



MIRRIN

Multi-Channel Load Logger

MODEL: LL400

User Manual





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1 Getting Started

1.1 Brief

The **Mirrin** Multi Channel Load Logger (MLL) measures AC RMS current (load) up to four channels and is ideal for monitoring loads on circuits and switchboards to record load profiles that can be used to identify slow changing events such as long duration interruptions, outages and derive estimates of usage patterns. The MLL is also useful as a diagnostic tool to assess load sharing on single phase circuits and load balancing on three phase systems.

The MLL incorporates a Liquid Crystal Display (LCD) which shows the maximum current measurement in each channel together with the date-time stamp of its occurrence and therefore ideally suited as a Maximum Demand Indicator (MDI).

The MLL is generally asleep and wakes up four times a second (every 250ms) and takes a measurement by sampling the input at 1600Hz. The aggregated measurements are committed to memory (logged).

The maximum current reading is based on the instantaneous readings with a sixty-second exponential time constant.

The MLL is housed in a small light-weight polycarbonate weatherproof box.

1.2 Feature summary

- Logs four (4) current channels (standard) and two (2) temperature channels (optional);
- Programmable logging interval, minimum one second;
- programmable alarms;
- Over two years memory capacity at 10 minute logging interval (8GB SD card included);
- Displays the maximum demand and maximum temperature with a date-time stamp for each channel;
- Local wireless options: Bluetooth or Wi-Fi enabled;
- Android and iOS Apps that provide for online measurements, graphical displays and options to download data and email;
- Battery operated with power saving mode to extend battery life to near 12 months;
- Facility for external DC power source including solar charging; and
- Suitable for indoor and outdoor applications.

1.3 Power up

The MLL will power up and enable logging only when it detects a current sensor connected to one of the four terminals. This is intended so that battery energy is better conserved when not in use. The MLL will still power when energised via the communications cable but will not commence logging.

1.4 Connections



(A) LEDs:

An LED indicator exists at the top of the unit.

- **Heartbeat:** when active will flash blue every ten (10) seconds.
- **Low battery / malfunction:** when active will flash red every sixty (60) seconds.
- **Charging:** when the Mirrin is being charged it will blink blue every two (2) seconds. At full charge, it will remain solid blue until the port is disconnected.
- **Button:** will turn solid blue for the duration of when the button is held. During charging, if the button is held longer than successive blinks, it will only remain solid blue until the next blink. At full charge, the LED will only respond to short button presses (described below) by blinking off.






(B) Button:

The button is a negative edge triggered button where actions with the button register upon release. The button can either be short pressed or long pressed which are defined as follows:

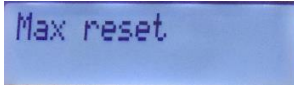
- **Short Press:** when the button is pressed down and released immediately.
- **Long Press:** when the button is pressed down and released within 3 seconds to 10 seconds.

If the button is held and released after 10 seconds, the Mirrin will ignore it. The unit is normally in sleep mode. When the button is pressed it will activate the LCD and Bluetooth or Wi-Fi for sixty (60) seconds.

If the button is pressed again after the LCD is activated, the unit will display the message on the right. While on this screen, the user has a 7 second window to initiate a long **press** of the button so that the Mirrin will clear the minimum and maximum values. No logged data is erased.



If the minimum and maximum values were cleared successfully, the unit will display the message on the right.



On the other hand, if clearing of the minimum and maximum value is unsuccessful, the unit will display the message on the right. Reasons for this include not initiating the long press within the 7 second window or not holding down the button for the specified time.



The max reset message will continue to be displayed for 12 seconds, and will then return to the default page, unless the button is pressed within this time.

(C) Liquid Crystal Display(LCD):

The LCD shows ten (10) pages for the standard unit and fourteen (14) pages if temperature option is included. Examples of page displays are shown on the right-hand side. Each page is displayed for three (3) seconds.

- **Page 1:** Name and serial number.
- **Page 2:** Percentage of log capacity filled and firmware version.
- **Pages 3-10:** Current and maximum current measurements for channels A, B, C and N.
- **Pages 11-14:** Temperature and maximum temperature measurements for channels T1 and T2.



MIRRIN
SN: 14043001

Page 1

Log: 99.9%
FW: 00.27

Page 2

A: .0 A
14/10/29 16:02

Page 3

A MAX: .3 A
14/10/29 16:00

Page 4

B: .0 A
14/10/29 16:02

Page 5

B MAX: .0 A
--/--/-- --:--

Page 6

C: .0 A
14/10/29 16:02

Page 7

C MAX: .0 A
--/--/-- --:--

Page 8

N: .0 A
14/10/29 16:02

Page 9

N MAX: .0 A
--/--/-- --:--

Page 10

T1: 23.8 C
2015/02/06 13:03

Page 11

T1 MAX: 25.9 C
2015/02/06 11:09

Page 12

T2: 23.5 C
2015/02/06 13:04

Page 13

T2 MAX: 25.0 C
2015/02/06 11:32

Page 14

(D) Current channels:

Designated as A, B, C, and N.

(E) Port:

Used for USB communications and for an external power adaptor.

(F) Temperature channels (optional):

Two external temperatures available for correlating current and temperature measurements.

1.5 Kit

Includes:

- MLL;
- Four (4) flexible current sensors (600mm in length);
- Communications cable;
- Application software for PC (Citrus);
- Application software for Android and iOS based devices (Citrus Lite); and
- Carry bag.



1.5.1 Accessories



Communications cable



Carry bag



Flexible current sensor
rated at 3000A (CATIV 600V)



Clamp-on current sensor
rated at 500A (CA TIV 600V)



Temperature sensor 5m



Temperature sensor 5m
(magnetic mount)

1.5.2 Options

Includes:

- Various flexible current sensors of smaller diameter;



- 15mm clamp-on current transformers;
- External power supplies:
 - Solar panel rated at 12V;
 - Parasitic clamp-on current transformer power supply;
 - USB supply via communications cable;
- Other inputs:
 - Two temperatures. Requires temperature connections on the MLL;
- Mounting:
 - Flanged case;
 - Magnetic feet; and
 - Holster.

1.6 Power modes

The unit detects its available power source and automatically switches to Sleep Mode if the power source is internal batteries. In this case, during normal operation, the LCD is blanked and Bluetooth or WiFi disabled. Measurements are performed in the background. The LCD and Bluetooth or WiFi are active for sixty (60) seconds when the button is pressed.

If the unit detects external power (via Port) then the LCD and Bluetooth or WiFi remain permanently enabled.

1.7 Internal batteries

The MLL is powered by a single rechargeable 3.2Ah Lithium iron phosphate battery as shown in Figure 1.7.1.



Figure 1.7.1

The rechargeable battery can be charged by connecting the port described in section 1.4(E) using the provided USB communication cable to a PC or a regulated 5VDC USB charger. The MLL battery can also be recharged via a 17VDC solar panel charger though a different communication cable is required. Please contact CHK if you require charging the MLL via a solar panel charger.

MLLs manufactured and supplied before 2015, are powered by two non-rechargeable 'AA' cell lithium batteries or a rechargeable battery pack supplied by the manufacturer.



Recommended 'AA' size batteries include:

- Energizer® Ultimate Lithium AA Batteries; and the
- Alternative is the Varta Professional Lithium AA - Mignon (6106-1.5V).



Energizer® Ultimate Lithium

Figure 1.7.2



Varta Professional Lithium

Figure 1.7.3

1.8 Current sensors

The MLL is designed to interface to voltage output current sensors, which is standard with all flexible current sensors provided by CHK Power Quality Pty Ltd.

It is also possible to utilise the existing clamp-on current sensors (100A, 500A and 1000A) as provided for the MaxiAmp unit. This will require an adaptor for each.

The MLL will read 20% over-range for each current clamp and 50% over-range for each flexible current sensor.



2 Citrus Application Software

2.1 Installing the Citrus application software

Step 1: Click on the following link which takes you to the 'Downloads' page of the CHK Power Quality website <http://www.chkpowerquality.com.au/downloads/>

Step 2: On the 'Downloads' page click on 'Citrus Software' as shown in figure 2.1.1.

An executable file, as highlighted by the file icon shown in figure 2.1.2 and appears at the bottom left corner of your screen, will be downloaded to your computer and placed in the 'Downloads' folder. The file icon shows the version number of the 'Citrus software' which is 0.26 at the time of writing this document.

Mirrin Load Logger and Load Remote

- [Mirrin Load Logger Brochure](#)
- [Brochure Load Remote](#)
- [Mirrin Multi Channel Logger LL400 User Manual](#)
- [Citrus Software](#)
- [Virtual com port drivers](#)
- [Microsoft .Net framework 4.5](#)
- [Installation of non market Android Apps](#)
- [Citrus Lite Android App](#)
- [Mirrin Firmware \(Ver 0.44\)](#)

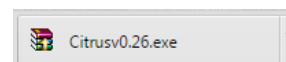


Figure 2.1.1

Figure 2.1.2

Step 3: Click on the file icon. The message box in figure 2.1.3 appears.

Step 4: Click the 'Run' button as shown in figure 2.1.3. The box in figure 2.1.4 appears.

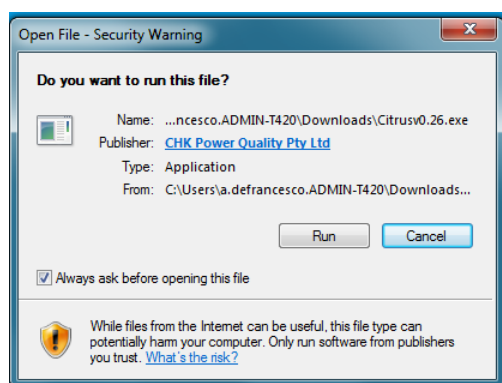


Figure 2.1.3

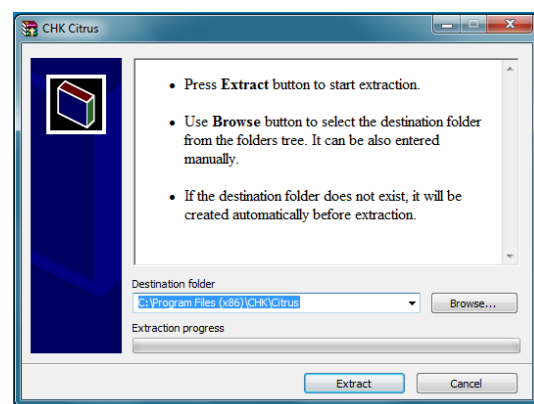


Figure 2.1.4

Step 5: Click the 'Extract' button shown in figure 2.1.4 to the desired location. The icon in figure 2.1.5 will appear on your desktop and in the **start menu** as shown in figure 2.1.6.



Figure 2.1.5

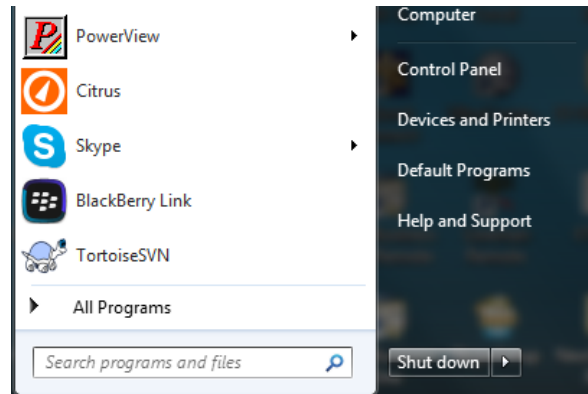


Figure 2.1.6

The Citrus application is installed.

2.2 Installing an FTDI USB to serial driver

Note: You may need to install an FTDI USB to serial driver. You can download a Virtual COM Port (VCP) driver which can be found at:

<http://www.chkpowerquality.com.au/downloads/> or at
<http://www.ftdichip.com/Drivers/VCP.htm>

Step 1: Click on the following link which takes you to the 'Downloads' page of the CHK Power Quality website <http://www.chkpowerquality.com.au/downloads/>

Step 2: On the 'Downloads' page click on 'Virtual com port drivers' as shown in figure 2.2.1.

An executable file, as highlighted by the file icon shown in figure 2.2.2 and appears at the bottom left corner of your screen, will be downloaded to your computer and placed in the 'Downloads' folder.

Mirrin Load Logger and Load Remote

- [Mirrin Load Logger Brochure](#)
- [Brochure Load Remote](#)
- [Mirrin Multi Channel Logger LL400 User Manual](#)
- [Citrus Software](#)
- [Virtual com port drivers](#)
- [Microsoft .Net framework 4.5](#)
- [Installation of non market Android Apps](#)
- [Citrus Lite Android App](#)
- [Mirrin Firmware \(Ver 0.44\)](#)

Figure 2.2.1

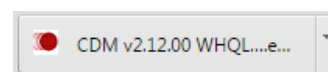


Figure 2.2.2

Step 3: Click on the file icon. The message box in figure 2.2.3 appears.



Step 4: Click the 'Run' button shown in figure 2.2.3. The box in figure 2.2.4 appears.

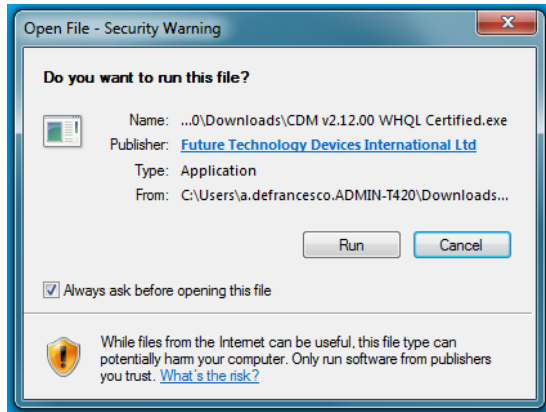


Figure 2.2.3

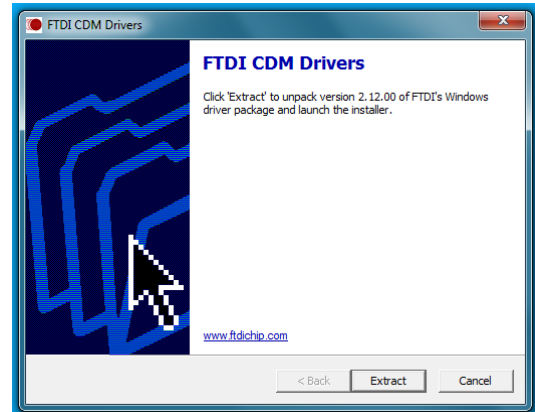


Figure 2.2.4

Step 5: Click the 'Extract' button shown in figure 2.2.4. The box in figure 2.2.5 appears.

Step 6: Click the 'Next' button shown in figure 2.2.5. The box in figure 2.2.6 appears.

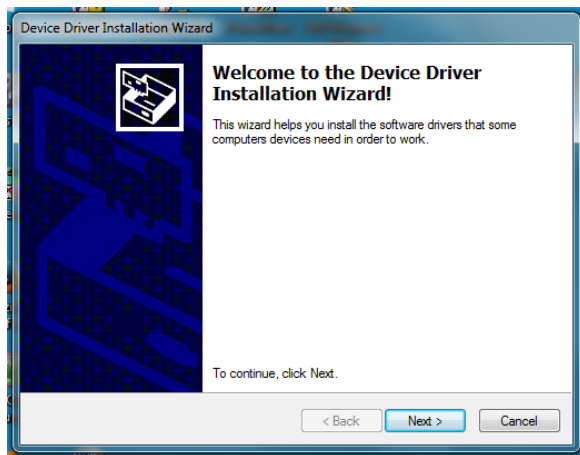


Figure 2.2.5

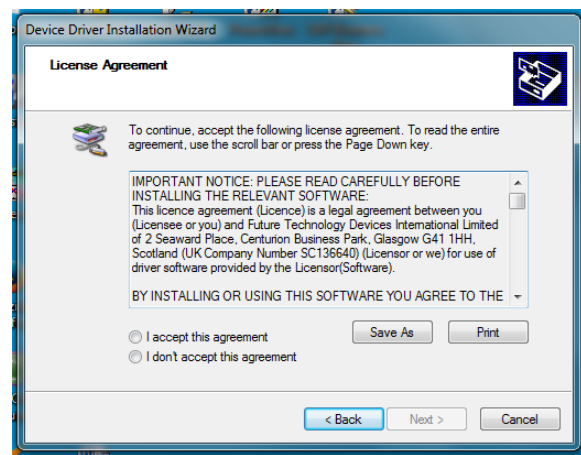


Figure 2.2.6

Step 7: Check (tick) 'I accept this agreement' as shown in figure 2.2.6. The 'Next' button becomes active as shown in figure 2.2.7.

Step 8: Click the 'Next' button shown in figure 2.2.7. The box in figure 2.2.8 appears.

Step 9: Click the 'Finish' button.

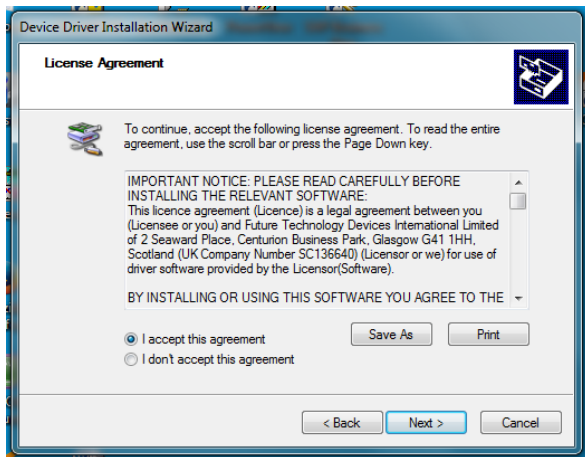


Figure 2.2.7

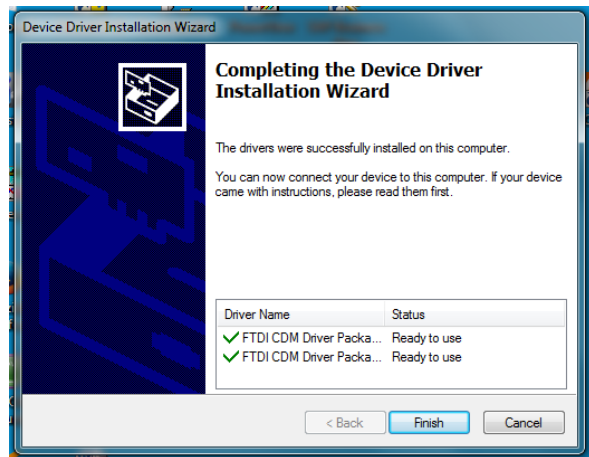


Figure 2.2.8

The FTDI USB to serial driver is installed.

2.3 Establishing communications

Depending upon the model, you can establish communications between your computer and the MLL using:

- a USB port with the cable provided; and
- Bluetooth (wireless); or
- WiFi (wireless).

2.3.1 Pairing your computer to a Bluetooth enabled Mirrin

Step 1: Go to the start menu and click on the control panel icon shown in figure 2.3.1.1. The window in figure 2.3.1.2 appears.

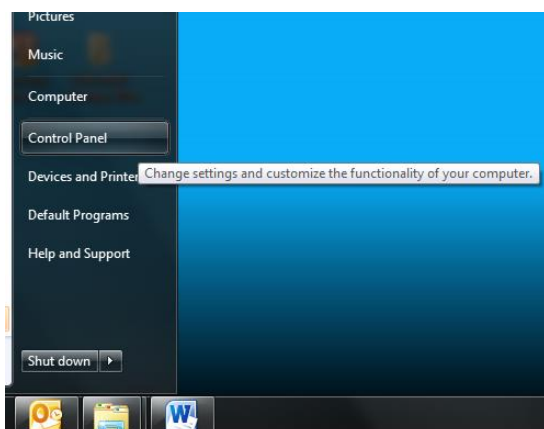


Figure 2.3.1.1

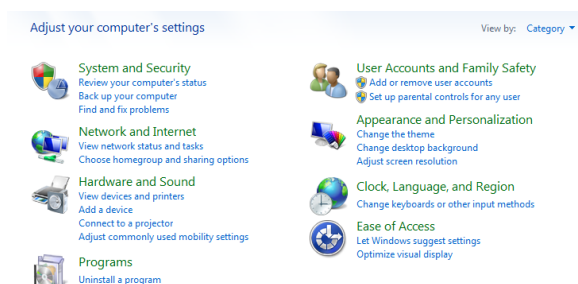


Figure 2.3.1.2

Step 2: Click on 'Hardware and Sound' as shown in figure 2.3.1.3. The window in figure 2.3.1.4 appears.

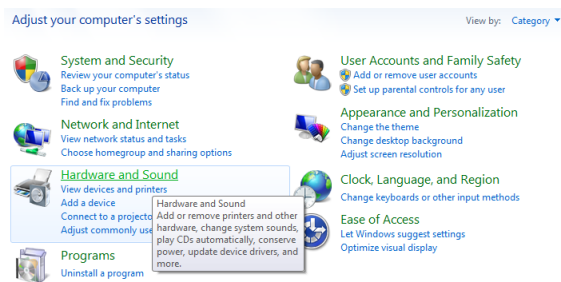


Figure 2.3.1.3

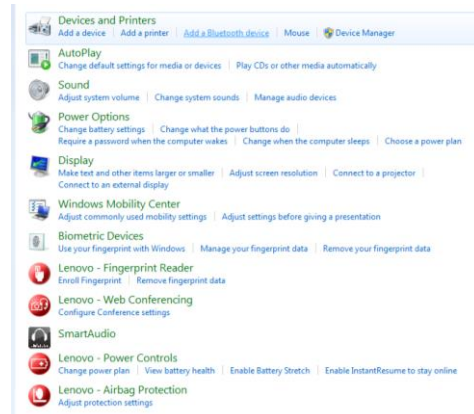


Figure 2.3.1.4

Step 3: Click on 'Add a Bluetooth device' as shown in figure 2.3.1.4. The window in figure 2.3.1.5 appears.

Step 4: Press the button on the MLL to activate the Bluetooth wireless module and wait a few seconds. The window will update with the MLL showing the serial number as shown in figure 2.3.1.6.

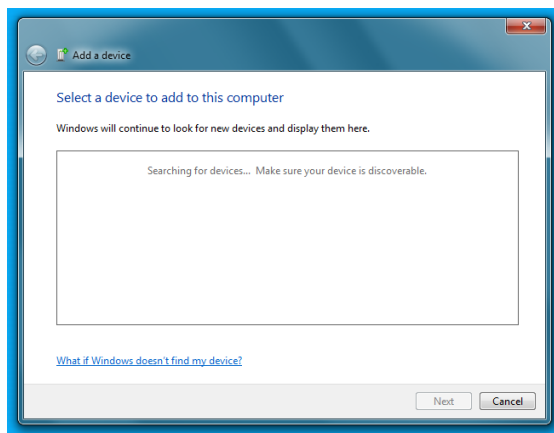


Figure 2.3.1.5

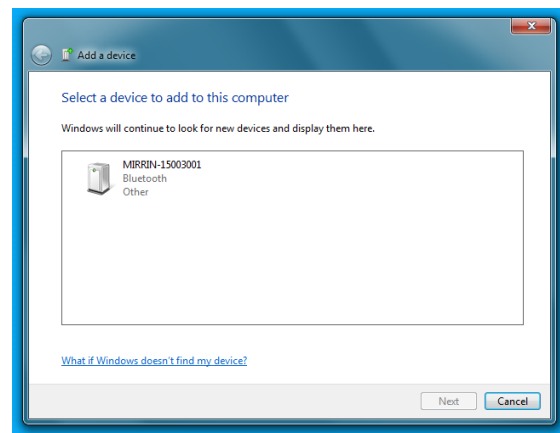


Figure 2.3.1.6

Step 5: Click on the device icon to select the device. The device icon is highlighted as shown in figure 2.3.1.7. The computer will attempt to connect to the device as shown in figure 2.3.1.8. Ensure the MLL is still active.

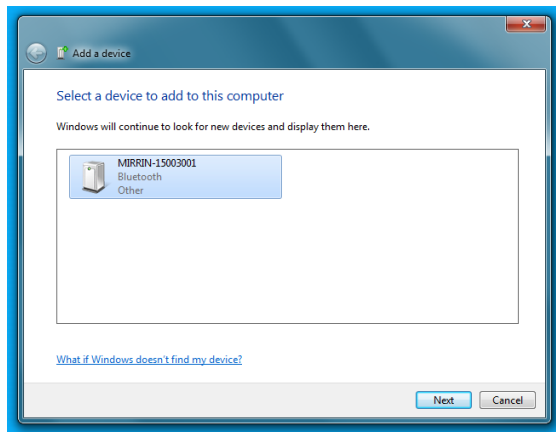


Figure 2.3.1.7

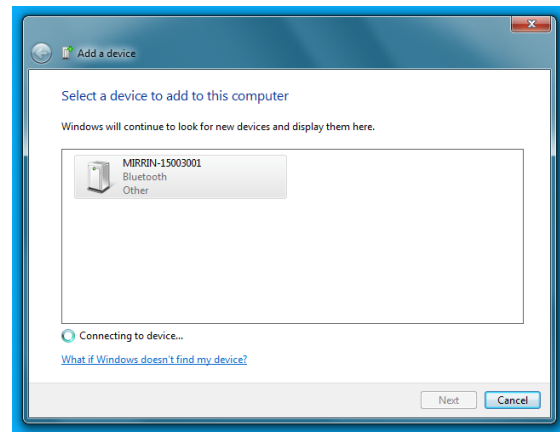


Figure 2.3.1.8

Step 6: The window in figure 2.3.1.9 appears. Click the 'Next' button. The computer is configuring the device as shown in figure 2.3.1.10.

