MOORE INDUSTRIES WORLDWIDE

HES

HART® to Ethernet Gateway

September 2018

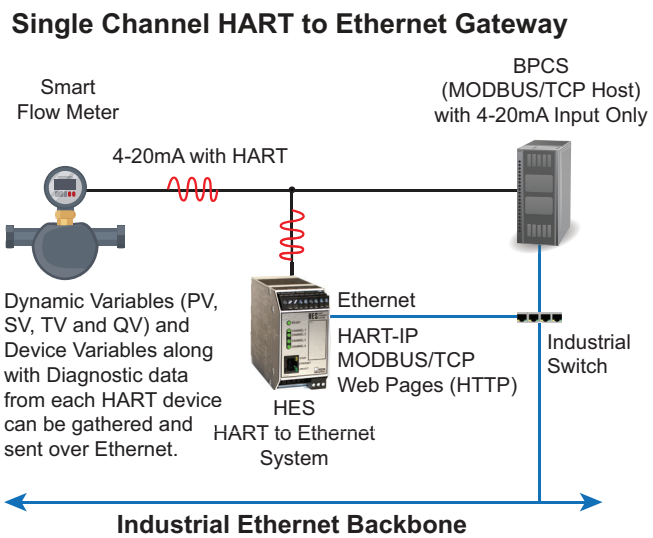
Description

The HES HART to Ethernet Gateway System converts signals from wired HART devices to Ethernet MODBUS/TCP and HART-IP. The HES offers a flexible and economical way to gather process data and instrument diagnostics from just one smart HART instrument, or several in HART digital multidrop networks, and share it over an Ethernet infrastructure with MODBUS/TCP or HART-IP hosts. This enables fast and seamless connectivity for the advanced monitoring of critical process variables and parameters.

Industrial Internet of Things - HART Over Ethernet

Moore Industries' rugged HES supports HART 5, 6 and 7 devices with sufficient memory to handle thousands of process variables, and diagnostic data points from up to 64 connected smart HART devices. The HES allows you to further leverage your industrial Ethernet investment by making all of this valuable HART data viewable with any web browser or MODBUS/TCP compliant host. The HES also supports HART-IP, allowing any of the connected HART device variables, HES variables, or diagnostics to be monitored. Support for these open industrial protocols enables you to easily interface with any process control or asset management system while taking advantage of any Industrial Internet of Things (IIoT) initiatives that facilitate the propagation of process data to higher level corporate or analytical systems.

Figure 1. *The HES converts HART to MODBUS/TCP and HART-IP protocol.*



* HART is a registered trademark of the HART Communication Foundation

The HES features a metal, RFI resistant *housing that snaps onto standard DIN-style rails.*

Features

- **Available with multiple channels.** Available in a single channel or four channel configuration supporting up to 64 HART devices.
  - Single channel configuration 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. (See Figure 1)
  - Four channel configuration can support up to 64 total HART devices for high density installations. (See Figure 2)
- **HART Multiplexer Capability.** Multiplex up to 64 HART instruments and share dynamic and device variables along with instrument diagnostic data with your asset management system over industrial Ethernet networks.
- **Compatible with all HART devices.** The HES communicates with all HART 5, 6 and 7 devices including smart valves, multivariable flowmeters, pressure, pH, level, and temperature transmitters and more.
- **Enhanced Security.** HES configuration can be write protected using hardware jumpers and network communication connections can also be limited.
- **Simple to Configure.** Configure over Ethernet using PACTware or other FDT compliant host with the supplied HES DTM.

