Last Updated Oct 22, 2008

How to Configure a Modbus Interface Between Zetron SCADA Hardware and VTScada HMI software

NOTE: This document includes information from Zetron's Modbus configuration guide.

Section 1.0 Physical Equipment Setup

The typical setup herein pertains to a radio-linked Zetron 1700M base station communicating to various RTU's (1708 or 1716). The setup supports polling and report by exception (RBE). The VTScada HMI computer is connected via a 9-pin serial cable to the 1700M.

Note that many existing Zetron SCADA systems use the 1700 base station model. This model can be easily upgraded to the '1700M' (Modbus) version by upgrading a relatively inexpensive microchip. Contact Zetron for pricing and delivery.

Section 2.0 Base Station/RTU Configuration

The 1700M is set for an "Auto polling" interval of 60 minutes with RTU storage "enabled". The 1700M will poll each RTU every 60 minutes and accept any unsolicited RBE communications as well. VTScada polling tags are set for 60 second poll intervals. They poll the 1700M registers every 60 seconds for updates.

Following is an excerpt from the Zetron Modbus document;

In a Modbus system, a master device initiates queries while all other devices (slaves) supply the requested data or take the action requested. The PC or PLC is the "master" device; the M1700 controller, M1708 and M1716 RTUs are "slave" devices.

The Modbus option for the M1700 is a replacement EPROM containing code with support for the Modbus protocol. With the Modbus option installed, the M1700 will send Modbus protocol through its serial port instead of the standard Zetron RS-232 protocol. Only the M1700 "speaks" Modbus - the M1708 and M1716 RTUs communicate with their standard on-air FFSK protocol. For Modbus queries addressed to RTUs, the M1700 translates back and forth between the Modbus protocol and the RTU FFSK protocol.

Using the M1700 With Modbus

There are two ways to set up a Modbus system using the M1700 controller with the Modbus option: Polled-only and report-by-exception.

Polled-Only System

In a polled-only system, the "master" PC or PLC controls all communication in the system. When a Modbus query is sent to an RTU through the M1700 controller, the controller always translates the query to the RTU FFSK protocol and sends it out over the radio. When the RTU responds, the response is translated from RTU FFSK protocol to Modbus protocol and sent back to the master through M1700 controller's serial port.

Configuring a system as polled-only gives the master complete control over communications, particularly use of the radio channel which can be a bottleneck. Radio communications occur only when the master polls an RTU. The RTUs never transmit except in response to a poll.

There is no possibility of data collisions, which completely eliminates one cause of communication failures.

On the other hand, there is one major disadvantage to a polled-only system. The master will not be able to see changes in RTU input status that occur between polls. It only sees the current input status at the time each poll response is sent. Any RTU input changes that occur between polls are lost.

End of excerpt from Zetron Modbus document

Combined Polled and Report by Exception

The RTUs will also report by exception. Simply program it to do so. The 1700M will hold the data and VTScada will read it within 60 seconds. Setting an autopoll rate of 60 minutes provides plenty of time for polling and opportunity for RBE without congestion. In addition, the RTU detects a busy channel (COR) and holds off transmitting until the channel is clear.

Following is an excerpt from the Zetron Modbus document;

Modbus Master Requirements

Requirements for the Modbus master are as follows...

- It must support three wire (Tx, Rx, ground) RS232 serial communications at 4800 Baud, 8 data bits, no parity and 2 stop bits.
- It must have a configurable polling timeout period. The range must allow enough time for a radio transmission to be sent to an RTU and a response sent back (a minimum of 3-5 seconds).

NOTE: ****** 2 stop bits for Modbus communications *******

M1700 Controller Configuration

With the Modbus option, the M1700 controller address is usually set to 1 (DIP switch one ON, DIP switches 2-6 OFF). Any address in the range 1-63 could be used. It should never be set to 0 [1].

RS232 Watchdog Configuration

The M1700 controller has the ability to monitor the RS232 serial connection for Modbus protocol queries. If the master fails to send a Modbus query for a specific amount of time, the M1700 controller will turn on its output number 1. This output could be connected to some kind of alarm that would notify the system operator that the master or the RS232 connection between the master and the M1700 controller has failed.

This feature can be enabled or disabled, and the timeout period set through the M1700 controller RS232 watchdog menu.

