ENERGY TRACKER

User Guide

DISCLAIMER

All possible care has been taken in the preparation of this user guide. However, specification and particulars in relation to the product referred to in this document are subject to change without prior notice. Some photographs contain samples which are representative only. Yarl Technologies will not be held liable for any errors or omissions in this document.

1   Introduction

This eight channel Energy Tracker was designed and built by Yarl Technologies Pty Ltd, Australia. This Energy Tracker uses state-of-the-art credit-card sized computer "Raspberry Pi 2 Model B" to monitor and display the energy generated by eight independent direct current (DC) sources. As with any

Figure 1 Energy Tracker. Model 8C.

standard computer, this energy tracker requires a keyboard, mouse and a monitor. It runs on Raspbian operating system, based on the Debian Linux distribution. The user interface is similar to Microsoft windows, with limited features and functionality. The energy tracker software application is written in Python language to acquire the signals from eight power sources, process the signals and display the signal data on the screen. This computer can connect to the internet to access all the web resources such as email, file upload / download, browse webpages, etc. If there is a need to update the energy tracker application, it can be easily done by connecting to the internet and downloading the new application and running it on this computer.

The following sections explain the setup process and how to use this energy tracker.

2   Hardware Setup

Before power is turned on, all peripheral devices such as the TV monitor, keyboard, and mouse MUST be connected. This will enable the computer to recognize these devices on boot up. If the computer fails to detect any of the devices on boot up, it may not function as expected. Follow the steps below to setup the hardware connections before turning on the unit.

Step1: Connect one end of the HDMI cable to this unit and the other end to a TV monitor as shown in figure 2.

Figure 2 HDMI cable connection.

Step 2: Connect the DC power cable, keyboard USB cable, mouse USB cable (or wireless USB dongle) to the back panel of the energy tracker unit as shown in figure 3. If you need to connect this computer to internet, then connect the Ethernet cable to this unit. This computer has 4 USB ports, 1 Ethernet port and 1 HDMI port.

Figure 3 5V DC power, keyboard, mouse, Ethernet connection.

Step 3: Turn on the TV monitor. Select the video source on the TV monitor to HDMI as shown in figure 4. If using wireless keyboard or mouse, make sure the batteries in the keyboard and mouse are in good condition and the power switch on these devices are turned on.

Figure 4 TV monitor selected to HDMI source.

Step 4: Connect the 5V DC power adapter to the mains wall socket. **Do Not** turn on the main power yet.

Step 5: Make sure the power switch on the front panel of the energy tracker is turned **OFF**. Switch on the mains power on the wall socket to energize the DC adapter.

Step 6: Turn on the power switch on the front panel of the energy tracker. This will supply power to the computer. On the TV monitor you should be able to view a few pages of texts indicating the computer is booting up as shown in figure 6 and 7.

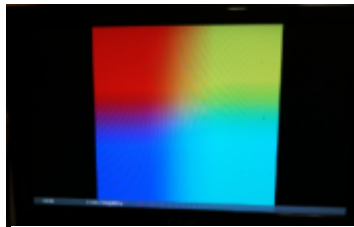*Figure 5 Power, shutdown switches on front panel.*

Figure 6 TV monitor connected to HDMI source.

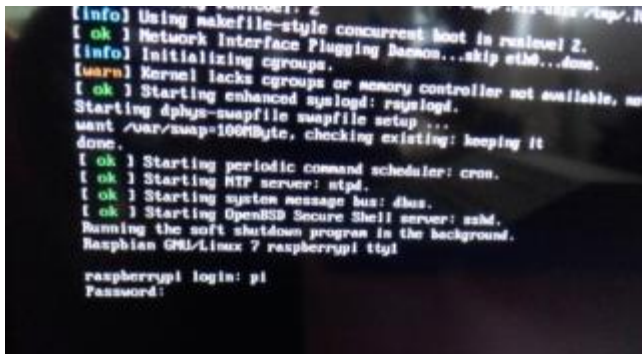*Figure 7 TV monitor showing boot up screen.*

Figure 8 Login Prompt.

