



**HART**<sup>®</sup> 

The word "HART" is written in a large, bold, red, sans-serif font. To its right is a red waveform consisting of two full cycles of a sine wave, representing the HART protocol signal.

***TEK-TROL HART GATEWAY SOFTWARE***  
***Operating Instruction Manual***

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## 1 Getting Started

This instruction manual describes the Tek-Trol HART Gateway Software. HART® is a registered trademark of the HART Communication Foundation. The Tek-Trol HART Gateway software provides a PC interface to all Tek-Trol Sensor Technology 2-wire HART enabled level sensors. Using the Tek-Trol HART Gateway, the users can change a sensor's calibration and operation.

### 1.1 Setup Procedure

The following 10 steps will assist you in setting up the Gateway software and connecting a sensor:

#### 1. Install a HART Modem

Before installing the HART Gateway software, a HART modem must be installed. HART modems are available from Spring Technology, MACTek Corporation and other manufactures.

#### 2. Install the Tek-Trol HART Gateway Software

Install the Tek-Trol HART Gateway Software on the PC by selecting SETUP.EXE from the CD and follow the instructions on the screen.

#### 3. Start the Tel-Trol HART Gateway Software

Click the Windows "Start" button, "Programs", "Tek-Trol Probe Gateway" and select "HART Gateway".

#### 4. Select a Serial Port

When the HART Gateway software is started for the first time a dialog box will appear as shown in Figure 1 (top). Click the "Next" button. Select the desired serial port from the drop-down list Figure 1 (middle). Figure 1 shows communication port 6 selected. Click the "Next" button. To save your selection click the "Finish" button Figure 1 (bottom). To change your selection, click the "Previous" button. The selected serial port will be saved and used each time the HART Gateway software is started. After selecting a valid serial port, the main screen of the Tek-Trol HART Gateway will appear as shown in Figure 2.

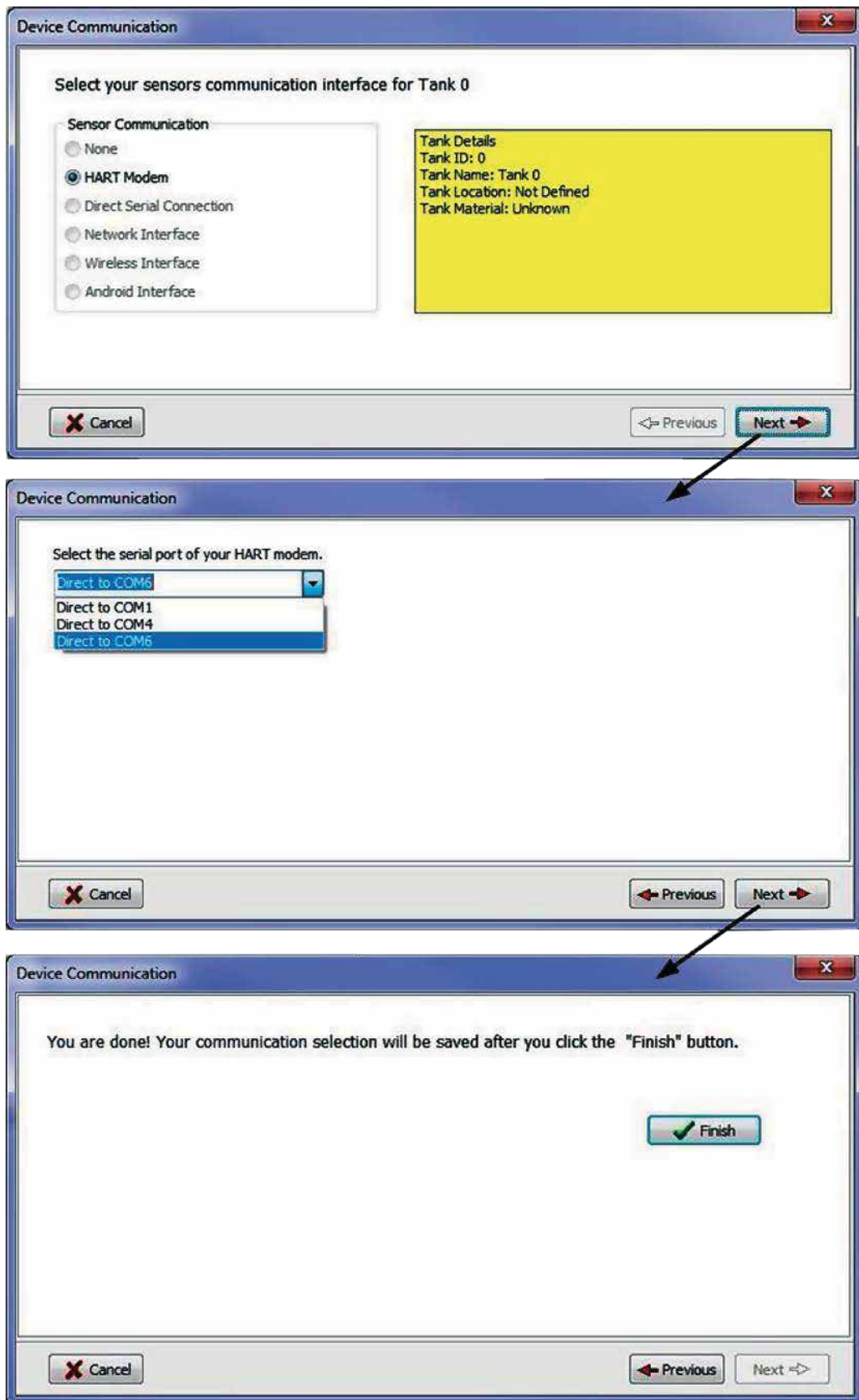


Fig 1: When the HART Gateway software is started the first time a communication wizard dialog box will appear to help select the serial port.

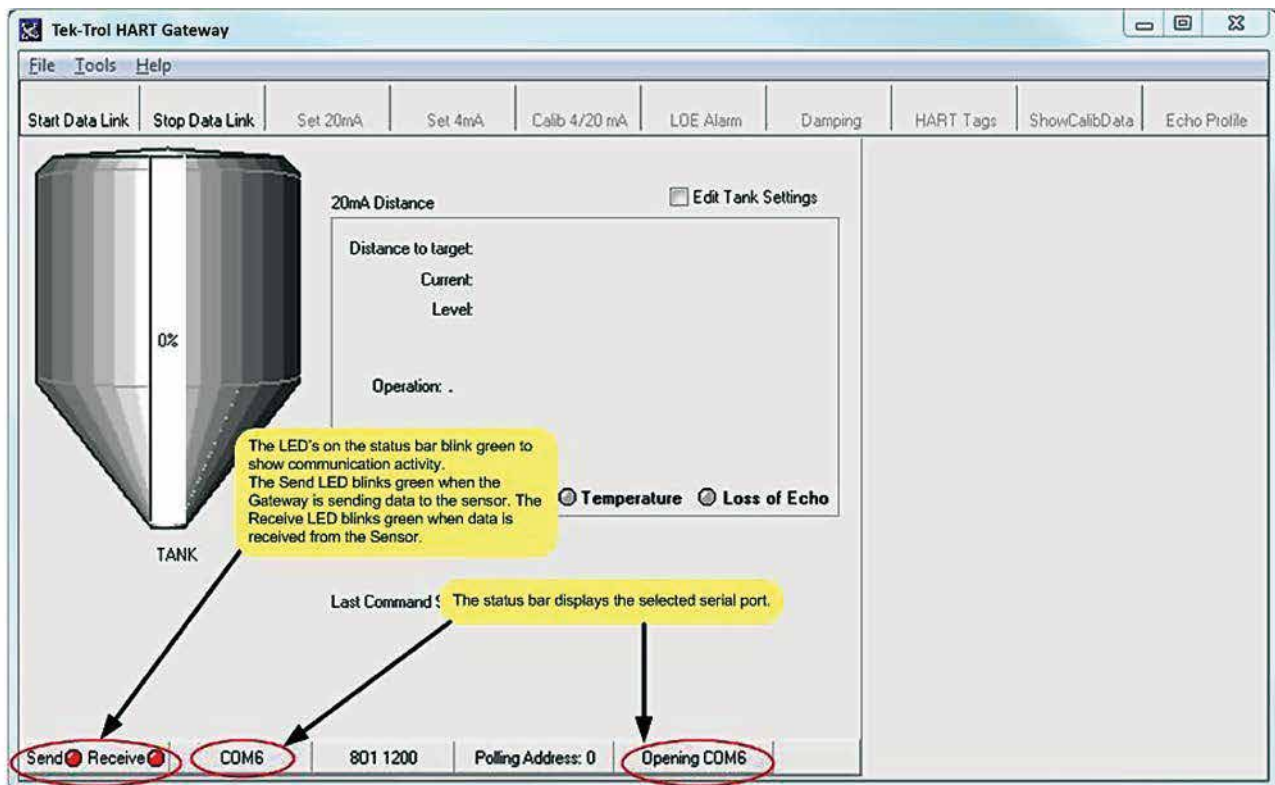


Fig 2: The main screen of the Tek-Trol HART Gateway.

### 5. Changing serial port

The serial port can be changed at any time by clicking on the serial port number (see Figure 3) shown on the tank status bar. After clicking on the displayed serial port number the dialog box shown in Figure 1 will appear.

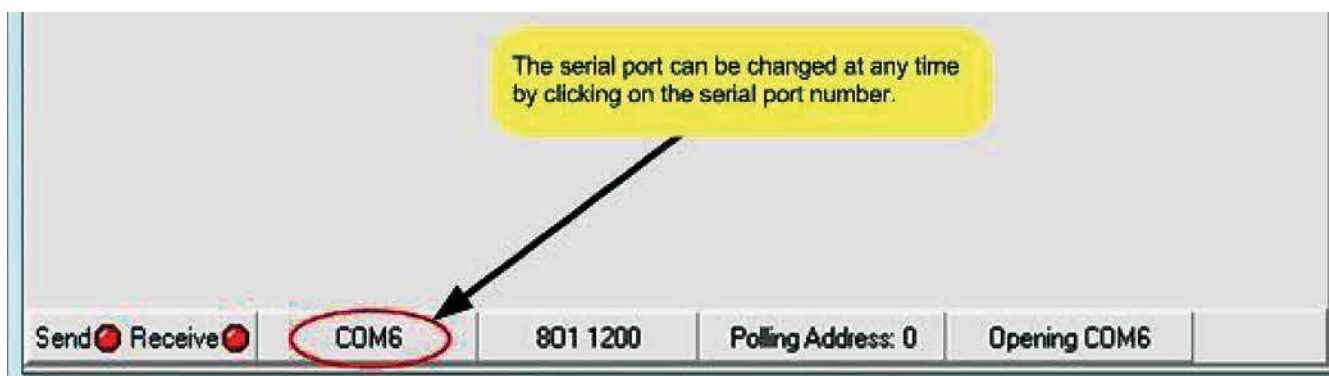


Fig 3: Changing the serial port

## 6. Connecting the Sensor

For this step, you will need a 250 ohm 1/4W (or higher) resistor (not supplied with sensor). Connect your HART modem to the sensor as shown in Figure 4. The HART modem must be connected to each side of the load resistor. The value of the load resistor should be 250 ohms and minimum 1/4W. Failure to use the correct value of resistor will cause communication problems and possible damage to your HART enabled sensor.

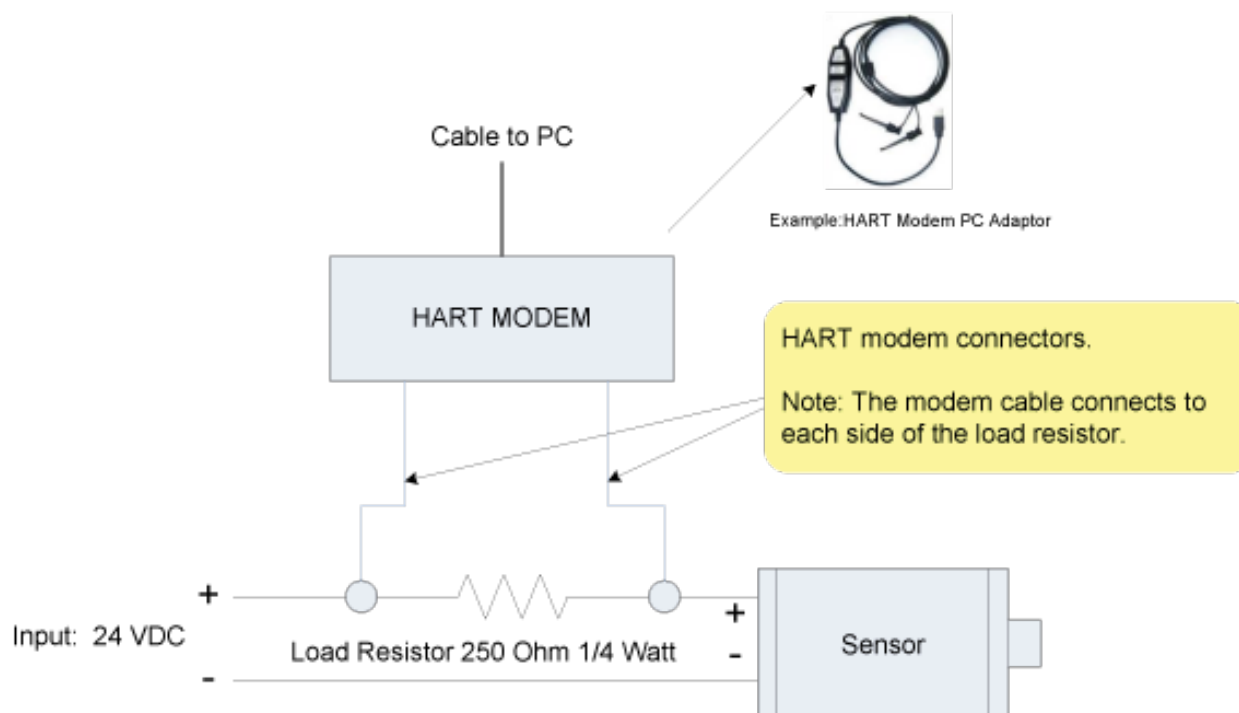


Fig 4: HART modem connection diagram. See sensor documentation for input voltage range.

