

TECHNICAL GUIDE

# Elevate Intelligent PDUs

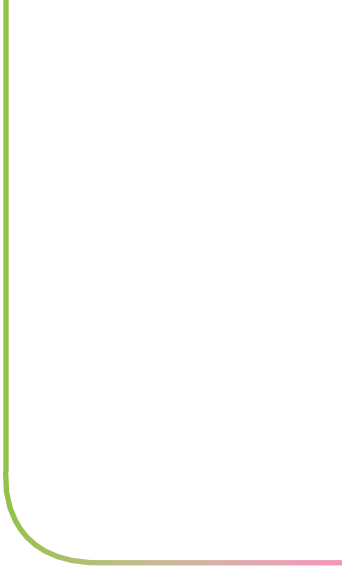
# Table of Contents

## General

1.1.	Purpose and Scope	4
1.2.	Product Purpose	4
1.3.	Variants	4
1.4.	Glossary	5

## Technical Requirements

2.1.	PDU-SNMP Advanced Control Unit based PDU	6
2.1.1.	Overview	6
2.1.2.	Power	7
2.1.3.	Operation	7
2.1.4.	Connections	9
2.1.5	Configuration	14
2.1.6.	Control	14
2.2.	Operating Environment	14
2.3.	Safety Integrity	14
2.4.	International Standards	14



Appendix A. Web server HTML page description	15
Appendix B. SNMP trap setup and register description	35
Appendix C. SNMP manager description	51
Appendix D. Telnet command line interface description	52
Appendix E. XML and CGI protocol description	58
Appendix F. Email and Syslog alarm message formats	72
Appendix G. RADIUS Client description	75

# General

## 1.1. Purpose and Scope

The purpose of this specification is to define the IPT PDU-SNMP Advanced Control Unit based PDU product. Definitions will cover electrical and operational characteristics.

## 1.2. Product Purpose

The IPT Power Distribution Unit [PDU] is installed into a data centre server cabinet and distributes a single or three-phase power supply to up to 48 socket outlets. The PDU is a meter grade product [Accuracy  $\pm 1\%$ ] that monitors and records total voltage, current, power and energy usage to all socket outlets and also individually monitors and records each socket outlet current/power. The recorded information is made available over an Ethernet network via an internal web server and SNMP registers.

The PDU-SNMP Advanced Control Unit replaces the current control board within the PDU system and provides enhanced features including, USB ports, internal high-capacity log storage, IPv6 and SNMPv3 support, SNMP manager functionality etc.

## 1.3. Variants

There are two product variants that use the control board:

1. Strip version (Version that can be fitted within a PDU strip for the monitoring of a single or three-phase supply, control/monitoring up to 48 socket outlets, present an Ethernet port, MODBUS port for the monitoring of multiple PDU's, external contact monitoring, door entry/control, temperature and humidity sensor ports. Power is derived from an incoming mains phase.)
2. Rack-mount version (Version that is mounted within a 1-6U sub-rack enclosure for the monitoring of a single or three-phase supply, control/monitoring up to 48 socket outlets, present an Ethernet port, MODBUS port for the monitoring of multiple PDU's, external contact monitoring, door entry/control, temperature and humidity sensor ports. Power is derived from an incoming mains phase.)

## 1.4. Glossary

**PCB** Print Circuit Board, also called Printed Wiring Board. Fibre glass board with copper wiring layers forming electrical circuit in conjunction with mounted components.

**ETHERNET** Ethernet is a family of computer networking technologies for local area networks (LANs) commercially introduced in 1980. Standardized in IEEE 802.3, Ethernet has largely replaced competing wired LAN technologies. Systems communicating over Ethernet divide a stream of data into individual packets called frames. Each frame contains source and destination addresses and error-checking data so that damaged data can be detected and re-transmitted. The standards define several wiring and signalling variants. The original 10BASE5 Ethernet used coaxial cable as a shared medium. Later the coaxial cables were replaced by twisted pair and fibre optic links in conjunction with hubs or switches. Data rates were periodically increased from the original 10 megabits per second, to 100 gigabits per second.

**SNMP** Simple Network Management Protocol (SNMP) is an “Internet-standard protocol for managing devices on IP networks. Devices that typically support SNMP include routers, switches, servers, workstations, printers, modem racks, and more. It is used mostly in network management systems to monitor network-attached devices for conditions that warrant administrative attention. SNMP is a component of the Internet Protocol Suite as defined by the Internet Engineering Task Force (IETF). It consists of a set of standards for network management, including an application layer protocol, a database schema, and a set of data objects.

**SNTP** Simple Network Time Protocol (SNTP) is a simplified version of Network Time Protocol (NTP) that is used to synchronize computer clocks on a network. This simplified version of NTP is generally used when full implementation of NTP is not needed.

**HTML** HyperText Markup Language (HTML) is the main markup language for web pages. HTML elements are the basic building-blocks of webpages. HTML is written in the form of HTML elements consisting of tags enclosed in angle brackets (like <html>), within the web page content. HTML tags most commonly come in pairs like <h1> and </h1>, although some tags, known as empty elements, are unpaired, for example <img>. The first tag in a pair is the start tag, the second tag is the end tag (they are also called opening tags and closing tags). In between these tags web designers can add text, tags, comments and other types of text-based content.

**PDU** PDU [Power Distribution Unit] is a product which allows the distribution of a single or three phase mains supply to a number of mains powered devices. Each output to a device, or socket, may be individually controlled by the PDU by activating or deactivating its associated relay which is placed in series with the mains supply. In this way externally connected devices may be switched on or off as required by the application.

**MODBUS** Modbus is a serial communications protocol published by Modicon in 1979 for use with its programmable logic controllers (PLCs). It has become a de facto standard communications protocol in industry, and is now the most commonly available means of connecting industrial electronic devices.

# Technical Requirements

## 2.1. PDU-SNMP Advanced Control Unit based PDU

### 2.1.1. Overview

The IPT Power Distribution Unit [PDU] is a meter grade power distribution product that can be supplied in power strip or 19" sub-rack format.

The main function of the product is to distribute a single or three-phase power supply to up to 48 socket outlets while monitoring and recording total voltage, current, power and energy usage to a meter grade accuracy of  $\pm 1\%$ . Additionally the product can monitor external environmental conditions, such as temperature or humidity, voltage free contacts and provide a complete cabinet door card entry control system. The product is controlled remotely over an Ethernet network using the integrated web server or SNMP registers.

The product provides the following features:

1. ARM based system supporting IPv4/6, HTTP(s), SNMPv2 & v3 trap alarms, SNTP time stamping, SMTP email alarms and SysLog alarms.
2. Highly flexible build configuration consisting of 'Control', 'Meter' and 'Socket' PCB sub-assemblies.
3. Universal input voltage range 85-264VAC on-board SMPS.
4. Real Time Clock (RTC) with capacitor backup.
5. Single or three phase 63A capable  $\pm 1\%$  accuracy metering modules.
6. Monitoring and recording of VRMS, IRMS, kW, kWh, Power factor, kVA, kgCO<sub>2</sub>, BTU/h, kJ/h and frequency measurements.
7. Internal USB2.0 host port for USB flash drive storage of log data.
8. Ethernet port [IEEE 802.3 with full 10/100Base-T network compatibility].
9. External USB2.0 host port with HTML/SNMP power control.
10. High-speed MODBUS RS485 port for local daisy-chaining of up to 31 PDU slaves.
11. Pluggable 16x2 LCD panel with RGB backlight support and full colour LCD touch panel support.
12. Temperature sensor bus port [8x chained].
13. Humidity sensor port.
14. External contact monitoring ports x3.
15. Cabinet door contact monitoring port.
16. Cabinet door lock control port.
17. Cabinet door Wiegand card reader port.
18. 48 socket outlet support with current monitoring and/or switching using 4way socket module with automatic searching [Phase configuration on socket module].
19. Remote monitoring and configuration [HTML webserver and SNMP registers].

### 2.1.2. Power

Operational power is derived from one of the incoming phases [85-264VAC] which is connected to the board via a screw terminal connection. 12VDC power is distributed to all connected Socket boards.

### 2.1.3. Operation

The PDU product is energised when supplied with AC power.

When a LCD panel is connected to the LCD port the product displays the welcome screen and then toggles between a screen showing the voltage [VRMS], amps [IRMS], kW's, Power factor and Energy used in kWh and a screen showing environmental parameters, see section 2.1.6.

Dependant on the number of Meter boards connected the system will collect data from each and store this for access via the Web server, SNMP registers or Modbus requests.

#### **MODBUS connection**

The PDU product may be configured as a 'Master' and connected to up to thirty-one [31] other PDU's, via a 2 wire RS485 interface, that are configured as 'Slaves' to allow the master PDU to collect measurements from the slaves for query over the masters SNMP interface.

#### **Ethernet connection**

The PDU product may be connected to a PC or laptop using a cross-over CAT5 Ethernet cable or to a router using a straight through CAT5 Ethernet cable. The GREEN LED on the Ethernet connection port indicates that the product is connected to a valid device, the YELLOW LED indicates data traffic to/from the unit.

The product, as default, is not configured for DHCP [Dynamic Host Configuration Protocol] which allows a connected Ethernet router to assign an IP address to the product for Ethernet communication. DHCP may be configured using the 'Network Configuration' button within the Web server, see Appendix A 'Web server HTML page description' for more information.

#### **External USB2.0 port**

The product provides a USB2.0 host port with configurable power activation for external USB device such as USB flash drives, cameras, input devices and additional WIFI/Bluetooth network support.

#### **Web server access**

The PDU product supports full HTTP and HTTPS access of the internal HTML web pages using any standard internet browser ie. Internet Explorer (pre-Edge), Firefox, Google Chrome etc.

Please see Appendix A 'Web server HTML page description' for more information on accessing this service.

### **SNMP register access**

The PDU product is provided with a MIB [Management Information Base] for use with any SNMP manager. This MIB outlines all the accessible registers, there type and description. The file is called 'PDUSNMP\_Vx.xx.xx.mib'. For more information please look at the MIB file.

Please see Appendix B 'SNMP register description' for more information.

### **NTP time update**

The PDU product supports Network Time Protocol (NTP) time and date synchronisation with a pool of NTP time servers when it has network access. The built in Real Time Clock (RTC) stores this time/date and recalls it on every boot so if network access is down the clock for logging functions will always be correct. The NTP server or time/date may be configured in the webserver, see Appendix A 'Web server HTML page description' for more information.

### **USB flash drive configuration update**

The PDU product supports the update of system configuration using a standard USB flash drive. This allows a set of default configuration options to be setup on the USB flash drive and this drive used on a number of systems.

When the front panel USB is configured for power output (default) a USB flash drive containing a modified copy of the current 'config.ini' file may be inserted and within 10 seconds the key values contained in the config.ini file will be copied to the system.

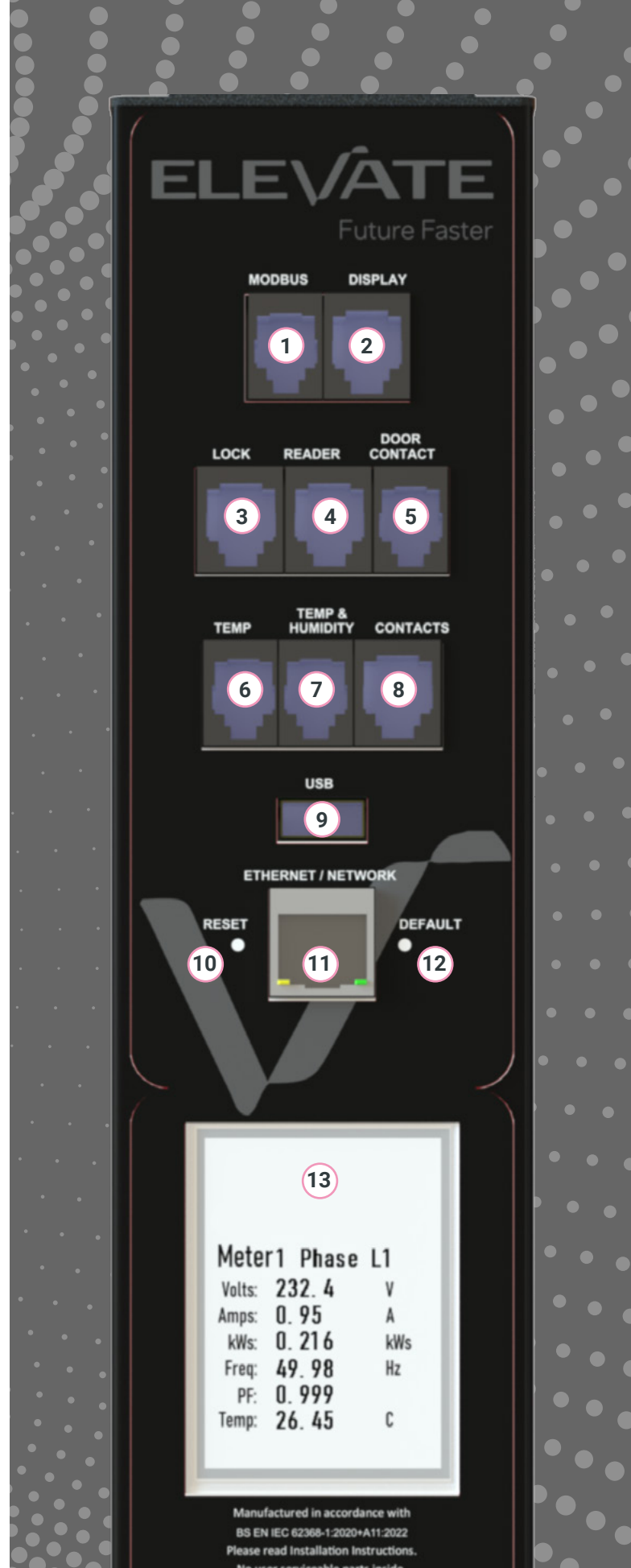
Additionally if the key value 'dhcpenabled = 0' is configured within the config.ini on the USB flash drive and the 'ipaddress' field is set to an IP address value other than the one currently configured on the system ('192.168.1.70' default) then the system will be re-configured for this IP address and an automatic reboot undertaken.



#### 2.1.4. Connections

IP1, 2, 3, 4 (ACU) – Port Identification.

1. **Modbus Port**  
High Speed MODBUS RS 485, Daisy chain up to 32 PDUs
2. **Remote Display Port**  
Connect a secondary RGB display for ease of viewing
3. **Cabinet Lock Control Port**  
Connect Electronic Handles
4. **Cabinet Door Card Reader Port**  
Connect Card Reader or Electronic Handle Card Reader aspect
5. **Cabinet Door Contact Monitoring Port**  
Connect door contacts
6. **Temperature Sensor Port**  
Connect up to 8 daisy chained sensors
7. **Humidity Sensor Port**  
Connect Humidity / Temperature Sensor
8. **Voltage Free Contacts**  
3 sets of Volt Free Contacts for connection of any accessory such as leak detection
9. **USB 2.0 Port**  
Used for small PIN camera or Automatic Config upload
10. **Reset Button**
11. **Ethernet Port**  
IEEE 802.3 with full 10/100 Base-T network capability
12. **Default Button**  
Enables a “Factory Reset”. Please contact us for correction operation.
13. **Local TFT “Touch Screen Display”**  
IEEE 802.3 with full 10/100 Base-T network capability



## LCD panel function

The PDU can provide visual system status if a LCD panel is connected to the system. The 'Touch keypad output enable' option must be unchecked for the LCD panel output to work. Indication as follows:

### Power on welcome message

The LCD displays the following welcome message for five [5] seconds after initialisation:

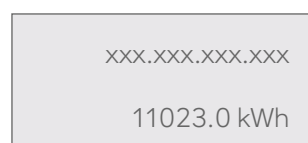


PDU Vn.nn.nn  
2020 IPT Limited

### Single phase mode

The display provides status information for a number of parameters and is updated every <LCD rotation period> [default 3] seconds, as follows:

Single phase mode screen 1:



xxx.xxx.xxx.xxx  
11023.0 kWh

Single phase mode screen 2:



L1 240.3V 6.35A  
1.50 kW 0.736PF

If environmental sensors are connected then screen 2, see below, is displayed otherwise

Single phase mode screen 3, then returns to screen 1:



Humidity 58.45%  
Temp 23.56°C

### Three phase mode

The display provides status information for a number of parameters and is updated every second, as follows:

Three phase mode screen 1:

xxx.xxx.xxx.xxx
11023.0 kWh

Three phase mode screen 2:

L1 240.3V 6.35A
1.50 kW 0.736PF

Three phase mode screen 3:

L2 238.1V 4.56A
1.12 kW 0.834PF

Three phase mode screen 4:

L3 239.5V 12.67A
3.03 kW 0.986PF

If environmental sensors are connected then screen 4, see below, is displayed otherwise screen 1 is re-displayed.

Three phase mode screen 4, then returns to screen 1:

Humidity 58.45%
Temp 23.56°C

## Touch LCD panel function

The PDU can also provide visual system status if a Touch LCD panel is connected to the system. The 'Touch keypad output enable' option must be checked for the LCD panel output to work. Indication as follows:

### Welcome message

The LCD displays the following welcome message until system initialisation:



### Single phase mode

The display provides status information for a number of parameters and is updated every <LCD rotation period> [default 3] seconds, as follows:

Single phase mode screen 1:



Single phase mode screen 2:

Meter1 Phase L1		
Volts:	232.4	V
Amps:	0.95	A
kWs:	0.216	kWs
Freq:	49.98	Hz
PF:	0.999	
Temp:	26.45	C

Single phase mode screen 3, then returns to screen 1:

Environmental		
Humidity:	48.34	%
Temp:	23.67	C
Contacts 1:	OPEN	2: OPEN
Contacts 3:	OPEN	
Door:	CLOSED	
Lock:	LOCKED	

### Three phase mode

In three phase mode screen 3 & 4 show meter 2 & 3 measurements respectively.

#### 2.1.5. Configuration

All board configuration is undertaken via the web server, SNMP registers or using the a USB flash drive.

