Application Note

PROFINET to Modbus RTU Gateway

OVERVIEW

Industrial communication protocols are used to establish a client-server or master-slave communication between industrial automation devices, such as Programmable Logic Controllers (PLC), Remote Terminal Unit (RTU), Distributed Control Systems (DCS) and Human Machine Interfaces (HMI). For industrial automated applications, there are many industrial Ethernet communication protocols, such as Modbus TCP, EtherNet/IP and PROFINET.

As new protocols are created, it becomes more and more difficult for various devices to communicate with each other and form a cohesive system. The SignalFire Gateway natively communicates over Modbus RTU or Modbus TCP, but may need to be converted to another protocol to communicate with a master device.

PROFINET is an Ethernet communication protocol created by Siemens for high-speed data transfer. This document describes how to configure a Phoenix Contact PROFINET Gateway to integrate your SignalFire network into your Siemens system. It is assumed the reader is familiar with SignalFire

Within SignalFire's 900MHz RF system, it polls the remote sensors and IO modules configured within the network and stores its measurement information within the gateway's memory registers. Due to our Gateway being a slave device, as it was designed, a master Modbus device will need to be added to the Modbus network to interrogate these registers. There are two data exchange options to collect this data from the wireless system. The first option is for a Modbus Master to read and/or write to registers within each remote wireless node directly. This is called "Transparent Modbus" mode. Within this mode, a Modbus Master can read and write directly to and from the nodes over the wireless network. The other option allows a Modbus Master to access registers from the Gateway. This mode is called "Pre-Configured Register Set" mode using the "Slave Register Remapping" feature. It allows register mapping of up to 750 registers from remote sensors and IO modules to be stored in the gateway's memory. In comparison to the first mode, Transparent Modbus, this gateway's Pre-Configured Register Set mode using the Slave Register Remapping feature is more efficient because it reads or writes a large chunk of registers to and from the gateway rather than using more of the network's bandwidth to individually read and/or write message requests to each individual wireless node.

MATERIAL USED

SignalFire Gateway
SignalFire USB-to-Serial cable
Siemens S7-1200 Controller (P/N: 6ES7 214-1BG31-0XB0)
Phoenix Contact PROFINET Gateway (PN GW) (P/N: GW PN/MODBUS 1E/1DB9)
Ethernet Switch

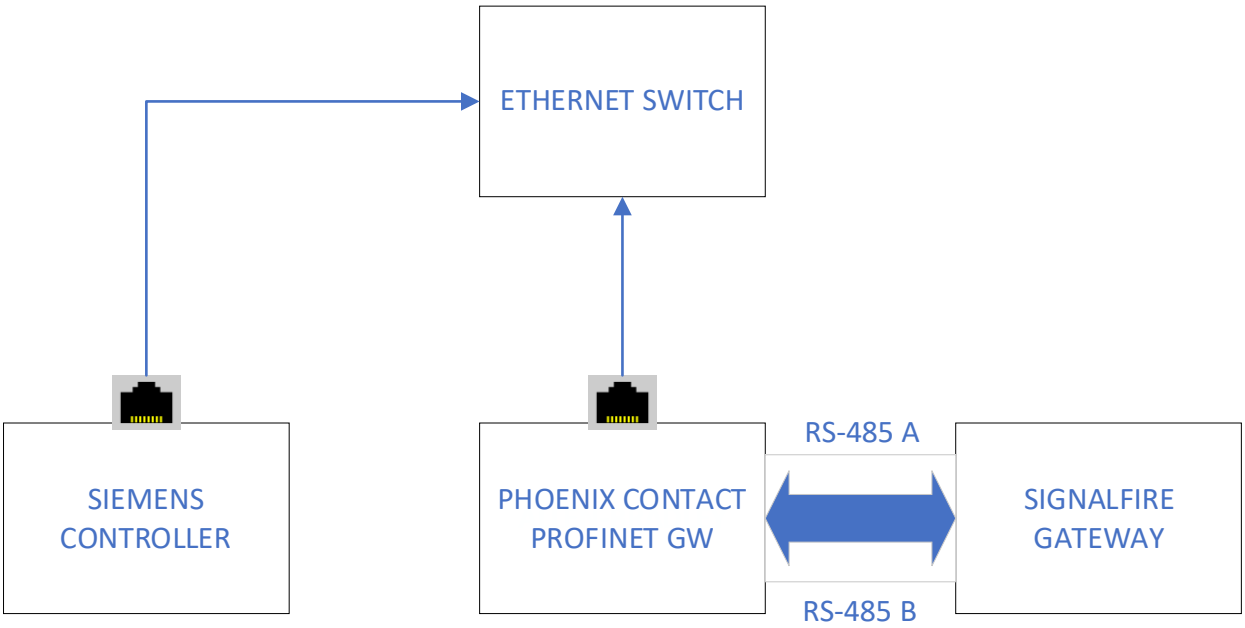

Figure 1

NOTE The 'A' and 'B' lines need to be swapped between the Phoenix Contact and Gateway. All devices in this system can take 24VDC for power.

Depending on your network settings, you may have to change your computer's IP address. The computer had its IP settings changed as follows:

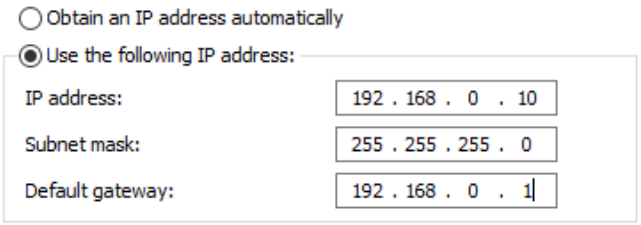

Figure 2

Click here to download configuration files

PROCEDURE

SignalFire Gateway Slave Register Remapping Configuration

Set up the SignalFire network with its nodes as needed. Keep in mind that every SignalFire node needs to have the same Radio Network, Radio Network Group, and Encryption Key as the Gateway to connect to it, but must each have a unique Slave ID. Refer to either the Gateway manual or the Quick Startup Guide for putting together a SignalFire network.