Certifications

CE Conformant – EMC Directive 2014/30/EU EN61326; ROHS2 Directive 2011/65/EU

226-701-00A

HES

HART® to Ethernet Gateway

Leverage Your Existing Network Investment

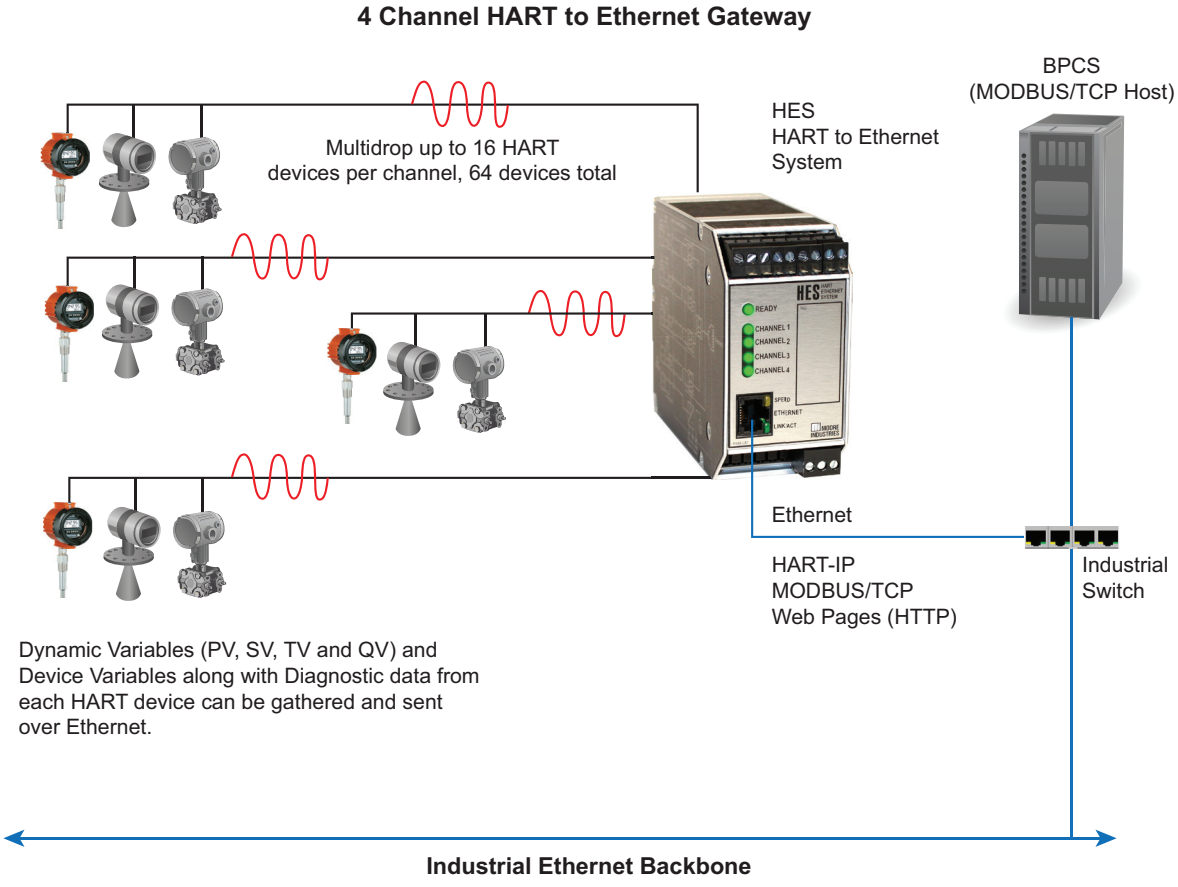
When monitoring process points, whether dispersed or in small clusters, the HES leverages existing Ethernet network investments by collecting and concentrating process variables from multiple devices onto a single Ethernet communications link. Up to 16 HART instruments can be multidropped on each of the HES' four channels (4-channel model) onto a low-cost Ethernet communication link allowing up to 64 instruments to be connected using one HES.

The HES communicates with IIoT systems using MODBUS/TCP or HART-IP over Intranet or Internet to historians, control, or higher level systems. (See Figure 2). Using the HES to interface with existing HART instruments, as opposed to installing new process instruments and wiring, allows the use of existing Ethernet networks to communicate with a host system, delivering significant savings on upgrade and installation costs.

Multiplex HART Data to Asset Management Systems

Asset management and predictive analytics software systems rely on supplemental process variable and diagnostic data from smart HART field devices but not all control systems are capable of reading this HART digital data. When this additional HART data and variables are required, consider using the HES HART to Ethernet gateway as very cost effective HART multiplexer that allows up to 64 field devices' HART data to be shared with any host or monitoring system within your industrial Ethernet network. (See Figure 3)

Figure 2. *Four Channel HART to Ethernet Gateway*



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 your process (see Figure 3).

The diagnostic data collected by the HES from connected devices are 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.

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. The HES, acting as a HART host, communicates with all HART field devices with revision 5, 6 or 7. It is important to verify what revision of HART the field device supports to ensure that the HES is configured correctly.

