Instruction Manual

Model HART-Bridge Module

Model HRT Bridge
For use with Model 700 series sensors

TELEDYNE DETCON, Inc.
14880 Skinner Road, Cypress, Texas 77429
Phone 713.559.9200
www.teledynegasandflamedetection.com

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Shipping Address: 14880 Skinner Road, Cypress, Texas 77429
Phone: 713.559.9200
http://www.teledynegasandflamedetection.com • detcon-sales@teledyne.com

1. Introduction

1.1 Description

The HRT Bridge PCA is a bi-directional digital communication interface that provides data communication between the Model 700 sensors and HART®-enabled devices. The HART® (Highway Addressable Remote Transducer) Communication Protocol is a standard for sending and receiving digital information across analog wires between smart devices and a control host or monitoring system. A host can be any software application from a technician's hand-held device or laptop to a plant's process control, asset management, safety or other system using any control platform.

The HART Communication Protocol makes use of the Bell 202 Frequency Shift Keying (FSK) Standard to superimpose digital communication signals on the 4-20mA signal utilized by the Model 700 sensors. This enables two-way communication and makes it possible for additional information to be transferred to and from the sensor.

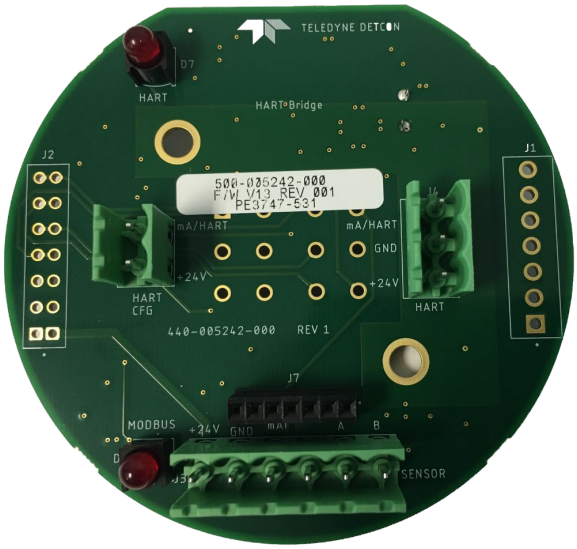

Figure 1 HART-Bridge PCA

The HRT Bridge PCA communicates with the Model 700 sensors via its Modbus™ interface and transfers that information to the HART Communication Protocol along with the 4-20mA Signal. This provides the ability for a HART Host System to communicate with the Model 700 sensor. This communication includes the ability for the Host to:

- Configure or re-configure the sensor
- Perform sensor diagnostics
- Troubleshoot the sensor
- Read additional information from the sensor
- Determine the sensor's health and status

2. Installation

The HRT Bridge PCA replaces the Transient Protection Assembly in the condulet the Model 700 sensor is attached to. The condulet and the Model 700 sensor should be mounted as prescribed in the sensor's manual. For units that have been ordered with the HRT Bridge installed, the section on installing the HRT Bridge PCA can be skipped.

NOTE: Block any unused ¾" NPT holes with the proper Plug. (Teledyne Detcon P/N 8522-750)

NOTE: Install only where the ambient temperature at place of installation is within the rated temperature limits of this device (see specifications).

NOTE: All devices connecting to the ¾" NPT conduit entries should be tightened to a minimum of 16 Foot-Pounds torque.

NOTE: The flamepath joints are not intended to be repaired if damaged.

NOTE: For ATEX & IECEx use, cable glands, adapters, and/or blanking elements shall be ATEX & IECEx certified to Ex d IIC and shall be installed.

WARNING: Cables and cable glands must be rated for ≥90°C.

NOTE: Use internal and external grounding points as required or recommended by electrical installation guidelines. Tighten to full hand-tight or 12 Foot-Lbs torque.

NOTE: Connect earth wire to crimped terminal (≥4mm^2) (Internal and external ground points).

CAUTION: Keep cover tight while circuits are live.

ATTENTION: Garder le couvercle bien ferme lorsque les circuits sont sous tension.

WARNING: Do not open when an explosive atmosphere may be present.

2.1 Installation of HRT Bridge PCA

The HRT Bridge PCA replaces the Transient Protection Assembly (TPA) in the condulet attached to the Model 700 sensor. The sensor is wired to the HRT Bridge PCA the same way as it is on the TPA so no re-wiring of the sensor connector is necessary.