Each node that checks into the Gateway will have its own Slave ID, cache its registers at the Gateway, and can be addressed individually. While this is a valid way to pull information from the network, it is far more efficient and flexible to use the Gateway's Slave Register Remapping system. That allows the user to access only the registers needed and pull them all from the Gateway's Slave ID (default 247).

Go to Settings → Slave Register Remapping, and type in the Slave ID's and addresses of the registers needed in the Siemens PLC. Click "Write to GW" to set them in memory. There are 750 Remapped Addresses ranging from register 5000 through 5749. In Figure , each node's battery voltage register is remapped to the Gateway.

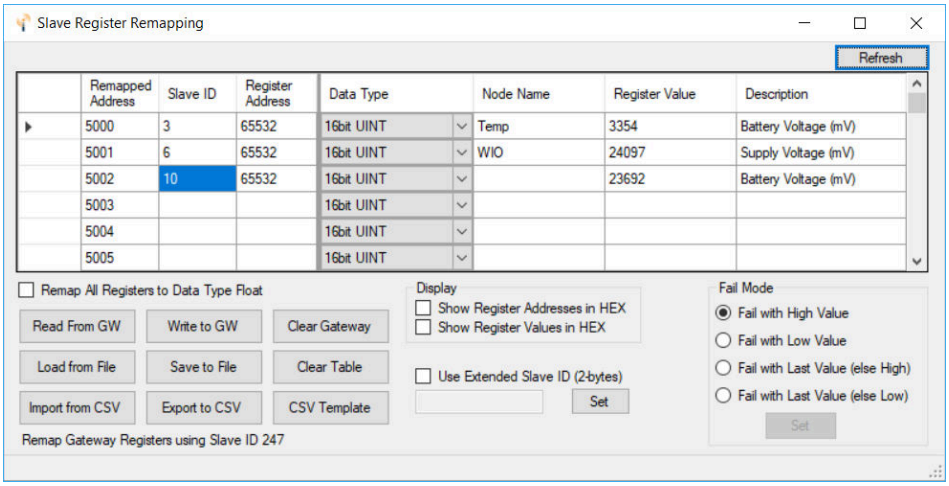

Figure 3

PROFINET Gateway Configuration

Power up the PROFINET Gateway (PN GW), wire its DB9 port to the Modbus RTU network, and its Ethernet port to an Ethernet switch as shown in Figure. From a Browser, type in the IP address of the PN GW and a window will pop up to enter the default username (Admin) and password (admin). Go to the Serial Settings tab and set the Serial Port Configuration to the settings in Figure 4. This will allow the PN GW to communicate on the same Modbus RTU RS485 network as the SignalFire Gateway.

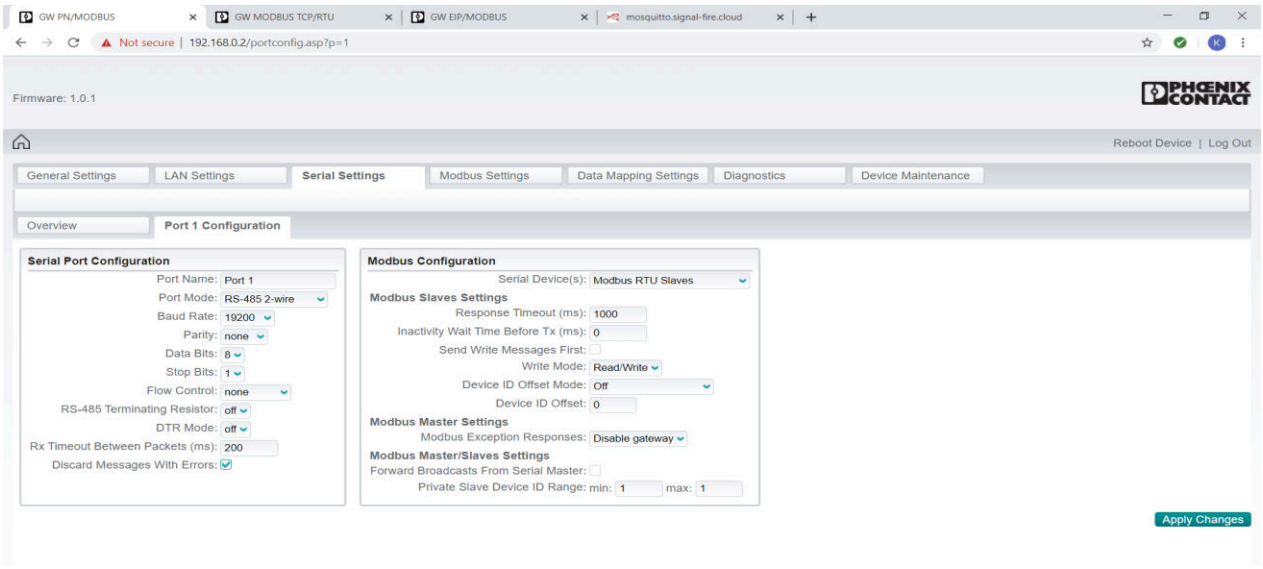

Figure 4

The PN GW communicates with RS-485 to the SignalFire Gateway, so its communication parameters need to match. Make sure the Baud Rate, and Data/Parity/Stop bits of the Phoenix PN (seen above) match those same parameters for the SignalFire Gateway; the Gateway's settings can be found in the bottom left of its ToolKit configuration window. The default setting is 9600-8N1.

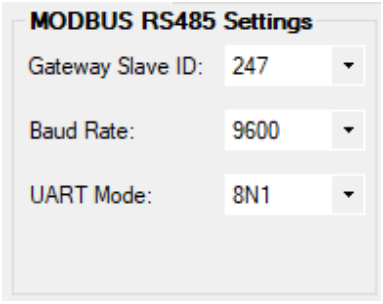

Figure 5

The next step is to configure the PN GW data to be mapped between the Modbus network and the PROFINET network. This section is where the Modbus data is mapped. Select the "Data Mapping Settings" tab then select the "Modbus to Modbus" as shown in Figure 6.

