MOORE INDUSTRIES WORLDWIDE

Demand Moore Reliability

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HART to Ethernet Gateway System

HES

User's Manual

MOORE INDUSTRIES WORLDWIDE

Demand MOORE Reliability

Customer Support

Moore Industries is recognized as the industry leader in delivering top quality to its customers in products and services. We perform a sequence of stringent quality assurance checks on every unit we ship. If any Moore Industries product fails to perform up to rated specifications, call us for help. Our highly skilled staff of trained technicians and engineers pride themselves on their ability to provide timely, accurate, and practical answers to your process instrumentation questions. Our headquarters and other facilities phone numbers are listed below.

There are several pieces of information that can be gathered before you call the factory that will help our staff get the answers you need in the shortest time possible. For fastest service, gather the complete model and serial number(s) of the problem unit(s) and the job number of the original sale.

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Safety Messages

Please read this manual in its entirety. It should answer most of your questions. For personal and system safety, and for optimum product performance, make sure you thoroughly understand the contents before installing, using, or maintaining this product. Should you still have questions please visit our web site at www.miinet.com or contact any of our sales/ support offices nearest you.

Your safety and the safety of others is very important. We have provided many important safety messages in this manual. Please read these messages carefully. These safety messages alert you to potential hazards that could hurt you or others or render damage to units.

All Moore Industries instrumentation should only be used for the purpose and in the manner described in this manual. If you use this product in a manner other than that for which it was intended, unpredictable behavior could ensue with possible hazardous consequences.

Each safety message is associated with a safety alert symbol. These symbols are found in the throughout the manual. The definition of these symbols is described below:

Pay particular attention wherever you see the following symbols:

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.

Qualified Personnel

The Moore Industries' product/systems described in this manual may be operated only by personnel qualified for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these Moore Industries' products/systems.

Proper use of Moore Industries products

Moore Industries' products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Moore Industries' . Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

We have reviewed the contents of this publication to ensure consistency with the hardware and/or software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions. Specifications and information are subject to change without notice.

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1 HES Quick Start Guide

The HES is ready to install and is set up either with your specified configuration or the default configuration.

After programming your HES, Ethernet Gateway System, install the unit into your application using the connection diagrams and terminal designation table located in this manual.

1.1 HART Input Settings:

- For each HART input Primary Master, 1 HART Field Device with address 0, Normal mode, 1 retry, polling with command 3, additional status off

1.2 Factory Default User Configuration for MODBUS:

- Mapping = By variable
- Compressed unused devices = OFF
- Compressed CMD3/CMD9 Variables = OFF
- Floating Point Word Order = Standard LSW
- Number of Decimal Places = 0
- Failed HART Device's Register Value = Hold Last Value

1.3 HES System Settings:

- ID tag=blank
- Descriptor = blank
- Message = blank
- PV=DV66
- SV=DV68
- TV=DV70
- QV=DV72

1.4 Network Default Configuration:

- DHCP = ON
- Name = HES
- Location = TBD
- MODBUS TCP connections = 4
- HART-IP connections = 4

1.5 Security Jumpers Set To:

- Network configuration = Read / Write
- User configuration = Read / Write

1.6 Network Ports Required (for firewall configuration):

- WWW 80
- MODBUS/TCP 502
- MIIP DTM (HART-IP) 5094
- NAC Client 2850/2851

2 Introduction

The Moore Industries' HES HART® to Ethernet Gateway System converts signals from wired HART devices to Ethernet MODBUS/TCP and HART-IP. This manual contains information needed to install, operate and maintain this product.

2.1 Overview

2.2 Description

The flexible HES HART to Ethernet Gateway System converts signals from wired HART devices to Ethernet MODBUS TCP/IP. The robust HES is the perfect economical way to process data and instrument diagnostics from multiple connected smart HART instruments via MODBUS TCP/IP by allowing greater process uptime through acquisition of process variable data and instrument diagnostics, enabling timely and effective analysis of a process.

The HES HART to Ethernet Gateway System is available with 1 or 4 HART input channels. It supports up to16 field devices per channel (in multidrop mode) for a total of 64 Field Devices on 4 channels, configurable for Primary or Secondary Master, support for retries, BURST mode and HART Command 3 or 9.

The Ethernet output supports up to four MODBUS/TCP and four HART-IP connections. A built-in web server provides quick and easy viewing of HES and device status, HART field device variable data and its MODBUS register address using any web browser. Configuration is available using PACTware and the associated DTMs.

2.3 Features

The Moore Industries HES has many features including single and multiple HART channels, HART Multiplexer Capability, and much more. The HES features are listed here:

Available with multiple channels. 1 or 4 HART channels to support up to 16 or 64 HART devices.

Single HART channels: Up to 16 HART devices in digital multidrop mode, or one device in a standard point-to-point 4-20mA loop configuration.

HART channels: Up to 16 on each of four multidrop HART networks to HES transmits to IIoT systems over Internet or Intranet to control systems, asset manager and historians.

HART Multiplexer Capability: Multiplex up to 64 HART instruments with dynamic and device variables and diagnostic bits that you want to capture in your asset management system over your industrial Ethernet network.

Works with HART compatible devices: The HES communicates with HART 5, 6 and 7 smart multivariable mass flow, pressure, pH and temperature transmitters, coriolis, magnetic, ultrasonic and vortex flow meters and more.

Monitor up to 8 variables per device plus instrument diagnostics. Using the Field Device Status byte data, the HES reads diagnostic data including smart device configuration changed; primary and non-primary variables out of limits; primary variable analog output fixed and more HART status data. It can also be configured to read the Additional Status from the Field Devices (using command 48).

Network configuration. Supports DHCP or fixed IP address, subnet mask and gateway settings (NAC client), auto negotiation and auto MDIX.

Security. Two layer security. User and Network configuration can be independently write protected using hardware jumpers (see Section 3) and the number of connections (MODBUS/TCP and HART-IP) can be set by the user (see Section 5).

Easy MODBUS mapping selection. Provided by variable or by device grouping.

Simple to Configure. Configure over HART-IP, using PACTware or other FDT host and supplied DTM. Easy to use menus provide full configuration of HES, HART channel communications and MODBUS data.

Web page monitoring and status. A built-in web server in the HES provides quick and easy viewing of HES and HART field device status, HART device variable data and its MODBUS register address using any web browser.

Operating power. 9-30DC

2.4 Model Numbers and Options

The following section provides details of the Moore Industries model number and the available options for the HES.

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

Moore Industries model numbers for HES is structured as follows:

HES/4HART/ETH/9-30DC/-MB [DIN]

Unit/Input/Output/Power/-Options [Housing]

Refer to Section 10 Ordering Information for a quick reference table of ordering information.

2.4.1 INPUTS:

Accepts a HART digital protocol input directly from a smart HART transmitter.

HART - Single HART channel input supporting up to 16 HART devices.

4HART - Four HART channel inputs supporting up to 64 HART devices.

2.4.2 OUTPUT:

ETH

HES has Ethernet Output that supports 10/100 Mbps Cat 5/6 Ethernet communications.

2.4.3 POWER:

9-30DC

Accepts any power input range of 9-30Vdc.

2.4.4 OPTIONS:

-MB

HES has MODBUS/TCP Output. This option must be specified.

2.4.5 HOUSING:

[DIN]

DIN-style aluminum housing mounts on 35mm Top Hat DIN-rail (EN50022).

3 Dynamic and Device Variables

Before setting up the HES, or incorporating the unit in your application, Moore Industries suggests that all users take a few moments to become familiar with the different HART revisions and variables available in their HART field devices.

3.1 Understanding How the HES Retrieves and Stores HART Field Device Data

3.1.1 HART Revisions

HART field devices are compliant to a certain HART revision. Most field devices released within the last twenty years support HART revisions 5, 6 or 7. Each new revision of HART offers different features and capabilities but all field devices, regardless of revision, still support backwards compatibility with HART masters and handheld communicators. The HES, acting as a HART master, communicates with all HART field devices that contain HART revision 5, 6 or 7. It is important to verify what revision of HART the field device contains to ensure that the HES is configured correctly.

3.1.2 HART Dynamic and Device Variables

HART devices can provide a significant amount of data in addition to the primary variable, which is embedded onto the 4-20mA loop. In addition to diagnostic and status bits and bytes, there are two types of HART variables that you can retrieve from HART devices – Dynamic Variables and Device Variables.

All HART field device variables are IEEE 754 Floating Point values and are retrieved by the HES from the field device by utilizing HART Command 03 or Command 09.

Dynamic Variables consist of the Primary Variable (PV), Secondary Variable (SV), Tertiary Variable (TV) and Quaternary Variable (QV). These variables can be obtained from the field device using HART Command 03 or 09.

Device Variables may also be used in more sophisticated or multivariable HART field devices to provide additional process, diagnostic or status related information. Device Variables are only available in HART 6 and 7 revision field devices and are read using HART Command 09. Each field device can define up to 240 Device Variables (HART 7) numbered consecutively from 0 to 239. The Device Variable Codes are unique to each field device and may be defined in the operation manual or obtained from the manufacturer. In addition, the following Device Variable Codes are defined in the HART specification (see Table 1-1).

Table 3-1: HART Additional Device Variables

DV	Description
242	(Optional) Battery Voltage
243	(Optional) Battery life
244	Percent Range
245	Loop Current
246	Primary Variable (PV)
247	Secondary Variable (SV)
248	Tertiary Variable (TV)
249	Quaternary Variable (QV)

NOTE: On some HART field devices the Dynamic Variables - PV, SV, TV, and QV, can be assigned and represented as any of the Device Variables.

3.1.3 HES as a HART Master

The HES can be configured as a Primary or Secondary HART master and polls up to 16 field devices on each of its four channels (total of 64 field devices maximum per HES). The HES supports HART Commands 03 and 09 for the reading of Dynamic and Device Variables. Additionally, the HES supports HART Command 48 which reads the field device's Additional Status data. The HART revision of the field device will determine how it supports these commands. Below is a brief summary of which HART Commands are supported by each HART Revision.

HART 5 Devices support HART Command 03 only.

Using HART Command 03, the HES will read the Dynamic Variables, i.e. PV, SV, TV, QV and loop current from the field device.

HART 6 Devices support HART Command 03 and Command 09.

Using HART Command 03, the HES will read the Dynamic Variables and loop current from the field device. Using Command 09, the HES can read up to 4 four Device Variables from the field device. To use Command 09, the number of Device Variables and each Device Variable Code from the specific field device need to be specified.

HART 7 Devices support HART Command 03 and Command 09.

Using HART Command 03, the HES will read the Dynamic Variables and loop current from the field device. Using Command 09, the HES can read up to eight Device Variables from the field device. To use Command 09, the number of Device Variables and each Device Variable Code from the specific field device need to be specified.

All HART revisions support the Additional Status Command 48.

For multivariable and more complex HART field devices, where data is required from more than eight Device Variables, the field device can be polled multiple times by the HES with each poll specifying up to eight unique Device Variables. For example, if you wanted Device Variables 2-25 from a specific field device, you could configure the HES to poll that same field device using HART Command 09 three times specifying eight unique Device Variables in each poll.

3.1.4 HES as a HART Field Device

The HES acts as both a HART Master (reading up to 64 field devices across four channels) and as a HART Field Device. As a HART Field Device, it is HART 7 compliant and has both Dynamic and Device Variables, which can be read via MODBUS/TCP, HART-IP or can be viewed on the HES' web page. See Table 3.2

Table 3-2: HES HART Status & Variables web page

HES: HART Ethernet System

HES HART Status & Variables

HES Field Device Status			
Register Name	**MB Reg**	**Value**	**Status Messages**
Field Device Status	9067	0x0000	No status bits set

HES Additional Status			
Status Bytes	**MB Reg**	**Value**	**Description**
System Overall (Upper)	9072	0x00	No status bits set
System Overall (Lower)	9073	0x00	No status bits set
Channel 1 Consolidated Status	9074	0x00	No status bits set
Channel 2 Consolidated Status	9075	0x00	No status bits set
Channel 3 Consolidated Status	9076	0x00	No status bits set
Channel 4 Consolidated Status	9077	0x00	No status bits set
Extended Status Code (not used)	9078	0x00	No status bits set
Device Operating Mode (not used)	9079	0x00	No status bits set
Standardized Status 0	9080	0x00	No status bits set

HES Dynamic Variables			
Dynamic Variable	**MB Reg**	**Value**	**Source Device Variable**
PV	9001	16.000	DV: 66, Source: Ch 1: Number of slaves communicating
SV	9003	1.000	DV: 68, Source: Ch 2: Number of slaves communicating
TV	9005	1.000	DV: 70, Source: Ch 3: Number of slaves communicating
QV	9007	1.000	DV: 72, Source: Ch 4: Number of slaves communicating

HES Device Variables			
Device Variable	**MB Reg**	**Value**	**Description**
DV1	9203	84.024 DEG F	Source: Mapped - Chan: 1, Device: 1, PV
DV2	9205	474.767 OHMS	Source: Mapped - Chan: 1, Device: 2, PV
DV3	9207	181.645 OHMS	Source: Mapped - Chan: 1, Device: 3, PV
DV4	9209	129.706 OHMS	Source: Mapped - Chan: 1, Device: 4, PV
DV5	9211	885.471 OHMS	Source: Mapped - Chan: 1, Device: 5, PV
DV6	9213	323.190 OHMS	Source: Mapped - Chan: 1, Device: 6, PV
DV7	9215	846.968 OHMS	Source: Mapped - Chan: 1, Device: 7, PV
DV8	9217	996.493 OHMS	Source: Mapped - Chan: 1, Device: 8, PV
DV9	9219	523.627 OHMS	Source: Mapped - Chan: 1, Device: 9, PV
DV10	9221	191.073 OHMS	Source: Mapped - Chan: 1, Device: 10, PV
DV11	9223	1820.651 OHMS	Source: Mapped - Chan: 1, Device: 11, PV
DV12	9225	308.479 OHMS	Source: Mapped - Chan: 1, Device: 12, PV
DV13	9227	338.773 OHMS	Source: Mapped - Chan: 1, Device: 13, PV
DV14	9229	1615.203 OHMS	Source: Mapped - Chan: 1, Device: 14, PV
DV15	9231	69.750 OHMS	Source: Mapped - Chan: 1, Device: 15, PV
DV16	9233	575.270 OHMS	Source: Mapped - Chan: 1, Device: 16, PV

The HES has 74 defined Device Variables (see default assignments in Table 3.3). DV1-64 are assigned by default to represent the PV of each device (1-16) on each HES channel (1-4). However, any of these 64 Device Variables can be re-configured to represent any variables of the connected HART field devices. DV65-74 are fixed Device Variables that include information on HES channel and device communications.

Table 3-3: HES HART Device Variables

DV Code	Name	Description
1	FieldDevData	Ch1, Device 1, PV
2	FieldDevData	Ch1, Device 2, PV
----------	----------	*thru*
16	FieldDevData	Ch1, Device 16, PV
17	FieldDevData	Ch2, Device 1, PV
----------	----------	*thru*
32	FieldDevData	Ch2, Device 16, PV
33	FieldDevData	Ch3, Device 1, PV
----------	----------	*thru*
48	FieldDevData	Ch3, Device 16, PV
49	FieldDevData	Ch4, Device 1, PV
----------	----------	*thru*
63	FieldDevData	Ch4, Device 15, PV
64	FieldDevData	Ch4, Device 15, PV
65	ch1 num configured	Number of field devices channel 1 is configured to poll
66	ch1 w/ comms	Number of field devices channel 1 is communicating with
67	ch2 num configured	Number of field devices channel 2 is configured to poll
68	ch2 w/ comms	Number of field devices channel 2 is communicating with
69	ch3 num configured	Number of field devices channel 3 is configured to poll
70	ch3 w/ comms	Number of field devices channel 3 is communicating with
71	ch4 num configured	Number of field devices channel 4is configured to poll
72	ch4 w/ comms	Number of field devices channel 4 is communicating with
73	total configured	Total number of field devices the HES is configured to poll
74	total w/ comms	Total number of field devices the HES is communicating with

The Dynamic Variables are assigned by default as shown below, but any of the HES' 74 Device Variables can be assigned to any of the Dynamic Variables - PV, SV, TV and QV, when configuring the device. The Loop Current value of the HES is set to NaN (Not a Number).

Table 3-4: HES HART Dynamic Variable Defaults

Dynamic Variable	DV Code	Description
PV	DV66	Number of field devices channel 1 is communicating with
SV	DV68	Number of field devices channel 2 is communicating with
TV	DV70	Number of field devices channel 3 is communicating with
QV	DV72	Number of field devices channel 4 is communicating with

3.1.5 HES MODBUS Data

The HES provides access to both HART field device data, HES device data and additional status information.

For each field device, the following information is made available to the MODBUS memory map:

- Dynamic Variables (PV, SV, TV, QV) plus Loop Current or Device Variables (1-8)*
- Variables' Quality Stamps
- Status and Additional Status** Information
- Configuration Data – Serial number, Tag, HART revision, Manufacture and Device Type Code, EGU, PV Upper & Lower Range

There are various options to organize and compress the HART field device data within the MODBUS memory map. Compression allows each group of data within the memory map to be organized in a contiguous manner, which optimizes and minimizes the number of MODBUS master polling records. The default setting organizes the HART field device data by variable type and uses no compression.

For the HES, the following information is available within the MODBUS memory map:

- System Information (Overall status, information, diagnostics, security, configuration errors)
- Channel status
- Dynamic Variables (PV, SV, TV, QV)
- Device Variables (1-64)
- Variables' Quality Stamps

Once the HES is fully configured, the HES web pages can be referenced to confirm the MODBUS registers used for all data.

*2 sets of registers are provided for the device data, one set is 32 bit floating point and the other set is 16 bit integer values

The **Acquire Additional Status setting needs to be enabled for the channel in the HES

4 Calibration and Bench Check

4.1 Calibration

As the Input signals and Output data are in a digital format, no calibration is necessary.

4.2 Bench Check

We strongly recommend that you initially configure and test the HES on your bench prior to installing it on your HART loop(s).

Your first task would be to configure the IP address for your HES.

4.3 Configuring the HES Ethernet Settings

Configuring your HES for your local area network (LAN) is the first step in this process. Our Network Address Configuration (NAC) Client software will help you configure the HES properly. Begin by installing the NAC Client software onto your PC.

4.3.1 Installing the NAC Client

To install the software, insert the Interface Solution Configuration Tools and Installation Manuals CD into the CD drive of a Windows® equipped PC. Open the CD/Configuration Software and Tools, navigate to Ethernet NAC Client Software and run the Moore NAC program, then use the setup program to install the NAC Client. The setup program may require you to upgrade certain Windows® components before it will install.

4.3.2 Fixed Network Settings or DHCP

To use the HES on a given Ethernet network, three settings must be configured – IP address, gateway and subnet mask. The HES comes with DHCP (Dynamic Host Configuration Protocol) enabled, allowing the network settings to be acquired automatically when the HES is connected to a network with a DHCP server. If connected to a network without a DHCP server, fixed network settings must be configured in the HES.

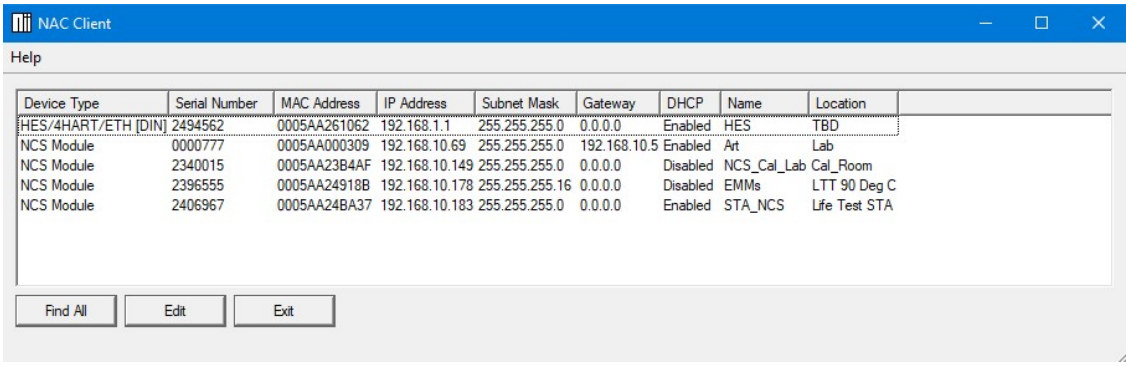
 **NOTE:** If the HES is using DHCP at start up, the network address information displayed in the list box is how it is currently configured. When you double-click to open the Edit window, the network settings boxes are disabled. You cannot set the IP address, subnet mask or gateway address manually if DHCP is enabled.

 **CAUTION:** The use of DHCP introduces the possibility of change or loss of IP address, caused by DHCP server outages or configuration specifics, or by an untimely power outage to the HES (i.e. coincident with DHCP lease expiration). Use of fixed network settings in the HES is recommended. This avoids these potential problems.

To access the network settings of any HES, run the NAC Client on a PC connected to the same network as the HES or, if no network is available, connect an Ethernet cable between the Ethernet port of the HES and PC.

1. Start the NAC Client by clicking on the icon in the Start Menu.
2. Once the program is running, click “Find All”. If more than one HES is on the network, the NAC Client will list them all.
3. Either use the serial number to identify the HES, or simply disconnect the network cable from the HES in question, click “Find All” again and determine which HES disappeared from the list.

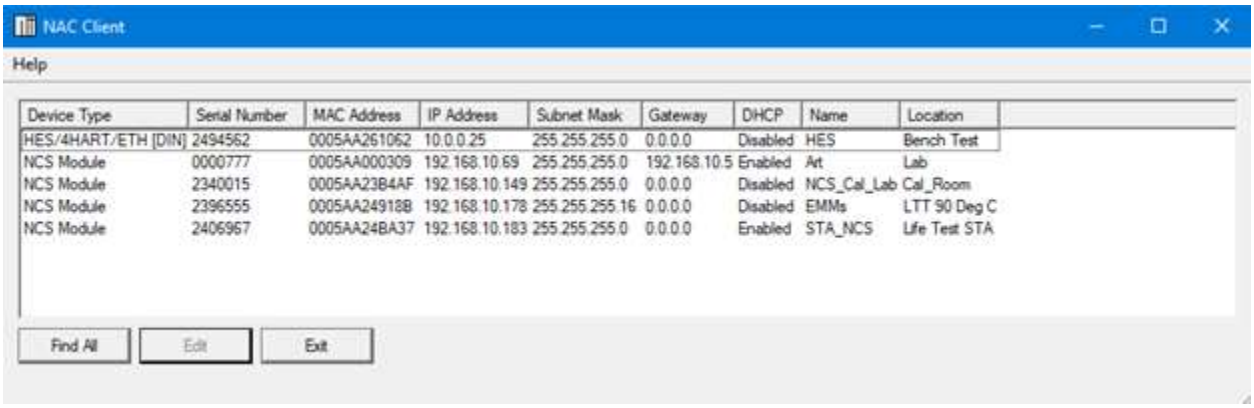
Figure 4.1 NAC Client showing HES default setting with DHCP enabled.



To change the network settings for the HES, double-click on the HES that you want to change. This will open a second window where you can view and change all network settings. Click *OK* when you are finished.