Step 7: As shown in figure 8, enter the login user name and password. The default user name is **pi** and the password is **raspberry**. Note: when typing the password, there will not be any feedback, so type in the password without any typo errors. All letters are lower case without any spaces. Press the enter key on the keyboard to accept login. The TV monitor will show the login and wait for you to start the Raspbian operating system.
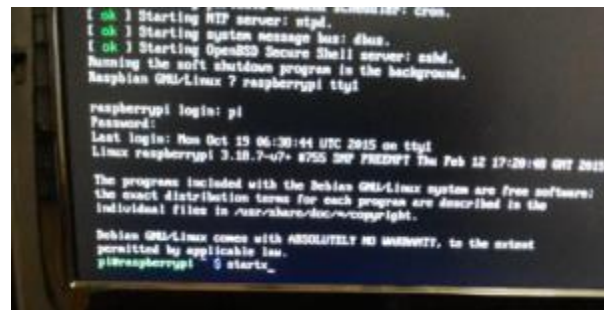

Figure 9 After login, startx.

Step 8: At pi@raspberrypi ~$ prompt type in 'startx', press the enter key to start the Raspbian operating system as shown in figure 9. You can also use the up or down arrow key on the key board to scroll through the last few commands that you typed. When it shows 'startx', press the enter key. It will load a screen as shown in figure 10. If an error pop up as shown in figure 10, press the OK button with the mouse to close that pop up window.
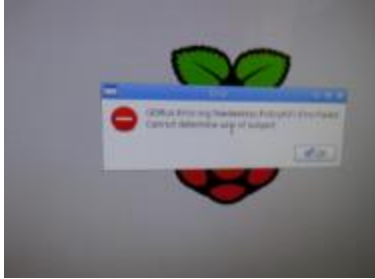
Step 9: Use the mouse to click on the LX Terminal icon at the top as shown in figure 11. It will open a terminal window as shown in figure 12.
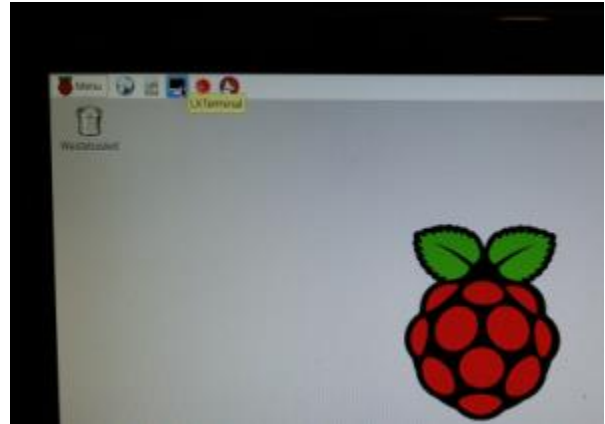

Figure 10 Error pop up window.

Figure 11 Starting LX Terminal window.

Step 10: In the LX terminal window at the prompt pi@raspberrypi ~$ type in 'python energy_tracker.py' and then press the enter key as shown in figure 12. You can also use the up or down arrow key on the key board to scroll through the last few commands that you typed. When it shows 'python energy_tracker.py', press the enter key. This will start the energy tracker application.
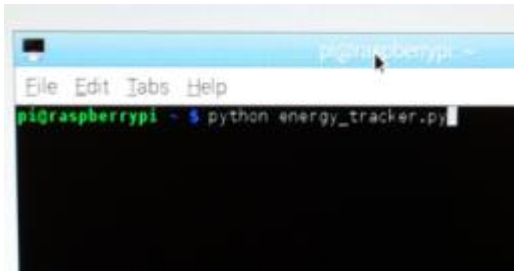

Figure 12 LTX Terminal to start Energy Tracker Application.

It will display a text window showing the energy tracker application running as shown in figure 13. This window will close after a few seconds and launch the energy tracker display as shown in figure 14.
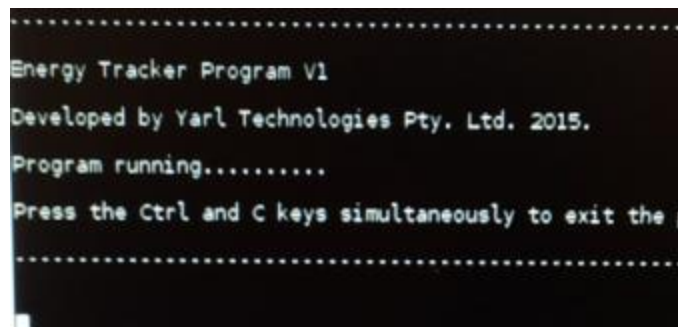

