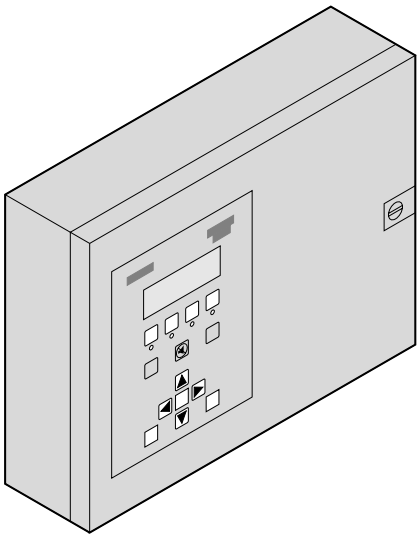
Raychem

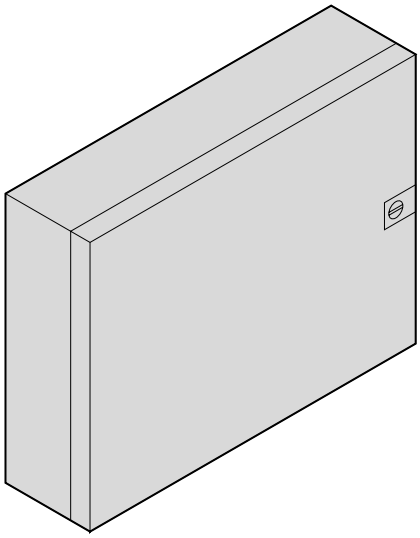
TraceTek TTDM-NMM and TTDM-SIM
Leak Detection and Location System

Operation and Maintenance Manual

TTDM-NMM



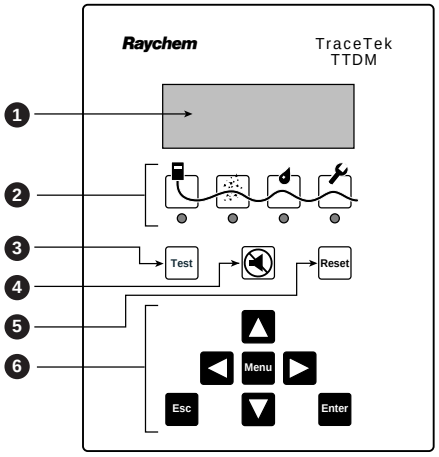
TTDM-SIM



Identifying TTDM-NMM and TTDM-SIM Features

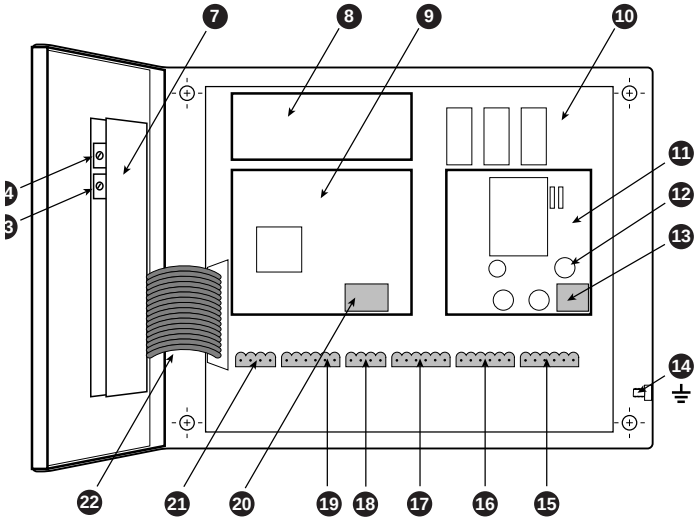
TTDM-NMM Network Master Module

A



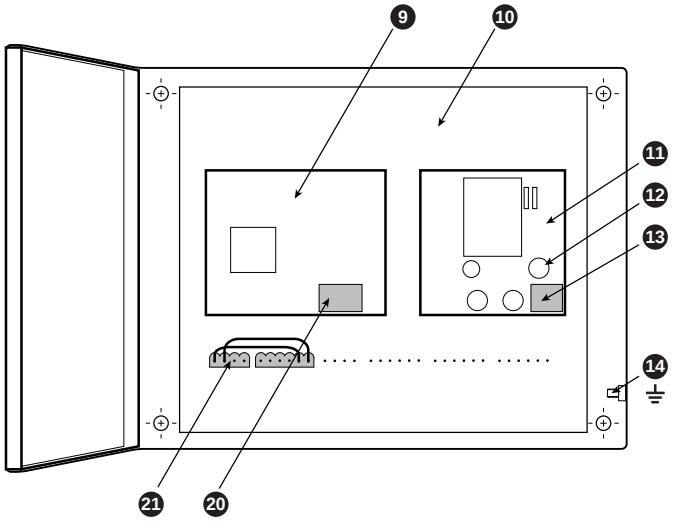
(enlarged)

B



TTDM-SIM Sensor Interface Module

B



Asterisk (*) preceding a feature denotes a TTDM-NMM feature not included in TTDM-SIM.

External View [A] (TTDM-NMM only)

1. *LCD display gives up-to-date information regarding the condition of the system.
2. *Icons and LEDs (light emitting diodes):
   Monitoring LED - green
   Service (Required) LED - yellow
   Leak LED - red
   Fault LED - red
3. *(Self) Test key
   Can be used at any time to verify that the module is operating correctly. The module performs a series of self-diagnostic checks.
4. *Silence key
   Used to silence audible alarms.
5. *Reset key
   Used to reset the leak alarm relay after a leak has been cleared.
6. *Menu keys
   The menu button provides access to various features that may be viewed and/or edited. The menus are navigated with the arrow keys along with the Esc (escape) and Enter keys.

Internal View [B]

7. *User interface (UI) board
8. *4-20 mA board
9. Sensor Interface (SI) board
10. Motherboard (MB)
11. Power supply (PS-1, 2, or 24) board
12. Fuse (200 mA, 250 V)
13. Power cable terminal block
14. Ground (earth) stud
15. *Fault relay cable plug and socket
16. *Leak relay cable plug and socket
17. *Service relay cable plug and socket
18. *4-20 mA port plug and socket
19. *Plug and socket for RS-232/485 external communications serial port
20. Sensing cable plug and socket
21. RS-485 plug and socket for SIM network
22. *Ribbon cable
23. *Volume adjustment
24. *LCD contrast adjustment

Contents

Please read before use

Please read these instructions carefully and keep in a safe place (preferably close to the TTDM-NMM module) for future reference.

The instructions provided in this document should be followed carefully to ensure proper operation. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Note: **Software selections** and **key** entries are highlighted in bold throughout this manual.

Introduction

TTDM-NMM and TTDM-SIM modules are part of a TraceTek leak detection system; they link multiple areas into a single leak detection network. The modules have been specifically designed for use with TraceTek sensing cables (all TT1000, TT3000, and TT5000 series sensing cables*). Each TTDM-SIM Sensor Interface Module (and the Sensor Interface board in the TTDM-NMM Network Master Module) can monitor up to 5000 ft (1500 m) of sensing cable. A TTDM-NMM Network Master Module can monitor up to 15 TTDM-SIMs, allowing a maximum of 80,000 ft (24,000 m) of sensing cable in a single system. In addition, each TTDM-NMM has an assignable RS-485 address, which allows a host system to monitor up to 31 TTDM-NMM leak detection systems.

The TraceTek system can detect and locate the presence of liquid at any point along any of the sensing cables connected to the TTDM-NMM and TTDM-SIM modules. The modules also monitor the system for other alarm conditions:

- Service required
- Fault

Each “event” (service, leak, or fault) is recorded in an Events History with the time and date of occurrence. This allows easy tracking of events. The TTDM-NMM module has a serial port that allows a host system to remotely access the events history and all user settings.

Preparation

Before operation, installation instructions that accompany each module must be followed so that each module is properly:

- Mounted.
- Powered (wired and energized).
- Connected to a TraceTek sensing cable with a TraceTek jumper or leader cable.
- Interconnected with the other leak detection modules using RS-485 wiring.

If these steps have not been taken, refer to the documents noted below to complete the installation. This literature can be obtained from the Raychem Fax-on-Demand service at (800) 329-4494; a voice prompt leads you through the process.

- For the TTDM-NMM module, see the *TTDM Installation Instructions* (Raychem literature reference H55471).
- For the TTDM-SIM module, see the *TTDM-SIM Installation Instructions* (Raychem literature reference H56314).
- For interconnection of the modules with RS-485 wiring, see the *TTDM-SIM Installation Instructions* (Raychem literature reference H56314) and Appendix 5 of this operation and maintenance manual.

Important: There should be a system map for each TTDM-SIM and the TTDM-NMM; the system map shows the sensing cable layout with reference landmarks throughout the system. The system map (an integral part of a TraceTek locating system) is often compiled when the leak detection system is commissioned. Ensure that a copy of each map is readily available near the TTDM-NMM module and (if the TTDM-NMM is connected to a building or facility management system) the host system as well.

Notes

- Throughout this manual, the examples shown use distances in feet.
- Later versions of software may provide new features and change certain other details. This manual documents UI software version 1.00_.
- For technical assistance, call (800) 553-1737 or (415) 361-4900.

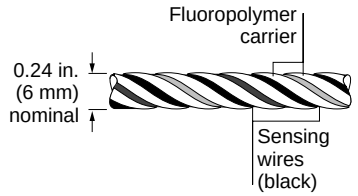
* TTDM-NMM and TTDM-SIM modules are also compatible with all long-line versions of the earlier sensing cables (TT100, TT300, and TT500 series).

Description of TraceTek Leak Detection System

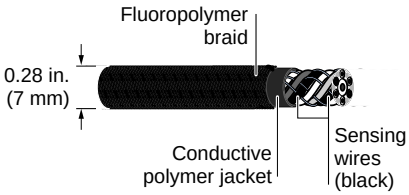
TraceTek Sensing Cables

The TraceTek leak detection system is based on sensing cables that detect liquid at any point along their length. Four types of TraceTek sensing cables are available to detect different types of liquids. Multiple types of sensing cables may be used in a single sensing circuit.

TT1000 and **TT3000**
Water and other conductive fluids



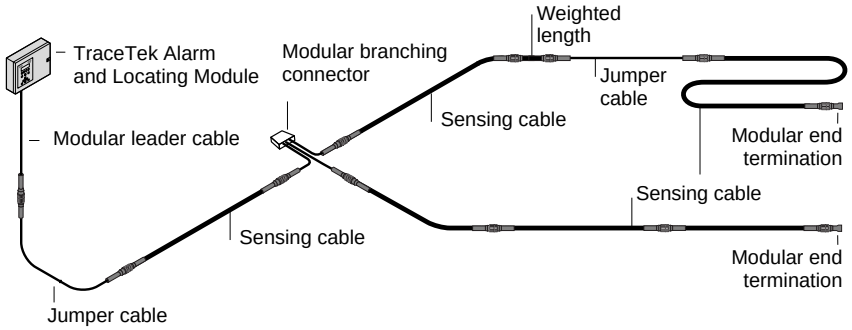
TT5000 – fuels and oils
TT5001 – organic solvents



Components of TraceTek Locating System

TraceTek leak detection is a versatile modular system, with interchangeable components that can be configured in many different ways. For more information on the products and systems available, consult the appropriate TraceTek product selection guide: Raychem document H53874 for water detection in commercial buildings, H55869 for industrial and environmental applications.

A TraceTek locating system provides distributed leak detection and location to monitor long lengths and wide areas. A TraceTek locating circuit consists of a TraceTek locating module, up to 5000 ft (1500 m) of sensing cable per module, and circuit components (leader cable, jumper cables, end terminations, weighted lengths, and branching connectors) with connectors that allow components of the system to plug together.



The **weighted length** resistor simulates a 15-ft (5-m) length of sensing cable. Installed at the boundary between two areas, it allows the user to clearly identify the area where the leak has occurred.

The **branching connector** enables the sensing cable to be branched. An **end termination** completes each branch. At the branching connector, the system first counts the sensing cable along the branch (middle connector), before it continues with the main run. Two built-in 15-ft (5-m) weighted-length resistors allow the user to clearly identify on which leg a leak has occurred near the branching connector.

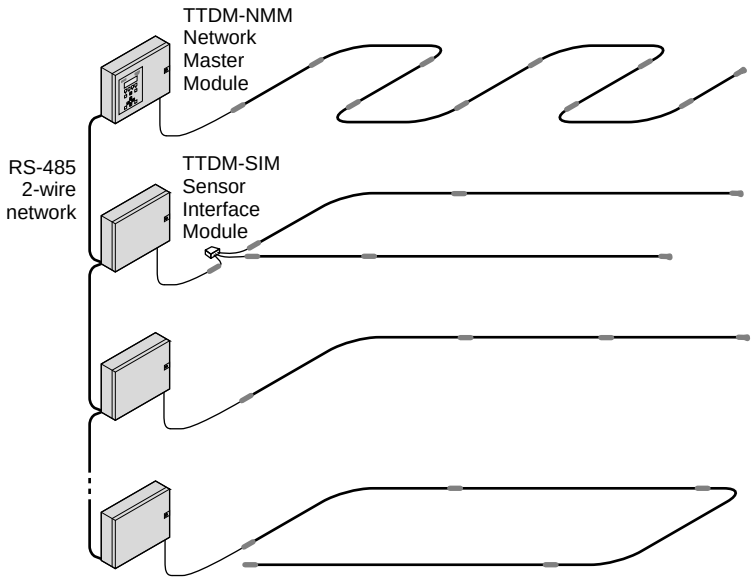
An important part of a TraceTek locating system is the system map, a sensing cable layout plan with actual distance readings. Thus, in case of an alarm, the location of the event can be determined quickly. The map should be placed near the Alarm and Locating Module.

Network of TraceTek TTDM-NMM and TTDM-SIM Modules

The network of TTDM-NMM and TTDM-SIM modules adds capabilities beyond those of a stand-alone TraceTek TTDM single-channel alarm and locating module. Note that a separate operation and maintenance manual is available for the stand-alone single channel system (Raychem document H55472).

In a network of TTDM-NMM and TTDM-SIM modules, each TTDM-SIM Sensor Interface Module (and the Sensor Interface board in the TTDM-NMM Network Master Module) can independently monitor up to 5000 ft (1500 m) of sensing cable. If liquid contacts sensing cable connected to a Sensor Interface Module, that module communicates the alarm condition to the TTDM-NMM Network Master Module, which signals an alarm, displays the distance to the leak, and records the event. The TTDM-NMM communicates with the SIMs over an RS-485 network (which uses a shielded, twisted pair); see Appendix 5 for wiring details. The RS-485 address for each SIM is assigned using the TTDM-NMM system software.

A TTDM-NMM Network Master Module can monitor up to 15 TTDM-SIMs, allowing a maximum of 80,000 ft (24,000 m) of sensing cable in a single system. In addition, each TTDM-NMM has an assignable RS-485 address, which allows a host system to monitor up to 31 TTDM-NMM leak detection systems.



Connection of TraceTek TTDM-NMM System to Other Devices

All connections with external devices are made at the TTDM-NMM Network Master Module. The TTDM-NMM has three types of interface for communication with other systems:

- Relays
- 4-20 mA analog interface
- Serial port

See Appendix 6 for wiring and operating details.

Relays

The TTDM-NMM has three relays:

- Service
- Leak
- Fault

The relays are triggered by an alarm in any SIM channel. Each relay provides two Form-C relay contacts, with normally open and normally closed contacts both provided.

4-20 mA Interface

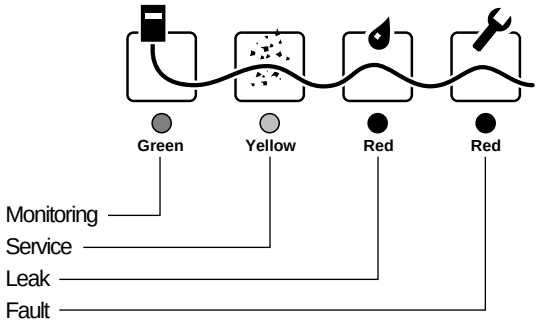
The TTDM-NMM is equipped with a 4-20 mA analog interface which can be used to communicate the status of a single channel. The module adjusts its current output based on whether an alarm condition exists and (when a leak is detected) the location of the leak. The output for leak location can be scaled to make full use of the 4-20 mA range for the length of sensing cable connected to the assigned SIM channel. The SIM channel communicated over the analog interface is assigned using the TTDM-NMM system software; default is channel 01 (factory setting for the sensor interface board inside the TTDM-NMM itself).

