

LTM – Series

Models: LTM-250 and LTM-350
Magnetostrictive Level Transmitters



Instructions & Operation Manual

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Icon Key



Warning/Caution Valuable Operation Information



Important Information to Know



Read Carefully these Tips are the “DON'Ts” of the instrument.

Section

1

Warranty

1.0 Warranty

All Babbitt products are warranted against defects in materials and workmanship for a period of no less than one year from the date of shipment. The level gage chamber and process connections are guaranteed for the life of the tank or vessel to which it is attached. Floats are guaranteed for two years. **Babbitt will repair or replace at its discretion those products that fail to perform as specified**, with the following exceptions:

1. Products repaired or modified by persons that are not authorized by Babbitt.
2. Products subjected to misuse, negligence or accidents.
3. Products that are connected, installed, or otherwise used in such a way not in strict accordance with manufacturer's instructions.

This warranty is in lieu of any other warranty expressed or implied by any party other than Babbitt. Repairs and/or replacements shall be at the sole discretion of Babbitt based on the terms and conditions of this warranty. Defective products shall be returned to the factory prepaid by the buyer after obtaining a Return Authorization Number from Babbitt. All warranty repairs or replacements will be performed at the factory in Houston. Factory warranties do not include field service. Field service warranty repairs will be at the buyer's expense.

Any modifications to terms and condition of this warranty will not be binding unless made in writing and signed by an authorized agent or official of Babbitt.



All Babbitt gages and transmitters should be unpacked and thoroughly inspected upon receipt. Gages are shipped FOB factory and are fully protected against damage or loss during shipment. Any claims for parts damaged during shipment should be submitted within 15 days of receipt of goods by customer.



We value your opinion and want to better serve you. Please go our website: www.babbittinternational.com and click the customer feedback survey option (on the left side of the screen). Some of the best suggestions for improvement come from our valued customers. Let us know how we are doing and what we can do better to improve your satisfaction with our product and service.

Section

2

Transmitter Overview

2.0 General Description

The LTM-Series are electronic field instruments, suitable for installation in hazardous and non-hazardous locations. Testing and certification has been obtained from different agencies for installation in such areas. This instrument is designed to measure and transmit an analog and/or digital signal proportional to liquid level in a tank. The complete assembly includes a dual compartment explosion-proof enclosure and attached sensor tube and a magnetic float. The LTM-Series are available in a variety of lengths and wetted materials to accommodate many different applications.

2.1 Product Identification

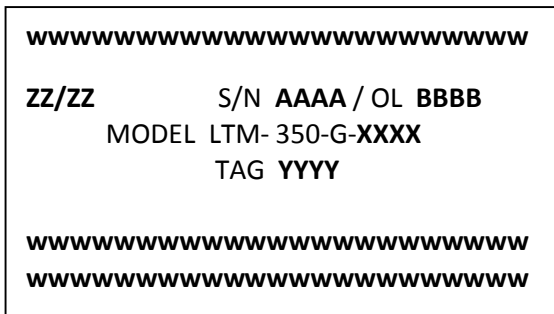


Figure 1. Example label/name plate

The product can be identified by the stainless steel label that is located on the side of the transmitter enclosure/housing.

The label can be read as follows:

www = Any hazardous location area classification markings that the instrument is approved for.

ZZ/ZZ = Born on date; the 2 digit month and 2 digit year the instrument was shipped to the customer.

AAAA = The specific serial number assigned by Magtech for complete traceability.

BBBB = The overall probe length of the instrument.

Note: THIS IS NOT THE MEASURING RANGE.

XXXX = The measuring range of the instrument. The 0 and 100% (4/20mA) output range.

YYYY = The end user specified tag number (only when specified).

2.2 Transmitter Configurations

LTM-Series transmitters generally have two configurations:

1. **Gage Mounted:** Where the transmitter is mounted on the outside of a magnetic level gage and strategically located within a certain longitudinal distance from the transmitter sensor probe and a magnetic float is placed inside the level gage.
2. **Standalone (or Direction Insertion Type):** Where the transmitter has a magnetic float directly around the transmitter sensor probe and the probe is directly inserted into a tank/vessel.

In either configuration as the tank level changes, the float tracks the change and continuously activates the sensor probe. The electronics process the change in signal and output an analog and/or digital signal. This output is precisely the liquid level in the tank.



Babbitt is always willing to explore unique applications that require their own distinctive configurations. Please consult the factory for guidance.

2.3 Gage Mounted Transmitter

The LTM-Series may be strapped to the outside of the Babbitt LG series magnetic level gage. In such an installation, it is used as an accessory transmitter for the visual level gage. The same float used to activate the magnetic gage is also used to activate the magnetostrictive sensor of the LTM and transmit a directly proportional 4/20mA signal.

The depiction below shows the gage mount installation of the LTM-Series to a mag-gage. The transmitters may be calibrated for the same range as the visual indicator on the mag-gage, or for part of the range depending on the application.

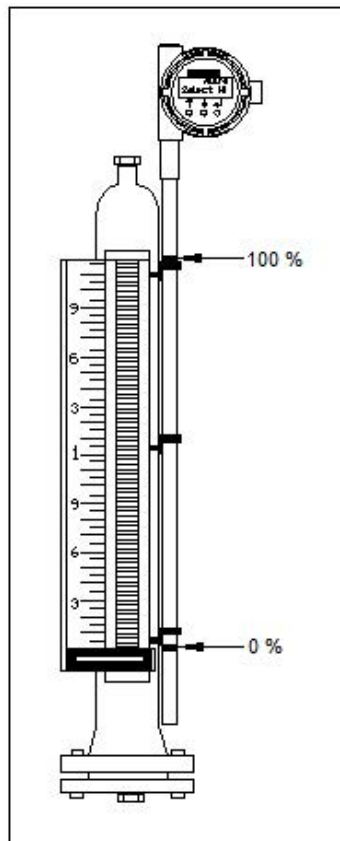


Figure 2. Gage mounted transmitter



Babbitt transmitters may also be used in conjunction with other manufacturers' magnetic level gages. Full warranties will apply upon factory approval. Float replacement may be required.

2.4 Standalone Transmitter

When a magnetic level gage is not present, the LTM can be inserted into the tank/vessel with its own float mounted around the sensor tube.

The depictions below show the standalone version of the LTM-Series with various process connections and the standard float stop with centering ring.

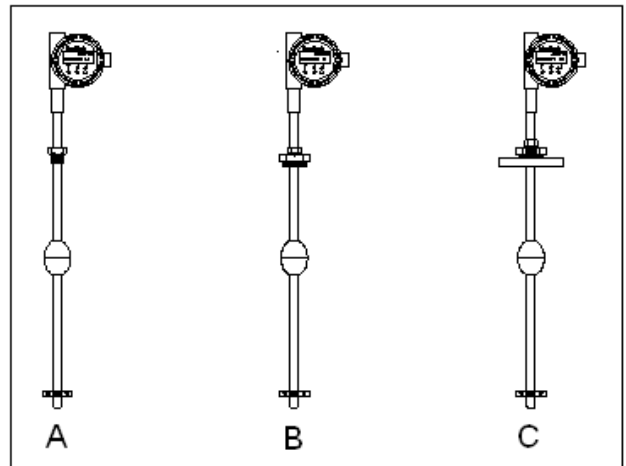


Figure 3. Transmitters with various process connections.

In Figure 3:

Transmitter A depicts a standard $\frac{3}{4}$ " compression fitting that is on all standalone transmitters.

Transmitter B depicts a $\frac{3}{4}$ " compression fitting and a hex plug. This option is highly recommended because the hex plug is selected based on the float's diameter (OD), so if the instrument ever needs to be removed or serviced for any reason it can be removed by the hex plug.

Transmitter C depicts a flanged option with a $\frac{3}{4}$ " compression fitting and a hex plug.

A stilling well may be used along with the transmitter inside the tank. Stilling-well is a pipe external to the sensor probe and float encasing the entire assembly protecting it from surface agitation or from physical damage due to the length of the sensor probe. A depiction of a transmitter with a stilling well is provided below.

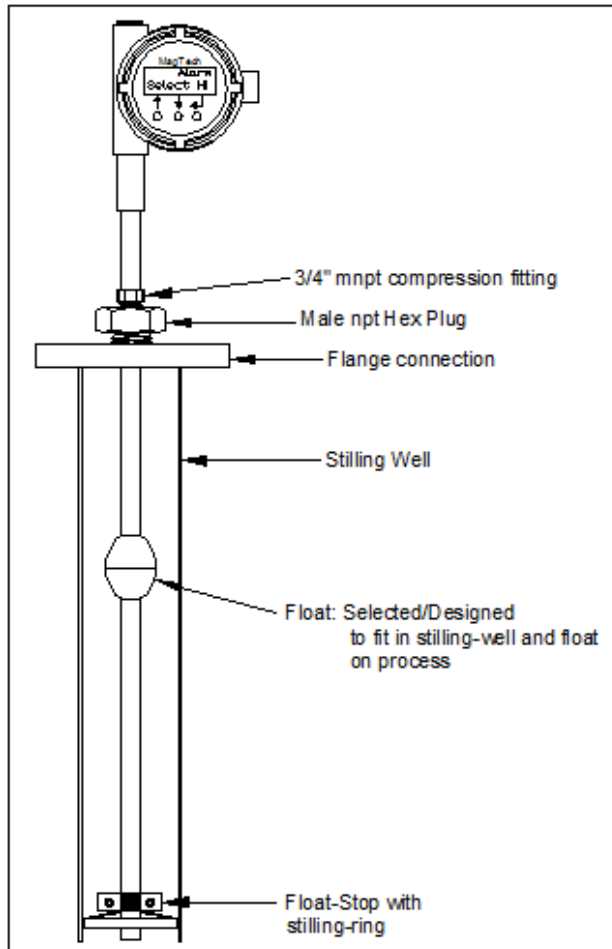


Figure 4. Transmitter with a Stilling-well



When a stilling well is used, care should be exercised when installing the tube to center it in the chamber so that the float can freely travel the entire length of the probe. **Stilling wells are required for transmitters over 10 feet or the instrument cannot be considered under warranty.**

Optional Features that are available with the LTM-350 but **NOT the LTM-250** are:

1. HART Protocol, which enables:
 - a. A second digital output proportional to an interface level (requires a second float of different specific gravity)
 - b. A digital temperature output that reflects the liquid temperature.
 - c. Advanced diagnostics and features highly beneficial for commissioning, troubleshooting or monitoring.

Up to two floats may be used with the LTM-350 only. The second float will typically sense the interface level (the heavier of the two fluids) in the tank. The specific gravity of the second float will be such that it can be totally immersed in the lighter fluid. The drawing below shows a transmitter with dual floats, one for total level and the other for interface level (also available with various process connections).

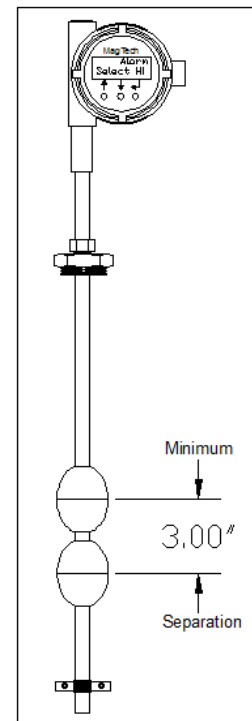


Figure 5. Dual Output Transmitter



A dual output transmitter is also available in a gage mount configuration. Consult factory for further details.

Section

3

Transmitter Description

3.0 Detailed Description

The LTM-Series is an assembly of two major components:

The Sensor Tube Assembly: This is a 5/8" diameter stainless steel probe, sealed on one end, with the magnetostrictive waveguide in its center. In addition to the magnetostrictive waveguide, the tube also houses the optional temperature sensor and the sensing elements. The tube is made to lengths of 2-30ft. in rigid construction.

The Enclosure and Electronics: The extruded aluminum housing has two compartments. The enclosure is rated NEMA 4X and 7. One side contains the microprocessor board assembly and calibration push buttons. The other side contains the field wiring termination board. The electronics module is connected to the detector board of the sensor tube assembly via a plug-in cable. The electronics module houses printed circuit boards (PCB) that encompass surface mount component construction utilizing the latest integrated circuit technology.



Babbitt also has a stainless steel enclosure that can be utilized. Please contact factory for further details.

3.1 Technology – Theory of Operation

The LTM-250/350 series level transmitters are based on the principle of magnetostriction, first used for digital delay lines and later precision distance or displacement in the machine tool industry. This principle, if designed and applied properly, has potentially very high measurement resolution, typically better than 0.001 inch. In the machine tool industry such a high resolution is desirable. In the level measurement application, however, a resolution of 0.01 inch is more than adequate.

In a brief description, the magnetostrictive principle consists of a wire extruded and heat treated under carefully chosen conditions to retain desired magnetic properties, which is pulsed by a circuit with a relatively high current pulse. The high current pulse produces a circular magnetic field as it travels down the wire at the speed of sound. Another magnetic field generated by a permanent magnet (the float), placed near or around the wire at some distance from the point of entry of this pulse interferes with the magnetic field of the current pulse and a torsional force results at the collision point.

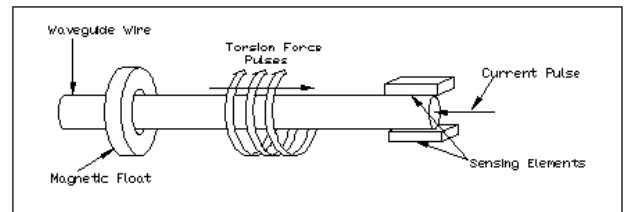


Figure 6. Principle of Operation

The effect of this torsion force is a twist to the wire at this point producing torsion wave traveling towards both ends of the wire. The propagation time (or time-of-flight) of this wave is measured precisely and if the wire properties remain stable, it is very repeatable at about 5-10 microseconds per inch, which is approximately the speed of sound in that medium. By measuring the exact number of microseconds it took the torsion wave to reach a designated termination point of the wire, the distance to the magnet from this termination point can be easily calculated.

A high-speed microcontroller is utilized in the design to process and calculate the elapsed time measurement. Accurate crystals are used for the time based to resolve sub-microsecond timing increments. The binary number, equivalent to the microseconds of the echo travel time is used to calculate the distance of the float and a corresponding digital signal is output. A basic block diagram describing the operation is shown below.

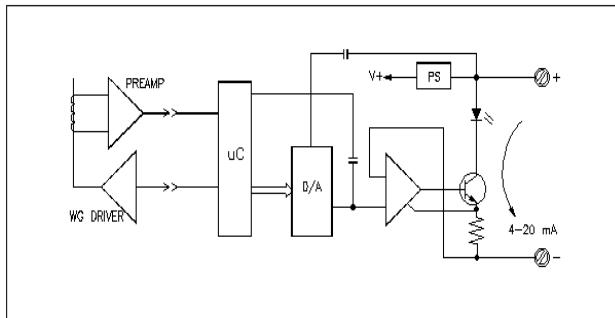



Figure 7. Basic Transmitter Block Diagram

Calibration routines are included in the software to the 0% and 100% points for any distance desired. Even reverse calibration is a simple task using the software routines. Reverse calibration is desirable if ullage instead of level is required, or when the probe is installed with bottom mount head.


The **LTM-350** transmitter has four output configurations.

 **Configuration options must be chosen at quoting stage.**

1. Primary Level – The most basic version of this transmitter is that it computes the distance between the float and the detector from the elapsed time measurement. A specific interrogation pulse is applied to the waveguide. Any feedback signal received before and after this window is rejected as noise. Even signals received during the active window are evaluated and filtered so that only high integrity data is accepted. The conditioned signal is converted to a percent of full-scale number and a number representing the distance and output as a digital signal. (LTM-250/350)

 **LTM-350, via HART protocol only.**

- 2. Primary Level and Interface Level** – A second float may be added below the first, and the second output will be calibrated automatically. The second time interval is timed in the same manner as the first one and added to the first to derive the position of the heavier float. The two floats require a separation of approximately three inches. The float size, geometry, and magnetic strength all play a factor in how close the two floats can be without interfering with each other.
- 3. Primary Level and Temperature** – An optional temperature sensor is embedded inside the bottom tip of the probe, and it is configured to be the third digital output of the transmitter, and comes factory calibrated for the operating range of -50C to 149C (-58F to 300F)
- 4. Primary Level, Interface Level, and Temperature** – This options is called a ‘full-blown’ unit and offers all three possible outputs.

 **A deadband of approximately two inches, next to the detector, is fixed in the software and the float is not permitted to enter this area. If this happens output readings maybe erratic or go to fail mode.**

Section

4

Installation

4.0 Gage Mount Installation

The LTM-Series can be mounted to the side of a Babbitt LG series level gage using special mounting brackets and stainless steel hose clamps. When mounting the transmitter to an LG series gage the active sensor region of the probe should fall within the centerline of the process connections on the gage. If the transmitter's deadband region is inside the centerline of the process connections the transmitter will not output an accurate measurement because the active region of the probe is too short. When placing an order for a transmitter to accompany an existing gage it is important to indicate the style of the gage, the temperature, and the center-to-center dimension.

Calibration of the probe is factory set to the center-to-center dimensions provided; however a re-ranging may have to be performed to match the probe to the desired control room specifications. See Section 7.1 "Change Range" for more details.

4.1 Standalone Installation

The LTM-Series standalone transmitter comes equipped with a $\frac{3}{4}$ " mnpt compression fitting, mounted approximately 6.00" below the electronics housing. The fitting is placed in this area to ensure the transmitter is calibrated in the sensor tubes active region. Refer to the standalone drawings for a visual description of the transmitter features. Optional configurations are available upon request (2" mnpt, flanges, etc...). The magnetic float used in the stand-alone unit is designed to travel up the sensor tube with the change in fluid level. If build-up of process or contaminants should restrict the movement of the float, the transmitter sensor tube will have to be cleaned or the float may have to be replaced with one that has a larger inside diameter. The floats are designed to match the pressure and specific gravity for the process being measured and come in various materials ranging from stainless to kynar. The magnetic float can be changed out at any time to accommodate the processes being measured. The float stop, located at the bottom of

the transmitters, can be removed to allow the float to slide off the sensor tube.

