POWEROPTIMAL

THE FUTURE OF ENERGY

POWERGUARD

PowerGuard Commercial Range User Manual

Version number:	1.5
Author(s):	Dr. Sean Moolman
	Mr. Johan Theron
General contact:	sean.moolman@poweroptimal.com
	082 788 1615
Technical contact:	johan.theron@poweroptimal.com
	083 600 1827
Address:	PO Box 39521
	Capricorn Square
	7948
	Cape Town

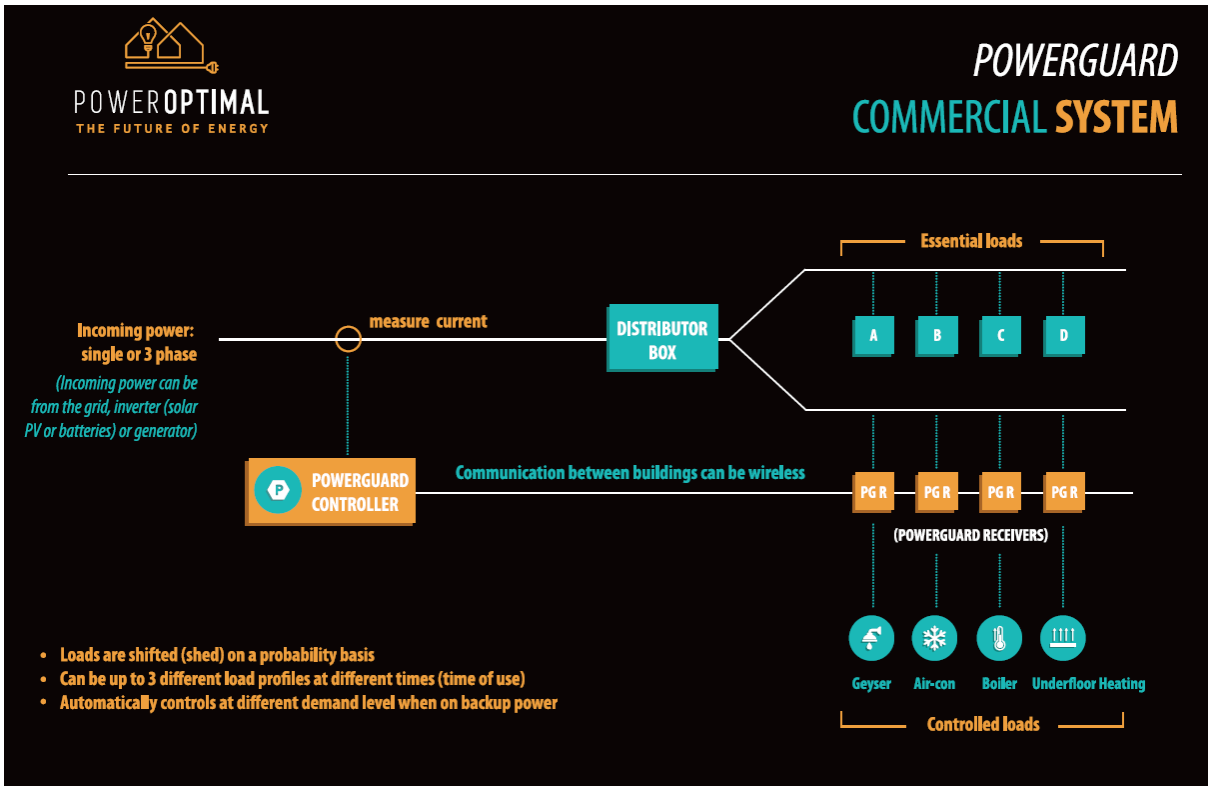
Table of Contents

1. PowerGuard unit operation

The PowerGuard system is fully automated and has been designed to require no user intervention.

1.1 System operation

The below simplified diagram shows how the PowerGuard system is connected to a facility's electrical system.



The PowerGuard Controller measures the total incoming current using current transformers installed on the incoming power line(s) (either single phase or 3 phase). It also measures the average voltage on the incoming power line(s).

Based on the measured current and voltage values, the Controller calculates the power demand (in kVA) for the facility. This value (total power demand of the facility) is displayed on the LCD screen.

a. Normal operation

Based on the preset **control level**, the PowerGuard Controller will start sending out **shed requests** to all the Receivers (PG R in the diagram). Each Receiver has its own pre-set settings that determine how it will respond to the controller – specifically, how regularly it should switch off (probability of responding), for how long it should switch off, and for how long after a previous switch-off it should not switch off again (see Section 1.4).

The Controller will continue to send shed requests until the power demand stabilises at a level below the control level.

This simple configuration allows a lot of flexibility in how the facility can be managed, and effectively distributes switch-off of loads across the facility in a balanced manner. (However, it is not necessary to change ANY settings once the system has been commissioned and configured by PowerOptimal. The overall **control level** can be changed if there are substantial changes to occupancy or circumstances, but no other settings need to be changed.)