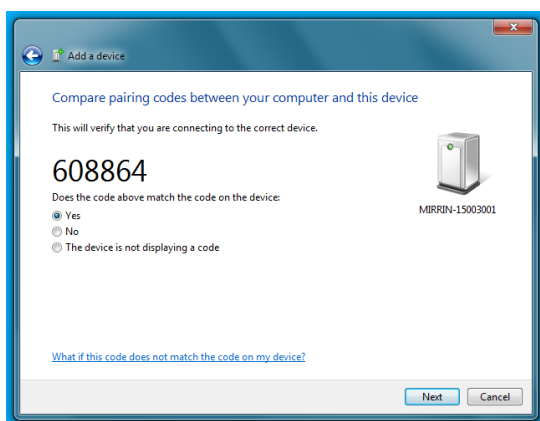


Figure 2.3.1.9

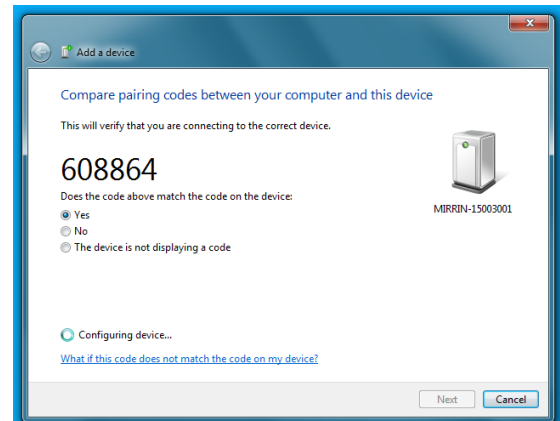


Figure 2.3.1.10

Step 7: Upon a successful pairing the window in figure 2.3.1.11 appears. Click the 'Close' button.

The device icon should now appear in the list of devices under the heading 'Devices and Printers' as shown in figure 2.3.1.12.



Figure 2.3.1.11

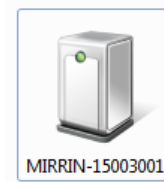


Figure 2.3.1.12

Step 8: Double click on the device icon and the window in figure 2.3.1.13 appears.

Step 9: Click on the hardware tab. The COM port assigned to this device (COM 17) is listed as shown in figure 2.3.1.14. Use this com port when connecting to this MLL using Bluetooth.

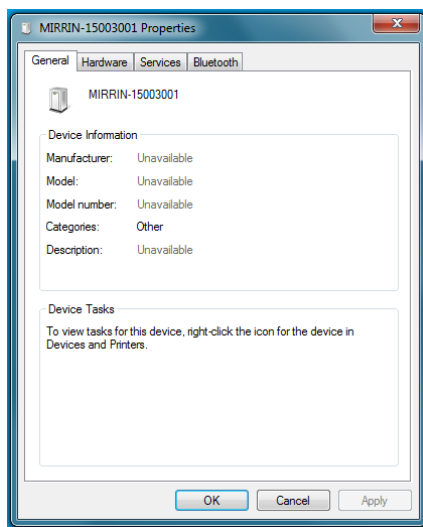


Figure 2.3.1.13

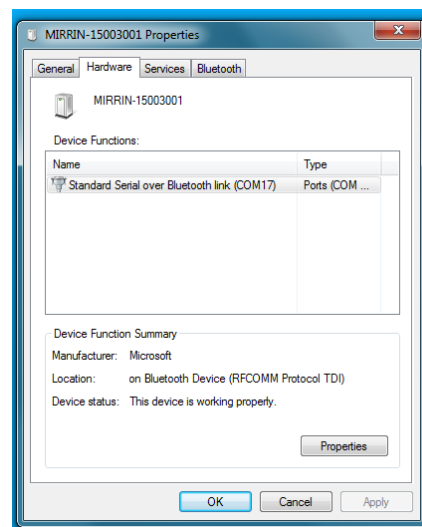


Figure 2.3.1.14

2.3.2 Establishing an access point for a WiFi enabled Mirrin

Step 1: Go to the start menu and click on the control panel icon shown in figure 2.3.2.1. The window in figure 2.3.2.2 appears.

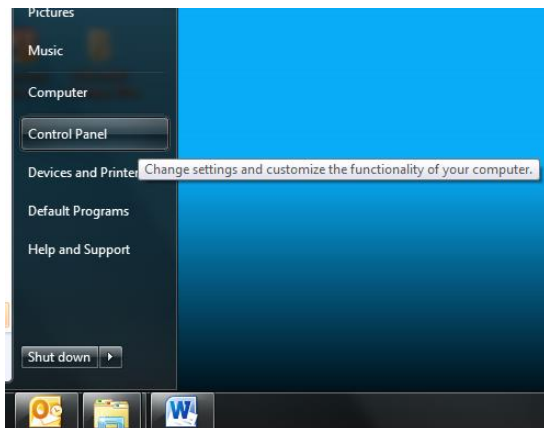


Figure 2.3.2.1

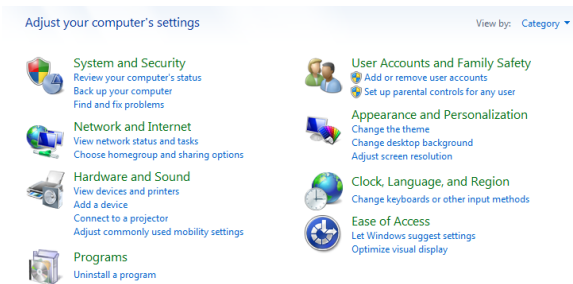


Figure 2.3.2.2

Step 2: Click on 'Network and Internet' as shown in figure 2.3.2.3. The window in figure 2.3.2.4 appears.

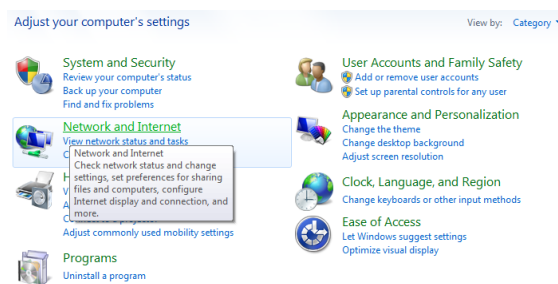


Figure 2.3.2.3

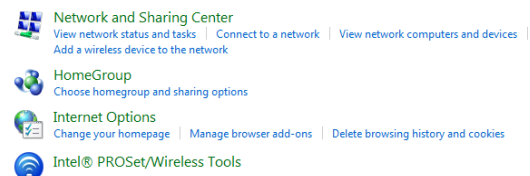


Figure 2.3.2.4

Step 3: Click on 'Network and Sharing Center' as shown in figure 2.3.2.4. The window in figure 2.3.2.5 appears.

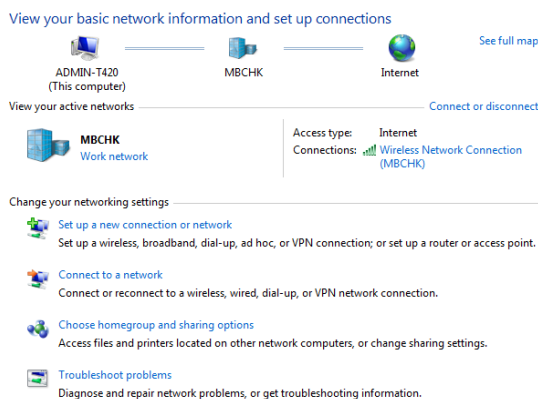


Figure 2.3.2.5

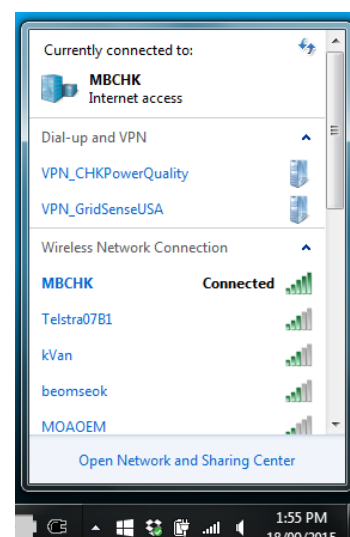


Figure 2.3.2.6



Step 4: Click on 'Connect to a Network' as shown in figure 2.3.2.5. The window in figure 2.3.2.6 appears.

Step 5: Press the button on the MLL to activate the WiFi wireless module and wait a few seconds. The window will update with the MLL showing the serial number as shown in figure 2.3.2.7.



Figure 2.3.2.7

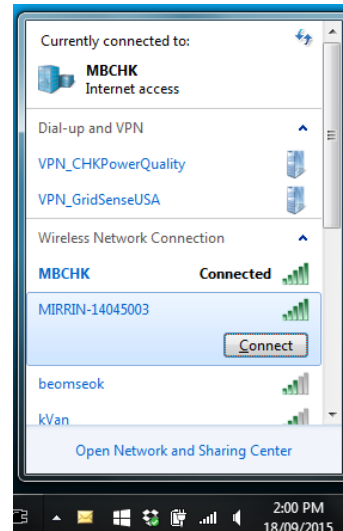


Figure 2.3.2.8

Step 6: Click on the MLL and the 'Connect' button will become visible as shown in figure 2.3.2.8.

Step 7: Click on the 'Connect' button. The window shown in figure 2.3.2.9 appears. If successful, the MLL device will be connected as shown in figure 2.3.2.10.

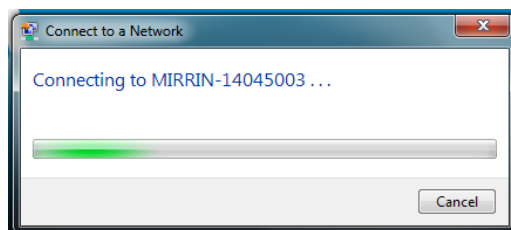


Figure 2.3.2.9

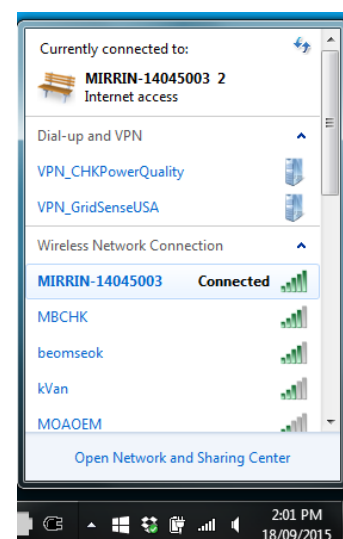


Figure 2.3.2.10



2.3.3 Connecting to the Mirrin

Step 1: Click on the Citrus icon in the start menu or double click on the Citrus icon on the desktop to launch the application. The application form shown in figure 2.3.3.1 will appear with available ports listed in the window on the left hand side.

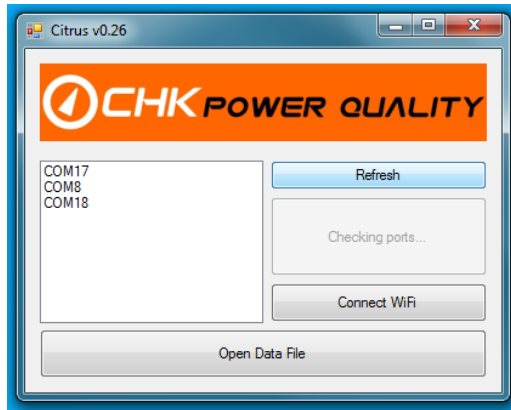


Figure 2.3.3.1

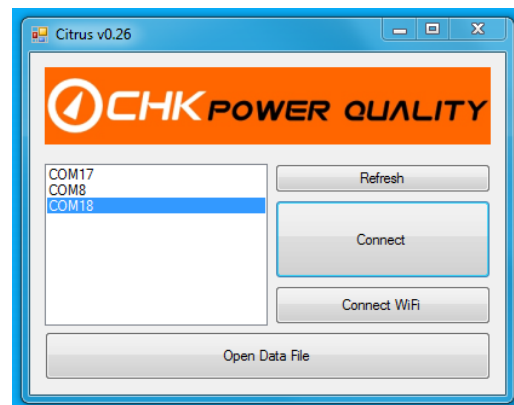


Figure 2.3.3.2

Note that the application is '**Checking ports**'. Once completed the button text changes to '**Connect**' and highlights the first port that can be opened as shown in figure 2.3.3.2. In this case it is COM18. The **Refresh** button scans for available ports and updates the list mentioned above.

Step 2: To connect using the serial cable or Bluetooth.

- (a) Using the serial cable provided connect one end to a USB port on your PC and the other end to the port of the MLL.
- (b) The serial cable is not required if using Bluetooth but ensure that the MLL's Bluetooth module is activated by pressing the button on the MLL.

Step 3: Click on the '**Connect**' button. The '**Status**' reading in the '**Status**' window shown in figure 2.4.1 will appear as '**Status: Good**' if the connection is successful. If the connection failed then a message box appears as shown in figure 2.3.3.3.

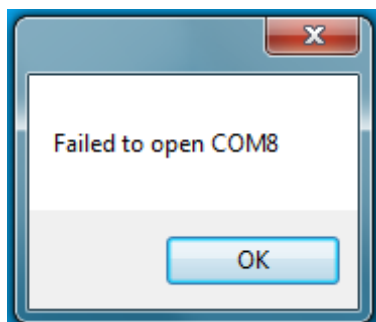


Figure 2.3.3.3

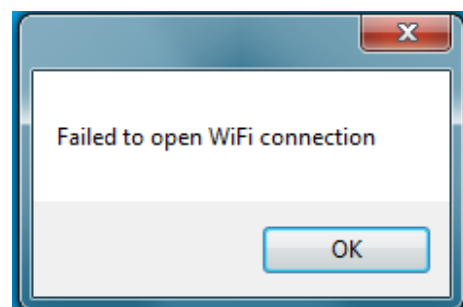


Figure 2.3.3.4



Step 4: To connect using WiFi.

The serial cable is not required if using WiFi but ensure that the MLL's WiFi module is activated by pressing the button on the MLL.

Step 5: Click on the 'Connect WiFi' button. The 'Status' reading in the 'Status' window shown in figure 2.4.1 will appear as 'Status: Good' if the connection is successful. If the connection failed then a message box appears as shown in figure 2.3.3.4.

2.4 Status Window

The status window provides useful information about the logger together with console buttons for managing the logger and its logged data.

Step 1: Click the 'Connect' button shown in figure 2.3.3.2. If communication is successful the status window will appear as shown in figures 2.4.1 and 2.4.2.

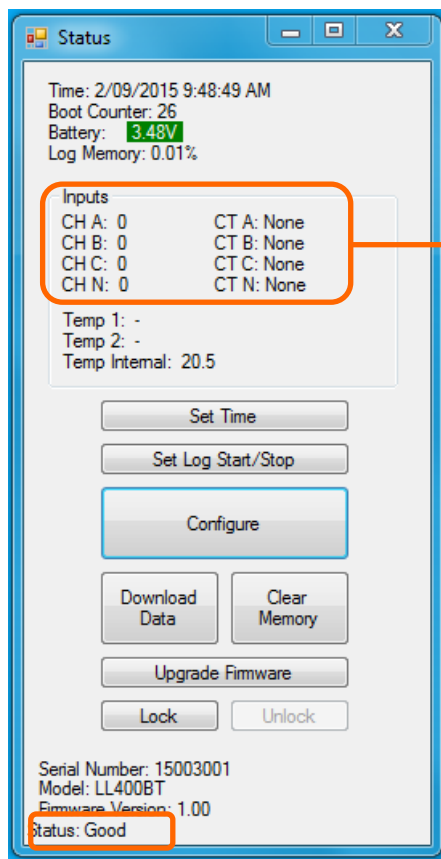


Figure 2.4.1
No sensors connected

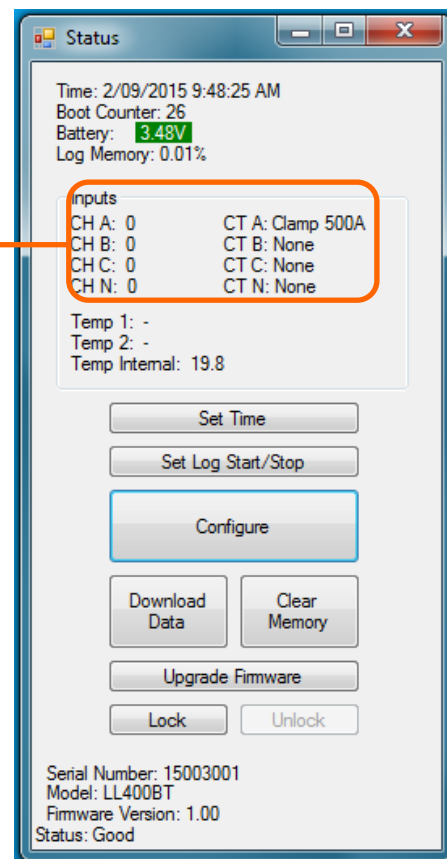


Figure 2.4.2
One sensor connected to channel A

2.4.1 Date and time

The date and time as shown in figure 2.4.1.1 is read from the logger's real time clock and updated every three seconds.



Time: 2/09/2015 9:48:49 AM

Figure 2.4.1.1

2.4.2 Boot counter

The 'Boot Counter' as shown in figure 2.4.2.1 essentially monitors the number of power-up cycles and is provided for diagnostic purposes.

Boot Counter: 26

Figure 2.4.2.1

2.4.3 Battery indicator

The battery voltage level is monitored and displayed as shown in figure 2.4.3.1. The background colour utilises a traffic light scheme as shown in figure 2.4.3.2 to provide an indication of battery health.

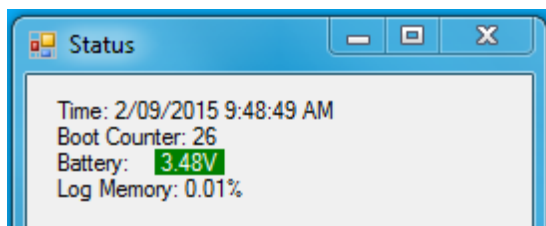


Figure 2.4.3.1

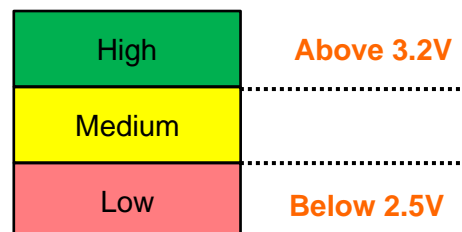


Figure 2.4.3.2

2.4.4 Log memory

'Log Memory' as shown in figure 2.4.4.1 displays the percent of memory utilised.

Log Memory: 0.01%

Figure 2.4.4.1

2.4.5 Inputs

Current: Displays the value of the load and the type of current sensor attached for each channel.

Temperature: Displays the temperature in Degrees Celsius for each channel. If the MLL does not support the optional temperature inputs the software will grey out the temperature channels and replace the value with "n/a".

2.4.6 Serial number

The 'Serial Number' is a unique number that identifies the device.



2.4.7 Model

The '**Model**' number varies according to the installed hardware features. See table below.

Model Type	Model Number	Model Type	Model Number
Standard	LL400	Temperature	LL400T
Bluetooth	LL400B	Bluetooth / Temperature	LL400BT
WiFi	LL400W	WiFi / Temperature	LL400WT

2.4.8 Firmware

The '**Firmware Version**' is the current version of code loaded in the logger.

2.4.9 Status

The '**Status**' describes the functional state of the logger.

2.5 Set time

Clicking the '**Set Time**' button sets the logger time to the PC time. An illustration of the times before and after the set is shown in figures 2.5.1 and 2.5.2.

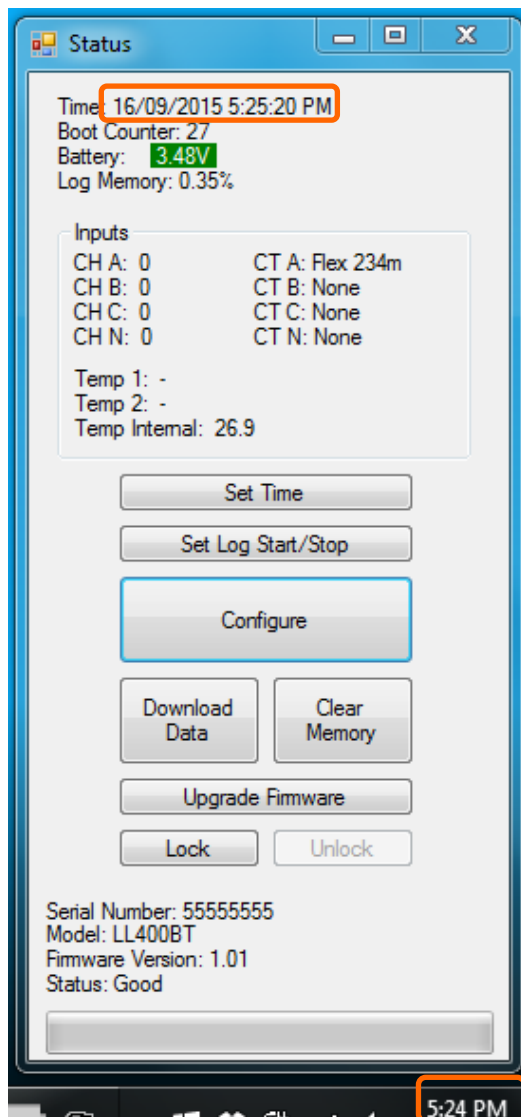


Figure 2.5.1

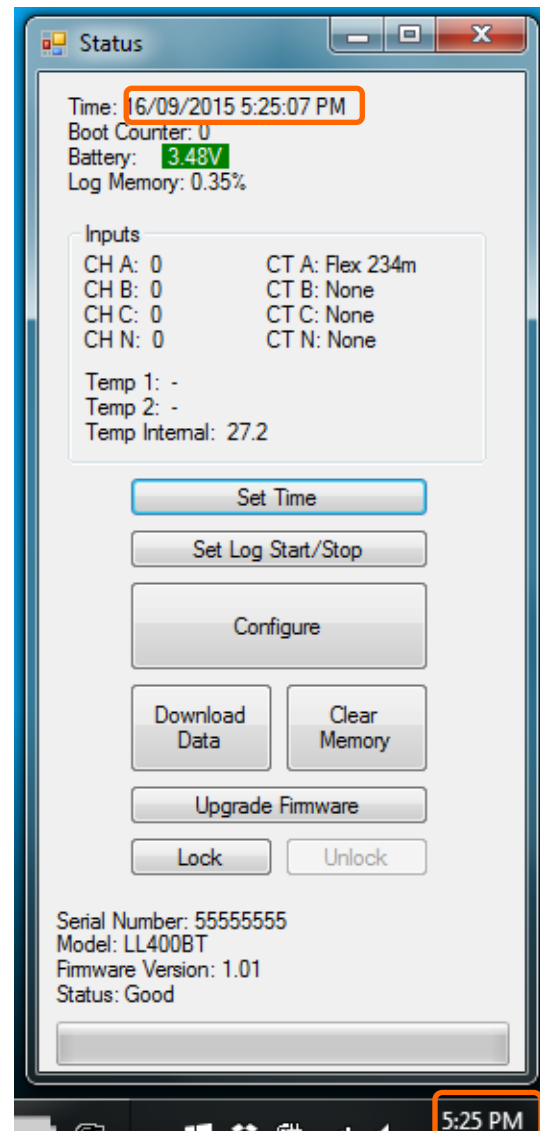


Figure 2.5.2

2.6 Set log start / stop

Step 1: Clicking the 'Set Log Start/Stop' button on the 'Status' window opens the window shown in figure 2.6.1 allowing the user to enter start and stop dates and times.

Step 2: To enable this feature, check (tick) the 'Restrict Logging Time' button as shown in figure 2.6.2.

The Start/Stop date-times are cleared automatically when the memory is cleared.

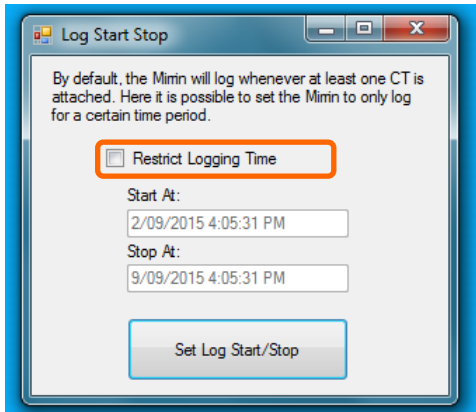


Figure 2.6.1

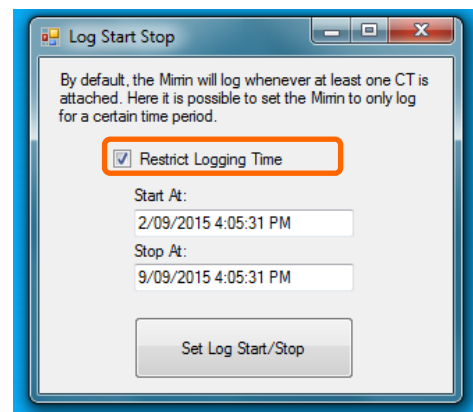


Figure 2.6.2

Step 3: Click on the 'Set Log Start/Stop' button to set (load) the start and stop times.

2.7 Configuration

Clicking the 'Configure' button on the 'Status' window opens the 'Configuration' window shown in figure 2.7.1 which displays the current configuration parameters stored in the logger.

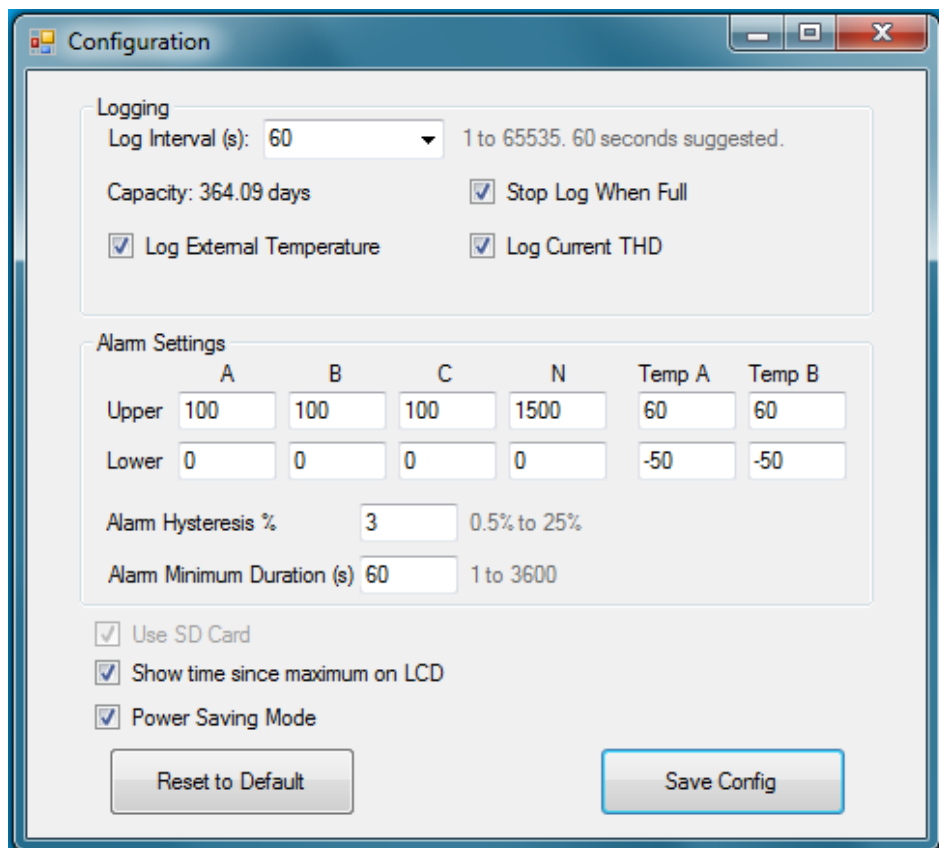


Figure 2.7.1



2.7.1 Log interval

The 'Log Interval' is settable from 1 second to 65535 seconds. The user is able to click in the cell and alter the value or click on the arrow to expand the drop down box as shown in figure 2.7.1.1 which provides some preferred options.

