



*Smart HART® Loop
Interface and Monitor*

HIM

Table of Contents

Introduction.....	4
About this Manual	4
The HIM.....	4
Model and Serial Numbers.....	4
Inputs	4
Outputs.....	4
Options.....	4
TX Power Supply.....	4
HIM Dimensions.....	5
Specifications	6
Configuring the HIM	7
Terminal Designations.....	7
Installing the HIM.....	8
Installing the HIM into the Loop.....	8
Bench Checking the HIM	8
PC Configuration Software.....	11
HART Tab	12
Display Tab	14
Alarms Tab	15
Analog Outputs Tab.....	17
Custom Curve Tab.....	19

Scaling Tab.....	20
MODBUS Tab.....	21
Installation.....	26
Mounting	26
Making the Electrical Connections	26
Recommended Ground Wiring Practices	26
CE Conformity.....	26
Power Sourcing Parameters for General Locations, Intrinsically Safe and Non-Incendive/Type N Applications	26
Operation.....	26
Maintenance.....	26
Customer Service	26

Introduction

This is the user's manual for the Moore Industries HIM Smart HART® Loop Interface and Monitor. It contains all of the information needed to configure, install, operate and maintain this instrument.

About this Manual

Pay particular attention wherever you see a "**Note**", "**Caution**" or "**WARNING**".

Note— Information that is helpful for a procedure, condition or operation of the unit.

Caution— Hazardous procedure or condition that could damage or destroy the unit.

WARNING— Hazardous procedure or condition that could injure the operator.

The HIM

The HIM allows up to three additional analog process variable measurements from a multivariable transmitter or valve with no additional process penetrations. Installed transparently across the 4-20mA instrument loop, the HIM reads the HART digital process data that rides on the loop wires. It converts the digital information for up to three isolated analog (4-20mA) process signals that are readily accepted by in-place control systems, such as a DCS or PLC.

The HIM allows you to leave existing smart HART transmitters and valves in place, yet still take advantage of all the information they have to offer.

Model and Serial Numbers

Moore Industries uses the model and serial numbers of our instruments to track information on each unit that we sell and service. If a problem occurs with your HIM, check for a tag affixed to the unit listing these numbers. Supply the Customer Support representative with this information when calling.

Inputs

The HIM accepts a HART digital protocol input directly from a smart HART multivariable temperature, pressure, level, flow transmitter or from a valve positioner.

Outputs

The HIM can be ordered with the following outputs.

2AO / 3AO

With this output, the HIM comes equipped with either two (2AO) or three (3AO) programmable analog output channels.

MB

Two redundant MODBUS RTU (RS-485) data links are available for use.

MB1AO

Provides two redundant MODBUS RTU (RS-485) data links with one analog output channel.

Options

The following options may be ordered with the HIM:

-1PRG / -2PRG

One (-1PRG) or two (-2PRG) user-programmable alarm outputs; DPDT relay, 1 form C, rated 5A@250Vac, 50/60Hz, non-inductive (see Table 2 for details). CSA Approved for use in General/Ordinary Locations only.

-FMEDA

Unit comes with Failure Modes, Effects and Diagnostic Analysis (FMEDA) data for evaluating the instrument for suitability of use in a safety-related application.

-RF

Enhanced RFI/EMI protection (see *Specifications* for details)

TX Power Supply

A transmitter excitation (TX) power supply (regulated 24.0Vdc \pm 10% @24mA) is standard on the HIM. You may access it externally at the terminals shown in the installation drawings.

Figure 1. The HIM Accepts a Digital HART Signal and Outputs Both Analog Signals and Alarm Relays

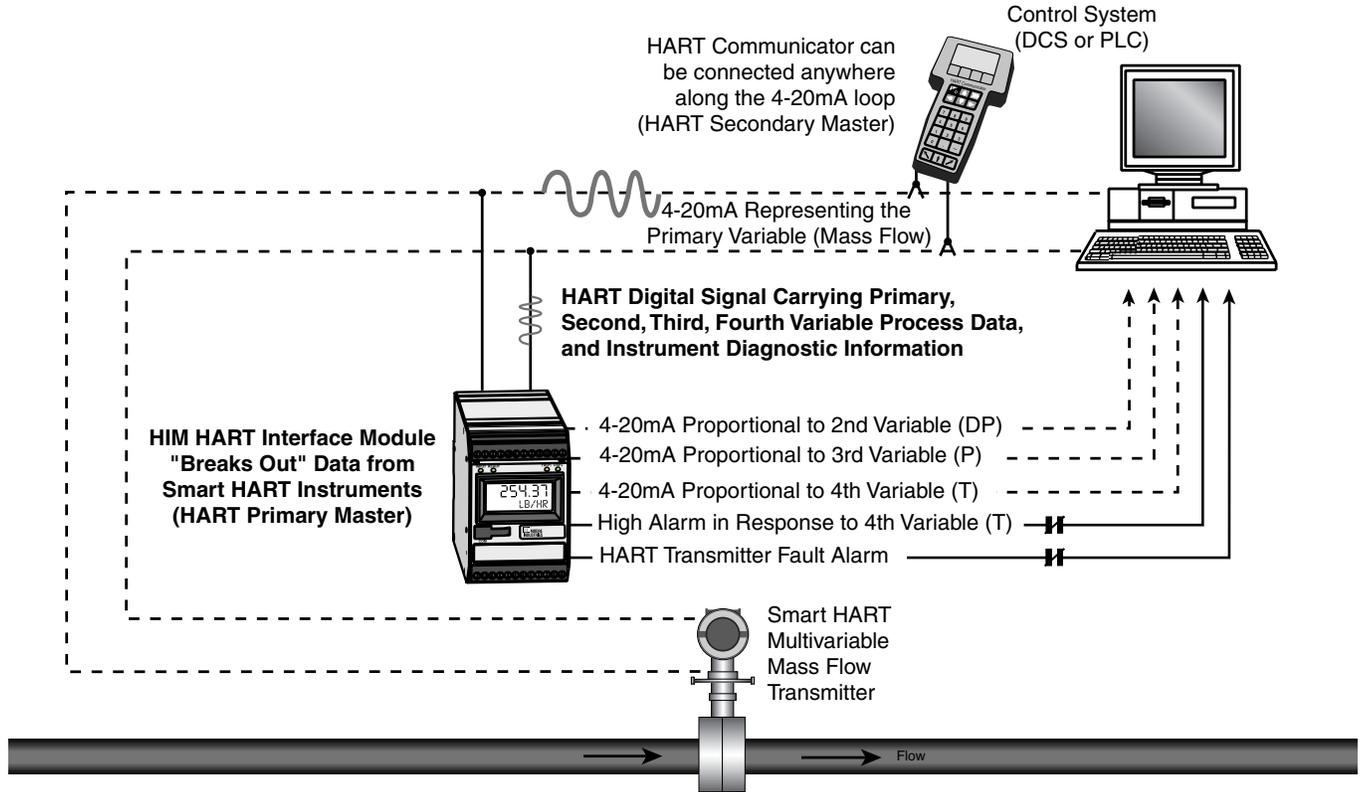
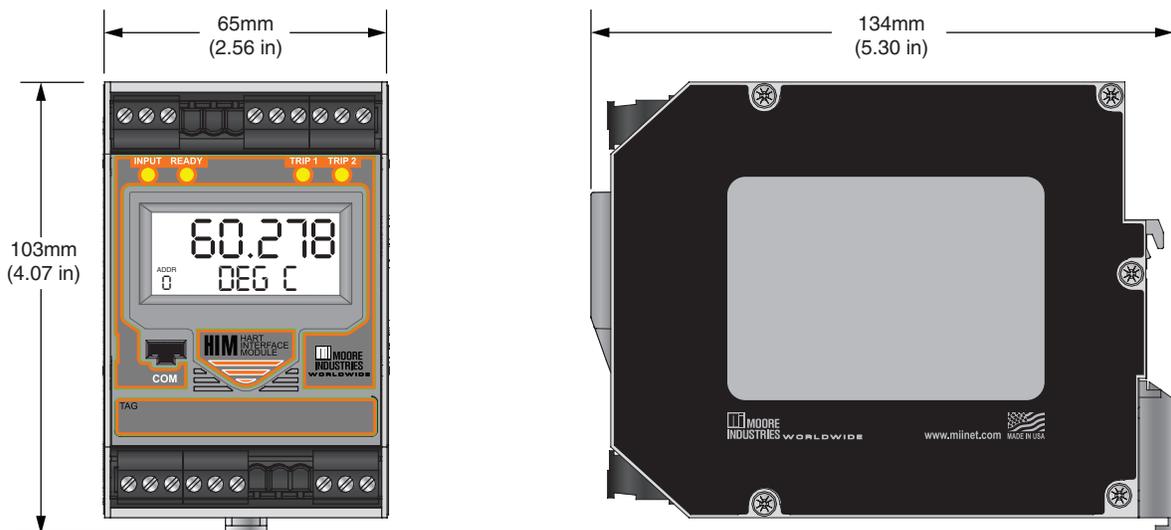


