagnostic indicators, if any, appear with their explanations in descending priority order. Each additional active indicator name-explanation pair is separated by a blank line from the one above.

If the explanation and remedy text (and additional name-explanation pairs) exceeds the available space, a ⇩ appears in the rightmost column of the last line indicating more text below. In this situation, the DOWN key scrolls the text up. Similarly, while text exists above the upper line of the text field, a ⇧ appears in the rightmost column of the top (text) line. In this situation, the UP key scrolls the text down. Otherwise the DOWN and UP keys are inoperative. In all cases the ENT or BACK key reverts to the previous screen.

When the transmitter is operating normally and the highlight cursor is positioned on Present Status, the bottom LCD line displays "OK" because no diagnostic indicators are active.

EVENT HISTORY – This menu displays the parameters related to diagnostic event logging.

ADVANCED DIAGNOSTICS – This menu displays parameters related to some of the advanced diagnostics available within the Model R86.

> **INTERNAL VALUES** – Displays read-only internal parameters.
>
> **ELEC TEMPERATURES** – Displays temperature information as measured in the potted module in degrees F or C.

ECHO CURVES – This menu allows the user to display the live Echo Curve, Echo Reference Curve, Echo History Curves, or Echo Rejection Curve on the LCD.

ECHO HISTORY SETUP – The Model R86 contains the unique and powerful feature that allows waveforms to be automatically captured based on Diagnostic Events, Time or both. This menu contains those parameters that configure that feature.

Eleven waveforms can be saved directly into the transmitter.

- Nine Troubleshooting Curves
- One Echo Rejection Curve
- One Reference Curve

TREND DATA – A 15-minute trend of the PV can be displayed on the LCD.

5.2 Diagnostic Parameters

Each detected diagnostic condition potentially affects the status of one or more of the Transducer Block output parameters.

The Process Variable Status is described by three characteristics—Quality, Sub-status and Limit.

The following table assigns the proposed values of these characteristics, in order of decreasing priority, for each of the diagnostic conditions and/or device configurations.

NOTES: 1. Only the highest priority status will be indicated for a given process variable.

2. If a process variable is not listed for a given diagnostic condition and/or device configuration, the status of that process variable is not affected and will be shown as Good::Non-specific: Not limited

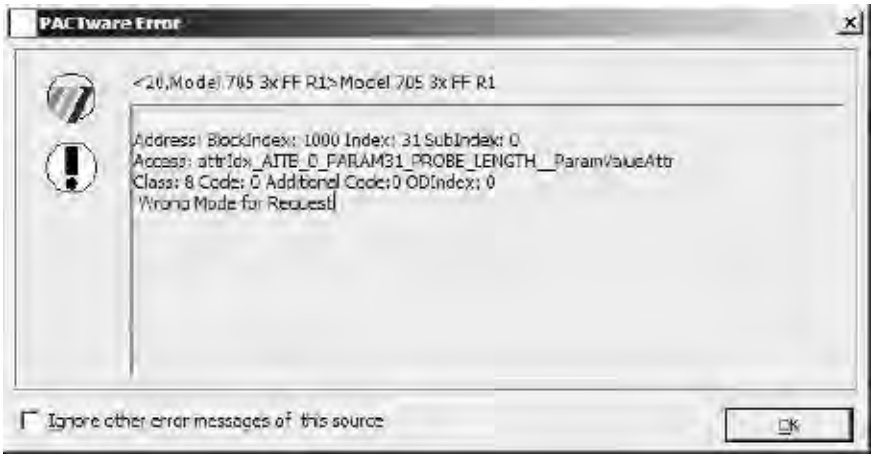
Diagnostic/Condition	Process Variables	Quality	Sub-status	Limit
Level TB –> OOS	Level Distance Echo Strength Echo Margin Elec Temperature	Bad	Out of Service	Not limited
Vol TB -> OOS	Volume	Bad	Out of Service	Not limited
Flow TB -> OOS	Flow Head NR Totalizer R Totalizer	Bad	Out of Service	Not limited
Analog Board Error	All PVs except Elec Temperature	Bad	Sensor Failure	Constant limited
Software Error	All PVs	Bad	Device Failure	Constant limited
RAM Error	All PVs	Bad	Device Failure	Constant limited