## 7. Power up the sensor

Connect power to the sensor. Please note: power requirements vary by device, always consult the sensor datasheet for the correct input voltage.

- **2-Wire Radar Level Device**

The loop voltage should be between 22 to 30 VDC when a 250 ohm load resistor is connected (see Figure 4). 24 VDC is recommended.

## 8. Start Data link

Once the sensor is powered on and the HART modem is connected to the sensor, click the "Start Data Link" button as shown in Figure 5 to start communication with your HART enabled sensor.

After clicking on the "Start Data Link" button, the button will display a green square to show the button is active. Clicking on the "Stop Data Link" button will stop communication with the sensor. Once the "Stop Data Link" button is pressed the button will display a red square to indicate that communication has stopped.

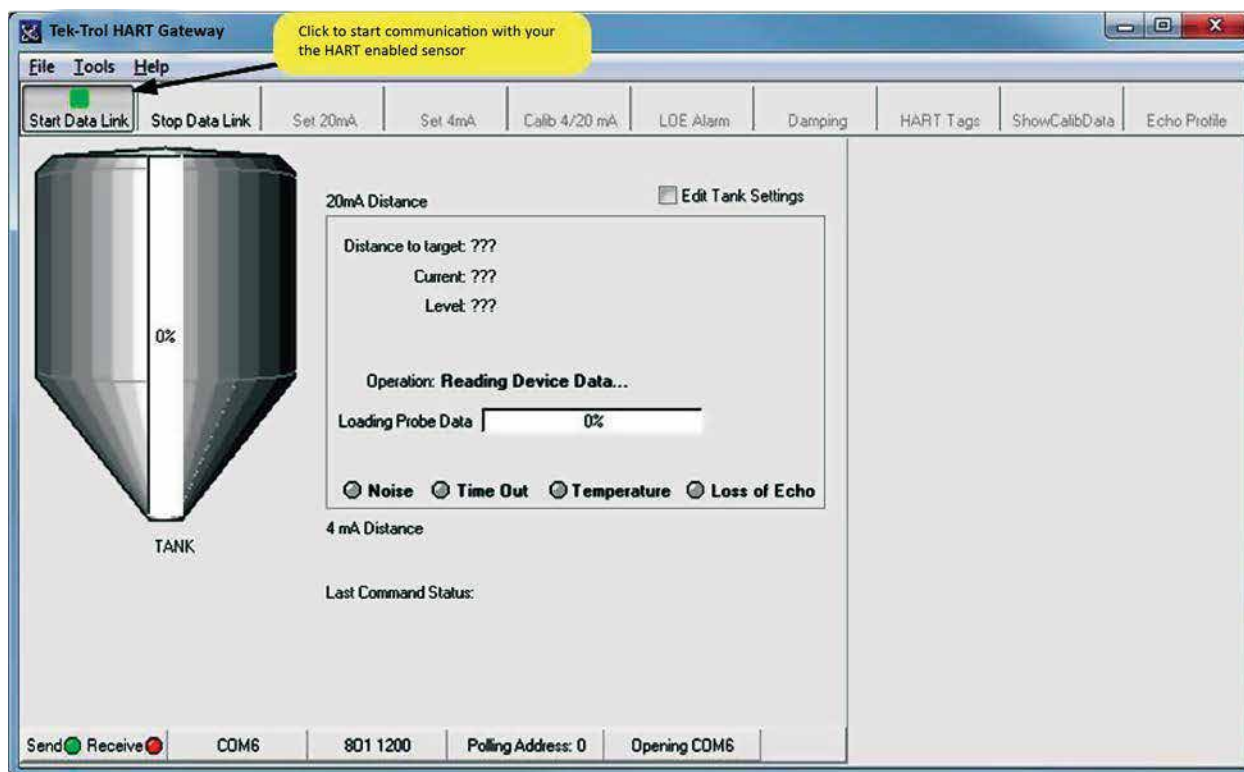


Fig 5: Communication with the sensor is started by clicking the “Start Data Link” button. The “Start Data Link” button will display a green square to show the button is active.

## 9. Loading sensor data

The Tek-Trol HART Gateway will now attempt to communicate with the level device. If the connection is successful, the Gateway software will start to download data from the sensor as illustrated in Figures 6 to 9. The Gateway software will determine the type of sensor connected and configure the toolbar buttons and menus for the sensor. The progress bar in the center of the screen shows the download progress. When the download is completed, the HART Gateway is ready to use as shown in Figure 10.

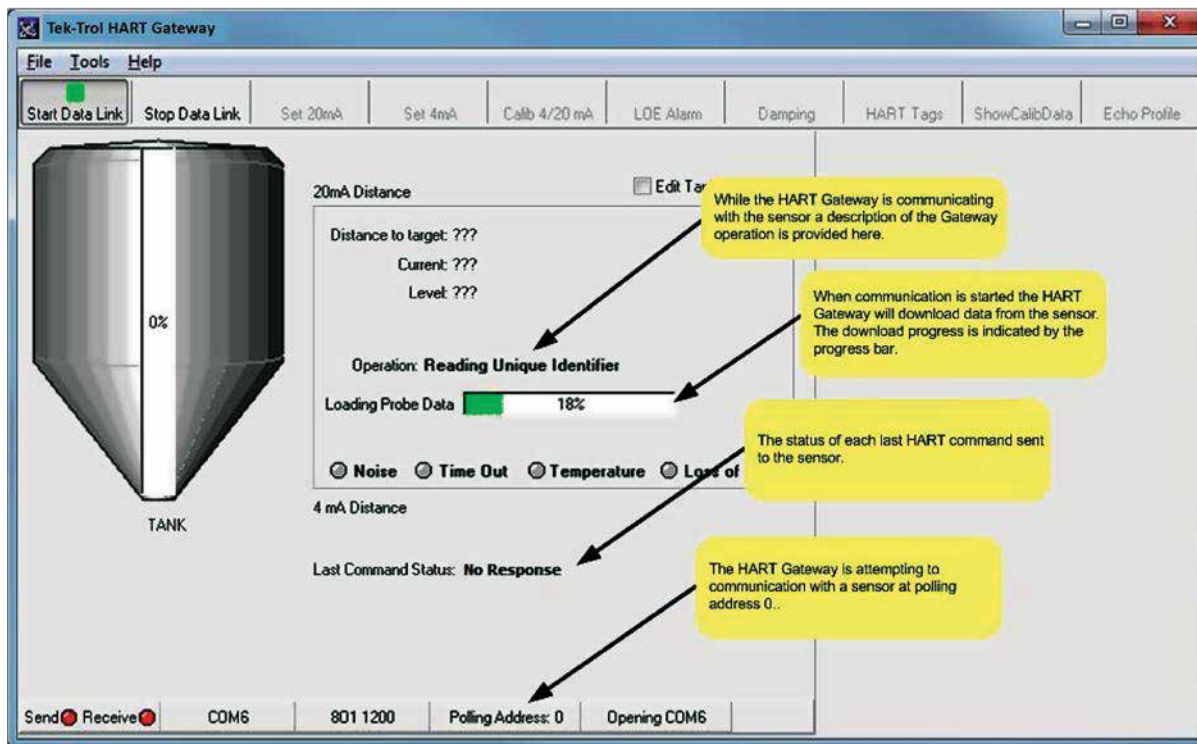


Fig 6: Tek-Trol Gateway downloads data from the sensor and provides a description of its current operation.

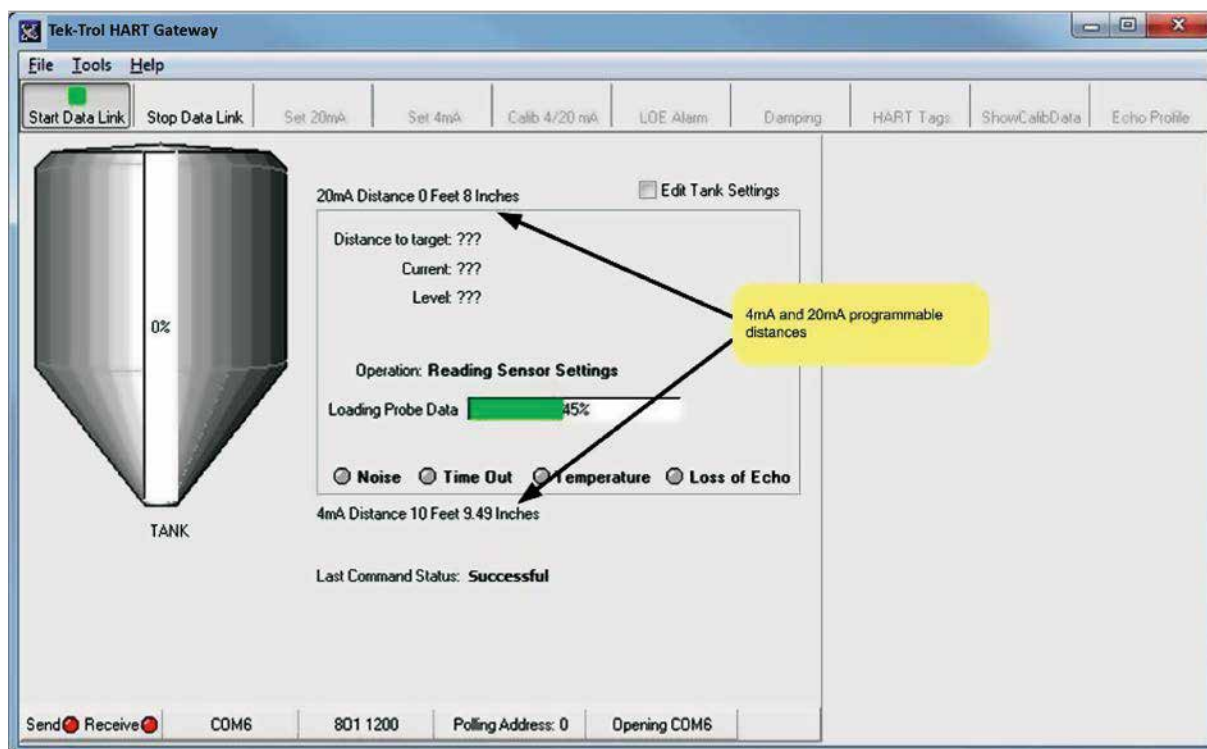


Fig 7: As data is downloaded from the sensor the screen will be updated with the 4mA and 20mA calibration.