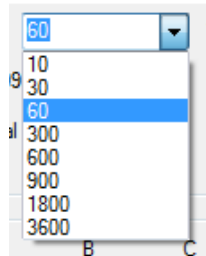


Figure 2.7.1.1

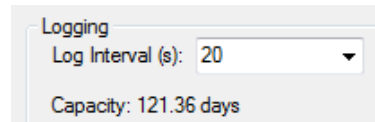


Figure 2.7.1.2

As the log interval changes the 'Capacity' also changes to reflect the available memory usage in days. The user can observe the 'Capacity' vary as the value of the 'Log Interval' is altered as shown in figure 2.7.1.2.

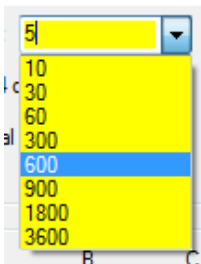


Figure 2.7.1.3

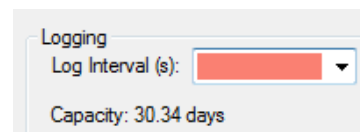


Figure 2.7.1.4

The background colour of the 'Log Interval' cell changes as follows:

Yellow: values are outside the preferred values; and
Red: values are not allowed.

The above is illustrated with figure 2.7.1.3 and 2.7.1.4.

2.7.2 Memory fill options

The function of the 'Stop Log when Full' checkbox.

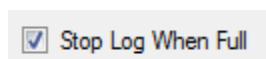


Figure 2.7.2.1

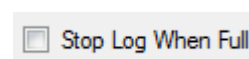


Figure 2.7.2.2

Checked (ticked) as shown in figure 2.7.2.1: The logger will stop logging when memory is full.



Unchecked (unticked) as shown in figure 2.7.2.2: The memory will continue to wrap when full and overwrite the first logged data.

2.7.3 Total harmonic distortion (THD)

Checking (ticking) the '**Log Current THD**' check box will enable the calculation and logging of THD.

2.7.4 Temperature channels

Checking (ticking) the '**Log External Temperature**' check box will enable the logging of both temperature channels. This option is not available in models that do not support external temperature channels.

2.7.5 Alarm settings

The logger provides for setting '**Upper**' and '**Lower**' alarm limits together with '**Alarm Hysteresis %**' and '**Alarm Minimum Duration**'. Figures 2.7.5.1 and 2.7.5.2 depict the alarm operations.

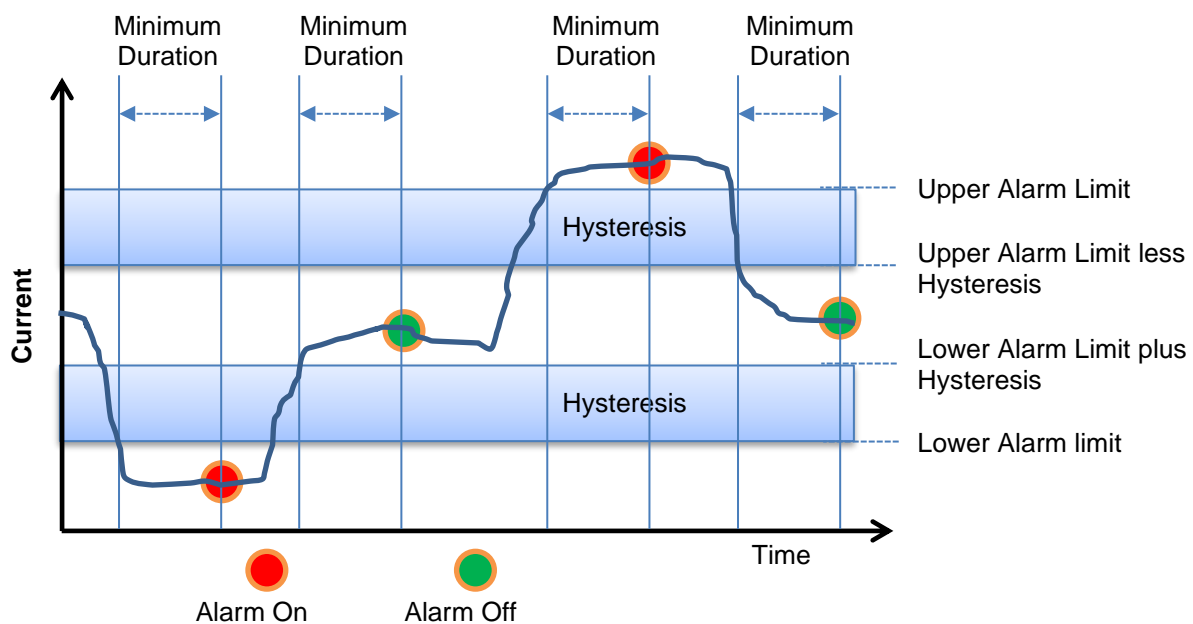


Figure 2.7.5.1



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Fax: +61 2 8212 8105
ABN: 53 169 840 831



The 'Upper' and 'Lower' magnitude threshold limits are shown in figure 2.7.5.1.1.

Figure 2.7.5.1.1

Figure 2.7.5.1.2

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Alarm Hysteresis %	0.49	0.5% to 25%
Alarm Minimum Duration (s)		1 to 3600

Figure 2.7.5.2.1

Alarm Hysteresis %	25.1	0.5% to 25%
Alarm Minimum Duration (s)	3601	1 to 3600

Figure 2.7.5.2.2

The background colour changes to red when the cell value is not allowed, as shown in figures 2.7.5.2.1 and 2.7.5.2.2.

2.7.6 Memory card

An SD Card is usually fitted to expand the base memory. If the unit is fitted with an SD card then the 'Use SD Card' check box will be ticked else remain unchecked. There is no option for the user to alter this setting.

2.7.7 Display time option for maximum value

The unit normally displays the maximum value with a time stamp of its occurrence. Checking the 'Show time since maximum on LCD' check box will instead show the elapsed time from when the maximum current occurred (from the recorded maximum demand).

2.7.8 Power saving mode

Ticking the 'Power Saving Mode' reduces the normal sampling of four cycles per second to one cycle per second and hence extends internal battery life by up to three times longer.

2.7.9 Reset to default

Clicking the 'Reset to Default' button will load factory configuration settings as shown in figure 2.7.9.1.

The Configuration window displays the following settings:

- Logging:**
 - Log Interval (s): 900 (dropdown menu, 1 to 65535, 600 seconds suggested)
 - Capacity: 5461.33 days
 - ☐ Stop Log When Full
 - ☐ Log External Temperature
 - ☒ Log Current THD
 - ☐ Log Current Min/Max
- Alarm Settings:**

	A	B	C	N	Temp A	Temp B
Upper	3000	3000	3000	3000	100	100
Lower	15	15	15	15	-50	-50

 - Alarm Hysteresis %: 0.5 (0.5% to 25%)
 - Alarm Minimum Duration (s): 1 (1 to 3600)
- ☒ Use SD Card
- ☐ Show time-since-maximum on LCD instead of actual time
- ☐ Show 15-min average on LCD instead of latest measurement
- ☐ Power Saving Mode

Buttons at the bottom: Reset to Default, NEC 220.87, Save Config

Figure 2.7.9.1



2.7.10 NEC 220.87

The Mirrin can be configured to generate the NEC220.87 Connected Load Survey reports. This report is very useful in that it gives users information on existing loads and how adding additional loads are going to affect the overall loading and if it is within the switchboard rating. Clicking the '**NEC 220.87**' button in the '**Configuration**' window as seen in figure 2.7.9.1 will set the '**Log Interval**' to 900 seconds (15 minutes) as required for the NEC220.87 report. A popup will appear confirming this change as seen in figure 2.7.9.2.

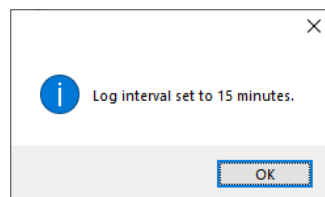


Figure 2.7.9.2

2.7.10.1 Explanation of NEC 220.87

The NEC 220.87 load analysis is useful for users who wish to perform load studies. It is a US National Electric Code requirement which specifies that calculation of a feeder or service load for existing installations shall be permitted to use actual maximum demand to determine the existing load under **all** the following conditions:

- 1) Maximum demand data is available for 1-year period.
- 2) 125% of the Maximum demand plus the addition of new loads does not exceed the current-carrying capacity of the switchboard, feeder or rating of the service.
- 3) Feeder or service has overcurrent protection in accordance with NEC 240.4 and has overload protection in accordance with NEC 230.90

There is an exception to the first rule which permit the calculated load to be based on the maximum demand recorded continuously over at least a 30-day period if maximum demand data over a 1-year period is not available. The maximum demand over the 30-day period in this case is defined as the measure of average power demand over a 15-minute measurement interval. This 30-day period is to be measured at the highest loaded phase of the feeder or service, based on the initial loading at the start of the recording.

Please note that the NEC 220.87 cannot be used for load analysis of any feeder or service that contains renewable energy systems or any form of load shaving/load shedding.



2.7.11 Save config

Clicking the 'Save Config' button commits the changes to the logger. A visual indication is shown in figure 2.7.10.1.

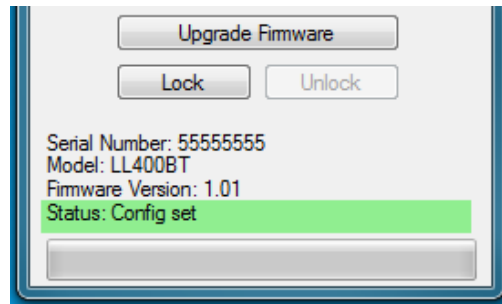


Figure 2.7.10.1

2.8 Upgrade firmware

Step 1: Click the 'Upgrade Firmware' button in the 'Status' window as shown in figure 2.8.1. A browsing window opens.

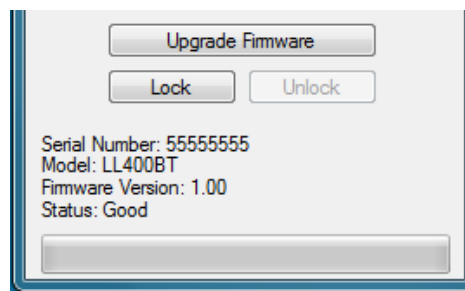


Figure 2.8.1

Step 2: Go to the folder containing the updated firmware file as shown in figure 2.8.2. Note the file has an extension of 'cfw'.

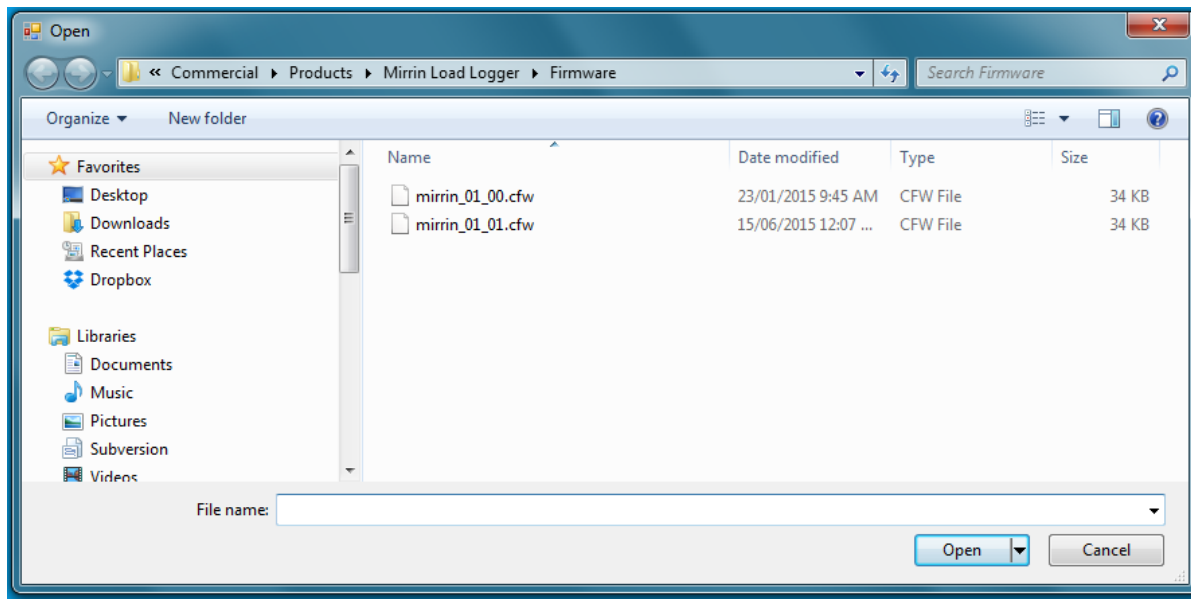


Figure 2.8.2

Step 3: Select the most recent file, in this example 'mirrin_01_01.cfw'. The selected file will appear in the 'File name' window as shown in figure 2.8.3.

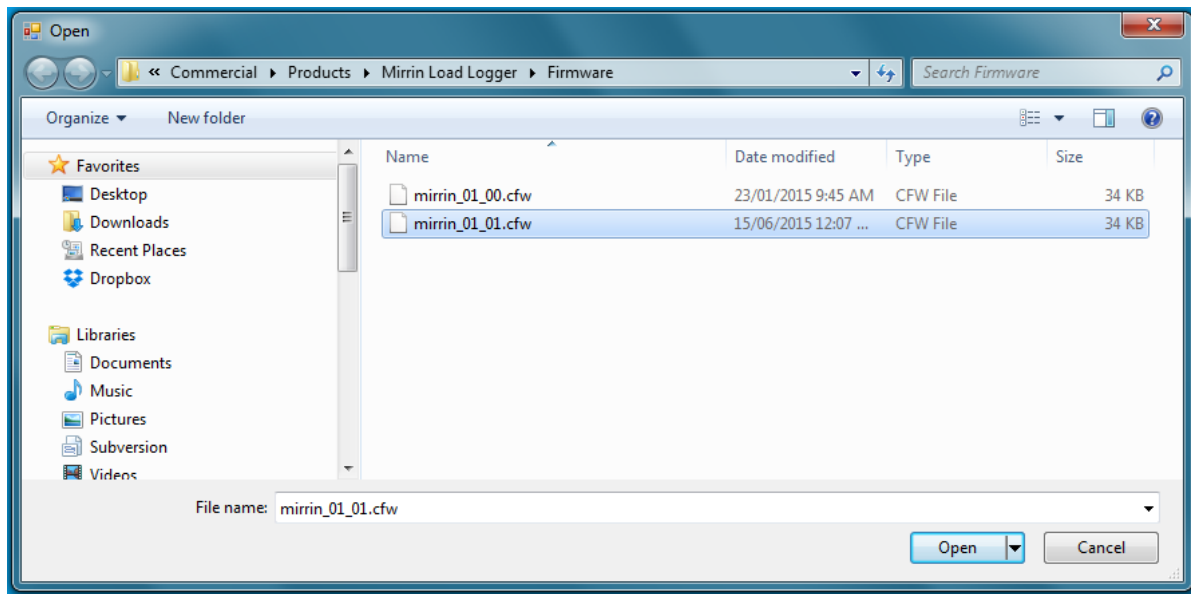


Figure 2.8.3

Step 4: Click the 'Open' button. A sequence of events will display on the 'status' screen as illustrated in figures 2.8.4 through to 2.8.7.

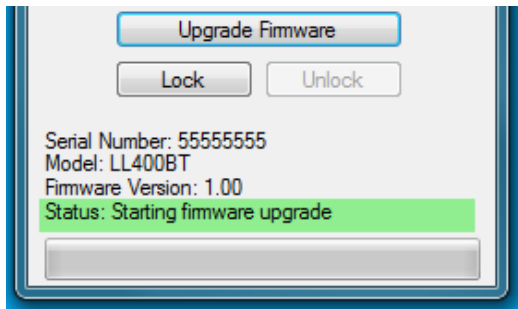


Figure 2.8.4

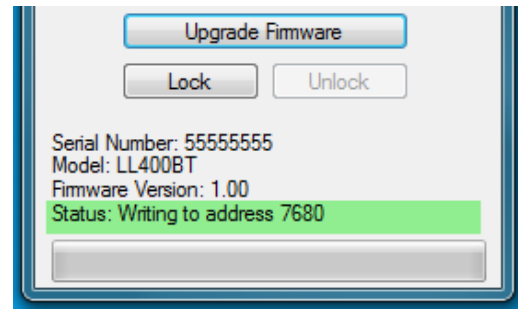


Figure 2.8.5

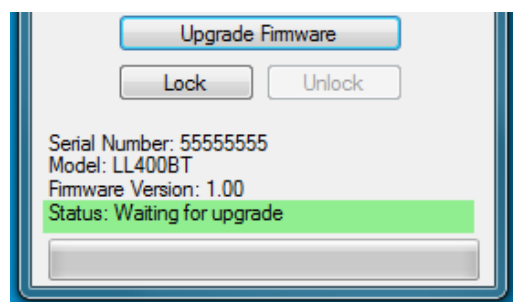


Figure 2.8.6

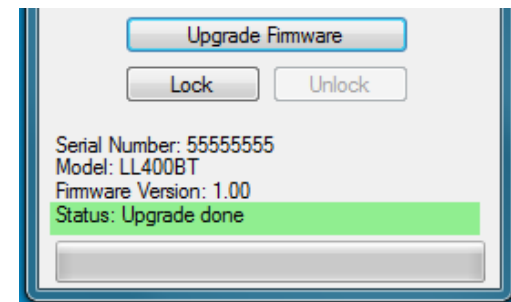


Figure 2.8.7

2.9 Downloading data

Step 1: Click the 'Download Data' button in the 'Status' window as shown in figure 2.9.1. A browsing window opens as shown in figure 2.9.2 that allows for downloading the logger file with a predefined file name in the format of 'Mirrin-Serial Number-Year-Month-Day_Hour-Minute-Second'.

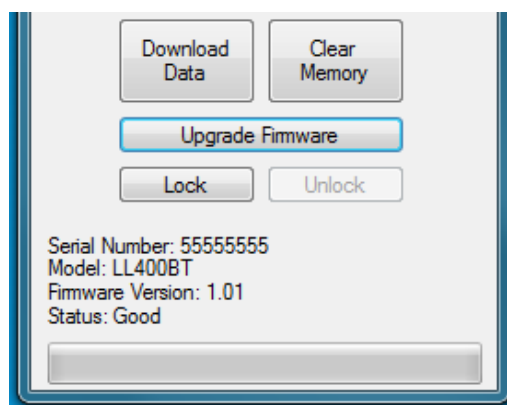


Figure 2.9.1

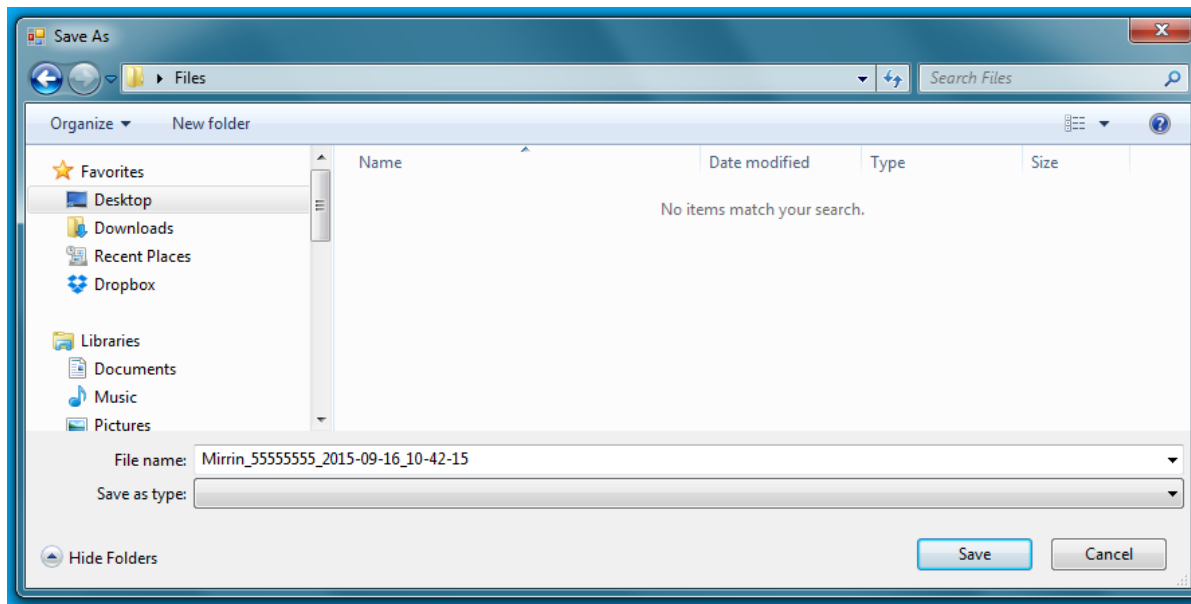


Figure 2.9.2

Step 2: Click on the 'Save' button. A sequence of events will display on the 'status' screen as illustrated in figures 2.9.3 through to 2.9.5.

Step 3: Click the 'Download Data' button again to verify that the file has been saved to the desired folder as shown in figure 2.9.6.

Step 4: Click the 'Cancel' button. The window in figure 2.9.6 closes.

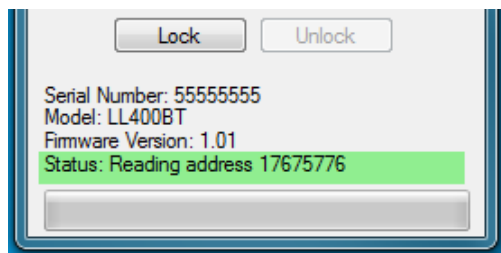


Figure 2.9.3

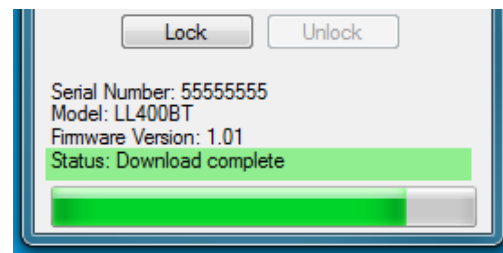


Figure 2.9.4

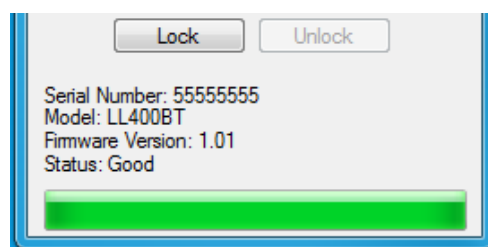


Figure 2.9.5

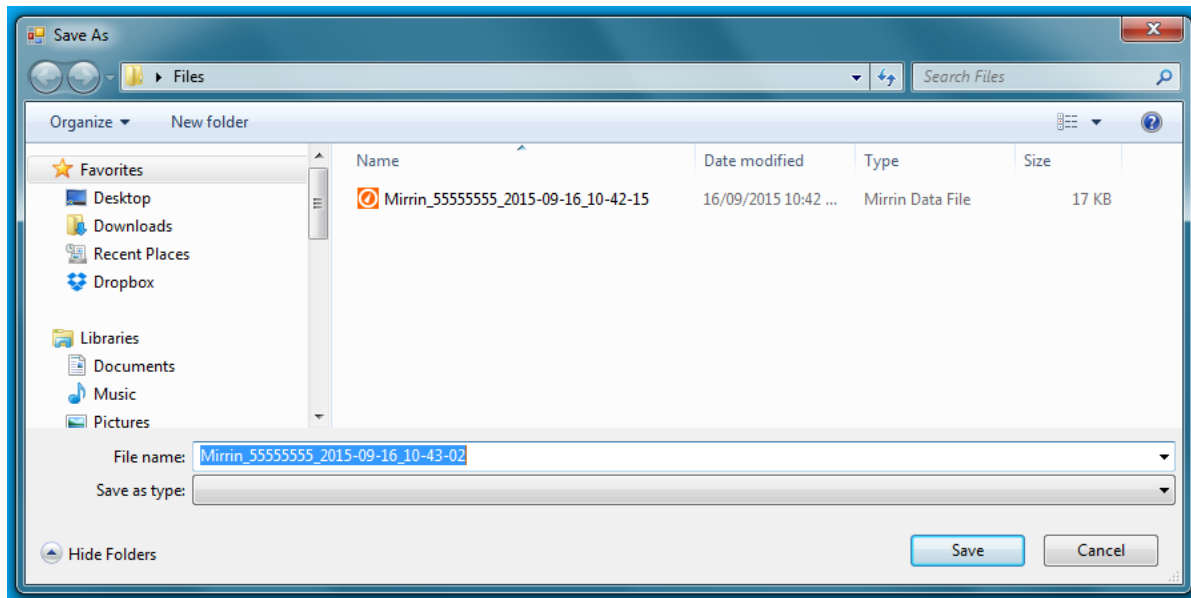


Figure 2.9.6

2.10 Clear memory

Step 1: Click on the 'Clear Memory' button in the 'Status' window as shown in figure 2.10.1. A message box as shown in figure 2.10.2 appears.

