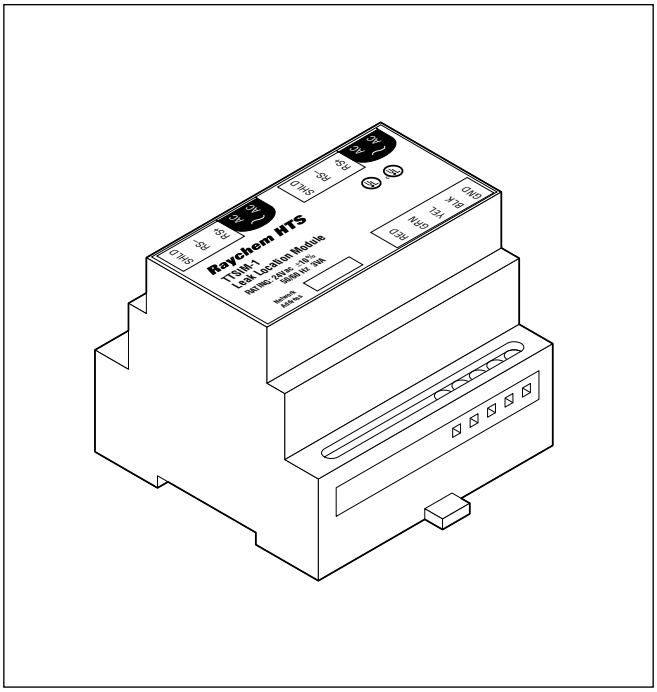
Raychem

TTSIM-1

Sensor Interface Module

Installation/Operation Guide



Product Information

TTSIM-1	24Vac ±10% 50/60 Hz
Power Consumption	3 VA (3 watts)
Installation categories (per IEC 664)	Overvoltage Category II Pollution Degree 2
Temperature	Storage 0°F to 140°F (–18°C to 60°C) Operating 32°F to 122°F (0°C to 50°C)
Enclosure	NEMA 1; IP20 Optional NEMA 4x; IP56

Approvals and Certifications

UL, Ulc, VDE, CE

Additional Items

An agency-approved zener barrier must be used where sensing cable connected to the TTSIM-1 will be located in Class1 Div 1 (or Zone 0 or Zone 1 in Europe) Hazardous Locations. A zener barrier may also be selected to provide lightening protection.

General Information

Please read these instructions and keep them in a safe place. These instructions must be followed carefully to ensure proper operation.

The TTSIM-1 has been designed for use with TraceTek sensing cables (TT1000, TT3000, TT5000 and TT5001) or any normally open, dry contact device (float switch, pressure or vacuum switch, optical probe with adapter, limit switch etc.). Up to 5000 feet (1500M) of sensor cable can be monitored (contact factory for information regarding longer monitoring distance).

The TTSIM-1 is designed for use in an ordinary area or a Class1 Division 2 area in a temperature range of 32°F to 122°F (0°C to 50°C). The TTSIM-1 requires 24 Vac 50/60 hz to operate and this voltage can be supplied either locally or through the same four wire jumper cable used for telemetry.

The TTSIM-1 has five small LED's to indicate power, status and communications activity but no other user readout or interface. All alarm and monitoring functions are analyzed and displayed either at a TTDM-Plus alarm and control panel or at the operator console of a Building or Factory Automation System. The TTDM-Plus can support up to 32 TTSIM-1 units and a typical building or factory automation system can monitor up to 123 TTSIM-1's per twisted pair, RS-485 channel.

Installation Items (not supplied)

- 35 mm DIN rail mounting strip (for wall mounts or interior of large control cabinets) and attachment hardware.
- Optional TT-JBS NEMA 4x environmental enclosure for outdoor or corrosive environments.

Tools Required

- Small flat blade screwdriver
- Tools to mount DIN rail or JBS enclosure

Storage

Keep the TTSIM-1 modules in a dry place prior to installation. Avoid damage to components.

