Instruction Manual

Digital Power Meter Model PM21

Version 1.0

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Introduction to the PM21 Digital Power Meter

The Esensors, Inc. Digital Power Meter **PM21** is an electronic device *classified* as a *Smart Sensor*. The PM21 is designed to utilize the Internet to transmit voltage, current and power information, and optionally temperature, relative humidity, and illumination data, from a remote acquisition point to a host computer or hosted database.

The PM21 offers built-in sensors for monitoring/ measuring for power line parameters such as Voltage, Current, Power factor, etc, and an embedded mini-webserver. Users are able to access the sensor data using Hypertext Transfer Protocol (HTTP) based commands.
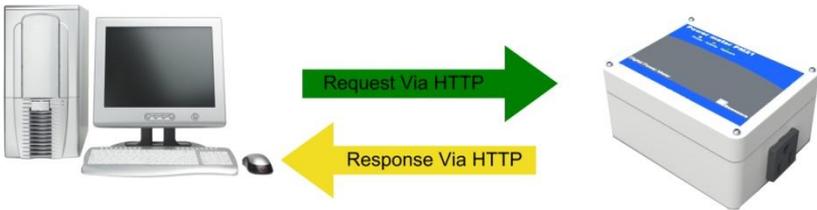

Figure 1 – PM21 HTTP: Request/Response

Figure 1 (above) shows the PM21 returning data via a HTTP: response.

How the PM21 Works

Simply, the PM21's function is to send a response (by a HTTP: message containing sensor data) upon request from a *central website* or the *User's PC*.

The PM21 supports a user configurable *IP address.* The PM21's IP address gives it uniqueness on the Ethernet based network which it is attached to. It is through the IP address, that the PM21 is able to take its place on the Internet, becoming fully accessible to queries by the user.

The PM21 consists of a base unit with one Ethernet communication port.   Within the base unit are microcomputers, which handle the Internet protocol, the communication ports, sensors, and sensor signal conditioning. The PM21 has no switches, keyboard or display because it functions as a sensor, not as a computer.
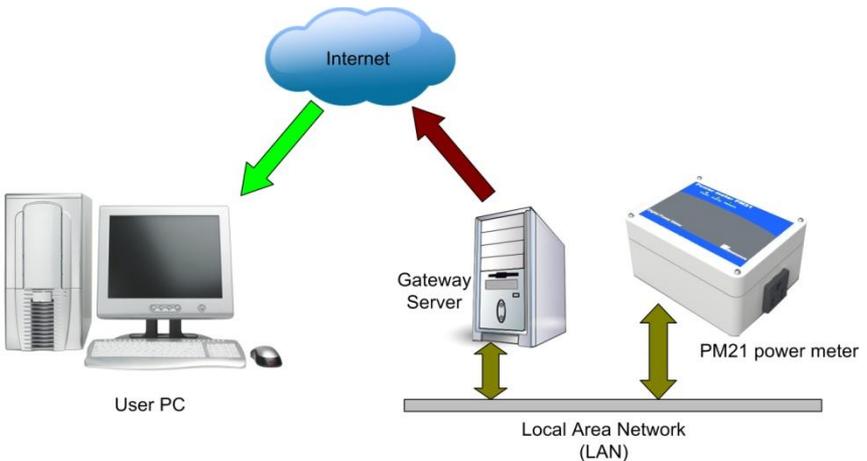

Figure 2 – How the PM21 works.

PM21 Hook-up

a. Powering up the PM21

The PM21 is powered by the regular 120V 60Hz AC supply. A power cord is included along with every PM21. Remove the power cord from the pack, and plug the female end of the cord to the wall supply connector of the PM21 shown in figure 3. Plug the other end of the cord to a standard 3 pin 120V AC wall socket. The Power LED should turn on at this time.
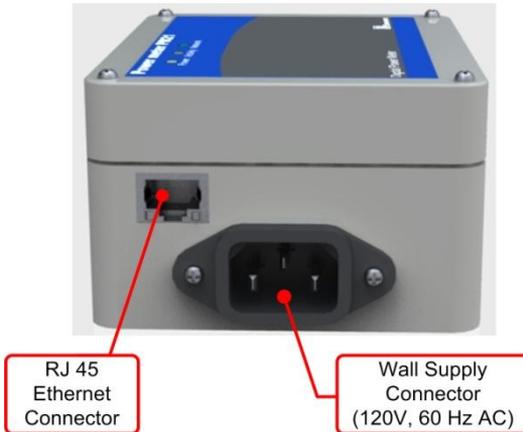

Figure 3 – Location of Wall Supply connector, and RJ 45 port.

b. Configuring the PM21

To configure and use the PM21 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. It is the gray patch cable. This is shown in figure 4.