End of excerpt from Zetron Modbus document

NOTE: If you plan on using 1700M digital output 1 for an alarm output, disable the RS232 watchdog. Otherwise the relay triggers periodically. Or…just use digital outputs 2, 3 ,4 for alarms.

Following is an excerpt from the Zetron Modbus document;

M1708/M1716 RTU Configuration

With the Modbus option, all RTU DIP switch addresses must be in the range 1-255 [2]. Each must have a unique DIP switch address, and the RTU address must be different from the M1700 controller address.

If the M1700 controller is doing autopolling, the RTU addresses should be consecutive. If not, the M1700 will waste air time polling non-existent RTUs.

Follow the same steps described for the M1700 controller to access the RTU configuration menus, except for the last step. Once the terminal is configured, the PC and RTU serial ports connected, and the RTU powered up, press the space bar on the PC three times to bring up the RTU menus (instead of moving DIP switches seven and eight as on the M1700).

Once the menus are up, do the following...

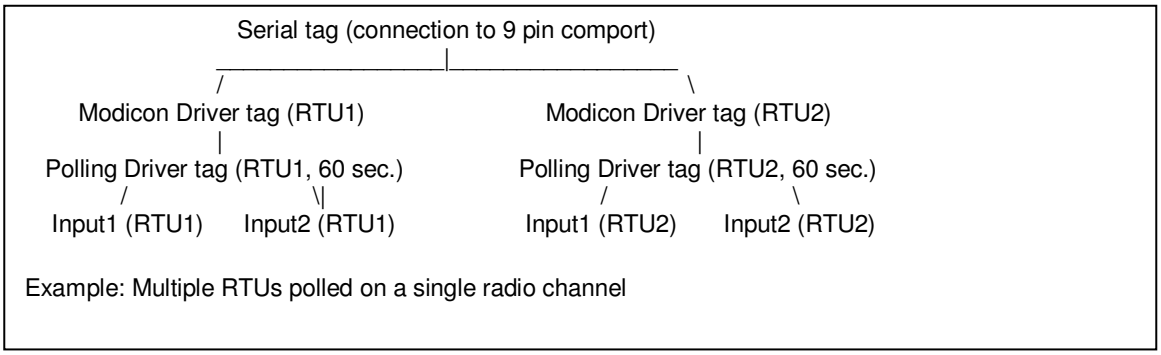
- Change the Controller Address setting in the RTU to match the DIP switch setting of the M1700 controller. Otherwise the controller and RTU will not be able to communicate with each other. The default value for the RTU is 0 and usually must be changed in a Modbus system.
- For a poll-only system, disable exception reports through the ***Fail safe setup | Disable exception reports*** menu item.

In poll-only systems, the polling interval is generally set to a value that allows the master enough time to poll all the RTUs in the system. For example, if it takes 5 seconds for each RTU, and the system consists of 10 RTUs, the polling interval would be 50 seconds minimum (it could be longer if desired). Some software packages allow different polling intervals for each RTU, so more important or rapidly changing signals could be polled more often than less important or slowly changing signals.

End of excerpt from Zetron Modbus document

Section 3.0 VTScada Configuration

VTScada will require a single serial comport tag for the serial 1700M connection. However, each addressed RTU must have its own VTScada polling driver tag and Modbus (i.e. Modicon) driver tag. For example. If you have 5 RTU's, they will have PLC addresses 2, 3, 4, 5 and 6. Remember that the 1700M must be addressed as 1.



Example: Multiple RTUs polled on a single radio channel

When first setting up the VTScada software…set the polling rate for each RTU Polling Driver tag at 60 seconds. The default is 5 seconds. When communications have been established the rates can be adjusted as required.

The table below matches the various Zetron I/O types to corresponding VTScada tags types.

Zetron I/O Type	VTScada Tag Type
Digital Input	Digital Status
Digital Output	Digital Control
Analog Input	Analog Status
Analog Output (if available)	Analog Control

IMPORTANT - In a Polled multi-RTU system, the RTU register addresses are the same for all RTUs regardless of the unit being polled. The only difference is in the Modbus network address associated with each RTU.