Installing the TTSIM-1

Note: To avoid damage to the TTSIM-1, store the unit in it's packaging until ready to install.

Select the mounting position.
Choose a location indoors where the module will be protected from the elements, temperature extremes or heavy vibration. The TTSIM-1 is designed to be snapped onto standard 35 mm DIN rail. Existing electrical or instrumentation cabinets with spare rail space make good mounting locations. It is also possible to install a small section of DIN rail directly on a wall or cabinet surface and mount the TTSIM-1 in any location as long as it does not create a tripping hazard or expose the TTSIM-1 to impact damage. The TTSIM-1 should be mounted within 4000 feet (1200 m) wire run from the controlling TTDM-Plus or control system host. (Contact the factory for methods to increase the wire run distance beyond 4000 feet).

> ***Important:*** The TTSIM-1 is an electronic unit. Take the following precautions to avoid damage to electronic components:
>
> - Handle with care, avoid mechanical shock and impact.
> - Keep dry.
> - Avoid exposure to static electricity by touching a nearby piece of grounded equipment or water pipe prior to handling the TTSIM-1.
> - Avoid contact with metal filings, grease, pipe dope and other contaminants.

Mounting the TTSIM-1 module (without NEMA 4x Enclosure)

- Secure a 6" (15 cm) length of DIN rail to the desired mounting surface, or locate an existing DIN rail with sufficient space to install the TTSIM-1.
- Remove the TTSIM-1 from it's packaging and snap onto the DIN rail with the release tab towards the bottom.
- Note: When properly oriented, there will be two terminal strips on the top of the module and one on the bottom. See Figure 1.

Mounting the TTSIM-1 module in the optional NEMA-4X enclosure

- The TT-JBS enclosure is available either pre-drilled for 3/4" conduit fittings or without any pre-drilled holes.
- Plan conduit alignment and drill holes if necessary.
- A typical outdoor or harsh environment installation will require three holes in the JBS: one for inbound power and telemetry, one for outbound power and telemetry and one for the sensor cable leader. See Figure 2.
- Secure the TT-JBS to any convenient vertical surface using the four corner mounting holes and hardware suitable for the selected surface.
- Rough-in conduit as required and pull 4 x 18AWG shielded jumper wire for power and telemetry. Leave approximately 8" (20cm) for connections. Pull in the leader cable to the sensor circuit through the bottom fitting.
- In order to provide the maximum ESD protection, and to be CE compliant, the DIN rail must be grounded.

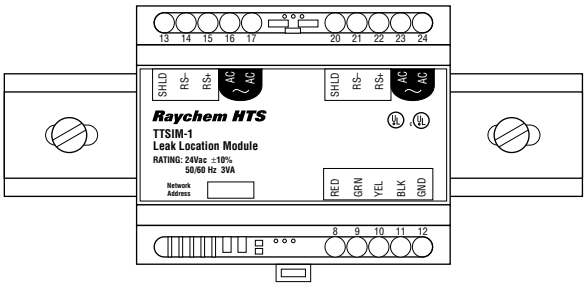


Figure 1. DIN Rail Mount

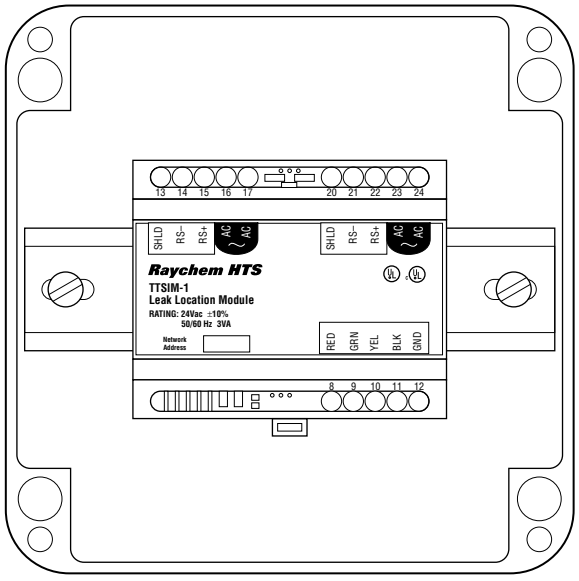


Figure 2. NEMA 4x Enclosure

Note: Rough-in and final connections do not have to be completed at the same time, however make sure to replace the cover and tighten the cover screws if the JBS box will be left in a partially installed condition overnight or longer.