If you receive an error, you may have an incorrect setting in the network window.

Figure 4.2 – NAC Client showing HES with DHCP disabled and showing a user specific IP address.



4.3.3 Verifying the HES Ethernet Connection

To test the HES Ethernet connection, open a web browser (for example Internet Explorer) and type the IP address of the station into the address bar. If you are successful, you will see a web page entitled “HES: HART Ethernet System”.

4.3.4 Testing your HES

To test that your HES is operating properly you will need the following:

Table 4-1: Assembling the Necessary Test Equipment

Device	Specifications
HART Load Resistor	250 – 1100 ohms
Power Supply	9 – 30Vdc
Personal Computer	Microsoft Windows based PC; 16MB free RAM; 20MB free disk space on hard drive; Microsoft Windows 7 or 10 or later Ethernet cable Internet Explorer (or other web browser)
HART Field Device	At least one HART device to be used to test the functionality of the HES
MODBUS/TCP Host	To be used to verify the transfer of data from the HART Field Device to the MODBUS/TCP Host

4.3.5 Front Panel LEDs

The front panel of the single channel HES has two LEDs, Ready and Channel 1.

The front panel of the four channel HES has five LEDs, Ready and Channels 1 - 4.

Table 4-2: LED Meanings

LED	Color	Description
Ready	RED	Initializing on power up or Unit Fault
	GREEN	System OK
Channel X (1, 2, 3, 4)	RED	Initializing, Fault or No HART communication
	GREEN	Channel OK and HART communication with all field devices
	RED/GREEN	Some but not all field devices responding to polling

4.3.6 Wiring your HES

For your testing, your HART Field Device can be powered either by the HES, or by a separate power source.

See Figure 4.3 for connecting your HART Field Device to the HES by using the HES to provide power to the HART Field Device. Note that this method is only applicable to testing on Channel 1 of the HES. Only Channel 1 has the transmitter excitation (TX) terminal.

See Figure 4.4 for connecting your HART Field Device using an external power source to provide power to the HART Field Device.

Figure 4.3: Installing the HES into the Loop using the TX Power Supply to power the HART Field Device(s)

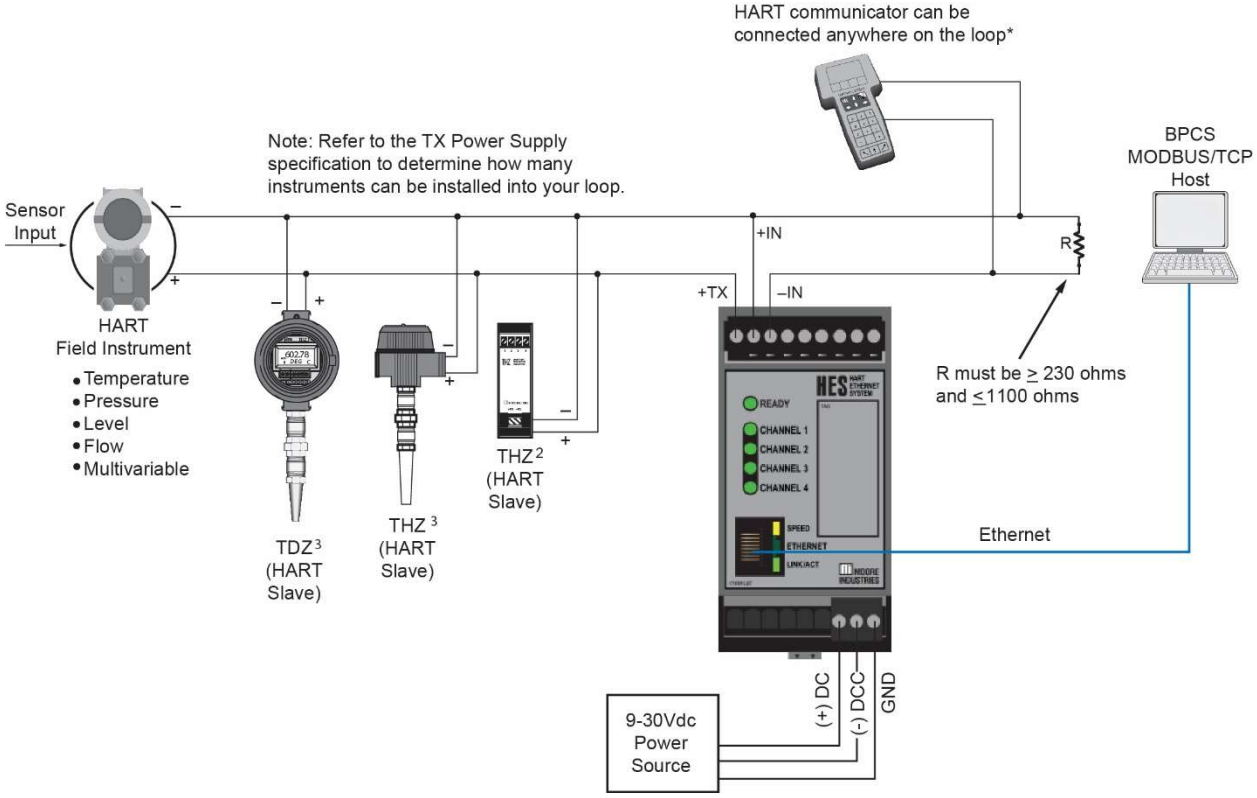
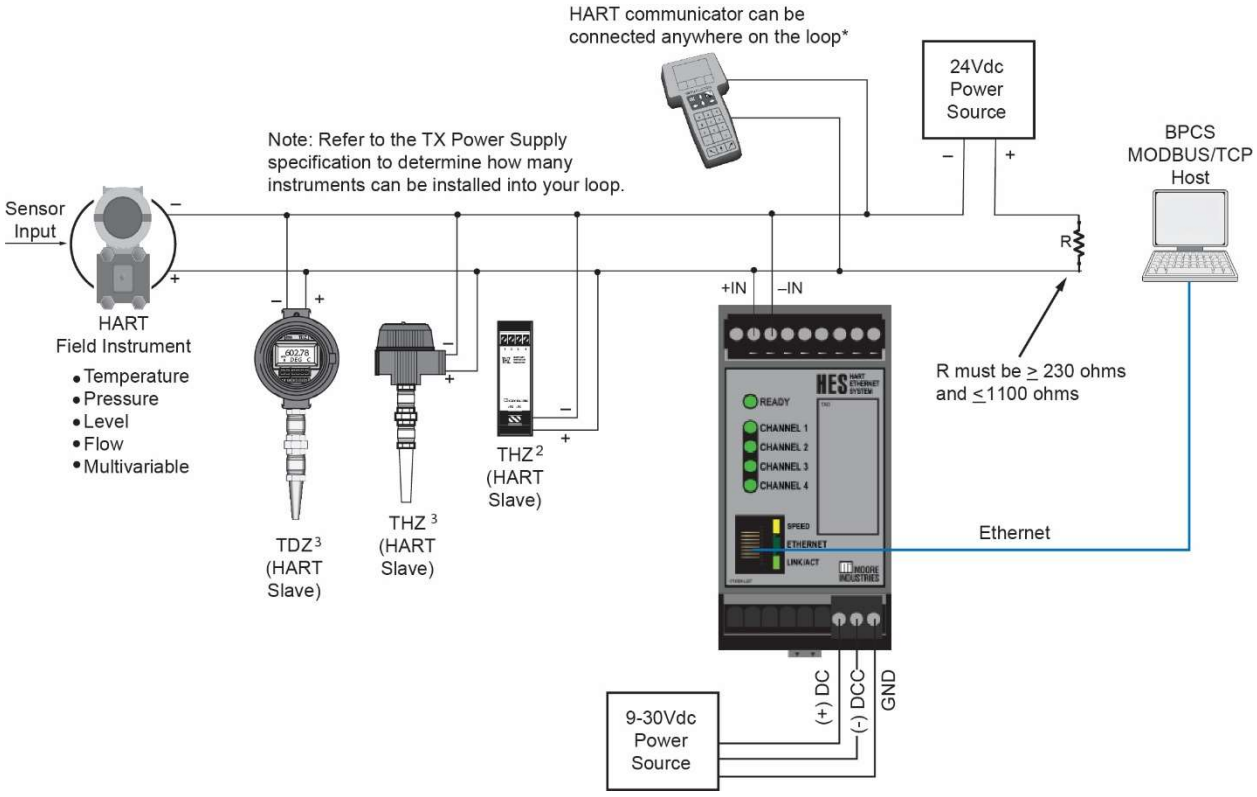


Figure 4.4: Installing the HES into the Loop Using an External Power Source to Power the HART Field Device(s)



4.3.7 Testing Channel 1

By default, Channel 1 of the HES is configured to poll one device at HART address 0, so set up your HART field device for HART address 0. Connect it to the input of the HES by following the wiring diagram of either Figure 4.3 (using the HES TX terminal to power your HART field device) or Figure 4.4 (using an external power source to power your HART field device). If everything is correct, you should observe a green indication on the LED adjacent to Channel 1 on the front panel of the HES.

You can now use your MODBUS/TCP Host to verify that the HES is passing MODBUS data correctly. First, use your PC to view the HES web page for the IP address that you provided earlier in this bench test procedure. View the System Status Registers for Channel 1 and look at the Register Name “Detected Devices”. The value in the register should be 0x001 that implies Device 1 is present.

If you see a value of 0x000 press the F5 key on your keyboard to update the web page. When you see the 0x001 value then your HES is successfully communicating with your MODBUS Host via Ethernet (see Table 4-3).

Table 4-3: System Status Registers for Channel 1

Channel 1			
Register Name	**MB Reg**	**Value**	**Status**
Ch 1 Consolidated Status	9566	0x0010	(4) One or more Devices have Device Malfunction Bit Set
Detected Devices	9569	0x0001	(0) Device 1 is Present
Devices Not Producing Data	9571	0x0000	No status bits set

Now you can verify that HART data is passing from your HART device, through the HES, and on to your MODBUS/TCP Host (even though your HART Field Device is not connected to your process).

Go to the page entitled Field Device HART Status and observe the registers for Channel 1. You should be able to see status information for Channel 1, Device 1 similar to the Table 2-4.

Table 4-4: Status Information for Channel 1, Device 1

Channel 1			
Device	**MB Reg**	**Status**	**Status Message**
Channel 1, Device 1 Addr: 0 Tag: TAG4	4225	Field Device Status	(4) More Status Available (7) Device Malfunction
	4545	Additional Status	Not Read
Channel 1, Devices 2 to 16 are not polled.			

Note that the Field Device Status in this example shows a code of (4) for More Status Available and a code of (7) for Device Malfunction. This data is being transmitted by the HART Field Device and is being successfully read by the HES. To ensure that this data is being successfully passed along to your MODBUS/TCP Host you will have to use your MODBUS/TCP Host to read Register 4225. Please see Table 4-4 and notice that register 4225, bit position 4 shows a 1, and register 4225, bit position 7 also shows a 1. This proves that the HART data is being successfully passed from your HART Field Device, through the HES, and on to your MODBUS/TCP Host without error.

Figure 4.5: MODBUS Register Information

If you have an HES with a single HART channel then your testing is now complete. If you have an HES with four HART channels, you can now proceed to test the remaining three channels. The major difference will be in the way the HART loop is powered (by an external power source) as shown in Figure 4.4.

.

5 Wiring and Installation

Instructions in this section and others may require special precautions to ensure the safety of the personnel performing the operations. Notes, Cautions and Warnings that may cause potential safety issues are indicated throughout this manual by symbols, please refer to the Safety Message Page.

5.1 Terminal Designations

The following Tables (5-1-5-4) are the terminal designation information for both the single and four channel HES.

Table 5-1:Top Terminal Configuration for Single Channel HES

Top Terminals (Left to Right)			
	T1	**T2**	**T3**
Input Single Channel	TX	+IN	-IN

Table 5-2: Top Terminal Configuration for Four Channel HES

Top (Left to Right)									
	T1	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
Input Four Channel	TX	+IN	-IN	+IN	-IN	+IN	-IN	+IN	-IN
	Channel 1			**Channel 2**		**Channel 3**		**Channel 4**	

Table 5-3: Bottom Terminal Configuration for Single and Four Channel HES

Bottom Terminals (Left to Right)			
	B1	**B2**	**B3**
Power 9-30VDC	(+)DC	(-)DCC	GND

Table 5-4: Key for Tables for 5-1 – 5-3

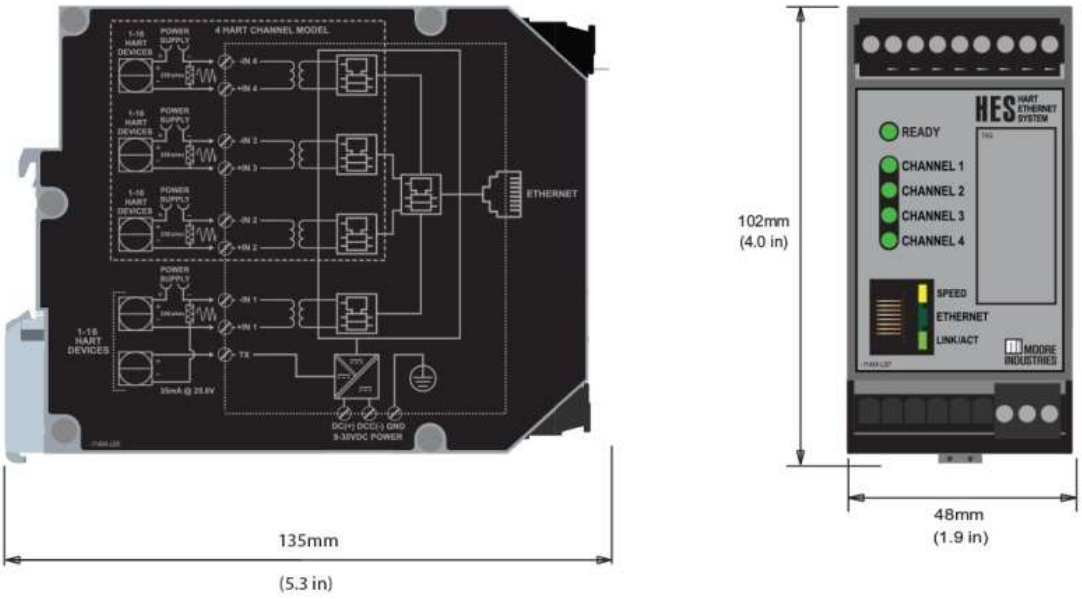
Abbreviation	Meaning
TX	Power for 2-Wire transmitter
+IN	Positive input
–IN	Negative input
(+)DC	Positive power input
(–)DCC	Negative power input
GND	Ground

 **NOTE:** Terminal blocks can accommodate 14-22 AWG solid wiring. Tighten terminals to four inch-pounds (maximum).

5.2 Dimensions

Dimensions are the same for the 1 channel and 4 channel models.

Figure 5.1: HES Dimensions



5.3 Installation

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

5.4 Mounting

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

5.5 Electrical Connections

When installing any Moore Industries product, always follow all local regulations and standards for grounding, shielding, and safety.

5.6 Installation Category

All terminals are rated CAT 1.

5.6.1 Equipment Ratings

The HES does not generate hazardous voltages, it provides a low current (4-20mA) input or Ethernet output. Products connected to the HES should be designed to receive this type of input.

5.6.2 Input

The HES has a choice or either 1 or 4 channels HART inputs with the ability to individually configure each channel as either a Primary, Secondary, or Disabled Master. Each channel supports up to 16 HART devices in digital multidrop mode or can support just one device in a standard point-to-point 4-20mA loop configuration.

A four-channel configuration can support up to 64 total HART devices for high density installations. The HES communicates with all HART 5, 6 and 7 devices including smart valves, multivariable flowmeters, pressure, pH, level, and temperature transmitters and more.

A transmitter excitation power supply on Channel 1 only: 25.8Vdc ±3%@35mA; capable of powering multiple HART field devices configured as multidrop model.

5.6.3 Output

The HES offers a standard one RJ45 connector for Ethernet.

5.6.4 Protective Earth Conductor

The Protective Earth Conductor shall be of equal or larger size wire than the other two power conductors. The Protective Earth Conductor shall be the first conductor connected to the unit when the unit is being wired. It shall be the last conductor removed when the unit is being un-wired.

5.6.5 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). 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.

5.6.6 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.

5.7 User Configurable Hardware

The HES has access to internal security jumpers with the ability to set them to read only (see Figures 5.3 and 5.4). The jumpers are accessed by a sliding panel on the bottom of the device (see Figure 5.2).

Security jumpers are set by default to:

- Network configuration = Read / Write
- User configuration = Read / Write

 **CAUTION:** Please power down unit before accessing the jumpers.

Figure 5.2: Jumpers Access Located on the Bottom of the HES under a Sliding Panel

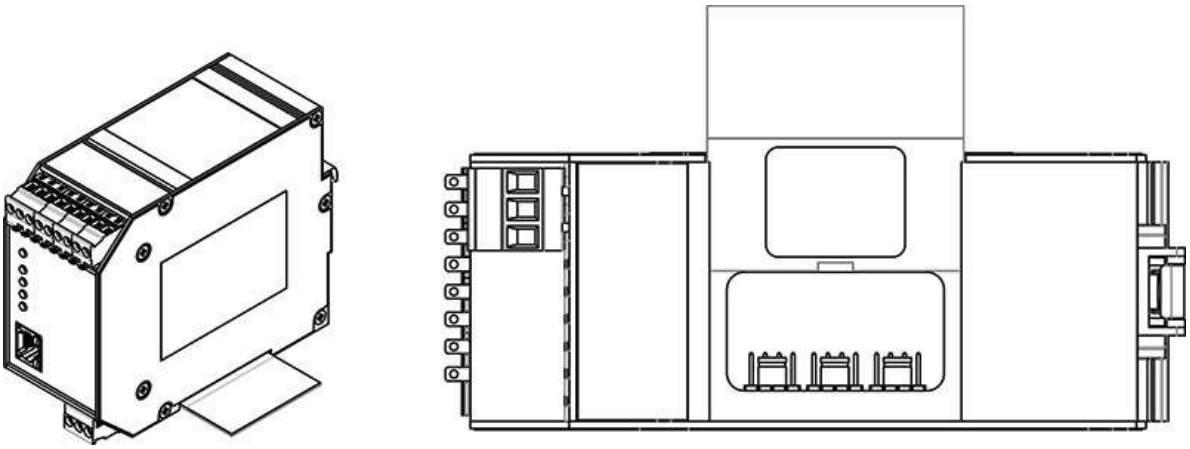


Figure 5.3: HES Jumper Configuration for Read/Write

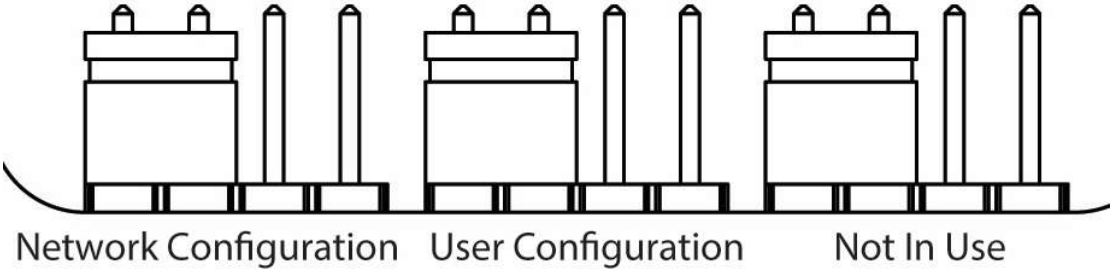
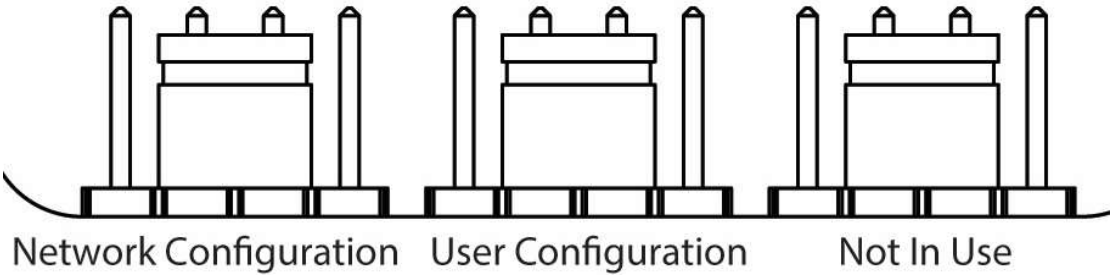


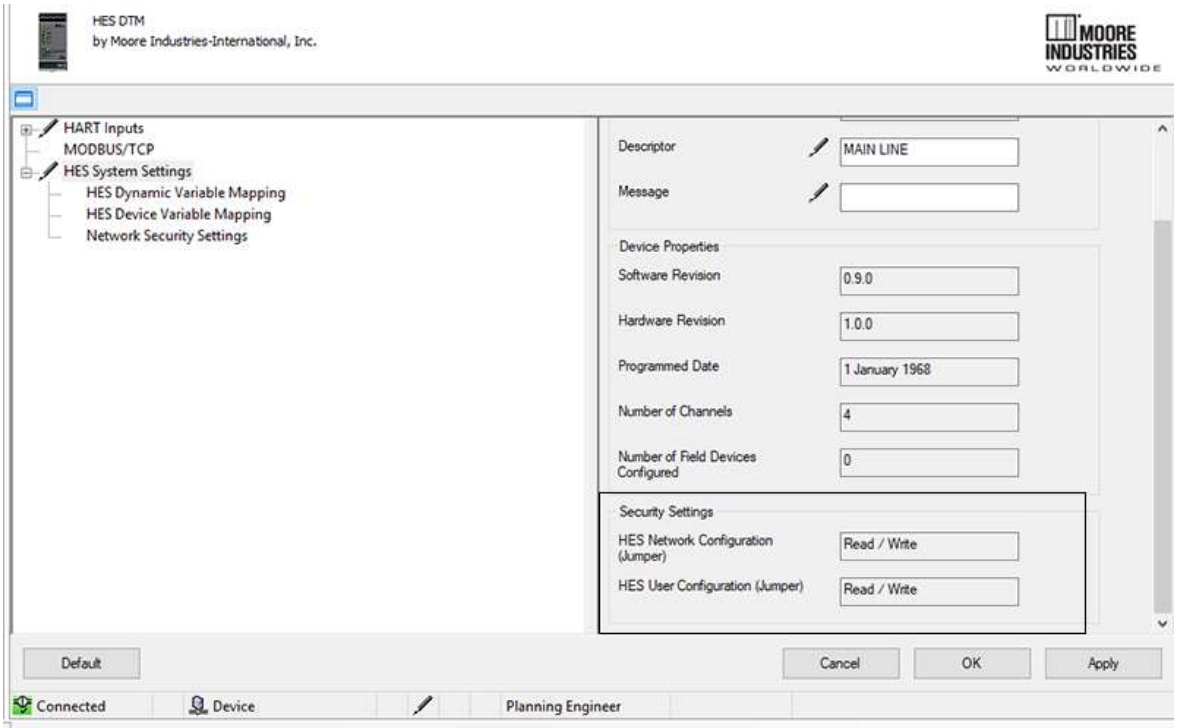
Figure 5.4: HES Jumper Configuration for Read Only



NOTE: For jumper configuration change to take effect, the HES will need to be power cycled (turn power off and back on).

