

4310 / 4320 Wireless Position Monitor Modbus® System Integration Guide

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This document will guide you through configuring Modbus parameters that pertain to the 4310 and 4320 wireless position monitor.

For detailed information on the 4310 or 4320 wireless position monitor refer to the appropriate instruction manual, available at www.fisher.com or your Emerson Process Management sales office.

4310 Wireless Position Monitor Instruction Manual (D103391X012)

4320 Wireless Position Monitor Instruction Manual (D103392X012)



Introduction

The Smart Wireless Gateway enables IEC62591 WirelessHART®, wireless self-organizing devices to communicate with each other, and manages security and connectivity. The Gateway is the entry point for wireless device data that is then converted to a format that is compatible with other systems. System integration is possible with Modbus, OPC, or TCP/IP via Ethernet or serial connections. This document focuses on Modbus system integration for the 4310/4320 wireless position monitor.

Modbus Interface

The Smart Wireless Gateway can communicate with the host system using the Modbus protocol. There are two communication options available, serial or TCP/IP. The Modbus RS485 serial interface supports data rates from 9600 bps to 57600 bps. Modbus TCP/IP integration is available using the Ethernet interface.

Communication Specifications

RS485

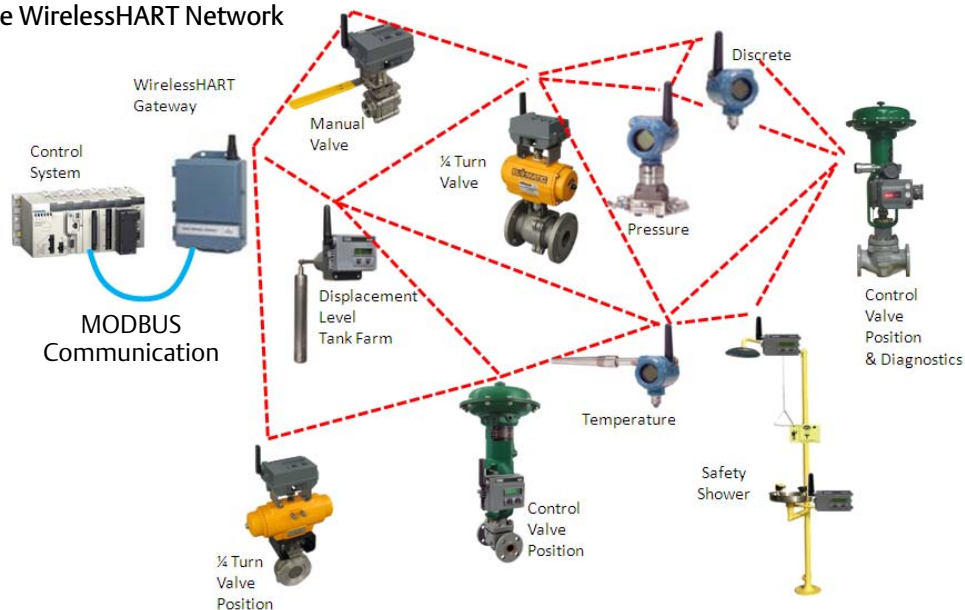
- 2-wire communication link for Modbus multidrop connections.
- Baud rate: 57600, 38400, 19200, or 9600
- Protocol: Modbus RTU
- Wiring: Single twisted shielded pair, 18 AWG. Wiring distance is approximately 5,000 ft. (1,524 m)

Ethernet

- 10baseT/ 100base-TX Ethernet communication port,
- Supports Modbus TCP/IP with 32 bit floating point values.
- Scaled integers are supported with Modbus TCP/IP.

Refer to the Smart Gateway Reference Manual (00809-0200-4420) for cabling, wiring details and general Modbus communications set up.

Example WirelessHART Network



Data to be Mapped

Data values (registers) from the wireless position monitor to be used via Modbus can be 32 bits per value (also called floating point) or individual bits (inputs transferred in groups of eight – also called bytes) and coils typically related to discrete outputs that connect to solenoids.

Note

Discrete outputs or coils were not available in *WirelessHART*® devices at the time this document was created.

