
Getting Started with the InLink-HM using the InLink Evaluation Board

INTRODUCTION

InLink-HM 101-0014 is a complete OEM HART protocol modem module for Highway Addressable Remote Transducer (HART) communications. It can also be used as a HART to modbus accumulator polling up to 16 HART devices. For evaluation and development support, the InLink-HM module is compatible with the [101-0003 InLink Evaluation Board](#). InLink-HM is designed to be implemented on a PCB for OEM applications.

As a HART protocol modem - InLink-HM receives packets on the TXD input pin, at the configured baud rate and parity setting, and then sends the packet to the HART loop. After sending the packet, InLink-HM switches the modem to receive, to acquire the reply. The reply is transmitted on the RXD output pin at the configured baud rate and parity setting. The HR output pin provides indication that a HART packet is being received.

As a Modbus accumulator - InLink-HM can be configured to continuously poll up to 16 HART devices and save the HART device data into modbus registers. Modbus RTU commands can then be used to read the HART device data. Configuration is simple using the included HM Configuration software. Settings are saved in modbus registers so modbus RTU commands can also be used to edit the InLink settings.

Included with the InLink-HM is a CD that includes PACTware, HART device addresser, and the HM Configurator. Also included are the HART DTM and Generic DTM modules which will be used in conjunction with PACTware, to allow you to use InLink-HM as a HART modem.

This document will demonstrate how to install the included software and connect the necessary hardware that will allow you to communicate to a HART Device using the InLink-HM with the InLink Evaluation Board. It also demonstrates how to configure and use InLink-HM as a HART to modbus accumulator.

RS-232 HART PROTOCOL INTERFACE MASTER

The InLink application shown in [Figure 1](#) is for an RS-232 HART protocol interface master or Modbus accumulator. This configuration will be used to evaluate the InLink-HM in this document.

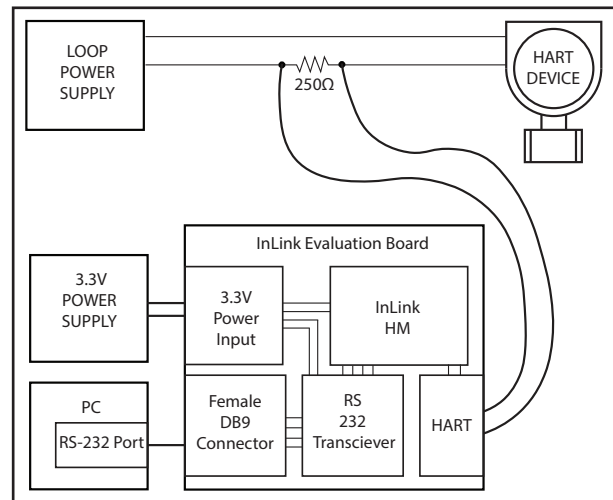


Figure 1. HART master or Modbus Accumulator application

INLINK EVALUATION BOARD

The InLink Evaluation Board, Microflex [part # 101-0003](#), provides product developers the ability to quickly evaluate the InLink-HM modem module (see [Figure 2](#)). It provides a simple RS-232 to HART interface compatible with most off the shelf HART protocol software including PACTware and the Generic HART DTM. The InLink Evaluation board has the following components:

1. RS-232 DB9 Female Connector that will allow you to connect the InLink Evaluation board to your PC via an RS-232 DB9 Male to DB9 Female Extension cable
2. 2 Position Screw Terminal Connector that allows you to input a 3.3V power supply to the Evaluation Board

WARNING : Use only 3.3V with InLink-CC and InLink-HM modules

3. Sipex SP3223 RS-232 Transceiver to convert data between the InLink-HM's 3.3V logic levels and your PC's RS-232 logic levels
4. Compatible InLink-HM footprint with female pins to allow you to easily snap in your InLink-HM
5. 2 Position Screw Terminal to allow you to easily connect to the HART loop. InLink-HM includes transformer isolation and capacitor coupling. Terminals can be connected directly to the HART loop.
6. LED to indicate power to the InLink Evaluation board is present.
7. LED to indicate when a HART reply was received (see [Figure 4](#)).

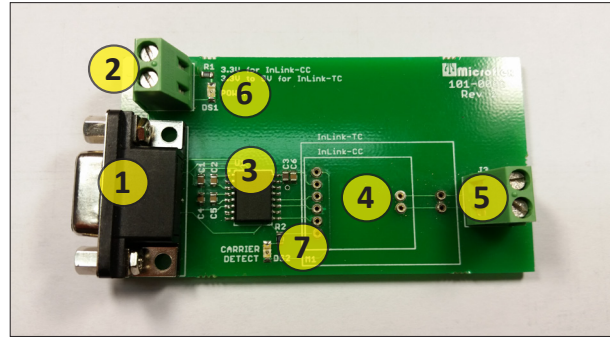


Figure 2. InLink Evaluation Board

CONNECTING THE HARDWARE

PLACING THE INLINK-HM MODULE ON THE INLINK EVALUATION BOARD

The InLink-HM module can easily be placed into the InLink-Evaluation board by aligning the InLink's gold plated pins with the InLink Evaluation boards female pins and pressing down on the InLink module (see [Figure 3](#)).