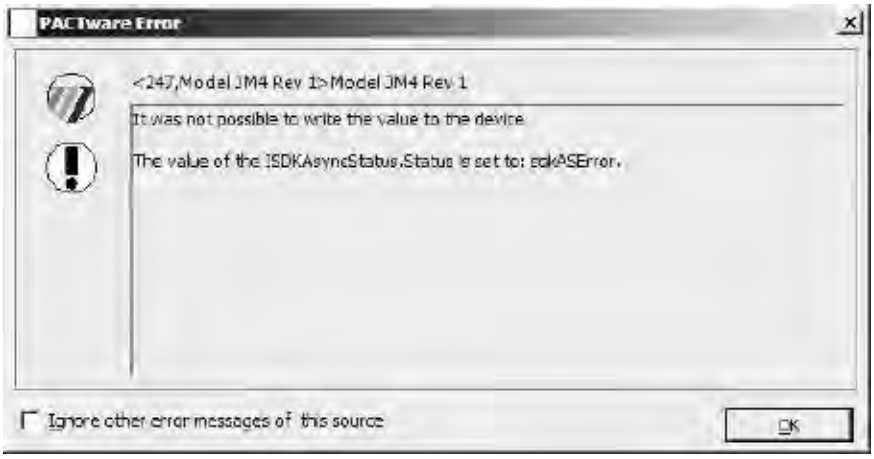
Diagnostic/Condition	Process Variables	Quality	Sub-status	Limit
ADC Failure	All PVs	Bad	Device Failure	Constant limited
EEPROM Error	All PVs	Bad	Device Failure	Constant limited
Sweep Time Error	All PVs except Elec Temperature	Bad	Device Failure	Constant limited
Too Many Echoes	All PVs except Elec Temperature	Bad	Device Failure	Constant limited
Echo Lost	All PVs except Elec Temperature	Bad	Device Failure	Constant limited
Inferred Level	Echo Strength Echo Margin	Bad	Device Failure	Constant limited
Totalizer Data Lost	NR Totalizer R Totalizer	Bad	Device Failure	Not limited
Default Parameters	ALL PVs	Bad	Config Error	Not limited
MeasType = Volume & Level	Volume	Bad	Config Error	Constant limited
MeasType = Flow	Flow Head NR Totalizer R Totalizer	Bad	Config Error	Constant limited
MeasType = Flow and R Totalizer Mode off	R Totalizer	Bad	Config Error	Constant limited
High Volume Alarm	Volume	Bad	Config Error	High limited
HIgh Flow Alarm	Flow Head	Bad	Non-specific	High limited
Safety Zone Alarm	Level, Distance, Volume, Head, Flow	Bad	Non-specific	Not limited
Initializing	All PVs except Elec Temperature	Uncertain	Initial Value	Constant limited
High Elec Temp	All PVs	Good	Non-specific	Not limited
Low Elec Temp	All PVs	Good	Non-specific	Not limited
Calibration Req'd	All PVs	Good	Non-specific	Not limited
Reject Curve Invalid	All PVs	Good	Non-specific	Not limited
Max Jump Exceeded	All PVs	Good	Non-specific	Not limited
Low Echo Margin	All PVs	Good	Non-specific	Not limited
High Surface Velocity	All PVs	Good	Non-specific	Not limited
TB Config Changed	All PVs	Good	Non-specific	Not limited
Sequence Record	All PVs	Good	Non-specific	Not limited.