Register Numbers	Data Type	Description
1...19999	Boolean, bit, coil, input	Two bytes (16 bits)
20000+	Floating point, or integer	Four bytes (32 bits)

Modbus Register Mapping Instructions using the Emerson Smart Wireless Gateway

To add a new data point to the Modbus register map (see figure 1 for configuration screen layout):

1. Click New entry.
2. Complete all of the table entries for the new data point (note that the entry columns may vary based on the Modbus communications settings).

Address: the Modbus RTU address used by the Gateway for this data point. It is possible to group data points assigning them the same address (i.e., all data points from the same process unit can have the same address). This column only appears if Multiple Modbus Addresses is selected on the Modbus Communications page.

Register: the Modbus register number used for this data value. Modbus registers hold two bytes (16 bits) of information; therefore 32 bit floats and integers require two Modbus registers. Each data point needs a unique Modbus register number, unless they are assigned different addresses. Register numbers 0-19999 are reserved for Boolean (bit, coil, binary, etc...) values. Register numbers 20000+ are reserved for floating point or integer values.

Point Name: a two part name for the data point. The first part is the HART Tag of the wireless field device which is producing the data. The second part is the parameter of the wireless field device. Point Name is entered as <HART Tag.PARAMETER>. Point Name can be entered manually or by using the list of values (...). The following table gives a list of standard device parameter which may be considered for Modbus register mapping.

State (state value): the value of a data point which drives a Modbus output of 1. For example, if a data point is reported as either True or False, a state value of True will report a 1 for True and 0 for False. A state of False will report a 0 for True and a 1 for False. State is only required for register numbers 0-19999 (Boolean, bit, coil, binary, etc.).

Invert: This check box will invert the Modbus output from a 1 to a 0 or a 0 to a 1. Invert is only used for Boolean values using register numbers 0-19999.

3. Repeat for each new data point.
4. Click Submit.
5. When changes have been accepted, click Return to form.

Figure 1. Configuration Screen



HART Tag

Locate the HART tag of the field instrument to map Modbus data.

Click on Explorer on the left side, as shown in figure 2, then identify the appropriate tag. The example shows “657” as the 4310 or 4320 instrument tag. Re-tag the device using a handheld (such as the 475 Field Communicator) or go to HART > Device.

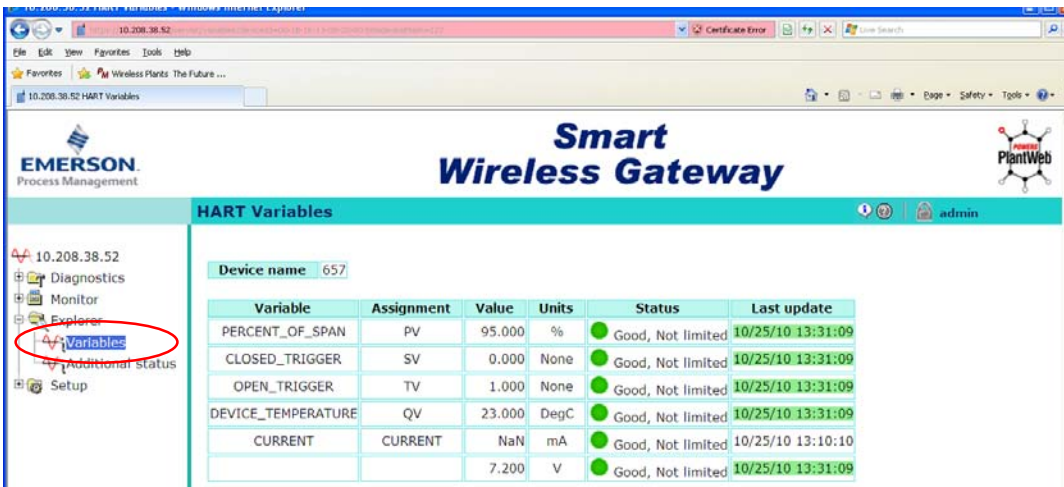
Figure 2. Smart Wireless Gateway Explorer



Standard HART Values

To determine the standard HART values to map, click on the Variables selection as shown on the left side in figure 3. Select the associated assignment values.

Figure 3. Variables



Note

Supply voltage has been assigned to variable 4 (not to be confused with QV).

Additional Status

To take advantage of other data values to be mapped, click on the **Additional status** icon on the left side of the desired tag as shown in figure 4. Select the associated assignment values as indicated in table 1 below.

Note

Values such as Bit0, Bit1, etc. with no other definition are not used by the wireless position monitor.