Figure 13 Energy Tracker Application starting.
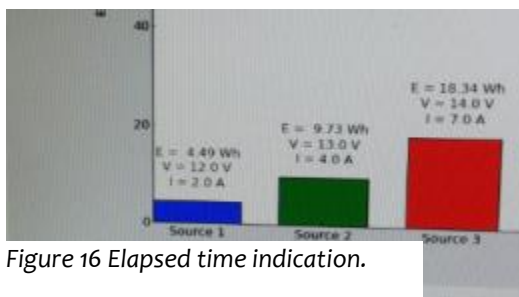
Figure 14 Energy Tracker display.

Figure 16 Elapsed time indication.

Figure 15 Energy, voltage and current values.

If the power sources are connected to the energy tracker unit, it will display a bar graph of the energy in Watt hours for each source. It will display the numeric values of energy, voltage and current for that source as shown in figure 16. On top of each bar graph, it will display the Watts as shown in figure 14. On the left bottom corner of the display window, it shows the elapsed time since the application was open, as shown in figure 17. If you want to reset all values to zero and start again to plot the bar graphs, click on LX Terminal pi@rapsberrypi and it will open the terminal window. Select File > Quit from the menu. This will close the energy tracker application. Then follow step 10 to restart the energy tracker application.
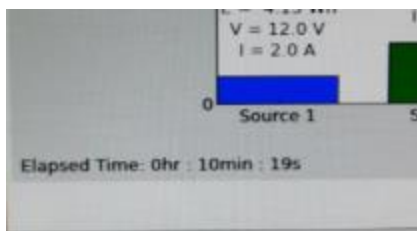

Figure 17 Elapsed time indication.

If you need to use the internet, click on the Epiphany Web Browser icon on the top menu bar and it will launch the web browser as shown in figure 18 and 19. You can then browse the internet and access web-based email.
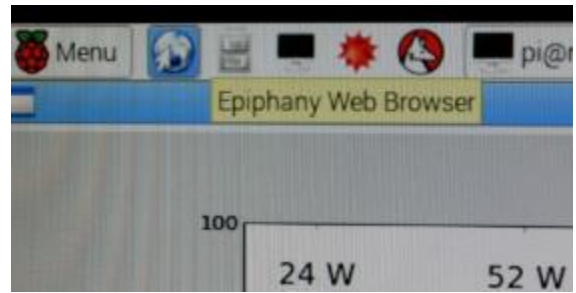
Figure 18 Web browser icon.

Figure 19 Web browser window.

Before shutting down the computer, make sure all running applications are closed. To close the energy tracker application, click on the LX terminal pi@raspberrypi icon and it will show the LX terminal window as shown in figure 20. Press 'Ctrl' key and 'c' key simultaneously on the keyboard. You may have to press these two key simultaneously once or twice. This will close the energy tracker application. Alternatively with the mouse open the LX terminal and select File > Quit from the top menu as shown in figure 21.
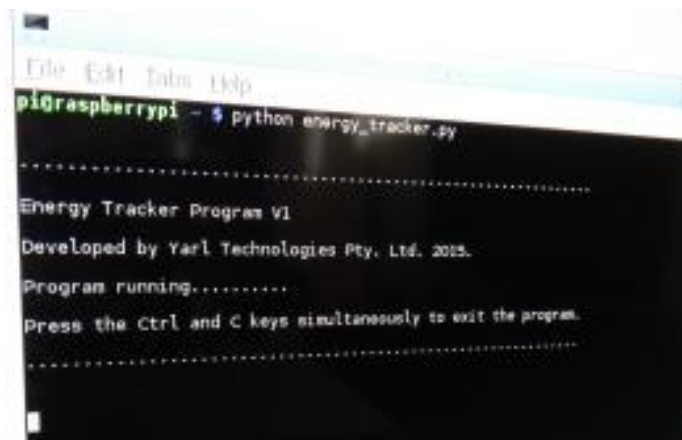
Figure 21 LX Terminal window pi@rapsberrypi.

Figure 20 LX Terminal - File > Quit.