Power Supply Options:
The TTSIM-1 units require 24 Vac ±10% 50/60 Hz. In most networks the operating voltage will be supplied from a step down transformer mounted near the TTDM-Plus alarm panel or PLC. Figure 3 shows typical wiring adequate for any network that will be monitored by a TTDM-Plus. For very large networks or very long telemetry cable runs, there may be too much voltage drop in the power/telemetry cable to power the entire network from one location. In those situations, a second transformer at the distant end of the system will be required. Be sure that each TTSIM-1 receives operating voltage from one and only one source.

Connections for Power and Telemetry
TTSIM-1 communicates all alarm and status messages via RS-485 twisted pair telemetry. Two of the four conductors in the power/telemetry cable are used for telemetry and the other two wire are used to run the operating voltage. Belden P/N 8722 is a good choice.

For all TTSIM-1 modules except the last one, there will be an incoming cable (from the TTDM-Plus or other host system) and an outgoing cable (toward the next TTSIM-1).

Strip back a sufficient amount of the jacket insulation and shielding to expose about 1" (2.5 cm) of the four primary colored wires. The preferred color code is red, black, green, white plus a shield drain wire, however any color code is acceptable as long as the installer is consistent with the intent of these instructions. See Figure 4.

Strip the primary wires to expose approximately 1/4" (6 mm) of conductor and make the following connections:

Terminal	Color	Item
13	—	Shield Drain Wire
14	Blk	RS-485 (–)
15	Red	RS-485 (+)
16	Grn	24 Vac (no polarity)
17	Wht	24 Vac (no polarity)
20	—	Shield Drain Wire
21	Blk	RS-485 (–)
22	Red	RS-485 (+)
23	Grn	24 Vac (no polarity)
24	Wht	24 Vac (no polarity)

Special Note for the last TTSIM-1 in the chain:
The RS-485 network will perform better if the twisted pair telemetry is properly terminated at the last TTSIM-1 in the network. There are two jumper pins that should be shorted with a jumper block as shown in Figure 5.

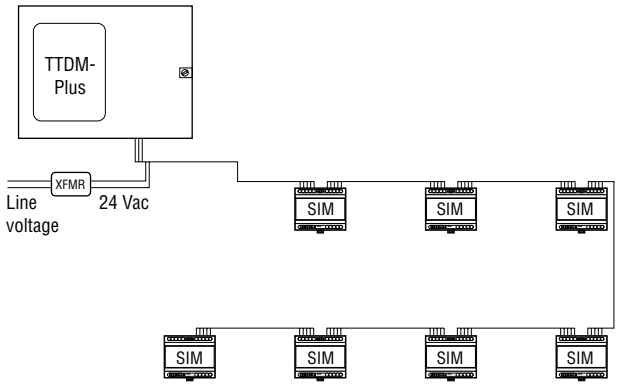


Figure 3. Power Supply to SIM units

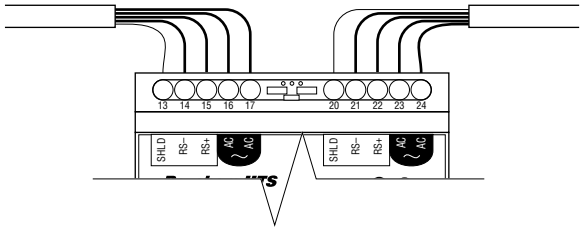


Figure 4. Power and Telemetry Connections

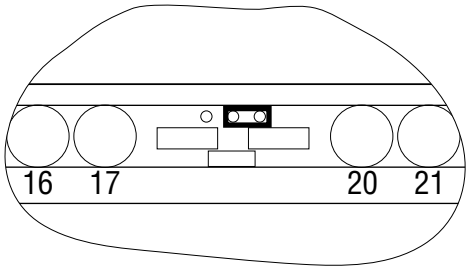


Figure 5. End of Line Jumper Block

Leader Cable Connections for Sensor Cable
TTSIM-1 can be used with any of the TraceTek family of sensor cables including: TT1000, TT3000, TT5000 and TT5001. Connect the leader cable to the sensor as shown in Figure 6.