#### 2.1.6. Control

##### **Reset button**

The RESET button allows the PDU to be restarted. Momentarily press the 'RESET' button to reboot the PDU.

##### **Default button**

The DEFAULT button allows the PDU to reset to factory defaults. Press and hold the 'DEFAULT' button and momentarily press the 'RESET' button to reset configuration to factory defaults.

### 2.2. Operating Environment

The product shall operate in a temperature range of 0 – +60oC and a humidity of up to 80% non-condensing.

### 2.3. Safety Integrity

The product shall be designed in accordance with relevant safety standards [5] [6]

### 2.4. International Standards

The product shall be designed in accordance with relevant International standards [7]

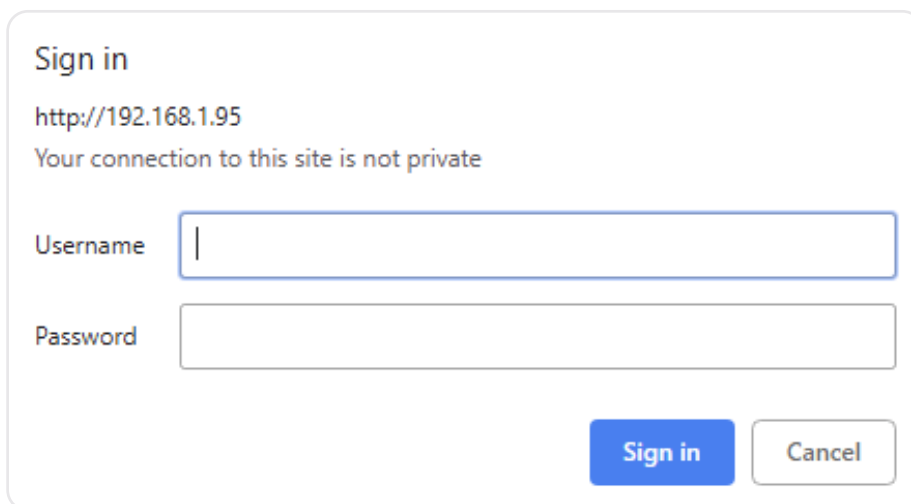
# Appendix A. Web server HTML page description

## Web server HTML page description

The PDU HTTP web server service provides a set of HTML pages that can be viewed within any HTML compatible web browser [ie. Internet Explorer, Firefox, Google Chrome etc.].

### Logging into the web server

The HTTP service provides Domain Name Service [DNS] resolution so that the PDU IP address does not need to be known, entering 'PDUSNMP' into the browsers URL bar will contact the web server and initiate the authentication process to allow entry into the PDU system. The following authentication screen will be displayed:



Sign in

http://192.168.1.95

Your connection to this site is not private

Username

Password

Sign in Cancel

At this point the operator may enter the system as a User, Administrator or Factory operator. The default User name and Password for the default administrator account is 'admin', both are case sensitive.

New accounts may be configured under the 'Configuration' tab settings, see later in this appendix.

### User account

A User account prevents access to the all configuration options and most other operations that could compromise PDU SNMP operation.

## Administrator account

An Administrator account allows the operator to re-configure any aspect of the PDU SNMP configuration. This configuration includes re-naming of the PDU client name, location, cabinet ID, Phase names, socket equipment names and changes to default parameters including kgCO2 conversion factor, cost per kWh, currency symbol, LCD colours, Slave modbus address, timeout and retry values, alarm threshold values and configuration, network and SNMP settings etc.

The Administrator also has access to buttons that allow the PDU to turn individual ports ON/OFF and reset currently stored energy levels etc.

## Factory account

As the Administrator account but allows changes to be made to the Advanced Configuration page



## Overview page

After successful authentication the operator is presented with the initial Overview page which provides an overview of the PDU unit.

The following screen shot shows a single phase application:

The screenshot displays the 'Overview' page of a PDU management interface. The top navigation bar includes links for Overview, Metering, Socket Outlets, Security, Environmental, Configuration, Logout, and Slave PDUs. The main content area is divided into three sections: PDU Information, Phase status, and PDU Totals. A Help box is located on the right side.

**PDU Information**

Client	Client Name		
Location	Location Name		
Cabinet ID	Cabinet ID		
IP Address	192.168.1.95		
PDU Mode	NORMAL	Slave PDUs	0
Alarm status	NONE		
Time/date	14:28:33 01/10/2018		

**Phase L1 status**

Volts AC	229.00	kWatts	0.000
Amps AC	0.00	Power Factor	0.029

**Phase L2 status**

Volts AC	0.00	kWatts	0.000
Amps AC	0.00	Power Factor	0.000

**Phase L3 status**

Volts AC	0.00	kWatts	0.000
Amps AC	0.00	Power Factor	0.000

**PDU Totals**

Amps	-	kW	-
kVa	-		
kWh	-	BTU/h	-
kg/CO2	-	kJ/h	-
Cost(£)	-		

**Help**

Thank you for choosing our Power Distribution Unit [PDU]

This PDU unit can provide metering for 3 phases, individual socket monitoring and switching for upto 48 sockets, cabinet door security control, contact monitoring, environmental monitoring of humidity and multiple temperature sensors.

This page displays an overview of the PDU including configuration, alarm status, time and date, individual phase measurements and totals.

On all pages there is a help box on the right of the screen, this giving relevant information about the page and its controls.

The PDU Information provides an overview of the location and client to which the PDU belongs, its IP address, the mode of operation (NORMAL, MASTER or SLAVE), the alarm status and the real time clock current time/date.

Below this an overview of the connected meters is given along with totals for all the connected meters.

## Metering page

Clicking on the **Metering** button the operator is presented with the metering page which contains details of the individual meters connected to the system. The following screen shot shows the first meter (the other two are identical):

Phase L1 Meter			
		Low Alarm	High Alarm
Volts (VAC)	227.10	<input type="checkbox"/> 210.00	<input type="checkbox"/> 205.00
Current (Amps)	0.96	<input type="checkbox"/> 0.20	<input type="checkbox"/> 4.00
Wattage (kW)	0.218	<input type="checkbox"/> 0.10	<input type="checkbox"/> 5.00
Frequency (Hz)	49.00	<input type="checkbox"/> 45.00	<input type="checkbox"/> 50.00
Power Factor (PF)	0.999	<input type="checkbox"/> 0.100	<input type="checkbox"/> 0.900
Temperature (C)	27.20	<input type="checkbox"/> 1.00	<input type="checkbox"/> 50.00

**Help**

This page provides status for each of the three metered phase(s) connected to the PDU. High and low alarm thresholds may be setup for voltage, current, wattage, frequency, internal temperature or power factor by clicking on the associated checkbox, changing the threshold value and clicking on 'Save Changes'. Clicking on 'Reset Energy' will zero all energy values for this phase.

**Extended values**

Peak Voltage (VAC)	312.10	Peak Current (A)	1.35
kVA (kVA)	0.218		

**Energy usage**

kWh	0.3	BTU/h	1023.6
kg/CO2	0.2	kJ/h	1089.0
Cost(E)	0.0		

Reset Energy

Save Changes

The PDU's RMS volts, amps, kW's, frequency, power factor and internal temperature are shown along with check boxes and threshold level to configure alarms against these parameters. [Please see later topic for alarm setup.](#)

The Extended values box shows additional parameters for the PDU including Peak volts and amps and the VA that the meter is delivering.

The final box provides the total energy usage on this PDU, including relevant conversions such as kgCO2, and the total cost based on the currently configured cost per kWh.

Buttons on this page allow the alarm thresholds to be saved and the energy consumption to be reset if required.

Configuration of the meter shunt used on the meter board to allow current measurements above 32A may be configured under the Advanced Configuration page.

## Sockets page

Clicking on the **Socket Outlets** button the operator is presented with the sockets status page which contains details of each individual socket connects to the system. The following screen shot shows the first five sockets on a 48 socket system:

The screenshot displays the 'PDU Socket Outlets' page. At the top, a navigation bar includes links for Overview, Metering, Socket Outlets (active), Security, Environmental, Configuration, Logout, and Slave PDUs. The main content area lists five sockets, each with a status icon, a table of metrics, and a control button.

Socket	Equipment name	Current (Amps)	Power (VA)	Energy (kWh)	Phase setup
Socket 1	Reception heater	0.05	0.05	0.0	Phase L1
Socket 2	Reception computer	0.05	0.05	0.0	Phase L1
Socket 3	None	0.05	0.05	0.0	Phase L1
Socket 4	None	0.05	0.05	0.0	Phase L1
Socket 5	None	0.05	0.05	0.0	Phase L1

Each socket entry includes a status icon (OFF) and a control button (OFF). A help box on the right provides instructions on how to use the page's controls.

**Help**

This page provides status for each of the 48 socket outlets on this PDU. The equipment name and individual measurements for each socket are shown along with the option to turn the socket ON or OFF. A checkbox on each socket allows the socket to be selected for global control using the buttons below:

Selected ON  
Selected OFF  
Selected OFF-ON  
All ON  
All OFF  
Select All  
Deselect All

The 'Selected OFF-ON' button undertakes a 5 second OFF then ON power cycle on the sockets selected.

Each socket is displayed with an associated picture of the sockets type installed [Please see [Configuration page for socket setup](#)] the equipment name, the current and VA being drawn from the socket, the energy used by the socket and its associated phase. If the socket is currently ON then the RED neon indicator is lit on the graphic and switching button indicates that you can turn the socket 'OFF'.

Other buttons on this page allow the selected sockets, check box on each socket, to be turned ON or OFF, all the sockets turned ON or OFF or all the check boxes to be selected or unselected.

## Security page

Clicking on the **Security** button the operator is presented with the security status page which contains all Cabinet door, lock and Card number information for the PDU. The following screen shot shows the cabinet door open, the door locked with the last unlock user and a four card numbers stored:

The screenshot shows a web interface for the Security page. At the top is a navigation bar with links: Overview, Metering, Socket Outlets, Security, Environmental, Configuration, Logout, and Slave PDUs. The main content area is divided into two sections: Cabinet Status and Card Number Setup. The Cabinet Status section shows the door status as OPEN and the lock status as LOCKED. There are checkboxes for Opened, Closed, Unlocked, and Locked, and a text field for the last unlock user showing 'HINK'. An UNLOCK button is present. The Card Number Setup section shows a table with 6 rows for User details, including Code, Username, and Group. A Save Changes button is located between the two sections. A Help sidebar on the right provides instructions on how to configure the cabinet door security options.

	Code	Username	Group
User 1 details	3376601	David	Designer Systems
User 2 details	12345678	Jonathan Eaton	IP
User 3 details	987654321	Peter	GoFlex
User 4 details	3423236	David Shoolley	IP
User 5 details	0	None	None
User 6 details	0	None	None

The cabinet status dialog provides the door and lock status along with check boxes to configure alarms for door OPEN/CLOSED and lock UNLOCKED/LOCKED conditions. The last user that the lock was unlocked is also displayed. The operator can unlock the lock at any time by clicking 'UNLOCK'. [Please see later topic for alarm setup.](#)

The Card Number Setup dialog provides a list of the currently stored card numbers that can unlock the door when presented to the card reader at the cabinet location. Any of these numbers can be changed, along with the Username and Group and the PDU updated by clicking 'Save Changes'. The 'Clear All' button clears all the current Card numbers to zero. The 'Learn Card' button activates the card reader learn function during which the reader LED will flash. If a card is swiped within 30 seconds this card will be stored in the next available slot otherwise learn will timeout and the reader LED turn off.

The 'Wildcards' checkbox can be used to enable/disable the Card/PIN wildcard feature. The wildcard feature allows a pre-learned Card/PIN number to be modified or a new one entered that will respond to a range of Card/PIN numbers when presented/entered.

The wildcard value is represented by using trailing full stops in the Card number starting in the units column and continuing into the tens, hundreds, thousands columns as required.

### Example

Pre-learned card number modified to support wildcard function on digits 5 to 8.

Card/PIN registers contain value '12345678' due to pre-learn are modified to '1234....'

Cards swiped/scanned in the range '12340000' to '12349999' will activate the door lock.

## Environmental page

Clicking on the **Environmental** button the operator is presented with the environmental status page which contains details of any humidity probe, temperature probes, particle sensors and contacts connected to the system. The following screen shot shows both a humidity probe and two temperature probes connected:

The screenshot displays the 'Environmental' page of a system interface. At the top, a navigation bar includes links for Overview, Metering, Socket Outlets, Security, Environmental (selected), Configuration, Logout, and Slave PDUs. The main content area is divided into two primary sections: 'Humidity Probe Status' and 'Temperature Probe Status'. The 'Humidity Probe Status' section shows a current humidity of 51.87%, a temperature of 24.08°C, and a location of 'Cabinet top'. It includes checkboxes for 'Low Alarm' and 'High Alarm' with corresponding threshold values of 5.00 and 60.00. A 'Save Changes' button is located at the bottom right of this section. The 'Temperature Probe Status' section lists six probes. Probes 1 and 2 show temperatures of 24.62°C and 24.43°C respectively, with locations set to 'None'. Probes 3 through 6 all show 0.00°C. Each probe has a 'Low Alarm' checkbox with a threshold of 5.00 and a 'High Alarm' checkbox with a threshold of 60.00. A 'Save Changes' button is also present at the bottom right of this section. On the right side of the page, there is a 'Help' section with three paragraphs explaining the functionality of the Humidity Probe Status, Temperature Probe Status, and Contact Set Status sections.

Humidity Probe Status					
Humidity (%)	51.87	<input type="checkbox"/> Low Alarm	5.00	<input type="checkbox"/> High Alarm	60.00
Temperature (C)	24.08	<input type="checkbox"/> Low Alarm	5.00	<input type="checkbox"/> High Alarm	60.00
Location	Cabinet top				
<button>Save Changes</button>					

Temperature Probe Status					
Probe 1 Temperature (C)	24.62	<input type="checkbox"/> Low Alarm	5.00	<input type="checkbox"/> High Alarm	60.00
Probe 1 Location	None				
Probe 2 Temperature (C)	24.43	<input type="checkbox"/> Low Alarm	5.00	<input type="checkbox"/> High Alarm	60.00
Probe 2 Location	None				
Probe 3 Temperature (C)	0.00	<input type="checkbox"/> Low Alarm	5.00	<input type="checkbox"/> High Alarm	60.00
Probe 3 Location	None				
Probe 4 Temperature (C)	0.00	<input type="checkbox"/> Low Alarm	5.00	<input type="checkbox"/> High Alarm	60.00
Probe 4 Location	None				
Probe 5 Temperature (C)	0.00	<input type="checkbox"/> Low Alarm	5.00	<input type="checkbox"/> High Alarm	60.00
Probe 5 Location	None				
Probe 6 Temperature (C)	0.00	<input type="checkbox"/> Low Alarm	5.00	<input type="checkbox"/> High Alarm	60.00
Probe 6 Location	None				
<button>Save Changes</button>					

### Help

This page allows the humidity probe, temperature probes and contact status to be viewed and location names to be configured.

Humidity Probe Status reports the current humidity level measured from the externally connected humidity probe and it's temperature. High and low alarm thresholds may be setup by clicking on the associated checkbox, changing the threshold value and clicking on 'Save Changes'

Temperature Probe Status reports the current temperature levels measured from the externally connected temperature probes. The probes location and high and low alarm thresholds may be setup by clicking on the associated checkbox, changing the threshold value and clicking on 'Save Changes'

Contact Set Status reports the current status, TRIGGERED or OKAY, from up to three externally connected voltage free Normally Closed (NC) contacts. The contacts location and cleared/triggered alarms may be setup by clicking on the associated checkbox and clicking on 'Save Changes'. Clicking the 'Clear Trigger' button resets the associated status to OKAY if TRIGGERED.

The humidity probe status box provides the temperature and humidity output from any connected humidity probe along with location name and check boxes and threshold levels to configure alarms against these parameters. [Please see later topic for alarm setup.](#)

The temperature probe status box(s) provide the temperature output from up to eight temperature probes along with location name and check boxes and threshold levels to configure alarms against these parameters. [Please see later topic for alarm setup.](#)

The following screen shot shows a particle sensor connected mid page:

**Particle Probe Status**

Probe	PM1.0 (ug/m3)	PM2.5 (ug/m3)	PM4.0 (ug/m3)	PM10 (ug/m3)	Location	Low Alarm	High Alarm
Probe 1	7	8	9	10	None	<input type="checkbox"/> 100	<input type="checkbox"/> 5000
Probe 2	0	0	0	0	None	<input type="checkbox"/> 100	<input type="checkbox"/> 5000
Probe 3	0	0	0	0	None	<input type="checkbox"/> 100	<input type="checkbox"/> 5000
Probe 4	0	0	0	0	None	<input type="checkbox"/> 100	<input type="checkbox"/> 5000

**Save Changes**

The following screen shot shows the Contact Set Status at the bottom of the page:

**Contact Set Status**

Contact Set	Status	Location	Cleared	Triggered	Action
Contact set 1	OPEN	None	<input type="checkbox"/>	<input type="checkbox"/>	Clear Trigger
Contact set 2	OKAY	None	<input type="checkbox"/>	<input type="checkbox"/>	Clear Trigger
Contact set 3	OKAY	None	<input type="checkbox"/>	<input type="checkbox"/>	Clear Trigger

**Save Changes**

The contact set status box provides the status [OPEN, OKAY or TRIGGERED] and label of any switch, contact etc. connected to the three contact inputs along with check boxes to configure alarms against these inputs. Please see later topic for alarm setup. The contact inputs are ‘sticky’ which means that when triggered into an TRIGGERED condition they will hold this condition until cleared using the associated ‘Clear’ button.

Buttons on this page allow the alarm thresholds and status to be saved as required.

## Alarm setup and generation

Individual pages allow various low, high and event alarms to be configured.

To setup a low threshold alarm click on the Low Alarm checkbox and enter a threshold level at which an alarm should be generated if the reported value drops below i.e. for a temperature alarm enter 5.00 if you want an alarm to be generated if the temperature drops below 5.00C.

