Temposonics
AN AMPHENOL COMPANY

Operation Manual

Level Plus® Safety Manual

Magnetostrictive Liquid Level Transmitters

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2. Introduction

This manual provides to the user electrical installation and operation guidelines for the Level Plus® LP-Series line of liquid level transmitters with analog output in safety related applications. Specific LP-Series models are Safety Integrity Level (SIL) capable according to IEC 61508 Functional safety of electrical/electronic/programmable electronic safety-related systems. This Safety Manual is a supplement to the Operation and Installation Manual which should be consulted for standard operation and installation information.

3. Function

3.1 Safety Rated Function

The loop powered 4-20 mA analog output on loop 1 is the safety rated function of the SIL capable level transmitter. The range may be specified either from 4 to 20 mA or 20 to 4 mA. In the event of an over range or internal fault, loop 1 output will be set to either ≤3.6 mA or ≥21.0 mA to indicate the condition. The user can select if the fault state should be high or low via the integral display or HART®. The default setting from Temposonics is always low alarm.

Only Loop 1 is SIL capable. If a Dual Loop model has been ordered, SIL is only functional on Loop 1. Loop 2 is not SIL capable and cannot be used for safety systems. Loop 1 is automatically assigned to output the product level and cannot be changed. If Loop 2 has been ordered it can be configured for any of the available process variables including product level, interface level, or temperature.

The firmware is constantly running diagnostic tests. The test interval for program memory CRC is 10 seconds and 1.6 seconds for all other diagnostics. The tests are automatic and cannot be turned on or off.

3.2 Non-safety Rated Function

The following function of the LP-Series level transmitter are not part of the SIL rating:

- Optional loop 2 4-20 mA analog output of secondary level measurement
- Optional loop 2 4-20 mA analog output of temperature measurement
- Integral display
- HART® Interface

4. SIL information

4.1 SIL Rating

SIL Rating Parameters	
Safety Level	SIL 2 (lool)
Device Type	B
Hardware Fault Tolerance	0
PFDavg	1.63*10-3 1/h
Systematic capability	SC2

	λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}	SFF
LP Series	2490 FIT	2510 FIT	2080 FIT	363 FIT	93%

Table 2: LP Safe Failure Fraction

4.2 Intended Use

The LP Series SIL capable level transmitters is a magnetostrictive liquid level transmitter certified according to IEC 61508 for single input in low demand, SIL 2 Safety Instrumented Systems. The sensor measures the relative position of a traveling magnet housed inside of a float relative to its NULL position. The output signal is transmitted to an external controller and processed according to its requirements.

4.3 Installation

No special or additional sensor installation requirements exist beyond the standard installation practices documented in the operation and installation manuals. Tank Slayer manual is 551685. RefineME manual is 551690. SoClean manual is 551693. CHAMBERED manual is 551696. Environmental operating specifications are applicable as published in the specifications section in the aforementioned manuals. The user should be properly trained for operation of this type of device.

4.4 Model Number

4.4.1 Tank SLAYER®

The fourth character (Output) of the model number designates if the level transmitter is SIL rated or not. The fourth character must be a 5, 6, or 7 to be SIL rated. If the character is anything else then the unit is not SIL rated. Consult the Tank SLAYER data sheet (551688) for details.

4.4.2 RefineME®

The fourth character (Output) of the model number designates if the level transmitter is SIL rated or not. The fourth character must be a 5, 6, or 7 to be SIL rated. If the character is anything else then the unit is not SIL rated. Consult the RefineME data sheet (551691) for details.

4.4.3 SoClean®

The fourth character (Output) of the model number designates if the level transmitter is SIL rated or not. The fourth character must be a 5, 6, or 7 to be SIL rated. If the character is anything else then the unit is not SIL rated. Consult the SoClean data sheet (551694) for details.

4.4.4 CHAMBERED

The fourth character (Output) of the model number designates if the level transmitter is SIL rated or not. The fourth character must be a 5, 6, or 7 to be SIL rated. If the character is anything else then the unit is not SIL rated. Consult the CHAMBERED data sheet (551697) for details.

4.5 Firmware Revision

The firmware revision can be found in the LP Dashboard or the display. SIL rated firmware will always be 6.XX with the XX for the specific release. The most recent release is 6.02.

4.6 Hardware Revision

The hardware revision of each board is marked on the board with a label containing the part number and revision level. The table below shows the most recent release for each electronic board.

Part Number	Revision
254427	F
254428	D
254429	E
254430-x	F

5. Specifications

Level Output	
Inherent Accuracy	±1 mm (0.039 in.)
Safety Accuracy Limit	±2% Full Scale
Order length	**Flexible hose:** 1575 mm (62 in.) to 22000 mm (866 in.) Δ§ **Rigid pipe:** 559 mm (22 in.) to 7620 mm (300 in.) Δ§
Electronics	
Input voltage	10.5 to 28 Vdc
Fail safe	High, Full scale for digital Low, 3.5 mA default or High, 22.8 mA (Analog, HART®)
Reverse polarity protection	Series diode
Lightning/Transient protection	**Stage 1:** Line-to-ground surge suppression; IEC 61000-4-5, IEC 61326-3-2 **Stage 2:** Line-to-line and line-to-ground transient suppressors; IEC 61000-4-4, IEC 61326-3-2
Environmental	
Enclosure rating	NEMA Type 4X, IP65
Humidity	0 to 100% relative humidity, non-condensing
Operating temperatures	**Electronics:** -40 °C (-40 °F) to 71 °C (160 °F) **Sensing element:** -40 °C (-40 °F) to 125 °C (257 °F) ◊ **Temperature element:** -40 °C (-40 °F) to 105 °C (221 °F)

Δ Contact factory for longer lengths.
◊ Contact factory for specific temperature ranges.
§ Order length equals the measurement range plus the inactive zone.

Table 3: Specifications

Note: Power supply to the 4–20 mA current output

Overvoltages at the 4–20 mA current output (passive, output; input 1) - caused by a fault in the supply unit for example - can result in a leak current in the device's input protection circuit. This may lead to falsification of the output signal by more than the specified error or the minimum error current (3.6 mA) can no longer be set due to the leak current.

- Use a 4–20 mA power supply unit with either voltage limitation or voltage monitoring.

6. Quick start-up guide

6.1 Before you begin

NOTICE

Output will vary depending on the location of the 4 and 20 mA set points.

Tools needed:

- 24 Vdc linear regulated power supply
- Current meter

6.2 Quick start-up procedure

1. Connect 24 Vdc power supply to Loop 1.
2. Turn on power supply.
3. Connect Current Meter to test pins on interconnect board.
4. Move the float towards the tip of the pipe and verify 4 mA set point.
5. Move the float towards the top of the pipe and verify 20 mA set point.
6. If using two floats, repeat steps 4 and 5 for second float. Note both floats must be present or else the level transmitter will go into alarm.
7. Turn off power and disconnect power supply and current meter.
8. Install in tank.

7. Display Menu

All LP-Series liquid level transmitters are shipped with a Stylus (Part # 404108) to be used for manipulating the display. For single and dual cavity housings, the Stylus is designed to allow for programming of the unit without removing the housing. When using the Stylus make sure to align the Stylus with the shape outline around the buttons in the same orientation. Failure to correctly align the Stylus can cause the display to not function properly.

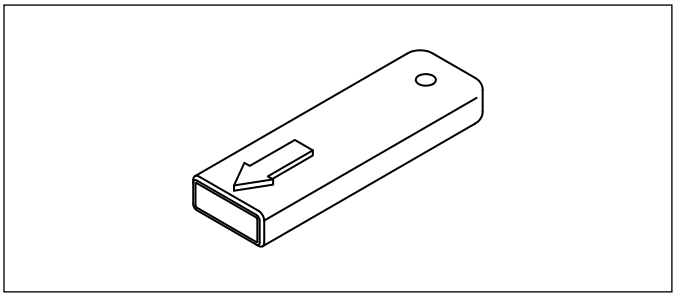

Fig. 1: Stylus (Part # 404108)

NOTICE

Do not use any device other than the Temposonics Stylus to operate the display on the LP Series.

NOTICE

Improper use of the Stylus can cause the display to not function properly.

7.1 Operation Modes

The LP Series level transmitter runs in one of the following modes of operation. You can use these modes to calibrate and set up various operating parameters.

7.1.1 Initialization

Upon startup the level transmitter will be in an initialization mode. During initialization mode the output will be held in fault state until all diagnostics are completed. If no errors are detected during initial startup the output shall be valid within 15 seconds of startup. If errors are detected then the unit shall remain in fault state until the errors are cleared.

7.1.2 Run Mode

After initialization is completed, the level transmitter begins continuous measurement operations in run mode. For SIL, diagnostics are continually run to detect possible hardware and software failures and to set the output into the safe state if a fault condition is determined. In run mode, all programming of parameters via the display and HART® is disabled. Run mode is the primary mode of operation. This mode will perform measurements and display data.

During normal operation the change in the magnet position shall be reflected in the output within 2 seconds of the magnet position changing. During normal operation a fault shall be detected and the output enter a fault state within 10 seconds of the fault being detected.

The output shall enter into fault state if a clearable fault such as loss of return signal persists for 5 seconds or more. During the 5 second time interval the output shall hold at the last measured position. The output shall clear the fault state if a clearable fault is not detected for a minimum of 5 seconds. The output shall be restored to the current magnet position.

7.1.3 Program Mode

Program mode is the primary mode for commissioning and troubleshooting the level transmitter. The full menu and available functions are shown in section 7.3 Menu Structure. To Enter program mode use the Stylus and press the Enter Key as shown in section 7.2 Display Diagram. Program Mode is protected by a password to keep unwarranted changes from occurring. The factory default password is 27513. When in program mode, remote communications are not functional. An automatic timeout feature is provided so that the transmitter does not remain inadvertently in program mode. The timeout is set for 1 minute before prompted for additional time. Total timeout is 2 minutes.

For SIL, programming is limited to non-safety related parameters. This allows the user to edit parameters that do not directly affect the safety functionality of the sensor. All safety related parameters cannot be programmed except by the factory. Programming by the factory is only needed on the SIL rated level transmitter as the other interfaces allows field programming of factory parameters.

NOTICE

Whenever program mode is exited from the display the unit will reset itself to insure all changes have been accepted. The reset will take approximately 5 seconds before the level transmitter is able to respond to commands.

NOTICE

In program mode, the transmitter will not respond to incoming HART® commands. A busy error will be sent to the controller to notify the unit is in program mode. This function will prevent a user at a remote terminal from programming the unit while a user is accessing program mode from the display.

