



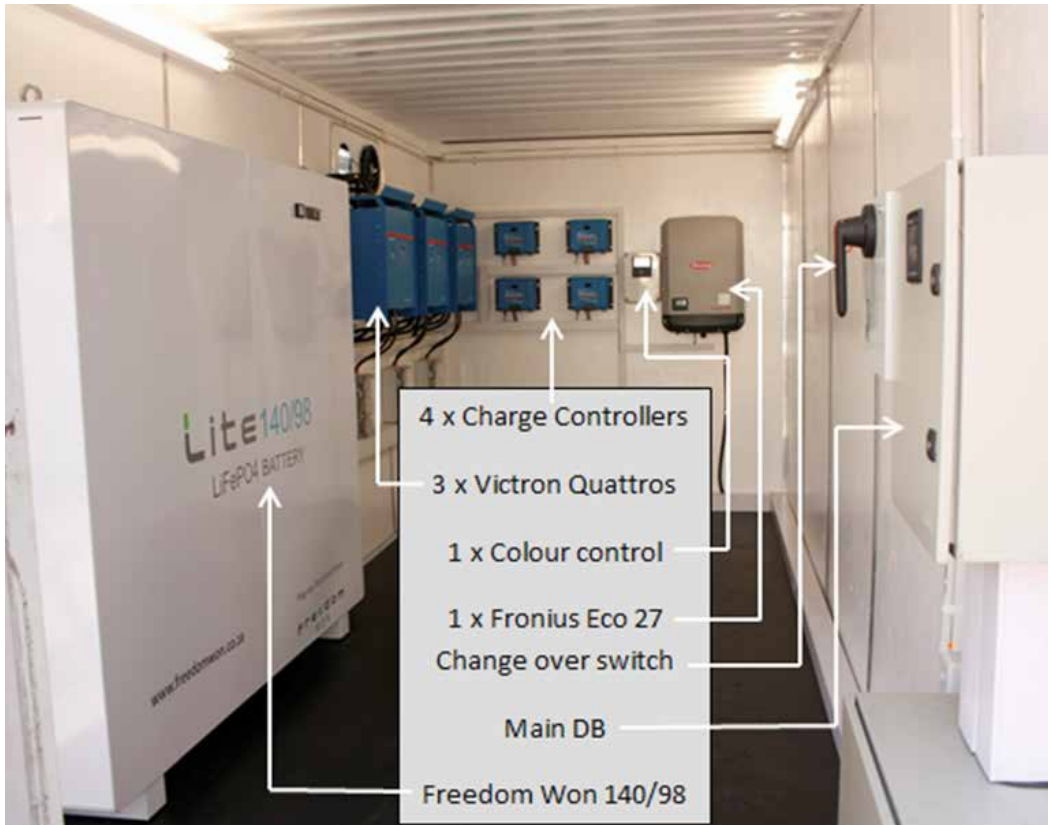
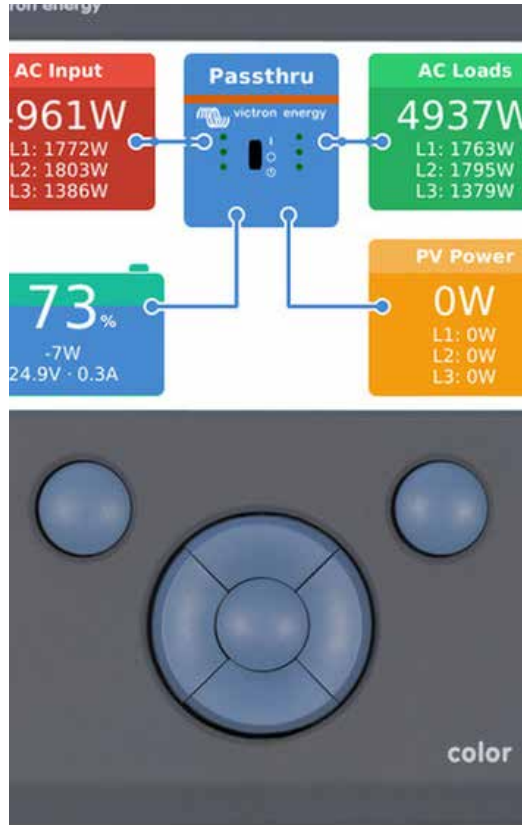
Magashi

Power Plant Manual 2019

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SOLAR PANEL ARRAY

145 X GCL 330W

- First row, 60 panels on a 4 x Victron MPPT 250/100 charge controllers.
- Second row, 85 panels on a Fronius Eco 27.

VICTRON

COLOUR CONTROL GX

- The central control of the system shows the contribution and status of each source of power.
- Communicates with the Victron VRM portal.

FREEDOM WON

140/98 LiFeP04 BATTERY



DEEP SEA ELECTRONICS

- Generator controller, default position should be on Auto.



GENERATOR CHECKS

- Make sure the genset controller is in auto mode.
- Make sure the fuel, oil and coolant levels are correct.
- Check for any fluid leaks.
- Make sure the starter battery volt is around 13.5V.
- Check the vee belt tension and condition it must be in good working order.
- Check to see if alarm light is on, if on investigate and solve.
- Consult generator manual for additional details.

PERKINS GENERATOR

60kVa, 3 phase

Engine model: Perkins 1103A-33TGC

Alternator end: Leroy Somer model # TAL 0428

- Normally left in “Auto Mode” on the controller.
- The generator can be automatically started by a signal from the colour control, based on the battery state of charge (SOC) to prevent deep discharge of the battery.



SOLAR PANEL ARRAY CHECKS

- Make sure all the PV panels are clean.
- If dusty clean with a damp cloth and dry.
- Do not leave water to dry on the panels.
- Remove any animal droppings from the panels.