Figure 4. Additional Status

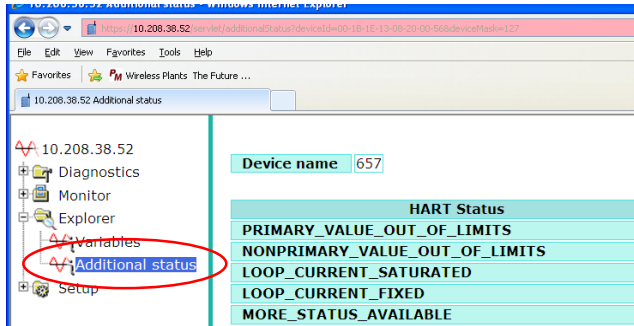


Table 1. Additional Status

HART Status	Additional Status 2	Additional Status 5	Standardized Status 1
PRIMARY_VALUE_OUT_OF_LIMITS	Bit 0	Bit 0	Bit 0
NONPRIMARY_VALUE_OUT_OF_LIMITS	Bit 1	Bit 1	Bit 1
LOOP_CURRENT_SATURATED	Bit 2	Bit 2	Bit 2
LOOP_CURRENT_FIXED	Bit 3	Bit 3	Bit 3
MORE_STATUS_AVAILABLE	Bit 4	Bit 4	Bit 4
COLD_START	Bit 5	Bit 5	Bit 5
CONFIGURATION_CHANGED	Bit 6	Bit 6	Bit 6
DEVICE_MALFUNCTION	Bit 7	Bit 7	Bit 7
			Analog channel saturated
Additional Status 0	Additional Status 3	Extended Status	Standardized Status 2
POSITION_SENSOR_LIMITED_LOW	Bit 0	MAINTENANCE_REQUIRED	SUBDEVICE_LIST_CHANGED
POSITION_SENSOR_LIMITED_HIGH	Bit 1	DEVICE_VARIABLE_ALERT	DUPLICATE_MASTER_DETECTED2
VALVE_CLOSED_ALERT	Bit 2	CRITICAL_POWER_FAILURE	Bit 2
VALVE_OPEN_ALERT	Bit 3		Bit 3
TEMPERATURE_LIMITED_HIGH	Bit 4		Bit 4
TEMPERATURE_LIMITED_LOW	Bit 5		Bit 5
LCD_TEMPERATURE_ALERT	Bit 6		Bit 6
CYCLE_COUNT_ALERT	Bit 7		Bit 7
Additional Status 1	Additional Status 4	Operating Mode	
EVENT_LOG_NOT_EMPTY	Bit 0	Standardized Status 0	Standardized Status 3
BATTERY_WARNING_GETTING_LOW	Bit 1	SIMULATION_ACTIVE	CAPACITY_DENIED
SENSOR_MODULE_ERROR	Bit 2	NONVOLATILE_MEMORY_DEFECT	DUPLICATE_MASTER_DETECTED3
Bit 3	Bit 3	VOLATILE_MEMORY_DEFECT	BANDWIDTH_ALLOCATION_PENDING
Bit 4	Bit 4	WATCHDOG_RESET_EXECUTED	BLOCK_TRANSFER_PENDING
Bit 5	Bit 5	VOLTAGE_CONDITIONS_OUT_OF_RANGE	Bit 4
Bit 6	Bit 6	ENVIRONMENTAL_CONDITIONS_OUT_OF_RANGE	Bit 5
Bit 7	Bit 7	ELECTRONIC_DEFECT	Bit 6
			Bit 7