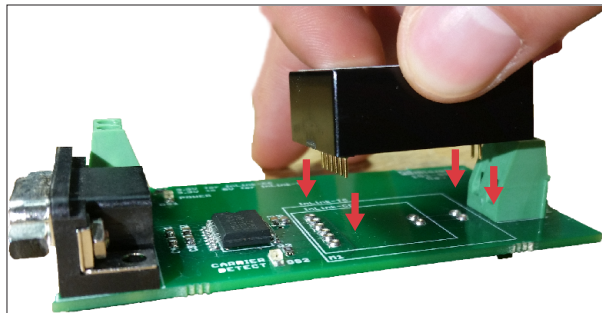


Figure 3. Placing the InLink-HM on the InLink Evaluation Board

[Figure 4](#) shows a diagram of the InLink-HM connected to the InLink Evaluation board. Notice the **HR** output Pin is connected to an LED. The HR output pin indicates when InLink-HM receives a HART reply. This LED will be helpful with software debugging.

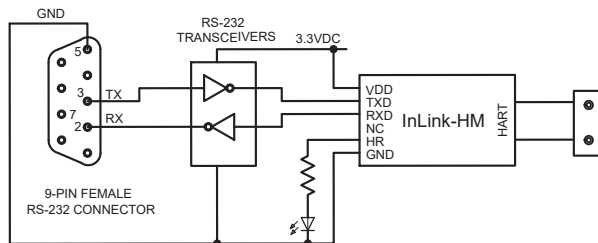


Figure 4. Diagram of InLink-HM placed on the InLink Evaluation board

CONNECTING THE EVALUATION BOARD TO A PC

To connect the InLink Evaluation board to a PC you will need an RS-232 DB9 Male to DB9 Female extension cable. Microflex offers [part# M01-06](#) RS-232 Extension cable. Connect the extension's cable DB9 male connector to the InLink Evaluation board and the female connector to an RS-232 serial port on your PC. If your PC does not have an RS-232 port, then a USB to RS-232 serial converter connected to a USB port can be used.

3.3 VOLT POWER SUPPLY

The InLink Evaluation Board will need an external power supply of **3.3V** to power the Inlink-HM module and the RS-232 transceiver on the evaluation board (see [Figure 1](#)). VDD should be heavily filtered to prevent noise from interfering with the received HART data and receiver filter. VDD should have less than $\pm 50\text{mV}$ P-P noise. Wait at least 25 milliseconds after power on before starting any HART transactions.

CONNECTING TO THE HART LOOP

The HART protocol requires that a HART modem be coupled to the field device loop in a way that does not interfere with the current loop. InLink-HM includes the necessary components to simplify this. There is no need to consider polarity or ground issues between the HART network and the InLink ground. InLink provides the necessary isolation between the modem interface and the HART loop. In most cases the two HART pins can be connected directly to the HART loop in the same way that any other HART modem can be connected.

The HART protocol requires a loop resistance of 230 to 600 ohms, typically 250 ohms. This resistor is not included in the InLink-HM - You will need to provide this. The evaluation board includes a two position screw terminal that allows you to easily connect to the HART loop. [Figure 1](#) shows a common method for connecting a HART modem to a loop powered device. Once you have made all the connections you are now ready to begin evaluating the InLink-HM module. See [Figure 5](#) for a picture of a typical RS-232 to HART interface application.

LOOP POWER SUPPLY

For the loop power supply please check with your HART Device manufacturer for the recommended settings. In this example the HART device will use a 24V power supply.

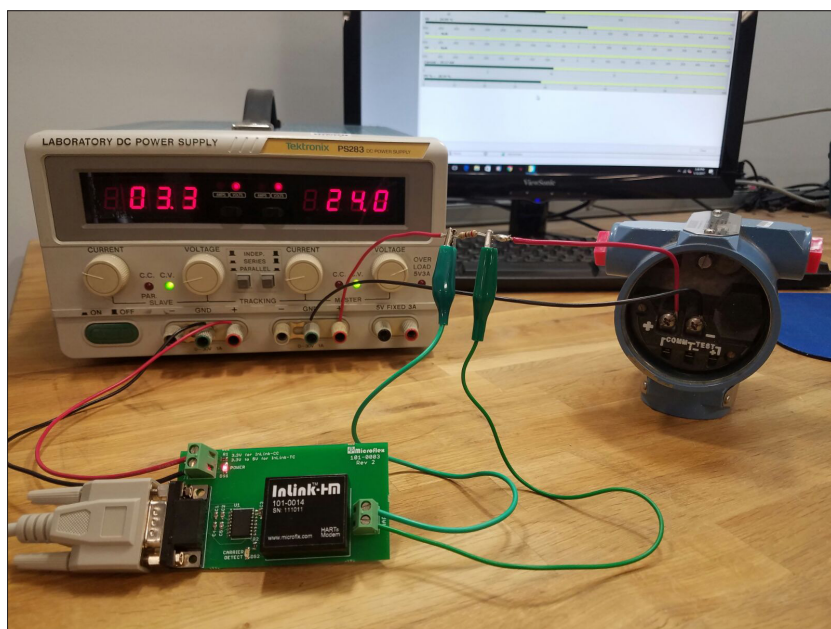


Figure 5. Picture of HART protocol interface master or modbus accumulator application

SOFTWARE

Included with the InLink-HM is all the necessary software to allow you to configure the InLink-HM, use the InLink-HM in an RS-232 to HART protocol interface master application, and use the InLink-HM in a HART to Modbus Accumulator application. Before installing the software, here is a brief description of all included software.

