Siretta

Inspired Wireless M2M Technology

EM01b Websensor

HVAC Monitor (Ethernet Port Configurable)

User Manual

Rev 6.8

Siretta
Inspired Wireless M2M Technology

EM01b Websensor
HVAC Monitor

Table of Contents

Warranty

Warranty

Siretta warranties the products to be substantially free of manufacturing defects for a period of 1 year after purchase during which time the product will be replaced without charge if defective.

Limitations

Siretta provides no warranty, expressed or implied, as to the fitness of the products for any particular purpose. Siretta will not be liable for incidental or consequential damages arising from the use of its product.

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Introduction

The Siretta EM01b Websensor is designed to utilize the internet to transmit temperature, relative humidity, detect contact closure, power supply voltage information and illumination data from a remote acquisition point to a host computer or hosted database.

The EM01b Websensor offers built-in signal conditioning and an embedded mini-webserver. Users are able to access the sensor using http: based commands.

Figure 1. Websensor EM01b returning data via a HTTP: response

Request via HTTP:

Response via HTTP:

EM01b websensor

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www.siretta.co.uk
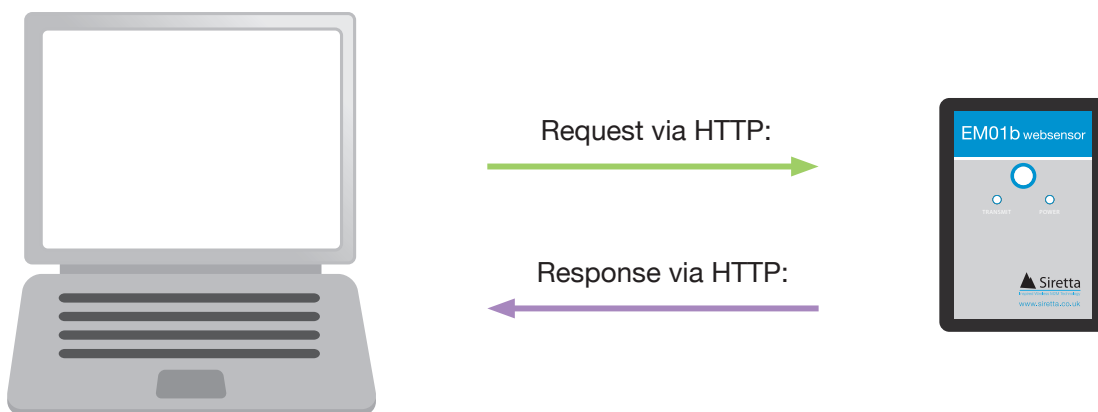
Using the EM01b

Simply, the Websensor's function is to send a response (by a HTTP: message) upon request of a central website or from the User's PC.

The EM01b Websensor supports a user configurable IP address. Websensor's IP address gives it uniqueness on the Ethernet based network to which it is attached. It is through the IP address, that the Websensor is able to take its' place on the Internet, becoming fully accessible to query by the user.

The Websensor consists of a base unit with two communication ports (Ethernet and ESbus).

The ESbus combines a networked version of the SPI serial bus and RS232. The ESbus port is used to support a variety of options available for the Websensor while the Ethernet port is the route to the Internet and is used to configure the IP address of the Websensor.

Available options which connect via the Esbus:

» ES01 Two Line LCD Display
» ES11 Flood Sensor
» ES bus hub - for connecting multiple displays or flood sensors to one EM01b

Periodically check **www.siretta.co.uk** for other options as they become available.

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How the EM01b Websensor Works

Within the base unit are microcomputers, which handle the Internet protocol, the communication ports, and the sensor and sensor signal conditioning. The Websensor has no switches, keyboard or display because it functions as a sensor, not as a computer.

Figure 2. How the Websensor works
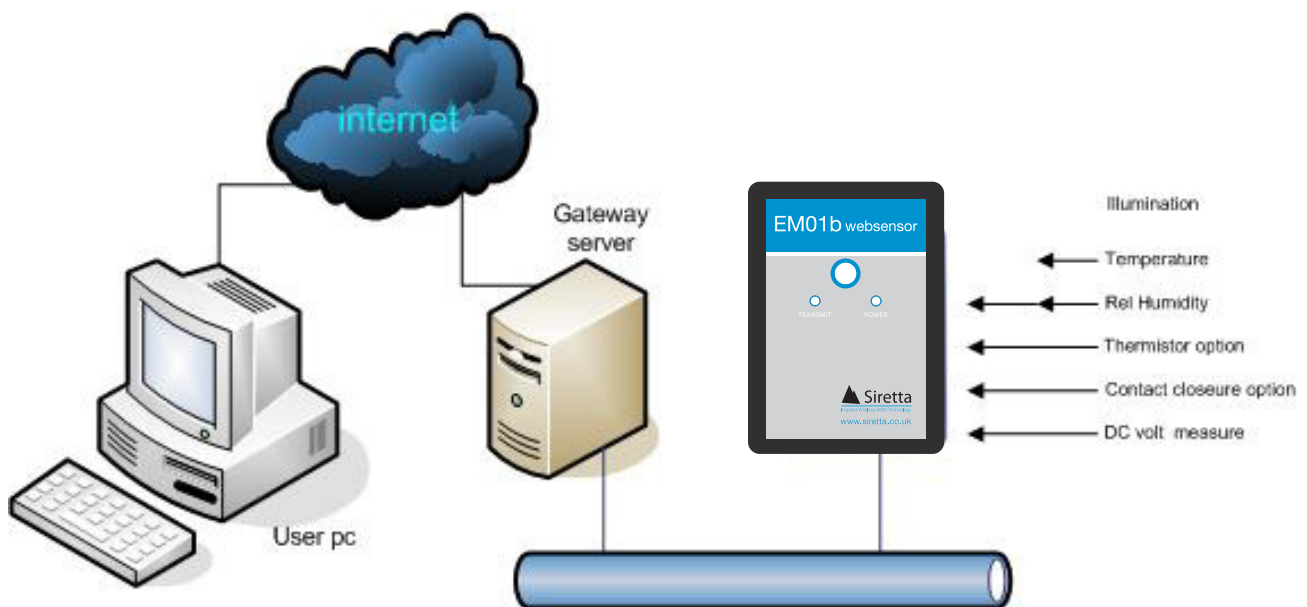
Compatibility with Earlier Websensors

Compatibility with the earlier models of Websensor has been maintained. Any version of the Websensor will always return temperature, relative humidity and illumination data by sending:

http://192.168.254.102/index.htm?em

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EM01b Variations

There are three versions of the EM01b available. Each version has the standard light, temperature and humidity sensor and they all operate in the same way. The EM01b features an extra port that can be used for a several purposes hence the three variations.

EM01b-STN

The standard EM01b has its extra port configured to sense switch opening and closing such as that used to detect a door open or shut. This version comes with a bare plug for the extra port for the user to wire up to.

EM01b-THM

The EM01b-THM features the extra port being used as an additional temperature sensor and comes supplied with a temp sensor on the end of a 3 metre cable which plugs into the extra port.

EM01b-VLT

The EM01b-VLT uses the extra port to measure DC voltage from 0-18V. This is most often used to monitor UPS batteries. This version comes with a bare plug for the extra port for the user to wire up to.

See websensor inventory page for parts included with each EM01b.