Step 2: Click on the 'Yes' button. Data is eliminated from the logger. A sequence of events will display on the 'status' screen as illustrated in figures 2.10.3 through to 2.10.4.

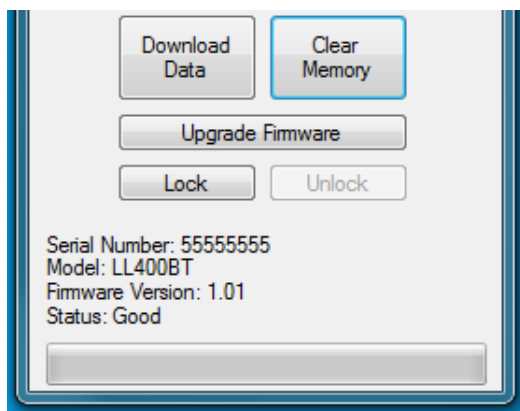


Figure 2.10.1

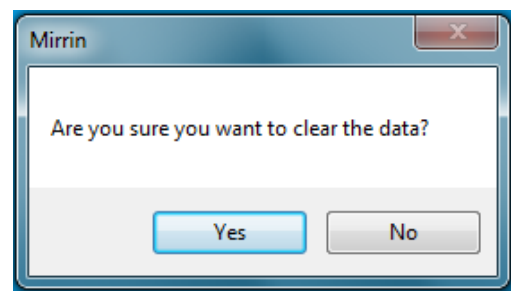


Figure 2.10.2

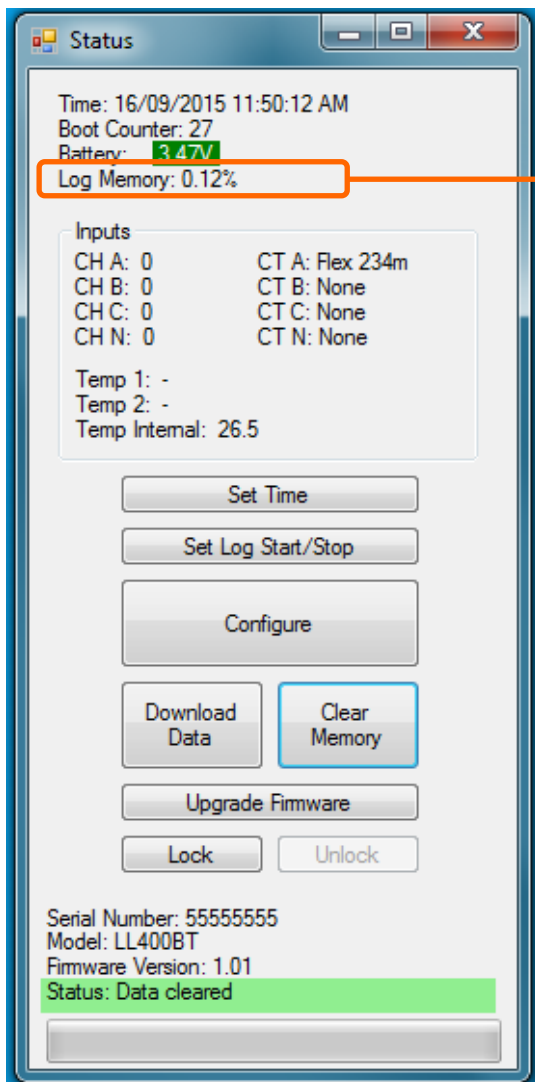


Figure 2.10.3

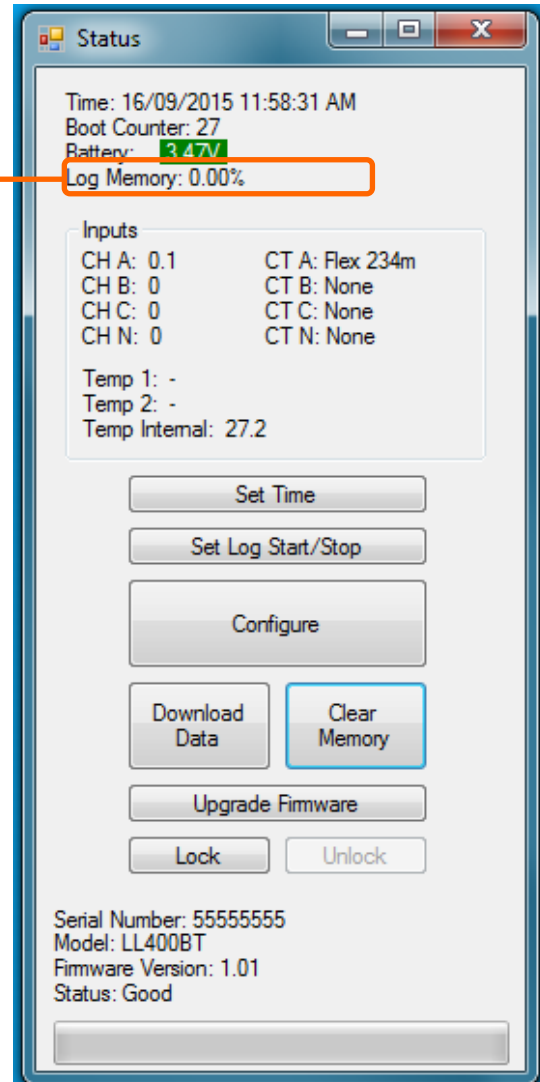


Figure 2.10.4

Note that the 'Log Memory' has been cleared.

2.11 Lock

This feature is intended to secure against unauthorised wireless access to the MLL.

Step 1: Click on the 'Lock' button in the 'Status' window as shown in figure 2.11.1. A message box as shown in figure 2.11.2 appears.

Step 2: Enter up to an eight digit number as the lock code in the input cell as shown in figure 2.11.2.

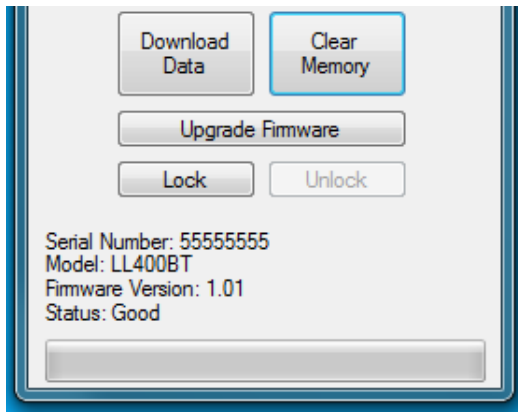


Figure 2.11.1

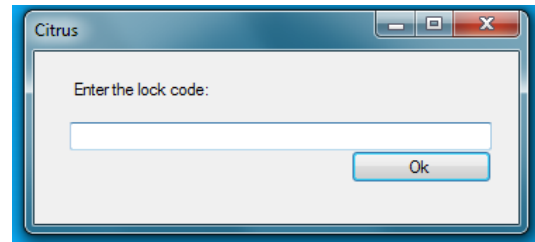


Figure 2.11.2

Step 3: Click on the 'Ok' button. The 'Status' window as shown in figure 2.11.3 is now protected.

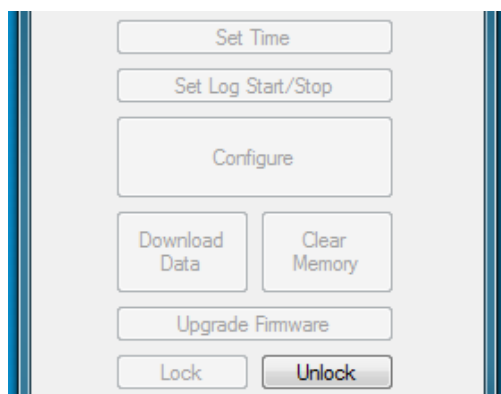


Figure 2.11.3

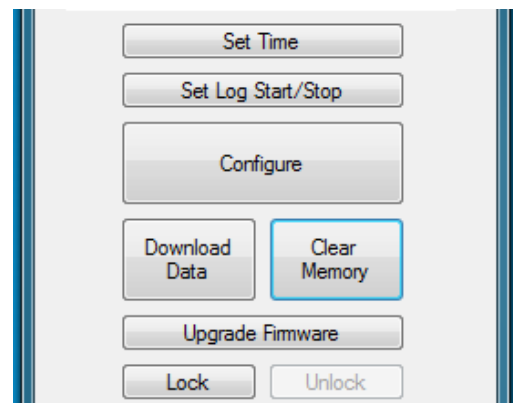


Figure 2.11.4

Step 4: Click on the 'Unlock' button, the window in figure 2.11.2 appears. Enter the lock code to unlock the device. The 'Status' window as shown in figure 2.11.4 is now unprotected.

2.12 Open data file

Step 1: Click on the 'Open Data File' button on the main 'Citrus' application menu shown in figure 2.12.1.

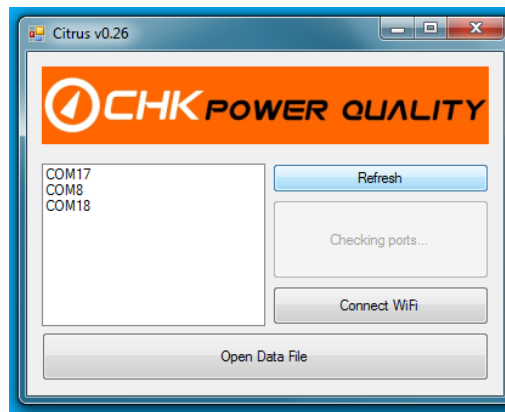


Figure 2.12.1

Step 2: A browsing window opens for locating a 'MLL file' as shown in figure 2.12.2.

Step 3: Select the desired 'MLL file' to open. The filename will appear next to 'File name' as shown in figure 2.12.3 and click on 'Open'.

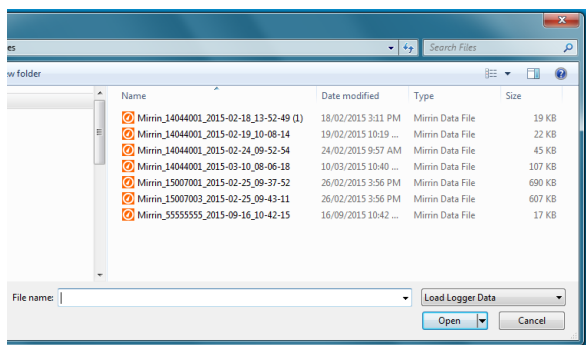


Figure 2.12.2

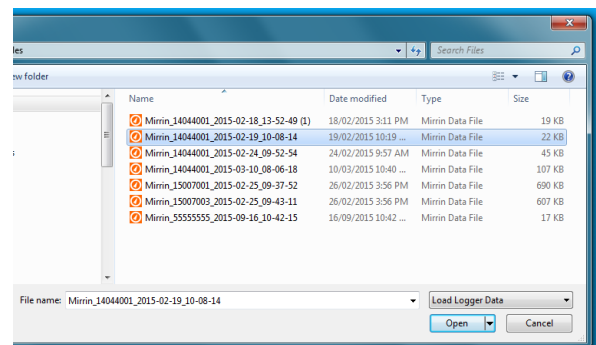


Figure 2.12.3

A graph appears as shown in figure 2.12.4 displaying four current channels together with external temperatures.

2.12.1 Active channels

All active channels able to be graphed are listed along the right hand side of the chart. In this case they include CH A, CH B, CH C, CH N, ATHD, BTHD, CTHD, NTHD, Temperature 1 and Temperature 2.

2.12.1.1 Additional active channels

Two additional channels, 'Temperature Internal' and 'Battery Voltage' become active when clicking the 'Show Diagnostics' button as shown in figure 2.12.1.1.1.

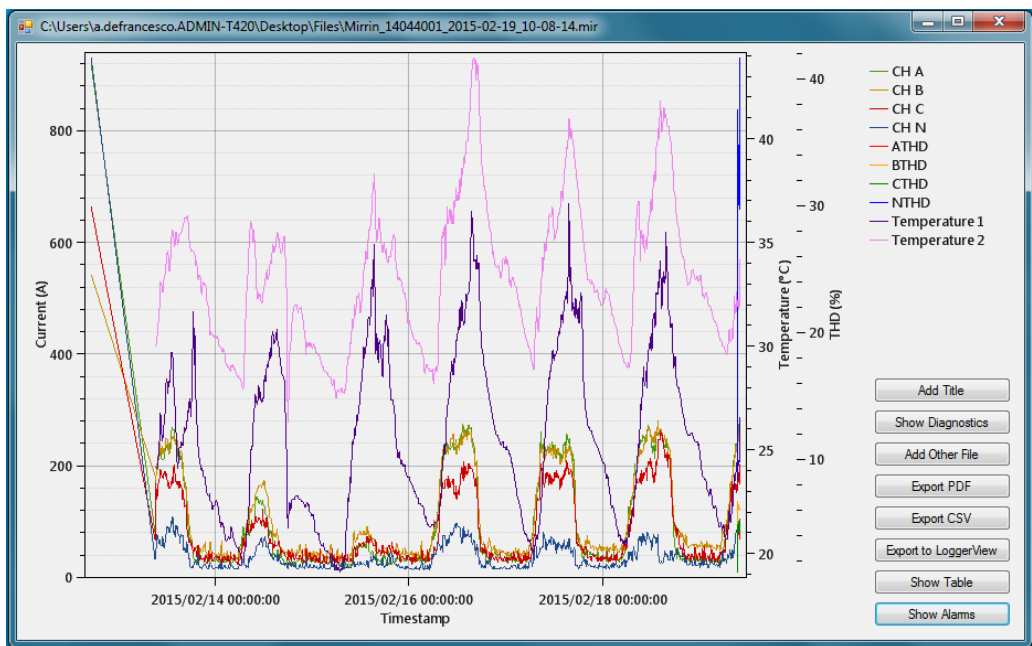


Figure 2.12.4

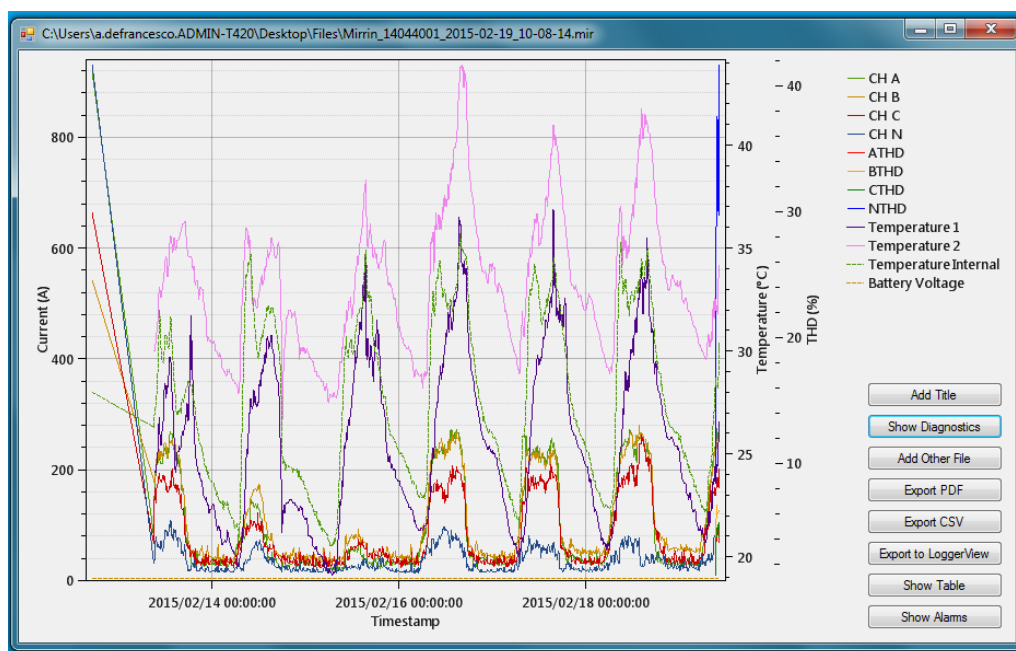


Figure 2.12.1.1.1

Toggling the 'Show Diagnostics' button effectively adds and removes these two channels which are primarily used for diagnostic purposes.

2.12.1.2 Trace selection



The user is able to remove or add any trace from the graph by alternatively clicking on the trace legend. The legend colour of deselected traces changes to a faint grey. See example shown in figure 2.12.1.2.1

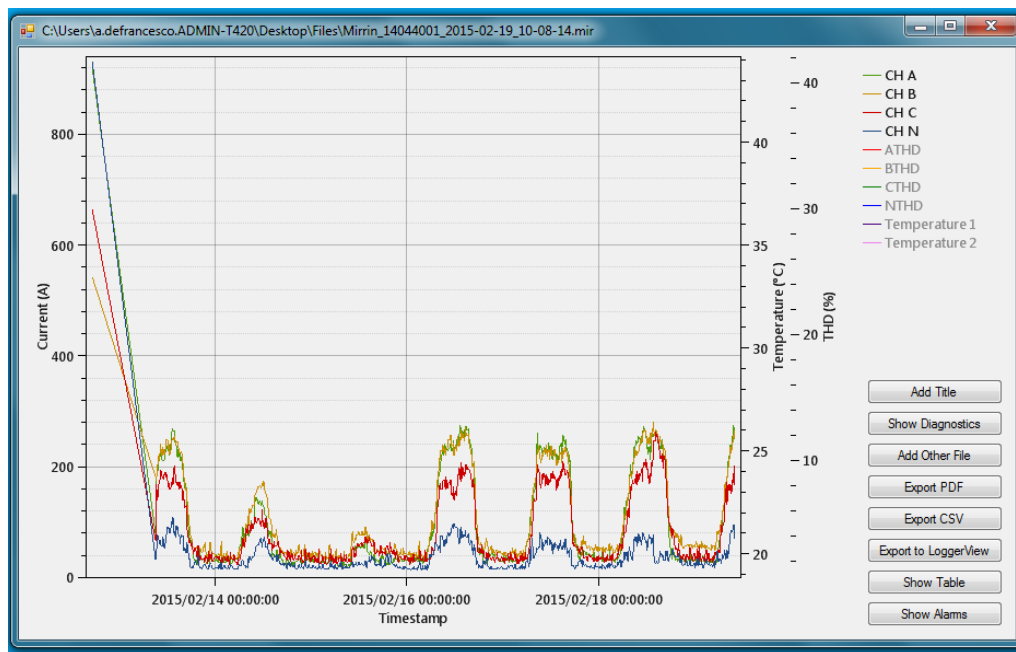


Figure 2.12.1.2.1

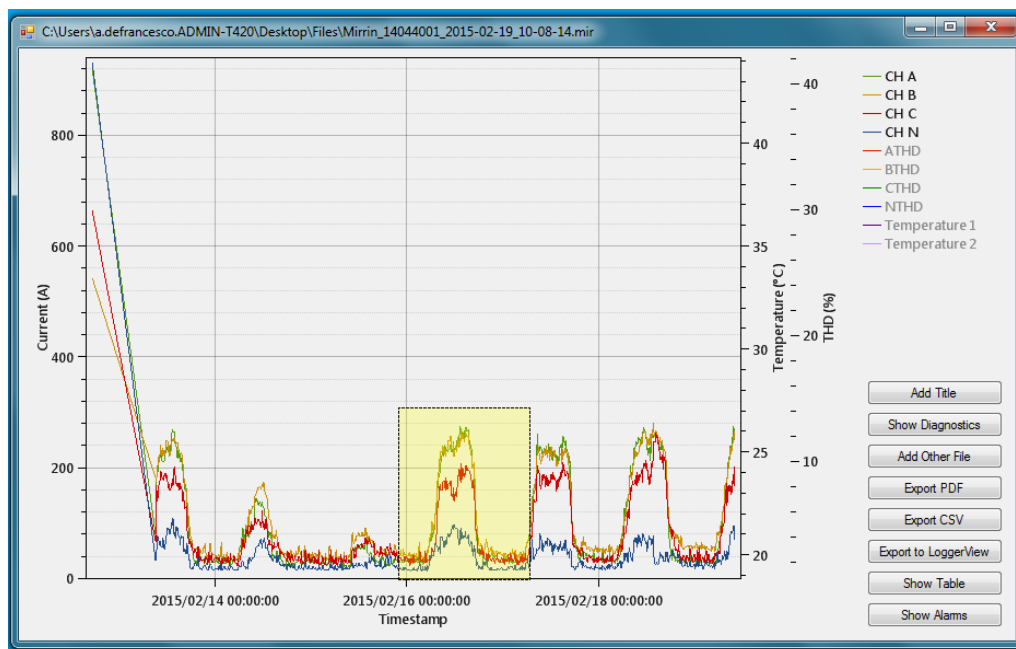


Figure 2.12.2.1



2.12.2 Adjusting scales

The user is able to alter the time and amplitude scales concurrently by selecting a portion of the graph. With the mouse the user is able to right click, hold, and drag it vertically and horizontally to generate a yellow highlighted box as shown in figure 2.12.2.1. The selected portion is expanded to fill the whole chart upon release of the right button as shown in figure 2.12.2.2. Another example is shown in figures 2.12.2.3 and 2.12.2.4.

Note: Double clicking in the chart area will reproduce the original chart using the full data range.

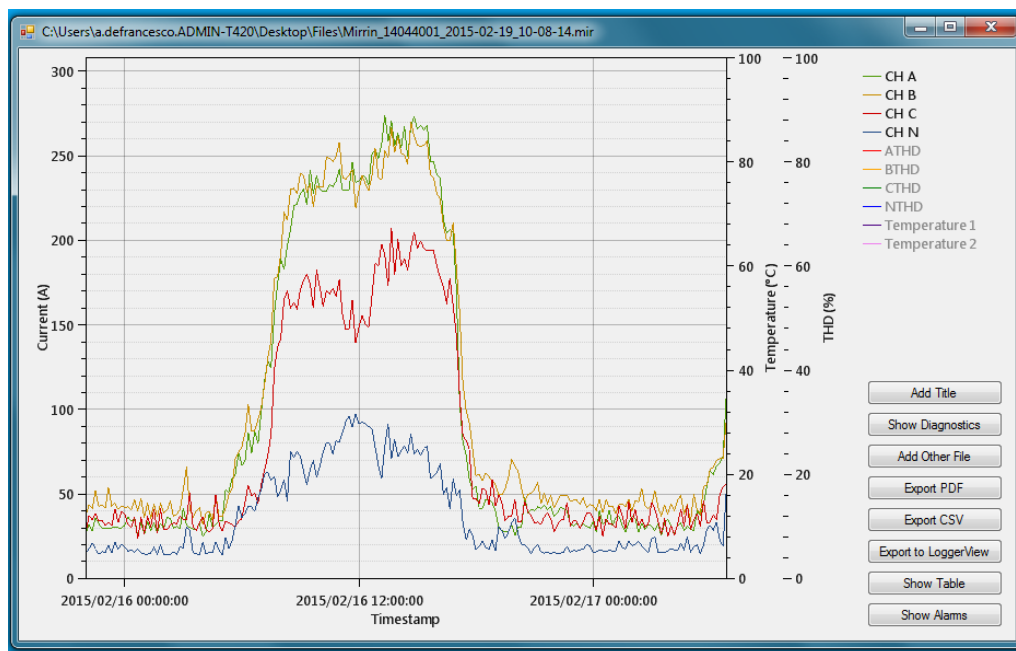


Figure 2.12.2.2

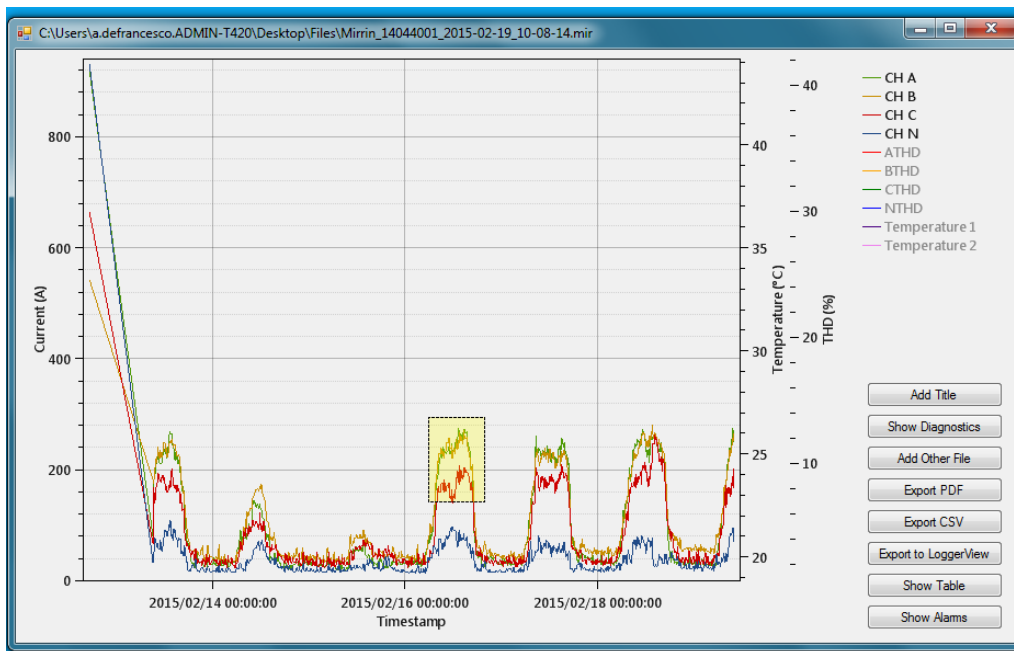


Figure 2.12.2.3



Figure 2.12.2.4

2.12.2.1 Moving axis

The user can select and move any amplitude axis by using the right hand side button on the mouse. Keeping this button pressed and hovering over the axis of interest the user can move (drag) the axis up or down. This is illustrated by moving the temperature axis down as shown in figures 2.12.2.1.1 and 2.12.2.1.2.