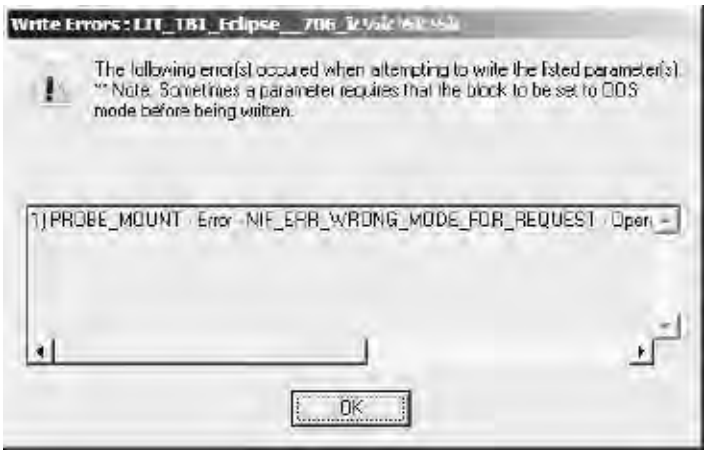
Appendix A

Block Mode Operation (OOS)

Screens such as shown below (which can be from a 475 Field Communicator, NI Configurator, AMS, DTMs, etc.) can be an indication that the block should be set to Out of Service (OOS):







Appendix B

Level Transducer Block Table

Item	Parameter Name	Parameter Label
0	BLOCK_STRUCTURE	BLOCK STRUCT
1	ST_REV	Static Revision
2	TAG_DESC	Tag Description
3	STRATEGY	Strategy
4	ALERT_KEY	Alert Key
5	MODE_BLK	Block Mode
6	BLOCK_ERR	Block Error
7	UPDATE_EVT	Update Event
8	BLOCK_ALM	Block Alarm
9	TRANSDUCER_DIRECTORY	Transducer Directory
10	TRANSDUCER_TYPE	Transducer Type
11	XD_ERROR	Transducer Error
12	COLLECTION_DIRECTORY	Collection Directory
13	MEASUREMENT_TYPE	Measurement Type
14	LEVEL	Level
15	LEVEL_UNIT	Level Unit
16	DISTANCE	Distance
17	DISTANCE_UNIT	Distance Unit
18	ANTENNA_MODEL	Antenna Model
19	ANTENNA_MOUNT	Antenna Mount
20	ANTENNA_EXTENSION	Antenna Extension
21	HEAT_EXTENSION	Heat Extension
22	TANK_HEIGHT	Tank Height
23	STILLWELL_ID	Stillwell ID
24	DIELECTRIC_RANGE	Dielectric Range
25	TURBULENCE	Turbulence
26	FOAM	Foam
27	RATE_OF_CHANGE	Rate Of Change
28	ECHO_REJECT_TYPE	Echo Reject Type
29	ECHO_REJECT_STATE	Echo Reject State
30	ECHO_LIST_MODE	Echo List Mode
31	SAVED_REJECT_LOCATION	Saved Reject Location
32	NEW_REJECT_LOCATION	New Reject Location
33	ECHO_REJECT_MATURITY	Echo Reject Maturity
34	SENSITIVITY	Sensitivity
35	TOP_BLOCKING_DISTANCE	Top Blocking Distance
36	BOTTOM_BLOCKING_DISTANCE	Bottom Blocking Distance
37	SAFETY_ZONE_ALARM	Safety Zone Alarm
38	SAFETY_ZONE_HEIGHT	Safety Zone Height
39	RESET_SAFETY_ZONE_LATCH	Reset SZ Latch
40	ECHO_LOSS_DELAY	Echo Loss Delay
41	ALARM_DELAY	Failure Alarm Delay
42	LEVEL_TRIM	Level Trim
43	TARGET_ALGORITHM	Target Selection
44	TARGET_THRESH_MODE	Target Thresh Mode
45	TARG_AUTO_THRESH_VALUE	Auto Threshold Value
46	TARG_FIXED_THRESH_VALUE	Fixed Threshold Value
47	BASE_THRESHOLD	Base Threshold
48	FME_DISTANCE_THRESHOLD	FME Distance Threshold
49	FME_MERGE_DISTANCE	FME Merge Distance
50	TVG_START_VALUE	TVG Start Value
51	TVG_START_LOCATION	TVG Start Location
52	TVG_END_VALUE	TVG End Value
53	TVG_END_LOCATION	TVG End Location
54	RUN_AVERAGE_DEPTH	Run Average Depth
55	MAX_SURFACE_VELOCITY	Max Surface Velocity

