PULSAR®
R86 RADAR

Pulsar® Model R86
PROFIBUS PA
Operating Manual

Software Version 1.x

High Performance

26 GHz Pulse Burst Radar

Level Transmitter

MAGNETROL®

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.

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Pulsar® Model R86 Radar transmitter with PROFIBUS PA Output

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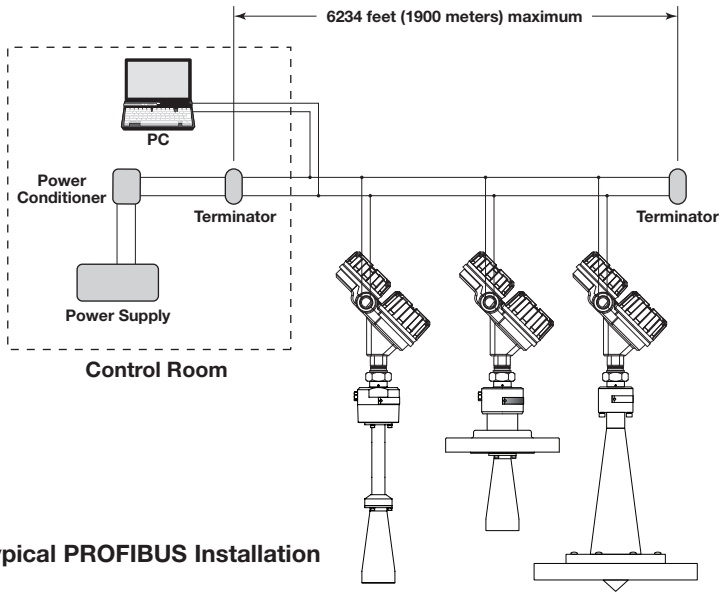
1.0 PROFIBUS PA™ Overview

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).

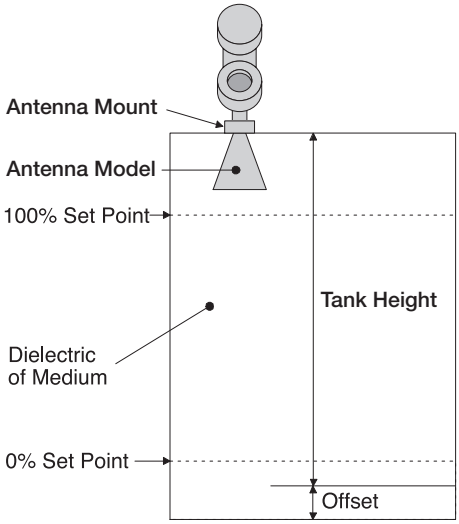
2.3 Analog Input Block

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.

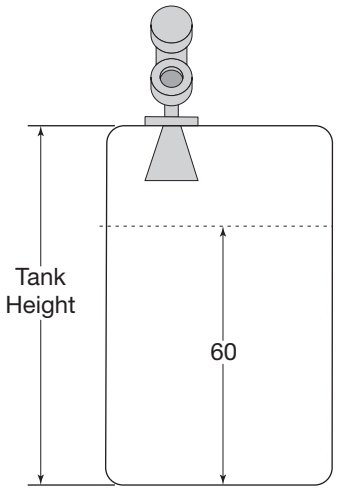
The [AI Block] PV Scale values are automatically converted to appropriate values if the units for the channel used by an AI block are changed. For example, if PV Scale Upper Value is 240 inches and Channel is Level, if Level Units is changed from inches to feet, PV Scale Upper Value will automatically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

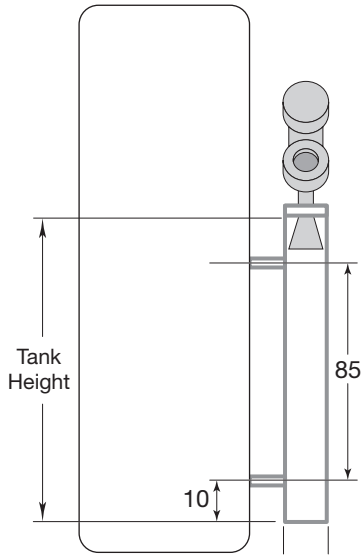


Transducer Block + LCD Level	AI Block Output [To PA segment]
60 [in / cm]	100%
Tank Height = inches or cm	
0 [in / cm]	0%

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]

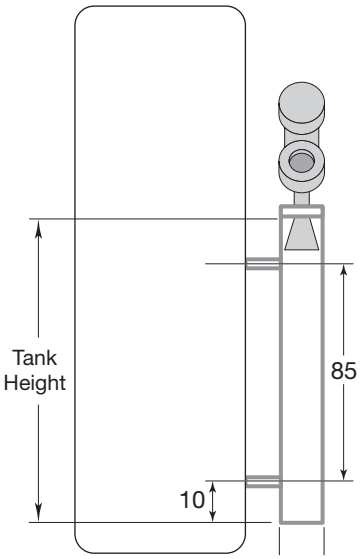


Transducer Block + LCD Level	AI Block Output [To PA segment]
85 cm	100%
0 cm	0%

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

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.