What's in the Box

» 1 x Websensor EM01b Module [See figure 3]

» 1 x Wall Transformer suitable for all countries with all country adaptors and 110 – 240 VAC

» 1 x Ethernet straight-thru cable for connection to an Ethernet Hub (Blue cable) [See figure 5]

» 1 x Ethernet crossover cable for direct connection to a Network Interface Card on a PC (RED cable with YELLOW boots or solid GRAY) [See figure 6]

» 1 x Connector (plug) for contact closure – voltage sense versions

» 1 x (EM01b-STN and EM01b-VLT) [See figure 7]

» 1 x Quickstart guide

» 1 x 3M thermistor cable and plug for extra temperature sensor version of EM01b only (EM01b-THM) [See figure 8]

Specifications

Table 1. EM01b specifications

Ranges	
Temperature:	-40 °C (-40°F) to +123.8 °C (254.9 °F)
Illumination:	0 to 1000 Lux
Relative Humidity:	0 to 100% RH
Accuracy	
Temperature:	+/- 0.2 °C @ 25 °C
Illumination:	Uncalibrated
Relative Humidity:	+/- 3%
DC Voltage Measurement	
0 to +18 VDC (Centre pin of connector is (+) positive.)	
Thermistor Interface	
Customer supplied specifications – resistance at 25°C required to determine correct components.	

Websensor Inventory

Figure 3. EM01b Websensor

Figure 4. Wall Power Supply

Figure 5. Straight Patch Cable

Figure 6. Crossover Cable

Figure 7. Contact Closure

Figure 8. Additional 3m Thermistor Cable (EM01b-THM only)

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Websensor Connection

How to Connect a Websensor Directly to a PC

To configure and use a Websensor it must be connected to a PC via an Ethernet cable as shown in either figure below.

If connecting directly to a PC, a crossover type Ethernet patch cable must be used. A crossover type Ethernet cable has been included with the Websensor. It is a solid GREY cable with BLACK connectors.

Figure 9. Websensor connected directly to the NIC in a PC

Ethernet Connection
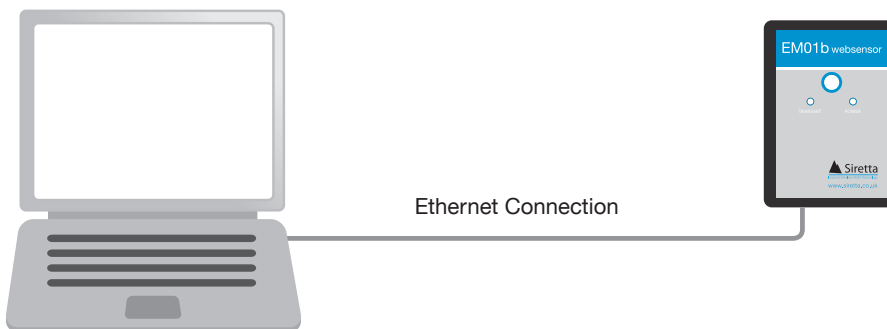
Connecting to a PC Through a Hub or Directly to a LAN

If connecting to a PC through a HUB, a "straight" type Ethernet patch cable must be used between the HUB and the Websensor. A "straight" type Ethernet patch cable is also included with the Websensor; it is the BLUE patch cable.

Figure 10. Websensor connected through a HUB to the NIC in a PC

Ethernet Connection
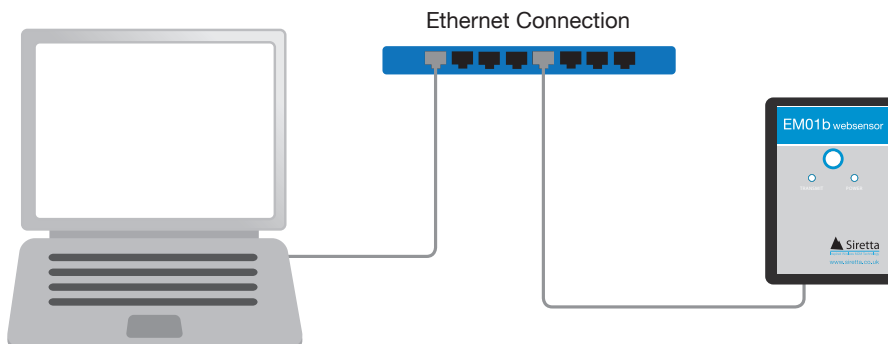
Connecting the Websensor

The figures below depict the locations of the connectors for the Ethernet, 12VDC power and Esbus connectors.

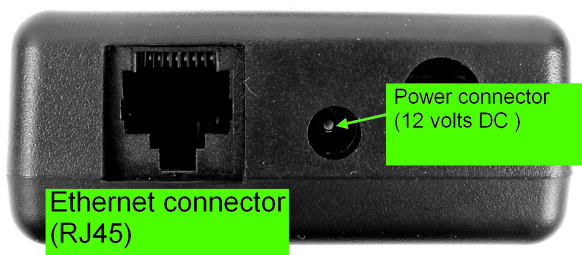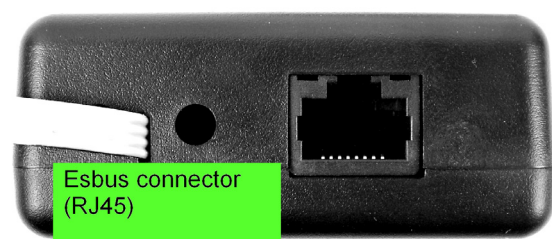Figure 11. Ethernet (RJ-45) & Power Connectors

Figure 12. Esbus Connector (RJ-45)

Power connector (12 volts DC)

Ethernet connector (RJ45)

Esbus connector (RJ45)

Esbus for connecting up to 7 other accessories:

» ES11 Flood Monitor
» ES01 Visual Temp Display
» ES02 Main Power Monitor (not yet available)
» EShub – hub for connecting more than one accessory to an EM01b

Check **www.siretta.co.uk** for specification of the above.

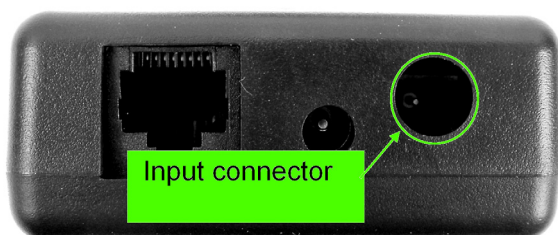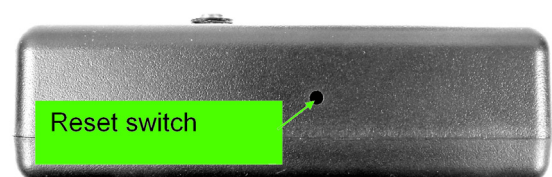Figure 13. Thermistor, Voltage Measurement and Contact Closure output connector

Figure 14. Location of RESET PUSHBUTTON

Input connector

Reset switch

Quickstart

☐ Set PC Network IP address to 192.168.254.10, Subnet to 255.255.254.0 and Gateway to 192.168.254.102

☐ Connect the power supply to the Websensor

☐ Connect crossover cable from the PC to Websensor Ethernet port.

☐ Switch on power at mains outlet.

☐ Both front face LEDs will flash twice with the amber power LED staying on permanently and the green transmit LED going out.

☐ The Websensor is now ready to communicate with the PC.

☐ Test communication to the websensor by using the 'ping' command at an MSDOS prompt (ping 192.168.254.102 return) and the default IP address of the websensor.

Default IP address – 192.168.254.102

☐ If unsuccessful response – press reset button on the side of the websensor for 10 seconds until the two LEDs flash twice and the amber LED stays lit with the green LED extinguishing. Leave the Websensor for a few seconds to settle down and try 're-pinging'.

☐ After successful communication with the 'ping' command try retrieving information from the Websensor by typing in the following command on the PC's web browser:-

http://192.168.254.102/index.htm?em

This is asking the Websensor for temperature, light and humidity information and will show a reply string similar to image over page.