The facility can be controlled either at a maximum current value (A) or a maximum demand value (kVA). This setting is found on the Controller (see Section 1.3). Whether it is controlled at maximum current value or maximum demand value is determined by the main purpose of the system – i.e. is it to (i) alleviate power supply constraints, or (ii) reduce demand charges. **Note:** this setting is typically only configured once (during installation) by PowerOptimal, and there is no need to change it.

(i) Power supply constraints – control at maximum current (A)

If the facility has power supply constraints (e.g. experiencing power trips), control at a maximum current value is more suitable, since loads will then only be shed on the phase that requires reduction in current to avoid power trips. The online monitoring system can be used to determine whether load balancing across the phases can be improved – e.g. if one notes that a specific phase is the main or only cause of shedding, loads can be moved from that phase to another phase.

(ii) Reducing demand charges – control at maximum demand (kVA)

When demand charge (electricity cost) reduction is the main purpose of the system, then it is better to control the facility's power use on a maximum demand (kVA) basis, since this is what demand charges are calculated on by the utility / municipality.

b. Time of use settings

The system can be configured to manage at three different control levels based on input from timers: 'normal', and two time of use settings. It can also be configured to completely switch off all loads at certain times. Please speak to a PowerOptimal representative if you wish to implement any of these settings. It will require installation of one or more timers.

c. Backup power setting

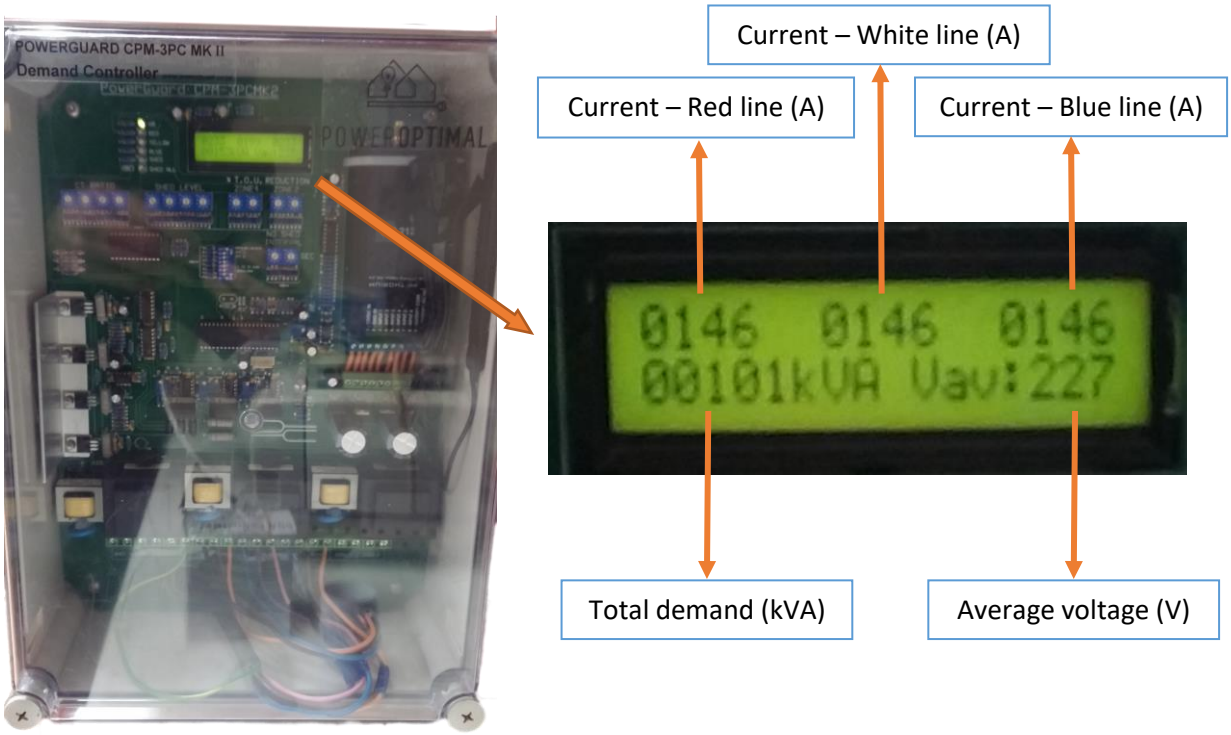
The system can be configured to automatically detect when there is a switch to backup power, and to manage at a different control level on backup power. Please speak to a PowerOptimal representative if you wish to configure the system for backup power management.

d. Power failures

When power returns after a power failure, the system will wait four minutes for the power to stabilise, and then it will systematically switch on the loads in a staggered manner, in order to avoid the cold pick-up power demand spike.

All controlled loads are protected against under- and overvoltage, and will be switched off should such an event occur.