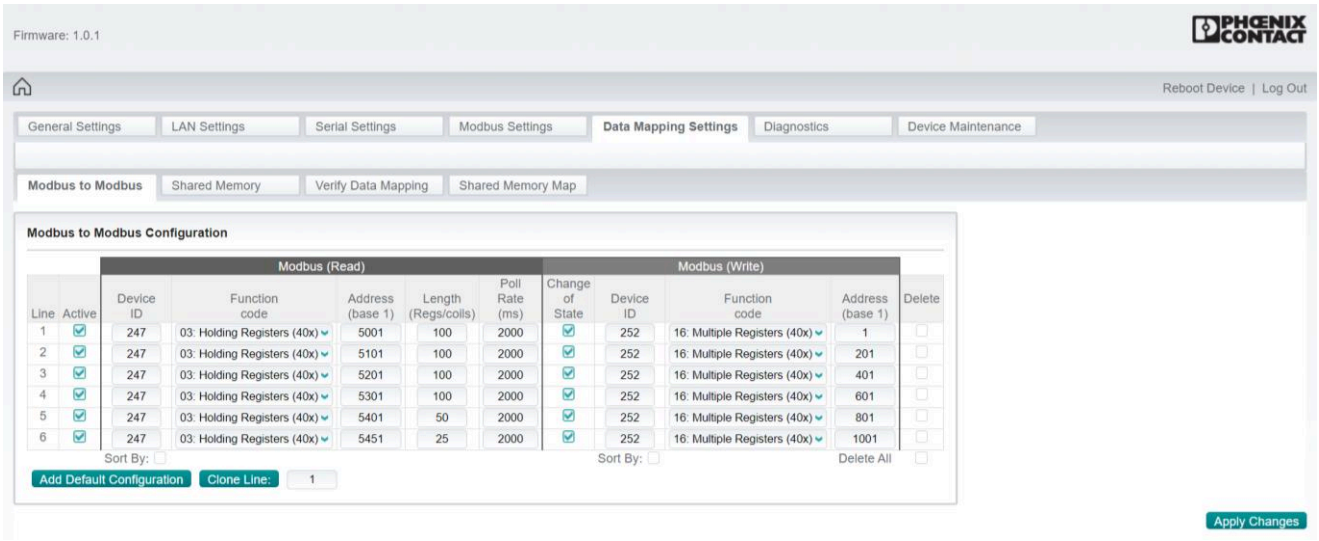

Figure 6

The left side of the panel is the entry for which registers to read off the SignalFire Gateway. Specify the Slave ID (247 for the Gateway), the function code (03 Holding Registers), starting address, and number of consecutive addresses to read from that starting address.

There is an offset of 1, so a starting address of 5001 in the Ethernet/IP will actually correspond to an address of 5000. Modbus protocol also has a 125-register limit for a single read, so break up reads into smaller sections if more than 125 registers are needed from any one Slave ID.

As mentioned earlier in this application note, the Siemens S7-1200 memory is limited to 475 because of the memory of this small controller where other larger controller can provide up to 720 registers which is a limit of PROFINET.) On the Modbus (Write) section of this configuration window, enter in the Modbus array of the length of 100 for registers as a Modbus Function Code 16 for a multiple register write. After all of this data is entered, select “Apply Changes” button on the bottom right of the configuration window.

The next step is to configure the shared memory portion of the PN GW. This is the section of the PN GW where the PROFINET data is mapped. First, it must be enabled and the Shared Memory Device ID set to 252. Within six of the eight Blocks of Shared Holding Registers must be configured as shown within the figure below. For example, set the first Block to have an Address Range of 1-200, PNIO Read Enabled, Write Master(s): Modbus to Modbus and Description: 200 holding registers.

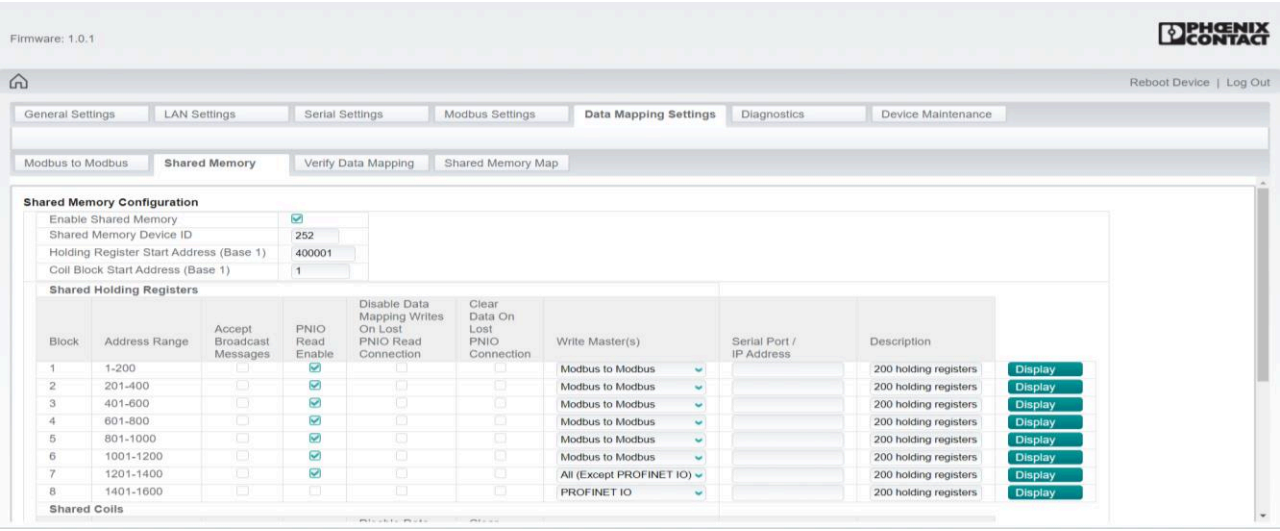

Figure 7

After all of the data is entered, select “Apply Changes” button on the bottom right of the configuration window. Once this is complete the PN GW is configured.