SOLAR ARRAY TOP

Monthly check and maintenance

- Check the cleanliness of all PV panels.
- If dusty clean with a clean damp cloth and dry.
- Record the energy yield readings from the colour control on the VRM Portal.
- Make sure the total energy yield of the inverters corresponds with the solar power meter.



SOLAR ARRAY UNDERNEATH

- Make sure no weeds or bushes are growing under the array cut them back if need be.
- Remove ant nests.
- Check all cabling, make sure the cables are not loose and the cable ties are not broken.
- Check to see if there is any shading on the array from trees or bushes, trim as needed.
- Check surge protection in the combiner boxes. Refer to the combiner box page.



VICTRON
250/100 MPPT



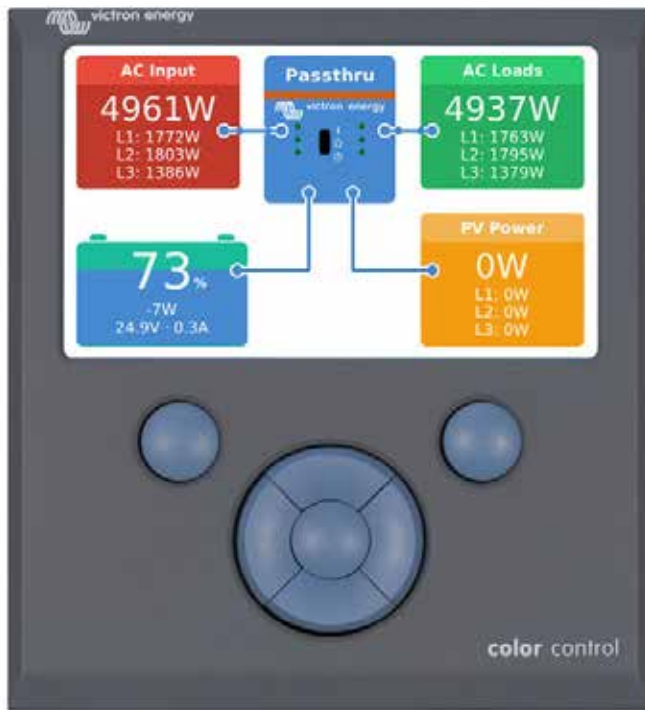
VICTRON 250/100 MPPT
CHARGE CONTROLLERS

- The charge controllers are connected to the first (shorter) row of 60 panels.
- There are 3 strings of 5 panels attached to each controller (15 panels per controller).
- The charge controllers produce DC current and are connected directly to the batteries and will charge them as long there is sun on the array.



VICTRON 15kVa QUATTRO'S

- The Quattro's are bi-directional inverter chargers. The three of them are synchronised to provide three phase power.
- The Quattro's are powered by the battery and produce AC voltage from the DC supply.
- This AC voltage provides the AC bus that the Fronius requires.
- When there is an excess of AC power, the Quattro's will use it to charge the batteries.
- Where there is a deficit or overnight, the Quattro's will draw power from the batteries to supply the AC power used by the camp.



VICTRON COLOUR CONTROL
DISPLAY SCREEN

- Check the daily solar yield, consumption and generator contribution on the Victron VRM portal.
- Make sure the SOC (state of charge) is not lower than 30%.



VICTRON COLOUR CONTROL
BACK BOARD

- Only to be opened under direction from Energenic.



DAILY OPERATION

- The unit will shut down when there is insufficient solar to feed in.
- The unit will turn on when there is sufficient solar from the array.
- The unit shuts down every night and starts up automatically every morning.
- The amount of power generated will be displayed.
- If the unit is not powered up refer to the user manual.

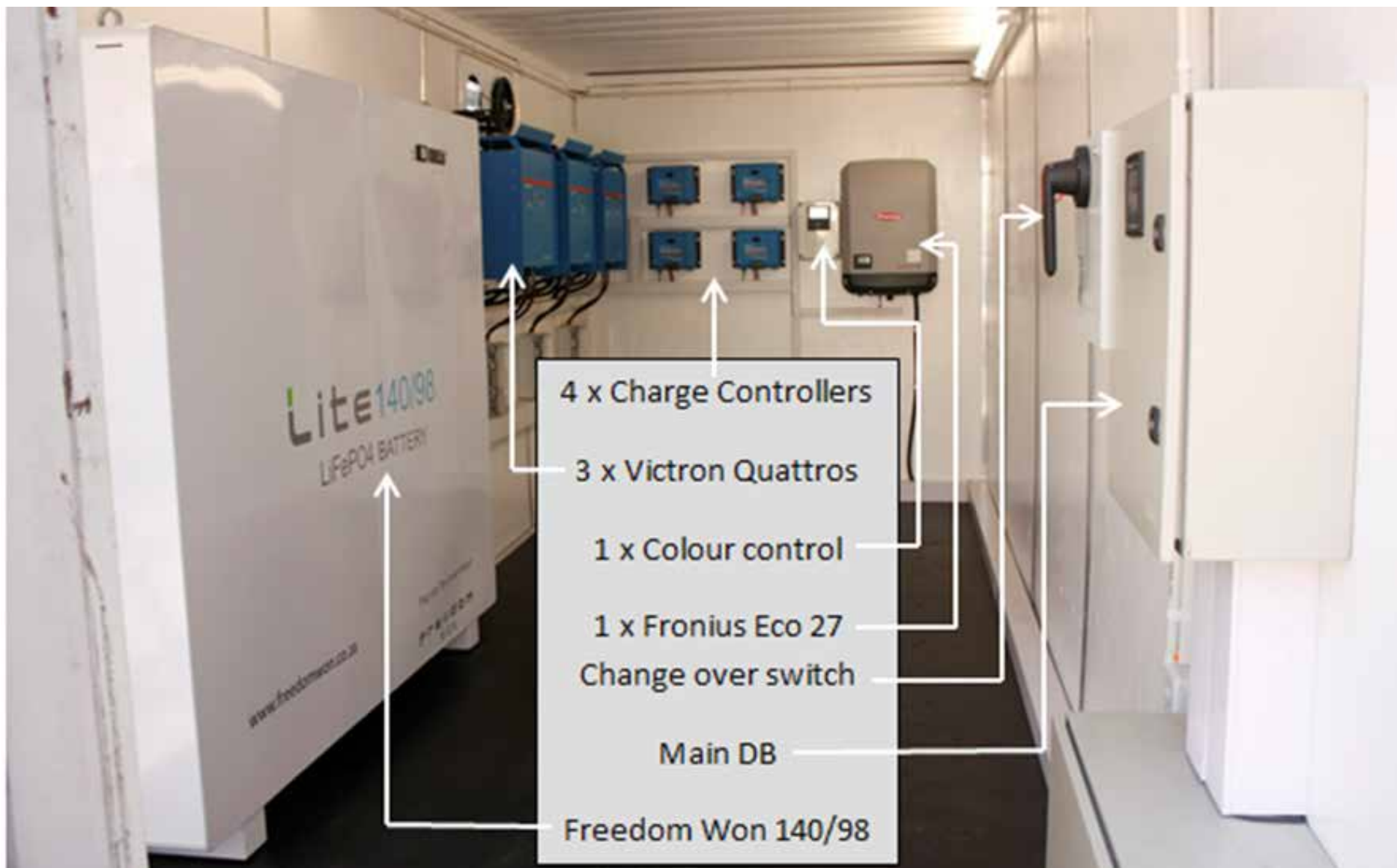
WHAT TO AVOID:

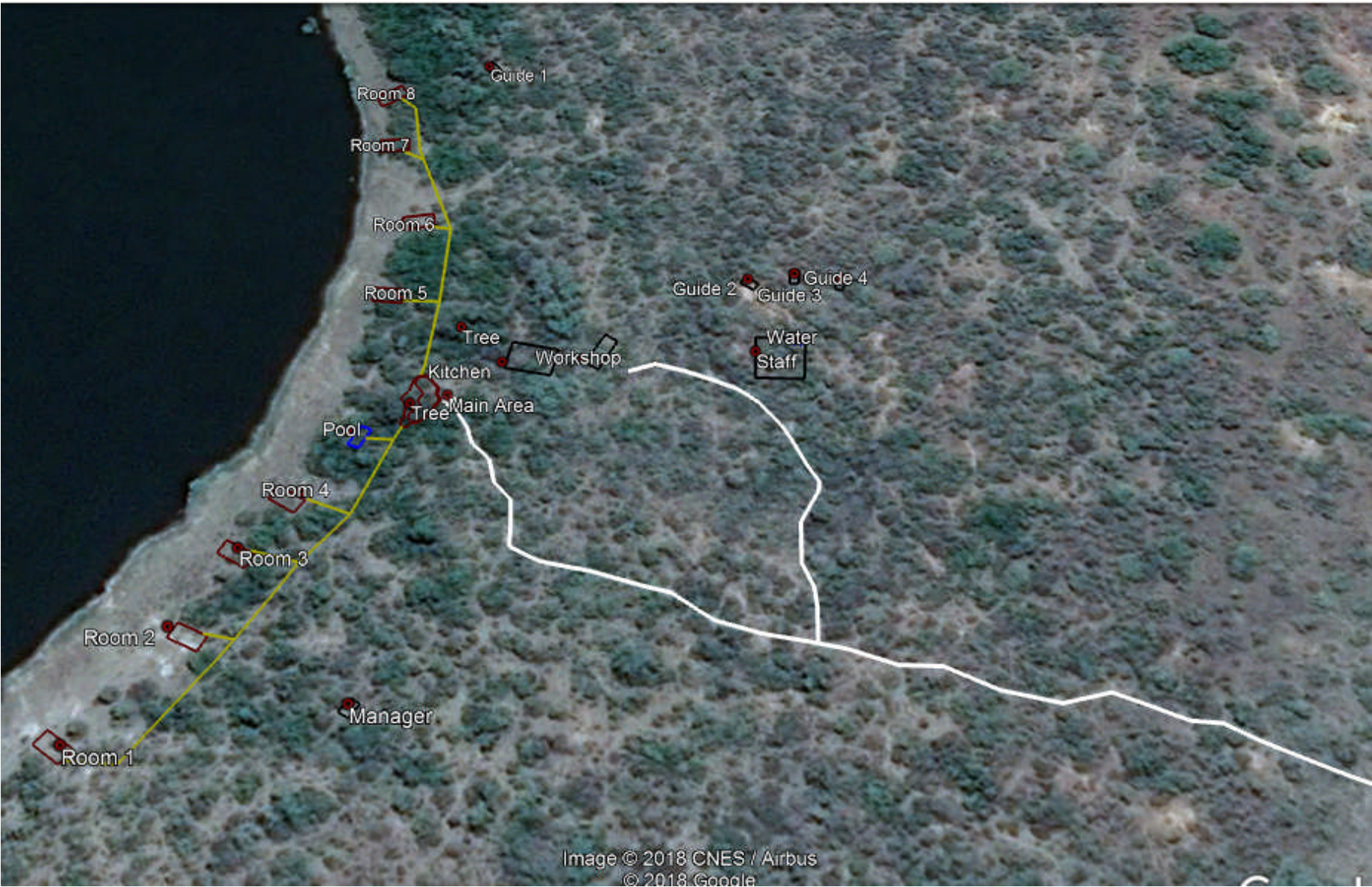
- Do not change any settings in the set-up.