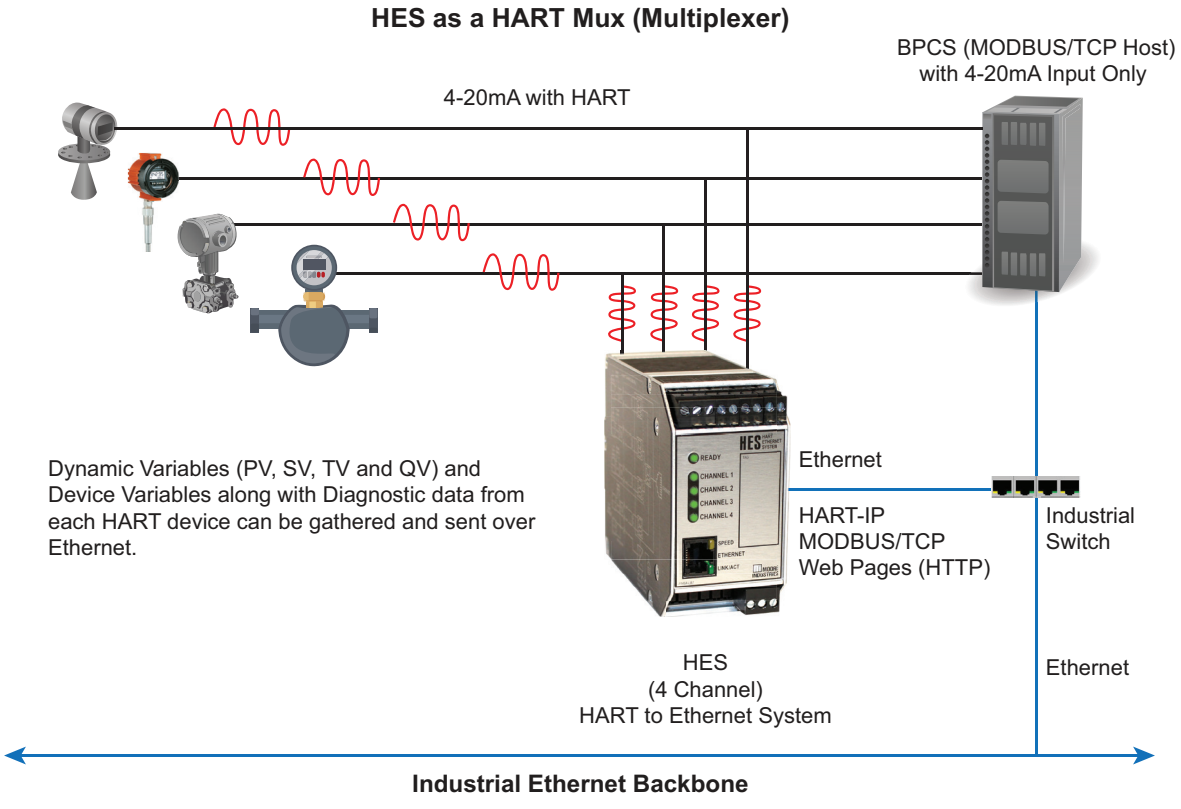
HART Variable Types

HART devices can provide a lot of additional data to the primary variable which is read on the 4-20mA loop. In addition to diagnostic status bits and bytes, there are two types of HART variables that you can retrieve from HART devices – Dynamic Variables and Device Variables. All of these HART variables are IEEE 754 Floating Point values and are retrieved by the HES from the field device by utilizing HART Command 3 or Command 9.

Using Command 3, the HES will retrieve the four Dynamic Variables from each HART device, while Command 9 retrieves up to eight Device Variables per request.

Device Variables may also be used in more sophisticated or multi-variable 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 9. Each field device can define up to 240 Device Variables (HART 7) numbered consecutively from 0 to 239.

Figure 3 *Use the HES to multiplex HART device data from up to 64 devices in order to communicate with an asset management system.*



HART 5 devices support Command 3 only. Using Command 3, the HES will read the Dynamic Variables and loop current from the field device.

HART 6 and 7 devices support Command 3 and Command 9. To use Command 9, the number of Device Variables and each Device Variable Code from the specific field device needs to be specified.

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 along with their Device Variable Codes.

The Device Variable Codes are unique to each field device and may be defined in the operation manual or obtained from the manufacturer of your HART field device. In addition, the following Device Variable Codes are defined in the HART specification:

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)

All HART revisions support Additional Status Command 48. HART protocol allows the manufacturer to report as many as 25 bytes of diagnostic data from each HART field device. This plays a key role in assessing the overall health and status of field devices.