Siemens S7-1200 GSDML & PROFINET Network Configuration

Follow the directions of Section 5 of the PC-QRG_918_EN_01_GW-PN-MODBUS-with-TIA-Portal document (link to download). It will instruct one to create a new project within TIA Portal,

configure the PROFINET network, download the GSDML file and assign the IP addresses of the controller & PN GW. Within the module configuration section 5.3 of this document, refer to it as an example but follow the next section of this application note.

Configure the head modules and submodules of the PN GW GSDML within the TIA Portal software as shown in Figure 8. To view the slots for reading and writing holding registers or coils, navigate to the Device View tab. Insert the modules into slots 1.1 through 1.6. On the right pane of the TIA Portal, navigate to the Hardware Catalog and open the Modules folder. Select coils or holding registers to read or write the data. Click and drag the selected module to the first slot in the device view which is the middle top pane. Next, open the Submodules folder in the Hardware Catalog. This will display the read and write options. Select the appropriate read or write option along with the number of corresponding coils or registers. Choose a length that is equal to or greater to the number of coils or registers being read or written. Drag the read or write command appropriate subslot. The subslots correspond to the Shared Memory Blocks in the PN GW. For example, subslot 1.1 corresponds to Shared Memory Block 1.

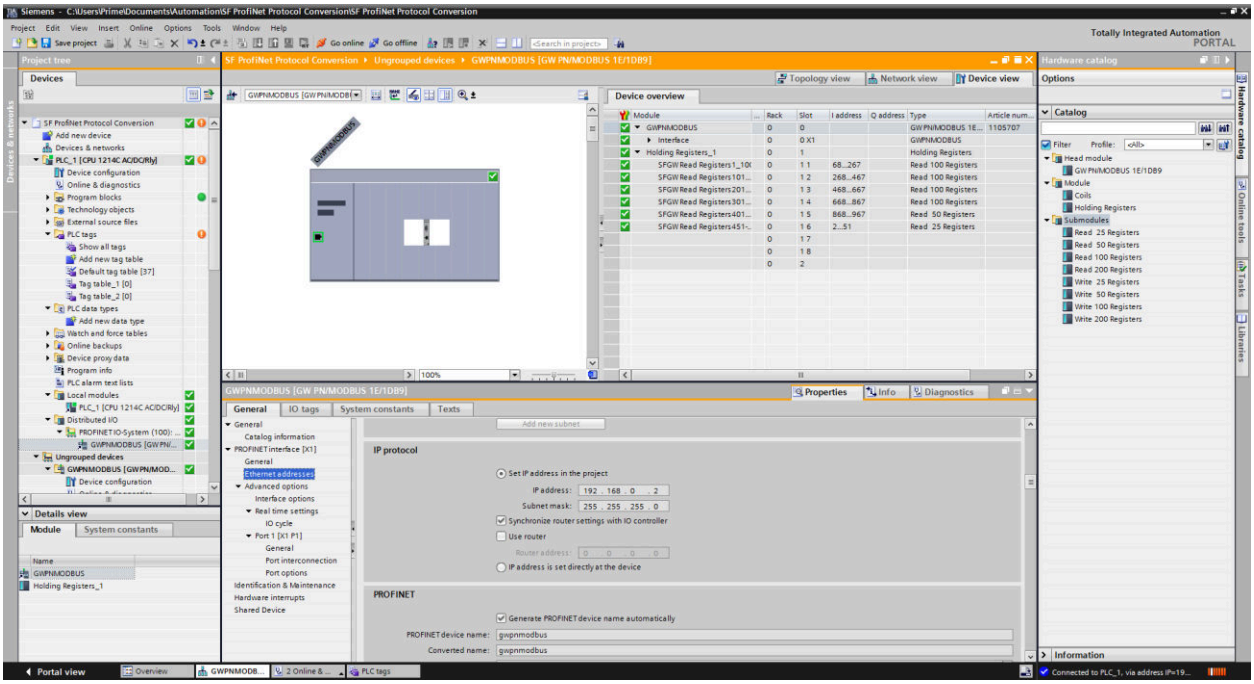

Figure 8

Assign the PROFINET device, as described within the section 5.4 of the document referred to earlier and download the program. During this process, the program is downloaded to the controller and the PN GW. Both of GSDML subslots of the automation controller and the PN GW Shared Memory Blocks become synchronized. If these PROFINET network configurations are not synchronized correctly, the TIA Portal software will provide tips for assistance.

Siemens S7-1200 Tag Configuration

To configure the PROFINET tags within a TIA Portal program, go to the Project tree under the Device tab, select the PLC>PLC tags>Default tag table, then double click it. Go to Default tag table window and select the last row where it states <Add new>. Type in the tag description, select Word for Data Type and the address of the subslot, which is the data needed to monitor. The three SignalFire registers configured within the Slave Remapping Table with the SF Gateway are configured and listed within this tag table. The other tags configured within this table are the first tag of each subslot/Shared Memory Blocks used as a test of viewing data from each subslot/Shared Memory Block. These tags are shown in Figure 9.