Home Screen

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

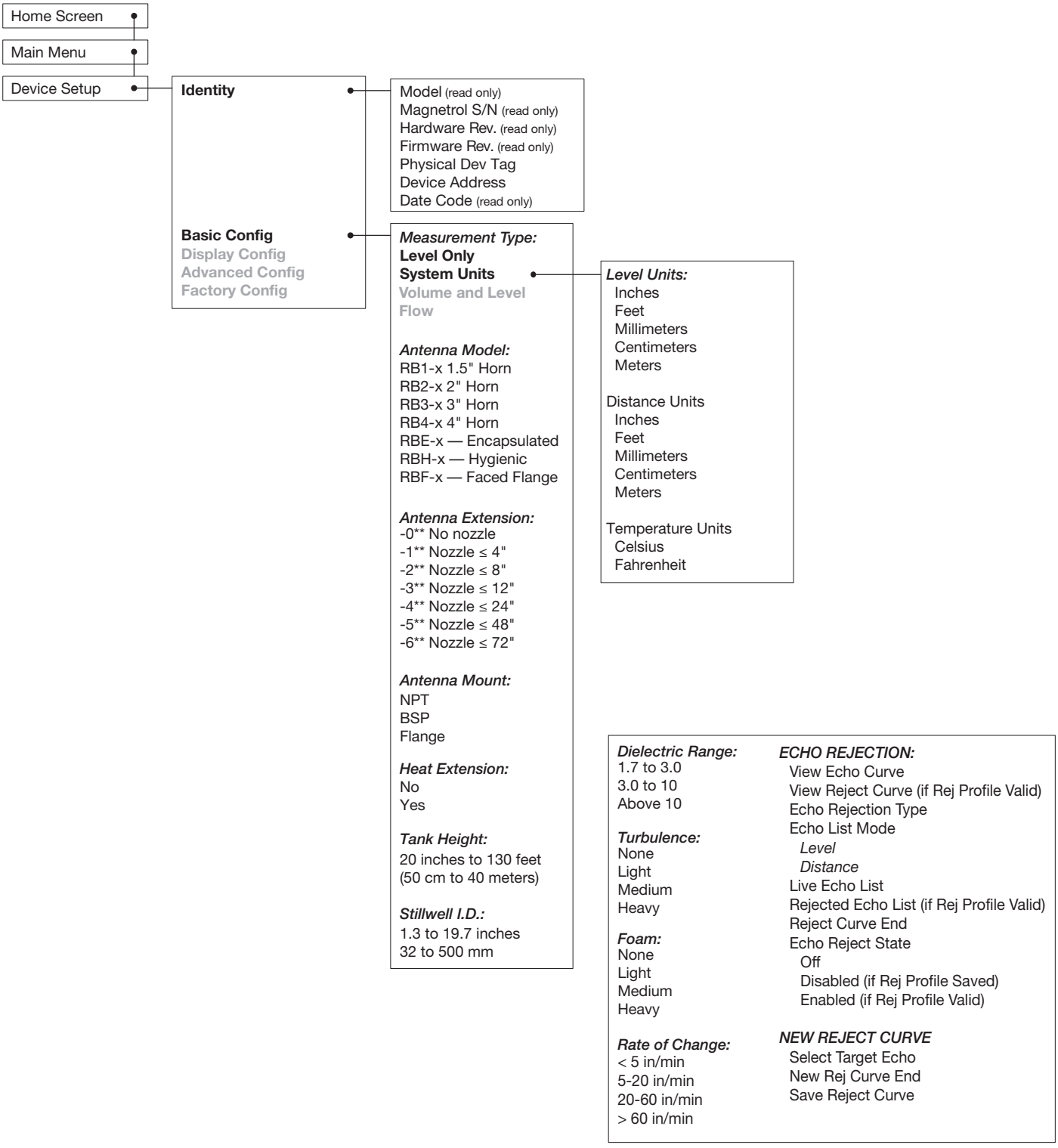
DIAGNOSTICS

Refer to Section 4.0

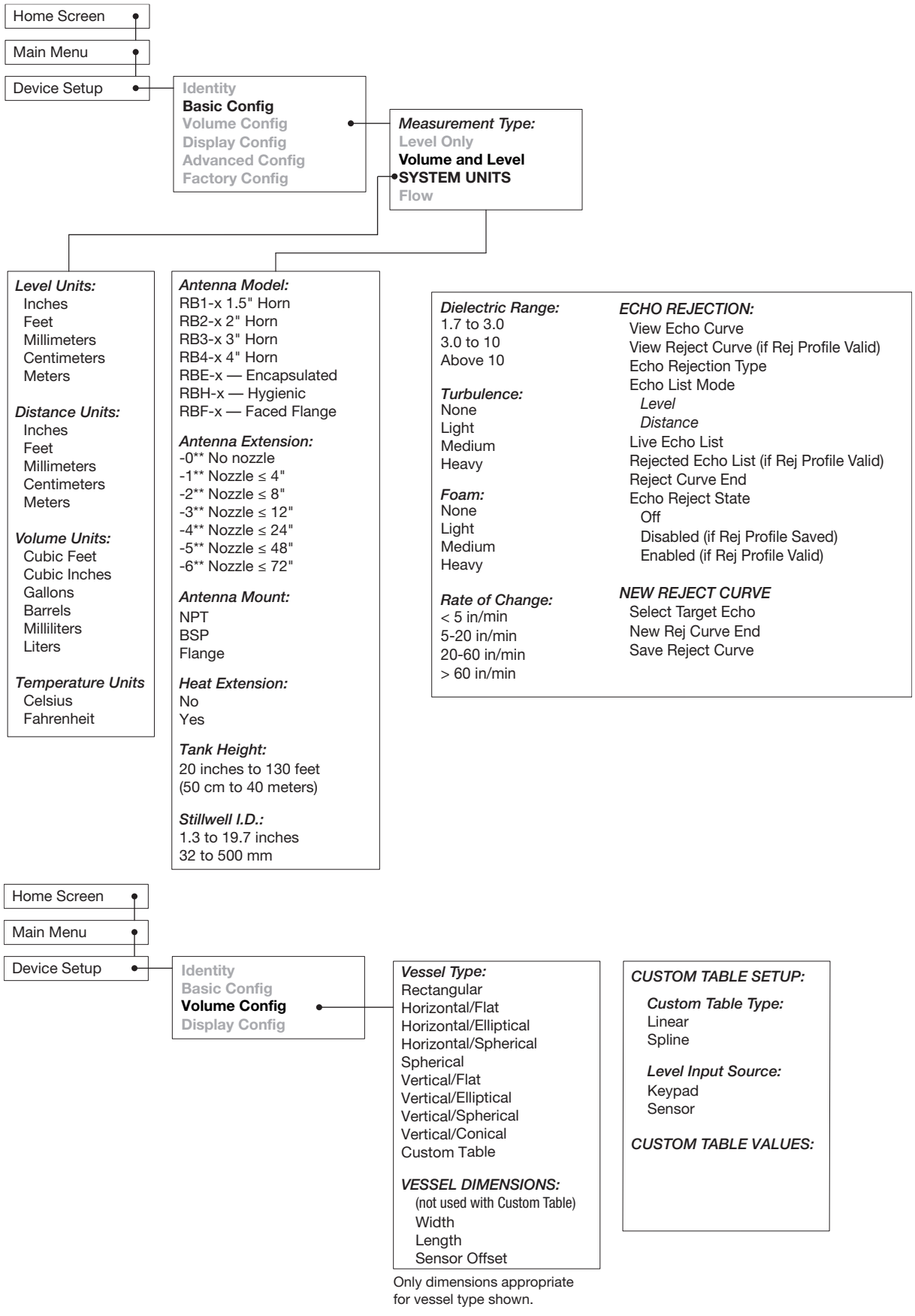
MEASURED VALUES