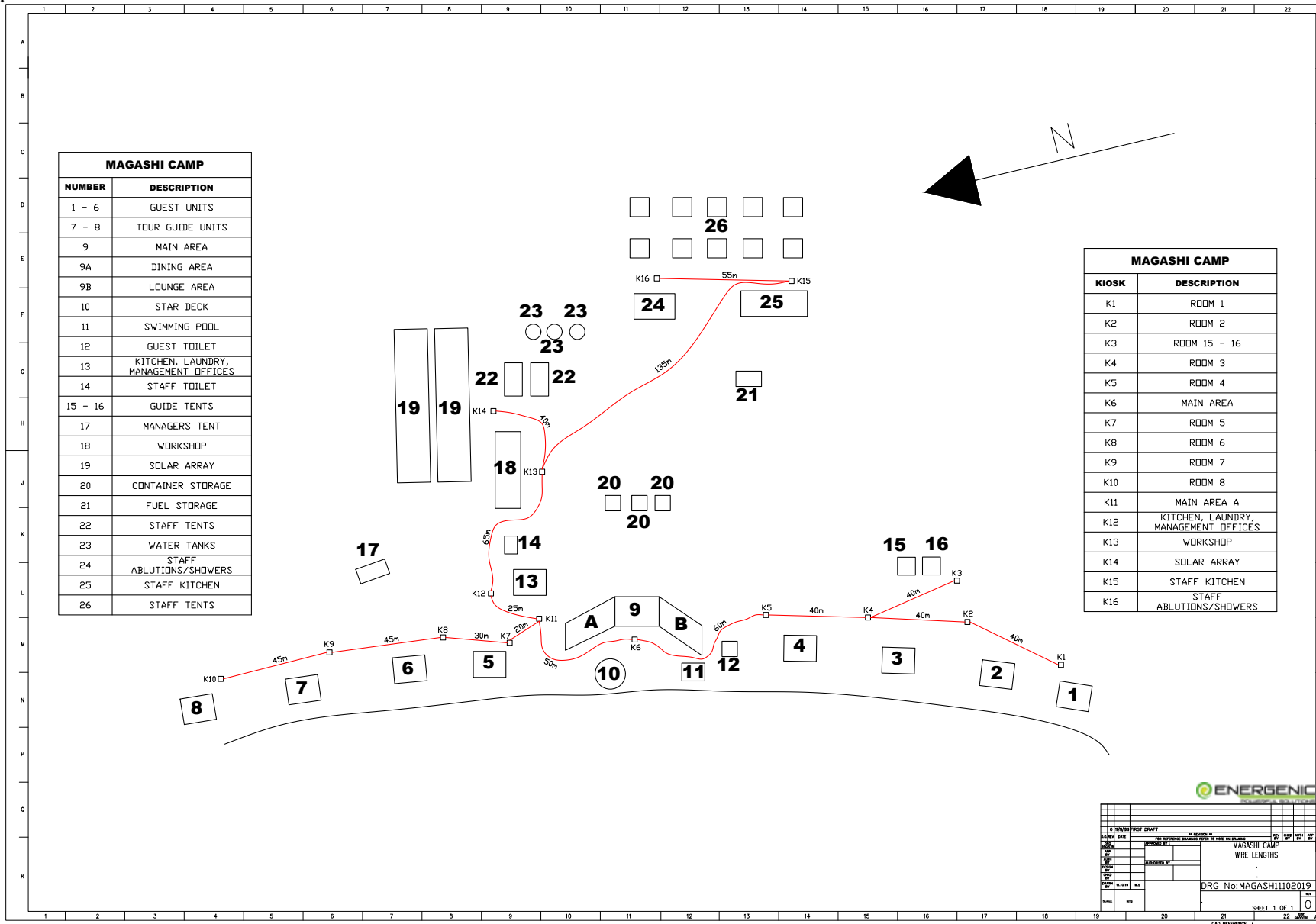
FRONIUS ECO 27 (27KW)

- The Fronius Eco 27 is a string or PV inverter and is connected to the second (longer) row of panels.
- The Fronius Eco 27 converts the output of the 85 panels to AC voltage and this goes directly to the camp loads.
- Any excess power is converted by the Victron Quattro's to DC current to charge the batteries.
- If there is no AC voltage present, the Fronius Eco 27 cannot operate.
- The Quattro's normally provide AC voltage.





MAGASHI CAMP LAYOUT MAP



MAGASHI/AKAGERA

The following Main Reticulation cabling was supplied:

- **4 Core SWA 16mm x 200M:** Room 2, kiosk to Room 1, borehole pump, plant to Staff Village
- **4 Core SWA 25mm x 450M:** Main trenches behind rooms
- **4 Core SWA 35mm x 100M:** Main DB@ plant, to kitchen to FOH (front of house) kiosk
- **2.5mm Surfex 2+ E x 450M:** Kiosks to rooms, guide 3 & 4,Mgr @ K2
- **4mm Surfex 2+ E x 75M:** Staff Village to Guide 2
- **Panel wire 10mm x 50M (Green/Yellow):** Various earthing
- **Bare Copper 16mm x 200M:** Array, and to earth rod @ kiosks, rooms

Estimated distances used in design stages before positions were locked down there may have been changes made to cable size and distances.

Staff to Guide #2:	Surfix 4mm 2+E	50M
Guide 2 to Guide:	Surfix 2.5 - 2+E	25M
Workshop to Staff Village:	SWA16/3	85M
Workshop to Kitchen:	SWA 35/4	40M
Kitchen to Main are:	SWA 35/4	60M
Main Area to Rm 5 Kiosk:	SWA 25/4	55M
Room 5 Kiosk to Rm 6 Kiosk:	SWA 25/4	44M
Room 6 Kiosk to Rm 7 Kiosk:	SWA 25/4	48M
Room 7 Kiosk to Rm 8 Kiosk:	SWA 25/4	46M
Room 8 Kiosk to Guides #1:	Surfix 2.5 - 2+ E	50M
Main Area to Pool Kiosk:	SWA 25/4	40M
Main Area to Rm 4 Kiosk:	SWA 25/4	60M
Room 4 Kiosk to Rm 3 Kiosk:	SWA 25/4	33M
Room 3 Kiosk to Rm2 Kiosk:	SWA 25/4	42M
Room 2 Kiosk to Manager:	Surfix 2.5mm 2+ E	57M
Room 2 Kiosk to Room1 :	SWA 16/4	85M