7.2 Display Diagram

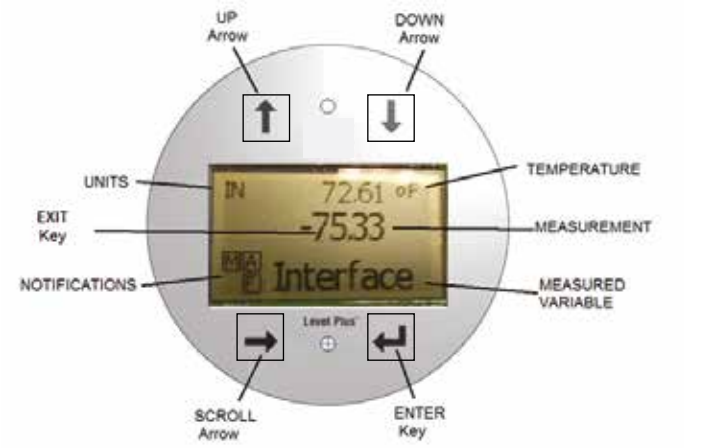

Fig. 2: Display

UP Arrow – Used to move cursor on screen up and to increment number
DOWN Arrow – Used to move cursor on screen down and to decrease number
SCROLL Arrow – Used to move cursor on screen to the right, cursor will cycle back. Also used to exit submenus from menu structure.
ENTER Key – Used to Enter Program Mode, select Highlighted Item, and Confirm Selection
EXIT Key – Hidden key in the middle of the display that is used to exit menu at any time. Also used to exit when entering a number.
MEASURED VARIABLE – The process variable that is selected to display. The display will automatically scroll between selected variables.
MEASUREMENT – The numerical value for the MEASURED VARIABLE shown on the display.
UNITS – Unit of measurement for the MEASURED VARIBLE shown on the display.
TEMPERATURE – Average temperature for the product in the tank. Only shown if the level transmitter was purchased with temperature.
NOTIFICATIONS – Four squares with letters. Top left square will show a S for SIL firmware. Top right square, A, will only show when there is an alarm. Toggle the UP Arrow key to view alarms. Bottom right square, F, will only show when there is a fault. Toggle the DOWN Arrow key to view error codes. Bottom left square, P, will only show when the units is being programmed remotely.

7.3 Menu Structure

- Data From Device
  - Display
  - Units
    - Length Units
    - Temp Units
  - Set Points
    - Prod LVR (4 mA)
    - Prd URV (20 mA)
    - Prd Current LRV
    - Prd Current URV
    - Int LRV (4 mA)
    - Int URV (20 mA)
    - Int Current LRV
    - Int Current URV
  - Alarm Select
  - Signal Strength
    - Product Signal
    - Interface Signal

- Calibrate
  - Product Level
    - Current Level
    - Offset
  - Interface Level
    - Current Level
    - Offset

- Factory
  - Settings
    - Serial Number
    - HW Revision
    - SW Revision
  - Temp Setup
  - Float Config
    - Loop 2
  - Reset to Factory

8. Alarms

Temposonics has two separate types of alarms featuring both a software fault alarm and a hardware fault alarm.

8.1 Software Fault Alarm

Temposonics offers a software fault alarm that will force the 4-20 mA output into an either a low or high alarm state. The default setting from the factory is a low alarm state. The low alarm state is ≤ 3.6 mA and the high alarm state is ≥ 21.0 mA. The software fault alarm follows the recommenda-tions by NAMUR NE 43. Typical faults that will cause a software fault alarm are a missing float, the float in the inactive range, and the level transmitter looking for the wrong number of floats.

8.2 Hardware Fault Alarm

Temposonics offers a hardware fault alarm that will force the 4-20 mA output into a low alarm. The hardware low alarm is 3.2 mA. The hardware low alarm is triggered when the internal diagnostics of the level transmitter have detected a hardware issue with the 4-20 mA output.

9. Error Codes (Faults)

Faul Code	Description	Corrective Action
101	Missing Magnet	• Verify Float Configuration is correct for the number of floats installed • Verify Float(s) are not in inactive zone. • Verify Auto Threshold is enabled. • Cycle power to sensor. If proper operation is not restored, Contact Factory
102	Internal Fault 1	Cycle power to sensor. If proper operation is not restored, Contact Factory
103	Internal Fault 2	Cycle power to sensor. If proper operation is not restored, Contact Factory
104	Internal Fault 3	Cycle power to sensor. If proper operation is not restored, Contact Factory
105	Lobe Fault 1	• Verify Auto Threshold is enabled • Cycle power to sensor • If proper operation is not restored, Contact Factory
106	Lobe Fault 2	• Verify Auto Threshold is enabled • Cycle power to sensor • If proper operation is not restored, Contact Factory
107	Delta Fault	Turn off Noise Detection if fault persist. Contact Factory for more information.
108	Internal Fault 4	Cycle power to sensor. If proper operation is not restored, Contact Factory
109	Peak Fault	• Verify Auto Threshold is enabled • Cycle power to sensor • If proper operation is not restored, Contact Factory
110	Hardware Fault 1	Cycle power to sensor. If proper operation is not restored, Contact Factory
111	Power Fault	• Cycle power to sensor • Verify Power Supply rating • Verify wiring • If proper operation is not restored, Contact Factory
112	Hardware Fault 2	Cycle power to sensor. If proper operation is not restored, Contact Factory
113	Hardware Fault 3	Cycle power to sensor. If proper operation is not restored, Contact Factory
114	Hardware Fault 4	Cycle power to sensor. If proper operation is not restored, Contact Factory
115	Timing Fault 1	Cycle power to sensor. If proper operation is not restored, Contact Factory
116	Timing Fault 2	Cycle power to sensor. If proper operation is not restored, Contact Factory
117	Timing Fault 3	Cycle power to sensor. If proper operation is not restored, Contact Factory
118	DAC Fault 1	Cycle power to sensor. If proper operation is not restored, Contact Factory
119	DAC Fault 2	Cycle power to sensor. If proper operation is not restored, Contact Factory
120	DAC Fault 3	Cycle power to sensor. If proper operation is not restored, Contact Factory
121	DAC Fault 4	Cycle power to sensor. If proper operation is not restored, Contact Factory
122	SPI Fault 1	Cycle power to sensor. If proper operation is not restored, Contact Factory
123	SPI Fault 2	Cycle power to sensor. If proper operation is not restored, Contact Factory
124	Setpoint Fault	The analog setpoints are too close. Minimum distance is 150 mm (6 in.) for analog and 290 mm (11.5 in.) for SIL. Adjust programmed setpoints as needed. (Analog only) If proper operation is not restored, Contact Factory
125	Loop 1 Out of Range	Verify that magnets are positioned within expected measuring range. Adjust programmed setpoints as needed. (Analog only) If proper operation is not restored, Contact Factory
126	Loop 2 Out of Range	Verify that magnets are positioned within expected measuring range. Adjust programmed setpoints as needed. (Analog only) If proper operation is not restored, Contact Factory
127	EEPROM Fault 1	Cycle power to sensor. If proper operation is not restored, Contact Factory
128	EEPROM Fault 2	CRC error. Use LP Dashboard and Flash tab to clear fault of HART Handheld and Clear CRC. If proper operation is not restored, Contact Factory.
129	Flash Failure	Cycle power to sensor. If proper operation is not restored, Contact Factory
130	Internal Error	CRC error. Use LP Dashboard and Flash tab to clear fault or HART Handheld and Clear CRC. If proper orientation is not restored, Contact Factory.

Fig. 3: Error codes

10. HART® Interface

Temposonics has tested and is compliant to HART® ITK 7.2. The device driver file is available for download from HART® Communication Protocol website at www.fieldcommgroup.org. Programming via HART® can be done either using the LP Dashboard via a HART® modem or with a handheld programmer with the LP-SIL device driver.

10.1 LP Dashboard

10.1.1 Installing LP Dashboard

Adjustments to the setup and calibration of the SIL Interface can be performed using the Temposonics LP Dashboard. The Dashboard can be run from any Windows 7 or newer OS using a HART® to USB converter (Part #380068).

Perform the following steps to install the LP Dashboard and establish communication:

1. Install LP Dashboard from the USB stick that came with the level transmitter or go to http://www.temposonics.com to download the latest version.
2. Connect level transmitter to HART® to USB converter, connect 24 Vdc power to the level transmitter, and connect the HART® to USB converter to the PC. Example setup shown below.

NOTICE

Power must be on Loop 1 for HART® communication to work. Power does not have to be applied on Loop 2 for HART® to work. Power must be applied to Loop 2 to check current output.

NOTICE

HART® requires a load resistor to work correctly. Add a 250 Ohm resistor for proper communication. Some PLC cards will have built in load resistors.

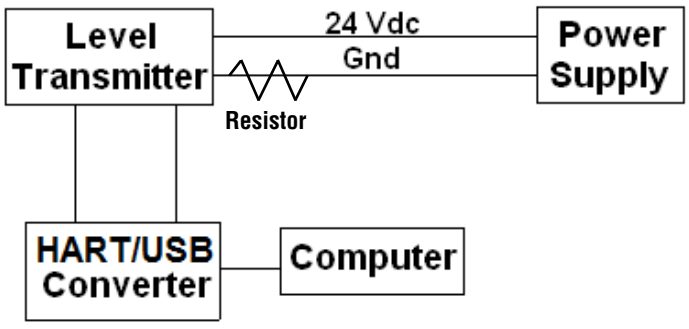

Fig. 4: Example setup

3. Open setup software and select SIL protocol from drop down menu.
4. Select COM Port. Software will show active COM ports. Make sure converter is connected before starting LP Dashboard or COM port will not show.
5. Select Address. Default address is 0. SIL is not available to be used in a HART multi-drop network and should always be address 0.

Fig. 12: Initial screen

10.1.2 Home screen

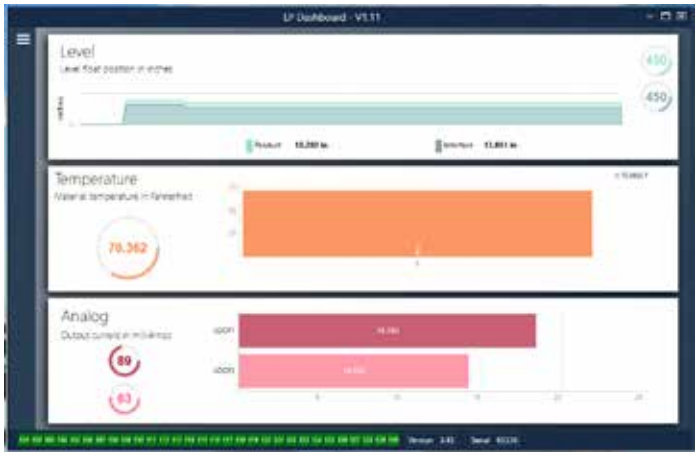

Fig. 5: Home screen

The LP Dashboard Home Screen will look different based on whether or not temperature has been ordered. If the level transmitter included temperature measurement then the Home Screen will look as shown. If the level transmitter does not include temperature measurement then the Home Screen will not show the middle panel for temperature. The Home Screen can be accessed by pressing the three white bars on the top left.

The level panel on top shows the level measurement for the Product level and Interface level. If only the Product Float is selected then only the product float will be shown. The bold numbers are the numerical level and the graph is a time lapse of the graphical representation of the numbers. The red line is the approximate maximum level based off of the order length of the level transmitter. The numbers on the right of the level panel are the Trigger Level for the product float on top and the Interface Float on bottom. These are a representation of how strong of a return signal the level transmitter is experiencing.

The temperature panel will only show if temperature measurement was ordered and turned on. The left side shows the numerical value of the temperature with a bar graph in the middle of the panel.

The analog panel is on the bottom. On the left side is the graphical and numerical value for percent full ranging from 0 to 100 percent. Loop 1 is on top and Loop 2 is on bottom. If only one loop was ordered then only one loop would be shown. The bar graph in the middle is the current output level with the numerical value shown in the middle. Again, Loop 1 is on top and Loop 2 is on bottom.

Across the bottom of the Home Screen is the visual indication of the fault codes from section 8. Green indicates no fault and red indicates fault. Next is the firmware version in the middle and the serial number on the far right.