Serial Port

The TTDM-NMM module has a serial port that can be configured for use either as an RS-232 or RS-485 transceiver. The factory default is RS-232 but can be changed to RS-485 using jumpers. Appendix 6 provides configuration and wiring details. Appendix 7 provides details on the TTDM-NMM Modbus implementation to facilitate integration with building and facility management systems.

The Icons

The Icons represent the four states of the TTDM-NMM leak detection network.

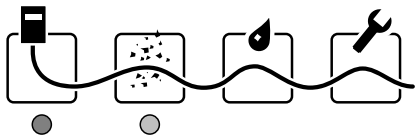


Note: The Service, Leak, and Fault LEDs will illuminate if the condition exists on any SIM channel (i.e., the TTDM-NMM display uses OR logic). Therefore, multiple LEDs may be illuminated simultaneously to indicate multiple types of alarms, perhaps on different SIM channels.

Monitoring

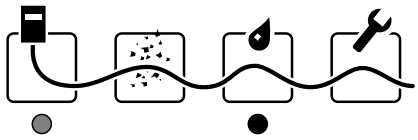
This green LED indicates that the TTDM-NMM is monitoring the -SIM units attached to the TraceTek leak detection network.

Service



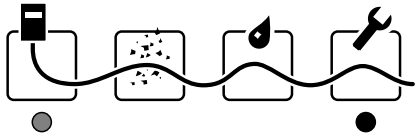
The TTDM-NMM is able to give advance warning of potential problems. This yellow Service LED illuminates to indicate that service is required on one of the sensing cables attached to the network. Note that the green LED remains illuminated; the unit continues to monitor for leaks during a Service alarm For further detail, see the “Service Events” section on page 9.

Leak



When liquid is detected in contact with a sensing cable, this red Leak LED illuminates. Note that the green LED remains illuminated; the unit continues to monitor for leaks and spills. This is covered more fully in the section “Leak Detection and Location Events” on page 8.

Fault



When the TTDM-NMM module detects a fault — either a cable fault or an electronics fault — it lights this red LED. After a fault on an individual SIM has been detected, the NMM module will, in most cases, continue to scan the remaining SIM units and their associated sensing cable. However, some fault conditions may disable multiple channels or even the entire system. The TTDM-NMM is unable to detect a leak on any channels affected by a fault, so always investigate the cause of a Fault condition immediately. For further information, see the “Fault Events” section on page 10.

Current Event/Status Display (Normal Display Mode)

```
CH01 USER_LABEL_0001
CURR. EVENT/STATUS
POSSIBLE USR ACTION
HH:MM  DD-MON-YYYY
```

The LCD display is a backlit 4-line by 20-character display. If there is no activity for several minutes, the backlighting turns off, but turns back on when any key is pressed.

Line 1 identifies the channel currently displayed: shows the SIM channel number and a user-defined label up to 14 characters in length. For a new system, the user-defined label is blank.

Line 2 indicates the current status of the SIM channel identified on Line 1,
or
in the case of Leak re-alarm, displays the initial Leak location of the SIM channel identified on Line 1.

Line 3 may advise action or provide special instructions,
or
in the case of Leak re-alarm, indicates the current status of the SIM channel identified on Line 1.

Line 4 displays the current time (in 24-hour format) and date; the colon blinks once a second,
or
in the case of Leak re-alarm may advise action or provide special instructions.

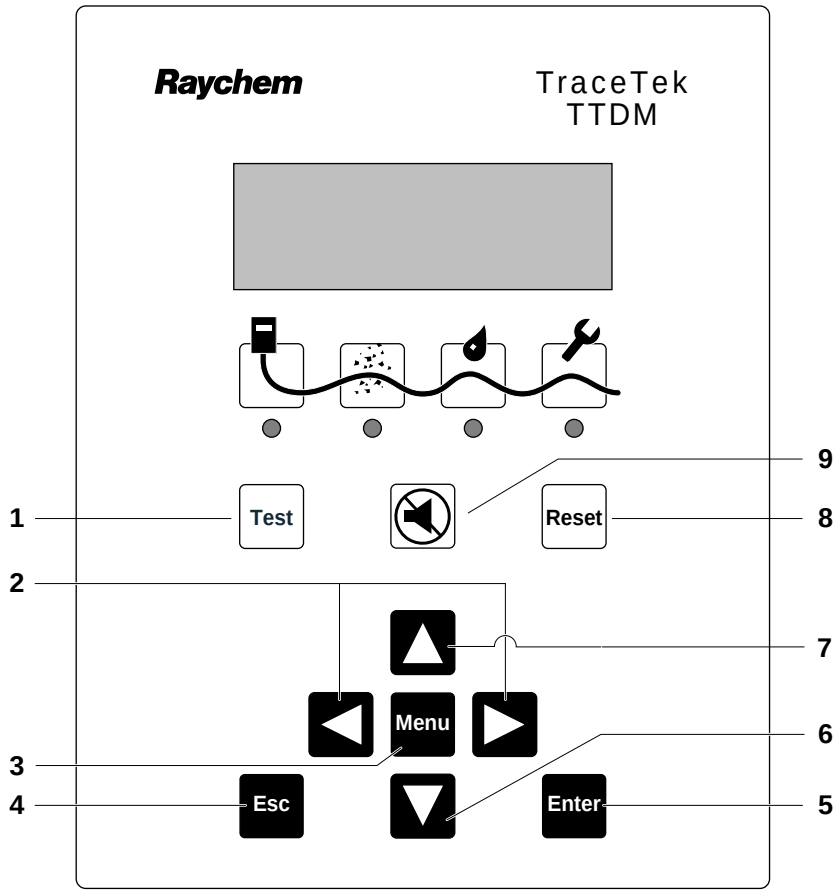
Hint: The LCD contrast may be adjusted (feature ㉔ in the diagram on the inside cover).

If no new alarm conditions exist, the LCD display scrolls through each connected SIM channel in sequence. The LCD presents the current event/status screen for each channel for about 4 seconds, then continues to the next available SIM channel number (and scrolls back to the first after the last channel).

If the TTDM-NMM detects a new Service, Fault, or Leak event, it immediately jumps the display to the SIM channel affected, turns on the LCD back light, and pauses at that channel number for several minutes.

Note: Use the left and right arrow keys to manually select the channel displayed.

The TTDM-NMM Keypad



1. Test	Triggers a limited series of self-tests; additional self-tests are accessed through the menu (see p. 22)
2. Left/right arrows	- In Current/Events Status display, manually select the channel displayed. - In menu selections, select digit to change.
3. Menu	Accesses menu of display and setup options (see “Navigating the Menu Structure” on page 13).
4. Esc	Goes back (up) one level in menu structure. ***Hint:*** Pressing Esc multiple times returns to the Current/Events Status display.
5. Enter	Selects a menu option.
6. Down arrow	- In Current/Events Status display, accesses detailed status information for the channel currently displayed (see page 14 for detail). - In menu selections, scrolls down through displays and menu options.
7. Up arrow	Scrolls up in status displays and menu options.
8. Reset	Resets the Leak alarm relay (if and only if all leaks have been cleared); see next section for details.
9. Silence	Silences the audible alarm.

Leak Detection and Location Events

A Leak Alarm

When liquid is detected by sensing cable in any channel, the following occur:

- The audible alarm sounds.
- The red Leak LED illuminates.
- The display changes to show the channel and location of the leak.
- The interfaces signal the event (Leak relay, 4-20 mA , and serial port)

```
CH01 USER_LABEL_0001
Leak 1662 ft

HH:MM  DD-MON-YYYY
```

The following actions should be taken:

- Silence the alarm (if necessary).
- Locate the leak.
- Clear the system.
- Reset the leak relay. (This occurs automatically if Auto-Reset is enabled; see page 19.)

Hint: If audible alarms are not required, the module can be set to disable them (see “Audible Alarm” under “Leak Setup” on page 19).

To Locate the Leak

Using the channel number and location displayed by the TTDM-NMM, refer to the system map and determine where the leak was detected.

To Clear the System

Fix the leak and clean up the area affected. Then dry the sensing cable (in the case of TT1000 and TT3000) or replace the tripped section (TT5000 series). Once the sensing cable is clear, the module responds and the display changes:

```
CH01 USER_LABEL_0001
Leak Cleared
Press reset
HH:MM  DD-MON-YYYY
```

Notice that the red LED remains on. This is to indicate that the leak relay is still in the alarm state.

To Reset the Leak Relay

In order to reset the leak relay and return the module to the “SIM Normal” state, press the reset button. Before doing so, check that any external equipment controlled by the leak relay is ready to be reset.

Once the Reset button is pressed, the relay returns to normal, the red Leak LED extinguishes, and the LCD returns to the normal display.

Hint: If manual reset is not required, the TTDM-NMM can be set to auto-reset; see page 19.

Service Events

Introduction

A TraceTek sensing circuit consists of two electrical loops (a diagram of the sensing circuit is shown in Appendix 3). The TTDM SIM module constantly monitors to see whether current is passing between the loops. When the system is normal, there is no current passing between the loops. When there is a leak on the system, the maximum current flows (just 270 µA; the sensing cable operates on low voltage and is safe to touch).

If, however, the TTDM-SIM module detects a lower but significant level of current flow between the loops, it communicates with the NMM module to activate the Service alarm.

A low-level current could indicate one or more of the following:

- A very small leak (which may soon develop into a full leak alarm).
- Heavy condensation or small spills (coffee, tea, etc.) on a sensing cable for water or aqueous solutions (TT1000 and TT3000).
- Conductive material on a sensing cable for water or aqueous solutions. The material might be metal filings, concrete dust, flux, mastic, or other construction debris, or carbon-based dust from air-handling units, printers, or copiers.

While it is recommended that service alarms be investigated, the operation of the system is not threatened; the TTDM-SIM and TTDM-NMM will continue to detect leaks. However, the accuracy of location may be affected in certain cases.

The Service Alarm

When the TTDM-NMM detects a condition requiring service (such as described above), it signals the event by taking the following actions:

- Sounds an intermittent beep.
- Illuminates the yellow Service LED.
- Switches the service relay to alarm condition.
- Changes the LCD display to the following:

```
CH01 USER_LABEL_0001
Service Req'd  [147]

HH:MM  DD-MON-YYYY
```

The number in square brackets indicates the estimated location of the material causing the alarm. The number is shown with square brackets to indicate that the value is only an estimate.

Hint: Because the cause (concrete dust, for example) of low-level current may be distributed over several feet/meters of cable, it is not always possible for the TTDM-NMM to report an accurate location. However, the indicated location is always a good point from which to begin a troubleshooting procedure.

The following actions should be taken:

- Silence the audible alarm.
- Clear the cable.

To Clear the Cable

Investigate the cause of the alarm and conduct cleanup or maintenance accordingly.

Hint: If material causing a service alarm is spread throughout the system, it is often useful to subdivide the system; see “Appendix 4 - Maintenance” for further information. When the material (such as moisture or concrete dust) or conditions causing the alarm are removed, the yellow LED goes out, and the service relay and the LCD display automatically return to their normal state. No reset is required.

Fault Events

Introduction

Several conditions could lead to a fault alarm:

- A cable is disconnected.
- A cable is damaged.
- A connection is damaged.
- A specific SIM module is damaged.
- Communication is lost between the NMM and one or more SIM modules.

What the NMM Module Does

The following shows how the alarm display would appear if the fault were caused by a broken or disconnected cable:

```
CH01 USER_LABEL_0001
Cable Break

HH:MM  DD-MON-YYYY
```

The TTDM-NMM would display a different message for a different type of fault, such as a loop imbalance or loss of communication to a specific SIM module.

When a fault condition is detected, the following occur:

- An audible alarm sounds.
- The red Fault LED illuminates.
- The LCD displays a message appropriate to the fault condition.
- The interfaces signal the event (Fault relay, 4-20 mA , and serial port).

To Remedy the Problem

Find the problem and rectify. This may mean reconnecting the cable, or finding the damaged section and replacing it. If the cause of the fault is not obvious by visual inspection, it is often useful to subdivide the system and test individual sections with a TraceTek Portable Test Box.

As soon as the fault is rectified, the relay, LED, and LCD display return to their normal state.

Multiple Events

Simultaneous Events on Different SIM Channels

The TTDM-NMM is capable of monitoring as many as 16 sensing circuits (using 15 external SIM modules plus its own internal sensor interface card). Each SIM operates independently of other SIMs in the leak detection network. The TTDM-NMM tracks information for all SIM channels and is capable of handling multiple events that occur in the same time frame. Any new event takes precedence on the LCD display. The LCD display will pause temporarily on the most recent event, giving the local operator time to read the LCD message and take action. After pausing several minutes on the most recent event, the TTDM-NMM display resumes automatic scrolling through each connected SIM channel.

At any time, the operator may manually select a channel by using the left or right arrow keys. When a channel has been selected manually, the display pauses on the selected channel for several minutes before scrolling resumes.

Multiple Events on a Single SIM Channel

In some circumstances, multiple events may occur on a single SIM channel. The system continues to monitor during Service and Leak alarms, ensuring that the installation provides full-time protection. The TTDM-NMM stores all events in memory, and in addition updates the display based on the sequence of events in a SIM channel.

Moving Leak

The TTDM will re-alarm when the leak moves more than the re-alarm distance, for which the default is 5 ft (1.5 m). The audible alarm will sound, the third line of the LCD will change, and a new event will be added to the Events History.

Example:

Suppose a leak is detected at 370 feet:

```
CH01 USER_LABEL_0001
Leak 370 ft

HH:MM  DD-MON-YYYY
```

Before the problem can be dealt with, the leak spreads. Once the module has detected significant movement (that is, greater than the re-alarm distance, a Leak setting described on page 19), the NMM module goes into alarm once again:

```
CH01 USER_LABEL_0001
Leak  370 ft
Re-Alarm  365 ft
HH:MM  DD-MON-YYYY
```

The LCD now displays:

- the **first leak** on the second line *and*
- the **most recent** alarm on the third line.

The **first leak** recorded on the SIM channel is likely to be close to the source of the leak.

The **most recent** leak shows the current “electrical center” of the liquid (essentially a weighted average). If the Re-Alarm number is close to the first (as in the example above), it is likely that the leak has spread.

Should the leak continue to spread, the TTDM would re-alarm again; the second line is updated again:

```
CH01 USER_LABEL_0001
Leak  370 ft
Re-Alarm  360 ft
HH:MM  DD-MON-YYYY
```

Hint: Use the Events History to track the events between the “first leak” and the “most recent event.” See “The Events History Log” section on page 16.

Additional Leak

If liquid contacts sensing cable in a SIM channel away from the initial leak, the module will re-alarm. If the location is distant from the last alarm, the TTDM shows a location in square brackets:

```
CH01 USER_LABEL_0001
Leak  370 ft
Re-Alarm  [205]
HH:MM  DD-MON-YYYY
```

Brackets indicate that the value shown requires interpretation; when an additional leak occurs, the value represents the “electrical center” of the leaks.

Service-to-Leak Alarm

Although the TTDM-NMM and -SIM system can continue to monitor a channel when a Service Required alarm is in effect, the accuracy of location may be impaired.

Example:

```
CH01 USER_LABEL_0001
Service Req’d [257]

HH:MM  DD-MON-YYYY
```

If sensing cable on that SIM channel detects a full-fledged leak before service is performed, the NMM displays a new leak alarm. If the location measured is nearly the same as the earlier Service Required alarm, the display would appear as below:

Leak at *same* location as Service Req’d

```
CH01 USER_LABEL_0001
Leak  257 ft

HH:MM  DD-MON-YYYY
```

If the leak location is different from the earlier Service Required alarm, the NMM shows a slightly different display:

Leak at *different* location from Service Req’d

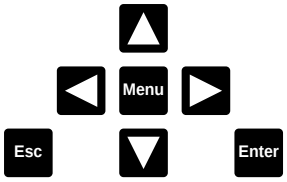
```
CH01 USER_LABEL_0001
Leak     [190]

HH:MM  DD-MON-YYYY
```

The TTDM-NMM indicates the uncertainty about the leak location (due to the prior Service Required alarm condition) by showing the location in brackets.