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

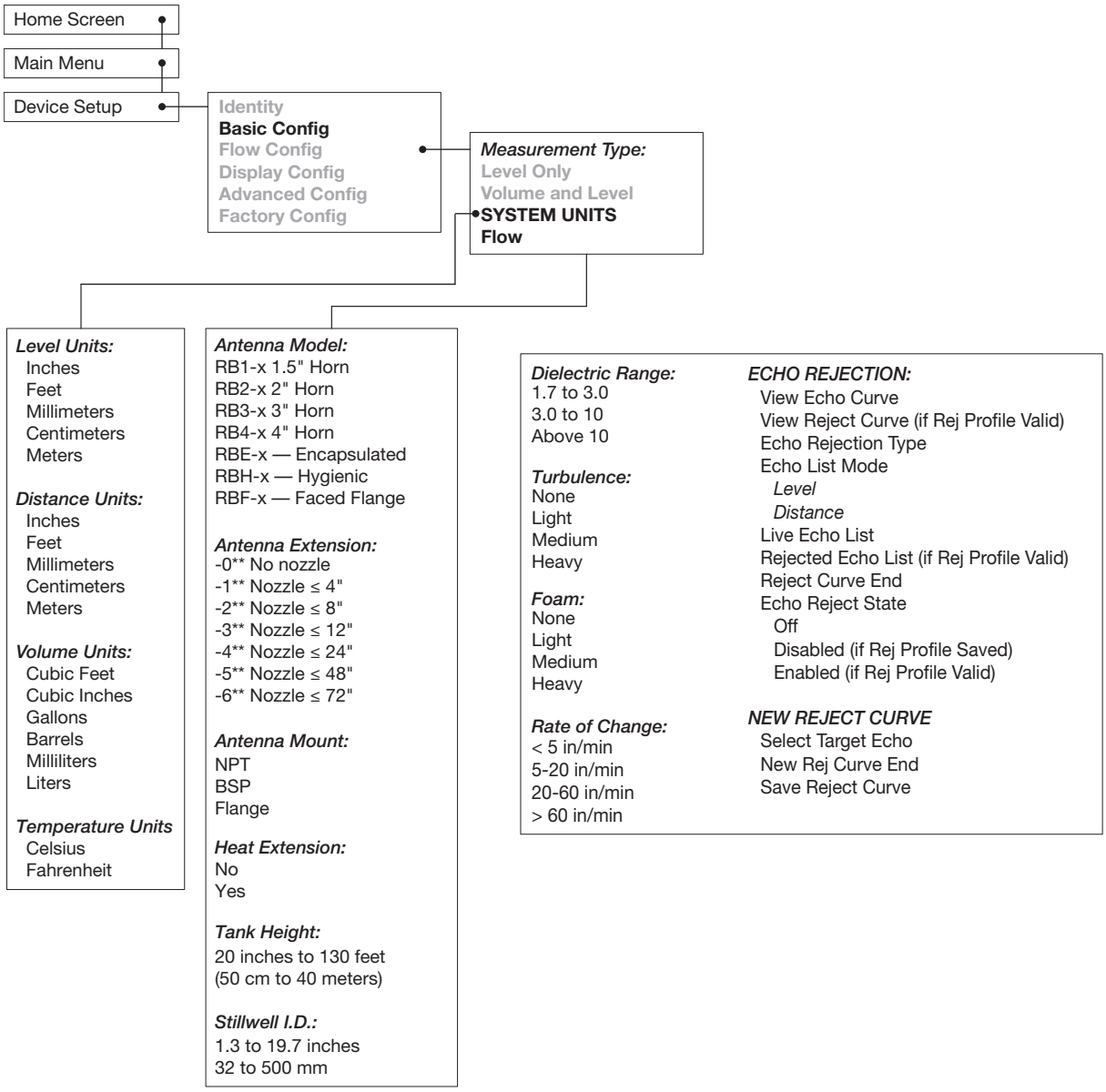


3.5 Model R86 Configuration Menu — Device Setup

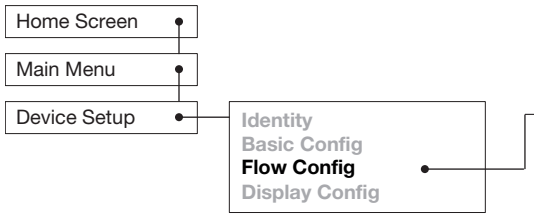


Only dimensions appropriate for vessel type shown.