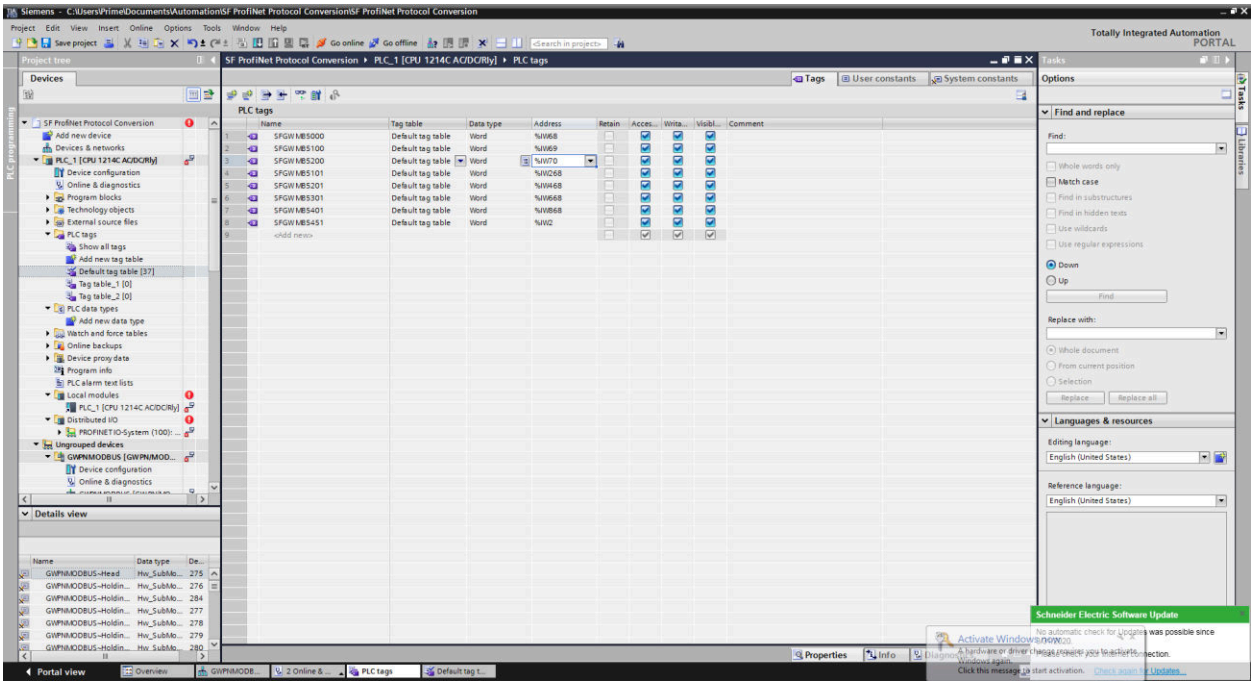

Figure 9

To view the data online, connect to the PLC and select the “Monitor all” icon at the top of this Default Tag Table. In Figure 10, the data for the first three tags show the Source Voltage values read from the SignalFire Gateway in hexadecimal format. The other tags are shown as 16#FFFF Hex (65535 Decimal), automatically inserted by the SF Gateway when a register is not configured.

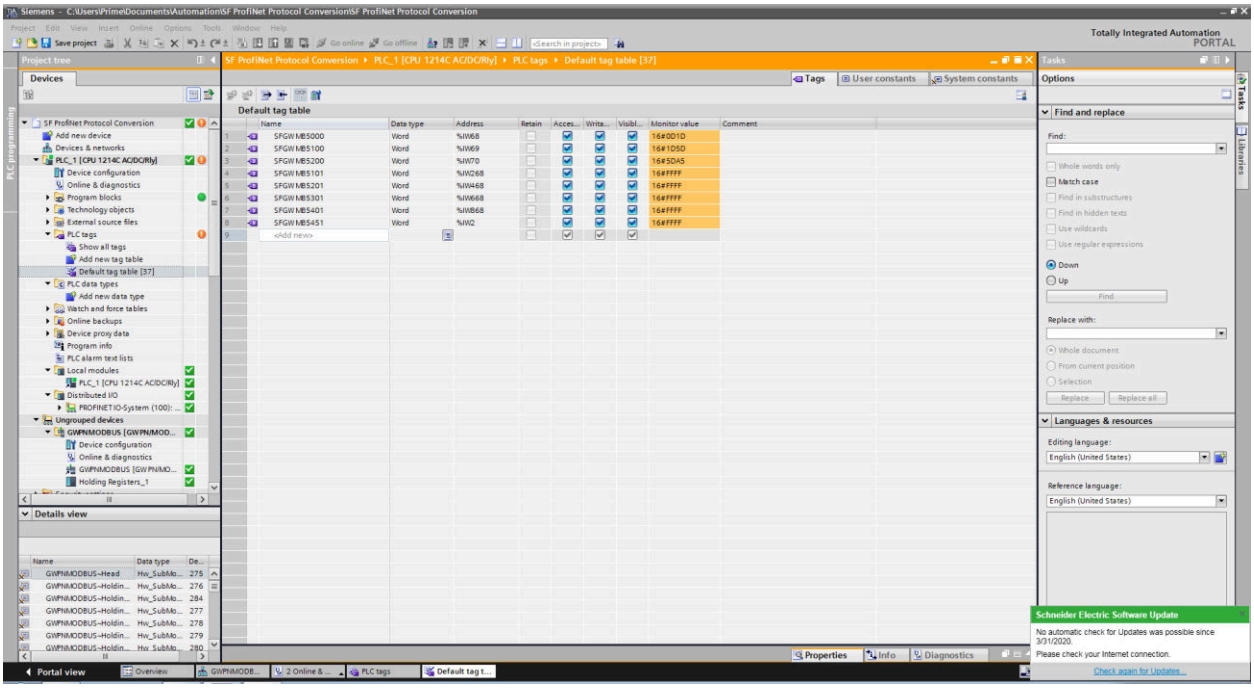
Siemens - C:\Users\Prime\Documents\Automation\SF ProfiNet Protocol Conversion\SF ProfiNet Protocol Conversion
Totally Integrated Automation
PORTAL
Project tree
Devices
SF ProfiNet Protocol Conversion ▸ PLC_1 [CPU 1214C AC/DC/Rly] ▸ PLC tags ▸ Default tag table [37]
Tags
User constants
System constants
Default tag table
Name
Data type
Address
Retain
Acces...
Write...
Visibl...
Monitor value
Comment
SFGW MBS000
SFGW MBS100
SFGW MBS200
SFGW MBS101
SFGW MBS201
SFGW MBS301
SFGW MBS401
SFGW MBS451
Word
%IW68
%IW69
%IW70
%IW268
%IW468
%IW668
%IW868
%IW2
16#0D1D
16#1DS0
16#5DAS
16#FFFF
<Add new>
Details view
Tasks
Options
Find and replace
Find:
Whole words only
Match case
Find in substructures
Find in hidden texts
Use wildcards
Use regular expressions
Down
Up
Find
Replace with:
Whole document
From current position
Selection
Replace
Replace all
Languages & resources
Editing language:
English (United States)
Reference language:
English (United States)
Schneider Electric Software Update
No automatic check for Updates was possible since 3/31/2020.
Please check your Internet connection.
Check again for Updates...
Properties
Info
Diagnostics
Portal view
Overview
PLC tags
Default tag t...