4.2 General Installation Guidelines

The basic steps to installing the LTMs are:

- 1. Inspection of equipment:** Inspect the parts that are listed on the packing slip. Make sure nothing appears to be damaged such as a broken glass from the level indicator assembly (flippers), damaged float, or a damaged transmitter. Please file a claim with the shipping company immediately if it is believed the shipment has arrived damaged and be prepared to provide pictures.



The sensor probe of the transmitter SHOULD NOT BE BENT, BOWED, OR KINKED in any way or the transmitter will not work (will most likely go into fail mode).

The following is a depiction of **damaged probes**:

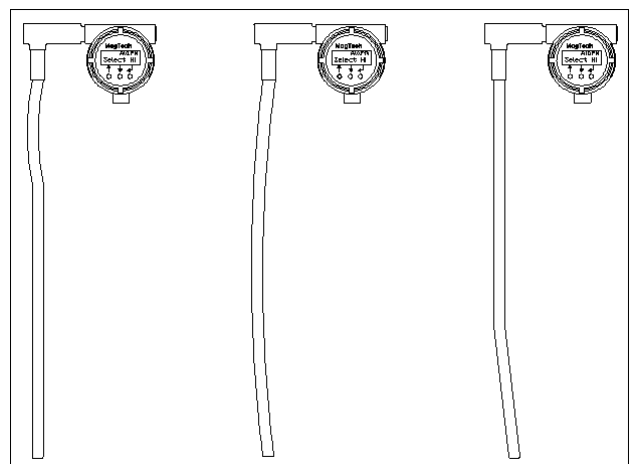


Figure 8. All damaged sensor probes

2. Identify Proper Orientation of Transmitter:

There are a few possible orientations of the LTM Series transmitters, they are:

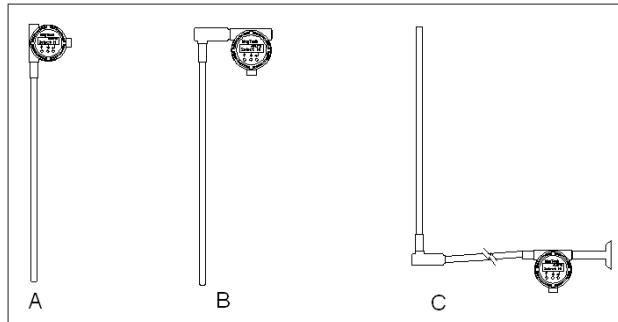


Figure 9. Possible transmitter configurations

Transmitter A is a standard top mount configuration.

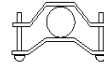
Transmitter B is a top mount with elbow, usually utilized when there are temperature or head room issues. There is also a bottom mount with elbow configuration which is not depicted.

Transmitter C is a bottom mount transmitter with remote electronics. This configuration is utilized in more extreme temperatures or for accessibility. There is also top mount with remote electronics which is not depicted.

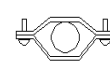
3. Mounting the Transmitter. Align the 4/20 mA (or 0 and 100%) markings with the center of the top and bottom process connection. Mount the transmitter along the level gage and use a nut driver to tighten the clamps so the sensor probe of the transmitter is held securely (will not slip up and down). Keep the transmitter supported while the clamps are being tightened (this can require more than one person).



Do not over tighten the clamps because they will bend and distort.



A: Correct



B: Incorrect



C: Incorrect

Figure 10. Top view of mounting clamps and sensor probe

A: Is the correct way to have clamps tightened.



The clamps do not have to meet.

B: Is incorrect because the clamp is flipped around and will not grip the sensor probe.

C: Is incorrect because the clamp has been tightened too much and damaged/distorted.



Effects of high vibration can be minimized early on by notifying the factory at time of order. The electronics can be remote mounted and special insulators can be installed. Please see the depiction below.

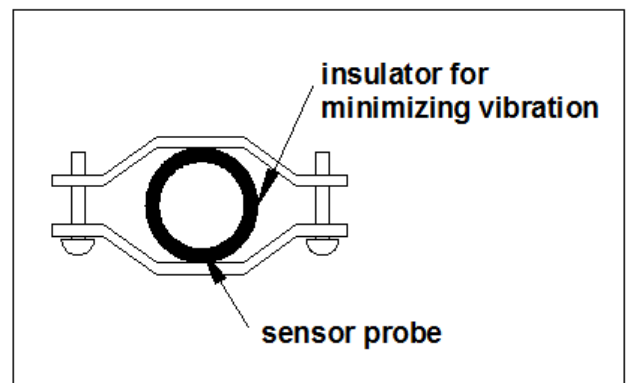


Figure 11. Insulator for high vibration

4. Remote Mount Electronics Option. Due to process temperature, vibration or accessibility the housing/electronics of the LTM transmitter can be remote mounted as far as 25 ft. The housing/electronics are supplied with a pipe-mount bracket that can be mounted most nearby posts or pipes with hose clamps. The drawing below depicts a gage mounted transmitter in the top mount remote electronics configuration.

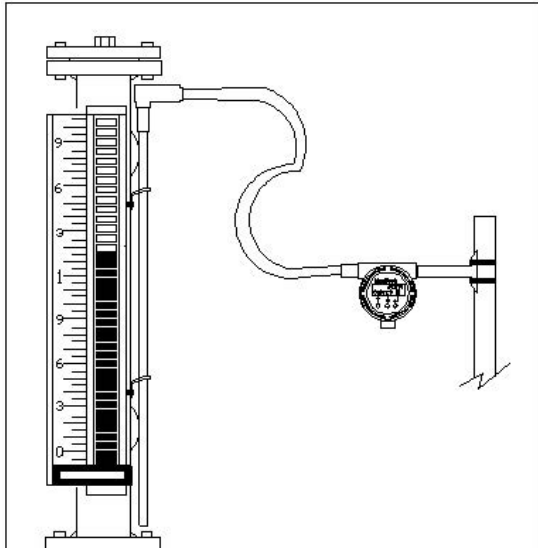


Figure 12. Gage mount transmitter in the top mount remote electronics configuration.



There are a variety of ways to install a standalone transmitters (i.e. crane, lift, etc...), the basic rule to remember when installing an LTM transmitter is **DO NOT DAMAGE the sensor probe**, this will void the warranty. If damage is suspected please contact the factory and be prepared to provide pictures.



In **REMOTE MOUNT** electronic options please support the sensor probe at the elbow/condulet and then every 3 feet (depending on length of cable). Support at every 2 feet may be required if explosion proof conduit is utilized by the end user.



NEVER install the sensor probe inside an insulation blanket that may be around the level gage. This will overheat the sensor probe and cause failure.



NEVER bend, bow or cause a kink in the sensor probe, this will damage the instrument and void the warranty. Do not attempt to straighten the sensor probe, this will not help the instrument work. If the shipment arrives damaged please file a claim with the shipping company and contact the factory to arrange for a replacement.

4.3 Insulation (against extreme heat/cold)

Babbitt strongly recommends that an experienced Babbitt Technician do insulation of the magnetic level gages at the factory with externally mounted transmitters.



If Cryogenic “Hard Skin” cold service type insulation is required, it must be done at the factory due to the custom “TUBE in TUBE” design necessary for removal of the transmitter if needed.



(When insulating gages):

Babbitt level transmitters have a maximum operating temperature of 300 F. When insulating a mag-gage and transmitter assembly in HOT service, keep the transmitter **OUTSIDE** the insulating material. Special blankets for this type of insulation are available from Babbitt, and recommended to guarantee proper insulation. For further information consult the factory.

If insulation is going to be done in the field, then the following guidelines MUST be followed:

1. Flexible type insulation jackets (NOT HARD SKIN) are required and must be installed around the mag-gage chamber only. DO NOT cover the LTM sensor tube, as this may burn up the sensor and possibly the electronics.
2. After the insulation jacket is installed, the LTM sensor tube must be remounted at its factory-preset distance from the mag-gage chamber and must be parallel to the chamber as well (small cut-outs in the jacket are required to re-attach the transmitter properly).
3. Make sure that the 0% and 100% (4/20mA) marking on the sensor tube are re-aligned at the centers of the process connections.

Section

5

Field Wiring

5.0 Recommended Loop Wiring

The following is the recommended loop wiring.

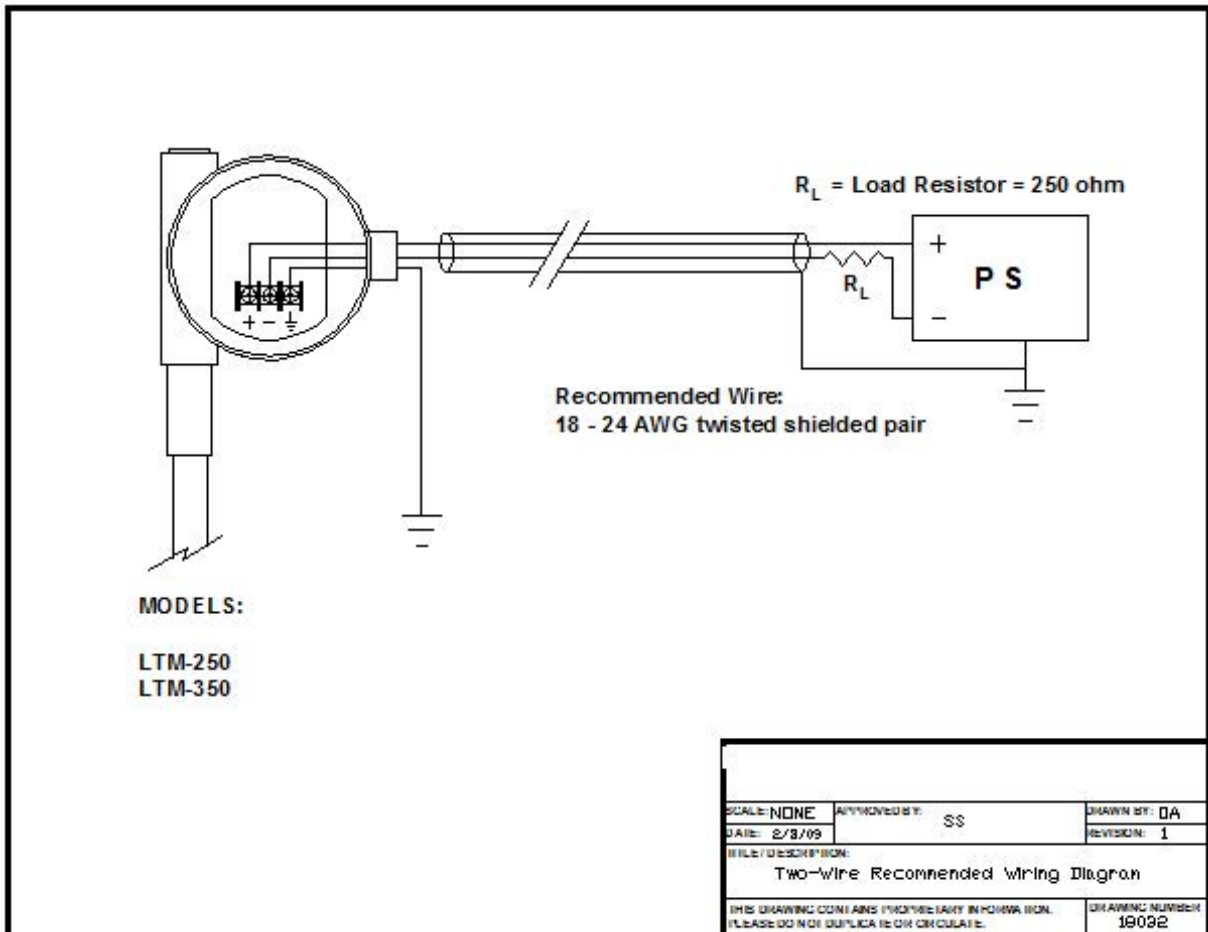


Figure 13. Recommended Loop Wiring

The following is the Hart Topology.

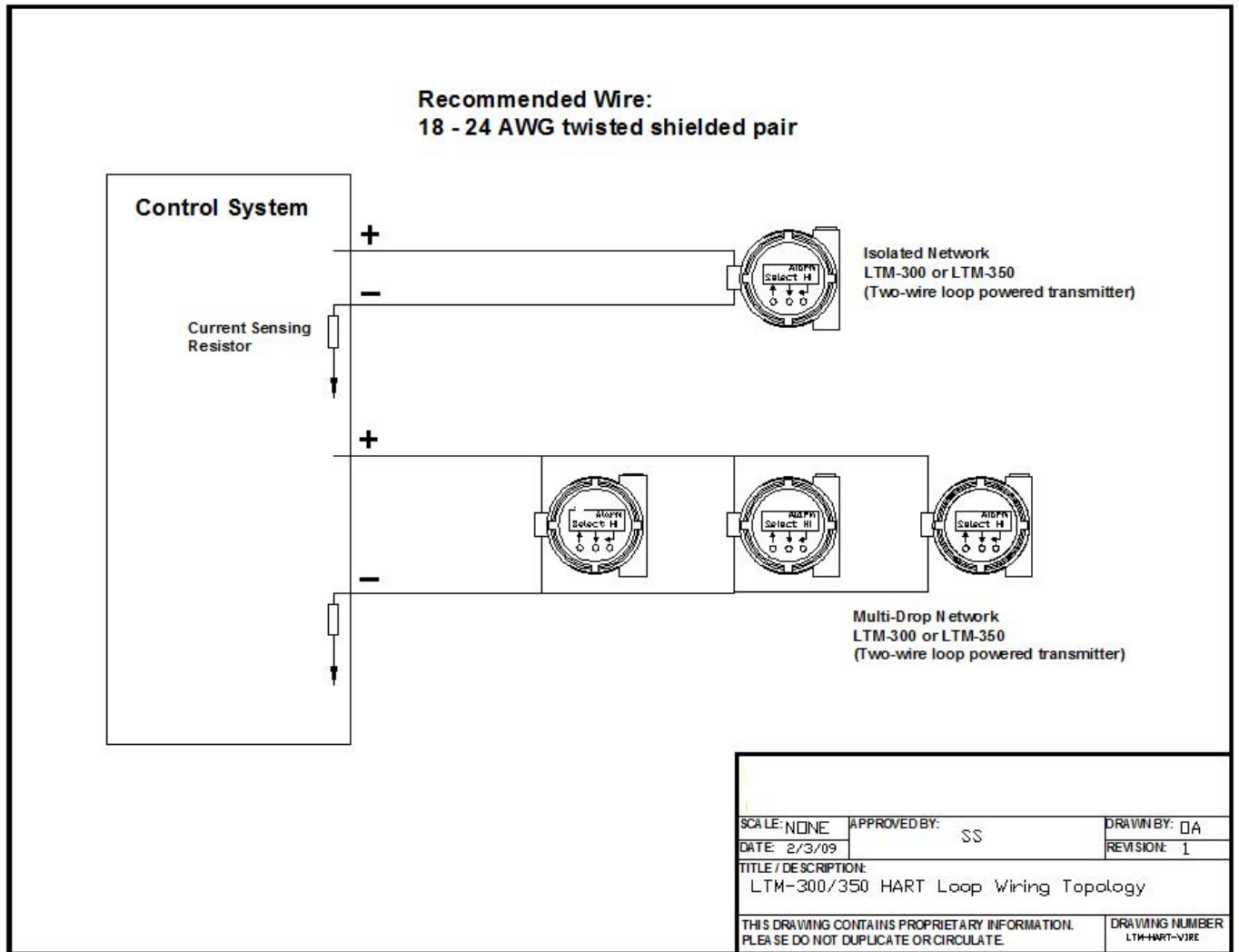


Figure 14. HART Loop Topology



Please visit www.hartcomm2.org to learn more about HART Protocol.

5.1 Area Classification Installation Safety



If the instrument is used as an explosion proof (exp) device then exp conduit must be sealed within 18 inches of the termination point – at the instrument.



Power must be supplied by an isolated supply.



Caution-To reduce the risk of ignition of hazardous atmospheres, disconnect the device from the supply circuit, or area must be known to be non-hazardous, before opening.

Section 6

Transmitter Specifications

6.1 Hazardous Locations / General Ratings

CSA and CSAUS: Explosion Proof:

Class I Div. 1 or 2, Grps. B, C, D
Class II, Grps. E, F, G
Class III
T_{amb} -40C to 85C (- 40F to 185F)

Housing: Explosion proof, dual compartment,
½"npt conduit, epoxy coated
aluminum; NEMA 4X, 7

Humidity Limits: SAMA PMC 31.1-5.2

Vibration Limits: SAMA PMC 31.1-5.3

RFI Limits: SAMA PMC 31.1-
20 to 1000 MHz
Up to 30 V/m

6.2 Electronic Specifications

Supply Voltage: 13 – 36 Vdc (13V @ 20mA)

Repeatability: .005% of full scale or
.010", whichever is greater

Non-Linearity: .01% of full scale or .030",
whichever is greater

Sensor Accuracy: .01% of full scale or .020",
whichever is greater

Damping: 1 to 25 seconds

Operating Temp: -50 to 85 C
(-58 to 185 F)

6.3 Sensor Probe Specifications

Material: 5/8" 316ss standard, optional:
Hastalloy, Monel, or Kynar sleeved

Operating Temperature: -50 to 149 C
(-58 to 300 F)

Maximum Pressure: 2000psig @ 300F

Range: 12 in. to 30 ft.

Section

7

Menu Structure and Features

7.0 Pushbutton Operation

The menu structure and pushbutton operation of the LTM series transmitters is simple and user-friendly. The electronics module has 3 pushbuttons (from left to right):

↑ : This button is used to increment values and change “Yes” to “No” and “No” to “Yes”.

↓ : This button is used to decrement values and change “Yes” to “No” and “No” to “Yes”.

← : This is the enter button used to execute functions and enter/exit into or out of submenus.



The pushbuttons are timed **not** pressurized. It does not matter how hard/firm you press them. The buttons depend on the length of time they are pressed. The longer you hold the button the faster it will increment/decrement values. Hold the enter button down for 2 seconds to enter the configuration menus and 1 second for all subsequent menus.