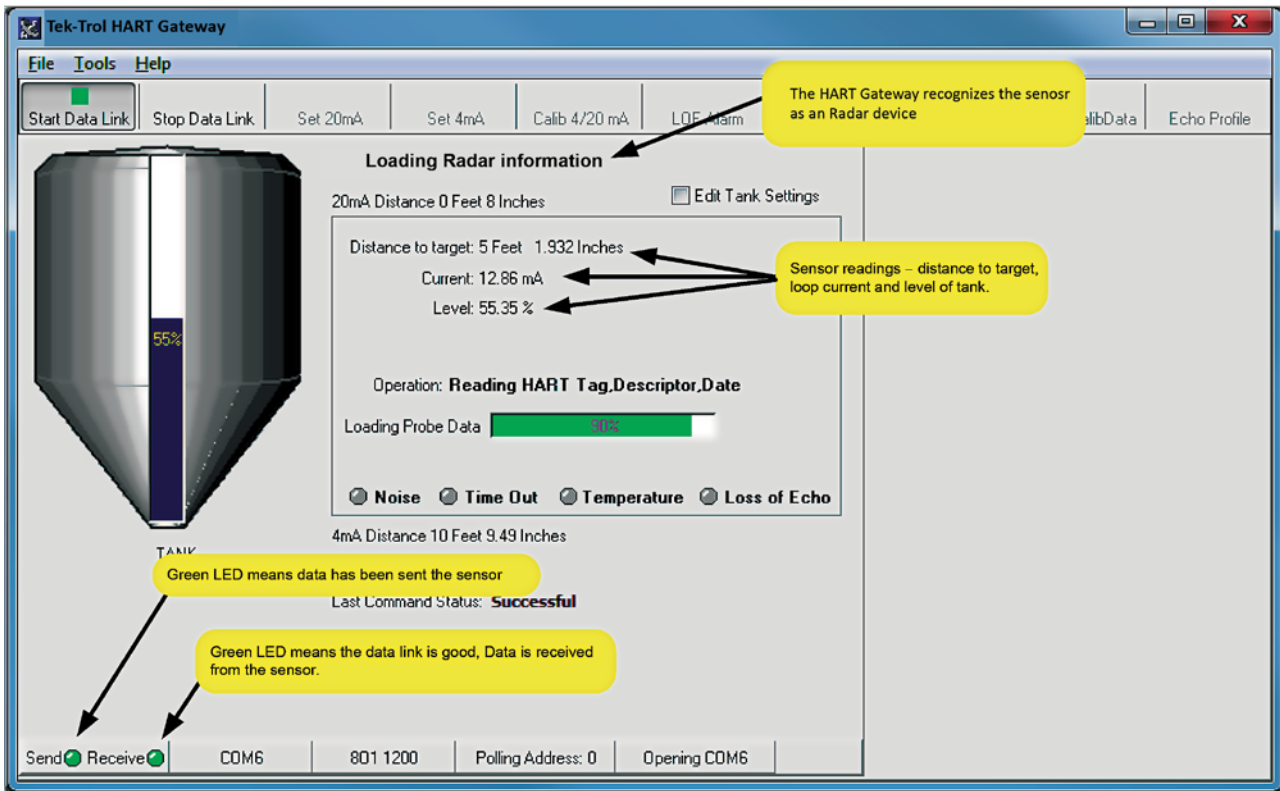


Fig 8: The Gateway has determined that the connected sensor is a radar sensor.

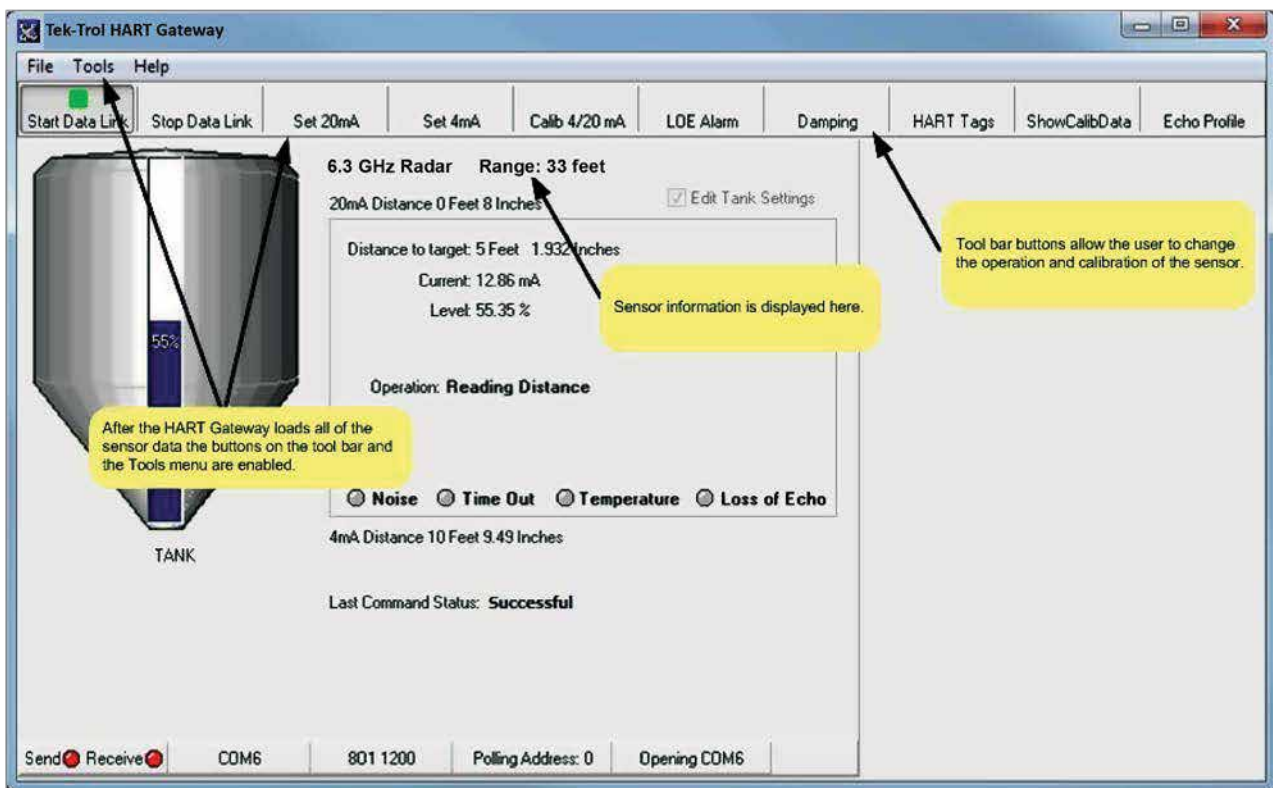


Fig 9: Once the Gateway has finished downloading the sensor data, the menus and toolbar buttons are enabled

## 10. Ready to use

The download is complete and the progress bar in the center of the screen has disappeared, see Figure 10. The Gateway software is now ready for use. The Gateway software can be used to display calibration data or to change the sensors calibration.

Before using your Tek-Trol HART enabled level device, you may want to change the different programmable features to suit your application. **Section 2** and **Section 3** describes the different programmable features and how to use them.

As a minimum, you should program the 4 mA and 20 mA distances that correspond with your application.

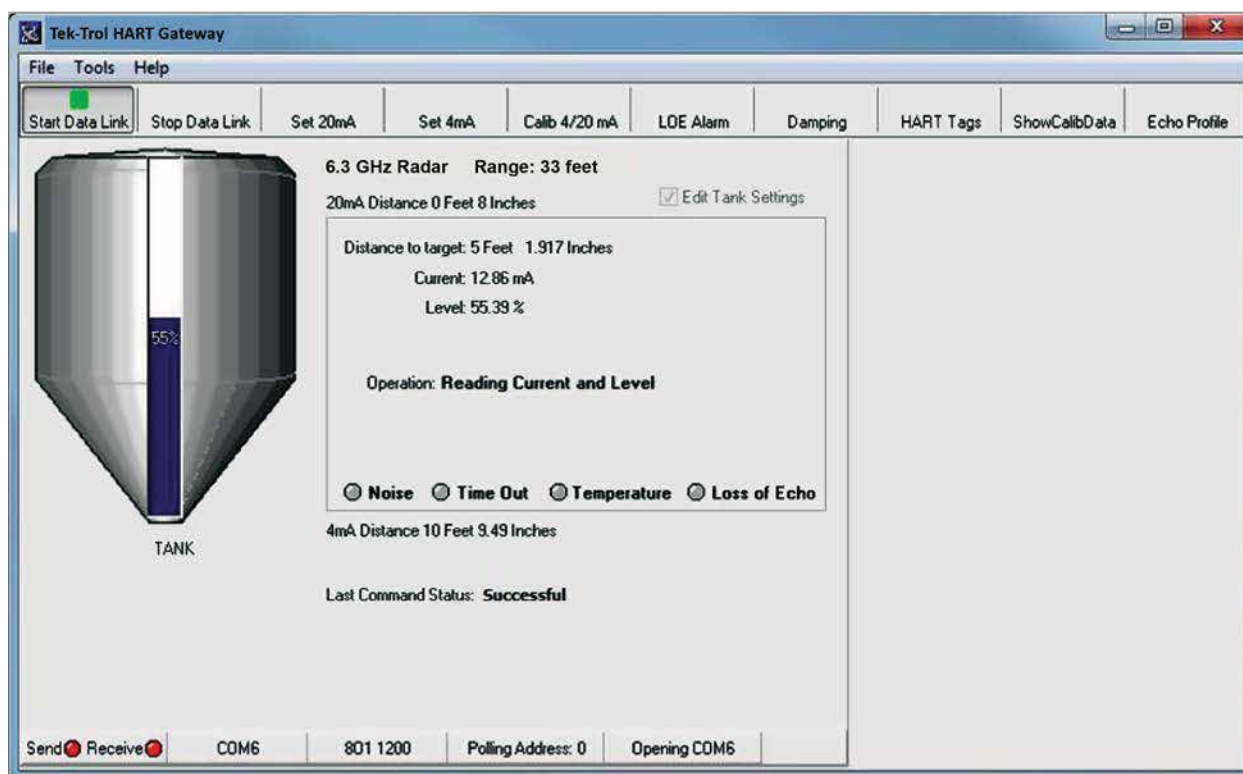


Fig 10: The HART Gateway screen after completion of the download

## 1.2 Quick Setup Guide for Radar sensors

To setup a radar sensor you must have a HART modem installed and the Tek-Trol HART Gateway software installed as described in **Section 1.1**

### Setup steps:

- Connect power and the HART modem to the sensor. (**Section 1.1, Step 6 and 7**)
- Start the Gateway software. (**Section 1.1, Step 8**)
- Set the 4 mA and 20mA distance using the “Calib 4/20 mA” button on the toolbar. (**Section 2.5**)
- Set the damping value using the “Damping” button on the toolbar. (**Section 2.7**)
- Set the Low Dielectric on or off using the “Tools”, “Low Dielectric Material” menu Item. (**Section 3.6**)

## 2 Level Device Programming

Tek-Trol HART enabled level devices can be programmed to fit your specific application. This section will describe the common functions used by both radar and ultrasonic sensors. **Section 3** describes the “Tool” menus which vary depending on the device attached.

### 2.1 How to Change Sensor Settings

The Gateway software provides dialog boxes to change each of the sensors programmable settings. When a toolbar button is clicked or a menu item is selected a dialog box will open. As shown in Figure 11 each dialog box opens and then retrieves sensor data. If the user changes the data in the dialog box and clicks the save button, then each piece of data will be written to the sensor. After all data has been written to the sensor a “Sensor Updated” status will be shown before the dialog box is closed.

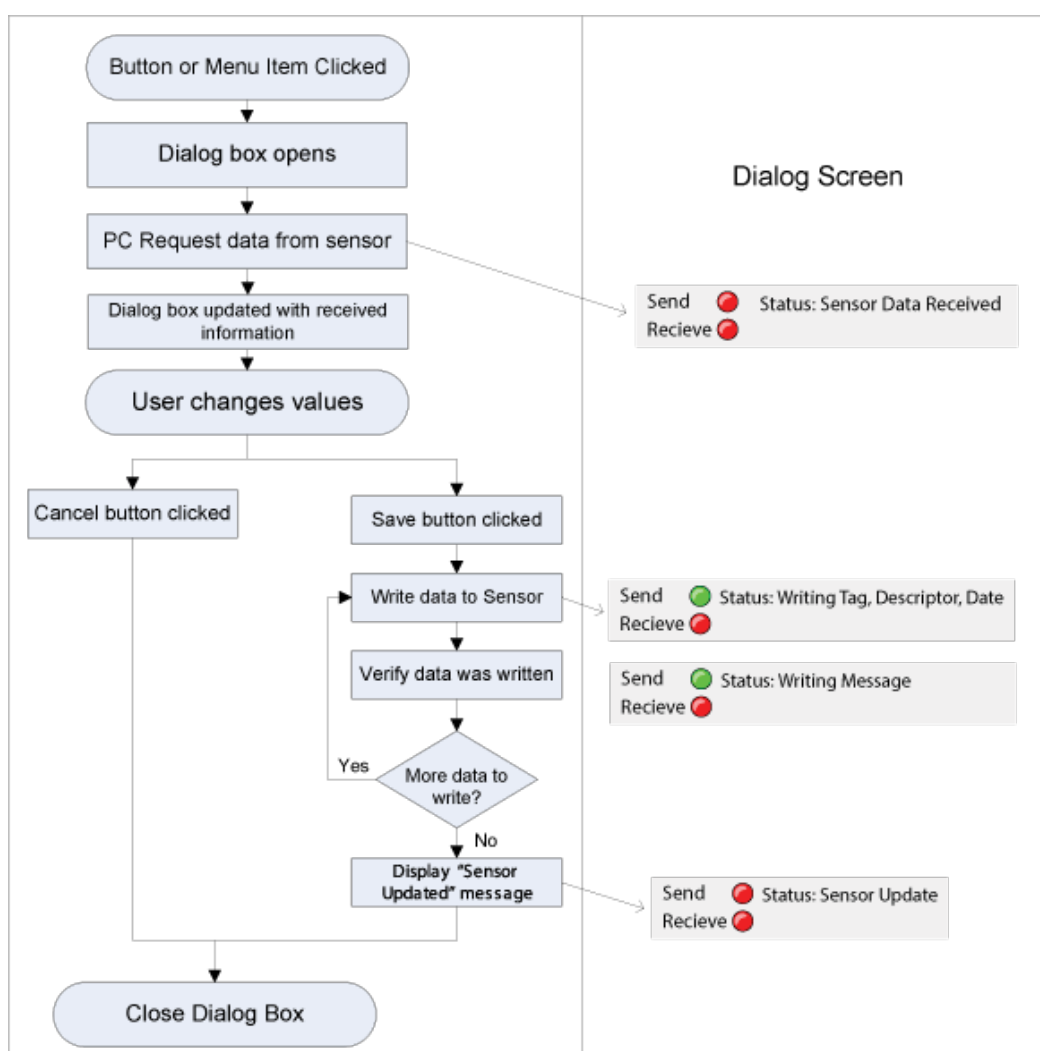


Fig 11: Flow chart illustrating how all dialog boxes operate in the Gateway. If the saved button is pressed the data is written to the sensor

## 2.2 Sensor ID and Polling address

HART enabled Sensors can be used in a multi-sensor environment where each sensor has a unique address referred to as the polling address or identification number (ID). The default polling address for all sensors is 0. The polling address is displayed on the tank status bar as shown in Figure 12.