HES as a HART Host

The HES can be configured as a Primary or Secondary HART Host and polls up to 16 field devices on each of its four channels (total of 64 field devices maximum per HES). As a Primary or Secondary Master the HES can be configured to communicate in the normal mode or burst mode per channel. The HART standard permits only one device to be in the burst mode per channel. The HES supports HART Commands 3 and 9 for the reading of Dynamic and Device Variables. Additionally the HES supports Command 48 which reads the field device's Additional Status data.

HES as a HART Field Device

The HES acts as both a HART host (reading up to 64 field devices across four channels) and a HART field device.

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 pages. (See Figure 4.)

Figure 4. *Dynamic Variables and Device Variables are viewable on HES-served web pages.*

HES: HART Ethernet System

Field Device HART Data

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	9574	0x0000	No status bits set
Ch3 Consolidated Status	9582	0x0000	No status bits set
Ch4 Consolidated Status	9590	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	DV3	DV4	DV0	DV7	DV10	DV5	DV6	DV8
Addr: 0, CMD9, #DVs: 8	0.671	10.046	25.822	5.358	9.375	0.671	10.046	-9.375
DVs: 3,4,0,7,10,5,6,8	PCT	PCT	DEG C	DEG C	PCT	DEG C	DEG C	DEG C
Tag:	(1025)	(1153)	(1281)	(1409)	(1537)	(1665)	(1793)	(1921)
Channel 1, Devices 2 to 16 are 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	3.076	27.547	3.076	3.076	Not	Not	Not	Not
Addr: 0, CMD3	PCT	DEG C	PCT	PCT	Polled	Polled	Polled	Polled
Tag: TDZ3 HP	(33)	(161)	(289)	(417)				

HES Device Variables

As a HART field device, the HES has 74 Device Variables. Device Variables (DV) 1-64 are assigned by default to represent the PV of each device (1-16) on each HES channel (1-4). However, any of the DV1- 64 Device Variables can be re-mapped to represent any variables of the connected HART field devices. DV 65-74 are fixed Device Variables that include information on HES channel and device communications.

The Dynamic Variables are also assigned by default, 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).

Retrofitting Existing HART Installations

There are millions of existing HART instruments installed across many industries. Oftentimes these installations were put in place before there were avenues to gather, collect or disperse critical process data away from the immediate process vicinity.

Nowadays Ethernet, fiber and wireless networks are being installed everywhere to analyze and collect data from remote locations for interfacing with corporate WANs (Wide Area Network) and servers. In these cases where the communication infrastructure now exists, consider using the HES as a gateway between your remote process locations and corporate monitoring systems. (See Figure 5).

MODBUS/TCP

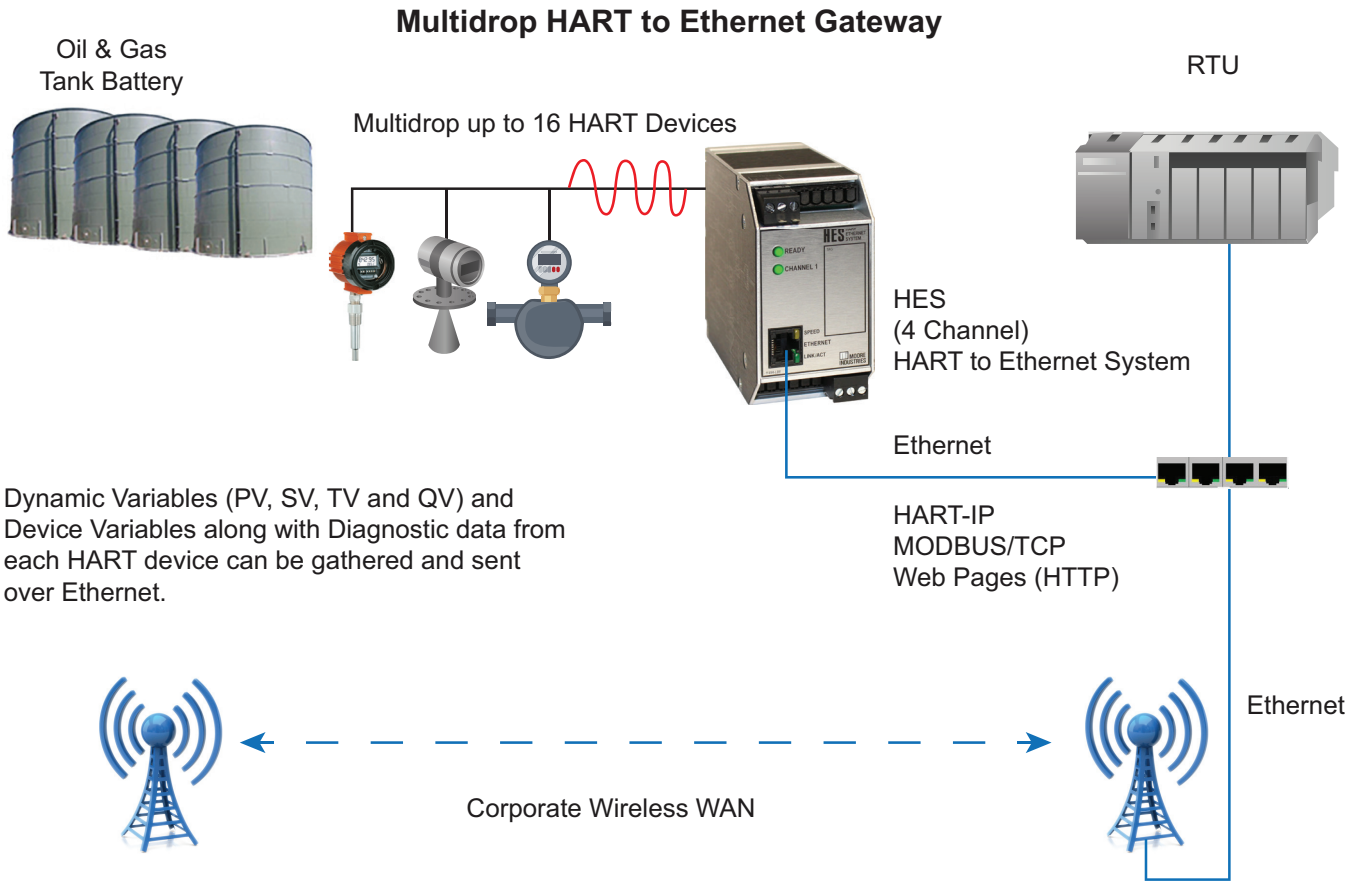
The HES supports up to four concurrent MODBUS/TCP connections.