Figure 15. Requesting temperature, humidity and illumination details
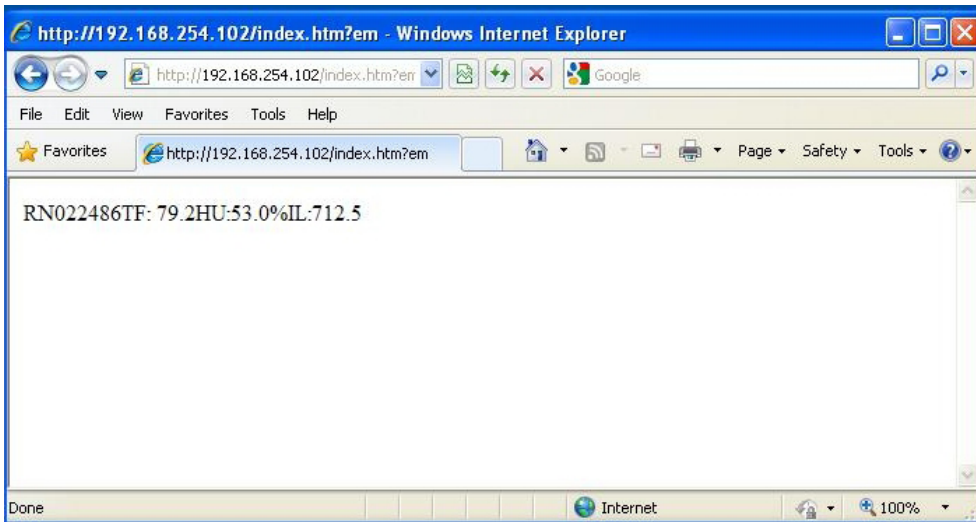
TC = temp

HU = humidity

IL = illumination

Your Websensor is now fully functioning and is ready for you to programme to your requirements. Continued below.

HELPFUL HINT: Prior to assigning the Websensor's IP address, it may prove useful to confirm that the IP address chosen for Websensor is not being utilized by another device on the network. This is easily checked by pinging the selected address on the network that the Websensor will be connected to, prior to connecting the Websensor to the network.

Programming the IP Address

Programming your chosen IP address into the Websensor is performed by using the browser to issue the following command:

http://192.168.254.102/index.htm?eipaaabbbcccddd, where aaabbbcccddd is the new IP address of the Websensor.

For example, suppose the new address to be assigned to the Websensor is 192.168.10.20. The command to perform this change is:

http://192.168.254.102/index.htm?eip192168010020

As the new address is entered, each octet must have three digits.

After programming is complete, the command to access the Websensor would be:

http://192.168.10.20/index.htm?em

NOTE: Once the command to change the IP address is issued the Websensor will automatically reset itself. After the reset process completes, the new IP address will be in effect.

FAQs Regarding IP Address Changes

Q: What if I forget what IP address is programmed into a Websensor, is there anyway to retrieve it?

A: There is no command that can be issued to a Websensor that will cause the Websensor to reveal its assigned IP address. If the assigned IP address is forgotten, the only recourse is to press the reset button for ten seconds, thus restoring the default IP address of 192.168.254.102.

Q: Why can't I read the Websensor's new programmed IP address?

A: The most likely reason is that the IP address on the NIC (network interface card) on the PC used to programme the Websensor is outside the IP address Class of the new IP address programmed into the Websensor.

For example, if 192.168.254.102 (default IP address) is used to program the Websensor and the new IP address is something like 141.123.6.10, it would be necessary to change the IP address of the NIC card to the 141.123.X.X subnet. Once the IP address used by the PC is changed to the same subnet/class as the Websensor, there should be no problems communicating with the Websensor.

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Default Settings

Resetting the Websensor's Settings to Default

To reset the Websensor settings to the default value perform the following steps:

1. Locate the small hole on the side of the Websensor (see PIC below).

2. Use a small object like the end of a straightened paper clip to gently press the reset button only until both LEDs on the Websensor start to flash.

Once the reset is completed the Websensor will be set to a default IP address of 192.168.254.102. From this address the User can configure the IP address of the Websensor to the desired value.

Figure 16. Location of the RESET button on the Websensor.

Reset switch
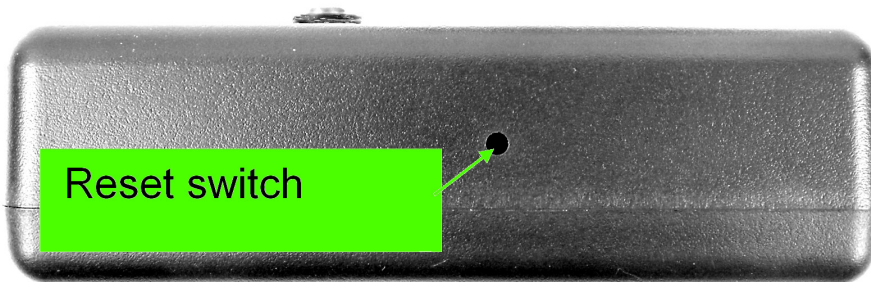
How to Recognize a Websensor RESET

When a Websensor resets (initializes) the following LED lighting sequence will occur:

» Only the amber POWER LED will be on for approximately 5 seconds

» Both (amber) POWER and (green) TRANSMIT LEDs will extinguish for approximately 5 seconds.

» Both POWER and TRANSMIT LEDs will flash two (2) times as the Websensor "resets".

» Finally, only the POWER LED will remain ON.

Units of Temperature

Selecting Units of Temperature to be Reported

To establish the units in which temperature is reported, either Fahrenheit or Celsius, perform the following:

For temperature in Fahrenheit use the browser to send this command,

http://192.168.254.102/index.htm?etpF

For temperature in Celsius use the browser to send this command,

http://192.168.254.102/index.htm?etpC

NOTE: The temperature unit selection setting applies to both the temperature sensor provided with the Websensor and the thermistor temperature readings.

Testing the IP Address

Once the Websensor has been configured, it is a good idea to confirm the IP address selected during the configuration process has been properly entered. One way to do this is to "ping" it.

Connect the Websensor to a PC via an Ethernet cable as shown on Page 9.

Open a Window with an MSDOS "Command Prompt".

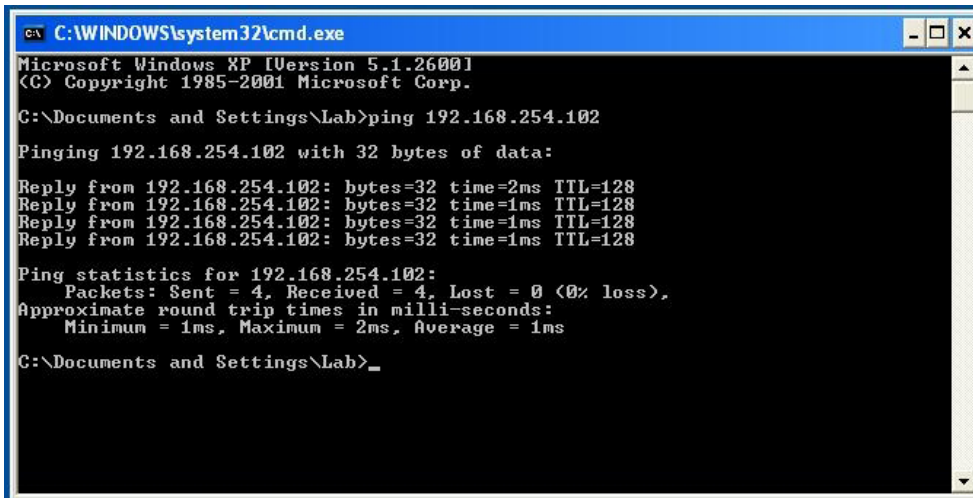START > ACCESSORIES > COMMAND PROMPT

In the "Command Window" type the IP address you entered in configuration Step 1. In this example we are using the websensor default address 192.168.254.102

ping 192.168.254.102

The IP address shown in the example is only for example. The IP address entered during configuration should be used for this test. See the Command Window.

Figure 17. Command Window

Testing the Websensor's IP Address

If the IP address has been configured and is working properly, the replies received should look like those shown in the "Command Prompt Window".