Figure 2. HIM Dimensions



Specifications

<p>Performance Input Accuracy: Reflects the accuracy of the HART field device Input Impedance: Transmit Mode: 150 ohms; Receive Mode: Less than 5kohms</p> <p>ANALOG OUTPUTS Output Accuracy: ±0.015% of maximum output span (20mA). Includes the combined effects of linearity, hysteresis, repeatability and adjustment resolution. Output Response Time: <120ms, 10-90% Isolation: 500Vrms channel-to-channel isolation; 1000Vrms between case, input, outputs and power terminals, and will withstand 1500Vac dielectric strength test for one minute with no breakdown Ripple: Less than 10mV peak-to-peak when measured across a 250 ohm resistor Output Limiting: 130% of span maximum; 125% of span typical Output Protection: Transient protection on output Load Capability: 0-20mA, 1100 ohms maximum Load Effect: ±0.01% of span from 0 to maximum load resistance Line Voltage Effect: ±0.005% of output span for a 1% change in line voltage Input Fail Modes: PC programmable to fail high, fail low, hold last, hold last then fail high, or hold last then fail low (configurable hold time, 0-60 seconds) Output Limits on Input Failure: 0-20mA: Fail Low to 0mA or Fail High to 23.6mA; 4-20mA: Fail Low to 3.6mA or Fail High to 23.6mA; X-20mA (0<X<4): Fail Low to 90% of XmA or Fail High to 23.6mA +TX Power Supply: 24.0Vdc ±10% @24mA ALARM OUTPUTS Digital Response Time: Defined by HART protocol</p>	<p>Performance (Continued) as 500msec maximum in Normal HART Mode; 333msec maximum in HART Burst Mode Alarm Response Time: Digital Response Time + 150msec (Defined as time from the field instrument's reporting a fault until the HIM alarm is tripped) Alarm Trip Delay: Programmable from 0-120sec</p> <p>MODBUS OUTPUTS Type: Standard MODBUS RTU protocol interface over RS485 (parameters as specified in U.S. Standard EIA-RS485) Address Range: Configurable from 1 to 247. Unit will assume a MODBUS address of 01 by default Baud Rate: Interface supports the following: 300, 600, 1200, 4800, 9600, 19.2k. MODBUS interface will support even, odd and no parities. Unit will assume a baud rate of 9600 and no parity by default Character Format: One start bit, 8 data bits and one stop bit Data Format: User-selectable Standard LSW (Least Significant Word) or Swapped MSW (Most Significant Word). Unit will assume Standard LSW by default Transmission Range: Using 24AWG twisted pair wiring, maximum of 2 mi. (3.2km) @ 4800 baud or less; maximum of 1 mi. (1.6km) @9600 baud; maximum of 0.5 mi. (0.8km) @19200 baud Power Consumption: 2-3.5W, nominal; 4.5W @24Vdc maximum for units using transmitter excitation to supply loop power a 2-wire instrument</p> <p>Indicators LCD Type: Two-line LCD; Top Row, 10mm (0.4 in) high black digits on a reflective background; Bottom Row, 6mm (0.225 in) high digits on a reflective background; two-digit HART address indicator Format: Top row is five alphanumeric characters, plus sign and decimal point; bottom row is five alphanumeric characters</p>	<p>Indicators (Continued) Decimal Points: User-selectable for 0, 1, 2 or 3 places after the decimal point or automatically adjusting with a four decimal point maximum Range: -99999 to 99999 Minimum Display Span: 1.00 Display Update Rate: 100msec LED Type: Dual color red/green indicate: INPUT LED: Whether (green) or not (red) the HART input is connected and functioning properly READY LED: Whether (green) or not (red) the HIM is initialized and operating properly TRIP 1 and 2 LED: Shows the status of alarm off (green) or alarm on (red)</p> <p>Ambient Conditions Operating and Storage Range: -40°C to +85°C (-40°F to +185°F) Display Range: -25°C to +85°C (-13°F to +185°F) Relay Range: -25°C to +70°C (-13°F to +158°F) Relative Humidity: 0-95%, non-condensing Ambient Temperature Effect: ±0.0065% of span/°C maximum RFI/EMI Immunity (Standard): 20V/m@20-1000MHz, 1kHz AM, when tested according to IEC1000-4-3-1995 RFI/EMI Immunity (with -RF Option): 30V/m@ 20-1000MHz, 1kHz AM, when tested according to IEC1000-4-3-1995 Noise Rejection: Common Mode: 100dB@50/60Hz</p> <p>Weight 567 grams (16 ounces)</p>
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Configuring the HIM

One of the benefits of the HIM is that there are no internal or external controls to adjust or settings to change. All operating parameters are set using the PC Configuration software.

Once these software settings are made, they are downloaded to the monitor in the form of a Configuration File and stored in the unit's non-volatile memory. You can choose to save a backup copy of the file on your PC hard drive or external media. The HIM communicates with the PC through a proprietary communications cable to the PC's serial (COM) port.

Begin by installing the PC Configuration Software.

Installing the PC Configuration Software

Refer to Table 2 for the equipment needed.

1. Insert the *Moore Industries Interface Solution PC Configuration Software* CD into the CD drive of the PC. Access the CD and open the *HIM PC Configuration Software* folder.
2. Double-click the installation program located in the folder. Follow the prompts to correctly install the program.

Once the Configuration Program is installed on the PC, the unit can be connected either into the loop or to test equipment to simulate input and monitor output. With the PC program, the user can then view and/or change its operating parameters. To begin the process, connect the HIM into the loop (see *Installing the HIM into the Loop*) or into a configuration setup (see *Bench Checking the HIM*).

Default Factory Configuration for HIM

The following are the factory default configuration settings for your HIM unit:

HART:

Mode: Normal
HART Address: 0
Number of Retries: 1
Master Mode: Primary
Auto Clear Status Bit: DISABLED

Display:

Source: PV
Decimal Places: AUTO

Alarm 1:

Field Device Fault Alarm
Alarm Conditions: Device Malfunction

Alarm 2:

Trip High Alarm
Source: PV
Trip Point: 50
Dead Band: 0
Delay: 0s
Fail Safe

Output 1:

Source: PV
Input Range: 0-100
Output Range: 0-20
Fail Mode: Low

Output 2:

Source: SV
Input Range: 0-100
Output Range: 0-20
Fail Mode: Low

Output 3:

Source: TV
Input Range: 0-100
Output Range: 0-20
Fail Mode: Low

Table 1. Terminal Designations

<p>HIM</p> <p>HART Input, 2 Analog Outputs (2AO) No Alarm</p>	<p>HIM</p> <p>HART Input, 2 Analog Outputs (2AO) Single Alarm (-1PRG)</p>	<p>HIM</p> <p>HART Input, 2 Analog Outputs (2AO) Dual Alarm (-2PRG)</p>
<p>HIM</p> <p>HART Input, 3 Analog Outputs (3AO) No Alarm</p>	<p>HIM</p> <p>HART Input, 3 Analog Outputs (3AO) Single Alarm (-1PRG)</p>	<p>HIM</p> <p>HART Input, 3 Analog Outputs (3AO) Dual Alarm (-2PRG)</p>
<p>HIM</p> <p>HART Input, 2 MODBUS Outputs and 1 Analog Output (MB1AO) No Alarm</p>	<p>HIM</p> <p>HART Input, 2 MODBUS Outputs and 1 Analog Output (MB1AO) Single Alarm (-1PRG)</p>	<p>HIM</p> <p>HART Input, 2 MODBUS Outputs and 1 Analog Output (MB1AO) Dual Alarm (-2PRG)</p>
<p>HIM</p> <p>HART Input, 2 MODBUS Outputs (MB) No Alarm</p>	<p>HIM</p> <p>HART Input, 2 MODBUS Outputs (MB) Single Alarm (-1PRG)</p>	<p>HIM</p> <p>HART Input, 2 MODBUS Outputs (MB) Dual Alarm (-2PRG)</p>

KEY:

+IN/-IN = Current input to HIM from HART device
 +I/-I Source = Analog Source Output
 A/B = MODBUS Output
 NC/NC# = Normally Closed
 (+) DC/(-) DCC = 24VDC Connection

+TX = Transmitter Excitation Current
 +I/-I Sink = Analog Sink Output
 NO/NO# = Normally Open
 CM/CM# = Common
 (AO#) = Analog Output

NOTES:

1. The standard Single Alarm unit (1PRG) utilizes a DPDT relay.
2. Terminal blocks can accommodate 14-22 AWG solid wiring (torque to 4 inch-pounds, maximum).

Installing the HIM

There are two methods for connecting the HIM for configuration. The recommended method requires you to install the instrument into the loop before it is configured. The secondary method allows you to bench check the HIM by attaching it to test equipment that will simulate the input and monitor the output.

Installing the HIM into the Loop

To install the HIM into the loop for configuration, use the equipment shown in Table 2. Refer to Figure 5 (to install without using the TX power supply) or Figure 6 (to install using the TX power supply).

Bench Checking the HIM

If you would like to configure the HIM before attaching it to the loop, you need to hook it up with the equipment listed in Table 1. Refer to Figures 3 and 4 for instructions on how to bench check the HIM either with or without taking advantage of the Transmitter Excitation (+TX) terminal. If you need further descriptions of the terminals, see Table 2.