HM CONFIGURATOR

HM Configurator is a Microsoft Windows app used to setup and configure the Microflex HM series of HART protocol modems. HM modems can be configured to continuously poll up to 16 HART devices, acquiring variable data and saving it into modbus registers. The variable data can then be read using modbus RTU commands. The HM Configurator software uses the HM devices serial port connected to your PC or laptop for configuration so no special configuration cable is needed. You may need a USB to serial cable if your computer does not have an RS-232 port.

HART DEVICE ADDRESSER

When using HART devices in a multi-drop configuration where more than one device is in the loop, each device must be set to a different polling address. The HART Device Addressing App will scan through a range of HART polling addresses to learn the polling address for the connected HART device and then allow you to change it.

HART DTM

The HART DTM is not a stand alone program but a device-specific software driver designed to operate within a frame program like PACTware. It defines the protocol layer that will be used within PACTware.

PACTWARE

PACTware (Process Automation Configuration Tool) is a program which allows the selection of communication-capable field devices of different manufacturers from a device catalog, and combine them in projects. PACTware is used as frame program for DTMs (Device Type Managers) which are delivered as configuration software by the manufacturers of field devices.

MICROFLEX GENERIC DTM

The Generic HART Device Type Manager (DTM) is used to parameterize field devices with HART capability. Generic HART DTM-6 installs into the PACTware frame Device Catalog to add basic HART protocol support for HART devices. DTM-6 works with any HART device because it supports the HART protocol common practice and universal commands.

INSTALLING THE SOFTWARE

BEGIN INSTALLATION

To begin installation simply insert the CD. If autorun is not configured to run the CD file when the CD is inserted, you will need to navigate to your optical disk drive and open **Microflex HM and PACTware Setup**. Within the installation files, open the **Msetup** application file.

INSTALL HM CONFIGURATOR

Start by clicking **Install HM Configurator**. Simply follow the on-screen prompts to install the HM Configurator software (see [Figure 6](#)). This step will also install the HART Device Addresser. The HART Device Addresser is a tool that can be used to change the slave address of a HART Device to be installed in a HART multi-drop loop.

INSTALL PACTWARE AND HART DTMS

Next click **Install PACTware and HART DTMs...** If you already have PACTware and the HART DTM installed on your computer, skip this step and click **Install Microflex Generic HART DTM... PACTware is already installed**. Otherwise click **Install PACTware and HART DTMs...** to install PACTware, HART DTM, and the Microflex Generic HART DTM. Simply follow the on-screen prompts (see [Figure 6](#)). You now have the necessary software to begin evaluating the Inlink-HM.

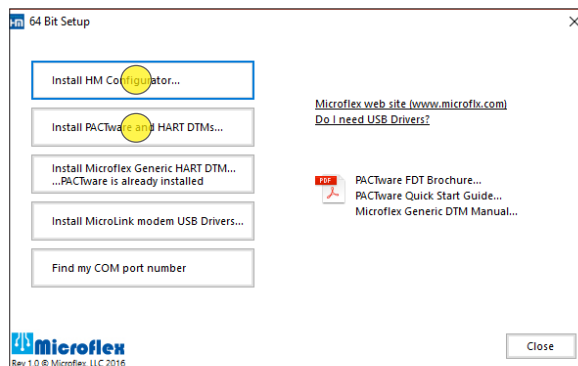


Figure 6. Installing the HM Configurator, PACTware and HART DTMs

SETTING THE INLINK-HM TO HART MODEM MODE

The InLink-HM ships configured to function as a HART modem with the following settings : **1200 Baud rate, Odd Parity, Modbus Registers Disabled**. Most HART software will require these setting.

The HM Configurator app can be used to verify that InLink-HM is configured with **1200 baud, odd parity** serial port settings. **Fill modbus Registers** is disabled when shipped but this setting will not interfere when trying to use the InLink-HM as a HART modem. In the event that **Fill modbus registers** is enabled and InLink-HM detects a HART command, InLink will stop filling Modbus registers and switch to HART modem mode. Verify that InLink-HM is configured as a HART modem by following these simple steps.