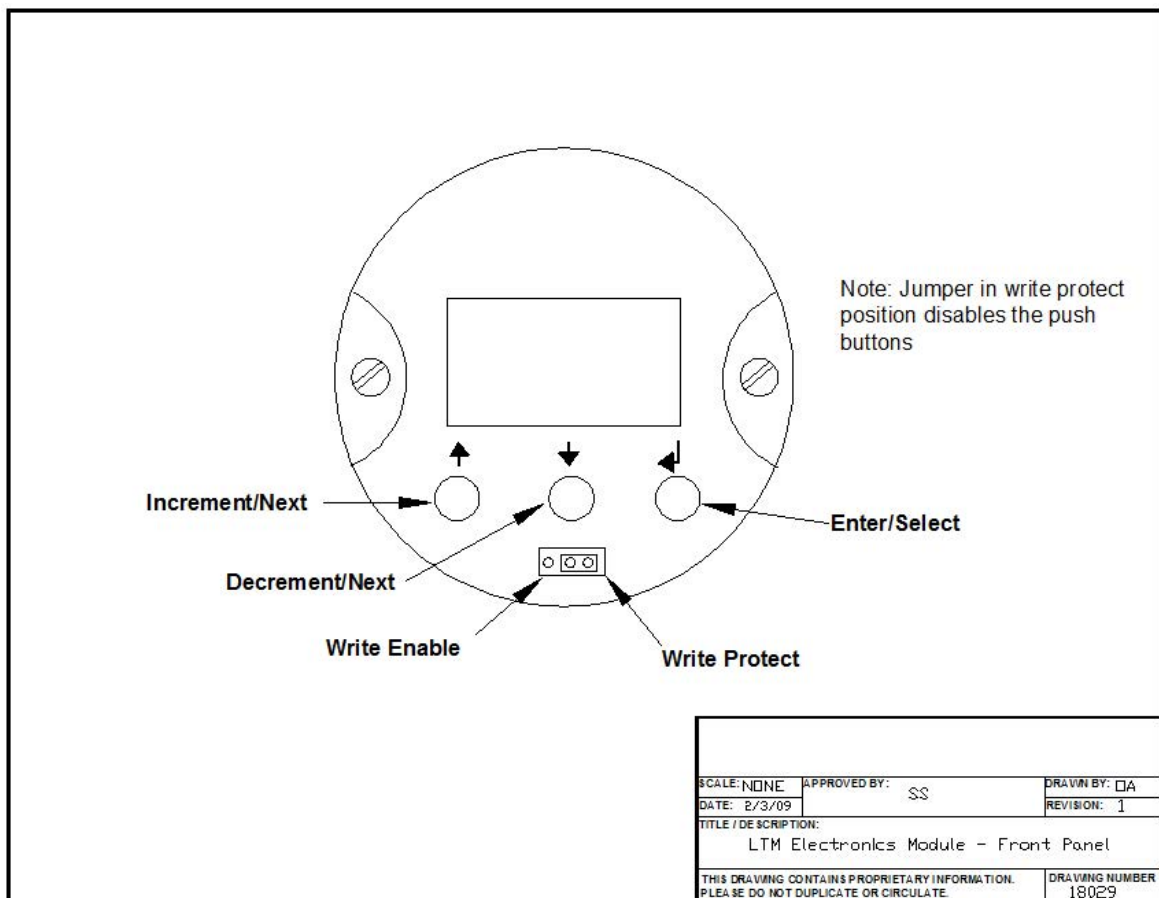


Figure 15. Front Panel of Electronics Module

7.1 Menu Structure

Main Screen (scrolling):

The menu structure has been designed so the end user can make parameter changes relatively fast and easy. Below is a detailed description of these menus.

The LTM-250/350 LCD is a 2x8 character screen. The main screen scrolls between the following parameters:

1. Level (in selected engineering units)
2. Interface (when option is provided – in selected engineering units)-LTM-350 only
3. Temperature (when option is provided – in selected engineering units)-LTM-350 only
4. The analog current corresponding to level (in mA)
5. Percent of range corresponding to level (in %)

If the user desires to enter into the configuration menus simply press/hold the enter button for 2 seconds.



Make sure the electronics are not in write protect mode.



The menu order can change and new menus can be introduced based on transmitter output options and hardware or software revisions.

7.1 Menu Structure Continued...

Description

Manufacturer and Model:

Software Revision Status:

This is the current software revision.

Hardware Revision Status:

This is the current hardware revision.

Scrolling Option:

Allows the user to stop the main menu from scrolling and choose 1 of 5 possible parameters: Engineering Units (level, interface, and temp), Current (mA), or Percentage. Select the desired parameter and then press enter. "Auto" is the default parameter this option keep the main menu scrolling. See section "7.2 Features" for more details.



Interface and Temperature options only appear if the option(s) are configured.

Select Length:

Note: THIS IS NOT THE MEASURING RANGE.

This parameter should only reflect the overall sensor length. It can be adjusted by incrementing and decrementing the value and then pressing enter.

Level Units:

This menu can be used to change the level engineering units. It can be changed by incrementing/decrementing to one of the following units: **in, ft, mm, cm, m** and then pressing **enter**.

Temperature Units:

This menu can be used to change the temperature engineering units. It can be changed by incrementing/decrementing to one of the following units: **F, C, R, K** and then pressing **enter**.



This menu only appears if the temperature option is provided.

LCD Menu (example)

```
M a g t e c h
L T M - 3 5 0
```

```
S W R e v
1 . 0 0 . 0 0
```

```
H W R e v
1 . 0 0 . 0 0
```

```
D i s p l a y ?
A u t o
```

```
S e l L n g t h
3 0 . 0 0 i n
```

```
L v l U n i t s
i n
```

```
T e m p U n i t
° C
```

7.1 Menu Structure Continued...

Description

Select PV:

This menu allows the user to select the measurement that controls the transmitter's current output (mA).



This menu only appears if the interface (2 floats) option is provided.

Select Alarm:

The following alarm settings can be chosen:

“FailHigh” = 21.00mA

“FailLow” = 3.50mA

“HoldOut” = holds last good reading until transmitter recovers.

Change Range:

This menu allows the user to change the measuring range or span. Enter the menu by changing the “No” to a “Yes” and press enter.

- Select Lower Range Value (LRV):

This is the 4.00mA (0.00%) point on the sensor. This value should only be incremented. For example if the value is changed from “0.00in” to “3.00in” the 4.00mA point will shift 3.00 inches higher than the original point. It is recommended to leave this at 0.00 most of the time unless a special circumstance arises. Press enter to go the next screen.

- Select Upper Range Value (URV):

This is the 20.00mA (100.00%) point on the sensor. This value should only be decremented. Changing this parameter will change the measuring range or span of the transmitter.

Select Damping:

This parameter is used to slow down the reaction of the instrument in order to ignore or average out any agitation on the process surface that may be causing an unsteady output. The units are fixed in seconds and values can be from 1 to 25 seconds.

LCD Menu (examples)

```
S e l P V
      L e v e l
```

```
S e l A l a r m
F a i l H i g h
```

```
C h g R n g e ?
                N o
```

```
S e l L R V
      0 . 0 0 i n
```

```
S e l U R V
      2 0 . 0 0 i n
```

```
S e l D a m p
                1 s
```

7.1 Menu Structure Continued...

Description

Rate of Change (RoC) Filter:

This parameter helps ignore erroneous readings from the transmitter's surroundings. If the user knows how fast the level can change in the vessel (i.e. inches per second) then this parameter should be set at a rate that the level in the vessel cannot suddenly jump to. See section "7.2 Features" for more details.

Trim Sensor:

This menu can be used to recalibrate the transmitter.



There is no need to recalibrate the instrument simply use the "Change Range" menu and change the LRV and URV as desired.



If the need arises to use this menu then level simulation will be required at 0 and 100 percent.

Offset:

This parameter simply adds a digital value to the measuring range or span it does NOT shift or move the measuring range. See section "7.2 Features" for more details.



The span will not change and the 4/20mA will not shift from its original calibrated points. This value also affects the reading for interface level when available.

LCD Menus (examples)

```
R o C F i l t r
  1 0 .0 i n / s
```

```
T r m S n s r ?
                      N o
```

```
O f f s e t
      0 . 0 0 i n
```

7.1 Menu Structure Continued...

Description

Trim Digital-Analog-Converter (DAC):

These are factory set parameters used to provide an accurate 4.000mA and 20.000mA. This parameter should not be changed as Magtech uses NIST traceable equipment to calibrate our transmitters and only accredited laboratories for the yearly calibration of our equipment. This menu will allow the user to change the accuracy of the transmitter output.



A current meter should be used to monitor the 4/20mA when this function is selected.

Test Loop:

This function allows for direct control of the Transmitter's current output (mA) capability. Simply enter into this menu and change the current (mA) output as desired. This option is excellent for plant startup verification.

Exit:

This signifies the last menu before the main screen. If the user desires go back through the configuration menus then change the "Yes" to "No" and review the configuration again else press enter while the screen shows "Yes" and return to the main screen.

LCD Menu (examples)

```
T r i m D A C ?  
N o
```

```
T s t L o o p ?  
N o
```

```
E x i t ?  
Y e s
```

7.2 Features

This section will describe in more detail some of the LCD Menus and **new features** exclusive to models LTM-250/350.

Scrolling Option: When choosing not to scroll the main menu the following options can be chosen by pressing the up and down push buttons (**exclusively for models LTM-250/350**).

- | | | | | | |
|------------------|-------------------|-----------------------|------------------|--------------------|----------------|
| 1. Display? | Display? | Display? | Display? | Display? | Display? |
| Auto (or) | Level (or) | Interface (or) | Temp (or) | mA Out (or) | % Range |



The “scroll” option will vary depending on how many outputs are configured.

Rate of Change (RoC) Filter: The RoC filter is an excellent tool to help eliminate erroneous noise that can occur in-field. For example if the level in a tank cannot rise or fall faster than 1.0 in/s then the setting for the RoC filter should be set to 2.0 in/s or more to help filter/ignore erroneous readings. The engineering units will change according to units selected (i.e. cm/s) – (**exclusively for models LTM-250/350**).

Offset: The offset is a digital number that gets added to both the LRV and URV to account for any distance below the sensor probes measuring distance. For example if the offset is changed from “0.00in” to “2.00in” the ‘Level’ on the main screen will show “2.00in” at 4.00mA and the 20.00mA value will simply have 2.00 inches added to it.



The span will not change and the 4/20mA will not shift from its original calibrated points. This offset value will also add to the interface level when available.

7.2 Features (Exclusive to the LTM-250/350 models)



There is a “special” menu incorporated into the LTM-250/350 models. To access this menu **press and hold** the increment (↑) button first then while holding the increment button **press and hold** the enter button for 3 seconds. A new menu will appear on the LCD screen.

ComPort: This menu is currently only utilized at the factory and will not assist in any troubleshooting. When the menu first appears the “No” option is defaulted, simply press enter to bypass this option. If “Yes” is selected and this menu is accidentally entered into then the push buttons will be locked out. Simply cycle the power to the instrument to clear the effect of entering into this option.

Default: The next menu is the “Default Configurations” menu. This option allows the user to “load” the original factory settings or load settings saved in slots labeled “Sensor 1”, “Sensor 2” or “Sensor 3” (if utilized by end user). If desired one electronics module can save settings for 3 other sensor probes by calibrating the electronics module to a particular sensor probe then saving those settings into slots labeled sensor 1, 2, or 3. Change the menu screen from “load” to “save”. Then the user can save current setting into slots labeled sensor 1, 2 or 3.



The factory settings can never be overwritten (or saved to), only load from.

Single Point Calibration (1pt Cal): The following menu is the 1 –point Calibration option. The need may arise to recalibrate the transmitter but a two point level simulation and calibration may not be possible in field. In this case the single point calibration option can be utilized. Enter into the option and the next screen will display “CrntLvl?” This screen requires that the “current level” be entered (in the engineering units be utilized). Use the up and down push buttons to enter the current level being displayed by the level gages visual indicator and then press enter. If the next menu appears then the operation was successful. If the menu reverts back to the beginning of the “1pt Cal” menu then the operation was unsuccessful. Further troubleshooting may be necessary if the operation is unsuccessful. See **Section 8** for troubleshooting guide.



1 point calibration may not be within the published accuracy specification. After a 1pt Cal the transmitter has an accuracy of ± 0.10 in (± 4 mm).

7.2 Features (Exclusive to the LTM-250/350 models)

Field Reversible Transmitter (FlipPrb): An important and key feature of the LTM-250 and LTM-350 Models is the ability to flip (rotate) the entire transmitter 180 degrees. This procedure is recommended for gage mount transmitters with an elbow connection on them. If the transmitter does not have an elbow connection please contact factory for assistance. If the need arises and a bottom mount transmitter is preferred over a top mount transmitter or vice versa then following these simple steps. THIS PROCEDURE IS FOR GAGE MOUNT TRANSMITTERS ONLY.

1. Physically flip (rotate) the entire transmitter (this includes the sensor probe) and mount it accordingly.



Be careful not to damage the sensor probe while rotating the transmitter.

2. Remove the front glass cover of the transmitter enclosure and then using needle nose pliers pull on the protection screws (snake-eye screws) to pull out the electronics module. Alternate pulling on the screws in order to prevent damage to the electronics module.
3. Rotate the electronics 180 degrees module and insert it back into the enclosure. The module should now be right side up.



Do not twist or rotate the transmitter housing to adjust the conduit entry. The conduit entry must be left in the opposite position.

4. There is a “special” configuration menu that is utilized to achieve this task. To access this menu **press and hold** the increment (↑) button then while holding the increment button **press and hold** the enter button for 3 seconds.
5. The “FlipPrb?” (Flip Probe) menu should appear. Use the up or down buttons to select “Yes” if rotating the sensor is what is desired else select no and exit the menu.
6. When “Yes” is selected the next menu is the “Config” (Configuration/Orientation) menu. This is where the “Top” or “Bottom” mount configuration is selected. This configuration/orientation is with reference to where the sensor probe “bulkhead” is located on top or bottom. Select the appropriate “Config” and press enter. If the original orientation is selection the menu will revert back to “FlipPrb?” menu.
7. The next menu is “Rerange?” (Change Range) menu. Select “Yes” if the measuring range (or span) is changing from the original span. Select “No” if the span is to able to remain the same. Selecting “Yes” will then go through change range procedure discussed in section 7.1 of this manual.
8. After the “Rerange?” menu is the “CrntLvl?” (current level/one-point calibration) menu. Simply enter where the existing level is in the vessel and a one-point calibration will take place automatically and the next menu will appear. If the next menu appears then the operation was successful. If the menu reverts back to the beginning of the “FlipPrb” menu then the operation was unsuccessful. Further troubleshooting may be necessary if the operation is unsuccessful. See **Section 8** for troubleshooting guide.

7.2 Features (Exclusive to the LTM-250/350 models)

Change Signal (ChngSgnl): The next and final menu in the special features menu is “ChngSgnl” or change signal option. The feature allows the adjustment of the signal being sent down the sensor probe. It can be utilized when one electronics module is being utilized to save settings for various different length sensor probes.

This menu has 3 parameters that can be adjusted. The first is “Energy” [%], it is increased for a longer sensor probe and decreased for a shorter sensor probe. The second parameter is “DCOffset” or DC Offset [v], this parameter is decreased for longer sensor probes and increased for shorter sensor probes. The third (and final) parameter is the “HoldTme” or hold time [us], this parameter recommended to stay within a certain range.



There is purposely not much detail on this option as it is recommended that these parameters not be changed unless the electronics module is being utilized for more than one sensor probe. It is also recommended that the user be guided by the factory if this option is being utilized.



This option is also intended for mainly factory use. Changing these parameters can cause undesirable results. Please consult factory with any questions. The “factory” default configurations can be loaded if the parameters have been drastically changed.

Conversion from Gage Mount to Standalone: When converting from a gage mount transmitter to a standalone transmitter or vice versa simply contact the factory to order appropriate parts. Please have the serial number of the transmitter documented so the factory can make traceable record changes and offer better assistance. Most conversions can now be done in-field with minor configurations.

Converting from gage mount to standalone: Remove transmitter from gage, then remove 4/20mA (or 0/100%) stickers from the sensor probe. Call factory with serial number and desired process connections (3/4” mnpt, 2” mnpt hex plug, flanges, etc...).

Converting from standalone to gage mount: Remove transmitter from vessel, then remove process connections. Call factory with serial number of transmitter and the level gage to which the transmitter is to be mounted.



Always be careful not to damage the sensor probe when removing/installing the transmitter to/from the gage or vessel.

Section

8

Transmitter Calibration and LTM Troubleshooting

8.0 Calibration



There really is no need to re-calibrate this instrument. The LTM-Series arrive calibrated to specified measuring ranges at order placement.

If the need arises and a recalibration is deemed necessary please follow these instructions carefully.



Level simulation will be required at 0% and 100% positions.

1. Verify the “probe length” is **not** the same as the “measuring range” desired. If so please change accordingly.
See Sections 2.1 and 7.1.
2. Go to the “Change Range” menu and set the desired URV (measuring range).
3. Go to the “Trim Sensor” menu and enter.
4. At the “Trim Zero” screen place the level (or magnet/float) at 0% (4mA point) and then press enter.
5. At the “Trim Span” screen place the level (or magnet/float) at 100% (20mA point) and then press enter.
6. “Exit” the configuration menus and the instrument should be calibrated. If not begin to troubleshoot or consult factory for assistance.

Error Proof Calibration: The LTM-250/350 transmitters are protected from incorrect calibration so if something is done incorrectly it will display “Span Error” on the LCD for 5 seconds and then return to the beginning of the “Trim Sensor” menu.

Recommendation: Again there is no need to recalibrate the instrument simply go to the “Change Range” menu and adjust the LRV or URV as desired.

8.1 Troubleshooting

Babbitt manufactures custom built products so each transmitter has been specifically designed to fit on a magnetic level gage or be inserted into a tank/vessel and has been approved by the end user at some point during the ordering/purchasing process. Each transmitter has been factory calibrated to meet end user requirements so there is no need to recalibrate these transmitters unless the requirements have changed from the time of purchase/delivery to installation. If the need arises to calibrate these units to a new range please carefully read and follow the calibration procedure in the instruction and operation (I/O manual) or consult the factory. Always feel free to contact the factory if any questions or uncertainties arise. The following guide has been established to guide the end user through some troubleshooting procedures if the need arises.

There are 3 basic scenarios that can potentially cause issues. They are:

1. **Physical damage** to the sensor probe.
Accidents can happen during the installation process and if the sensor is permanently bent, bowed, or kinked it will no longer work properly. Some symptoms of damage to the sensor probe are:
 - a. Erratic output, unit jumping to full scale (alarm mode) randomly, usually around the damage point.
 - b. Unit in constant alarm condition
 - c. Unit going into alarm condition after a certain point.