If the response shown in the command prompt screen is "not received", please refer to the "Troubleshooting Websensor" section in the appendices.
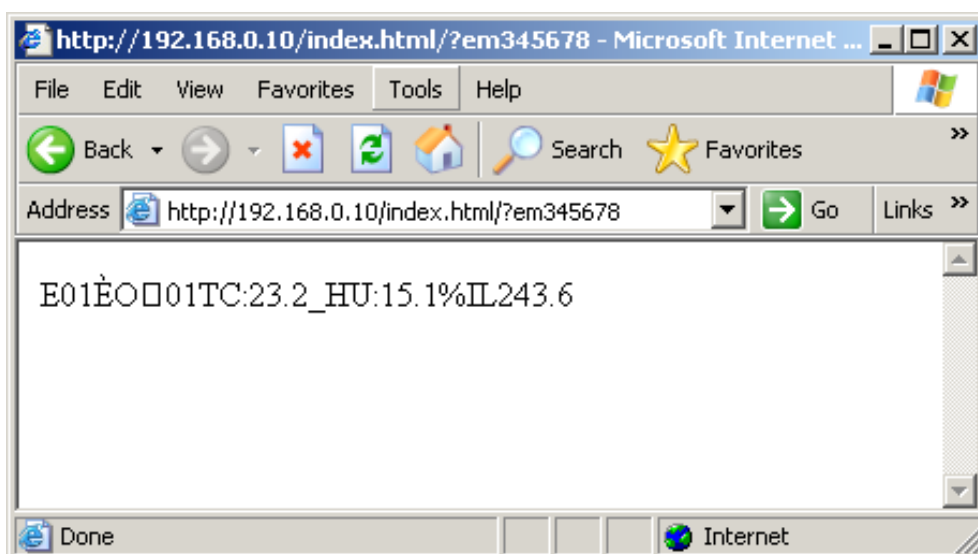
Testing the Websensor's IP address
Once you are able to successfully "ping" the Websensor, it is time to try a http: request for some "live" data. To issue a request, start your internet browser (Internet Explorer / Netscape). In the URL address field enter the following address:

http://192.168.254.102/index.htm?em

Note: For purposes of explanation the IP address 192.168.254.102 is being used. However, the USER should enter the IP address that was programmed into the Websensor during the configuration step.

Once the URL is entered, press the "ENTER" key and the Websensor should acknowledge with a response. The response you see will be similar to what is shown on the browser screen depending on which features are enabled (see below). The information returned starts with "E01" signifying that the response is from an EM01b Websensor. The next several bytes have to do with "check-sum". "TC:" begins the temperature reading, "HU" is the humidity reading and "IL" is the illumination value.

Figure 18. BROWSER SCREEN response from the HTTP: request

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Websensor's Tail

The EM01b Websensor has a tail. Functionally, the tail is the sensor which measures temperature and relative humidity. The reason for the tail is to move the temperature sensor outboard of the EM01b enclosure so that any heat emitted by the EM01b electronics, will not skew the temperature/relative humidity measurements.

NOTE: Websensor was designed to measure "air temperature". Websensor's tail should not be immersed in any liquid.

Figure 19. Websensor's tail (temp/RH sensor).

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Additional Websensor Functions

Websensor now offers three (3) new functions to the User, however only one of the three can be used or programmed into the Websensor at any one time. One of the three functions should be specified at the time of purchase as only one of the functions can be configured because all three functions utilize the same port on the Websensor and each one requires a specific modification to the Websensor hardware.

The Websensor will come pre-configured pending which function is selected. ***If no function is specified then the Websensor will come with the 'Contact Closure' option configured.***

Contact Closure

The Contact Closure option can be used to detect the opening of a server rack door (intrusion). However, contact closure detection can be used for many applications other than security.

Connection to the Websensor port is made via a small plug (3.5mm outside X 1.0 mm pin supplied with each Websensor) which is inserted. The Websensor's default is normally closed.

Magnetic door switches suitable for this application are available from Sensormetrix.

When the door (and switch) is opened and the circuit is broken, the Websensor will 'latch' on the open condition. In the event a door is quickly opened and closed in between Websensor scans (polls), the 'open condition status' is captured (latched) so that an ALERT can be generated by the polling software.

Figure 20. Mini plug

Figure 21. Location of Contact Closure Jack and Plug
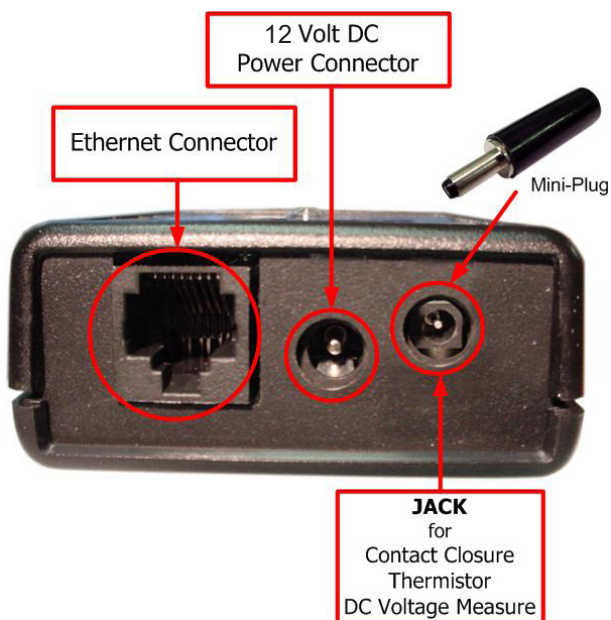
If your Websensor is purchased with the Contact Closure feature configured (default) the following step was already performed during testing. To assure that the correct firmware is enabled type the following command:

http://192.168.254.102.index.htm?eFC

Figure 22. Command enabling Contact Closure
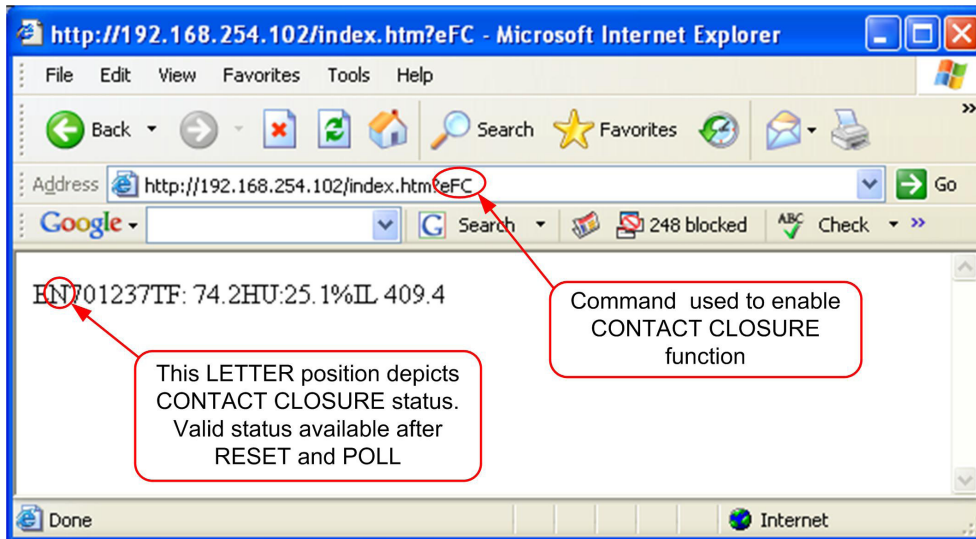

Once this command is entered the Websensor will go through a RESET sequence.

Note that the 'second character' in the command string indicates whether the Websensor detects the contact (switch) as being open or closed.

'W' indicates the contact/switch is closed – see Figure 24.
'N' indicates that the contact/switch has been opened – see Figure 23.

NOTE: The initial 'contact closure' information returned is not valid at the time the ENABLE command is sent. Any requests sent AFTER the function ENABLE and Contact Closure RESET commands will contain valid contact closure status.