To setup a high threshold alarm click on the High Alarm checkbox and enter a threshold level at which an alarm should be generated if the reported value rises above i.e. for a temperature alarm enter 40.00 if you want an alarm to be generated if the temperature rises above 40.00C.

Click on the '**Save Changes**' button to update the alarm setting. *Note: An alarm comparison is immediately undertaken on configuring a new alarm.*

The normal alarm check repeat period of 1 to 240 minutes can be configured on the Configuration page. On every alarm repeat period timeout all configured alarm thresholds are re-compared with the currently report value and if found to be above or below the threshold and if the **SNMP trap N enabled** checkbox is selected an SNMP trap generated, see SNMP Trap Host Setup in Appendix B, and if the **Email alarms enabled** checkbox is selected on the Configuration page and alarm email will also be generated to the configured email address and if the SysLog enabled checkbox is selected a SysLog message generated.

## Configuration page

Clicking on the **Configuration** button the operator is presented with the Configuration page which contains configuration details. The following screen shot shows the System Information and configuration dialog and System Settings dialog at the top of the page:

The screenshot displays the Configuration page with a navigation bar at the top containing: Overview, Metering, Socket Outlets, Security, Environmental, Configuration, Logout, and Slave PDUs. The main content area is divided into two sections: System Information and Configuration, and System settings.

**System Information and Configuration**

Current User Level	ADMINISTRATOR
Software version	0.11.00
Client	Designer Systems Limited
Location	Designer Systems Offices
Cabinet ID	TEST0002
Phase 1 name	Phase L1
Phase 2 name	Phase L2
Phase 3 name	Phase L3

Save Changes

**System settings**

kpi/CEP Connection	01514	Range: 00000-99999
Currency symbol	£	Symbol: £ S S Y
Energy cost (kWh)	0.15	Range: 0.00000-999.999
LCD rotation period	5	Range: 1-20 seconds
LCD normal colour	000000	Range: 000000-FFFFFF (RGB, 16.7M, 65,536)
LCD alarm colour	FF0000	Range: 000000-FFFFFF (RGB, GREEN, BLUE)
LCD alarm flash rate	200	Range: 100-600Hz
LCD rotation period	1	Range: 1-240 minutes
Lock unlock period	5	Range: 1-240 seconds
Alarm repeat period	1	Range: 1-240 minutes
Radius logout period	20	Range: 1-240 minutes

Save Changes

**Help**

This page allows the PDU system to be configured.

**System Information and Configuration** reports the current user level, firmware and web page versions and provides configuration options for metering and loading the PDU. System settings allows various communication parameters to be set as well as LCD backlight colour for normal and alarm indication, rotation period, alarm flash rate, period to check for alarms and lock and socket periods.

**PDU Mode settings** allows the PDU mode to be configured (DI I-his ANCHORUS support, MASTER to-ANCHORUS shows new queries and their collected and SLAVE to-ANCHORUS collects data from the PDU using the configured slave address). When configured for MASTER the forward (time to wait for a slave to respond) and retries (number of times the master retries a query) are configurable. When configured for SLAVE, the MODBUS Slave Address must be configured to an exclusive address on the MODBUS network. The MODBUS Status bar provides real-time information about MASTER mode queries or SLAVE mode requests being made on the MODBUS network.

**Socket settings** allow each socket on the system to be configured with a socket picture, equipment name and alarm thresholds. Use the drop down box to select the socket to be displayed. Click on a socket image to configure the socket type picture. High and low alarm thresholds may be setup for current by clicking on the associated checkbox, changing the threshold value and clicking on 'Save Changes'.

The System Information and Configuration box shows the currently logged in operator level, USER, ADMINISTRATOR or FACTORY, client name, location and cabinet ID names and the names to be used for the three phases.

The System Settings box shows all the parameters that can be configured within the system.



The second section of the page contains the PDU Mode settings and Socket settings dialogs:

**PDU Mode settings and status**

MODBUS Status: **RUNNING**

PDU Mode: **MASTER** Note: Configuring the PDU for SLAVE mode disables all MODBUS master operations.

MODBUS Slave Address: **02**

MODBUS Timeout (ms): **1000** Range: 500-10000

MODBUS Retries: **5** Range: 1-10

**SEARCH**

**Save Changes**

**Socket settings**

Select socket: **1** Select the socket to configure.

Socket picture: Click on a socket image to select.

Equipment name: **None**

Power-on delay: **500** Range: 100-10000ms, DHCP (Note: Only for R12, not legacy sockets)

Current (Amps): **0.00** Low Alarm: ☐ 0.10 High Alarm: ☐ 15.00

Energy (kWh): **0.0** Phase setup: **Phase L1**

**Reset Energy**

**Save Changes**

**Changes:**

**Network settings** allows the host name and DHCP configuration to be configured. When DHCP is disabled a static IP address + CIDR, gateway and DNS addresses may be configured. Changes can be made to the fields by de-selecting the 'DHCP enabled' checkbox, updating the fields and clicking 'Save Changes'. CIDR in the format /x must be added to the IP Address fields, default /24 for IPv4 and /64 for IPv6.

**TimeDate settings** allow an NTP server for network time/date or local time/date setting to be configured. Changes can be made to the fields by selecting the 'NTP' server enabled checkbox, updating the fields and clicking 'Save Changes'.

**SNMP Settings** allow the SNMP Read and Write communities and SNMPv3 settings to be configured. Enter up to 3 communities for read and write or leave blank if unused, enable SNMPv3 with associated authentication and privacy keys and update by clicking 'Save Changes'.

**Telnet Settings** allow the Telnet username and password to be configured and update by clicking 'Save Changes'.

**Radius Settings** allow the Radius server and secret to be configured.

The PDU Mode settings dialog allows the PDU mode to be configured (**NORMAL**-No MODBUS support, **MASTER-MODBUS** Slaves are queried and data collected and **SLAVE**-External master collects data from this PDU using the configured slave address).

When configured for **MASTER** the Timeout (time to wait for a slave to respond) and Retries (Number of times the master retries a query) are configurable. Additionally, the SEARCH button is available to allow all connected Slave to be re-searched without rebooting the system.

When configured for **SLAVE** the MODBUS Slave Address must be configured to an exclusive address on the MODBUS network. The MODBUS Status box provides real-time information about MASTER mode queries or SLAVE mode requests being made on the MODBUS network.

The Socket settings dialog allows each socket on the system to be configured with a socket picture, equipment name and alarm thresholds. Using the drop down box the socket to be displayed can be selected. Clicking on a socket picture allows it to be selected. High and low alarm thresholds may be setup for current by clicking on the associated checkbox, changing the threshold value and clicking on the 'Save Changes' button.

Socket energy may also be reset by clicking the 'Reset Energy' button.

The third section of the page contains the Network settings and Time/Date settings dialogs:

The image shows two configuration dialogs. The top dialog, titled 'Network settings', contains fields for MAC Address (B8:27:EB:85:D0:A3), DHCP enabled (checkbox), IP4 Address (192.168.1.200), IP4 Gateway (192.168.1.254), Static IPv6 enabled (checkbox), IPv6 Address (fd01:0102:2989:4000:c83a:068d:53ef:a4fc), IPv6 DNS (fd01:0102:2989:4000:c83a:068d:53ef:a4fc), HTTPS enabled (checkbox), HTTP Port (80), and HTTPS Port (443). A 'Save Changes' button is at the bottom right. The bottom dialog, titled 'Time/Date settings', contains fields for NTP Server enabled (checkbox), NTP server (0.uk.pool.ntp.org), Setup time/date (00:00:00 00/00/0000), and Current time/date (14:58:39 21/01/2020). A 'Save Changes' button is at the bottom right.

The Network settings dialog allows IPv4/IPv4 DHCP to be enabled and the webserver port and secure (https) access to be configured. When DHCP is disabled a static IPv4 or IPv6 address and Gateway/DNS address may be configured. When DHCP is enabled the IPv4 and IPv6 addresses are allocated and displayed. Changes can be made to the fields by selecting/de-selecting the checkboxes, updating the fields and clicking the 'Save Changes' button.

The Time/Date settings box allows the NTP and time/date settings to be configured. Enter the NTP server you wish to use and check NTP Server enabled to specify a particular NTP server or uncheck NTP Server enabled and enter a time and date in the format shown and update by clicking 'Save Changes'.

The fourth section of the page contains the SNMP settings, Telnet settings and Radius settings dialogs:

The screenshot displays three configuration sections within a single dialog box:

- SNMP settings:** Includes fields for Read Community 1 (public), Read Community 2 (read), Read Community 3 (empty), Write Community 1 (private), Write Community 2 (write), and Write Community 3 (empty). It also has a checkbox for 'SNMPv3 enabled', a dropdown for 'SNMPv3 Authentication' (MD5), a text field for 'Authentication key' (masked), a dropdown for 'SNMPv3 Privacy' (DES), and a text field for 'Privacy key' (masked). A 'Save Changes' button is at the bottom right.
- Telnet settings:** Includes a text field for 'Telnet Username' (admin) and a text field for 'Telnet Password' (masked). A 'Save Changes' button is at the bottom right.
- Radius settings:** Includes a checkbox for 'Radius enabled' (checked), a text field for 'Radius server' (192.168.1.5), and a text field for 'Radius Secret' (masked). A 'Save Changes' button is at the bottom right.

The SNMP settings box allows the SNMP Read and Write communities and SNMPv3 settings to be configured. Enter up to 3 communities for read and write or leave blank if unused, enable SNMPv3 with associated authentication and privacy keys and update by clicking 'Save Changes'.

The Telnet settings box allows the Telnet server Username and Password to be configured. Enter a username, password and update by clicking 'Save Changes'.

The Radius settings box allows the radius authentication server to be configured. See Appendix I for more information.

The fifth section of the page contains the Alarm and Logging settings dialog:

Alarm and Logging settings

Email settings

Email enabled ☐

Exchange server enabled ☐

Secure server enabled ☐

Email Server mail.designersystems.co.uk

Email port 25

Email Username david.designersystems.co.uk

Email Password .....

Email From david@designersystems.co.uk

Email Destination support@designersystems.co.uk

SysLog settings

SysLog enabled ☒

SysLog Server 192.168.1.66 SysLog Port 514

SNMP Trap settings

SNMP trap 1 enabled ☒

SNMP trap 1 IP/DNS 192.168.1.66 SNMP trap 1 community trap

SNMP trap 2 enabled ☐

SNMP trap 2 IP/DNS 0.0.0.0 SNMP trap 2 community trap

General settings

Auto Log period (M) 30

Save Changes

System control

Reboot system

The Email setting dialog allows the email address and mail server to be configured for email alarms. Select the 'Email enabled' checkbox, enter the destination email, from email and the email server information and click 'Save Changes'.

The SysLog setting dialog allows the SysLog port and server to be configured for SysLog alarms. Select the 'SysLog enabled' checkbox, enter the SysLog port, normally 514, and SysLog server information and click 'Save Changes'.

The SNMP Trap settings dialog allows the two trap destinations to be configured for SNMP trap alarms. Select either or both the 'SNMP trap N enabled' checkboxes, enter the SNMP trap destination and community and click 'Save Changes'.

The General settings dialog allows the auto log period to be configured i.e. the period at which an email and SysLog message are routinely sent to confirm system operation. Enter a minute value and click 'Save Changes'.

## Slave PDUs page

Clicking on the **Slave PDUs** button the operator is presented with the Slave page which contains information about the connected slave PDUs. The following screen shot shows the Site Totals, Slave PDU Status, PDU Information and Meter Status dialogs at the top of the page:

The screenshot displays the 'Slave PDUs' page with a navigation bar at the top containing: Overview, Metering, Socket Outlets, Security, Environmental, Configuration, Logout, and Slave PDUs.

**Site Totals**

Amps	0.16	kWh	0.011
kVa	0.036		
kWh	0.0	BTU/h	0.0
kg/CO2	0.0	kJ/h	0.0
Cost(£)	0.0		

**Slave PDU Status**

Select PDU Slave: 2 (Select the slave to view)

**PDU Information**

Cabinet ID: None

Phase 1 name: Phase 1

Phase 2 name: Phase 2

Phase 3 name: Phase 3

PDU Status: ONLINE Address: 2

Software: 0.00.00 Sockets: 0

Save Changes

**Meter Status**

Select Meter: 1 (Select the meter to view)

	Low Alarm	High Alarm
Volts (V)	230.0	255.00
Current (Amps)	0.04	44.00
Wattage (kW)	0.057	50.00
Frequency (Hz)	50.00	60.00
Power Factor (PF)	0.728	0.900
Temperature (C)	28.65	50.00

Extended values

Energy usage

**Help**

This page provides information for all the SLAVE PDU's connected when this PDU is configured as a MASTER.

Site Totals reports the total Amps, kVA's, kWh's, BTU/h's, kg/CO2, kJ/h's and cost for all the PDU's connected to the system.

Slave PDU Status allows a PDU slave address to be selected and its status displayed in the following status boxes.

PDU Information reports the current status of the slave PDU including its name, operation status (ONLINE or OFFLINE), firmware version, MODBUS address and number of sockets.

Meter status reports the current status of the currently selected meter. Use the drop down box to select the meter to be displayed and use the other drop down box to select the phase to which the meter is connected [L1, L2 or L3] and click on 'Save Changes' to save this setting. High and low alarm thresholds are displayed for voltage, current, wattage, frequency, internal temperature or power factor.

Socket Status reports the Amps and kWh's of the selected socket and displays the equipment name and individual alarm thresholds. Use the drop down box to select the socket to be displayed.

Environmental/Probe Status reports the current humidity or temperature levels measured from the slaves externally connected humidity and temperature probes. The probes location and high and low alarm thresholds are also displayed.

Contact Set Status reports the current status, TRIG or OKAY, from the slaves externally connected voltage free Normally Closed (NC) contacts. Use the drop down box to select the probe to be displayed. The contacts location and cleared/triggered alarms are also displayed.

Cabinet Status reports the current

The Site Totals dialog shows the totals associated with this PDU and all slave PDUs connected to the system.

Selecting a slave PDU address from the Select PDU Slave drop down allows any slave to be selected with its information appearing under the PDU Information dialog.

A Cabinet ID and Phase names for the current slave may be entered and saved using the 'Save Changes' button.

The Meter Status dialog shows the meter status for the selected meter (1,2 or 3) along with the currently configured alarm thresholds and enable status.

The bottom section of the page contains the Socket Status, Environmental Probe Status, Contact Set Status and Cabinet Status settings dialogs:

The image shows two stacked configuration dialogs. The top dialog, titled 'Socket Status', features a 'Select socket' dropdown set to '1'. It displays a socket icon, an 'ON' button, and fields for 'Current (Amps)' (0.0), 'Energy (kWh)' (0.0), and 'Equipment Name' (Socket 1). Alarm settings for 'Low Alarm' (1.00) and 'High Alarm' (150.00) are shown with checkboxes. A 'Phase setup' dropdown is set to 'Phase L1'. A 'Save Changes' button is at the bottom right. A text box on the right explains that the 'CLOSED' status indicates the cabinet door lock status, which can be 'LOCKED' or 'UNLOCKED', and that the 'Time/Date of the last unlock' is also displayed. The bottom dialog, titled 'Environmental Probe Status', has a 'Select probe' dropdown set to 'Humidity'. It shows a 'Level' of 55.67 and 'Probe Location' as 'Cabinet top'. It also includes 'Low Alarm' (0.00) and 'High Alarm' (0.00) settings with checkboxes and a 'Save Changes' button.

The Socket Status dialog allows the socket status to be viewed for the selected socket (1..32) along with the currently configured alarm thresholds, enable status, phase name and the equipment name may be entered and saved using the 'Save Changes' button.

The socket on/off status is also show along with a button that allows the socket output to be switched on or off.

The Environmental Probe Status dialog allows the humidity/temperature probe and temperature sensor status to be viewed and the probe location names may be entered and saved using the 'Save Changes' button.

Contact Set Status

Contact set 1 status

OKAY

Cleared

Triggered

Contact set 1 location

Contact 1

Contact set 2 status

OKAY

Contact set 2 location

Contact 2

Contact set 3 status

OKAY

Contact set 3 location

Contact 3

Save Changes

Cabinet Status

Door status

OPEN

Opened

Closed

Door name

Door

Lock status

LOCKED

Unlocked

Locked

Save Changes

The Contact Set Status dialog allows the state of the three [3] contacts to be viewed and the contact location names may be entered and saved using the 'Save Changes' button.

The Cabinet Status dialog allows the door and lock status to be viewed along with the currently configured alarm enable status and the door name may be entered and saved using the 'Save Changes' button.

## Advanced Configuration page (hidden)

On entering the IP address followed by /config.html in the top bar the operator is presented with the Advanced Configuration page which contains advanced configuration details. The following screen shot shows the top section of the page showing the Advanced Configuration and Software upgrade configuration dialogs:

The screenshot displays the Advanced Configuration page with a navigation bar at the top containing links: Overview, Metering, Socket Outlets, Security, Environmental, Configuration, Logout, and Slave PDUs. The main content area is divided into three sections: Advanced Configuration, Software upgrade, and System Configuration. The Advanced Configuration section contains a table of settings with checkboxes for various features like Socket monitoring, USB Power, Meter 1 DC, Security features, Meter 1 enable, SHT21 Sensor, Meter 1 80A, Socket switching, Socket restore, Telnet, Meter 2 DC, LCD alarms, Meter 2 enable, Force thresholds, Meter 2 80A, Normally Closed, LCD IP display, Touch LCD, CCTV snapshot, Meter 3 enable, Meter 3 200A, and Meter 3 80A. The Software upgrade section shows the current software version (0.18.02) and a file upload area. The System Configuration section shows the configuration filename and buttons for uploading, downloading, and defaulting the configuration. A Help sidebar on the right provides instructions for using the page, including information about the Factory level user, Advanced configuration, Software upgrade, System Configuration, User Configuration, and Meter Calibration.