Configuration Examples

Example 1: Using Floating Point Data Values

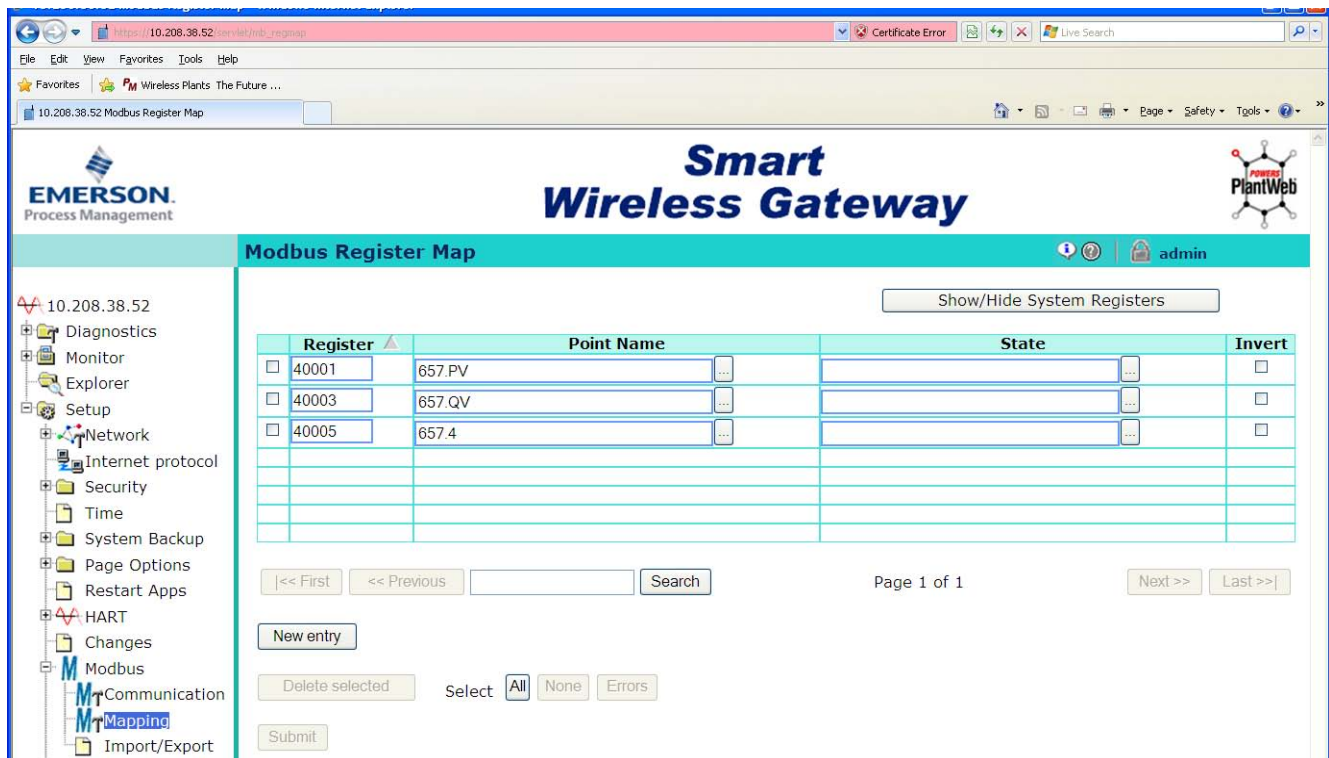
Map the following data using floating point registers in the 40001 to 50000 range:

- % of span feedback (position) tag.PV
- internal device temperature tag.QV
- power module voltage tag.4

Note

It is recommended to schedule power module maintenance when the power module warning (BATTERY_WARNING_GETTING_LOW) occurs. This is at approximately 6.5 volts at room temperature. The device contains a “remaining days left” indication that is available at the local user interface or using AMS Device Manager. This value is updated once per day and is affected by the device’s update rate plus the update rate of the number of device(s) reporting through this device as well their update rates. The critical power failure indication occurs at approximately 6.0 volts.

Figure 5. Mapping Modbus Data using Floating Point Data Values



Example 2: Using Bit Data Values with Input Registers

Map the data below using (bit values) to input registers 10001 to 19999:

Note

When using input registers (registers 10,001 through 20,000), the *tag.parameter* plus the *state* determination is required to send each value. Enter 'True' or 'False' depending on which value will be transmitted as a 1 over Modbus.

Enter a state value of True in the Modbus table and the Gateway will report a 1 whenever that parameter is true. Entering a state value of False effectively inverts the signal and the Gateway will report a 0 whenever that parameter is true.

- | | |
|--------------------------------|---------------------------------|
| • closed state | tag.VALVE_CLOSED_ALERT |
| • open state | tag.VALVE_OPEN_ALERT |
| • power module needs replacing | tag.BATTERY_WARNING_GETTING_LOW |
| • power level is critical | tag.CRITICAL_POWER_FAILURE |
| • cycle count has been reached | tag.CYCLE_COUNT_ALERT |

Note

The open and closed alerts are disabled by default in firmware revision 1 of the 4310/4320 wireless position monitor . Refer to page 10 for additional information.