Step 11: To shut down the computer, you can either click on the Shutdown from the menu as shown in figure 22 or press the shutdown switch on the front panel as shown in figure 23.
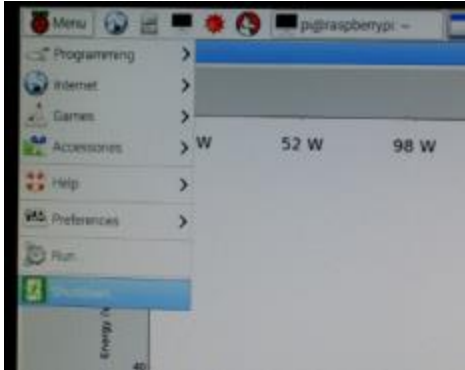
Figure 22 Shutdown from menu.

Figure 23 Shutdown switch on front panel.

Figure 24 Shutdown process.

The TV monitor will show the shutdown process as shown in figure 24. **Do not** turn off the power to the computer while the shutdown process as it will damage the computer memory. Once the shutdown is complete (it should typically take less than 10 to 15 seconds), turn the power switch off on the front panel of the unit. Then switch off the mains power to the DC adapter on the wall socket.

3 Connecting Power Sources

Once you are familiar with starting up and shutting down the energy tracker computer, follow the steps below to connect the power sources to the energy tracker unit. Each source is electrically isolated and has a resettable 10A circuit breaker on the front panel. The front panel connections accept the power sources and the back panel connections feed the loads.

Step 1: Connect the first power source to source 1, observing polarity. Each source is numbered (1 to 8) on the front panel as shown in figure 26. The RED banana socket is for the positive terminal and the BLACK banana socket is for the negative terminal of the power source. If the voltage of the power source is more than 7.5V DC, the green LED for that source will be turned on. Figure 26 shows the front panel connections, circuit breaker and LED indicator for each source.
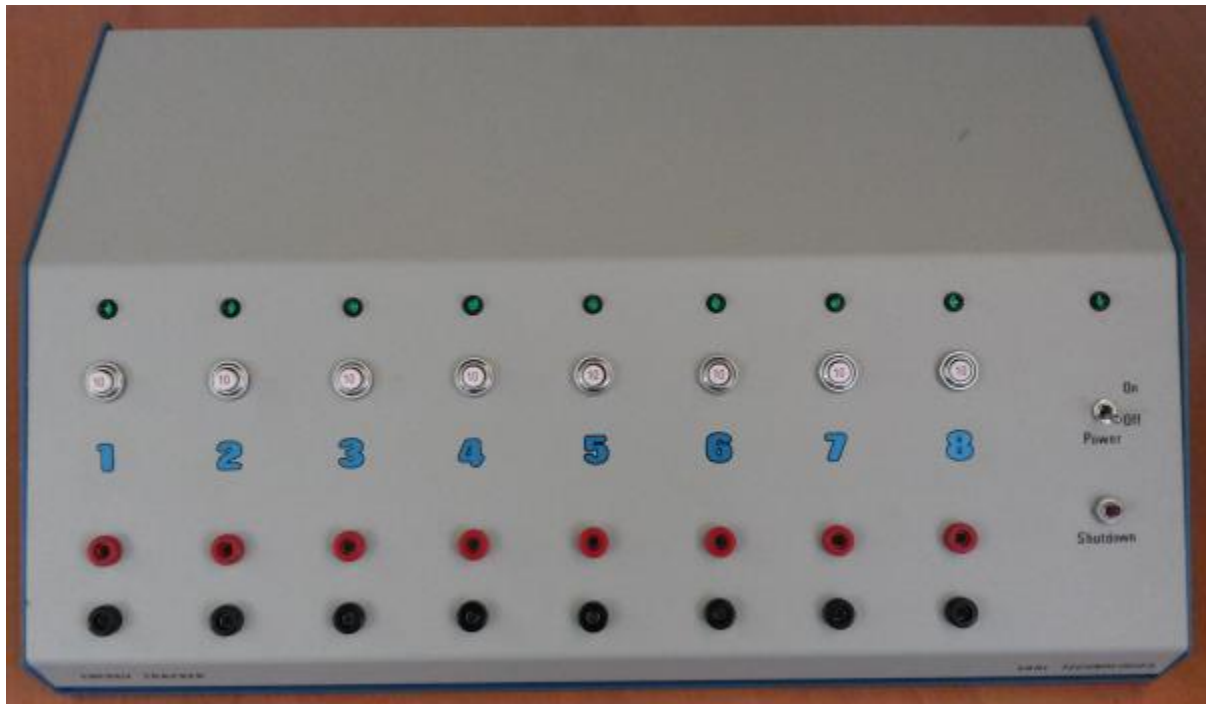
Figure 25 Front panel layout.

