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Document

USER MANUAL For GWHM

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Applicable to Firmware Ver: GWHM_Firm_1.0_23-03-23

1. INTRODUCTION

This is the user's manual for the HART to Modbus Gateway. It contains all of the information needed to configure and install this instrument.

2. FEATURES

GW HM is a HART to Modbus Gateway which is used to interface HART Transmitter & field instruments with Modbus RTU based monitoring & control systems. Gateway converts HART signal to Modbus RTU Protocol and provides variables in fixed Modbus address registers.

Supported HART Commands

- **Command 0**: Read Unique Identifier
- **Command 3**: Read Dynamic Variables and Loop Current
- **Command 13**: Read Tag, Descriptor, Date
- **Command 15**: Read Device Information
- **Command 38**: Reset Configuration Changed Flag
- **Command 48**: Read Additional Device Status

3. OPERATION

3.1Mode of Operation

- **Point to point Mode**

In point-to-point mode, GW HM is connected to exactly one HART field device. This connection variant requires that the device address of the field device be always set to zero. In Single mode loop current is 4mA in series with HART and power supply.

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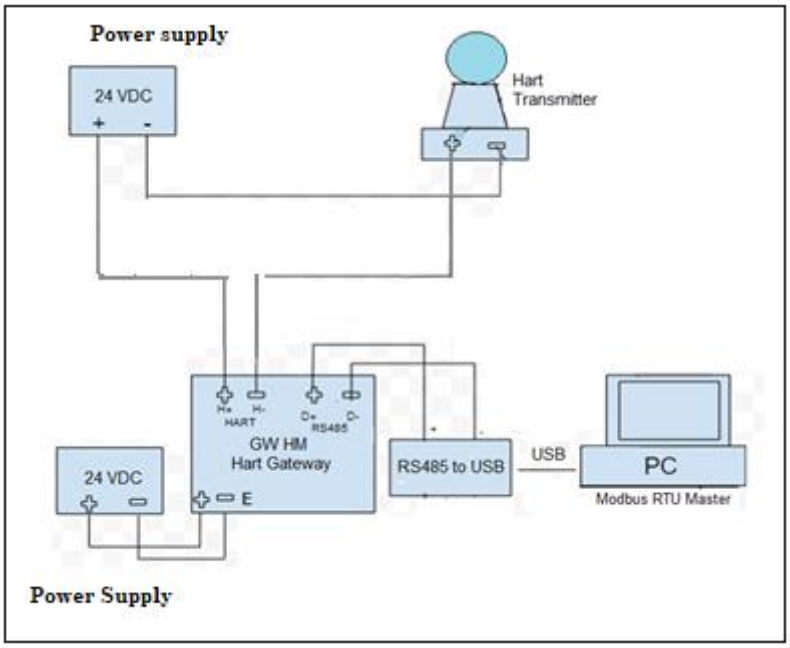

- **Multi-drop Mode**

In a digital multi-drop HART network, up to 15 HART instruments digitally communicate on the same wires. The GW HM can be set to monitor any or all devices within the network.

Only one Modbusdevice address and one RS485 communication channel is needed to send the process data from up to 15 HART devices to a MODBUS host.
GW HM distinguishes the field devices by their preset addresses which range from 1 to 15.

In Multi drop mode digital signal can be used and the analog loop current is fixed at 4 mA.