It is recommended to schedule power module maintenance when the power module warning (BATTERY_WARNING_GETTING_LOW) occurs. This is at approximately 6.5 volts at room temperature. The device contains a “remaining days left” indication that is available at the local user interface or using AMS Device Manager. This value is updated once per day and is affected by the device’s update rate, plus the number of device(s) reporting through this device, as well their update rates. The critical power failure indication occurs at approximately 6.0 volts.

Figure 6. Mapping Modbus Data using Bit Data Values with Input Registers



Example 3: Using Byte Data Values with Input Registers

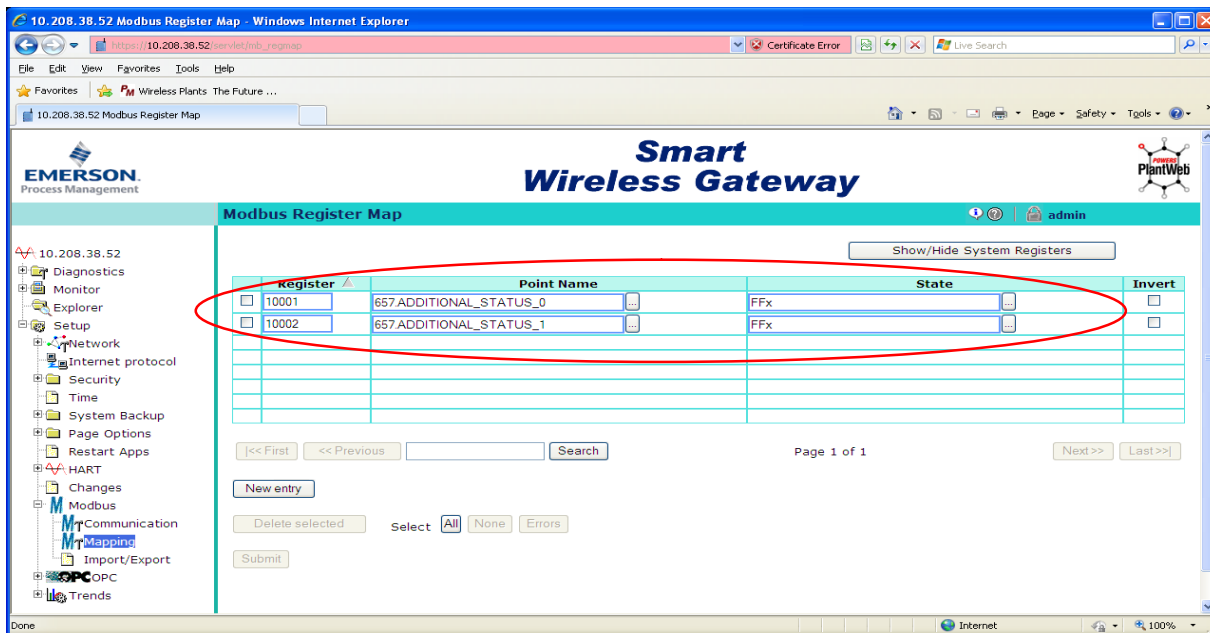
Map the data below using (bit values) to input registers 10001 to 19999. This is similar to example 2, however, this example uses two registers, the minimum number of registers allowable. The State field requires a two digit hexadecimal number ending in x; it is recommended to use FFx to send all bits to the PLC.

- Located in tag.Additional Status 0: data starting with bit 0 from top to bottom in each section
- Located in tag.Additional Status 1:

Additional Status 0		Bit	Hexadecimal	Binary
POSITION_SENSOR_LIMITED_LOW		0	0	0
POSITION_SENSOR_LIMITED_HIGH		1	1	1
VALVE_CLOSED_ALERT		2	10	10
VALVE_OPEN_ALERT		3	11	11
TEMPERATURE_LIMITED_HIGH		4	100	100
TEMPERATURE_LIMITED_LOW		5	101	101
LCD_TEMPERATURE_ALERT		6	110	110
CYCLE_COUNT_ALERT		7	111	111

Additional Status 1		Bit	Hexadecimal	Binary
EVENT_LOG_NOT_EMPTY		0	1010	1010
BATTERY_WARNING_GETTING_LOW		1	1011	1011
SENSOR_MODULE_ERROR		2	1100	1100
			1101	1101
			1110	1110
			1111	1111