1.2 LCD screen readout

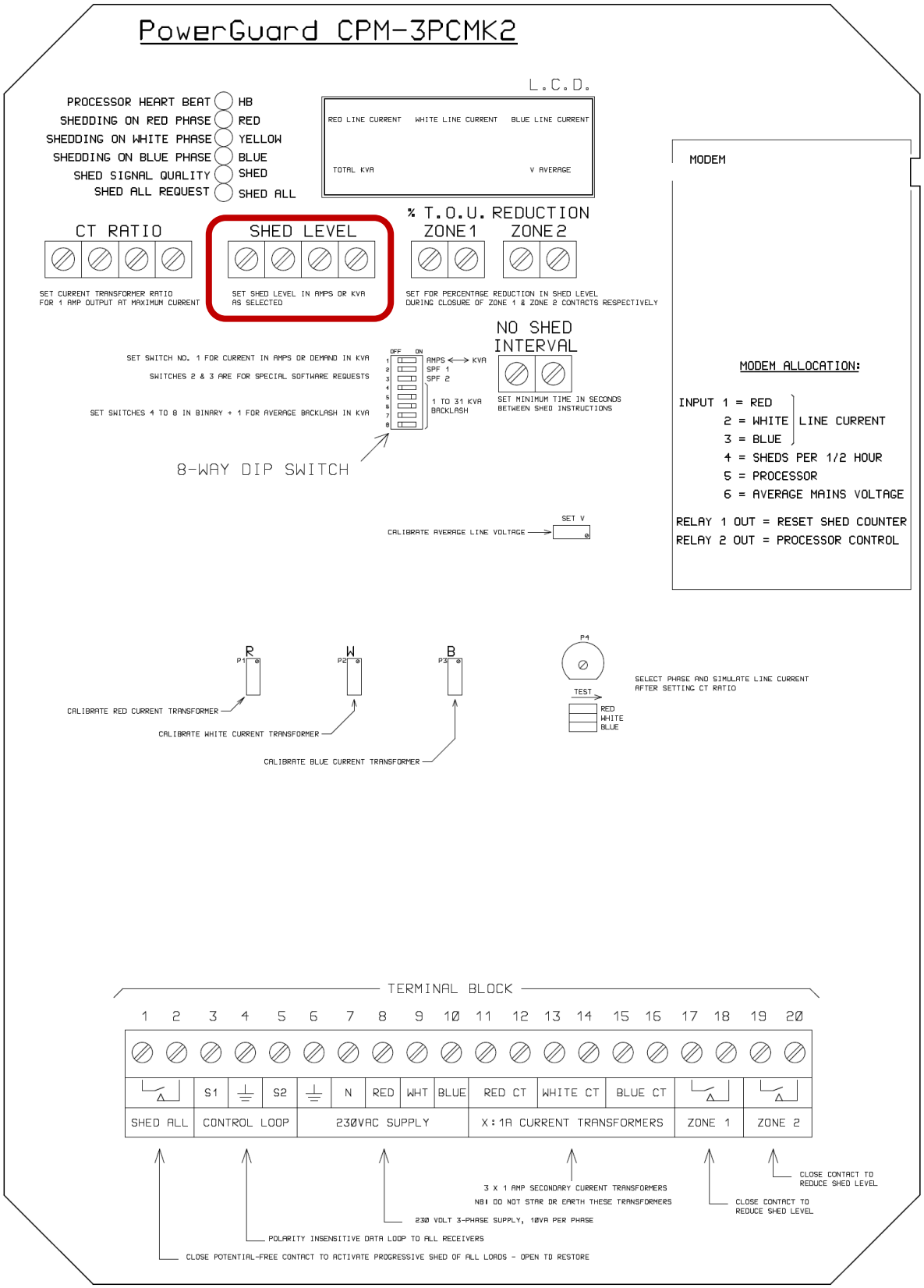


1.3 Settings on the PowerGuard Controller

On the next page is the front face of the PowerGuard Controller.

The **only setting that should be changed by the user under normal circumstances is the Shed Level (circled in red)**. Just turn the dials with a screwdriver to select the control level. The numbers read as one would a normal number (e.g. dial settings 0 – 1 – 0 – 5 would be 105 kVA or amps).

The other settings are configured during installation & commissioning and **should not be altered**.



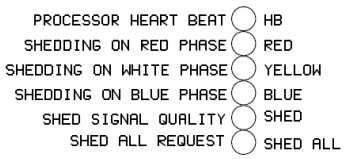
1.4 Settings on PowerGuard Receivers

See Annexure A for the front face of the CPM30-1W receiver and Annexure B for the front face of the CPM16-30 receiver. **No settings should be or need to be changed by the user**.