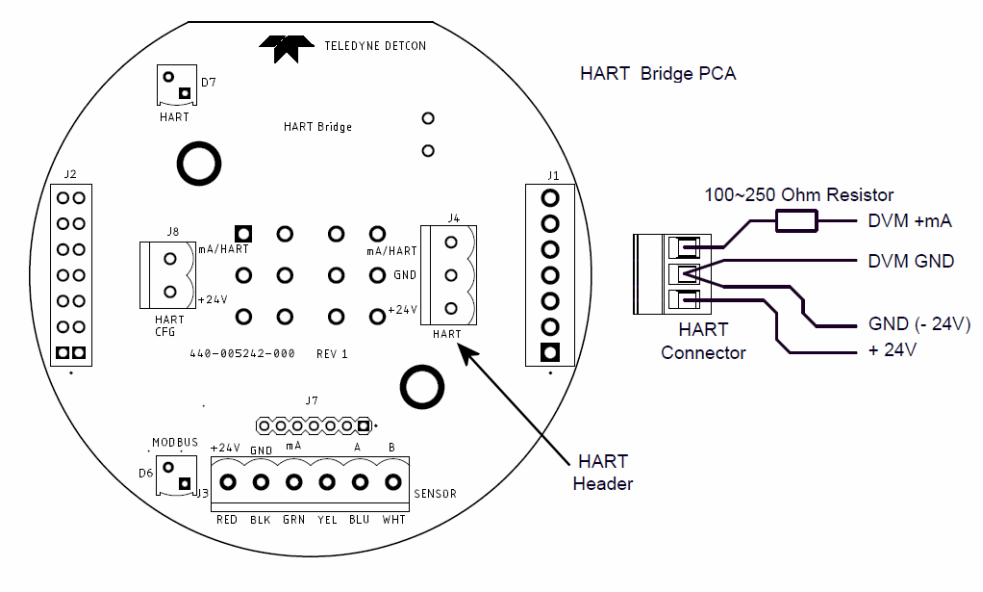

Figure 2 HRT-Bridge PCA

1. Remove the power/mA output connector from the TPA if power is applied.
2. Remove the connector from the Transient Protection PCA that connects to the 700 sensor.
3. Remove the hardware holding the Transient Protection PCA and remove the TPA from the condulet.
4. Install the HRT Bridge PCA in the condulet, using the same hardware used with the TPA.
5. Plug the sensor's connector into J3 on the HRT Bridge PCA, labeled "SENSOR".
6. Wire the power and 4-20mA output as described below.

NOTE: For products utilizing the aluminum junction box option, the conduit seal shall be placed at the entry to the junction box (see Figure 3 as an example). For products utilizing the stainless steel junction box option, the conduit seal shall be placed within 18" of the enclosure. Crouse Hinds type EYS2, EYD2 or equivalent are suitable for this purpose.

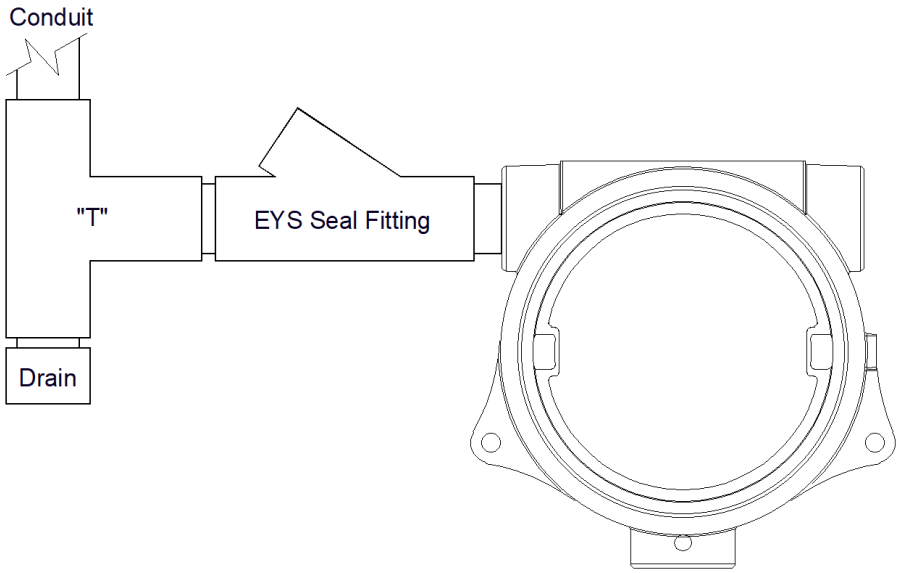

Figure 3 TYP Installation

2.2 Connecting the HRT Bridge

The HRT Bridge connection to the Host is a simple 3 wire connection of Power, Power Return, and mA. Refer to Figure 2.

1. Connect the 24VDC to the connector at J4 pin-3 labeled 24V.
2. Connect the 24V Return to the connector at J4 pin 2 Labeled GND
3. Connect the 4-20mA to the connector at J4 pin 1 labeled mA/HART.

The 4-20mA signal from the HRT Bridge must be connected to a load resistor to operate properly. If this signal is not terminated properly, the HRT Bridge, and the HART Interface will fail to work properly.

If not already plugged in, plug the connector from the Model 700 sensor into the header J3, labeled "SENSOR" on the HRT Bridge PCA.

The HART CFG Connector (J8) provides a connection for handheld devices such as the Emerson 375 Field Communicator without having to remove power from the unit. The two pins of the HART CFG connector are polarity independent and the two leads from the handheld configurator may be connected in any order.

3. Operation

When power is applied to the HRT Bridge PCA with the Model 700 sensor attached, the HRT Bridge will go through a boot up sequence that will last for approximately 30 seconds. During this time, the 4-20mA line is not enabled. After the boot up sequence the HRT Bridge will enter normal operation, and communication with the Host will begin. A red LED (D7) Labeled "HART" on the HRT Bridge PCA will illuminate when the PCA is communicating with the HART Host.

The 4-20mA signal from the HRT Bridge must be connected to a load resistor for HART communication to operate properly. If this signal is not terminated properly, the HRT Bridge, and the HART Interface, will fail to work. Normal termination for the 4-20mA signal is accomplished by connection to a Host device, which will have the correct load to terminate the signal properly.

The HRT Bridge receives 4-20mA signal from the 700 sensor and communicates with the Model 700 sensor through the Modbus™. A red LED (D6) Labeled "MODBUS" will blink when communication with the sensor occurs.

The HART interface has the ability to take the sensor into calibration. If the sensor is taken into calibration via the HART interface, the HART Communication Protocol will inform the Host that the sensor is in calibration mode, and will not set a fault. The 4-20mA signal will be set at 2mA. Starting a calibration using the sensor interface and magnetic tool will also cause the 4-20mA to be set to 2mA.