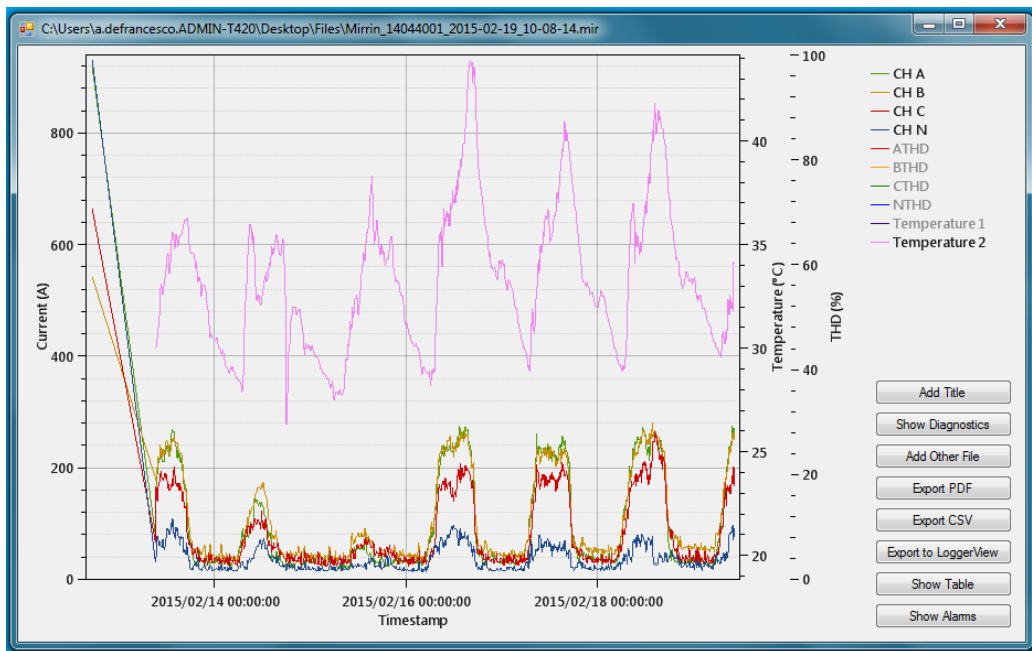


Figure 2.12.2.1.1

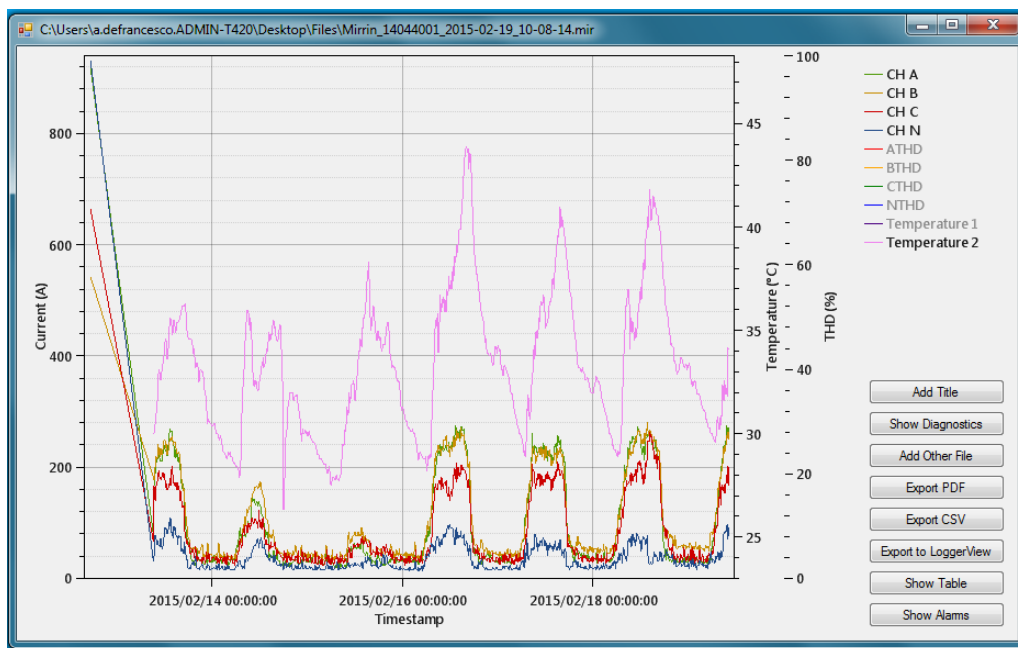


Figure 2.12.2.1.2

2.12.2.2 Changing axis range

The user can change the range of any axis. Using the centre wheel of the mouse the user can increase or decrease the range by moving the wheel up or down respectively. Figures 2.12.2.2.1 and 2.12.2.2.2 show that the ranges for the temperature and time axis have been respectively altered.

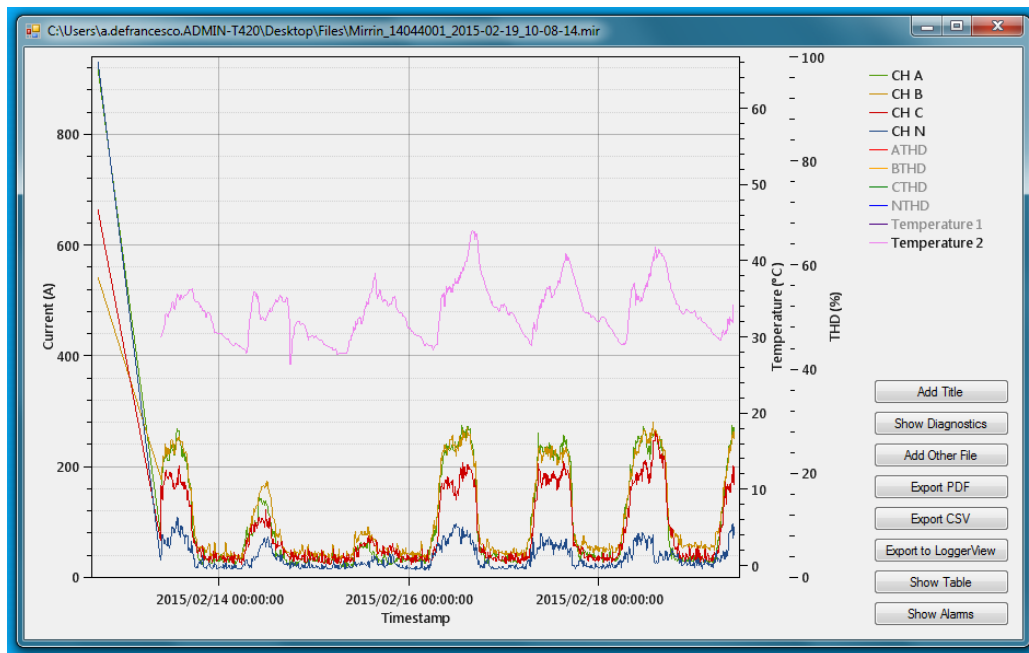


Figure 2.12.2.2.1

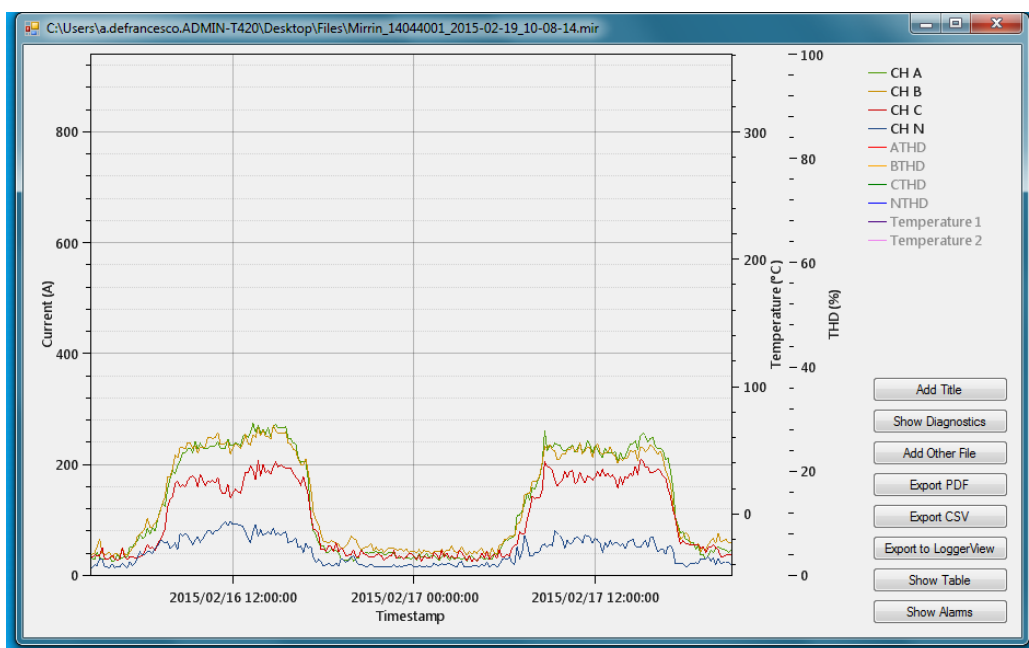


Figure 2.12.2.2.2

2.12.2.3 Zooming

The user can zoom in and out using the centre wheel of the mouse. Hover inside the chart area and over the portion of the chart which you desire to zoom. The user can increase or decrease the zoom by moving the wheel up or down respectively. Figures 2.12.2.3.2 and 2.12.2.3.3 show zoom-in and zoom-out with respect to figure 2.12.2.3.1.

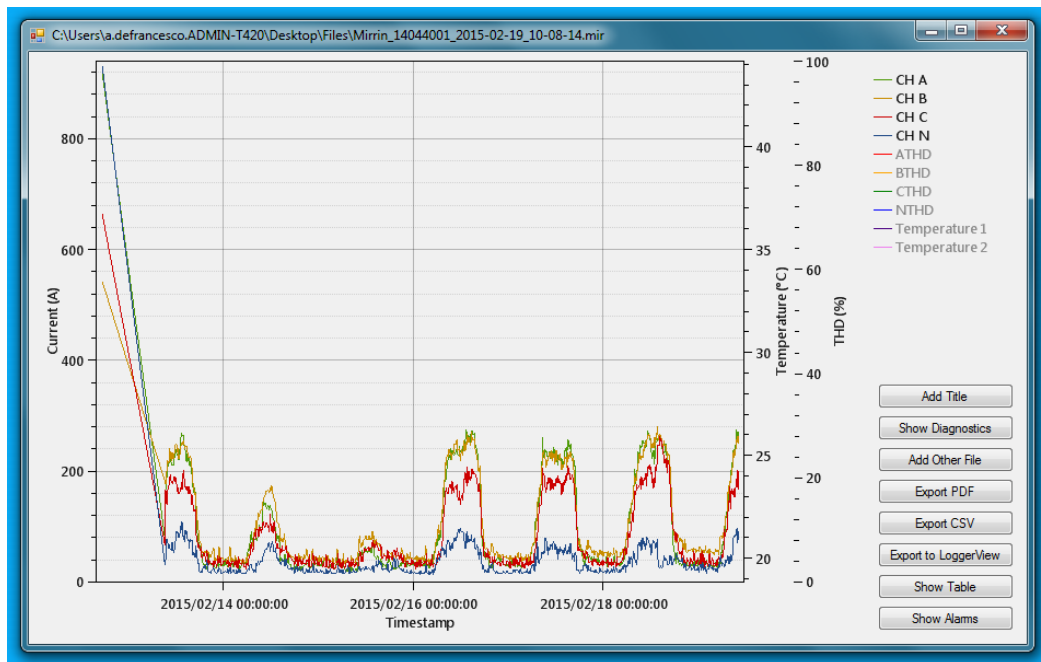


Figure 2.12.2.3.1

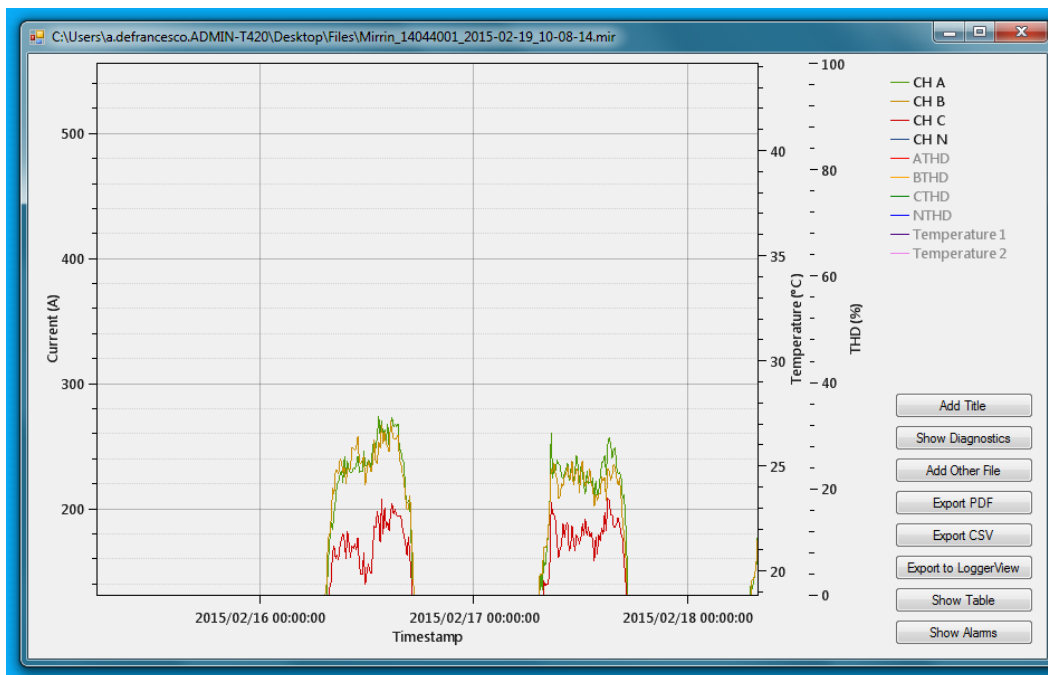


Figure 2.12.2.3.2

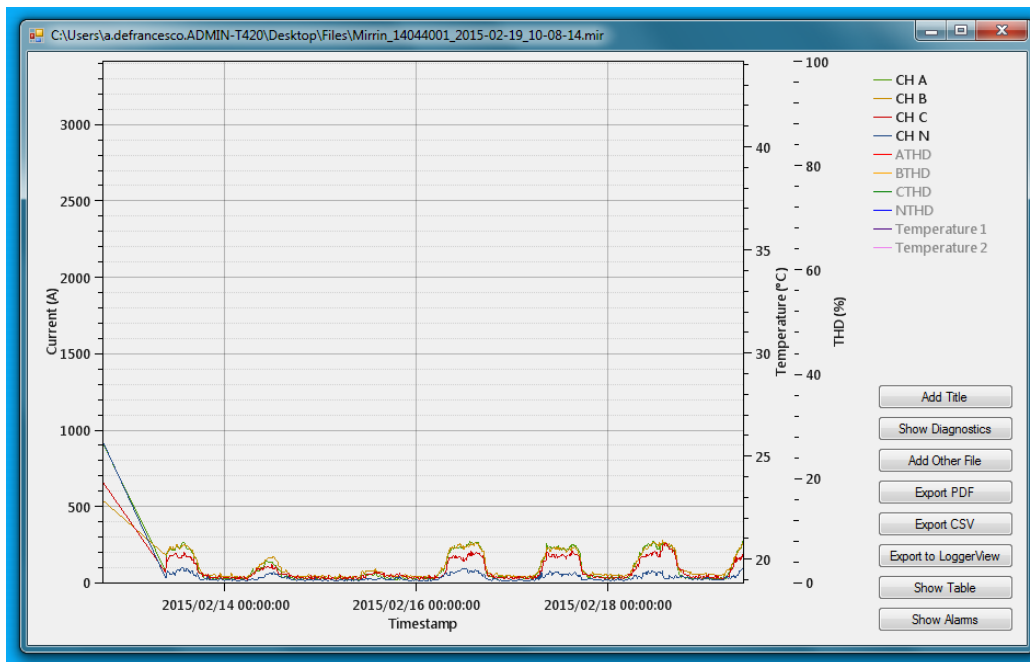


Figure 2.12.2.3.3

2.12.3 Title

Step 1: Click on the 'Add Title' button. A window opens as shown in figure 2.12.3.1.

Step 2: Enter a description as shown in figure 2.12.3.2. and then click the 'Ok' button. The chart is now updated with a title as shown in figure 2.12.3.3

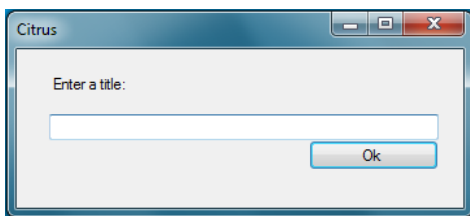


Figure 2.12.3.1

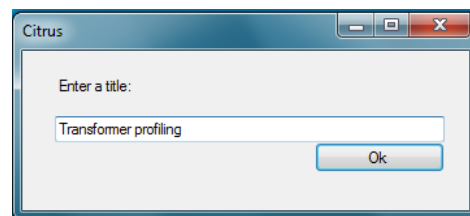


Figure 2.12.3.2

Repeat step 1 to remove the title, but enter nothing.

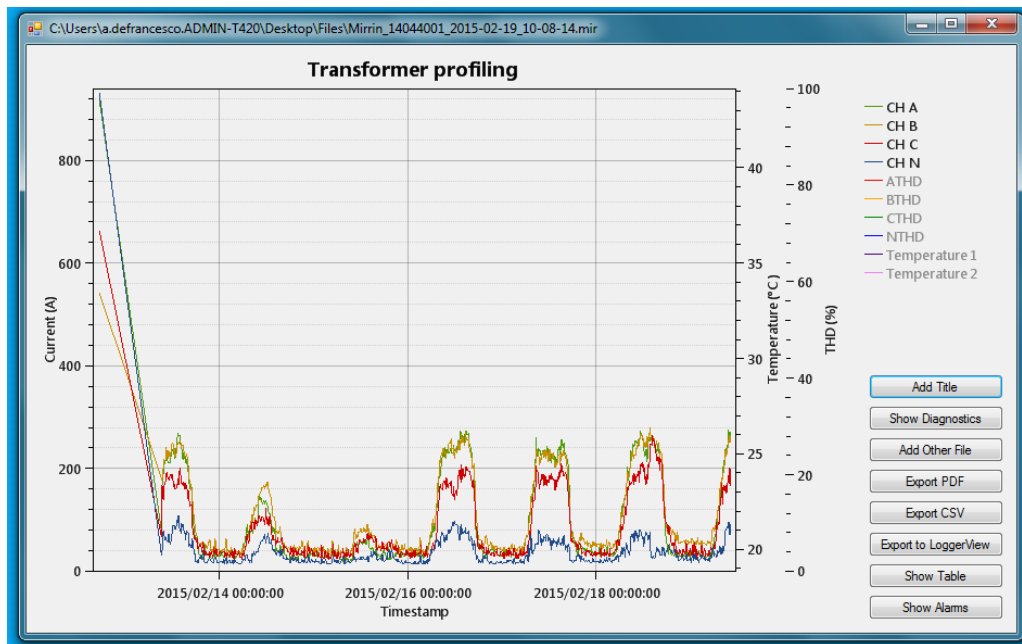


Figure 2.12.3.3

2.12.4 Generate a PDF

Step 1: Click on the 'Export PDF' button. A browsing window opens as shown in figure 2.12.4.1.

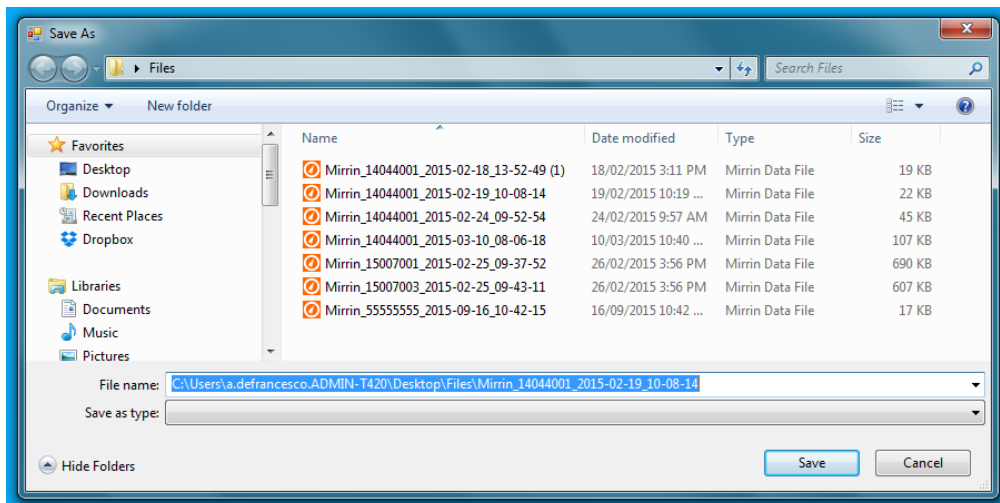


Figure 2.12.4.1

Step 2: Click on the 'Save' button. The window closes.

Step 3: Again, click on the 'Export PDF' button. A browsing window opens as shown in figure 2.12.4.2. Note that the folder now also includes the recently saved PDF.

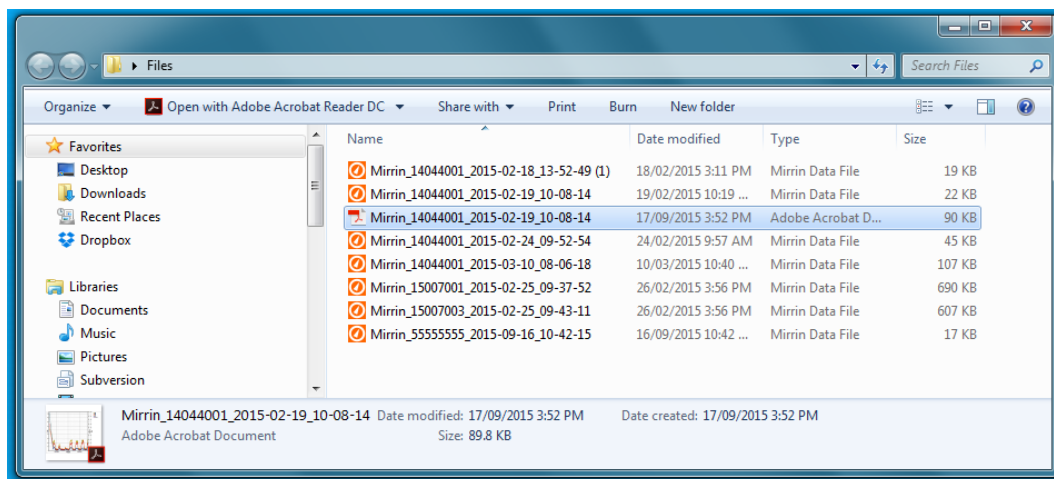


Figure 2.12.4.2

Step 4: Double click on the 'PDF' as shown in figure 2.12.4.2. The PDF is shown in figure 2.12.4.3.

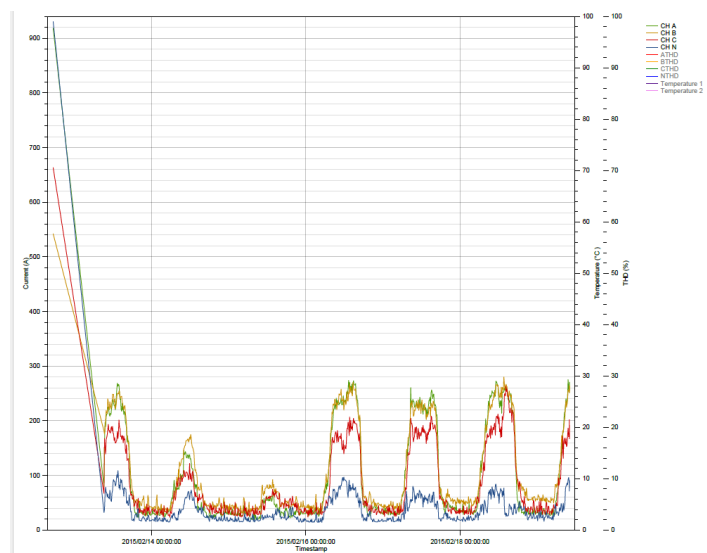


Figure 2.12.4.3



2.12.5 Export CSV

Step 1: Click on the 'Export CSV' button. A browsing window opens as shown in figure 2.12.5.1.

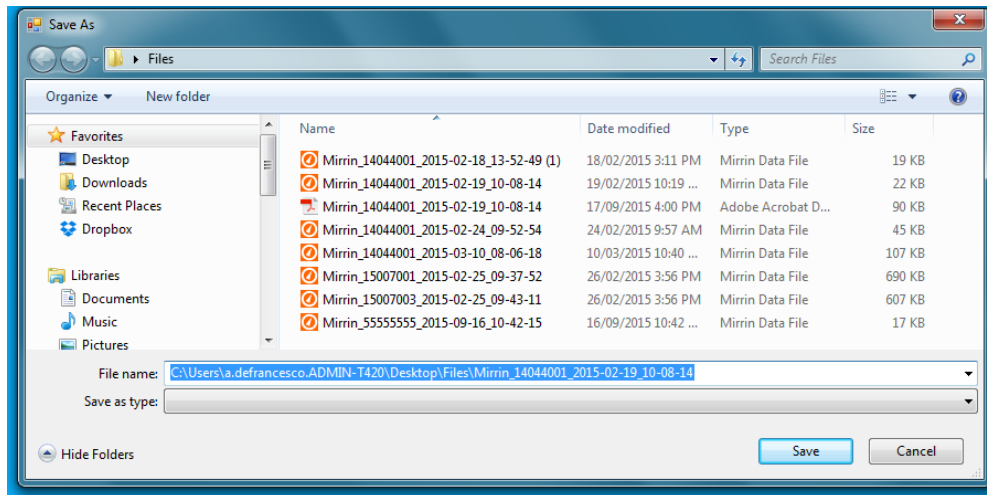


Figure 2.12.5.1

Step 2: Click on the 'Save' button. The window closes.

Step 3: Again, click on the 'Export CSV' button. A browsing window opens as shown in figure 2.12.5.2. Note that the folder now also includes two CSV files, one for data and other for alarms.