To communicate with a Tek-Trol level sensor using HART, the polling address being sent by the HART Gateway must match the polling address programmed in the sensor. If the polling addresses do not match the sensor will not reply to any HART commands. To change the polling address used by the HART Gateway software click on the “Polling Address” displayed on the status bar as shown in Figure 12. To program an address in the sensor, refer to the “HART Programmable Settings and Tags” in **Section 2.8**

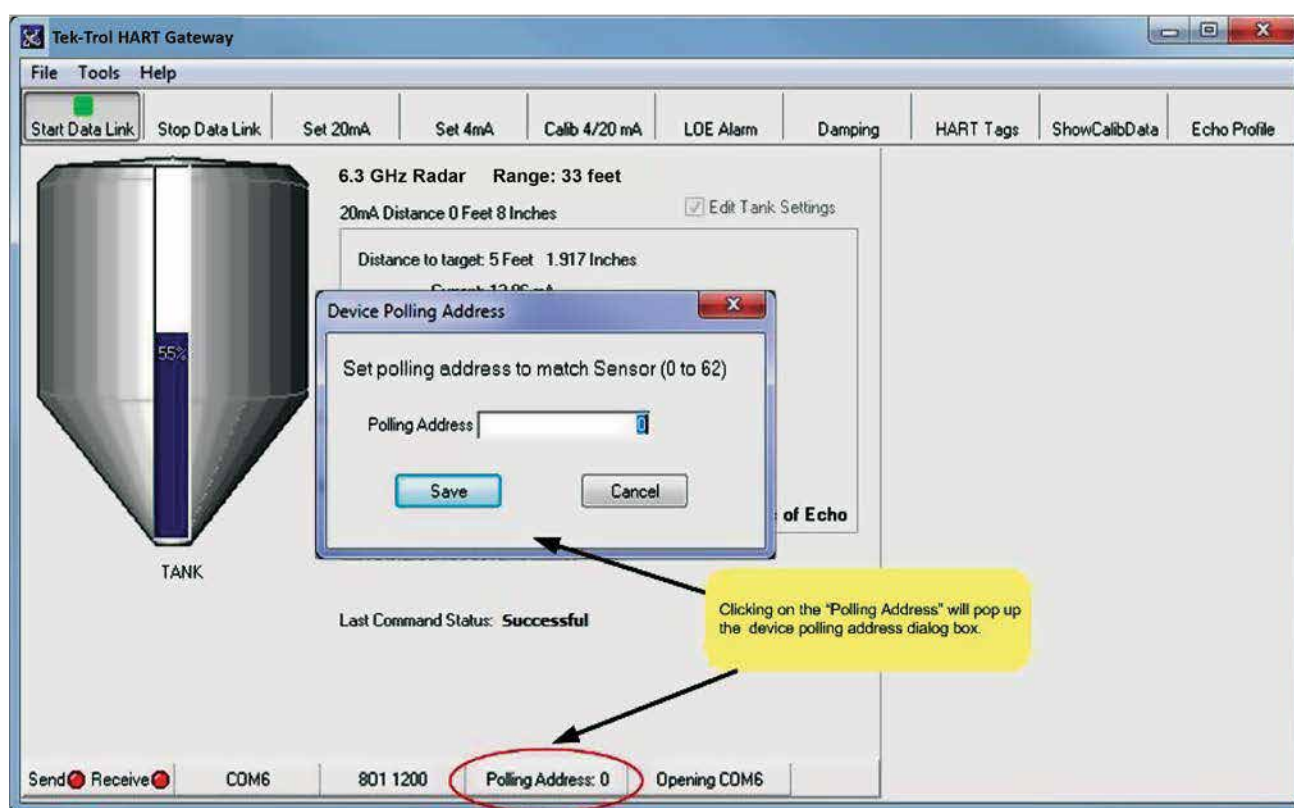


Fig 12: Programming the polling address. Set the polling address to match the polling address in the sensor. By default, all sensors have a polling address of 0.

### 2.3 Setting the 20 mA Distance to the Current Target Distance

The 20 mA distance can be programmed to the current target distance by clicking on the “Set 20mA” button. As shown in Figure 13, the 20 mA distance calibration dialog box will appear and the Gateway will send HART commands to the sensor to retrieve the target distance.



#### NOTE

This operation can be performed using the push button on the sensor, see **Section 3.3** for more details.

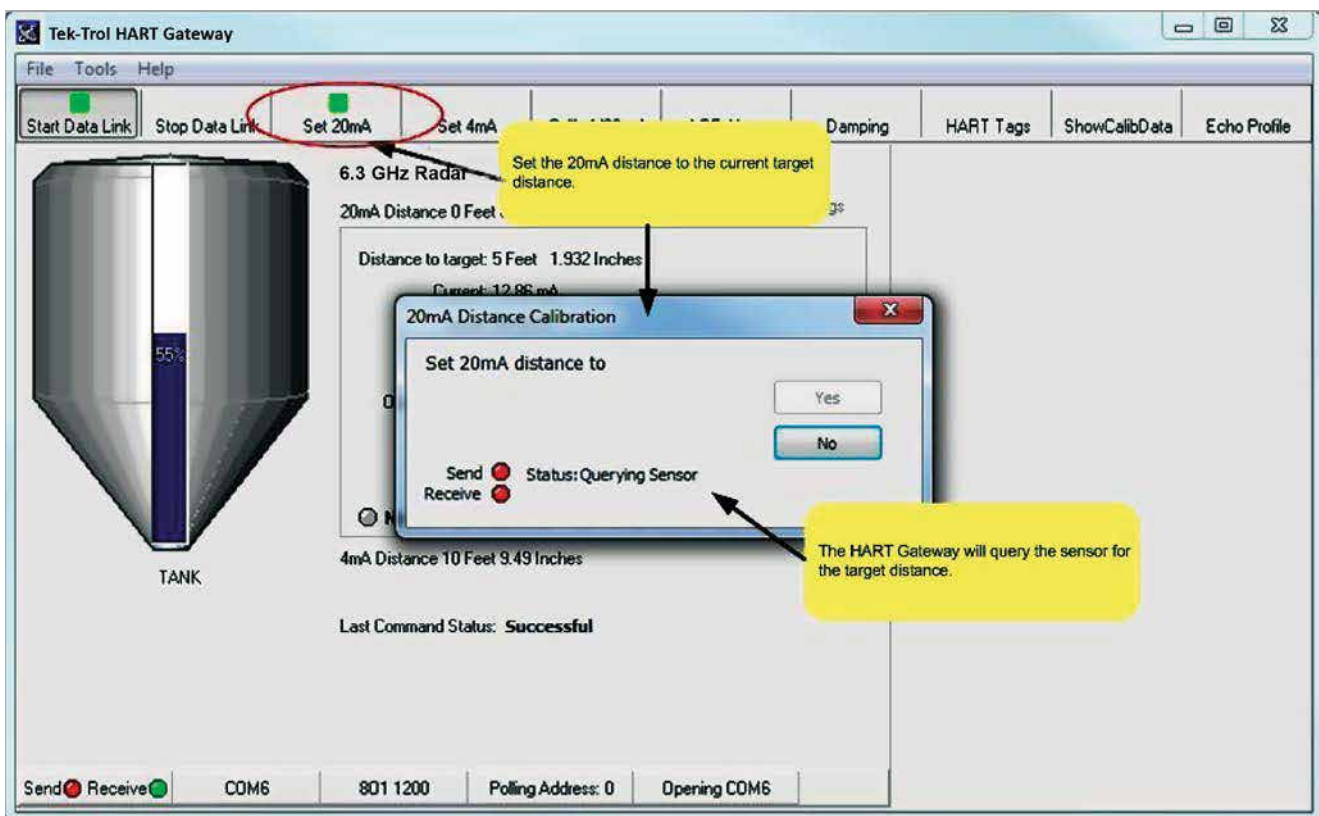


Fig 13: The 20mA distance calibration dialog. The Gateway queries the sensor to determine what the target distance is.

The Gateway will continue to query the sensor until a response is received. Once a response is received from the sensor the Gateway will update the dialog box with the distance information as shown in Figure 14.

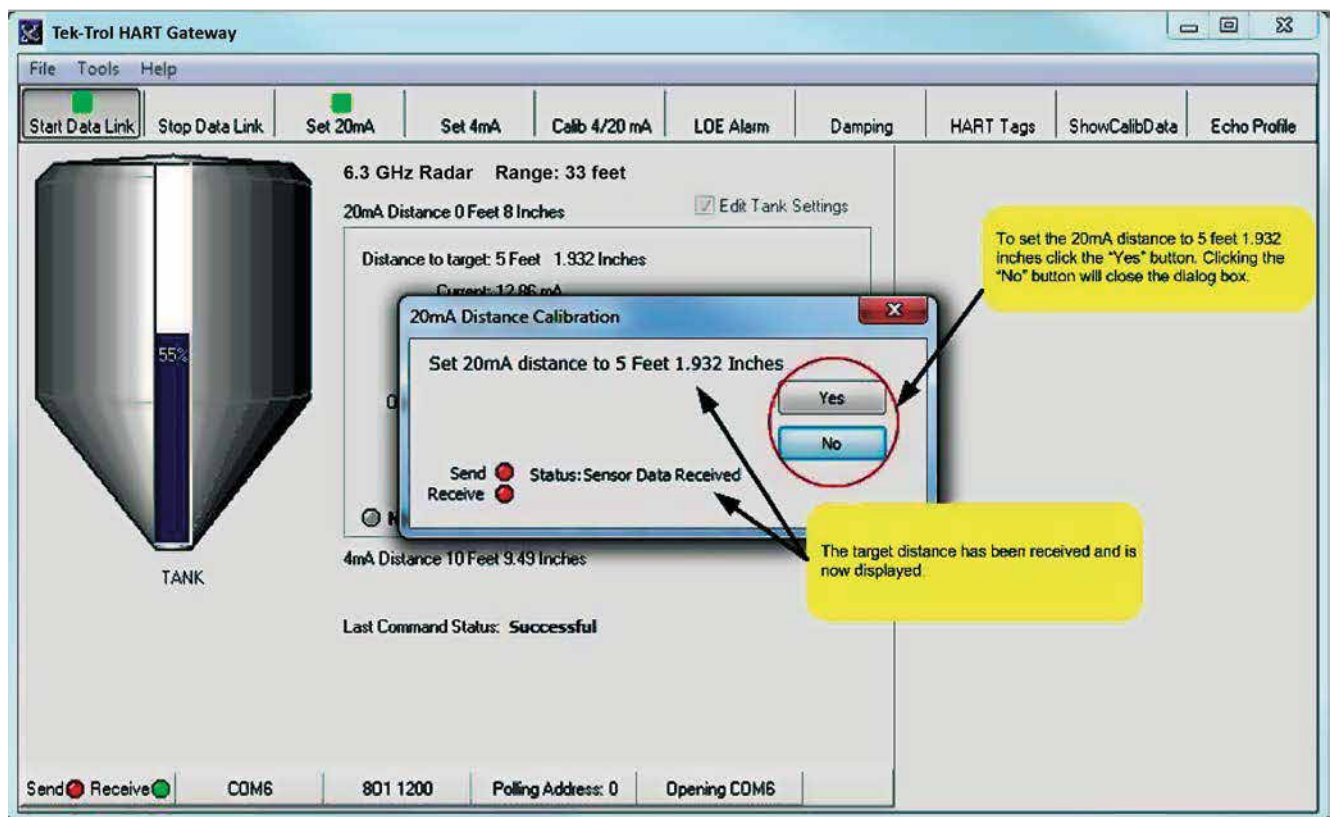


Fig 14: 20mA calibration dialog box showing the distance to the target. Click the “Yes” button to set the 20mA distance to the distance shown. Click the “No” button to close the dialog box without changing the calibration.

## 2.4 Setting the 4 mA Distance to the Current Target Distance

The 4 mA distance can be programmed to the current target distance by clicking on the “Set 4mA” button as shown in Figure 15.



### NOTE

This operation can be performed using the push button on the sensor, see **Section 3.3** for more details.