Figure 7. Mapping Data using Bit Data Values with Two Input Registers



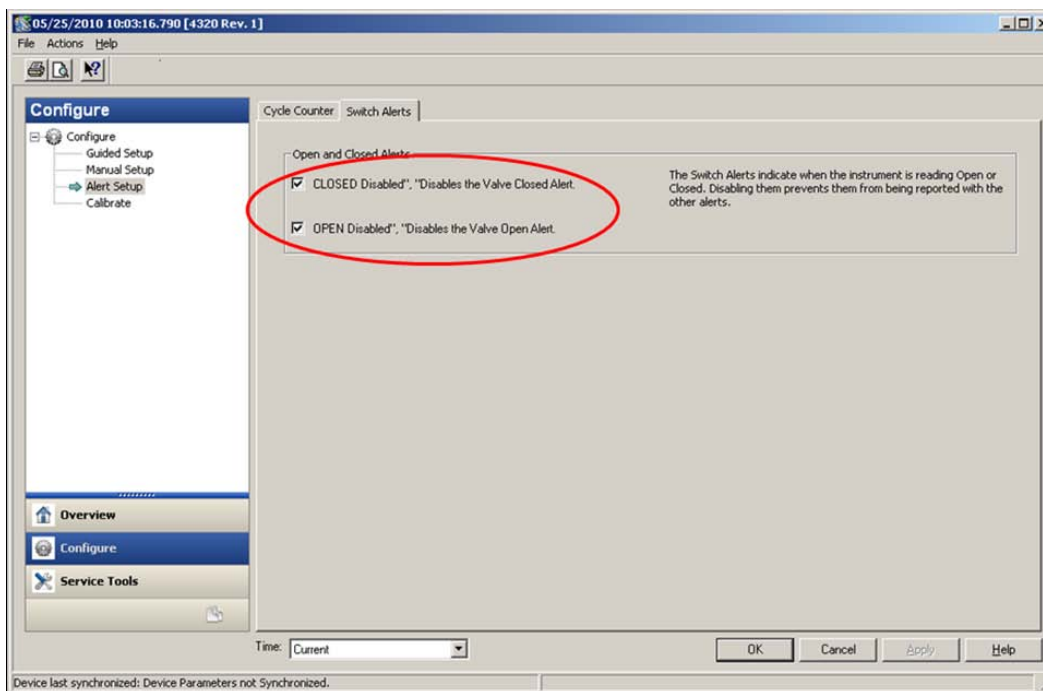
Open /Closed Alert Note

Note

Open and closed alerts are disabled by default in firmware revision 1 of the 4310/4320 wireless position monitor.

To enable open and closed alerts, use AMS Device Manager to open the wireless position monitor. Select Configure > Alert Setup > Switch Alerts.

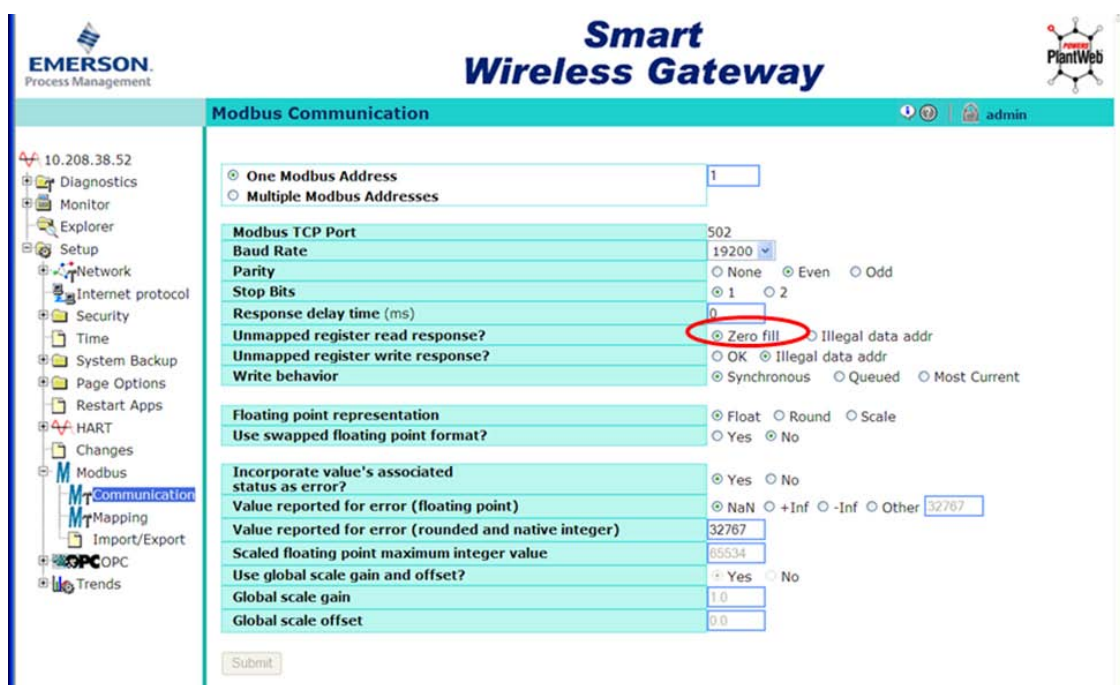
Figure 8. Enabling Open and Closed Alerts