10.1.3 Configuration

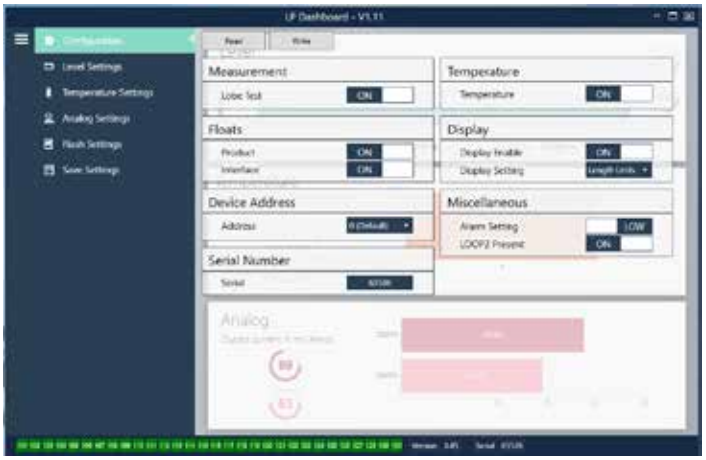

Fig. 6: Configuration

The Configuration tab allows the level transmitter to be configured for the specific application.

Factory Set:

Product Float: Default setting of ON for all applications.

Interface Float: Default setting of ON if ordering 2 Loops. Default setting of OFF if ordering 1 Loop. If the number of floats turned on is different from the number of floats physically on the level transmitter the level transmitter will go into Fault.

Serial Number: Serial Number assigned by Temposonics at the time of manufacture. The serial number is used for tracking and replacement parts. Do not change.

Temperature: Default setting of OFF if ordered without temperature. Default setting of ON if ordered with temperature. Turning temperature ON when the level transmitter was not ordered with temperature will not cause temperature to work and will force the level transmitter into Fault.

Display Enable: Default setting of ON. Display can be turned off by changing to OFF and cycling power.

User Configurable:

Device Address: The end user can configure the HART address when using a multi-node network. Default address is 0 and should not be changed for a SIL capable level transmitter.

Display Setting: Allows the end user to configure the display. Available options are engineering units, current output, or percent full. Default setting is engineering units.

Alarm Setting: Allows the end user to select a Low (≤3.6 mA) or High (≥22 mA) alarm fault state. The default alarm is Low alarm. Both alarms are NAMUR NE 43 compliant.

10.1.4 Level settings

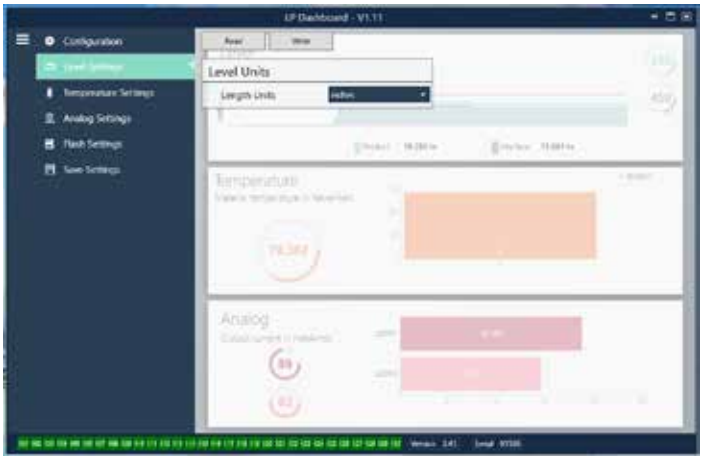

Fig. 7: Level settings

User Configurable:

Length Units: the unit of measurement used for engineering units. Default is inches if ordered in inches and mm if ordered in mm. Options include inches, feet, millimeters, centimeters, and meters.

10.1.5 Temperature settings

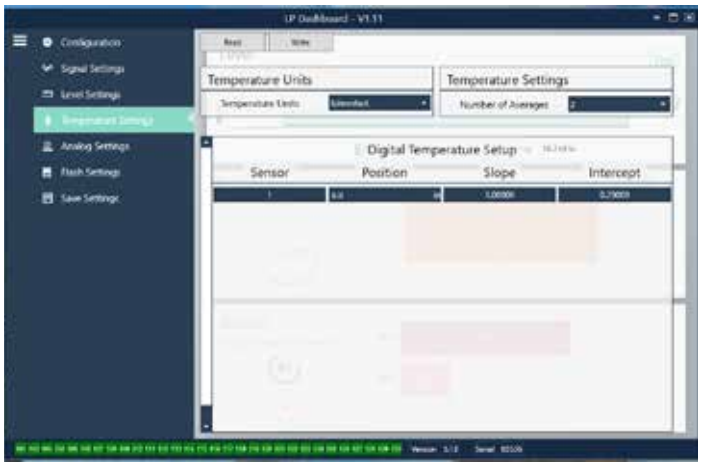

Fig. 8: Temperature settings

Factory Set:

Number of Averages: This is the number of temperature readings that are averaged together for the temperature output. The higher the number the more temperature readings that are averaged. The higher the number the smoother the output but also the slower the update to changes in the process temperature.

Position: The location of the temperature sensor in reference to the end of the pipe.

Slope: Calibration factor for the temperature sensor. Do not change unless a new sensing element with temperature is ordered.

Intercept: Calibration factor for the temperature sensor. Do not change unless a new sensing element with temperature is ordered.

User Configurable:

Temperature Units: Change the units of measure for the temperature settings. Options are Fahrenheit or Celsius.

10.1.6 Analog settings

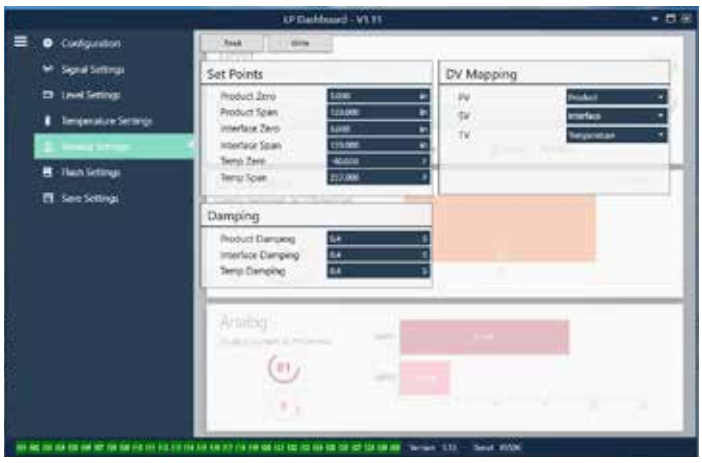

Fig. 9: Analog settings

Factory Set:

PV: is the Primary Variable in HART® and the default setting is the Product Level. For SIL units, the PV cannot be changed from the Product level.

SV: is the Secondary Variable in HART® and the default setting is the Interface Level. This determines which variable is output on Loop 2. The same variable can be output on Loop 1 and Loop 2.

TV: is the Tertiary Variable in HART® and the default setting is Temperature. The TV can only be viewed via HART®.

User Configurable:

Product Zero: The Zero, 4 mA, and/or LRV for the product level. Default setting is the minimum level reading outside the inactive zone. The Zero should always be within the active measuring range and at least 152 mm (6 in.) away from the Span. The Zero and Span can be reversed.

Product Span: The Span, 20 mA, and/or URV for the product level. Default setting is the order length minus 25 mm (1 in.). The Span should always be within the active measuring range and at least 152 mm (6 in.)away from the Zero. The Zero and Span can be reversed.

Interface Zero: The Zero, 4 mA, and/or LRV for the interface level. Default setting is the minimum level reading outside the inactive zone. The Zero should always be within the active measuring range and at least 50 mm (2 in.) away from the Span. The Zero and Span can be reversed. If there is no Interface Level then the boxes will not be shown.

Interface Span: The Span, 20 mA, and/or URV for the interface level. Default setting is the order length minus 25 mm (1 in.). The Span should always be within the active measuring range and at least 50 mm (2 in.) away from the Zero. The Zero and Span can be reversed. If there is no Interface Level then the boxes will not be shown.

Temperature Zero: The Zero, 4 mA, and/or LRV for the temperature. Default setting is -40°C (-40°F). The Zero and Span cannot be reversed as the Zero must always be lower than the Span. If there is no temperature measurement then the boxes will not be shown.

Product Span: The Span, 20 mA, and/or URV for the temperature. Default setting is 125°C (257°F). The Zero and Span cannot be reversed as the Zero must always be lower than the Span. If there is no temperature measurement then the boxes will not be shown.

Product Damping: Slows the rate of change of the product level. Default setting is 0.4s. Setting cannot be changed for product level.

Interface Damping: Slows the rate of change of the interface level. Default setting is 0.4s.

Temp Damping: Slows the rate of change of the temperature. Default setting is 0.4s.

10.1.7 Flash settings

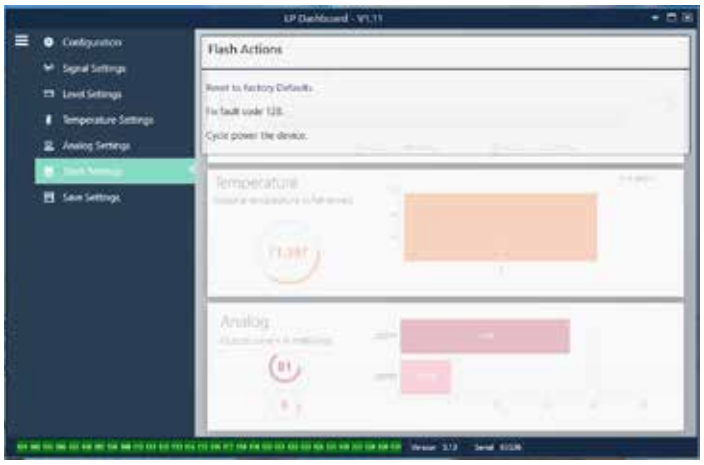

Fig. 10: Flash settings

User Configurable:

Reset to Factory Defaults: Allows the end user to reset all settings back to the original settings as they were when they left the Temposonics factory. This is intended to be used as a first step in trouble shooting. Do note, the Zero and Span set points will reset to factory settings.

Fix fault code 128: If fault code 128 appears red then click the link on the Dashboard to clear the fault.

Cycle power the device: Allows the end user to have the level transmitter automatically turn power off, turn power on, and reboot the device.

10.1.8 Save settings

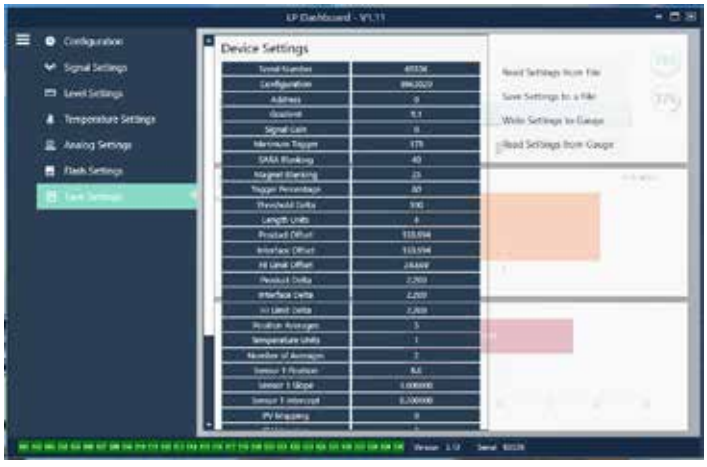

Fig. 11: S*ave settings*

User Configurable:

Read Settings from File: Allows the end user to upload factory parameters from a backup file to the LP Dashboard. This task is usually performed from a saved backup file or the original backup file maintained by Temposonics.