For example, if trying to read Digital Input 1 on RTU 1, create a Digital Status tag in VTScada with address (register) 10001. This would read from the RTU 1 Polling Driver tag, which would in turn read from the RTU 1 Modbus Driver tag. The Modbus driver would include the Modbus network address of the RTU. Thus, Digital Input 1 on RTU 2 would still read address 10001, but the Modbus driver tag for RTU 2 would specific a different Modbus network address.

Therefore, when setting up the VTScada tags to read each RTU, use only the registers in the tables below titled “Use this table for all RTUs” , regardless of the RTU being polled. The Zetron manual includes the tables below titled “Modbus Registers by RTU” showing up to 40 RTU’s with different registers for each RTU. DO NOT follow these tables as they will not work in the configuration described herein.

********** **Don’t use these tables**********

MODBUS REGISTERS by RTU (This table only shows register addresses for the 1st 40 of a possible 150 RTUs)

Digital Output Registers		
0 (Off), 1 (On)		
RTU	Output Registers	
1	1	16
2	17	32
3	33	48
4	49	64
5	65	80
6	81	96

Digital Input Registers		
0 (Open Ckt), 1 (Gnd)		
RTU	Input Registers	
1	10001	10016
2	10017	10032
3	10033	10048
4	10049	10064
5	10065	10080
6	10081	10096

Analog Input Registers		
Raw Value 0-32767		
RTU	Input Registers	
1	30001	30008
2	30009	30016
3	30017	30024
4	30025	30032
5	30033	30040
6	30041	30048

Analog Output Registers		
Raw Value 0-32767		
RTU	Output Registers	
1	40001	40004
2	40005	40008
3	40009	40012
4	40013	40016
5	40017	40020
6	40021	40024

********** **Use these tables for all RTU’s** **********

Digital Output Registers		
0 (Off), 1 (On)		
RTU	Output Registers	
1	1	16

Digital Input Registers		
0 (Open Ckt), 1 (Gnd)		
RTU	Input Registers	
1	10001	10016

Analog Input Registers		
Raw Value 0-32767		
RTU	Input Registers	
1	30001	30008

Analog Output Registers		
Raw Value 0-32767		
RTU	Output Registers	
1	40001	40004

Zetron M1700, M1708, M1716			Modbus		
I/O type	Address range	Value range	I/O type	Address range	Value range (raw)
Digital Outputs	1-16	off, on	Coils	1-16	0 (off), 1 (on)
Digital Inputs	1-16	open circuit, grounded	Input Status	10001-10016	0 (open circuit), 1 (grounded)
Analog Inputs	1-8	0-5V or 0-20mA	Input Registers	30001-30008	0-32767
Analog Outputs	1-4	0-5V	Holding Registers	40001-40004	0-32767

Section 4.0 Typical I/O Configuration

This section describes details how an Analog Input would be installed and configured in a Zetron SCADA system with a VTScada HMI.

To measure a 12vdc battery bank on a 1716 analog input, wire up the resistor divider network as described in the Zetron RTU installation manual (near the beginning). Make sure you remove the 249 ohm analog input jumper 4-20ma, 0-5vdc.…

In VTScada, create an Analog Status tag and set the raw scaling values to 0 (min), 32767 (max) as per the tables below. For now, use these same values for the scaled values (i.e. 0 (min), 32767 (max)). Draw an indicator for this value on your VTScada display screen.

Following is an excerpt from the Zetron Modbus document;

↓ I/O type Value→	0	1
Coil (digital output)	off (open circuit)	on (grounded)
Input Status (digital input)	off (open circuit or high voltage)	on (grounded or low voltage)

Table 4 Coil and Input Status Values

↓ I/O type Value→	0	6553	32767
Input Register (analog input)	0V, 0mA	1V, 4mA	5V, 20mA
Holding Register (analog output)	0V	1V	5V

Table 5 Input Register and Holding Register Values

End of excerpt from Zetron Modbus document

Connect the analog input to the battery bank (or bench supply for testing), poll it and look at the value shown on the VTScada display. It will be approximately 21717 (in this case representing 13.6 Volts.)

To determine the correct scaling values for the VTScada Analog Status tag, we first determine the scaling per volt (21717 / 13.6vdc = 1597/Volt) and then multiply it by our scaling range (20 x 1597 = 31940.)

We then edit the VTScada Analog Status and set the maximum raw scaling to 31940 and the maximum scaled value to 20.) Our VTScada display will now correctly show 13.6V.)