Advanced Configuration			
Socket monitoring	<input checked="" type="checkbox"/>	Socket switching	<input checked="" type="checkbox"/>
Socket read	<input type="checkbox"/>	Socket restore	<input type="checkbox"/>
USB Power	<input checked="" type="checkbox"/>	Telnet	<input type="checkbox"/>
Meter 1 DC	<input type="checkbox"/>	Meter 2 DC	<input type="checkbox"/>
Security features	<input type="checkbox"/>	LCD alarms	<input checked="" type="checkbox"/>
Meter 1 enable	<input checked="" type="checkbox"/>	Meter 2 enable	<input checked="" type="checkbox"/>
Meter 1 200A	<input type="checkbox"/>	Meter 2 200A	<input type="checkbox"/>
SHT21 Sensor	<input checked="" type="checkbox"/>	Force thresholds	<input checked="" type="checkbox"/>
Meter 1 80A	<input type="checkbox"/>	Meter 2 80A	<input type="checkbox"/>
		Normally Closed	<input type="checkbox"/>
		LCD IP display	<input checked="" type="checkbox"/>
		Touch LCD	<input checked="" type="checkbox"/>
		CCTV snapshot	<input type="checkbox"/>
		Meter 3 enable	<input checked="" type="checkbox"/>
		Meter 3 200A	<input type="checkbox"/>
		Meter 3 80A	<input type="checkbox"/>

Unplug threshold (A)  Range 0.01-1.00

Serial number

Copyright

MAC address

Software upgrade

Current software version

Software filename  No file chosen

System Configuration

Configuration filename  No file chosen

**Help**

This page allows a FACTORY level user to configure advanced settings and should be used carefully.

**Advanced configuration** The system can be configured using the check boxes to select different configuration options. Other manufacturing level configuration may also be entered such as serial number and copyright label.

**Software upgrade** allows the PDU-SNMP software to be upgraded.

**System Configuration** allows the current configuration file to be downloaded as 'config.new', uploaded as 'config.new' or defaulted to the factory default.

**User Configuration** allows a maximum of 20 user to be configured with one of 3 different user levels. USER level allows access to all pages, but 'Save Changes' buttons are disabled. ADMINISTRATOR level allows access to all pages and 'Save Changes' are enabled as well as upgrade functions. FACTORY level provides access to all pages and buttons as well as advanced configuration functions. A delete select user button deletes the currently selected user.

**Meter Calibration** The metering devices can be calibrated below. To calibrate voltage measure the mains voltage [RMS] at the feed input, enter the value in the DMM field and click on Calibrate. To calibrate current an RMS ammeter must be placed in series with one of the heater loads and load device eg. heater connected to the

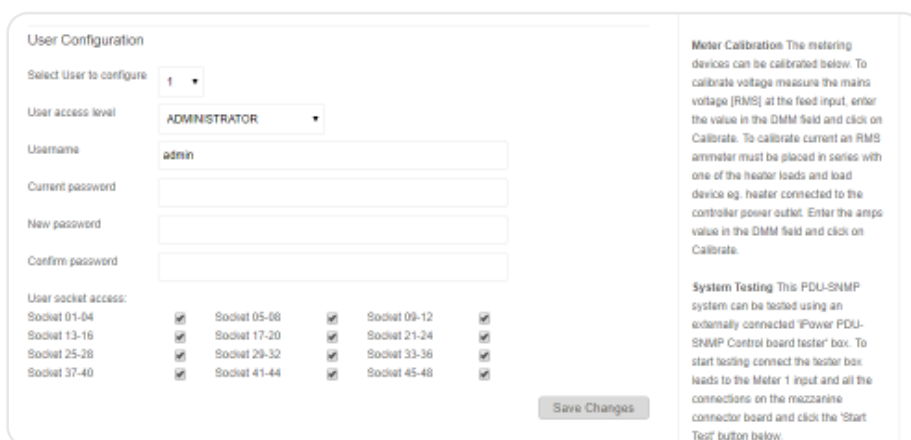
The Advanced Configuration box allows a number of factory configurable settings to be changed, including: Socket unplug threshold, System serial number, page copyright notice and a printable page can also be generated containing this information along with the system MAC address.

The Software upgrade dialog allows the PDU software to be upgraded by choosing the 'update.tar.cpt' supplied by IPT and click 'Upload file'. On upload completion the new software will be installed and the PDU will reboot. NOTE: That the webserver will go off-line during this reboot.

The System Configuration dialog allows the current configuration to be downloaded as a 'config.new' file, uploaded (eg. from another system downloaded file) as 'config.new' or defaulted to the factory defaults.



The centre section of the page contains the User Configuration dialog:



The User Configuration dialog box is divided into two main sections. The left section contains configuration fields for a user, and the right section contains informational text and a 'Save Changes' button.

**User Configuration**

Select User to configure: 1

User access level: ADMINISTRATOR

Username: admin

Current password:

New password:

Confirm password:

User socket access:

Socket 01-04	<input checked="" type="checkbox"/>	Socket 05-08	<input checked="" type="checkbox"/>	Socket 09-12	<input checked="" type="checkbox"/>
Socket 13-16	<input checked="" type="checkbox"/>	Socket 17-20	<input checked="" type="checkbox"/>	Socket 21-24	<input checked="" type="checkbox"/>
Socket 25-28	<input checked="" type="checkbox"/>	Socket 29-32	<input checked="" type="checkbox"/>	Socket 33-36	<input checked="" type="checkbox"/>
Socket 37-40	<input checked="" type="checkbox"/>	Socket 41-44	<input checked="" type="checkbox"/>	Socket 45-48	<input checked="" type="checkbox"/>

Save Changes

**Meter Calibration** The metering devices can be calibrated below. To calibrate voltage measure the mains voltage [RMS] at the feed input, enter the value in the DMM field and click on Calibrate. To calibrate current an RMS ammeter must be placed in series with one of the heater loads and load device eg. heater connected to the controller power outlet. Enter the amperage value in the DMM field and click on Calibrate.

**System Testing** This PDU-SHMP system can be tested using an externally connected 'Power PDU-SHMP Control board tester' box. To start testing connect the tester box leads to the Meter 1 input and all the connections on the mezzanine connector board and click the 'Start Test' button below.

The User Configuration dialog allows a maximum of 20 users to be configured with one of 3 different user levels. USER level allows access to all pages, but 'Save Changes' buttons are disabled. ADMINISTRATOR level allows access to all pages and 'Save Changes' are enabled as well as upgrade functions. FACTORY level provides access to all pages and buttons as well as advanced configurations on the config.html page.

The bottom section of the page contains the Meter Calibration and System Testing dialogs:

The screenshot shows two UI sections. The top section, titled 'Meter Calibration', contains a table with three columns: 'Meter', 'Meter volts', and 'DMM volts'. It lists six rows for Meter 1 and Meter 2, each with Voltage and Current. The 'Meter volts' column has input fields with values like '229.60', '9.80', '0.00', and '0.00'. The 'DMM volts' column has input fields with values like '240.0', '2.0', '240.0', and '2.0'. To the right of each row is a 'Calibrate' button. The bottom section, titled 'System Testing', has a 'Test status' label and a text box containing 'Connect the iPower Control board tester and click START TEST...'. Below this are two buttons: a '-' button and a 'START TEST' button. At the very bottom is a 'Printable test page' button.

	Meter volts	DMM volts	
Meter 1 Voltage	229.60	240.0	Calibrate
Meter 1 Current	9.80	2.0	Calibrate
Meter 2 Voltage	0.00	240.0	Calibrate
Meter 2 Current	0.00	2.0	Calibrate
Meter 3 Voltage	0.00	240.0	Calibrate
Meter 3 Current	0.00	2.0	Calibrate

System Testing

Test status

Connect the iPower Control board tester and click START TEST...

- START TEST

Printable test page

The Meter Calibration dialog allows each of the three meters to be individually calibrated. To calibrate voltage measure the mains voltage [RMS or DC] at the feed input, enter the value in the DMM field and click on Calibrate. To calibrate current a RMS ammeter must be placed in series with one of the heater loads and load device eg. heater connected to the controller power outlet. Enter the amps value in the DMM field and click on Calibrate.

The System Testing box allows the PDU to be tested. Connect an IPT PDU-SNMP Control board tester to the relevant interfaces and click START TEST.

### Logout button

Clicking on the Logout button the operator is presented with a blank page with the authentication screen displayed.

# Appendix B. SNMP trap setup and register description

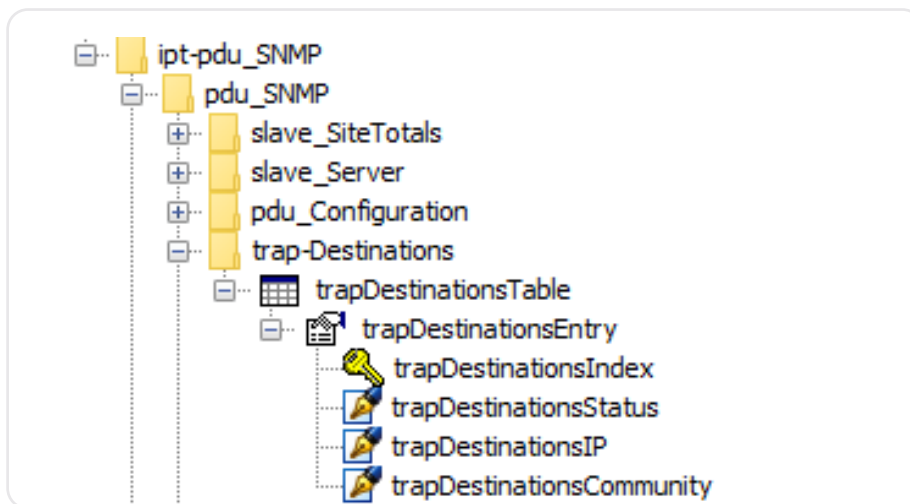
## Overview

The PDU supports multiple SNMP registers which can be accessed through its MIB file definition [IPT-PDU\_Vx.mib] by any SNMP manager. The product supports all standard SNMP operations such as GET, SET, GET NEXT, GET SUBTREE, GET BULK and WALK along with table viewing for some sets of registers and global registers.

The product is also capable of generating SNMP traps when previously setup alarm thresholds or alarm conditions are encountered. Traps consist of the client name and location followed by the PDU label that generated the trap, the current level/condition that caused the alarm and the trap alarm description.

## SNMP trap host setup

The PDU supports two SNMP host IP addresses allowing two different host systems to be sent trap alarm information. The host destination enable status, destination IP address and SNMP community string are setup through a table view of the TRAPDestinationsTable:



Which when viewed as a table will look like this:

	trapDestinatio...	trapDestinatio...	trapDestinatio...	trapDestinatio...	Index Value
1	1	enabled	192.168.1.66	trap	1
2	2	disabled	0.0.0.0	trap	2

The destination IP address should be set to the IP of the host that is to receive the trap notifications and the trap destination status set to '1' for ENABLED. The SNMP trap community can also be changed if required. Once configured any alarms generated by the system will be sent as traps every <AlarmPeriod> minutes.

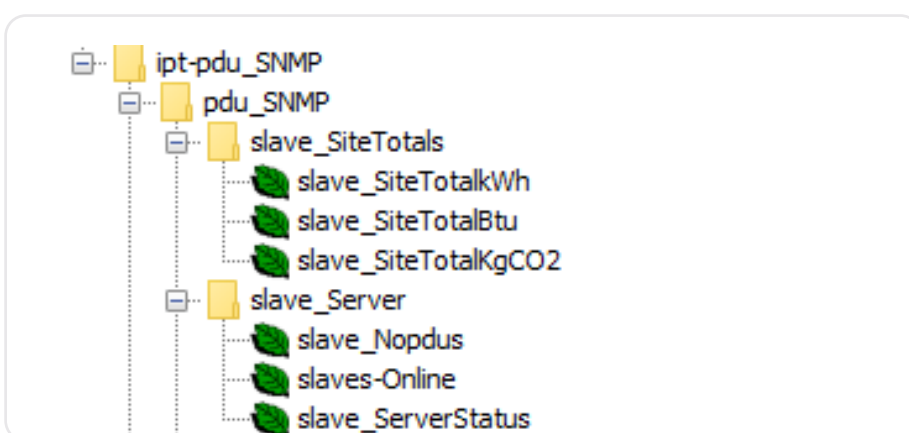
## SNMP register definitions

The PDU-SNMP register set can be broken into three [3] functional categories, PDU-SNMP, Slave-PDUs and Slave-Global.

Please refer to Appendix A – Web server HTML web page description for more information about the individual values available as registers.

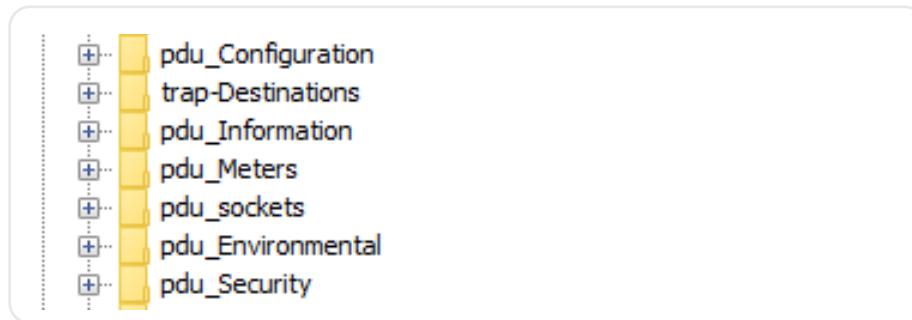
### pdu\_SNMP Slave total registers

The pdu\_SNMP register category contains registers that allow the PDU-SNMP Slave site totals to be read and the slave status read. The following MIB tree shows the registers available:



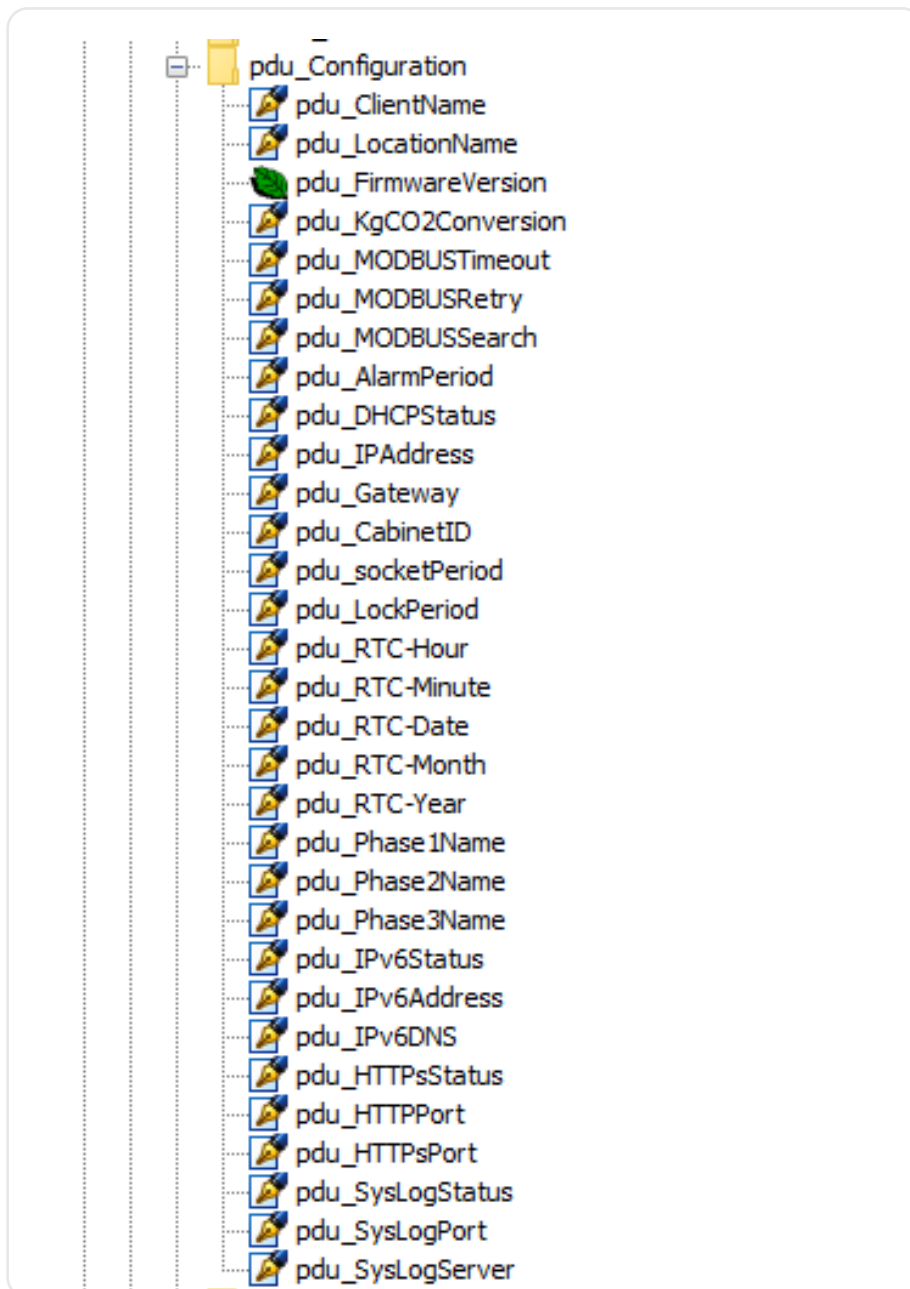
## pdu\_SNMP PDU registers

The pdu\_SNMP PDU register category contains registers that allow the master PDU (When the PDU is configured for NORMAL or MASTER) status registers to be read (Meters 1-3, RTC, Sockets, Environmental and Security), allow the PDU to be configured and trap thresholds to be setup. The following MIB tree shows the registers available:



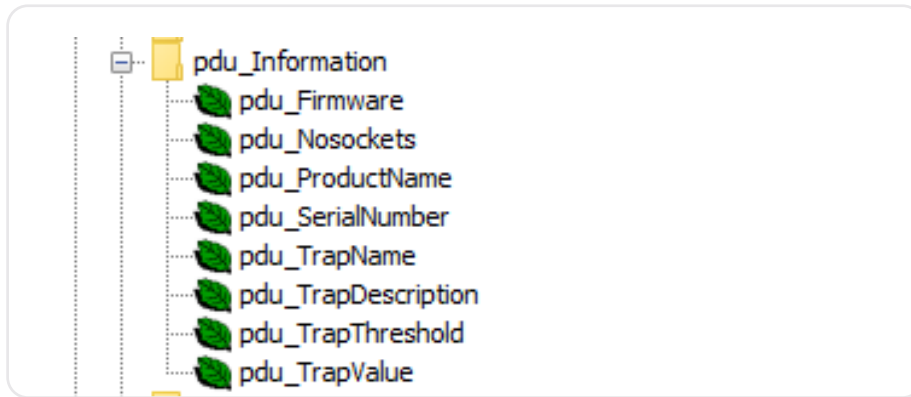
## pdu\_Configuration sub-category

The pdu\_Configuration sub-category contains relevant configuration information for the master PDU as follows:



## pdu\_Information sub-category

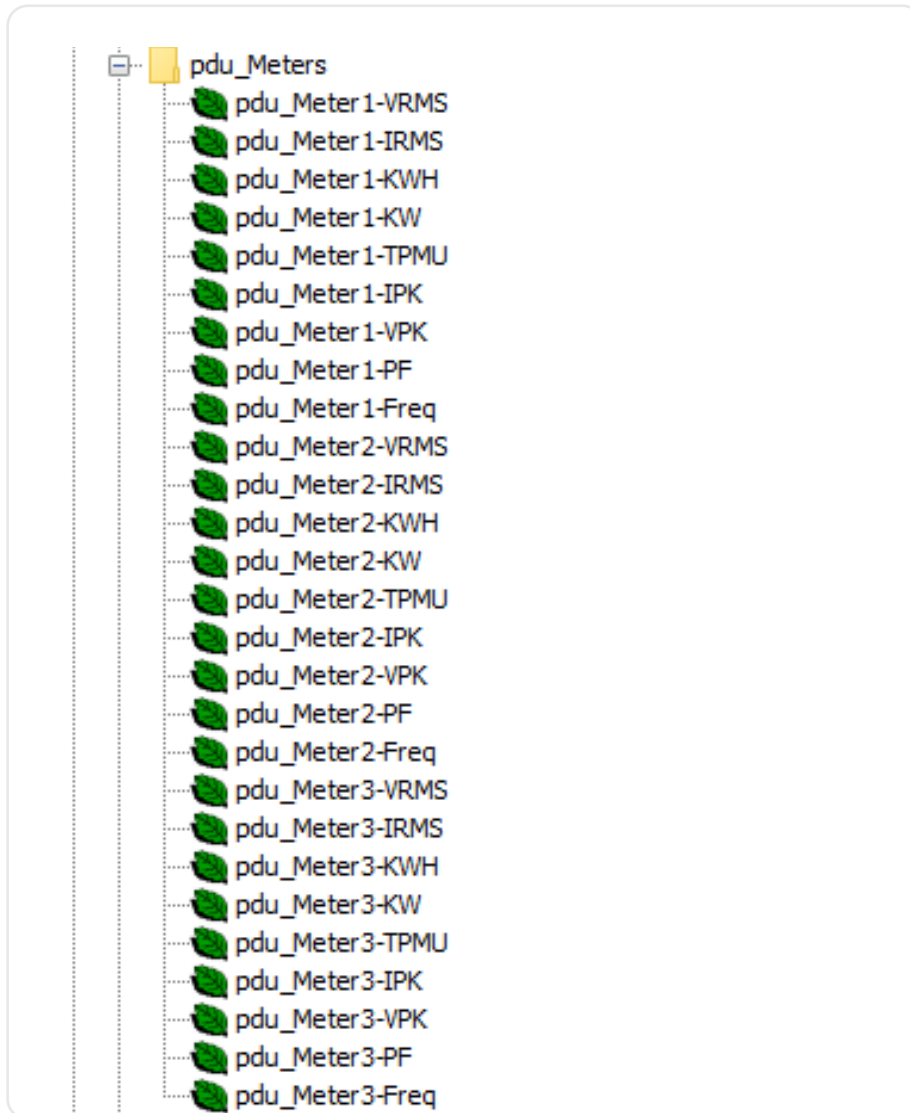
The pdu\_Information sub-category contains relevant information for the master PDU as follows:



pdu\_ProductName and pdu\_SerialNumber are set at factory.

## pdu\_Meters sub-category

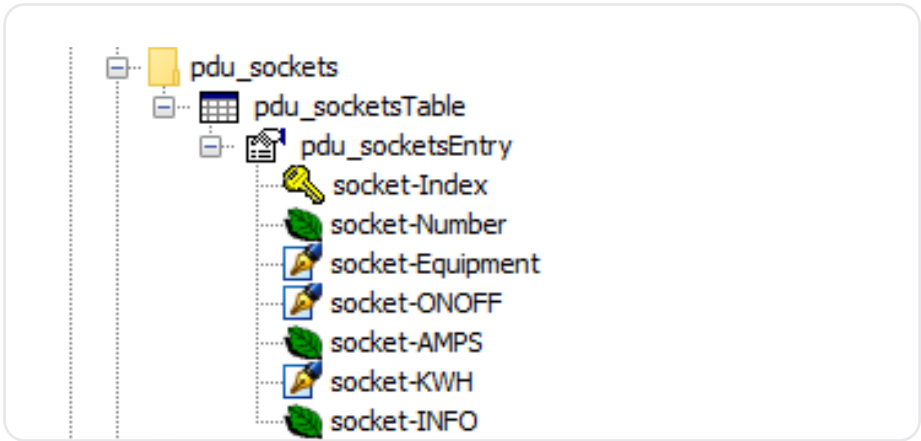
The pdu\_Meters sub-category contains meter measurements for the master PDU as follows:





pdu\_Sockets sub-category

The pdu\_Sockets sub-category contains socket status and measurements for the master PDU as follows:

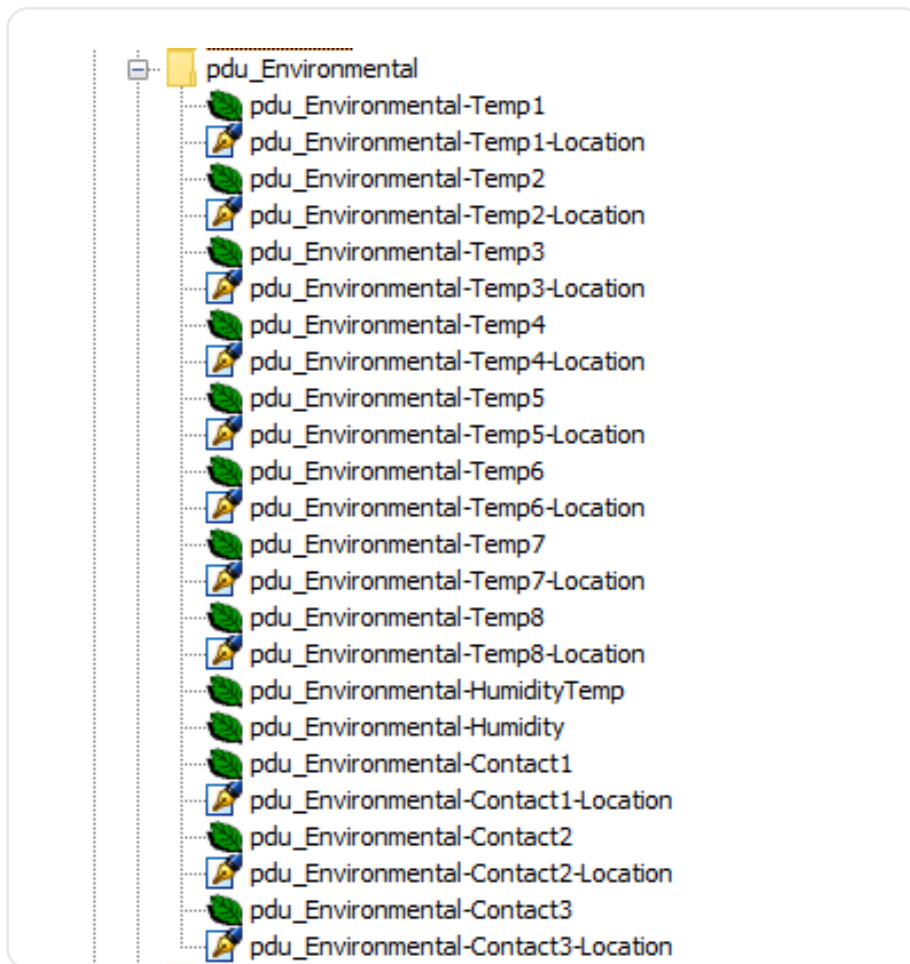


Which when viewed as a table will look something like this:

	socket-Index	socket-Number	socket-Equipm...	socket-ONOFF	socket-AMPS	socket-KWH	socket-INFO	Index Value
1	1	1	Reception heater	on	0	0	17	1
2	2	2	Reception computer	on	0	0	25	2
3	3	3	None	on	0	0	1	3

## pdu\_Environmental sub-category

The pdu\_Environmental sub-category contains humidity probe, temperature probe status and measurements and Contact status for the master PDU as follows:



pdu\_Security sub-category

The pdu\_Security sub-category contains door and lock status and the security card/PIN numbers for the master PDU as follows:

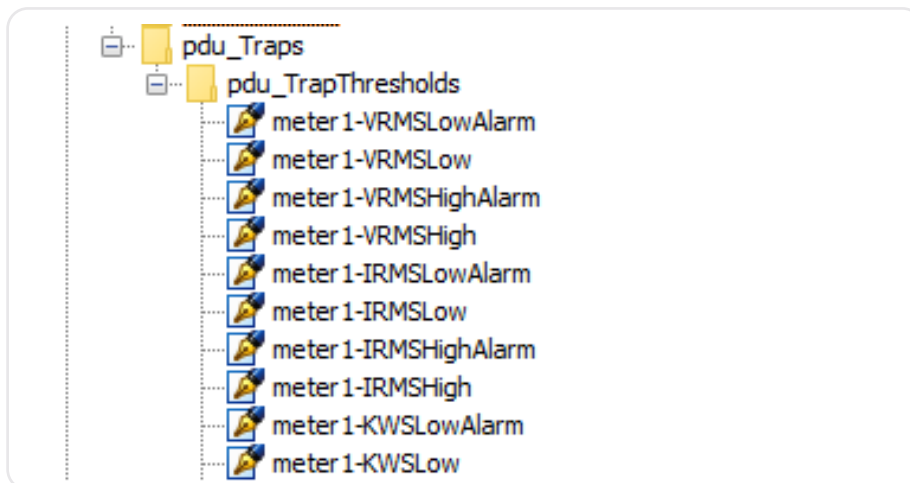


The pduSecurityTable when viewed as a table will look something like this:

	pdu_Security-...	pdu_Security-...	pdu_Security-...	pdu_Security-...	Index Value
1	1	3370501	David	Designer Systems	1
2	2	12345678	Jonathan Eaton	IPT	2
3	3	987654321	Peter	GoFlex	3
4	4	3423236	David Stockley	IPT	4

## pdu\_Traps, pdu\_TRAPThresholds sub-category

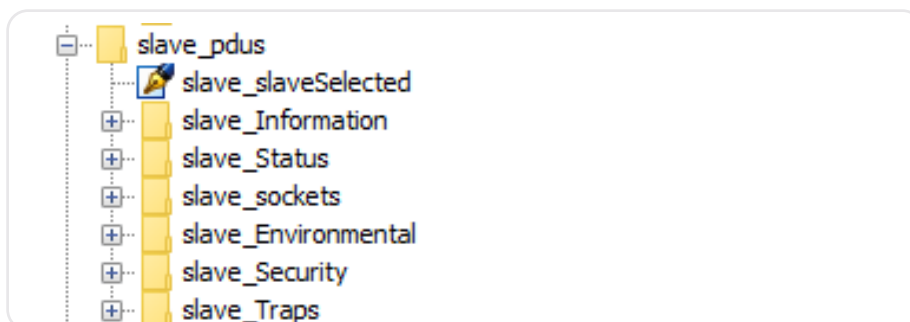
The pdu\_TRAPThresholds sub-category allows the master PDU alarm thresholds and conditions to be configured. The first few can be seen as follows:



Please refer to Appendix A – Web server HTML web page description for more information about the individual values available as registers.

## slave\_PDUs registers

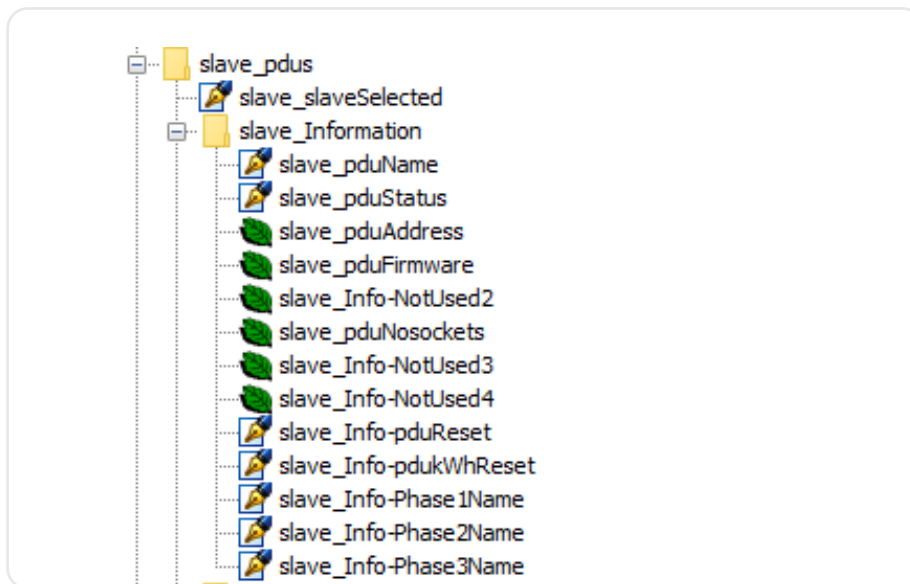
The slave\_PDUs register category contains registers that allow individual Slave PDU's in the installation to be queried. A Slave PDU can be selected by writing an index value [1 to number of Slave PDU's in system] to the slave\_SlaveSelected register as follows:



Subsequent GET's and SET's target this selected Slave PDU for each of the sub-categories above.

## slave\_Information sub-category

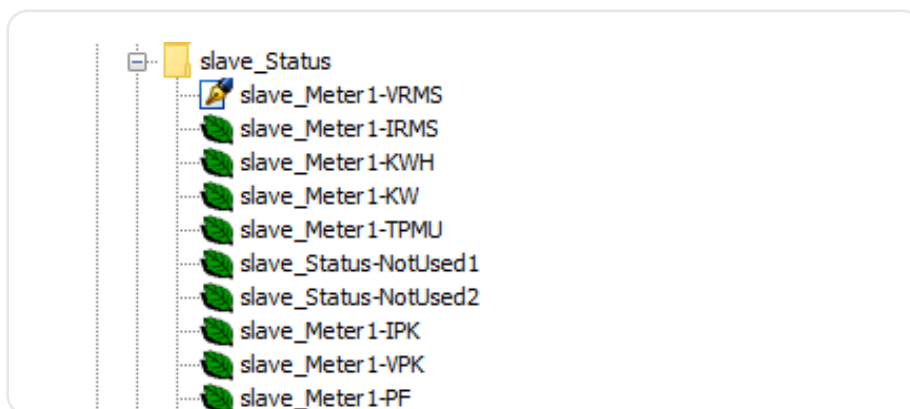
The slave\_Information sub-category contains relevant configuration information for the selected PDU as follows:



Note: NotUsed registers are for system compatibility.