PM21 Hook-up

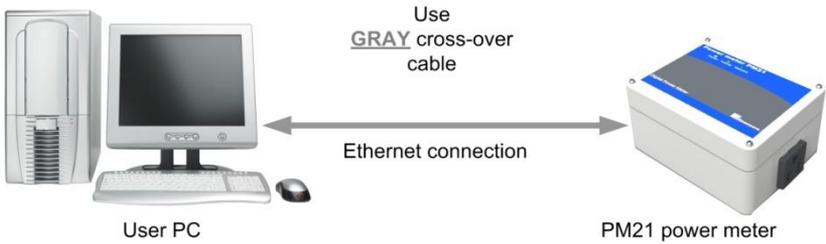A crossover type Ethernet cable is included in the *Software & Documentation Package.*

Figure 4 – PM21 connected directly to the NIC in a PC

If connecting to a PC through a HUB, a **straight** type Ethernet patch cable must be used between the HUB and the PM21. A "straight" type Ethernet patch cable is also included with the PM21. it is the BLUE patch cable. Refer Figure 5 on the following page.
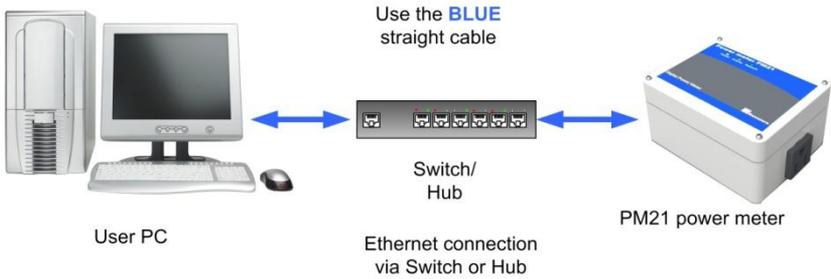
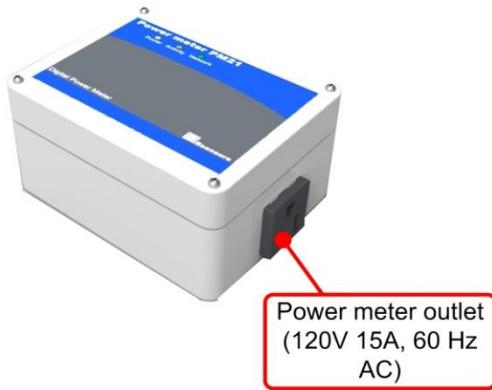Figure 5 – PM21 connected through a HUB to the NIC in a PC.

Figure 6 – Location of AC outlet on the PM21.

PM21 User Interface

Once the PM21 is connected to a PC and powered via the AC Wall Supply, the PM21 can be queried by typing the following command into the address line of the browser.

http://192.168.254.102

Note: The default address for the PM21 is 192.168.254.102. This requires that the PC being used to program the Websensor have its "network interface card" (NIC) set with the same subnet address: 192.168.254.***

Once the default IP address is entered, the browser screen should display the "PM21 Sensor status Page" as shown in Figure 7 below.