1.5 LED light codes / meanings

Controller

The following LED lights are present on the PowerGuard Controller for monitoring and diagnostic purposes:

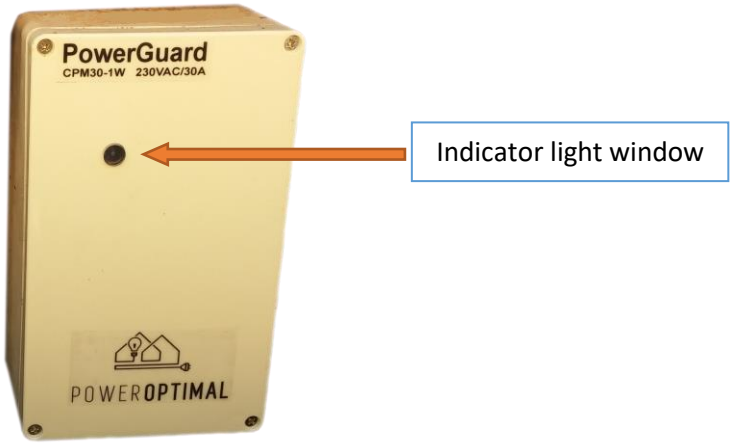


The LED lights have the following meanings:

Name	Colour	Meaning		
		On	Flashing	Off
Processor Heart Beat	Green	NA	Processor operational	Processor not operational / no power
Shedding on Red Phase	Red	NA	1 sec – in backlash range 2 sec – shed 4 sec – shed all	No shed signal being sent at specific point in time
Shedding on White Phase	Yellow	NA	1 sec – in backlash range 2 sec – shed 4 sec – shed all	No shed signal being sent at specific point in time
Shedding on Blue Phase	Blue	NA	1 sec – in backlash range 2 sec – shed 4 sec – shed all	No shed signal being sent at specific point in time
Shed Signal Quality (only indicates whilst shed signal is being sent)	Red-Green bi-colour	If both colours are visible – good signal	NA	Off or only one colour visible – poor signal / faulty condition
Shed All Request	Orange	Shed all request active	NA	NA

Receiver

The PowerGuard Single Channel Receiver (CPM30-1W) has a single small light window on the front of the cover for diagnostic purposes. The light position is indicated below.



The indicator light window indicates the following:

Colour & mode	Meaning
No light	No power
Red and blue lights	(a) Alternating – processor active / power on (b) Slow-down / temporary stop in speed or rhythm of alternating – receiving shed instruction
Green light	Power available to load

2. Online monitoring

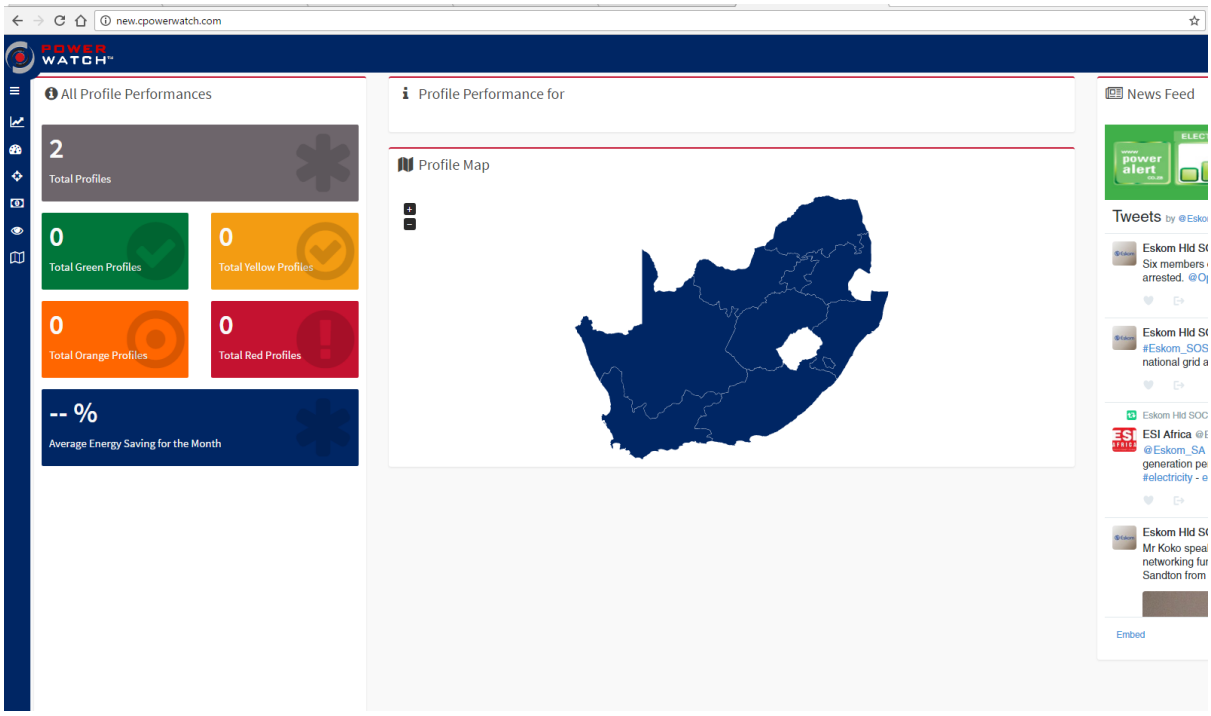
The PowerGuard system has a built-in modem and sends measurements to the PowerOptimal database every half hour. The database is accessible via Energy Cybernetics' Powerwatch front-end.