Terminal	Color	Item
8	Red	Red / Green Sensor Cable Loop
9	Grn	
10	Yel	Yellow /Black Sensor Cable Loop
11	Blk	
12	—	Wire to local ground point (optional)

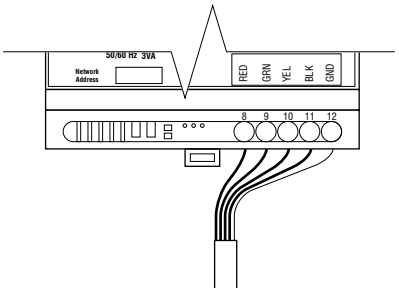


Figure 6. Sensing Cable Connections

Leader Cable Connections for Float Switches and Other Open Contact Devices
The TTSIM-1 can monitor any open contact device that generates a contact closure when an alarm condition occurs. Typically this device will be a float switch, a pressure switch, a limit switch or any similar on/off sensor. Connect the leader to the normally open contacts of the sensing device as shown in Figure 7.

Terminal	Color	Item
8	Red	Twist red and green wires together at the switch device and connect to the N.O contact
9	Grn	
10	Yel	Twist yellow and black wires together at the switch device and connect to the C contact
11	Blk	
12	—	No connection

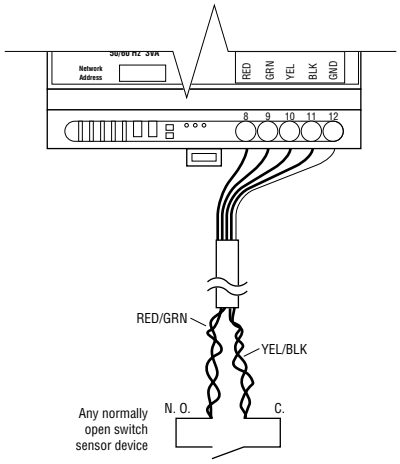


Figure 7 Switch Type Sensor

Operating Instructions

Network Address Assignment
All TTSIM-1 units are shipped from the factory with their network address pre-set to a value above the normal range of valid addresses. This allows the network of TTSIM-1 units to be simultaneously powered during the start-up process without the possibility of address conflicts. However, each TTSIM-1 unit requires a unique address before it can communicate with the TTDM-Plus or other host. A jumper block is provided adjacent to Terminal 8 as shown in Figure 8. When the jumper clip is positioned as shown, the TTSIM-1 is temporarily forced to address 0. With the address forced to 0, the TTDM-Plus panel can be used to assign a permanent address in the valid range of 1 to 31. After the permanent address is assigned, the jumper clip is removed and the process is repeated for the next SIM in the network. Typically, the sensor interface card inside the TTDM-Plus is assigned address 1, so the first TTSIM-1 in the network is assigned with address 2, the next address 3 and so on.

When a PLC or other generic host system hosts the TTSIM-1 network, the host determines the valid address range. The TTSIM-1 can be assigned to any address from 0 to 255 (decimal) (00 to FF hex).

The assigned address is stored in the modbus register 40011 (see page 7).