Setting the device clock

The PM21 comes with a built in real time clock. The timer will be used to keep track of the time for which the period energy was accumulated. Period energy is explained later in this manual.
To set the device clock, simply click the "Set device clock" button on the home page. The device will automatically update its time registry with your PC's system time. The timer power is backed-up by a battery to hold the data even when power is lost or disconnected.
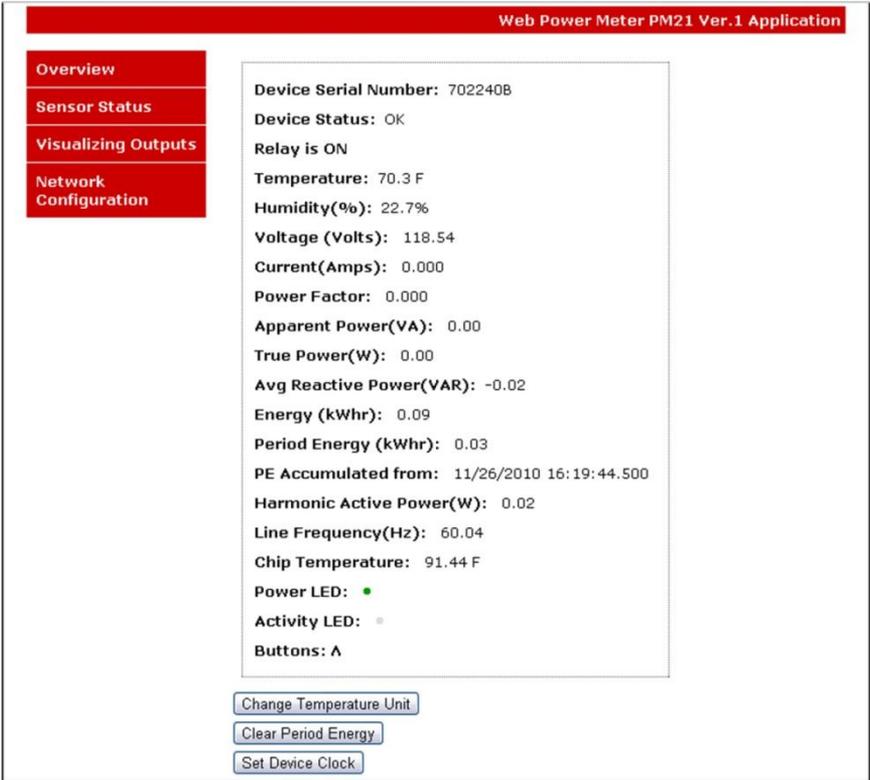
Figure 7 – PM21 Sensor status (Home) Page display

From the MAIN Page several other options are available from the panel displayed in the left-hand-side of the screen.

- Overview
- Sensor Status
- Visualizing Outputs
- Network Configuration

Overview

The "Overview" screen depicts information specific to the PM21 such as the version of the firmware, build date of the firmware, device serial number, and technical specifications.   See Figure 8 for the Overview screen depiction.
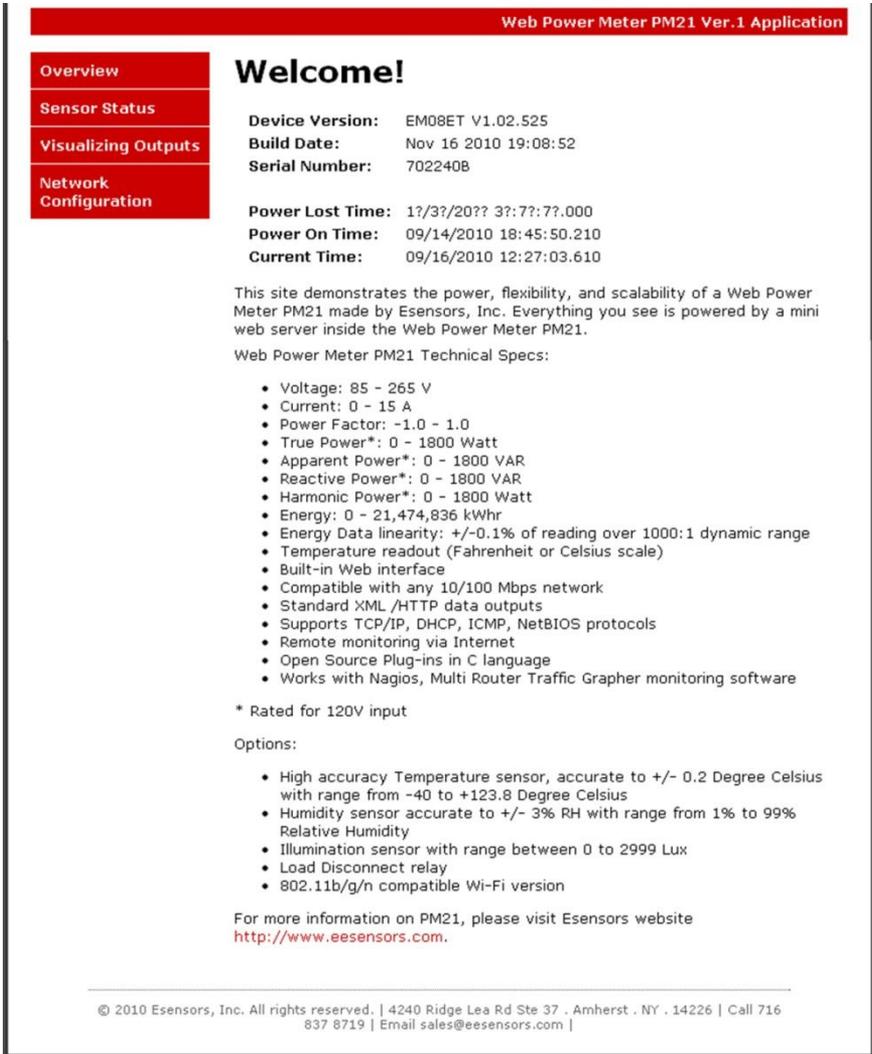
Figure 8 – The OVERVIEW Screen.