Table 2. Assembling the Necessary Equipment

Device	Specifications
Precision Load Resistor	250 ohms, $\pm 0.01\%$
Multimeter or Ammeter	Accurate to $\pm 0.009\%$ of span, e.g. HP Model 3487A
Power Supply	24Vdc, $\pm 10\%$
Personal Computer	Microsoft Windows based PC; 16Mb free RAM; 20MB free disk space on hard drive Microsoft Windows XP, Vista or 7 1 (one) serial port or one available USB port (with optional USB cable)
Moore Industries PC Configuration Software	Version 1.0 or higher, successfully installed to the hard drive
Communication Cable	Part# 803-053-26 or optional USB cable Part# 208-836-00

Figure 4. Bench Checking the HIM Using an External Power Source to Power a Transmitter

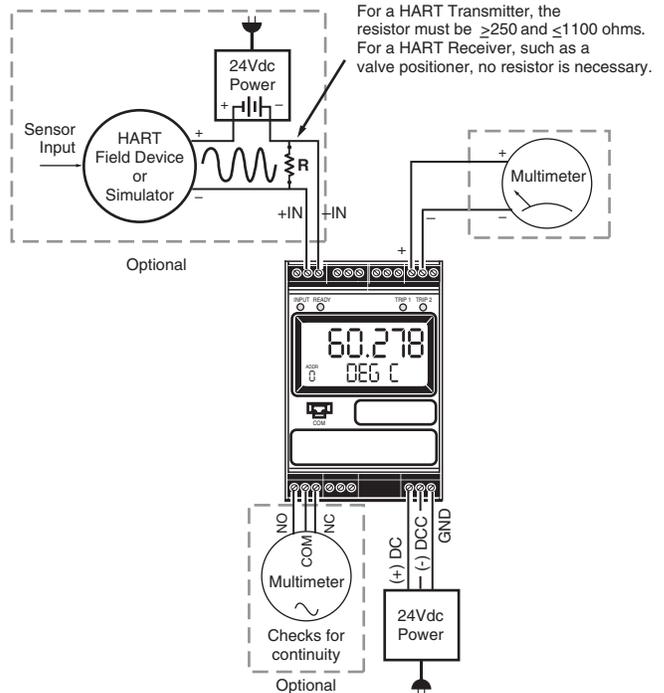


Figure 3. Bench Checking the HIM Using the Transmitter Excitation (+TX) Terminal to Power a Transmitter

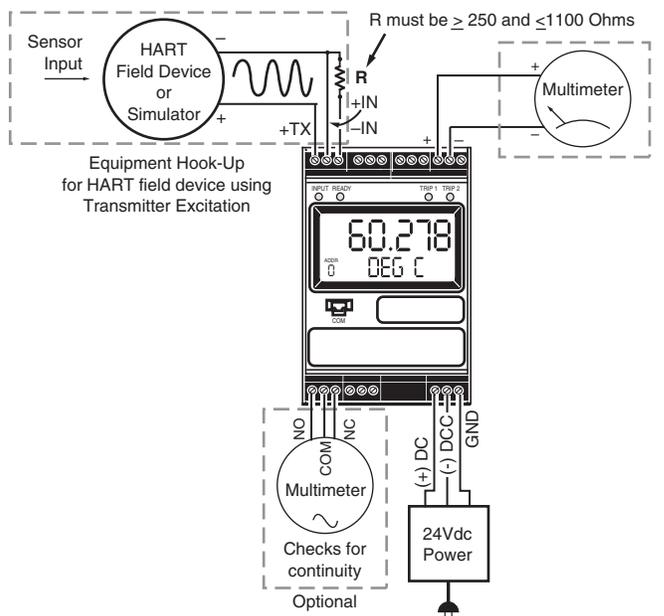


Figure 5. Installing a HIM Into the Loop Using an External Power Source to Power a Transmitter

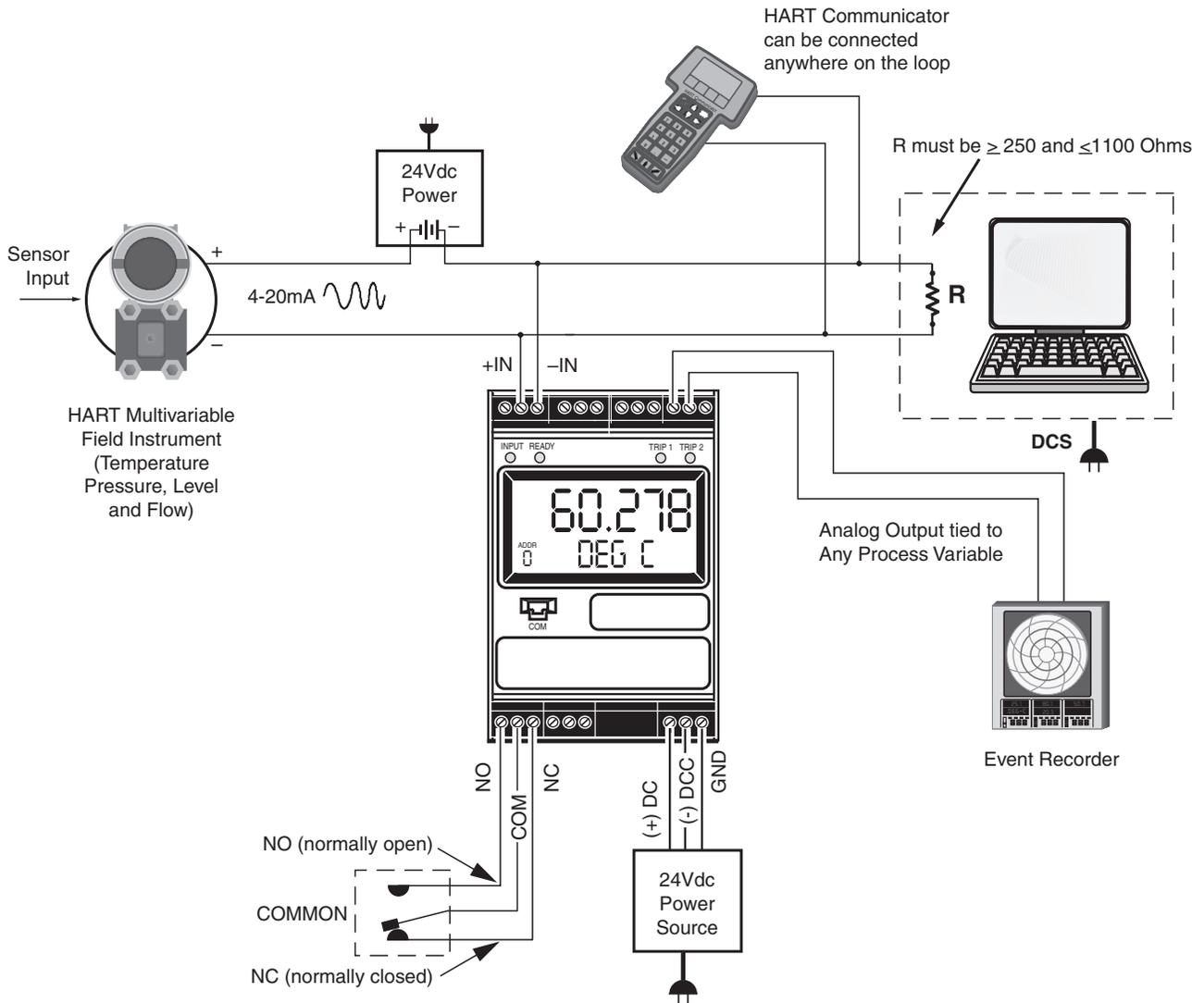
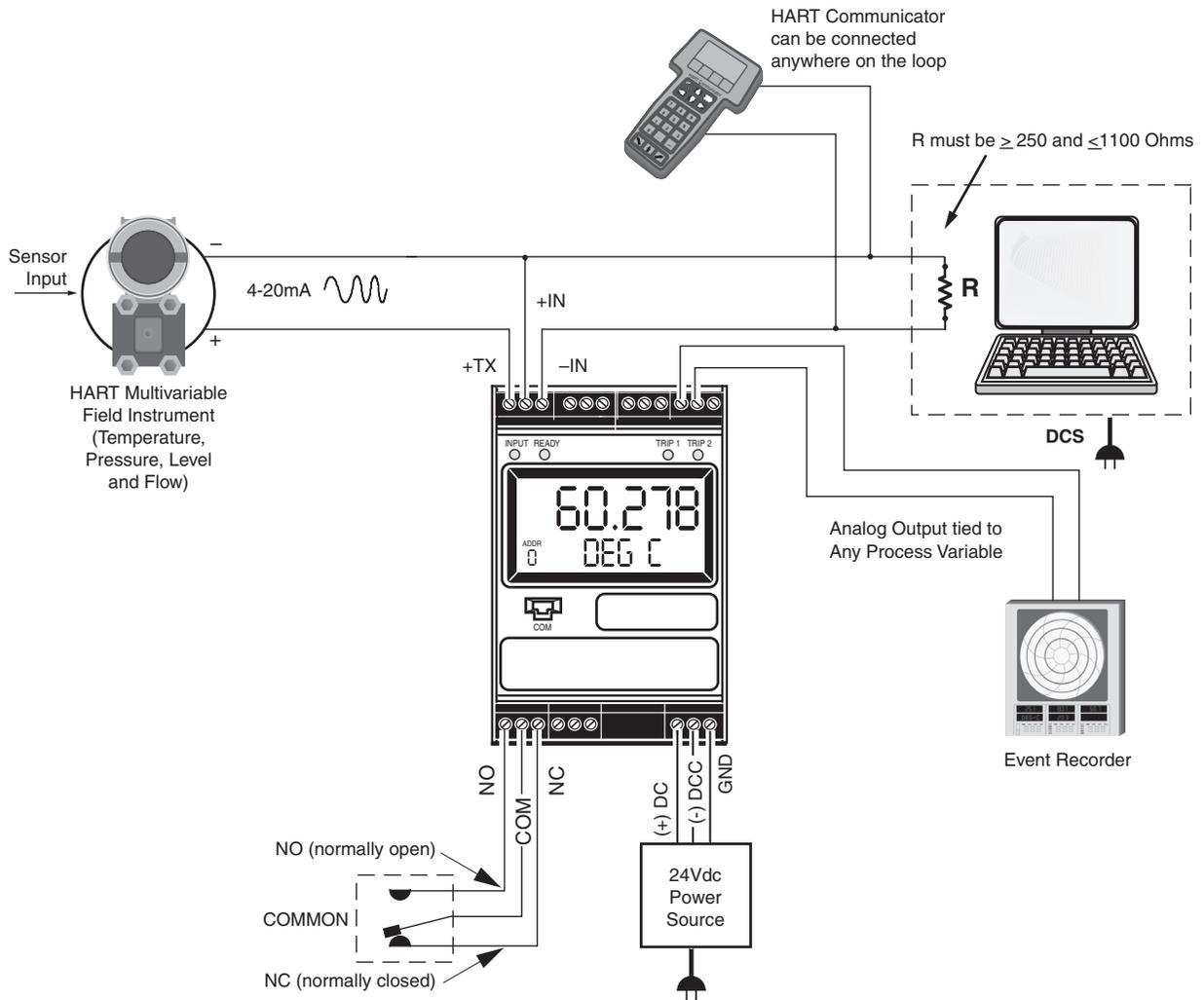
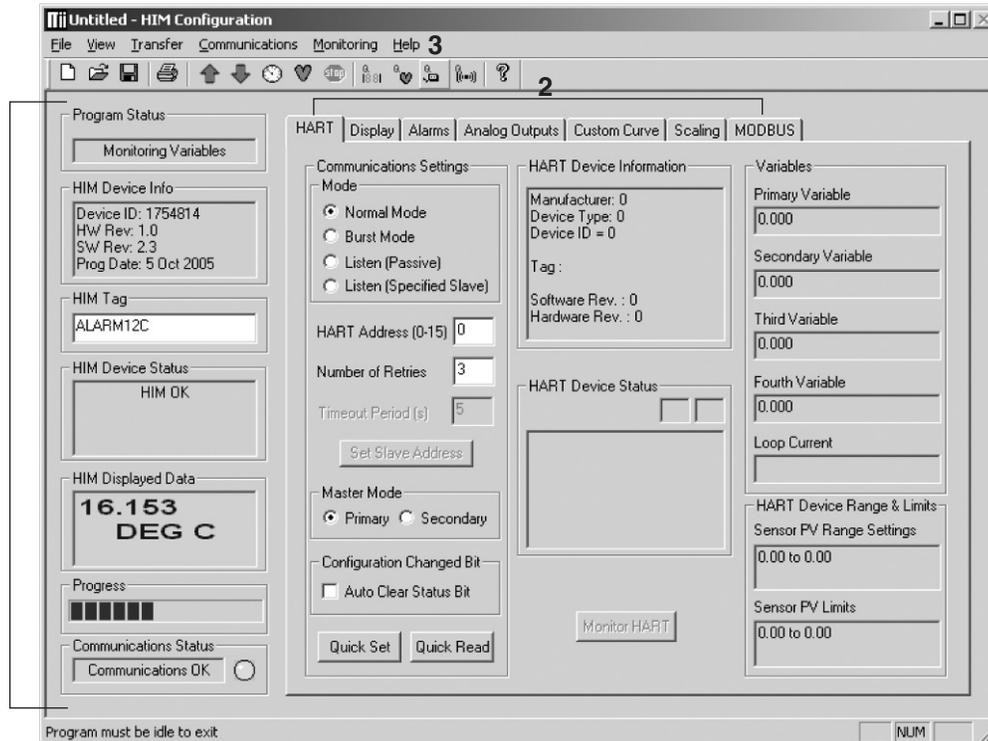


