



ELM ENTERPRISE MANAGER MONITORING SOLUTIONS:
ENVIRONMENTAL MONITORING

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INTRODUCTION

Environmental monitoring is critically important to business enterprises. The computer and network equipment room must operate within a specific range of environmental conditions. If conditions exceed that range, unpredictable and potentially catastrophic results such as system failure, application failure, or network problems, can occur. The most common cause of environmental problems in the equipment room is air conditioning failure leading to high temperatures, humidity problems, gas leakage and water leakage. The costs of such catastrophic events are interrupted business and dissatisfied customers.

Using ELM Enterprise Manager's (EEM) ability to receive SNMP traps as events or using the SNMP Monitor, environmental sensor devices may be installed in a facility and EEM sends alerts and notification in real time when environmental factors exceed tolerance.

The choice of receiving traps or using the SNMP Monitor depends upon the individual company policies and procedures. Using the trap-receiving technique, the responsible staff is immediately notified when a sensor exceeds its tolerance. Using the SNMP Monitor, the device is checked by ELM Enterprise Manager on a scheduled basis. Both can be used at the same time, providing peace of mind.

No matter which sensor device is selected, there are three basic steps required:

- Enable SNMP on the ELM Server Windows system and on any computer running a Service Agent and SNMP Monitor
- Configure the environmental sensor device
- Configure ELM Enterprise Manager

This paper outlines those steps with a focus on one environmental sensor product, the Sensatronics EM1. It is an example only. Any environmental monitor that uses SNMP will work with ELM Enterprise Manager in a similar way.

SNMP

The Simple Network Management Protocol (SNMP) is part of the internet protocol suite, a set of standards defined by the Internet Engineering Task Force, a group of engineers responsible for the creation and review of specifications and standards for protocols enabling the interoperability of diverse networks.

The SNMP design has three basic components:

1. Master Agents
2. Subagents
3. Management Stations

A master agent is software on an SNMP network device that makes it possible for that network device to respond to requests from a management station. A master agent communicates with subagents to gather information.

Subagents retrieve information from specific functionalities of each network device, such as managed objects or configuring parameters of those managed objects. The subagent generates traps when significant events occur for a managed object. In the application we discuss here, the EM1 device would be the master agent and the subagents.

The management station is a server that sends requests for management operations information and receives traps from the agents. The ELM Server is the management station for this application.

THE SNMP PROTOCOL

The SNMP protocol is one of several protocols that operate in layer 7 of the Open Systems Interconnection Reference Model (OSI Model), an abstract description for communications and computer network protocol design divided into functional layers. In version 1, five core protocol data units (PDUs) were defined:

- GET REQUEST, a retrieval function to request a specific piece of management information.
- GETNEXT REQUEST, a retrieval function to request sequences of management information.
- GET RESPONSE
- SET an assignment function to change a value of a managed subsystem.
- TRAP a reporting function to send an alert or other asynchronous event about a managed subsystem.

ELM supports the Get Request, the Set and the Trap.