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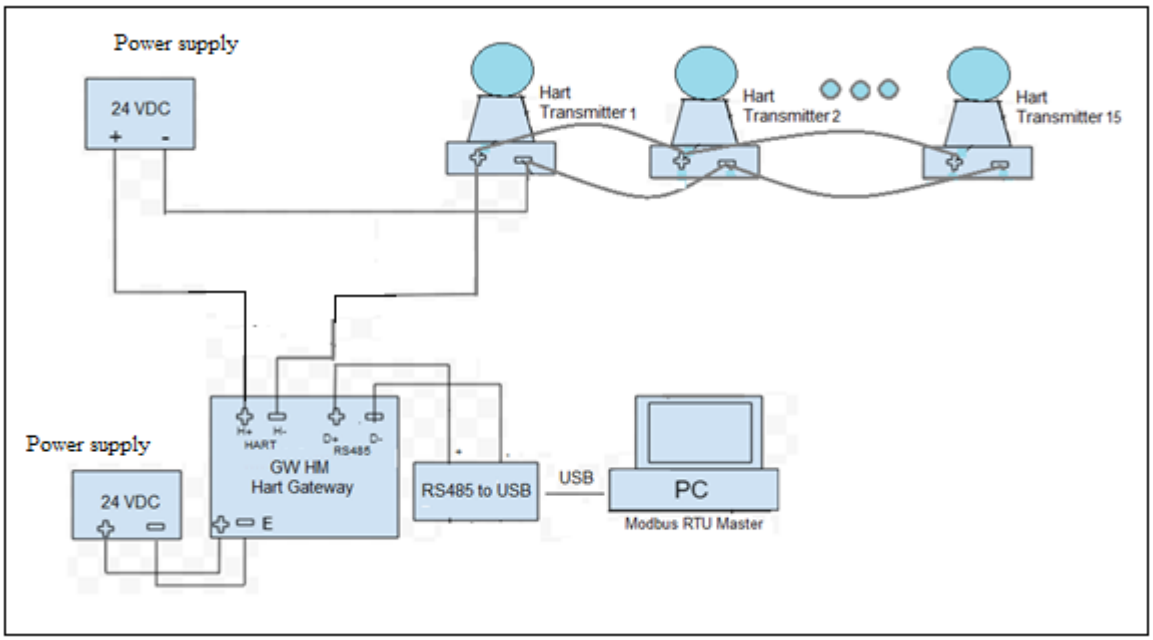

3.2 GW HM Operation

GW HM is powered for the first time; Gateway enters into discovery mode and sends Command 0 as per number of devices configured. The discovered device IDs are stored in the Gateway. The Gateway then sends Command 13, Command 15, and Command 48 to all device IDs. Then Gateway enters into run mode and sends Command 3 continuously to all configured devices.

If any device fails to send a valid response to the command, then the gateway retries the same command 3 times. If all of the configured devices fail to respond to the command 3 in run mode, then GW HM enters into discovery mode and sends command 0 again to check for connected devices and the whole operation gets repeated.

The Gateway polls the HART devices and makes data available on the Modbus RTU port. It acts as a Modbus slave on RS485 port. Any Modbus RTU master software can be connected to it for reading data. Device specific data & variables can be read from Modbus registers. (Ref. Section 6 Modbus Registers for Device Specific Data).

DIP Switches are provided on the front side of GW HM, to select operation mode, Load resistor, debug mode. (ref. Section DIP Switch Operation).
A USB connector is provided on the front side of GW HM, to monitor communication frames on the HART and Modbus Channel.