ACTUAL BOM (BILL OF MATERIALS):

KIOSKS 1 – 12 (MB-5040D200-G):

1 x 63A 3 POLE BREAKER
1 X 40A 3 POLE BREAKER

FOH KIOSK (260G):

2 x 63A 3 POLE CIRCUIT BREAKER
6 x 25A CIRCUIT BREAKER
6 x 16A CIRCUIT BREAKER
12 x 10A CIRCUIT BREAKER

KITCHEN KIOSK (260G):

2 x 63A 3 POLE CIRCUIT BREAKER
6 x 25A CIRCUIT BREAKER
6 x 16A CIRCUIT BREAKER
12 x 10A CIRCUIT BREAKER

WORKSHOP KIOSK (260G):

2 x 63A 3 POLE CIRCUIT BREAKER
6 x 25A CIRCUIT BREAKER
6 x 16A CIRCUIT BREAKER
12 x 10A CIRCUIT BREAKER

STAFF UNIT DBS (STEEL DB EAB5) X 10:

1 x 63A EARTH LEAKAGE KRC263
2 x 2A CIRCUIT BREAKER

BOH (BACK OF HOUSE) KITCHEN DB (SDB316):

1 x 63A 3 POLE C/BREAKER
3 x 63A EARTH LEAKAGE
15 x 16A CIRCUIT BREAKER
12 x 10A CIRCUIT BREAKER

FOH (FRONT OF HOUSE) DB (SDB316):

1 x 63A 3 POLE CIRCUIT BREAKER
3 x 63A EARTH LEAKAGE
6 x 16A CIRCUIT BREAKER
4 x 10A CIRCUIT BREAKER
16 x 6A CIRCUIT BREAKER

BOH WORKSHOP DB (SDB316):

1 x 63A 3 POLE CIRCUIT BREAKER
3 x 63A CIRCUIT BREAKERS
12 x 16A CIRCUIT BREAKERS
8 x 10A CIRCUIT BREAKERS

GUIDE UNITS DBS (SDBEDIN18) X 4 EACH:

1 x 63A EARTH LEAKAGE
1 x 16A CIRCUIT BREAKER
1 x 10A CIRCUIT BREAKER

STAFF ABLUTION (DB BOX SDBEDIN8) X 2:

1 x 63A EARTH LEAKAGE KRC263
1 x 2A CIRCUIT BREAKER

STAFF KITCHEN DB (SDB316):

1 x 63A 3 POLE CIRCUIT BREAKER
3 x 63A EARTH LEAKAGE
13 x 25A CIRCUIT BREAKERS
18 x 6A CIRCUIT BREAKERS
8 x 10A CIRCUIT BREAKERS

STAFF CANTEEN DB (SDB316):

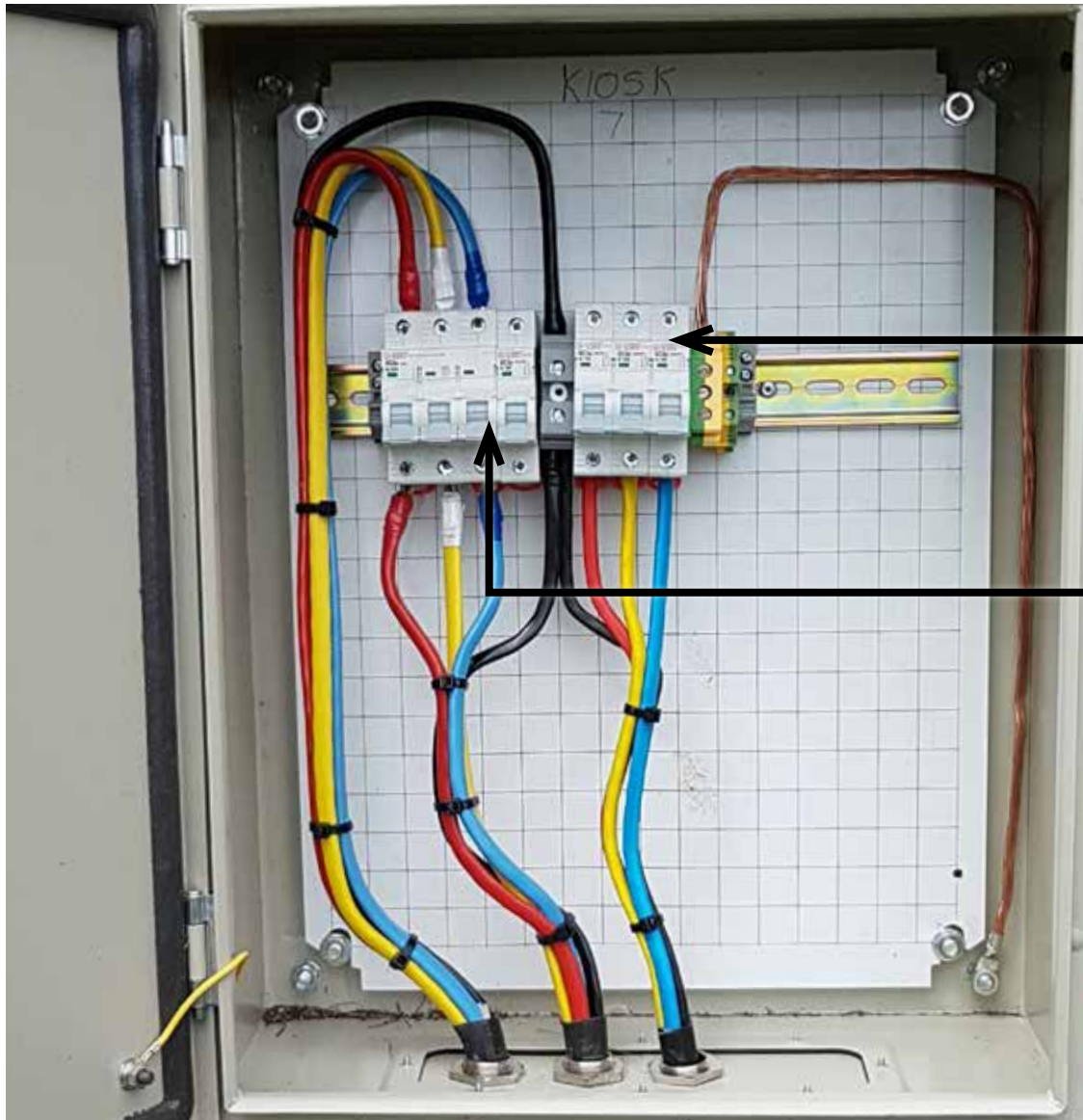
1 x 63A 3POLE CIRCUIT BREAKER
3 x 63A EARTH LEAKAGE
12 x 25A CIRCUIT BREAKERS
12 x 16A CIRCUIT BREAKERS
15 x 10A CIRCUIT BREAKERS