Figure 6. Installing a HIM Into the Loop Using the Transmitter Excitation (+TX) Terminal to Power a Transmitter



PC Configuration Software

Figure 7. HIM PC Configuration Software Screen



The HIM PC Configuration Software can be used to program all of the HIM's parameters. Once the default configuration has been saved, it is safe to program other parameters. The PC Software is made up of these sections:

1. **HIM Status and Information Section**—The left side of the screen includes seven boxes that display the different settings of the attached HIM.

Program Status—Displays the activity of the connected HIM. It will show you if the unit is *Idle*, *Uploading*, *Downloading*, *Monitoring* or *Searching*.

HIM Device Info—Displays the individual characteristics of the attached HIM, such as its Identification, Hardware and Software Revisions, and the last date that the device was configured.

HIM Tag—A phrase used to identify a HIM.

HIM Device Status—Displays how the HIM is functioning, giving a brief summary of any errors or displaying *OK* if it is operating normally.

HIM Displayed Data—this display mirrors what the attached HIM is displaying.

Progress—This bar stays in motion any time the HIM is monitoring, uploading or downloading.

Communication Status—monitors the PC Software's ability to communicate with the HIM.

2. **HART/Display/ Alarms/Analog Outputs/Custom Curve/ Scaling/MODBUS Tabs**—These tabs change the right side of the screen to allow you to set the appropriate part of the HIM's configuration. Refer to the associated pages in this document for additional information on these tabs.

3. **Menu Bar/Tool Bar**— Dropdown menus and corresponding icons allow you to perform various functions throughout the PC Configuration Program.

HART Tab

To program the HART parameters, change the settings in the *Communications Settings* box, then press *Quick Set*. See the descriptions below of the various sections of the screen.

HART Address

The *HART Address* is the address of the HART device that the HIM will be monitoring.

Number of Retries

The *Number of Retries* can be set between 1 and 9, and will determine how many times the HIM will attempt to poll the HART transmitter (without success), before it indicates a HART Fault condition.

Normal/Burst/Listen (Passive) Modes

The HIM can operate in one of four modes: *Normal*, *Burst*, or *Listen (Passive)* and *Listen (Specified Slave)*. In each of these modes, the HIM attempts to find a HART transmitter.

In *Normal* mode, the HIM polls the HART loop for a transmitter, then polls the HART instrument twice per second, requesting the current process status and the HART instrument's diagnostic status. The HART instrument responds with the requested data.

In *Burst* mode, the monitored HART instrument is programmed to continuously transmit its process variable and health status. The HIM samples the continuous HART data three times per second.

Listen (Passive) mode allows the HIM to operate on a loop that already has primary and secondary HART masters. In *Listen (Passive)* mode, the monitor connects passively, continuously sampling HART data from a smart instrument without affecting normal loop operation. When using this mode, either the monitored smart HART instrument must be set in *Burst Mode* or a HART master must be continuously polling the smart HART slave device.

The HART protocol allows for two communications masters on the loop, a Primary and a Secondary. Setting the HIM to function as the Primary HART Master in the application means that any other HART device in the loop must be configured either as a HART Secondary Master (1 per loop) or as a HART Slave (up to 16 per loop). Conversely, setting the HIM to function as the Secondary HART Master allows other HART devices to function either as a Primary Master or as slaves. Configuring more than one device on a single loop as a Primary or Secondary HART Master will cause a communications failure.

Listen (Specified Slave)

When multiple HART instruments are present, the *Listen (Passive)* mode cannot be used because data returned from one instrument will overwrite the data previously stored in the HIM. If multiple HART slave instruments are communicating on the loop, the HIM will overwrite its internal HART data sets with the latest device read from the bus, no matter where the data originates. To allow selective monitoring on a multi-instrument loop, and to allow multiple HIMs to be used on a digital loop, the *Listen (Specified Slave)* feature is used.

If the HIM is in "Listen" mode it is not a HART communication master and therefore is not in control of communication. Other HART masters are controlling the polling of slaves and the HIM can only "Listen".

The HIM must be able to detect when it has not heard from its assigned slave device so that it can declare a "No HART" input and force outputs to the values specified by the user. The HIM must therefore be told to wait an appropriate amount of time for the slave device to send its message before the HIM declares "No HART". This timing coordination is accomplished with *Timeout Period*.

Timeout Period is a value between 1 and 30sec and must be greater than the period between polls by the HART master of the Specified Slave. For example, assume that there are five HART transmitters on the same multi-drop loop as the HIM. The HART master is configured to poll each device every second. It then takes the HART master five seconds to repeat the poll to the one device being monitored by the HIM. the HIM *Timeout Period* must be set at a value greater

than five seconds. In this example, we will use seven seconds. The HIM then sees its slave device speak and waits seven seconds for it to speak again. As long as the HIM sees a new message from its slave device its outputs are updated based upon the measured variables. If the slave device does not speak within the seven second period, the HIM declares a “No HART” situation and sends its outputs to the failed communications values.

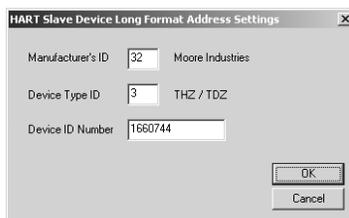
To use this feature, proceed with the following steps:

1. Select the *Listen (Specified Slave)* button.
2. Enter your desired value into the *Timeout Period(s)* text box.

Factory default is 5 seconds. The maximum Timeout Period is 30 seconds.

3. Set the exact slave address of the instrument you wish to monitor. Click the *Set Slave Address* button. This brings up the *HART Slave Device Long Format Address Settings* screen (Figure 8). Enter the required information into the appropriate text boxes.

Figure 8. HART Slave Device Long Format Address Settings Screen



The *Manufacturer's ID* and *Device Type ID* for the instrument that the HIM will listen to are available from the HART Foundation website at www.hartcomm.org and/or the instrument manufacturer.

Values obtained from the HART website are in HEX code. The HIM does not use HEX code; you must convert this value to Decimal code.

To convert HEX to Decimal code, perform the following steps:

Access the Calculator feature in Microsoft Windows® by opening the *Start* menu. Next, select *Programs* then *Accessories* and finally *Calculator*.

Ensure that the Calculator is in *Scientific* mode. To do this, select the *View* dropdown menu and choose *Scientific*.

Click the *Hex* radio button and enter the HEX code value.

Next, click the *Dec* button and the value will be converted into the Decimal value.

Enter the converted value into the proper parameter.

The *Device ID Number* is the serial number of the exact device to which the HIM will listen.

4. Once complete, press *OK*.

Download the information to your instrument once you are finished.

Auto Clear Status Bit

Most HART instruments indicate when a device's configuration has been changed. This indication (status bit) can be reset by sending HART command 38—reset configuration changed. Checking the *Auto Clear Status Bit* box causes the HIM to issue this command whenever the HART instrument it is monitoring has its configuration changed. However, the HIM can also be set to alarm on this bit (see *Programming the Alarm Parameters*). If the HIM is both set to alarm and to auto clear, then it will do both—going into alarm mode and resetting that indication.

Quick Read/Set

The *Quick Read* button causes the PC Configuration Software to read the communications information from the attached HIM; the *Quick Set* button causes the software to configure the HIM's communications settings to match those of the PC Software.