In Figure 22, the string returned indicates contact closure (switch closed / loop unbroken) as well as temperature in Fahrenheit, relative humidity and illumination information.

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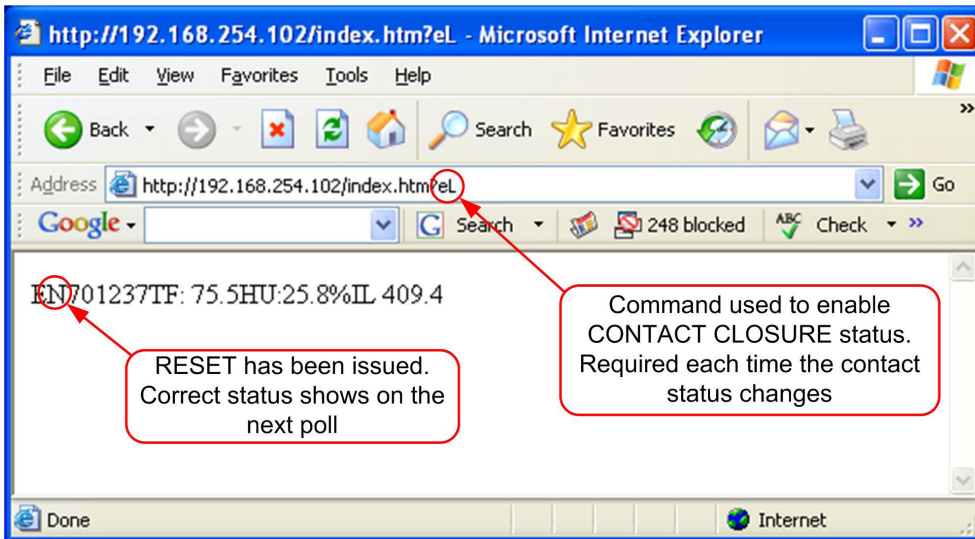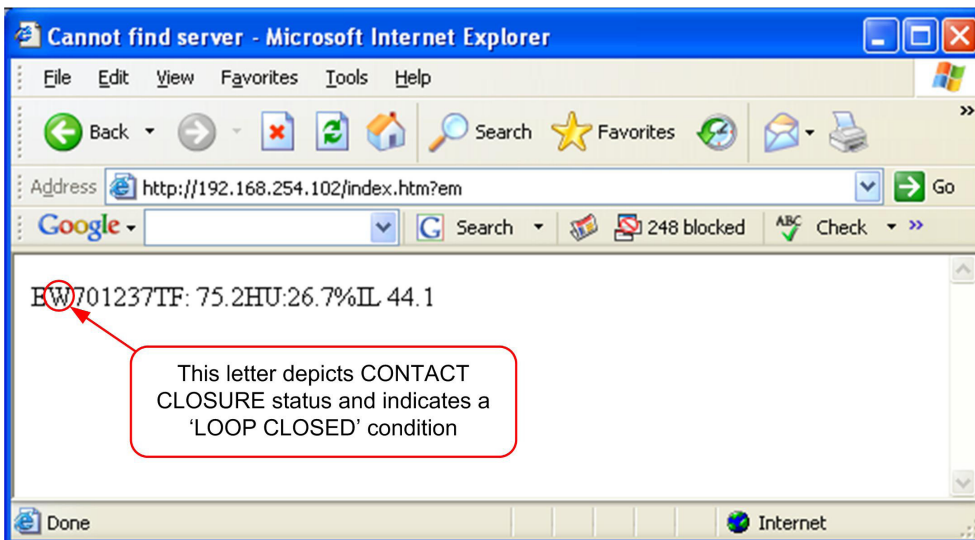**Figure 23.** Contact Closure RESET command issued

Figure 24. Valid Contact Closure status showing switch closed after resetting

NOTE: Contact Closure status is VALID after the command is issued

Figure 25 shows a regular command being issued, but this time the 'N' indicates that the switch has opened (loop broken) even if only momentarily.

Figure 25. Open switch or open loop indication
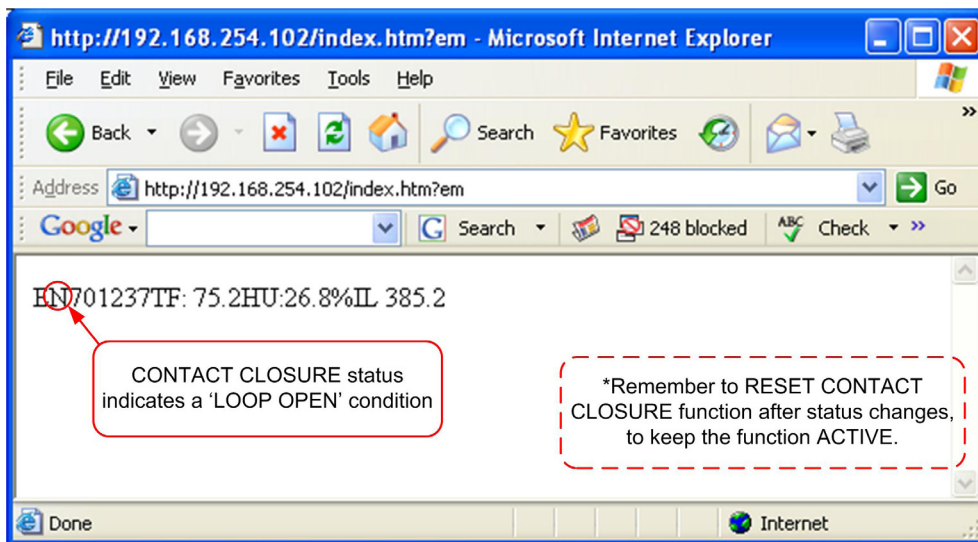
NOTE: Contact closure can only be reset after the switch (loop) has been restored to a closed condition.

NOTE: Should the Websensor lose power or have its power recycled, the Websensor will report an open switch/loop condition and will need to be reset by using the 'eL' command.

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Thermistor Interface

The Thermistor Interface permits the User to utilize an additional external temperature sensor with Websensor. An example might be to use a thermistor sensor suitable for immersion in liquids or gases.

If the thermistor interface feature is desired it must be indicated at the time the Websensor is ordered so that the correct hardware options are enabled prior to shipment.

Prior to using the Websensor Thermistor Interface for the first time, the following command should be issued to assure the correct firmware is selected for operation.

http://192.168.254.102/index.htm?eFR

Figure 26. Command used to enable Thermistor function.
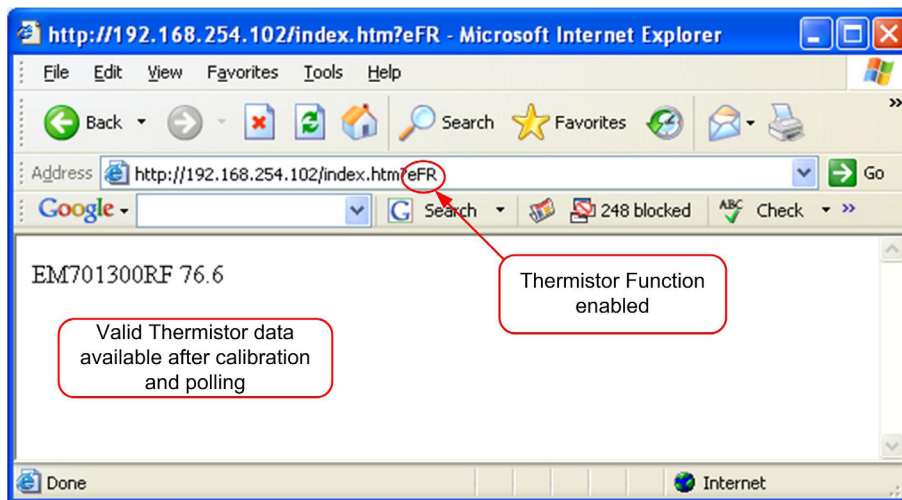
(A suitable thermistor is available from Sensormetrix: Thermistor Cable - 32731)

Once this command is entered the Websensor will go through a RESET sequence.