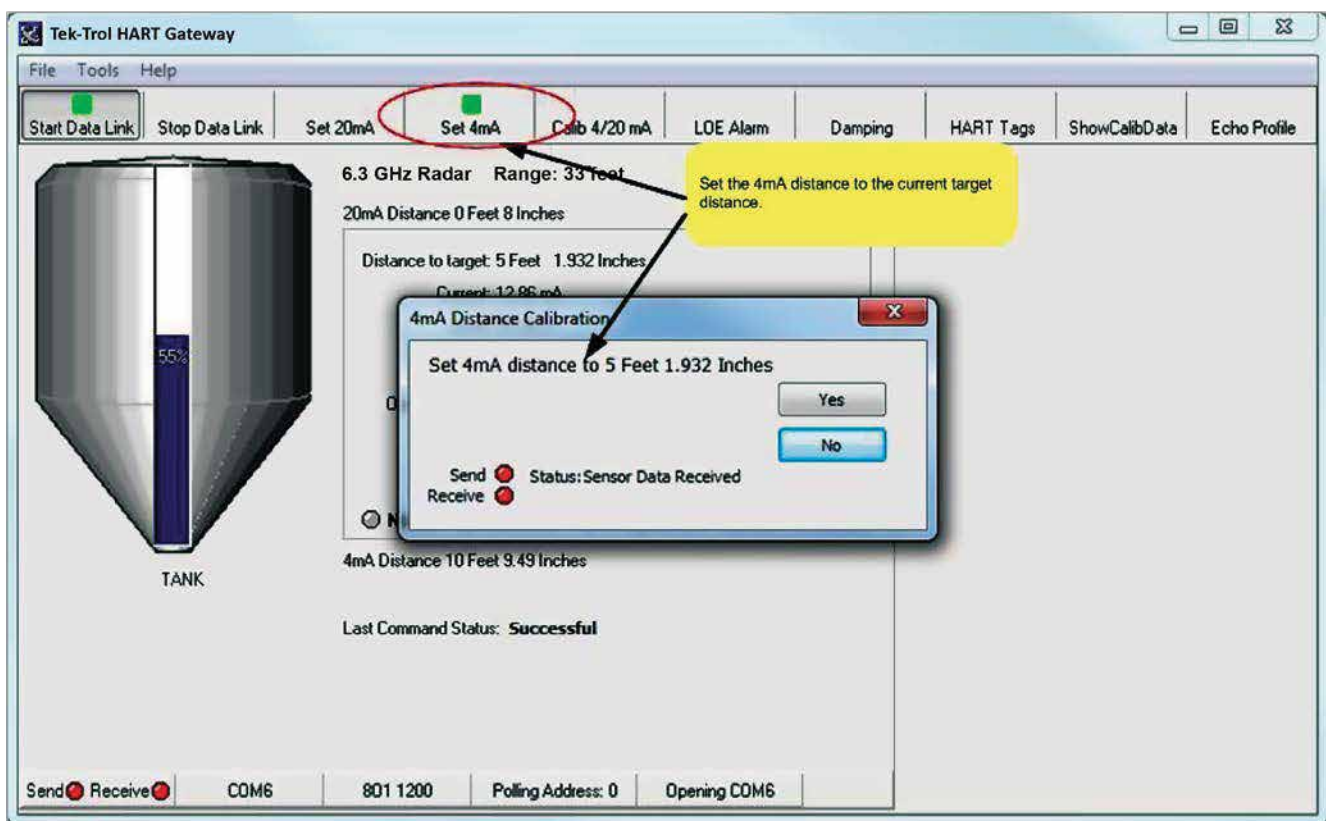


Fig 15: 4mA calibration dialog box showing the distance to the target. Click the “Yes” button to set the 4mA distance to the distance shown. Click the “No” button to close the dialog box without changing the calibration.



## 2.5 Entering 4/20 mA Distance Calibration Values

To manually enter the 4 and 20 mA distance click on the “Calib 4/20 mA” button. The dialog box shown in Figure 16 will appear. The desired distances can be entered in Feet or Meters by selecting the desired unit of measure from the drop down list.



### NOTE

During these steps, the target can be at any distance from the sensor

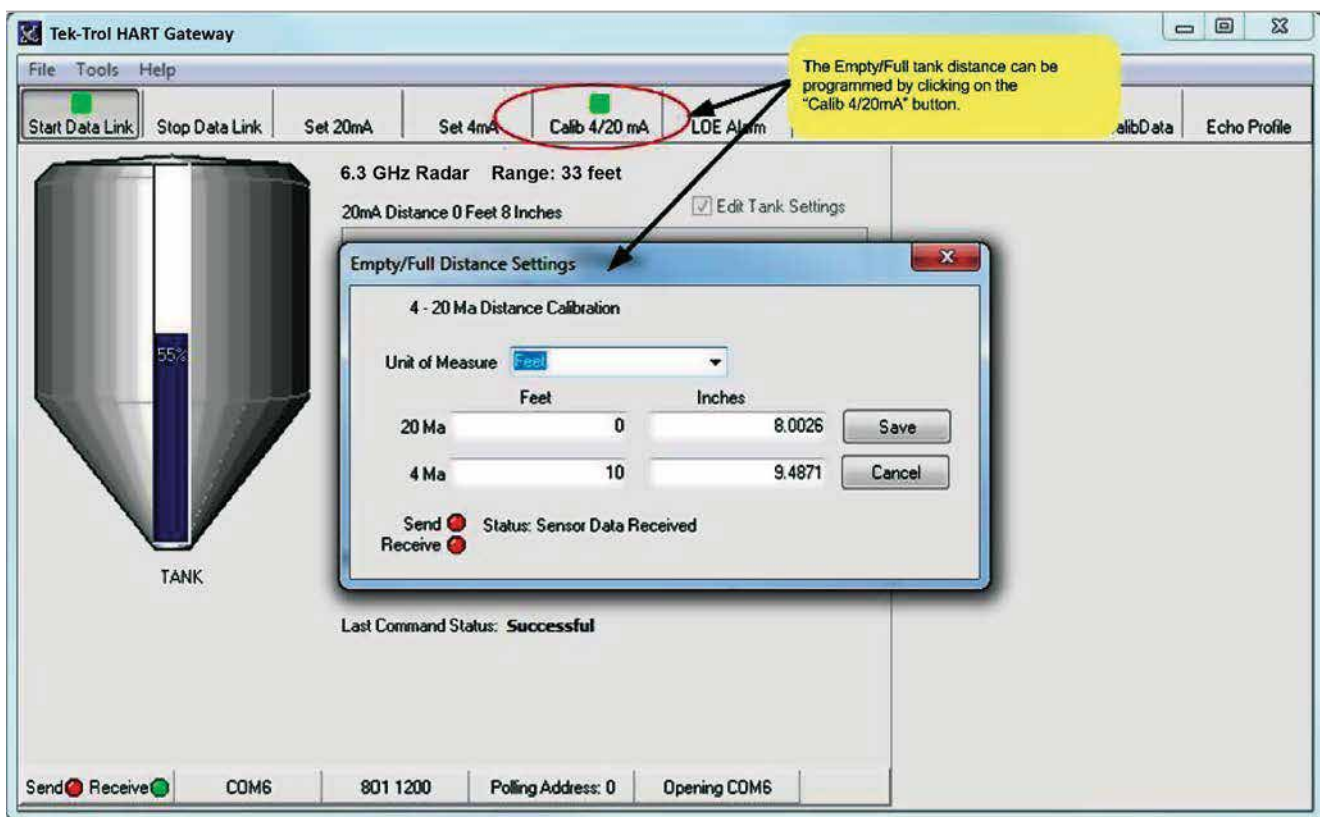


Fig 16: To change the Empty/Full tank distance click the “Calib 4/20 mA” button on the tool bar. Enter the desired distance values and click save.

## 2.6 Loss of Echo alarm

The loss of echo alarm can be configured to raise an alarm if the sensor cannot detect an echo for a long period of time. For example, the sensor can be configured to change the loop current to 22 mA if an echo has not been received for 2 minutes. When an echo is detected the current will return to a value that represents the distance.

The loss of echo time and the loss of echo current signal can be programmed using the “LOE Alarm” button. To set the loss of echo alarm options click the “LOE Alarm” button to display the Loss of echo dialog box as shown in Figures 17.

The sensor can be programmed to signal a loss of echo condition in 3 different ways. The loop current can be changed to 3.5 mA, 22 mA or remain the same (No Alarm). With the “No Alarm” option selected the sensor will keep the loop current constant until an echo is found. The 3.5 mA and 22 mA settings will cause the loop current to change after the specified loss of echo time. The loss of echo time can be set in minutes. Entering 0 minutes is the same as selecting “No Alarm”. Entering a value greater than 0 means the loop current will be changed to the desired current (3.5 or 22 mA) after the sensor has been in a loss of echo state for the number of minutes entered. For example, entering a value of 1 (minute) and clicking on 3.5 mA means the sensor will change the loop current to 3.5mA after 1 minute of no echoes. When the sensor starts detecting echoes again the loop current will be updated to the appropriate value.



### NOTE

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The loss of echo time range in minutes (1 to 4) will vary according to the device connected.

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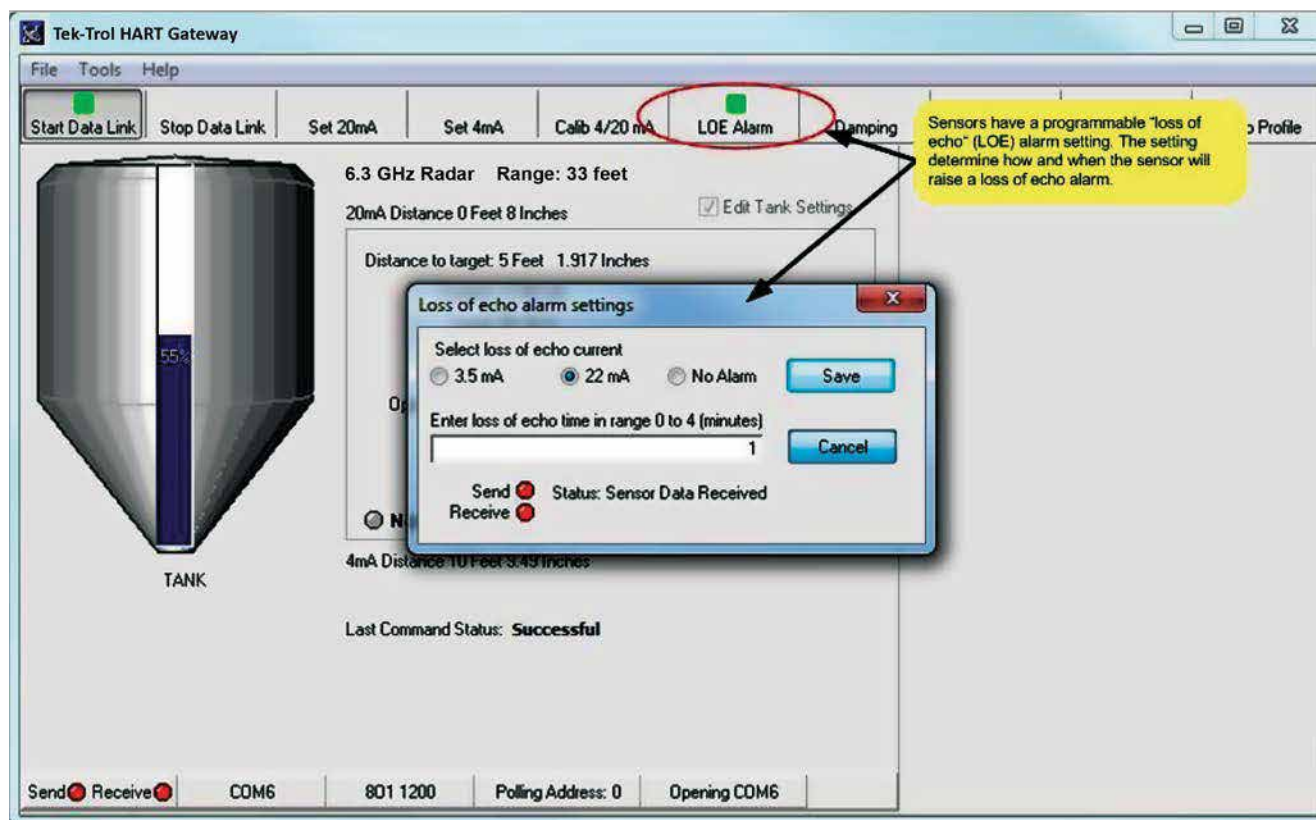


Fig 17: Loss of Echo Alarm settings can be viewed or modified by clicking on the “LOE Alarm” button.

## 2.7 Damping

In some applications, the material being sensed changes in position or shape due to the process being applied or the environment where the material is stored. Liquid material can be disturbed by waves and solid materials can shift. If the surface of the material being sensed changes frequently then the distance being measured by the sensor will fluctuate frequently. To increase the stability of the distance reading a damping factor can be programmed into the sensor. Using the lowest damping factor of 2 seconds provides the fastest response and helps reduce measurement fluctuations. A damping factor of 10 provides a relatively stable reading. Entering higher values will reduce the sensor response time.