Write Setting to a File: Allows the end user to download a backup file of factory parameters from the LP Dashboard to a PC. This task is usually performed after Read Settings from Gauge. Note – wait until all settings have changed from Red to White before writing as the color change signals that the settings have been updated.

Write Settings to Gauge: Allows the end user to program the level transmitter with the factory parameters displayed on the LP Dashboard. This task is usually performed after Read Settings from File.

Read Settings from Gauge: Allows the end user to update all of the factory parameters displayed on the screen. All settings will turn Red and then will turn white as they are updated.

NOTICE

A copy of the backup file is maintained by Temposonics including all factory parameteres as the level transmitter was originally setup after completing testing and calibration at the Temposonics factory. Temposonics can provide a copy of the backup file upon request based off of the serial number of the level transmitter. Contact Temposonics Technical Support for assistance.

10.2 Handheld Programming

10.2.1 Handheld Menu Tree

NOTICE

The LP-Series driver must be loaded on the handheld HART® communicator in order to turn off Write Protect which is enabled by default. If the driver is not present contact the manufacturer of the handheld HART® communicator about updating the DD files on the handheld.

- **Device Setup**
  - **↳ Write Protect (Must be disabled to show complete menue tree**
  - **↳ Process Variables**
    - ↳ PV
    - ↳ SV
    - ↳ TV
  - **↳ Diag/Service**
    - ↳ Test Device
      - ↳ Status
      - ↳ Self Test
    - ↳ Loop Test
      - ↳ 4 mA
      - ↳ 20 mA
      - ↳ Other
    - ↳ Set Factory Values
    - ↳ Set Data CRC
    - ↳ Power Cycle Device
  - **↳ Basic Setup**
    - ↳ Tag
    - ↳ PV Unit
    - ↳ PV LRV
    - ↳ PV URV
    - ↳ PV Damp
    - ↳ Device Information
  - **↳ Detailed Setup**
    - ↳ Variable mapping
    - ↳ Configuration
      - ↳ Sys Config
        - ↳ Alarm
        - ↳ Level 1
        - ↳ Level 2
        - ↳ Temperature
        - ↳ Display
        - ↳ Display Setting
        - ↳ Lobe Count
      - ↳ Gradient
      - ↳ Offsets
        - ↳ Float 1 Offset
        - ↳ Float 2 Offset
      - ↳ LCD settings
        - ↳ Screen delay
        - ↳ Screen contrast
      - ↳ Sensors
        - ↳ Level 1
          - ↳ Level 1 Unit
          - ↳ Level 1
          - ↳ Level 1 Class
          - ↳ Level 1 LRV
          - ↳ Level 1 URV
          - ↳ Level 1 Min Span
          - ↳ Level 1 Damp
        - ↳ Level 2
          - ↳ Level 2 Unit
          - ↳ Level 2
          - ↳ Level 2 Class
          - ↳ Level 2 LRV
          - ↳ Level 2 URV
          - ↳ Level 2 Min Span
          - ↳ Level 2 Damp
        - ↳ Temp
          - ↳ Temp Unit
          - ↳ Temp
          - ↳ Temp Class
          - ↳ Temp LRV
          - ↳ Temp URV
          - ↳ Temp Min Span
          - ↳ Temp Damp
      - ↳ HART® ouput
        - ↳ Poll addr
        - ↳ Num reg preams
      - ↳ Device Information
  - **↳ Review**
- **PV**
- **PV Loop Current**
- **PV LVR**
- **PL URV**

10.2.2 Handheld Menu Screenshots

10.2.2.1 Online Menu Screen

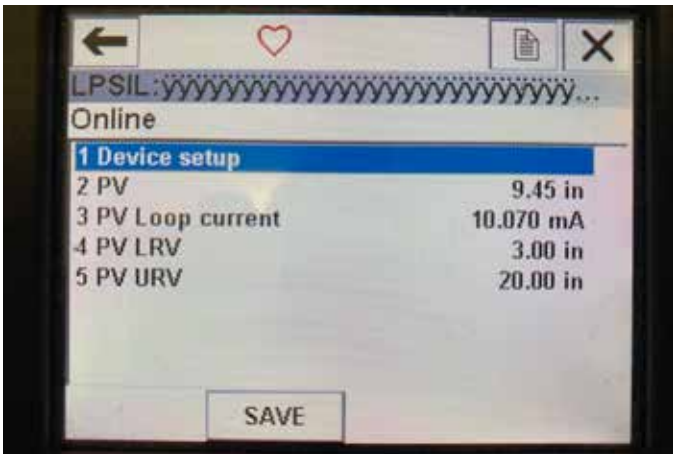

Fig. 13: Online Screen

Parameters
No Editable Parameters
Data
PV, PV Loop current, PV LVR, and PV URV are all shown on screen

10.2.2.2 Device setup Menu Screen

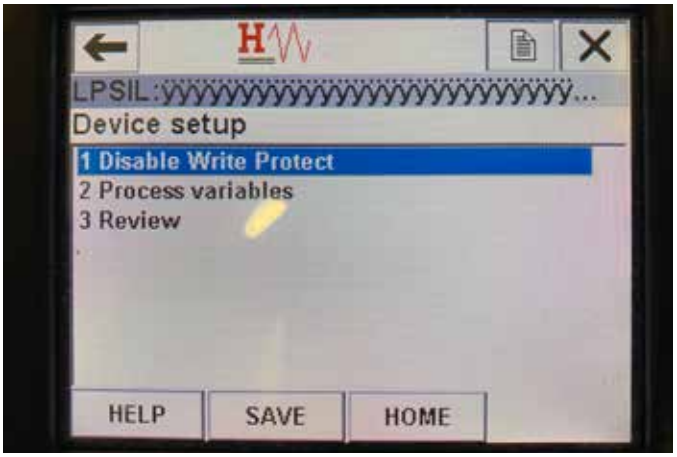

Fig. 14: Write Protect Enabled Screen

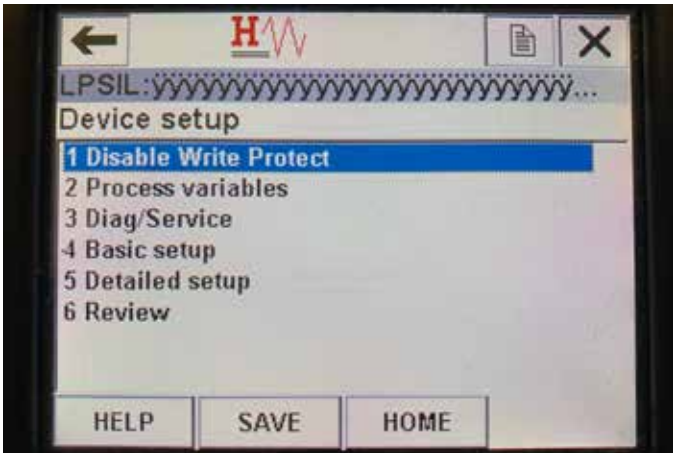

Fig. 15: Write Protect Disabled

Parameters
Write Protect - user can turn disable or enable write protect mode. While write protect is enable no variables can be changed and the full menu tree cannot be seen.
Data
No Data is displayed

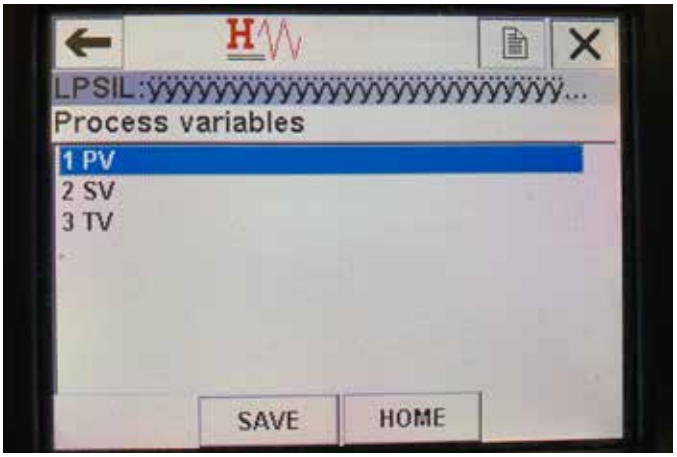

Fig. 16: Process Variable Screen

10.2.2.3 Process variables Menu Screen

Parameters
PV – Primary Variableis the HART® parameter that is by default mapped to the Product Level. This can be changed using Variable mapping feature. SIL2 Capable units do not allow the PV to be changed.
SV – Secondary Variable is the HART® parameter that is mapped to the Interface Level unless Temperature is ordered. This can be changed using the Variable mapping feature.
TV – Tertiary Variable is the HART® parameter that is mapped to the Temperature by default. This can be changed using the Variable mapping feature.
Data
No Data is displayed

10.2.2.4 PV Menu Tree

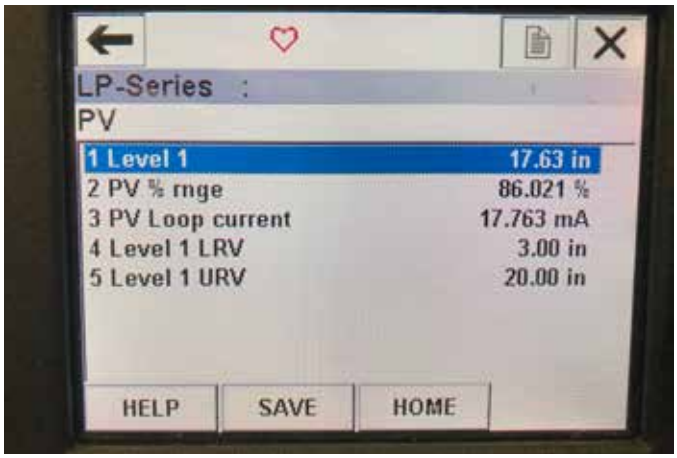

Fig. 17: PV Menu Tree

Parameters
Level 1 LRV – lower range value of the PV that correlates to the location of the 4 mA set point of the output.
Level 1 URV – upper range value of the PV that correlates to the location of the 20 mA set point of the output.
Data
Level 1 – the product level is displayed.
PV% rnge – the percentage (0 to 100%) of the active range that the process variable is currently at.
PV Loop current – the current output level of the PV based on the settings of the LRV, URV, and Level 1

10.2.2.5 SV Menu Tree

Parameters

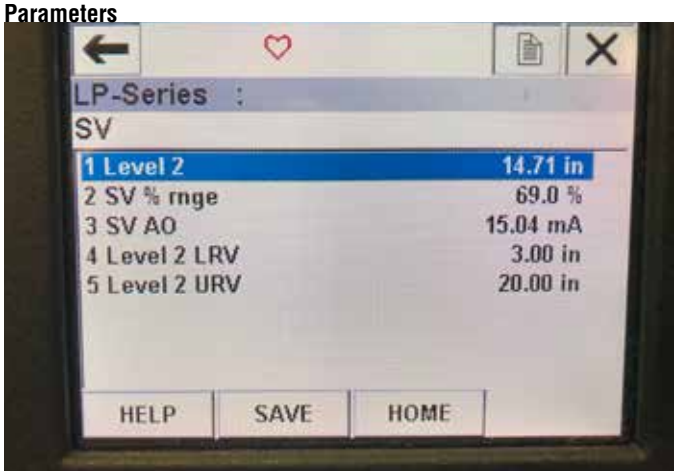

Fig. 20: SV Menu Tree

Level 2 LRV – lower range value of the SV that correlates to the location of the 4 mA set point of the output.
Level 2 URV – upper range value of the SV that correlates to the location of the 20 mA set point of the output.
Data
Level 2 – the interface level is displayed.
SV% rnge – the percentage (0 to 100%) of the active range that the process variable is currently at.
SV Loop current – the current output level of the SV based on the settings of the LRV, URV, and Level 2.