Before accurate thermistor readings can be taken, it will be necessary to calibrate the Websensor by accurately measuring the temperature which the thermistor sensor is reading. If the thermistor sensor is measuring liquid, either a thermometer or other electronic temperature reading device must be used to capture the reference temperature being read by the thermistor.

The websensor's temp unit must be selected before further actions. The temp unit command is as follows:

Celcius - **http://192.168.254.102/index.htm?etpC**
Farenheit - **http://192.168.254.102/index.htm?etpF**

Figure 27. Using Websensors own temperature for calibration
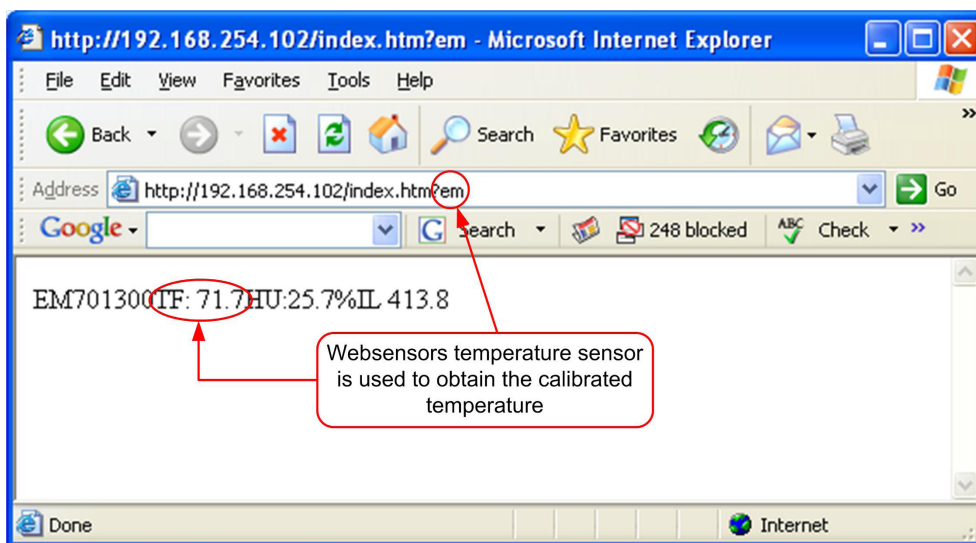
Once the calibration value is known, enter it into the Websensor using the following command:

In this example, the value 70.500 degrees Fahrenheit will be entered,

http://192.168.254.102/index.htm?er70.50

NOTE: All temperatures entered must be of the format XX.XX

Figure 28. Calibration temperature is entered.

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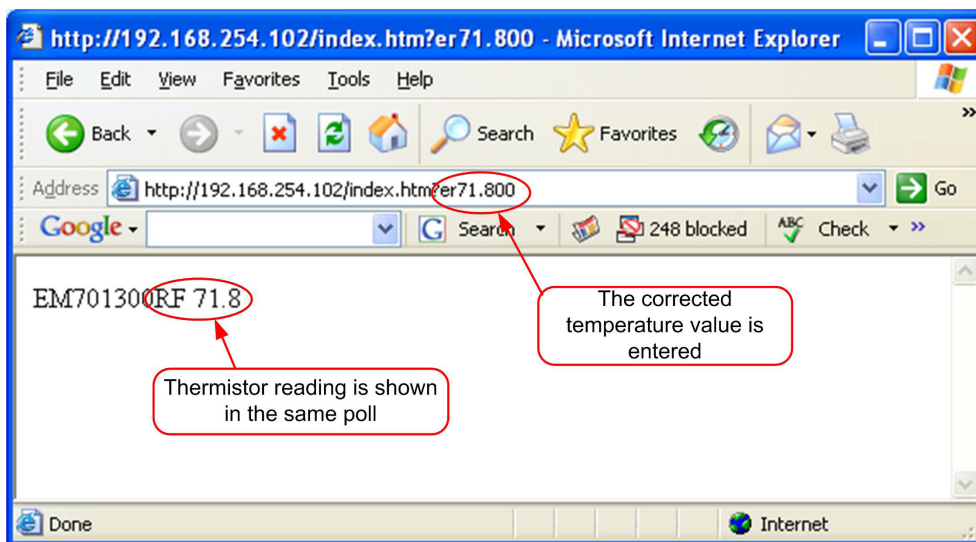
An example of entering a Celsius temperature of 25.5 degrees would be:

http://192.168.254.102/index.htm?er25.50

NOTE: Websensor Temperature Units should be selected prior to temperature calibrations.

Figure 29. How to obtain a Thermistor reading

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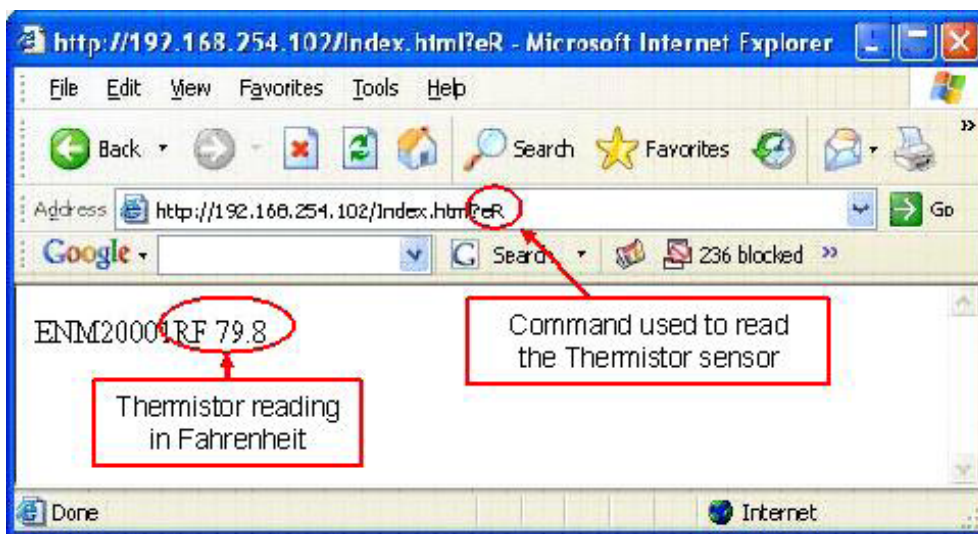
Measure Voltage (DC)

The Measure Voltage feature permits the User to read a DC voltage with Websensor. The range of DC voltage that can be measured is 0.0 VDC to +54 VDC.

This feature can be used to monitor the Websensor's supply voltage in applications where the Websensor is located remotely and is being powered by a battery.

Prior to using the Websensor Measure Voltage feature for the first time, the following command should be issued to assure the correct firmware is selected for proper operation.

http://192.168.254.102/index.htm?eFV

Figure 30. Command to enable DC Voltage Measurement.