You can check the current status of the Network and User Configuration jumpers via your FDT program with the HES' DTM. To check, connect to the HES and upload the configuration, then click on the HES System Settings. Scroll down to Security Settings as shown below in Figure 5.5.

Figure 5.5: Viewing of Status of HES Network and User Configuration Jumpers



NOTE: The jumper settings are also viewable on the HES Home web page in the Security section.

6 HES Configuration

Four different pieces of software are required for configuring your HES. They are available on the Moore Industries' CD shipped with the HES or for download from Moore Industries' web site at http://www.miinet.com/. The software required includes:

- PACTware v. XXX (Download the latest version) or any FDT frame application
- Moore Industries MIIP Communications DTM
- Moore Industries' HES Device DTM
- Moore Industries' Network Address Configuration (NAC) Client

For users who already have an FDT Frame Application, all the following information is still relevant except for the PACTware installation. For more information on FDT/DTM please refer to www.fdtgroup.org.

NOTE: If configuring the HES through a firewall, please ensure the relevant ports are open for the services you need.

- WWW 80
- MODBUS/TCP 502
- MIIP DTM (HART-IP) 5094
- NAC Client 2850/2851

6.1 FDT Frame Application

Moore Industries has always provided proprietary software to configure and operate our field instruments to the full extent. The HES will require the use of an FDT frame application, which allows configuration and adjustment of any and all field instruments, which have a DTM. For users who do not already have an FDT frame application, Moore Industries provides PACTware.

An FDT frame application, such as PACTware, is a PC program, which interfaces with individual software modules for instrument operation. This interface is regarded as the FDT; the individual software modules for instrument adjustment are called DTMs (Device Type Manager). This configuration makes user-friendly adjustments possible because the interface for instrument adjustment is optimally adapted to each instrument.

When installing the version of PACTware supplied by Moore Industries, the installation will include three communication DTMs. They are a HART Communication DTM, and two proprietary communication DTMs. The MISP DTM stands for Moore Industries Serial Port and the MIIP DTM stands for Moore Industries Internet Protocol. The HES only uses the MIIP DTM.

6.2 FDT/DTM Software Installation

In order to get started you will need to either install the PACTware software and DTMs or just install the DTMs (if you already have an FDT frame application installed). All the files you need can be found on our website www.miinet.com.

The PACTware installer file will install PACTware and all required communication DTMs. The HES and other device DTMs need to be installed separately (see below).

PACTware_vxxx_FDT_DTM_Installation_Moore_Industries.exe

When you run the installer, you will have the option to select which components you want to install.

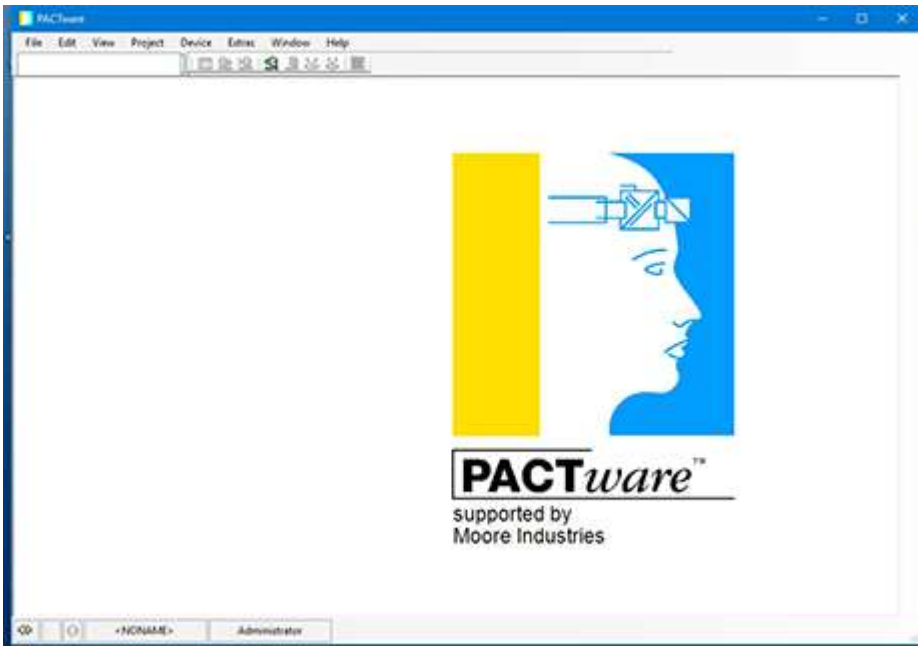
NOTE: xxx is the current version of software. Download the latest version of all software to assure compatibility.

6.2.1 To Install PACTware

Click on installer and follow prompts.

You will find individual DTM installers on the website and Moore Tools CD in Comms and Device folders. Use these to install or update the Moore Industries DTMs.

Figure 6.1: PACTware Ready for MIIP DTM Installation



6.2.2 Moore Industries MIIP DTM Installation

To communicate with the HES you will need to install the MIIP DTM. The MIIP DTM can be found on the Moore Industries Configuration Tools CD, or from our website www.miinet.com.

To install simply locate file, double click file and follow on screen instructions to install.

NOTE: The MIIP Communications DTM: Is a Moore Industries Internet Protocol, which allows communication via Ethernet.

6.2.3 Moore Industries HES Device DTM Installation

File is named: HES_PC_Configuration_Software_Moore_Industries

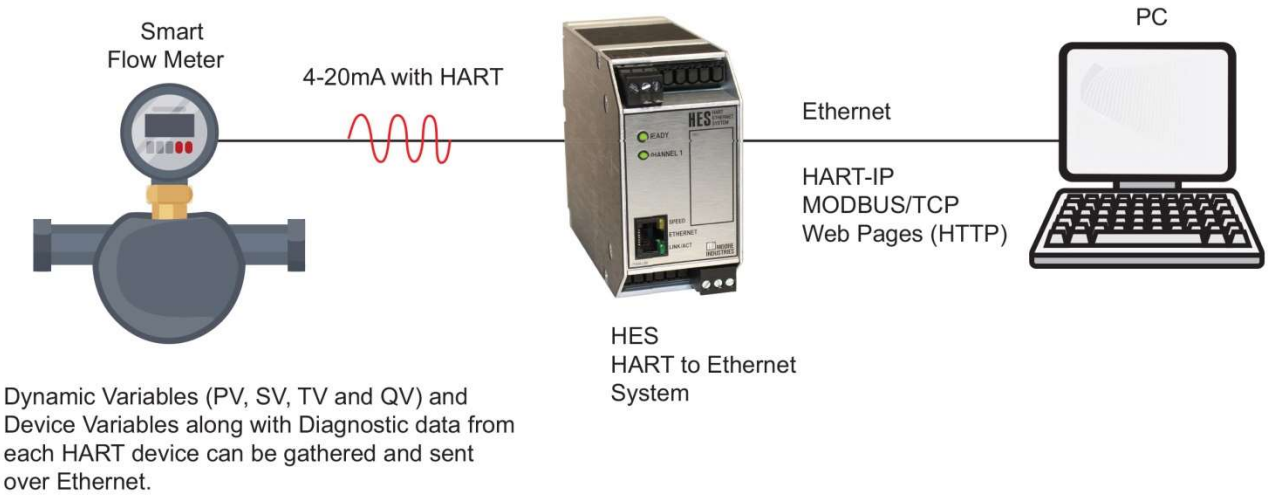
To install simply locate file on the CD or download from the web site, double click file and follow on screen instructions to install.

Once you have installed all the necessary DTMs on your system, you are now ready to launch the FDT frame application (PACTware) and configure your device.

6.3 Basic Setup

Once the HES is powered up and the software is loaded, a simple setup is all that is needed to get started with a laptop, CAT 5 Ethernet cable with RJ45 connection (see Figure 6.2). The HES supports Auto MDIX (Medium Dependent Interface), which means that either a straight through Ethernet patch cable or crossover cable can be used for commissioning and configuration.

Figure 6.2: HES connection to PC for Configuration



6.4 Network Configuration

The HES comes default from the factory set to DHCP. Configuring the HES for your local area network (LAN) is the first step in this process. Our Network Address Configuration (NAC) Client software will help you configure the HES properly. Begin by installing the NAC Client software onto your PC.

6.4.1 Installing the NAC Client

To install the software, insert the Interface Solution Configuration Tools and Installation Manuals CD into the CD drive of a Windows® equipped PC. The NAC client software available in the Resources Area on the Moore Industries website or on the CD included with your product.

Run the Moore NAC program, then use the setup program to install the NAC Client. The setup program may require you to upgrade certain Windows® components before it will install.

6.4.2 Fixed Network Settings or DHCP

To use the HES on a given Ethernet network, three settings must be configured– IP address, gateway and subnet mask. The HES comes with DHCP (Dynamic Host Configuration Protocol) enabled, allowing the network settings to be acquired automatically when the HES is connected to a network with a DHCP server. Change the DHCP to a static IP. The number can be obtained from your system administrator. NAC client should always be used initially and DHCP should not be set permanently.

 **NOTE:** If the HES is using DHCP at start up, the network address information displayed in the list box is how the server is currently configured. When you double-click to open the Edit window, the network settings boxes are disabled. You cannot set the IP address, subnet mask or gateway address manually if DHCP is enabled.

 **CAUTION:** The use of DHCP introduces the possibility of change or loss of IP address, caused by DHCP server outages or configuration specifics, or by an untimely power outage to the HES (i.e. coincident with DHCP lease expiration). Use of fixed network settings in the HES is recommended, and avoids these potential problems.

6.4.3 Change Network Settings

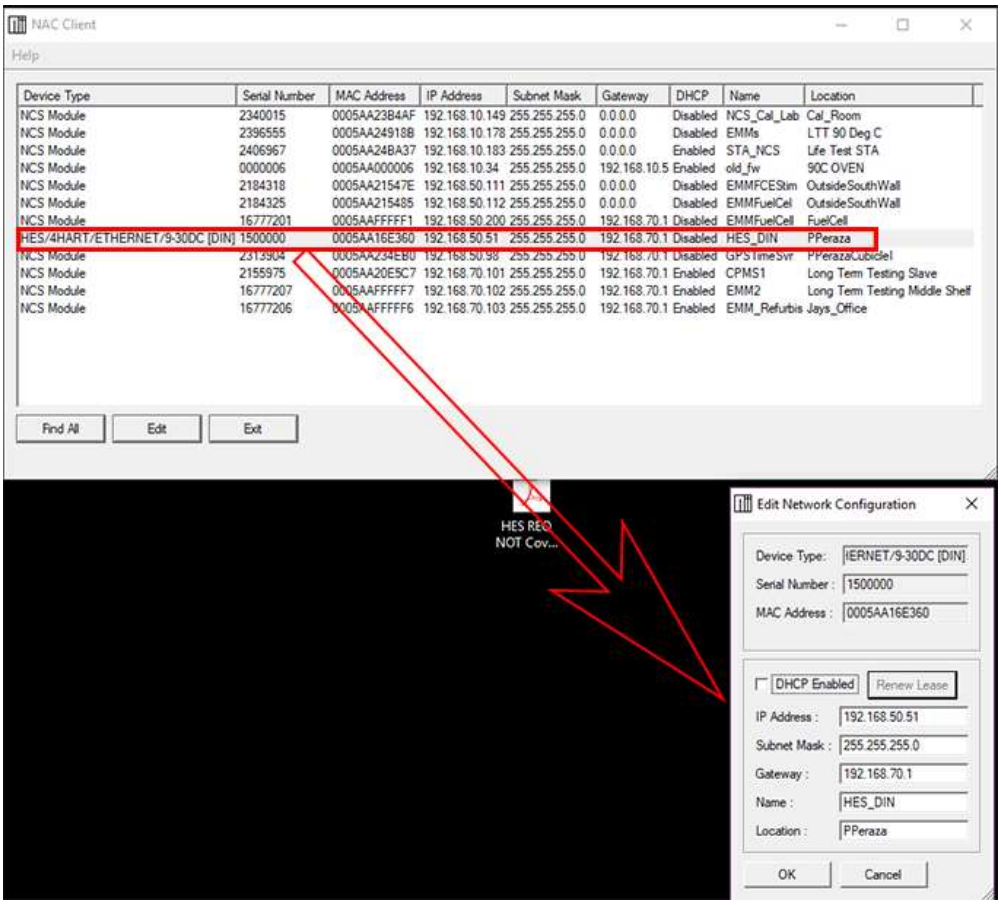
To access the network settings of the HES, run the NAC Client on a PC connected to the same network as the HES or, if no network is available, connect a network cable between the Ethernet ports of the HES and PC. No cross over cable is necessary.

1. Start the NAC Client by clicking on the icon in the Start Menu.
2. Once the program is running, click Find All.
3. If more than one HES is on the network, the NAC Client will list them all.
4. Disconnect the network cable from the HES in question, click Find All again and determine which HES disappeared from the list.

6.4.4 To Change the Network Settings for a HES

1. Double click on the HES that you want to change. This will open a second window where you can view and change all network settings (Figure 6.3).
2. Set Static IP Using NAC Client.
3. Click OK when you are finished.

Figure 6.3: Use NAC Client to configure the HES network, name and locating settings.



Power the HES on and off.

6.5 Connecting to the HES Using MIIP

Once you have installed all the necessary DTMs on your system, connected your HES to an Ethernet Network, and you know the IP address of the HES (use the NAC client for the IP), you are now ready to launch the FDT frame application (PACTware) and configure your device.

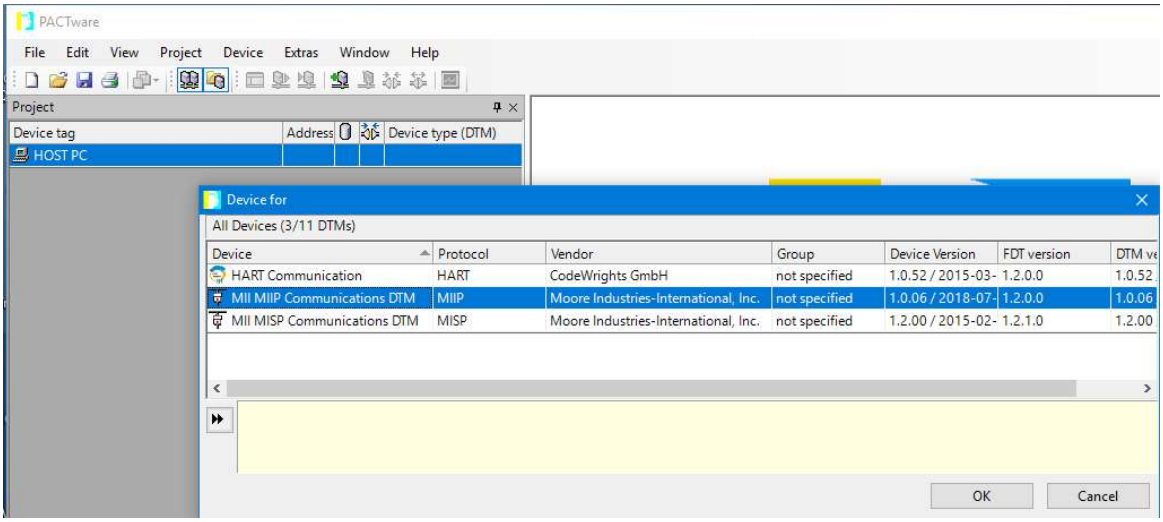
1. Click on the "PACTware**"** Icon to launch the software. 

2. Right Click on Host PC, select "Add Device**".**

3. Select the "MII MIIP Communications DTM" from the pop up window.

    a. Click OK.

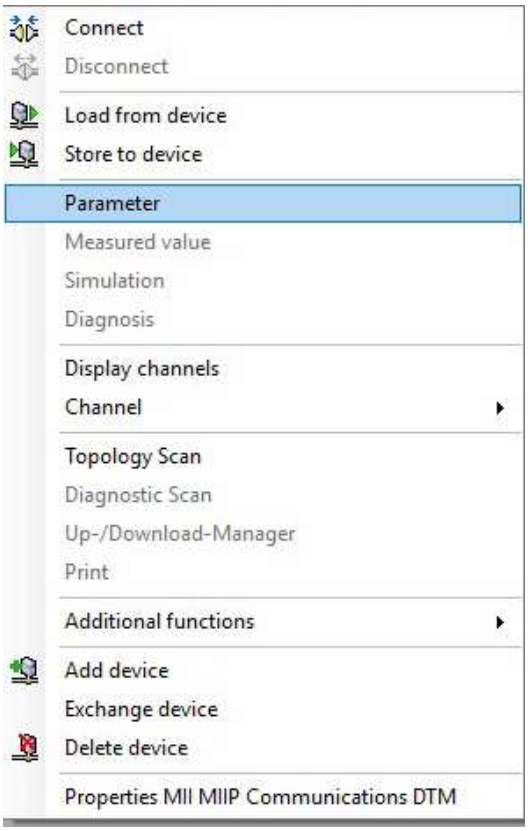
Figure 6.4: Select the MIIP Communication DTM to configure the HES



4. To be able to configure the HES, you will need to set its IP address in the MIIP DTM.

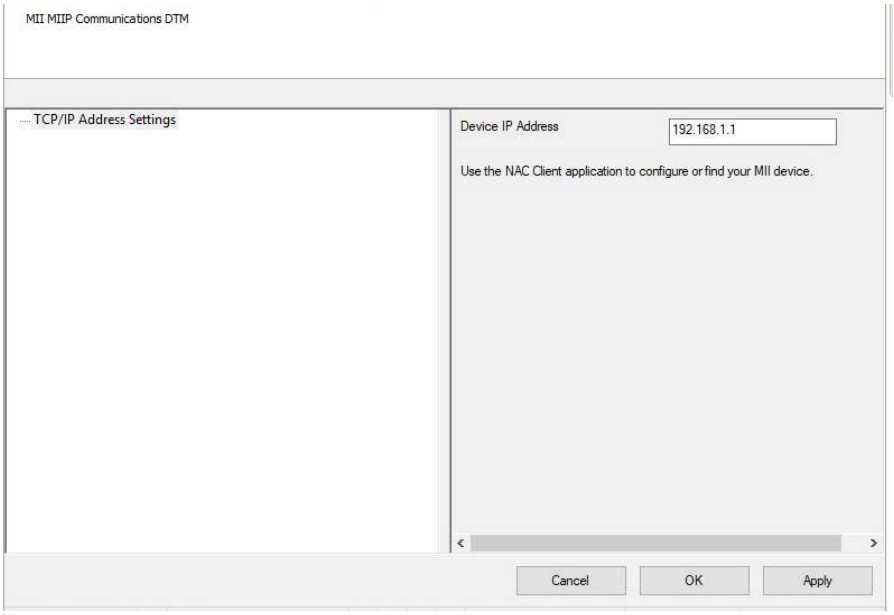
    a. Right click on the MII MIIP Communications DTM and select “Parameter”.

Figure 6.5: Parameter Selection



2. Enter the IP for the HES, Click ”Apply”.

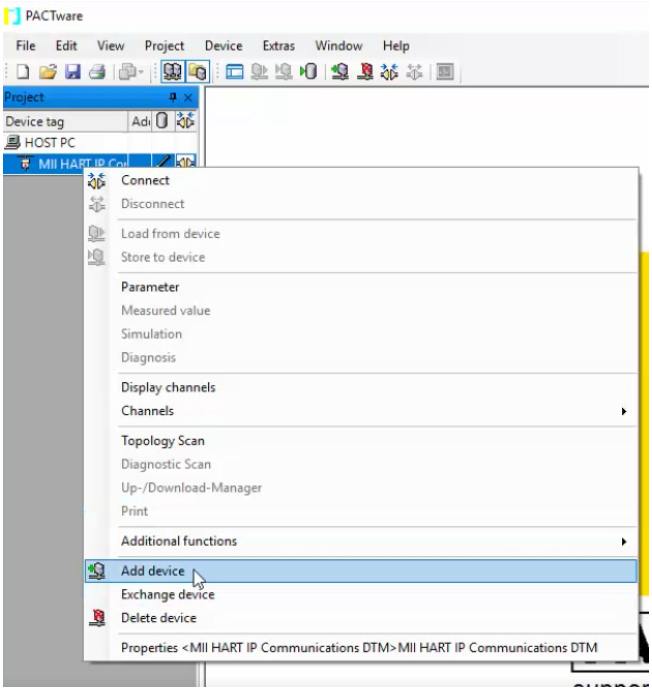
Figure 6.6: MIIP Communications DTM



6.5.1 Add Device

Right click on the MIIP Communication DTM listed under HOST PC (where the IP address was just set).

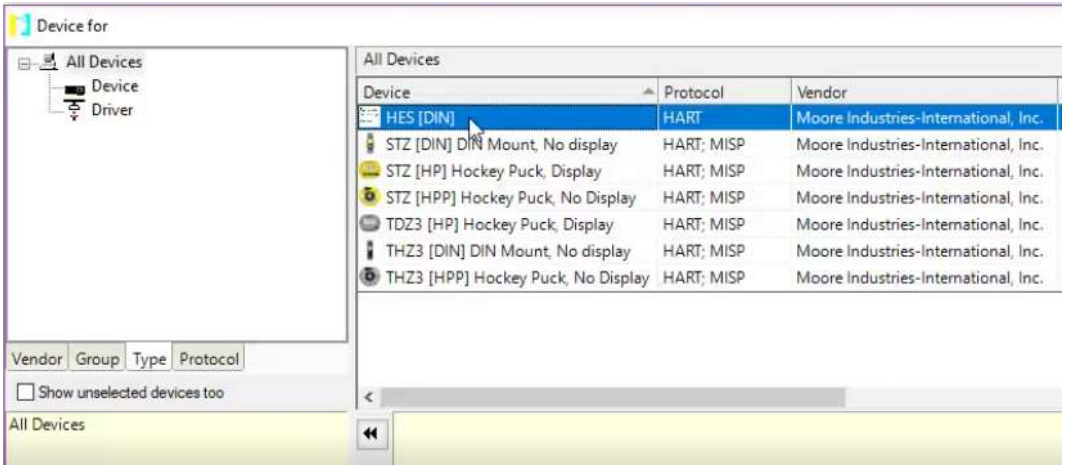
Figure 6.7: Add Device Selection



1. Select “Add Device**”.**

In the pop up Device Catalog window, select “HES”.