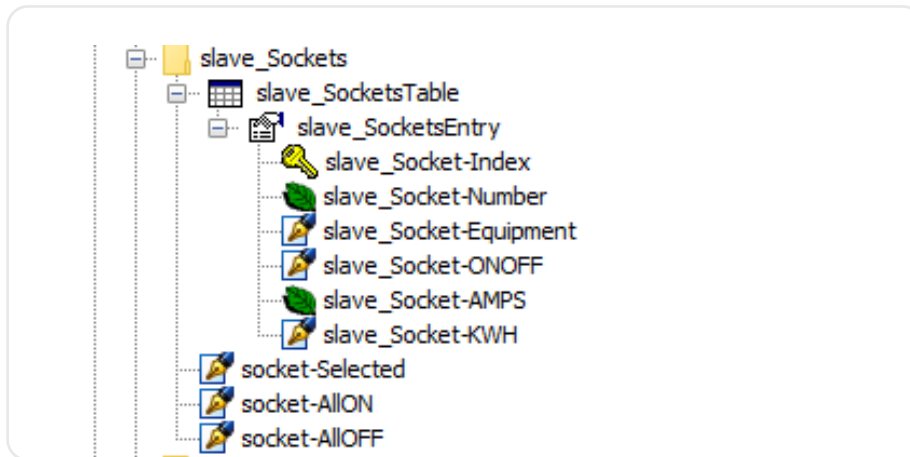
## slave\_Status sub-category

The slave\_Status sub-category contains relevant status information for the selected. The first few can be seen as follows:



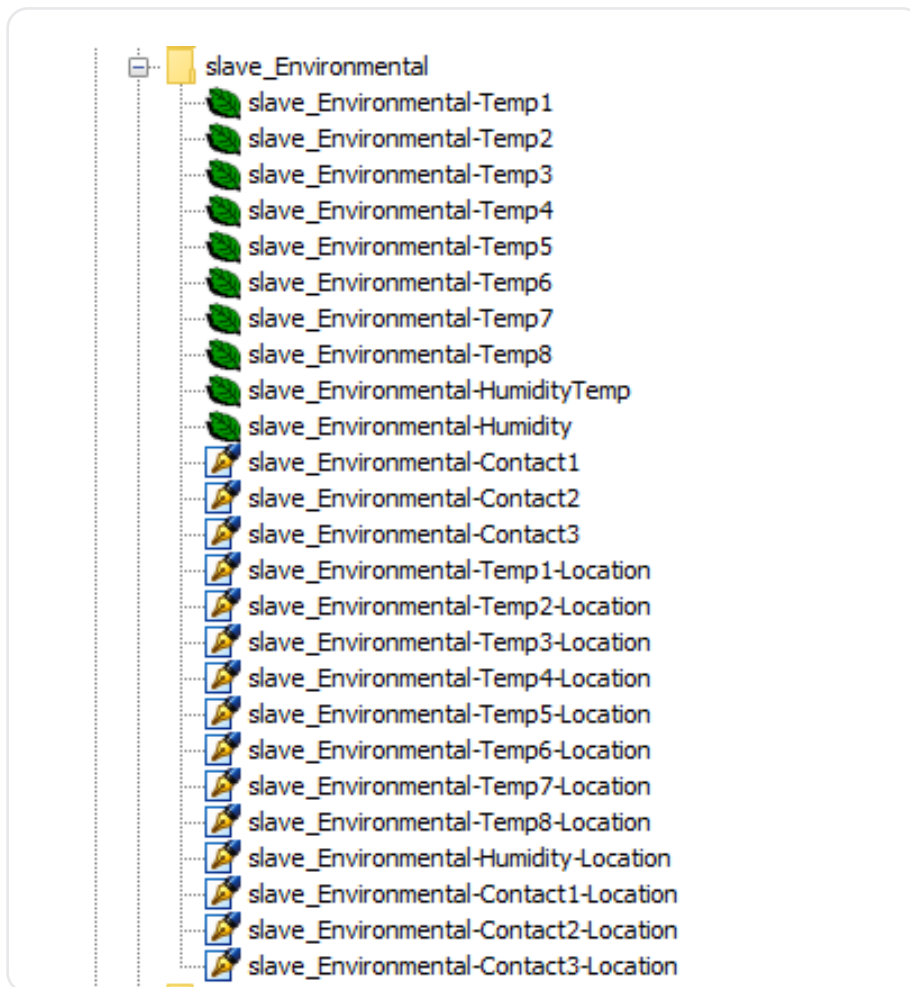
## slave\_Sockets sub-category

The slave\_Sockets sub-category contains relevant status information for the selected PDU individual sockets as follows:



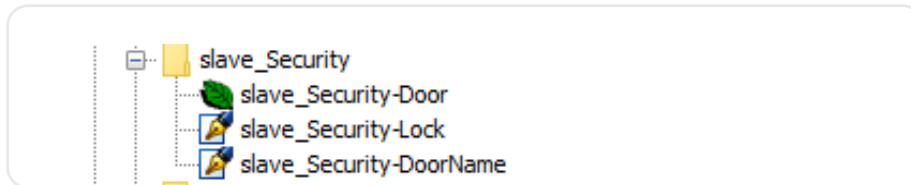
## slave\_Environmental sub-category

The slave\_Environmental sub-category contains humidity and temperature status and measurements for the selected PDU as follows:



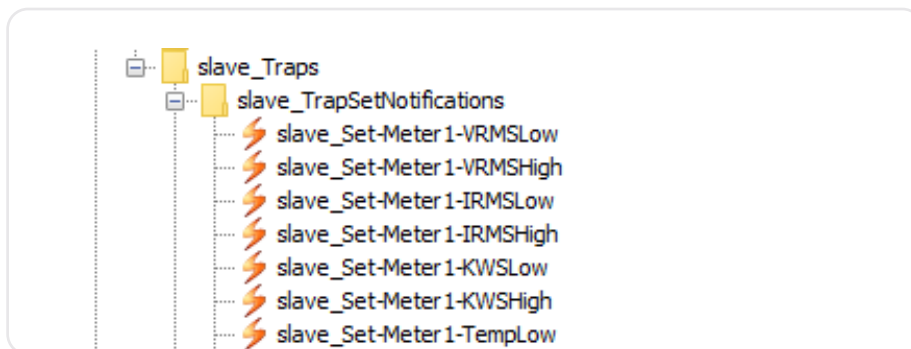
## slave\_Security sub-category

The slave\_Security sub-category contains door and lock status for the selected PDU as follows:



## slave\_Traps sub-category

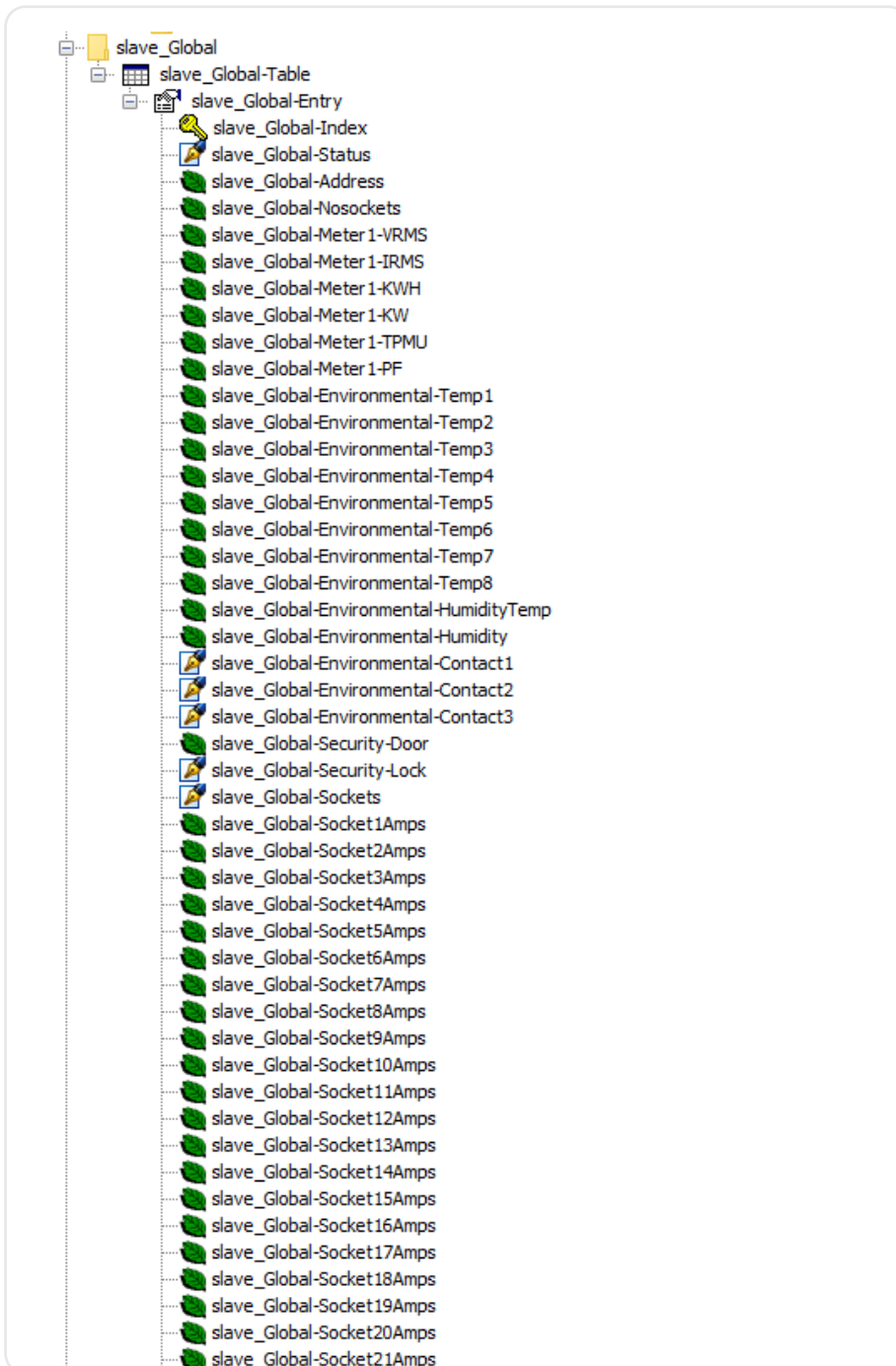
The slave\_Traps sub-category contains Set and Clear trap definitions for all slave traps, a small sample of the Set traps are as follows:





## slave\_Global registers

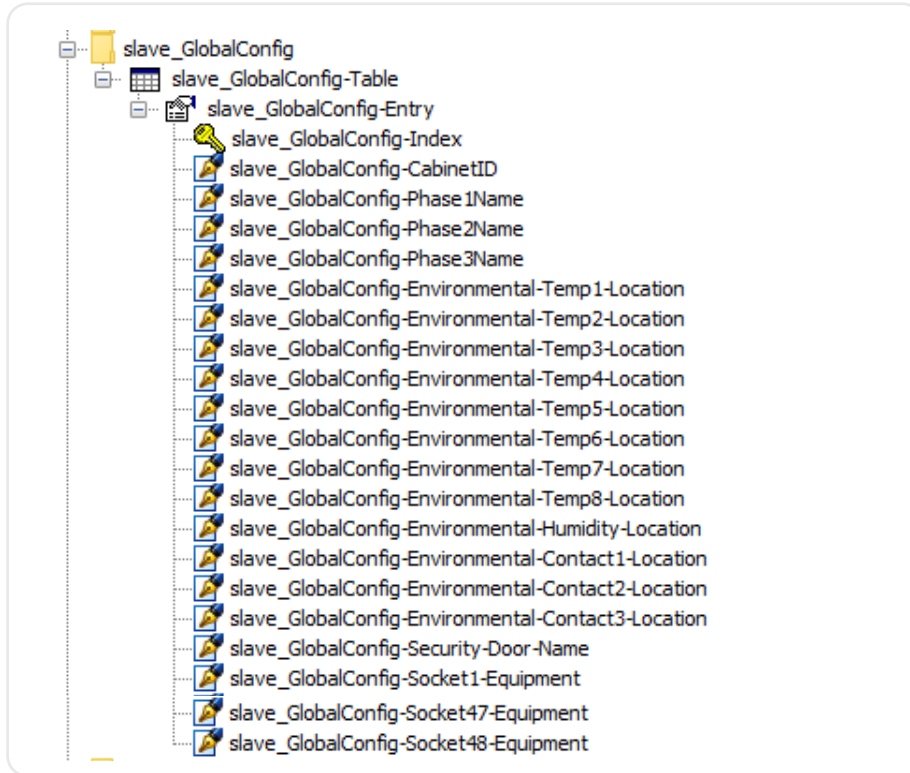
The slave\_Global register category contains registers that allow all PDU's in the installation to be viewed as follows:



Please refer to Appendix A – Web server HTML web page description for more information about the individual values available as registers.

## slave\_GlobalConfig registers

The slave\_GlobalConfig register category contains registers that allow all PDU's in the installation to have their names read and configured:



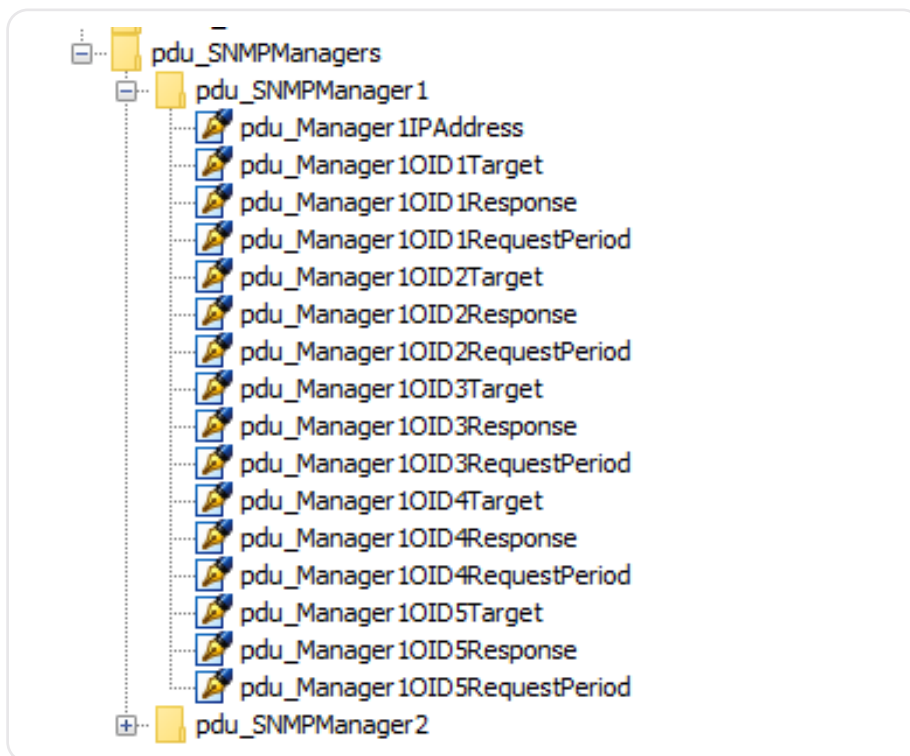
# Appendix C. SNMP manager description

## Overview

The PDU-SNMP supports a SNMP manager that can be configured to request data OIDs from other SNMP compliant equipment.

There are two managers, pdu\_SNMPManager1 and pdu\_SNMPManager2, that can be configured with individual destination IP addresses and up to 5 OID targets can be configured under each manager.

The pdu\_SNMPManagers sub-category contains the two managers with each formatted as follows:



Once the IP Address of the destination SNMP agent has been configured the manager generates GET requests to the Target every RequestPeriod seconds. The response to this GET request is then stored in the Response register which can be read at any time.

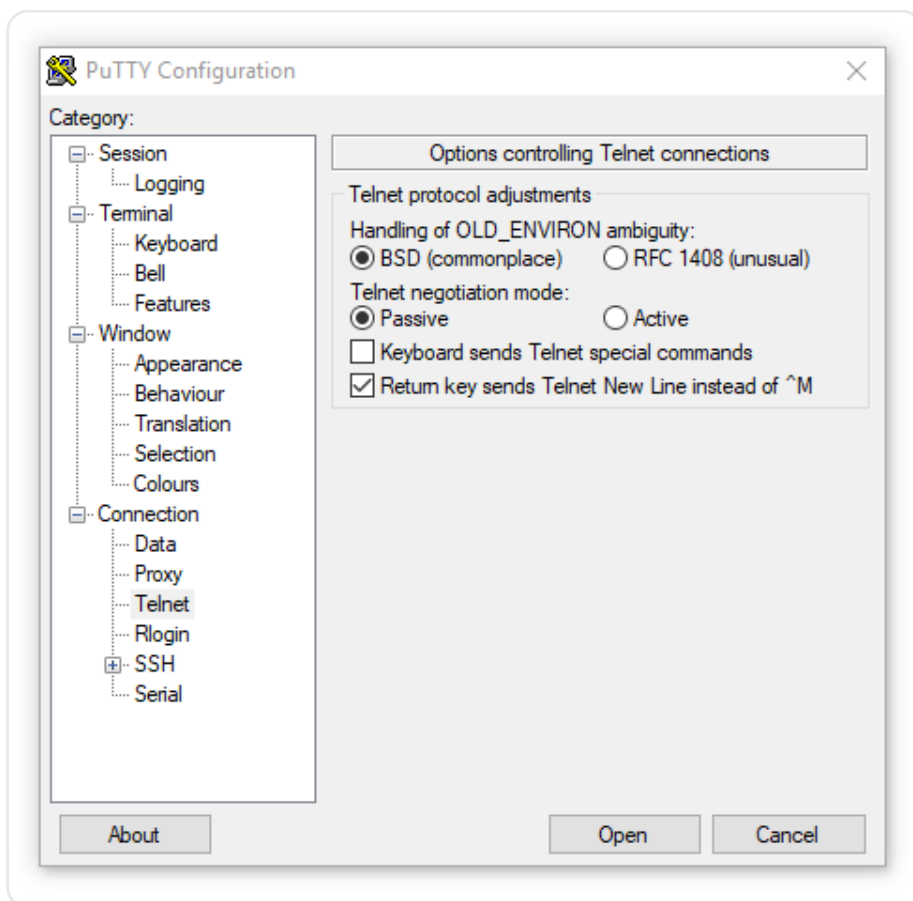
## Appendix D. Telnet command line interface description

### Telnet server

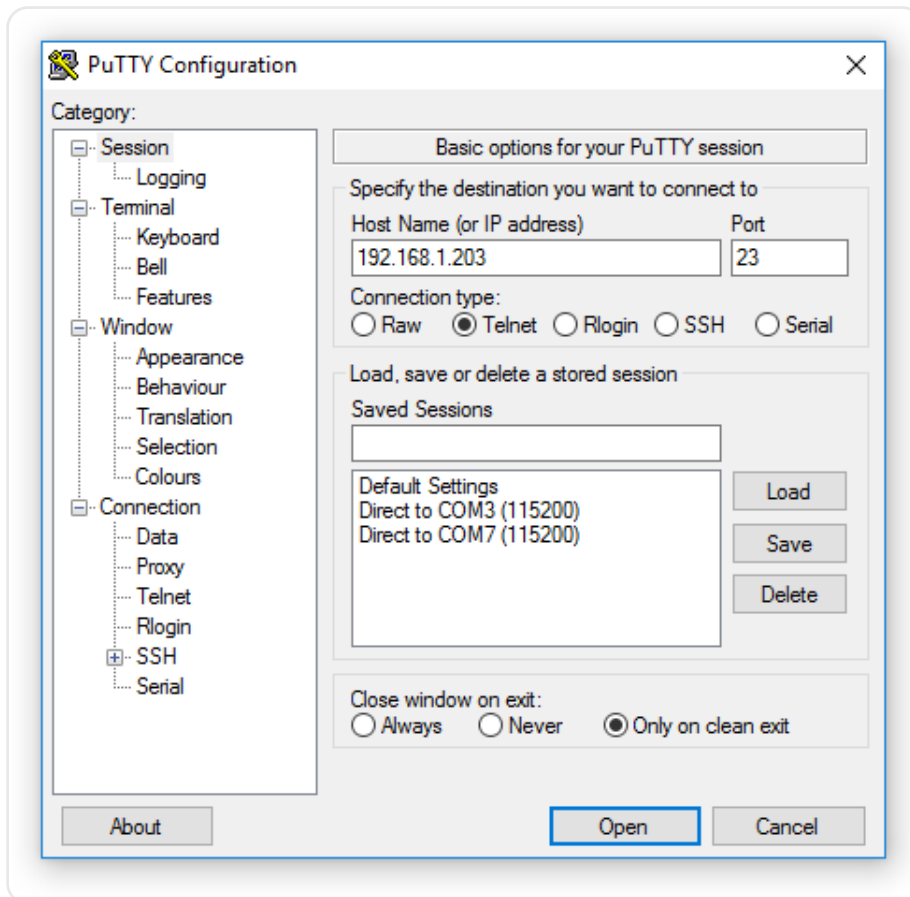
The PDU-SNMP supports a Telnet command line interface that allows a user to control/monitor system settings and measurements.