For more secure network environments, that 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 so no sessions with a MODBUS host will ever initiate.

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 MODBUS memory map to be compressed and laid out by variable or device type. Additionally, the user can decide what value the MODBUS register should post when there is lost communication with connected HART devices.

Figure 5. *The HES installed in a remote oil & gas tank battery application.*



Quick and Easy Setup

The HES HART to Ethernet gateway system is easily and quickly programmable. Use any FDT compliant host, or download free PACTware software from our website which allows you to set up all HES settings utilizing our DTM. (See Figure 6)

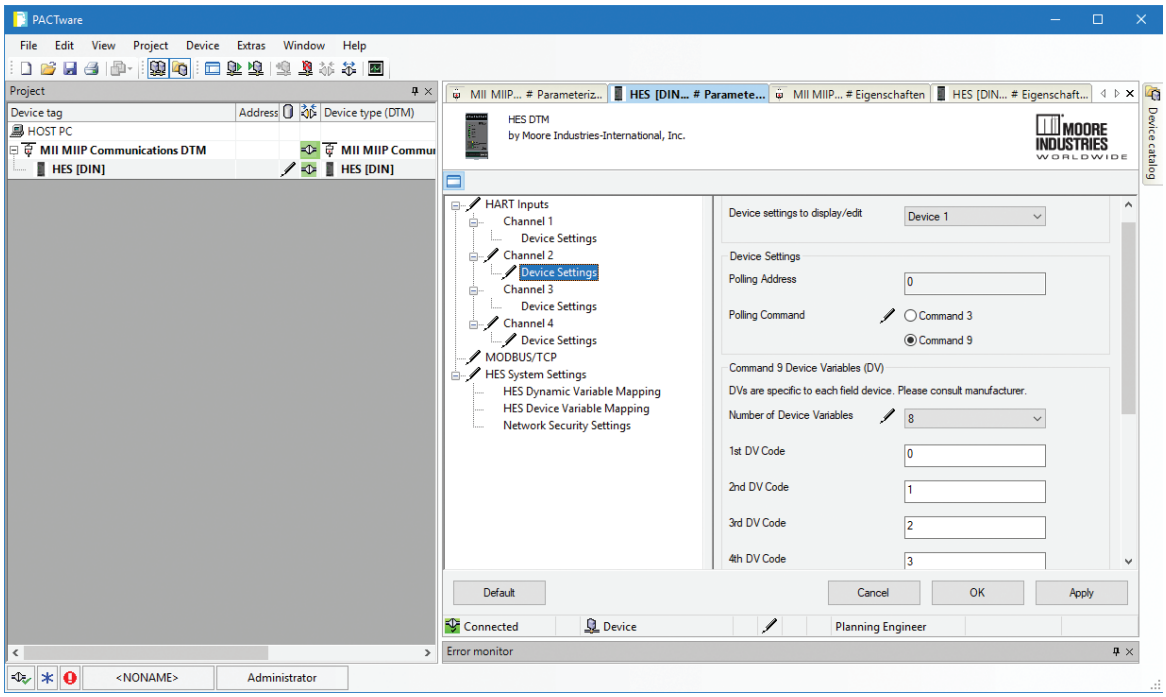
The HES' IP address is configured with Moore Industries Network Addressing Configuration (NAC) Client Software, which can also be downloaded for free from our website. The HES supports Auto MDIX (Medium Dependent Interface), which means that either a straight through Ethernet patch cable or crossover cable can be used for commissioning and configuration.