2.1 How to log in

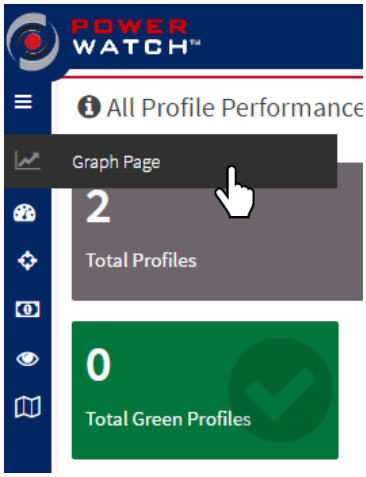
1. Go to: www.cpowerwatch.com
2. Click on the "Sign In" button at the top right of the screen.
3. Enter your username and password as provided during installation.

2.2 Landing page

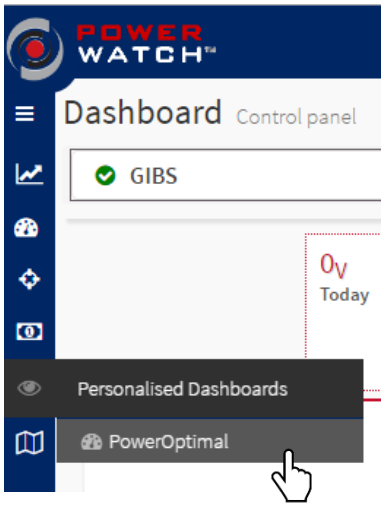
Upon login, you should see a screen similar to the below:



The blue band on the left-hand side contains the functionality for your site. If you hover over the symbols, text will appear indicating the function for that button.



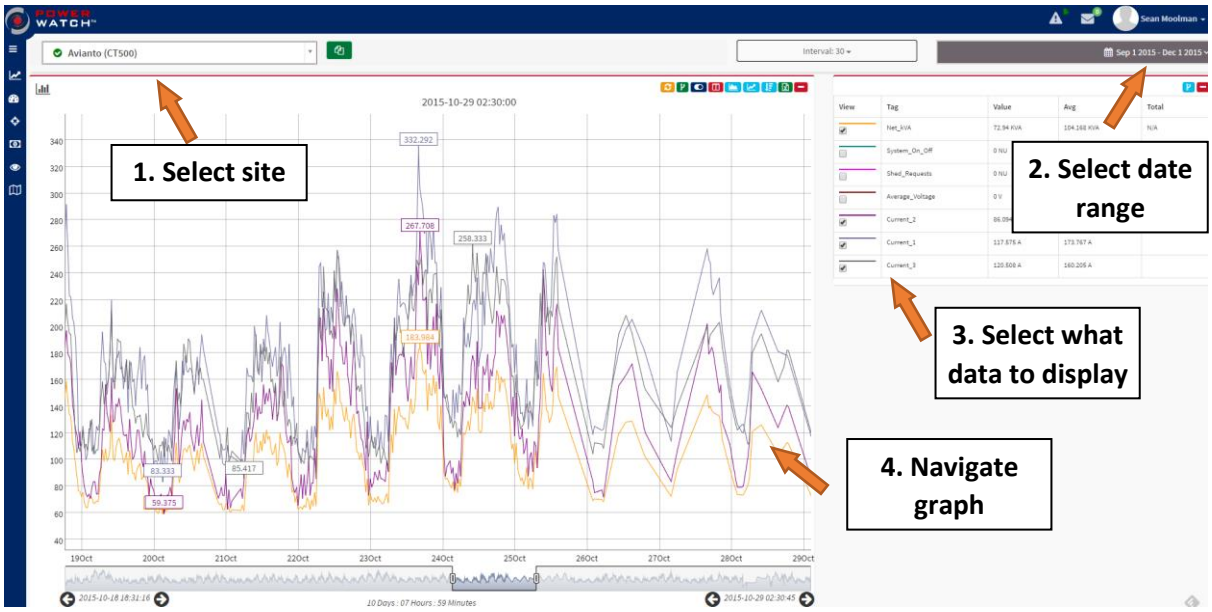
Click on the “Graph Page” button to view near-real time graphs of your system.



Click on the “Personalised Dashboard – PowerOptimal” button to view a dashboard of system performance.