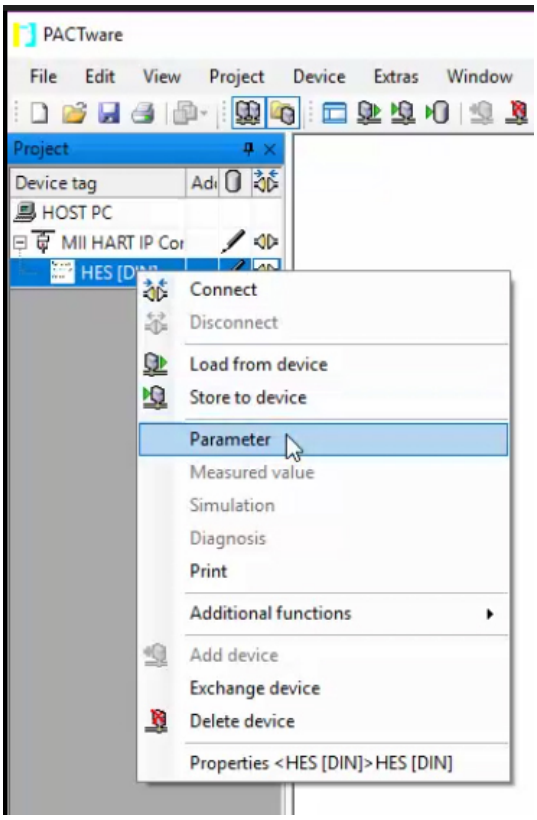
Figure 6.8: Device List



Display Default and Current HES Configuration

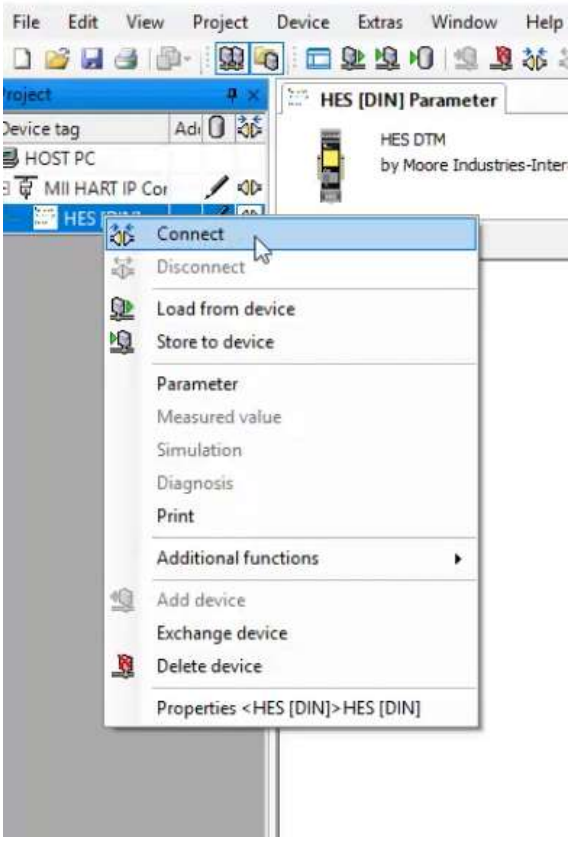
1. Right click on the HES and select “Parameter”.

Figure 6.9: Parameter Selection



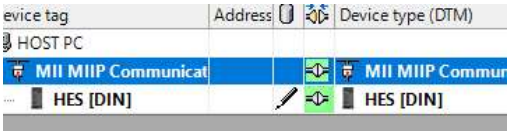
2. Right click on the “HES” (selected DTM), and select “Connect”.

Figure 6.10: Connect Selection



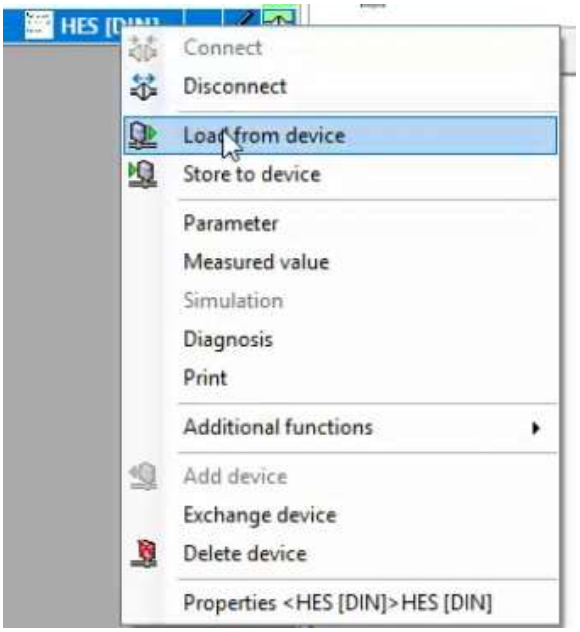
A green box will appear around the connection symbols showing the device is connected.

Figure 6.11: Device List



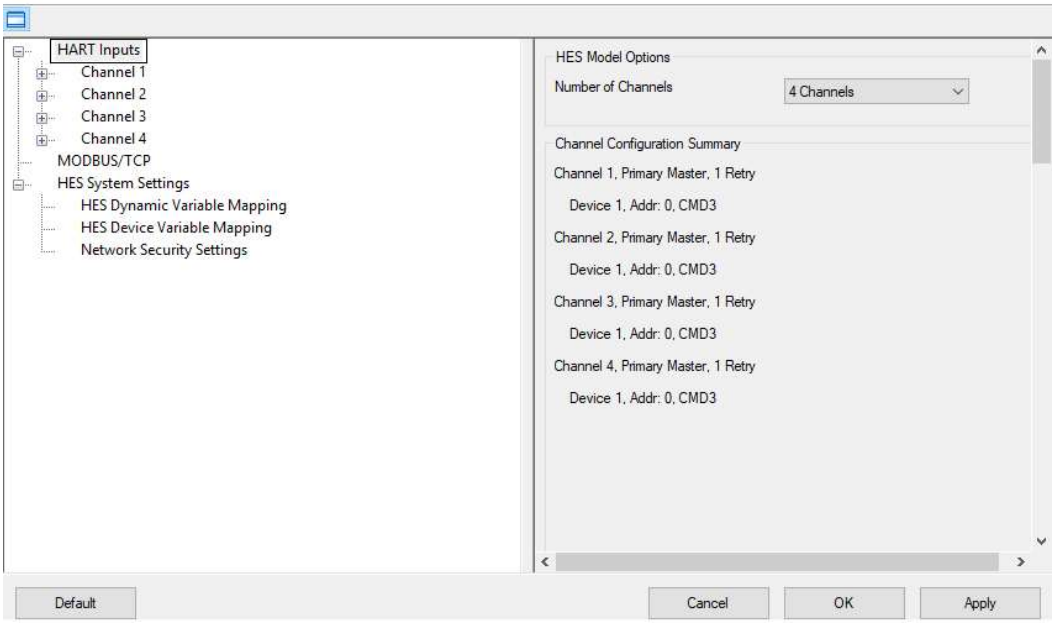
3. Load the parameters from the device to see the current device settings.
    a. Right click on the HES, select “Load From Device” (Figure 6.12).
    b. A window will appear while loading the information.

Figure 6.12: Load From Device Selection



The configuration of the connected HES will be shown (Figure 6.13).

Figure 6.13: HES Configuration Overview Window

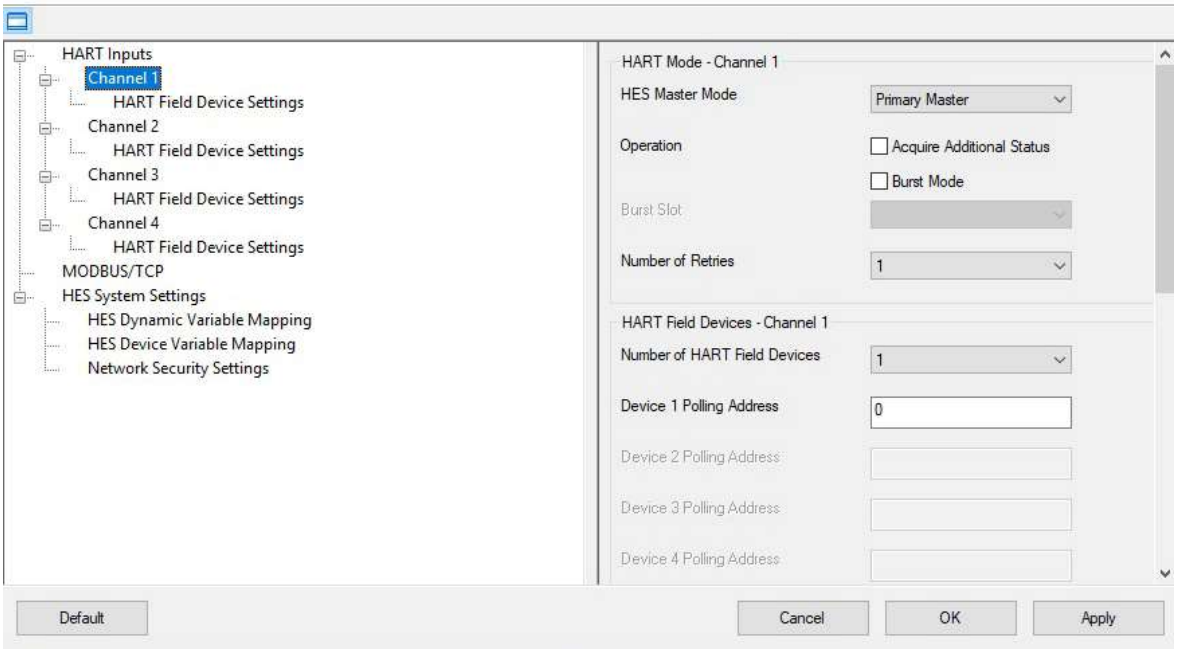


For HES Default Settings, please refer to the HES Quick Start Guide. Default values for each parameter are also shown below in [ ] (on the following pages).

6.6 HART Inputs Settings

6.6.1 HART Inputs - Channel Settings

Figure 6.14: Channel Settings Window



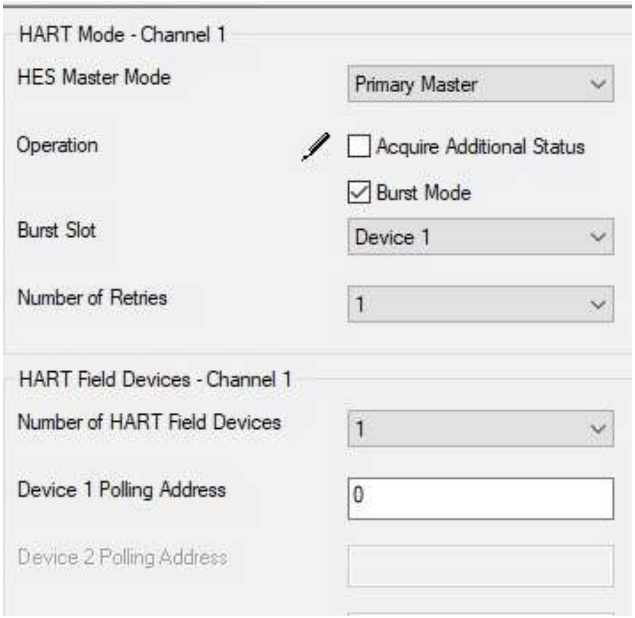
Each channel has identical settings. Channel 1 is shown as an example.

- **HES Master Mode [Primary]** - The user can select Primary Master, Secondary Master, or Disabled. Choose Disabled when a channel has no devices hooked up to it or you want to disable the HART monitoring on that channel.
- **Operation**
    - **Acquire Additional Status** [off] - The field devices all produce device specific Additional Status bytes (25 maximum) as defined by the HART standard. If configured and available, the HES will read the field device additional status bytes. These are displayed on the 'Field Device HART Status' web page and can also be found in the MODBUS registers (see MODBUS registers section).

- **Burst Mode** [off] - The HES supports enhanced broadcast messaging more commonly referred to as burst mode for one field device per channel. When set to burst mode, the field device will proactively send out messages instead of waiting for the HART master to request them. This enables event driven communication (high, low, deviation of signal or change in status) and/or timed communication to the master. Burst slot is enabled when the user selects Burst Mode. Select the Device number in the pull down menu.

NOTE: The HART field device needs to be configured for Burst with the same burst configuration (Command 3 or 9) as the HES.

Figure 6.15: HART Mode Channel 1 Settings



- **Number of Retries** [1] – The number of times the HES will try a HART field device that isn't responding before declaring a communications error for that Field Device.
- **HART Devices – Channel X**
  - **Number of HART Devices [1]** – the number of devices (up to 16) chosen on a channel will equal the number of polling device addresses available (not grayed out).
  - **Device Y Polling Address** - This is the HART Polling Address for the selected field device, enter a number from 0-63.

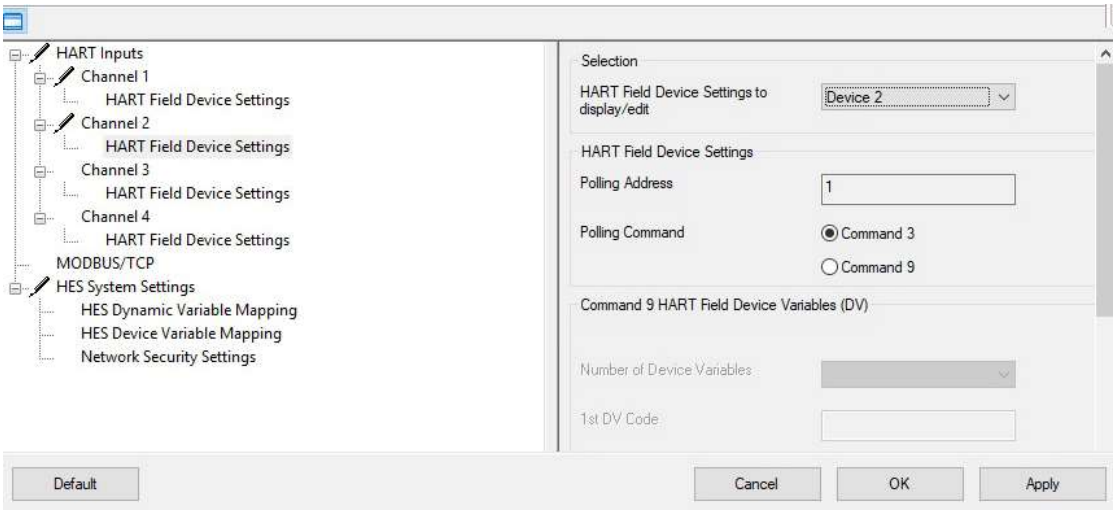
NOTE: The pencil icon means you have not saved or applied the change.

Please remember to download to your device, refer to Saving the Configuration File to the HES at the end of this section.

6.6.2 HART Field Device Settings

First, select the device you want to configure from the pull down list.

Figure 6.16: HART Input Configuration

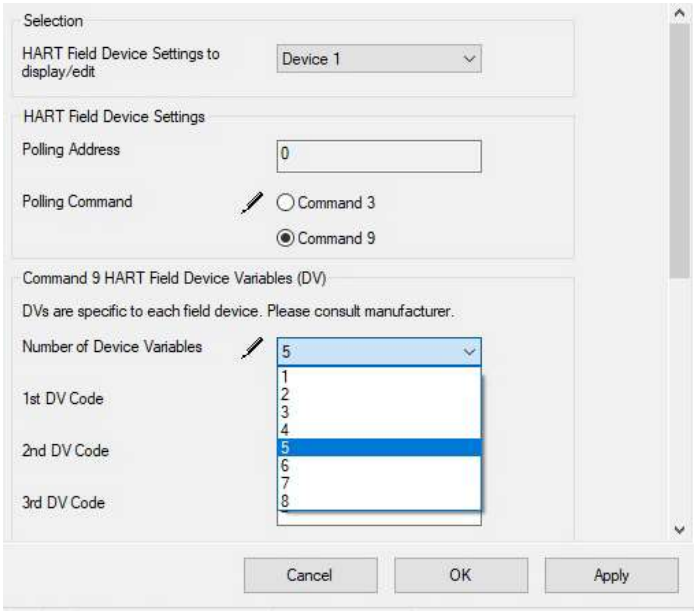


- **Polling Address -** This is the HART Polling Address, as entered on the Channel Configuration screen. It is read-only on the Field Device Settings screen.
- **Polling Command [Command 3] -** This is used to select the HART command for retrieving Dynamic or Device Variables. See Section 1 Introduction, Dynamic and Device Variable for more information.
    - **Command 3 -** Used for retrieving PV, SV, TV, QV and loop current from the field device.
    - **Command 9 -** Command 9 is supported by HART 6 or 7 devices. Selecting this command requires the user to define the number of Device Variables (DVs) and each DV code to be read.

Configure Using Command 9

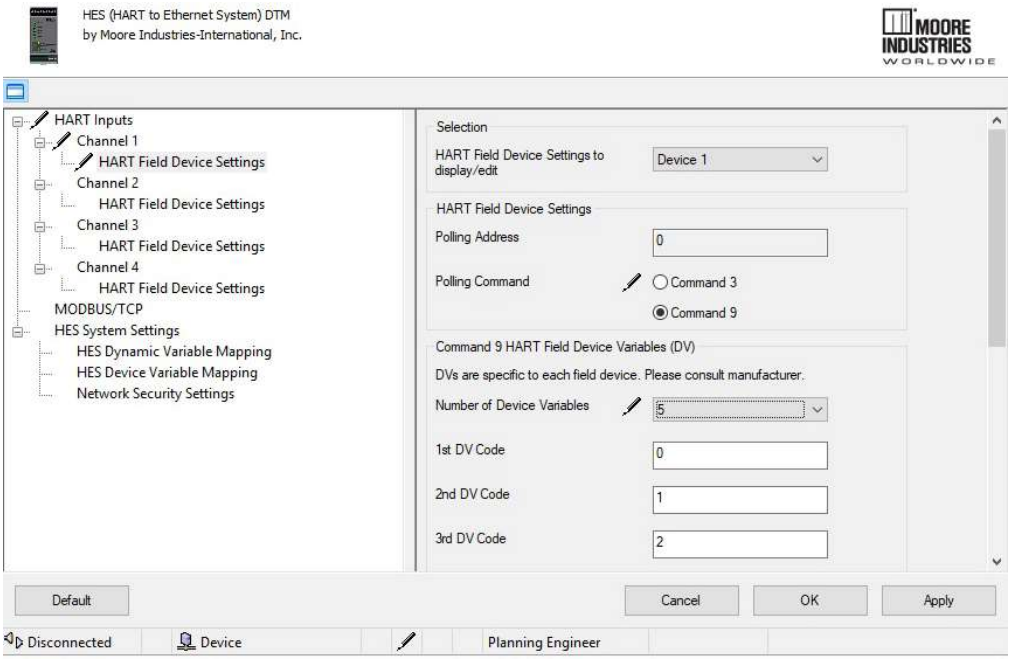
1. Select the number of “Device Variables” on the channel you are configuring.

Figure 6.17: Configuring Command 9 Device Variables



2. Enter Device Variable codes for the data to be read from connected HART devices (Figure 6.18).
3. Click “Apply”.

Figure 6.18: Applying Device Variable Codes

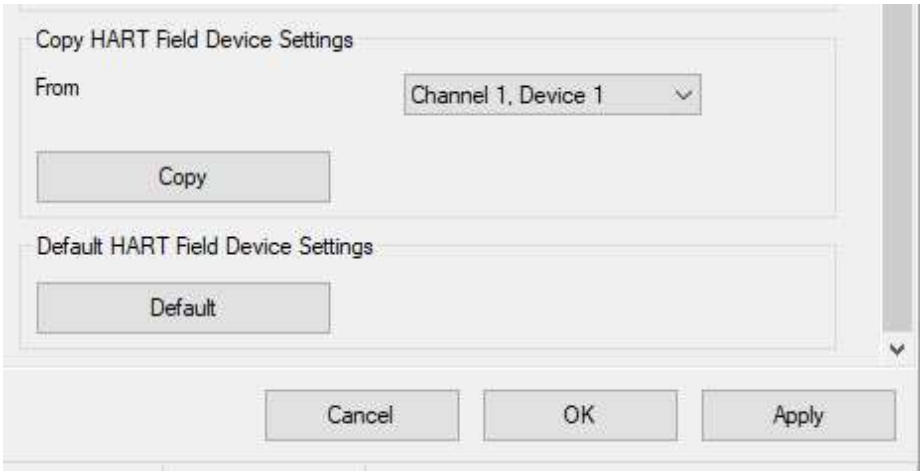


6.6.3 Copy Device Settings to a Different Channel

If you have a number of devices with the same settings, this feature helps to speed up configuration.

1. Set up 1 device with your command settings.
2. Go to the channel and device you want to copy the setting to and scroll to the bottom of the Device Setting.
3. Select “Copy HART Field Device Settings From” and choose the Device you want to copy from in the pull down menu.
4. Click “Copy”.
5. Click “Apply”.

Figure 6.19: Copy HART Field Device Settings



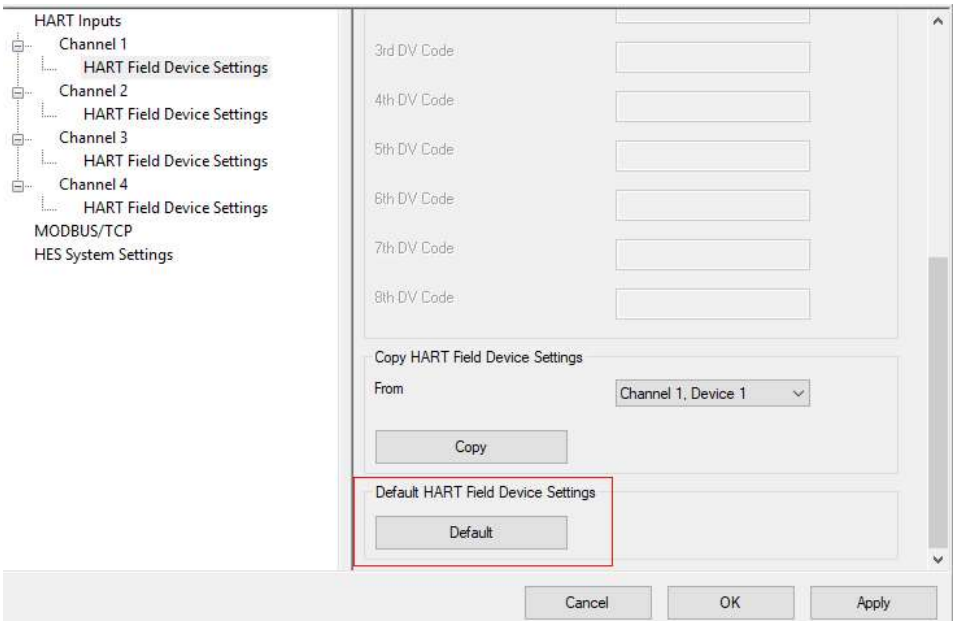
Please remember to download to your device, refer to Saving the Configuration File to the HES at the end of this section.

6.6.4 Default Device Settings

Use “Set to Default” to set a particular device to the default configuration.

1. Click on the channel then the “HART Field Device Settings” you want to change to default.
    a. Select the device you wish to default.
2. Click on the “Default“ Button under “Default HART Field Device Settings”.
3. Click “Apply”.

