

HART Plug-In module

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Abstract:

HART (Highway Addressable Remote Transducer) Plugin module easily enables HART in any legacy 4 - 20 mA transmitters and Valve Positioners. As HART enabled instruments are widely installed in Process and Chemical plants, most of the manufacturers are upgrading their legacy devices to HART. While upgrading, manufacturers need to redesign the hardware and HART stack has to be integrated into the existing device firmware. These efforts can be minimized by using the HART Plugin module.

This module can be connected to any field device through a serial interface(RS232/TTL/RS485) / 4-20mA loop. The module captures the device data and converts to HART signals, enabling the field device to communicate with HART master. This helps to continuously validate the integrity of loops and capture performance data for maintenance diagnostics.

The module will have HART 7 stack that supports the backward compatibility for Revisions 5 and 6. Device Specific commands, UI(DD) application will be developed & Commands (Universal and Common practice commands) will be included as per customer specification.

The devices which supports TTL, RS-232, RS-485 and 4 - 20 mA legacy devices can be made HART compatible with this module. Plug-in module gets the device information through the serial interface.

This module consists of a controller with HART stack (Rev 7.0), HART modem and ADC and DAC. The module can be connected to any field device type like Valve positioner, Transmitter, flow meter etc., If the field device is a Valve Positioner (Current input device) the master will set the HART 4 - 20 mA data which will be read in the plug-in module through ADC. If the field device is a transmitter (Current output device) the slave device will set the 4-20mA through plug-in module DAC interface.

A generic UI (universal and common practice commands) application will be provided along with HART module for easy interpretation of HART commands.

The module is already tested for HART compliance which makes the field device certification process easy.

This paper mainly focuses on enabling HART in any 4 – 20 mA legacy or on any field device which supports the above mentioned serial interfaces and make device diagnostics data accessible.

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Acronyms

HART	Highway Addressable Remote Transducer
ADC	Analog to Digital Converter
DAC	Digital to Analog Converter
EEPROM	Electrically Erasable Programmable Read Only Memory
RAM	Random Access Memory
DD	Device Description
FCG	Field Comm Group

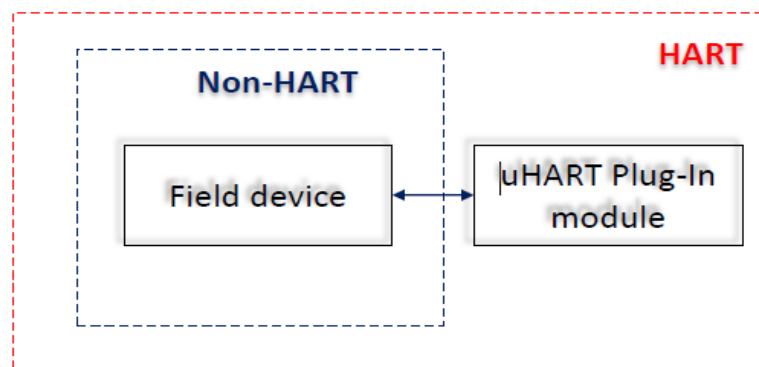
1. Introduction

As HART protocol is a hybrid (Analog + Digital) protocol it is most widely used in process Automation industries. HART has several advantages like no data loss, easy device diagnostics as the main process variable value will always be available in the loop and more information can be collected through digital signals.

To make a device HART compatible manufacturers need to redesign the hardware and HART stack has to be integrated into the existing device firmware and the device has to undergo Physical Layer testing and Pre-compliance testing as per HART specs to get the device certified by FCG. These efforts can be minimized by using this HART Plug-in module.

Any field device which supports the TTL, RS-232, RS-485 serial interfaces can be made HART compatible.

This paper explains how the HART Plug-in module is designed and how it can be integrated with any field device to make it as HART compatible.



2. HART plug-in module

2.1 Description

It is a readily available HART module which can be plugged to any legacy 4 – 20 mA devices or any serial interface supporting devices and convert them to HART compatible device and make device diagnostics data accessible.