2.3 How to view & interpret graphs

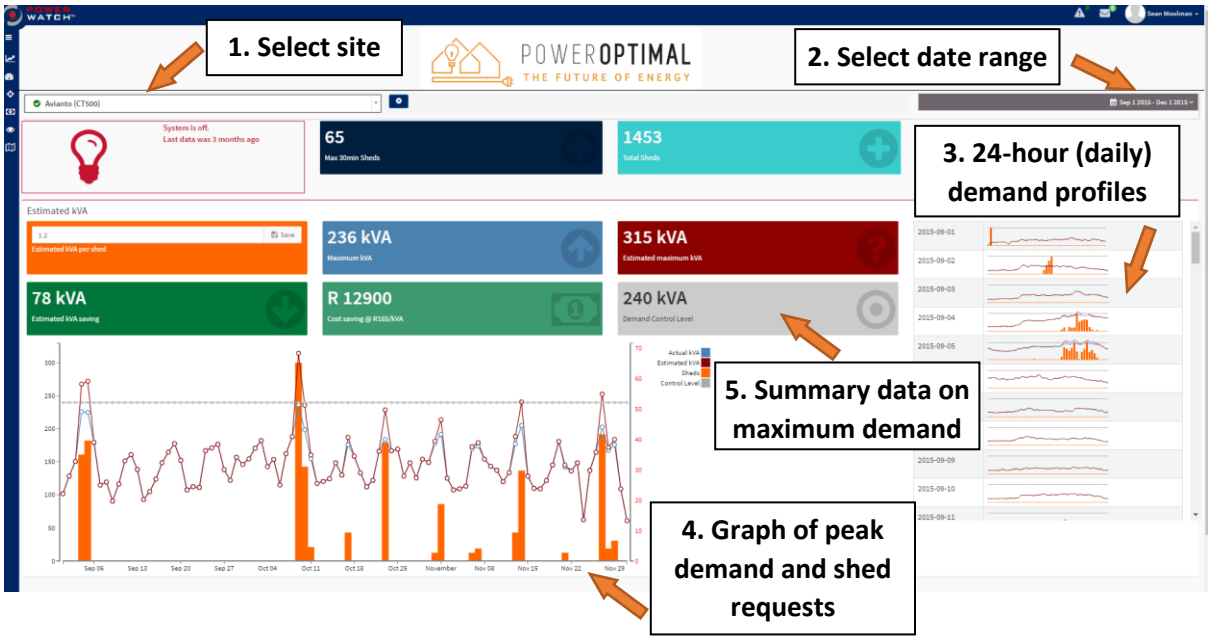
Below is a screenshot of the graph page:



1. Select your site from the drop-down list;
2. Select the date range that you want to view;
3. Select the data that you want to display on the graph;
4. You can navigate the graph in several ways. For example, you can hover over a data point to see the values at that time. You can select a date range on the graph itself by clicking anywhere on the graph and keeping the mouse button pressed whilst moving the mouse horizontally across the graph. You can also drag the bottom date selection left and right to view other / different dates.

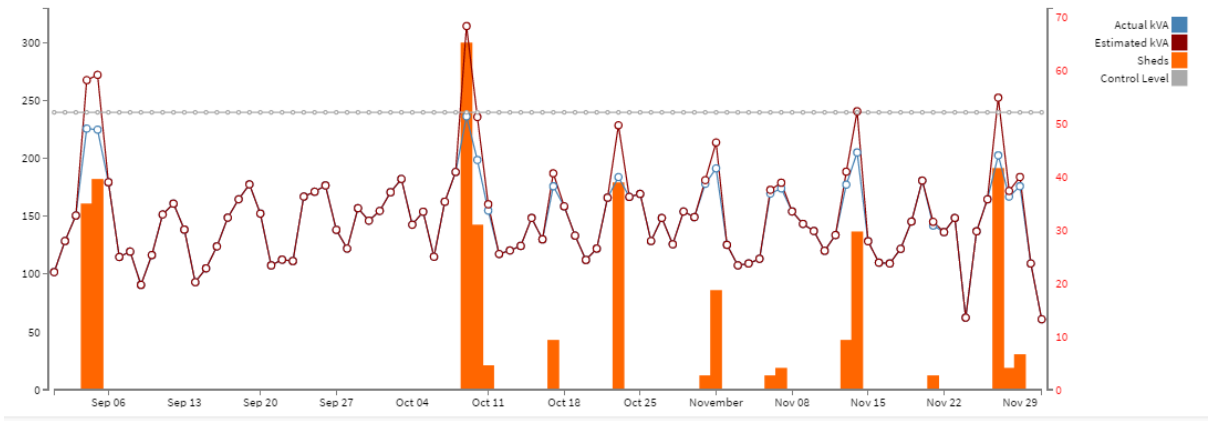
2.4 How to view & interpret the dashboard

Below is a screenshot of the dashboard page:



1. Select your site from the drop-down list;
2. Select the date range that you want to view;
3. You can see a set of 24-hour demand profiles and shed requests on the right-hand side.
4. Bottom left is the graph for the selected date range, showing the highest number of sheds in a 30-minute period for the day, as well as the highest demand (in kVA) for the day.
5. The boxes in the middle indicate the maximum kVA and estimated savings for the selected date range. (**Note:** maximum demand charge is applied once per billing period, so to see the estimated savings for a specific billing period, use the start and end date of that billing period as the date range.)

Below is a close-up of the above graph:



The orange columns indicate the highest number of shed requests in any 30 minute period on the specific date (with values on the right vertical axis), whilst the lines indicate the highest actual (blue) and estimated (dark red) kVA values for the specific date. The grey horizontal line indicates the control level of the PowerGuard unit.