If the unit arrives damaged please contact factory immediately.

2. **Water damage** to the electronics module or sensor probe. This is potentially the most severe case the symptoms are unpredictable. If there is any suspicion that the transmitter may have incurred water damage please contact the factory to make arrangements to have the unit sent back for factory inspection.



Physical and water damage are not covered under warranty.

3. **Magnetic Indentation.** It is possible for any magnetostrictive instrument to have residual magnetic energy stored along the length of the waveguide. These magnetic anomalies can interfere with the output response signal. If this appears to be the case a level gage float (or a bar magnet preferably) may be run along the length of the sensor tube, past the head of the transmitter, in an even motion without stopping. This will usually clear all such magnetic anomalies.



Never move a magnet in perpendicular motion away from the sensor tube. This will always leave a residual magnetic field in the waveguide which causes the transmitter output to be erroneous or unstable.



The LTM-350 is HART compatible, however HART communication will not work if the unit is not powering up.

8.2 Power Supply Troubleshooting

The LTM-250/350 is designed to operate with a supply voltage of 13 – 36 Vdc (minimum 13V @ 20mA) across its terminal without affecting the analog current output. The most common supply voltage used is 24Vdc.

At times additional resistance in the loop is necessary, either in the form of a second load resistor or higher resistance safety barrier. This will appear to limit the maximum output of the transmitter to below 20mA. The transmitter will perform correctly up to a certain point. To resolve this problem, the voltage of the loop supply must be increased. Even a slight adjustment of 1Vdc may be sufficient.

All connections must be checked for improper wiring or polarity before power is applied. LTM-Series transmitters are polarity protected.

8.3 General Troubleshooting

Below are some troubleshooting procedures for the LTM transmitters that have been established overtime.

**Symptom: Transmitter is not powering up.
The LCD is not turning on.**

Resolutions:

1. Make sure power is applied correctly (meaning plus and minus are not reversed). The transmitter is polarity protected.
2. Make sure the electronics module is seated properly. Open the front cover (where the LCD is) and firmly push on the “Magtech” text. A good way to tell if the electronics are not seated properly is by making sure the protection screws are not physically higher than the outside of the housing. Sometimes pulling the electronics module out and putting it back in can reseal the electronics correctly. Use cutters or needle nose pliers to grip the protection screw and lightly pull on each screw (alternate).

Section 9

LTM-350 has HART Protocol

9.0 Hart Protocol: General Information

The LTM-350 is a HART compliant instrument. The section presents how the HART Communication Protocol has been utilized in the LTM-350. This section does not explain what HART Protocol is, please visit www.hartcomm2.org to learn about HART.

The following depictions are the major screen selections available to the user. The latest Hart Protocol utilizes a windows-based format allowing for a more familiar environment for computer users.



The following depictions are shown with a Magtech “specific” DD, some feature or parameters may not appear in HART “Generic” mode.

The LTM-350 has 6 major monitoring and configurations menus. They are:

1. Process Variables
2. HART Info
3. Device Setup
4. Calibration Review
5. Advance Device Setup
6. Device Diagnostics

9.1 Process Variables

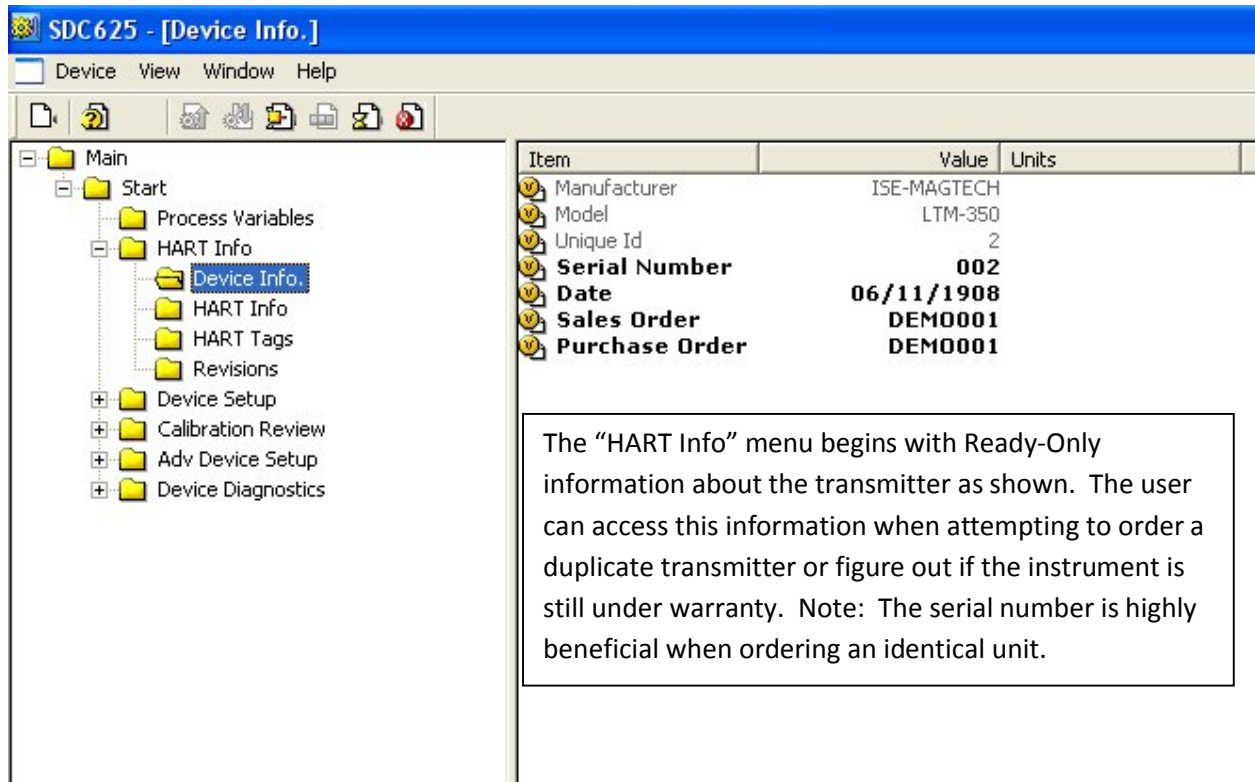
Item	Value	Units
Loop current	14.301	mA
% rng	64.383	%
Level	9.01	in

The “Process Variables” menu monitors up to five variables depending on how the instrument is configured (at time of purchase): Level, Interface, Temperature (in engineering units), corresponding percent of range and loop current (for Level).

9.2 HART Information

SDC625 - [Device Info.]

Device View Window Help

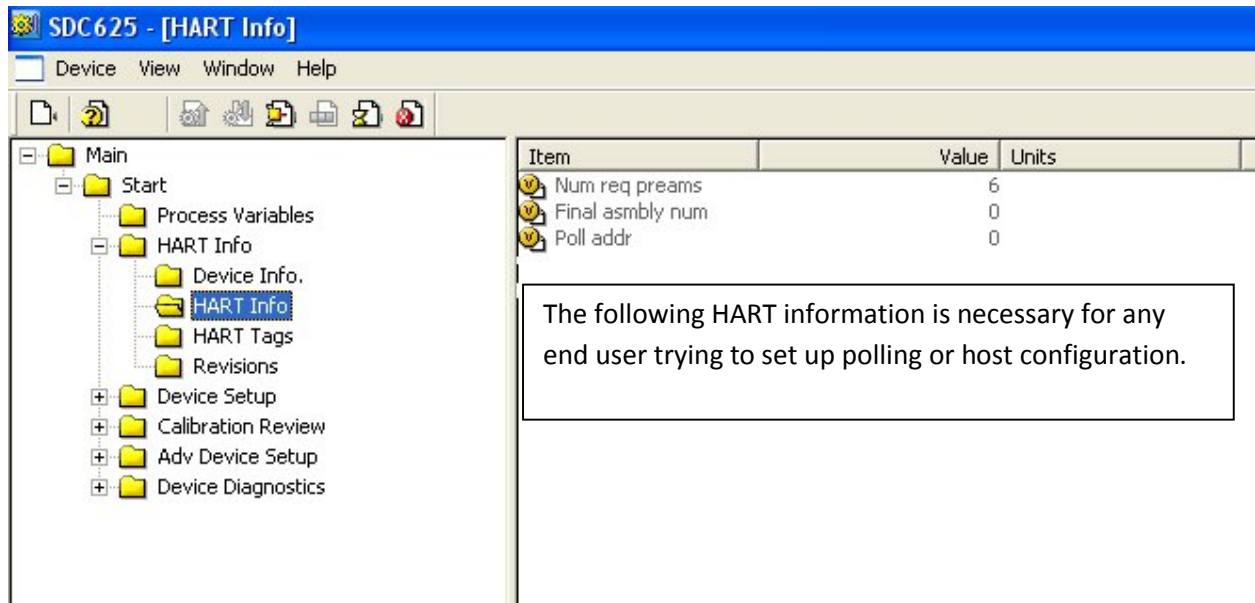


Item	Value	Units
Manufacturer	ISE-MAGTECH	
Model	LTM-350	
Unique Id	2	
Serial Number	002	
Date	06/11/1908	
Sales Order	DEM0001	
Purchase Order	DEM0001	

The "HART Info" menu begins with Ready-Only information about the transmitter as shown. The user can access this information when attempting to order a duplicate transmitter or figure out if the instrument is still under warranty. Note: The serial number is highly beneficial when ordering an identical unit.

SDC625 - [HART Info]

Device View Window Help



Item	Value	Units
Num req preams	6	
Final asmbly num	0	
Poll addr	0	

The following HART information is necessary for any end user trying to set up polling or host configuration.

SDC625 - [HART Tags]

Device View Window Help

Main

- Start
 - Process Variables
 - HART Info
 - Device Info.
 - HART Info
 - HART Tags**
 - Revisions
 - Device Setup
 - Calibration Review
 - Adv Device Setup
 - Device Diagnostics

Item	Value	Units
Tag	LTM-350	
Long tag	Demo Unit	
Message	MAGNETOSTRICTIVE XMTR	
Descriptor	LEVEL XMTR	

“Hart Tags” are meant to be utilized by the end user to identify the transmitter within the application. Generally the “Tag” is provided by the customer at time of order. Note: “Long Tag” can be up to 32 ASCII characters. Message and Descriptor can be utilized to describe the application.

SDC625 - [Revisions]

Device View Window Help

Main

- Start
 - Process Variables
 - HART Info
 - Device Info.
 - HART Info
 - HART Tags
 - Revisions**
 - Device Setup
 - Calibration Review
 - Adv Device Setup
 - Device Diagnostics

Item	Value	Units
Universal rev	7	
Fld dev rev	1	
Software rev	1	
Hardware rev	1	

The “Revisions” menu displays the latest major Hart Revision, Field Device Revision, and Software and Hardware Revisions.

9.3 Device Setup

SDC625 - [Basic Setup]

Device View Window Help

Main

- Start
- Process Variables
- HART Info
- Device Setup
 - Basic Setup**
 - Level Setup
- Calibration
- Calibration Review
- Adv Device Setup
- Device Diagnostics

Item	Value	Units
Orientation is:		Top
LCD Output is:	AutoScroll	
Probe Length	20.00	in
Unit		in
Damping		1 s

The “Basic Setup” menu allows the user to modify the engineering units, damping value, whether the Local Display scrolls or is fixed on a particular process variable (unit, % or mA). The option to change the transmitters probe length is also available but is not recommended. Note: probe length is NOT the measuring range; it is the overall length of the transmitter – including its deadbands.

SDC625 - [Level Setup]

Device View Window Help

Main

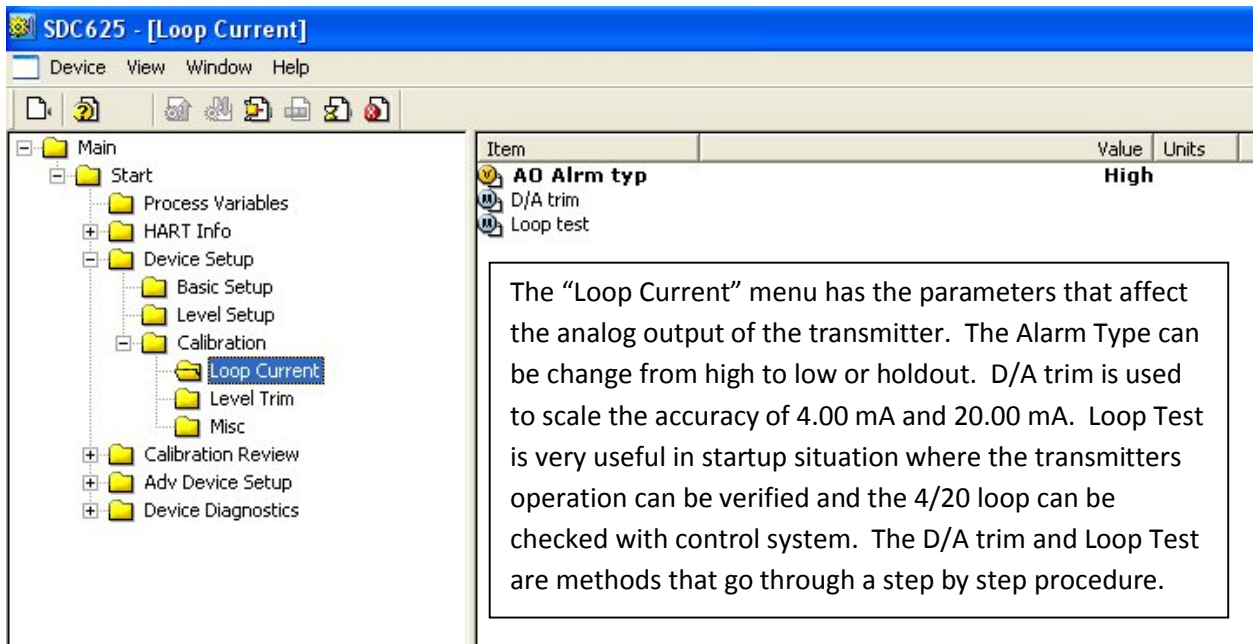
- Start
- Process Variables
- HART Info
- Device Setup
 - Basic Setup
 - Level Setup**
- Calibration
- Calibration Review
- Adv Device Setup
- Device Diagnostics

Item	Value	Units
USL	20.00	in
LSL	-20.00	in
PV URV	14.00	in
PV LRV	0.00	in
Level Offset	0.00	in
Rate of Change	10.0	in

The parameters shown in bold can be edited by the user. Changing “PV URV” from 14.00” to 12.00” would scale the 4-to-20 mA output of the instrument (**without** level simulation). Level Offset is a digital value added to both the LRV and URV but does not affect the mA output only the digital number displayed. Rate of Change can be used to ignore spontaneous noise that can occur in applications that are not wired properly.