HART Device Info

This box displays the identification and revision information of the monitored HART instrument.

HART Device Status

The HART Device Status box displays the current status of the monitored HART transmitter. In a small double-box, the software displays the code (hex number) associated with the status.

Variables

The device will monitor up to the first four HART variables sent by your transmitter. This portion of the screen displays those variables and the Loop Current.

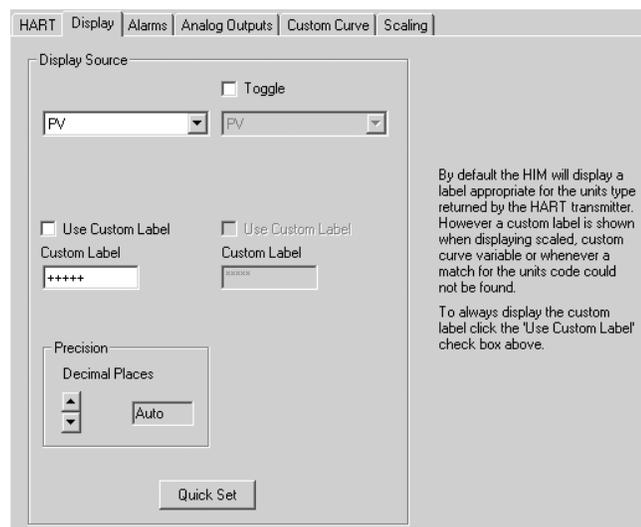
HART Device Range & Limits

This portion of the screen displays the range and the sensor limits of the monitored HART transmitter.

Display Tab

The *Display* tab configures the HIM's LCD display. To program the Display parameters, change the settings in the *Display Source* box, then press *Quick Set*. See the following descriptions of the various sections of the screen.

Figure 9. *Display Tab*



Toggle, Variable List

The *Toggle* checkbox causes the HIM to sequentially display two HART variables in five second increments. Directly below the *Toggle* checkbox are two list boxes to select the variables that you would like to be displayed. Notice that if you select a scaled variable, it is important to check on the *Scaling* page to verify that you have set all of the scaling parameters.

Use Custom Label

The *Custom Label* is used to display a calculated or scaled variable. Clicking the *Use Custom Label* box causes the HIM to always display the custom label as Engineering Units (EGUs).

Precision

The *Precision* buttons allow you to change the number of decimal places displayed by the HIM.

Quick Set

The *Quick Set* button programs the HIM with the information on the Display page.

Display Format

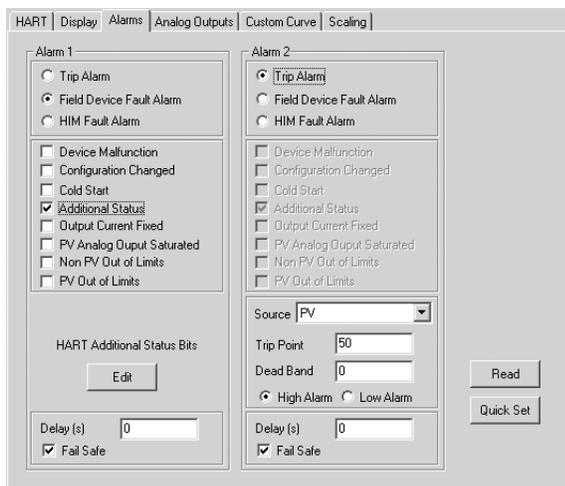
The HIM reads the dynamic process variable supported by HART sensors. Generally, the HIM's LCD displayed values range from -99999 to 99999. Occasionally, these process variable values may extend past this range. To improve the displayed readings, values below -XXXXX and above XXXXX are translated into exponential form. Below is an example of the appearance of the display when certain values are sensed.

Value	Display
12345	12345
1234500	1.23E06
-500000	-5.00E05

Alarms Tab

The Alarms tab controls the programmable alarm trip(s) option. This screen will be grayed out if the attached HIM is not equipped with at least one alarm trip. To program the Alarm parameters, change the settings in the *Alarm1* and/or *Alarm2* box, then press *Quick Set*. The sections of the screen are described below.

Figure 10. Alarms Tab



Trip/Fault Alarms

A *Trip Alarm* monitors a selected variable and trips either when the variable exceeds a set value (Trip High) or when the variable falls below a selected value (Trip Low). The *Source* specifies which variable will be monitored, while the *Trip Point* sets the point at which the alarm will trip. After the alarm trips, the *Dead Band* determines how far past the trip point the variable will have to go before the alarm condition returns to normal.

There are two types of Fault Alarms. A *HIM Fault Alarm* monitors the health of the HART monitor. It will trip whenever the internal error status word is set. For example, if the HIM's configuration file becomes corrupt, this alarm will trip and the monitor will display BAD_CONFIG. A *Field Device Fault Alarm* monitors the health of the HART transmitter. This fault alarm will trip for any of these eight malfunctions:

Device Malfunction (Bit 7)

Relay trips whenever it detects that a hardware error or failure has occurred in the connected HART device.

Configuration Changed (Bit 6)

Relay trips whenever it detects that the connected HART device has had its configuration changed.

Cold Start (Bit 5)

Relay trips whenever the power to the HART device is interrupted. It will also trip during a HART Master Reset or Self Test Command.

Additional Status (Bit 4)

Relay trips whenever the connected HART device reports a condition requiring HART Command #48, which is Read Additional Information. This indicates that the instrument needs attention from a device with full HART command capability.

Output Current Fixed (Bit 3)

Relay trips whenever the HIM detects that the connected HART device's output is no longer responding to changes in its input, and is being held at a predefined level.

PV Analog Output Saturated (Bit 2)

Relay trips whenever it detects that both its analog and digital representations of the Primary Variable are outside rated operating limits, and no longer reflect the true sensor input.

Non-PV Out of Limits (Bit 1)

Relay trips whenever one of the HART ancillary variables (second, third or fourth), is operating outside the limits that can be effectively measured.

PV Out of Limits (Bit 0)

Relay trips whenever the HART Primary Variable is operating outside the limits that can be effectively measured.

Delay & Fail Safe

By entering a value in the *Delay* box, you can specify how long (in seconds) the alarm condition needs to exist before the alarm trips. *Failsafe* alarms (box checked) de-energize when in alarm condition; *Non-Failsafe* alarms energize when tripped.

HART Additional Status Alarm Bits

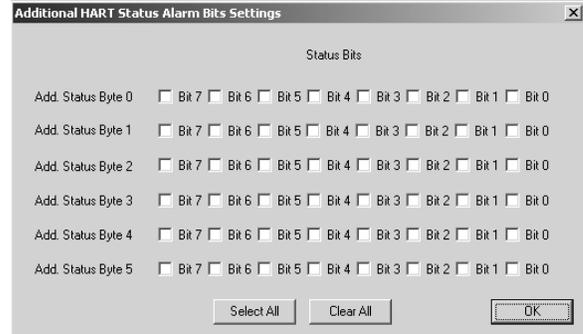
HART Additional Status also called “More Status” and “Command 48” is where device manufacturers install the custom diagnostics for the specific device. For your particular application, you may choose all of these diagnostics to cause the HIM relay to trip or just one diagnostic bit to trip the HIM relay (or any combination in between). The manufacturer of the HART device will be the source for the specific diagnostic information.

Selecting the *Field Device Fault Alarm* function in the *Alarms* screen allows you to enable the HIM to set alarm states, when in fault mode, based on the bit settings of the additional status information returned by certain HART instruments. This provides flexibility to the requirement of alarming on additional status information.

Choosing this feature, you are given the ability to specify the bit(s) on which to alarm. To access this feature, check the *Additional Status* box. The *Edit* button will appear in the *HART Additional Status Bits* section of the screen. Clicking the *Edit* box brings up the *Additional HART Status Alarm Bits Settings* window (Figure 11). Check the box(es) that correspond to the bits you wish to use; click *OK*.

Download the information to your instrument once you are finished.

Figure 11. Additional HART Status Alarm Bits Settings Window



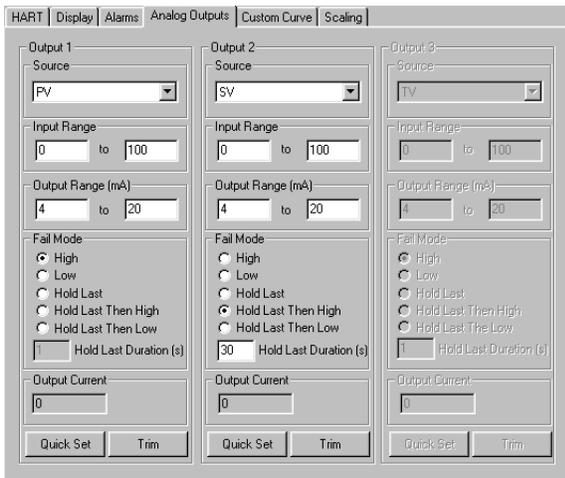
Read & Quick Set Buttons

The *Read* button causes the PC Configuration Software to read the alarm information from the attached HIM; The *Quick Set* button causes the software to configure the HIM’s alarm settings to match those currently entered in the PC Software.

Analog Outputs Tab

The HIM comes with either two (–2AO) or three (–3AO) analog outputs. The *Analog Outputs* tab allows you to specify which HART variable is to be monitored as the source of the analog output, the input range and output range, and how the output will react when the variable input is out of range. To program the Analog Outputs parameters, change the settings in the *Output1/2/3* boxes, then press *Quick Set*. See the descriptions below of the various sections of the screen.

Figure 12. Analog Outputs Tab



Source

Source defines the variable that the analog output will monitor. Notice that selecting one of the scaled outputs will require you to make changes to the *Scaling* tab, and selecting the Custom Curve option will require you to make changes to the *Custom Curve* tab.