4. Operator Interface

The HRT Bridge PCA provides the ability to interface with the sensor via the HART Interface. The HART interface Host can be a PC, a Laptop, or several handheld devices such as the Emerson 375 Field Communicator. Although the displays on each device may be different and the menu names may change, the information provided should be the same. The HART Interface consists of three basic menus, each with a subset of menus or screens:

Device Variables Menu
- Primary Variables
- Identification

Diagnostics Menu
- Device Status
- Sensor Status

Device Status Menu
- Configuration Setup
- Calibration
- HART Setup

NOTE: The screen shots shown below are taken from the HART Communication Foundation SDC625 Reference Host. The user's screen appearance may be different depending on the HART host used.

4.1 Device Menu

4.1.1 Primary Variables

The primary Variable Screen contains the basic information from the sensor and is broken into four basic sections. None of these variables are changeable, and are directly read from the sensor.

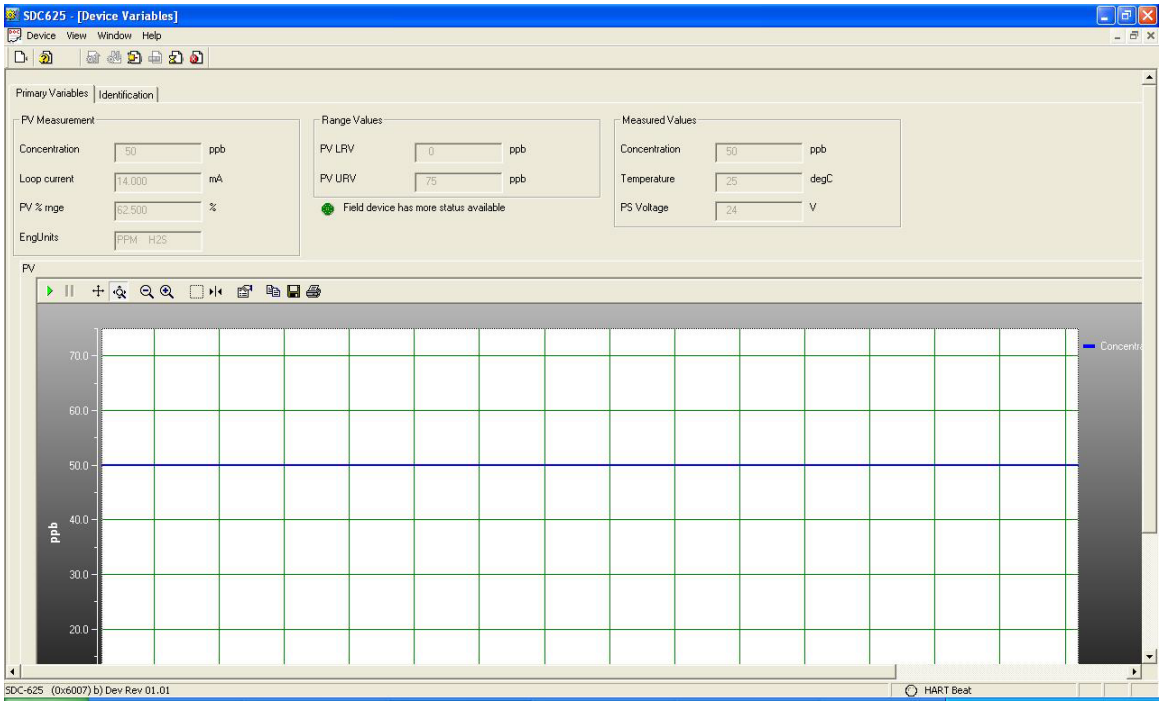

Figure 4 Primary Variables

Primary Variables

- Concentration – the value of the gas concentration measured by the sensor. The units of measurement (ppm, ppb, or %) are shown to the right of the concentration value. This is the HART primary variable.
- Loop Current – the value of the output 4-20mA loop current
- PV %rnge – Primary variable percent of range
- EngUnits – the measurement units and gas type

Range Variables

- PV LRV – Primary variable lower range value (normally 0 for most sensors)
- PV URV – Primary variable upper range value, or the range of the sensor (i.e. 100ppm, 10ppm, 5%, etc.)

Device Status

- Indicates the device has more status information available. If this icon is green, no additional status information is available. If it is red, refer to Section 4.2 Diagnostics for more information.

Measured Values

- Concentration – the value of the gas concentration measured by the sensor. The units of measurement (ppm, ppb, or %) are shown to the right of the concentration value
- Temperature – displayed in degrees Centigrade.
- PS Voltage – power supply voltage. Nominally 24VDC

PV – Graphic display

A graphic display of the sensor concentration reading may also be displayed in this screen. The graph will be a graphic display of concentration verses time.

4.1.2 Identification

The Identification screen contains 4 sections that provide some basic HART information as well as some additional sensor information. None of these variables are able to be changed in this screen, although some of these variables may be changed elsewhere.