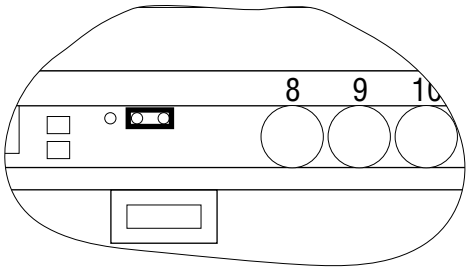


Figure 8. Configuration Jumper in Position

TTSIM-1 Reset

In the event that the TTSIM-1 appears to be hung-up and unresponsive to the network it is possible to force a system reset. To force a RESET of the TTSIM-1 processor, use a small flat blade screwdriver to momentarily short the pads shown in Figure 9.

Maintenance and Troubleshooting

No user maintenance is required! There are no user adjustments or calibrations that can be performed in the field.

Each TTSIM-1 is tested and calibrated in the factory at production time through the test header. An operating TTSIM-1 runs a continuous self check routine and reports any discrepancies to the host TTDM-Plus or PLC. If the TTSIM-1 or the network wiring fails is such a way that the TTSIM-1 cannot communicate with the host, then the host reports the failure as a communications failure.

Status Indicators

There are 5 LED's on the TTSIM-1 circuit board to indicate: operating power, communications (inbound and outbound), sensor status (leak detected and trouble). See Figure 10 for locations and colors

Table 1 indicates various status conditions and possible corrective actions:

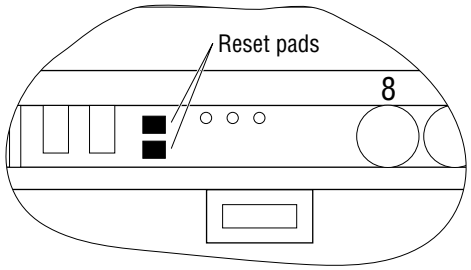


Figure 9. Reset Pads

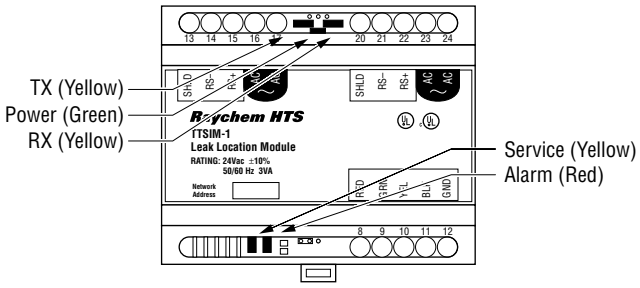


Figure 10. LED Locations

Table 1. TTSIM-1 LED Status Indications

POWER	TX	RX	ALARM	SERVICE	INDICATION
OFF	OFF	OFF	OFF	OFF	No power to unit. Check wiring, connections and power supply. Measure voltage at pins 16 and 17. Should be 24 Vac ±10%.
ON	FLASHING	FLASHING	SLOW FLASH	OFF	Normal Operation. No alarms or service requests. Alarm LED flashes once every 5 seconds to indicate normally operating microprocessor.
ON	FLASHING	FLASHING	ON	OFF	Leak detected by sensor cable or switch type device. Check location being monitored for leak or spill.
ON	FLASHING	FLASHING	OFF	FLASHING	SIM unit has detected a condition requiring outside attention. Flash Code: 1 Sensor cable break 2 Sensor cable loop imbalance 3 EPROM hardware error 10 Sensor cable contamination
ON	OFF	FLASHING	SLOW FLASH	OFF	SIM unit is not responding to network master unit. Use INIT SIM Network command on TTDM-Plus and/or use configuration jumper to force SIM address to zero then, re-address to an unused address.
ON	OFF	OFF	OFF	OFF	SIM unit not receiving any communication from network master unit. Check other SIM units for flashing RX light, if none seen, then check wiring at network master unit or intermediate wiring and connections.

TTSIM-1 Modbus Implementation

TTSIM-1 uses two wire, RS-485, full duplex, no hardware handshaking at 9600 baud. The TTSIM-1 software is able to distinguish between three different communication protocols and respond automatically in the mode being used by the host system. The three supported protocols are: Modbus-ASCII, Modbus-RTU, and a proprietary version of Opto22 (automatically invoked when the host is a TTDM-Plus). System integrators choosing to communicate directly with the TTSIM-1 are free to use either Modbus-ASCII or Modbus-RTU using the registers listed in the following tables.

