nVent RAYCHEM TraceTek TTSIM System Integration using the MODBUS Protocol

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The nVent RAYCHEM TraceTek TTSIM-1, TTSIM-1A and TTSIM-2 Sensor Interface Modules provide communication capability to a host system (personal computer, building management system or other automation system) using the MODBUS protocol over an RS-485 serial connection. This document describes briefly the most common system integration method used with a TTSIM based leak detection system. There are many possible leak detection network arrangements using one or more nVent RAYCHEM TraceTek TTDM and/or TTSIM modules; the TTDM-128 User Manual H56853 illustrates most of these possibilities. This document assumes that you will be communicating only with a network of TTSIMs.

We assume the reader is an experienced Systems Integrator who already understands the MODBUS protocol itself, and that the physical connection (RS-485) between the host system and the TTSIM has already been made. Refer to the TTSIM installation instructions for information on making the host communication connections.

The factory default communication parameters are:

Default Factory Modbus address: 199 (adjustable)

Baud Rate: 9600

Parity: None

Stop bits : 1

Data bits: 8

For most system integration applications using TTSIMs, it is only necessary for the host system to scan each leak detection circuit for status and leak location information. Each TTSIM stores all of its data in an array of Modbus registers. Modbus register 30001 contains the status bits for the TTSIM. Modbus register 30002 contains the location of the leak in sensor cable resistance units. Table 1 TTSIM Register Summary table provides a list of all registers intended for normal use.

TABLE 1. TTSIM REGISTER SUMMARY

MODBUS register	Function Code	Applies to	Meaning	Value
1	4	All TTSIM	Status Units: bit-mapped	Normally non-zero; see bit map table for details
2	4		Leak location resistance Units: Ohms	value should be <= loop resistance when there is a leak
3	4		Detection resistance Units: K Ohms	Normally >= 61000 for no leak
4	4		Detection current Units: micro-Amps x10	Normally < 10 for good, clean system
5 6	4		RG loop resistance YB loop resistance Units: ohms	Used to determine the total circuit length. These 2 registers should be nearly equal
10	4		Firmware version	If < 2000, = old TTSIM-1 If 2000 ~ 2999, = TTSIM-1 If >3000, = TTSIM-1A or TTSIM-2
1	3	TTSIM-1A and TTSIM-2 only	Relay reset	Write a 1 to this register to reset the relay

The status register contains details of the operating condition of the sensor cable and the SIM unit. These details are bit mapped into the register value. The following table is a list of the status bits and how they are to be interpreted.

TABLE 2. STATUS REGISTER (30001) BIT MAPPING

Bit # (bit value)	Meaning	Interpretation
1 (1)	Leak indication (detection resistance < leak sensitivity)	0 = no leak, 1 = leak
2 (2)	Sensor contamination (detection current > service required sensitivity)	0 = cable is clean, 1 = contamination (if no leak indication) or leak
3 (4)	Sensor loop integrity	0 = sensor OK, 1 = sensor cable break
4 (8)	Sensor loop balance (RG loop <> YB loop)	0 = sensor OK, 1 = cable loop imbalance
5 (16) 6 (32) 7 (64)	SIM unit program status	If any of these bits = 1, there is a problem with the SIM unit itself.

The higher order bits (bits 8 to 16) provide other information about the SIM itself, however these first seven are all that is required to determine the integrity of the leak detection circuit.

When a leak occurs, the location can be determined by reading the location resistance (register 2, Function code 4) and dividing that value by 3.900 to obtain the location in feet, or dividing by 12.796 to obtain the location in meters. To determine the total length of the circuit, divide the loop resistance (register 6, Function code 4) by 3.900 for feet, or by 12.796 for meters.

To reset the alarm relay on a TTSIM-1A or TTSIM-2, write a 1 to register 1 Function code 3. TTSIM-1 has no reset function. To determine the TTSIM version, read register 10 function code 4; if the value is 3000 or higher, it is a TTSIM-1A or TTSIM-2; if the value is less than 3000, it is a TTSIM-1.

Each TTSIM should be scanned and tested as follows:

1. read the status register (STATUS)
2. test STATUS value for leak indication:

   LEAK if (STATUS bitand 1)=1 …i.e., bit 1 is set

   a. if LEAK, read the location register (RLOC) and calculate the leak location:

      LOCATION = RLOC / 3.900 … location in feet from start of sensor

      -or-

      LOCATION =RLOC / 12.796 … location in meters from start of sensor
3. test STATUS value for cable and TTSIM integrity:

   FAULT if (STATUS bitand 124) <> 0 … i.e., any one of bits 3~7 is set

If desired additional details can be displayed on the host system by testing the status bits individually and providing appropriate responses. It is usually sufficient for the host system to detect an alarm in the event of a leak or a system fault.

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