Input/Output Range

The *Input* or *Output Range* defines the range of the source input and the range of the analog output. These two sets of fields can be used to scale the HIM's output.

For example, you have a vortex flow meter with an imbedded RTD that measures the process temperature, and that temperature is assigned to the HART Secondary Variable. The full range of the RTD sensor is from –400°F to +1760°F, but your flow stream will always be between 0° and 400°F. To scale the analog output, for Output 1, set the *Source* as SV. Set the *Input Range* to 0° and 400°F, and the *Output Range* to 4mA to 20mA. Click *Quick Set* to download the new configuration file to the HIM.

Output Current Box

The *Output Current* Box on the *Analog Outputs* Tab displays up-to-the-second information on the value, in mA, of the analog output.

Fail Mode

The *Fail Mode* setting determines how the HIM will respond when its monitored input fails. If *Fail Mode* is set to *High* and the measured input goes out of range, or any detected error occurs in the HART transmitter, the analog output will output a 23.6mA signal. If *Fail Mode* is set to *Low* and the measured input goes out of range, or any detected error occurs in the HART transmitter, the analog output will output a signal that is 90% of the lower range value below 4mA; it will output 0mA if the lower range is set to 0mA.

If *Fail Mode* is set to *Hold Last*, the HIM will continue to output the last value it recorded before the input failed. If *Fail Mode* is set to *Hold Last Then High* or *Hold Last Then Low*, the HIM will continue to output the last value recorded for a set amount of time (according to Hold Last Duration box), then either fail high or fail low, respectively.

Quick Set Button

The *Quick Set* button causes the software to configure the instrument's analog output settings to match those currently entered in the PC Software.

Trim Button

The *Trim* button brings up the Trim Menu, allowing you to set the device's output to match the reading of the loop. Refer to the *Programming the Trimming Parameters* section of this manual for more information.

Configuring Analog Output Trimming

The *Analog Output Trimming* section of the software allows you to match the HART monitors analog output to the output measured by a calibration device. This will require a calibrated multimeter, such as a HP Model 3478A or equivalent, accurate to $\pm 0.009\%$.

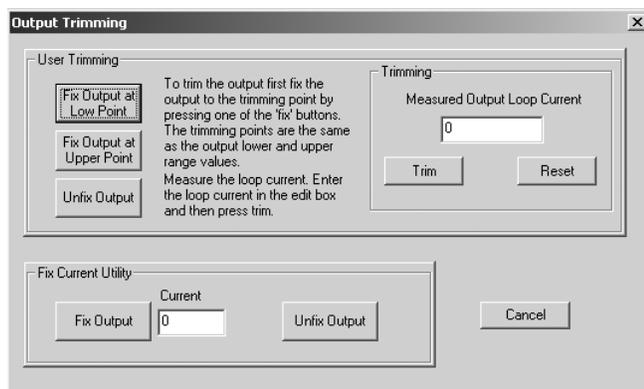
Note:

Trimming the analog output of the monitor nullifies any scaling that may have been performed in the Scaling tab.

Fix Current Utility

The *Fix Current Utility* allows you to force the HIM to output any current value from 0-20mA. This can be used to match the calibration of your other equipment. To fix the current, simply enter the value in the *Current* box (in mA) that you want the HIM to output, and click *Fix Output*. When you are finished, make sure to press the *Unfix Output* button so that the HIM can return to normal operation.

Figure 13. Trimming Window



User Trimming

To trim the device, attach a multimeter to the analog output, then click the *Fix Output at Low Point* button. Read the value on the multimeter, enter it into the *Measured Output Loop Current* portion of the *Trimming* box, and press *Trim*. Repeat this sequence until the analog output matches the minimum point (4mA for a 4-20mA output) when you click the *Fix Output at Low Point* button.

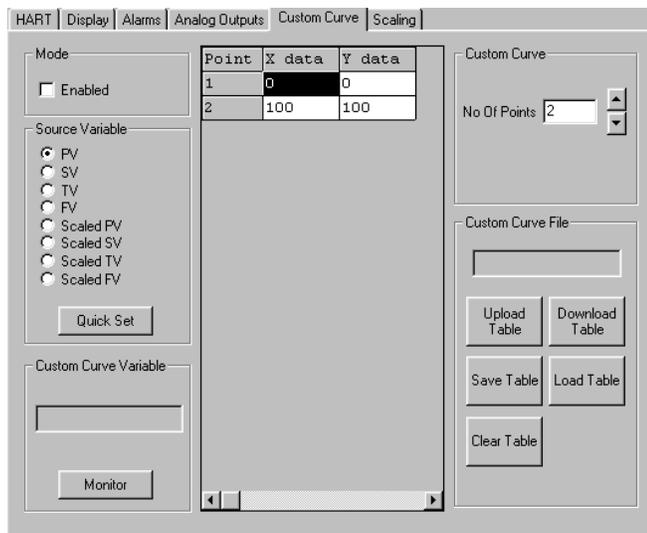
After the low point is trimmed, press the *Fix Output at High Point* button. Read the value on the multimeter, enter it into the *Measured Output Loop Current* portion of the *Trimming* box, and press *Trim*. Repeat this sequence until the analog output matches the maximum point (20mA for a 4-20mA output) when you click the *Fix Output at High Point* button.

When finished, press the *Unfix Output* button.

Custom Curve Tab

The custom curve tab allows you to set up a custom curve of up to 128 points. A custom curve can either be created from scratch or loaded from a previously created comma separated value (.csv) file. To program the Analog Outputs parameters, change the settings in the *Custom Curve* tab, then press *Download Table*. See the descriptions below of the various sections of the screen.

Figure 14. Custom Curve Tab



Mode

Check the *Enabled* box to begin programming the custom curve.

Source Variable

The *Source Variable* defines the variable that the custom curve will calculate. Notice that if you select a scaled variable, you may need to click on the *Scaling* tab and verify the settings for your scaled variable.

Quick Set

The *Quick Set* button causes the software to configure the HIM's custom curve settings to match those currently entered in the PC Software.

Custom Curve Variable

The *Custom Curve Variable* displays up-to-the-second information on the value of the Custom Curve. Press the *Monitor* button to display the variable information.

Custom Curve

The middle section of the screen displays the custom curve table. After enabling custom curve mode and setting the variable to be monitored, continue by selecting the number of points for the curve. Enter the actual linearization points into the custom curve table, inserting the source variable into the X Column, and the corresponding data (i.e. the °C, °F, Gallons, PSIG, Millimeters, etc.) into the Y Column.

Note:

When entering data in the linearization table, make sure that you enter a number into every open cell.

Custom Curve File

These buttons allow you to manipulate custom curve files, including the important *Save Table* command that will save a table to your hard drive.

Upload Table

Moves a custom curve file from the connected HIM to the PC Software for editing or storage.

Download Table

Configures the HIM by downloading the custom curve table from the PC Software to the HIM.

Save Table

Saves a displayed custom curve table to memory on your computer's hard drive.

Load Table

Loads a previously saved custom curve table.

Clear Table

Clears the displayed custom curve table.

When you have finished changing all your settings, download the information to the HIM using the *Download Table* button. If you have selected a scaled variable, you should also click on the *Scaling* tab and set the scaling parameters.

Scaling Tab

The *Scaling* tab allows you to configure the values for scaled variables. To scale the selected variable, enter the values into the appropriate boxes, then click on the *Transfer* menu and click *Download* to transfer the new scaled values to the HIM. (If any scaled variable was selected in the *Display*, *Alarm* or *Analog Outputs* tabs, then the corresponding scaled variable section will become active for editing).

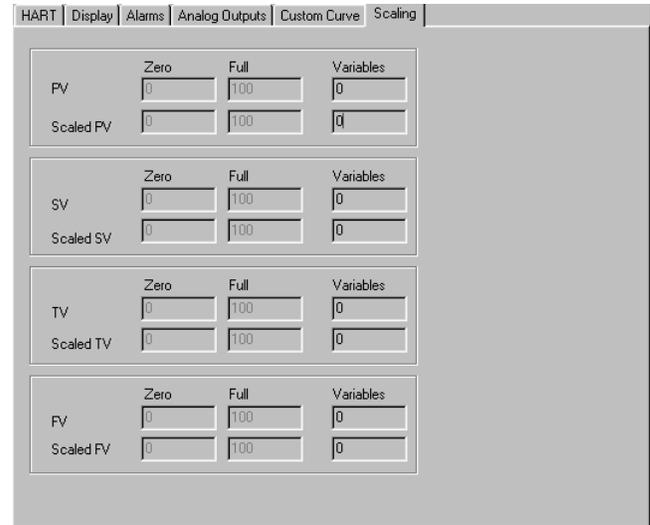
The HIM's versatile scaling feature has many possible applications, as is shown in the illustration below.

Suppose you are using a digital pressure (DP) transmitter to measure the level of a tank in either centimeters/inches or PSI. Since the tank is only 300 centimeters (10 feet) high, the full range of the primary variable (PV) output from the DP transmitter is 0-4.3 PSI. You want to display the full level range (in centimeters/inches of water) on the HIM. You also need to control the level from 50% to 100%, since the tank must be at least 50% full at all times. Finally, your existing loop indicator and level controller needs 4-20mA to represent 150 to 300 centimeters (60 to 120 inches) of water. How do you do this?

Scaling Illustration

1. Since you want to display the full level range in inches of water (in H₂O) on the HIM, and the HIM is reading PSI as the primary variable, first go to the *Display* tab and select *Scaled PV* as your display source.