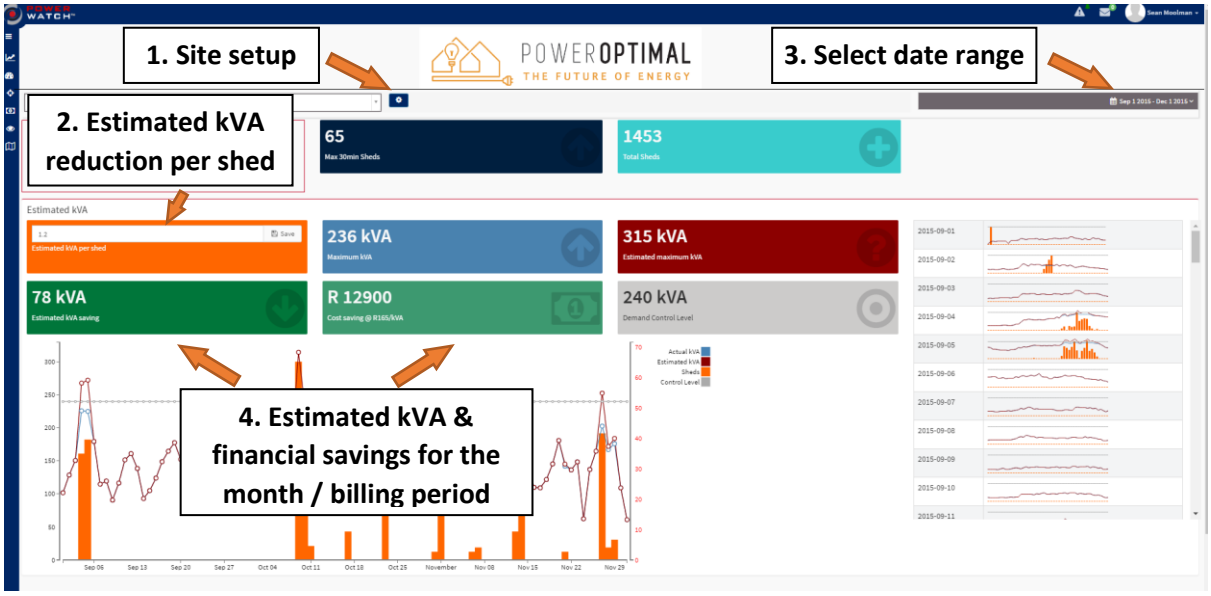
You can hover over the graph to see specific values.

This graph and the small daily graphs on the right makes it easy to see the functioning of the PowerGuard system and provides a ready overview of the total demand of your facility. As the total demand approaches the peak demand level, the system starts to shed in order to maintain overall demand below the peak level.

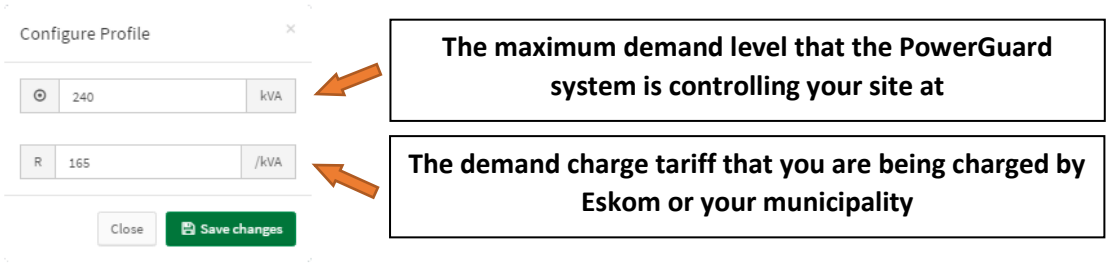
The difference between the “Actual kVA” and “Estimated kVA” lines is the estimated kVA reduction achieved by the PowerGuard system on that day.

2.5 Estimated monthly savings

You can use the PowerOptimal Dashboard (discussed in Section 2.3) to obtain an estimate of the monthly savings achieved through the use of PowerGuard.



1. Click on the gear icon and check that the data is correctly configured for your site:



2. Check the estimated kVA reduction per shed request for your site. **Note:** This value is configured by PowerOptimal during the initial commissioning and calibration of the system. You don't need to change this number.
3. Set the date range that you wish to look at (**you should preferably set the date range to coincide with the billing date range on your electricity bill**).
4. Now you can read off the estimated savings in kVA and rands for the specific date range (billing period)!

3. Basic troubleshooting

Below is a table with basic troubleshooting tips. If you cannot resolve the problem using the below table, please contact your electrician or give us a call!