#### Logging into the Telnet server

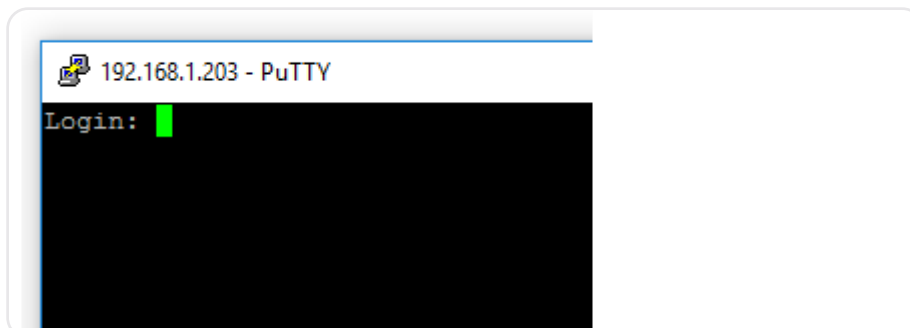
The Telnet server can be logged into using any Telnet compatible application. For clarity the following description uses the Putty application (<http://www.chiark.greenend.org.uk/~sgtatham/putty/latest.html>) as the client as it is available as a free download. After starting the application click on the 'Telnet' branch under 'Connection' and select the 'Passive' radio button under the 'Telnet negotiation mode:' as follows:



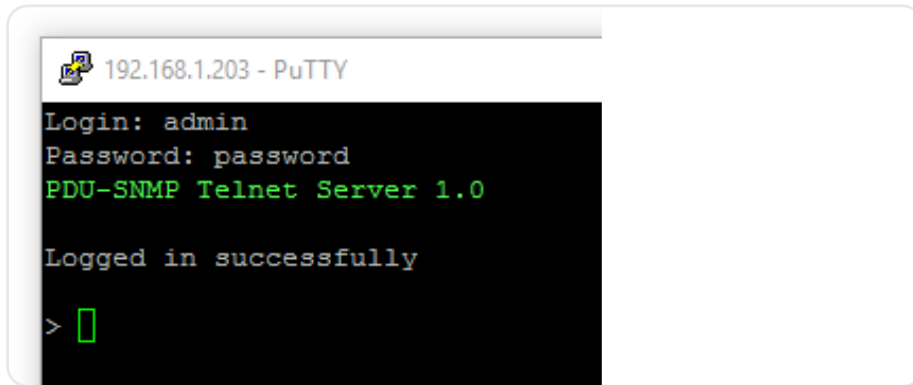
Click on 'Session' select the 'Telnet' radio button and enter the PDU-SNMP IP address into the 'Host Name' box as follows:



Click the 'Open' button and if a connection is made you will be presented with the following screen:



Enter the default user name 'admin' and password 'password' and the following screen will be displayed:



```
192.168.1.203 - PuTTY
Login: admin
Password: password
PDU-SNMP Telnet Server 1.0
Logged in successfully
> 
```

### Telnet server commands

The Telnet server supports a number of commands that allow the slave PDU-SNMP to be selected, outlets read and set and metering/environmental measurements to be read.

#### Set slave command

The set slave command allows the slave PDU-SNMP to be set ready for other read/set commands, the format being:

**ss xx**

Where xx is the slave address 01-31, replies with:

**Slave xx set**

#### Set meter command

The set meter command allows the meter number to query on the slave PDU-SNMP to be set ready for other read/set commands, the format being:

**sm xx**

Where xx is the meter number 01-03, replies with:

**Meter xx set**

### Read status command

The Read status command allows the status of a socket to be returned, the format being:

**read status oxx**

Where xx is the socket number 01-48, replies with:

**Socket xx: ddd**

Where ddd is ON if the socket is on, OFF if the socket is off.

### Switch socket command

The Switch socket command allows a socket to be switched on/off instantly or with a delay and be rebooted (off/on with a delay), the format being:

**sw oxx tttt**

Where xx is the socket number 01-48 and tttt is as follows:

**on imme**

Turns the socket on immediately.

**off imme**

Turns the socket off immediately.

**on delay**

Turns the socket on after 2 seconds.

**off delay**

Turns the socket off after 2 seconds.

**reboot**

Turns the socket off and then on again after 2 seconds.

Replies with:

**Socket xx updated**

Where xx is the socket number.

### Read meter command

The Read meter 'dev' command returns the voltage, current, power, power factor, frequency or dissipation for the currently selected meter, the format being:

**read meter dev volt**

Replies with:

**Meter volts: vvv.vVAC**

Where vvv.v is the current AC voltage.

**read meter dev curr**

Replies with:

**Meter current: aa.aaA**

Where aa.aa is the current AC amperage.

**read meter dev pow**

Replies with:

**Meter power: ww.wwwkWs**

Where ww.www is the current power in kWs.

**read meter dev freq**

Replies with:

**Meter frequency: ff.fHz**

Where ff.f is the current frequency in Hz.

**read meter dev pf**

Replies with:

**Meter PF: p.ppp**

Where p.ppp is the current power factor.

**read meter dev pd**

Replies with:

**Meter dissipation: eeeee.ekWh**



Where eeeee.e is the current energy dissipation in kWhs.

The Read meter 'olt' command returns the current or dissipation for the requested socket, the format being:

**read meter olt oxx curr**

Where xx is the socket number 01-48 and replies with:

**Socket xx current: aa.aA**

Where aa.a is the current AC amperage.

**read meter olt oxx pd**

Where xx is the socket number 01-48 and replies with:

**Socket xx dissipation: eeeee.ekWh**

Where eeeee.e is the current energy dissipation in kWhs.

#### Read sensor command

The Read sensor command returns the current humidity or temperature measured by the probes connected to the system, the format being:

**read sensor oxx**

If xx is 01, replies with humidity probe level:

**Humidity: hh.hh% Temperature: tt.ttC**

Where hh.hh is the humidity in percent and tt.tt is the temperature in celsius.

If xx is 02-09, replies with the selected temperature probe level:

**Temperature probe xx: tt.ttC**

Where tt.tt is the temperature in celsius.

#### Quit command

The Quit command exits the Telnet session, the format being:

**quit**

# Appendix E. XML and CGI protocol description

## XML protocol

The PDU-SNMP supports Extensible Markup Language (XML) status protocols to allow the web server to provide system configuration and measurement data.

### XML status files

XML status consist of webserver accessible files with the .xml extension and are formatted in the following manner:

```
<response>

    <field>data</field>

</response>
```

Where:

field is the human readable description of the data within.  
data is the configuration or measurement data

### status.xml

The status.xml file provides system configuration and meter measurement values and id formatted as follows:

```
<response>

<PDU_client>Designer Systems Limited</PDU_client>

<PDU_location>Designer Systems Offices</PDU_location>

<PDU_cabinetID>DES001</PDU_cabinetID>

<PDU_software>0.10.00</PDU_software>

<PDU_timedate>12:19:40 06/12/2019</PDU_timedate>

<PDU_Alarm_Status>NONE</PDU_Alarm_Status>

<PDU_Meter1_Vrms>230.2</PDU_Meter1_Vrms>

<PDU_Meter1_Irms>0.08</PDU_Meter1_Irms>

<PDU_Meter1_kWs>0.005</PDU_Meter1_kWs>
```

```
<PDU_Meter1_Freq>49.8</PDU_Meter1_Freq>
<PDU_Meter1_PF>0.302</PDU_Meter1_PF>
<PDU_Meter1_Temperature>23.60</PDU_Meter1_Temperature>
<PDU_Meter1_Vpeak>317.8</PDU_Meter1_Vpeak>
<PDU_Meter1_Ipeak>0.15</PDU_Meter1_Ipeak>
<PDU_Meter1_kWhs>0.6</PDU_Meter1_kWhs>
<PDU_Meter2_Vrms>230.7</PDU_Meter2_Vrms>
<PDU_Meter2_Irms>0.06</PDU_Meter2_Irms>
<PDU_Meter2_kWs>0.005</PDU_Meter2_kWs>
<PDU_Meter2_Freq>49.8</PDU_Meter2_Freq>
<PDU_Meter2_PF>0.409</PDU_Meter2_PF>
<PDU_Meter2_Temperature>25.68</PDU_Meter2_Temperature>
<PDU_Meter2_Vpeak>318.3</PDU_Meter2_Vpeak>
<PDU_Meter2_Ipeak>0.16</PDU_Meter2_Ipeak>
<PDU_Meter2_kWhs>0.3</PDU_Meter2_kWhs>
<PDU_Meter3_Vrms>230.4</PDU_Meter3_Vrms>
<PDU_Meter3_Irms>0.00</PDU_Meter3_Irms>
<PDU_Meter3_kWs>0.004</PDU_Meter3_kWs>
<PDU_Meter3_Freq>49.8</PDU_Meter3_Freq>
<PDU_Meter3_PF>0.506</PDU_Meter3_PF>
<PDU_Meter3_Temperature>25.38</PDU_Meter3_Temperature>
<PDU_Meter3_Vpeak>318.6</PDU_Meter3_Vpeak>
<PDU_Meter3_Ipeak>0.15</PDU_Meter3_Ipeak>
<PDU_Meter3_kWhs>0.3</PDU_Meter3_kWhs>
<PDU_No_Slaves>0</PDU_No_Slaves>
<PDU_Slave_Total_kWs>0.014</PDU_Slave_Total_kWs>
<PDU_Slave_Total_kWhs>1.2</PDU_Slave_Total_kWhs>
</response>
```

## CGI protocol

The PDU-SNMP supports Common Gateway Interface (CGI) control protocols to allow the web server to accept and decode commands sent over the HTTP GET. These commands allow the configuration of settings and the control of power outlets.

### CGI commands

CGI commands consist of HTTP GET formatted ASCII textual command lines in the format:

**`http://xxx.xxx.xxx.xxx/page.html?id=id&param1=value1&param2=value2....`**

Where:

xxx.xxx.xxx.xxx is the IP address of the PDU-SNMP unit  
page.html is the webpage used by the command  
id is the command description  
param is the parameter to be set  
value is the parameter value

Note: There is no syntax checking of parameter values, please ensure that values adhere to the ranges defined within the web server. Additionally textual names should not use ampersand '&' or commas ',' within their definitions.

### Set meter alarm thresholds command

The set meter alarm thresholds command allows the voltage, current, kilowatt, frequency, power factor and temperature high and low alarm thresholds and activation to be set for meters 1,2 or 3, the format being:

**`meter.html?id=meter_param&meter=meter&voltslow=var1&voltshigh=var2&voltslowenable=var3&voltshighenable=var4&ampslow=var5&ampshigh=var6&ampslowenable=var7&ampshighenable=var8&kwslow=var9&kwshigh=var10&kwslowenable=var11&kwshighenable=var12&frequencylow=var13&frequencyhigh=var14&frequencylowenable=var15&frequencyhighenable=var16&pflow=var17&pflowhigh=var18&pflowenable=var19&pflowhighenable=var20&temperaturelow=var21&temperaturehigh=var22&temperaturelowenable=var23&temperaturehighenable=var24`**

Where:

meter = Meter number , range 1..3 (1..3)  
var1 = Volts low threshold x10, range 10..3000 (0.1..300.0V)  
var2 = Volts high threshold x10, range 10..3000 (0.1..300.0V)  
var3 = Volts low alarm enable, range 0..1 (1 = alarm enabled)  
var4 = Volts high alarm enable, range 0..1 (1 = alarm enabled)  
var5 = Current low threshold x10, range 10..1000 (0.1..100.0A)  
var6 = Current high threshold x10, range 10..1000 (0.1..100.0A)

var7 = Current low alarm enable, range 0..1 (1 = alarm enabled)  
 var8 = Current high alarm enable, range 0..1 (1 = alarm enabled)  
 var9 = Kilowatts low threshold x10, range 10..1000 (0.1..100.0kw)  
 var10 = Kilowatts high threshold x10, range 10..1000 (0.1..100.0kw)  
 var11 = Kilowatts low alarm enable, range 0..1 (1 = alarm enabled)  
 var12 = Kilowatts high alarm enable, range 0..1 (1 = alarm enabled)  
 var13 = Frequency low threshold x10, range 100..900 (10.0..90.0Hz)  
 var14 = Frequency high threshold x10, range 100..900 (10.0..90.0Hz)  
 var15 = Frequency low alarm enable, range 0..1 (1 = alarm enabled)  
 var16 = Frequency high alarm enable, range 0..1 (1 = alarm enabled)  
 var17 = PF low threshold x1000, range 0..1000 (0.000..1.000)  
 var18 = PF high threshold x1000, range 0..1000 (0.000..1.000)  
 var18 = PF low alarm enable, range 0..1 (1 = alarm enabled)  
 var20 = PF high alarm enable, range 0..1 (1 = alarm enabled)  
 var21 = Temperature low threshold x10, range 10..1000 (0.1..100.0C)  
 var22 = Temperature high threshold x10, range 10..1000 (0.1..100.0C)  
 var23 = Temperature low alarm enable, range 0..1 (1 = alarm enabled)  
 var24 = Temperature high alarm enable, range 0..1 (1 = alarm enabled)

### Set humidity/temperature probe alarm thresholds command

The externally connected humidity/temperature probe alarm thresholds and activation can be set, the format being:

**enviro.html?id=enviro\_hum&templo=var1&temphigh=var2&templowen=var3&temphighen=var4&humlow=var5&humhigh=var6&humlowen=var7&humhighen=var8&location=var9**

Where:

var1 = Temperature low threshold x100, range 1..15000 (0.01..150.00C)  
 var2 = Temperature high threshold x100, range 1..15000 (0.01..150.00C)  
 var3 = Temperature low alarm enable, range 0..1 (1 = alarm enabled)  
 var4 = Temperature high alarm enable, range 0..1 (1 = alarm enabled)  
 var5 = Humidity low threshold x100, range 1..10000 (0.01..100.00%)  
 var6 = Humidity high threshold x100, range 1..10000 (0.01..100.00%)  
 var7 = Humidity low alarm enable, range 0..1 (1 = alarm enabled)  
 var8 = Humidity high alarm enable, range 0..1 (1 = alarm enabled)  
 var9 = Location name, range 1..50 characters.

### Set temperature probe name and alarm thresholds command

The externally connected temperature only sensor probes (1 to 8) name/location, alarm thresholds and activation can be set, the format being:

**enviro.html?id=enviro\_temp&probe=var1&templow=var2&temphigh=var3&tem  
plowen=var4&temphighen=var5&location=var6**

Where:

var1 = Probe number , range 1..8

var2 = Temperature low threshold x100, range 1..15000 (0.01..150.00C)

var3 = Temperature high threshold x100, range 1..15000 (0.01..150.00C)

var4 = Temperature low alarm enable, range 0..1 (1 = alarm enabled)

var5 = Temperature high alarm enable, range 0..1 (1 = alarm enabled)

var6 = Location name, range 1..50 characters. [Set contact alarm triggers command](#)

The externally connected contacts (1 to 3) alarms and name/location can be set, the format being:

**enviro.html?id=enviro\_contact&contact=var1&cleareden=var2&triggereden=var3  
&location=var4**

Where:

var1 = Contact number, range 1..3 (1..3)

var2 = Contact cleared alarm enable, range 0..1 (1=alarm enabled)

var3 = Contact triggered alarm enable, range 0..1 (1=alarm enabled)

var4 = Location name, range 1..50 characters.

### Set door/lock alarm trigger command

The door and lock open/close alarm activation can be set, the format being:

**security.html?id=security\_door&dooropenen=var1&doorcloseen=var2&lockunlockeden=var3&  
locklockeden=var4**

Where:

var1 = Door open alarm enable, range 0..1 (1 = alarm enabled)

var2 = Door close alarm enable, range 0..1 (1 = alarm enabled)

var3 = Lock unlocked alarm enable, range 0..1 (1 = alarm enabled)

var4 = Lock locked alarm enable, range 0..1 (1 = alarm enabled)

### Activate unlock command

The lock can be unlocked, the format being:

**security.html?id=security\_unlock&pin=var1**

Where:

var1 = Product serial number

### Set new card number command

A new card can be added, the format being:

**security.html?id=security\_card&card=var1&cardnum=var2&carduser=var3&cardgrp=var4**

Where:

var1 = Card slot number, range 1..30 (1..30)

var2 = Card number, range 0..9999999999999999

var3 = Card username, range 1..50 characters.

var4 = Card group name, range 1..50 characters.