GUEST UNIT DBS (SDBEDIN18) X 8 EACH:

1 x EARTH LEAKAGE KRC263
2 x 16A CIRCUIT BREAKER
2 x 10A CIRCUIT BREAKER
2 x 6A CIRCUIT BREAKER

DB BOX 410C9

1 x 25A EARTH LEAKAGE
1 x CIRCUIT BREAKER
1 x CIRCUIT BREAKER



MAIN BREAKERS

- Distribution breakers to the room DB board.
- Turning off the main breaker will cut the power supply to all kiosks beyond the main breaker.

RIGHT HAND BREAKER (3 SWITCH)

- Main breaker to the rooms.

LEFT HAND BREAKER (4 SWITCH)

- Main reticulation breaker will cut power to all kiosks beyond that.



CHECKS

- This is the main Distribution Board (DB board) generally located at the back of house (BOH) and has the main breakers on the **TOP ROW** controlling the reticulation to the North and South rooms.
- The **SECOND AND THIRD ROWS** are for local distribution to various areas such as, front of house (FOH) kitchen etc.
- On the main DB board there are labels indicating which areas in the camp are supplied.
- If there is a power outage to a particular area then check the DB board to see where the breaker has tripped.



**CAUTION VERY HIGH DC VOLTAGE PRESENT
DO NOT TOUCH!**

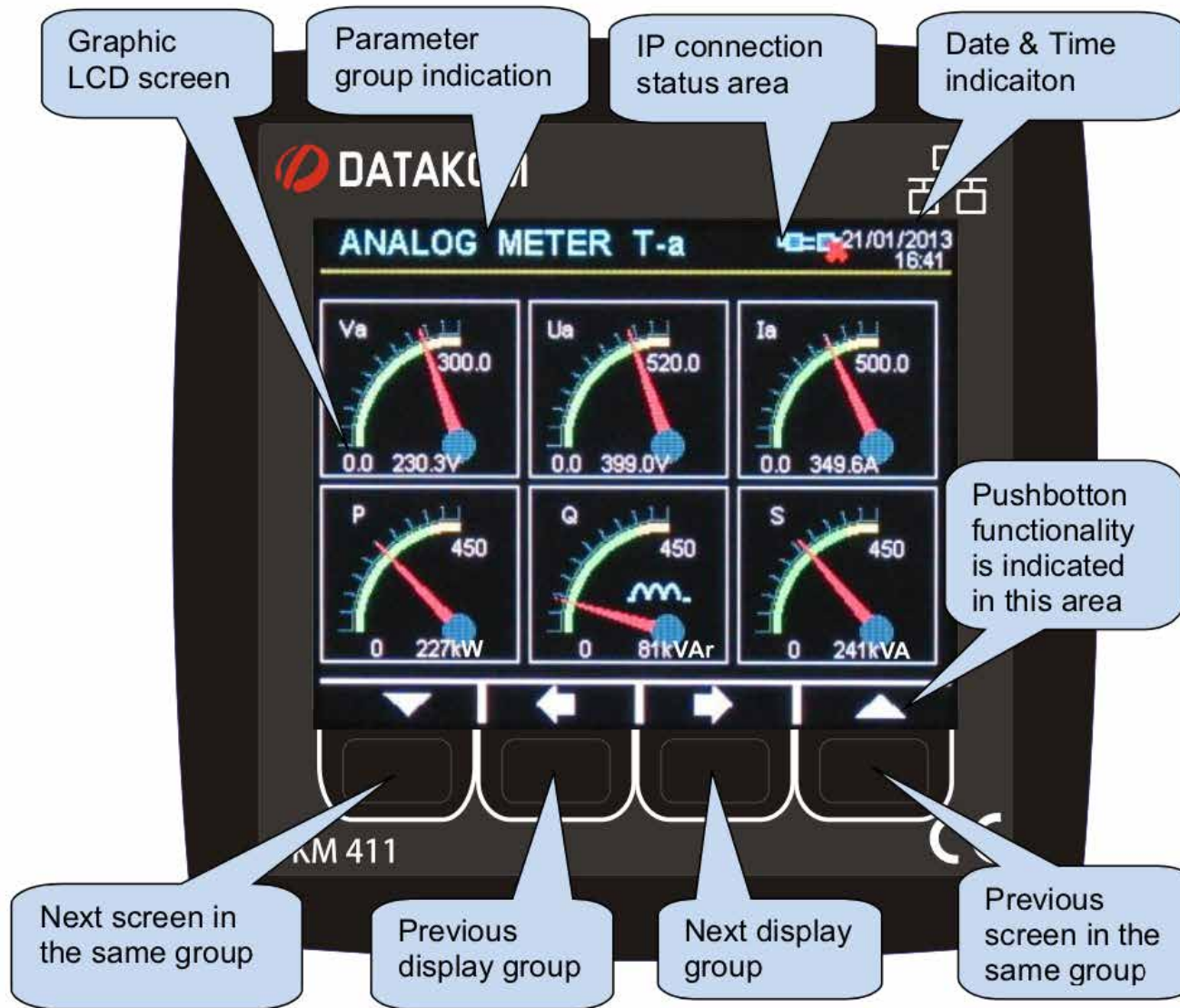
- On a monthly basis conduct a visual check by looking through the window to ensure all three (3) colours are green.
- If a red colour is detected contact Energenic immediately.
- The three white buttons are **PV fuses**. Positive on the left side, negative to the right side.
- The middle yellow section are **PV surge protectors**. The window at the top should be green, if red the module needs to be replaced, and will indicate various areas such as, front of house (FOH) kitchen etc.