IMPORTANT : BEFORE OPENING THE HM CONFIGURATOR APP, MAKE SURE TO POWER ON THE INLINK EVALUATION BOARDS 3.3V POWER SUPPLY AND THE HART DEVICE'S LOOP POWER SUPPLY

OPEN THE HM CONFIGURATOR APP

The first time you open the HM Configurator app it will search for the InLink-HM at the supported baud rates and parity settings (see [Figure 7](#)). After a successful connection with InLink-HM, the HM-Configurator will remember the connection settings and will try to connect using these settings the next time you open the app.

HM CONFIGURATOR FAILED TO CONNECT TO INLINK-HM

If the HM Configurator App does not find the InLink-HM, you may be connecting to the wrong COM port. You will need to set the HM Configurator's COM port to match that of the InLink-HM. Refer to **SELECT THE CORRECT COM PORT** in the following page.

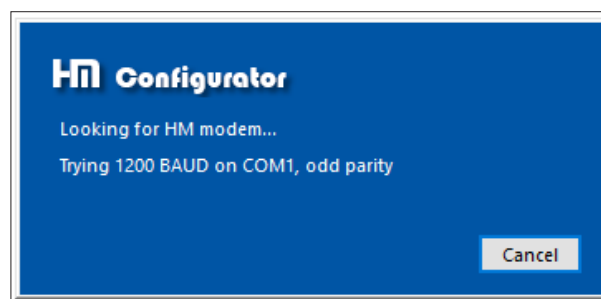


Figure 7. Searching for HM Modem

SELECT THE CORRECT COM PORT

The HM Configurator must be set to use the same COM port as the InLink-HM. If InLink-HM is connected to a different COM port, click **cancel** (see [Figure 7](#)) then click **Setup > Com Port...** (see [Figure 8](#)).

Select the COM Port that the InLink-HM is connected to and click **Connect** to attempt to connect using the settings selected (see [Figure 9](#)). The connection process will first try the last good baud rate and parity settings. If it fails to connect the process will work through other settings to try to find the correct InLink-HM settings for communications. If it still does not connect, verify that you have chosen the correct COM number, connections are correct, and power is on before trying again.

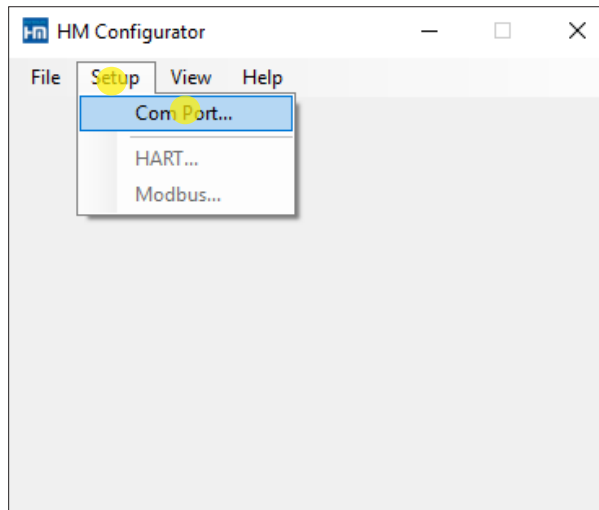


Figure 8. Selecting the correct COM port number

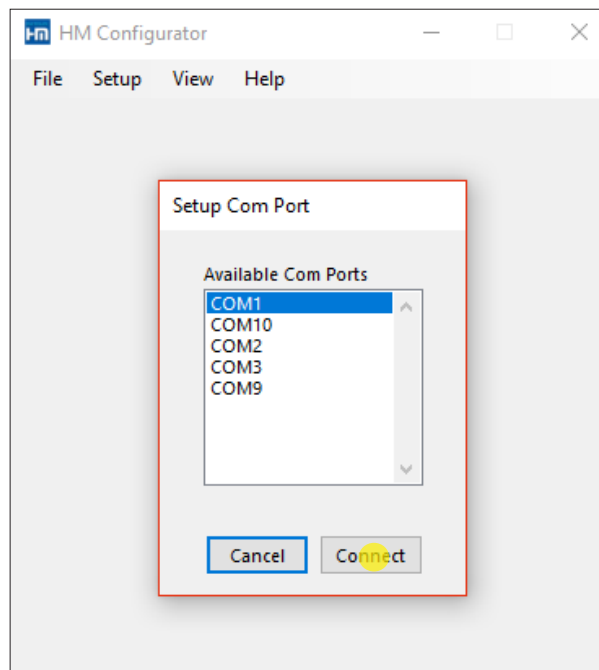


Figure 9. Connect to the InLink-HM

VERIFY HART MODEM SETTINGS

After a successful connection between your PC and the InLink-HM, the HM Configurator dialog box should appear.

NOTE : STATUS WILL INDICATE THE COM NUMBER THAT INLINK-HM IS CONNECTED TO. THIS COM NUMBER WILL BE USED TO SETUP PACTWARE FOR HART COMMUNICATIONS.

If your InLink-HM does not have the COM port settings set to **1200 Baud, Odd Parity**, then you will need to change the settings accordingly.