Node addressing: All TTSIM-1 units are shipped from the factory with address set to 199. New TTSIM-1 units must be added to a network one at a time and immediately re-addressed to a unique unused address. Alternatively, the TTSIM-1's can be pre-addressed by the TraceTek distributor using a TTDM-Plus panel. If for some reason a TTSIM-1 has been assigned an unknown address, it can be temporarily forced to 0 by installing Configuration Jumper (See Figure 8) . With this jumper in place the TTSIM-1 will respond to node address 0 and a new unique address can then be loaded in register 40011. After the configuration jumper is removed the address loaded in 40011 will take precedence.

Note: In the following tables those registers in bold type are the most likely registers to be used by system integrators. All registers are documented but many are used only for factory calibration or internal system monitoring.

Table 2. Analog Input Registers

Modbus Register	Name	Description	Units	Range
30001	Status Word	Bit level status flags, (see Table 4.)	None	0-65535
30002	Location Resistance	Location of leak or contamination when detection is above current thresh.	Ohms	0-65535
30003	Detection resistance	Resistance through the leak or contamination	Kohms	0-65535
30004	Detection Current	Current flowing through leak or contamination	0.1 micro-amps	0-65535
30005	RG Resistance	Loop resistance red to green	Ohms	0-65535
30006	YB Resistance	Loop resistance yellow to black	Ohms	0-65535
30007	ADC Counts1	Adc count of V1 (internal value)	count	0-65535
30008	ADC Counts2	Adc count of V2 (internal value)	count	0-65535
30009	ADC Counts3	Adc count of V3 (internal value)	count	0-65535
30010	F/W version	Firmware version V x.xx	none	0-65535
30011	Product ID	Product ID number	none	0-65535
30012	EEPROM Checksum	Check sum	none	0-65535
30013	Voltage Step Size	Step size in ohms (internal value)	ohms	0-65535

Table 3. Analog Output Registers

Modbus Register	Name	Description	Units	Range
40001	SIM Operating Mode	0: normal, 8 normal w/no off time, 64: detect Earth to RG loop, 72 detect Earth to YB loop	None	0 - 4095 [0 default]
40002	Leak Resistance Threshold	Leak alarm is triggered when resistance is less than or equal to	Kohms	0 - 4095 [18 default]
40003	Service Current Threshold	Service alarm is triggered when current is greater than or equal to	0.1 micro-amps	0 - 4095 [500 default]
40004	Sensor Delta Threshold	Maximum difference in percent between RG loop resistance and YB loop resistance	percent	0 - 4095 [25 default]
40005	Rref	Reference resistance minus offset of 6000 (Factory calibration value)	Ohms	0 - 4095 [2020 default]
40006	K	Op Amp Gain correction (Factory calibration value)	none	0 - 4095 [2000 default]
40007	Vref	A/D reference voltage (Factory calibration value)	mVolts	0 - 4095 [2500 default]
40008	Settling Time	Settling time before making A/D measurements	mSec	0 - 255 [50 default]
40009	Cycle Time	Seconds of measurement cycle plus off-time	Sec	0-655 5 default]

40010	Cycles per Polarity	Number of cycles before alternating polarity	count	0 - 4095 0 default]
40011	Node Address	RS485 node address	none	0 - 255 [0 default]
40012	High Voltage Threshold	YB loop resistance above which high voltage mode is automatically selected	Ohms x 10	0 - 4095 [800 default]
40013 - 40020	Misc. Flags, Gain setting	Calibration and mode controls used during calibration. -RESERVED	none	
40021	EEPROM Check	Checksum for EEPROM	None	varies

Table 4 Status Word Flags (Register 30001)