3.5 Model R86 Configuration Menu — Device Setup

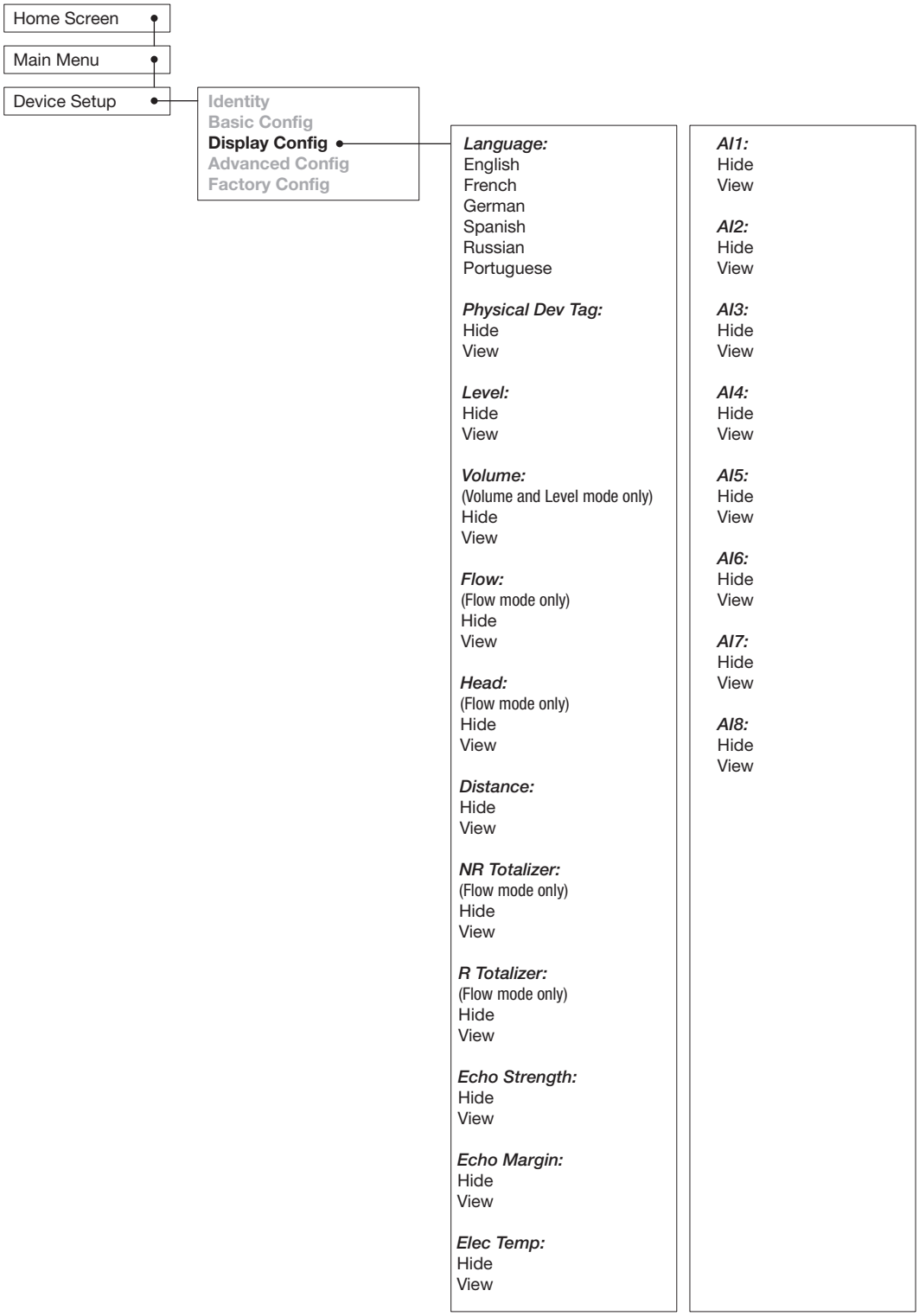


3.5 Model R86 Configuration Menu — Device Setup

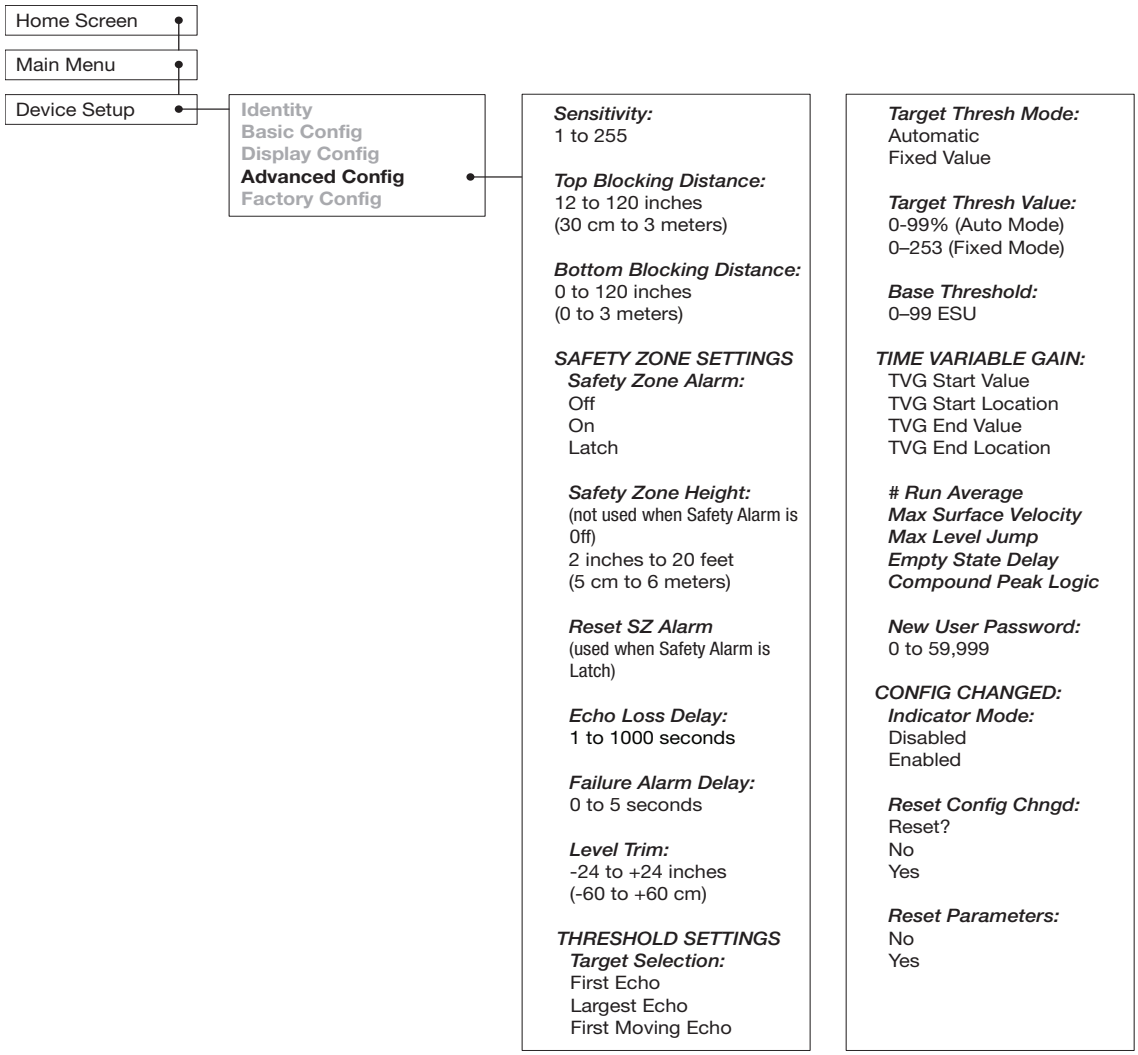


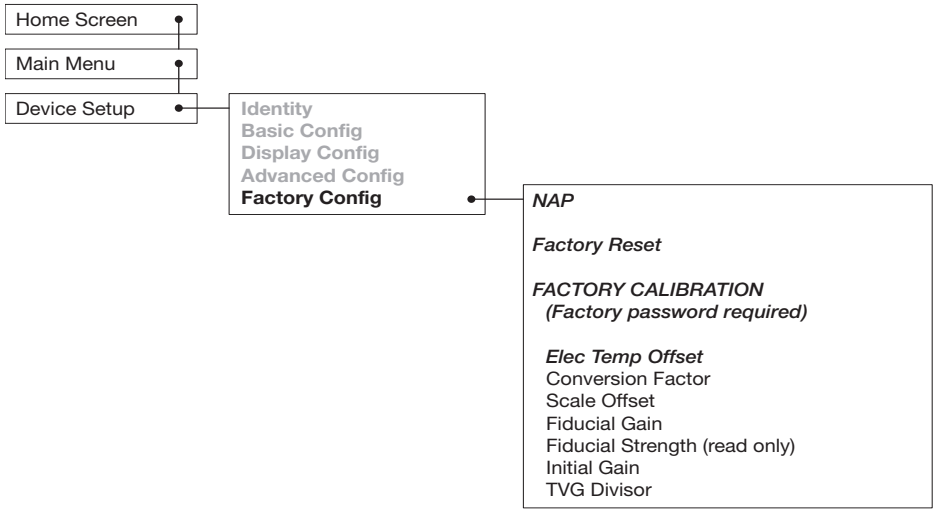
Flow Units: Cubic Ft/Second Cubic Ft/Minute Cubic Ft/Hour Gallons/Minute Gallons/Hour Mil Gallons/Day Liters/Second Liters/Minute Liters/Hour Cubic Meters/Hour ***Head Units:*** Inches Feet Millimeters Centimeters Meters ***Flow Element:*** ***Palmer-Bowlus Flume*** ***Flume Channel Width:*** 4 inches 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.”

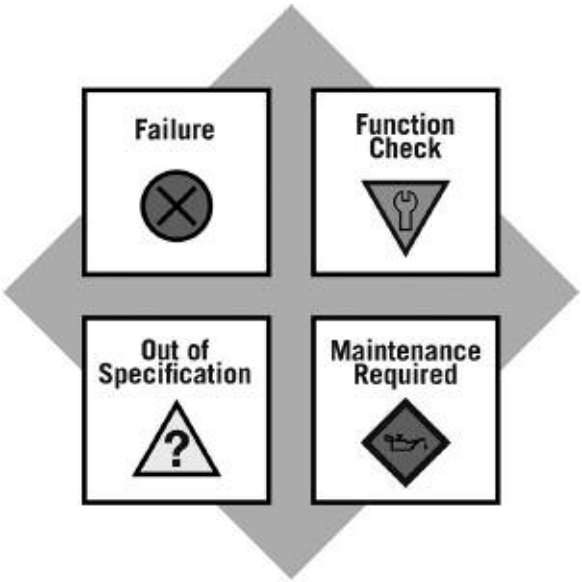
If the Model R86 fails to find a measurable level, the TRANSDUCER BLOCK maintains the last good value as the output and flags the failure. The QUALITY is “Bad,” the SUB_STATUS is “Sensor failure” for no level, and the LIMIT attribute is “Constant.”