To change the sensor’s damping factor, click the “Damping” button. The damping dialog box will appear as shown in Figure 18. Damping can be turned off by unchecking the “Damping Enabled” box. If damping is enabled a value in the range of 2 to 255 can be entered. Recall that the higher the damping value the slower the response. After entering a damping factor click the “Save” button.

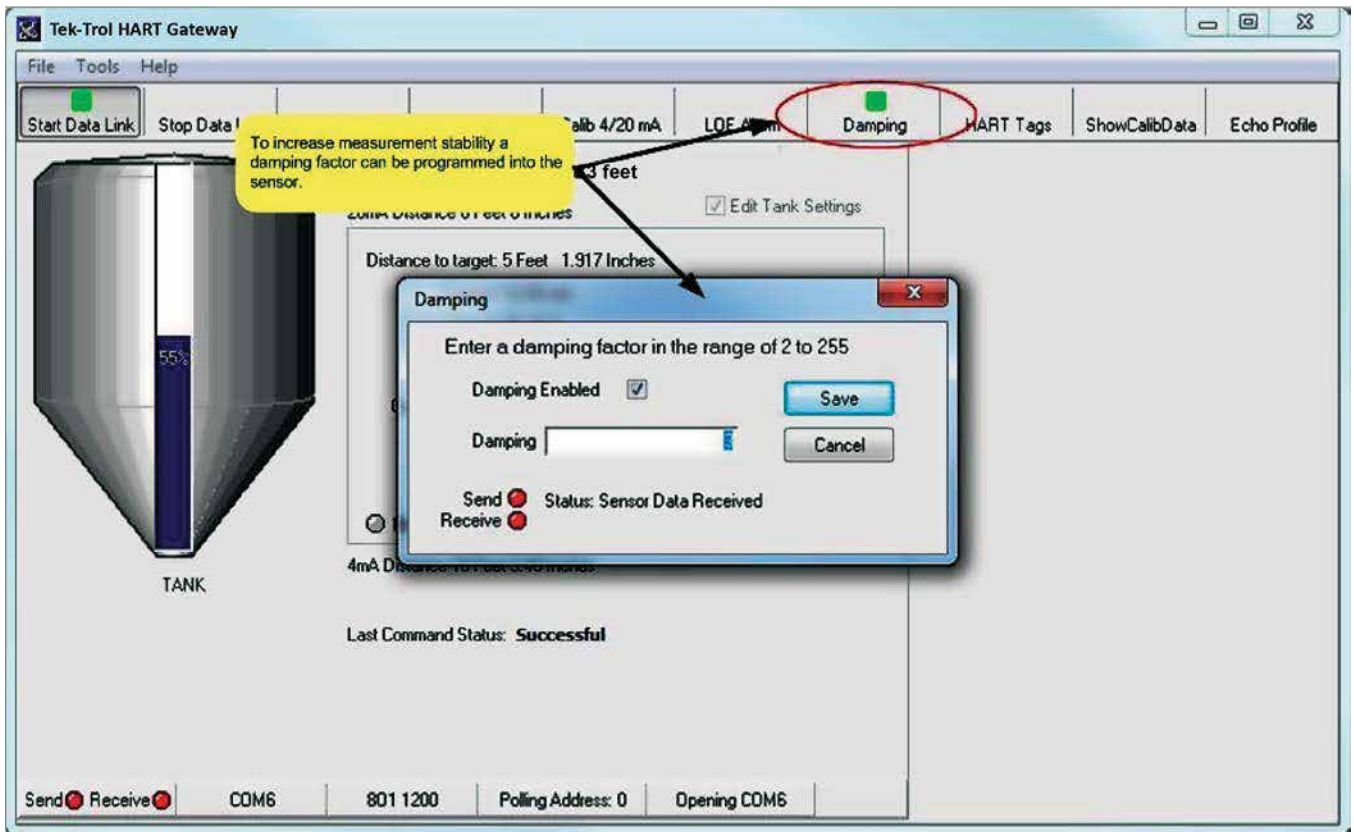


Fig 18: Clicking on the “Damping” button will pop-up the Damping dialog. The Damping dialog allows the user to set the damping factor from 2 to 255.

## 2.8 HART Programmable Settings and Tags

Your HART enabled 2 wire level device supports the HART 7 protocol. To access the HART settings and programmable tags click on the “HART Tags” button as shown in Figure 19.

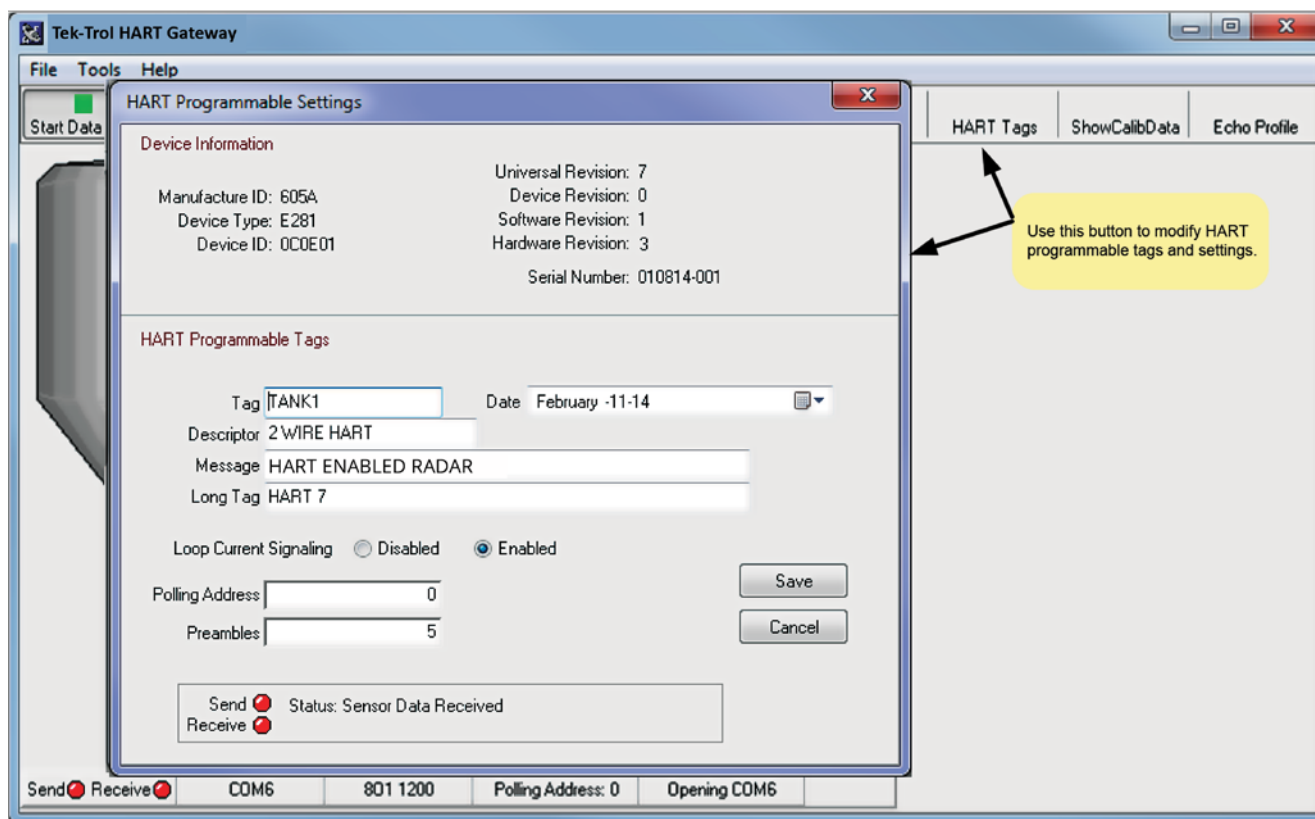


Fig 19: Clicking the “HART Tags” button on the tool bar will activate the “HART Programmable Settings” dialog box.

Figure 19 shows the values programmed into an Tek-Trol HART enabled radar level device. The values shown in the upper half of Figure 19 are fixed. The values in the upper left identify your Tek-Trol level device and are used for device specific communication. The values in the upper right show the HART revision and device revisions and your sensor’s serial number.

The edit boxes in the lower half of Figure 19 are for your use. The information stored in the Date, TAG, Descriptor, Message and Long Tag fields can be changed to asset tracking values or device identification. The values containing strings are restricted by the HART specification too specific characters’ sets. Your Tek-Trol HART Gateway will automatically restrict and modify the characters you can enter into these fields. For example, the “Tag” field may only contain upper case letters, lower case letters typed into this field will automatically be converted to uppercase as you type.

When a field value is changed the field color will turn yellow as shown in Figure 20. The yellow indicates the field will be updated when the “Save” button is clicked.

The “Loop Current” radio buttons control loop current signalling. If loop current is disabled, the sensor will set the loop current to 4 mA. If the loop current is enabled the sensor will update the loop current as the target moves.

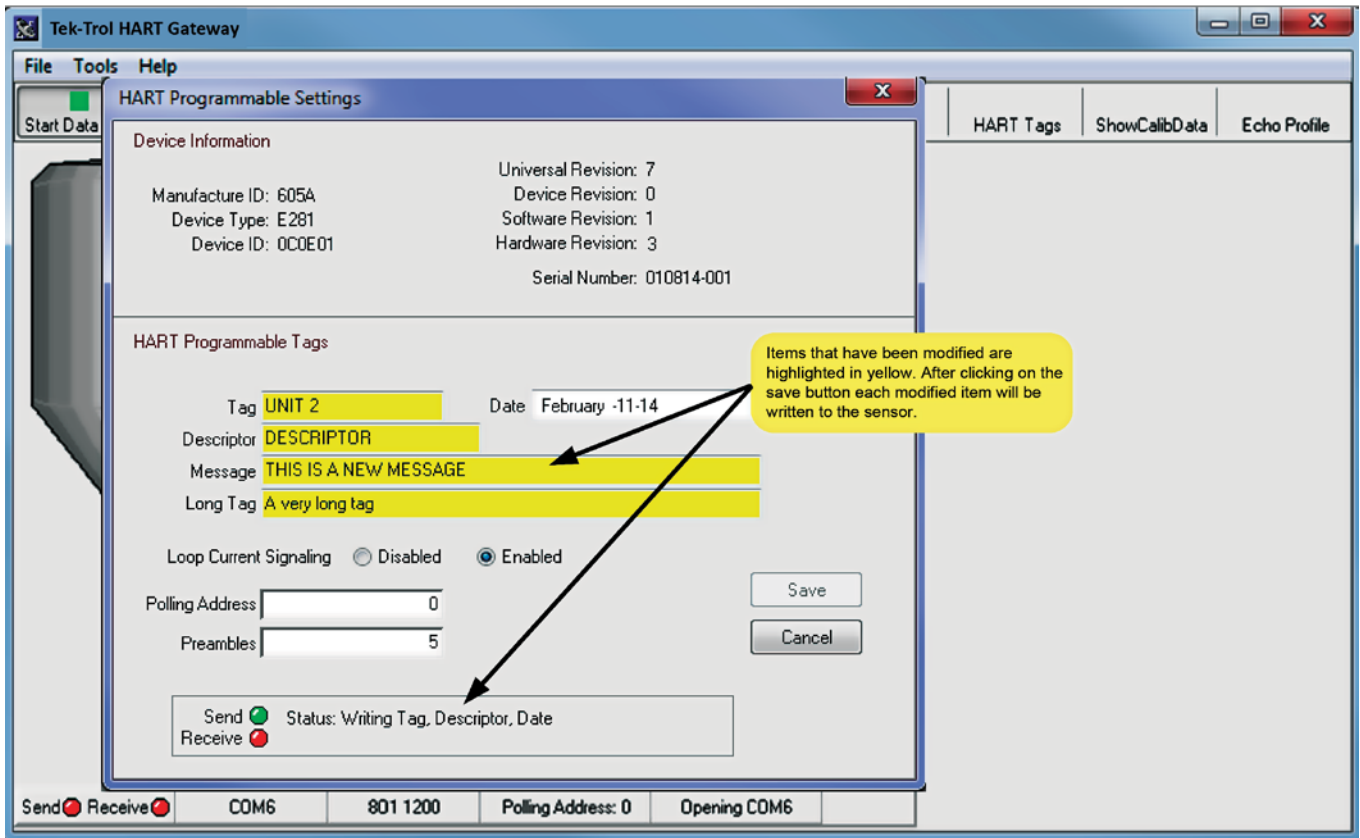


Fig 20: The fields shown in yellow have been modified and will be written to the sensor when the save button is clicked.

The “Polling Address” field allows you to change the sensors polling address. In order to communicate with the sensor, the Tek-Trol HART Gateway software must be configured to use the same polling address (see **Section 2.2**).

The HART protocol transfers data in frames. Each frame is preceded by a preamble character of hexadecimal “0xFF”. Each frame must be preceded by a minimum of 5 preambles and a maximum of 20. The “Preambles” field allows the number of preambles sent with each frame to be modified. It is recommended that the number of preambles be left at the default value of 5.

## 2.9 Show sensor calibration

Sensor calibration data can be viewed by clicking the “ShowCalibData” button as shown in Figure 21. After making changes to the sensor you should verify the calibration values before putting the sensor into use. The maximum temperature value can be displayed in Celsius or Fahrenheit by double clicking on the words “Maximum Temperature”.