COMMUNITY NAME

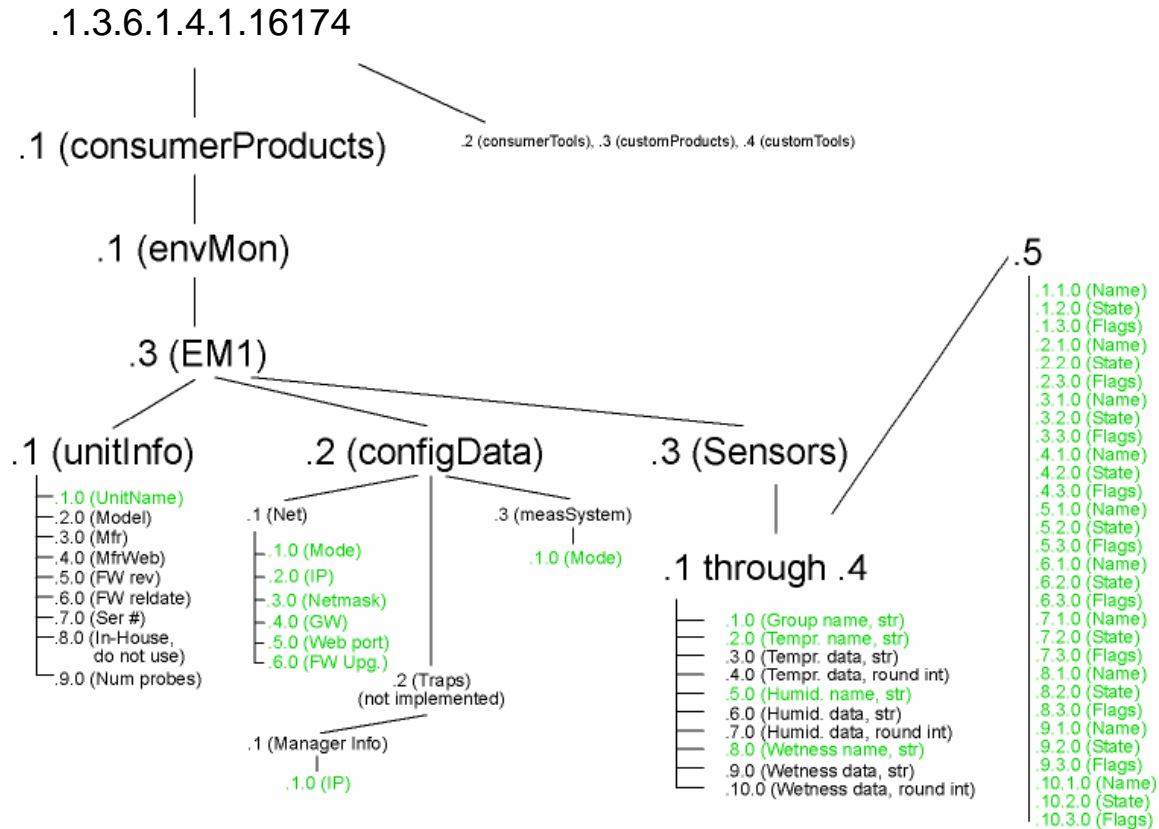
The group to which devices running SNMP belong is called a community. The name of a community helps the master and agents define where information is sent. An SNMP device may belong to more than one community. It will not respond to requests from management stations that do not belong to one of its communities. SNMP default community names are:

- Write = private
- Read = public

MANAGEMENT INFORMATION BASE (MIBS)

The management information base (MIB) stores the management data for the subsystems of an SNMP-enabled device. The MIB structure is a tree containing many levels, the leaf nodes of which are object identifiers (OIDs). These managed objects can be hardware, configuration parameters, performance statistics, sensor thresholds, and more. The Sensatronics EM1 MIB map is:

The green leaf nodes are the variable values that may be user configured.



ELM ENTERPRISE MANAGER

ELM integrates with and leverages the native Windows SNMP Service and SNMP Trap Service. The Windows SNMP Service must be installed on the ELM Server and on any computer running a Service Agent in order to use SNMP-related features. ELM supports SNMP in two ways:

1. The ELM Server includes a receiver for SNMP traps. The receiver registers with the Windows SNMP Trap service on the ELM Server computer. The ELM Server can listen for and receive SNMP traps from any SNMP-compliant system or device on your network. Traps are treated as events; they will appear in event views, they will be stored in the database, and you can create Notification Rules to trigger Notification Methods when any SNMP trap is received. By default, the ELM Server listens on UDP port 162.
2. The ELM Server can run an SNMP Monitor to query an SNMP OID and trigger an action if the value becomes greater than, less than or equal to a user-configured value. The SNMP Monitor compares the result of the query to that value. If the comparison yields a true, then the Success Action is triggered. If the comparison yields a false, the Warning Action is triggered. If the SNMP Monitor is unable to retrieve a value, the Failure Action is triggered. The SNMP Monitor includes an object browser and MIB browser for selecting the OID. Using the browser, you may query the namespace on an SNMP device, and walk the SNMP tree to select the specific OID for monitoring.

CONFIGURING THE SENSOR DEVICE

The following instructions are taken from the Sensatronics EM1 User Guide. This is presented as an example of how to set up an environmental sensor device. The setup for other brands will be similar.