HART module comprises of

- Micro controller with HART slave stack
- HART modem
- DAC
- ADC
- Non-volatile memory (EEPROM / Flash)

2.2 Features

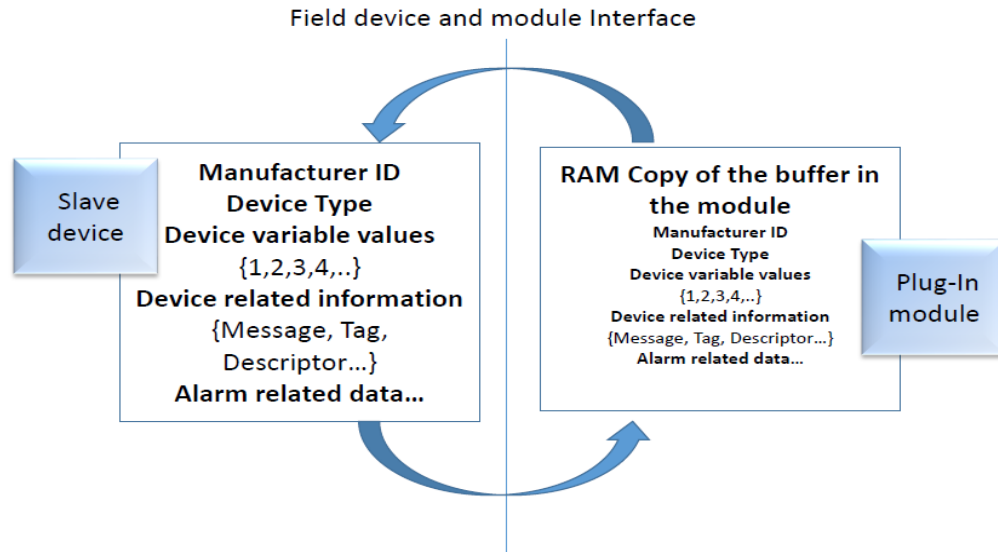
- This module comes with HART 7.0 stack which also provides backward compatibility for HART revision 5 and 6.
- Supports all Universal commands.
- Support all Common practice commands required for regular HART device.
- Device specific commands can be implemented as per user requirement.
- Module is already tested for HART compliance.
- Generic UI(DD) or customized DD application can be provided.

2.3 Updating device information in the HART Plug-in module

To configure the module, necessary information (Manufacturer ID, Exp Dev Type, Message, tag,...) related to the field device has to be provided by the customer.

When the user interfaces the plug-in module with the slave device (which is already powered), it reads the device related information through the Serial interface and configures the HART module according to the information obtained from the slave device.

This module reads the device variable information periodically by requesting data from the device through the Serial interface and stores the latest data in the local RAM variable.



2.4 Configuring the module as Positioner or Transmitter

At the time of initialization, plug-in module reads the slave device information through the serial interface and the module will be configured accordingly.

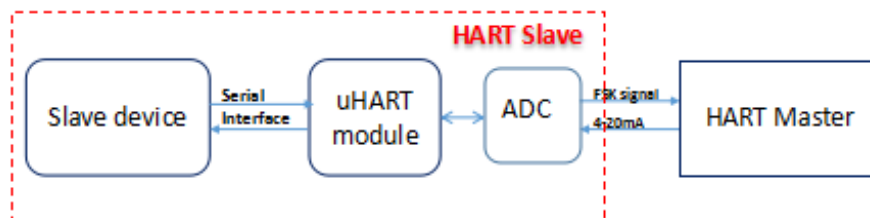
If the target device is a transmitter, DAC is enabled in the module. If the target device is a Positioner, ADC is enabled in the module at the HART master end. This enabling can be done through the switching mechanism.

2.5 Data handling between HART master and Non-HART slave device

When the module receives hart request, it responds with the latest information collected from the slave device through the Serial interface.

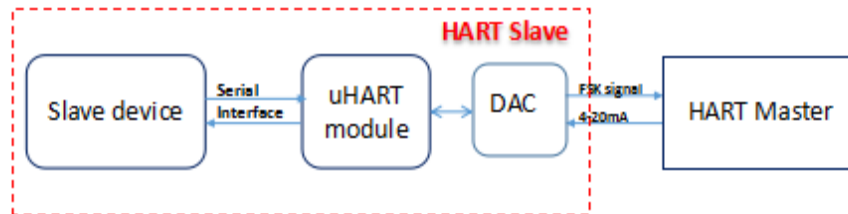
In Positioner, master can source the current to control the slave device. This plug-in module reads the current sourced by master and stores the information in the RAM and transmits the information to the slave device through the serial interface.

Non-HART slave Positioner



In transmitter, slave device output the current through the DAC. This plug-in module reads the latest Primary Variable value through the serial interface and stores the information in the RAM. This module converts the value to the current and source the current to DAC.