Figure 6.20: HART Input Default Settings

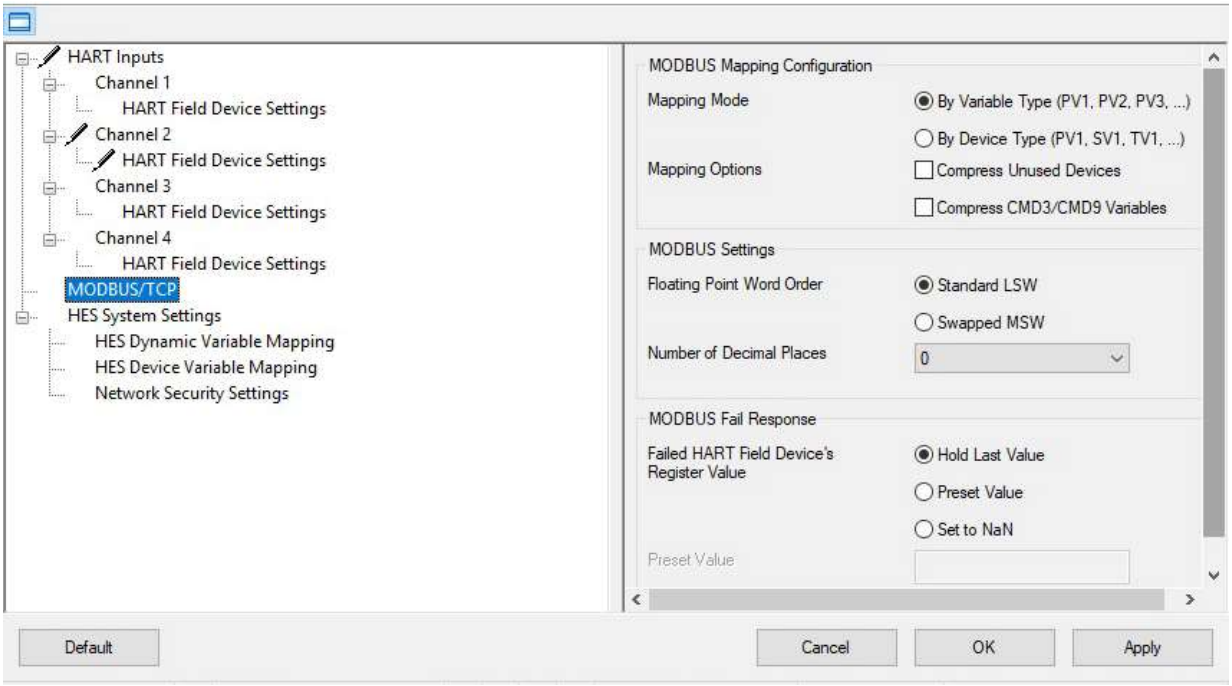


Please remember to download to your device, refer to Saving the Configuration File to the HES at the end of this section.

6.7 MODBUS/TCP Settings

1. Select MODBUS/TCP in the selection pane.
2. Configure the various options, which control how Field Device data is placed in MODBUS registers, and how errors are handled.
3. Click “Apply”.

Figure 6.21: HART Input to MODBUS Mapping Configuration



Please remember to download to your device, refer to Saving the Configuration File to the HES at the end of this section.

6.7.1 MODBUS Mapping Configuration

Allows the mapping of the HART field device variables to MODBUS registers. See Section 5 for details on MODBUS Register definitions and HART field device registers.

6.7.2 Mapping Mode [By Variable Type]

- **By Variable Type** – Organize by Variable Type (Primary Variable 1 (PV1), Primary Variable 2 (PV2), Primary Variable 3 (PV3), etc.)
- **By Device Type** - Organize by Device Type (Primary Variable (PV1), Secondary Variable (SV1), Tertiary Variable (TV1), Quaternary (QV1) etc.)

6.7.3 Mapping Options

- **Compress Unused Devices [off]** – Remove unused device visibility; this will eliminate empty devices
- **Compress CMD3/CMD9 Variable [off]** – Compress MODBUS map data device variables for command 3 and command 9; applies to float data, integer data, and quality

Figure 6.22: *MODBUS map "By Variable" with "Compress CMD3/CMD9" option*

HES Modbus map - Device Data by Variable								
IO Channel								
		CHANNEL	1	1	1	1	1	1
		DEVICE	1	2	3	4	5	6
Parameter	Type	Group(s)						
Float Data								
PV	float32	Float Dyn Vars A	1	3	5	7	9	11
SV	float32	Float Dyn Vars A	109	111	113	115	117	119
TV	float32	Float Dyn Vars A	217	219	221	223	225	227
QV	float32	Float Dyn Vars A	325	327	329	331	333	335
Loop Current	float32	Float Dyn Vars B	513	515	517	519	521	523
POR	float32	Float Dyn Vars B	621	623	625	627	629	631
RESERVED	float32	Float Dyn Vars B	729	733	737	741	745	749
Var1	float32	Float Dev Vars	1025	1027	1029	1031	1033	1035
Var2	float32	Float Dev Vars	1133	1135	1137	1139	1141	1143
Var3	float32	Float Dev Vars	1241	1243	1245	1247	1249	1251
Var4	float32	Float Dev Vars	1349	1351	1353	1355	1357	1359
Var5	float32	Float Dev Vars	1457	1459	1461	1463	1465	1467
Var6	float32	Float Dev Vars	1565	1567	1569	1571	1573	1575
Var7	float32	Float Dev Vars	1673	1675	1677	1679	1681	1683
Var8	float32	Float Dev Vars	1781	1783	1785	1787	1789	1791
Integer Data								
PV Integer	fixed point	Int Dyn Vars A	2049	2050	2051	2052	2053	2054
SV Integer	fixed point	Int Dyn Vars A	2103	2104	2105	2106	2107	2108
TV Integer	fixed point	Int Dyn Vars A	2157	2158	2159	2160	2161	2162
QV Integer	fixed point	Int Dyn Vars A	2211	2212	2213	2214	2215	2216
LoopCurrent Integer	fixed point	Int Dyn Vars B	2305	2306	2307	2308	2309	2310
POR Integer	fixed point	Int Dyn Vars B	2359	2360	2361	2362	2363	2364
RESERVED		Int Dyn Vars B	2413	2415	2417	2419	2421	2423
Var1 Integer	fixed point	Int Dev Vars	2561	2562	2563	2564	2565	2566
Var2 Integer	fixed point	Int Dev Vars	2615	2616	2617	2618	2619	2620
Var3 Integer	fixed point	Int Dev Vars	2669	2670	2671	2672	2673	2674
Var4 Integer	fixed point	Int Dev Vars	2723	2724	2725	2726	2727	2728
Var5 Integer	fixed point	Int Dev Vars	2777	2778	2779	2780	2781	2782
Var6 Integer	fixed point	Int Dev Vars	2831	2832	2833	2834	2835	2836
Var7 Integer	fixed point	Int Dev Vars	2885	2886	2887	2888	2889	2890
Var8 Integer	fixed point	Int Dev Vars	2939	2940	2941	2942	2943	2944
Quality								
RESERVED		Quality	3073	3081	3089	3097	3105	3113
Var1 Quality	Quality Stamp - see	Quality Dev Vars	3585	3586	3587	3588	3589	3590
Var2 Quality	Quality Stamp - see	Quality Dev Vars	3639	3640	3641	3642	3643	3644
Var3 Quality	Quality Stamp - see	Quality Dev Vars	3693	3694	3695	3696	3697	3698
Var4 Quality	Quality Stamp - see	Quality Dev Vars	3747	3748	3749	3750	3751	3752
Var5 Quality	Quality Stamp - see	Quality Dev Vars	3801	3802	3803	3804	3805	3806
Var6 Quality	Quality Stamp - see	Quality Dev Vars	3855	3856	3857	3858	3859	3860
Var7 Quality	Quality Stamp - see	Quality Dev Vars	3909	3910	3911	3912	3913	3914
Var8 Quality	Quality Stamp - see	Quality Dev Vars	3963	3964	3965	3966	3967	3968

HES Modbus map - Device Data by Variable with CMD3/9 Compression								
IO Channel Data								
		CHANNEL	1	1	1	1	1	1
		DEVICE	1	2	3	4	5	6
Parameter	Type	Group(s)						
Float Data								
PV/Dev Var 1	float32	Float Dev Vars	1	3	5	7	9	11
SV/ Dev Var 2	float32	Float Dev Vars	109	111	113	115	117	119
TV/ Dev Var 3	float32	Float Dev Vars	217	219	221	223	225	227
QV/ Dev Var 4	float32	Float Dev Vars	325	327	329	331	333	335
Dev Var 5	float32	Float Dev Vars	433	435	437	439	441	443
Dev Var 6	float32	Float Dev Vars	541	543	545	547	549	551
Dev Var 7	float32	Float Dev Vars	649	651	653	655	657	659
Dev Var 8	float32	Float Dev Vars	757	759	761	763	765	767
Integer Data								
PV/Dev Var 1 Integer	fixed point	Int Dev Vars	2049	2050	2051	2052	2053	2054
SV/ Dev Var 2 Integer	fixed point	Int Dev Vars	2103	2104	2105	2106	2107	2108
TV/ Dev Var 3 Integer	fixed point	Int Dev Vars	2157	2158	2159	2160	2161	2162
QV/ Dev Var 4 Integer	fixed point	Int Dev Vars	2211	2212	2213	2214	2215	2216
Dev Var 5 Integer	fixed point	Int Dev Vars	2265	2266	2267	2268	2269	2270
Dev Var 6 Integer	fixed point	Int Dev Vars	2319	2320	2321	2322	2323	2324
Dev Var 7 Integer	fixed point	Int Dev Vars	2373	2374	2375	2376	2377	2378
Dev Var 8 Integer	fixed point	Int Dev Vars	2427	2428	2429	2430	2431	2432
Quality								
RESERVED		Quality	3073	3081	3089	3097	3105	3113
Var1 Quality	Quality Stamp - see	Quality Dev Vars	3585	3586	3587	3588	3589	3590
Var2 Quality	Quality Stamp - see	Quality Dev Vars	3639	3640	3641	3642	3643	3644
Var3 Quality	Quality Stamp - see	Quality Dev Vars	3693	3694	3695	3696	3697	3698
Var4 Quality	Quality Stamp - see	Quality Dev Vars	3747	3748	3749	3750	3751	3752
Var5 Quality	Quality Stamp - see	Quality Dev Vars	3801	3802	3803	3804	3805	3806
Var6 Quality	Quality Stamp - see	Quality Dev Vars	3855	3856	3857	3858	3859	3860
Var7 Quality	Quality Stamp - see	Quality Dev Vars	3909	3910	3911	3912	3913	3914
Var8 Quality	Quality Stamp - see	Quality Dev Vars	3963	3964	3965	3966	3967	3968

This illustrates that in non compressed mode PV and Var1 will be in different MODBUS registers but with CMD3/CMD9 compression on, either PV (for CMD3) or Var1 (for CMD9) will be in the same register.

6.7.4 MODBUS Settings

Floating Point Word Order: [Standard LSW]

- **Standard LSW** – Least significant word; this stores the most significant bits in the second register and the least significant bits in the first register.
- **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.

Number of Decimal Places: [0]

- Number of places possible = 0-3

6.7.5 MODBUS Fail Response: [Hold Last Value]

Failed HART Device's Register Value:

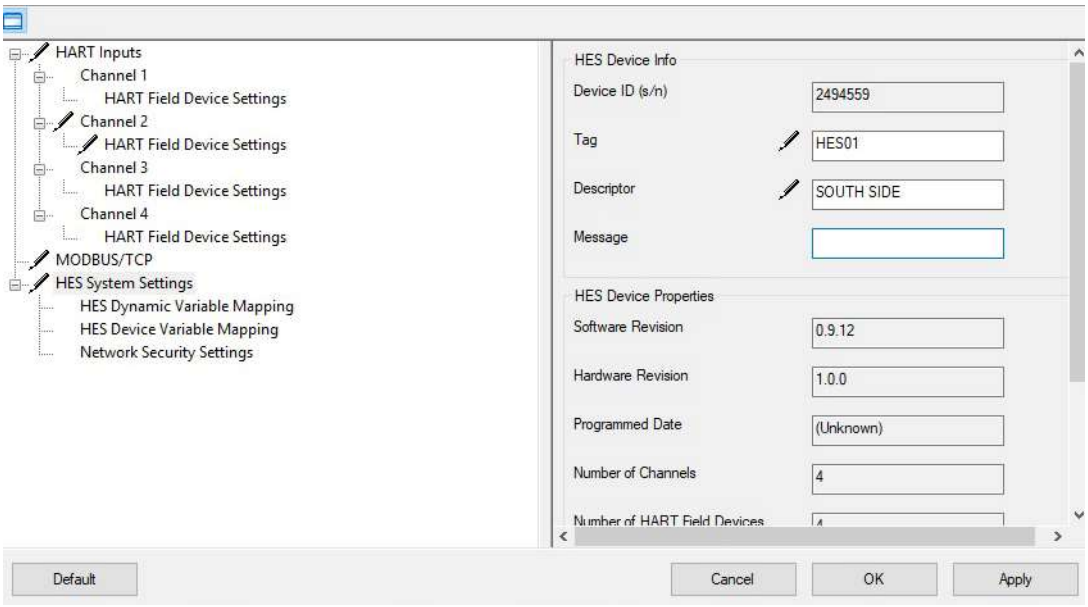
- **Hold Last Value** - Use the last received value upon lost communication with the Field Device or upon receiving invalid data.
- **Preset Value** - Use the Preset Value Box to add a custom value; go to a pre-defined value upon lost communication with the Field Device or upon receiving invalid data; for example use 777 for errors.
- **Set to NaN** – set to not a number (a special numeric data type value representing an undefined value in floating-point calculations) upon lost communication with the Field Device or upon receiving invalid data.

Please remember to download to your device, refer to Saving the Configuration File to the HES at the end of this section.

6.8 HES System Settings

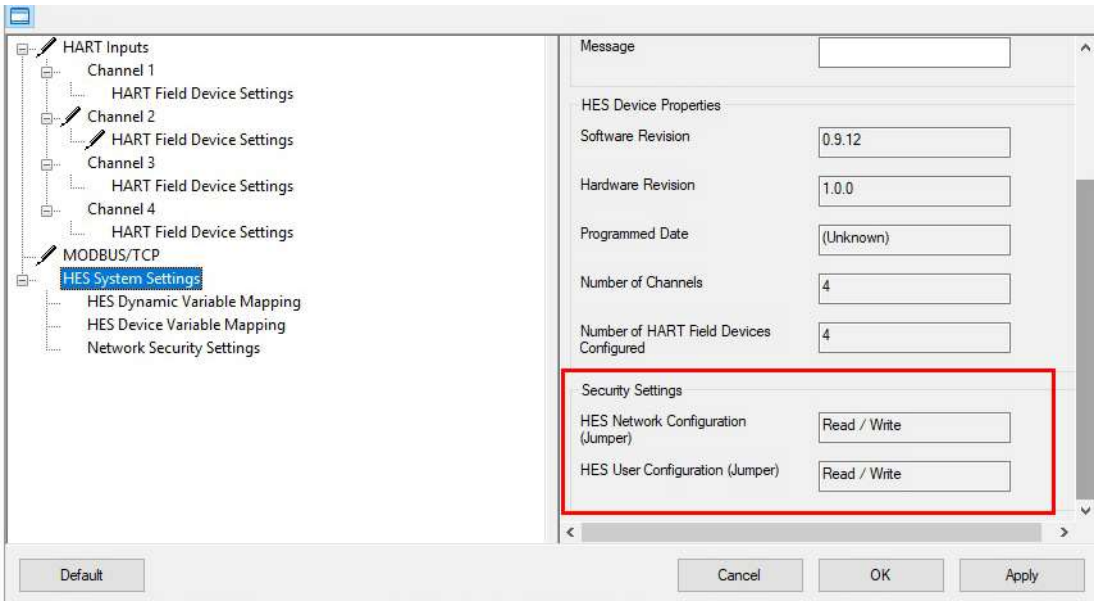
Use the System Settings to add a Tag, Descriptor, or Message, and to review Device Property information.

Figure 6.23: Adding a Tag



Scrolling down allows the user to see the current Security Settings (for jumper configuration options please see Section 5 – Wiring and Installation).

Figure 6.24: Security Settings

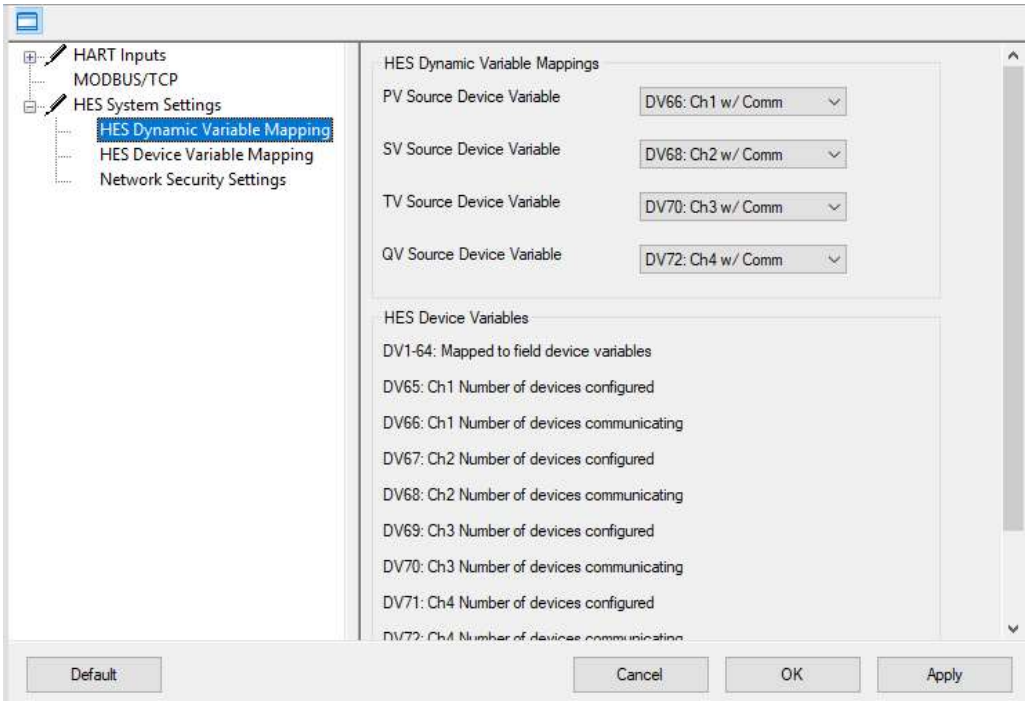


As a HART Field Device, the HES is HART 7 compliant and has both Dynamic and Device Variables which can be read via MODBUS/TCP, HART-IP or can be viewed on the HES' web page. The HES allows users to map HES and field device data to both the Dynamic and Device Variables.

6.8.1 HES Dynamic Variable Mapping

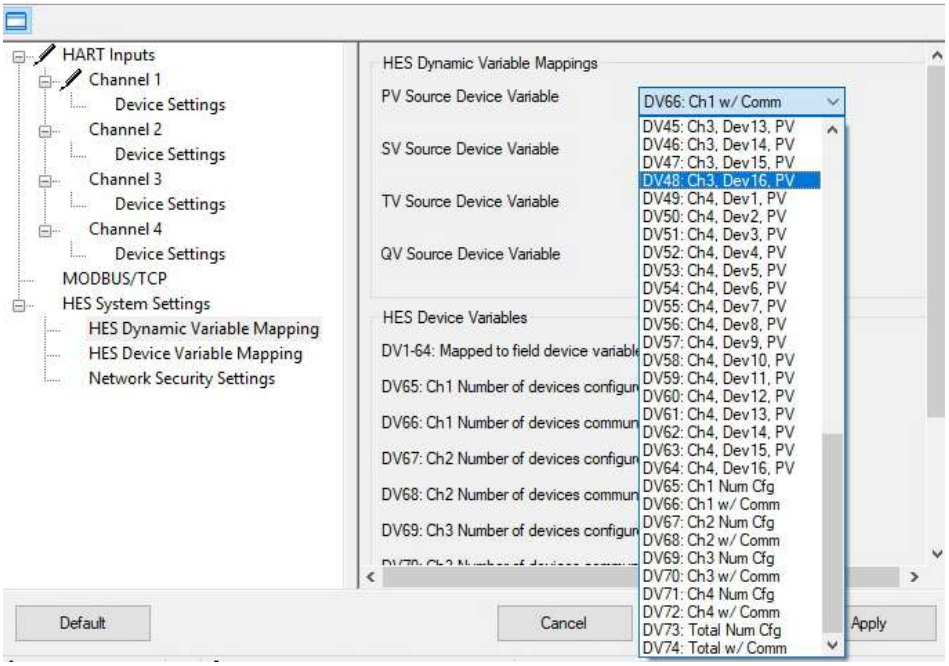
To map Dynamic Variables, click on “HES Dynamic Variable Mapping”.

Figure 6.25: HES Dynamic Variables Mapping



Map the listed variable (PV, SV, TV, and QV) to any of the HES Device Variables (1-74) in the pull down list. When done click “Apply.”

Figure 6.26: Source Device Variable



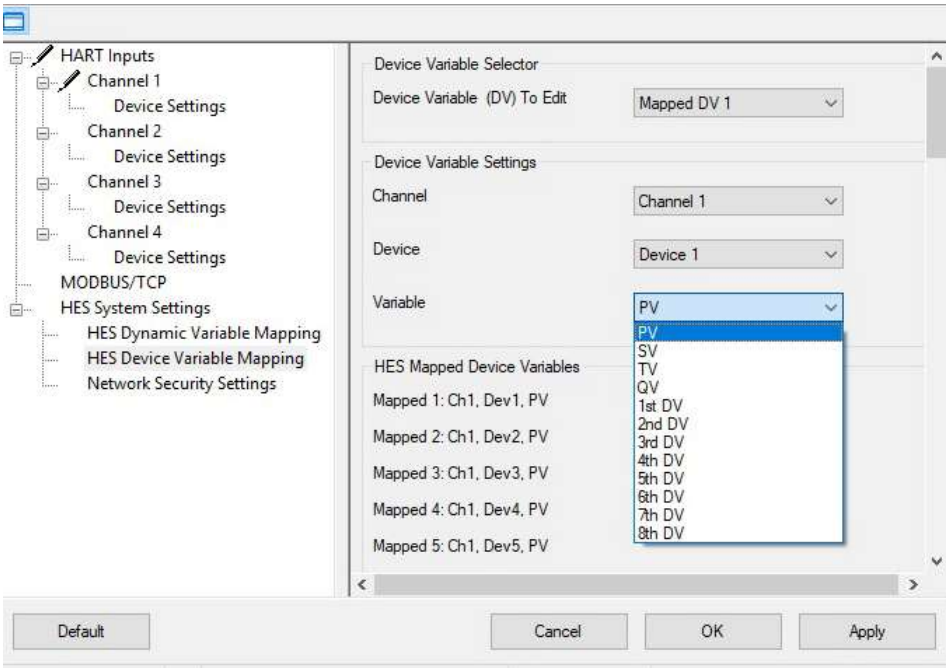
Please remember to download to your device, refer to Saving the Configuration File to the HES at the end of this section.

6.8.2 HES Device Variable Mapping

Map specific Device Variables for the HES to a specific variable (in a specific device,) so they can be mapped as HES Dynamic Variables, and can be viewed on the HES web page.