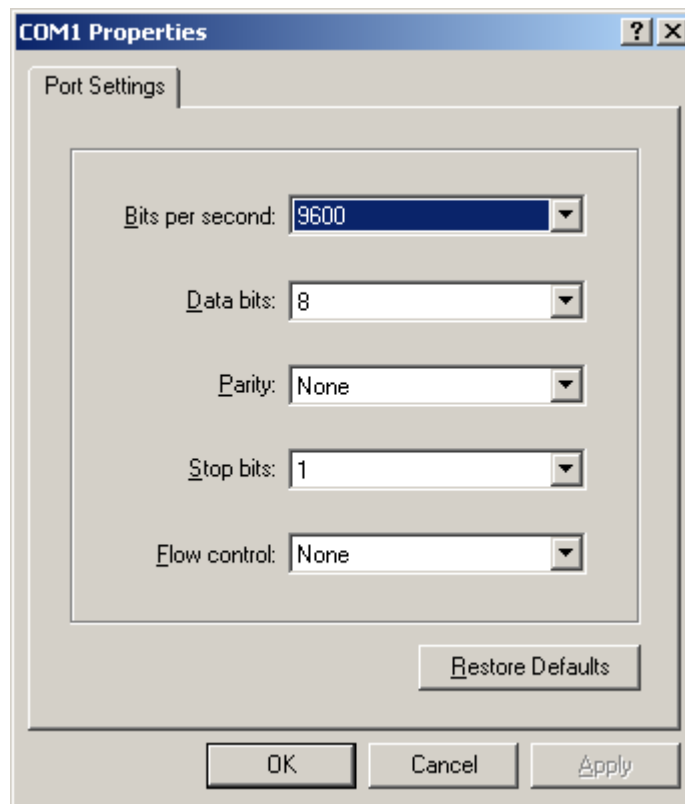
CONFIGURING EM1 FOR ELM

Before the Environmental Monitor unit can be used, it must be configured for its IP address and net mask.

NOTE: *If communicating outside your LAN, the gateway must also be configured.*

To configure the unit:

1. Determine a static IP and netmask that is available on your network.
2. Connect the unit to a PC serial port, using the supplied RS-232 cable.
3. Start a terminal emulator program. (HyperTerminal is included with Microsoft Windows.)
4. Set the RS-232 port settings to 9600, 8, N,1 (no flow control).



IMPORTANT: *Make sure that the settings include “No Flow Control”. If this setting is incorrect, the unit will be unable to communicate with your terminal emulator.*

1. Connect the power cord to the unit. Make sure the wall transformer is plugged into a powered outlet.
2. Press Return to reach the main window.

```
DHCP IP: 0.0.0.0
A. Set IP Address
B. Set Unit Name & Port Identifiers
C. SNMP, Temp Mode, and Web Settings
R. Reset Unit
X. Restore Default Configuration
Enter choice:
```

3. Select the menu items for configuring the unit, and for setting the IP address and net mask. If DHCP is selected for your network mode, the menu will appear as below:

```
Environmental Monitor IP Configuration Menu
Current settings
IP:
Net Mask:
Gateway:
HTTP Server Port: 80
Network mode: DHCP
A. Set IP Address
B. Set Netmask
C. Set Default Gateway
D. Set HTTP Server Port
M. Toggle Network Mode
R. Return to Previous Menu
```

If static IP is selected as your network mode, the menu will appear as below:

```
Environmental Monitor IP Configuration Menu
Current settings
IP:
Net Mask:
Gateway:
HTTP Server Port: 80
Network mode: STATIC IP
A. Set IP Address
B. Set Netmask
C. Set Default Gateway
D. Set HTTP Server Port
M. Toggle Network Mode
R. Return to Previous Menu
```

4. Return to the Main Menu to set the name of the unit and probes.

```
Environmental Monitor Identity Configuration
Menu
A. Set Unit Name
B. Set Group Names
R. Return to Previous Menu
Enter choice: b
Please enter the group number to rename:1
Current group name is "Group 1"
Please enter a new name for group 1 (up to 15 characters):Lab Group
Name for group 1 set to "Lab Group"
```