Step 2: Connect the load terminals to the corresponding source on the back panel observing polarity. Each load is numbered (1 to 8) on the back panel as shown in figure 27. The RED banana socket is for the positive terminal and the BLACK banana socket is for the negative terminal of the load. NOTE: the energy tracker does not switch the power flow from the source to load, meaning that, if the power is available on source the current will flow direct to the load. The back panel load connections are shown in figure 27.

A good practice is to install a switch before the load. This will enable the user to turn on and turn off the load, without having to disconnect the banana plugs.

Figure 26 Back panel layout.

Step 3: Testing the source and load. Once the connections to source and load are connected, (turn on the load switch if installed) if the power is available, the load should consume the power supplied by the source. For testing purposes, the load could be a 12V 50W halogen lamp, which is easier to note when the power flows to the load.
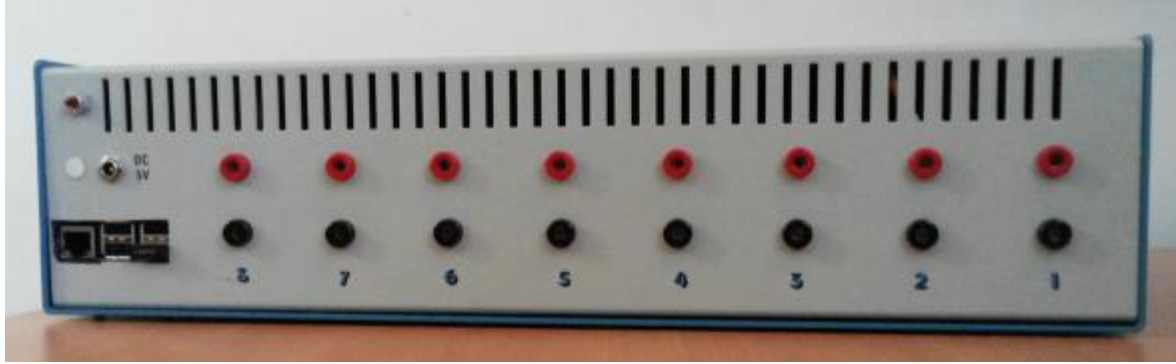
Step 4: Once all the sources and loads are connected, follow the steps described in section 2 to start the energy tracker computer.

Step 5: Shutdown the computer by following the steps described in section 2 and then disconnect the load from the energy tracker unit one by one. After disconnecting all the load terminals on the back panel, disconnect all the power sources from the front panel. **Note**: Take extra precaution when disconnecting the power sources from the front panel, the positive and negative banana plugs should not come into contact with each other and cause a short circuit of the power source. Yarl Technologies recommends the use of shrouded banana plugs and install a switch to each power source. The shroud covers the exposed banana plug terminal as you pull the plug off the socket, providing insulation to the plug. A set of shrouded banana plugs are supplied with this energy tracker unit.

4 Troubleshooting

4.1 Power source connected to source 1, but no power available at load 1 terminals.

Test the voltage at the source terminals. Test if the LED is turned on. Check if the circuit breaker has tripped. If the circuit breaker has tripped, the white button will pop up. Press the white button down to reset the circuit breaker. If the circuit breaker trips again, then check the load connections for any short circuit.

Figure 27 Front panel connections, circuit breaker buttons, and LED indicators.

4.2 Power source connected to source 1, power available at load 1 terminals, but the computer is not displaying the voltage nor current for this channel.

Check the voltage level at the source and load terminals. The voltage must be greater than 7.5V DC.

Check the polarity of the source terminals and load terminals. If the polarity is wrong, the display will not show the readings.

Check another channel. If another channel works, it may be one of the internal protection circuit components that have failed due to excessive voltage and/or current.