Sensor Status

The SENSOR STATUS screen depicts the same information as the MAIN (HOME) page. See Figure 7. In addition the device

specifications and status, the parameters displayed on this page includes

- Voltage

- Current

- Power factor

- True, apparent, reactive and harmonic power,

- Energy, Period Energy*.

- Temperature, humidity and illumination (Optional).

* Period energy is identical to a trip meter. It can be used to track/ measure the energy for a specific time period. Clicking the 'clear period energy' button resets this value to zero.

From the Sensor Status screen it is possible to alter the temperature units by clicking on the "Change Temperature Unit" button.

Visualizing Outputs

The VISUALIZING OUTPUTS screen permits simple graphs to be depicted for the True power and Current data points the PM21 collects.

Altering the ranges is easily accomplished by "left clicking" in the value areas and entering the desired range numbers. Next, click on the "Update Chart" button to make the changes.

Reference Figure 9 for a typical data capture.

Built in Relay

The PM21 comes with a built-in (Normally open) relay which is turned OFF by default under factory conditions. The relay needs to be turned on for the power to be passed on to the load

For safety reasons and to avoid unintended changes, the interface to control the relay is provided as a web command instead of a User Interface (UI) button. Please refer to quick reference (page 23) in this user manual for relay control access commands.

Note: The relay will automatically return to its OFF mode in the event of a **hardware reset** by the user.
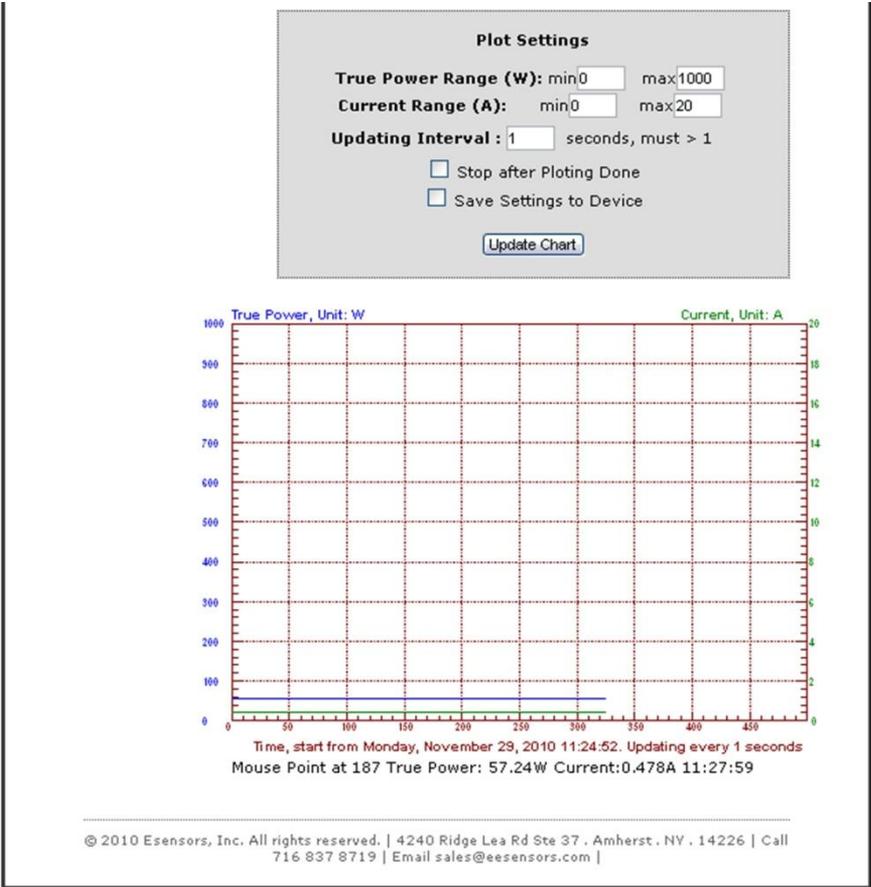
Figure 9 – Visualizing Outputs screen (Data collected with an incandescent bulb rated at 120V 60W as load)