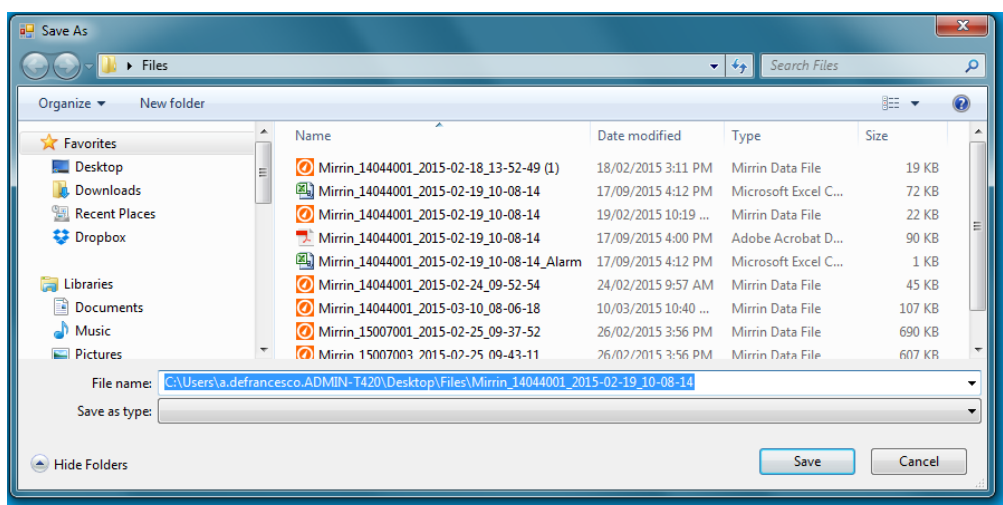


Figure 2.12.5.2



2.12.6 Export to LoggerView

Step 1: Click on the 'Export to LoggerView' button. A message window popup appears as shown in figure 2.12.6.1.

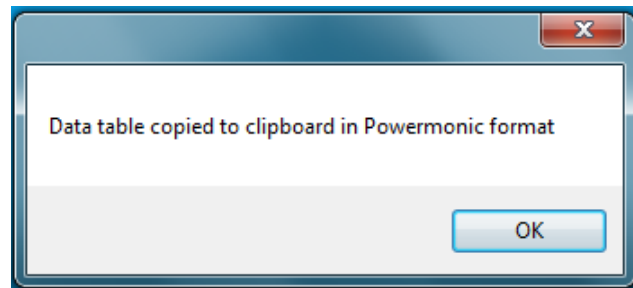


Figure 2.12.6.1

2.12.7 Show table

Step 1: Click on the 'Show Table' button. A list of logged values is displayed in a table as shown in figure 2.12.7.1.

Timestamp	CH A	CH B	CH C	CH N	THD A (%)	THD B (%)	THD C (%)	THD N (%)	Ext Temp 1 (C)	Ext Temp 2 (C)	Internal Temp (C)
12/02/2015 5:20:00 PM	918.8	542.4	663.7	930.9	-100.0	-100.0	-100.0	-100.0	6310.2	6309.7	28.0
13/02/2015 9:10:00 AM	79.6	181.4	66.9	31.8	-100.0	-100.0	-100.0	-100.0	6310.2	30.0	26.3
13/02/2015 9:20:00 AM	162.6	176.0	167.7	37.9	-100.0	-100.0	-100.0	-100.0	24.2	30.0	27.0
13/02/2015 9:30:00 AM	196.9	187.1	152.4	64.9	-100.0	-100.0	-100.0	-100.0	24.1	30.2	27.1
13/02/2015 9:40:00 AM	188.9	201.0	138.9	78.7	-100.0	-100.0	-100.0	-100.0	24.1	30.5	27.4
13/02/2015 9:50:00 AM	207.5	219.3	166.2	69.7	-100.0	-100.0	-100.0	-100.0	24.4	30.8	27.7
13/02/2015 10:00:00 AM	211.7	214.9	168.5	68.6	-100.0	-100.0	-100.0	-100.0	24.7	31.2	28.5
13/02/2015 10:10:00 AM	212.7	213.4	174.2	60.5	-100.0	-100.0	-100.0	-100.0	25.1	31.4	29.0
13/02/2015 10:20:00 AM	222.3	240.6	181.9	66.5	-100.0	-100.0	-100.0	-100.0	25.9	32.3	29.9
13/02/2015 10:30:00 AM	225.5	234.9	193.8	58.8	-100.0	-100.0	-100.0	-100.0	26.8	33.1	31.4
13/02/2015 10:40:00 AM	218.9	223.1	182.7	60.5	-100.0	-100.0	-100.0	-100.0	26.1	33.0	32.0
13/02/2015 10:50:00 AM	211.3	219.8	182.3	56.7	-100.0	-100.0	-100.0	-100.0	25.6	32.9	31.1
13/02/2015 11:00:00 AM	208.4	234.9	178.6	72.8	-100.0	-100.0	-100.0	-100.0	25.4	32.6	30.1
13/02/2015 11:10:00 AM	213.7	226.5	177.7	65.0	-100.0	-100.0	-100.0	-100.0	25.9	32.6	29.5
13/02/2015 11:20:00 AM	211.5	221.8	185.6	54.2	-100.0	-100.0	-100.0	-100.0	26.2	33.2	29.4
13/02/2015 11:30:00 AM	220.6	229.3	189.3	52.1	-100.0	-100.0	-100.0	-100.0	26.4	33.3	29.5
13/02/2015 11:40:00 AM	228.2	234.2	181.2	67.7	-100.0	-100.0	-100.0	-100.0	26.9	33.5	29.4
13/02/2015 11:50:00 AM	239.3	248.6	189.8	73.0	-100.0	-100.0	-100.0	-100.0	28.1	33.8	30.0
13/02/2015 12:00:00 PM	236.5	248.3	177.5	88.6	-100.0	-100.0	-100.0	-100.0	28.4	34.3	30.6
13/02/2015 12:10:00 PM	232.2	248.1	175.6	92.4	-100.0	-100.0	-100.0	-100.0	28.3	34.5	30.8
13/02/2015 12:20:00 PM	227.9	233.5	163.5	88.8	-100.0	-100.0	-100.0	-100.0	27.7	34.6	30.8
13/02/2015 12:30:00 PM	227.7	240.3	169.6	88.8	-100.0	-100.0	-100.0	-100.0	28.3	34.3	30.6
13/02/2015 12:40:00 PM	219.7	222.2	159.3	81.0	-100.0	-100.0	-100.0	-100.0	28.2	33.6	30.3
13/02/2015 12:50:00 PM	228.7	224.8	159.5	81.8	-100.0	-100.0	-100.0	-100.0	28.4	33.6	30.2
13/02/2015 1:00:00 PM	243.4	231.2	162.4	90.0	-100.0	-100.0	-100.0	-100.0	28.9	34.3	30.1
13/02/2015 1:10:00 PM	258.2	244.3	164.9	101.1	-100.0	-100.0	-100.0	-100.0	29.7	34.9	30.8
13/02/2015 1:20:00 PM	269.0	250.3	180.8	95.5	-100.0	-100.0	-100.0	-100.0	29.7	35.6	31.3
13/02/2015 1:30:00 PM	262.9	248.1	167.2	109.0	-100.0	-100.0	-100.0	-100.0	29.6	35.6	31.7
13/02/2015 1:40:00 PM	266.5	248.8	178.4	87.5	-100.0	-100.0	-100.0	-100.0	29.5	35.3	31.0

Figure 2.12.7.1

2.12.8 Show alarms

Step 1: Click on the 'Show Alarms' button. A list of alarms is displayed in a table as shown in figure 2.12.8.1.

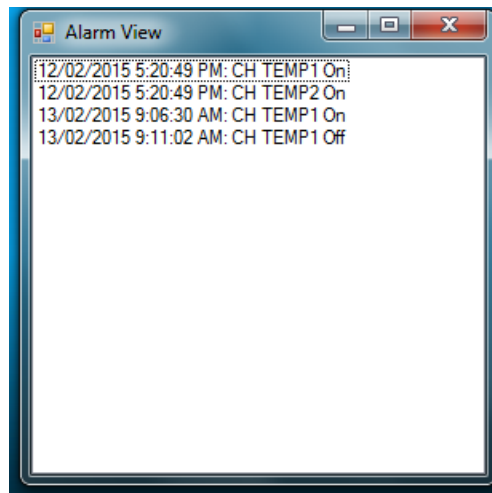


Figure 2.12.8.1

2.12.9 Add another file

This feature provides the option to open multiple data files and view them together on the same chart.

Step 1: Click on the 'Add Other file' button. A browsing window opens as shown in figure 2.12.9.1.

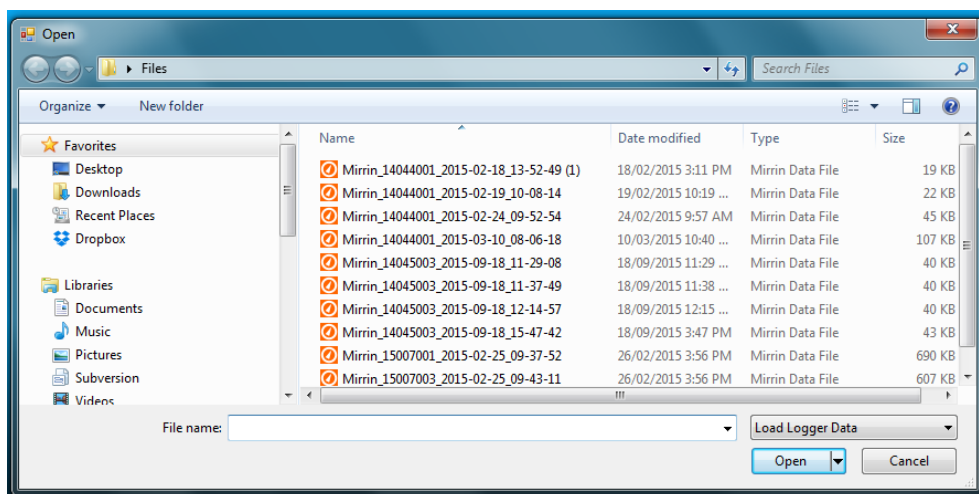


Figure 2.12.9.1

Step 2: Select one additional file and click the 'Open' button. The chart can now display all traces from both files.

It is possible to open multiple files. It is not possible to remove files. You must close the chart viewing window and again use the 'Open Data File' button on the main 'Citrus' application menu shown in figure 2.12.1 to open the desired file.



2.12.10 NEC 220.87 Report

Clicking on 'NEC 220.87 Report' under the 'Analysis' tab will bring up the following window as shown in figure 2.12.10.1. Here, the user is able to generate a NEC 220.87 report.

Figure 2.12.10.1

2.12.10.1 Phases and Data Range

First Record: this is the timestamp of the first data point in the data file.

Last Record: this is the timestamp of the first data point in the data file.

Start date & End date: these dates set the data range for the NEC 220.87 report where the 'Start date' and 'End date' is the timestamp on the first and last data point that is to be included in the report respectively. Both are user settable with timestamp format in 'year-month-day hour:minutes:seconds'.

Excluded data: this indicates the amount of data from the data file that has been left out of the report. The first 'Excluded data' indicates the amount of data left out before the 'Start date' of the report and the second 'Excluded data' indicates the amount of data left out after the 'End date'.

Included data: this indicates the length of the data range for the NEC 220.87 report. If the length is less than the minimum requirement of 30 days as indicated by the standard, the line will be highlighted yellow as seen in figure 2.12.10.1.



Set to 30 days: clicking this button will automatically set the 'Start date' to the timestamp listed under the 'First Record' and the 'End date' to be the date exactly 30 days after the 'Start date'.

Reset Range (all data): clicking this button will automatically set the 'Start date' and 'End date' to the timestamp listed under 'First record' and 'Last record' respectively.

Included Phases: here the user can select which current channels to include in the NEC 220.87 report.

2.12.10.2 Load Details

Here the user can enter the required parameters for the NEC220.87. The required parameters are defined in the table below. Note that the maximum demand does not require a user input as it is determined by the highest recorded aggregated RMS current in the data. If any of the fields are left blank, a non-numerical or a number outside the allowable range is entered, the field will be highlighted red to warn the user of an erroneous value.

Parameter	Definition
Maximum Demand	The highest average RMS current logged for at least 1 interval or aggregation period (15 minutes) over the entire logged period for a particular phase.
Seasonal Load (Amps)	Any load that is turned on a cyclic or seasonal basis i.e. an air conditioner system that is only turned on in summer.
Known Non-Operating Load (Amps)	Any load that would be usually turned on but for some reason was not switched on during the logging interval e.g. a process machine breaking down and being out of commission for a 5-week period during which the logging took place.
Newly Planned Loads (Amps)	The expected maximum demand of the new load.
Feeder Ampacity/Service Rating (Amps)	The rated current of the main switchgear panel/main disconnect panel (MDP) to where the new load is going to be connected. e.g. main switchgear panel is rated at 1000A
Maximum Expected Load	The maximum expected load is the maximum demand plus twenty-five percent of the maximum demand plus the seasonal load plus the known non-operating load plus the newly planned load.



2.12.10.3 Report

Hear the user is able to generate the NEC 220.87 report

2.12.10.3.1 Process Data

Pressing this button will process the data for the selected current channels and will determine whether the feeder is capable of carrying the expected load, as per the NEC220.87 requirements.

Upon Citrus successfully processing and analysing the data, the result will appear as a 'Pass' (figure 2.12.10.3.1.1) or as a 'Fail' (figure 2.12.10.3.1.2).

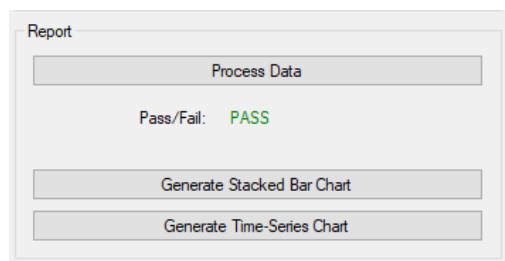


Figure 2.12.10.3.1.1

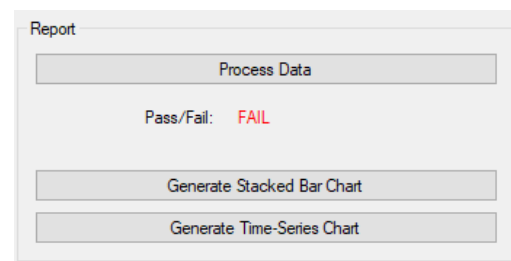


Figure 2.12.10.3.1.2

In order for a 'Pass' result to appear, each of the selected phases must comply with the following criteria:

Maximum Expected Load < 80% of Feeder Ampacity/Service Rating (Amps)

Where:

Maximum Expected Load = (Maximum Load) + (25% of Maximum Load) + (Seasonal Load) + (Known Non - Operating Load) + (Planned Loads)

If any of the selected phases does not meet the criteria listed above, a 'Fail' result will appear

If the total range of the data is less than the NEC220.87 minimum requirement of 30 days, a warning popup will appear as shown in figure 2.12.10.3.1.3 warning the user of the non-compliance of the data to the NEC220.87. The user can still go ahead with the analysis by clicking 'Yes'.

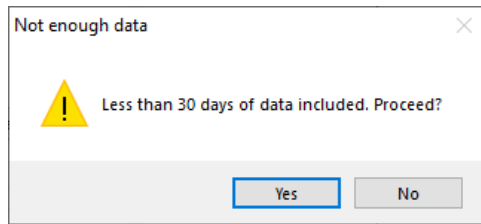


Figure 2.12.10.3.1.3



Figure 2.12.10.3.1.4

A numerical value for the '**Feeder Ampacity/Service Rating (Amps)**' and '**Newly Planned Loads (Amps)**' must be entered before generating a report, otherwise the popup shown in figure 2.12.10.3.1.4 will appear during report generation and the report will not be generated.

If the 15-minute aggregation interval was not set before logging, the analysis will be based on the longest aggregation interval used during logging. No warning appears regarding this but will be noted in the PDF report.

2.12.10.3.2 Generate Stacked Bar Chart

Once the data has been successfully processed and analysed with a result showing either a '**Pass**' or a '**Fail**', the user can view a stacked bar chart which gives a visual representation of the calculations. An example stacked bar chart where a '**Fail**' result occurred is shown in figure 2.12.10.3.2.1. Just like with the main graph, the user is able to alter the time and amplitude scales concurrently by selecting a portion of the stacked bar chart in the same way as described in section 2.12.2.

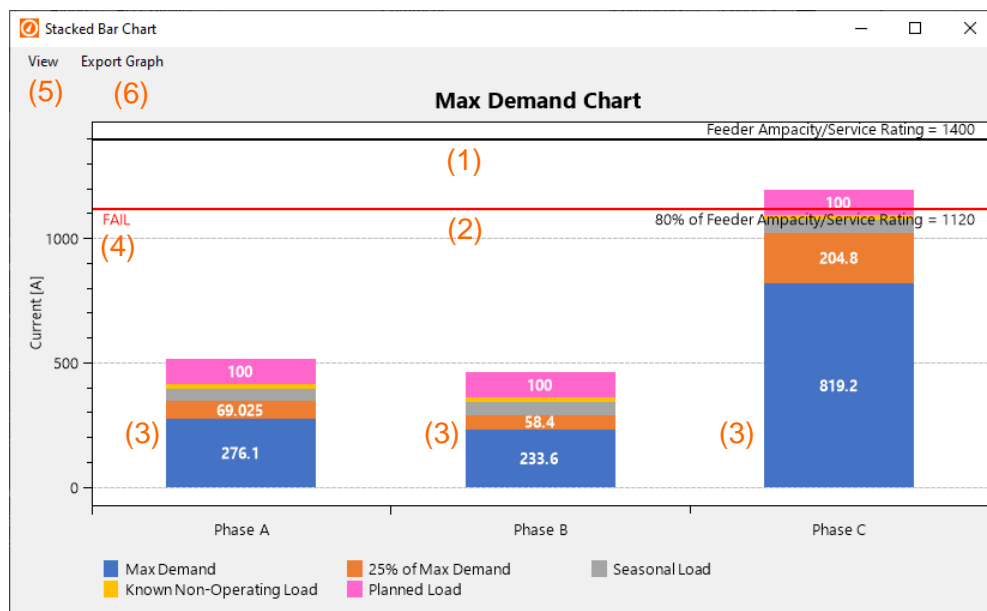


Figure 2.12.10.3.2.1

(1): This black line represents the rating of the feeder and is equal to the value the user set in the '**Feeder Ampacity/Service Rating (Amps)**' field.



(2): This red line is equal to 80% of the feeder rating. If any one of the bars for the individual phases selected cross this line, a 'FAIL' result will appear which is the case in figure 2.12.10.3.2.1.

(3): These bars for the individual phases represent the 'Maximum Expected Load' (defined and explained in section 2.12.10.2 and 2.12.10.3.1). The bar graph is also broken down by colour which correspond to the labels on the legend below the graph into the different components that add to make the 'Maximum Expected Load'. The numerical value for each component is also shown inside each colour component though some may not view the value if it is too small like with the 'Seasonal Load' and 'Known Non-Operating Load' in figure 2.12.10.3.2.1 until zoomed into as seen in figure 2.12.10.3.2.2.

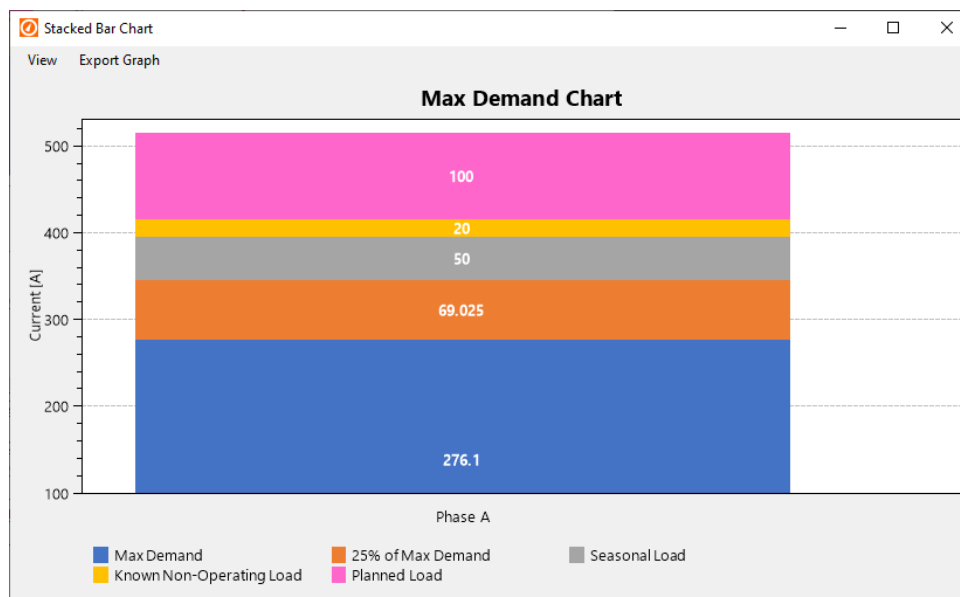


Figure 2.12.10.3.2.2

(4): Here is where it will say on the graph whether the load analysis meets the NEC220.87 requirements, i.e., 'PASS' or 'FAIL'.

(5): Clicking the 'View' tab will open the drop-down list as shown in figure 2.12.10.3.2.3.

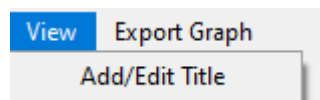


Figure 2.12.10.3.2.3



Clicking 'Add/Edit Title' will bring up a window (figure 2.12.10.3.2.4) that allows the user to edit the title of the stacked bar chart. The default title is 'Max Demand Chart' as shown in figure 2.12.10.3.2.4.

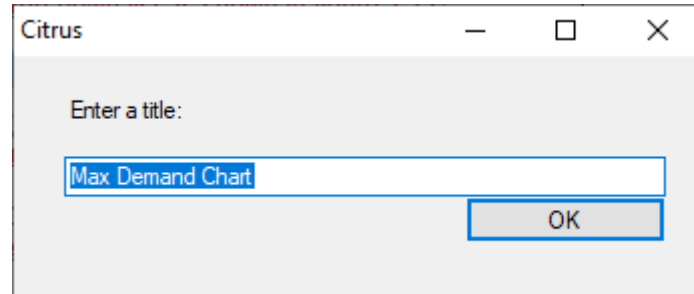


Figure 2.12.10.3.2.4

(6): Clicking the 'Export Graph' tab will open the drop-down list as shown in figure 2.12.10.3.2.5.

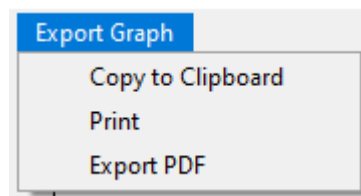


Figure 2.12.10.3.2.5

'Copy to Clipboard': This will save a screenshot of the Stacked Bar Chart in the PC's clipboard and can be pasted into another document as necessary.

'Print': This will allow the user to print the Stacked Bar Chart.

'Export PDF': This will export the stacked bar chart in PDF format. Upon successful export, Citrus will ask if the user wants to open up the PDF immediately as seen in figure 2.12.10.3.2.6. Click 'Yes' to open immediately, otherwise click 'No'.

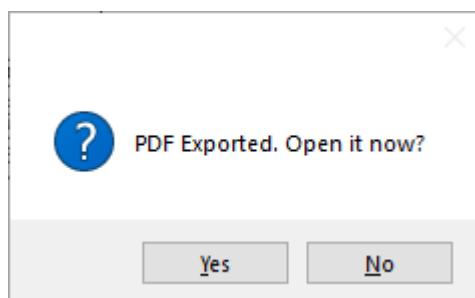


Figure 2.12.10.3.2.6

2.12.10.3.3 Generate Time-Series Chart

Once the data has been successfully processed and analysed with a result showing either a 'Pass' or a 'Fail', the user can view the time series RMS current graph, together with a visual



representation of the calculations that resulted in the either the 'Pass' or 'Fail' result. An example of this graph where a 'Fail' result occurred is shown in figure 2.12.10.3.3.1.

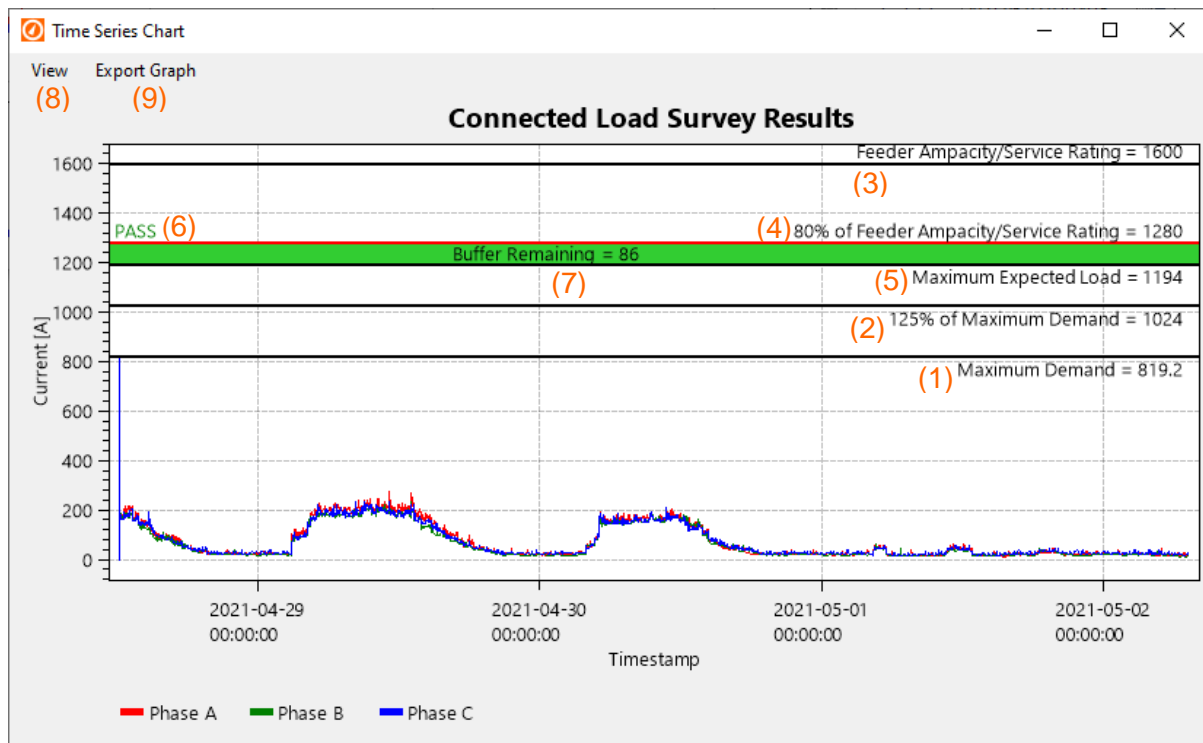


Figure 2.12.10.3.3.1

(1): This black line represents the 'Maximum Demand' of the selected phases. When multiple phases have been selected for NEC220.87 load analysis, since it is only one line the maximum demand will be based on the highest (worse case) maximum demand out of all the three phases. In figure 2.12.10.3.3.1, note how the maximum demand is equal to the magnitude of the current spike that occurs on Phase C at the beginning of the datafile.