10.2.2.6 TV Menu Screen

Fig. 18: TV Menu Tree

Parameters
Temp LRV – lower range value of the TV that correlates to the location of the 4 mA set point of the output.
Temp URV – upper range value of the TV that correlates to the location of the 20 mA set point of the output.
Data
Temp – the temperature is displayed.

10.2.2.7 Diag/Service Menu Screen

Fig. 19: Diag/Service Menu Screen

Parameters
Loop Test - allows the user to set current loop to specific outputs to test functionality.
Set Factory Values – clears all programming and resets factory parameters to default values. Do not perform this function unless instructed to do so by factory technical support.
Set Data CRC – allows the user to rest the CRC in the level transmitter and clear the 128 Fault Code.
Power Cycle Device – allows the user to power cycle the level transmitter without disconnecting power from the unit.
Data
No Data is Displayed

Fig. 21: Test Device Menu Screen

10.2.2.8 Test device Menu Screen

Parameters

Self Test – allows user to force level transmitter to check for fault codes. Fault codes would be displayed under Status.

Data

Status – shows any existing fault codes

Fig. 24: Status Menu Screen

10.2.2.9 Status Menu Screen

Parameters

No editable parameters

Data

Fault – shows fault codes displayed by level transmitter. These codes are explained in section 8. Use must run Self Test before fault codes will appear.

10.2.2.10 Loop Test Menu Tree

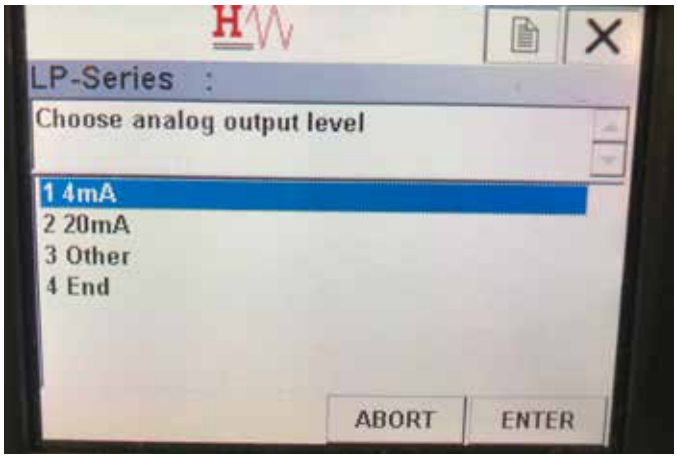

Fig. 22: Loop Test Menu Tree

Parameters

4 mA – allows the user to force loop test and current output to 4 mA

20 mA – allows the user to force loop test and current output to 20 mA

Other – allows the user to force loop test and current output to selected level

End – Stops loop test and returns level transmitter to normal output

Data

No data is displayed

Fig. 23: Basic Setup Menu Screen

10.2.2.11 Basic setup Menu Screen

Parameters

Tag – HART® descriptor that can be edited by user

PV Unit – unit of measure for the PV variable

PV LRV – lower range value of the PV that correlates to the location of the 4 mA set point of the output.

PV URV – upper range value of the PV that correlates to the location of the 20 mA set point of the output.

PV Damp – allows the user to select the damping of the PV variable

Data

Device Information – provide detailed information on the setup of the PV

10.2.2.12 Detailed setup Menu Screen

Fig. 25: Detailed Setup Menu Screen

Parameters
Variable mapping – allows the user to select the Temposonics variables that are mapped to the PV, SV, and TV
Configuration – allows access to several Temposonics parameters
Offsets – allows access to calibrating the level transmitter
LCD settings – allows access to customizing LCD display
Sensors – allows access to data and programming of PV, SV, and TV
HART® output – allows access to setting HART® multidrop network
Data
Device Information – provide detailed information on the setup of the PV

10.2.2.13 Variable mapping Menu Screen

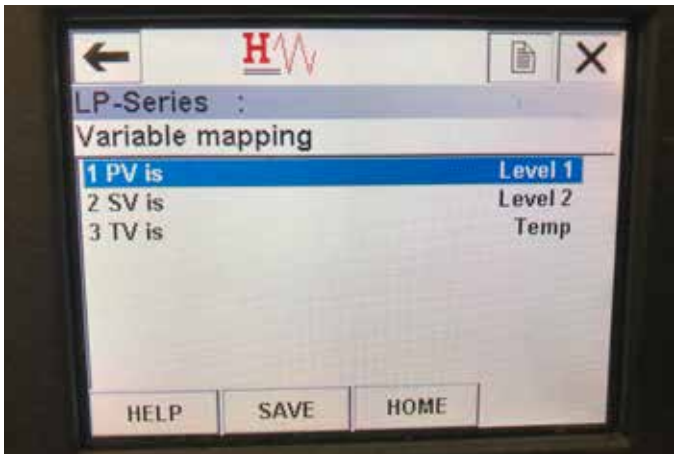

Fig. 28: Variable Mapping Menu Screen

Parameters
PV is – allows user to select the Temposonics variable that is mapped to the PV in HART®
SV is – allows user to select the Temposonics variable that is mapped to the SV in HART®
TV is – allows user to select the Temposonics variable that is mapped to the TV in HART®
Data
No data is displayed

10.2.2.14 Configuration Menu Screen

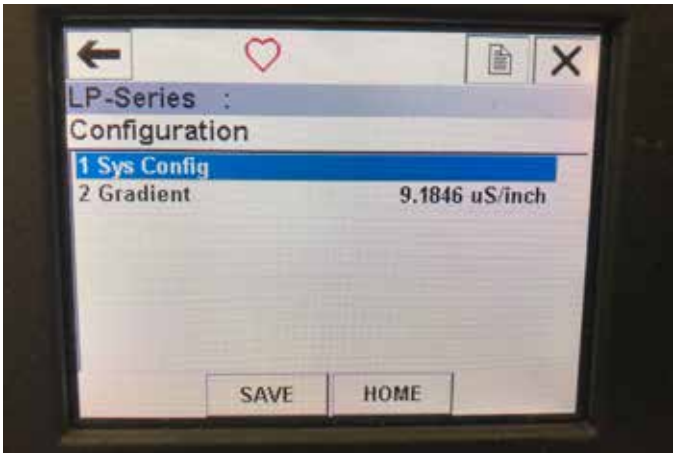

Fig. 26: Configuration Menu Screen

Parameters
Sys Config – allows access to Temposonics factory parameters
Gradient – calibration factor for level transmitter that should not be changed unless replacing a sensing element.
Data
No data is displayed

10.2.2.15 Sys Config Menu Screen

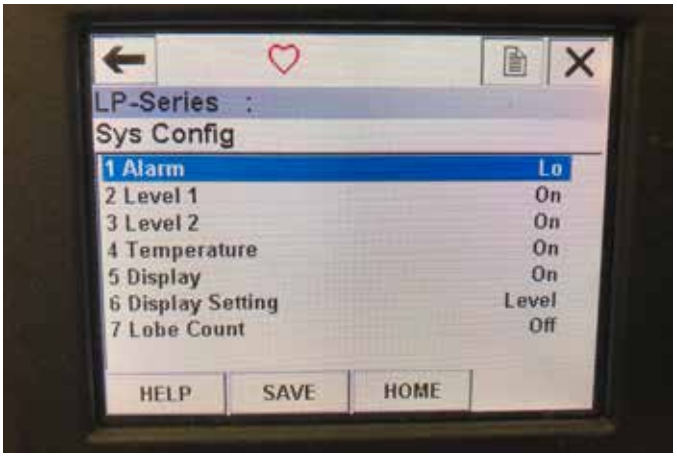

Fig. 27: Sys Config Menu Screen

Parameters
Alarm – allows user to select between a Hi (>21 mA) and Lo (<3.6 mA) alarm setting. Default is a low alarm.
Level 1 – allows user to turn product level on or off. Should always be on.
Level 2 – allows user to turn interface level on or off. This will not work if a second float is not used.
Temperature – allows user to turn temperature on or off. This will not work unless temperature is ordered on the level transmitter.
Display – allows the user to turn the display on or off. Power must be cycled for this to take affect.
Display Setting – allows the user to select if the display shows Level, mA, or %. Default setting is Level.
Lobe Count – allows the user to turn the lobe fault on or off. The lobe count should be on unless not using a Temposonics magnet.
Data
No data is displayed

10.2.2.16 Offsets Menu Screen

Fig. 29: Offsets Menu Screen

Parameters
Float 1 Offset – allows user to change the offset of the product level that is used for calibration. Please contact the factory for technical support to make this change.
Float 2 Offset – allows user to change the offset of the interface level that is used for calibration. Please contact the factory for technical support to make this change.
Data
No data is displayed

10.2.2.17 LCD settings Menu Screen

Fig. 31: LCD Settings Menu Screen

Parameters
Screen delay – allows user to change the update rate of the display. This should not be adjusted without factory support.
Screen contrast – allows user to change the darkness of the display.
Data
No data is displayed

10.2.2.18 Sensors Menu Screen

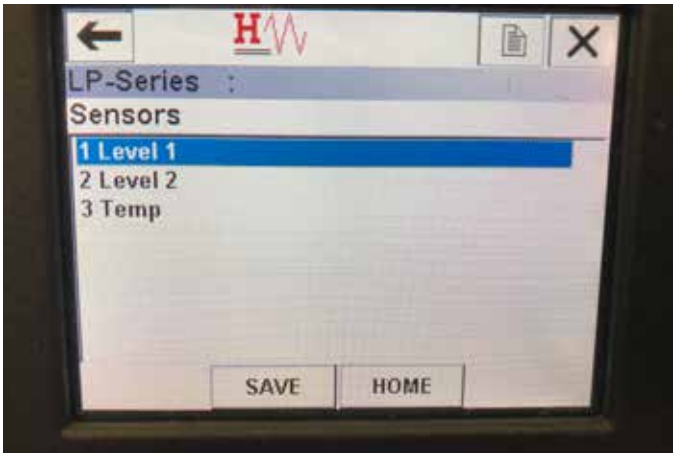

Fig. 30: Sensors Menu Screen

Parameters
Level 1 – allows user to access parameters and data for product level.
Level 2 – allows user to access parameters and data for interface level.
Temp – allows user to access parameters and data for temperature.
Data
No data is displayed