For each source, there is a 1A fuse inside the energy tracker unit. If this fuse is blown, the display will not show the readings. Shutdown the computer and disconnect all terminals. Open the unit by unscrewing the screws at the bottom of the unit. The location of the fuse for one source is shown in figure 29. Test the fuse and replace. If the fuse blows again, check the voltage of the source. If the source voltage is more than 24V DC, the inrush current can blow this fuse.

If the fuse is intact, one of the other circuit protection components has failed. The protection circuit has a 24V 1W clamp down Zener diode. If the voltage exceeds 24V this Zener diode will short circuit and burn out. Check for any burn marks on the circuit board. Refer to schematic diagram to locate the Zener diode.

Alternatively, if the fuse and the 24V 1W clamp down Zener diode are intact, the 33V TVS (transitional voltage suppressor) diode has failed. If the voltage exceeds 33V, regardless of polarity, this TVS diode will short circuit and burn out. Check for any burn marks on the circuit board. Refer to schematic diagram to locate the TVS diode.

1A Fuse
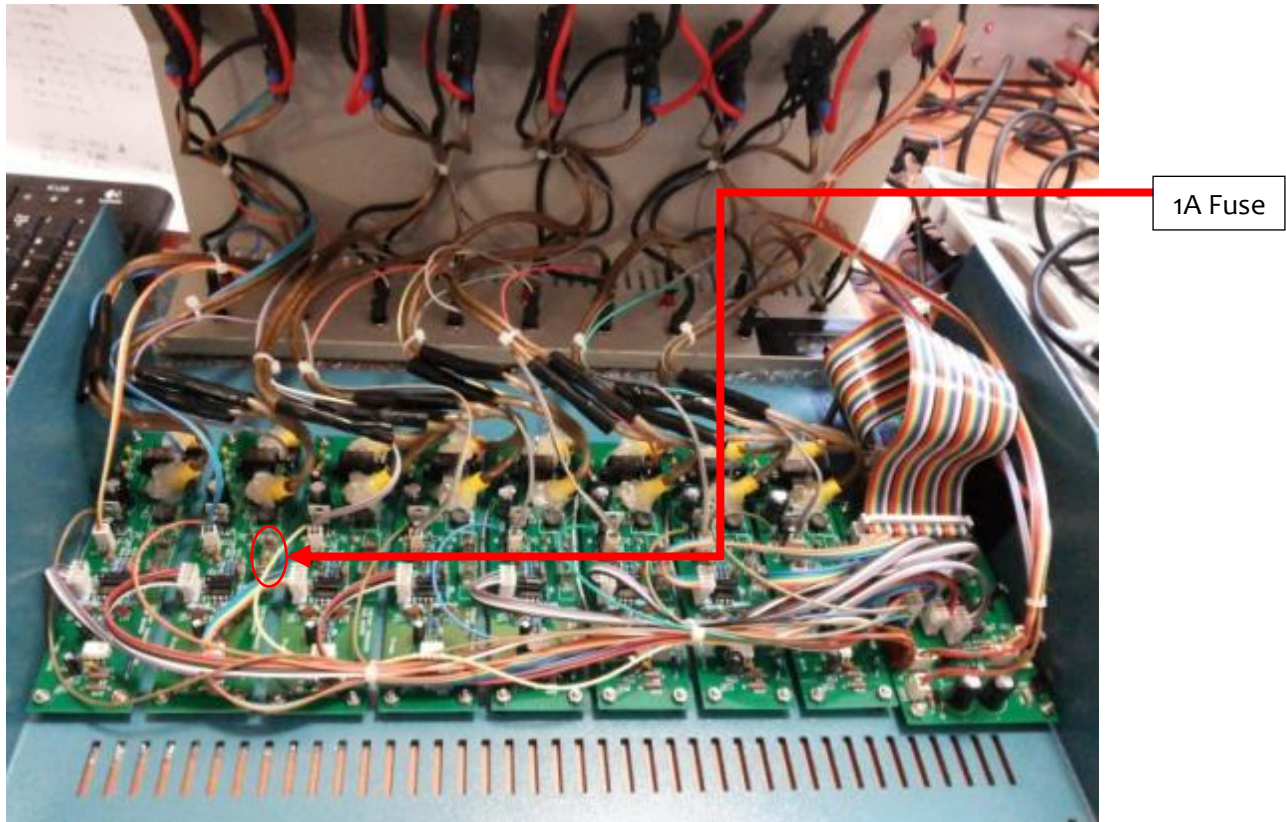
Figure 28 Circuit board for each source.