1. Select “HES Device Variable Mapping”.

Figure 6.27: Selecting a Variable



2. Choose which device variable to edit.
3. Select channel you want to map to, including device as well as the variable itself. For example choose PV for primary variable.
4. Click “Apply”.

Please remember to download to your device, refer to Saving the Configuration File to the HES at the end of this section.

6.8.3 Network Security

Two-layer security is standard on the HES. There is a hardware level, which can make the network configuration read only (see User Configurable Hardware section for details) as well as the ability to limit the number of active connections.

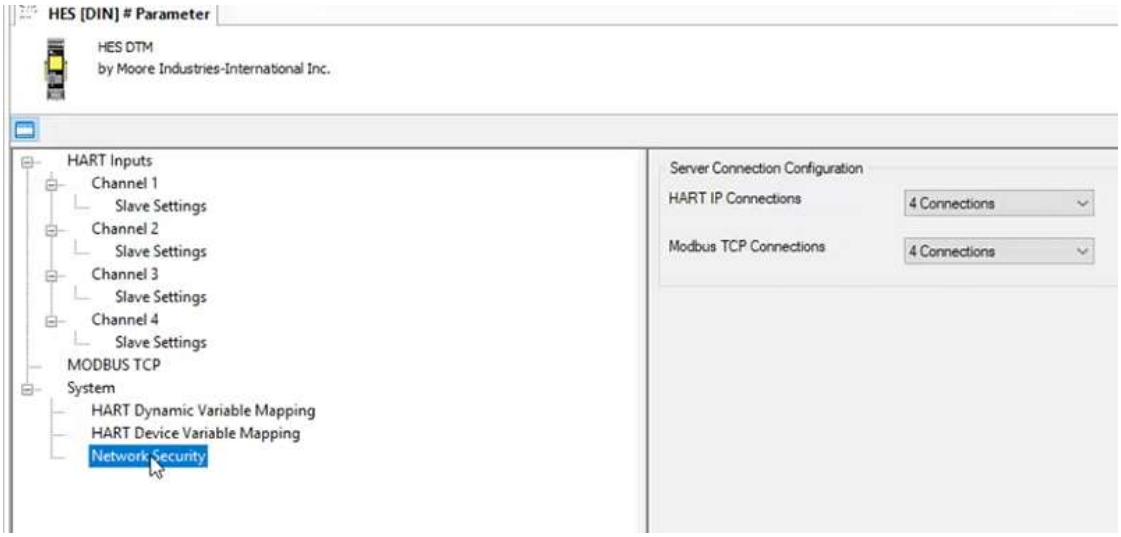
Modbus TCP connections = 4 HART-IP connections = 4

For more secure network environments, the number of active MODBUS/TCP connections can be limited to just one. This will ensure that there are not multiple unauthorized or undesired MODBUS/TCP hosts polling the HES. If only the web server pages or HART-IP are going to be used, you can set the number of MODBUS/TCP connections to zero preventing any MODBUS hosts from connecting to the HES.

To set the number of allowed HART IP or MODBUS TCP connections to the HES:

1. Click on “Network Security” in the selection pane.
2. Choose the number of HART-IP connections (1-4) in the pull down menu.
3. Choose the number of MODBUS TCP Connections (0-4).
4. Click “Apply”.

Figure 6.28: Network Security Configuration



Please remember to download to your device, refer to Saving the Configuration File to the HES at the end of this section.

6.9 Downloading the Configuration File to the HES (DTM)

Once you have finished configuring your unit, remember to download the new settings to your HES. To save the configuration to the HES:

1. When connected to the HES, Right click on the HES .
2. Select “Store to Device”.
3. A window will appear while saving the configuration to the HES.

Figure 6.29: Storing to Device

6.9.1 Saving the Configuration File to a Location

1. Click on the “File Menu”.
2. Select “Save As**”.**
3. Select a location to save and name the file.
4. Select “Save**”.**

6.9.2 Print the HES [DIN] Configuration

1. Click on the “File Menu”.
2. Select “Print**”.**
3. Follow the prompts.

6.9.3 Disconnect the HES

To disconnect from the HES:

1. Right click on the HES DTM.
2. Choose “Disconnect”.

Figure 6.30: Disconnecting from Device

You can verify the new configuration and check MODBUS register locations by accessing the web page.

6.10 Built-in HTTP Web Server

The HES has a built-in HTTP web server to provide a quick and efficient to view system information, system status registers, Field Device HART Data and HES HART data. It also provides the MODBUS register locations for all the device status and data.

To view the web pages use any browser such as Chrome and put the IP address of the HES into the URL in the browser.

 **NOTE:** The web page does **not** update the information automatically. The user must refresh the browser to see updated information.

 **NOTE:** The web page is read only. The data cannot be changed or modified from the browser.

The following tables provide screen shots of the web pages with example data.

Table 6-1: Home Page and HES System Information Web Page

HES: HART Ethernet System

Home - System Information

Unit	
Property	**Value**
Serial Number	2494563
Model Number	HES/4HART/ETH/9-30DC/-MB [DIN]
Network Name	MII_Demo
Network Location	North Hills CA USA
HART Tag	HES DEMO
HART Descriptor	4 CH 64 DEV
HART Message	READ ONLY CONFIGURATION
HART Programmed Date	24 September 2018

Build	
Property	**Value**
Software Version	1.0.00
Hardware Version	1.0.00

Security	
Property	**Value**
Network Admin Jumper Position	Read Only
User Config Jumper Position	Read Only

Network			
Connection	**Limit**	**Current**	**Total**
HART IP/TCP	4	1	1
MODBUS/TCP	4	0	0

Status			
Register Name	**MB Reg**	**Value**	**Status Messages**
System Overall	9501	0x0000	No status bits set
System Status Summary	9502	0x0000	No status bits set
Diagnostic Status	9509	0x0000	No status bits set

Table 6-2: System Status Registers (4 channel) Web Page

HES: HART Ethernet System

System Status Registers

System Summary			
Register Name	**MB Reg**	**Value**	**Status Messages**
System Overall	9501	0x0000	No status bits set
System Status Summary	9502	0x0000	No status bits set
User Config Error Summary	9513	0x0000	No status bits set
Config Storage Error Summary	9514	0x0000	No status bits set
System Security Status	9516	0x0000	No status bits set

Channel 1			
Register Name	**MB Reg**	**Value**	**Status Messages**
Ch1 Consolidated Status	9566	0x0000	No status bits set
Detected Devices	9569	0xFFFF	(0) Device 1 is Present (1) Device 2 is Present (2) Device 3 is Present (3) Device 4 is Present (4) Device 5 is Present (5) Device 6 is Present (6) Device 7 is Present (7) Device 8 is Present (8) Device 9 is Present (9) Device 10 is Present (10) Device 11 is Present (11) Device 12 is Present (12) Device 13 is Present (13) Device 14 is Present (14) Device 15 is Present (15) Device 16 is Present
Devices Not Producing Data	9571	0x0000	No status bits set

Channel 2			
Register Name	**MB Reg**	**Value**	**Status Messages**
Ch2 Consolidated Status	9598	0x0000	No status bits set
Detected Devices	9601	0x0001	(0) Device 1 is Present
Devices Not Producing Data	9603	0x0000	No status bits set

Channel 3			
Register Name	**MB Reg**	**Value**	**Status Messages**
Ch3 Consolidated Status	9630	0x0000	No status bits set
Detected Devices	9633	0x0001	(0) Device 1 is Present
Devices Not Producing Data	9635	0x0000	No status bits set

Channel 4			
Register Name	**MB Reg**	**Value**	**Status Messages**
Ch4 Consolidated Status	9662	0x0000	No status bits set
Detected Devices	9665	0x0001	(0) Device 1 is Present
Devices Not Producing Data	9667	0x0000	No status bits set

Table 6-3: Field Device HART Information Web Page

HES: HART Ethernet System

Field Device HART Information

System Summary			
Register Name	**MB Reg**	**Value**	**Status Messages**
System Overall	9501	0x0000	No status bits set
System Status Summary	9502	0x0000	No status bits set
Ch1 Consolidated Status	9566	0x0000	No status bits set
Ch2 Consolidated Status	9598	0x0000	No status bits set
Ch3 Consolidated Status	9630	0x0000	No status bits set
Ch4 Consolidated Status	9662	0x0000	No status bits set

Channel 1						
Device	**Poll Address**	**Tag**	**HART Revision**	**Mfg ID**	**Device ID**	**Serial Number**
Channel 1, Device 1	0	TEMP1	HART 5	0x20	0x06	2505200
Channel 1, Device 2	1	RES2	HART 5	0x20	0x06	2505201
Channel 1, Device 3	2	RES3	HART 5	0x20	0x06	2505202
Channel 1, Device 4	3	RES4	HART 5	0x20	0x06	2505203
Channel 1, Device 5	4	RES5	HART 5	0x20	0x06	2505204
Channel 1, Device 6	5	RES6	HART 5	0x20	0x06	2505205
Channel 1, Device 7	6	RES7	HART 5	0x20	0x06	2505206
Channel 1, Device 8	7	RES8	HART 5	0x20	0x06	2505207
Channel 1, Device 9	8	RES9	HART 5	0x20	0x06	2505208
Channel 1, Device 10	9	RES10	HART 5	0x20	0x06	2505209
Channel 1, Device 11	10	RES11	HART 5	0x20	0x06	2505210
Channel 1, Device 12	11	RES12	HART 5	0x20	0x06	2505211
Channel 1, Device 13	12	RES13	HART 5	0x20	0x06	2505212
Channel 1, Device 14	13	RES14	HART 5	0x20	0x06	2505213
Channel 1, Device 15	14	RES15	HART 5	0x20	0x06	2505214
Channel 1, Device 16	15	RES16	HART 5	0x20	0x06	2505215

Channel 2						
Device	**Poll Address**	**Tag**	**HART Revision**	**Mfg ID**	**Device ID**	**Serial Number**
Channel 2, Device 1	0	HUMIDITY	HART 5	0x20	0x05	2278553
Channel 2, Devices 2 to 16 are not polled.						

Channel 3						
Device	**Poll Address**	**Tag**	**HART Revision**	**Mfg ID**	**Device ID**	**Serial Number**
Channel 3, Device 1	0	DUALTEMP	HART 7	0x0020	0x2008	2419157
Channel 3, Devices 2 to 16 are not polled.						

Channel 4						
Device	**Poll Address**	**Tag**	**HART Revision**	**Mfg ID**	**Device ID**	**Serial Number**
Channel 4, Device 1	0	LEVEL	HART 7	0x0062	0x62DC	5971658
Channel 4, Devices 2 to 16 are not polled.						

Table 6-4: Field Device HART Variables (4 channel) Web Page

HES: HART Ethernet System

Field Device HART Variables

System Summary			
Register Name	**MB Reg**	**Value**	**Status Messages**
System Overall	9501	0x0000	No status bits set
System Status Summary	9502	0x0000	No status bits set
Ch1 Consolidated Status	9566	0x0000	No status bits set
Ch2 Consolidated Status	9598	0x0000	No status bits set
Ch3 Consolidated Status	9630	0x0000	No status bits set
Ch4 Consolidated Status	9662	0x0000	No status bits set

Channel 1								
Device	**1st DV/PV Units (MBReg)**	**2nd DV/SV Units (MBReg)**	**3rd DV/TV Units (MBReg)**	**4th DV/QV Units (MBReg)**	**5th DV Units (MBReg)**	**6th DV Units (MBReg)**	**7th DV Units (MBReg)**	**8th DV Units (MBReg)**
Channel 1, Device 1 Addr: 0, CMD3 Tag: TEMP1	83.888 DEG F (1)	85.484 DEG F (129)	83.888 DEG F (257)	0.000 NOUSE (385)	Not Polled	Not Polled	Not Polled	Not Polled
Channel 1, Device 2 Addr: 1, CMD3 Tag: RES2	474.770 OHMS (3)	29.988 DEG C (131)	474.770 OHMS (259)	0.000 NOUSE (387)	Not Polled	Not Polled	Not Polled	Not Polled
Channel 1, Device 3 Addr: 2, CMD3 Tag: RES3	181.646 OHMS (5)	30.355 DEG C (133)	181.646 OHMS (261)	0.000 NOUSE (389)	Not Polled	Not Polled	Not Polled	Not Polled
Channel 1, Device 4 Addr: 3, CMD3 Tag: RES4	129.719 OHMS (7)	30.449 DEG C (135)	129.719 OHMS (263)	0.000 NOUSE (391)	Not Polled	Not Polled	Not Polled	Not Polled
Channel 1, Device 5 Addr: 4, CMD3 Tag: RES5	885.462 OHMS (9)	30.275 DEG C (137)	885.462 OHMS (265)	0.000 NOUSE (393)	Not Polled	Not Polled	Not Polled	Not Polled
Channel 1, Device 6 Addr: 5, CMD3 Tag: RES6	323.179 OHMS (11)	30.358 DEG C (139)	323.179 OHMS (267)	0.000 NOUSE (395)	Not Polled	Not Polled	Not Polled	Not Polled
Channel 1, Device 7 Addr: 6, CMD3 Tag: RES7	846.954 OHMS (13)	30.017 DEG C (141)	846.954 OHMS (269)	0.000 NOUSE (397)	Not Polled	Not Polled	Not Polled	Not Polled
Channel 1, Device 8 Addr: 7, CMD3 Tag: RES8	996.501 OHMS (15)	29.773 DEG C (143)	996.501 OHMS (271)	0.000 NOUSE (399)	Not Polled	Not Polled	Not Polled	Not Polled
Channel 1, Device 9 Addr: 8, CMD3 Tag: RES9	523.641 OHMS (17)	29.933 DEG C (145)	523.641 OHMS (273)	0.000 NOUSE (401)	Not Polled	Not Polled	Not Polled	Not Polled
Channel 1, Device 10 Addr: 9, CMD3 Tag: RES10	191.073 OHMS (19)	29.942 DEG C (147)	191.073 OHMS (275)	0.000 NOUSE (403)	Not Polled	Not Polled	Not Polled	Not Polled
Channel 1, Device 11 Addr: 10, CMD3 Tag: RES11	1820.672 OHMS (21)	30.278 DEG C (149)	1820.672 OHMS (277)	0.000 NOUSE (405)	Not Polled	Not Polled	Not Polled	Not Polled
Channel 1, Device 12 Addr: 11, CMD3 Tag: RES12	308.488 OHMS (23)	30.479 DEG C (151)	308.488 OHMS (279)	0.000 NOUSE (407)	Not Polled	Not Polled	Not Polled	Not Polled
Channel 1, Device 13 Addr: 12, CMD3 Tag: RES13	338.750 OHMS (25)	30.505 DEG C (153)	338.750 OHMS (281)	0.000 NOUSE (409)	Not Polled	Not Polled	Not Polled	Not Polled
Channel 1, Device 14 Addr: 13, CMD3 Tag: RES14	1615.204 OHMS (27)	30.391 DEG C (155)	1615.204 OHMS (283)	0.000 NOUSE (411)	Not Polled	Not Polled	Not Polled	Not Polled
Channel 1, Device 15 Addr: 14, CMD3 Tag: RES15	69.746 OHMS (29)	30.297 DEG C (157)	69.746 OHMS (285)	0.000 NOUSE (413)	Not Polled	Not Polled	Not Polled	Not Polled
Channel 1, Device 16 Addr: 15, CMD3 Tag: RES16	575.278 OHMS (31)	30.042 DEG C (159)	575.278 OHMS (287)	0.000 NOUSE (415)	Not Polled	Not Polled	Not Polled	Not Polled

Channel 2								
Device	**1st DV/PV Units (MBReg)**	**2nd DV/SV Units (MBReg)**	**3rd DV/TV Units (MBReg)**	**4th DV/QV Units (MBReg)**	**5th DV Units (MBReg)**	**6th DV Units (MBReg)**	**7th DV Units (MBReg)**	**8th DV Units (MBReg)**
Channel 2, Device 1 Addr: 0, CMD3 Tag: HUMIDITY	62.629 DEG F (33)	84.372 PCT (161)	57.936 DEG F (289)	0.000 NOUSE (417)	Not Polled	Not Polled	Not Polled	Not Polled
Channel 2, Devices 2 to 16 are not polled.								

Channel 3								
Device	**1st DV/PV Units (MBReg)**	**2nd DV/SV Units (MBReg)**	**3rd DV/TV Units (MBReg)**	**4th DV/QV Units (MBReg)**	**5th DV Units (MBReg)**	**6th DV Units (MBReg)**	**7th DV Units (MBReg)**	**8th DV Units (MBReg)**
Channel 3, Device 1 Addr: 0, CMD9, #DVs: 8 DVs: 0,3,4,6,7,8,10,11 Tag: DUALTEMP	DV0 30.773 DEG C (1089)	DV3 30.215 DEG C (1217)	DV4 29.603 DEG C (1345)	DV6 29.603 DEG C (1473)	DV7 29.909 DEG C (1601)	DV8 0.611 DEG C (1729)	DV10 0.611 DEG C (1857)	DV11 29.603 DEG C (1985)
Channel 3, Devices 2 to 16 are not polled.								

Channel 4								
Device	**1st DV/PV Units (MBReg)**	**2nd DV/SV Units (MBReg)**	**3rd DV/TV Units (MBReg)**	**4th DV/QV Units (MBReg)**	**5th DV Units (MBReg)**	**6th DV Units (MBReg)**	**7th DV Units (MBReg)**	**8th DV Units (MBReg)**
Channel 4, Device 1 Addr: 0, CMD3 Tag: LEVEL	4.544 METER (97)	77.276 PCT (225)	77.276 PCT (353)	77.276 L (481)	Not Polled	Not Polled	Not Polled	Not Polled
Channel 4, Devices 2 to 16 are not polled.								

Table 6-5: Field Device HART Status Web Page

HES: HART Ethernet System

Field Device HART Status

System Summary			
Register Name	**MB Reg**	**Value**	**Status Messages**
System Overall	9501	0x0000	No status bits set
System Status Summary	9502	0x0000	No status bits set
Ch1 Consolidated Status	9566	0x0000	No status bits set
Ch2 Consolidated Status	9598	0x0000	No status bits set
Ch3 Consolidated Status	9630	0x0000	No status bits set
Ch4 Consolidated Status	9662	0x0000	No status bits set

Channel 1			
Device	**MB Reg**	**Status**	**Status Messages**
Channel 1, Device 1 Addr: 0 Tag: TEMP1	4225	Field Device Status	No status bits set
	4545	Additional Status	Not Read
Channel 1, Device 2 Addr: 1 Tag: RES2	4226	Field Device Status	No status bits set
	4570	Additional Status	Not Read
Channel 1, Device 3 Addr: 2 Tag: RES3	4227	Field Device Status	No status bits set
	4595	Additional Status	Not Read
Channel 1, Device 4 Addr: 3 Tag: RES4	4228	Field Device Status	No status bits set
	4620	Additional Status	Not Read
Channel 1, Device 5 Addr: 4 Tag: RES5	4229	Field Device Status	No status bits set
	4645	Additional Status	Not Read
Channel 1, Device 6 Addr: 5 Tag: RES6	4230	Field Device Status	No status bits set
	4670	Additional Status	Not Read
Channel 1, Device 7 Addr: 6 Tag: RES7	4231	Field Device Status	No status bits set
	4695	Additional Status	Not Read
Channel 1, Device 8 Addr: 7 Tag: RES8	4232	Field Device Status	No status bits set
	4720	Additional Status	Not Read
Channel 1, Device 9 Addr: 8 Tag: RES9	4233	Field Device Status	No status bits set
	4745	Additional Status	Not Read
Channel 1, Device 10 Addr: 9 Tag: RES10	4234	Field Device Status	No status bits set
	4770	Additional Status	Not Read
Channel 1, Device 11 Addr: 10 Tag: RES11	4235	Field Device Status	No status bits set
	4795	Additional Status	Not Read
Channel 1, Device 12 Addr: 11 Tag: RES12	4236	Field Device Status	No status bits set
	4820	Additional Status	Not Read
Channel 1, Device 13 Addr: 12 Tag: RES13	4237	Field Device Status	No status bits set
	4845	Additional Status	Not Read
Channel 1, Device 14 Addr: 13 Tag: RES14	4238	Field Device Status	No status bits set
	4870	Additional Status	Not Read
Channel 1, Device 15 Addr: 14 Tag: RES15	4239	Field Device Status	No status bits set
	4895	Additional Status	Not Read
Channel 1, Device 16 Addr: 15 Tag: RES16	4240	Field Device Status	No status bits set
	4920	Additional Status	Not Read

Channel 2			
Device	**MB Reg**	**Status**	**Status Messages**
Channel 2, Device 1 Addr: 0 Tag: HUMIDITY	4241	Field Device Status	No status bits set
	4945	Additional Status	Not Read
Channel 2, Devices 2 to 16 are not polled.			

Channel 3			
Device	**MB Reg**	**Status**	**Status Messages**
Channel 3, Device 1 Addr: 0 Tag: DUALTEMP	4257	Field Device Status	(6) Configuration Changed
	5345	Additional Status	Not Read
Channel 3, Devices 2 to 16 are not polled.			

Channel 4			
Device	**MB Reg**	**Status**	**Status Messages**
Channel 4, Device 1 Addr: 0 Tag: LEVEL	4273	Field Device Status	No status bits set
	5745	Additional Status	Not Read
Channel 4, Devices 2 to 16 are not polled.			

Table 6-6: HES HART Status and Variables Web Page

HES: HART Ethernet System

HES HART Status & Variables

HES Field Device Status			
Register Name	**MB Reg**	**Value**	**Status Messages**
Field Device Status	9067	0x0000	No status bits set

HES Additional Status			
Status Bytes	**MB Reg**	**Value**	**Description**
System Overall (Upper)	9072	0x00	No status bits set
System Overall (Lower)	9073	0x00	No status bits set
Channel 1 Consolidated Status	9074	0x00	No status bits set
Channel 2 Consolidated Status	9075	0x00	No status bits set
Channel 3 Consolidated Status	9076	0x00	No status bits set
Channel 4 Consolidated Status	9077	0x00	No status bits set
Extended Status Code (not used)	9078	0x00	No status bits set
Device Operating Mode (not used)	9079	0x00	No status bits set
Standardized Status 0	9080	0x00	No status bits set

HES Dynamic Variables			
Dynamic Variable	**MB Reg**	**Value**	**Source Device Variable**
PV	9001	16.000	DV: 66, Source: Ch 1: Number of slaves communicating
SV	9003	1.000	DV: 68, Source: Ch 2: Number of slaves communicating
TV	9005	1.000	DV: 70, Source: Ch 3: Number of slaves communicating
QV	9007	1.000	DV: 72, Source: Ch 4: Number of slaves communicating

HES Device Variables			
Device Variable	**MB Reg**	**Value**	**Description**
DV1	9203	84.024 DEG F	Source: Mapped - Chan: 1, Device: 1, PV
DV2	9205	474.767 OHMS	Source: Mapped - Chan: 1, Device: 2, PV
DV3	9207	181.645 OHMS	Source: Mapped - Chan: 1, Device: 3, PV
DV4	9209	129.706 OHMS	Source: Mapped - Chan: 1, Device: 4, PV
DV5	9211	885.471 OHMS	Source: Mapped - Chan: 1, Device: 5, PV
DV6	9213	323.190 OHMS	Source: Mapped - Chan: 1, Device: 6, PV
DV7	9215	846.968 OHMS	Source: Mapped - Chan: 1, Device: 7, PV
DV8	9217	996.493 OHMS	Source: Mapped - Chan: 1, Device: 8, PV
DV9	9219	523.627 OHMS	Source: Mapped - Chan: 1, Device: 9, PV
DV10	9221	191.073 OHMS	Source: Mapped - Chan: 1, Device: 10, PV
DV11	9223	1820.651 OHMS	Source: Mapped - Chan: 1, Device: 11, PV
DV12	9225	308.479 OHMS	Source: Mapped - Chan: 1, Device: 12, PV
DV13	9227	338.773 OHMS	Source: Mapped - Chan: 1, Device: 13, PV
DV14	9229	1615.203 OHMS	Source: Mapped - Chan: 1, Device: 14, PV
DV15	9231	69.750 OHMS	Source: Mapped - Chan: 1, Device: 15, PV
DV16	9233	575.270 OHMS	Source: Mapped - Chan: 1, Device: 16, PV

7 MODBUS Register Definitions

The HES supports up to four concurrent MODBUS/ TCP connections. The diagnostic data collected by the HES from connected devices are transmitted through MODBUS/TCP to control systems, historians, etc. for predictive analytics that permits scheduled preventative device maintenance, greatly reducing unplanned or emergency process interruptions or shutdowns.