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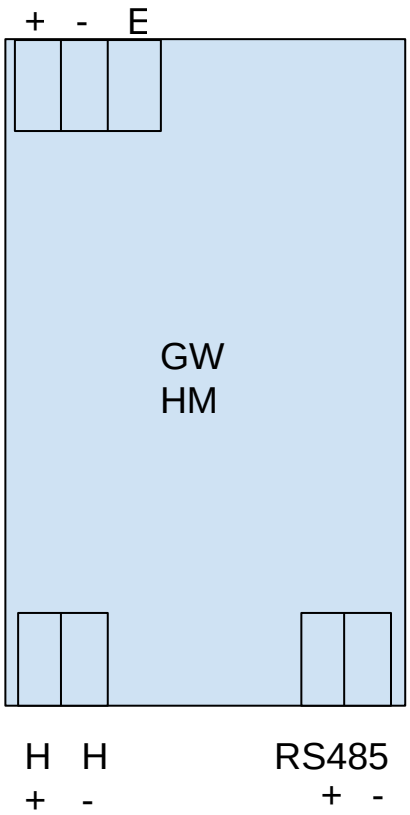
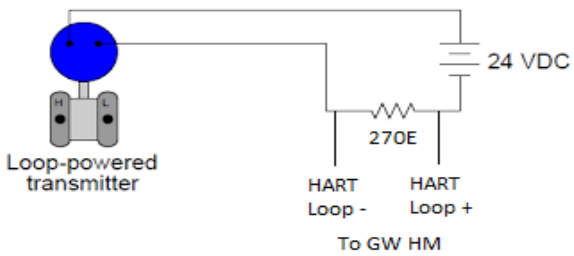
HART Configuration through Modbus allows to configure a number of connected HART devices. Modbus configuration allows configuring Modbus slave ID & communication parameters. (Ref. section HART configuration through Modbus & Modbus configuration)

4. INSTALLATION





Installation consists of physically mounting the unit and completing the electrical connections. The GW HM is designed to mount easily onto DIN rails.

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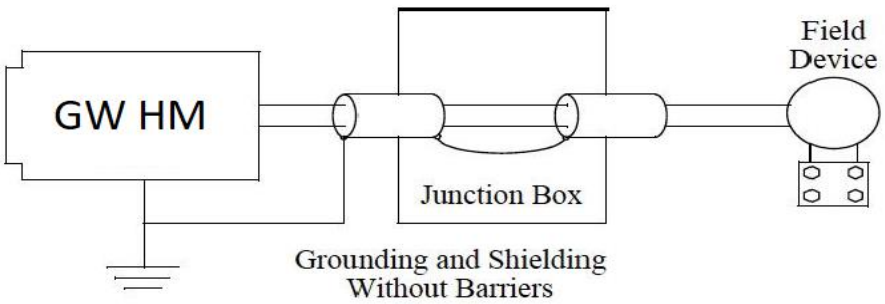
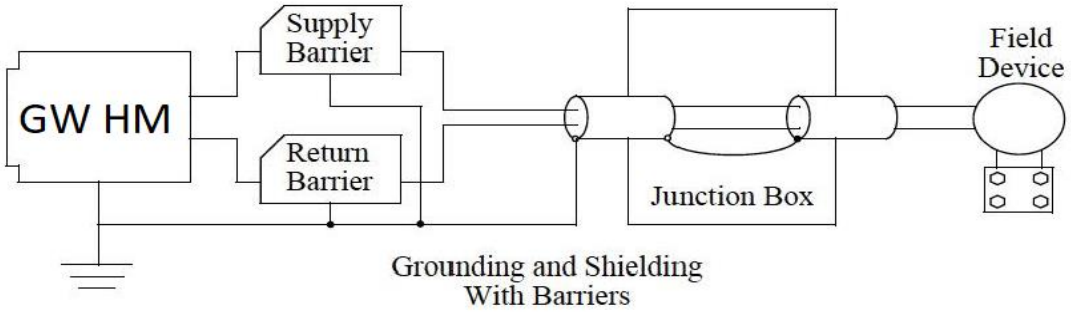
Making the Electrical Connections After mounting, you are ready to connect the GW HM to the loop.

4.1 Grounding and Shielding

Please provide instrument earth to the GW HM. Please ensure that you are not using the same earthling connection to high current carrying equipment as protective earth. Please connect your device as shown:





HART and Modbus Connections

4.2 Connections

HART:
GW HM provides a 2-pin connector for HART loop connections. For loop-powered transmitters, connect HART loop + (H+) & HART loop - (H-) terminals from connector across a 250E load resistor as shown in above picture.

For externally powered transmitters, connect H+ & H- terminals of GW HM to the H+ & H- terminals of the transmitter with 250E load resistor in parallel.