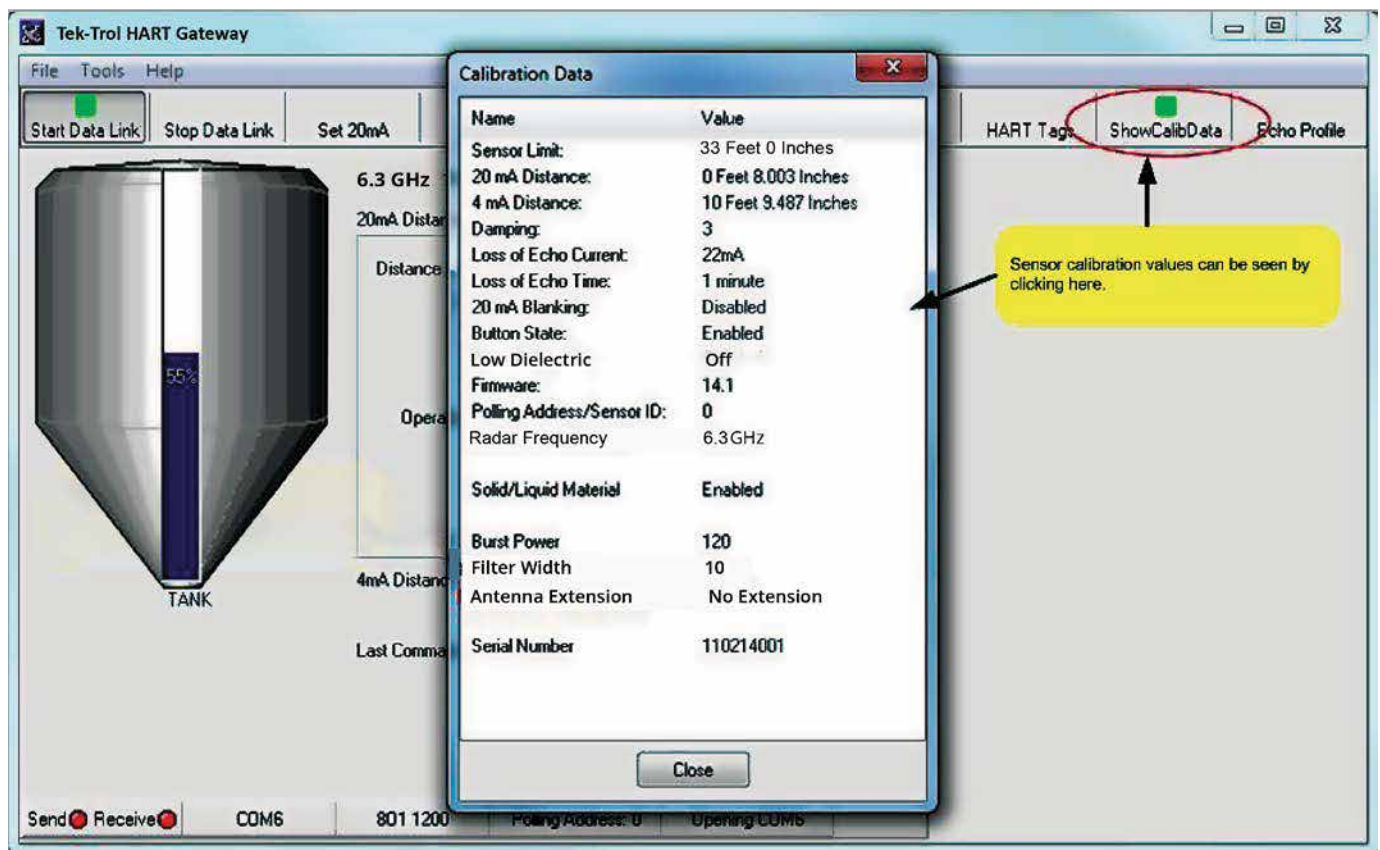


Fig 21: The calibration data dialog shows the current sensor calibration values.

## 2.10 Profile

The sensor “echo profile” is a diagnostic tool that displays a snapshot of the sensor’s transmission pulse and the echo marker received.

Click the “Echo Profile” button to show the echo profile dialog. Figure 22 shows the profile of a Radar sensor. Figure 22 displays a graph showing the transmission pulse and the echo marker. The echo distance is displayed in the selected unit of measure. The current measurement is displayed in the lower left corner and the previous measurement is displayed across the top of the display. The “Save profile to file” button saves a copy of the profile graph to a bitmap file. The file will be saved in the same folder as the Gateway software. The file name will be comprised of the current date followed by the “.bmp” extension.

### Radar Profile

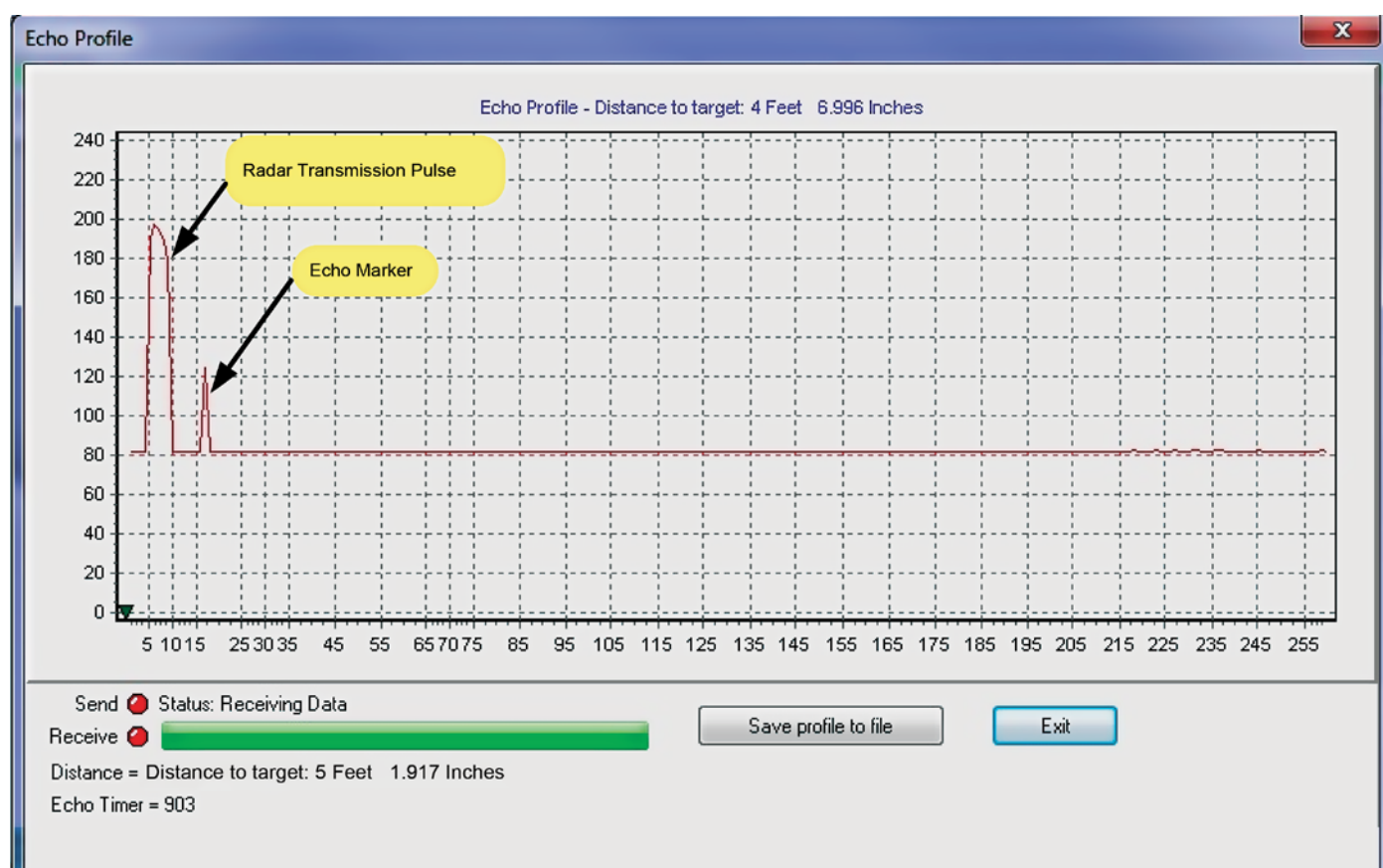


Fig 22: The echo profile screen showing an echo profile from a radar sensor.



### 3 Tools Menu

The “Tools” menu located at the top left of the main screen provides additional calibration options. The items listed on the menu will vary depending on the type of sensor connected. Figure 23 tool menu items for a radar sensor. There are 3 common menu items: 20 mA blanking, button (enable/disable) and units of measure. The other menu items are device specific.

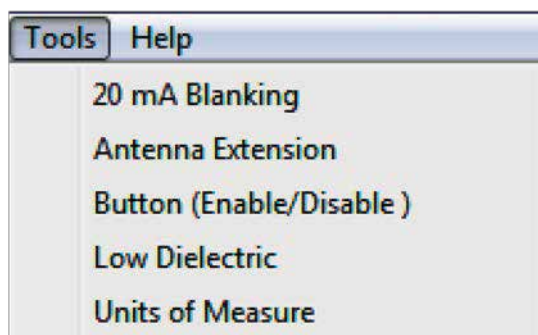


Fig 23: Radar Menu

#### 3.1 20mA Blanking Menu Item

20mA blanking must be used with caution. The 20mA blanking feature is used to ignore unwanted echoes which are closer than the full tank calibration minus 5 inches. 20mA blanking can be used when the full tank is represented by either 20mA or 4mA. As shown in Figure 24 the feature can be enabled by clicking on the “Tools” menu and then on the “20mA Blanking” menu item. The 20mA feature must not be used when calibrating the sensor using the sensor push button.

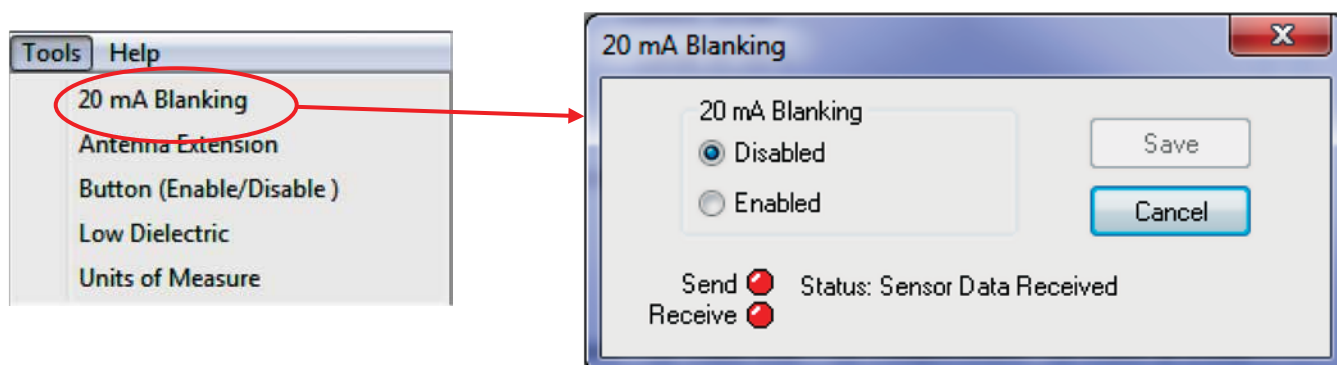


Fig 24: The 20mA blanking control dialog box. The dialog box will query the sensor and display the current setting.

### 3.2 Button Menu Item

The sensors have a push button calibration (see Figure 26) that allows the user to set the 4 mA distance, 20 mA distance and toggle a device specific feature on or off. The button can be enabled or disabled from the “Tools” menu as shown in Figure 25.

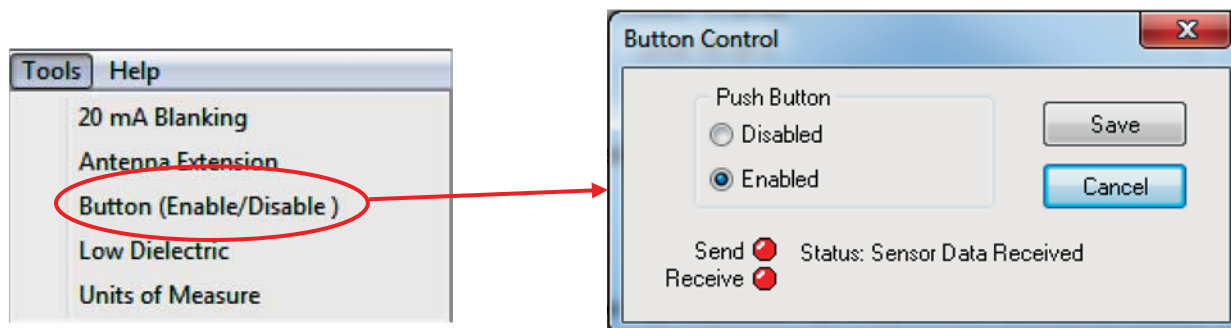


Fig 25: The button control dialog box is displayed. The dialog box will query the sensor and display the button current setting. To change the button setting click on the radio button with the desired status and then click the “Save” button.