FRONT PANEL








BACK PANEL





FRONT PANEL FUNCTIONALITY

- The front panel comprises a 320 x 240 pixels 3.5" colour LCD display and 4 multi-function pushbutton keys.
- The top section of the display is reserved for menu and status indications. This area displays the active menu, internet connection status and date-time information.
- The function of the pushbuttons may vary following the active menu item and is dynamically indicated at the bottom section of the graphic display.
- Generally pushbuttons function as arrow keys to the 4 basic directions. Left-right arrow keys change the menu group. Up-down arrow keys navigate inside the same menu group.

BUTTON	FUNCTION
	<p>Selects next display screen in the same display group. <u>WHEN HELD PRESSED FOR 5 SECONDS:</u> Makes the current display screen the default screen that comes up at power-on.</p>
	<p>Selects previous display group.</p>
	<p>Selects next display group.</p>
	<p>Selects previous display screen in the same display group. Resets the ALARM RELAY. If long-pressed, cancels all alarms.</p>
	<p><u>WHEN HELD PRESSED FOR 5 SECONDS:</u> enters or exits PROGRAMMING mode.</p>

IF THERE IS A POWER FAILURE AT THE CAMP INVESTIGATE THE FOLLOWING

- First check to see if any of the main DB board breakers are tripped.
- If no breakers are tripped, carry out the change over procedure so the generator can provide power to the camp.
- When power is restored to the camp and the solar plant isolated, begin to identify the problem.
- Check that the Freedom Won battery main breaker has not tripped.
- If tripped, check what the battery state of discharge (SOC) LED's indicate.
- If there is a very low SOC then the battery has been discharged to the point that the battery has shut itself down.
- This implies the generator did not start, possibly not in "AUTO MODE", low on fuel, or the battery is flat.
- If the SOC is satisfactory but a breaker tripped, reset the breaker. If it trips again, push and hold the battery reset button for a few seconds.
- If this still continues to trip there is an issue that requires outside assistance (contact Energenic).
- If it powers up then check if the Quattro's are powering up.
- If this happens then confirm they are producing power.
- At an appropriate point, reverse the changeover procedure and revert to solar power and ensure the generator panel is set to AUTO.

TROUBLE SHOOTING WITH THE FOLLOWING EQUIPMENT

- **SOLAR PANEL:** if there is no output, check all fuses in the string combiner boxes.
- **VICTRON QUATTRO INVERTER:** download the Victron toolkit app for LED codes for the Quattro. Use the colour control to check errors on the devices.
- **VICTRON 250/100 SMART CHARGE CONTROL:** use the Victron toolkit app for LED codes for the charge controllers. Use the Colour Control to check errors on devices.
- **FRONIUS ECO 27.0-3-5:** refer to the trouble shooting codes in the Fronius manual.
- **FREEDOM WON 140/98LiFeP04 BATTERY:** refer to previous page.
- **PERKINS GENERATOR:**

Overheating: check coolant level, check vee belt, check radiator for obstructions, check coolant is circulating through the radiator, and allow to cool, then check the thermostat, check load is not excessive.

Will not start: check the controller alarms and clear them.

Did not start on battery SOC: make sure the generator is on AUTO.

Frequency/voltage low: check the air filter, check for fuel restrictions and or a clogged filter.