4.2.1 Modbus:

GW HM provides the RS-485 interface for Modbus.
Connect RS-485 D+ & D- to the connector.

4.2.2 Power Supply

24V DC (Range: 18 to 36V DC)
Screw type 3 pin connector with 3.81mm pitch

4.2.3 HART channel

GW HM equipped with one HART Channel. This can handle up to 15 devices in multidroped.

4.2.4 RS485 channel

GW HM provides a standard RS-485 port that supports the Modbus RTU protocol.

4.2.5 Default Factory Configuration

- **HART Settings**
  Number of HART Slave Devices: 1
  GW HM is a Primary Master.
  Point to Point Mode

- **Modbus Settings**
  Address: 1
  Baud Rate: 9600 Modbus
  Parity: None
  Stop Bit: 1

5. GW HM CONFIGURATIONS

5.1 HART Number of devices

- Number of HART Devices Configuration through Modbus Setting value of Modbus register (44001) to configure number of connected field devices.
- For Point-to-Point mode value of Modbus register (44001) must be set to 1. Hence GW HM only polls to address 0.
- For Multi-drop mode, the value of Modbus register (44001) must be set to (Poll address of last device in multidrop (i.e. field device having higher poll address) + 1).

Ex. In Multi-drop of 5 devices, if the highest address in the 5 devices is 5, then the value of Modbus register (44001) must be set to 6.

This will skip poll address zero while polling and start polling field devices from 1 to 5, as in multi-drop all connected filled devices must have non-zero poll addresses.

- Ensure that the Poll Address matches the address of the device you connected in the loop. **Note: After configuration of number of connected field devices, GW HM shifts to discovery mode & sends command 0 to all number of connected field devices.**

Value of Modbus register 4001		**Poll Address**
1	Device 1	0
2	Device 2	1
3	Device 3	2
4	Device 4	3
5	Device 5	4
6	Device 6	5
7	Device 7	6
8	Device 8	7
9	Device 9	8
10	Device 10	9
11	Device 11	10
12	Device 12	11
13	Device 13	12
14	Device 14	13
15	Device 15	14
16	Device 16	15

5.2 RS485 port Configuration (Device ID, Baud Rate, Parity, Stop Bit)

Open Modscan Software on PC. Select ID as 1, Serial parameters as 9600,8,N,1

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Address 5001 length 4

- Modbus protocol address map

Modbus Register	Function	Description	Action
5001	Modbus device address	Modbus device Address The rage is 1 to 247	R/W
5002	Baud Rate Setting	1-2400 2-4800 3-9600 4-19200 5-38400 6-57600 7-115200	R/W
5003	Parity	0-None 1-Even 2-Odd	R/W
5004	Stop bits	0-1 Stop bit 1-2 Stop bits	R/W

6. MODBUS REGISTERS FOR DEVICE SPECIFIC DATA

6.1 Modbus Register Mapping

- Note: Device address mentioned in this section refers to HART field device address,

In point-to-point mode, the device address of the field device is always set to zero.
In Multi-drop Mode, the device address of the field devices ranges from 1 to 15.
Ensure correct Modbus register address calculation to monitor processed data from field devices.

Register Range	Description
1001 - 1128	PV, SV, TV, QV Float Values (HART device IDs 0 - 15) Each device takes 8 registers (Total 8*16 Modbus Registers)
1201 - 1264	PV, SV, TV, QV Integer Values (HART device IDs 0 - 15)(4*16 Modbus Registers)

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1301 - 1316	Status & Response Codes (HART device IDs 0 - 15) (1*16 Modbus Registers)
1321 - 1368	Additional Status Byte 0 to Byte 5 (HART device IDs 0 - 15) (3*16 Modbus Registers)
1401 - 1432	PV, SV, TV, QV Unit Codes (HART device IDs 0 – 15) (2*16 Modbus Registers)
1501 - 2300	HART device 0 - 15 Device Information (8*15 Modbus Registers)
4001	1 Modbus Register to configure number of HART devices
5001 - 5004	Modbus Configuration (Device ID, Baud Rate, Parity, Stop Bit)

PV, SV, TV, QV values are received in Command 3.
Status and Response codes are received in response of every command i.e., Command 3, 13, 15, 38, 48
Additional Status Bytes are received in Command 48 response
PV, SV, TV, QV unit codes are received in Command 3.
HART device information is received in Command 0, 13 and 15.