Navigating the Menu Structure

Please refer to “Appendix 1 - Menu Structure” for an overview of the menu structure, and refer to the diagram on page 7 to locate the menu keys shown below:



From the Current Event/Status display:

Press the **down arrow** key to access detailed status information for the channel currently displayed (described in detail on next page).

Press the **left** and **right arrow** keys to manually select the channel displayed.

Press the **Menu** key to access the many display and setup features in this section.

Use **up** and **down arrow** keys to scroll through menu options and status displays.

Use the **left** and **right arrow** keys to select individual characters.

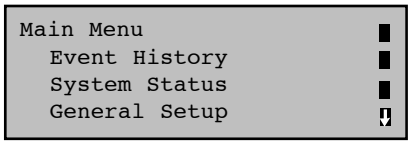
Press **Enter** to make a selection or go one level deeper into the menu structure.

Press **Esc** to go back (up) one level in the menu structure.

Note: If the unit is left in a menu display with no key presses for roughly 30 minutes, it automatically returns to the Current Event/Status display.

The Scroll Bar

The scroll bar (see example below) indicates that there is more information offscreen; an arrow indicates the direction of further information.



Menu Options

The following are the options presented at the **Main Menu** level:

- Event History
- System Status
- General Setup
- Leak Setup
- SIM Network
- TTDM Network
- Self-Test

Entering a Password

When a user attempts to change a restricted setting, the TTDM-NMM displays a password prompt. The factory default password is 0010 (to change the password, see page 18). To enter the password, proceed as follows:

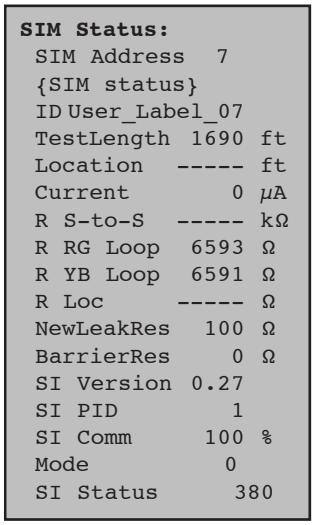
- Use **left/right arrow** keys to move to each digit.
- Use the **up/down arrows** to increase/decrease the number.
- Press **Enter** when complete.

Note: Once the password is entered, it remains in effect (allowing access) until exit from the main menu to the normal display mode, or until there has been no keypad activity for 30 minutes.

Status of Individual SIM Channels

The NMM offers access to detailed real-time status information for each SIM channel. The status display for an individual SIM channel is accessed from the Current Event/Status display (the normal display mode):

- If in a menu, press **Esc** one or more times to return the display to the normal display mode.
- Use the **left** or **right arrow** keys to select the SIM channel of interest.
- Press the **down arrow** to access the detailed status information (as shown below) for the selected channel.



Note: Only four lines are displayed at one time. Arrows in the scroll bar indicate if other entries can be accessed with the up or down arrow keys. A description of each type of information available in SIM Status appears below:

SIM Address — Channel number for information in current display

SIM status — This is a variable field, which can contain any of the following text, depending on the state of that SIM channel:

- SIM Normal
- Leak
- Re-alarm
- Service Required
- Fault (for specifics, see “Appendix 2 - Events History”)

ID — An alphanumeric label specified by the user (maximum 14 characters). The default value is User_Label_xx where xx is the SIM channel number.

Test Length — Total length of sensing cable attached to the selected SIM. The test length should be the same as that recorded when the channel was mapped. If the length is not the same, it may mean that the system was modified (sensing cable was removed or added).
Note: The Test Length is typically about 1% longer than the physical or mapped length for the channel; this is normal.

Location — The current location — or electrical center — of the leak (or cause of a Service alarm). If the status is Normal, the Location entry is blank.

Current — This current (measured in µA) indicates the condition of the sensing cable. If a leak is detected in the channel, this rises to 270 µA. In a clean, leak-free sensing circuit, the current should be 5 µA or less. If the current rises above 20 µA, service is recommended, as it may indicate the presence of contamination. To better understand what the current means, see “Appendix 3 - Technical Data on TraceTek Operation,” which explains the TraceTek operating principle.

R S-to-S	This is the resistance from sensing wire to sensing wire (see Appendix 3 for detail). For a clean, leak-free sensing circuit, this resistance is in the MΩ range. If liquid is detected, it drops to the kΩ range or even lower. If the value is changing, it may indicate an event in progress.
R RG Loop, R YB Loop	These are the resistances of the Red-Green and Yellow-Black loops in the TraceTek sensing circuit (see Appendix 3 for detail). If these values are significantly different from each other, it may indicate damage to a sensing cable or connector.
R Loc	This is the resistance measured along the black sensing wire to the location of the leak (see Appendix 3 for detail).
NewLeakRes	This variable is used by the microprocessor to distinguish between a Re-alarm event and a new leak.
BarrierRes	This user setting is for the resistance of the zener safety barrier (if installed); the leak location algorithm subtracts this barrier resistance to "zero out" the barrier effect on the system map.
SI Version	This indicates the software version operating in the sensor interface microprocessor.
SI PID	This product code for the SI board is used by the NMM processor to recognize the type of SI card.
SI Comm	This indicates the success rate (in percent) for communications between the NMM and the SIM channel selected. A value below 90% may indicate a faulty connection or damaged RS-485 cable.
Mode	This index for the SI software location algorithm may assist factory personnel providing diagnostic support.
SI Status	This value indicates SIM solid state switch status and may assist factory personnel providing diagnostic support.

Modifying Settings for Individual SIM Channels

To change the alphanumeric tag for the selected SIM channel:

- Select the appropriate SIM channel as described previously in this section.
- Use the up and down arrows to select ID.
- Press **Enter.**
- Use the **left** and **right arrows** to select a character space to modify.
- Use the **Reset** key to "tab" between Letters, Numbers, and blank.
- Use the **up** and **down arrows** to cycle through all available characters until the desired character is displayed. There are numerous punctuation, currency, Katakana, and non-English alphabetical characters available. Going "up" or "down" cycles through all available characters.
- Press **Enter** once label has been set up.

To change the barrier resistance for the selected SIM channel:

- Select the appropriate SIM channel as described previously in this section.
- Use the **up** and **down arrows** to select BarrierRes.
- Press **Ente**r.
- Enter password when requested.
- Use the **left**, **right**, **up,** and **down arrows** to input a value for the DC resistance of the system zener barrier (if installed).
- Press **Enter** when done.
  Important: Always set the barrier resistance before mapping the sensing circuit connected to a SIM. Changing the barrier resistance changes all mapping references, which will invalidate a map created prior to the change.

Events History Log

One extremely useful function provided by TTDM-NMM is the ability to record a series of events. The TTDM module keeps track of a list of 256 events.

For a full list of event types, please refer to “Appendix 2 - Events Glossary.”

Events in the events history log may be specific to one SIM channel or may refer to the NMM module (such as user interactions).

Accessing the Events History Log

- Press **Menu**
- Select Events History (scroll if necessary with the up or down arrow key)
- Press **Enter**

The most recent (that is, current) event is displayed first.

Typical NMM Event

```
Events History
Alarm Silenced
HH:MM  DD-MON-YYYY
```

Typical SIM Event

```
Events History
CH01 USER_LABEL_0001
Leak 237 ft
HH:MM  DD-MON-YYYY
```

An arrow at the bottom right-hand corner indicates that there are further events “below” (before) this one.

The bottom line of the display indicates the date and time the displayed event was recorded.

- Press **down arrow** key. The previous event is displayed.
- Press **down arrow** key again. The third from last event is displayed.

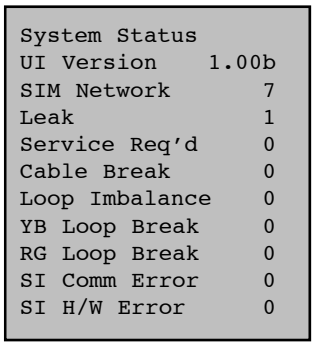
Hint: To quickly move to a view of the most recent event, press the **right arrow** key. To move to the oldest event, press the **left arrow** key.

The TTDM-NMM can store up to 256 events. If 256 events are already stored, the oldest event is discarded as a new event is registered.

System Status

Summary Information for the Entire NMM/SIM System

System Status provides a real-time view of the status of the TTDM-NMM system. You gain access to this feature through the **Main Menu**. When System Status is selected, the TTDM displays the following:



Note: Only four lines are displayed at one time. The arrow at the bottom right (in the scroll bar) indicates other entries can be accessed with the **down arrow** key. A description of each type of information available in System Status appears below:

UI Version — This identifies the version of the User Interface Software that is operating in the TTDM-NMM.

SIM Network — This indicates the number of SIM units in the leak detection network (the Sensor Interface board internal to the TTDM-NMM is counted as 1).

Leak — This indicates the number of SIM channels that presently have the status "Leak."

Service Req'd — This indicates the number of SIM channels that presently have the status "Service Req'd."

Cable Break — This indicates the number of SIM channels that presently have the status "Cable Break."

Loop Imbalance — This indicates the number of SIM channels that presently have the status "Loop Imbalance." (Note: Loop imbalance can be an early indicator of cable corrosion or damage.)

YB Loop Break — This indicates the number of SIM channels with a broken Yellow/Black loop.

RG Loop Break — This indicates the number of SIM channels with a broken Red/Green loop.

SI Comm Error — This indicates the number of SIM channels failing the minimum communications level test.

SI H/W Error — This indicates the number of SIM channels reporting internal hardware errors.

General Setup

Access the General Setup menu from the **Main Menu**. The General Setup menu has the following sub menus:

- Time/Date
- Units
- Language
- Password

Time/Date

Use the **left**/**right arrow** keys to select each digit. Use the **up**/**down arrow** keys to increase/decrease the number.

Units

Use the cursor to select feet, meters, or zones as required.
Important: The unit of measure applies for all SIM channels in the system.

Do not choose zones unless all SIM channels include only TraceTek zone sensing cables with zone connectors; see the *Product Selection Guide for TraceTek Zone Systems* (Raychem document H56012) for details on the restrictions with a zone system. Note that a TraceTek zone system can always be mapped as a locating system (with each zone defined by a length range rather than a zone number), so a zone system can (with some limited amount of work translating the map) be integrated into a network that displays location in feet or meters.

Language

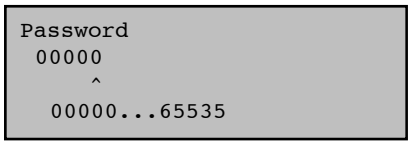
Select from available options (English, Français, Deutsch, Espanol, Japanese).

Password

Entering a Password

When the user attempts to change a restricted setting, a password prompt appears.

- Use the **left/right arrow** keys to move to each digit.
- Use the **up/down arrows** to increase/decrease the number.
- Press **Enter** when complete.



The module is supplied from the factory with the password 00010.

Changing the Password

- Enter the old password if requested.
- Enter the new password (using the **arrow** keys) and press **Enter**.

Hint: If password protection is not required, set the password to 0000. After that, you will not be prompted for a password.

Leak Setup

Gain access to the Leak Setup menu through the main menu. The Leak Setup menu has the following submenus:

- ReAlrmDist (Re-Alarm Distance)
- ReAlrmInt (Re-Alarm Interval)
- Auto Reset
- AudibleAlrm
- Sensitivity
- Service Req'd

These parameters determine alarms for all SIMs, and password entry is required to change them.

Re-Alarm Distance

This is the distance over which the electrical center of the leak must move before TTDM-NMM will re-alarm. It can be set between 3 ft (1 m) and 20 ft (6 m); the factory default is 5 ft (2 m).

Re-Alarm Interval

The TTDM can be made to re-alarm automatically if a leak has not been cleared after a certain length of time. Choose from:

- Never (factory default)
- 8 hr
- 12 hr
- 24 hr

Hint: Use this to automatically alert the next shift when the system has an uncleared leak.

Auto Reset

By default, TTDM-NMM requires a manual reset following a leak event. This allows the user to, for example, verify that any equipment controlled with the Leak relay is ready to be switched back on.

If Auto Reset is set to "On," the leak relay will automatically reset as soon as the leak has been cleared.

- Select Auto Reset Off/On.

Audible Alarm

The audible alarm may be disabled if not required.

- Select: Audible Alarm On/Off.

Hint: The volume may be adjusted (see feature ㉓ in the diagram on the inside front cover).

Sensitivity

The leak detection sensitivity is adjustable. Select:

- **Normal** (factory default) for most applications
- **High** for deionized water
- **Low** for particularly active or exposed applications
- **TT500x** only for systems using ***only*** hydrocarbon-sensing cables

Service Req'd

The threshold for Service Required alarms may be adjusted with these options:

- Normal (factory default)
- High
- Low
- Never

SIM Network

Access the SIM Network menu from the main menu. The SIM Network menu has the following submenus:

- SIM Address
- Init Network
- Update Network

SIM Address

This command allows the user to assign a new address to a SIM unit from the TTDM-NMM. This function is vital to starting up a new leak detection network of TTDM-SIMs.

To assign an address to an individual TTDM-SIM, the TTDM-NMM must communicate unambiguously with that SIM. This is accomplished by setting the initial address for a new SIM to 0 before it is connected to the RS-485 network. Any SIM can be forced to address 0 by placing a jumper clip on J1 at the lower left corner of the Sensor Interface board (see Appendix 5 for details).

To add a new SIM to the leak detection network and assign it an address

Install the SIM in accordance with the *TTDM-SIM Installation Instructions* (H56314) that accompany it. Then complete the following steps:

1. Verify that factory-installed jumper clip is in place at J1 (see Appendix 5 for details); the jumper clip forces the SIM address to 0 when the SIM is powered.
2. Connect the SIM to the TTDM-NMM RS-485 network (see Appendix 5 for details) and power the SIM.
3. Use the TTDM-NMM's SIM Address function to assign a new (non-zero) address to the SIM.
   a. Press the **Menu** key to access the main menu.
   b. Select **SIM Network** and press **Enter.**
   c. Select **SIM Address** and press **Enter.**
   d. Use the **arrow keys** to select SIM Address 0.
   Important: Be careful to select channel 0, so you are changing the address intended.
   e. Press **Enter.**
   f. Select **New Address** and press **Enter.**
   g. Set the new address to an unused SIM address from 01 to 15 (note that address 01 is the factory default for the Sensor Interface board on the TTDM-NMM).
   Important: Be sure to assign a unique SIM address, or communications problems will result.
   h. Press **Enter.**
   i. Remove the jumper clip from J1 (the display will prompt you to do this).
   l. Press **ESC** several times to return to the monitoring display.
4. Repeat as necessary for each SIM added to the network.

Note: Do not add more than one new SIM to the network at a time; assign each new SIM an address other than 0 before proceeding with the next SIM.

Init Network

Use this command to initiate the NMM/SIM network once all attached SIMs have been assigned unique addresses. When this option is selected, the NMM immediately searches all 16 possible addresses to determine which SIM channels are active.

Also use this command if you have removed one or more SIMs from the leak detection network.

Update Network

Use this command when adding a single SIM to an existing network.

Note: Use the Update Network command only to *add* SIMs to an existing network; use Init Network to trigger the TTDM-NMM to recognize that one or more SIMs have been removed.

TTDM Network

Access the TTDM Network menu through the main menu. The TTDM-Network menu has the following submenus:

- Baud
- Modem
- 485 Address
- Modbus
- Terminal
- Print Events

These parameters affect only the serial port for *external* communications (feature 19 in diagram on inside cover). The first four submenus require a password to make a change.

Baud

Use this option to select the baud rate of the external communications serial port. Standard values from 600 to 19200 baud are available. Default is 9600.