Default group names are, “Group1”, “Group2”, and so on. Set probe names, as desired.

```
Current T probe name is "Temperature"
New name for group 1 temperature probe (up to 15 characters):G1 Temp
Name for group 1 temperature probe set to "G1 Temp"
Current H probe name is "Humidity"
New name for group 1 humidity probe (up to 19 characters):G1 Rel Humid
Name for group 1 humidity probe set to "G1 Rel Humid"
Current W probe name is "Wetness"
New name for group 1 wetness probe (up to 15 characters):G1 Wetosity
Name for group 1 wetness probe set to "G1 Wetosity"
```

5. From the Main Menu, set SNMP parameters:

SNMP and Temp Mode Settings Menu
A. Set Trap Servers
B. Set SNMP Read Community (Current: public)
C. Set SNMP Write Community (Current: private)
D. Set SNMP Trap Community (Current: trap)
E. Enable/Disable SNMP (Current: Enabled)
F. Enable/Disable Traps (Current: Disabled)
G. Trap value to send (Current: 1)
H. Max traps per error (Current: 5)
I. Minimum trap interval (Current: 60s)
J. Maximum trap interval (Current: 1000s)
K. Extra OIDs on trap (Current: Disabled)
L. Modify trap thresholds
S. Set Web Username (Current: defaultuser)
T. Set Web Password (Current: defaultpassword)
U. Toggle Temp Units (Current: Fahrenheit)
V. Set index refresh (Current: 60s)
R. Return to previous menu

For the EM1: in order to write an SNMP OID, the SNMP Write community name must be different from the SNMP Read community name.

6. Return to the main menu for the settings to take effect.

IMPORTANT: *There will be a short pause before the Main Menu reappears. This is normal.*

7. Disconnect the RS-232 cable.

PING TEST

8. Connect the supplied Ethernet cable to the unit; ensuring the other end of the cable is connected to the network through a hub or switch. You should now be able to ping the Environmental Monitor, using the assigned IP address. You should also be able to get temperature data with your web browser. Use the IP address you assigned. For example, if the unit IP is 192.168.2.201, enter <http://192.168.2.201> in your web browser's address bar.

Temperature data is provided in the temperature scale to which the unit is set. Check (and change) by performing an SNMP Get (or Set) on:

.1.3.6.1.4.1.16174.1.1.3.2.3.1.0

F = Fahrenheit, C = Celsius, R = Rankine, K = Kelvin

This variable can be written to change the temperature mode. (The Monitor will reinitialize when any writable variable is changed.)

WEB PAGE TO REVIEW CONFIGURATION

The Environmental Monitor is running an internal web server, listening for TCP/IP HTTP /GET requests on Port 80. The Monitor responds to three different URL requests:

Model:	EM1	Firmware Version:	5.2
Manufacturer:	Sensatronics	Release Date:	September 12, 2005
Website:	http://www.sensatronics.com/	Serial Number:	EM7G0L0T125
Unit name: TNT Software			
Group 1			
Temp (P1)	Hum (P2)	Wet (P3)	
-999.9 °F	-999.9 %	-999.9	
Server Room		Group 2	
Wetness	-999.9	Temp (P4)	Hum (P5)
Humi	34.5 %	-999.9 °F	-999.9 %
Temp	73.0 °F	Wet (P6)	-999.9
		Group 4	
		Temperature	-999.9 °F
		Humidity	-999.9 %
		Wetness	-999.9
Sensatronics Environmental Sensing			
Model EM1			
IT Environmental Monitor			

/index.html: This is the main index page. It returns an HTML-formatted web page that contains the temperatures of all connected probes. This index page also details information about the Monitor, such as manufacturer, serial number, unit, and probe names.

/data and **/config** return this data in other formats.

SNMP

Only SNMP Version 1.0 is supported in the Environmental Monitor. MIB-II information is NOT supported.

To set the SNMP community strings use the serial port configuration.

IMPORTANT: When configuring the SNMP community strings (read, read/write, and trap), be sure you don't leave any of them blank. They default to "public", "private", and "trap"

SENSATRONICS WEB SITE

The Sensatronics web site is <http://www.sensatronics.com>. There are a number of useful pages found in the Customer Support area. The Downloads area contains a link to the manual for the EM1 and a link for the MIB file. The FAQs area contains the Sensatronics Knowledge Base.