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.

5.0 Reference Information

5.1 Agency Approvals

These devices are in compliance with the RED-directive 2014/53/EU, the EMC directive 2014/30/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 ia 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 1, Zone 2 AEx nA ia IIC T4…T1 Class 1, 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 = -15º C to +70º C Type 4X, IP67 **ATEX – FM17ATEX0027X:** II 2 D Ex ia tb IIIC T100º C Db Ta = -15º C to +70º C IP67 **IEC – IECEx FMG 17.0012X:** Ex ia tb IIIC T100º C Db Ta = -15º C to +70º C 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, EN60079-1:2014, EN60079-11:2012, EN60079-15:2010, EN60079-26:2007, EN60079-31:2009, EN60529+A1:1991-2000, 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 "g" (seal option) is "N":

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

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

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

Process temperature range for the 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 "g" (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 200 °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 1½" 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

5.1.1 Agency Drawing and Entity Parameters

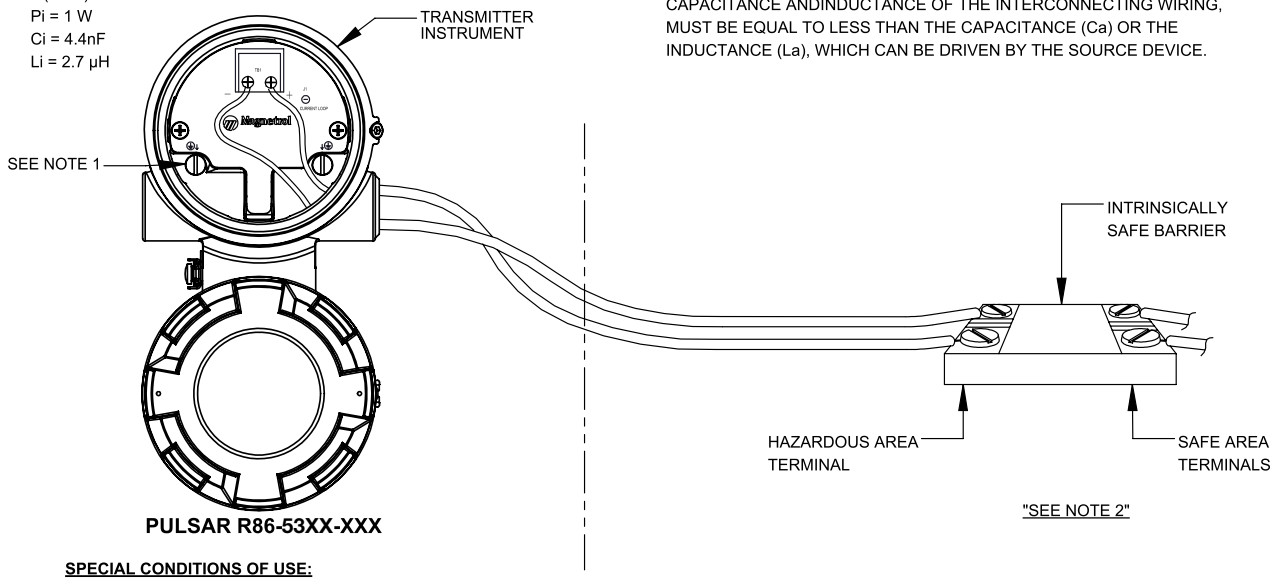
HAZARDOUS LOCATION
PULSAR R86 LEVEL TRANSMITTER
INTRINSICALLY SAFE FOR:
CL I,II,III DIV 1 GRP A,B,C,D,E,F,G
CL I, ZONE 0 AEx ia IIC
CL I, ZONE 0 Ex ia IIC
II 1 G Ex ia IIC
Ex ia IIC