Modem

This menu item provides access to three submenus:

- **Auto Answer** causes a text string to be sent to the external serial port, which will set a Hayes-compatible modem to autoanswer mode.
- **Dial** allows the user to program an 11-digit numerical string into the menu.
  Hint: Use the **Reset** Button as a “tab” to jump to the numerical character. When **Enter** is pressed (after selecting the final digit in the numeric string), the dial commands and the numeric string are sent to the serial port to command an external Hayes-compatible modem.
- **Hang-up** allows the user to send a hang-up command to an external modem attached to the serial port.

485 Address

When more that one TTDM-NMM is connected to a host computer on an RS-485 network, each TTDM-NMM unit must be assigned a unique address. This menu allows the user to assign the TTDM-NMM an RS-485 address (the default address is 1). An address of 0 through 20 hex can be selected; however, 0 and 20 should be reserved for testing only. Using addresses 1 through 1F hex allows as many as 31 TTDM-NMMs on one network.

Modbus

Use this menu to select the correct Modbus protocol type, as used by the host computer, either **ASCII** or **RTU**.

Terminal

Use this option to view a one-line display of characters being sent to or received from the TTDM-NMM external communications serial port.

Print Events

Use this menu selection to send an ASCII text message through the serial port to an attached serial device (either a directly connected PC running a terminal-emulation program, a serial printer, or a modem). This function allows the user to download all events in the Event History memory for later analysis. Do not use this when connected to a Modbus network, as it may disrupt communications.

Self-Test

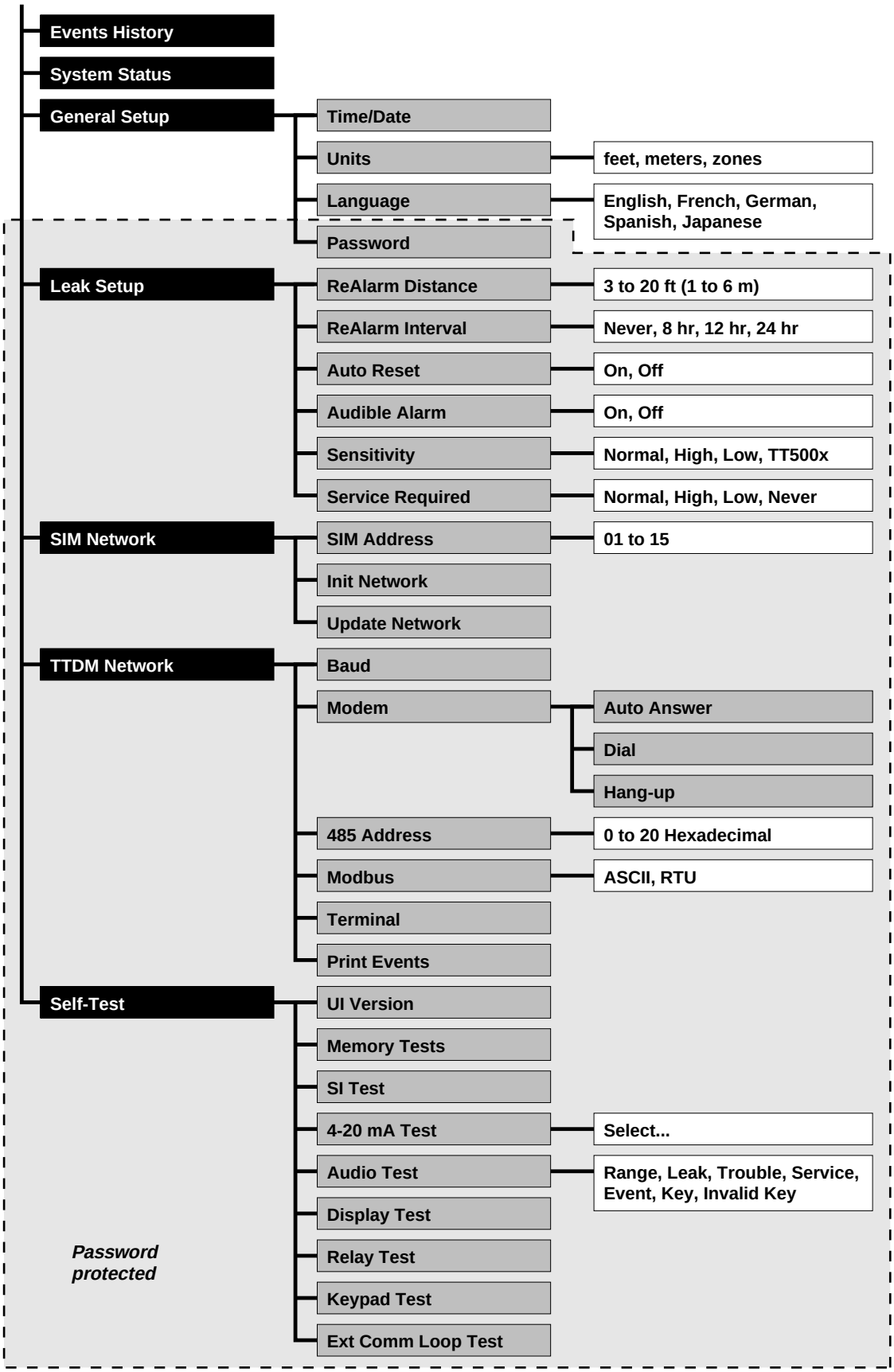
The Self-Test menu provides access to specific user-selected test routines:

- UI Version
- Memory Tests
- SI Test
- 4-20 mA Test (see “Appendix 6 - Connection to Other Devices” for details)
  - Electronics Fault
  - SI Comm Error
  - Cable Break
  - Loop Imbalance
  - Service Req’d
  - System Normal
  - Leak (user selects location)
  - 20 mA Val
  - 4-20 mA SIM
- Audio Test
  - Audio Range
  - Alarm Audio
  - Trouble Audio
  - Service Audio
  - Event Audio
  - Key Audio
  - Invalid Key Audio
- Display Test
- Relay Test
- Keypad Test
- Ext Comm Loop Test (see “Appendix 6 - Connection to Other Devices” for details)

The Self-Test menu is password-protected to prevent inadvertent emergency response activity, because in many installations the leak relay or 4-20 mA output may be connected to external systems. Always notify the appropriate response personnel before using the Relay Test or 4-20 mA Test to alter their outputs.

The first three tests are also accessed by pressing the **Test** key when the display is in the Normal Display Mode. This key is not password protected.

Appendix 1 – Menu Structure



Appendix 2 – Events Glossary

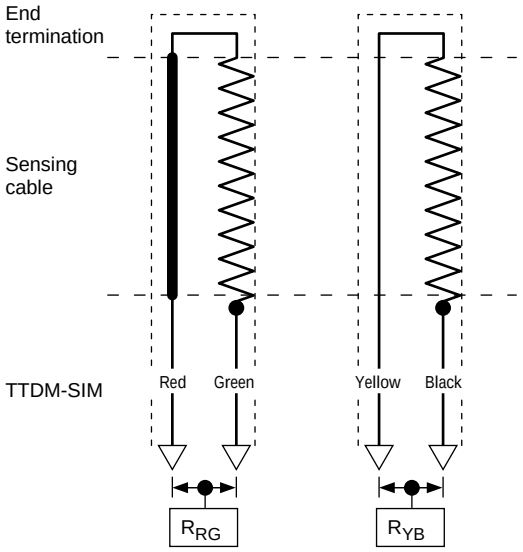
Type of Event	Message	Description
Power	Power Down	The time the power was last supplied to the TTDM-NMM is stored in nonvolatile memory and is entered into the Events History log when power is restored.
	Restart	The Events History log records when power is supplied to the unit or when the unit is manually restarted.
Leak	Leak	Liquid detected at the displayed channel and location.
	Re-Alarm	Occurs under three different situations: • Location changed past Re-Alarm threshold. • New leak location is more than 25 feet from the last stored location on the channel (new average is shown in brackets). • Automatic Re-Alarm after the Re-Alarm interval (a user setting) if the leak condition still exists.
	Leak Cleared	Displayed when channel status returns to normal after a leak is cleared.
	New Leak	A new leak on a channel is detected after an earlier leak is cleared but before the leak relay is **Reset**.
Fault	Cable Break	Loss of continuity in both loops of the sensing circuit. May be caused by broken or disconnected sensing cable, jumper cable, or connections.
	YB Loop Break	Break in the Yellow/Black loop of the sensing cable; see Appendix 3 for description of the sensing circuit.
	RG Loop Break	Break in the Red/Green loop of the sensing cable.
	Loop Imbalance	Resistance of the two cable loops indicates more than 25% difference in measured resistance. May be early indication of cable deterioration or damage, or electrical contact of one sensing wire with a ground (earth) path.
	Cable Restored	Displayed when cable returns to normal after any fault condition.
	SI Comm Error	Communications problem between NMM unit and any installed SIM channel.
	SI Comm Recovered	Displayed when communication with SIM unit is re-established.
	SI H/W Error	A self-test of the SIM unit has failed. The unit needs to be repaired or replaced.
	SI H/W Recovered	Displayed after a SIM hardware problem has been corrected.
Service	Service Required	A small amount of current is flowing between the two sensing wires in the sensing cable (see Appendix 3 for description of the sensing circuit). Usually caused by a small leak or buildup of contaminants. NMM may indicate the location in brackets if it can obtain consistent measurements.
	Service Clear	Displayed when the condition requiring service has been cleared (for example, the sensing cable is clean and dry).
User Action	(Settings) Changed	Whenever any user-setup parameter is changed, the event is logged in the Event History
	Alarm Silenced	Event History item
	Reset	Event History item

Appendix 3 – Technical Data on TraceTek Operation

TraceTek Operation Diagram

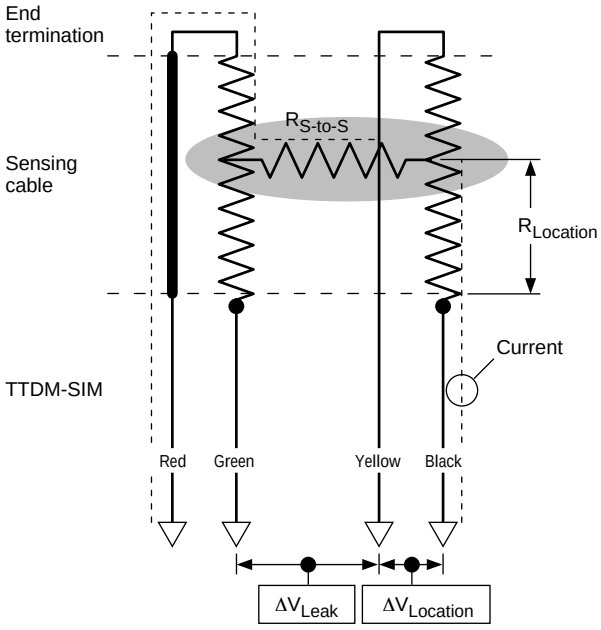
The TraceTek Sensor Interface Module (or board) measures resistance of each circuit loop independently to ensure the integrity of the circuit. The resistance of the Yellow-Black loop is used to compute the Test Length displayed in the detailed channel status screen (see page 14); it is based on a real-time measurement.

Loop Resistances and Test Length



The TraceTek Sensor Interface Module (or board) measures current “leakage” between the two sensing loops. When a leak is present, the module limits the current to 270 microamps, and measures the voltage difference between the yellow and black wires. The resistance along the black sensing wire to the leak is determined by a simple application of Ohm’s law (R = V/I). The resistance per unit length of the sensing wire is tightly controlled in manufacturing, so the location is easily computed.

Leak Current, Resistance, Location



Appendix 4 – Maintenance

Cleaning the Module

To clean the outside surface, use a damp cloth or sponge. Do not use solvents or abrasive cleaners and do not open the enclosure while it is wet (it is an electrical device).

Fuse Replacement

The fuse on the power supply board of the TTDM-NMM and TTDM-SIM units is a 200-mA, 250-V, quick-acting microfuse. It has an F1 rating, characteristic code F (quick-acting). Use no other type of fuse or the TTDM could be damaged or could fail to perform properly.

Routine Maintenance

It is recommended that the TraceTek system be thoroughly checked twice a year. Such a check will identify conditions that adversely affect the leak-locating capability of the system. More frequent checks may be required if the sensing cable is repeatedly exposed to leaks, or may be exposed to abuse due to construction or repair work. Contact your local Raychem TraceTek representative for further information on service support.

Storage and Handling of Sensing Cable

Despite their rugged construction, TraceTek sensing cables must be handled in a manner appropriate for a sensing device or they may be damaged and require replacement. Therefore, you should follow some basic rules for storing and handling all TraceTek sensing cables:

- Store spare cable in its original container in a clean, dry place until ready for installation.
- Schedule cable installation after all mechanical, plumbing, and electrical work has been completed.
- Clean the area where the cable is to be installed, and remove any obvious debris or other sources of contamination.
- Do not solder or weld near the cable without providing protection from heat, solder flux, or weld splatter.
- Do not drop tools or floor tile on the cable; sharp or heavy objects may damage the cable.
- Avoid walking or stepping on the cable. Provide shielding (for example, a half shell of plastic pipe) where additional protection is necessary.
- Do not use tape to secure sensing cable (some tapes and adhesives absorb moisture) or use solvents that could eventually cause an alarm.
- Do not drag sensing cable through contaminants (such as pipe dope, PVC cement, solvents, oil, or dirt).

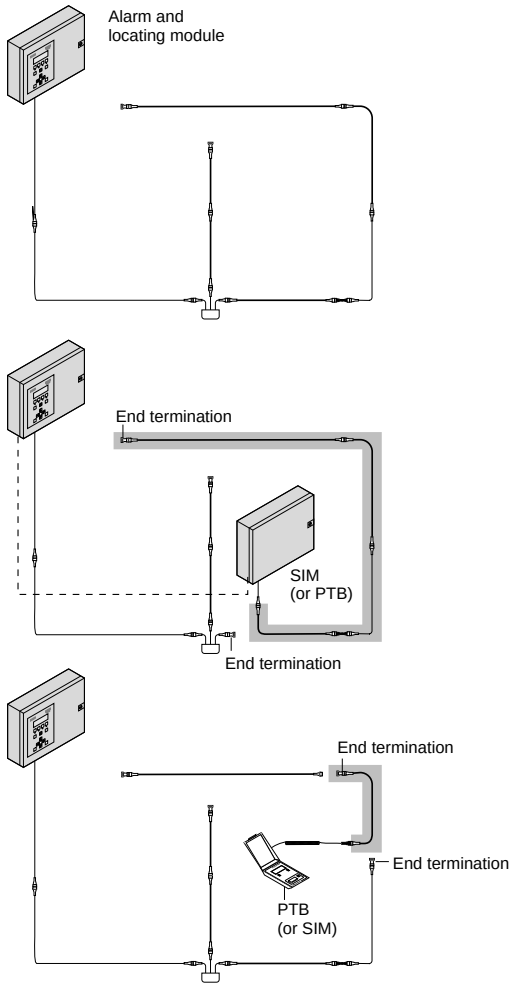
Investigating Leaks and Faults

If the location of a leak is not apparent, it is often useful to subdivide the leak detection circuit. To accomplish this, it is best to have a TraceTek Portable Test Box (PTB) or extra Sensor Interface Module, and an extra Modular End Termination. Contact your locate TraceTek representative to obtain these products.

To subdivide the system and isolate the problems, find a connection at a convenient point somewhere at the center of the detection circuit. You can then use a PTB or add an additional TTDM-SIM to test the “back half” of the sensing circuit (to verify circuit integrity, and to detect the presence of liquid and determine its location). If you install an end termination on the “front half” of the circuit (going back to the existing module), you can use that module to check the “front half” of the sensing circuit.

If you add a new SIM to the leak detection network (by connecting it to the RS-485 wiring connected to the TTDM-NMM), use the SIM Network menu and select Update Network to add the new SIM to the existing network. Examine the SIM Status of the new (“front half”) and old (“back half”) channels, and compare with the SIM Status of the former combined sensing circuit.