Figure 10

Online System Verification and Diagnositcs

To view Modbus communication across the RS-485 line, click on the “RS485 Modbus Details” button, and a transmission log will pop up. Figure 11 is the SignalFire Toolkit menu for a Gateway with the three nodes communicating. It is displaying each of the 125 register array requests with a message of “SUCCEEDED” in green.

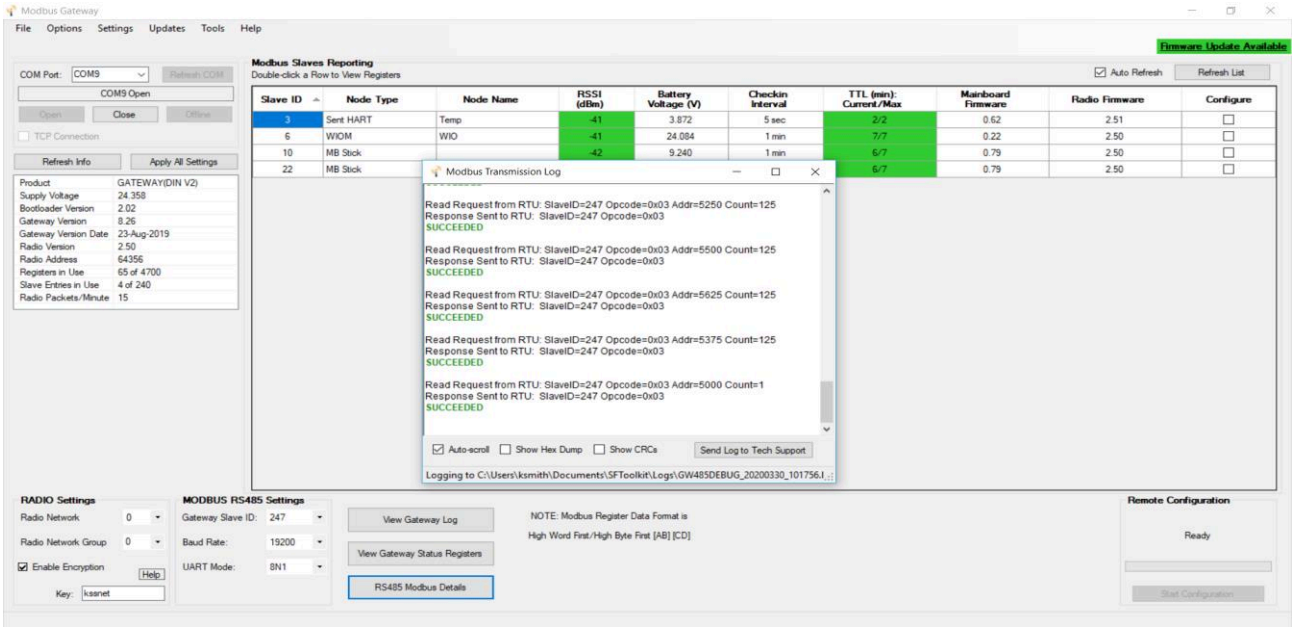

Figure 11

The data being polled was configured within the SignalFire Gateway’s Slave Register Remapping shown in Figure 12. The Slave Register Remapping window can be accessed by going under Settings.

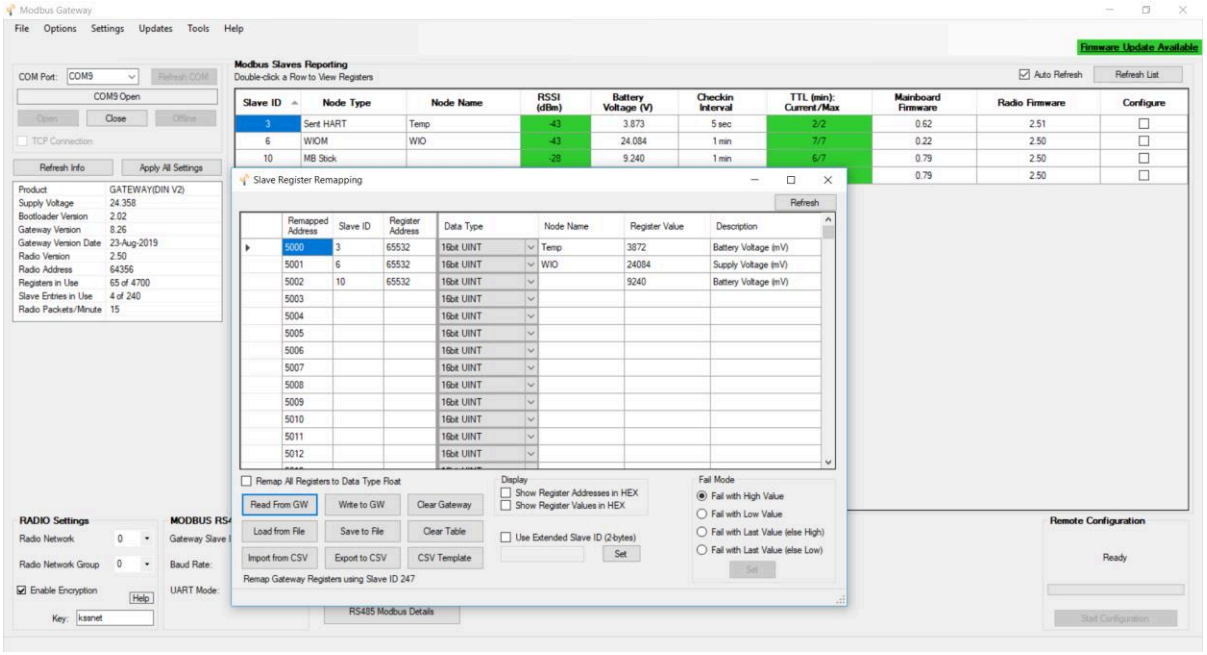

Figure 12

Within the PN GW, there are diagnostics options to view serial statistics and logs and others for Modbus and PROFINET. These diagnostics snapshots are shown in the Figures 13-16.