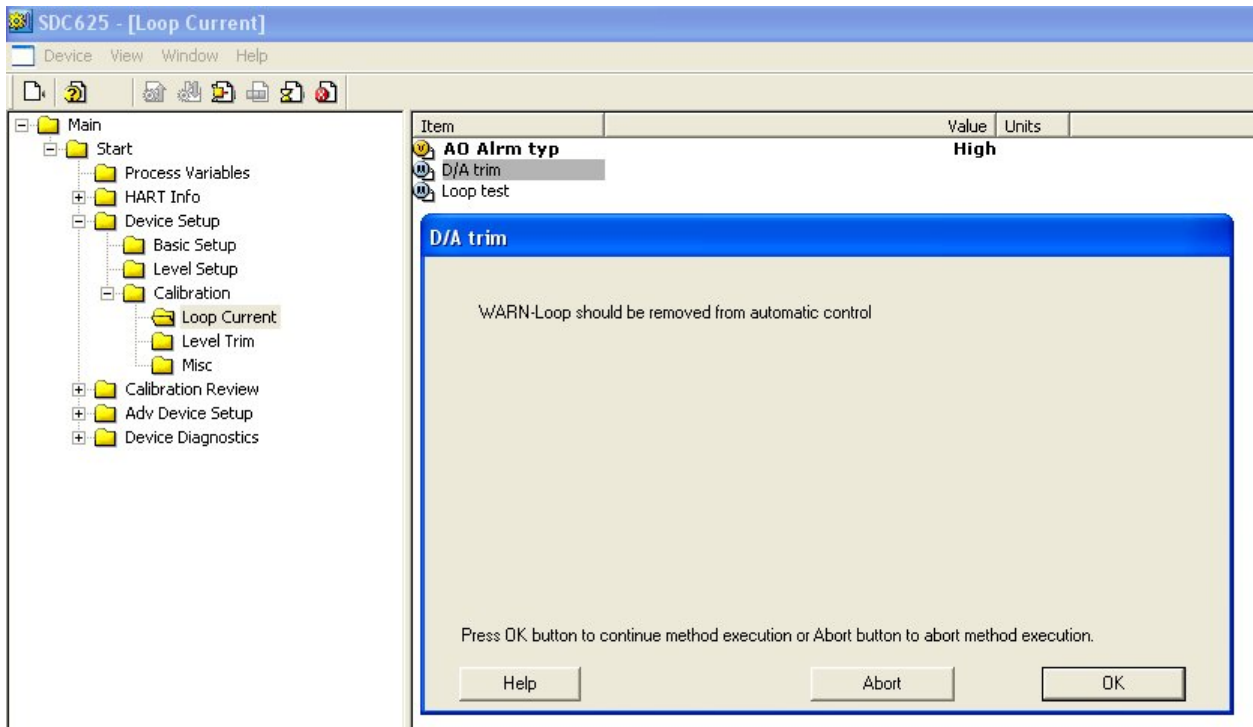


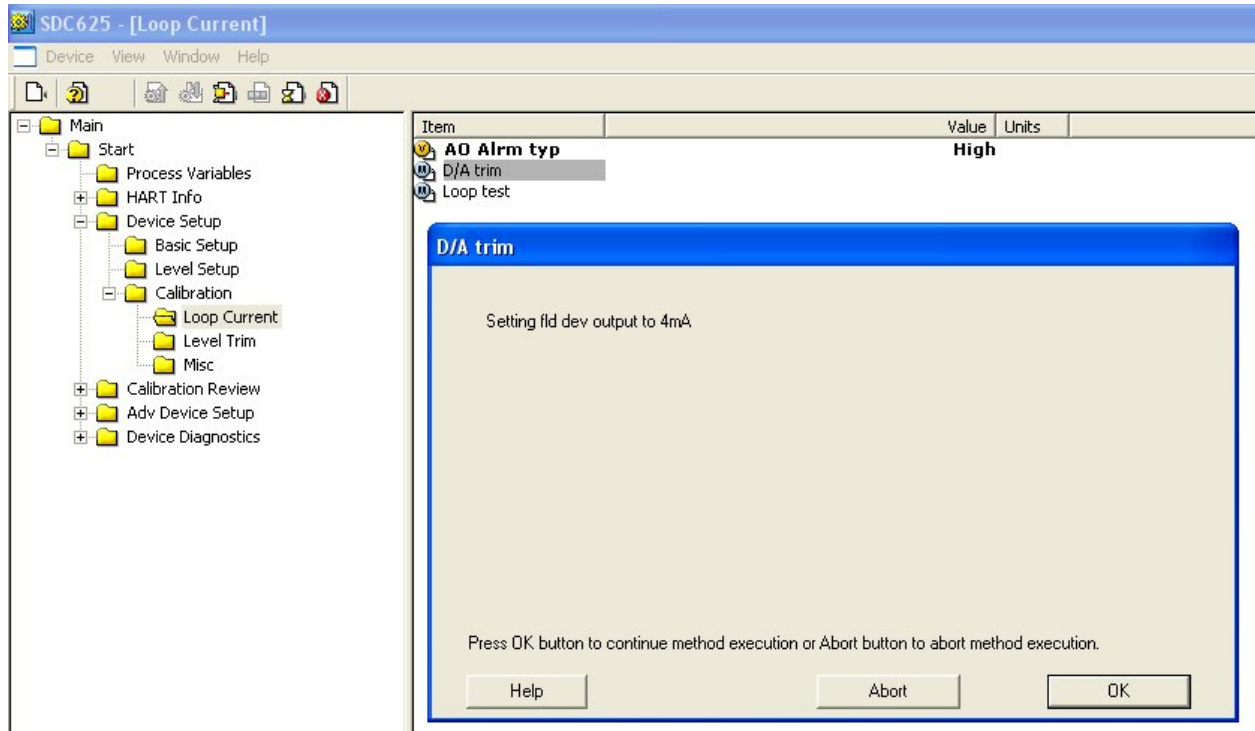
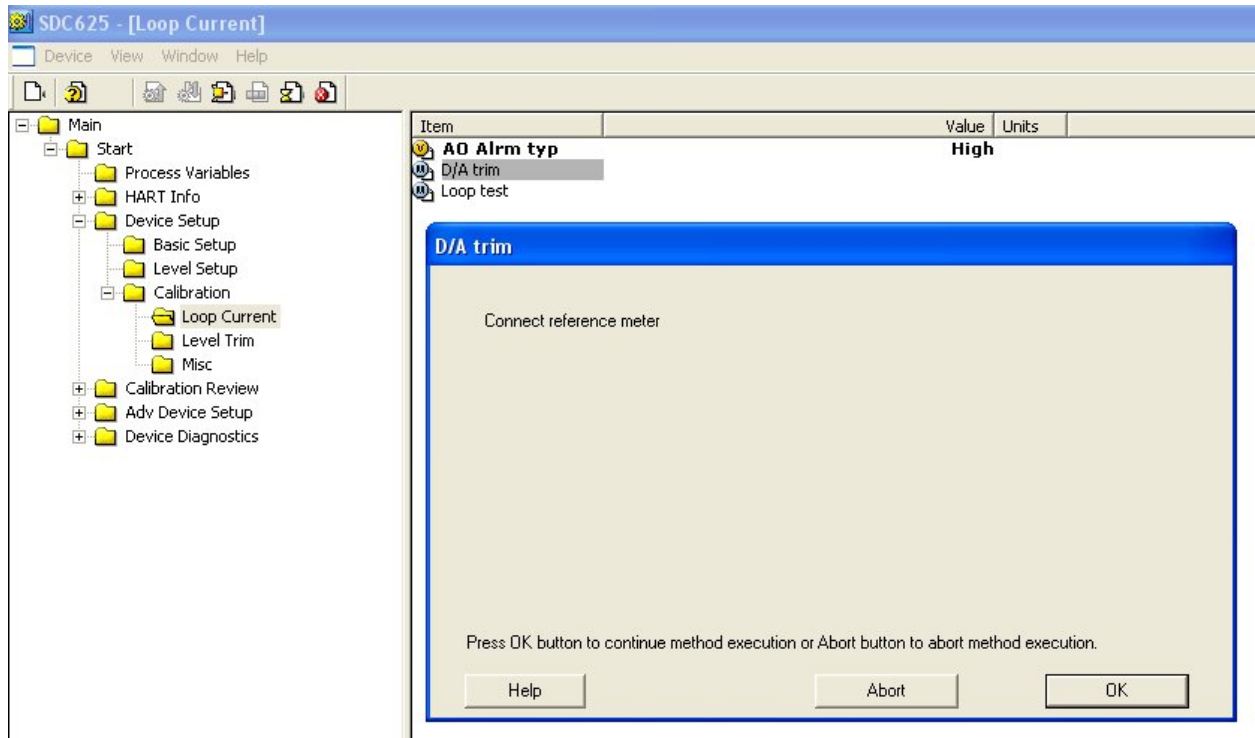
Section 7.1: Menu Structure has more detail on each parameter discussed in this section.

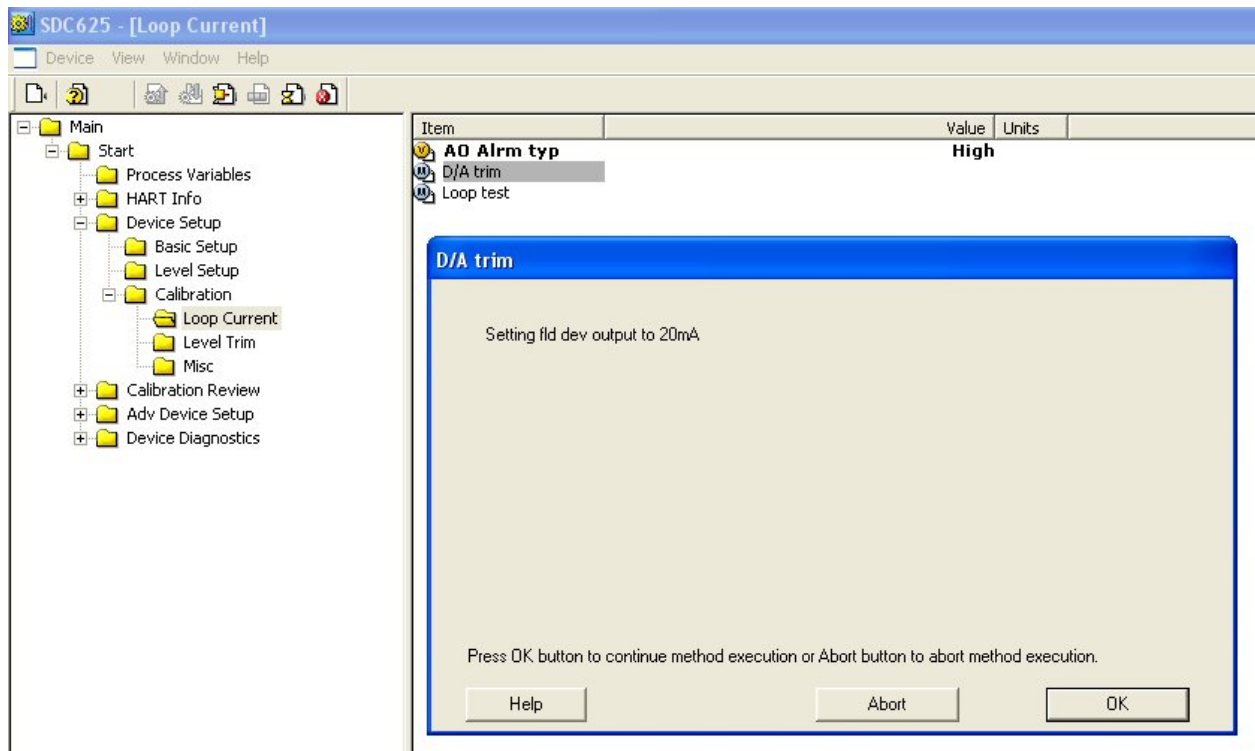
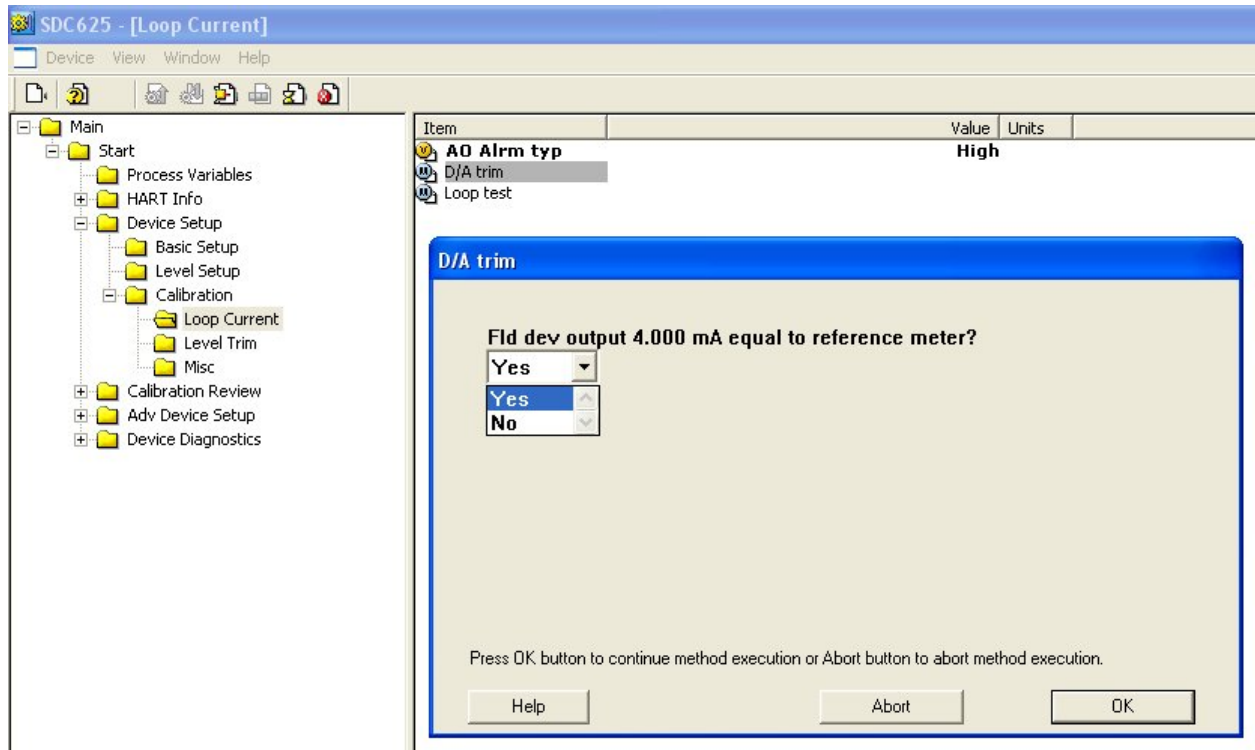


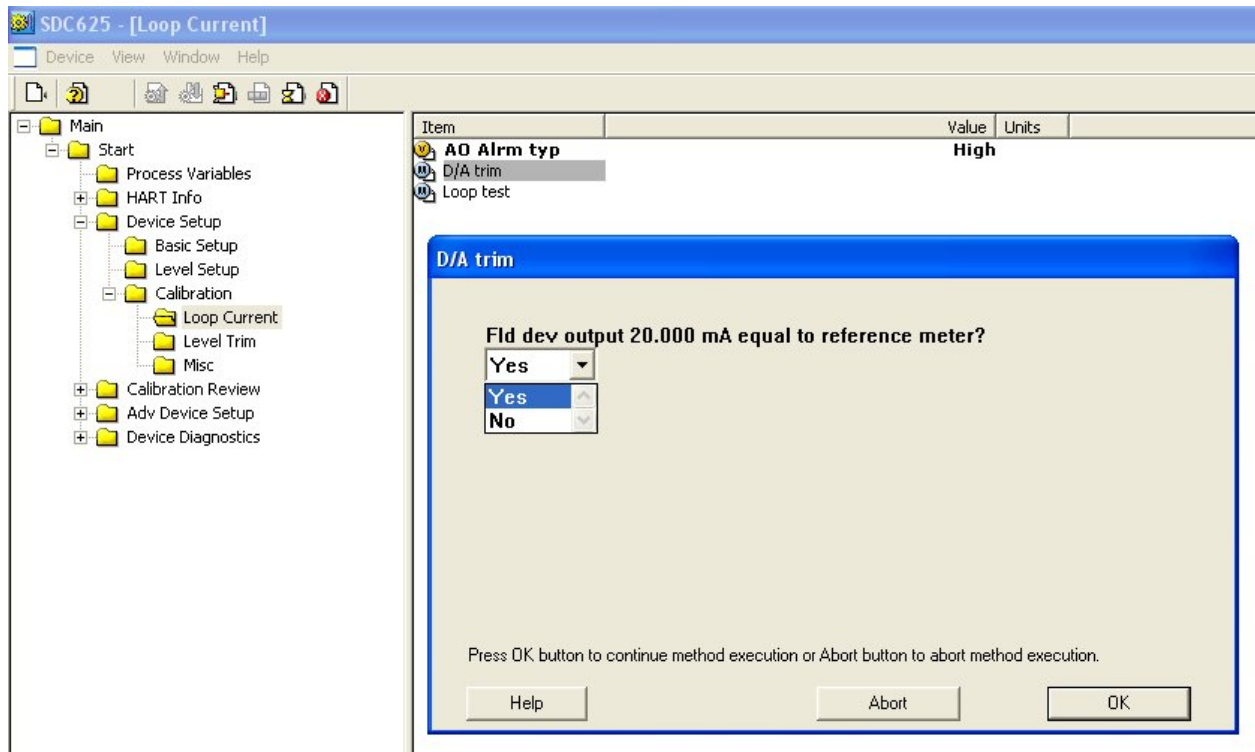
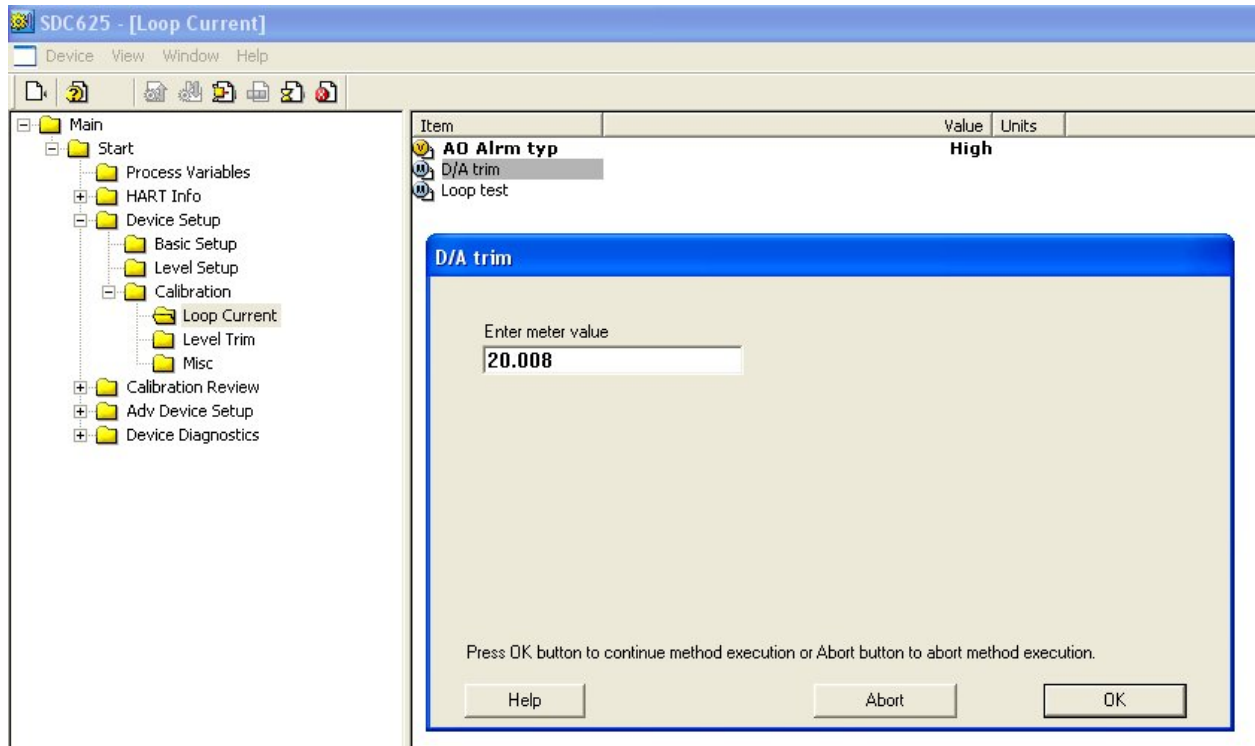
The following screens show the D/A Trim method and Loop Test Method.