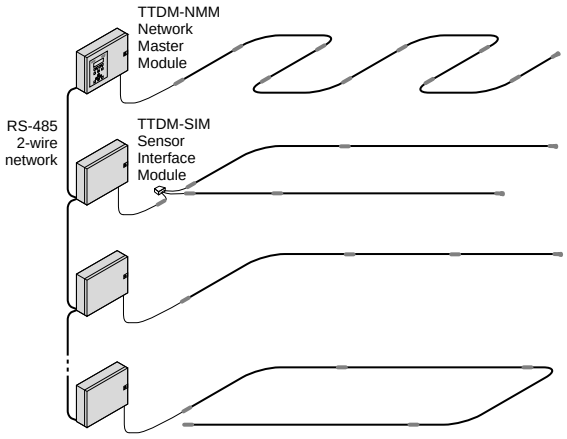
You can further subdivide the circuit, and even test individual lengths of cables. Even the most perplexing problems can usually be isolated and resolved using this methodical approach. If you wish to remove SIMs, remember to use the Init Network menu.



Appendix 5 – Connection of TTDM-SIMs to RS-485 Network

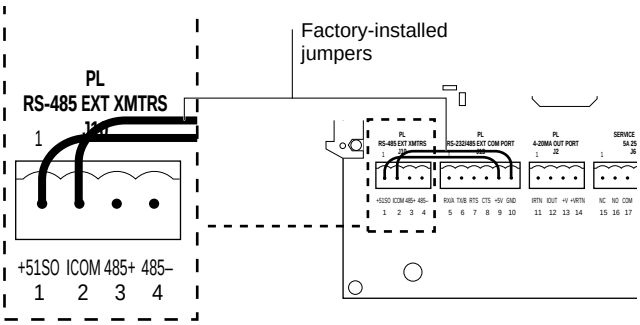
Leak Detection Network of TraceTek TTDM-NMM and TTDM-SIMs

In a network of TTDM-NMM and up to 15 TTDM-SIM modules, each TTDM-SIM Sensor Interface Module can independently monitor up to 5000 ft (1500 m) of sensing cable. The SIMs communicate with the TTDM-NMM Network Master Module (which provides the user interface) via an RS-485 network, as illustrated below. TTDM-SIMs are daisy-chained with RS-485 wiring (shielded cable with a twisted pair of wires 22 AWG or larger); the RS-485 wiring may have a total length of 4000 ft (1200 m).



RS-485 Wiring for Connection of SIM Network

To build the RS-485 leak detection network, connect the pair of wires in the RS-485 cable to connector J10 on the motherboard of the TTDM-NMM and TTDM-SIMs (feature ㉑ in the diagram on the inside front cover).



In the TTDM-NMM

- Connect the one wire of the RS-485 cable to pin J10-3; this wiring defines + polarity for the network.
- Connect the other wire of the RS-485 cable to pin J10-4; this wiring defines – polarity for the network.
- Connect and secure the shield of the RS-485 cable to the chassis ground/earth stud (feature ⑭ in the diagram on the inside front cover)

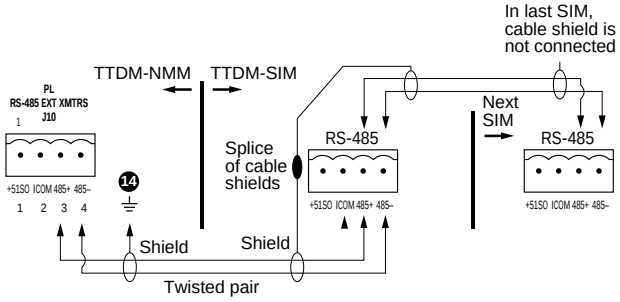
In Each TTDM-SIM

There will be both incoming and outgoing RS-485 cables unless the SIM is the last in the network string.

- Connect the + wire of each RS-485 cable (per polarity defined by connection in NMM) to pin J10-3.
- Connect the – wire of each RS-485 cable to pin J10-4.
- Splice the shields of incoming and outgoing RS-485 cables to each other. Do not connect the cable shields to the chassis ground/earth in each SIM (variations in ground potential can generate spurious currents).

Note: Do not connect and power more than one new SIM on the network without assigning each SIM a unique address (see next page for details). For guidance on the most practical approach to configuring the SIM network for your application, call (800) 553-1737 or (650) 361-4900 and request technical assistance.

Note: Do not exceed 4000 ft (1200 m) of interconnecting RS-485 cable.

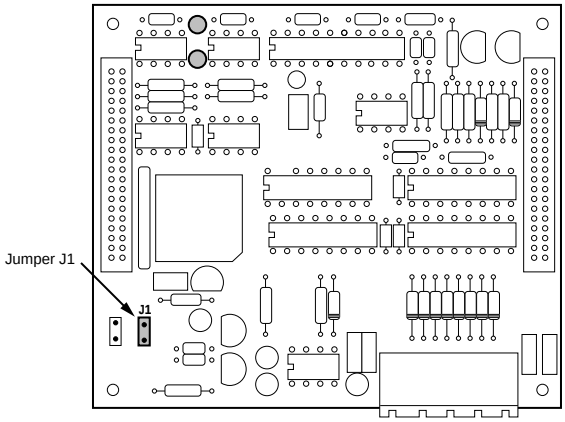


Assigning a SIM Address

When a TTDM-SIM is connected to the leak detection network, it must have a unique RS-485 address so that it does not conflict with other SIMs in the network. To establish the RS-485 address for a new SIM, the recommended approach is as follows:

1. Verify that the factory-installed jumper clip is in place on J1 at the lower left corner of the Sensor Interface board (the Sensor Interface board is feature ❾ in the diagram on the inside front cover; location of jumper J1 is illustrated at right). This jumper clip forces the SIM address to 0 when the SIM is powered.
2. Connect the SIM to the TTDM-NMM with RS-485 wiring (as described on previous page) and power the SIM.
3. Use the **SIM Address** function of the TTDM-NMM software (also described on page 19) to assign a new (non-zero) address to the SIM.
   a. Press the TTDM-NMM **Menu** key to access the main menu.
   b. Select **SIM Network** and press **Enter.**
   c. Select **SIM Address** and press **Enter.**
   d. Use the arrow keys to select SIM Address **0.**
      Important: Be careful to select channel 0, so you are changing the address intended.
   e. Press **Enter.**
   f. Select **New Address** and press **Enter.**
   g. Set the New Address to an unused SIM address from 01 to 15 (note that address 01 is the factory default for the Sensor Interface board in theTTDM-NMM).
      Important: Be sure to assign a unique SIM address, or communications problems will result.
   h. Press **Enter.**
   i. Remove the jumper clip from J1 (the display will prompt you to do this).
   j. Press **ESC** several times to return to the monitoring display.
4. Repeat as necessary for each SIM added to the network.
   - ***Important:*** Do not add more than one new SIM to the network at a time; assign the new SIM an address other than 0 before proceeding with the next SIM.

Sensor Interface Board
(feature ❾ in the diagram on the inside front cover)



Appendix 6 – Connection to Other Devices

Note: All connections to external devices are made at the TTDM-NMM.

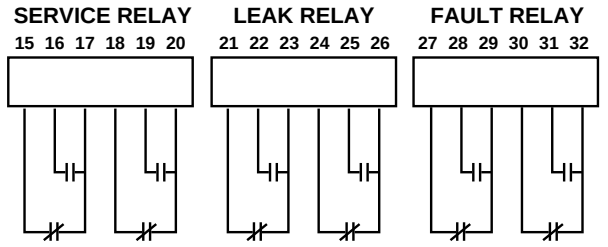
Relays

TTDM-NMM has three relays:

- Service
- Leak
- Fault

Relay Logic

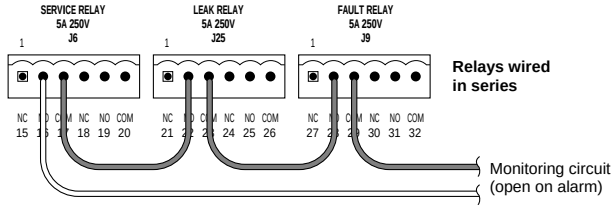
Each relay provides two Form-C relay contacts, with normally open and normally closed contacts both provided. The relays are de-energized to indicate an alarm condition. The diagram below shows the relay status when each is in an alarm (de-energized) state.



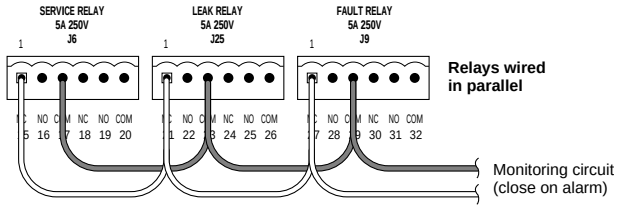
Wiring Options to Gang Alarm Relays on a Single Pair of Wires

The illustrations below show how the relays (features ⓯, ⓰, and ⓱ in the diagram on the inside front cover) can be jumpered together to allow remote monitoring of the TTDM-NMM system status with only a single pair of wires. The TTDM-NMM ***de-energizes*** its relays to signal an alarm condition. Therefore, loss of power as well as any other type of alarm would trip the remote alarm.

Open on Alarm



Close on Alarm



4-20 mA Interface

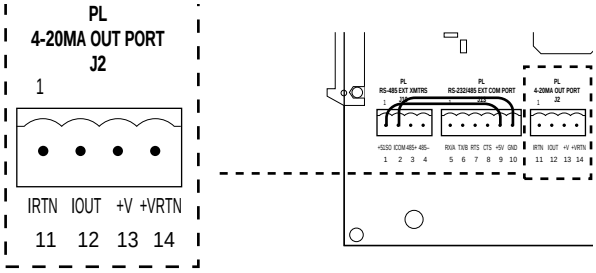
The module is equipped with an analog 4-20 mA interface which can communicate the status of a selected SIM channel. The TTDM-NMM adjusts its current output based on whether an alarm condition exists in the selected channel, and (when a leak is detected) on the location of the leak. The module's output can be scaled to make full use of the 4-20 mA range for the length of sensing cable connected to the selected SIM channel.

Important: The 4-20 mA interface communicates the status of a single SIM channel. The default SIM channel is the TTDM-NMM internal Sensor Interface board. To use the port for a different SIM channel, select **4-20 mA SIM** from the **4-20 mA Test** menu (as described at the end of this section).

Note: The current output is isolated from the sensing circuit and therefore requires an external 24 Vdc power supply.

4-20 mA Wiring

The 4-20 mA output port is connector J2 on the TTDM-NMM motherboard (feature ⓲ in the diagram on the inside front cover), with terminals as noted in the following table:



Pin	Desc.	Use
J2-11	IRTN	Current loop return
J2-12	IOUT	Current output
J2-13	+V	24 Vdc supply (required)
J2-14	+VRTN	24 Vdc common (required)

4-20 mA Output Signals

The TTDM-NMM adjusts its 4-20 mA output based on the leak detection status of the selected SIM channel, as detailed in the table below. The 4-20 mA board uses a 12-bit DAC (digital to analog converter), which means the 20 mA range is divided into 4096 increments; the DAC value used to set the 4-20 mA board output is listed in the table (and the DAC value can be accessed in Modbus register 30016).

Fault conditions
(coded into the 0-4 mA range for use by devices which have full 0-20 mA input capability)

Output (mA)	Description	DAC value
0	Electronics fault or loss of power	0
1.00	Fault — SIM communications	204
2.00	Fault — cable break	410
3.00	Fault — cable damage (loop imbalance)	614
3.50	Service Required alarm	716

Normal condition and leaks

Output (mA)	Description	DAC value
4.00	System normal	819
5.00–20.00	Leak — value scaled to indicate location of leak	1024–4095

Testing and Calibration of 4-20 mA Interface

When external equipment is connected to the TTDM-NMM 4-20 mA output port, the current loop can be tested and calibrated using the "**4-20 mA Test**" series under the **Self-Test** menu. Before conducting the tests, confirm that all connections have been made, including 24 Vdc to TTDM-NMM terminals J2-13 and J2-14. To conduct the 4-20 port tests, select **Self-Test** from the **Main Menu** (it is the last option), then **4-20 mA Test**. The options in the **4-20 mA Test** menu are:

Electronics Fault
SI Comm Error
Cable Break
Loop Imbalance
Service Req'd
SIM Normal
Leak (a submenu prompts for a location to simulate)

} Sets 4-20 mA output to simulate the condition selected

20 mA Val } Used to adjust the scale for leak location
4-20 mA SIM } Used to select the SIM channel communicated through the port

When the user makes a **4-20 mA Test** menu selection, the 4-20 mA port adjusts the current level to correspond to the condition selected (per table at bottom of page 31); the 4-20 mA output remains at that level until another selection is made. When the user exits the **4-20 mA Test** menu, the port returns to normal operating status, with current per the condition of the selected SIM channel.

Adjusting the 4-20 mA Scale

The scale of the 4-20 mA port is determined by the **20 mA Va**l. The value entered determines the upper bound — the location that results in the maximum current output of 20 mA. The default for this upper bound is 5000 ft (1500 m). To change the scale, select **20 mA Val** from the **20 mA Test** menu, then enter a new upper bound to provide a reasonable scale for the selected SIM channel. To confirm that the scale is acceptable, use the **Leak** option in the **4-20 mA Test** menu to simulate leaks at various locations and to verify that the output is as expected with the equipment or instrument connected to the 4-20 mA port.

Important: The upper bound must be greater than the Test Length which the TTDM-NMM displays as part of the Status of Individual Channels (see page 14).

Selecting the SIM Channel for the 4-20 mA Port

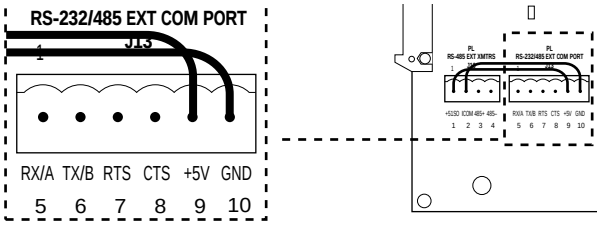
The 4-20 mA interface communicates the status of a single SIM channel. The default is SIM channel 01 (which is the factory setting for the Sensor Interface board inside the TTDM-NMM itself). To use the 4-20 mA port for a different SIM channel, select **4-20 mA Test** from the **Self-Test** menu, then **4-20 mA SIM** (the last menu item).

Serial Port

The TTDM-NMM module has a serial port (marked EXT COM PORT, feature 19 in the diagram on the inside front cover) that can be configured for use either as an RS-232 or RS-485 transceiver. The standard factory configuration is RS-232 full-duplex with no hardware handshaking, which is suitable for connection to many devices (such as a remote host PC, laptop, serial printer, or modem). The standard setup for the serial port is 9600 baud (adjustable in the **TTDM Network** menu), 8 data bits, no parity, and 1 stop bit. With the appropriate cable and software, a remote computer can send and receive data from a TTDM-NMM using a standard terminal emulation program. The TTDM-NMM follows the Modbus communication protocol (the user can select either ASCII or RTU mode), so it can be readily integrated into a building or facility management system.

Wiring Detail for External Communications Serial Port

The serial port for external communications (using either RS-232 or RS-485) is connector J13 on the TTDM-NMM motherboard (feature 19).

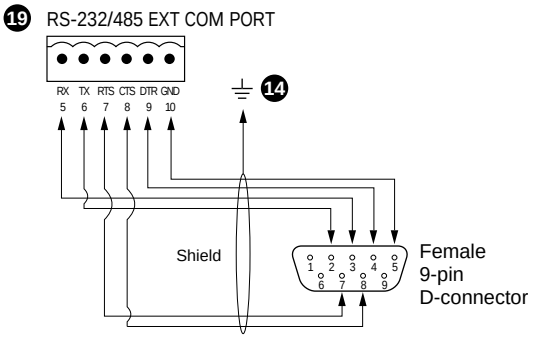


RS-232 communications may use either 3 wire (TX, RX, GND) or 5 wire (with optional RTS/CTS handshaking). RS-485 communications use 2 wire, half-duplex (A, B). The pinouts for connector J13 on the TTDM-NMM motherboard are listed below.