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 R86-53XX-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 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.

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

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

5.2 Model Number

5.2.1 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
3	PROFIBUS PA

6 | SAFETY OPTIONS

0	None (FOUNDATION fieldbus and PROFIBUS only, 5th digit = 2)
1	SIL 2 Hardware - HART only (5th digit = 1)
A	None (FOUNDATION fieldbus and PROFIBUS only, 5th digit = 2) – 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 or Non-incendive (FM & CSA)
A	Intrinsically Safe (ATEX/IEC)
B	Flame-proof (ATEX/IEC) Zone 0 requires 10th digit = 0, 8 or N
C	Non-sparking (ATEX)
D	Dust Ignition-proof

9 | HOUSING

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

10 | CONDUIT CONNECTION

0	½" NPT
1	M20
2	½" NPT with sunshade
3	M20 with sunshade

R	8	6	—	5				—			

5.2.2 PULSAR Model R86 Radar Antenna

1–2 | TECHNOLOGY

R B	PULSAR Radar Antennas - 26 GHz

3 | CONFIGURATION/STYLE

1	1½" Horn (only for installations directly into tanks)
2	2" Horn (only for installations directly into tanks)
3	3" Horn (for installation inside tanks or outside of tanks for FCC and Canada)
4	4" Horn (for installation inside tanks or outside of tanks for FCC and Canada)
E	Encapsulated – Polypropylene available only with: 4th and 5th digits = 31, 43, 53, 63, 73, DA, EA, FA, GA
F	Faced Flange – PTFE Coated Wetted Surfaces Available only with: 4th digit = 2 or 3; 4th and 5th digits = 43, 53, DA, EA
H	Hygienic (future)

4–5 | PROCESS CONNECTION - SIZE/TYPE

31	1½" NPT thread	41	2" NPT Thread
32	1½" BSP (G 1½") thread	42	2" BSP (G 2") Thread

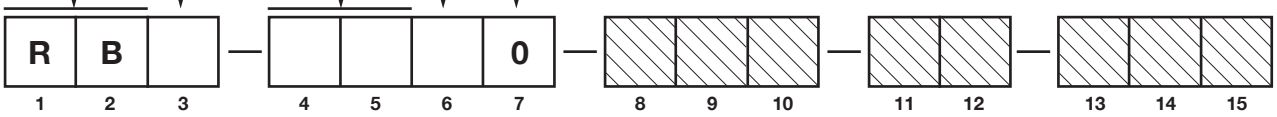
ASME Flanges		EN (DIN) Flanges		
43	2" 150# ASME raised face flange	DA	DN 50, PN 16	EN 1092-1 Type A
44	2" 300# ASME raised face flange	DB	DN 50, PN 25/40	EN 1092-1 Type A
45	2" 600# ASME raised face flange	DD	DN 50, PN 63	EN 1092-1 Type B2
53	3" 150# ASME raised face flange	EA	DN 80, PN 16	EN 1092-1 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

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



5.2.2 PULSAR Model R86 Radar Antenna

8 | MATERIAL OF CONSTRUCTION - MFG/NUT/ROD/INSULATION

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

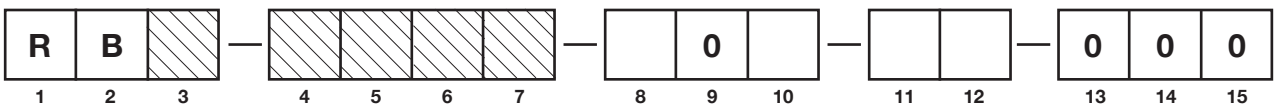
0	Viton VX065
2	Kalrez 4079 (not suitable for ATEX/IEC flameproof Zone 0)
8	Simriz SZ485 (formerly Aegis PF128) — NACE
A	Kalrez 6375 (not suitable for ATEX/IEC flameproof Zone 0)
N	None - Alumina seal