Network Configuration

The NETWORK CONFIGURATION page enables the user to set up the device IP and host name using the web interface.

See Figure 10.

From the NETWORK CONFIGURATION screen it is possible to change the various addresses involved in any IP addressable device.   Once changes are made it is necessary to "left click" on the "Submit" button to have the changes take effect.

Note that in Figure 10, the "Submit" button is "grayed-out".   This is because the page is "locked".

The only time data may be changed on this page is during the first five (5) minutes after a "power-up" or by pressing the rest button (See Figure 16 for reset button location).   In this way the page is protected from being changed inadvertently (or maliciously).

See Figure 11 which depicts a "timer window" showing the time available to change the settings before the CONFIGURATION PAGE becomes locked.

When you change the IP address though the webpage interface, the next page displayed is the "Reboot in Progress" page depicted in Figure 12.

Figure 10 – Network Configuration screen.

Figure 11 – Network Configuration screen (timer activated)

Figure 12 – "Reboot in Progress" screen

Alternative Method to Change the PM21 IP Address

Alternately, there is a "keyboard short-cut" way of changing the IP address by using following command:

http://192.168.254.102/index.htm?eipaaabbbcccddd

where: *aaa.bbb.ccc.ddd*   is the new IP address of the PM21.

You can confirm the change by typing the new IP address on the address bar.　Or, ping the new address from a command prompt screen.

Refer to the Quick Reference section for more administrative "keyboard short-cut" commands.

Figure 13 – Error Message – CONNECTION LOST.

The reason for the "Error: Connection to PM21 device was lost" message is because the browser still points to the former IP address.　When the new IP address is entered into the address bar the screen will correctly display the PM21 SENSOR STATUS (Home) Page.

Simple Http Request

The PM21 outputs a data string when it receives http request. This simple approach enables end users to develop their own application to monitor data.

The string can be obtained by typing the device IP followed in the address bar of the browser.

For Power Parameters use *http://192.168.254.102/status.xml*

For individual parameters, *http://192.168.254.102/data/X...X.cgi*

Listed below are the cgi file names for individual parameters.

Voltage - vrms.cgi

Current -irms.cgi

Power factor - pfact.cgi

Apparent power -papp.cgi

True power - ptrue.cgi

Avg. reactive power -preact.cgi

Energy -enga.cgi

Period energy -engp.cgi

Harmonic power – pharm.cgi

Temperature- temp.cgi

Humidity - humd.cgi

Illumination- illum.cgi

Http Request

For temperature, humidity and illumination alone, the following string may also be used.

http://192.168.254.102/index.htm?em

or

http://192.168.254.102/index.html?em

A Sample Return String:
}N123456TF: 71.2HU:24.5%IL:218

- Where 123456 is device serial number,
- Temperature in Fahrenheit TF is 71.2,
- Relative Humidity HU is 24.5%,
- Illumination IL is 218

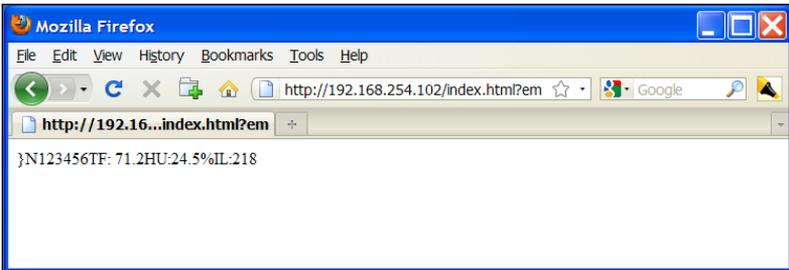See Figure 14 (below) for a sample screen depicting the returned string.