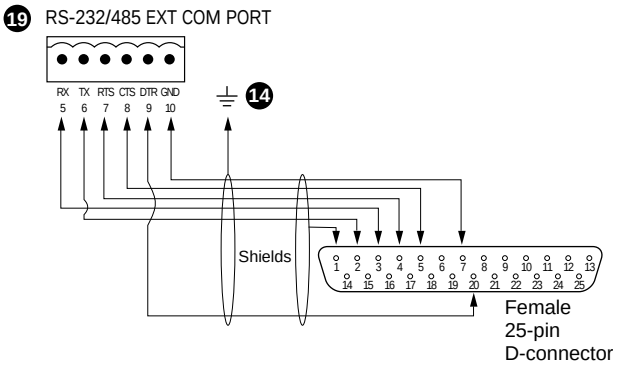
Pin	Desc.	Use
J13-5	RX/A	Receive data for RS-232 or A(+) terminal for RS-485
J13-6	TX/B	Transmit data for RS-232 or B(-) terminal for RS-485
The following pins are not used with RS-485:		
J13-7	RTS	Request to send — for hardware handshaking, with CTS (optional)
J13-8	CTS	Clear to send — for hardware handshaking, with RTS (optional)
J13-9	+5V/DTR	+5 V supply/DTR if needed by modem (optional)
J13-10	GND	Signal ground (earth)

Connections to External Communications Serial Port

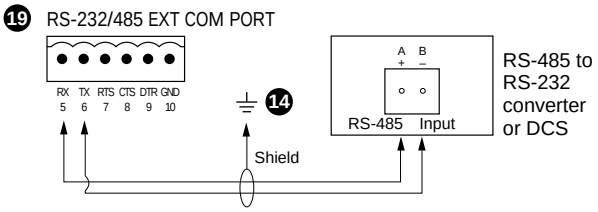
RS-232 Connection Using a 9-Pin D-cable



RS-232 Connection Using a 25-Pin D-cable



RS-485 Connection



Configuration and Testing of Serial Port

For many useful configuration and testing functions for the external communications serial port, select **TTDM Network** from the **Main Menu** (see page 21 for details). The options available in the TTDM Network menu are:

- **Baud** (adjustable from 600 to 19200 baud, with a default of 9600).
- **Modem** (which allows user commands to a Hayes-compatible external modem.
- **485 address** (which allows the user to assign an RS-485 to the TTDM-NMM; this is valid only if the unit has been configured for RS-485 communications).
- **Modbus** (which allows selection of the Modbus protocol, either ASCII or RTU; see Appendix 7 for details on the Modbus implementation).
- **Terminal** (which allows the user to view communications through the TTDM-NMM external communications serial port).
- **Print Events** (which triggers the TTDM-NMM to send the entire Events History as an ASCII message; this is useful with a serial printer or a PC running a terminal emulation program, but must not be used if the TTDM-NMM is connected to a Modbus network.)

When the serial port is configured for RS-232 communications, a quick test of the serial port hardware is available under the **Self-Test Menu: External Comm Loop Test** (the last option in the Self-Test menu). Before running the test, a short piece of wire must be connected between the RX and TX terminals (J13-5 and J13-6). This test does not work if the TTDM-NMM has been configured for RS-485 communications.

Communications with Host Using Terminal-Emulation Program

The TTDM-NMM is set up to communicate with a host system using the Modbus communications protocol. However, some communications are possible with a host system running a terminal-emulation program such as HyperTerminal (an accessory in Microsoft Windows 95 developed by Hilgraeve). To establish communications using a terminal-emulation program on a laptop or other host system, follow these steps:

1. In the **TTDM Network** menu, select ASCII as the **Modbus** setting.

2. Set up the communications properties in the terminal emulation program. The normal communications settings are:

Baud Rate	9600
Data Bits	8
Parity	None
Stop Bits	1
Flow Control	None (if making a direct connection); Hardware (if using a modem)

   Note: The baud rate of the TTDM-NMM can be changed under the **TTDM Network** menu. The TTDM-NMM default is 9600 baud; if it is changed, the baud rate of the laptop or host system must be changed accordingly.

3. Adjust the ASCII settings in the terminal-emulation program; turn on the following features:

ASCII Sending:	Send line ends with line feeds
	Echo typed characters locally
ASCII Receiving:	Append line feeds to incoming line ends
	Force incoming data to 7-bit ASCII
	Wrap lines that exceed terminal width

4. If communicating via modem (vs. a direct connection):

   - Have someone at the TTDM-NMM unit execute the **Auto Answer** command from the **Modem** submenu of **TTDM Network;** the TTDM-NMM then sends a text string through its serial port to set a Hayes compatible modem to autoanswer mode; a host computer can then dial up and communicate with the TTDM-NMM from a remote location.

     or

   - Use the **Dial** command from the **Modem** submenu of **TTDM Network** to dial up the host system.

Notes to table on following page

Important: The numerical code for the logging state (a decimal value from 0 to 15) selects the logging mode(s) (combinations can be selected by adding the code values together). Selecting the proper logging mode is essential for proper communications with a host computer.

If terminal-emulation mode (code 8) is selected, LCD display strings and LED states are sent to the host port in a set of five strings, each 20 characters long and terminated by a carriage return. The set of strings is preceded by the special ASCII character for Form Feed (0x0C), which can be used by host software to align the new display set. The first four strings echo the LCD display of the TTDM-NMM. The fifth communicates the LED states with the format shown in the next column.

Capital letter	(M = Monitor, S = Service, A = Alarm, F = Fault)
0 or 1	(0 = Off, 1 = On)
4 spaces	(for first three LEDs) or carriage return (for fourth LED)

Typical terminal-emulation output:
“[Form Feed]”
“line 1 from LCD”cr
“line 2 from LCD”cr
“line 3 from LCD”cr
“line 4 from LCD”cr
“M1 S0 A1 F0”cr

While terminal emulation is enabled, this output to the host port occurs every time the display changes or a key is pressed.

Command Format for Host Using Terminal-Emulation Program

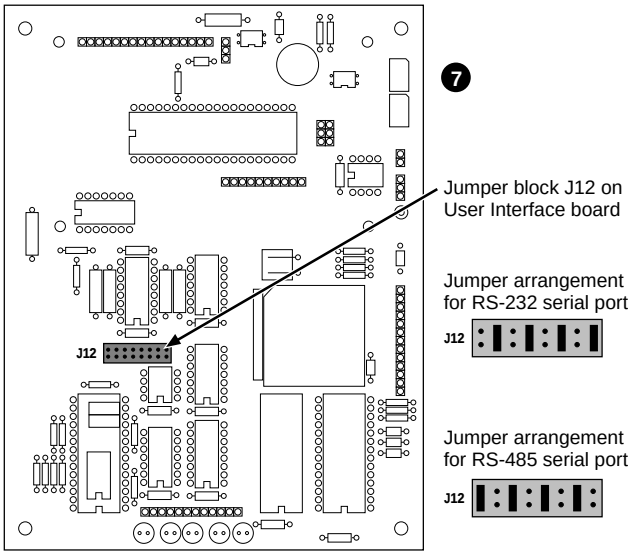
Command	Syntax	Description
Events History	**<xxe?** (e.g., <01e?)	Transmit **number of events** (first, last, and maximum) for TTDM-NMM with RS-485 address xx (address 01 [the TTDM-NMM default] in the example)
	Data format:	<01,e,001,245,256
	Meaning:	245 events in TTDM-NMM with RS-485 address 01
	<xxe (e.g., <01e)	Transmit the **entire Events History** for TTDM-NMM with RS-485 address xx (address 01 in the example)
	<xxennn (e.g., <01e193)	Transmit **record for single event** nnn in TTDM-NMM with address xx (event number 193 in the example)
	<xxemmm,nnn (e.g., <01e142,150)	Transmit **records for series of events** numbered mmm to nnn in TTDM-NMM with address xx (events 142 to 150 in the example)
	Data format for each event record (1 record per line):	<01,e,nnn,CC,EEE,LLLLL,UUU,HHMM,DDMMYY 01 RS-485 address of TTDM-NMM nnn Event record for event number CC Event on SIM channel (entry is "ff" if it is a system event such as "Silenced Alarm") EEE Event code (per table on page 37) LLLLL Location (applicable only for leaks and service req'd) UUU Text code for units (system use) HHMM Time (hours and minutes) DDMMYY Date (day, month, and year)
Query	**<xxq**	Transmit product code and UI software version for TTDM-NMM with RS-485 address xx
	Data format:	<xx,q,PP,VV PP two-digit product code VV UI software version number (e.g., 1.00b)
Relay	**<xxr**	Transmit state of LEDs/relays
	Data format:	<xx,r,M,S,L,F (1 indicates LED is on, relay is in alarm state) M = Monitoring LED S = Service Required LED and relay L = Leak LED and relay F = fault LED and relay
Logging state	**<xxl?**	Transmit the decimal value for the current logging state of TTDM-NMM with address xx
	<xxlN	**Set** the logging state of TTDM-NMM xx to state N
	Logging states:	0 = serial port is passive, only receives and responds to messages. 1 = log or print events to serial port as they occur. 2 = log all SIM communication strings to serial port (for remote diagnostics). 4 = log TTDM-NMM time and date to serial port each second. 8 = enables terminal emulation mode, which logs LCD display strings and LED states to serial port whenever there is a change, and accepts remote key commands via the host port.
Key inputs	**<xxkY**	If TTDM-NMM with address xx is in terminal emulation mode (logging state 8), commands the TTDM-NMM to respond as if key Y (per codes below) had been pressed 0 = Null (No key) 1 = Menu Key 2 = Left Arrow Key 3 = Up Arrow Key 4 = Right Arrow Key 5 = Down Arrow Key 6 = Esc (Escape) Key 7 = Enter Key 8 = Test Key 9 = Silence Key 10 = Reset Key
	If the serial port logging mode has been set to terminal-emulation mode (by setting the logging state to 8), the host can make key inputs to the TTDM-NMM remotely (using terminal commands). The TTDM-NMM responds to these remote key commands just as if a local user had pressed the associated key. A key press on the NMM itself overwrites a remote command, and remote entries are only accepted after a period of several seconds of no key presses.	

Selecting RS-485 vs. RS-232 Communications

The external communications serial port is set up at the factory for RS-232 communications and is suitable for connecting the TTDM-NMM to a single device up to 50 ft (15 m) away. RS-232 communications may use either 3 wire (TX, RX, GND) or 5 wire (with optional RTS/CTS handshaking).

The TTDM-NMM can be configured for host communication using an RS-485 bus (two-wire twisted pair, half-duplex). As many as 31 TraceTek TTDM- NMM systems can be connected on the two-wire RS-485 bus, plus one master device (host computer). To change the TTDM-NMM configuration for RS-485 communications, jumpers on its User Interface board must be moved to the RS-485 position.

To move the jumpers to the RS-485 position entails removing the User Interface (UI) board (feature ❼ in the diagram on the inside front cover). To remove the UI board, follow the detailed instructions — and precautions for working on this electronic unit — in the *TraceTek TTDM UI Software EPROM Replacement Installation Instructions* (H55875). After removing the User Interface board in accordance with those instructions, move the four jumpers on jumper block J12 of the User Interface board to the RS-485 position (see figure at right). Replace the UI board in accordance with the EPROM replacement instructions.



Appendix 7 – Modbus Implementation

Overview

The TraceTek TTDM-NMM module can communicate with host systems through its serial port. The TTDM-NMM follows the Modbus communication protocol to allow easy integration into building or facility management systems. The module acts as a slave to the host system, and provides remote access to all data and settings, including the following:

- Event status and history
- System status
- Status of individual SIM channels
- Setup functions

Modbus Communications

As noted in Appendix 6, the TTDM-NMM external communications serial port can be configured for use either as an RS-232 or RS-485 transceiver. The table below summarizes the standard configuration and options.

Standard configuration	Options
RS-232	RS-485 (selectable with jumpers; see p. 35)
Full-duplex, no hardware handshaking	
9600 baud	600 to 19200 baud (selected from TTDM Network menu)
8 data bits, no parity, 1 stop bit	

The TTDM-NMM supports both Modbus transmission modes: ASCII (American Standard Code for Information Interchange) and RTU (Remote Terminal Unit). The TTDM-NMM must be set to the transmission mode used by the Modbus master (the host system); to select the TTDM-NMM transmission mode, use the **Modbus** selection in the **TTDM Network menu**. Both modes communicate the same information, but format messages differently, as summarized in the table below.

Transmission mode	Beginning of message frame	Data format	Error check	End of Frame
ASCII	:	Hexadecimal, ASCII characters (16 bits)	LRC*	Carriage return and line feed
RTU	Silence (3.5 character times)	8 bit binary	CRC**	Silence (3.5 character times)

* LRC = Longitudinal Redundancy Check

**CRC = Cyclical Redundancy Check

Supported Modbus Functions

The TTDM-NMM provides the Modbus master (host system) with access to all functions that would be available using the keypad on the TTDM-NMM unit itself. The table below shows how this access is implemented using Modbus functions (identified by Modbus function code and location reference). For an explanation of the Modbus protocol, consult the web site of Modicon (a division of AEG Schneider Automation, Inc.) at http://www.modicon.com, and/or their publication “Modicon Modbus Protocol Reference Guide (PI-MBUS-300).”

Modbus functions					Type of data	
Read	Write (single)	Write block	Location reference	Modbus description	TTDM-NMM usage	Field size*
1	5	15	0XXXX	Coils	Global commands and module settings	2
2	‡	‡	1XXXX	Digital inputs	Alarm relay/LED status	2
4	‡	‡	3XXXX	Input registers	Event and status data	4
3	6	16	4XXXX	Holding registers	Query selections (SIM channel, event number) Module settings	4

* Number of digits, ASCII encoded headecimal; half that number of digits in RTU (binary) mode.

‡ Digital inputs and input registers are read-only; there are no Modbus write functions for those registers.

Important: Maximum block size for a query/response is 16 coils, inputs, or registers in the TTDM-NMM.

TTDM-NMM Data Structure for Modbus Access

The following paragraphs describe the data structure used by the TTDM-NMM to serve its purpose of leak detection and location. This information is provided to assist those configuring the Modbus master (host system) to communicate with the TTDM-NMM and provide effective monitoring of the leak detection system. These next paragraphs highlight areas important for leak detection, and are followed by a detailed technical reference.

Note: The host application software may use either the register address or the hexadecimal address to construct the Modbus message frame; this manual shows the decimal address only for reference.

System Status

To obtain summary information for the entire NMM/SIM system (as described in “System Status” on page 17), use the Modbus 4 function to read the registers noted below.

Input Register	**Address** (decimal)	**Address** (hexadecimal)	**Name/description of 16-bit value** (4 hexadecimal characters)
30001	0	0000	Product ID (0–255)
30002	1	0001	UI Version — Major Version number/minor version number: MV =0–99/ mv = 0–99
30003	2	0002	UI Version letter (1 ASCII character)
30007	6	0006	SIM Network: Number of active nodes
30008	7	0007	Number of Leak Alarms
30009	8	0008	Number of Service Req’d Alarms
30010	9	0009	Number of Cable Breaks
30011	10	000A	Number of Loop Imbalances
30012	11	000B	Number of YB Breaks
30013	12	000C	Number of RG Breaks
30014	13	000D	Number of SI Comm Errors
30015	14	000E	Number of SI H/W Errors

Events

Events are stored in a circular buffer containing multiple event records. The capacity of the list (maximum number of events: 256) is stored in Input Register 30018. The number of events that have been recorded is stored in Input Register 30017; this value can be used by the host system to determine if any events have occurred since the TTDM-NMM was last polled.

Input Register	**Address** (decimal)	**Address** (hexadecimal)	**Name/description of 16-bit value** (4 hexadecimal characters)
30017	16	0010	Number of events recorded (1–32767)
30018	17	0011	Capacity of event list (256)

Note: If the number of events recorded exceeds the capacity of the list (register 30017 > register 30018) the events list is full. When this occurs, the list “wraps around”: when a new event occurs the TTDM-NMM overwrites the earliest event, and the list then stores the 256 most recent events.

To allow a host system to access various event records without extensive register mapping, the TTDM-NMM incorporates a seven-register overlay that holds a single event record. Holding Register 40001 determines the event number for which the overlay stores data.