6.2 Modbus Register Map for HART device 0 - 15 PV, SV, TV, QV Float Values

For each HART Device, 4 bytes float value of each variable is stored in 2 Modbus Registers. To access a particular register, its assigned Modbus register must be used.

For PV float value
Modbus Register Address = 1001 + (Device Address * 8) + 0

For SV float value
Modbus Register Address = 1001 + (Device Address * 8) + 2

For TV float value
Modbus Register Address = 1001 + (Device Address * 8) + 4

For QV float value
Modbus Register Address = 1001 + (Device Address * 8) + 6

Below table shows, respective Modbus address for float variables for Device 0.

Register Address	Description
1001	Device 1 PV Float Value

1003	Device 1 SV Float Value
1005	Device 1 TV Float Value
1007	Device 1 QV Float Value

6.3Modbus Register Map for HART device 0 - 15 PV, SV, TV, QV Integer Values

For each HART Device, 2 bytes integer values of each variable are stored in 1 Modbus Registers.
To access a particular register, its assigned Modbus register must be used.

For PV integer value
Modbus Register Address = 1201 + (Device Address * 4) + 0;

For SV integer value
Modbus Register Address = 1201 + (Device Address * 4) + 1;

For TV integer value
Modbus Register Address = 1201 + (Device Address * 4) + 2;

For QV integer value
Modbus Register Address = 1201 + (Device Address * 4) + 3;

Below table shows, respective Modbus address for integer variables for Device 0.

Register Address	Description
1201	Device 1 PV integer Value
1202	Device 1 SV integer Value
1203	Device 1 TV integer Value
1204	Device 1 QV integer Value

6.4 Modbus Register Map for HART device 0 - 15 Status & Response Code

For each HART Device, 2 bytes status & response code are stored in 1 Modbus Registers.
To access a particular register, its assigned Modbus register must be used.

Modbus Register Address = 1301 + Device Address

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Below table shows, respective Modbus address for Status & Response Code for Device 0 & 1.

Register Address	Description
1301	Device 1 status & response code
1302	Device 2 status & response code

6.5Modbus Register Map for HART device 0 - 15 Device Specific Status

For each HART Device, 6 bytes Additional Status are stored in 3 Modbus Registers.
To access a particular register, its assigned Modbus register must be used.

Modbus Register Address = 1321 + Device Address * 3

Below table shows, respective Modbus address for device specific status for Device 0 & 1.

Register Address	Description
1321	Device 1 status & response code
1324	Device 2 status & response code

6.6 Modbus Register Map for HART Device 0 -15 Unit Codes

For each HART device, PV, SV, TV, QV are stored in 2 Modbus Registers.
To access a particular register, its assigned Modbus register must be used.

For PV & SV unit Code
Modbus Register Address = 1401 + (Device Address * 2) + 0;

For TV & QV unit Code
Modbus Register Address = 1401 + (Device Address * 2) + 1;

Below able shows, respective Modbus address for unit codes for Device 0.