4.3 Keyboard or mouse does not work

Check the keyboard / mouse connection on the back panel. Connect the keyboard / mouse to a different USB port and try again.

Turn off the power switch of the computer and then turn it on.

Some brands / model keyboard / mouse are not compatible with the Raspberry computer operating system. Make sure you use a compatible device by checking the website and selecting a compatible brand and model.

If the TV monitor also fails to display anything, this issue may be related to point 4.5 below.

Figure 29 Keyboard / Mouse connections.

4.4 TV monitor not displaying

Check whether TV monitor video source is set to HDMI. Some TV monitors have more than one HDMI port, so make sure the energy tracker HDMI cable is connected to the correct HDMI port of the TV monitor.

Check if the TV monitor works with another device such as a DVD player connected to the same HDMI port.

This issue may be related to point 4.5 below.

4.5 Energy tracker computer does not boot up

Check the 5V DC power adapter is plugged into the wall socket and 5V DC power is available at the DC plug. On the DC plug, inside connection is +5V and outside connection is 0V.

Check that when the energy tracker power switch is turned on, the green LED is turned on.

A power outage during operation or improper shut down can cause the memory to get corrupted. In this case, you may have to replace the memory card on the computer board. The memory card must be pre-loaded with the operating system. Contact Yarl Technologies for technical assistance or search the website to resolve this issue.

5 Technical Specifications

The eight channel energy tracker technical specifications are listed below for model 8C.

Energy Tracker	
Computer	Raspberry Pi 2 Model B
Operating system	Raspbian
Application software	Python 3
Energy tracker application	Version 1. 2015
Power rating	5V DC, max 1A
DC power adapter	5V DC, 2A switch mode power supply. Input voltage range is 100 to 240 AC, 50/60Hz
Ports	4 USB, 1 HDMI, 1 Ethernet
Enclosure	Folded Aluminum
Dimension	235 x 270 x 110 mm
Weight	3.300 kg
Operating Temperature	0 – 40 °C (32 – 104 °F)
Operating Humidity	10 – 90%
Power source channels	
Number of channels	8 independent channels
Isolation	The source voltage sensing uses optical and current sensing uses electromagnetic isolation. All channels are floating with respect to the energy tracker chassis and ground connection.
Sensing circuit protection	Protected by 33V TVS (transitional voltage suppressor), 24V 1W Zener diode, and 1A replaceable quick blow fuse (1A 20mm, 5mm dia.)
Voltage sensor type	DC
Voltage sensor range	7.5V to 24V. Max. 25V
Voltage sensing resolution	10 bit ADC over 0 to 24V range
Current sensor type	DC
Current sensor range	0A to 15A. Max. 25A
Current sensing resolution	10 bit ADC over 0 to 15A range
Circuit breaker type	B type (trip current x3 to x5 rated current for 100 ms)
Circuit breaker rating	10A continuous, 15A (typically few minutes)
Connection type	4mm banana socket rated at 15A. Red: positive, Black: negative.
Voltage and current measurement precision	Better than +/- 5% of maximum rated voltage and current.

6   Warranty Terms and Conditions

Warranty only applies to situations where a defect has arisen, wholly or substantially, as a result of faulty manufacture, parts or labour. Warranty is valid for 12 months from the invoice date. Warranty is rendered void if the product is serviced or modified in any way by an unauthorized service agent.

The warranty does not apply to situations where damage is caused by other factors or negligence, including without limitation:

- Wear and tear from use
- Surface damage such as scratches, cracks and stains
- Accidental or intentional abuse and/or mishandling of the product
- Failure to follow operating instructions
- Direct exposure to elements of the environment such as sun light, rain and lightning strikes
- Exposure to liquid substances or infiltration of foreign particles

Upon contacting Yarl Technologies with a technical issue or problem, Yarl Technologies will diagnose the problem and provide a suitable solution in a timely manner. This may require transport of the damaged product to and from Yarl Technologies. Any loss or consequential damage incurred during transportation is not covered by this warranty. These costs will be borne, in full, by the client.

7   Technical Support

Yarl Technologies will provide technical support to troubleshoot any issues with this energy tracker unit. For any improvements or suggestions, please contact Yarl Technologies using the details provided below.

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