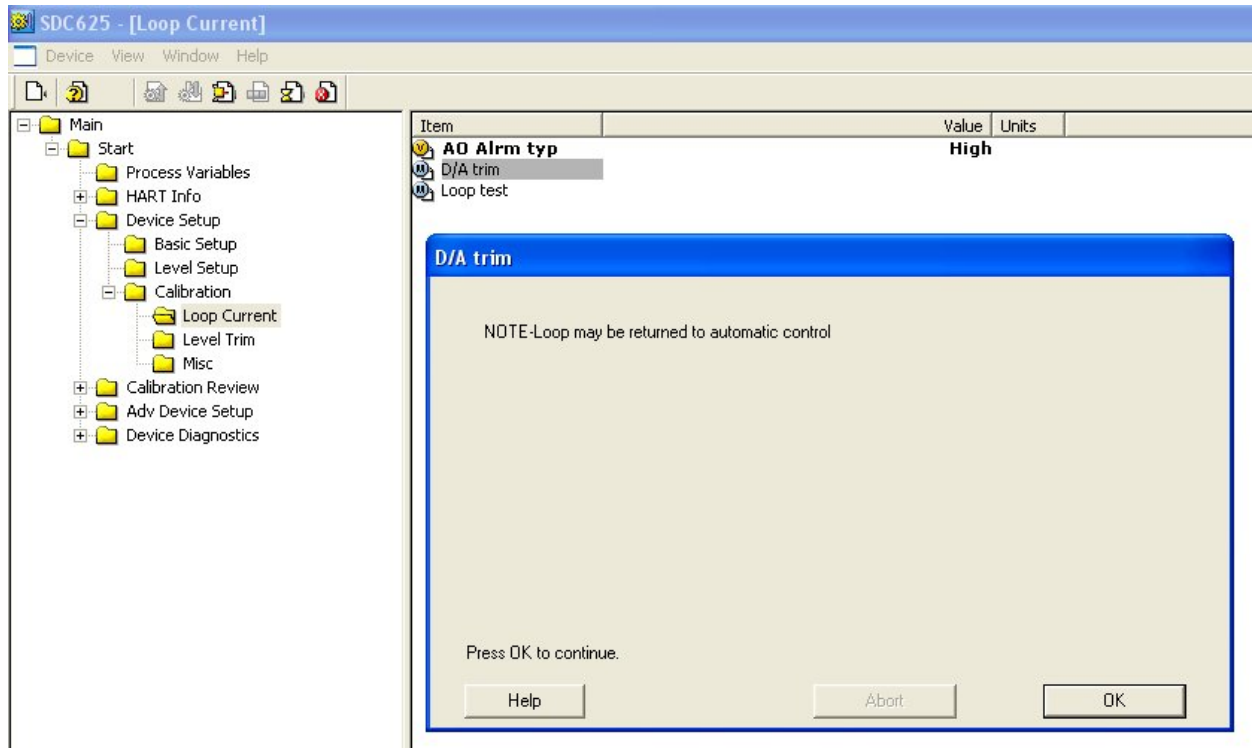
D/A Trim



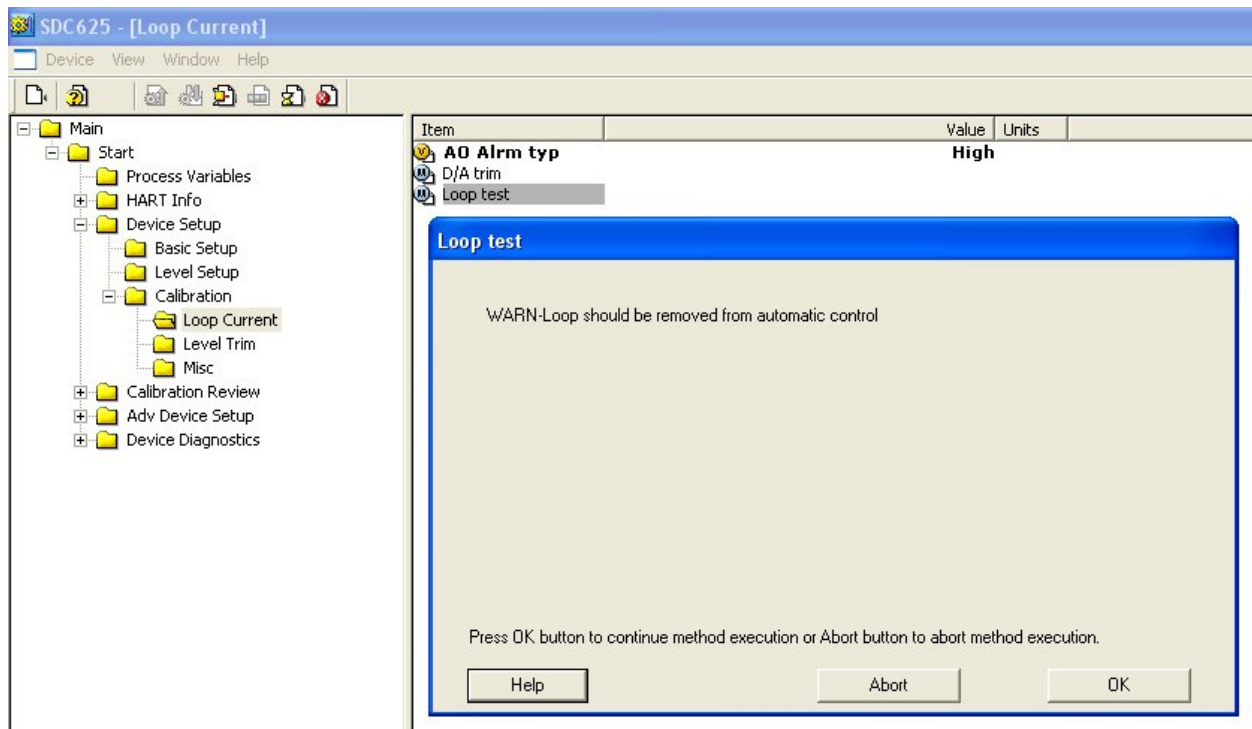


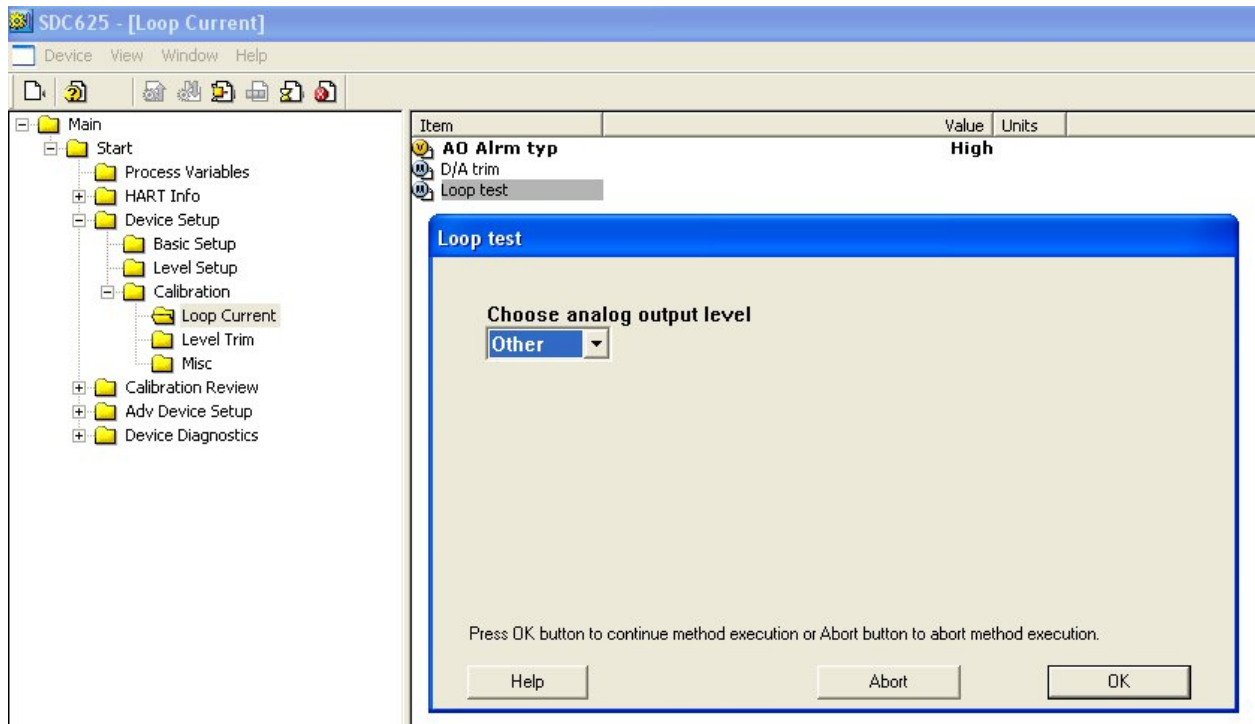
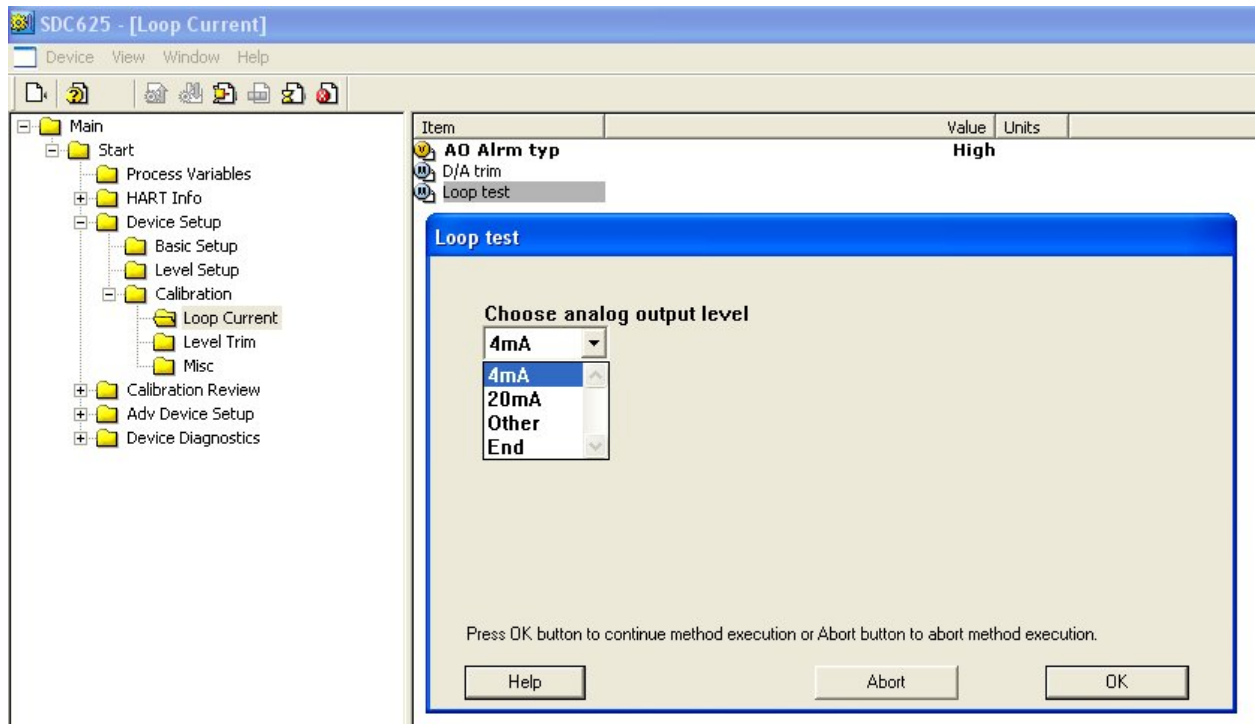


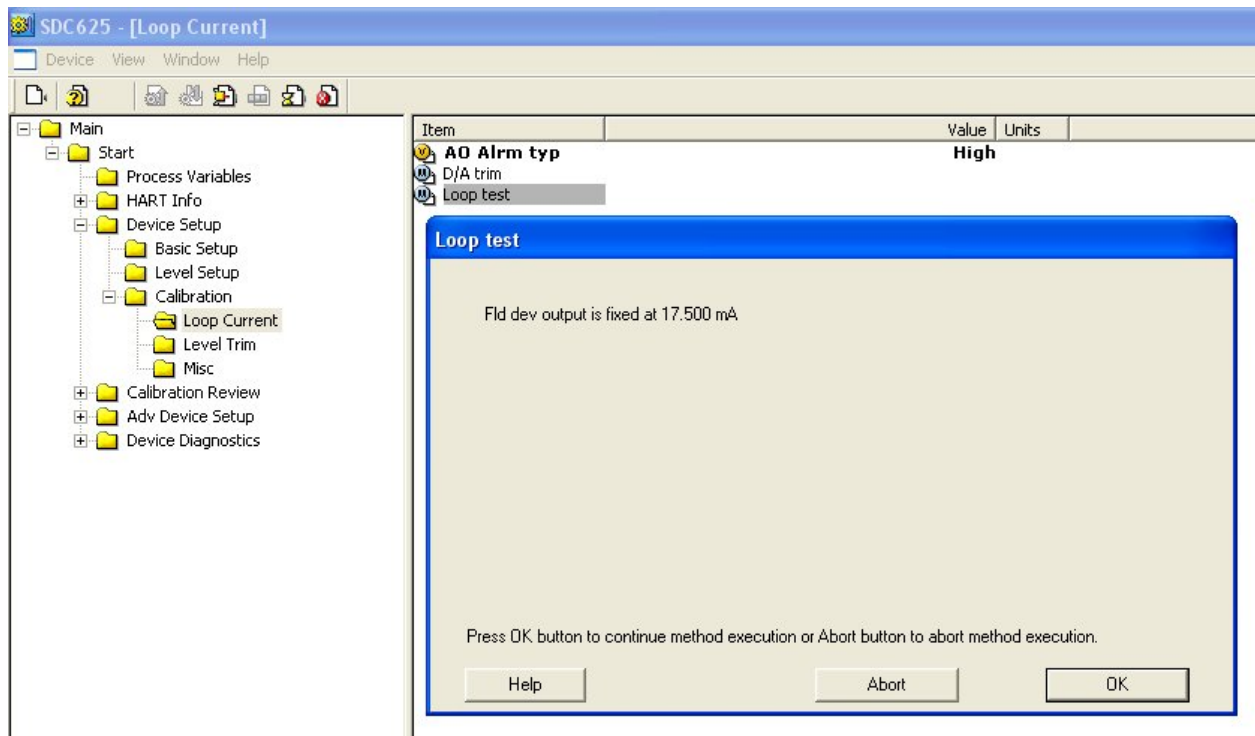
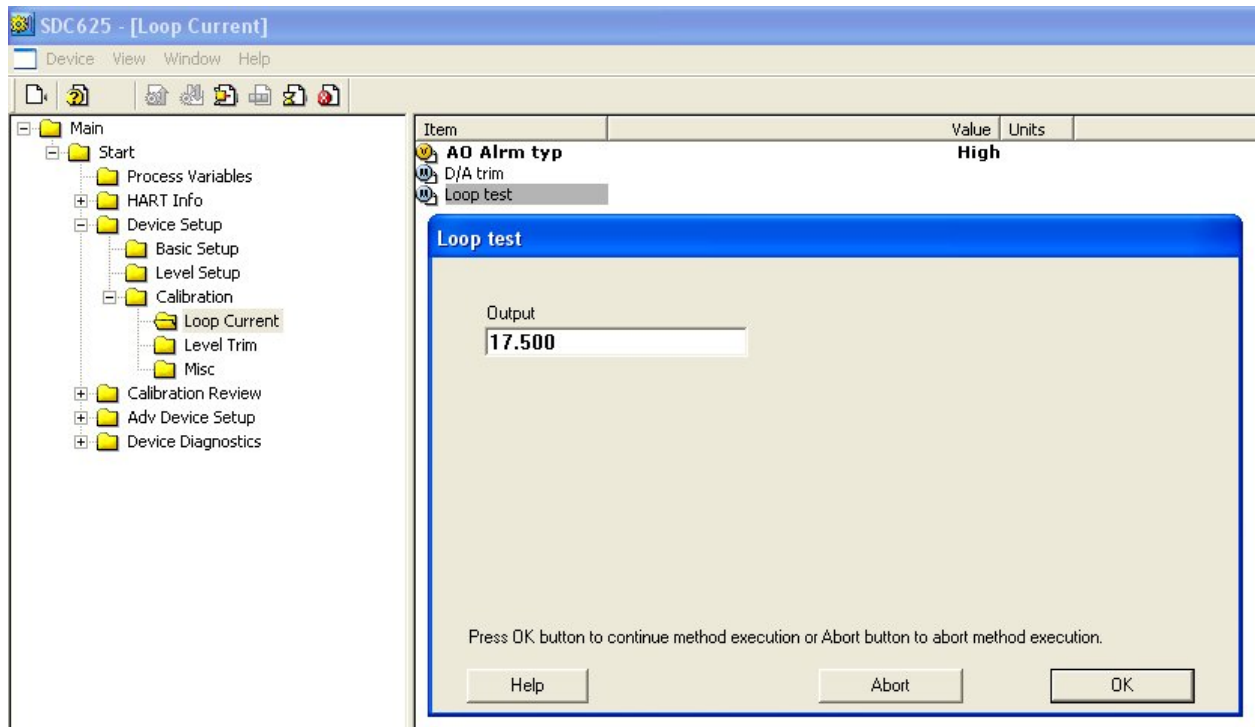