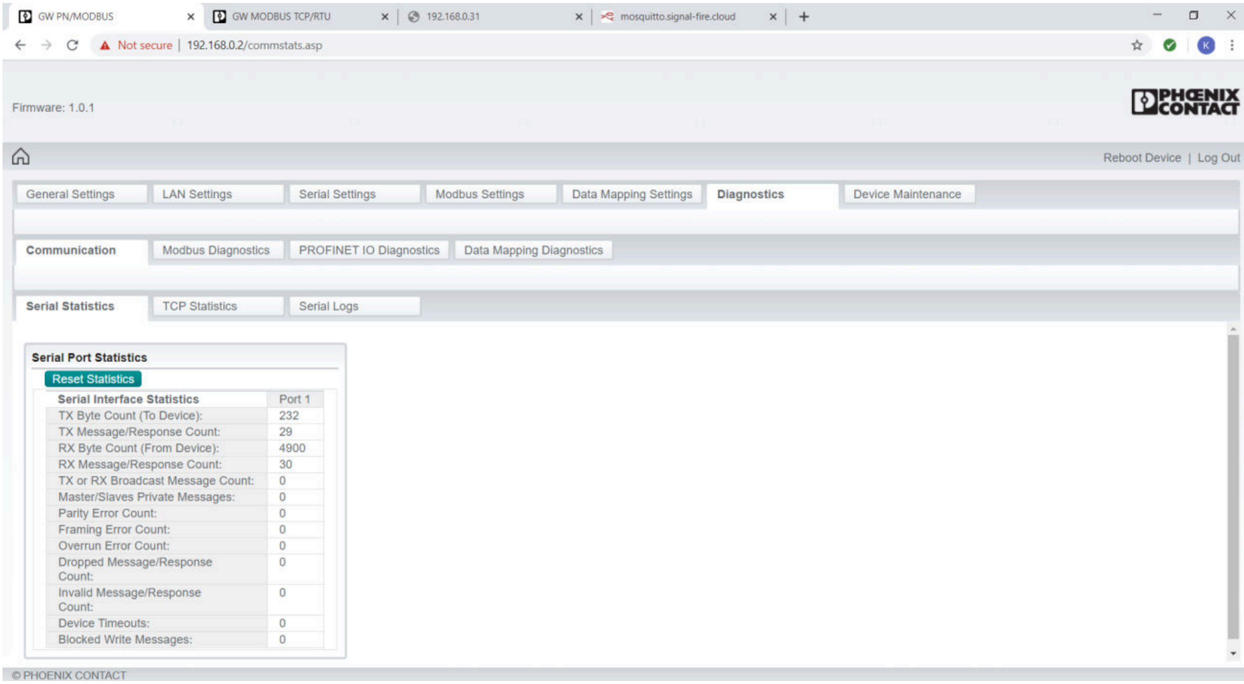

Figure 13

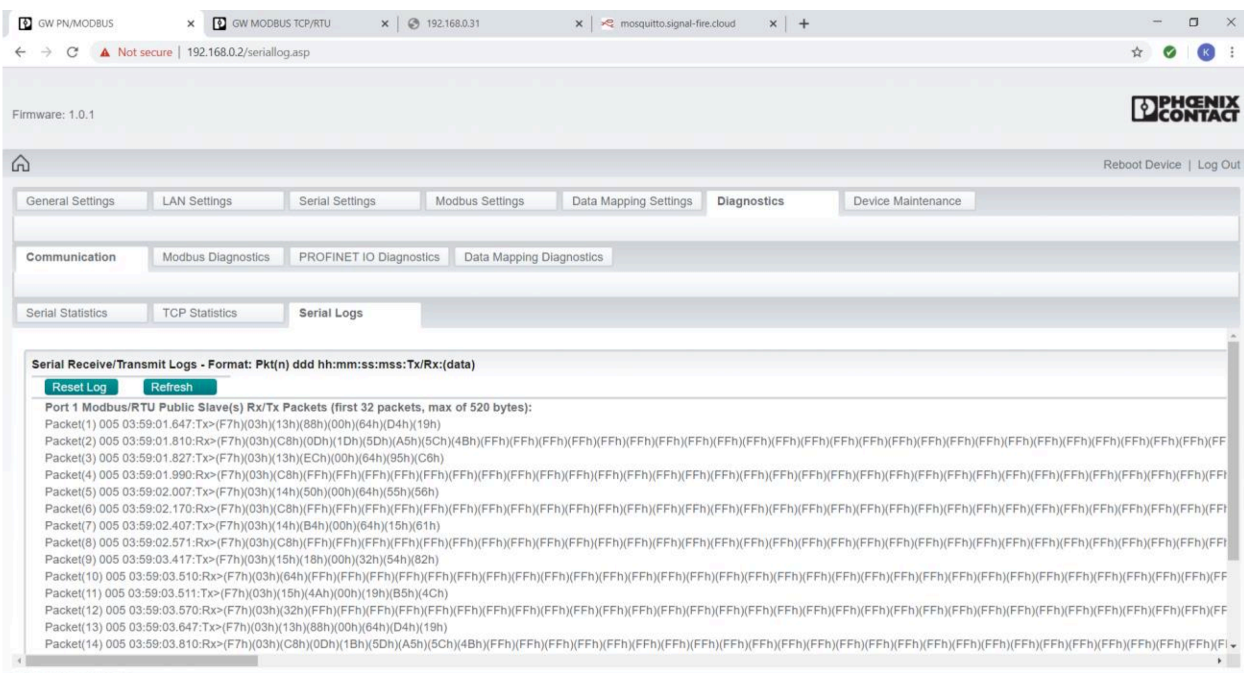

Figure 14

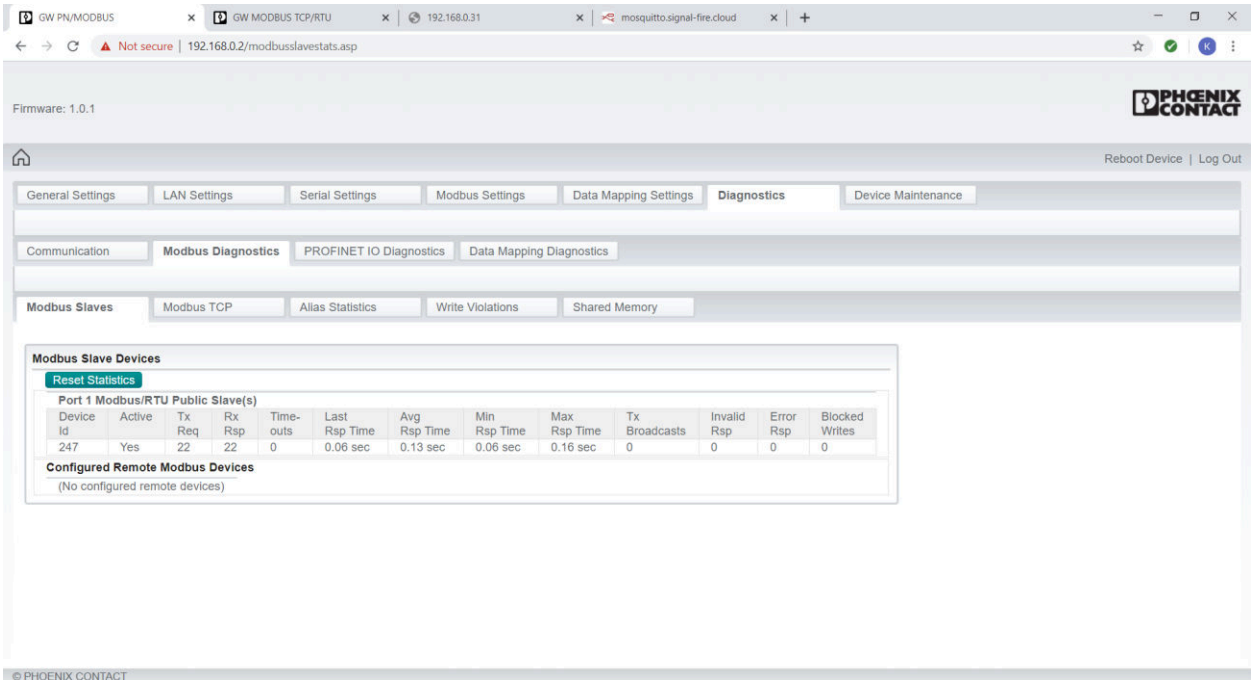

Figure 15

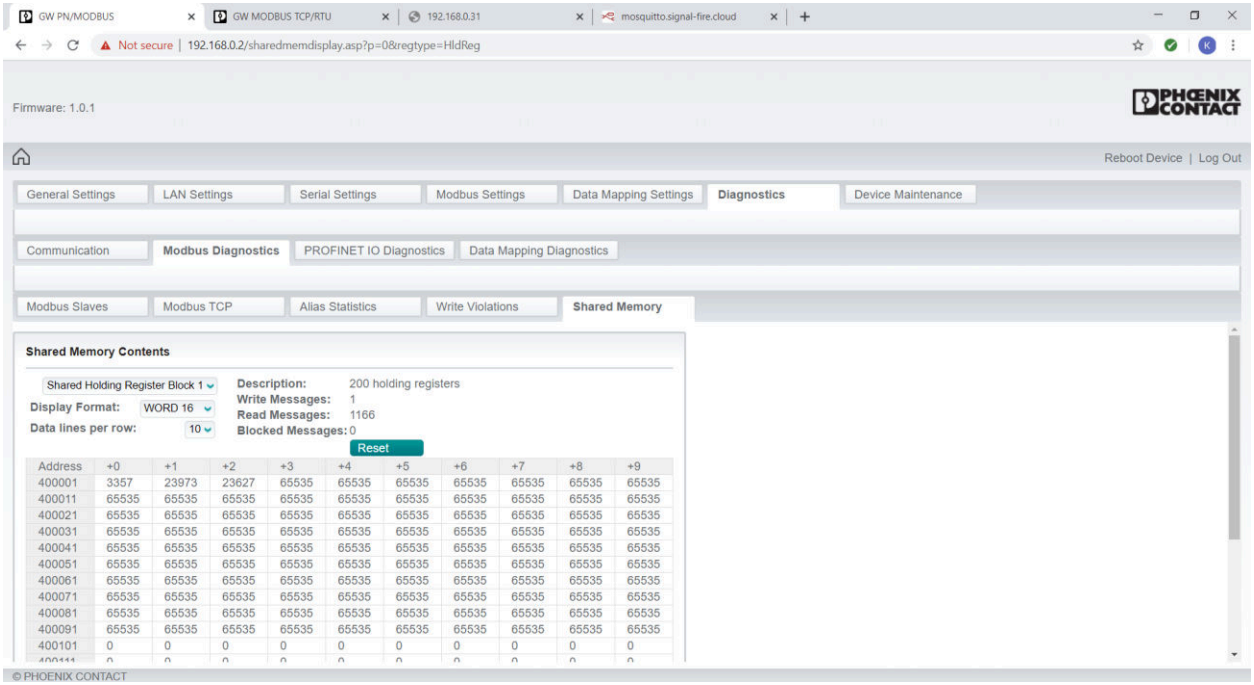

Figure 16

Conclusion

The PN GW is the least complicated PROFINET-to-Modbus-RTU Gateway to setup and has the most diagnostics to assist troubleshooting issues on the market. To speed the configuration of this gateway up, SignalFire has made configuration files available online (click here to download). The files include configuration for the PN GW, the six subslots of the PN GW GSDML for a Siemens S7-1200 PLC TIA Portal, and another two files for larger Siemens PLCs.

To get an PROFINET Gateway up and running, the major steps are as below.

1) Load the Phoenix Contact Phoenix Contact PROFINET to Modbus RTU Gateway configuration files
2) Download the SignalFire Gateway PROFINET to Modbus RTU TIA Portal PLC Controller file into your S7-1200 PLC. NOTE: The TIA Portal PLC program may need to be modified per the specific automation controller used plus the GSDML may need to be added.
3) Configure the addresses from each wireless node on a SignalFire Gateway into the Slave Register Remapping table.