Due to the number of HES channels and devices per channel, there can be a large number of MODBUS registers. Great consideration was given to the optimizing of polling requests made by MODBUS/TCP hosts over Ethernet networks in order to protect bandwidth. Hence, the HES allows the following MODBUS memory map to be laid out by variable or device type and optionally compressed. Additionally, the user can decide what value the MODBUS register should post when there is lost communication with connected HART devices. It is recommended that the user familiarize themselves with the following MODBUS register tables and most used register ranges.

7.1 HES MODBUS Register Definitions

The following tables define the MODBUS input and holding register assignments. These tables are based on one based register assignments. If your MODBUS host requires programming using zero based MODBUS addresses, then deduct 1 from the listed (or computed) one based register value. Please refer to your MODBUS host documentation to determine if it should be programmed using address or register values.

Table 7-1: MODBUS Register Overview

Register Range	Name	Description	Ref. Table
1-8192	HART Field Device Data	HART data collected for all field devices	Table 5-2 and 5-3
9001-9128	HES HART Data		Table 5-4
9201-9500	HES Device Variables		Table 5-5
9501-9828	HES Status Registers		Table 5-6
9901-9999	HES System Information	Information about the system including version, model etc.	Table 5-7

HART field device data is assigned to registers 1-8192 depending on the mapping and compression options. HES data is always assigned to fixed registers 9001 through 9999.

7.2 HART Field Device Registers

The MODBUS registers are organized into groups. Each group starts at a fixed MODBUS register but the variables will be organized differently based on the selected mapping and compression options.

NOTE: The MODBUS registers and data for most of these parameters are also available on the HES generated web pages.

The following equations are used for calculating the MODBUS registers for each of the parameters.

Mapping By Variable Type (PV1, PV2, PV3..): MODBUS register = $b + (o*t) + (r*p)$

Mapping By Device Type (PV1, SV1, TV1..): MODBUS register = $b + o + (g*p)$

The following variables can be found on the appropriate table (below)

b = MODBUS group base register

g = Device group size

r = Parameter size (number of registers)

o = Parameter (Register) offset

These variables are determined by your HES' specific configuration

p = Device position (calculated)

t = Total number of HART field devices

x = HES channel number (1 thru 4)

y = Device number on Channel x

7.2.1 Use <u>without</u> compression

When compression of unused devices is NOT used, then the device position (p) is always calculated assuming 16 devices per channel. Device position can be a value from 0 to 63.

$p = [(x-1)*16] + (y - 1)$

Where x is the HES channel number (1 to 4) and y is the device number on that channel (1-16).

For example, when device compression is turned off, the 3rd device on channel 4 has a device position of [(4-1)*16] + (3-1) = 50

7.2.2 Use with compression

When compression of unused devices IS used, then you need to know the number of devices on each channel to calculate the device position (p) and total number of devices on all channels (t).

So for a device on channel 3 you need to know how many devices are on channels 1 and 2 and also the total number of devices on all 4 channels. Device position can be a value from 0 to 63.

For example:

Channel 1	Channel 2	Channel 3	Channel 4
6 devices	5 devices	2 devices	1 device

Total number of devices on all channels t = 6+5+2+1 = 14;

For Ch1 Dev3, device position p = 2;

For Ch2 Dev4, device position p = 6 + 4 – 1 = 9;

For Ch4 Dev1, device position p = 6 + 5 + 2 + 1 – 1 = 13

Variables b, g, r and o are provided in the tables below for every field device parameter stored in the HES. Table 5-2 is used for all mapping and compression except when CMD3/CMD9 compression is selected. When CMD3/CMD9 compression is selected, Table 5-3 should be used.

Example Calculations:

HES is configured with 14 field devices

Channel 1	Channel 2	Channel 3	Channel 4
6 devices	5 devices	2 devices	1 device

1) Locate Integer value of PV for HART Device 3 on Channel 2

Mapped by Variable Type, NO compression*:

MODBUS register = *b + (o*t) + (r*p)*

t=64, p=18;

From Table 5-2: b=2049, o=0, r=1

MODBUS register = 2049 + (0*64) + (1*18) = **2067**

*with NO compression each channel is assumed to have 16 devices

2) Locate Float value of SV for HART Device 1 on Channel 3

Sorted by Device Type, unused device compression:

MODBUS register = *b* + *o* + *(g*p)*

p=11;

From Table 5-2: b=1, o=2, g=8

MODBUS register = 1 + 2 + (8*11) = **91**

3) Locate Float value of Device Variable 3 for HART Device 1 on Channel 4

Sorted by Variable Type, compression of unused devices and CMD3/CMD9 compression:

MODBUS register = *b* + *(o*t)* + *(r*p)*

t=14; p=13;

From Table 5-3: b=1, o=4, r=2

MODBUS register = 1 + (4*14) + (2*13) = **83**

Table 7-2: HART Field Device Parameters

Parameter	Type	Group(s)	Base Register (b)	Group size (g)	No. of registers (r)	Register Offset (o)
Float Data						
PV	float32	Float Dyn Vars A	1	8	2	0
SV	float32	Float Dyn Vars A	1	8	2	2
TV	float32	Float Dyn Vars A	1	8	2	4
QV	float32	Float Dyn Vars A	1	8	2	6
Loop Current	float32	Float Dyn Vars B	513	8	2	0
Device Variable 1	float32	Float Dev Vars	1025	16	2	0
Device Variable 2	float32	Float Dev Vars	1025	16	2	2
Device Variable 3	float32	Float Dev Vars	1025	16	2	4
Device Variable 4	float32	Float Dev Vars	1025	16	2	6
Device Variable 5	float32	Float Dev Vars	1025	16	2	8
Device Variable 6	float32	Float Dev Vars	1025	16	2	10
Device Variable 7	float32	Float Dev Vars	1025	16	2	12
Device Variable 8	float32	Float Dev Vars	1025	16	2	14
Integer Data						
PV Integer	fixed point	Int Dyn Vars A	2049	4	1	0
SV Integer	fixed point	Int Dyn Vars A	2049	4	1	1
TV Integer	fixed point	Int Dyn Vars A	2049	4	1	2
QV Integer	fixed point	Int Dyn Vars A	2049	4	1	3
Loop Current Integer	fixed point	Int Dyn Vars B	2305	4	1	0
Device Variable 1	fixed point	Int Dev Vars	2561	8	1	0
Device Variable 2	fixed point	Int Dev Vars	2561	8	1	1
Device Variable 3	fixed point	Int Dev Vars	2561	8	1	2
Device Variable 4	fixed point	Int Dev Vars	2561	8	1	3
Device Variable 5	fixed point	Int Dev Vars	2561	8	1	4

Parameter	Type	Group(s)	Base Register (b)	Group size (g)	No. of registers (r)	Register Offset (o)
Device Variable 6	fixed point	Int Dev Vars	2561	8	1	5
Device Variable 7	fixed point	Int Dev Vars	2561	8	1	6
Device Variable 8	fixed point	Int Dev Vars	2561	8	1	7
Quality						
Device Variable 1 Quality	unit8	Quality Dev Vars	3585	8	1	0
Device Variable 2 Quality	unit8	Quality Dev Vars	3585	8	1	1
Device Variable 3 Quality	unit8	Quality Dev Vars	3585	8	1	2
Device Variable 4 Quality	unit8	Quality Dev Vars	3585	8	1	3
Device Variable 5 Quality	unit8	Quality Dev Vars	3585	8	1	4
Device Variable 6 Quality	unit8	Quality Dev Vars	3585	8	1	5
Device Variable 7 Quality	unit8	Quality Dev Vars	3585	8	1	6
Device Variable 8 Quality	unit8	Quality Dev Vars	3585	8	1	7
Status						
Last HART Command	unit8	Status	4097	32	1	0
Response Code	unit8	Status	4097	32	1	1
Field Device Status	unit8	Status	4097	32	1	2
Configuration Change Counter	unit16	Status	4097	32	1	3
Additional Device Status	unit8	Status	4097	32	25	7
Field Device Configuration						
PV, SV, TV & QV Units	unit8 array	Field Device Config	6145	32	2	0
Loop Current Units	unit8	Field Device Config	6145	32	1	2
Var1-8 Units	unit8 array	Field Device Config	6145	32	4	4
Transmitter HART Revision	unit8	Field Device Config	6145	32	1	15
PV Upper Range	float32	Field Device Config	6145	32	1	16
PV Lower Range	float32	Field Device Config	6145	32	1	18

Parameter	Type	Group(s)	Base Register (b)	Group size (g)	No. of registers (r)	Register Offset (o)
Tag Bytes 0-7	ascii	Field Device Config	6145	32	4	24
Manufacturing code	unit6	Field Device Config	6145	32	1	28
Device Type code	unit16	Field Device Config	6145	32	1	29
Field Device Serial Number	unit8	Field Device Config	6145	32	2	30

Table 7-3: HART Field Device Parameters (with CMD3/CMD9 Compression)

Parameter	Type	Group(s)	Base Register (b)	Group size (g)	No. of registers (r)	Register Offset (o)
Float Data						
PV/Device Variable 1	float32	Float Dev Vars	1	16	2	0
SV/Device Variable 2	float32	Float Dev Vars	1	16	2	2
TV/Device Variable 3	float32	Float Dev Vars	1	16	2	4
QV/Device Variable 4	float32	Float Dev Vars	1	16	2	6
Loop Current/Device Variable 5	float32	Float Dev Vars	1	16	2	8
Device Variable 6	float32	Float Dev Vars	1	16	2	10
Device Variable 7	float32	Float Dev Vars	1	16	2	12
Device Variable 8	float32	Float Dev Vars	1	16	2	14
Integer Data						
PV/Device Variable 1 Integer	fixed point	Int Dev Vars	2049	48	1	0
SV/Device Variable 2 Integer	fixed point	Int Dev Vars	2049	84	1	1
TV/Device Variable 3 Integer	fixed point	Int Dev Vars	2049	84	1	2
QV/Device Variable 4 Integer	fixed point	Int Dev Vars	2049	84	1	3
Loop Current/Device Variable 5 Integer	fixed point	Int Dev Vars	2049	84	1	4
Device Variable 6 Integer	fixed point	Int Dev Vars	2049	8	1	5
Device Variable 7 Integer	fixed point	Int Dev Vars	2049	8	1	6

Parameter	Type	Group(s)	Base Register (b)	Group size (g)	No. of registers (r)	Register Offset (o)
Device Variable 8 Integer	fixed point	Int Dev Vars	2049	8	1	7
Quality						
Var1 Quality	unit8	Quality Dev Vars	3073	8	1	0
Var2 Quality	unit8	Quality Dev Vars	3073	8	1	1
Var3 Quality	unit8	Quality Dev Vars	3073	8	1	2
Var4 Quality	unit8	Quality Dev Vars	3073	8	1	3
Var5 Quality	unit8	Quality Dev Vars	3073	8	1	4
Var6 Quality	unit8	Quality Dev Vars	3073	8	1	5
Var7 Quality	unit8	Quality Dev Vars	3073	8	1	6
Var8 Quality	unit8	Quality Dev Vars	3073	8	1	7
Status						
Last HART Command	unit8	Status	4097	32	1	0
Response Code	unit8	Status	4097	32	1	1
Field Device Status	unit8	Status	4097	32	1	2
Configuration Change Counter	unit16	Status	4097	32	1	3
Additional Device Status	unit8	Status	4097	32	25	7
Field Device Configuration						
PV, SV, TV & QV Units	unit8 array	Field Device Config	6145	32	2	0
Loop Current Units	unit8	Field Device Config	6145	32	1	2
Var1-8 Units	unit8 array	Field Device Config	6145	32	4	4
Transmitter HART Revision	unit8	Field Device Config	6145	32	1	15
PV Upper Range	float32	Field Device Config	6145	32	2	16
PV Lower Range	float32	Field Device Config	6145	32	2	18

Parameter	Type	Group(s)	Base Register (b)	Group size (g)	No. of registers (r)	Register Offset (o)
Tag Bytes 0-7	ascii	Field Device Config	6145	32	4	24
Manufacturing code	unit6	Field Device Config	6145	32	1	28
Device Type code	unit16	Field Device Config	6145	32	1	29
Field Device Serial Number	Unit24	Field Device Config	6145	32	2	30

HES HART data is always assigned to fixed registers 9001 through 9128.

Table 7-4: HES HART Data

Register	Type	No. of registers	Parameter
			Float Data
9001	float32	2	PV
9003	float32	2	SV
9005	float32	2	TV
9007	float32	2	QV
9017	float32	2	Var1
9019	float32	2	Var2
9021	float32	2	Var3
9023	float32	2	Var4
9025	float32	2	Var5
9027	float32	2	Var6
9029	float32	2	Var7
9031	float32	2	Var8
			Integer Data
9033	fixed point	1	PV Integer

Register	Type	No. of registers	Parameter
9034	fixed point	1	SV Integer
9035	fixed point	1	TV Integer
9036	fixed point	1	QV Integer
9041	fixed point	1	Var1 Integer
9042	fixed point	1	Var2 Integer
9043	fixed point	1	Var3 Integer
9044	fixed point	1	Var4 Integer
9045	fixed point	1	Var5 Integer
9046	fixed point	1	Var6 Integer
9047	fixed point	1	Var7 Integer
9048	fixed point	1	Var8 Integer
			Quality
9057	unit8	1	Var1 Quality
9058	unit8	1	Var2 Quality
9059	unit8	1	Var3 Quality
9060	unit8	1	Var4 Quality
9061	unit8	1	Var5 Quality
9062	unit8	1	Var6 Quality
9063	unit8	1	Var7 Quality
9064	unit8	1	Var8 Quality
			Status
9065	unit8	1	Last HART Command
9066	unit8	1	Response Code
9067	unit8	1	Field Device Status
9068	unit16	1	Configuration Change Counter
9072	unit8	25	Additional Device Status
			Field Device Configuration

Register	Type	No. of registers	Parameter
9097	unit8 array	2	PV, SV, TV & QV Units
9101	unit8 array	4	Var1-8 Units
9112	unit8	1	Transmitter HART Revision
9121	ascii	4	Tag Bytes 0-7
9125	unit6	1	Manufacturing code
9126	unit16	1	Device Type code
9127	unit8	2	Field Device Serial Number

Table 7-5: HES Device Variables

HES Device Variable data is always assigned to fixed registers 9201 through 9500.

Register	Type	No. of registers	Parameter	Description
9201	float32	2	DV0 (Reserved)	
9203	float32	128	DV1-64	(channel, device, variable) mapped from field device data
9331	float32	2	DV65	Number of field devices channel 1 is configured to poll.
9333	float32	2	DV66	Number of field devices channel 1 is communicating with.
9335	float32	2	DV67	Number of field devices channel 2 is configured to poll.
9337	float32	2	DV68	Number of field devices channel 2 is communicating with.
9339	float32	2	DV69	Number of field devices channel 3 is configured to poll.
9341	float32	2	DV70	Number of field devices channel 3 is communicating with.
9343	float32	2	DV71	Number of field devices channel 4 is configured to poll.
9345	float32	2	DV72	Number of field devices channel 4 is communicating with.
9347	float32	2	DV73	The total number of Field Device the HES is configured to poll.
9349	float32	2	DV74	The total number of Field Device the HES is communicating with.

Table 7-6: HES Status Registers

HES status registers are always assigned to fixed registers 9501 through 9828.

Register	Parameter
9501	System Overall
9502	System Status Summary
9513	User Configuration Error Summary
9514	Configuration Storage Error
9516	System Security Status
9566	Channel 1 Consolidated Status
9569	Channel 1 Detected Devices
9571	Channel 1 Devices Not Producing Data
9598	Channel 2 Consolidated Status
9601	Channel 2 Detected Devices
9603	Channel 2 Devices Not Producing Data
9630	Channel 3 Consolidated Status
9633	Channel 3 Detected Devices
9635	Channel 3 Devices Not Producing Data
9662	Channel 4 Consolidated Status
9665	Channel 4 Detected Devices
9667	Channel 4 Devices Not Producing Data

Table 7-7: HES System Information

HES system information is always assigned to fixed registers 9901 through 9999.

Register	Type	Parameter
9901 9902	u24 - sn	Serial Number (upper byte / lower word) 9001 contains the upper byte, 9002 contains the two lower bytes
9903 9904 9905	u8 - maj u8 - min u8 - build	HES Hardware rev (maj.min.build)
9906 9907 9908	u8 - maj u8 - min u8 - build	HES Software Revision (maj.min.build)
9909	u8 - number	Number of channels
9911 9912	u32 - ms	System millisecond counter follows float word order setting

8 Operation and Maintenance

8.1 Operation

Once installed HES begins to operate immediately. Depending upon environmental conditions, it can be expected to operate unattended for extended periods of time. No calibration is required.

8.2 Firewall Configuration

If you are connecting to the HES through a firewall, please ensure the relevant posts are open for the services you need,

- WWW 80
- MODBUS/TCP 502
- MIIP DTM (HART-IP) 5094
- NAC Client 2850/2851

8.3 HES Status Information

There is a wide range of status information available in the HES. The types of information can be broadly grouped into system status and HART device status. Most status data is reported on the web pages and in the MODBUS Register Map.

8.3.1 HES System Status

8.3.2 Status LEDs

The LEDs provide an indication of the device's operating status without the need to communicate with the unit. There is one Ready LED and one or four Channel LEDs (depending on the model). See Table 8-1 for LED status information.

Figure 8.1: LED Indication and device status OK

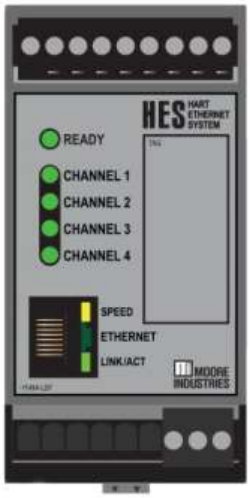


Table 8-1: LED Indication and device status

LED	Color	Description
Ready	RED	Initializing on power up or Unit Fault
	GREEN	System OK
Channel X	RED	Initializing, Fault or No HART communication
	GREEN	Channel OK and HART communication with all field devices
	RED/GREEN	Some, but not all field devices responding to polling

8.3.3 System Status Registers

The HES has a wealth of diagnostic data to help identify any HES or field device issues. The status registers are organized in a hierarchy, with the higher levels summarizing the contents of the lower levels (see Table 6-2). These registers are displayed on the 'System Status Registers' web page and can also be found in the MODBUS registers.

Table 8-2: System Status

System Register Hierarchy
System Overall
- System Status Summary
  - User Configuration Error
  - Configuration Storage Error
  - System Security Status
  - IO Channels
  - Channel x Consolidated Status
    - Channel x Detected Devices
    - Channel x Devices Not Producing Data

The following Tables 8-3 through 8-10 summarize each of the registers and actions required in the event of an error.

8.3.4 System Overall

Table 8-3: MODBUS register: 9501

Bit	Name	What it Means	What to Do
0	Initialization	The system is initializing including startup diagnostics and configuration	Wait for initialization to complete (approximately 3-5 seconds)
1	System Error	Unit or IO channel failure. This will also set Device Malfunction bit of the HES Field Device Status (HART)	See System Status Summary
2	General Error	System and communication errors	See System Status Summary

8.3.5 System Status Summary

Table 8-4: MODBUS register: 9502

Bit	Name	What it Means	What to Do
0	Diagnostic Failure	One of the diagnostics has detected a fault	Contact Moore Industries Customer Support
1	IO Channel System Error	One or more IO channels are reporting a system failure	See IO Channel Consolidated Status Registers
2	IO Channel General Error	One or more IO channels are reporting a general failure	See IO Channel Consolidated Status Registers
3	IO Channel Warning	One or more IO channels are reporting a warning	See IO Channel Consolidated Status Registers
4	User Configuration Error	User configuration error	See User Configuration Error Register
5	Reserved		
6	Reserved		
7	Configuration Storage Error	Error detected in non-volatile memory storage of configuration	See Configuration Storage Error Register
8	Internal Error	Indicates an HES internal fault	Contact Moore Industries Customer Support
9	Security Status	Indicates open security settings	See System Security Status

8.3.6 User Configuration Error

Table 8-5: MODBUS register: 9513

Bit	Name	What it Means	What to Do
0	IO Channel 1 Config Error	IO Channel 1 has a configuration error	Correct configuration error
1	IO Channel 2 Config Error	IO Channel 2 has a configuration error	Correct configuration error
2	IO Channel 3 Config Error	IO Channel 3 has a configuration error	Correct configuration error
3	IO Channel 4 Config Error	IO Channel 4 has a configuration error	Correct configuration error
4	HART Config Error	The HART configuration has an error	Correct configuration error
5	MODBUS Config Error	The MODBUS configuration has an error	Correct configuration error
6	Network Config Error	The network configuration has an error	Correct configuration error

8.3.7 Configuration Storage Error

Table 8-6: MODBUS register: 9514

Bit	Name	What it Means	What to Do
0	Factory Data Error	There was a problem reading the factory information	Power cycle unit, if the error returns then contact Moore Industries Customer Support.
1	Network Config Data Error	There was a problem reading or writing the network configuration information	If this occurred after reconfiguring the network settings, reconfigure again and power cycle the unit. Otherwise contact Moore Industries Customer Support.
2	User Data Error	There was a problem reading or writing the user configuration information	If this occurred after reconfiguring the user settings, reconfigure again and power cycle the unit. Otherwise contact Moore Industries Customer Support.

8.3.8 System Security Status

Table 8-7: MODBUS register: 9516

Bit	Name	What it Means	What to Do
0	Network Administration Security Open	The Network Configuration Jumper is in the enabled position. The system's network properties including IP Address can be reconfigured.	If security is required then set network security jumper and power cycle the unit.
1	User Configuration Security Open	The User Configuration Jumper is in the enabled position. The system's user configurable settings can be reconfigured.	If security is required then set user configuration jumper and power cycle the unit.
2	RESERVED		
3	Configuration Default Triggered	During power cycle, the Configuration Default jumper was detected, and the network configuration was defaulted.	If this was unexpected then contact Moore Industries Customer Support.