Embedded Web Server

A built-in web server in the HES provides quick and easy read only viewing of any and all connected HART devices. The web pages include simple to navigate menus and tables that neatly lay out all of the HART Dynamic and Device Variables from each of the connected HART devices. In addition the HES' HART variables and diagnostic data are also included within these web pages. To make communication setup with a MODBUS/TCP host easier, the tables within the web pages include MODBUS memory map address referencing so users can more easily configure the MODBUS/TCP host settings. (See Figure 4)

PACTware™

Figure 6. *Quick and Easy Setup using our DTM with any FDT compliant host such as PACTware.*



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 two Moore TCMs 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.)

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

To order, specify: Unit / Input / Output / Power / Options [Housing]
Model Number Example:
HES/4HART/ETH/9-30DC/-MB [DIN]

Specifications and information subject to change without notice.

Figure 7. *HES Installation Dimensions, Same for 1 and 4 Channel Version (4 channel shown)*

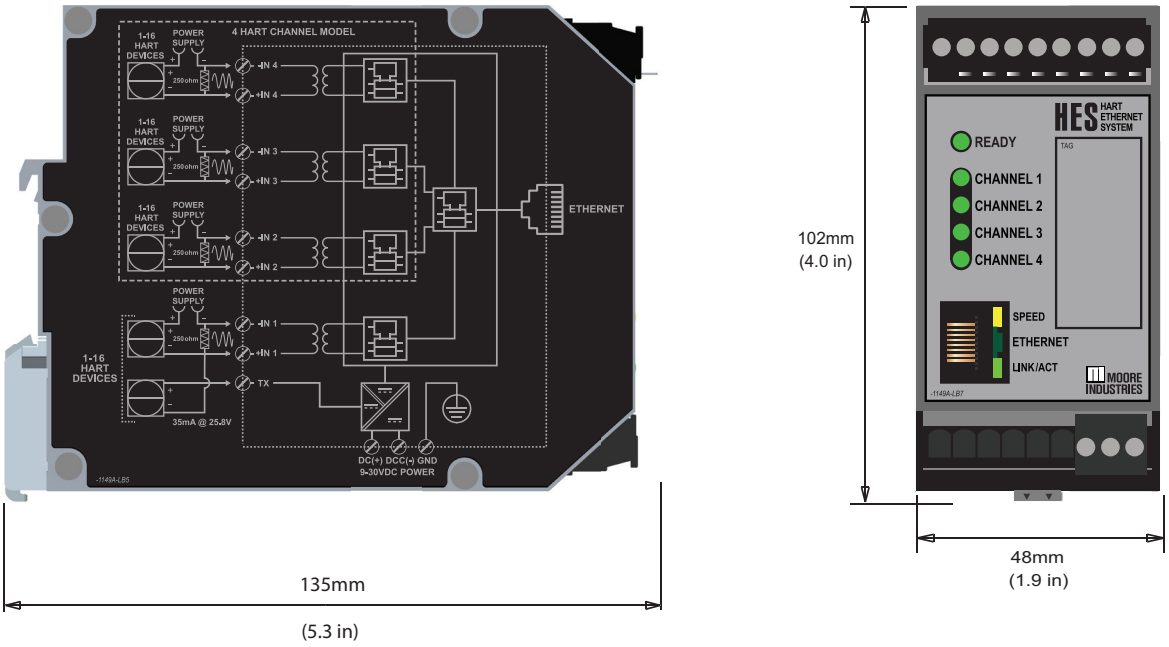


Figure 8. *Terminal Designations*

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

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

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

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

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

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