Holding register	**Address** (decimal)	**Address** (hex)	**Name/description of 16-bit value** (4 hexadecimal characters)
40001	0	0000	Number of event record stored in Input Register overlay

To access an event record using the overlay:

- Use Modbus function 06 to write the desired event number in Holding Register 40001.
- Use Modbus function 04 to read the overlay registers, as tabulated below.

Input Register	**Address** (decimal)	**Address** (hexadecimal)	**Name/description of 16-bit value** (4 hexadecimal characters)
30021	20	0014	Event Type (numeric code; see table below)
30022	21	0015	SIM Module Address (channel number)
30023	22	0016	Module Subaddress (not used)
30024	23	0017	Event Time Stamp (high byte: hours; low byte: minutes)
30025	24	0018	Event Date Stamp (high byte: month; low byte: day)
30026	25	0019	Event Date Stamp (low byte-year)
30027	26	001A	Event Data (i.e., location)

Note: Event Data (leak location, in Input Register 30027) uses the unit of measure selected for the system, as defined in Holding Register 40007.

The TTDM-NMM communicates the event type (Input Register 30021) with a numeric code, as defined in the table below (See “Appendix 2 - Events Glossary” for further detail).

Code	**Event type**
001	Leak
002	New Leak
003	Re-Alarm
004	Service Req’d
005	Cable Break
006	YB Loop Break
007	RG Loop Break
008	Loop Imbalance
009	SI H/W Error
010	SI Comm Error
011	System Restart
012	System Power Down
013	Leak relay Reset
015	Leak Cleared
016	Service Cleared
017	Cable Restored
018	SI H/W Recovered
019	SI Comm Recovered
020	SIM Normal
021	System Normal
022	Memory Cleared
023	RTC/RAM Error
024	Re-Alarm 8 Hours
025	Re-Alarm 12 Hours
026	Re-Alarm 24 Hours
027	Alarm Silenced

Hint: An event record can also be accessed with a single read function. Page 43 in the “Modbus Technical Reference” section provides a register map so the host system can be programmed to access events records directly.

SIM Channel Status

The TTDM-NMM offers access to detailed real-time status information for each SIM channel, as detailed on pages 14 and 15. To allow a host system to access status information for each SIM channel without extensive register mapping, the TTDM-NMM incorporates a 16-register overlay that holds status data from a single SIM channel. The value in Holding Register 40002 determines the SIM channel number for which the overlay stores data.

Holding Register	Address (decimal)	Address (hex)	Name/description of 16-bit value (4 hexadecimal characters)
40002	1	0001	Number of SIM channel for which the register overlay is used

To access status data for an individual SIM channel using the overlay:

- Use Modbus function 06 to write the desired SIM channel number into Holding Register 40002.
- Use Modbus function 04 to read the overlay registers, as tabulated below.

Input Register	Address (decimal)	Address (hex)	Name/description of 16-bit value (4 hexadecimal characters)
30048	47	002F	SIM Status (using numerical code for Event Type defined in table on page 37)
30044	43	002B	Test Length
30045	44	002C	Location
30036	35	0023	Current (microAmps or 10E-7 Amps)
30035	34	0022	R S-to-S (kohms)
30037	36	0024	R RG Loop (ohms)
30038	37	0025	R YB Loop (ohms)
30034	33	0021	R Loc (ohms)
30046	45	002D	New Leak Res (ohms)
30042	41	0029	SI Version
30043	42	002A	SIM PID
30047	46	002E	SIM Comm (%)
30033	32	0020	Mode
30041	40	0028	SI Status

Note: In the table above, the overlay data fields are presented in the order in which they are defined on pages 14 and 15 (“Status of Individual SIM Channels”). Page 40 of the “Modbus Technical Reference” section lists the fields in numerical order, including the two spares (unused fields).

Note: Lengths for Test Length and Location use the unit of measure selected for the system, as defined in Holding Register 40007.

Hint: Data for a SIM channel can also be accessed with a single read function. Page 42 of the “Modbus Technical Reference” section provides a register map so the host system can be programmed to access registers with data for a SIM channel directly.

TTDM-NMM Module Settings

The TTDM-NMM provides the Modbus master (host system) with access to all settings that would be available using the keypad on the TTDM-NMM itself. The locations of these settings are detailed in the following section (“Modbus Technical Reference”). TTDM-NMM module settings appear in two Modbus memory areas: 0xxxx (coils) and 4xxxx (holding registers).

Note: Because the TTDM-NMM is a slave to its Modbus master, the host system should be set up with password protection for TTDM-NMM settings (as it is provided for TTDM-NMM keypad entries) to prevent unauthorized changes.

Modbus Technical Reference

Serial Port Logging State

The logging state of the TTDM-NMM serial port is determined by Holding Register 40016.

Holding Register	Address (decimal)	Address (hex)	Name/description of 16-bit value (4 hexadecimal characters)
40016	15	000F	TTDM-NMM Serial Port Log State (numerical code)

The numerical code—a decimal value from 0 to 15—selects the logging mode(s):

0 = host port is passive, only receives and responds to messages (default state, and required for Modbus communications).
1 = log or print events to host port as they occur (useful if connected to a serial printer rather than a Modbus host).
2 = log all SIM communication strings to host port (used for remote diagnostics).
4 = log TTDM-NMM time and date to host port each second.
8 = enables terminal emulation mode, which logs LCD display strings and LED states to host port whenever there is a change, and accepts remote key commands via the host port.

Note: Combinations can be selected by adding the code values together.

Important: For Modbus communications to work correctly, the serial port logging state must be set to 0 (its factory default).

"Coils"— Global Commands and Module Settings

Modbus Function 01 to Read
Modbus Function 05 to Write
Modbus Function 15 to Block Write

Coil Location	Address (decimal)	Address (hex)	Name/description of 8-bit value (2 hexadecimal characters)
00001	0	0000	Init Network (write 1 to do function per "SIM Network," page 20)
00002	1	0001	Update Network (write 1 to do function per "SIM Network," page 20)
00003	2	0002	Clear Memory (write 1 to do function)
00004	3	0003	Restore Defaults (write 1 to do function)
00005	4	0004	Modbus Mode (0 = ASCII, 1 = RTU; see "SIM Network," page 20)
00006	5	0005	Auto Reset (1 = Yes, 0 = No; see "Leak Setup," page 19)
00007	6	0006	Audible Alarm (1 = Yes, 0 = No; see "Leak Setup," page 19)
00008	7	0007	spare

The first four "coils" make it possible to remotely launch special functions normally executed from the TTDM-NMM keypad. If executing one of these functions, ensure that the Modbus host application writes a 1 to the coil location only momentarily (i.e., that it does not repeat the write command). When the TTDM-NMM receives the Write 1 command, the function (e.g., **Update Network**) begins to execute, and communications may be temporarily delayed until completion of the task. Since these tasks will change/update data, associated registers should always be re-read following execution of the task.

Note: These coils always send back the value "0" when read.

Digital Inputs — Alarm Relay/LED Status

Modbus Function 02 to Read

Digital Input	Address (decimal)	Address (hex)	Name/description of 8-bit value (2 hexadecimal characters)
10001	0	0000	Monitor LED (0 = On, 1 = Off)
10002	1	0001	Service LED/Relay (0 = On, 1 = Off)
10003	2	0002	Leak LED/Relay (0 = On, 1 = Off)
10004	3	0003	Trouble LED/Relay (0 = On, 1 = Off)

When in the alarm state (0 = On), the relay is de-energized and LED illuminated; one digital input indicates status of both the relay and its corresponding LED.

Input Registers — System Status

Modbus Function 04 to Read

Input Register	Address (decimal)	Address (hex)	Name/description of 16-bit value (4 hexadecimal characters)
			System Status Info (see “System Status,” page 17)
30001	0	0000	TTDM-NMM Product ID (Numeric code: 0–255)
30002	1	0001	TTDM-NMM UI version Major Version number /minor version number: MV =0-99/ mv = 0-99
30003	2	0002	TTDM-NMM UI version letter (1 ASCII character)
30004	3	0003	TTDM-NMM UI ROM Checksum
30005	4	0004	spare
30006	5	0005	spare
30007	6	0006	SIM Network: Number of active nodes
30008	7	0007	Number of Leak Alarms
30009	8	0008	Number of Service Req’d Alarms
30010	9	0009	Number of Cable Breaks
30011	10	000A	Number of Loop Imbalances
30012	11	000B	Number of YB Breaks
30013	12	000C	Number of RG Breaks
30014	13	000D	Number of SI Comm Errors
30015	14	000E	Number of SI H/W Errors
30016	15	000F	4-20 mA DAC Value (0, 204, 410, 614, 716, 819, 1024–4095; see page 31)

Input Registers — Event Data and Event Record Overlay

Modbus Function 04 to Read

Input Register	Address (decimal)	Address (hex)	Name/description of 16-bit value (4 hexadecimal characters)
			Event Data (see pages 37–38)
30017	16	0010	Number of events recorded (1–32767)
30018	17	0011	Capacity of event list (256)
30019	18	0012	Event Pointer — computed index; used for debugging events list access (0–255)
30020	19	0013	spare
			Event record overlay (see pages 37–38)
30021	20	0014	Event Type
30022	21	0015	SIM Module Address (channel number)
30023	22	0016	Module Subaddress (not used)
30024	23	0017	Event Time Stamp (high byte: hours; low byte: minutes)
30025	24	0018	Event Date Stamp (high byte: month; low byte: day)
30026	25	0019	Event Date Stamp (low byte: year)
30027	26	001A	Event Data (location, in unit of measure per register 40007))
30028	27	001B	spare
30029	28	001C	spare
30030	29	001D	spare
30031	30	001E	spare
30032	31	001F	spare

Input Registers — SIM Channel Status Overlay

Modbus Function 04 to Read

Input Register	Address (decimal)	Address (hex)	Name/description of 16-bit value (4 hexadecimal characters)
			SIM Channel Status Overlay (see page 39)
30033	32	0020	ADC counts (for factory diagnostics)
30034	33	0021	R Loc (ohms)
30035	34	0022	R S-to-S (kohms)
30036	35	0023	Current (microAmps or 10E-7 Amps)
30037	36	0024	R RG Loop (ohms)
30038	37	0025	R YB Loop (ohms)
30039	38	0026	spare
30040	39	0027	spare
30041	40	0028	Status bitmap (for factory diagnostics)
30042	41	0029	SIM Software Version
30043	42	002A	SIM Product ID
30044	43	002B	SIM Test Length (in system units, see register 40007)
30045	44	002C	SIM Leak Location (in system units, see register 40007)
30046	45	002D	SIM New Leak Resistance (ohms)
30047	46	002E	SIM Comm Rate (%)
30048	47	002F	SIM Event Type (see page 37 for list of numeric codes)
30049–30100	48–99	0030–0063	Unused

Input Registers — SIM Status Data

Modbus Function 04 to Read

As noted previously, status data for each SIM channel can be accessed using the overlay in Input Registers 30033 to 30048; this requires writing the desired SIM channel number in Holding Register 40002 before reading the status data for the selected SIM channel. Status data for each SIM channel can also be accessed directly (without writing the SIM channel number in the Holding Register). Input Registers 30101 through 30356 store the status data, with a group of 16 registers for each SIM channel. The following table identifies the register and addresses for each SIM channel.

	Input Register								
Description	**SIM channel overlay**	**SIM 0**	**SIM 1**	**SIM 2**	**SIM 3**	**SIM 4**	**SIM 5**	**SIM 6**	**SIM 7**
ADC counts (testing)	30033	30101	30117	30133	30149	30165	30181	30197	30213
R Loc	30034	30102	30118	30134	30150	30166	30182	30198	30214
R S-to-S	30035	30103	30119	30135	30151	30167	30183	30199	30215
Current	30036	30104	30120	30136	30152	30168	30184	30200	30216
R RG Loop	30037	30105	30121	30137	30153	30169	30185	30201	30217
R YB Loop	30038	30106	30122	30138	30154	30170	30186	30202	30218
spare	30039	30107	30123	30139	30155	30171	30187	30203	30219
spare	30040	30108	30124	30140	30156	30172	30188	30204	30220
Status bitmap (testing)	30041	30109	30125	30141	30157	30173	30189	30205	30221
SIM Software Version	30042	30110	30126	30142	30158	30174	30190	30206	30222
SIM Product ID	30043	30111	30127	30143	30159	30175	30191	30207	30223
SIM Test Length	30044	30112	30128	30144	30160	30176	30192	30208	30224
SIM Leak Location	30045	30113	30129	30145	30161	30177	30193	30209	30225
SIM New Leak Res	30046	30114	30130	30146	30162	30178	30194	30210	30226
SIM Comm Rate	30047	30115	30131	30147	30163	30179	30195	30211	30227
SIM Event Type	30048	30116	30132	30148	30164	30180	30196	30212	30228
Decimal address range	32–47	100–115	116–131	132–147	148–163	164–179	180–195	196–211	212–227 243
Hex address range	20–2F	0064–0073	0074–0083	0084–0093	0094–00A3	00A4–00B3	00B4–00C3	00C4–00D3	00D4–00E3

	Input Register							
Description	**SIM 8**	**SIM 9**	**SIM 10**	**SIM 11**	**SIM 12**	**SIM 13**	**SIM 14**	**SIM 15**
ADC counts (testing)	30229	30245	30261	30277	30293	30309	30325	30341
R Loc	30230	30246	30262	30278	30294	30310	30326	30342
R S-to-S	30231	30247	30263	30279	30295	30311	30327	30343
Current	30232	30248	30264	30280	30296	30312	30328	30344
R RG Loop	30233	30249	30265	30281	30297	30313	30329	30345
R YB Loop	30234	30250	30266	30282	30298	30314	30330	30346
spare	30235	30251	30267	30283	30299	30315	30331	30347
spare	30236	30252	30268	30284	30300	30316	30332	30348
Status bitmap (testing)	30237	30253	30269	30285	30301	30317	30333	30349
SIM Software Version	30238	30254	30270	30286	30302	30318	30334	30350
SIM Product ID	30239	30255	30271	30287	30303	30319	30335	30351
SIM Test Length	30240	30256	30272	30288	30304	30320	30336	30352
SIM Leak Location	30241	30257	30273	30289	30305	30321	30337	30353
SIM New Leak Res	30242	30258	30274	30290	30306	30322	30338	30354
SIM Comm Rate	30243	30259	30275	30291	30307	30323	30339	30355
SIM Event Type	30244	30260	30276	30292	30308	30324	30340	30356
Decimal address range	228–243	244–259	260–275	276–291	292–307	308–323	324–339	340–355
Hex address range	00E4–00F3	00F4–0103	0104–0113	0114–0123	0124–0133	0134–0143	0144–0153	0154–0163

Input Registers — Event Records

Modbus Function 04 to Read

As noted previously, each event record can be accessed using the overlay in Input Registers 30021 to 30027; this requires writing the desired event number in Holding Register 40001 before reading the selected event record. Event records can also be accessed directly (without writing the event number in the Holding Register). Input Registers 30357 through 32148 store the event records, with a group of seven registers for each event. The following table identifies the register and addresses for event entries.

	Input Registers					
Description	**Event record overlay**	**Event no. 1**	**Event no. 2**	**Event nos. 3 to 254**	**Event no 255**	**Event no 256**
Event Type	30021	30357	30364	See	32135	32142
SIM module address (channel number)	30022	30358	30365	formula	32136	32143
Module Subaddress (not used)	30023	30359	30366	below	32137	32144
Event Time Stamp (high byte: hours; low byte: minutes)	30024	30360	30367		32138	32145
Event Date Stamp (high byte: month; low byte: day)	30025	30361	30368		32139	32146
Event Date Stamp (low byte: year)	30026	30362	30369		32140	32147
Event Data (location)	30027	30363	30370		32141	32148
Decimal address range	20–26	356–362	363–369	370–2133	2134–2140	2141–2147
Hex address range	0014–001A	0164–016A	016B–0171	0172–0855	0856–085C	085D–0863

Formula to calculate the first register for an event record:

First register for event record = 30357 + ([(Event number – 1) modulo 256] x 7)

X modulo 256 = the integer remainder after dividing the value X by 256

Examples: 5 modulo 256 = 5, 500 modulo 256 = 244, 700 modulo 256 = 188

For example to calculate the registers for event number 5:

30357 + ([4 modulo 256] x 7) = 30357 + 28 = 30385

Event number 5 occupies Input Registers 30385 to 30391, with the same format as Input Registers 30021—30027.