Zero Fill Application Note

When developing the Modbus map in the 1420 gateway, you may want to leave room in the tables for future devices. The key is how the host system configures the Modbus data sets. A data set asks for 'y' number of registers starting at register 'x'. If any part of the data set is empty or broken, the request fails. The Gateway can fill these empty holes with zeros if configured properly. Go to Setup > Modbus > Communications and select 'Zero fill' for unmapped register read response. The other option is to create multiple data sets for each group of registers you have created.

Figure 9. Select Zero Fill



Example Modbus Table

Field Instrumentation Parameters	Register	State	TAG DCS	Comments
XV_1.VALVE_CLOSED_ALERT	10001	True	XV_1_ZSL	2 input registers used per monitored device for the open/closed alerts.
XV_1.VALVE_OPEN_ALERT	10002	True	XV_1_ZSH	
XV_2.VALVE_CLOSED_ALERT	10003	True	XV_2_ZSL	
XV_2.VALVE_OPEN_ALERT	10004	True	XV_2_ZSH	
702_1.BIT_1	10005	True	702_1_ZSL	
702_1.BIT_2	10006	True	702_1_ZSH	
XV_1.DEVICE_MALFUNCTION	10201	True	XV_1_X	1 input register used per monitored device for alerting when device needs maintenance soon.
XV_2.DEVICE_MALFUNCTION	10202	True	XV_2_X	
702_1.DEVICE_MALFUNCTION	10203	True	702_1_X	
TT_1.DEVICE_MALFUNCTION	10204	True	TT_1_X	
PT_1.DEVICE_MALFUNCTION	10205	True	PT_1_X	
XV_1.BATTERY_WARNING_GETTING_LOW	10301	True	XV_1_QSL	1 input register used per monitored device for alerting when power module servicing needed.
XV_2.BATTERY_WARNING_GETTING_LOW	10302	True	XV_2_QSL	
702_1.SUPPLY_VOLTAGE_LOW	10303	True	702_1_QSL	
TT_1.SUPPLY_VOLTAGE_LOW	10204	True	TT_1_QSL	
PT_1.SUPPLY_VOLTAGE_LOW	10205	True	PT_1_QSL	
XV_1.CRITICAL_POWER_FAILURE	10401	True	XV_1_QSLL	1 input register used per monitored device for alerting when power module servicing needed <u>now</u> .
XV_2.CRITICAL_POWER_FAILURE	10402	True	XV_2_QSLL	
702_1.CRITICAL_POWER_FAILURE	10403	True	702_1_QSLL	
TT_1.CRITICAL_POWER_FAILURE	10204	True	TT_1_QSLL	
PT_1.CRITICAL_POWER_FAILURE	10205	True	PT_1_QSLL	
TT_1.PV	40001		TT_1_TT	Uses 2 registers each (Analog Process Value)
PT_1.PV	40003		PT_1_PT	
XV_1.4	40201		XV_1_QT	Uses 2 registers each (Analog Battery Voltage)
XV_2.4	40203		XV_2_QT	
702_1.QV	40205		702_1_QT	
TT_1.QV	40207		TT_1_QT	
PT_1.QV	40209		PT_1_QT	

Key:

Description / Use	Tag
● Position Monitor (valves)	XV_1, XV_2
● Discrete Transmitter (proximity switches)	702_1
● Temperature Transmitter	TT_1
● Pressure Transmitter	PT_1