Register Address	Description
1401	PV & SV Unit Code
1402	TV & QV Unit Code

Measurement Unit Code

Volume Units

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Unit Code	Description
40	Gallons
41	Liters
43	Cubic Meters
46	Barrels

Time Units (Flow Rate)

Unit Code	Description
51	(Per) Second
50	(Per) Minute
52	(Per) Hour
53	(Per) Day

Pressure Units

Unit Code	Description
6	Pounds per square inch
11	Pascal’s
12	Kilopascals
237	Mega Pascal's

Temperature Unit Codes

Unit Code	Description
32	Degrees Celsius
33	Degrees Fahrenheit
35	Kelvin

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Velocity Units

Unit Code	Description
20	Feet per second
21	Meters per second

6.7Modbus Register Map for HART device 0 - 15 Device, Device Information

For each HART Device, 54 bytes Additional Status are stored in 27 Modbus Registers.
To access a particular register, its assigned Modbus register must be used.
Detail register arrangement for Device Information in Modbus map is shown in below table:

Register Address	Description
1501	Tags
1505	Descriptor
1513	Date
1515	Unit Code
1516	Expanded Device Type Code
1517	Device ID
1519	Configuration Change Counter
1520	Extended Field Device Address
1521	Manufacture ID
1522	Private Level Distribution Code
1523	Device Profile
1524	Upper Range
1526	Lower Range

To get Modbus Register Start Address for each device,
Modbus Register Start Address = 1501 + (Device Address * 50)
Note: Out of 50 Modbus registers, 23 Modbus registers are reserve & kept unused.

Below table shows, respective Modbus address for device information for Device 0 & 1.

Register Address	Description
1501	Device 1 device information
1551	Device 2 device information

7. DIP SWITCHES OPERATION

- **DIP Switch 1**

Not Used

- **DIP Switch 2: Select Internal or External resistor**

DIP Switch 2 is in off position by default and allows the use of an external load resistor. By switching DIP switch to ON position internally provided 270E load resistor can be used as a load resistor.
With DIP switch ON & external resistor also, communication may not work fine due to load resistance imbalance.

- **DIP Switch 3: Turn ON/OFF Discovery mode**

DIP Switch 3 is in off position by default and allows the gateway to work normally i.e. first discover connected field devices as per number of field devices configured in a Modbus register 44001, then read device descriptor & ranges & real time variable continuously.
By switching DIP switch to ON position, the gateway shifts to discovery mode i.e. to poll all the connected devices as per number of field devices configured in a Modbus register 44001. If DIP switch is kept in ON position, gateway stays in discovery mode & poll Command 0 to all connected devices, as soon as DIP switch switches to OFF, gateway sends commands to all available devices to read device descriptor & ranges & real time variables continuously.

- **DIP Switch 4: Debug mode for HART/RS485 channel**

When DIP Switch 4 is in ON position, HART communication frames can be monitored through USB port and when it is in OFF position Modbus RTU frames can be monitored through USB port.

8. CONSOLE and INDICATIONS

Mini USB connector provided on a front side of gateway to monitor communication between gateway & field devices.

- **LED Indications**

1. Power: Green LED, indicates device is Powered ON.
2. RS485 Rx/Tx: Red LEDs, provided separately to indicate Rx/Tx operations on RS485.
3. HART Rx/Tx: Red LEDs, provided separately to indicate HART transmitting Command & receiving field response.

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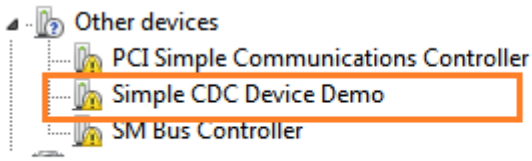
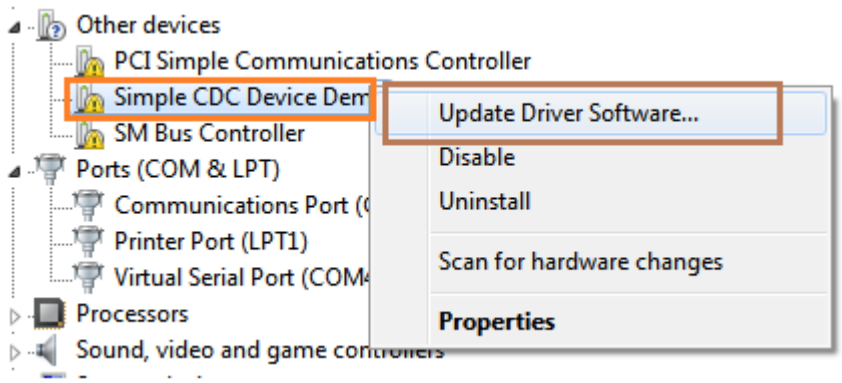
9. MICROCHIP USB DRIVER INSTALLATION

Note: For Windows 10 Microchip driver not Required. Used for Windows 7.
Microchip driver installation process followbellow steps.

