TraceTek® TTSIM System Integration using the Modbus Protocol

The 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[1] 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 TraceTek TTDM and/or TTSIM modules; the TTDM-128 User Manual 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.

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. Additional information can be read if desired – the TTSIM Register Summary table provides a list of all registers intended for normal use.

TTSIM Register Summary

MODBUS register	Applies to	Meaning	Value
30001	All TTSIM	Status *Units: bit-mapped*	Normally non-zero; see bit map table for details
30002		Leak location resistance *Units: Ohms*	value should be <= loop resistance when there is a leak
30003		Detection resistance *Units: K Ohms*	Normally >= 61000 for no leak
30004		Detection current *Units: micro-Amps x10*	Normally < 10 for good, clean system
30005 30006		RG loop resistance YB loop resistance *Units: ohms*	Used to determine the total circuit length. These 2 registers should be nearly equal
30010		Firmware version	If < 2000, = old TTSIM-1 If 2000 ~ 2999, = TTSIM-1 If >3000, = TTSIM-1A or TTSIM-2
40001	TTSIM-1A and TTSIM-2 ony	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.

[1] See www.modbus.org for details on the MODBUS protocol

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)	SIM unit program status	If any of these bits = 1, there is a problem with the SIM unit itself.
6 (32)		
7 (64)		

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 30002) 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 (either register 30005 or 30006) 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 40001. TTSIM-1 has no reset function. To determine the TTSIM version, read register 30010; 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.