Holding Registers - Query Selections

Modbus Function 03 to Read
Modbus Function 06 to Write
Modbus Function 16 to Block Write

Holding Register	**Address** (decimal)	**Address** (hex)	**Name/description of 16-bit value** (4 hexadecimal characters)
			SIM and events overlay pointers
40001	0	0000	Number of event for which the event record overlay is used
40002	1	0001	Number of SIM channel for which the SIM status overlay is used
40003	2	0002	spare

Holding Registers — Module Setup

Modbus Function 03 to Read
Modbus Function 06 to Write
Modbus Function 16 to Block Write

Holding Register	Address (decimal)	Address (hex)	Name/description of 16-bit value (4 hexadecimal characters)
			General Setup parameters (see page 18)
40004	3	0003	Time (high byte: hours; low byte: minutes)
40005	4	0004	Date (high byte: month; low byte: day)
40006	5	0005	Date (low byte: year)
40007	6	0006	System Units (0 = feet, 1 = metres, 2 = zones)
40008	7	0007	Language (0 = English, 1 = French, 2 = German, 3 = Spanish, 4 = Japanese)
40009	8	0008	Level 1 password (0–65535)
40010	9	0009	Level 2 password (0–65535)
40011	10	000A	reserved
40012	11	000B	4-20 mA SIM address (0–15; see page 32)
40013	12	000C	20 mA Value (1 to 5500 feet or 1676 metres or 107 zones; see page 32)
40014	13	000D	spare
40015	14	000E	spare
40016	15	000F	TTDM Serial Port Logging State (see page 36)
40017	16	0010	Key Input (not for use in Modbus communications)
			ASCII string characters: stored as 16 bit integer with 1st character in the upper byte, 2nd character in the lower byte. To write: Value = (ASCII of char 1) x 256 + (ASCII of char 2) To read: ASCII(char1)=Value/256 ASCII(char2)=Value mod 256
40018	17	0011	Modem Dial String ASCII Characters 1 and 2
40019	18	0012	Modem Dial String ASCII Characters 3 and 4
40020	19	0013	Modem Dial String ASCII Characters 5 and 6
40021	20	0014	Modem Dial String ASCII Characters 7 and 8
40022	21	0015	Modem Dial String ASCII Characters 9 and 10
40023	22	0016	Modem Dial String ASCII Characters 11 and 12
40024	23	0017	Modem Dial String ASCII Characters 13 and 14
			Leak Setup parameters (see page 19)
40025	24	0018	Re-AlarmDistance (3-20 ft, 1-6 m, 1 zone per System Units)
40026	25	0019	Re-Alarm Interval (0 = Never, 1 = 8 hrs, 2 = 12 hrs, 3 = 24 hrs)
40027	26	001A	Leak Sensitivity (0 = Normal, 1 = High, 2 = Low, 3 = TT500x)
40028	27	001B	Service Sensitivity (0 = Normal, 1 = High, 2 = Low, 3 = Never)
40029	28	001C	spare
40030	29	001D	spare
40031	30	001E	spare
40032	31	001F	spare

Holding Registers — SIM Channel Barrier Resistance and Alphanumeric Tag

Modbus Function 03 to Read
Modbus Function 06 to Write
Modbus Function 16 to Block Write

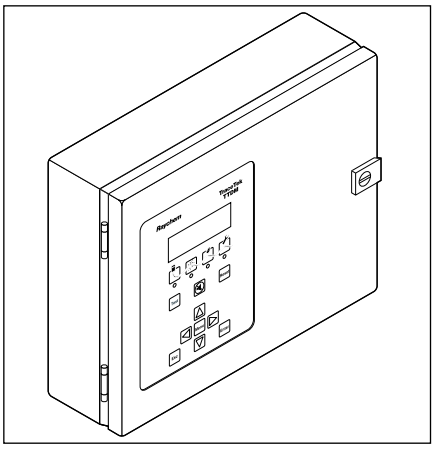
The barrier resistance and alphanumeric tag for each SIM channel can be accessed using the same overlay technique used for SIM channel status. Holding Register 40002 determines the number of the SIM channel that is active, either for reading or writing.

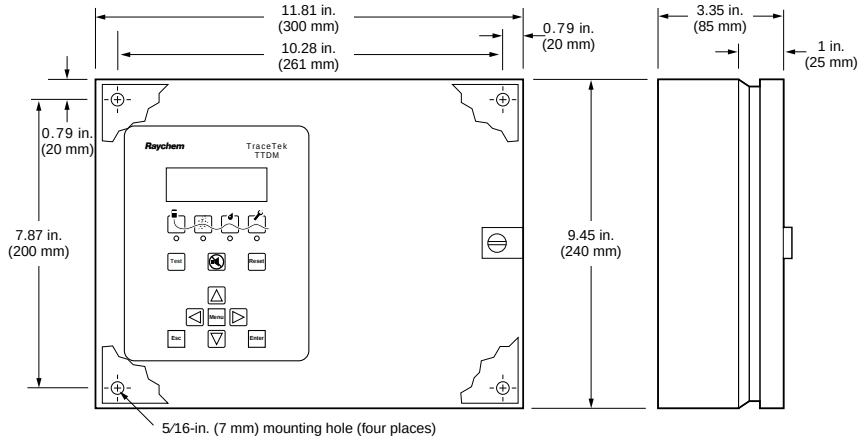
For the alphanumeric tag (ID label), the character string is stored in pairs of ASCII characters, with each pair stored as a 16-bit integer with the first character in the upper byte, the second character in the lower byte.

To write: Register Value = (ASCII code for character 1) x 256 + (ASCII code for character 2)
To read: ASCII code for character 1 = Integer portion of Register Value/256
ASCII code for character 2 = Register Value modulo 256

Holding Register	Address (decimal)	Address (hex)	Name/description of 16-bit value (4 hexadecimal characters)
			SIM barrier resistance and alphanumeric tag (see page 15) — for SIM in Holding Register 40002
40033	32	0020	SIM Barrier Resistance (0–4095 ohms)
40034	33	0021	SIM ID Label ASCII Characters 1 and 2
40035	34	0022	SIM ID Label ASCII Characters 3 and 4
40036	35	0023	SIM ID Label ASCII Characters 5 and 6
40037	36	0024	SIM ID Label ASCII Characters 7 and 8
40038	37	0025	SIM ID Label ASCII Characters 9 and 10
40039	38	0026	SIM ID Label ASCII Characters 11 and 12
40040	39	0027	SIM ID Label ASCII Characters 13 and 14
40041–40056	40–55	0028–0037	reserved
40057–40100	56–99	0038–0063	unused
			Mapped SIM barrier resistance and ID strings
40101–40124	100–123	0064–007B	SIM0 — see Registers 40033–40056 for format
40125–40148	124–147	007C–0093	SIM1 — see Registers 40033–40056 for format
40149–40172	148–171	0094–00AB	SIM2 — see Registers 40033–40056 for format
40173–40196	172–195	00AC–00C3	SIM3 — see Registers 40033–40056 for format
40197–40220	196–219	00C4–00DB	SIM4 — see Registers 40033–40056 for format
40221–40244	220–243	00DC–00F3	SIM5 — see Registers 40033–40056 for format
40245–40268	244–267	00F4–010B	SIM6 — see Registers 40033–40056 for format
40269–40292	268–291	010C–0123	SIM7 — see Registers 40033–40056 for format
40293–40316	292–315	0124–013B	SIM8 — see Registers 40033–40056 for format
40317–40340	316–339	013C–0153	SIM9 — see Registers 40033–40056 for format
40341–40364	340–363	0154–016B	SIM10 — see Registers 40033–40056 for format
40365–40388	364–387	016C–0183	SIM11 — see Registers 40033–40056 for format
40389–40412	388–411	0184–019B	SIM12 — see Registers 40033–40056 for format
40413–40436	412–435	019C–01B3	SIM13 — see Registers 40033–40056 for format
40437–40460	436–459	01B4–01CB	SIM14 — see Registers 40033–40056 for format
40461–40484	460–483	01CC–01E3	SIM15 — see Registers 40033–40056 for format

Appendix 8 – TTDM-NMM Network Master Module Specifications





Ordering Information	Catalog Number		Description	
Supply voltage	TTDM-NMM-24		24 Vac +5%, –35%; 24 Vdc ±20%	
	TTDM-NMM-1		115 V +15%, –20%; 50/60 Hz	
	TTDM-NMM-2		230 V ±10%; 50/60 Hz	
Spares	TTDM-PS24	24 Vac/dc power supply	TTDM-SI	Sensor interface
	TTDM-PS1	115 Vac power supply	TTDM-MB	Motherboard
	TTDM-PS2	230 Vac power supply	TTDM-NMM-UI	Network mstr user interface

General features	Sensing cable compatibility	All TT1000, TT3000, and TT5000 series sensing cables All TT100, TT300, and TT500 series long-line sensing cables
	Maximum size of network	
	Number of TTDM-SIMs	15 plus SI in TTDM-NMM
	Maximum length of sensing cables	16 X 5000 ft (1500 m); total 80,000 ft
	Maximum number of zones	16 X 100; total 1600 zones
	Precision	±0.1% of connected sensing cable length
	Units	Feet, meters, zones (selectable)
	Language	English
Temperature	Storage	0°F to 140°F (–18°C to 60°C)
	Operating	32°F to 122°F (0°C to 50°C)
Humidity		5% to 95% noncondensing
Audible alarm	Piezo electric	
Power consumption	<6 VA (5 W) for TTDM-NMM-1 and -2	<12VA (10 W) for TTDM-NMM-24
Interfaces	Relays	Number: 3 (service required, leak, fault) Type: DPDT Rating: 5 A at 250 Vac/24 Vdc
	TraceTek Network Port	RS-485 (2-wire)
	External Serial Port	RS-232 (3- or 5-wire connection) or RS-485 (2-wire connection)

Approvals and certifications pending

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76LJ
SIGNAL SYSTEM UNIT

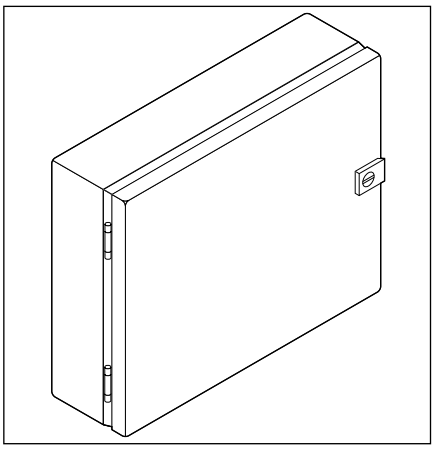
APPROVED

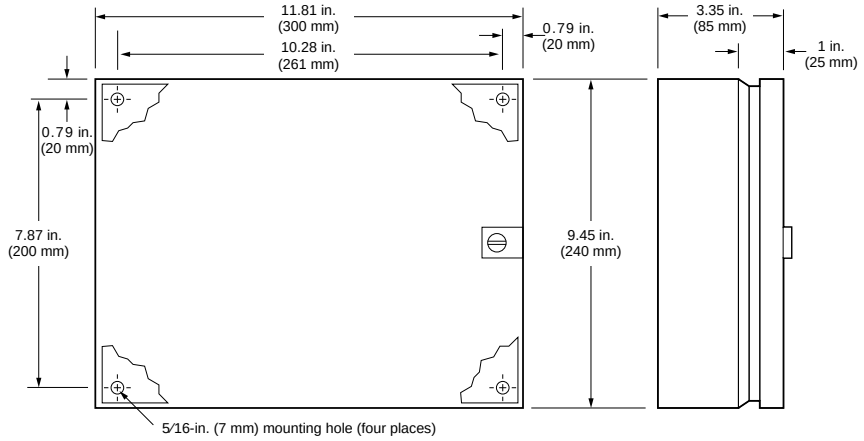
The TTDM-NMM unit is approved for use in ordinary areas. The module must be located in an ordinary area, but may monitor intrinsically safe TraceTek sensing cables located in hazardous locations. See diagram in “Appendix 9 – TTDM-SIM Specifications” for details.

The TTDM-NMM enclosure is NEMA 12, IP54.

Electromagnetic compatibility	Compliant with standards for immunity	EN50082-2 (light industrial)
	Compliant with standards for emissions	EN50081-2 (residential/commercial) FCC, Part 15, Class B, and EN55022 Class B

Appendix 9 – TTDM-SIM Sensor Interface Module Specifications





Ordering Information	Catalog Number		Description	
Supply voltage	TTDM-SIM-24		24 Vac +5%, –35%; 24 Vdc ±20%	
	TTDM-SIM-1		115 V +15%, –20%; 50/60 Hz	
	TTDM-SIM-2		230 V ±10%; 50/60 Hz	
Spares	TTDM-PS24	24 Vac/dc power supply	TTDM-SI	Sensor interface card
	TTDM-PS1	115 Vac power supply	TTDM-MB	Motherboard
	TTDM-PS2	230 Vac power supply		

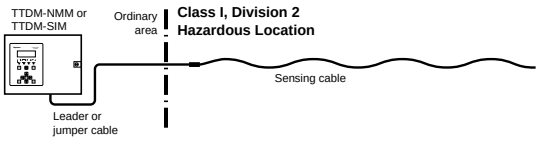
General features	Sensing cable compatibility	All TT1000, TT3000, and TT5000 series sensing cables All TT100, TT300, and TT500 series long-line sensing cables
	Maximum length of sensing cables	5000 ft (1500 m) per TTDM-SIM
	Maximum number of zones	100 per TTDM-SIM
	Precision	±0.1% of connected sensing cable length
	Units	Feet, meters, zones (selectable)
	Language	English,
Temperature	Storage	0°F to 140°F (–18°C to 60°C)
	Operating	32°F to 122°F (0°C to 50°C)
Humidity		5% to 95% noncondensing
Power consumption	<6 VA (5W) for TTDM-SIM-1 and -2	1 W for TTDM-SIM-24
Interfaces		
	TraceTek Network Port	RS-485 (2-wire connection)

Approvals and certifications pending

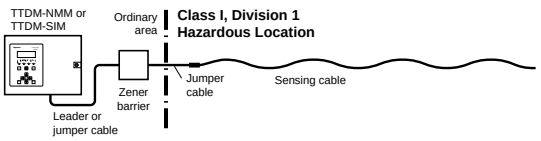
LISTED
76LJ
SIGNAL SYSTEM UNIT

F M
APPROVED

The TTDM-SIM unit is approved for use in ordinary areas. The module must be located in an ordinary area, but may monitor intrinsically safe TraceTek sensing cables located in hazardous locations, as shown below.



TraceTek sensing cable in Class I, Division 2, Groups A, B, C, D Hazardous Locations (Zone 2 in Europe)



If protected by an agency-approved zener barrier, TraceTek sensing cable in Class I, Division 1, Groups A, B, C, D Hazardous Locations (Zone 0 or Zone 1 in Europe). Contact Raychem to select proper zener barrier.

The TTDM-SIM enclosure is NEMA 12, IP54.

Electromagnetic compatibility	Compliant with standards for immunity	EN50082-2 (light industrial)
	Compliant with standards for emissions	EN50081-2 (residential/commercial) FCC, Part 15, Class B, and EN55022 Class B

EUR • USA • JPN

www.raychem.com
cheminfo@raychem.com

Belgium
NV Raychem SA
Diestsesteenweg 692
3010 Kessel-Lo
Tel (32) 16/351-800
Fax (32) 16/351-797

Korea
Raychem Korea Limited
831-45 Yeuksam-Dong
Kangnam-Ku
Seoul 135-080
Tel (82) 3468-1300
Fax (82) 2/558-5765

United Kingdom
Raychem Ltd.
Faraday Road
Dorcan, Wiltshire SN3 5HH
Tel (44) 1793/572-663
Fax (44) 1793/572-629

United States
Raychem Corporation
300 Constitution Drive
Menlo Park, CA 94025-1164
Tel (800) 553-1737
(650) 361-4900
Fax (650) 361-5073

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