CONFIGURING WINDOWS SNMP

CONFIGURING WINDOWS SNMP AGENT INFORMATION

To configure Windows SNMP agent information:

1. Open the Control Panel | Administrative Tools, and open Computer Management.
2. In the console tree, expand Services and Applications, and click Services.
3. In the right pane, open SNMP Service.
4. Go to the Agent tab.
5. You may enter the name of the user or administrator of the computer in the Contact box, and the physical location of the computer or contact in the Location box. These comments are informational only and are optional.
6. In the Service box, select the check boxes for the services that are provided by your computer. Service options are:
 - Physical: The computer manages physical devices.
 - Applications: The computer uses programs that send data using TCP/IP. This box must be checked in order for ELM to send and receive SNMP traps.
 - Datalink and subnetwork: The computer manages a TCP/IP subnetwork or datalink.
 - Internet: The computer acts as an IP gateway (router).
 - End-to-end: The computer acts as an IP host.
7. Configure SNMP Communities and Traps (following section) or click OK.

CONFIGURING SNMP COMMUNITIES AND TRAPS

To configure traps:

1. In the SNMP Service dialog from the previous step, go to the Traps tab.
2. Enter the community name to which this computer will send trap messages in the Community name box, and click the Add to list button.
3. Click the Add button under Trap destinations to open an SNMP Service Configuration dialog box.
4. Enter the name, IP or IPX address of the host in the Host name, IP or IPX address box, and then click Add. Your entry will appear in the Trap destinations list.
5. Repeat steps 2 through 4 to add more communities and trap destinations.
6. Configure SNMP Security (following section) or click OK.

CONFIGURING SNMP SECURITY

To configure SNMP security for a community:

1. In the SNMP Service dialog from the previous step, go to the Security tab.
2. Click to place a check in the Send authentication trap check box if you wish to have a trap message sent whenever authentication fails.
3. Click the Add button under the Accepted community names window.

4. Select the appropriate permission level in the Community Rights dropdown box to specify how the host should process SNMP requests from the community.
5. Enter the community name in the Community Name box, and click Add.
6. To accept SNMP requests from any host on the network, click Accept SNMP packets from any host. To restrict the acceptance of SNMP packets, click Accept SNMP packets from these hosts, and then click Add to open an SNMP Configuration dialog. Enter the host name, IP or IPX address of the host from which the computer will accept SNMP packets in the Host name, IP or IPX address box.
7. Click Add.
8. Click OK.

IMPORTANT: If all of the community names, including the default name "Public", are removed SNMP does not respond to any community names that are presented.

CONFIGURING ELM FOR EM1

ENABLING THE TRAP RECEIVER

ELM Enterprise Manager must be configured to receive traps. The steps are:

1. Go to the ELM Enterprise Manager control dialog by opening the Control Panel and clicking on ELM
2. On the Receivers tab, click Enable SNMP Trap Receiver. You can choose to display the SNMP Object IDs (OIDs) by checking the Show Object Identifiers checkbox.
3. Click Apply and OK

CREATE AN IP VIRTUAL AGENT

An agent is the fundamental component used by ELM to identify a monitored item. IP Virtual Agents are used to remotely monitor non-Windows systems from the ELM Server (no software is installed on the monitored system).

1. Right-click the Monitoring container in the ELM Console and select New|Agent to open the Agent Installation Wizard. Click Next.
2. Select the IP Virtual Agent radio button and click Next.
3. Enter the IP address of the device you wish to monitor. Click Next.
4. Select the IP Virtual Agent Category and click Next.
5. Enter a description, if desired, and click Finish.

ADDING EM1 MIB FILES

In order to facilitate the SNMP Monitor testing specific values on the EM1, the EM1 MIB file may be downloaded and stored on your ELM Server. The EM1 MIB file can be found at http://www.sensatronics.com/support_downloads.php. Click the Sensatronics MIBs link, select **Save** and place the download in a location you will remember. The download contains several zipped files. Extract the sensatronics-em1.my and sensatronics-smi.my files and save them to the ../ELM Enterprise Manager/MIBfiles folder on your ELM Server. This file will provide the descriptions matching the EM1 OIDs.