Figure 14 Sample Return String on screen

Basic Troubleshooting Instructions

1. **Did you change the IP address?**
   The DHCP server probably assigned the device a new IP address, but your computer's network cache has saved the wrong address. From the command prompt in Windows, enter "nbtstat -R" or "arp -d" to clear old values and try again. Make sure to launch the command prompt as administrator.

2. **Did you try the IP address?**
   Try accessing the device directly at the IP address just inputted if DHCP was turned off. (Example: enter "http://192.168.5.23/" into your browser). If this fails, then the IP address you set is not reachable. Accessing the device via IP address is more reliable than using host name since some networks may have trouble dealing with host name. If you forgot the IP address and the host name of PM21 device, try Step 3 below.

3. **Use Ethernet Discoverer to hunt PM21 devices**
   Microchip's Ethernet Discoverer is a very nice tool to list all PM21 devices on the same subnet. Double click *Microchip Ethernet Discoverer.exe*, Click "Discover Devices" button, the IP address, Host name and MAC address of all PM21 devices will be listed. The default host name is EM08F_ETHERNET. This is what will be displayed until you change the host name. It is also helpful to check PM21's IP address when it is automatically assigned by DHCP server. *Microchip Ethernet Discoverer.exe* does not need to be installed; it can be copied to and executed from any location. (This utility program can be found on the

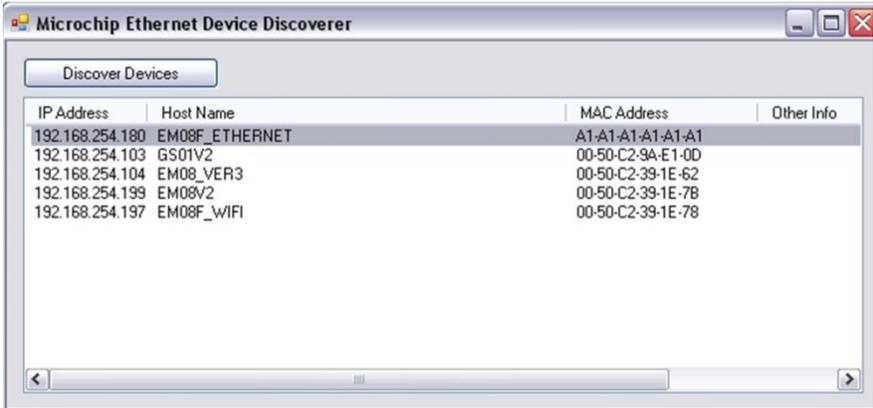supplied CD in the "Manual" Folder within the "PM21" Folder).

Figure 15 – Microchip Ethernet Device Discover screen

4. **Still not working? Device Reset**
   You can restore the factory default settings by erasing the device's flash ROM.

Resetting the PM21

- Hold the button by inserting a paper clip into the small hole on the left side panel of the device and then re-power the device.

- The device enters boot loading state which will last for four seconds, both Power LED and Activity LED are extinguished in this state, then they will flash for three times and enter startup state.

- Continue holding the button, the device will enter restoration state, In this state you will notice the Power LED and Activity LED remain ON.

- You should not release the button until both LEDs are extinguished, which means restoration is done.

- The whole procedure takes about eight to ten seconds. The factory default IP address is "192.168.254.102".

Figure 16 – Location of the RESET SWITCH

Quick Reference

PM21 Keyboard Short-cuts:

Display sensor measurements, using PM21V1 as the host name:
  http://pm21v1/index.htm/?em

Display sensor measurements:
  http://192.168.254.102/index.htm?em

Change Temp unit to C:
  http://192.168.254.102/index.htm?etpC

Change Temp unit to F:
  http://192.168.254.102/index.htm?etpF

Change Temp unit from C to F or F to C:
http://192.168.254.102/index.htm?etpX

Change IP to aaa.bbb.ccc.ddd:
http://192.168.254.102/index.htm?eipaaabbbcccddd
        (NOTE: no "octet-points" are required

Turn relay on:
http://192.168.254.102/index.htm?eEONR

Turn relay off:
http://192.168.254.102/index.htm?eEOFFR

Configuration Notes

Configuration Notes

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