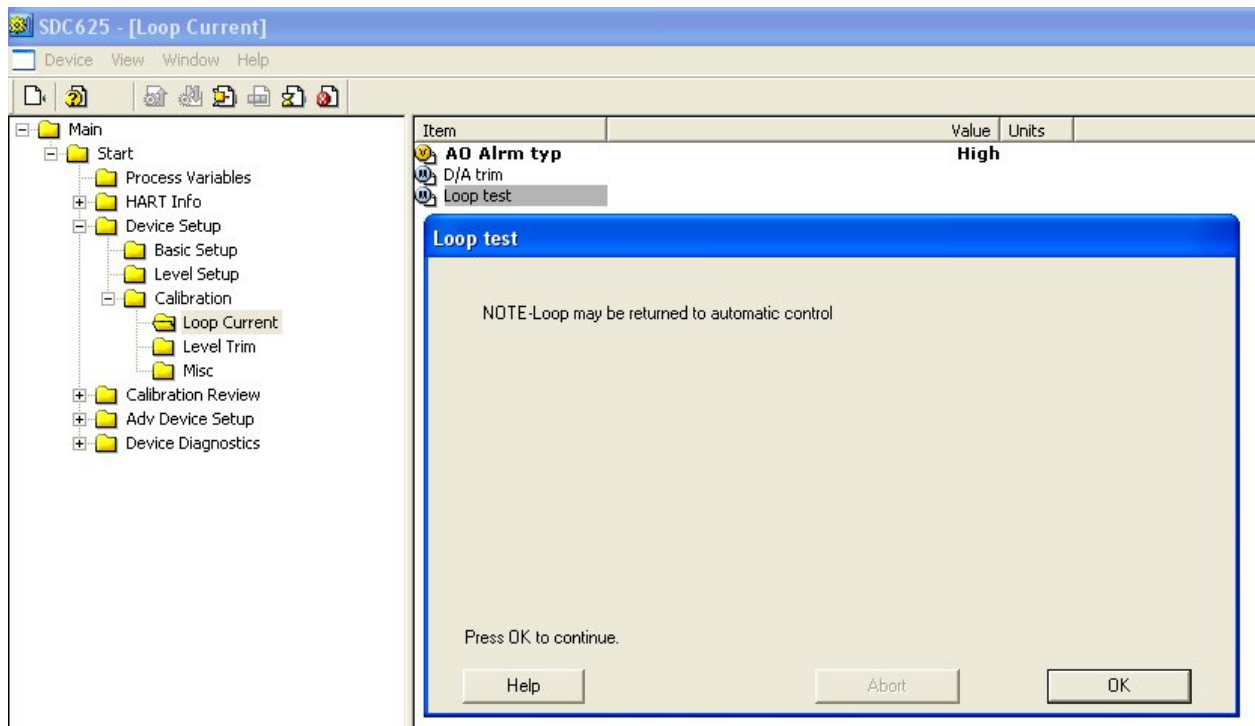
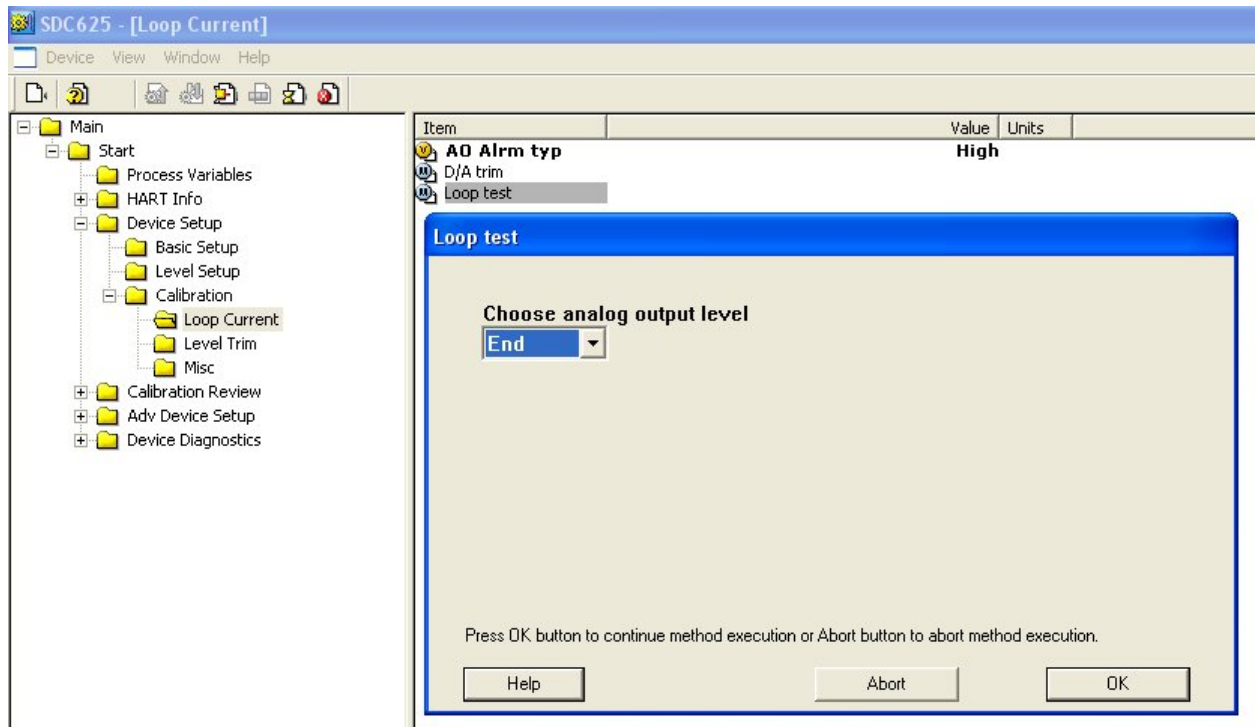


Loop Test









The following screens show the “Full Level Trim” or two-point calibration.

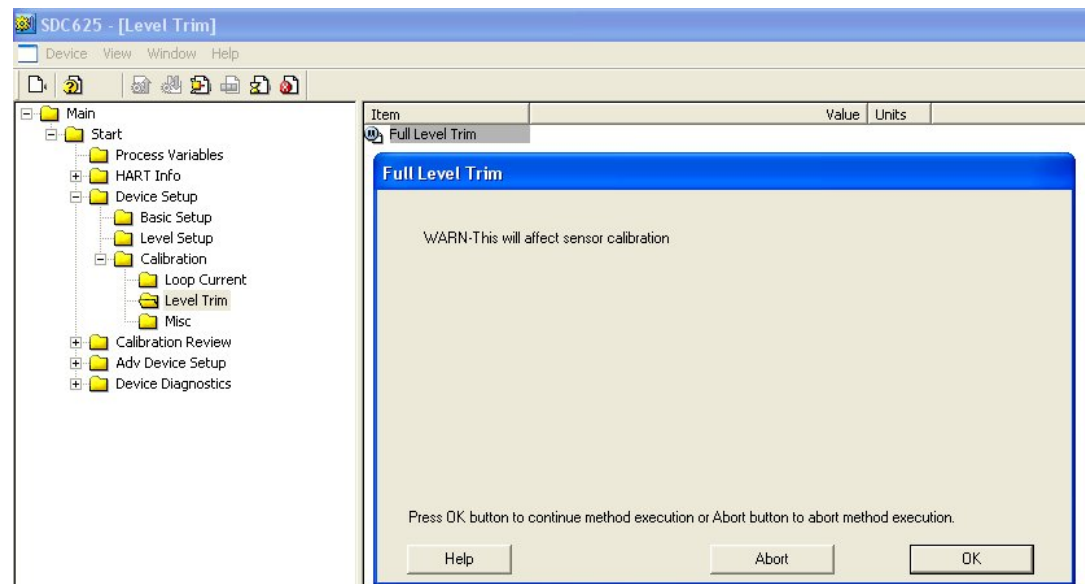
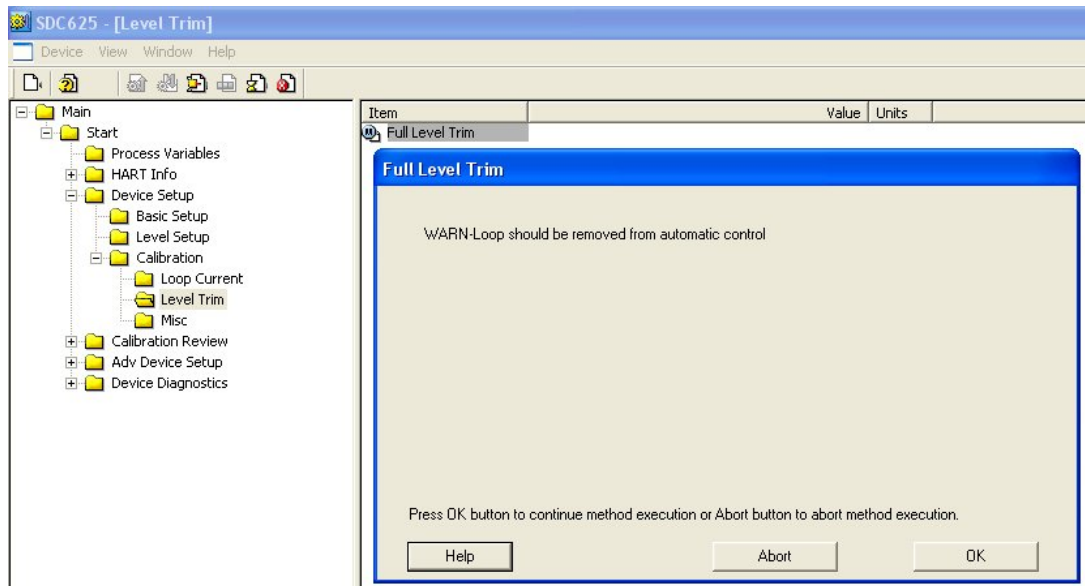
Full Level Trim

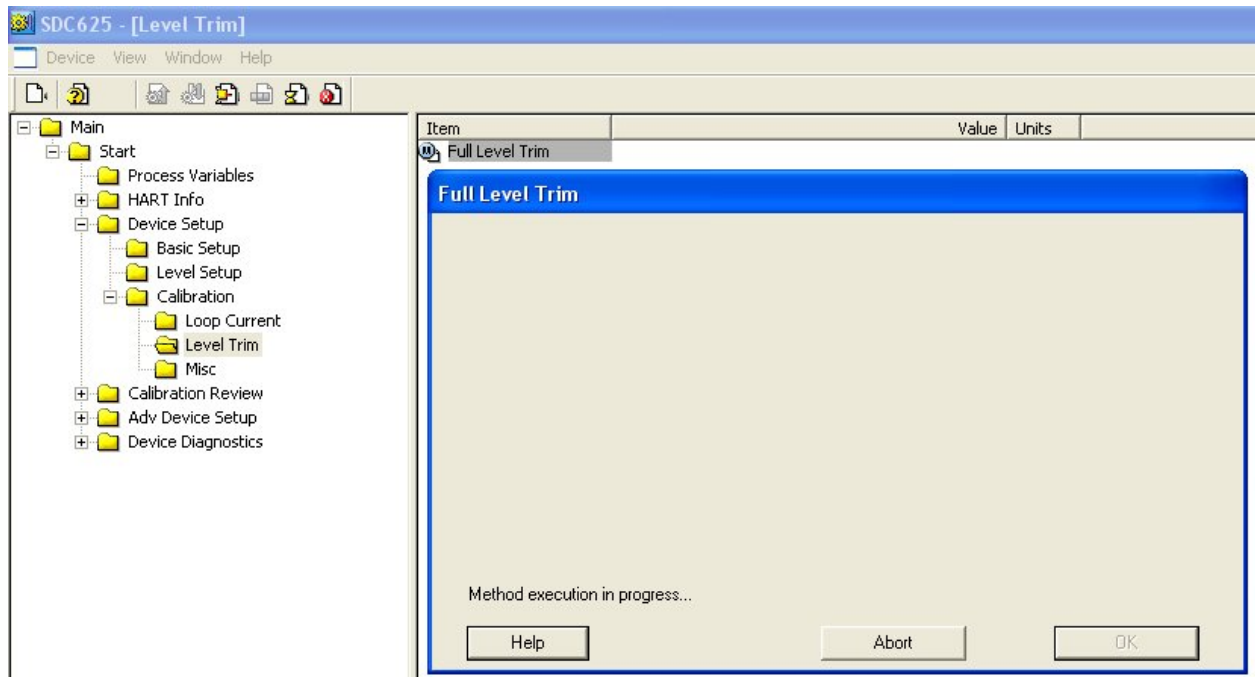
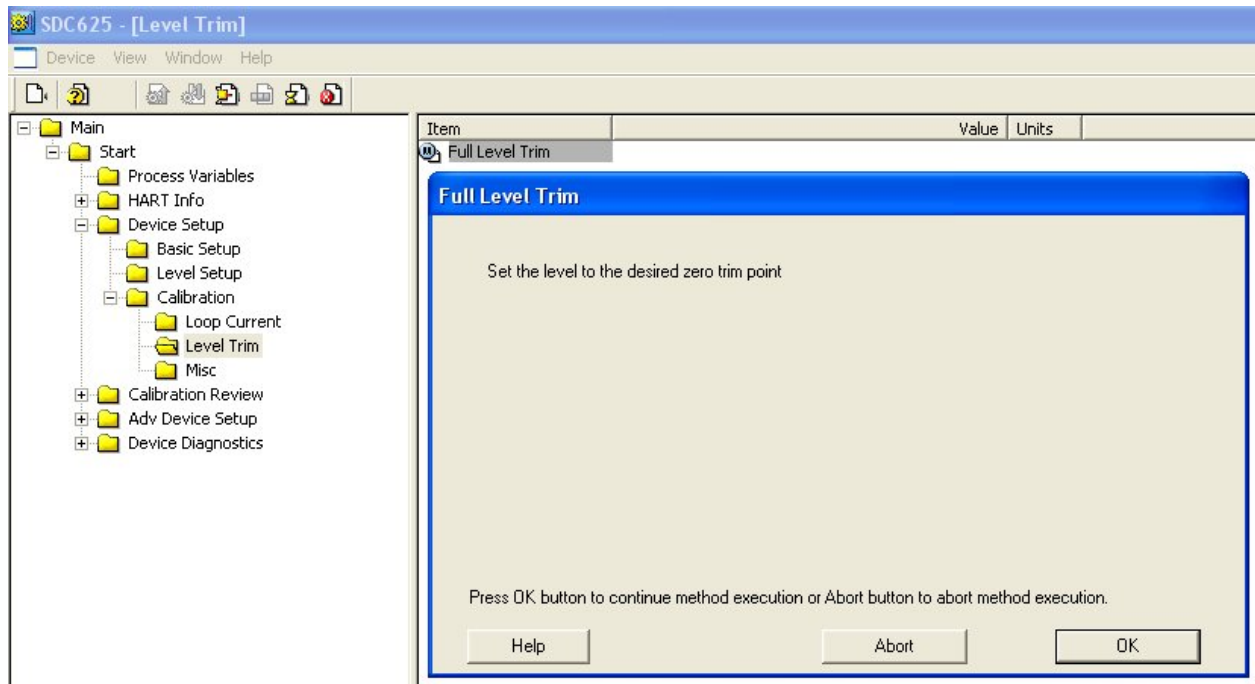


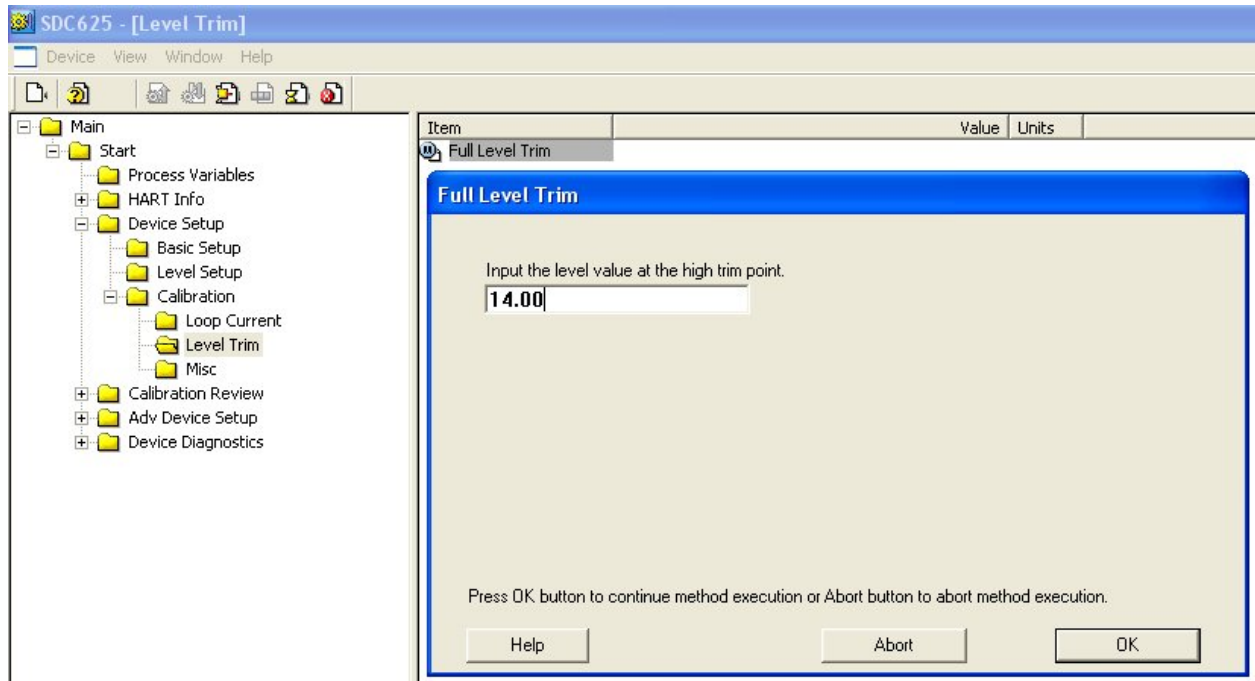
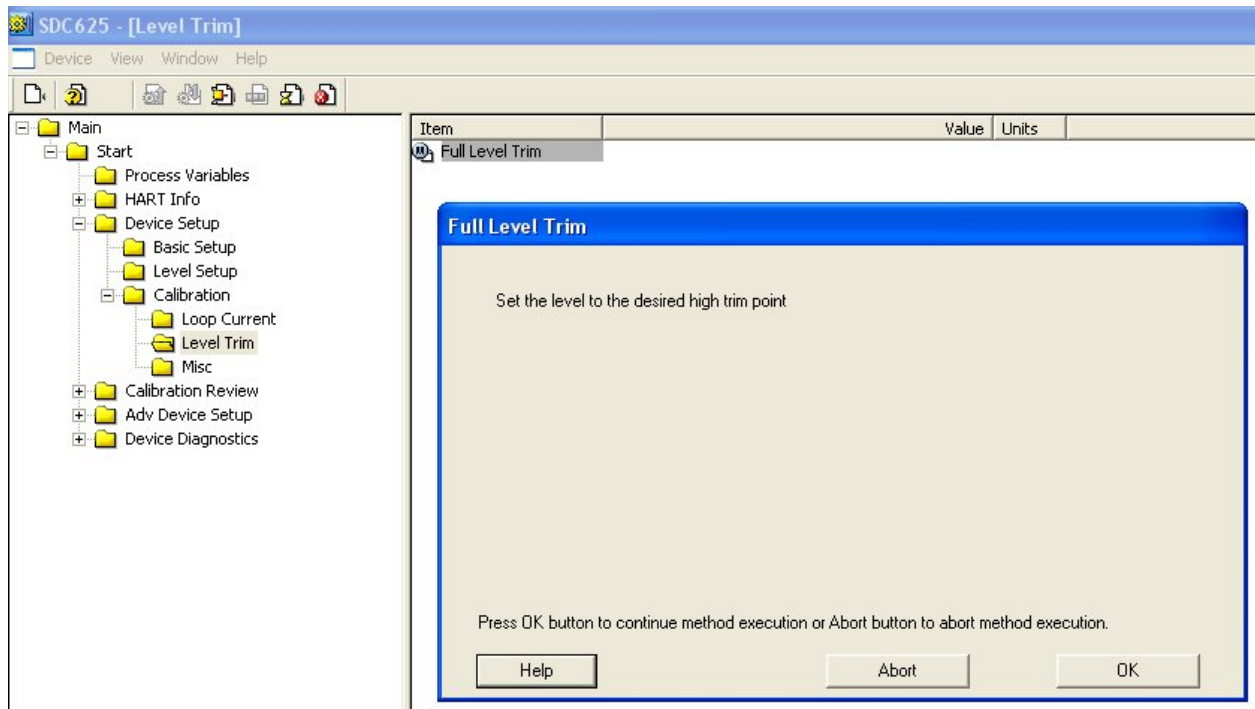
Two-point calibration requires actual level simulation, meaning the transmitter needs to detect level at the 0 and 100% points.