### 3.3 Using the Push Button

The sensors have a push button and LED (see Figure 26) that are used together to calibrate the sensor. Before using the push button to set a calibration distance, ensure that the target is at the desired distance (within the sensor’s operating distance) and that the sensor has been turned on and running for a minimum of 30 seconds. The LED must be blinking green.

#### 3.3.1 Setting the 4mA distance

To set the 4mA distance press and hold the button until the LED turns red (the LED will go from blinking green to yellow and then to red) then release the button. After the button has been released the sensor will acknowledge the change by changing the LED to green for 1 second then yellow for 1 second. The 4mA distance is now set to the current target distance.

#### 3.3.2 Setting the 20mA distance

To set the 20mA distance press and hold the button until the light on the sensor turns yellow (the LED will go from blinking green to yellow) then release the button. After the button has been released the sensor will acknowledge the change by changing the LED to green for 1 second then yellow for 1 second. The 20mA distance is now set to the current target distance.

#### 3.3.3 Toggle the Low Dielectric Filter On and Off

The low dielectric filter option is discussed in **Section 3.6**. To activate or deactivate the low dielectric filter press and hold the button until the light on the radar turns from blinking green to yellow to red and then off again - then release the button. After the button has been released the sensor will acknowledge the change by

changing the LED to green for 1 second then yellow for 1 second. This procedure will toggle the low dielectric filter either on or off. During normal operation of the radar the light will blink on and off. When the low dielectric filter is off the light will blink once per second. When the low dielectric filter is on the light will blink twice per second.



Fig 26: The illustration shows the location of the LED and the push button for Radar sensors.

### 3.4 Units of Measure Menu Item

Your sensor can be programmed to report the measured distance in feet, meters, inches or centimeters. The default value is feet. To change the default value, use the “Units of Measure” menu as shown in Figure 27.

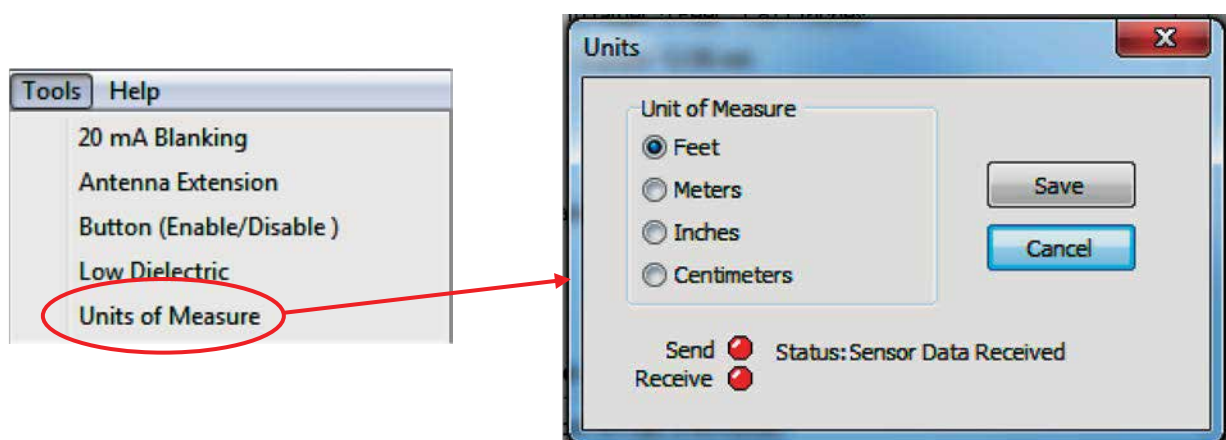


Fig 27: Unit of measure

### 3.5 Antenna Extensions Menu Item

Proper installation of the radar sensor requires the antenna to protrude completely inside the tank or below the surface it's mounted on. If needed a 6 or 8-inch antenna extension can be added. If an antenna extension is used the Radar must be programmed to compensating for the extension. Use the "Antenna Extension" menu item shown in Figure 28 to change the antenna settings.

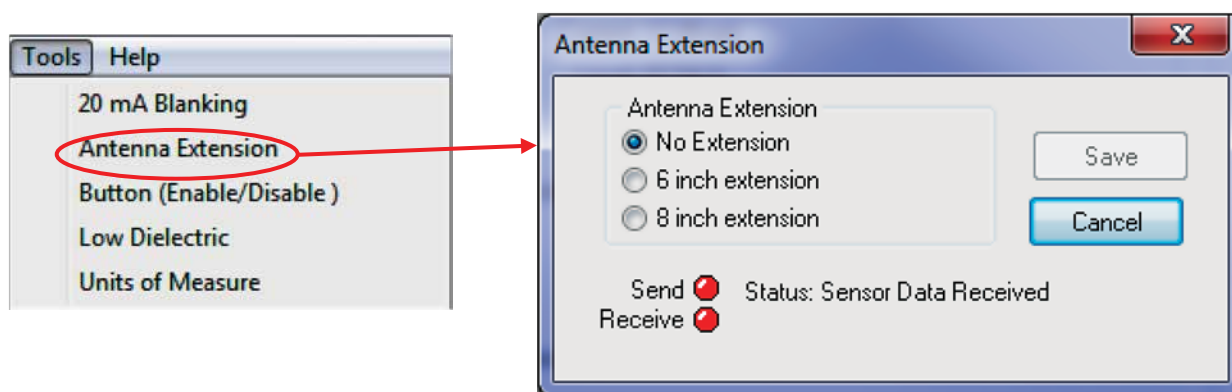


Fig 28: The antenna extension dialog box allows the user to select the appropriate antenna extension.

### 3.6 Low Dielectric Menu Item

For low dielectric material ( $\epsilon r \leq 4$ ) where  $\epsilon r$  is the dielectric constant, such as oil, a low dielectric filter within the Radar can be enabled. To enable the filter, use the "Low Dielectric" menu item shown in Figure 29.

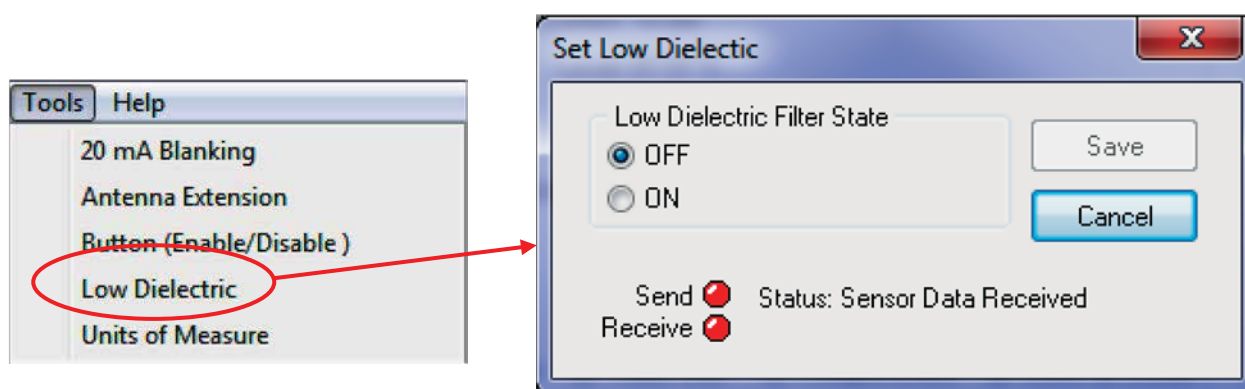


Fig 29: The "Low Dielectric" dialog box shown allows the user to enable or disable the low dielectric filter.

### 3.7 Fixed Current

The 2-Wire HART enabled radar does not have a programmable fixed current feature like the ultrasonic sensor. It is possible to force the radar to operate at 4mA continuously by turning off current signalling which can be found in **Section 2.8** HART programmable settings.

## 4 Help Menu

This user manual is included with the HART Gateway software and can be displayed at any time by clicking on the help menu and selecting the “Operating Instructions” as shown in Figure 30. The help menu also contains a link to Tek-Trol’s website. Clicking on the link will pop-up the default web browser and point the browser to Tek-Trol’s website.

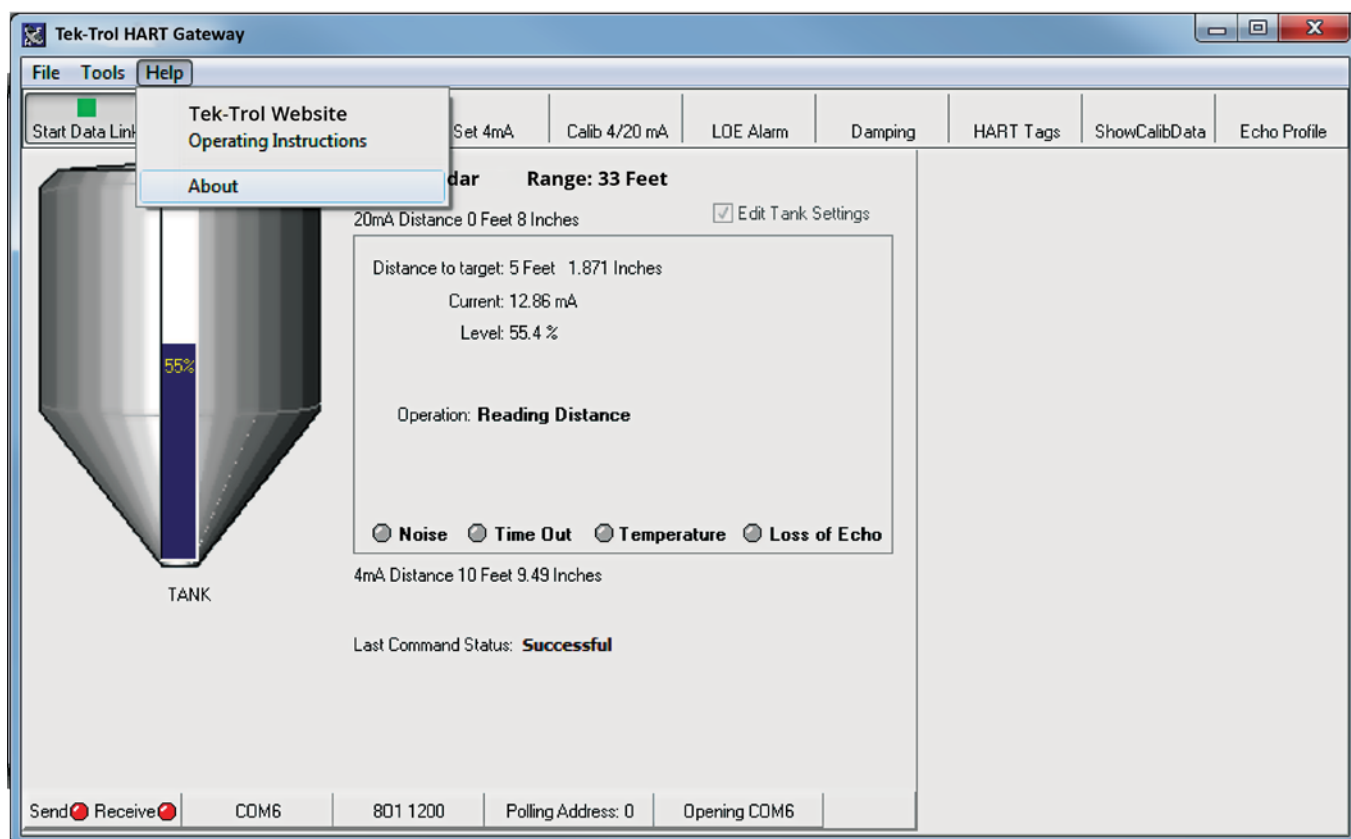


Fig 30: The “Help” menu contains a link to Tek-Trol’s website and a link to this user manual.

## 5 Troubleshooting

### 5.1 Problem: No communication with sensor

If the Tek-Trol HART Gateway software fails to communicate with your sensor check the following in this order.

- Ensure loop power is connect to the sensor.
- Ensure the load resistor is installed correctly (see Figure 4).
- Ensure the loop voltage is within the sensors specification (see sensor datasheet).
- Ensure that the HART modem is connected across the load resistor (see Figure 4).
- Ensure the load resistor is 250 ohms.
- Verify that the serial port and the polling address are correct. Both serial port and the polling address you have selected are displayed on the status bar (refer to **Section 2.2** and **Section 2.8**).

### 5.2 Problem: Distance fluctuates

To reduce or eliminate the fluctuations increase the damping value (refer to **Section 2.7**).



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TEKMATON LLC



[www.tek-trol.com](http://www.tek-trol.com)

**Tek-Trol LLC**

796 Tek Drive  
Crystal Lake, IL 60014  
USA

Tel : +1 847 857 6076

Fax : +1 847 655 6147

Email : [tektrol@tek-trol.com](mailto:tektrol@tek-trol.com)

[www.tek-trol.com](http://www.tek-trol.com)