Definition of Wireless Position Monitor Values

Value from wireless position monitor

Value from Wireless Position Monitor	Data Type	Description
PV	float	Primary variable - % of span. Only in 4320 wireless position monitor.
SV	float	Secondary variable. Open State
TV	float	Tertiary variable. Closed State
QV	float	Quaternary variable. Internal temperature in degrees C.
4	float	Power module voltage.
PRIMARY_VALUE_OUT_OF_LIMITS	bit	Feedback array problems. Check mounting and calibration.
NONPRIMARY_VALUE_OUT_OF_LIMITS	bit	Problems with temperature and other device variables not related to position or switch state.
LOOP_CURRENT_SATURATED	bit	Invalid - no loop current with wireless position monitor.
LOOP_CURRENT_FIXED	bit	Invalid - no loop current with wireless position monitor.
MORE_STATUS_AVAILABLE	bit	Set when any bit in additional status is set.
COLD_START	bit	Set until first WirelessHART message is seen.
CONFIGURATION_CHANGED	bit	Set until configuration cache in gateway has been updated.
DEVICE_MALFUNCTION	bit	Replace 4310/4320 wireless position monitor.
POSITION_SENSOR_LIMITED_LOW	bit	Feedback array problems. Check mounting and calibration.
POSITION_SENSOR_LIMITED_HIGH	bit	Feedback array problems. Check mounting and calibration.
VALVE_CLOSED_ALERT	bit	Position determined as closed.
VALVE_OPEN_ALERT	bit	Position determined as open.
TEMPERATURE_LIMITED_HIGH	bit	Temperature above 80°C.
TEMPERATURE_LIMITED_LOW	bit	Temperature below -40°C.
LCD_TEMPERATURE_ALERT	bit	Temperature below -20°C, LCD has been disabled.
CYCLE_COUNT_ALERT	bit	Number of cycle counts has exceeded configured value indicating maintenance should be conducted.
EVENT_LOG_NOT_EMPTY	bit	An event is stored in the device log.
BATTERY_WARNING_GETTING_LOW	bit	Power level below 6.5 volts. Maintenance suggested soon.
SENSOR_MODULE_ERROR	bit	Error found with position sensor sub-assembly. Replace 4310/4320 wireless position monitor.
MAINTENANCE_REQUIRED	bit	Maintenance is required, Look at other additional status areas to determine specifics.
DEVICE_VARIABLE_ALERT	bit	Set when any variable alert bit is set.
CRITICAL_POWER_FAILURE	bit	Power level below 6.0 volts. Maintenance suggested immediately.
Operating mode	byte	Not applicable for the 4310/4320 wireless position monitor.
SIMULATION_ACTIVE	bit	Not applicable for the 4310/4320 wireless position monitor.
NONVOLATILE_MEMORY_DEFECT	bit	Error found with non-volatile memory. Replace 4310/4320 wireless position monitor.
VOLATILE_MEMORY_DEFECT	bit	Not applicable for the 4310/4320 wireless position monitor.
WATCHDOG_RESET_EXECUTED	bit	Scheduled processing failed to complete in time to prevent the hardware timer from attempting to restart the instrument. Note the configuration of the device and contact the supplier. Replace 4310/4320 wireless position monitor.
VOLTAGE_CONDITIONS_OUT_OF_RANGE	bit	Power module voltage out of range. Check power module levels and replace power module.
ELECTRONIC_DEFECT	bit	Electronic fault not related to the sensor module has been detected. Replace 4310/4320 wireless position monitor.

Analog channel saturated

byte Not applicable for the 4310/4320 wireless position monitor.

SUBDEVICE_LIST_CHANGED
DUPLICATE_MASTER_DETECTED2

bit Not applicable for the 4310/4320 wireless position monitor.
bit Not applicable for the 4310/4320 wireless position monitor.

CAPACITY_DENIED
DUPLICATE_MASTER_DETECTED3
BANDWIDTH_ALLOCATION_PENDING
BLOCK_TRANSFER_PENDING

bit This device has requested an update from the gateway and was denied. Change updated rate to resolve.
bit Not applicable for the 4310/4320 wireless position monitor.
bit This device has requested an update rate from the gateway and is waiting for approval.
bit Not applicable for the 4310/4320 wireless position monitor.

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