1). Downloaded Microchip USB driver in Specific path.
2). Connect USB cable in GWHM USB Port.



3). In Device Manager go to Other Devices and Check CDC Device Demo.



4). Check Simple CDC Device Demo and write click on it get Update Driver software.
5). Click on Update Driver Software Select Browse my computer for driver software.

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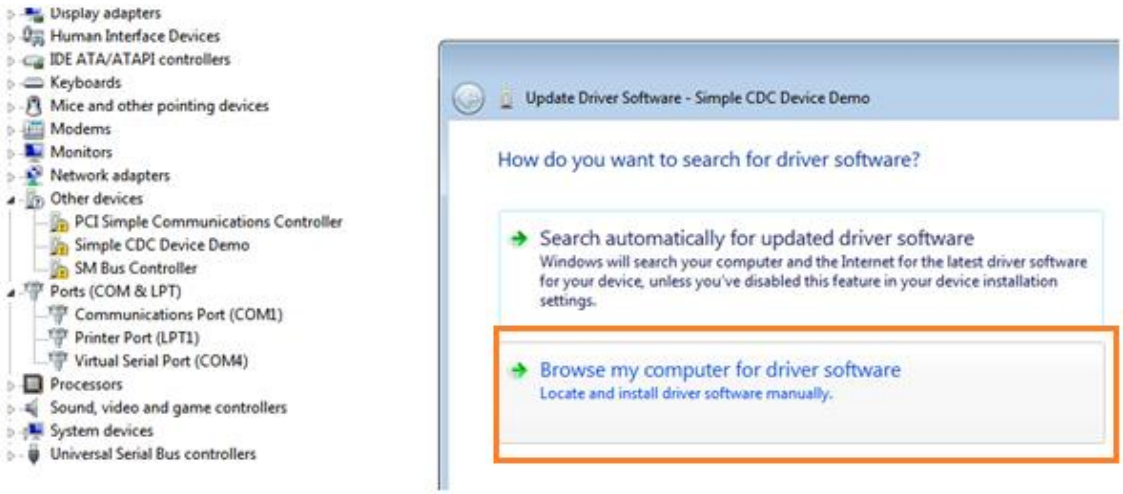
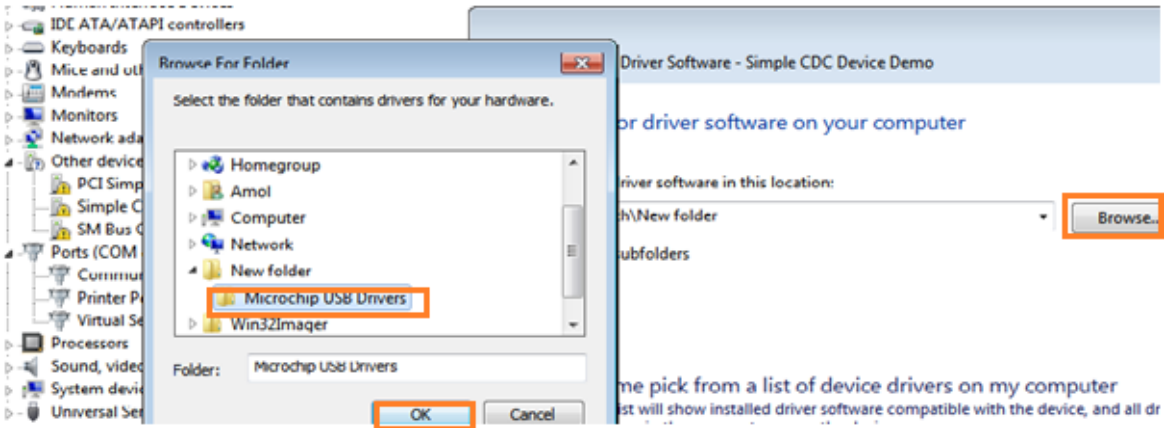
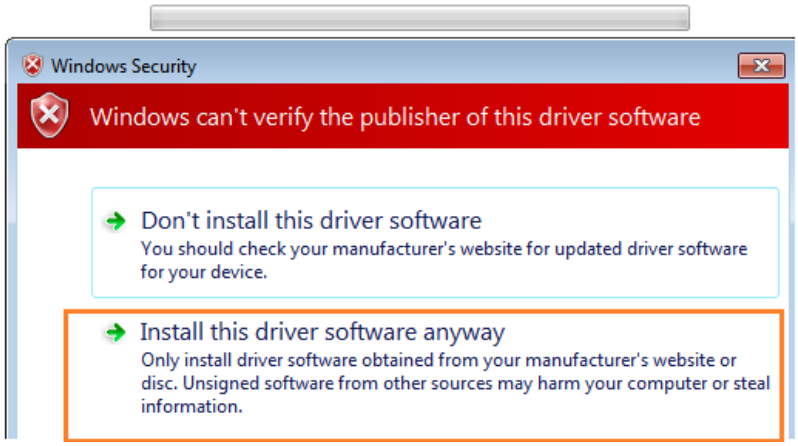