Item	Parameter Name	Parameter Label
56	MAX_DISTANCE_JUMP	Max Distance Jump
57	EMPTY_STATE_DELAY	Empty State Delay
58	COMPOUND_PEAK_LOGIC	Compound Peak Logic
59	RESET_PARAMETERS	Reset Parameters
60	SWEEP_DAC	Sweep DAC
61	SWEEP_WIDTH	Sweep Width
62	DIGIPOT_SETTING	Digipot Setting
63	FIDUCIAL_STRENGTH	Fiducial Strength
64	LEVEL_TICKS	Level Ticks
65	SENSOR_DISTANCE	Sensor Distance
66	ECHO_STRENGTH	Echo Strength
67	ECHO_MARGIN	Echo Margin
68	BOUNDARY_STATE	Boundary State
69	SURFACE_VELOCITY	Surface Velocity
70	ELECTRONICS_TEMPERATURE	Electronics Temp
71	TEMPERATURE_UNIT	Temperature Unit
72	MAX_ELECTRONICS_TEMP	Max Elec Temp
73	MIN_ELECTRONICS_TEMP	Min Elec Temp
74	RESET_ELECTRONICS_TEMPS	Reset Electronic Temps
75	ENTER_PASSWORD	Enter Password
76	ELEC_TEMP_OFFSET	Elec Temp Offset
77	NAP_VALUE	NAP Value
78	FACTORY_RESET	Factory Reset
79	CONV_FACT	Conversion Factor
80	SCLE_OFFS	Scale Offset
81	FIDUCIAL_GAIN	Fiducial Gain
82	INITIAL_GAIN	Initial Gain
83	TVG_DIVISOR	TVG Divisor
84	FACTORY_PARAMETER_1	Factory Parameter 1
85	FACTORY_PARAMETER_2	Factory Parameter 2
86	FACTORY_PARAMETER_3	Factory Parameter 3
87	FACTORY_PARAMETER_4	Factory Parameter 4
88	MAGNETROL_SERIAL_NUMBER	Magnetrol S/N
89	DATE_CODE	Date Code
90	CONFIG_CHANGED_MODE	TB Config Chgd Mode
91	RESET_CONFIG_CHANGED	Reset Config Changed
92	USER_PASSWORD	New User Password
93	LOCAL_DISP_MEAS_VALUES	Local Disp Meas Values
94	LOCAL_DISP_LANGUAGE	Local Disp Language
95	LOCAL_DISP_PHYS_DEV_TAG	Local Disp Phys Dev Tag
96	SOFTWARE_REV	Software Rev
97	HARDWARE_REV	Hardware Rev
98	PRESENT_STATUS	Present Status
99	STATUS_INDICATORS_1	Indicators Group 1
100	STATUS_INDICATORS_2	Indicators Group 2
101	STATUS_INDICATORS_3	Indicators Group 3
102	STATUS_INDICATORS_4	Indicators Group 4
103	STATUS_INDICATORS_5	Indicators Group 5
104	TREND_LEVEL_VALUE	Level
105	TREND_DISTANCE_VALUE	Distance
106	TREND_ECHO_STR_VALUE	Echo Strength
107	TREND_ECHO_MARGIN_VALUE	Echo Margin
108	DEVICE_CLOCK	Device Clock
109	HISTORY_CONTROL	History Control
110	HIST_ENTRY1	Event History 1
111	HIST_ENTRY2	Event History 2
112	HIST_ENTRY3	Event History 3
113	HIST_ENTRY4	Event History 4
114	HIST_ENTRY5	Event History 5
115	HIST_ENTRY6	Event History 6