10.2.2.19 Level 1 Menu Screen

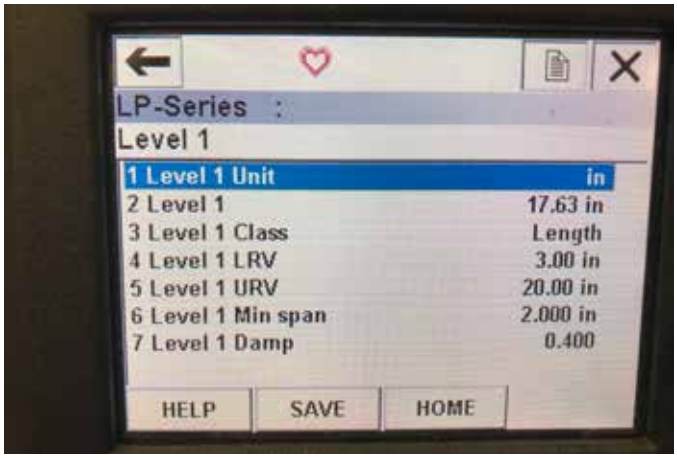

Fig. 32: Level 1 Menu Screen

Parameters
Level 1 Unit – allows user to change unit of measure for product level.
Level 1 LRV – lower range value of the product level that correlates to the location of the 4 mA set point of the output.
Level 1 URV – upper range value of the product level that correlates to the location of the 20 mA set point of the output.
Level 1 Damp – damping parameter for product level
Data
Level 1 – actual product level in units of measure
Level 1 Class – variable class for product level
Level 1 Min span – the minimum distance required between the Level 1 LRV and Level 1 URV

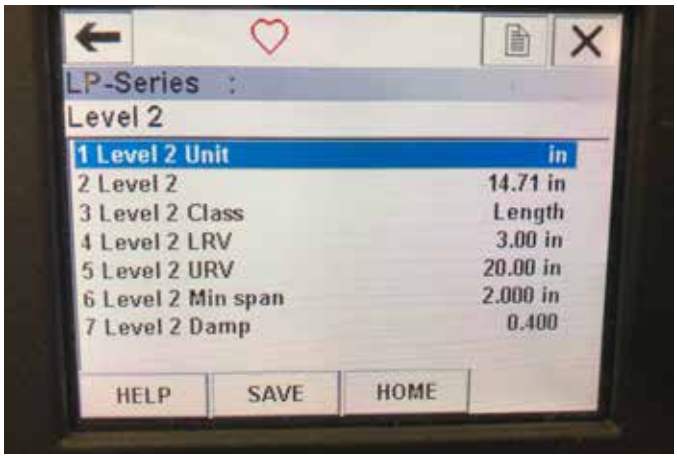

Fig. 34: Level 2 Menu Screen

10.2.2.20 Level 2 Menu Screen

Parameters
Level 2 Unit – allows user to change unit of measure for product level.
Level 2 LRV – lower range value of the interface level that correlates to the location of the 4 mA set point of the output.
Level 2 URV – upper range value of the interface level that correlates to the location of the 20 mA set point of the output.
Level 2 Damp – damping parameter for interface level
Data
Level 2 – actual product level in units of measure
Level 2 Class – variable class for interface level
Level 2 Min span – the minimum distance required between the Level 2 LRV and Level 2 URV

Fig. 33: Temp Menu Screen

10.2.2.21 Temp Menu Screen

Parameters
Temp Unit – allows user to change unit of measure for temperature.
Temp LRV – lower range value of the temperature that correlates to the location of the 4 mA set point of the output.
Temp URV – upper range value of the temperature that correlates to the location of the 20 mA set point of the output.
Temp Damp – damping parameter for temperature
Data
Temp – actual temperature in units of measure
Temp Class – variable class for temperature
Temp Min span – the minimum distance required between the Temp LRV and Temp URV

10.2.2.22 HART® output Menu Screen

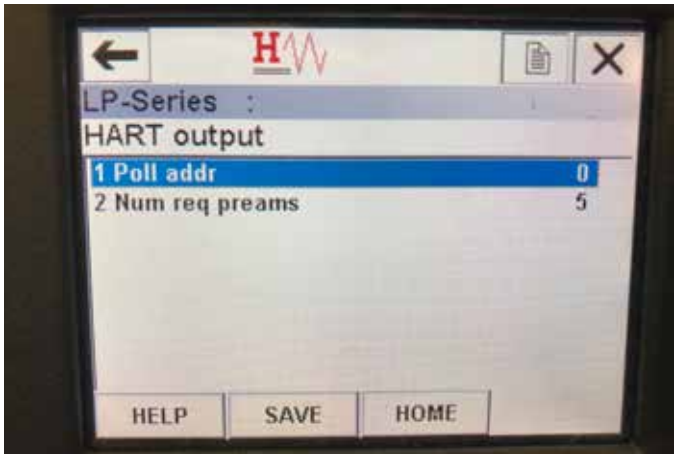

Fig. 35: HART®output Menu Screen

Parameter
Poll addr – allows user to change polling address of HART® device. Unless using HART® in multidrop network do not change Poll addr from default value of 0.
Num req preams – changes the HART® preamble. Do not adjust.
Data
No data displayed

10.3 Display Programming

The display menu and functionality is described in section 6. This section shows examples of the display screens and describes the variables that can be viewed and/or edited.

10.3.1 Main Menu

Fig. 36: Display "Main Menue"

Data From Device – Allows the user to access standard commissioning activities such as setting 4 and 20 mA set points.
Calibrate – Allows the user to calibrate the level measurement of product level and/or interface level.
Factory – Allows the user to access Factory settings and should only be accessed under the guidance of Temposonics Technical Support

10.3.1.1 Data From Device

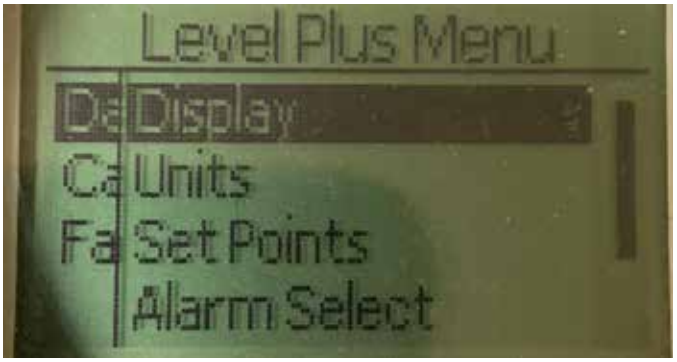

Fig. 37: Display "Data from Device"

Display – Allows the user to change the displayed value between engineering units, milliamps, and percentage.
Units – Allows the user to select the units of measure for level and temperature.
Set Points – Allows the user to adjust the positions of the 4 and 20 mA set points.
Alarm Select – Allows the user to switch the alarm between high and low output
Signal Strength – Allows the user to view the numerical value for the strength of the return signal for product and interface level.

10.3.1.1.1 Display

Fig. 38: Display "Length"

Length – Changes display to show the level measurement in the selected units
Current – Changes display to show the current output
Percent – Changes display to show percentage full

10.3.1.1.2 Units

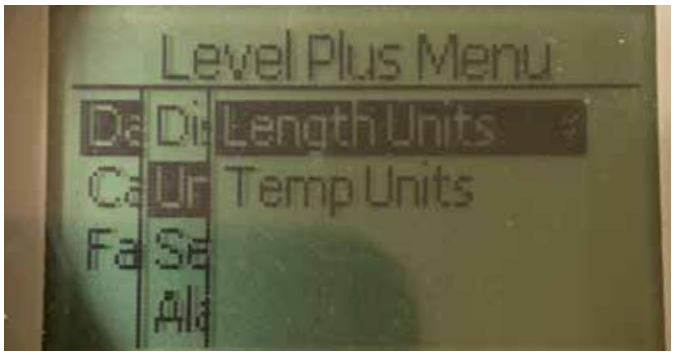

Fig. 39: Display "Units"

Length Units – Allows the user to select the units of measure for the level measurement
Temp Units – Allows the user to select the units of measure for the temperature measurement

10.3.1.1.2.1 Length Units

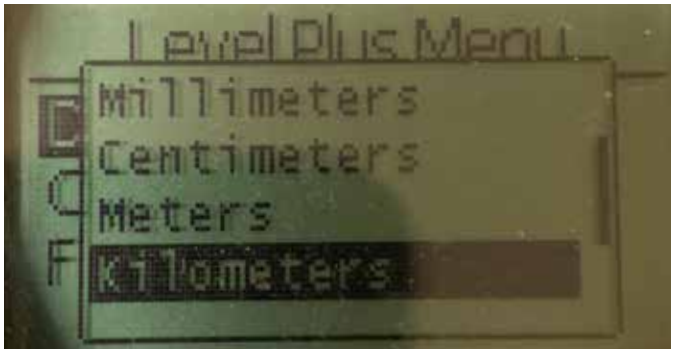

Fig. 40: Display "Lengths Unit"

Select between millimeters, centimeters, meters, kilometers, inches, feet, and yards

10.3.1.1.2.2 Temp Units

Fig. 41: Display "Temp Unit"

Select between Celsius and Fahrenheit

10.3.1.1.3 Set Points

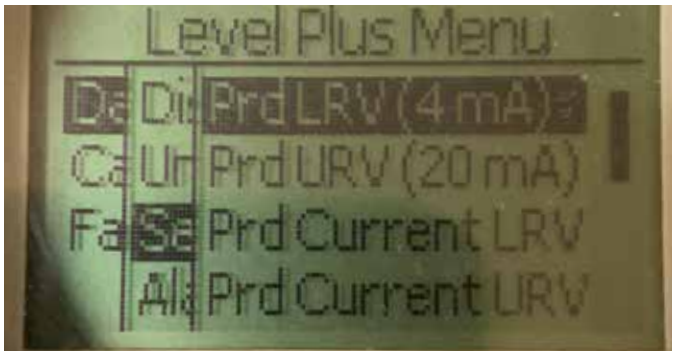

Fig. 42: Display "Set Points"

Prod LVR (4 mA) – Allows the user to change the Loop 1 4 mA set point by changing the numerical value
Prd URV (20 mA) - Allows the user to change the Loop 1 20 mA set point by changing the numerical value
Prd Current LRV - Allows the user to change the Loop 1 4 mA set point by changing the product float position
Prd Current URV - Allows the user to change the Loop 1 20 mA set point by changing the product float position
Int LRV (4 mA) - Allows the user to change the Loop 2 4 mA set point by changing the numerical value
Int URV (20 mA) - Allows the user to change the Loop 2 20 mA set point by changing the numerical value
Int Current LRV - Allows the user to change the Loop 2 4 mA set point by changing the interface float position
Int Current URV - Allows the user to change the Loop 2 20 mA set point by changing the interface float position
NOTE: The instructions above assume that Loop 1 is product level and Loop 2 is interface level. If either of these is changed then the user is changing the process variable assigned to that Loop.