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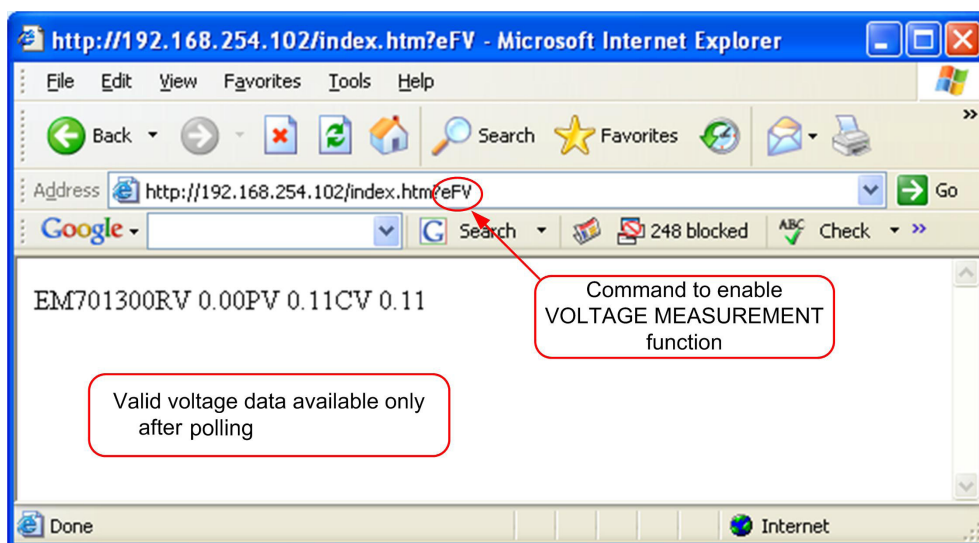
Similar to the other features, it is necessary to specify the 'Measure Voltage' feature at the time the Websensor order is placed.

The Websensor command to read DC voltage is:

http://192.168.254.102/index.htm?ev

Figure 31. Command to Measure DC Voltage.

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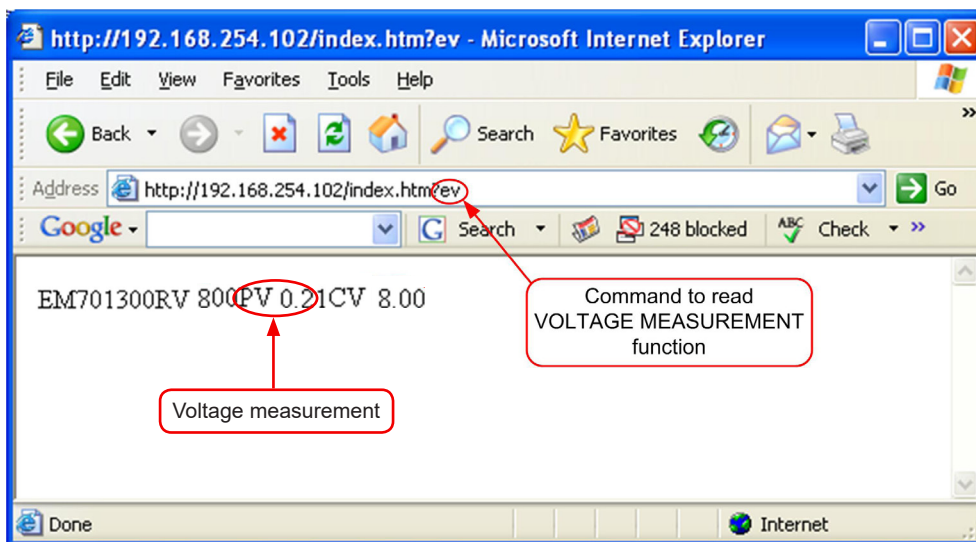
Connector Connections

The connections to the connector should be made such that the centre pin goes to the positive (+) polarity.

Figure 32. Connector connections

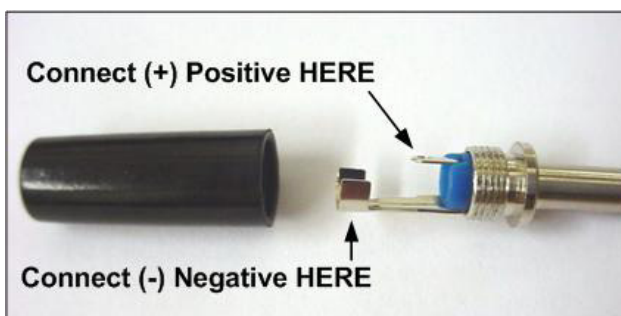**Table 2.** Commands and functions

Command	Function
http://192.168.254.102/index.html?em	Measure temperature, illumination and humidity.
http://192.168.254.102/index.html?etpF	Change temperature to Farenheit
http://192.168.254.102/index.html?etpC	Change temperature to Celsius
http://192.168.254.102/index.html?eFC	Change additional functions to door closed
http://192.168.254.102/index.html?eFR	Change addition function to additional thermistor
http://192.168.254.102/index.html?eFV	Change additional functions to voltage measure
http://192.168.254.102/index.html?ev	Measure voltage command
http://192.168.254.102/index.html?ecXX.XX	Calibrate voltage where XX.XX is calibration voltage (14.15 eg)
http://192.168.254.102/index.html?erXX.XX	Calibrate temperature of additional thermistor where XX.XX is calibrated temperature (eg 36.82)
http://192.168.254.102/index.html?eipaaabbbcccddd	Change IP address where aaabbbcccddd is the new IP address
http://192.168.254.102/index.html?eR	Read additional thermistor temperature
http://192.168.254.102/index.html?eL	Reset contact closure switch

NOTE - Lower case and upper case command characters

Troubleshooting the Websensor

This section describes some common problems associated with the initial set-up and configuration of Websensor.

1. If you are not able to "PING" the Websensor follow these steps:

a. Confirm that there is power to the Websensor. The Websensor comes with and is powered by the 12V DC wall transformer.

b. Confirm that the NIC (network interface card) is working in the PC being used to configure and test the Websensor. Proper operation can be verified by opening a "Command Prompt" window and issuing a "PING" command to the IP address of the NIC card. For example: ping 192.168.254.1. A reply should be received almost immediately. If no reply is received, confirm that the NIC card is configured with the desired IP address through the "Control Panel" in Windows.

c. Confirm that the correct "Ethernet patch cable" is being used. When properly connected, the LEDS on the NIC card should "light".

 "No LEDs lit", may indicate some hardware issue like an incorrect, or a faulty cable is being used. Connecting the Websensor directly to the NIC of a PC requires a crossover type of patch cable. The crossover cable included in the Websensor Kit is solid GREY colour with BLACK connectors.
 Connecting the Websensor to an Ethernet HUB requires a "straight" type of patch cable. The "straight" type of patch cable included in the Websensor Kit is BLUE.

d. It is important that the Websensor and the PC being used to "ping" the Websensor are in the same sub-network.

 What this means is if you using a sub-network mask of 255.255.255.0 the first three (3) octets of the PC's IP address and the Websensor's IP address must match.

 Example of *invalid* IP addresses:

 PC's IP address: 155.6.20.1
 Websensor's IP address: 192.168.254.102

 Example of *valid* IP addresses:

 PC/Server IP address: 192.168.254.10
 Websensor's IP address: 192.168.254.102

e. Confirm with the IT Systems Administrator that the IP address being used by the Websensor has not been previously assigned. Using the PING command to test the availability of a specific IP address could result in a false indication if the device using the IP address has its PING RESPOND disabled.

2. **If you are not able to execute commands using "Internet explorer" please make the following changes to turn off caching in IE.**

   Go to "tools", "internet options". Then under Temporary Internet Files tab, click on settings....then click on the radio button for "Every visit to the page". Finally, click on ok.

Websensor Connection via Router

Q: Why doesn't the Websensor need a subnet mask and default gateway?

A: Neither a subnet mask nor default gateway is needed because the Websensor only responds to HTTP requests. The incoming packet contains the necessary information needed for the Websensor to return data. As in Q4, we know that incoming TCP/IP packets include the source IP/MAC addresses. Websensor will never initiate any TCP/IP communication.

Q: How can I retrieve data from a Websensor?

A: The Websensor has a WWW service built in (mini web-server). You can use any web browser to access the Websensor.

Q: Will a Websensor initialize any kind of TCP/IP communication?

A: No. The Websensor will not initialize any TCP/IP communication. It only listens on port 80, waiting for other computers to send a HTTP request.

Q: How does the Websensor return data to the computer which sends the HTTP request?