Data is returned from register 300001 as four hexadecimal digits

Bit	**Description**	
00	1: detection resistance below high current threshold	
01	1: current is above locating current threshold	
02	1: open of high resistance in sensor loop(s)	
03	1: difference / average of loop resistance > delta threshold	
04	1: EEPROM read error	
05	1: EEPROM write error	
06	1: EEPROM verify error	
07	1: EEPROM type X24C01A or equivalent	0: EEPROM type X24C01
08	1: low voltage used	0: high voltage used
09	1: low current used	0: high current used
10	1: measurement cycle in progress	0: off time
11	1: reverse polarity mode	0: normal polarity mode
12	1: ADC calibrate disabled	0: ADC Calibrate enabled
13- 15	Spare (always 0)	

System Integration Guidelines

The system integrator has three main responsibilities: Assuring proper communications, monitoring for hardware failures and interpretation of detection parameters.

Communicating with the TTSIM-1 requires that the node address at **40011** be set to a unique value for each TTSIM-1 on the network. The TTDM-Plus has a specific function to do this at MENU | SIM NETWORK | SIM ADDRESS. Assuming that any newly added TTSIM-1 is forced to 0 with the configuration jumper as shown in Figure 8 then the TTDM-Plus can be used to assign any new unused address. For systems hosted by the TTDM-Plus the range of acceptable is 0 - 31, for systems hosted by the older TTDM-NMM the acceptable range of addresses is 0 - 15. System that will be hosted by a generic modbus host (PLC's DCS's BMS etc) will typically be limited by the address space specification of the generic host or to the maximum range of the TTSIM-1 of 0 - 255. When configuring the address of a TTSIM-1 using a generic host the TTSIM-1 unit can be forced to zero with the configuration jumper (See Figure 8) then while responding to address 0, a new address can be written to register **40011**. After the configuration jumper is removed, the TTSIM-1 unit will respond to the address set in register **40011**.

Important Note: Interpretation of leak parameters and location calculations are entirely automatic when the system is hosted by a TTDM-Plus. The following paragraphs apply to TTSIM-1 networks managed directly by a generic modbus host system.

Status Check: Register **30001** should be scanned for a "1" in bit locations 02 and 03. A "1" bit in either one of these locations indicates physical problems with the sensor cable that need to be addressed by the maintenance staff.

Interpreting the leak parameters is driven by the values in three registers: **30002**, **30003** and **30004**. Resistance through the leak is reported in **30003**. A clean and dry sensor cable or an open float switch will report back the maximum value of **65535**. Progressively lower resistances and higher currents (as seen in register **30004**) are the signatures of a detected leak. The following table gives some guidance in interpreting the leak parameters.

Table 5. Leak Parameters

Sensor / Cable Type	Normal Conditions	Leak Detected	Sensor Contamination
TT1000/ TT3000 water or water based fluids	30003 > 1000 K Ohms 30004 < 5 micro amps	30003 < 18 K Ohms 30004 > 200 micro amps	30003 < 200K Ohms 30004 > 50 micro amps
TT5000 / TT5001 fuels or solvents	30003 > 1000 K Ohms 30004 < 5 micro amps	30003 < 5 K ohms 30004 > 250 micro amps	Usually not applicable, Values similar to TT1000/TT3000 may indicate water intrusion
Float Switch or other normally open contact device	30003 > 1000 K Ohms 30004 < 5 micro amps	30003 < 1 K ohms 30004 > 250 micro amps	N/A

Calculating Leak Location: For sensor cables (TT1000, TT3000, TT5000, and TT5001) the value reported in register **30002** is the resistance measurement between the TTSIM-1 module and the leak location in ohms.

Subtract any known added-in resistance such as that of a zener barrier or very long leader cable runs.
The resulting value can then be scaled to engineering units as follows:

For feet: divide corrected value from register **30002** by 3.90
For meters: divide the corrected value from register **30002** by 12.796

Raychem HTS
300 Constitution Drive
Menlo Park, CA 94025-1164
Tel (800) 545-6258
Fax (650) 474-7711
Fax-on-Demand (800) 329-4494
info@raychemhts.com
www.tracetek.com