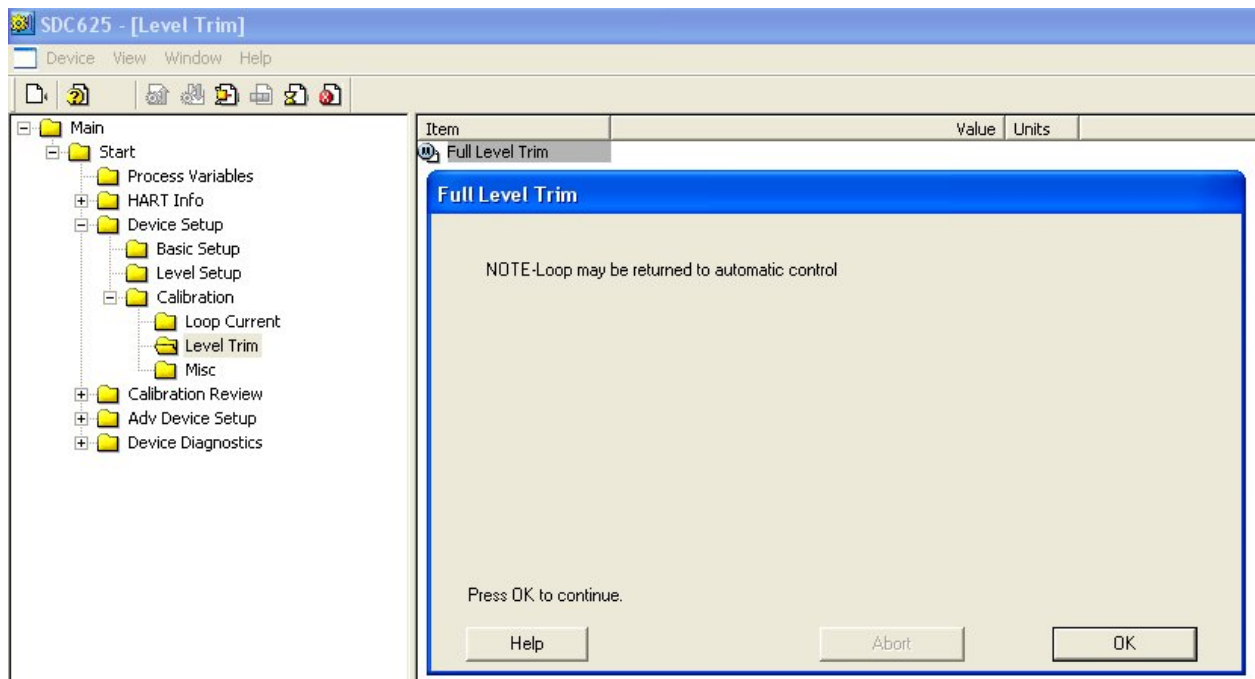
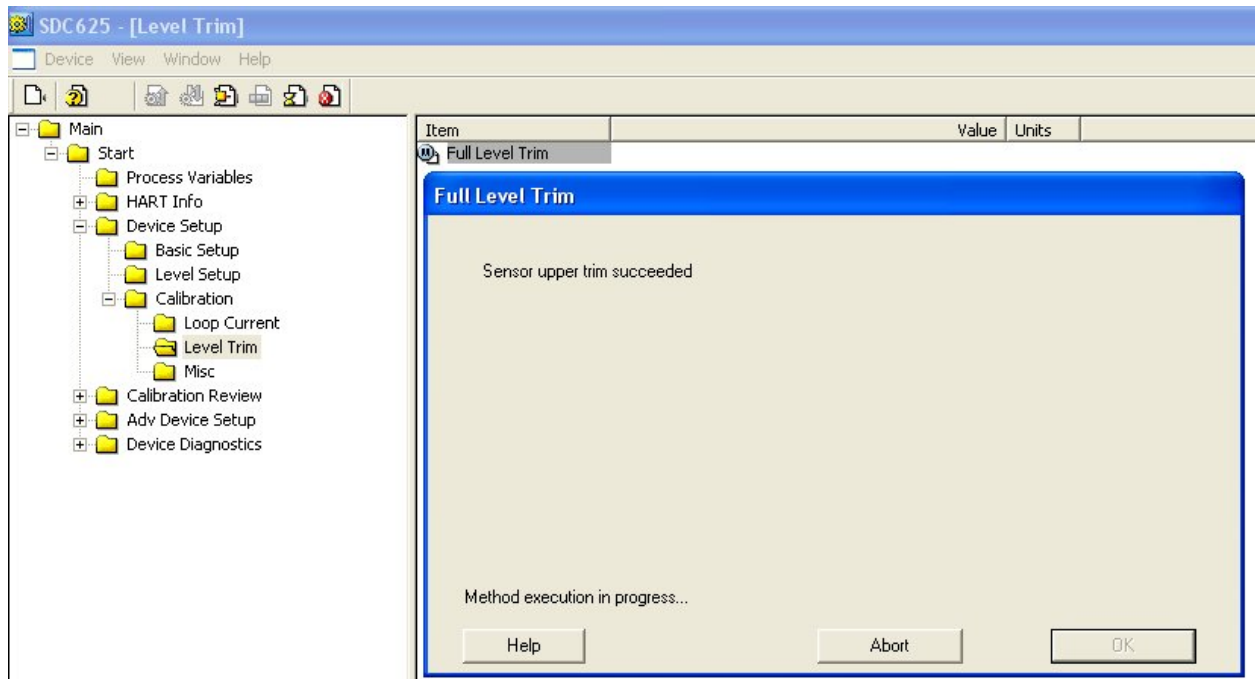


There is almost never a need to do a Full Level Trim, the LTM-350 (and 250) has 1-point calibration capabilities which allow calibration with existing level conditions. Also there are factory default configurations can be utilized to revert the transmitter back to its original settings (at time of shipment).









The "Misc" menu shows Magtech's software and hardware revision status. In following number: 1.01.05, the first "1" stands for the Major Device Revision (HART), the ".01" is for future features, and ".05" is for any minor software updates.

Item	Value	Units
Software Rev	1.01.05	
Hardware Rev	1.00.01	

9.4 Calibration Review

The "Calibration Review" menu displays READ-ONLY "raw" data values used for calculating level and the instruments linear output. These values will not mean much to the end user as is but can be highly beneficial when attempting to troubleshoot with factory assistance.

Level Gain = calculated slope using the linear equation: $y=mx+b$.

The menu depicts the raw data value (in tics) for the upper distance/level, also displayed in engineering units.

Item	Value	Units
Upper Point		
Lower Point		
Level Gain	-35.500	

Item	Value	Units
Raw Value	148 tics	
Measured Value	14.00 in	

SDC625 - [Lower Point]

Device View Window Help

Main

- Start
 - Process Variables
 - HART Info
 - Device Setup
 - Calibration Review
 - Level Calibration
 - Upper Point
 - Lower Point**
 - Raw Measurements
 - DAC Parameters
 - Adv Device Setup
 - Device Diagnostics

Item	Value	Units
Raw Value	645	tics
Measured Value	0.00	in

The menu depicts the raw data value (in tics) for the zero reference point, also displayed in engineering units.

SDC625 - [Raw Measurements]

Device View Window Help

Main

- Start
 - Process Variables
 - HART Info
 - Device Setup
 - Calibration Review
 - Level Calibration
 - Raw Measurements**
 - DAC Parameters
 - Adv Device Setup
 - Device Diagnostics

Item	Value	Units
Raw Temper A/D	0	
Level Pulse	151	tics
Interface Pulse	0	tics
Tic Limit	1620	tics

Raw Temper A/D – the raw RTD value (when configured).
 Level Pulse – the raw level reading (live)
 Interface Pulse – the raw interface reading (when configured).
 Tic Limit – the raw probe length value x 2.

SDC625 - [DAC Parameters]

Device View Window Help

Main

- Start
 - Process Variables
 - HART Info
 - Device Setup
 - Calibration Review
 - Level Calibration
 - Raw Measurements
 - DAC Parameters**
 - Adv Device Setup
 - Device Diagnostics

Item	Value	Units
Dac Zero	118	
Dac Full	3855	

The raw values of the digital-to-analog converter (DAC).

9.5 Advance Device Setup

Item	Value	Units
Alarms are:	Disabled	
Alarm...	22.00	in
Alarm High	22.00	in
Alarm Low	0.00	in
Alarm Low Low	0.00	in

These are digital alarms that can be utilized when attempting to control process level. All user selectable in engineering units.

Item	Value	Units
Energy	18	%
DC Offset	1.50	V
Hold Time	6	us
Interface:	Disabled	
Temperature:	Disabled	

The interface and temperature are read-only parameters that show how the transmitter has been configured. The Energy, DC Offset and Hold Time are all parameters that can be changed to accommodate longer/shorter probe lengths (see Section 7.2: Change Signal).

Item	Value	Units
Load	Factory	
Load	Sensor 1	
Save		
Load	Sensor 2	
Save		
Load	Sensor 3	
Save		
Save All		

The “Device Profiles” menu is easily the most valuable menu that the LTM-350 has to offer. This menu can be used to re-call the transmitter back to its original factory settings if parameters have been undesirably changed. Up to 3 additional settings can be stored to allow for easy plug, load play action.

9.6 Device Diagnostics

Device Diagnostics is a continuous monitor of transmitter health. The Device Status lets the user know about the analog output behavior of the transmitter.

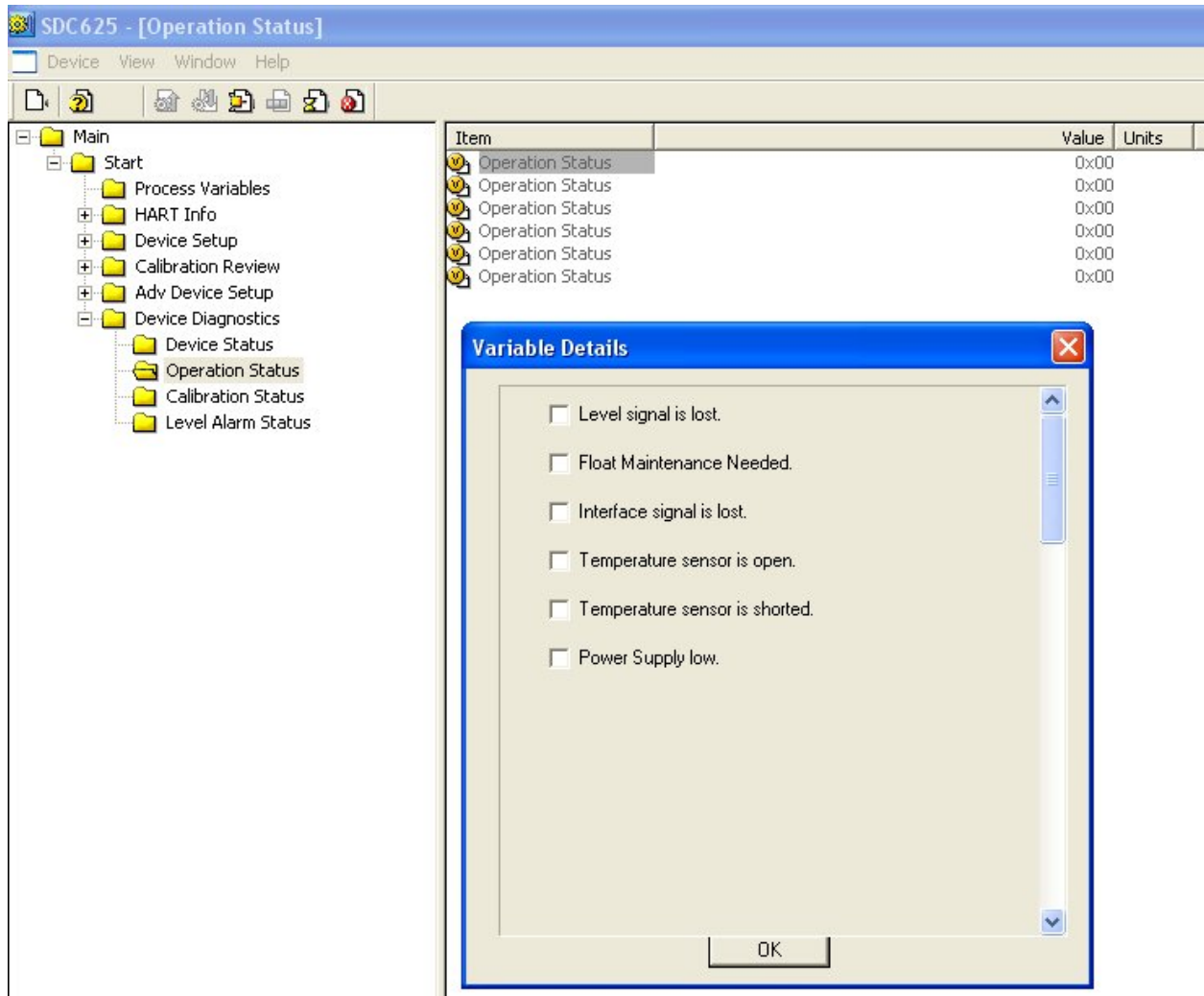
Item	Value	Units
Device status	0x00	
Device status	0x00	
Device status	0x00	
Device status	0x00	
Device status	0x00	
Device status	0x00	
Device status	0x00	
Device status	0x00	

Variable Details

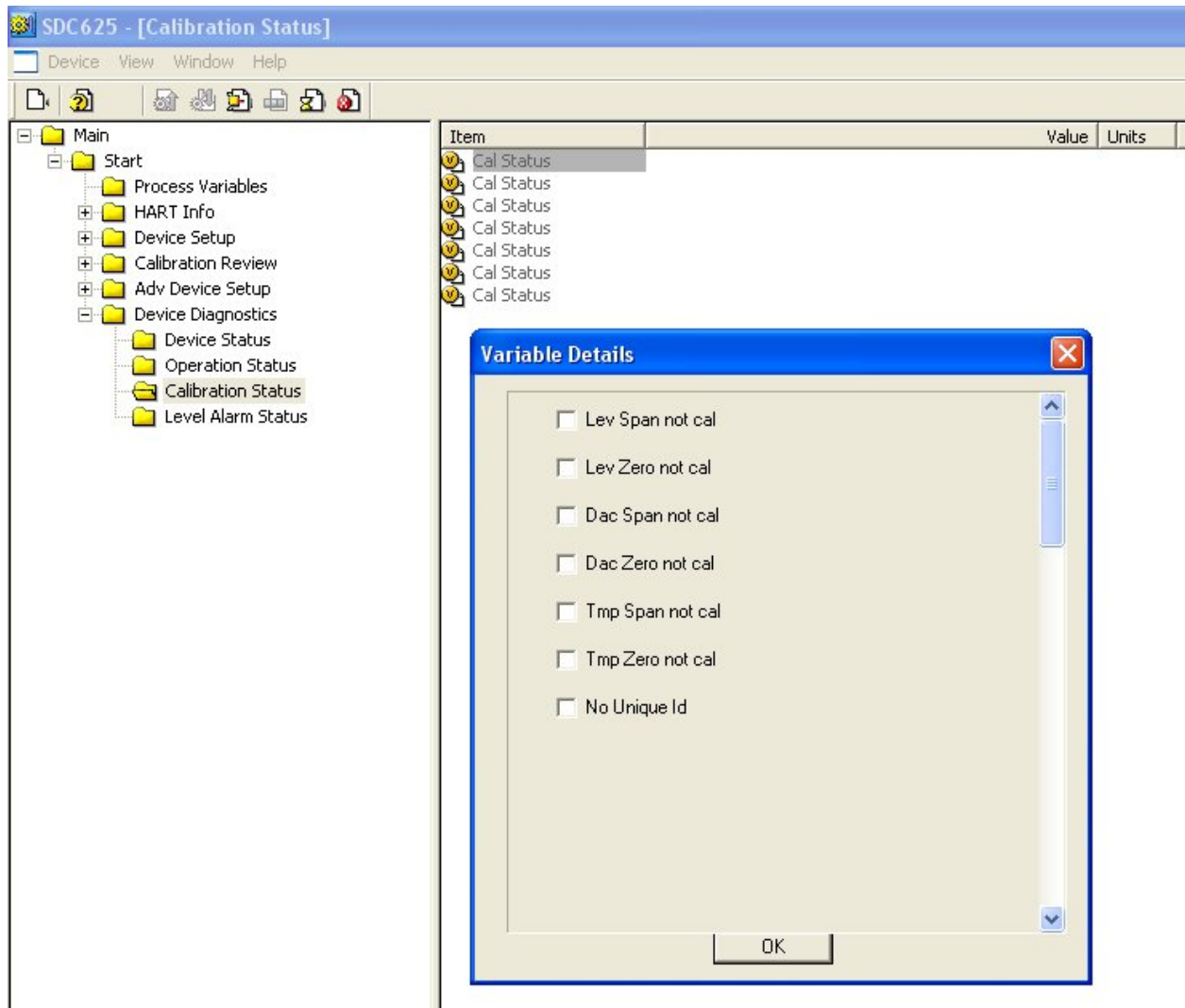
- Process applied to the primary variable is out:
- Process applied to the non-primary variable is
- Analog output 1 and its digital representation
- Analog output 1 and its digital representation
- Field device has more status available
- A reset or self test of the field device has occ
- A modification has been made to the configui
- Field device has malfunctioned due to a hard

OK

Operation status lets the user know how the transmitter is operating internally.



Calibration Status lets the user know if the instrument has been incorrectly calibrated.



Level Alarm status menu lets the user know if one or more of the digital alarms have been activated (if enabled by user).