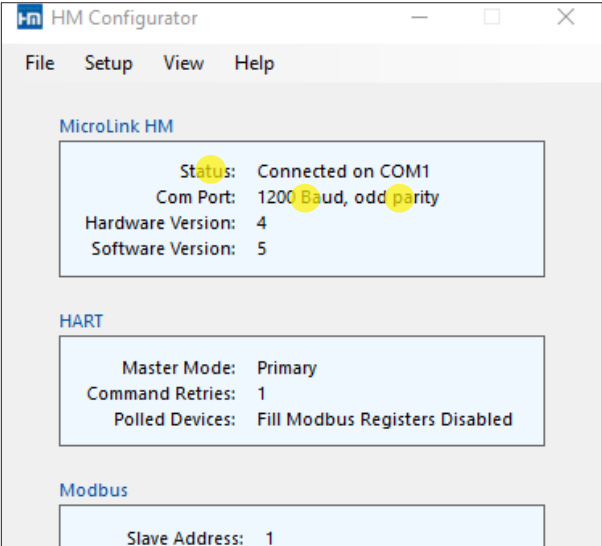


Figure 10. InLink-HM connected to COM 1 with HART protocol settings

SETTING THE PORT'S BAUD AND PARITY SETTINGS

To view and change the baud and parity settings of the InLink-HM simply click **Setup > Modbus**

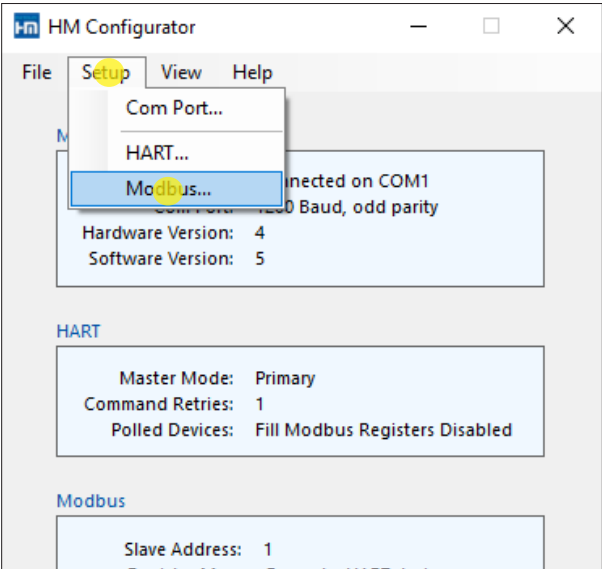


Figure 11. InLink-HM connected to COM 1 with HART protocol settings

click **Use HART Protocol Settings > Save**. This will set InLink-HM's Com settings to **1200 baud rate, odd parity** (see [Figure 12](#)). Most HART software will require these settings.

Now exit the HM Configurator App by clicking **File > Exit**. You are now ready to use the InLink-HM as a HART mode in conjunction with PACTware and the included DTMs. For information on how to setup PACTware, add DTMS, and connect to a HART device, please reference the [PACTware Quick Start Guide](#). For details on how to parameterize field devices with HART capability using the Microflex Generic DTM, please reference the [DTM-6 Software Manual](#).

Modbus-RTU Settings

Use HART Protocol Settings

Modbus Address (Decimal) 1 1 to 247 Baud Rate 1200 Parity Odd

Holding Registers Map

Use HART Device Map
 Use Variable Type Map

Floating Point Byte Order

AB CD - Standard
 CD AB - Swapped

HART Device Failed Register Value

Hold last value
 Set to Preset value Preset 1999
 Set to NaN (Not a Number)

Close Save

Figure 12. Select and save HART protocol settings

INLINK-HM AS A MODBUS ACCUMULATOR

In addition to being a HART Protocol modem module, InLink-HM can be set to collect and store process variable information from up to 16 HART devices. HART devices are continuously polled and variable information is accumulated into a table of Modbus registers. Using the InLink Evaluation Board serial port, the registers can be read using Modbus command 3. Variable data can be read as 16 bit integers or 32 bit floating point. Up to 4 variables for each polled HART device.

In the accumulate mode, InLink-HM will function as a HART master (primary or secondary) polling devices and storing variable values into registers. No additional HART software is needed. The HART loop may contain a single device or up to 16 devices. When more than one device is in the loop each HART device must have a unique HART polling address.

The address for each device is set before wiring the device into the multi-drop loop. The included HART Addresser app can be used to set the device polling address for your HART devices. The device polling address for each device is stored in the Inlink-HM using the HM Configuration app.

Modbus slave address, baud parity, and other settings are set using the HM Configuration app. Configuration is done using the same port that Modbus will use so no additional setup cable is required. Using the HM Configurator App, you are able to configure the InLink-HM to poll a HART device and view the variable data. **Figure 13** shows InLink-HM in the accumulate mode polling one hart device and displaying the variable data via the HM Configurator App. This document will demonstrate how the InLink-HM can poll a single device using the HM configurator. It will also demonstrate how to connect the HART multi-drop loop, configure each HART device with a unique polling address, poll multiple HART devices and view variable data using the HM Configurator app.