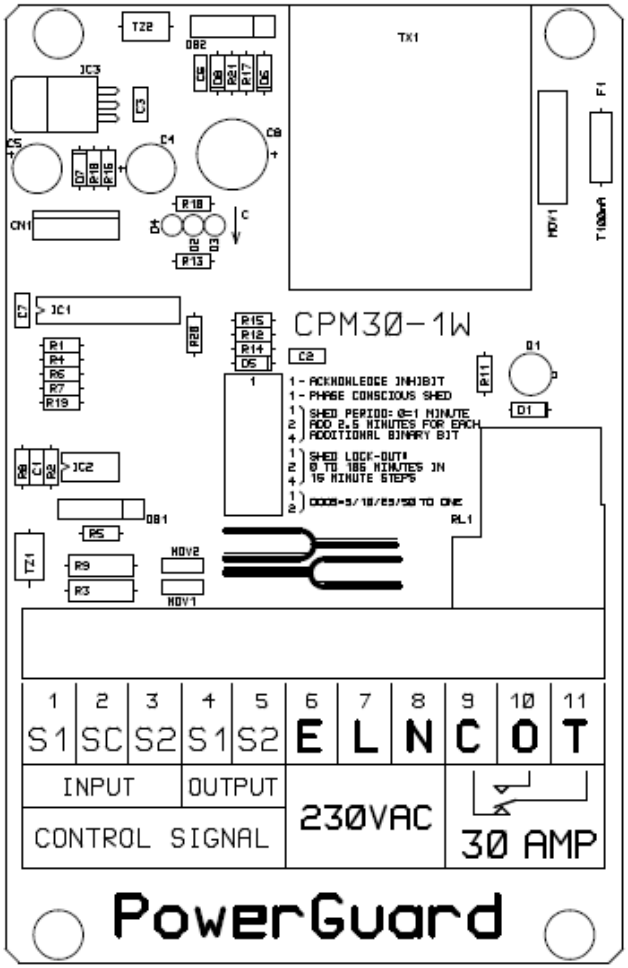
Issue	Possible causes	What to do
Water from the hot water tap is cold.	a. Geyser problem b. PowerGuard control level is set too low.	a. Call electrician to fix the geyser b. Increase PowerGuard control level on the Controller (see Section 1.3)
Air conditioner does not switch on again after a shed	The air conditioner has not been configured to switch on after a shed, or someone has changed the air conditioner settings.	See your air conditioner manual on how to change the settings to switch on automatically when power is returned.
I cannot log in on the PowerWatch online monitoring site.	Incorrect username and password.	Please check your username and password, or contact PowerOptimal for assistance.
We have unusually high activity at our facility, and I want to increase the maximum demand level.		Increase PowerGuard control level on the Controller (see Section 1.3)
Demand peak has increased – shed instructions seem not to have effect on peak demand level (loss of control)	Possible communication problem between controller and receivers	At a quiet time, reduce the PowerGuard control level on the controller to a very low level, and confirm reception of shed signal on each receiver as indicated by blue-red LED on the receiver slowing down its speed of flashing.

Troubleshooting the online monitoring graphs

Issue	Possible causes	What to do
System is not on air	1. Hardware disconnected (no power to PowerGuard controller) 2. SIM card off air 3. Modem faulty 4. Software problem (database / online monitoring software)	Wait for two hours and log in again. If problem persists: 1. Check if power is on at controller, and if the controller is functioning (see Section 1.5). 2. Call PowerOptimal to remotely test the modem, check if sim card is loaded and check the back-end software.
Gaps in data	1. Cell phone network problems 2. SIM card problems	If the gaps occur repeatedly, contact PowerOptimal to check SIM card.

Strange patterns / behaviour (e.g. very high shed activity for a long period; no shed activity over a few weeks / month; demand exceeds control level)	1. Change in electricity use (e.g. change in occupancy, behaviour, expansion of the facility, etc.) 2. Someone has changed the peak demand level control setting on the controller. 3. Communication problems between controller and receivers. 4. Faulty controller / receiver.	1. First check whether the controller is functioning (see Section 1.5), and whether it is still set at the correct peak demand control level (see Section 1.3). 2. Check communication between controller and receivers by (at a quiet time) reducing the PowerGuard control level on the controller to a very low level, and confirming reception of shed signal on each receiver as indicated by blue-red LED on the receiver slowing down its speed of flashing.

Appendix A. Front face of PowerGuard CPM30-1W Single Channel Receiver



TERMINAL ASSIGNMENT

1 = S1
2 = SCREEN
3 = S2

INCOMING CONTROL SIGNAL

Connect S1 & S2 to the control signal cable from the Demand Controller with the screen to terminal 2. This terminal is internally connected to earth. S1 & S2 are not polarity conscious

4 = S1
5 = S2

OUTGOING CONTROL SIGNAL

Terminals 4 & 5 connect to the outgoing control cable. These connections are not polarity conscious

6 = EARTH
7 = LINE
8 = NEUTRAL

POWER

Connect EARTH to pin 6, 230 Volt LINE to 7 and NEUTRAL to pin 8. Use the same line phase as that of the load to be controlled

9 = CLOSED
10 = OPEN
11 = COMMON

RELAY

The relay is ENERGISED to OPERATE the load. Normally CLOSED contacts on terminals 9 & 11, Normally OPEN contacts on terminals 10 & 11,

Appendix B. Front face of CPM16-30 16-Channel Receiver