6). Click on Browse my computer for driver software and select Microchip USB Driver folder path.



7). Click on install this driver software anyway.

Installing driver software...



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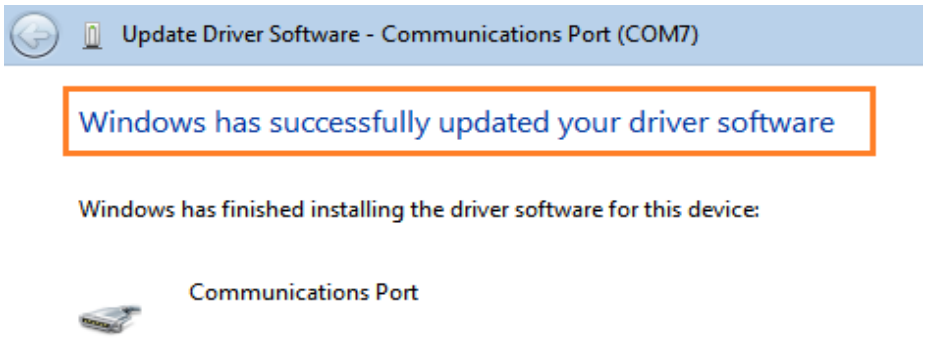
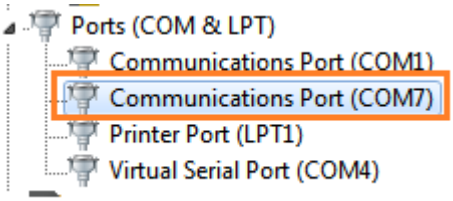
8). Verifying Driver updated Successfully.



9). Detectupdated COM Port after installation Microchip USB Driver.



10.TROUBLESHOOTING

- For troubleshooting, Mini USB connector provided on the front side of GW HM can be used to monitor communication between gateway & field devices.
- After connecting new field devices with GW HM, newly connected devices need to be configured with GW HM, discovery of new devices can be done by DIP Switch 3.
- Discovery of newly added devices can be done by updating the value of 44001 Modbus register.
- If the Hart transmitter not communicating with Hart Gateway make sure the connection and Loop current.