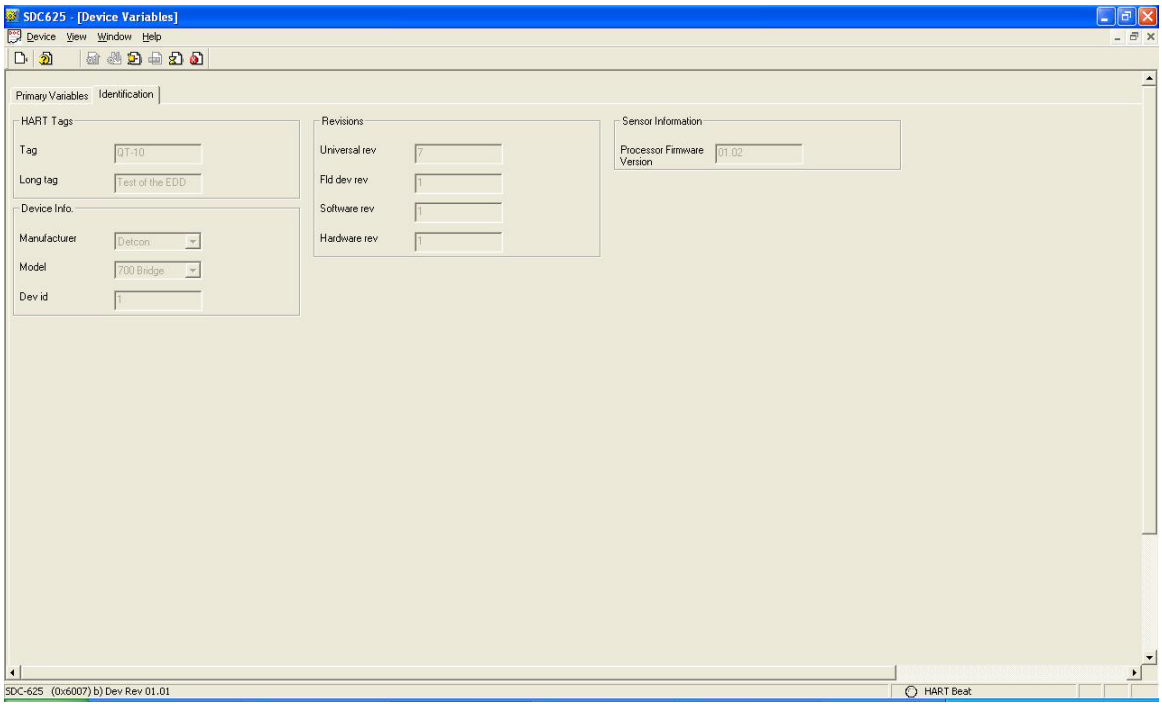

Figure 5 Identification

HART Tags

- Tag – Text that is associated with the field device installation. This text can be used by the user as they see fit. A recommended use is a unique label that correlates to a field device label: a plant drawing, or on a control system. This variable is also used as a type of data link layer address handle.
- Long Tag – Functions exactly like the Tag except the size is larger (max 32 ISO Latin 1 characters).

Device Info.

- Manufacturer – Device manufacturer – "Detcon"
- Model – Device model – "700 Bridge"

- Dev ID – Field Device Identification – Uniquely identifies the field device when combined with the Manufacturer and Model. This variable cannot be modified by the user. Normally "1".

Revisions

- Universal rev – Revision of the HART Communication Protocol (currently revision 7)
- Fld dev rev – Revision of the Field Device Specific Device Description
- Software rev – Revision of the software embedded in the HRT Bridge PCA
- Hardware rev – Revision of the hardware in the HRT Bridge PCA.

Sensor Information

- Processor Firmware Version – Version of the firmware currently loaded in the Model 700 sensor.

4.2 Diagnostics Menu

The Diagnostics Menu contains two screens; 1) Device Status and 2) Channel Status. Both screens consist of a list of possible device error or status conditions. Next to each status condition is a small icon—green to indicate normal status or red to indicate an abnormal, changed or malfunction condition.

4.2.1 Device Status

Device Status contains one screen that shows the status of the sensor and the HRT Bridge PCA. The left side of the screen (Device Status) displays the status of the HRT Bridge PCA, with icons that display either green to indicate normal condition or red to indicate an error, a change, or a malfunction.

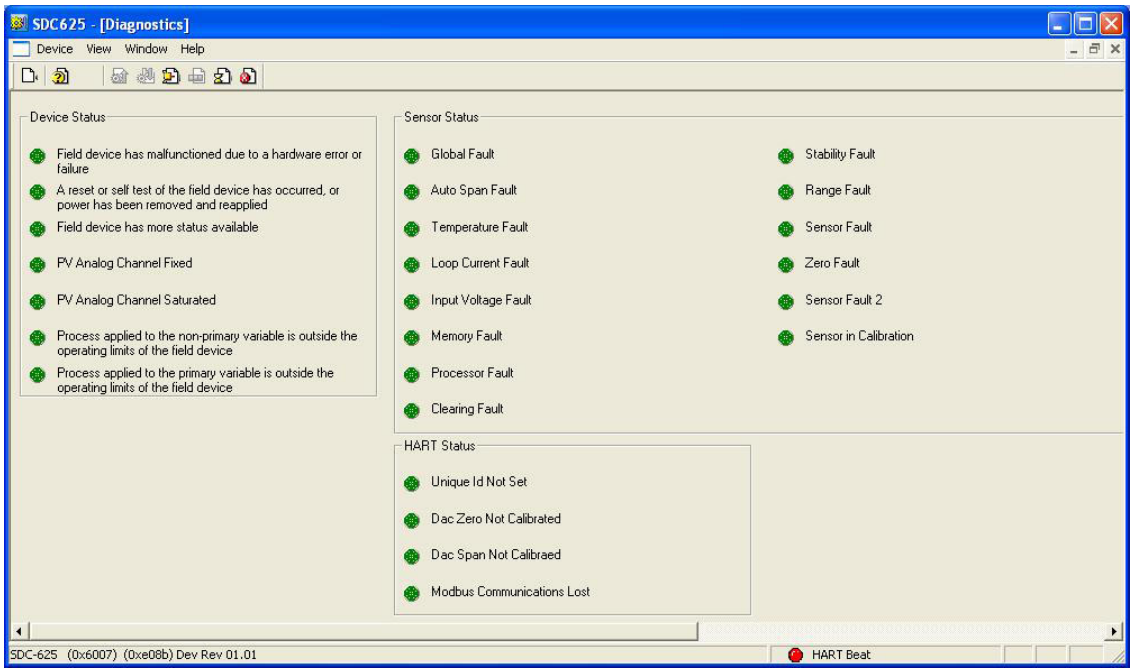

Figure 6 Device Stats Screen

Device status conditions include:

- Field device has malfunctioned due to a hardware error or failure
- A reset or self test of the field device has occurred, or power has been removed and reapplied
- Field device has more status available
- PV analog channel fixed
- PV analog channel saturated
- Process applied to the non-primary variable is outside the operating limits of the field device
- Process applied to the primary variable is outside the operating limits of the field device

4.2.2 Sensor Status

The Sensor Status section of the screen shows the status of the Model 700 sensor. Icons are used to display the status of the sensor and display either green to indicate normal condition or red to indicate an error, a change, or a malfunction.

Sensor status conditions include:

- Global Fault – The Model 700 sensor has one or more faults.
- Auto span fault – 180 days or more has elapsed since the last successful AutoSpan
- Temperature fault – the detector is currently reporting an ambient temperature that is outside of the –40C to +70C range
- Loop current fault – The sensor has detected a condition where the 4-20mA output loop is not functional
- Input voltage fault – The sensor is currently receiving an input voltage that is outside of the 11.5-28VDC range
- Memory fault – The detector has a failure in saving new data to memory
- Processor fault – The detector has an unrecoverable run-time error
- Clearing Fault – The sensor reading failed to clear after removal of span gas during an AutoSpan sequence
- Stability Fault – The sensor reading failed to attain a stable reading when span gas was applied during an AutoSpan sequence
- Range Fault – Sensor fails the minimum signal change criteria during an AutoSpan sequence
- Sensor fault – The sensor cell has failed
- Zero Fault – the sensor drifts below –10% of full range
- Sensor Fault 2 – heater fault (TP-700), bridge fault (FP-700), or missing cell (DM-700). This status is not used by the IR-700 or PI-700.
- Sensor in Calibration – The sensor is currently being calibrated.

4.2.3 HART Status

The HART status section of the screen shows the status of the HART interface on the HRT Bridge PCA. Icons next to each error description indicate if an error has occurred. A green icon indicates the error condition is not present and a red icon indicates an error has occurred.

- Unique ID Not Set – The unique device ID for the HRT Bridge PCA has not been set. This ID is set at the Detcon factory prior to shipping. If this error occurs, please contact Detcon technical support.
- Modbus Communications Lost – The Model 700 sensor has failed to respond to more than 3 Modbus poll requests. This error condition can be reset using the “Reset Comm Lost Status” button that appears when this error condition occurs

4.3 Device Setup Menu

The Device Status Menu consists of three sub menus that allow parameters within the HRT Bridge PCA and within the sensor to be changed or modified, and allows calibration of the sensor.

4.3.1 Configuration Setup

The Configuration Screen displays the configuration of the Model 700 sensor. There are no fields that can be changed on this screen, these fields are read directly from the Model 700 sensor.

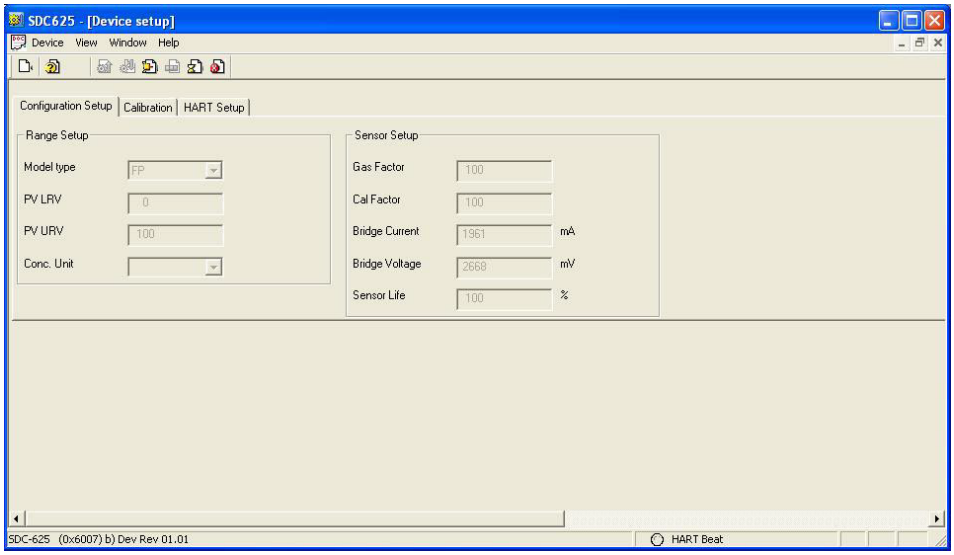

Figure 7 FP Configuration Setup

This screen will vary depending on the type of Model 700 sensor attached to the HRT Bridge. The Range Setup will display the model type of the sensor, followed by the PV LRV (Primary Variable Lower Range Value) and the PV URV (Primary Variable Upper Range Value), and the Conc Units (Concentration Units). The display may also show the Sensor Range. The Sensor Setup portion of the screen will display sensor specific parameters:

DM

- Sensor Range
- Cell Bias
- Gain Code
- Raw Counts
- Sensor Life

FP

- Gas Factor
- Cal Factor
- Bridge Current
- Bridge Voltage
- Sensor Life

IR

- Gas Factor
- Active Counts
- Reference Counts
- Range Multiplier
- Sensor Life

PI

- Sensor Range
- Gain Code
- Raw Counts
- Zero Offset
- Sensor Life

TP

- Heater Power
- Heater Voltage
- Sensor Resistance
- Heater Current
- Sensor Life

NOTE: The values above are read when the HRT Bridge boots up and are not updated in real-time

4.3.2 Calibration

The Calibration screen displays the days since the last calibration, and the auto span level. This screen also allows the user to calibrate the sensor by performing an Auto Zero Calibration and an Auto Span Calibration. Calibration of the sensor using this feature also notifies the Host that the sensor is in calibration mode.