### Activate card learn command

A new card can be learnt by activating the card learn function, the format being:

**security.html?id=security\_cardlearn**

### Clear all cards command

All cards can be cleared, the format being:

**security.html?id=security\_clearcards&pin=var1**

Where:

var1 = Product serial number

### Set socket outlet ON command

A socket outlet may be turned on, the format being:

**sockets.html?id=socket\_switch\_on&socket=var1**

Where:

var1 = Socket outlet number, range 1..Number of outlets(N) (1..N)

### Set socket outlet OFF command

A socket outlet may be turned off, the format being:

**sockets.html?id=socket\_switch\_on&socket=var1**

Where:

var1 = Socket outlet number, range 1..Number of outlets(N) (1..N)

### Set all socket outlets to ON command

All socket outlets may be turned on, the format being:

**sockets.html?id=socket\_switch\_all\_on**

### Set all socket outlets to OFF command

All socket outlets may be turned off, the format being:

**sockets.html?id=socket\_switch\_all\_off**



### Set system information command

The set system information command allows the client name, system location, cabinet ID and phase names to be configured, the format being:

**setup.html?id=setup\_info&client=var1&location=var2&cabid=var3&phase1name=var4&phase2name=var5&phase3name=var6**

Where:

var1 = Client textual name, range 1..50 characters  
var2 = Location textual name, range 1..50 characters  
var3 = Cabinet ID textual name, range 1..50 characters  
var4 = Phase 1 textual name, range 1..50 characters  
var5 = Phase 2 textual name, range 1..50 characters  
var6 = Phase 3 textual name, range 1..50 characters

### Set system parameter command

The set system parameter command allows the system to be configured, the format being:

**setup.html?id=setup\_param&kgco=var1&costsymbol=var2&unitcost=var3&lcdrotateperiod=var4&lcdnormalcolour=var5&lcdalarmcolour=var6&lcdalarmrate=var7&alarmrepeatperiod=var8&lockactivateperiod=var9**

Where:

var1 = kgCO2 conversion value x1000, range 1..1000 (0.001..1.000)  
var2 = Currency symbol, single character.  
var3 = Cost per kWh x100, range 1..10000 (0.01..100.00)  
var4 = LCD rotation period, range 1..20 seconds  
var5 = LCD normal colour, range 0..16777215 (0x000000..0xFFFFFF)  
var6 = LCD alarm colour, range 0..16777215 (0x000000..0xFFFFFF)  
var7 = LCD alarm flash period, range 100..5000 milliseconds  
var8 = Alarm repeat period, range 1..240 minutes  
var9 = Lock unlock period, range 1..240 seconds

Example. Default parameter setup.

**setup.html?id=setup\_param&kgco=544&costsymbol=£&unitcost=15&lcdrotateperiod=3&lcdnormalcolour=65280&lcdalarmcolour=16711680&lcdalarmrate=250&alarmrepeatperiod=1&lockactivateperiod=5**

### Set PDU mode and modbus parameter command

The set PDU mode and modbus parameter command allows the current operational mode, NORMAL, MASTER or SLAVE and the Modbus parameters to be configured, the format being:

**setup.html?id=setup\_mode&mode=var1&slaveaddress=var2&modbus timeout=var3&modbus  
retry=var4**

Where:

var1 = Mode setup, range 0..2 (0=NORMAL, 1=MASTER, 2=SLAVE)

var2 = Modbus slave address in SLAVE mode, range 2..32

var3 = Modbus timeout period, range 500...10000 milliseconds

var4 = Modbus retries, range 1..10

### Reset socket outlet energy command

The socket outlet to be reset must firstly be selected, the format being:

**setup.html?id=config\_socketselect&select=var1**

Where:

var1 = Socket outlet number, range 1..48

The energy on the selected socket may then be reset, the format being:

**setup.html?id=setup\_socketreset**

### Set socket outlet parameters and alarm thresholds command

The socket outlet to be configured must firstly be selected, the format being:

**setup.html?id=config\_socketselect&select=var1**

Where:

var1 = Socket outlet number, range 1..48

The parameters on this socket outlet may then be named and the current high and low alarm thresholds and activation may be set, the format being:

**setup.html?id=setup\_socket&equipment=var1&picture=var2&timedelay=var3&ampslowenable=var4&ampslow=var5&ampshighenable=var6&ampshigh=var7**

Where:

var1 = Socket outlet equipment textual name, range 1..50 characters

var2 = Socket picture select, range 0..6

var3 = Timedelay period to switch on after startup, range 100..100000 mS, 0=off

var4 = Current low alarm enable, range 0..1 (1 = alarm enabled)

var5 = Current low threshold x10, range 10..1000 (0.1..100.0A)

var6 = Current high alarm enable, range 0..1 (1 = alarm enabled)

var7 = Current high threshold x10, range 10..1000 (0.1..100.0A)

### Set network parameter command

The set network parameter command allows the network system to be configured, the format being:

**setup.html?id=setup\_network&dhcpenable=var1&ipv4address=var2&ipv4gateway=var3&staticipv6enable=var4&ipv6address=var5&ipv6dns=var6&httpsenable=var7&httpport=var8&httpsport=var9**

Where:

var1 = DHCP enable, range 0..1 (1 = DHCP enabled)

var2 = IPv4 static IP address, range 000.000.000.000 to 255.255.255.255

var3 = IPv4 gateway IP address, range 000.000.000.000 to 255.255.255.255

var4 = IPv6 static IP enable, range 0..1 (1 = IPv6 static IP enabled)

var5 = IPv6 static IP address, range 00:00:00:00:00 to FFFF:FFFF:FFFF:FFFF:FFFF

var6 = IPv6 DNS address, range 00:00:00:00:00 to FFFF:FFFF:FFFF:FFFF:FFFF

var7 = HTTPS enable, range 0..0 (1 = HTTPS enabled)

var8 = HTTP webserver port number, range 0..10000

var9 = HTTPS webserver port number, range 0..10000

### Set Telnet parameter command

The set Telnet parameter command allows the Telnet system to be configured, the format being:

**setup.html?id=setup\_telnet&username=var1&password=var2**

Where:

var1 = Telnet username, range 1..20 characters

var2 = Telnet password, range 1..20 characters

### Set SNMP parameter command

The set SNMP parameter command allows the SNMP system to be configured, the format being:

**setup.html?id=setup\_snmp&readcomm\_1=var1&readcomm\_2=var2&readcomm\_3=var3&writecomm\_1=var4&writecomm\_2=var5&writecomm\_3=var6**

Where:

var1 = Read community 1, range 1..50 characters

var2 = Read community 2, range 1..50 characters

var3 = Read community 3, range 1..50 characters

var4 = Write community 1, range 1..50 characters

var5 = Write community 2, range 1..50 characters

var6 = Write community 3, range 1..50 characters

## Set logging parameter command

The set logging parameter command allows the logging/alarm system to be configured, the format being:

```
setup.html?id=setup_logging&emailenable=var1&emailexchangeenable=var2&emailsecureenable=var3&emailserver=var4&emailport=var5&emailuser=var6&emailpassword=var7&emailfrom=var8&emailto=var9&syslogenable=var10&syslogserver=var11&syslogport=var12&trap1enable=var13&trap1destination=var14&trap1community=var15&trap2enable=var16&trap2destination=var17&trap2community=var18&trap3enable=var19&trap3destination=var20&trap3community=var21&autologgingperiod=var22
```

Where:

var1 = Email alarms enable, range 0..1 (1 = Email enabled)  
var2 = Email exchange server enable, range 0..1 (1 = Email exchange server enabled)  
var3 = Email secure server enable, range 0..1 (1 = Email secure server enabled)  
var4 = Email server name, range 1..50 characters  
var5 = Email server port number, range 0..10000  
var6 = Email server username, range 1..50 characters  
var7 = Email server password, range 1..50 characters  
var8 = Email from address, range 1..50 characters  
var9 = Email to address, range 1..50 characters  
var10 = SysLog alarms enable, range 0..1 (1 = SysLog enabled)  
var11 = SysLog server name, range 1..50 characters  
var12 = SysLog server port number, range 0..10000  
var13 = SNMP trap destination 1 enable, range 0..1 (1 = Destination enabled)  
var14 = SNMP destination 1 IP address, range 000.000.000.000 to 255.255.255.255  
var15 = SNMP destination 1 community name, range 1..50 characters  
var16 = SNMP trap destination 2 enable, range 0..1 (1 = Destination enabled)  
var17 = SNMP destination 2 IP address, range 000.000.000.000 to 255.255.255.255  
var18 = SNMP destination 2 community name, range 1..50 characters  
var19 = SNMP trap destination 3 enable, range 0..1 (1 = Destination enabled)  
var20 = SNMP destination 3 IP address, range 000.000.000.000 to 255.255.255.255  
var21 = SNMP destination 3 community name, range 1..50 characters  
var22 = Auto logging period, range 1..1000 minutes (0 = off)

### Set user configuration command

The set user configuration command allows a users level, username, password and user rights to be configured, the format being:

**config.html?id=config\_users&slot=var1&level=var2&username=var3&password=var4&newpass=var5&conpass=var6&userrights=var7**

Where:

var1 = Slot, range 1..20 (user slot to change)  
var2 = Level, range 0..3 (0 = None, 1 = User, 2 = Administrator, 3 = Factory)  
var3 = Username, range 1..40 characters  
var4 = Current password or new for creation, range 1..40 characters  
var5 = New password, range 1..40 characters  
var6 = New password confirmation, range 1..40 characters  
var7 = Userrights, range 0x0000..0x0F00 as follows:

0x0001	Sockets 1..4
0x0002	Sockets 5..8
0x0004	Sockets 9..12
0x0008	Sockets 13..16
0x0010	Sockets 17..20
0x0020	Sockets 21..24
0x0040	Sockets 25..28
0x0080	Sockets 29..32
0x0100	Sockets 33..36
0x0200	Sockets 37..40
0x0400	Sockets 41..44
0x0800	Sockets 45..48

Example, to configure user access to sockets 9..12 and 17..20 = 0x0004 + 0x0010 = 0x0014

### Delete user configuration command

The delete user configuration command allows a user to be deleted, the format being:

**config.html?id=delete\_users&slot=var1&username=var2&password=var3**

Where:

var1 = Slot, range 1..20 (user slot to delete)  
var2 = Username, range 1..40 characters  
var3 = Current password, range 1..40 characters

### Default configuration command

The system can be defaulted back to factory configuration, the format being:

`config.html?id=setup_default`

# Appendix F. Email and Syslog alarm message formats

## Outgoing messages

### Email message

The PDU-SNMP compiles and sends an alarm email to a set of up to five [5] pre-defined email addresses as an asynchronous response to changes in system alarm status. The email takes the following format:

**Customer:** {Customer}  
**Location:** {Location}  
**Cabinet ID:** {CabinetID}  
**Date:** [Date]  
**Time:** [Time]  
**SlaveID:** [SlaveID]  
**Message:** [Status]  
**Firmware:** <Firmware\_Version>

Format description:

< > parameters are factory programmed.

{ } parameters are programmable via the internal webserver.

[ ] values are from internal registers.

Parameter: {Customer}  
Description: Customer name text  
Format: Variable length ASCII string, range 0 to 40 characters

Parameter: {Location}  
Description: Location text  
Format: Variable length ASCII string, range 0 to 40 characters

Parameter: {CabinetID}  
Description: CabinetID text  
Format: Variable length ASCII string, range 0 to 40 characters

Parameter: [Date]  
Description: Current date text.  
Format: Variable length ASCII string, format DD/MM/YY eg. 10/04/18

Parameter: [Time]  
Description: Current time text.  
Format: Variable length ASCII string, format HH:MM eg. 10:45

Parameter: [SlaveID]  
Description: Slave address value  
Format: Variable length ASCII string, format SS eg. 01



Parameter: [Status]  
Description: Human readable status text.  
Format: Variable length ASCII string.

Value:

Value	Description	Sent
Starting	PDU-SNMP starting log	On Power-up
Periodic	Periodic log	Every {Auto log period} minutes
Alarm:	Alarm message	On configured alarm event

Parameter: <Firmware\_Version>  
Description: System firmware version.  
Format: 5 decimal digits, range 0.00.00 to 9.99.99.

### SysLog (RFC5424) message

The system compiles and sends an alarm Syslog message to a pre-defined web address as an asynchronous response to changes in alarm status. The message takes the following format:

**<9>1 [Date]T[Time] {IP\_Address} PDU 0000 Customer:{Customer} Location:{Location}  
CabinetID:{CabinetID} SlaveID:[SlaveID] Message:[Status] Firmware:<Firmware\_Version>**

Format description:

- < > parameters are factory programmed.
- { } parameters are programmable via the internal webserver.
- [ ] values are from internal registers.

Parameter: <9>1  
Description: Syslog RFC5424 facility code = 1 & severity = 0 or 1

Parameter: [Date]  
Description: Current date text.  
Format: Variable length ASCII string, format YYYY-MM-DD eg. 2014-08-15

Parameter: [Time]  
Description: Current time text.  
Format: Variable length ASCII string, format HH:MM:SS eg. 10:46:36

Parameter: {IP\_Address}  
Description: Currently configured IP address  
Format: 4 decimal values of 0 to 255 separated by full stops, range 0.0.0.0 to 255.255.255.255

Parameter: {Customer}  
Description: Customer name text  
Format: Variable length ASCII string, range 0 to 40 characters

Parameter: {Location}  
Description: Location text  
Format: Variable length ASCII string, range 0 to 40 characters

Parameter: {CabinetID}  
Description: CabinetID text  
Format: Variable length ASCII string, range 0 to 40 characters

Parameter: [SlaveID]  
Description: Slave address value  
Format: Variable length ASCII string, format SS eg. 01

Parameter: [Status]  
Description: Human readable status text.  
Format: Variable length ASCII string.

Value:

Value	Description	Sent
Starting	PDU-SNMP starting log	On Power-up
Periodic	Periodic log	Every {Auto log period} minutes
Alarm:	Alarm message	On configured alarm event

Parameter: <Firmware\_Version>  
Description: System firmware version.  
Format: 5 decimal digits, range 0.00.00 to 9.99.99.

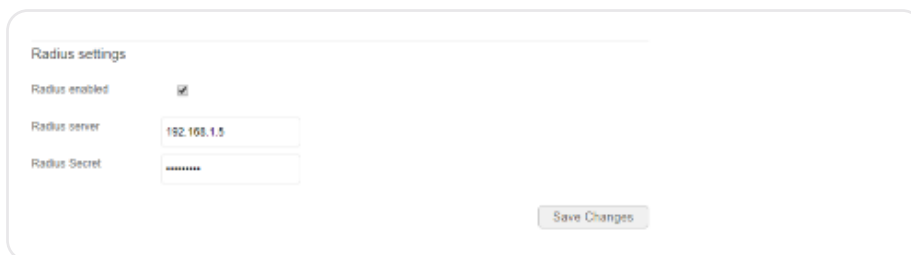
# Appendix G. RADIUS Client description

## RADIUS Client service

The PDU can provide a RADIUS client service that allows a user to be verified and authorised by an internal/external RADIUS server.

### RADIUS Configuration

The HTTP service provides a RADIUS configuration option under the 'Configuration' tab settings. The option allows the RADIUS Server IP or DNS address to entered, the Shared secret entered and RADIUS authentication to be enabled as follows:



The screenshot shows a web-based configuration form titled "Radius settings". It contains three input fields: "Radius enabled" with a checked checkbox, "Radius server" with the text "192.168.1.5", and "Radius Secret" with a masked password "\*\*\*\*\*". A "Save Changes" button is located at the bottom right of the form.

The RADIUS Server must be an active reachable IP or DNS address that has been pre-configured with the user information, the PDU's IP address and shared secret.

As an example to add a PDU IP address of 192.168.1.42 and the default shared secret 'pdusnmp' to a FreeRADIUS server you must edit the /etc/raddb/clients.conf file on the server to add the following:

```
client pdusnmp {  
    ipaddr      = 192.168.1.42  
    secret      = pdusnmp  
}
```

Then to add a new user 'charlie' with password 'brown' and user level administrator ("1"-User, "2"-Administrator "3"-Factory [see below]) to the server you must edit the /etc/raddb/users file on the server to add the following:

```
charlie    Cleartext-password := "brown"  
          Class = "2"
```

The server must then be started using the command 'radiusd -X' before login can be undertaken.

NOTE: It may be necessary to open port 1812 for RADIUS communication on the server !!

## RADIUS Login

When RADIUS has been enabled on the PDU basic authentication is disabled and replaced with RADIUS Server authentication. This means that any HTTP requests for web pages within the server are always replaced with a login page until the RADIUS authentication process has been completed successfully. The initial login page displayed is as follows:

The user must then enter their Username, Password and as an additional security measure the Shared secret that has been pre-configured within the PDU Configuration and RADIUS Server configuration. Clicking 'Login' will start the authentication process with the RADIUS server displaying 'CONTACTING SERVER' and after a short period the Status should change.

### RADIUS Server acceptance:

If the server accepts the user credentials the following is displayed:



The screenshot shows a web interface for RADIUS Login. On the left, under the heading "RADIUS Login", there are four input fields: "Username" with the value "chris", "Password" with masked characters, "Shared secret" with masked characters, and "Status" with the value "ACCESS-ACCEPTED". A "Login" button is located to the right of these fields. On the right side of the interface, there is a "Help" section titled "RADIUS Server Login" which contains a paragraph of text explaining the authentication requirements: "This equipment requires Username, Password and RADIUS Shared secret authentication to access other pages within the system. The user, their password and shared secret must be pre-configured on the destination RADIUS server for authentication to be possible, please contact your network administrator for further information."

After 3 seconds the page will automatically redirect to the normal ACU front page.

## RADIUS Server rejection:

If the server rejects the user credentials due to incorrect username, password or shared secret the following is displayed:

The screenshot shows a web interface for RADIUS Login. On the left, under the heading 'RADIUS Login', there are four input fields: 'Username' (containing 'baduser'), 'Password' (masked with dots), 'Shared secret' (masked with dots), and 'Status' (displaying 'ACCESS REJECTED' in red). To the right of these fields is a 'Login' button. On the right side of the interface, there is a 'Help' section titled 'RADIUS Server Login' which contains a paragraph of text explaining the requirements for successful authentication.

In this case correct the credentials and check that the shared secret is the same on the RADIUS server as it is on the PDU and click 'Login' again.

## RADIUS Server failed:

If the server request times out twice or some internal process fails the following is displayed:

The screenshot shows the same RADIUS Login interface. The 'Status' field now displays 'REQUEST FAILED' in red. The 'Username' field contains 'client', the 'Password' and 'Shared secret' fields are masked, and the 'Login' button remains visible. The 'Help' section on the right is identical to the previous screenshot.

In this case the RADIUS server status should be determined to ensure that it is running and 'Login' clicked again to re-try.

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