Item	Parameter Name	Parameter Label
116	HIST_ENTRY7	Event History 7
117	HIST_ENTRY8	Event History 8
118	HIST_ENTRY9	Event History 9
119	HIST_ENTRY10	Event History 10
120	HIST_ENTRY11	Event History 11
121	HIST_ENTRY12	Event History 12
122	HIST_ENTRY13	Event History 13
123	HIST_ENTRY14	Event History 14
124	HIST_ENTRY15	Event History 15
125	HIST_ENTRY16	Event History 16
126	HIST_ENTRY17	Event History 17
127	HIST_ENTRY18	Event History 18
128	HIST_ENTRY19	Event History 19
129	HIST_ENTRY20	Event History 20
130	RESET_HISTORY	Reset History
131	BCSM_LOGGING	BCSM Logging
132	ECHO_HIST_TRIGGER_MODE	Echo Hist Trigger Mode
133	ECHO_HIST_TIME_TRIGGERS	Echo Hist Time Triggers
134	ECHO_HIST_EVENT_TRIGGERS	Echo Hist Event Triggers
135	ECHO_STD_REJECT_LOG	Std Echo Rejection
136	ECHO_CUSTOM_REJ_LOG	Custom Echo Rejection
137	ECHO_REFERENCE_LOG	Echo Reference
138	ECHO_HISTORY_LOG1	Echo History 1
139	ECHO_HISTORY_LOG2	Echo History 2
140	ECHO_HISTORY_LOG3	Echo History 3
141	ECHO_HISTORY_LOG4	Echo History 4
142	ECHO_HISTORY_LOG5	Echo History 5
143	ECHO_HISTORY_LOG6	Echo History 6
144	ECHO_HISTORY_LOG7	Echo History 7
145	ECHO_HISTORY_LOG8	Echo History 8
146	ECHO_HISTORY_LOG9	Echo History 9
147	DELETE_ECHO_HISTORY	Delete Echo History
148	SAVE_ECHO_CURVE	Save Echo Curve
149	VIEW_ECHO_CURVE	View Echo Curve
150	WAVEFORM_SUMMARY	Waveform Summary
151	ECHO_CURVE_DATA	Echo Curve Data
152	ECHO_DATA_INDEX	Echo Data Index
153	ECHO_CHANGE_REQ	Echo Change Request
154	CUSTOM_ECHOREJ_CMDS	Echo Reject Commands
155	ECHO_REJ_PROFILE_STATUS	Echo Reject Profile Status
156	ECHO_REJ_PARAMS	Echo Reject Parameters
157	DATA_LOG_SETUP	Data Log Setup
158	DATA_LOG_SUMM_READ_REQ	Log Summary Read Req
159	DATA_LOG_SUMMARY	Data Log Summary
160	DATA_LOG_INDEX	Data Log Index
161	DATA_LOG_RECORDS	Log Data
162	PD_TAG_APPL_IMAGE	PD Tag
163	ECHO_LIST_CONTROL	Echo List Control
164	ECHO_LIST_TYPE	Echo List Type
165	ECHO_LIST_LENGTH	Echo List Length
166	ECHO_LIST_ENTRY1	Echo List 1
167	ECHO_LIST_ENTRY2	Echo List 2
168	ECHO_LIST_ENTRY3	Echo List 3
169	ECHO_LIST_ENTRY4	Echo List 4
170	ECHO_LIST_ENTRY5	Echo List 5
171	ECHO_LIST_ENTRY6	Echo List 6
172	ECHO_LIST_ENTRY7	Echo List 7
173	ECHO_LIST_ENTRY8	Echo List 8
174	ECHO_LIST_ENTRY9	Echo List 9
175	ECHO_LIST_ENTRY10	Echo List 10