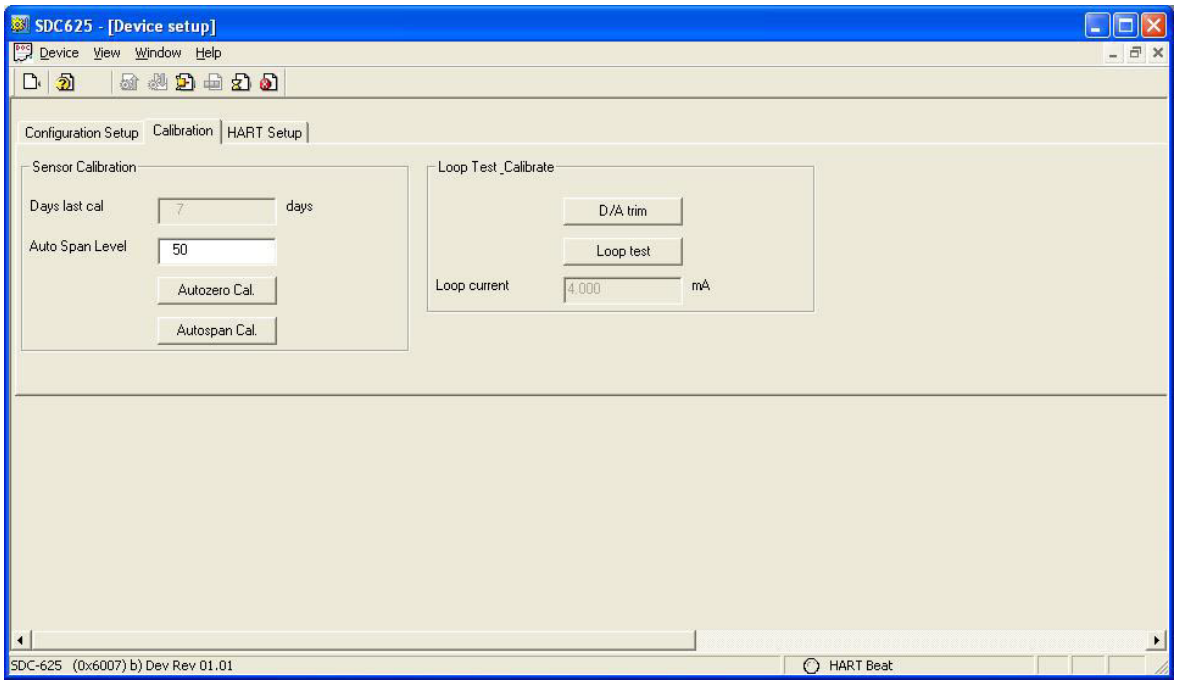

Figure 8 FP Calibration Screen

4.3.2.1 Sensor Calibration using the HRT Bridge

Calibration of a sensor using the HRT Bridge follows the same principle as calibrating the sensor via the magnetic interface. Since most of the calibration information can be found in the associated sensors manual, it is important to have the sensor manual on hand when performing sensor calibration.

Each sensor type has different criteria that need to be met before calibration of the sensor should be performed. Refer to the appropriate sensor manual for specific information on gas to be used, flow rates, interference gas, cross calibration gas, and other sensor specific criteria.

NOTE: The TP sensor does not perform an Auto Zero function. Although the menu may provide this option, the test is invalid, and is not performed.

Auto Zero

Auto Zero function is used to zero the sensor. Local ambient air can be used to zero most sensors as long as there are no traces of target or interference gases. If this cannot be confirmed, then a zero air or N2 should be used. N2 must be used for zero calibration of O2 deficiency sensors.

Material Requirements:

- Handheld Communicator or PC and interface for HRT Bridge
- Teledyne Detcon PN 613-120000-700 Model 700 Splash Guard with integral Cal Port. -OR- Teledyne Detcon PN 943-000006-132 Threaded Calibration Adapter
- Teledyne Detcon PN 942-001123-000 Zero Air cal gas (or use ambient air if no target gas is present)
- Teledyne Detcon P/N 942-640023-100 Nitrogen 99.99%

NOTE: Refer to appropriate sensor manual for the specific information on zero gas. For DM, IR, and PI sensors, the zero gas source may be zero air or N_2, but must be pure N_2 (99.99%) for O_2 deficiency sensors. For FP sensors, zero air should be used. Zero Air should have a normal background of 20.89% O_2. Pure Nitrogen (N_2) should not be used or errors may result.

Auto Zero consists of entering “Autozero Cal” and following the menu-displayed instructions.

1. If applicable install the Calibration Adapter or Splash Guard Adapter with integral Cal Port.
2. If applicable connect zero gas to the cal port.
3. Select "Autozero Cal" from the Sensor Calibration section of the screen.
4. Upon entering Auto Zero Calibration the procedure will prompt to begin Auto Zero Calibration. If zero gas is to be applied to the sensor, apply the gas.