The screenshot displays the 'HART Protocol Settings' window. On the left, under 'HART Protocol Settings', the 'Fill Modbus Registers' checkbox is checked, and 'Primary Master' is selected. The 'Retries' field is set to 1. Below this is a grid of 16 'Polled Devices', with device 1 selected. Under 'Settings for Device 1', the 'Polling Address' is 0, and the decimal places for Primary Variable (PV), Secondary Variable (SV), Tertiary Variable (TV), and Quaternary Variable (QV) are all set to 2.

On the right, the 'Device Variables (Modbus Register Values)' section shows data for 'Device 1' (Device code: F902, FieldComm Group). The 'HART Status (Hex)' is 0, and 'Com Status/Response Code = 0, Device Status = 40'. The variables are listed as follows:

Variable	Value	Units
PV	62.61	5 millimeters of mercury at 0
SV	17.99	32 Degrees Celsius
TV	39.93	170
QV	155.77	166 normal cubic meter
Loop	14.023	mA

At the bottom right of the window are 'Cancel' and 'Save' buttons.

Figure 13. Polling 1 HART device with address 0

ENABLE FILL MODBUS REGISTERS

With InLink-HM connected to your HART Device as in [Figure 1](#), the InLink Evaluation board's 3.3V power supply and the HART Device's loop power supply powered **ON**, open the HM Configurator App and click **Setup > HART... > Fill Modbus Registers** (see [Figure 14](#) and [Figure 15](#)). The HART Protocol Settings window will expand to show the Polled Devices settings. Click **Save** (see [Figure 16](#)).

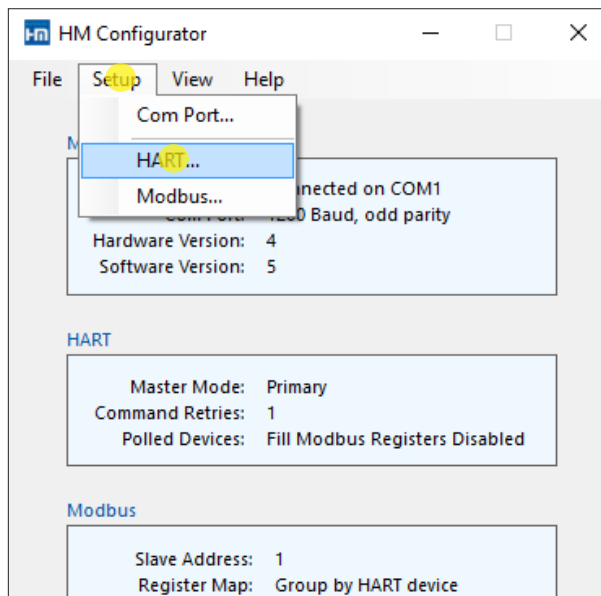


Figure 14. Navigating to HART settings

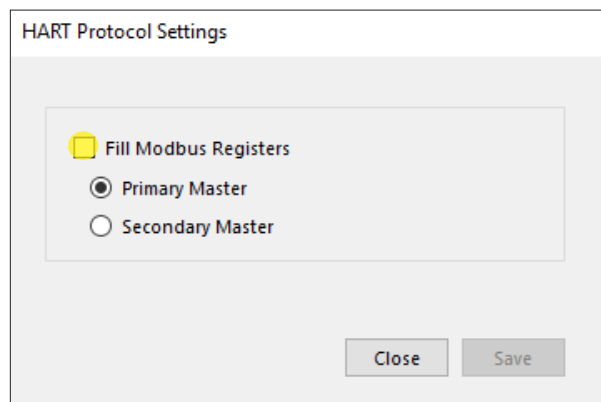


Figure 15. Enable Fill Modbus Registers

In the example screen shot (see [Figure 16](#)) InLink-HM is set to poll one HART device using polling address 0 (default polling address) and will retry 1 time before reporting a communications error. The Device Variables (Modbus Register Values) box on the right section of the window displays the register values for the active polled device. For more information on how to use the HM Configurator in conjunction with the InLink-HM, reference the [InLink-HM Manual \(PDF\)](#).