The MIB file will be added to the MIB browser in the SNMP Monitor when the monitor is created.

CONFIGURING NEW SNMP MONITORS

1. Right-click on the Monitoring container in the ELM Console. Select New | Monitor Item to start the Create Monitor Wizard. Click Next.
2. Select SNMP Monitor from the drop-down menu and click Next.

3. Select the SNMP value to test - In order for ELM to find a value, it must know its object identifier (OID). There are three ways to enter that value:
 - i. Enter it, if you know it.
 - ii. Use the ELM MIB browser to "walk" the OID namespace tree to select the specific OID you wish to test. To add a MIB to the ELM MIB browser, click on the MIB Files button, click the Add button and select the MIB file you wish to add. Click Next.
 - iii. Enter the IP address of your device into Host Computer, specify the Community for that device and click the Display Objects from computer/community button and then walk the MIB that appears in the MIB browser.
Click Next.
4. Enter the action to be performed when the monitor state changes and click Next.
5. Select the Agent on which to test the monitor item from the drop-down menu and click Start Test. If satisfied with the results of the test, click Next.
6. Select the Agent Categories to be monitored and click Next.
7. Define the schedule used to activate this monitor and click next.
8. Enter the monitor Name and Description, and then click Finish.

CONFIGURING NEW SNMP NOTIFICATION METHODS

SNMP is the delivery method for the SNMP Notification. SNMP Notification provides two methods.

- SNMP OID Notification SETs a value to an SNMP management object in the SNMP management information base of the local computer or a remote computer
- The SNMP Trap Notification generates an SNMP Trap using the existing SNMP management system.

TO CREATE AN SNMP OID NOTIFICATION METHOD:

1. Right click on the Notification container and select New | Notification Method from the menu. The ELM Create Notification Method Wizard opens. Click Next.
2. Select SNMP OID/Trap from the dropdown list. Click Next.
3. Select SNMP OID. Click Next.
4. Enter the SNMP OID and the value to set:
 - Enter the Host Computer name or use the IP address you assigned, for example 192.168.2.201 from the example used earlier, specify the Community, and click the Display Objects from computer/community button to browse.
 - Choose the target OID from the list in the OID browser, define the Value to store. Enter the Value. If you continue the example in this setup, you would enter the integer value representing the temperature at which you wish to be notified.
 - Select the type of this value: Integer.
 - Click the Test button to test the settings.
 - Click Next.

5. Place a check in the box next to the Notification Rule(s) to which this Notification Method will apply: Warnings. Click Next.
6. Configure the Notification thresholds for when and how often this Notification Method will be triggered. Click Next.
7. Select the days and hours for which this Notification Method will be active. Click Next.
8. Enter the name and description for this Notification Method and click Finish.

TO CREATE AN SNMP TRAP NOTIFICATION METHOD:

The SNMP Trap Notification sends event information as an SNMP Trap to an SNMP management system. A MIB file is provided in the ELM Server installation folder. It is used by the SNMP management system to decipher the SNMP Trap.

1. Right click on the Notification container and select New | Notification Method from the menu. The ELM Create Notification Method Wizard opens. Click Next.
2. Select SNMP OID/Trap from the dropdown list. Click Next.
3. Select SNMP Trap. Click Next.
4. Select “Use Event ID as Trap ID” for this application.
 - Trap ID - If the event ID is not used as the trap ID, enter the ID number you want for the trap in this field.
 - Enterprise ID - Enter an enterprise ID for the trap message.
 - Click the Test button to test the trap generation and settings. Click Next
5. Select the Notification Rule for this Notification Method: Warnings. Click Next.
6. Enter the threshold settings (under what conditions and how often). Click Next.
7. Create the schedule for the hours and the days this Method can be used. Click Next.
8. Enter a Name and Description for this Method and check Enabled. Click Finish.

The Notification Method just created can be found in the Notification | Warnings | Notification Methods container.

VERIFICATION

Now you can generate an event to verify that everything is configured correctly:

1. Cycle the EM1 device off and on.
2. Open Results | Event Views | All – SNMP Traps to see the EM1 offline and online trap messages. This verifies the ELM Event Collector is gathering SNMP traps as event log records.