(2): This black line represents 125% of the 'Maximum Demand' described in point (1).

(3): This black line represents the rating of the feeder and is equal to the value the user set in the 'Feeder Ampacity/Service Rating (Amps)' field.

(4): This red line is equal to 80% of the feeder rating entered in the 'Feeder Ampacity/Service Rating (Amps)' field.

(5): This black line represents the 'Maximum Expected Load' (defined and explained in section 2.12.10.2 and 2.12.10.3.1).

(6): Here is where it will say on the graph whether the load analysis meets the NEC220.87 requirements. If the 'Maximum Expected Load' < '80% of Feeder Ampacity/Service Rating', it will say 'PASS' as seen in figure 2.12.10.3.3.1 otherwise 'FAIL' will show as seen in figure 2.12.10.3.3.2.

(7): In a 'PASS' scenario, a green highlighted bar is seen like in figure 2.12.10.3.3.1 which is a visual representation showing the difference between the red '80% of Feeder



Ampacity/Service Rating and black **Maximum Expected Load** line, indicating how much headroom is available before the load is too high for the feeder being analysed. The numerical difference is also displayed in the highlighted green bar.

In a **FAIL** scenario, a red highlighted bar is seen like in figure 2.12.10.3.3.2 which is a visual representation showing the difference between the black **Maximum Expected Load** line and the red **80% of Feeder Ampacity/Service Rating** line. It indicates how much higher the available load is, compared to the acceptable level for the feeder (i.e., 80% of feeder rating) based on the NEC220.87 requirements. The numerical difference is also displayed inside the highlighted red bar.

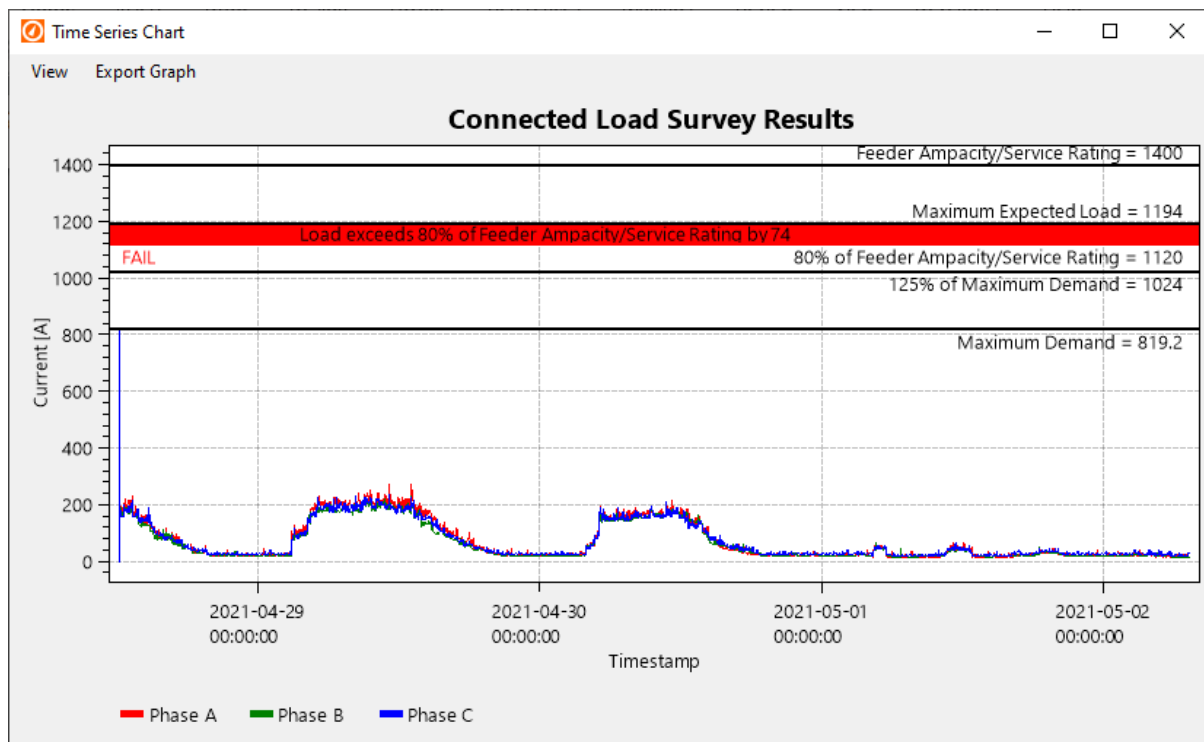


Figure 2.12.10.3.3.2

(8): Clicking the **View** tab will open the drop-down list as shown in figure 2.12.10.3.3.3.

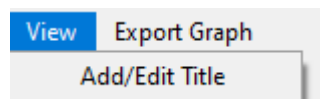


Figure 2.12.10.3.3.3



Clicking 'Add/Edit Title' will bring up a window (figure 2.12.10.3.3.4) that allows the user to edit the title of the stacked bar chart. The default title is 'Connected Load Survey Results' as shown in figure 2.12.10.3.3.4.

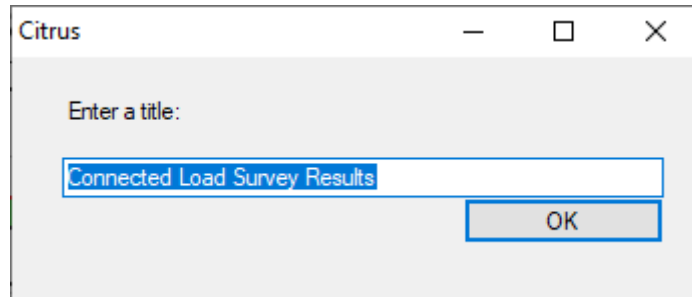


Figure 2.12.10.3.3.4

(9): Clicking the 'Export Graph' tab will open the drop-down list, allowing the user to select the preferred option.

2.12.10.4 PDF Report

Here the user is able to produce the report in PDF format. The report includes:

- a summary of the values used and calculated,
- whether each phase passed or failed,
- time series graphs and bar chart (same as the ones generated from pressing 'Generate Stacked Bar Chart' and 'Generate Time Series Chart' respectively,
- warnings e.g., when a different aggregation interval other than 15 minutes was used for the analysis,
- Citrus software version used for report generation and firmware version of the Miro.

The user can also add extra information into the PDF so that the generated report is more customised, allowing the user to add in things such as a heading, who prepared the report, who the report was done for, title etc as can be seen in figure 2.12.10.1. 'Generate PDF Report' will be greyed out and not user selectable until the user has processed data by pressing 'Process Data' under the 'Report' Section.

3 Citrus Lite Application Software

Two versions of Citrus Lite have been developed to operate on Android and iOS platforms.

3.1 Citrus Lite Android software application

3.1.1 Installing the Citrus Lite Android software application

Step 1: Using your Android device click on the following link <http://www.chkpowerquality.com.au/downloads/> which takes you to the 'Downloads' page of the CHK Power Quality website



Step 2: On the 'Downloads' page click on 'Citrus Lite Android App' as shown in figure 3.1.1.1.

A file named **Citruslitevx.x.apk** will appear in the 'Downloads' folder (in the main directory) as shown in figure 3.1.1.2 and figure 3.1.1.3. The file version number is 1.2 at the time of writing this document.

Mirrin Load Logger and Load Remote

- [Mirrin Load Logger Brochure](#)
- [Brochure Load Remote](#)
- [Mirrin Multi Channel Logger LL400 User Manual](#)
- [Citrus Software](#)
- [Virtual com port drivers](#)
- [Microsoft .Net framework 4.5](#)
- [Installation of non market Android Apps](#)
- **[Citrus Lite Android App](#)**
- [Mirrin Firmware \(Ver 0.44\)](#)

Figure 3.1.1.1

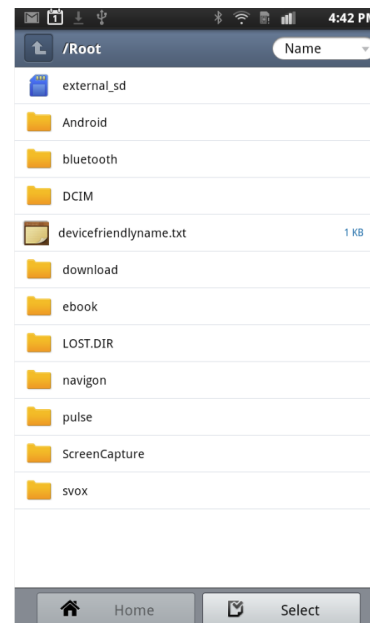


Figure 3.1.1.2

Step 3: Click on the latest version. The window in figure 3.1.1.4 appears.

Step 4: Press 'OK'. The window in figure 3.1.1.5 appears.

Step 5: Press 'Install'. The window in figure 3.1.1.6 appears. The Citrus Lite Android software application is now being installed. Upon completion figure 3.1.1.7 appears.

Step 6: Press 'Done'. The active window closes; press 'Open' to start the application. The window in figure 3.1.1.8 appears.

Step 7: Go back to the desktop. **Citrus Lite** is now available and ready to use as shown in figure 3.1.2.1.

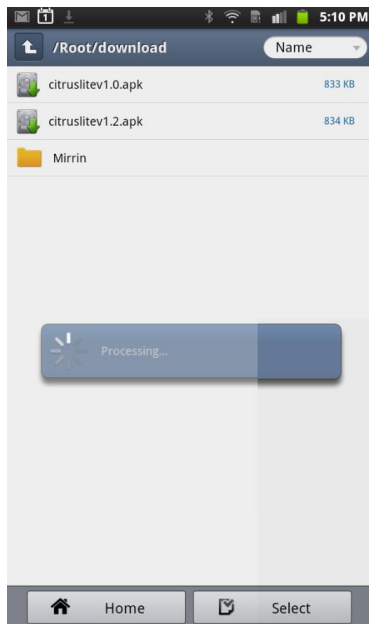


Figure 3.1.1.3

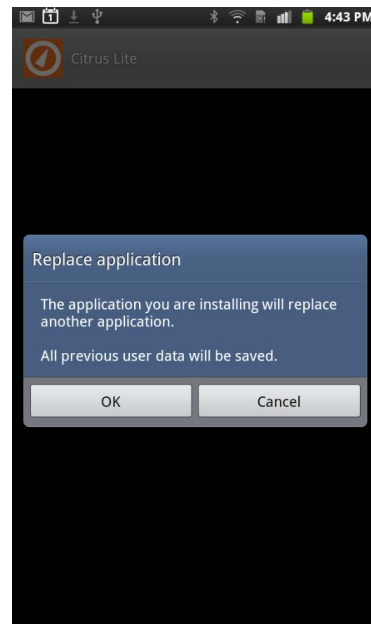


Figure 3.1.1.4

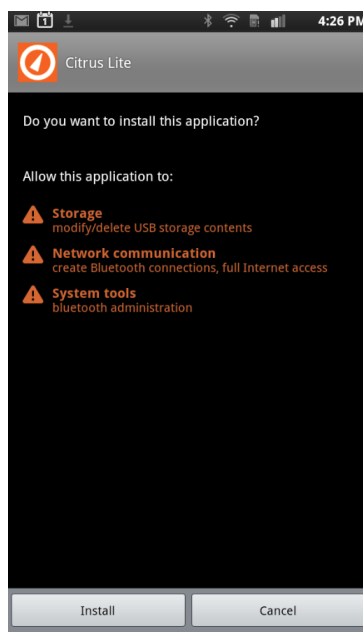


Figure 3.1.1.5



Figure 3.1.1.6

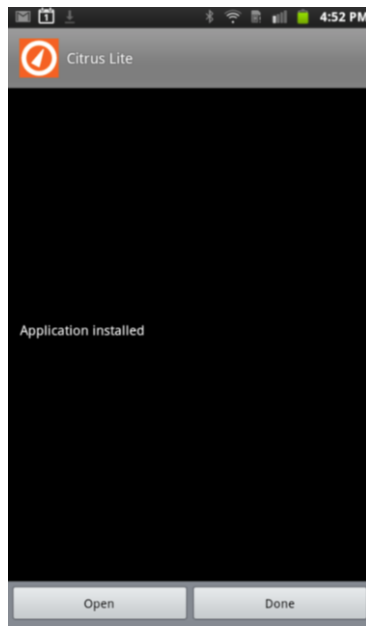


Figure 3.1.1.7

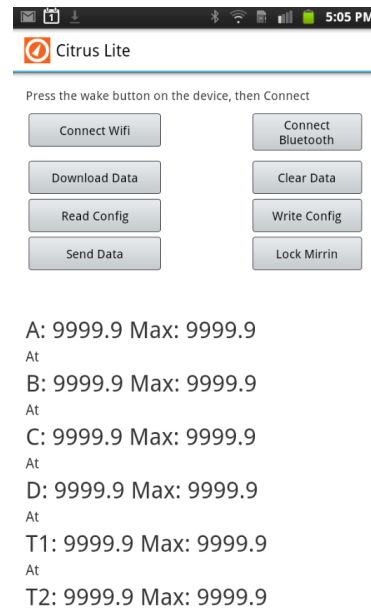


Figure 3.1.1.8

On this platform you are able to connect to the MLL which is Bluetooth or WiFi enabled.

3.1.2 Connecting to the MLL using Citrus Lite

Step 1: Download **Citrus Lite** onto your Android based device. An icon will appear as shown in figure 3.1.2.1.

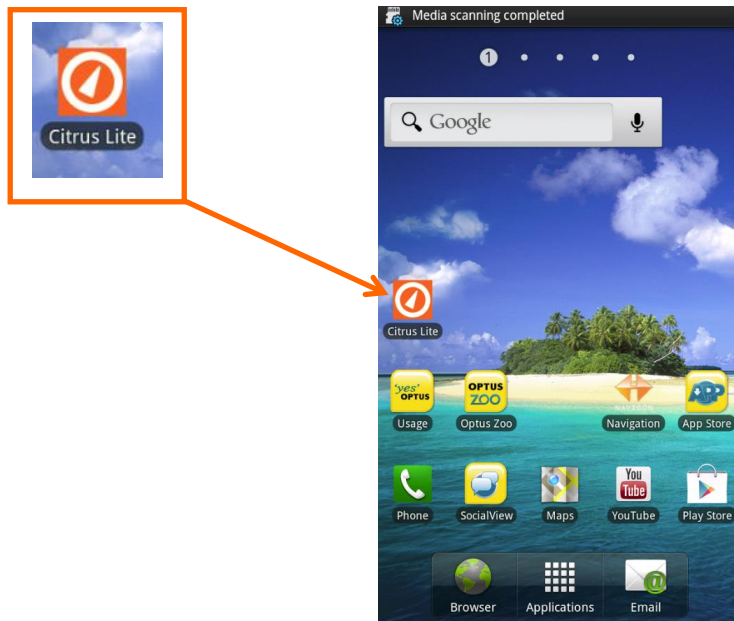


Figure 3.1.2.1

Step 2: Click on the icon in figure 3.1.2.1 and the status screen in figure 3.1.2.2 appears. Scrolling up will show an empty graph as shown in figure 3.1.2.3.

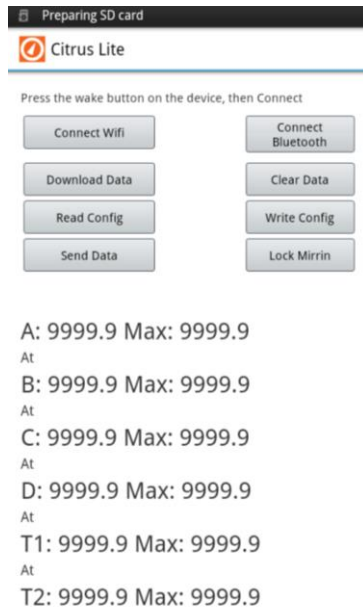


Figure 3.1.2.2

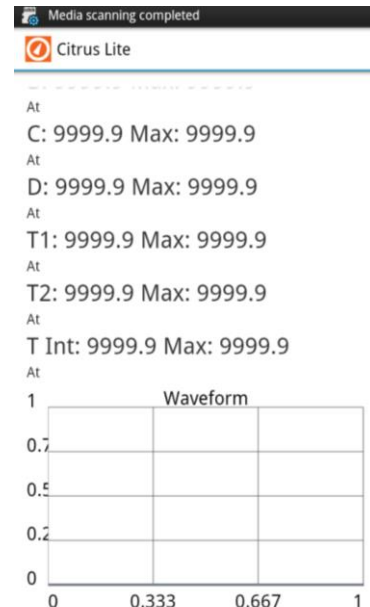


Figure 3.1.2.3

Step 3: Click on 'Connect Wifi' or 'Connect Bluetooth button' (this depends upon what local communications is enabled in the MLL) and the screen in figure 3.1.2.4 appears where the Android device will commence searching for MLL devices.

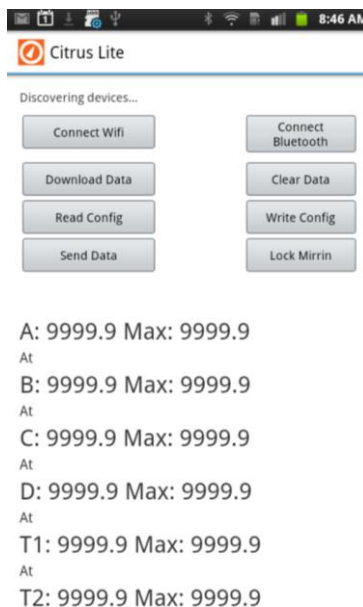


Figure 3.1.2.4

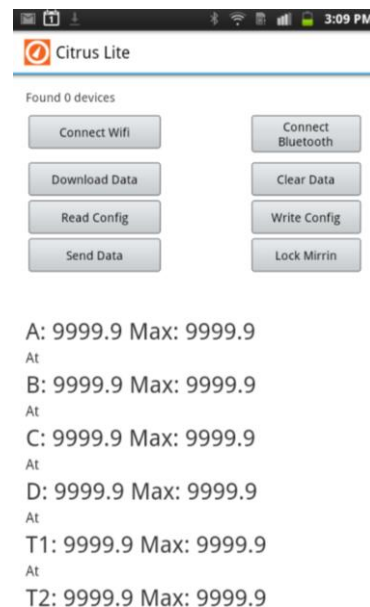


Figure 3.1.2.5

If it does not find any, it will report 'Found 0 devices' as shown in figure 3.1.2.5. If the Android device has found some MLL devices it will display 'Found x devices', where x is the total number of active MLL devices, and lists them as shown in figure 3.1.2.6.



Step 4: Select the desired MLL device from the list shown in figure 3.1.2.6.

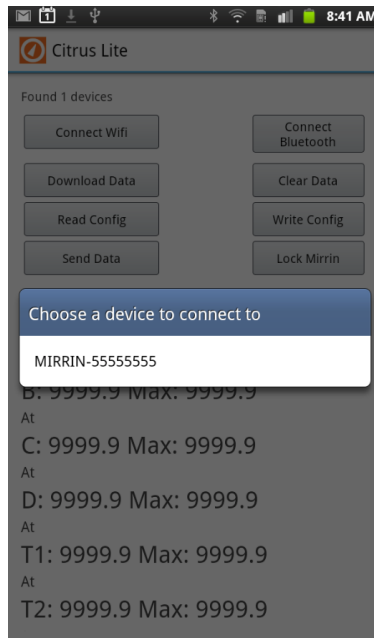


Figure 3.1.2.6

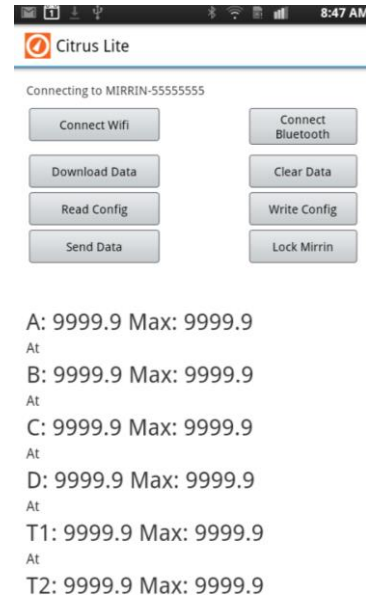


Figure 3.1.2.7

The Android device will then attempt to connect to the MLL as shown in figure 3.1.2.7. If successful, the status window will appear as shown in figure 3.1.2.8.

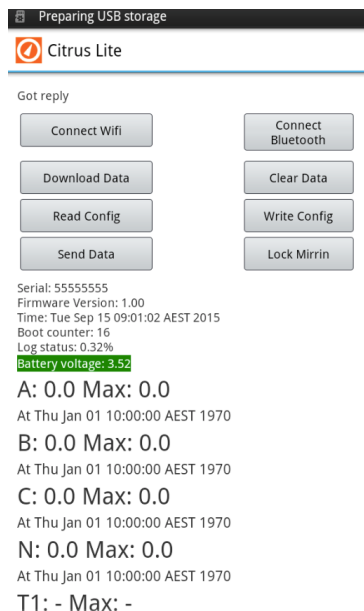


Figure 3.1.2.8

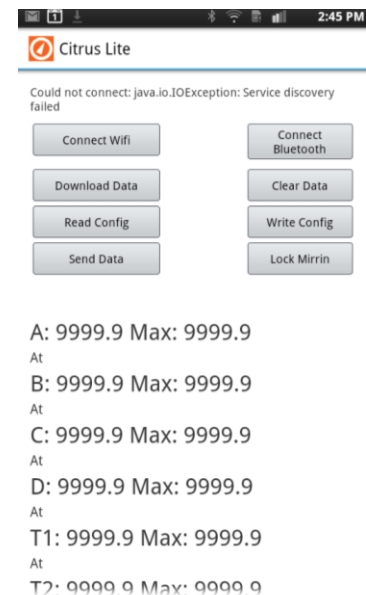


Figure 3.1.2.9

Else the screen shown in figure 3.1.2.9 will appear. This can occur if the user takes too long (more than 60 seconds) to select the MLL device from the list shown in figure 3.1.2.6.



3.1.3 Status

Connection to the MLL without current sensors connected.

If connected the screen in figure 3.1.2.4 will populate with the most recent values as shown in figure 3.1.3.1 and updated every 2.5 seconds. Note no measurements for currents. Accordingly, no waveforms as shown in figure 3.1.3.2.

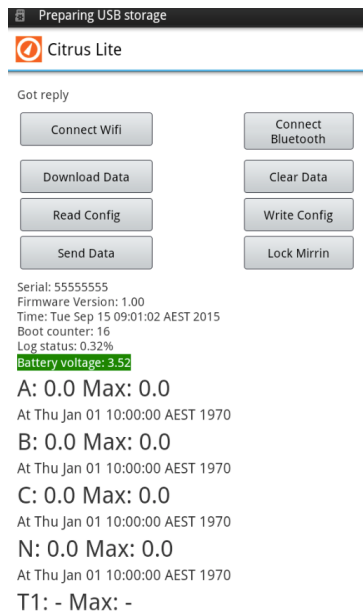


Figure 3.1.3.1

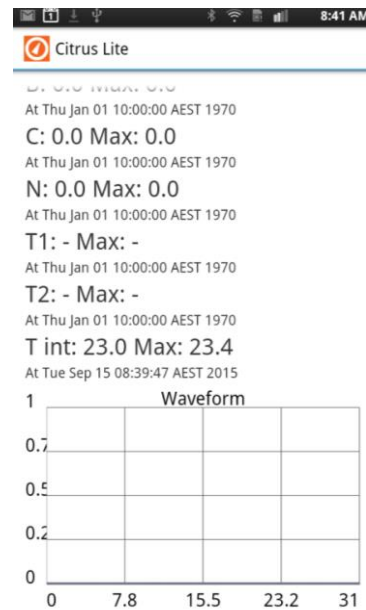


Figure 3.1.3.2

Connection to the MLL with one current sensor connected to channel A.

Channel A will display the rms value as shown in figure 3.1.3.3 and updated every 2.5 seconds. Accordingly, the waveforms will update displaying only channel A as shown in figure 3.1.3.4.

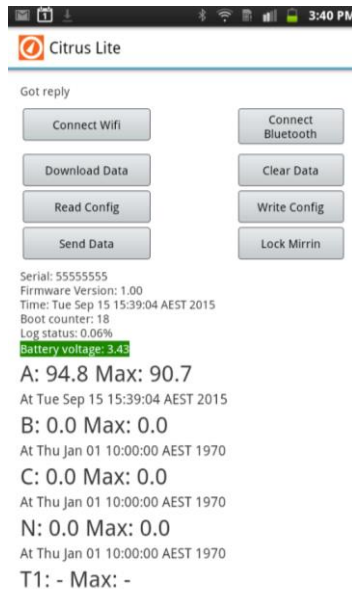


Figure 3.1.3.3

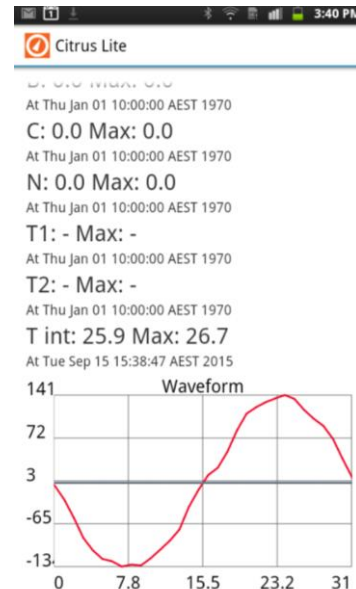


Figure 3.1.3.4

3.1.3.1 Serial number

The 'Serial' as shown in figure 3.1.3.1.1 refers to the serial number of the MLL.