Non-HART slave Transmitter

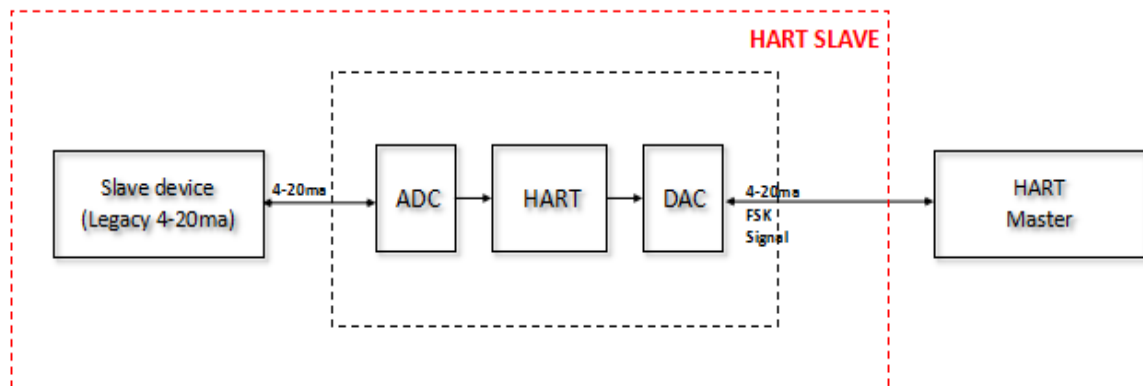


2.6 Data handling between HART master and Legacy 4-20 mA device

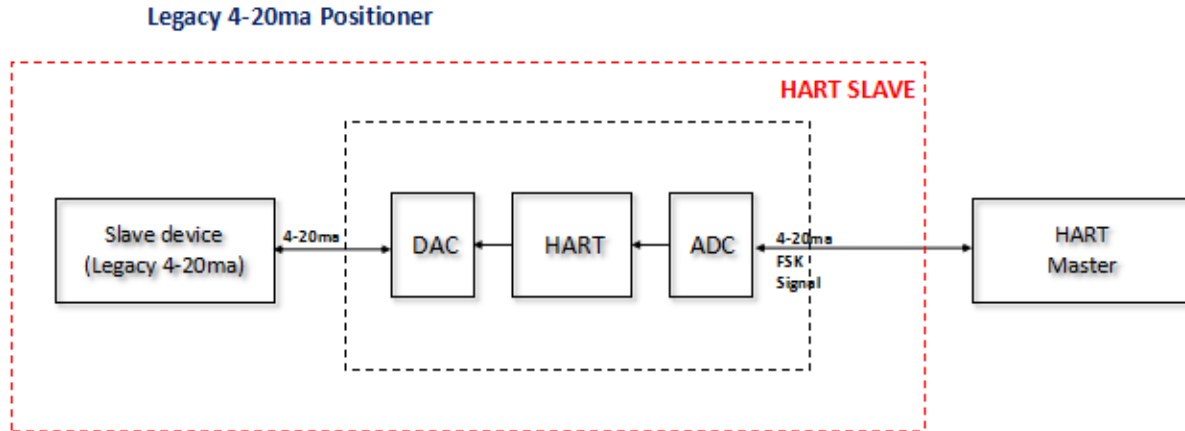
Dynamic variable values can be obtained and the slave device can be controlled from the corresponding 4-20ma current loop.

In Transmitter, plug-in module reads the slave output current through the respective ADC channel and updates the information in the RAM variables. This plug-in module sources the primary variable current at the HART output through the DAC.

Legacy 4-20ma Transmitter



In Positioner, master sources the current to control the slave device. This plug-in module reads the current sourced by master through ADC and updates the information in the RAM variable. It sources the current to the slave device through the DAC.



2.7 Advantages

- Easy to integrate with any legacy 4-20mA device /Serial interface devices.
- Shorter time to market.
- Minimized efforts for development of additional commands.
- Certification process is easy.

2.8 Uses

To get the device certified by FCG for HART compliance the device has to go through Physical layer testing and Pre – compliance testing. As the HART module has already gone through the above mentioned tests the device certification process is reduced.

2.9 Limitations

To control the slave device, necessary interfaces has to be provided by the customer.

Alarms related to data on 4-20 mA loop can be handled in the module. Customer has to provide the interface or access to handle the device specific alarms.

3. Conclusion

This paper gives brief information on how to upgrade a Non-HART device to HART compatible device. With the help of this paper one can get an idea on how to develop the HART Plug-in module in terms of hardware and firmware.

4. References

1. Adding HART protocol to a Product

<https://support.fieldcommgroup.org/en/support/solutions/articles/8000018135-adding-hart-protocol-to-a-product>

2. HART Technical Specifications

<https://fieldcomm-group.myshopify.com/collections/hart/products/hrt-spec>

3. HART Test Specifications

<https://fieldcomm-group.myshopify.com/collections/hart/products/hart-test-specification>

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