10.3.1.1.3.1 Prod LVR (4 mA)

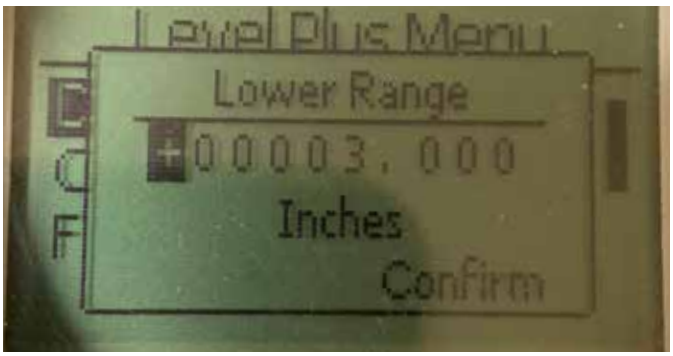

Fig. 43: Display "Prod LVR (4 mA)"

Set the Loop 1 4 mA set point by changing the numerical value

10.3.1.1.3.2 Prod URV (20 mA)

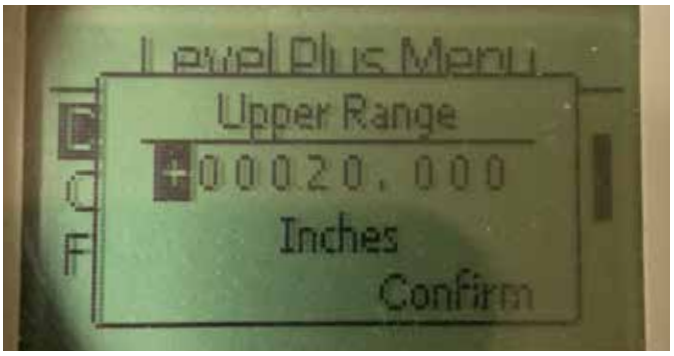

Fig. 44: Display "Prod URV (20 mA)"

Set the Loop 1 20 mA set point by changing the numerical value

10.3.1.1.3.3 Prd Current LRV

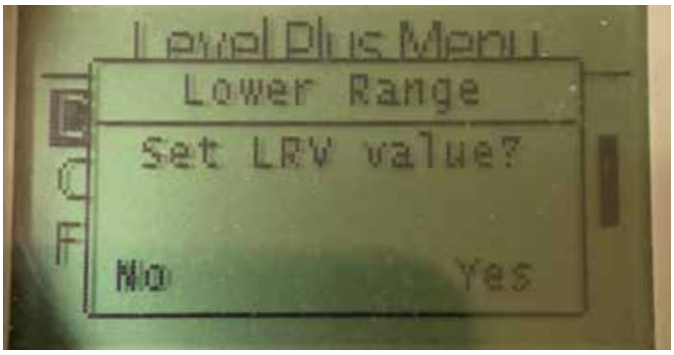

Fig. 45: Display "Prd Current LRV"

Set the Loop 1 4 mA set point by moving the float to the desired position and confirming the change

10.3.1.1.3.4 Prd Current URV

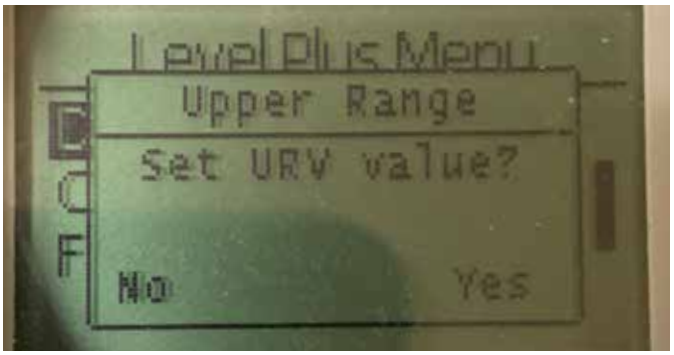

Fig. 46: Display "Prd Current URV"

Set the Loop 1 20 mA set point by moving the float to the desired position and confirming the change

10.3.1.1.3.5 Int LRV (4 mA)

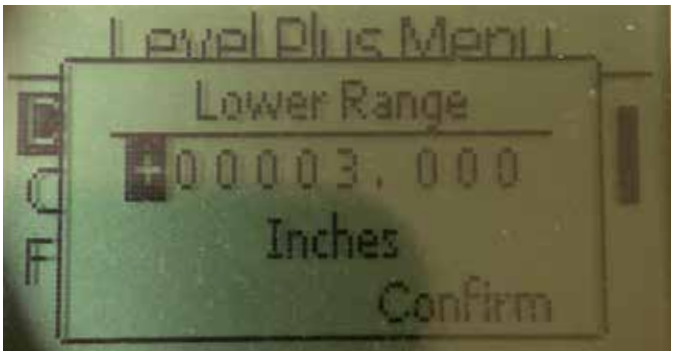

Fig. 47: Display "PInt LRV (4 mA)"

Set the Loop 2 4 mA set point by changing the numerical value

10.3.1.1.3.6 Int URV (20 mA)

Fig. 48: Display "Int URV (20 mA)"

Set the Loop 2 20 mA set point by changing the numerical value

10.3.1.1.3.7 int Current LRV

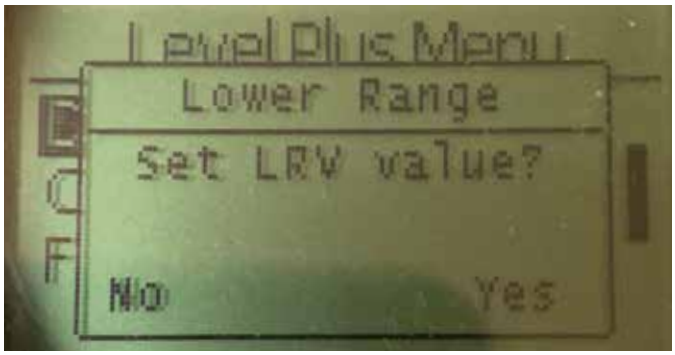

Fig. 49: Display "int Current LRV"

Set the Loop 2 4 mA set point by moving the float to the desired position and confirming the change

10.3.1.1.3.8 Int Current URV

Fig. 50: Display "Int Current URV"

Set the Loop 2 20 mA set point by moving the float to the desired position and confirming the change

10.3.1.1.4 Alarm Select

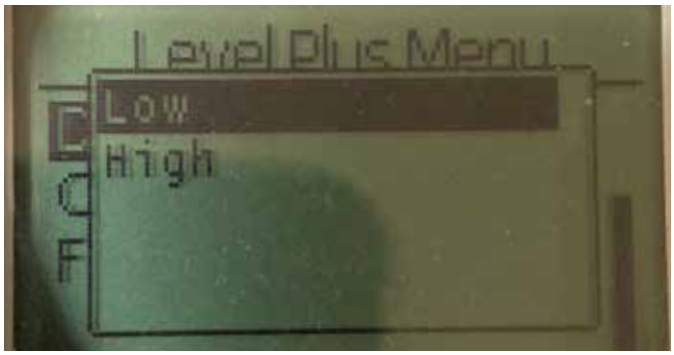

Fig. 51: Display "Alarm Select"

Select the alarm to go High or Low position and confirming the change

10.3.1.1.5 Signal Strength

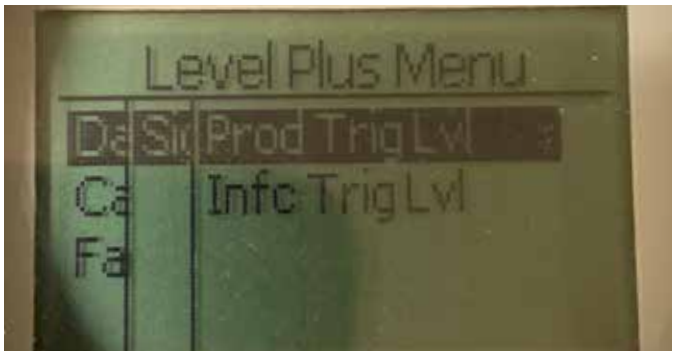

Fig. 52: Display "Signal Strength"

Prod Trig Lvl - Allows the user to view the numerical value for the strength of the return signal for product level.
Int Trig Lvl - Allows the user to view the numerical value for the strength of the return signal for interface level.

10.3.1.1.5.1 Prod Trig Lvl

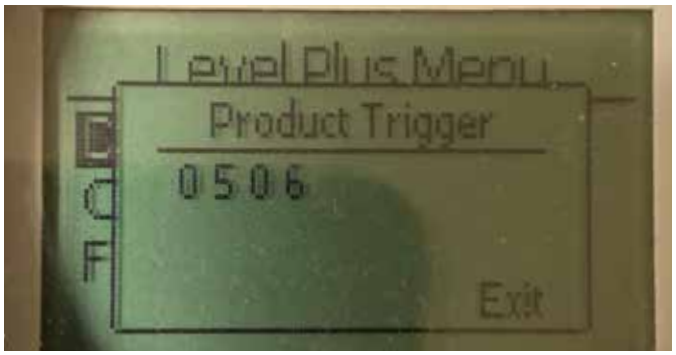

Fig. 53: Display "Prod Trig Lvl"

Numerical value for the strength of the return signal, cannot be edited.

10.3.1.1.5.2 Int Trig Lvl

Fig. 54: Display "Int Trig Lvl"

Numerical value for the strength of the return signal, cannot be edited.

10.3.1.2 Calibrate

Fig. 55: Display "Calibrate"

Product Level – Allows the user to calibrate the product level
Interface Level – Allows the user to calibrate the interface level

10.3.1.2.1 Product Level

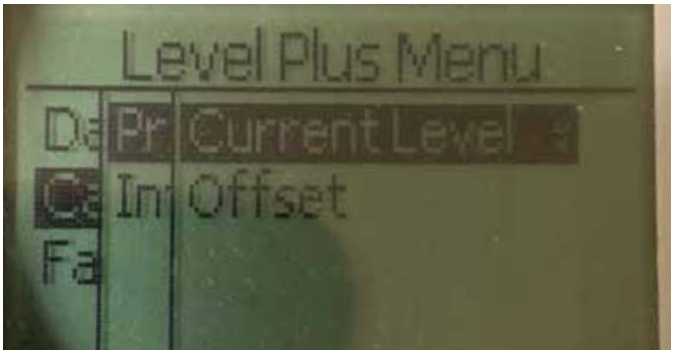

Fig. 56: Display "Product Level"

Current Level – allows the user to calibrate based on the current tank level
Offset – allows the user to calibrate by changing the offset value for the level, not recommended

10.3.1.2.1.1 Current Level

Fig. 57: Display "Current Level"

Enter the desired value that the product level should correspond to.

10.3.1.2.1.2 Offset

Fig. 58: Display "Offset"

Only used based on Factory Technical Support

10.3.1.2.2 Interface Level

Fig. 59: Display "Interface Level"

Current Level – allows the user to calibrate based on the current tank level
Offset – allows the user to calibrate by changing the offset value for the level, not recommended

10.3.1.2.2.1 Current Level

Fig. 60: Display "Current Level"

Enter the desired value that the product level should correspond to.