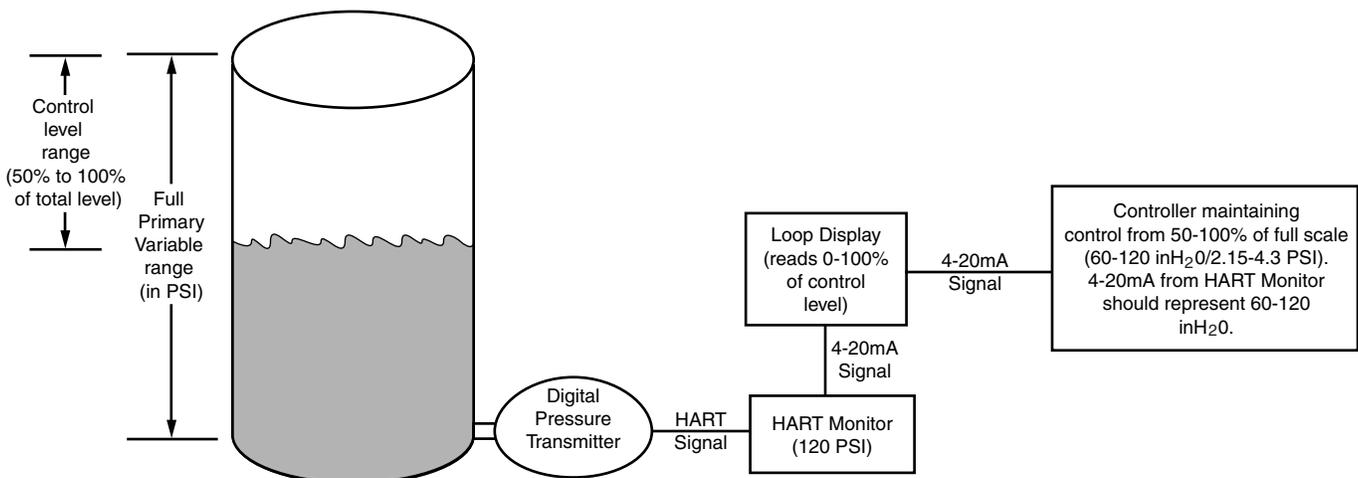
Figure 15. Scaling Tab



2. Go to the *Scaling* tab and set up the *PV Zero* and *PV Full* values, and the *Scaled PV Zero* and *Full* values. *PV Zero* would be 0 (PSI) and *PV Full* would be 4.3 (PSI). *Scaled PV* would correlate to zero being 0 in H₂O and full being 120 in H₂O. The HIM should now (after downloading) display the full range in in H₂O.

3. To manipulate the HIM's analog output, go to the *Analog Outputs* tab. Select *Scaled PV* as the Output 1 source. Since you need to control the level from 50% to 100%, the *Input Range* should be 60 to 120 in H₂O and the *Output Range* should be 4mA to 20mA.

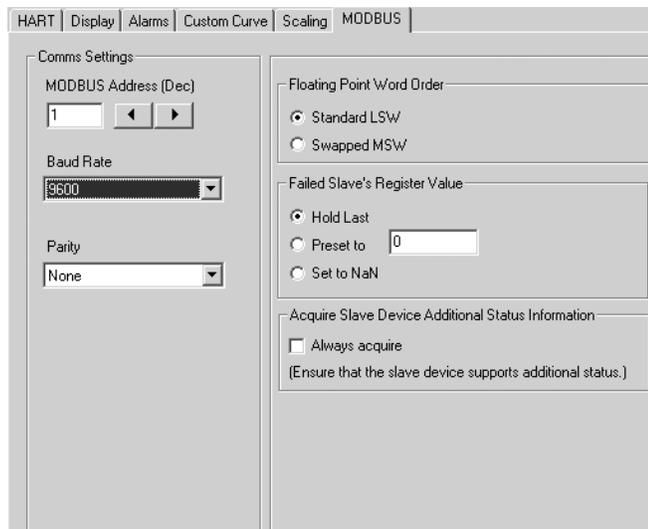
Figure 16. The HIM's Scaling feature works to get the most out of your existing process instruments



MODBUS Tab

The HIM PC program allows you to configure the HART monitor. A HART Monitor with MODBUS output provides a digital MODBUS output to a connected MODBUS-based controller. Selecting the *MODBUS* tab allows you to set the MODBUS communications parameters. Notice that the *MODBUS* tab will only be available in units with MODBUS configuration.

Figure 17. MODBUS Tab



Comms Settings

The Comms Settings include the following:

MODBUS Address

The *MODBUS Address* is the number that the HIM monitor uses to identify itself on the MODBUS network. The MODBUS address is configurable from 1 to 247. By default, it will assume a MODBUS address of 01.

Baud Rate

The *Baud Rate* is the speed of data transmission. It should be set to match the baud rate of the attached controller. The interface supports the following baud rates: 300, 600, 1200, 2400, 4800, 9600 and 19200.

Parity

The HART monitor supports even, odd and no *Parity*. The data format is one start bit, 8 data bits and one stop bit.

Floating Point Word Order

By default, the HART monitor will use the *Standard LSW* (least significant word) floating point word order format. This stores the most significant bits in the second register and the least significant bits in the first register. Selecting *Swapped MSW* (*most significant word*) will reverse the order, storing the most significant bits in the first register and the least significant bits in the second register.

Failed Slave's Register Value

You may select what would occur to a slave device's register value in the event that communication is lost with the HIM.

If selecting *Hold Last* and a failure is detected, the last measured value before the failure occurred is held.

Entering a user-set value in the *Preset to* text box recalls that value when a slave device failure is detected.

Selecting *NaN* (Not a Number—as put forth by the IEEE-754 standard) causes the floating point NaN value to be stored in the registers used for holding floating point values.

Acquire Slave Device Additional Status Information

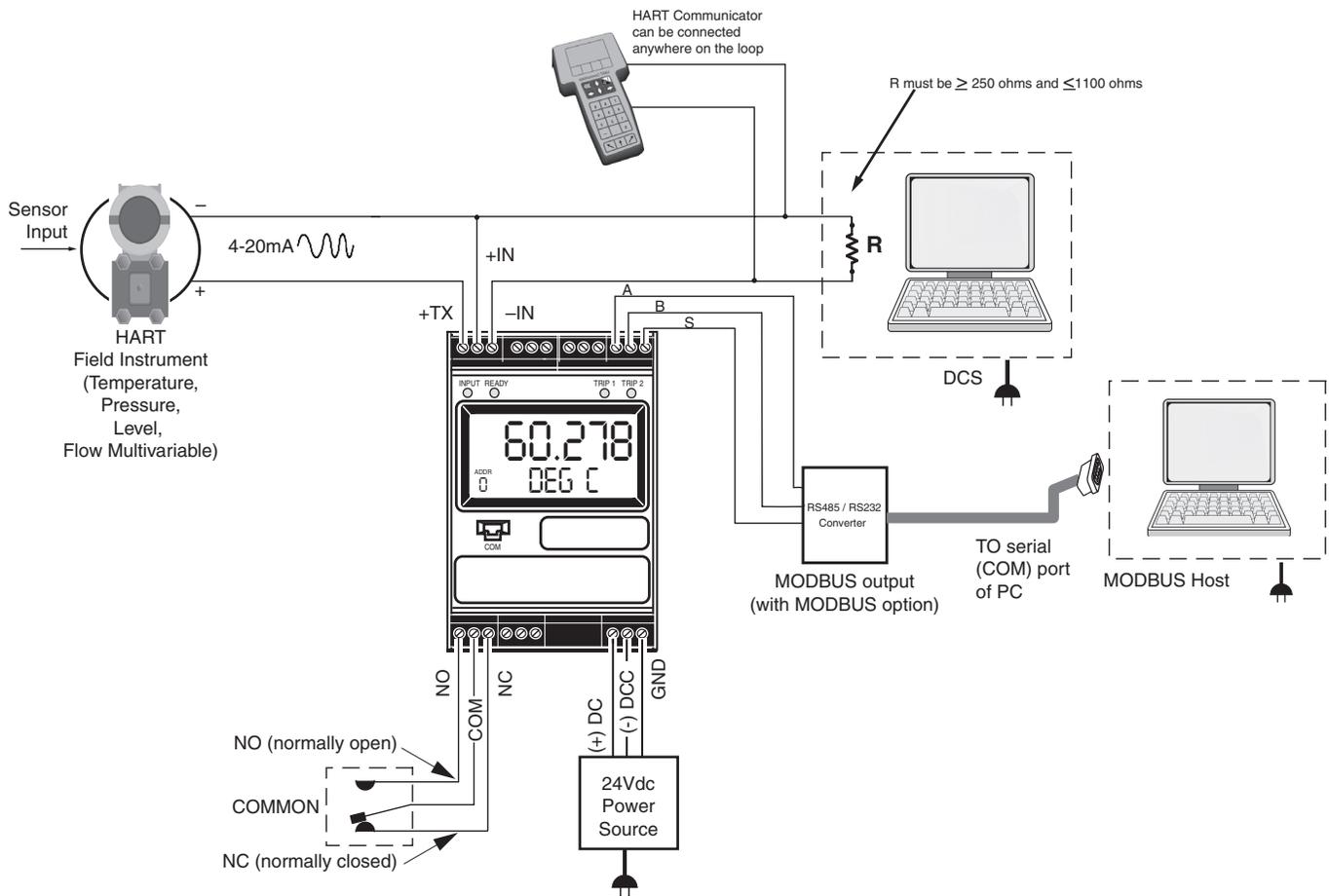
Checking the *Always acquire* box will allow the Additional Status information to be displayed in the corresponding MODBUS register (refer to Table 3). If the box remains unchecked, Additional Status information will be unavailable.

If this information is not needed, it is good practice to keep the box unchecked in order to keep polling of the additional status bytes from occurring. This will help maintain faster response times.

MODBUS Registers

The HART Monitor outputs a MODBUS signal to the attached controller. To access the MODBUS registers for variable, input/output or error information, refer to Tables 3 and 4 for more information.