Item	Parameter Name	Parameter Label
176	ECHO_LIST_ENTRY11	Echo List 11
177	ECHO_LIST_ENTRY12	Echo List 12
178	ECHO_LIST_ENTRY13	Echo List 13
179	ECHO_LIST_ENTRY14	Echo List 14
180	ECHO_LIST_ENTRY15	Echo List 15
181	FME_ECHO_LIST_REQ	FME Echo List Request
182	FME_TARGET_LOCATION	FME Target Location
183	TANK_PROF_SETUP	Tank Profile Setup
184	TP_SUMMARY	Tank Profile Summary
185	TP_SUMM_UPDATE_REQ	Request TP Summary Update
186	TP_READ_REQ_INDEX	Tank Profile Record Request
187	TANK_PROF_DATA_1	Tank Profile Data 1
188	TANK_PROF_DATA_2	Tank Profile Data 2

Volume Transducer Block Table

Item	Parameter Name	Parameter Label
0	BLOCK_STRUCTURE	BLOCK STRUCT
1	ST_REV	Static Revision
2	TAG_DESC	Tag Description
3	STRATEGY	Strategy
4	ALERT_KEY	Alert Key
5	MODE_BLK	Block Mode
6	BLOCK_ERR	Block Error
7	UPDATE_EVT	Update Event
8	BLOCK_ALM	Block Alarm
9	TRANSDUCER_DIRECTORY	Transducer Directory
10	TRANSDUCER_TYPE	Transducer Type
11	XD_ERROR	Transducer Error
12	COLLECTION_DIRECTORY	Collection Directory
13	MEAS_TYPE	Measurement Type
14	VOLUME	Volume
15	VOLUME_UNIT	Volume Unit
16	LEVEL_VALUE	Level
17	LEVEL_UNIT	Level Unit
18	VESSEL TYPE	Vessel Type
19	VESSEL_RADIUS	Vessel Radius
20	VESSEL_ELLIPSE_DEPTH	Vessel Ellipse Depth
21	VESSEL_CONICAL_HEIGHT	Vessel Conical Height
22	VESSEL_WIDTH	Vessel Width
23	VESSEL_LENGTH	Vessel Length
24	VESSEL_SENSOR_OFFSET	Vessel Sensor Offset
25	VOLUME_TABLE_TYPE	Volume Table Type
26	LEVEL_INPUT_SOURCE	Level Input Source
27	VOLUME_TABLE_LENGTH	Volume Table Length
28	VOLUME_TABLE_PT_01	Volume Table Pt 01
29	VOLUME_TABLE_PT_02	Volume Table Pt 02
30	VOLUME_TABLE_PT_03	Volume Table Pt 03
31	VOLUME_TABLE_PT_04	Volume Table Pt 04
32	VOLUME_TABLE_PT_05	Volume Table Pt 05
33	VOLUME_TABLE_PT_06	Volume Table Pt 06
34	VOLUME_TABLE_PT_07	Volume Table Pt 07
35	VOLUME_TABLE_PT_08	Volume Table Pt 08
36	VOLUME_TABLE_PT_09	Volume Table Pt 09
37	VOLUME_TABLE_PT_10	Volume Table Pt 10
38	VOLUME_TABLE_PT_11	Volume Table Pt 11
39	VOLUME_TABLE_PT_12	Volume Table Pt 12
40	VOLUME_TABLE_PT_13	Volume Table Pt 13
41	VOLUME_TABLE_PT_14	Volume Table Pt 14

Item	Parameter Name	Parameter Label
42	VOLUME_TABLE_PT_15	Volume Table Pt 15
43	VOLUME_TABLE_PT_16	Volume Table Pt 16
44	VOLUME_TABLE_PT_17	Volume Table Pt 17
45	VOLUME_TABLE_PT_18	Volume Table Pt 18
46	VOLUME_TABLE_PT_19	Volume Table Pt 19
47	VOLUME_TABLE_PT_20	Volume Table Pt 20
48	VOLUME_TABLE_PT_21	Volume Table Pt 21
49	VOLUME_TABLE_PT_22	Volume Table Pt 22
50	VOLUME_TABLE_PT_23	Volume Table Pt 23
51	VOLUME_TABLE_PT_24	Volume Table Pt 24
52	VOLUME_TABLE_PT_25	Volume Table Pt 25
53	VOLUME_TABLE_PT_26	Volume Table Pt 26
54	VOLUME_TABLE_PT_27	Volume Table Pt 27
55	VOLUME_TABLE_PT_28	Volume Table Pt 28
56	VOLUME_TABLE_PT_29	Volume Table Pt 29
57	VOLUME_TABLE_PT_30	Volume Table Pt 30
58	VOLUME_HIGH_LIMIT	Volume High Limit
59	LEVEL_LOW_LIMIT	Level Low Limit
60	LEVEL_HIGH_LIMIT	Level High Limit
61	ENTER_PASSWORD	Enter Password
62	PRESENT_STATUS	Present Status
63	STATUS_INDICATORS_1	Indicators Group 1
64	STATUS_INDICATORS _2	Indicators Group 2
65	STATUS_INDICATORS _3	Indicators Group 3
66	STATUS_INDICATORS _4	Indicators Group 4
67	STATUS_INDICATORS _5	Indicators Group 5
68	TREND_VOLUME_VALUE	Volume