NOTE: Upon entering calibration the 4-20mA signal drops to 2mA and is held at this level until the program returns to normal operation.

5. The procedure will prompt to verify that no gas is present, and the sensor will perform Auto Zero.

NOTE: The sensor will scroll "**Zero Cal . . . Setting Zero . . . Zero Saved**" twice.

6. After successfully setting Zero Cal the sensor and the HART Interface will return to Automatic Mode.
7. Remove the zero gas and calibration adapter (if applicable.)

Auto Span

The Auto Span function is used to calibrate the sensor. Unless otherwise specified by the associated sensor manual, span calibration is recommended at 50% of range.

Material Requirements:

- Handheld Communicator or PC and interface for HRT Bridge
- Teledyne Detcon PN 613-120000-700 Model 700 Splash Guard with integral Cal Port. -OR-
  Teledyne Detcon PN 943-000006-132 Threaded Calibration Adapter
- Teledyne Detcon Span Gas (See Detcon for Ordering Information). Recommended span gas is 50% of range with target gas. Other suitable span gas sources containing the target gas in air or N_2 balance may be acceptable.

NOTE: Refer to the appropriate sensor manual for information regarding Span Gas, flow rates, cross interference, or other sensor specific criteria.

Auto Span consists of entering "Autospan Cal" and following the display. The procedure will ask for the application of span gas. The applied gas concentration must be equal to the Autospan gas level setting. The factory default setting and recommendation for span gas concentration is normally 50% of range. If a span gas containing the recommended concentration is not available, other concentrations may be used as long as they fall between 5% and 100% of range. However, any alternate span gas concentration value must be set in the **"Auto Span Level"** field before proceeding with "Autospan cal".

CAUTION: Verification that the calibration gas level setting matches the calibration span gas concentration is required before executing "Autospan Cal". These two numbers must be equal. Refer to the appropriate sensor manual for more information.

1. If applicable install the Calibration Adapter or Splash Guard Adapter with integral Cal Port.
2. Verify that the Auto Span Level is equal to the calibration span gas concentration. If the Auto Span Level is not equal to the Calibration span gas concentration, adjust the Auto Span Level.
3. Connect the Cal Gas to the sensor, but do not apply the gas.
4. Select "Autospan Cal" from the Sensor Calibration section of the screen.

NOTE: Upon entering calibration the 4-20mA signal drops to 2mA and is held at this level until the program returns to normal operation.

5. Upon entering the procedure the procedure will prompt to begin Auto Span Calibration.
6. The procedure will prompt to apply span gas. Apply span gas from the attached cal gas cylinder and respond to the prompt.

NOTE: The sensor reading will respond to the gas and will switch to displaying a flashing "**XX**".

NOTE: Assuming acceptable sensor signal change, after 1 minute the reading will auto-adjust to the programmed Auto Span level. During the next 30 seconds, the Auto Span sequence checks the sensor for

acceptable reading stability. If the sensor fails the stability check, the reading is re-adjusted back to the Auto Span level and the cycle repeats until the stability check is passed. Up to three additional 30-second stability check periods are allowed before the unit reports a "**Stability Fault**" twice and the sensor will return to normal operation, aborting the Auto Span sequence. The sensor will continue to report a "**Stability Faul**t" and will not clear the fault until a successful Auto Span is completed.

NOTE: If the sensor passes the stability check, the sensor reports a series of messages:

"**Span OK**"
"**Sensor Life XXX%"**
"**Remove Span Gas**"

NOTE: When calibrating O2 deficiency sensors, there is no requirement to clear to <5% of range. The sensor will return to normal operation immediately after span adjustment.

7. When the sensor passes calibration the procedure will prompt to remove the span gas. Unsuccessful completion of the span calibration will create a Global Fault, and "Autospan Cal" will be aborted with a change to the HART Sensor Status (refer to section 4.2.2 Sensor Status).
8. After successfully setting span cal the sensor and the HART Interface will return to Automatic Mode.
9. The Auto Span Calibration is complete
10. Remove the cal gas and calibration adapter if applicable.

NOTE: If the sensor fails the minimum signal change criteria, a **"Range Fault"** will be declared and a "**Fault Detected**" message will be displayed alternately on the sensor with the current reading. The HART Sensor Status will change to reflect a Range Fault.

NOTE: If the sensor fails the stability criteria, a **"Stability Fault"** will be declared and a "**Fault Detected**" message will be displayed alternately on the sensor with the current reading. The HART Sensor Status will change to reflect a Sensor Fault.

NOTE: If the sensor fails the clearing time criteria, a "**Clearing Fault**" will be declared and a **"Fault Detected**" message will be displayed alternately on the sensor with the current reading. The HART Sensor Status will change to reflect a Clearing Fault

4.3.2.2 Loop Test Calibrate

The Calibration Screen contains a Loop Test Calibration section. This section displays the loop current reading. However, the HRT Bridge only receives the 4-20mA signal from the 700 series sensor—it cannot make changes to the 4-20mA output.

4.3.3 HART Setup

The HART Setup Screen allows parameters of the HRT Bridge to be changed or modified. Changes made on this screen will not be applied until power is cycled on the unit.