A: Every TCP/IP packet will include the destination IP/MAC, and source IP/MAC addresses. When the Websensor responds to a request (within the same subnet), it simply swaps the source and destination IP/MAC addresses. (During the very first transmission when the PC knows the Websensor IP address, but not the Websensor MAC address, it will issue an ARP request which contains the Websensor's IP address and use 'FF's' to fill-in the Websensor's MAC address. The Websensor performs an 'ARP respond' to broadcast its IP address and associated MAC address.)

Q: How does the Websensor return data between subnets?

A: In the case where a packet passes through a router, the router will substitute its own MAC address in place of the originating source MAC address. The source IP/MAC addresses can be retrieved from any incoming TCP/IP packet. The Websensor will use the modified IP/MAC address to return its data. This is further explained in the examples following the Q & A section.
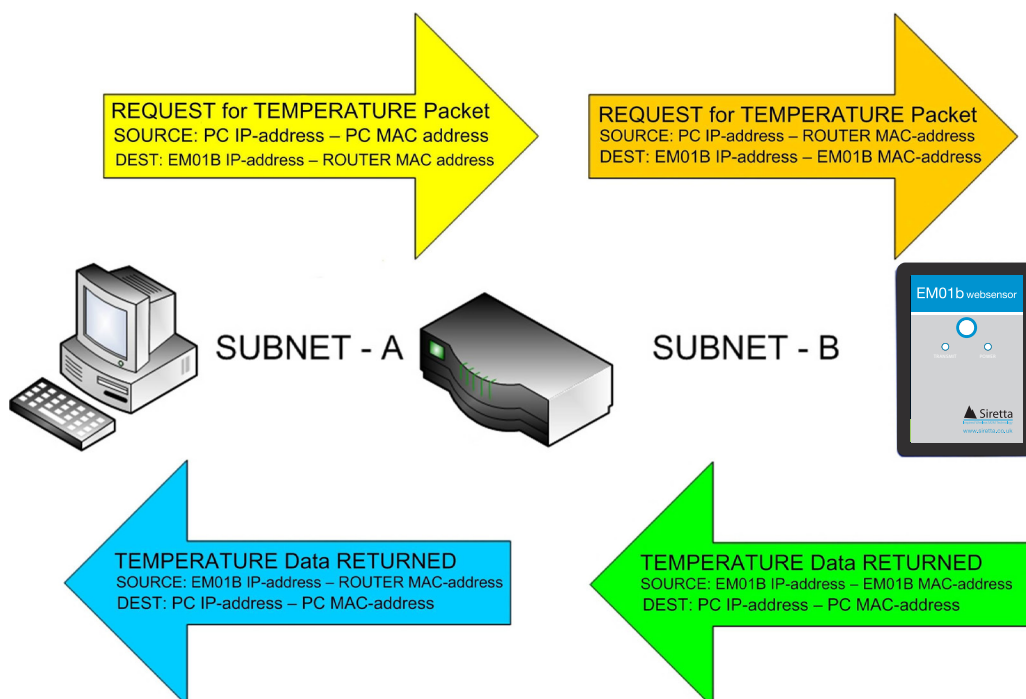
Please reference figure 33.

Q: How do computers know the Websensor's MAC Address?

A: Websensor has a portion of the ARP protocol built in. It will only do ARP responds (RFC1180).

For further information and details on IP kindly reference RFC791 INTERNET PROTOCOL, DARPA INTERNET PROGRAM PROTOCOL SPECIFICATION and other related documents.

Websensor Connection over the Internet

Figure 33. Websensor connection over the internet

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Addressing Examples

Example A. Server A tries to access Websensor A

The Websensor can retrieve exactly the IP/MAC addresses of Server A from the HTTP request that is sent from Server A.
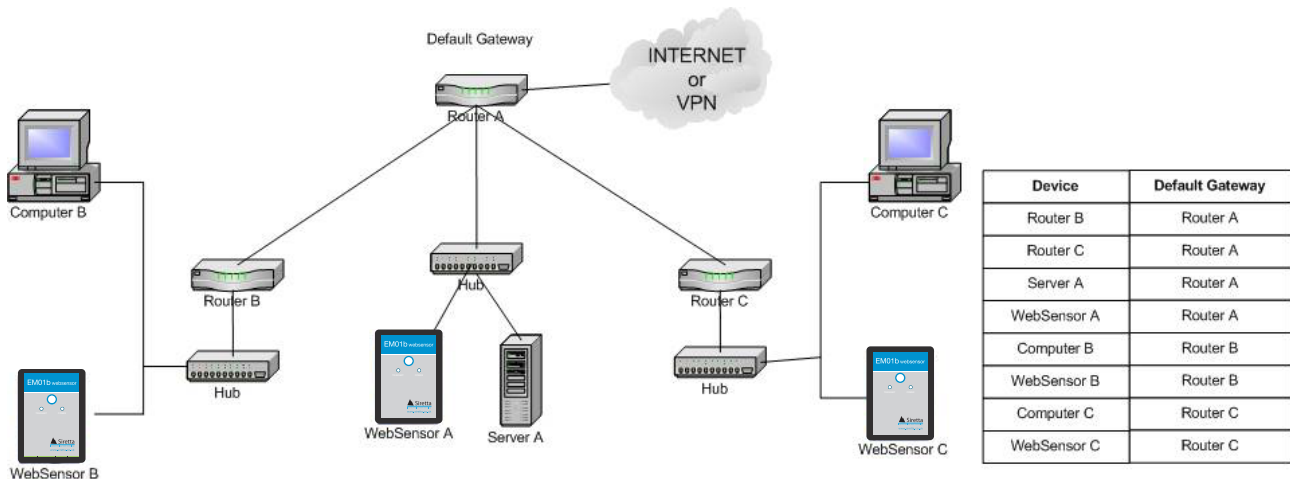
Example B. Server A tries to access Websensor B

The HTTP request will be forwarded by Router A first. Router A replaces the Websensor B MAC address with the Router A MAC address, and then sends the request to Router B. Router B does the same thing, replaces the Router A MAC address with the Router B MAC address, and then sends the request to Websensor B. Websensor B uses the IP (of Server A) and MAC (of Router B) to return the TCP/IP packet back to Router B. Router B knows how to forward these packets back to Router A (Server A IP address), Router A forwards the Websensor data packet back to Server A.

Example C. Computer B tries to access Websensor C

The HTTP request will be forwarded by Router B (with Router B MAC) to Router A. Router A then forwards it (with Router A MAC) to Router C. Router C sends it (with Router C MAC) to Websensor C. Websensor C uses the IP(Computer B) and MAC (Router C) and basically reverses the sequence in order to return the requested data back through the routers to Computer B.

Figure 34. Websensor connection over the internet

Device	Default Gateway
Router B	Router A
Router C	Router A
Server A	Router A
WebSensor A	Router A
Computer B	Router B
WebSensor B	Router B
Computer C	Router C
WebSensor C	Router C

Application Information

The EM01b does not work with Internet Explorer...

Solution: The EM01b does not work with Internet Explorer after .NET 2.0, this is because of the limitation of the thin Ethernet stack on the EM01b Websensor.

Power LED blinks and the devices loses connectivity...

Solution: The small Ethernet stack on the EM01b Websensor cannot service multiple simultaneous requests and work on a 10BaseT. You might want to put the EM01b behind a 10/100 Switch to filter the traffic. Avoid multiple simultaneous requests to the device.

Websensor Plug-in's

Plug-in's written in both PERL and C languages are provided on our website:

http://www.sensormetrix.co.uk/em01b-stn_websensor_p_12.php#

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Definitions

Term	Definition
ARP	Address Resolution Protocol
DC	Direct Current
DVM	Digital Voltmeter
HTTP	Hypertext Transfer Protocol
IP	Internet Protocol
LCD	Liquid Crystal Display
LED	Light-emitting Diode
MAC	Media Access Control
NIC	Network Interface Controller
SPI	Serial Peripheral Interface
TCP	Transmission Control Procotol
UPS	Uninterruptible Power Source

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