Flow Transducer Block Table

Item	Parameter Name	Parameter Label
0	BLOCK_STRUCTURE	BLOCK STRUCT
1	ST_REV	Static Revision
2	TAG_DESC	Tag Description
3	STRATEGY	Strategy
4	ALERT_KEY	Alert Key
5	MODE_BLK	Block Mode
6	BLOCK_ERR	Block Error
7	UPDATE_EVT	Update Event
8	BLOCK_ALM	Block alarm
9	TRANSDUCER_DIRECTORY	Transducer Directory
10	TRANSDUCER_TYPE	Transducer Type
11	XD_ERROR	Transducer Error
12	COLLECTION_DIRECTORY	Collection Directory
13	MEAS_TYPE	Measurement Type
14	FLOW	Flow
15	FLOW_UNIT	Flow Unit
16	HEAD	Head
17	HEAD_UNIT	Head Unit
18	DISTANCE_VALUE	Distance
19	DISTANCE_UNIT	Distance Unit
20	NR_TOTALIZER_MULTIPLIER	NR Totalizer Multiplier
21	NR_TOTALIZER	NR Totalizer
22	NR_TOTALIZER_UNIT	NR Totalizer Unit
23	NR_TOTALIZER_TIME	NR Totalizer Time
24	R_TOTALIZER_MODE	R Totalizer Mode
25	R_TOTALIZER_MULTIPLIER	R Totalizer Multiplier
26	R_TOTALIZER	R Totalizer
27	R_TOTALIZER_UNIT	R Totalizer Unit