11 | ANTENNA EXTENSIONS

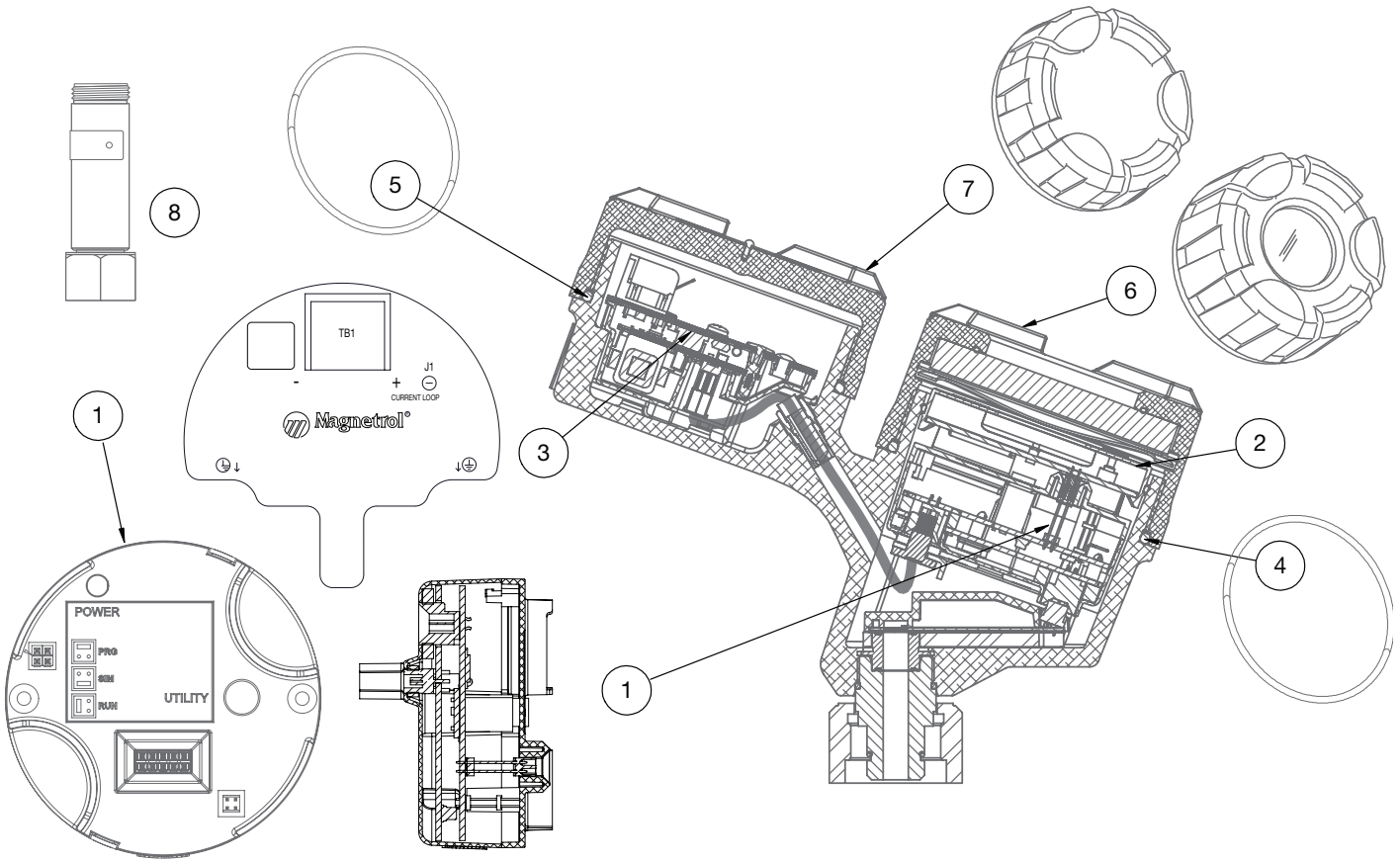
0	None
1	For nozzle height ≤ 4" (100 mm) (available only when Antenna 3rd Digit = 1)
2	For nozzle height ≤ 8" (200 mm) (not available when Antenna 3rd Digit = 3 or 4)
3	For nozzle height ≤ 12" (300 mm)
4	For nozzle height ≤ 24" (600 mm)
5	For nozzle height ≤ 48" (1200 mm)
6	For nozzle height ≤ 72" (1800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

12 | SPECIAL OPTIONS

0	None
1	⅛" Flushing Connection



5.3 Replacement Parts



Electronics:

Digit: 1 2 3 4 5 6 7 8 9 10

Part Number: [ ][R][8][6]–[5][ ][ ][ ]–[ ][ ][ ]

X = product with a non-standard customer requirement

Serial Number: [ ][ ][ ][ ][ ][ ]–[ ][ ]–[ ][ ][ ]

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

(1) Electronic Module		
Digit 5	**Digit 6**	**Replacement Part**
1	1	Z31-2864-001
2	0	Z31-2864-002
3	0	Z31-2873-001

(2) Display Module		
Digit 5	**Digit 7**	**Replacement Part**
1, 2 or 3	0	N/A
	A	Z31-2850-001

(3) Wiring PC Board		
Digit 5	**Digit 6**	**Replacement Part**
1	1	Z30-9180-001
2 or 3	0	Z30-9166-003

(4) (5) O-ring
Replacement Part
012-2601-237

(6) Housing Cover			
Digit 7	**Digit 8**	**Digit 9**	**Replacement Part**
0	all	1	004-9225-002
		2	004-9225-003
A	all	1	036-4413-013
	all	2	036-4413-016

(7) Housing Cover	
Digit 9	**Replacement Part**
1	004-9225-002
2	004-9225-003

(8) Heat Extension
Replacement Part
032-6922-001

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

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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