10.3.1.2.2.2 Offset

Fig. 61: Display "Offset"

Only used based on Factory Technical Support

10.3.1.3 Factory

Fig. 62: "Factory"

Settings – Allows the user to access factory settings
Temp Setup- Allows the user to setup temperature measurement if equipped
Float Config – Allows the user to setup the number of floats used
Damping – Allows the user to set the damping of the output signal
Auto Threshold – Allows the user to enable/disable auto threshold
Reset to Factory – Allows the user to reset all factory settings

10.3.1.3.1 Settings

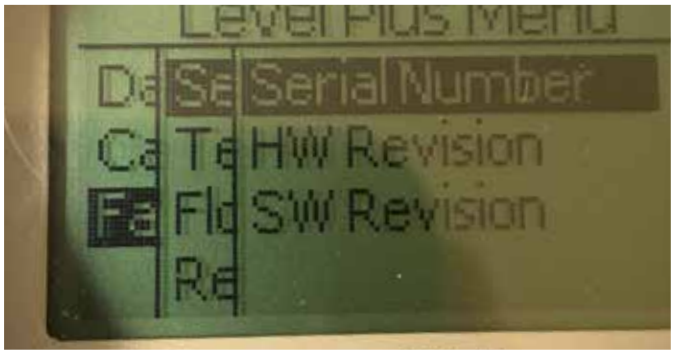

Fig. 63: "Settings"

Serial Number – Serial Number assigned by Temposonics at the time of manufacture. The serial number is used for tracking and replacement parts.
HW Revision – Read only information about the level transmitter's hardware
SW Revision – Read only information about the level transmitter's firmware

10.3.1.3.1.1 Serial Number

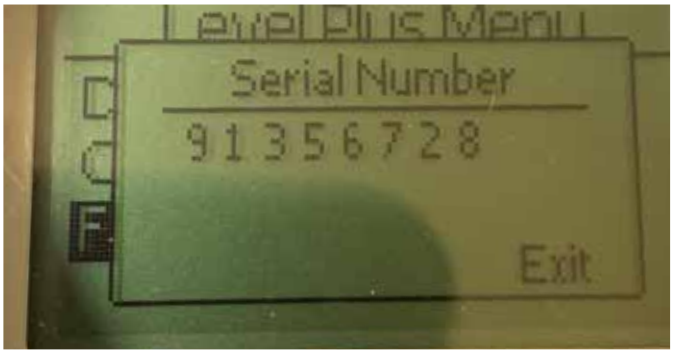

Fig. 64: "Serial Number"

Serial Number assigned by Temposonics at the time of manufacture. The serial number is used for tracking and replacement parts

10.3.1.3.1.2 HW Revision

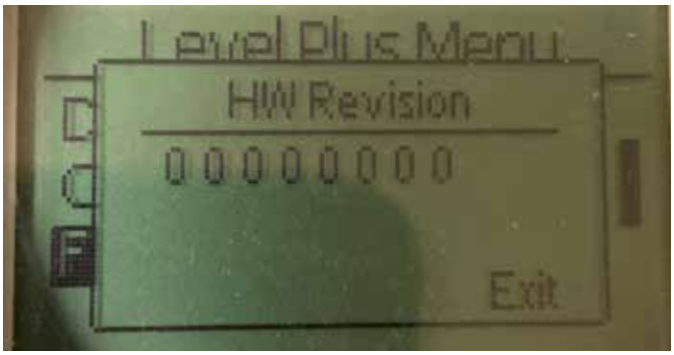

Fig. 65: "HW Revision"

Read only information about the level transmitter's hardware

10.3.1.3.1.3 SW Revision

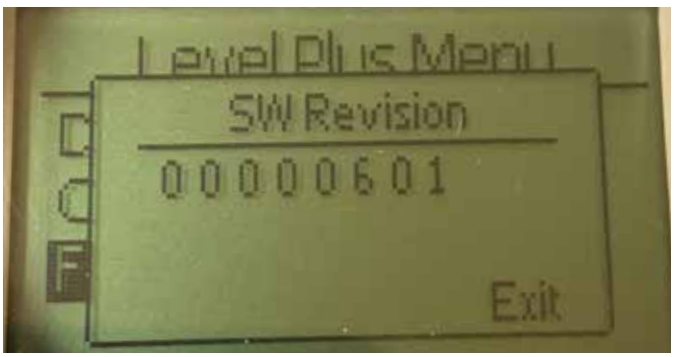

Fig. 66: "SW Revision"

Read only information about the level transmitter's firmware

10.3.1.3.2 Temp Setup

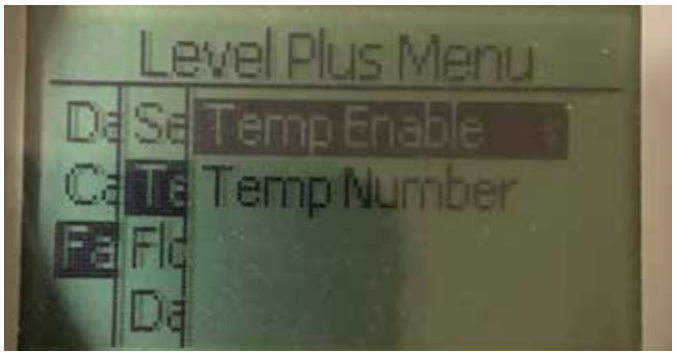

Fig. 67: "Temp Setup"

Temp Enable – Allows the user to turn the temperature measurement function on or off. Does not enable the function if the unit was not ordered with temperature measurement.
No of Temp – Allows the user to adjust the number of temperature measurement points the level transmitter is looking for. Does not adjust the physical number of temperature sensors that were ordered. Analog only has the option for one temperature sensor.

10.3.1.3.2.1 Temp Enable

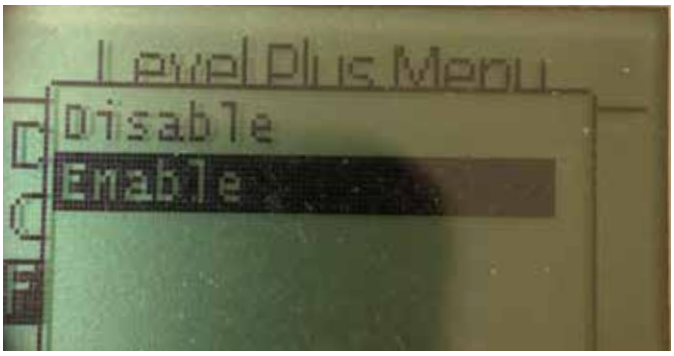

Fig. 68: "Temp Enable

Allows the user to turn the temperature measurement function on or off. Does not enable the function if the unit was not ordered with temperature measurement.

10.3.1.3.2.2 No of Temp

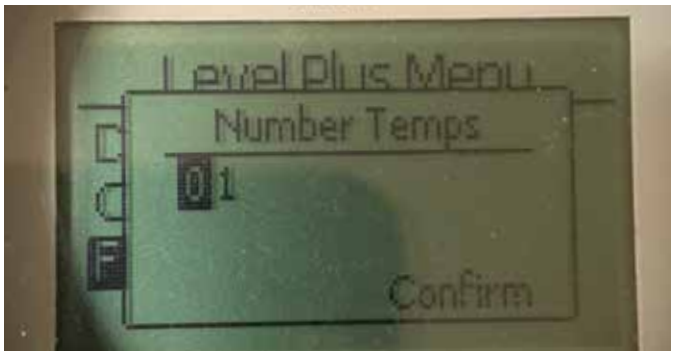

Fig. 69: "No of Temp"

Alows the user to adjust the number of temperature measurement points the level transmitter is looking for. Does not adjust the physical number of temperature sensors that were ordered. Analog only has the option for one temperature sensor.

10.3.1.3.3 Float Config

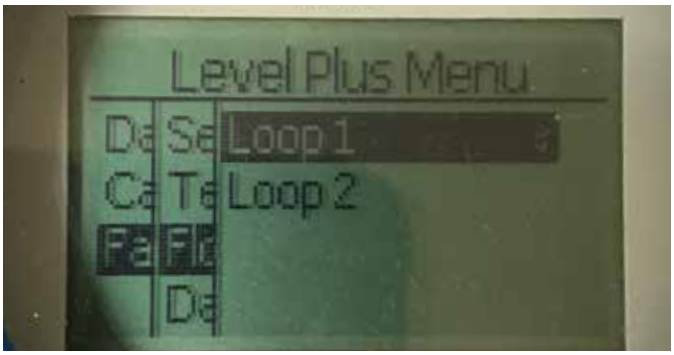

Fig. 70: "Float Config"

Loop 2 – Allows the user to turn on or off the interface level float. Does not change the number of floats on the level transmitter.

10.3.1.3.3.1 Loop 2

Fig. 71: "Loop 2"

Allows the user to turn on or off the product level float. Does not change the number of floats on the level transmitter.

10.3.1.3.4 Reset to Factory

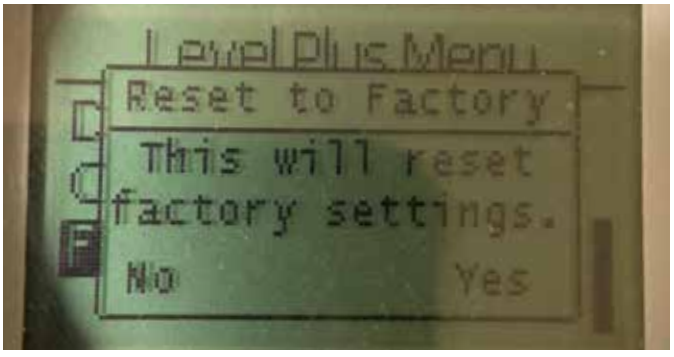

Fig. 72: "Reset to Factory"

Allows the end user to reset all settings back to the original settings as they were when they left the Temposonics factory. This is intended to be used as a first step in troubleshooting. Do note, the Zero and Span set points will reset to factory settings.

11. Proof Test

The Safety Function of the LP-Series SIL capable level transmitter is internally checked but the diagnostic coverage of the sensor can be increased by checking the function of the sensor externally. A proof test is typically required for applications where the level transmitter is being used in low demand mode. All applied methods and results of the proof test have to be written in a test report. When functional test results are negative the device and the system need to be shut down. The process has to be kept in a safe mode as seen fit by the end user while the transmitter is repaired or replaced. The suggested proof test interval is 1 year.

Caution:
In the event a magnetostrictive transmitter has suffered a failure in any component which is exposed to the process, any other magnetostrictive transmitter installed in the same or similar process should be inspected for the same failure regardless of its maintenance schedule. These Common Cause Failures include: 1) float collapse due to over pressure, 2) float corrosion due to material incompatibility, 3) damage of the sensor tube due to improper installation.

1. Bypass the safety PLC or take other appropriate action to avoid a false trip.
2. Using the Display entry or HART® command, set the Alarm Selection to High. Either remove the float, move the float outside of the active measuring range, or place an external magnet close to the electronic head and outside the active measuring range. The output current on Loop 1 should go to the High Alarm fault state (≥21.0 mA).
3. Using the Display entry or HART® command, set the Alarm Selection to Low. Either remove the float, move the float outside of the active measuring range, or place an external magnet close to the electronic head and outside the active measuring range. The output current on Loop 1 should go to the High Alarm fault state (≤3.6 mA).
4. Perform a two-point calibration check of the transmitter by applying level to two points on the probe and compare the trans mitter display reading and the current level value to a known refe rence measurement. It is recommended to keep the level transmitter in the tank and modulate the level in the tank by pumping product in and/or out of the tank.
5. If the calibration is correct (≤2%), the proof test is complete. Proceed to step 9.
6. If calibration is incorrect, remove the transmitter and probe assembly from the process. Inspect the pipe, hose, and/or float for buildup or clogging. Clean the pipe, hose, and/or float if necessary. Perform a bench calibration check by moving the float to two points. Measure the level from the bottom of the probe to the points and compare to the transmitter display and current level readings.
7. If the calibration is off by more than 2%, call the factory for assistance.
8. If the calibration is correct, the proof test is complete. Proceed to step 9.
9. Re-install the probe and transmitter.
10. Restore the loop to full operation.
11. Remove the bypass from the safety PLC or otherwise restore normal operation.

12. Change Request

If there are any issues during system integration then contact Temposonics and issue a change rquest. Use the Contact Us Form at www.temposonics.com. Select Technical Inquiry in the subject drop down menu and state in the comments section the change request and the technical reason for the request. The inquiry will be routed to the correct technical person for follow-up.

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