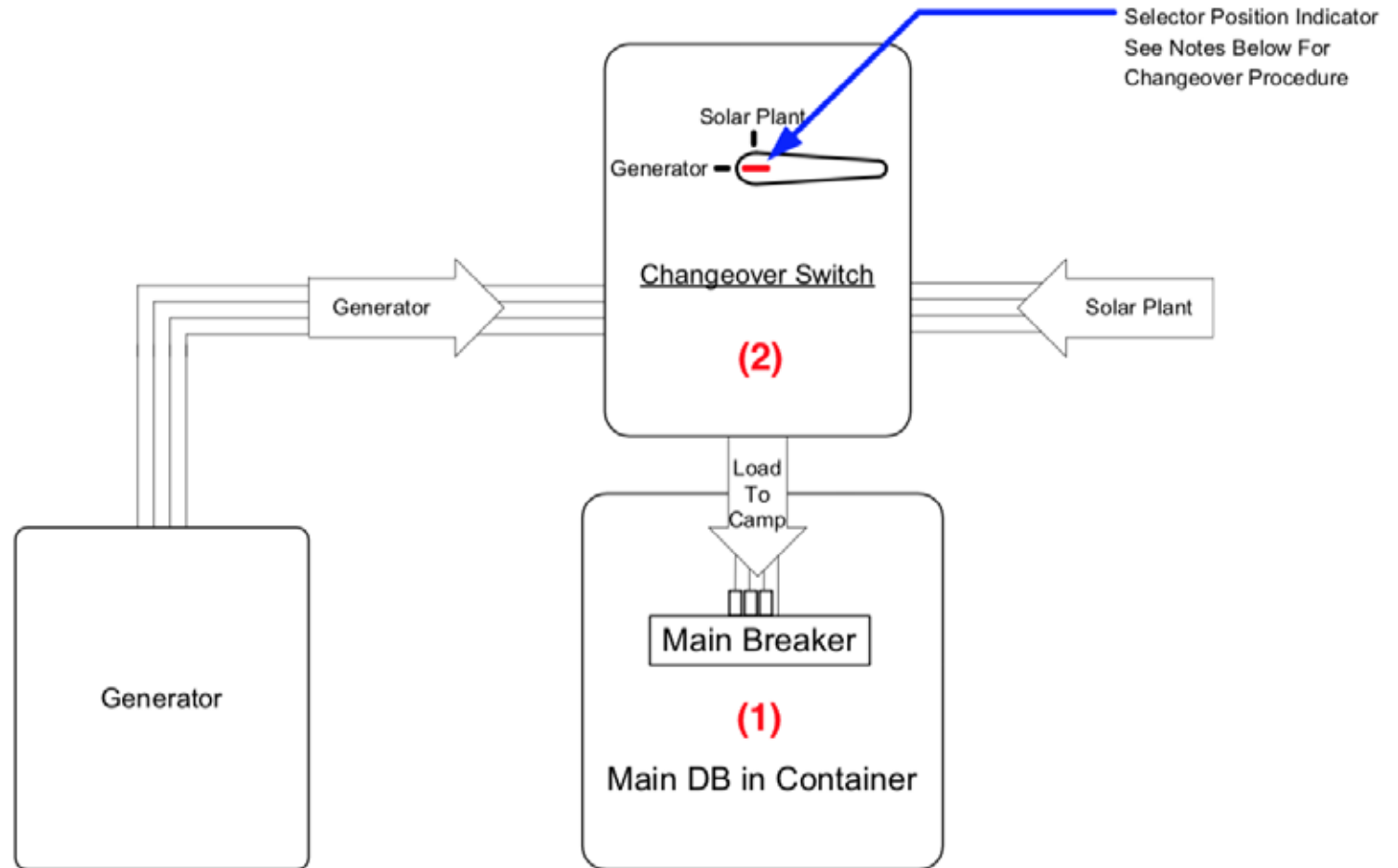
CHANGE OVER PROCEDURE THAT MUST BE FOLLOWED TO PREVENT DAMAGE TO EQUIPMENT

- Disconnect camp load by switching off the main breaker at the main DB Board in the container.
- At the changeover switch select generator by moving the handle to align with generator position.
- Select manual on the generator control and start it.
- Connect the camp load by turning on the main breaker.

The solar plant is now isolated from the camp loads and the generator, which will supply the camp with power directly and independently of the solar

To reset to solar, reverse the procedure:

- Disconnect camp load by turning off the main breaker at the main DB board in the container.
- Stop generator and set to AUTO on the generator control.
- Select solar at the change over switch.
- Reconnect camp load by turning on the main breaker at the main DB board in the container.



LOGISTICS:

All equipment arrived in sound working order at the Magashi camp.

The commissioning test conducted confirmed all the installed equipment was operating as per specification.

What do Energenic monitor?

- Energenic monitors the Victron VRM portal and the Datakom portal.
- Energenic should receive (e-mail) alarms for low battery, overload and over temp of inverter or battery only. The TSM should be locally monitoring the system's well-being and all alarms.

How often?

- Energenic monitors the following on a weekly basis in terms of the Victron VRM portal and the Datakom portal.
- Energenic suggests a weekly review of the portal for average SoC, consumption, solar and generator input and any alarms and (negative) trends.
- The camps need to take ownership and primary responsibility for their plant.
- Energenic can assist as necessary.

Procedures to be followed when warning/errors are found.

- The General Manager of Magashi to be informed immediately.

Responsibilities for rectifying problems?

- Once Energenic receives the input from the General Manager, Energenic will immediately

respond to the General Manager via the phone in order to rectify the problem.

- If Energenic are unable to rectify the problem by phone, measures will be taken to get an Energenic technician to site to rectify the problem.
- Camps need to be responsible for first-line troubleshooting and therefore problems such as low battery indicators which tend to be a result of generator failure to start due to no fuel, not left in auto or low generator battery SoC.
- Additionally camps need to monitor their consumption and, check daily for low solar output due to shading and/or dirt on the modules.

Energenic maintenance obligations:

- Energenic has not entered into any formal/ signed maintenance agreement for the Magashi camp.
- Any maintenance required will be at the specific request of Wilderness and will be charged out at an agreed amount.

Wilderness maintenance obligations:

- Wilderness to implement the daily, weekly and monthly checks as detailed in the Magashi camp manual.
- When problems/faults occur that cannot be solved in camp then Energenic to be contacted to resolve the issues.

Procedure to be followed once a problem/fault has been identified:

1. Camp TSM to refer to the camp manual to try to solve the issue.
2. If the TSM cannot resolve the issue, the TSM should write down all relevant fault descriptions and codes and transmit them to his local manager who should then forward these to Energenic in the event they cannot be resolved locally.

Energenic trained the staff on all aspects of the equipment as outlined in the camp manual when the camp was commissioned.

TIME LINES FOR ENERGENIC TO FIX PROBLEMS:

Telephonic support = same day

Site visits as a result of a major failure = earliest available flights and subject to availability of replacement parts/equipment

Site visits to remedy non-critical failures = to be agreed on a case by case basis consumption and, check daily for low solar output due to shading and/or dirt on the modules.

CONTACT DETAILS:

Pass word on the Fronius Solar web site is “*Magashi 1*” accessed via the browser [http//192.168.250.181](http://192.168.250.181)

Fronius warranty www.Fronius.com/solar

Victron Monitoring - User manual <https://vrm.victronenergy.com>

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