-or-

1. Before mounting the temperature sensor permanently, set it in proximity to a desk lamp for several minutes so that the heat of the lamp takes the sensor above the

temperature threshold. You may want to adjust the temperature threshold on the EM1 low enough for it to be triggered easily in normal room temperature situations.

2. Open Results | Event Views | All – SNMP Traps to see the events triggered by the test situation.

CONCLUSION

Successful systems administration requires awareness of all factors that may affect the operation of an information system. While current concerns lead us to focus on security issues such as viruses and unauthorized access or performance issues such as cpu usage, a fundamental factor that must also be monitored is the physical environment in which the systems hardware resides. Environmental monitoring is easily integrated into the comprehensive monitoring of a system using ELM Enterprise Manager.

ELM Enterprise Manager leverages the Windows SNMP services in two ways, giving IT Staff the ability to proactively monitor the environment with the SNMP Monitor and to be alerted when EEM receives a trap. Installing a sensor device and monitoring it with EEM gives continuous monitoring of temperature, humidity and more.

Find peace of mind with ELM Enterprise Manager environmental monitoring. Using an SNMP compliant environmental monitoring device, you will know when temperature, humidity, wetness and more are exceeding acceptable thresholds.

APPENDIX

SENSATRONICS EM1 SPECIFICATIONS

FEATURES

- Measure temperatures from -40°F (-40°C) to 212°F(100°C), accuracy within 0.5°F
- Measure Humidity with accuracy of 2%
- Measure Wetness
- Monitor up to 4 temperature, humidity or wetness locations
- Mounting flanges
- °F, °C, K, R units
- Low cost, small, light-weight
- The EM1 has Ethernet connectivity and includes an internal Web server. It can accommodate up to 16 probes from a single monitor.
- Ethernet connectivity: Setup the unit IP Address, Netmask and Gateway and begin collecting environmental data or let the unit dynamically configure the network settings. The EM1 also supports DHCP
- Internal Web Server: The EM1 has a built-in web server ...listening on TCP/IP Port 80 (or at a user selected port) for requests to display the current environmental conditions.
- Simple HTTP protocol: for retrieving temperature data... for users wishing to write their own interface (see details).

TECHNICAL SPECIFICATIONS

- Base Unit Operating Range: 0°F to 122°F
- Resolution: 0.1°F, °C, °K
- Temp Probe Accuracy: 0.5°F from -20°F to +120°F
- 1.5°F from -40°F to +205°F
- Humidity Probe Accuracy: 2% RH from 5% to 95%
- Measurement Interval: 3 seconds
- Units Selectable: °F, °C, K, R
- Power supply: 9VDC @ 250mA
- Exterior Dimensions: 4 1/4" x 3 1/4" x 0.75
- Shipping weight: 3 lbs., 1.3kg w/cables
- Computer Interface: RS232C (25-pin female D connector)

CONTROLLER OPERATING RANGE:

-40°F to 122°F
-40°C to +50°C

ACCURACY:

0.5°F from -20°F to 120°F
1.5°F from -40°F to 159°F

2.0°F from 160°F to 212°F
0.3°C from -3°C to 50°C
0.8°C from -40°C to 70°C
2.0°C from 71°C to 100°C*
* Not available on all units

RESOLUTION: 0.1°F, C, K, R

UNITS: Fahrenheit, Celsius, Kelvin, and Rankine

MEASUREMENT INTERVAL: 3 seconds

POWER SUPPLY: 9 VDC @ 250mA (wall transformer), 2.5mm plug, center positive

Note: The Environmental Monitor can be supplied by any 9-15 VDC power supply capable of supplying 250mA.

DIMENSIONS: 4.25" x 3.25" x 0.75" (108mm x 83mm x 20mm)

SHIPPING WEIGHT: 3 lb. (1.3 kg) with cables

MOUNTING: Flanges for wall or rack mounting

TEMP/HUMIDITY PROBE: Heavy duty

CABLE LENGTH: 10 feet (3.05). 75' and longer lengths are available on request.

WETNESS PROBE: 10' and 75' lengths

COMPUTER INTERFACE: RS232C (25-pin female D connector)