Figure 18. Installing a HIM with MODBUS output into the loop using the Transmitter Excitation (+TX) terminal



MODBUS Offsets (where applicable)

Table 3 contains (zero based) MODBUS addresses . Your MODBUS host may require you to enter the MODBUS register. Often MODBUS registers have an offset of “1” from the MODBUS address. For example, a MODBUS address listed below of 256 may have to be entered as 257 in your host. Please refer to your MODBUS host documentation for verification.

Table 3. MODBUS register definitions

Register Range	Description
0	HART Primary variable
1	HART Secondary variable
2	HART Third variable
3	HART Fourth variable
4	PV scaled
5	SV scaled
6	TV scaled
7	FV scaled
8	Linearized variable
9	Analog Output 1 current x 100mA
10	Analog output 2 current x 100mA
11	Analog output 3 current x 100mA
12	<p>HIM Status Information</p> <ul style="list-style-type: none"> Bit 0 = hardware failure Bit 1 = EEPROM fail Bit 2 = EEPROM configuration checksum error Bit 3 = EEPROM calibration checksum error Bit 4 = EEPROM blank Bit 5 = Out of range error Bit 6 = Division by zero error Bit 7 = Configuration data bad error Bit 8 = COP SW fail Bit 9 = RAM test fail Bit 10-13 = not used Bit 14 = HART device malfunction status bit set Bit 15 = No HART communications status
13	HART status information (see Tables 4 & 5)
14	HART instrument PV EGU (MSB = 0, LSB = HART EGU code)
15	HART instrument SV EGU (MSB = 0, LSB = HART EGU code)
16	HART instrument TV EGU (MSB = 0, LSB = HART EGU code)
17	HART instrument QV EGU (MSB = 0, LSB = HART EGU code)
18	Device ID MSW

Table 3. *Continued*

19	Device ID LSW
20	HART Device Manufacturer ID
21	HART Device, device type code
22	HART device, device ID MSW
23	HART Device, device ID LSW
24	HIM Alarm Status (Bit 0 = alarm 1, Bit 2 = alarm 2)
25	Additional Status Byte 0
26	Additional Status Byte 1
27	Additional Status Byte 2
28	Additional Status Byte 3
29	Additional Status Byte 4
256-257	HART Primary variable (float format)
258-259	HART Secondary variable (float format)
260-261	HART Third variable (float format)
262-263	Hart Fourth variable (float format)
264-265	Scaled Primary variable (float format)
266-267	Scaled Secondary variable (float format)
268-269	Scaled Third variable (float format)
270-271	Scaled Fourth variable (float format)
272-273	Linearized varialbe (float format)
274-275	Analog output 1 current (float format)
276-277	Analog output 2 current (float format)
278-279	Analog output 3 current (float format)

Note:

Trimming the analog output of the monitor nullifies any scaling that may have been performed in the Scaling tab.

HART Status Information

The following tables describe HART status information.

Table 4. MSB: HART First Byte

MSB	Bit/Code	Description
Bit 7 = 1 Communications Error (The byte consists of error FLAGS)	0	0 (undefined)
	1	RX buffer overflow
	2	0 (reserved)
	3	Checksum error
	4	Framing error
	5	Overrun error
	6	Parity error
Bit 7 = 0 Command Response (The byte is a numerical value representing a single error condition)	0	No error
	1	Undefined
	2	Invalid selection
	3	Passed parameter too large
	4	Passed parameter too small
	5	Too few bytes received
	6	Device specific command error
	7	In write protect mode
	8-15	Multiple meanings
	16	Access restricted
	28	Multiple meanings
	32	Device is busy
	64	Command not implemented

Table 5. LSB: HART Second Byte

MSB	Bit	Description
0 not used when a communications error exists	0	Primary variable out of limits
	1	Non primary variable out of limits
	2	Analog output saturated
	3	Analog output current fixed
	4	More status available
	5	Cold start
	6	Configuration changed
	7	Field device malfunction

Installation

Installation consists of physically mounting the unit and completing the electrical connections.

Mounting

The HIM is designed to snap easily onto 35mm Top Hat (EN50022) DIN-rails.

Making the Electrical Connections

After mounting, you are ready to connect the HIM to the loop. Each unit comes equipped with a transmitter excitation terminal which allows it to supply power to the monitored HART instrument, if necessary. Figures 5 and 6 show the connection diagrams for an HIM with or without using the transmitter excitation current.

Recommended Ground Wiring Practices

Moore Industries recommends the following ground wiring practices:

- Any Moore Industries product in a metal case or housing should be grounded.
- The protective earth conductor must be connected to a system safety earth ground before making other connections.
- All input signals to, and output signals from, Moore Industries' products should be wired using a shielded, twisted pair wiring technique. Shields should be connected to an earth or safety ground.
- For the best shielding, the shield should be run all the way from the signal source to the receiving device. (see Note below)
- The maximum length of unshielded input and output signal wiring should be 2 inches.

Note:

Some of Moore Industries' instruments can be classified as receivers (IPT², IPX², etc.) and some can be classified as transmitters (TRX, TRY, etc.) while some are both a receiver and a transmitter (SPA², HIM, etc). Hence, your shield ground connections should be appropriate for the type of signal line being shielded. The shield should be grounded at the receiver and not at the signal source.

CE Conformity

Installation of any Moore Industries' products that carry the CE marking must adhere to the guidelines in the Recommended Ground Wiring Practices section in order to meet the EN 61326 requirements set forth in the applicable EMC directive.

Power Sourcing Parameters for General Locations, Intrinsically Safe, and Non-Incendive/Type N Applications

In accordance with IEC 1010.1 Annex H (all models), the input terminals must be connected to and/or supplied from a certified energy limiting Class 2 or a Separate Extra Low Voltage (S.E.L.V.) power supply separated from all mains by double/reinforced insulation.

Operation

Once programmed, calibrated, installed, and supplied with the correct power, the instrument begins to operate immediately. Depending upon environmental conditions, it can be expected to operate unattended for extended periods of time.

Maintenance

Moore Industries suggests a check for terminal tightness and general unit condition every 6-8 months. Always adhere to any site requirements for programmed maintenance.

Customer Support

If service assistance is ever required for an instrument in your application, refer to the back cover of this manual for the telephone numbers to Moore Industries' STAR Center customer service department.

If possible, make a note of the model number of the offending unit before calling. For fastest assistance, have the following available: serial number and the job and purchase order number under which it was shipped.

RETURN PROCEDURES

To return equipment to Moore Industries for repair, follow these four steps:

1. Call Moore Industries and request a Returned Material Authorization (RMA) number.

Warranty Repair –

If you are unsure if your unit is still under warranty, we can use the unit's serial number to verify the warranty status for you over the phone. Be sure to include the RMA number on all documentation.

Non-Warranty Repair –

If your unit is out of warranty, be prepared to give us a Purchase Order number when you call. In most cases, we will be able to quote you the repair costs at that time. The repair price you are quoted will be a "Not To Exceed" price, which means that the actual repair costs may be less than the quote. Be sure to include the RMA number on all documentation.

2. Provide us with the following documentation:
 - a) A note listing the symptoms that indicate the unit needs repair
 - b) Complete shipping information for return of the equipment after repair
 - c) The name and phone number of the person to contact if questions arise at the factory
3. Use sufficient packing material and carefully pack the equipment in a sturdy shipping container.
4. Ship the equipment to the Moore Industries location nearest you.

The returned equipment will be inspected and tested at the factory. A Moore Industries representative will contact the person designated on your documentation if more information is needed. The repaired equipment, or its replacement, will be returned to you in accordance with the shipping instructions furnished in your documentation.

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ANY BUYER OF GOODS OR SERVICES FROM THE COMPANY AGREES WITH THE COMPANY THAT THE SOLE AND EXCLUSIVE REMEDIES FOR BREACH OF ANY WARRANTY CONCERNING THE GOODS OR SERVICES SHALL BE FOR THE COMPANY, AT ITS OPTION, TO REPAIR OR REPLACE THE GOODS OR SERVICES OR REFUND THE PURCHASE PRICE. THE COMPANY SHALL IN NO EVENT BE LIABLE FOR ANY CONSEQUENTIAL OR INCIDENTAL DAMAGES EVEN IF THE COMPANY FAILS IN ANY ATTEMPT TO REMEDY DEFECTS IN THE GOODS OR SERVICES, BUT IN SUCH CASE THE BUYER SHALL BE ENTITLED TO NO MORE THAN A REFUND OF ALL MONIES PAID TO THE COMPANY BY THE BUYER FOR PURCHASE OF THE GOODS OR SERVICES.

ANY CAUSE OF ACTION FOR BREACH OF ANY WARRANTY BY THE COMPANY SHALL BE BARRED UNLESS THE COMPANY RECEIVES FROM THE BUYER A WRITTEN NOTICE OF THE ALLEGED DEFECT OR BREACH WITHIN TEN DAYS FROM THE EARLIEST DATE ON WHICH THE BUYER COULD REASONABLY HAVE DISCOVERED THE ALLEGED DEFECT OR BREACH, AND NO ACTION FOR THE BREACH OF ANY WARRANTY SHALL BE COMMENCED BY THE BUYER ANY LATER THAN TWELVE MONTHS FROM THE EARLIEST DATE ON WHICH THE BUYER COULD REASONABLY HAVE DISCOVERED THE ALLEGED DEFECT OR BREACH.

RETURN POLICY

For a period of thirty-six (36) months from the date of shipment, and under normal conditions of use and service, Moore Industries ("The Company") will at its option replace, repair or refund the purchase price for any of its manufactured products found, upon return to the Company (transportation charges prepaid and otherwise in accordance with the return procedures established by The Company), to be defective in material or workmanship. This policy extends to the original Buyer only and not to Buyer's customers or the users of Buyer's products, unless Buyer is an engineering contractor in which case the policy shall extend to Buyer's immediate customer only. This policy shall not apply if the product has been subject to alteration, misuse, accident, neglect or improper application, installation, or operation. THE COMPANY SHALL IN NO EVENT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES.



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