Item	Parameter Name	Parameter Label
28	R_TOTALIZER_TIME	R Totalizer Time
29	RESET_R_TOTALIZER	Reset R Totalizer
30	REFERENCE_DISTANCE	Reference Distance
31	MAXIMUM_HEAD	Maximum Head
32	MAXIMUM_FLOW	Maximum Flow
33	LOW_FLOW_CUTOFF	Low Flow Cutoff
34	FLOW_ELEMENT	Flow Element
35	PALMER_BOWL_FLUME_WIDTH	Palmer Bowl Flume Width
36	PARSHALL_FLUME_WIDTH	Parshall Flume Width
37	V_NOTCH_WEIR_ANGLE	V Notch Weir Angle
38	WEIR_CREST_LENGTH	Weir Crest Length
39	GENERIC_EQN_K_FACTOR	Generic Eqn K Factor
40	GENERIC_EQN_L_FACTOR	Generic Eqn L Factor
41	GENERIC_EQN_C_FACTOR	Generic Eqn C Factor
42	GENERIC_EQN_N_FACTOR	Generic Eqn n Factor
43	FLOW_TABLE_TYPE	Flow Table Type
44	FLOW_TABLE_LENGTH	Flow Table Length
45	FLOW_TABLE_PT_01	Flow Table Pt 01
46	FLOW_TABLE_PT_02	Flow Table Pt 02
47	FLOW_TABLE_PT_03	Flow Table Pt 03
48	FLOW_TABLE_PT_04	Flow Table Pt 04
49	FLOW_TABLE_PT_05	Flow Table Pt 05
50	FLOW_TABLE_PT_06	Flow Table Pt 06
51	FLOW_TABLE_PT_07	Flow Table Pt 07
52	FLOW_TABLE_PT_08	Flow Table Pt 08
53	FLOW_TABLE_PT_09	Flow Table Pt 09
54	FLOW_TABLE_PT_10	Flow Table Pt 10
55	FLOW_TABLE_PT_11	Flow Table Pt 11
56	FLOW_TABLE_PT_12	Flow Table Pt 12
57	FLOW_TABLE_PT_13	Flow Table Pt 13
58	FLOW_TABLE_PT_14	Flow Table Pt 14
59	FLOW_TABLE_PT_15	Flow Table Pt 15
60	FLOW_TABLE_PT_16	Flow Table Pt 16
61	FLOW_TABLE_PT_17	Flow Table Pt 17
62	FLOW_TABLE_PT_18	Flow Table Pt 18
63	FLOW_TABLE_PT_19	Flow Table Pt 19
64	FLOW_TABLE_PT_20	Flow Table Pt 20
65	FLOW_TABLE_PT_21	Flow Table Pt 21
66	FLOW_TABLE_PT_22	Flow Table Pt 22
67	FLOW_TABLE_PT_23	Flow Table Pt 23
68	FLOW_TABLE_PT_24	Flow Table Pt 24
69	FLOW_TABLE_PT_25	Flow Table Pt 25
70	FLOW_TABLE_PT_26	Flow Table Pt 26
71	FLOW_TABLE_PT_27	Flow Table Pt 27
72	FLOW_TABLE_PT_28	Flow Table Pt 28
73	FLOW_TABLE_PT_29	Flow Table Pt 29
74	FLOW_TABLE_PT_30	Flow Table Pt 30
75	ENTER_PASSWORD	Enter Password
76	PRESENT_STATUS	Present Status
77	STATUS_INDICATORS_1	Status Indicators
78	STATUS_INDICATORS _2	Status Indicators
79	STATUS_INDICATORS _3	Status Indicators
80	STATUS_INDICATORS _4	Status Indicators
81	STATUS_INDICATORS _5	Status Indicators
82	TREND_FLOW_VALUE	Flow
83	TREND_HEAD_VALUE	Head

IMPORTANT

SERVICE POLICY

Owners of Magnetrol products may request the return of a control; or, any part of a control for complete rebuilding or replacement. They will be rebuilt or replaced promptly. Magnetrol International will repair or replace the control, at no cost to the purchaser, (or owner) ***other than transportation cost*** if:

a. Returned within the warranty period; and,
b. The factory inspection finds the cause of the malfunction to be defective material or workmanship.

If the trouble is the result of conditions beyond our control; or, is **NOT** covered by the warranty, there will be charges for labour and the parts required to rebuild or replace the equipment.
In some cases, it may be expedient to ship replacement parts; or, in extreme cases a complete new control, to replace the original equipment before it is returned. If this is desired, notify the factory of both the model and serial numbers of the control to be replaced. In such cases, credit for the materials returned, will be determined on the basis of the applicability of our warranty.
No claims for misapplication, labour, direct or consequential damage will be allowed.

RETURNED MATERIAL PROCEDURE

So that we may efficiently process any materials that are returned, it is essential that a “Return Material Authorisation” (RMA) form will be obtained from the factory. It is mandatory that this form will be attached to each material returned. This form is available through Magnetrol’s local representative or by contacting the factory. Please supply the following information:

1. Purchaser Name
2. Description of Material
3. Serial Number and Ref Number
4. Desired Action
5. Reason for Return
6. Process details

Any unit that was used in a process must be properly cleaned in accordance with the proper health and safety standards applicable by the owner, before it is returned to the factory.
A material Safety Data Sheet (MSDS) must be attached at the outside of the transport crate or box.
All shipments returned to the factory must be by prepaid transportation. Magnetrol ***will not accept*** collect shipments.
All replacements will be shipped Ex Works.

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