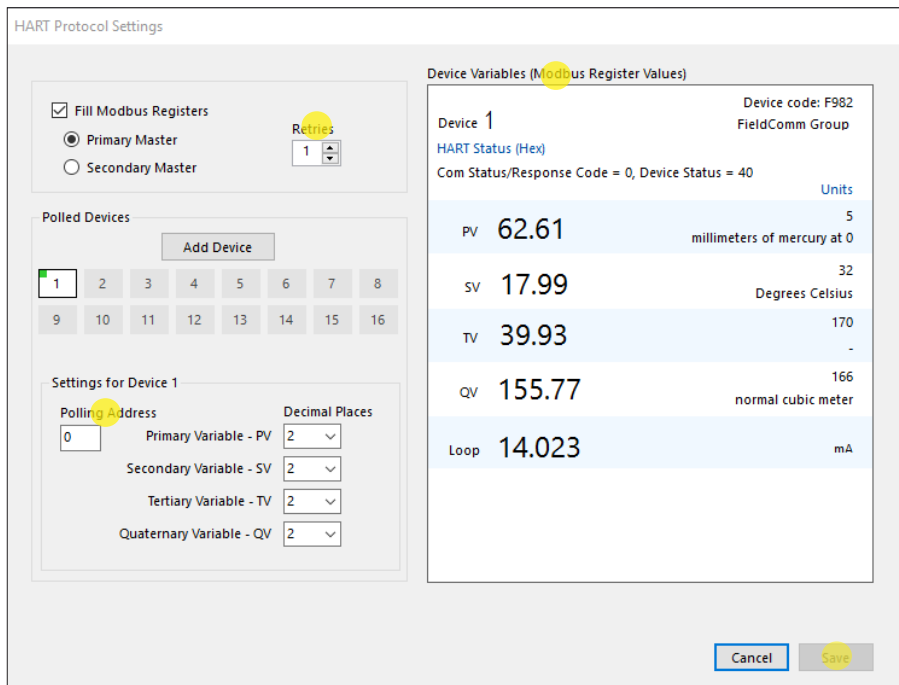


Figure 16. InLink-HM Polling a single HART Device with address 0

POLLING MULTIPLE DEVICES IN A HART MULTI-DROP LOOP

Each HART device has a polling address. By default, devices are set to use polling address 0 with the current output enabled. For multi-drop loops where more than one HART device is in the same loop each HART device must be set to have a unique polling address. For HART version 3 - 5 the polling address for multi-drop devices can be from 1 to 15. For HART version 6 and higher devices the polling address can be 1 to 63. In multi-drop mode the current output is set to a fixed value and cannot be used for a process value.

HART DEVICE ADDRESSER

The HART device addresser app is a tool that can be used to change the HART polling address of your HART devices. Setting the HART address will be required for a HART multi-drop loop. The HART Device Addresser app requires you to have the InLink-HM configured as a HART modem with the port settings set to **1200 baud, odd parity**. See [Setting the InLink-HM to HART modem mode](#) on how to verify or change the settings. The HART device addresser will work with any HART modem including [MicroLink HART Protocol Modems](#).

SCANNING FOR THE POLLING ADDRESS

To change the HART address of your HART devices you will need to connect to each HART device individually. Start by connecting to the first HART Device that will later be wired into multi-drop loop by using the same configuration as in [Figure 1](#). After connecting to the HART Device, powering on InLink Evaluation Board's 3.3V power supply and the loop power supply, open the HART Device Addresser app.

Click the **Serial Interface drop down arrow** and select the COM port number to match the COM number of your InLink-HM. Click **Scan** to scan for your HART device's polling address. You are able to change the starting and ending scan addresses by clicking in their respective boxes (see [Figure 17](#))

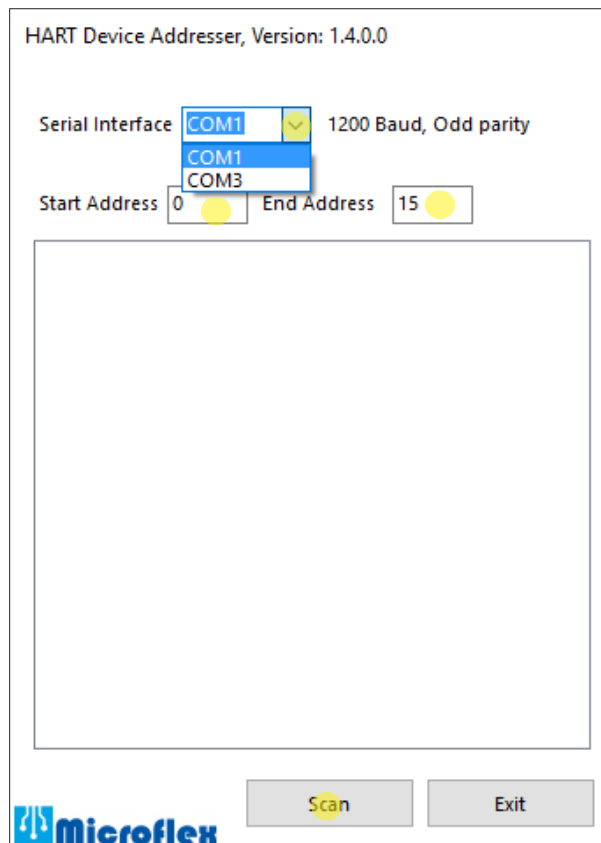


Figure 17. Selecting the COM number, Start and end Address for scanning a HART device

CHANGE POLLING ADDRESS

If the HART Device Addresser app failed to find your HART device, check your connections and verify that no other app is open and using the same COM port as your InLink-HM. After the HART Device addresser finds your HART device, edit the device's polling address to a unique number by clicking in the **Change to Polling Address** box (see [Figure 18](#)) > **Save**.

NOTE : If you are not be able to connect to your HART device using the HART Device Addresser you will need to download a device specific DTM to change your HART device's polling address. Contact your HART device manufacturer to acquire a device specific DTM.