8.3.9 IO Channel Registers

8.3.10 Channel X Consolidated Status

Table 8-8: MODBUS register: 9566 (Channel 1); 9598 (Channel 2); 9630 (Channel 3); 9662 (Channel 4)

Bit	Name	What it Means	What to Do
0	System Error	IO Channel has a system error.	Contact Moore Industries Customer Support.
1	General Error	IO Channel has a general error.	Usually caused by No HART or Partial Hart. See bits 2&3 below or other channel status registers.
2	No HART Communications	None of the devices on this channel have responded to command 0.	Check wiring / device connections and field device configuration (polling address).
3	Partial HART Communications	At least one of the devices on this channel is not responding to HART commands.	See Devices registers to identify problem device
4	Device Malfunction Bit Set	One or more devices on this channel has its device malfunction bit set.	See field device HART registers to identify the failed device and address the issue.
5	Configuration Change Bit Set	One or more devices on this channel has its configuration changed bit set	See field device status registers to identify the device and clear the bit.
6	Channel Disabled	This channel is configured to be disabled	Information only. Reconfigure if the channel is needed

8.3.11 Detected Devices

Table 8-9: MODBUS register: 9569 (Channel 1); 9601 (Channel 2); 9633 (Channel 3); 9665 (Channel 4)

Bit	Name	What it Means	What to Do
0	Device 1 is Present	Communications established with the specified device. (Valid response to CMD 0 received)	If not set and device is supposed to be present, check wiring / device connections and field device configuration (polling address).
1	Device 2 is Present		
2	Device 3 is Present		
3	Device 4 is Present		
4	Device 5 is Present		
5	Device 6 is Present		
6	Device 7 is Present		
7	Device 8 is Present		
8	Device 9 is Present		
9	Device 10 is Present		
10	Device 11 is Present		
11	Device 12 is Present		
12	Device 13 is Present		
13	Device 14 is Present		
14	Device 15 is Present		
15	Device 16 is Present		

8.3.12 Devices Not Producing Data

Table 8-10: MODBUS register: 9571 (Channel 1); 9603 (Channel 2); 9635 (Channel 3); 9667 (Channel 4)

Bit	Name	What it Means	What to Do
0	Device 1 is Not Producing Data	Data is not being produced for the specified device. Only devices configured for communication are monitored. This will become set if the polling fails (after all retries have failed) or if configured for burst mode, the data did not arrive in time. Successfully polling CMD3, CMD9, or receiving the correct burst message in time will clear the bit.	If set, check wiring / device connections and field device configuration (polling address, CMD3/9, burst mode settings).
1	Device 2 is Not Producing Data		
2	Device 3 is Not Producing Data		
3	Device 4 is Not Producing Data		
4	Device 5 is Not Producing Data		
5	Device 6 is Not Producing Data		
6	Device 7 is Not Producing Data		
7	Device 8 is Not Producing Data		
8	Device 9 is Not Producing Data		
9	Device 10 is Not Producing Data		
10	Device 11 is Not Producing Data		
11	Device 12 is Not Producing Data		
12	Device 13 is Not Producing Data		
13	Device 14 is Not Producing Data		
14	Device 15 is Not Producing Data		
15	Device 16 is Not Producing Data		

8.3.13 HES HART Device Status

HART device status messages are produced on the data being processed through the system (i.e. data quality stamps, channel and field device status registers).

8.3.14 Field Device Status

The HES and field devices all produce a Field Device Status byte as defined by the HART standard.

The field device status bytes are available on the 'Field Device HART Status' web page (see Table 6-5) and can also be found in the MODBUS registers (see MODBUS registers section for locations).

The HES Field Device Status byte is on the 'HES HART Status and Variables' web page and in the MODBUS registers.

Table 8-11: MODBUS register 90067

Bit	Name	HART definition	HES specific
0	*PV Outside Limits*	*Primary Variable is beyond its operating limit.*	*N/A*
1	*Non PV Outside Limits*	*A Device Variable not mapped to PV is beyond its operating limit.*	*N/A*
2	*Loop Current Saturated*	*The Loop Current has reached its upper (or lower) endpoint limit and cannot increase (or decrease) and further.*	*N/A*
3	*Loop Current Fixed*	*The Loop Current is being held at a fixed value and is not responding to process variations.*	*N/A*
4	More Status	More status information is available via Command 48, Read Additional Status Information	
5	Cold Start	Cold Start – A power failure or Device Reset has occurred	
6	Configuration Changed	An operation was performed that changed the device's configuration.	
7	Device Malfunction	The device detected a serious error or failure that compromises HES device operation.	

8.3.15 Additional Status

The HES and field devices all produce Additional Status bytes (25 maximum) as defined by the HART standard.

If configured and available, the field device additional status bytes are on the 'Field Device HART Status' web page (see Table 6-5) and can also be found in the MODBUS registers (see MODBUS registers section for locations).

The HES generates a 9 byte additional status which is displayed on the 'HES HART Status and Variables' web page and in the MODBUS registers.

Table 8-12: MODBUS registers 9072-9080

Byte	Name	Description
0	System Status Summary A	System Status Summary register Bits 8-15 (see System Status Registers)
1	System Status Summary B	System Status Summary register Bits 0-7 (see System Status Registers)
2	IO Channel 1	IO Channel 1 Consolidated Status register (see IO Channel Registers)
3	IO Channel 2	IO Channel 2 Consolidated Status register (see IO Channel Registers)
4	IO Channel 3	IO Channel 3 Consolidated Status register (see IO Channel Registers)
5	IO Channel 4	IO Channel 4 Consolidated Status register (see IO Channel Registers)
6	Extended Status Code	Not Used, Set to 0x00.
7	Device Operating Mode	Not Used, Set to 0x00.
8	Standardized Status 0	Per HART definition. Bit 0: Simulation Active (Not Used) Bit 1: Non Volatile Memory Defect Bit 2: Volatile Memory Defect Bit 3: Watchdog Reset Executed Bit 4: Voltage Out of Range (Not Used) Bit 5: Environmental Conditions Out of Range (Not Used) Bit 6: Electronic Defect (Not Used)

8.3.16 Device Variable Status

All HART 7 devices support Device Variables (DV) and produce Device Variable (DV) Status for each DV in response to Command 9 (per the HART standard).

The field device DV status are available in the MODBUS registers (see MODBUS registers section for information).

NOTE: The lower 4 bits are unused in the HES DV status since these are reserved for Device Family Specific Status.

Table 8-13: Device Variable Status

Bit	Name	HART definition
0-3	Device Family Specific	Includes 3 bits for Device Family Specific Status and 1 bit to indicate additional DV status available
4-5	Limit Status	11 – Constant 01 – Low Limited 10 – High Limited 00 – Not Limited
6-7	Process Data Status	11 – Good 01 – Poor Accuracy 10 – Manual/Fixed 00 – Bad (set if source device's Device Malfunction bit is set)

8.4 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.

8.4.1 Serial Numbers

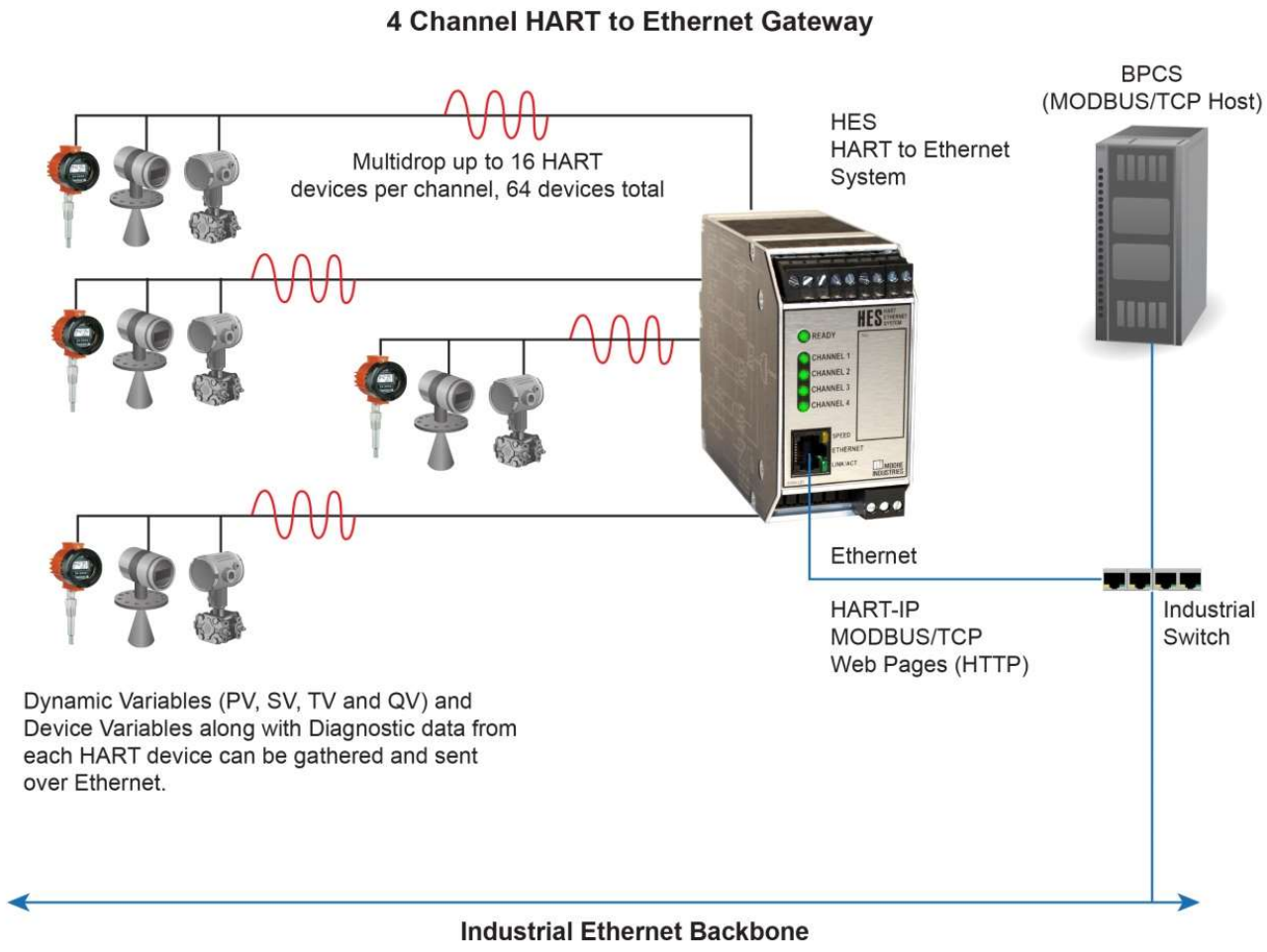
If problems involve a particular HES, there are several pieces of information that can be gathered before you call the factory that will help our staff get the answers you need in the shortest time possible. For fastest service, gather the complete model and serial number(s) of the problem unit(s) and the job number of the original sale. See Warranty at the end of this manual.

9 Application

9.1 Leveraging Existing Networks

Share multiple HART devices up to 16 per channel. The HES communicates with IIoT systems using MODBUS/TCP or HART-IP over Intranet or Internet to historians, control or higher level systems. Use the HES to interface with new or existing HART instruments. See Figure 9.1.

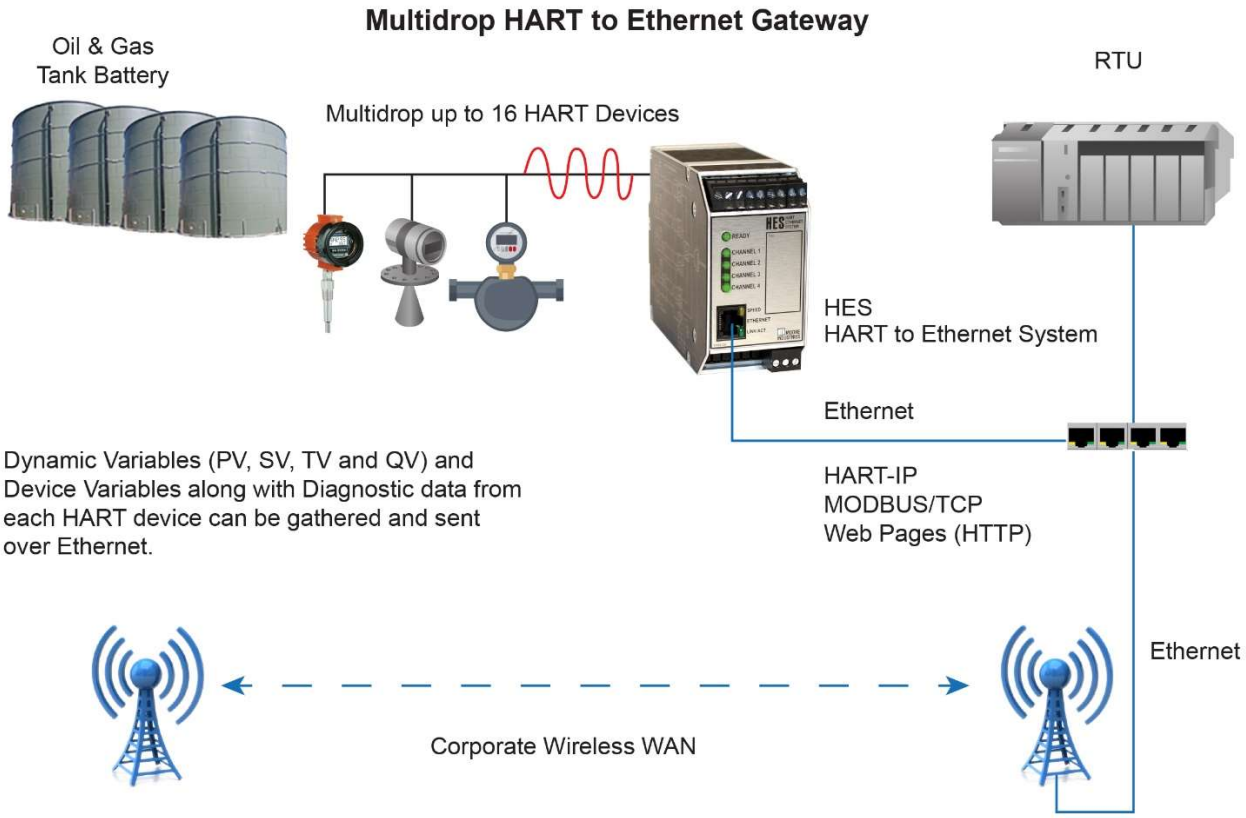
Figure 9.1: HART-to-Ethernet Gateways like the HES shown here offer a quick and economical way of sharing critical HART data with higher level systems.



9.2 HES Installation in Remote Oil & Gas Tank Battery

The HES HART to Ethernet Gateway System simplifies the exchange of data by polling up to 64 smart HART field devices and making that data available over Ethernet for easy access by MODBUS/TCP or HART-IP hosts. See Figure 9.2.

Figure 9.2: The HES installed in a remote oil & gas tank battery application.

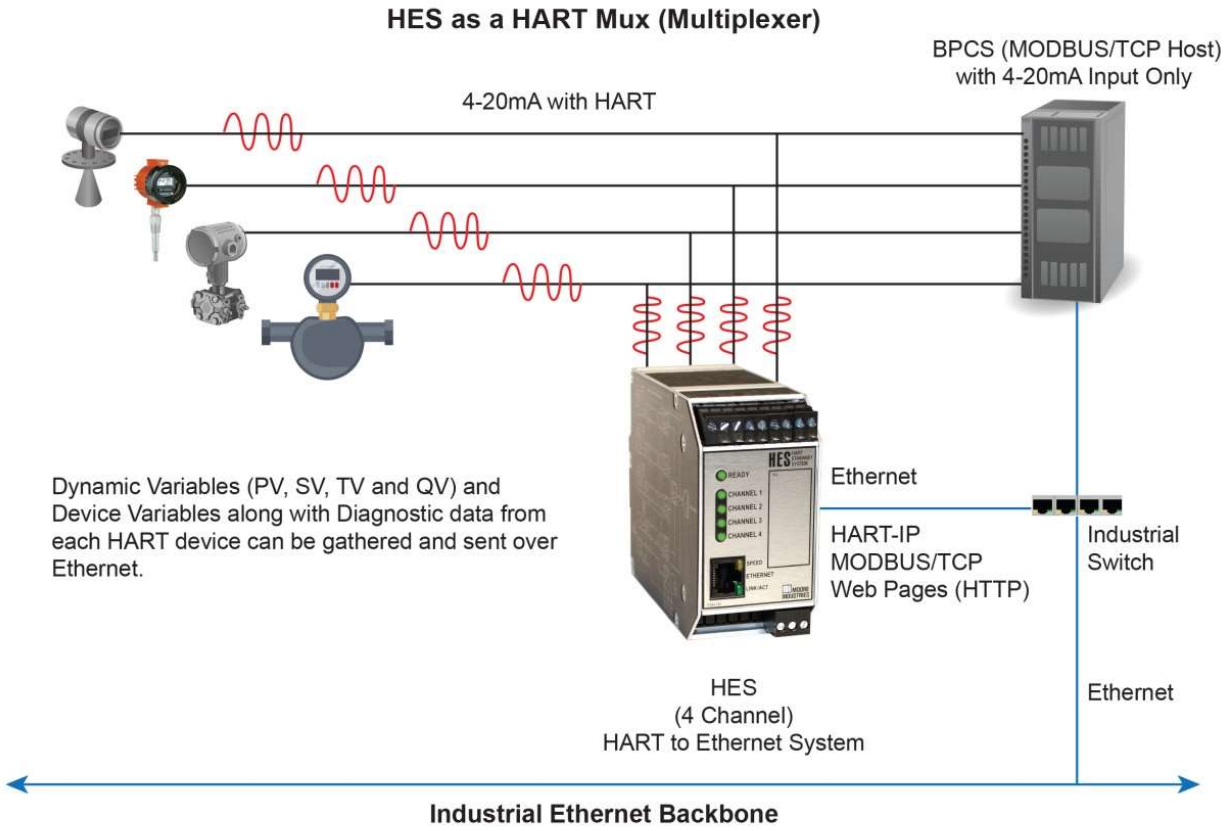


9.3 Diagnostics Help Improve Process Uptime

The HES is capable of collecting and transmitting diagnostics from multiple Smart HART instruments to enable a more timely and effective analysis of a process (see Figure 9.3).

The diagnostic data collected by the HES from connected devices is transmitted through MODBUS/TCP or HART-IP over Ethernet to control systems, historians, etc. for predictive analytics that permits scheduled preventative device maintenance, greatly reducing unplanned or emergency process interruptions or shutdowns.

Figure 9.3: Use the HES to capture up to 128 variables from each of four devices and deliver the data to an asset management system or BPCS.



10 Section 8 - Specifications

10.1 HES Specifications

Communications

HART Primary or Secondary Master: Supports up to 16 HART 5,6 & 7 devices per channel; supports normal and burst mode communication Address Range: 0-63 Number of retries:1-9

Ethernet: 10/100Base-T supports speeds up to 100Mb/second Standard RJ-45 Connection Auto negotiation, Auto MDIX, DHCP or fixed IP address

Protocol Types: MODBUS/TCP, HART-IP, HTTP (read only)

Performance

Digital Response Time:
Equals the combination of the HART field device(s) response time, HES update rate and the Ethernet response time. HART field device response is defined by the HART protocol as 500msec in Normal Mode and 333msec in Burst Mode.
HES typical update rate (Normal Mode):
One HART device per channel (CMD3. No additional Status) : 800 milliseconds
One HART device per channel (CMD3 + Additional Status) : 1.2 seconds
One HART device per channel (CMD9 No additional Status) : 2 seconds
One HART device per channel (CMD9 + Additional Status) : 3 seconds
Ethernet response (excludes external network delays):
MODBUS/TCP: The data request to response time is less than 10msec
HART-IP: The data request to response time is less than 10msec
HTTP: Response time to transfer the entire web page is less than 2 seconds

Input Accuracy: Reflects the accuracy of the HART field device
Input Impedance: Transmit Mode: 150 ohms; Receive Mode: Less than 5 kohms
MODBUS/TCP: Configurable MODBUS Register map (by variable or device) User-selectable Standard LSW (Least Significant Word) or Swapped MSW (Most Significant Word) 32 bit floats and 16 bit signed integers (0-3 decimal places)
Isolation: 500Vrms between case, input, output and power terminals and will withstand 1000Vac dielectric strength test for one minute continuous (with no breakdown)
Power Supply: 9-30Vdc
TX Power Supply: On channel 1 only; 25.8Vdc ±3%@35mA; capable of powering up one Moore TCM or 6 HART field devices configured in multi-drop mode
Power Consumption: 1.5W maximum for units not using TX supply; 3.5W maximum for units using TX supply @35mA

Security

User Configuration: Jumper sets Read only or Read/Write access to HES settings
Network Configuration: Limit number of concurrent HART-IP sessions (1-4), Limit number of concurrent MODBUS/TCP sessions (0-4); Jumper sets Read only or Read/Write access to IP and Network settings

Indicators

Ethernet:
Ready LED: System normal and ready (green); Initializing on power up or unit fault (red)
Channel (1-4) LED: Input and communication with all devices normal (green); Input is initializing, fault or no communication (red); Not all devices are communicating (flashing red/green)
LINK/ACT: This LED indicates transmit and receive activity in addition to the status of the Link. The LED will be ON when Link is good. It will blink when the transmitter or receiver is active.
Speed LED: When yellow, indicates 100Mb/second, off indicates 10Mb/second

Ambient Conditions

Operating & Storage Range:
–40°C to +85°C
(–40°F to +185°F)
Relative Humidity:
5-95%. non-condensing
RFI/EMI Immunity: 20V/m@80-1000MHz, 1kHz, when tested according to IEC61000-4-3
Noise Rejection: Common Mode: 100dB@50/60Hz

Weight

680 g (24 oz.)

11 Ordering Information

11.1 Ordering Information

Table 11-1: Ordering Information

Unit	Input	Output	Power	Options	Housing
HES HART to Ethernet Gateway System	**HART** Single HART channel input that accepts digital input signals from 1-16 HART smart field devices **4HART** Four HART channel inputs, each accepting digital input signals from 1-16 HART smart field devices (64 total)	**ETH** Ethernet output	**9-30DC**	**-MB** MODBUS/ TCP Output (Required)	**DIN** DIN-style housing mounts on 35mm Top Hat (EN50022) rails

When ordering, specify: Unit / Input / Output / Power / Options [Housing]

Model number example: HES/4HART/ETH/9-30DC/-MB [DIN]

Warranty Disclaimer

Moore Industries ("The Company") makes no express, implied or statutory warranties (including any warranty of merchantability or of fitness for a particular purpose) with respect to any goods or services sold by the company. The company disclaims all warranties arising from any course of dealing or trade usage, and any buyer of goods or services from the company acknowledges that there are no warranties implied by custom or usage in the trade of the buyer and of the company, and that any prior dealings of the buyer with the company do not imply that the company warrants the goods or services in any way.

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.

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.