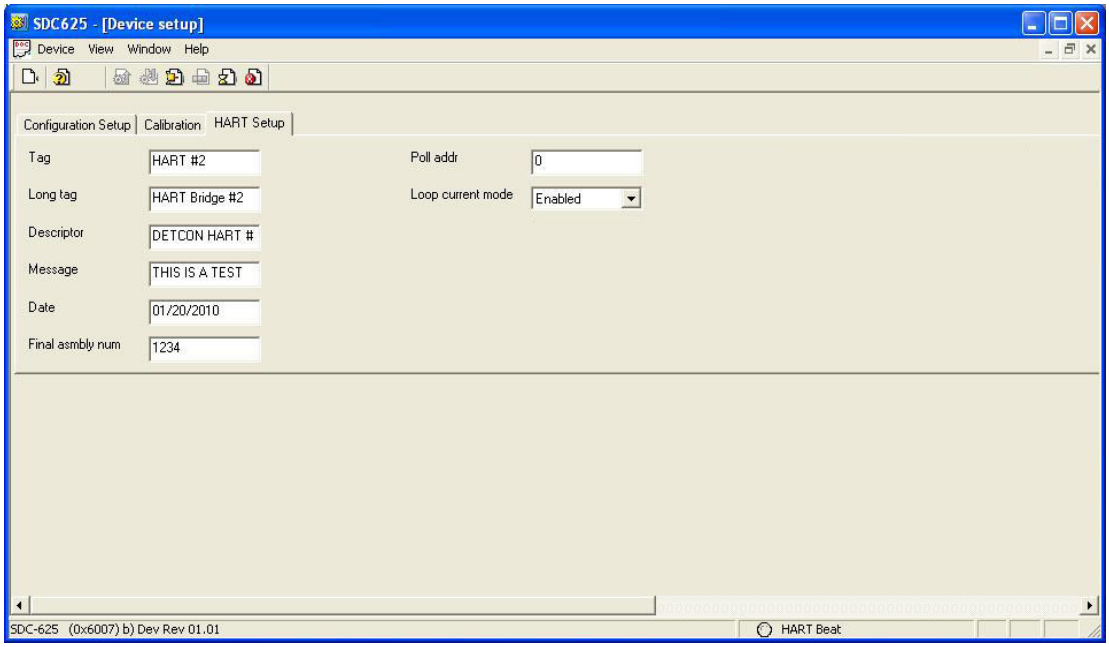

Figure 9 HART Setup

- Tag – Text that is associated with the field device installation. This text can be used by the user as they see fit. A recommended use is a unique label that correlates to a field device label: a plant drawing, or on a control system. This variable is also used as a type of data link layer address handle.
- Long Tag – Functions exactly like the Tag except the size is larger (max 32 ISO Latin 1 characters).
- Descriptor – Text that is associated with the field device. This text can be used by the user in any way. There is no specific recommended use.
- Message – Text that is associated with the field device. This text can be used by the user in any way. There is no specific recommended use.
- Date – Gregorian calendar date that is stored in the field device. This can be used by the user in any way. There is no specific recommended use.

NOTE: This field is not updated by the HRT Bridge and does not indicate the current date

- Final asmbly num – Number that is used for identification purposes, and is associated with the overall field device.
- Poll addr – This number is the address of the HRT Bridge on a network and must be set to 0.

5. Specifications

Inputs

Any Model 700 Gas Sensor

See specific Model 700 Gas Sensor manual for specifications

Input Power

11.5 to 30VDC (Nominal 24VDC)

Power Consumption (excluding 700 Gas Sensor)

< 0.4 Watts at 24VDC (Normal)

< 0.8 Watts at 30VDC (Maximum)

Ambient Temperature

–40°C to +70°C (ATEX & IECEx)

–25°C to +75°C (CSA)

Humidity: 10 to 95% Non-condensing

Hazardous Location Designation

Class I, Division 1 Groups BCD

Class I, Zone 1, AEx db IIB+H2

II 2 G Ex db IIB+H2 T4 Gb

EN IEC 60079-0:2018

EN 60079-1:2014

EMC Compliance

EN 50270:2015

Equipment Certifications

cCSAus (1840892)

ATEX (DEKRA 15ATEX0025X)

IECEx (DEK 22.0066X)

Outputs

Analog 4-20mA DC

HART® Communication Protocol

HART® Version

7.0

Manufacturer ID

0x6007

Device ID

0xE08B

Warranty

One year

Five year fixed fee service policy

6. Warranty

All warranties are FOB the Teledyne Detcon factory. Should any product fail to perform in accordance with published specifications within the warranty period, return it freight pre-paid to Teledyne Detcon Inc., 14880 Skinner Rd., Cypress, Texas 77429 for necessary repairs.

Teledyne Detcon Inc., as manufacturer, warrants each new HRT Bridge PCA to be free from defects in material and workmanship under intended normal use for a period of one year. The warranty period begins on the date of shipment to the original purchaser and ends one year thereafter.

7. Revision Log

Revision	Date	Changes made	Approval
0.0	02/16/10	Original Release.	LU
0.1	04/09/10	Add Approval block to Revision History	LU
0.2	06/03/10	Change product name to Model 700 HRT Bridge	LU
1.0	11/07/15	Updated per ATEX requirements	MJM
1.1	01/03/17	Added EU DOC	LU
1.2	06/07/18	Updated Section 2.1 Conduit Seal	MM
1.3	12/09/19	Updated Company Information and Label	MM
1.4	08/04/20	Removed references to HRT Bridge change or control of 4-20mA loop, to align with HRT Bridge PCBA change to use analog 4-20. New line drawing showing 5242 PCB.	KM
1.5	12/08/20	Updated company address and label	KM
1.6	12/22/22	Updated Certifications	KM

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Shipping Address: 14880 Skinner Road, Cypress, Texas 77429
Phone: 713.559.9200
http://www.teledynegasandflamedetection.com • detcon-sales@teledyne.com