For additional HART devices that will be added to a HART multi-drop loop, repeat the process in [Scanning for the Polling Address](#), next do [Change Polling Address](#).

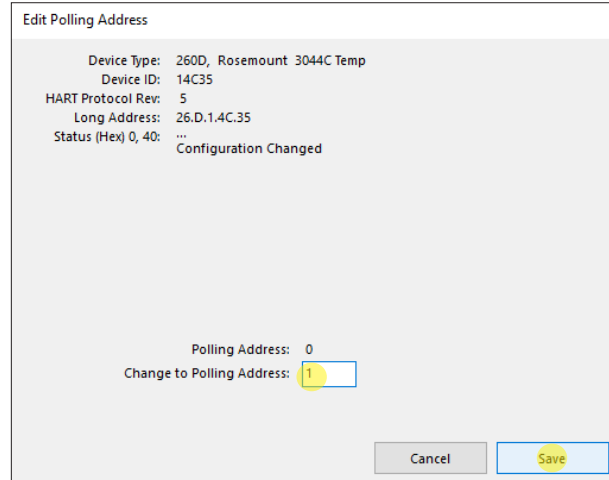


Figure 18. Changing the Polling Address

CONNECTING THE HART MULTI-DROP LOOP

After giving each HART device a unique polling address, connect your HART multi-drop loop as in [Figure 19](#). The number of HART devices in your HART multi-drop loop may be different. For more information on how to connect the hardware see [Connecting the Hardware](#) part of this document.

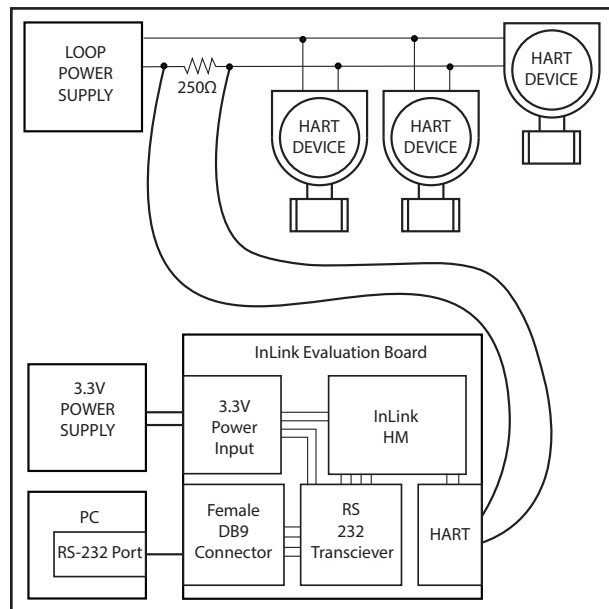


Figure 19. HART multi-drop loop

INLINK-HM AS A MODBUS ACCUMULATOR (HART MULTI-DROP LOOP)

With your HART multi-drop loop connected and powered on as in [Figure 19](#), open the HM Configurator app. Repeat the process [Enable fill modbus registers](#) to configure the InLink-HM as a HART to Modbus Accumulator. While in the HART protocol settings window click **1** under Polled devices to make it the active device and change the polling address to match the address of one of your HART devices in the HART multi-drop loop. (see [Figure 20](#)) click **Save**.

To add a second device to be polled simply click **Add Device > 2 > polling address** box, here enter a polling address to match that of a second HART device in your HART multi-drop loop and click **Save**. See [Figure 21](#) for an example screen shot of InLink-HM polling 2 HART devices using the HM Configurator app. To add additional HART multi-drop loop devices (**up to 16 HART Devices**) to be polled by InLink-HM, simply repeat this process. For more information on how to use the HM Configurator app please reference the [InLink-HM manual \(PDF\)](#).

Figure 20. Adding a HART Devices to be polled by InLink-HM

The screenshot displays the 'HART Protocol Settings' window. On the left, under 'Polling Address', 'Device 2' is selected. The 'Settings for Device 2' section shows 'Polling Address' set to 2 and 'Decimal Places' set to 2 for all four variables: Primary Variable - PV, Secondary Variable - SV, Tertiary Variable - TV, and Quaternary Variable - QV. The 'Device Variables (Modbus Register Values)' table on the right shows the following data:

Variable	Value	Units
PV	714.29	5 millimeters of mercury at 0
SV	222.39	32 Degrees Celsius
TV	281.89	170 -
QV	3473.48	166 normal cubic meter

Figure 21. InLink-HM polling 2 HART Devices in a HART multi-drop loop

INLINK-HM IN CONCLUSION

InLink-HM is a complete modem for Highway Addressable Remote Transducer (HART) communications. It allows designers to easily implement a HART compliant modem without knowledge of the HART physical layer requirements. InLink-HM can also be used as a HART to Modbus Accumulator. It can be configured to poll up to 16 HART devices and save the HART device data into Modbus registers. Modbus RTU commands can then be used to read the HART device data. Configuration is simple using the Microflex HM Configuration software or by writing to modbus registers using modbus RTU commands. InLink-HM is designed to be implemented on a PCB for OEM applications.