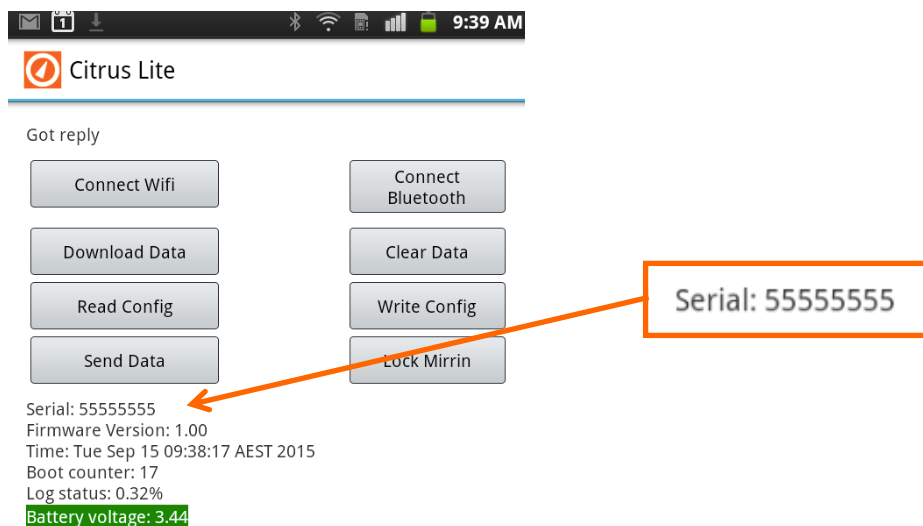


Figure 3.1.3.1.1

3.1.3.2 Firmware version

The 'Firmware version' as shown in figure 3.1.3.2.1 refers to the version number of the firmware in the MLL.

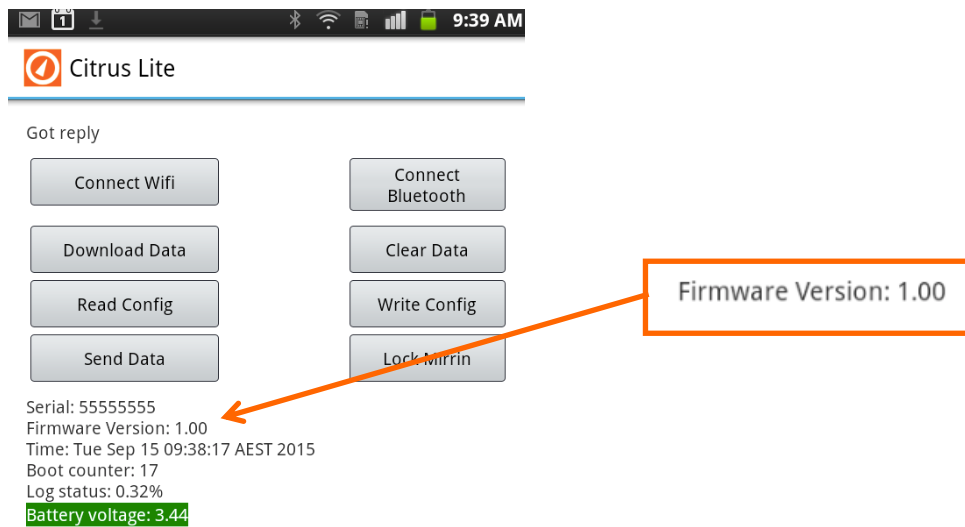


Figure 3.1.3.2.1

3.1.3.3 Date and time

The 'Time' as shown in figure 3.1.3.3.1 is the date and time read back from the MLL's real time clock and updated every three seconds.

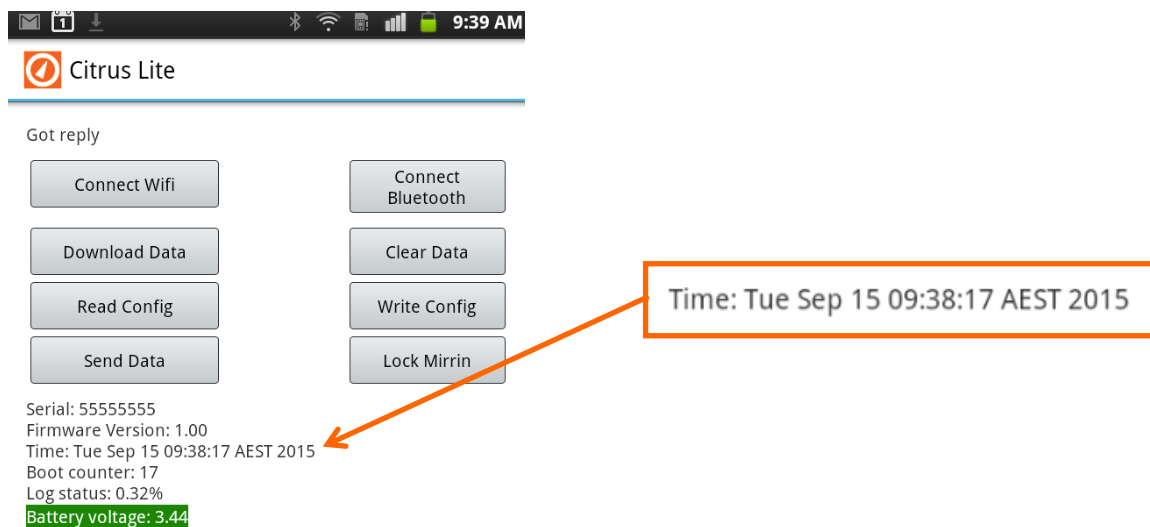


Figure 3.1.3.3.1

3.1.3.4 Boot counter

The 'Boot counter' as shown in figure 3.1.3.4.1 essentially monitors the number of power-up cycles and is provided for diagnostic purposes only.

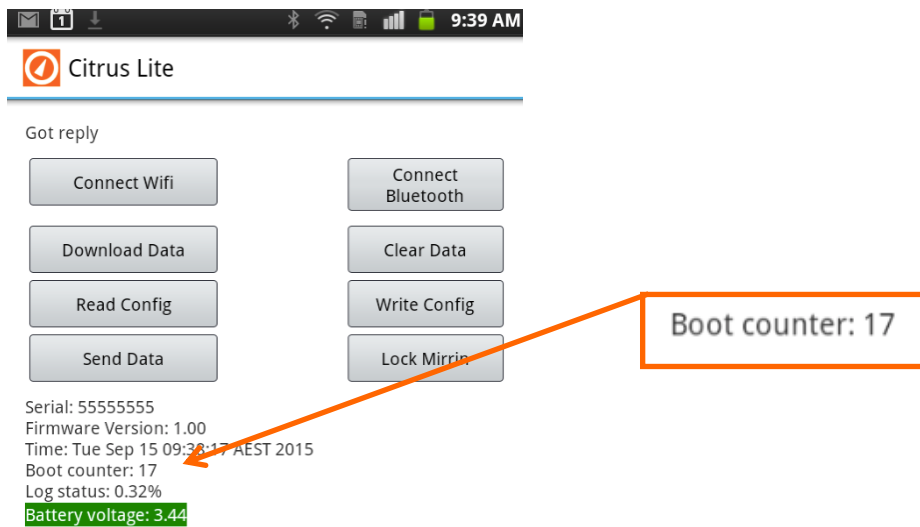


Figure 3.1.3.4.1

3.1.3.5 Log status

The 'Status Log' as shown in figure 3.1.3.5.1 displays the percentage amount of log memory utilised in the MLL.

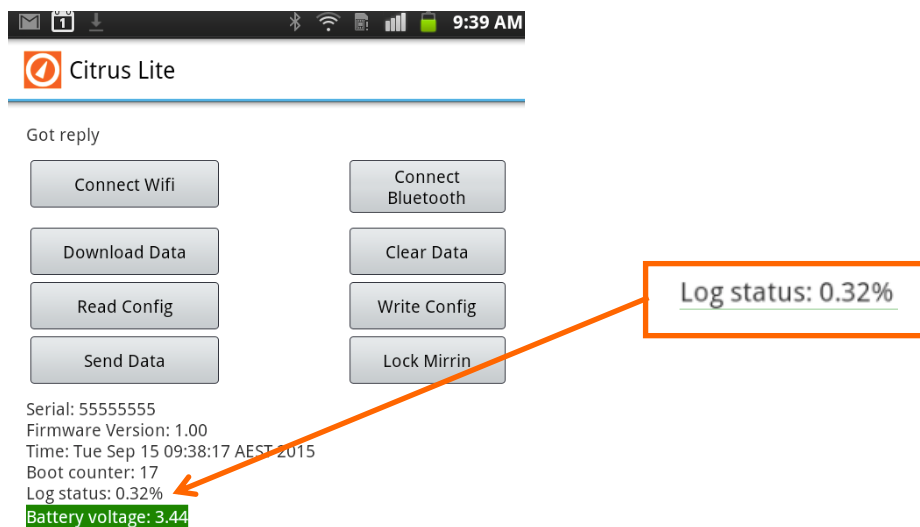


Figure 3.1.3.5.1

3.1.4 Configuration

Step 1: Click on the 'Read Config' button as shown in figure 3.1.4.1 and the screen in figure 3.1.4.2 appears showing key configuration parameters.



Figure 3.1.4.1

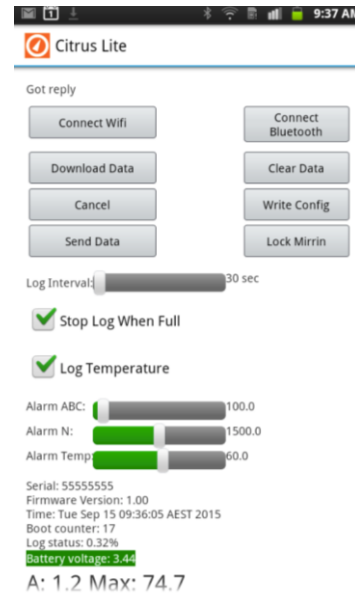


Figure 3.1.4.2

The user is able to alter:

- Log Interval via a scroll bar;
- Log Temperature;
- Alarm settings for current and temperature channels; and
- Halt logging when memory is full.

Step 2: Click on the 'Write Config' button as shown in figure 3.1.4.2 to update the MLL with the new configuration parameters.

Step 3: Click on the 'Cancel' button to take you back to the status window as shown in figure 3.1.4.1.

3.1.5 Clear data

Note that the 'Log status' reading in figure 3.1.5.1 is currently set to 0.32%.

Step 1: Click on 'Clear Data' button shown in figure 3.1.5.1. The popup message window appears as shown in figure 3.1.5.2.

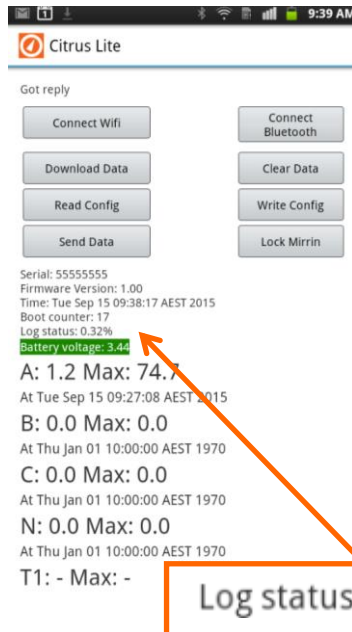


Figure 3.1.5.1

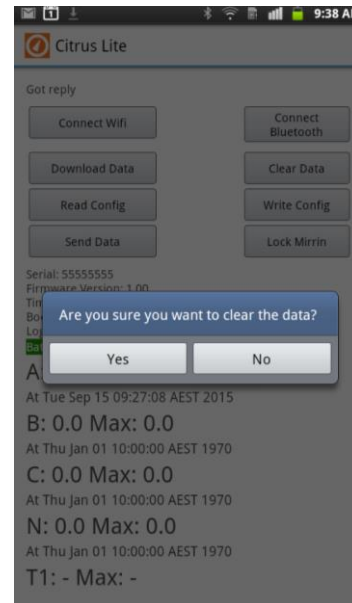


Figure 3.1.5.2

Step 2: Click on the 'Yes' button to confirm. The popup message window closes and the 'Log status' is reset to zero as shown in figure 3.1.5.3.

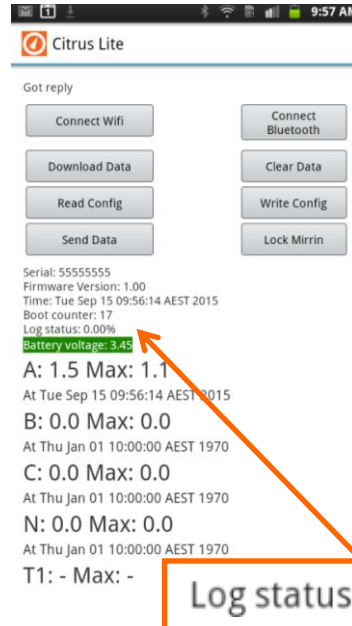


Figure 3.1.5.3

3.1.6 Download data

Step 1: Click on the 'Download Data' button as shown in figure 3.1.6.1 and the screen in figure 3.1.6.2 appears showing that logged data is being read and saved to the Android device.



Figure 3.1.6.1

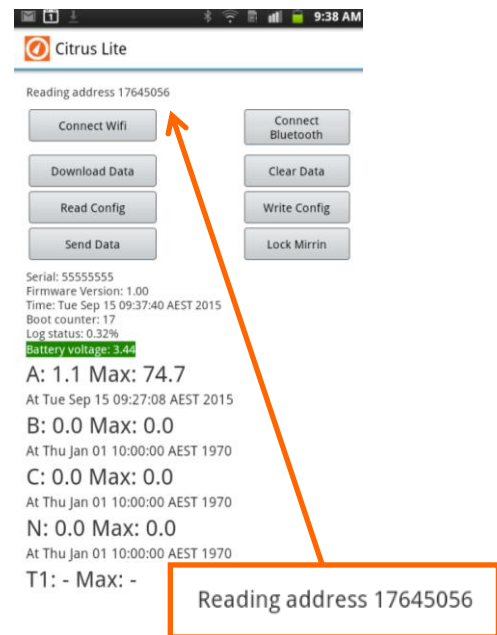


Figure 3.1.6.2

Once completed the screen appears as shown in figure 3.1.6.3 highlighting 'Download complete'.

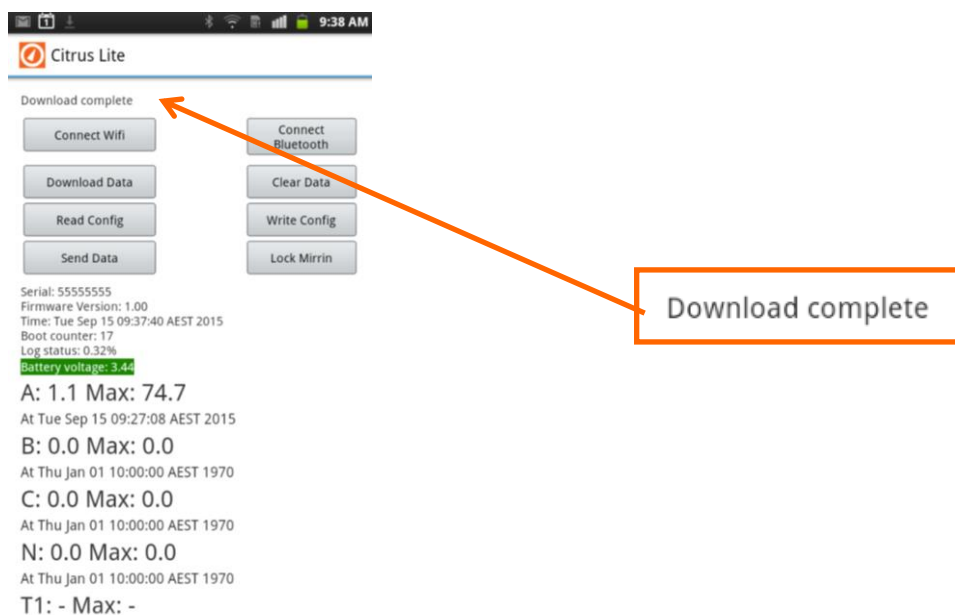


Figure 3.1.6.3

3.1.7 Send data

Once data has been downloaded you have the option to email the data file via the 'Send Data' button.

Step 1: Click on the 'Send Data' button as shown in figure 3.1.7.1 and the screen in figure 3.1.7.2 appears showing a list of downloaded data files.



Figure 3.1.7.1



Figure 3.1.7.2

Step 2: Select any file.

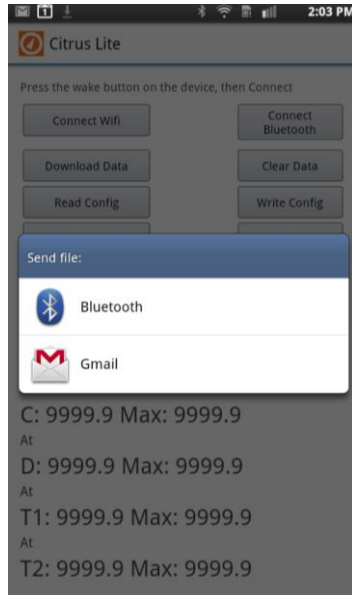


Figure 3.1.7.3

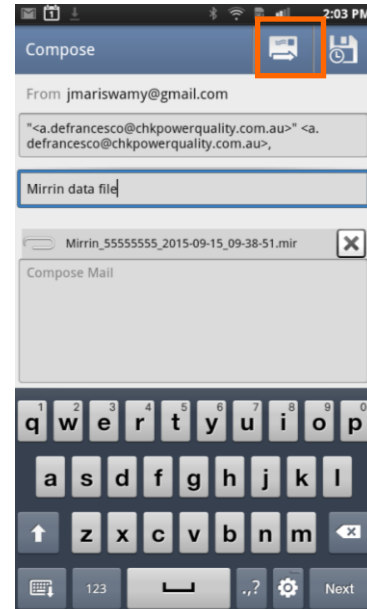


Figure 3.1.7.4

Step 3: The popup message window as shown in figure 3.1.7.3 appears. In this case, select 'Gmail'. The mail form as shown in figure 3.1.7.4 appears. Fill in the required fields and press the send icon.

Step 4: The popup message window in figure 3.1.7.5 appears. Click the 'OK' button. The mail with the attached data file should appear at the recipient's mailbox as shown in figure 3.1.7.6.



Figure 3.1.7.5

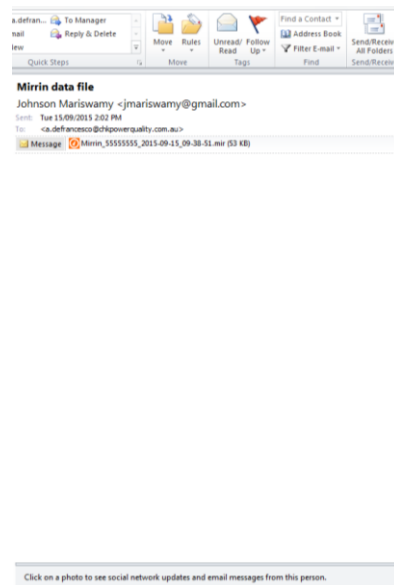


Figure 3.1.7.6

3.1.8 Lock / Unlock

Step 1: Click the 'Lock Mirrin' button on the status screen as shown in figure 3.1.8.1. The popup window asking to enter a PIN appears as shown in figure 3.1.8.2.

Step 2: In figure 3.1.8.2 click in the available cell next to the cursor. A number keyboard appears as shown in figure 3.1.8.3.



Figure 3.1.8.1

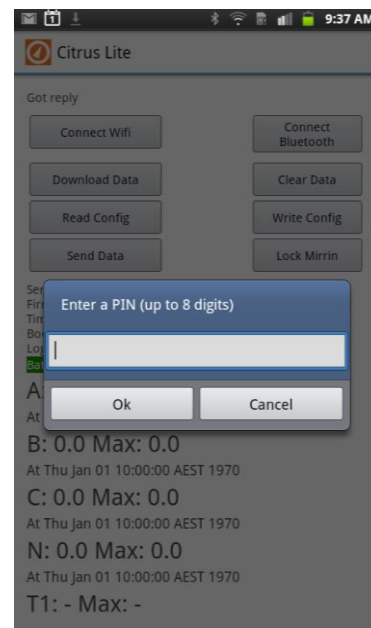


Figure 3.1.8.2

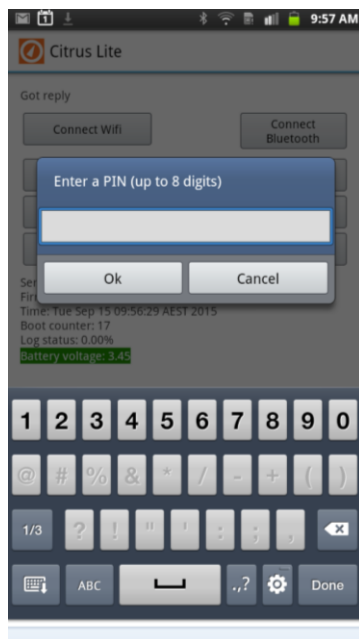


Figure 3.1.8.3

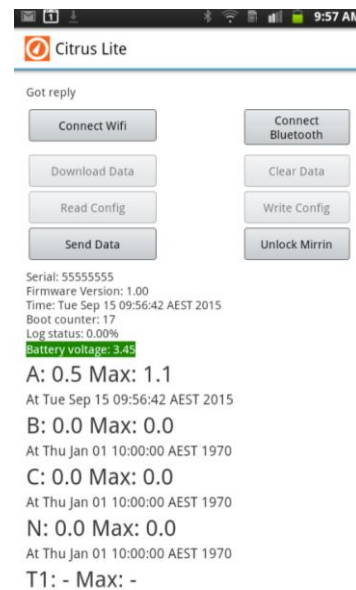


Figure 3.1.8.4

Step 3: Enter the required PIN and click the 'Ok' button. The popup window closes. As shown in figure 3.1.8.4 some functions of the status screen are now unavailable and the 'Lock Mirrin' button now changes to the 'Unlock Mirrin' button.

Step 4: To unlock the Mirrin, click the 'Unlock Mirrin' button on the status screen as shown in figure 3.1.8.4. The popup window asking to enter a PIN appears as shown in figure 3.1.8.2. Again enter the PIN and click the 'Ok' button. The status screen as shown in figure 3.1.8.1 will appear.

3.2 Citrus Lite iOS software application

3.2.1 Installing the Citrus Lite iOS software application

Step 1: Using your iOS device locate the 'App Store' icon as shown in figure 3.2.1.1 and click on it.

Step 2: Click on the 'Search' icon as shown in figure 3.2.1.2. Figure 3.2.1.3 appears.

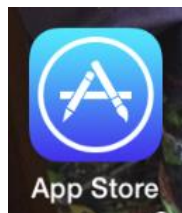


Figure 3.2.1.1

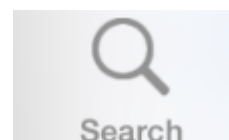


Figure 3.2.1.2

Step 3: Type in 'Citrus Lite' and click on the 'Search' button (with the blue background) as shown in figure 3.2.1.3.



Step 4: You should then be able to scroll and locate the 'Citrus Lite' application as shown in figure 3.2.1.4.

Step 5: Click on the cloud icon shown in figure 3.2.1.4. The cloud now changes to a 'working' icon as shown in figure 3.2.1.5. Once completed it again changes to 'Open' as shown in figure 3.2.1.6.

Step 6: Click on 'Open' to start the application as shown in figure 3.2.1.7.

Step 7: Close the application and on the desktop you should now have the 'Citrus Lite' icon as shown in figure 3.2.1.8.

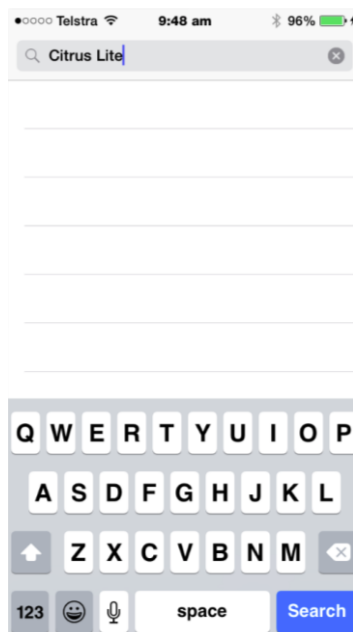


Figure 3.2.1.3



Figure 3.2.1.4

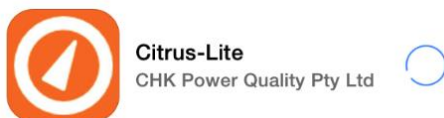


Figure 3.2.1.5



Figure 3.2.1.6

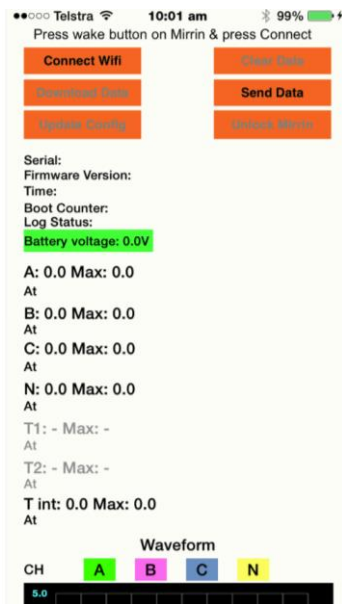


Figure 3.2.1.7

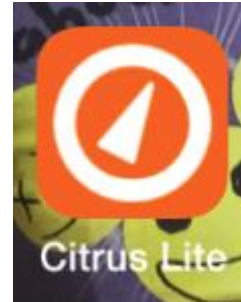


Figure 3.2.1.8

3.2.2 Configuring the iOS device

Step 1: Download 'Citrus Lite' onto your iOS based device.

Step 2: Click on the 'Settings icon' as shown in figure 3.2.2.1, locate the 'Wi-Fi' icon as shown in figure 3.2.2.2 and click it.

Step 3: Press the button on the MLL to wake up its Wi-Fi communications module. You should see the MLL with its associated serial number appear in the 'choose a network' list as shown in figure 3.2.2.3.

Step 4: Click on the MLL device. The MLL should now appear above the list and ticked as shown in figure 3.2.2.4.



Figure 3.2.2.1

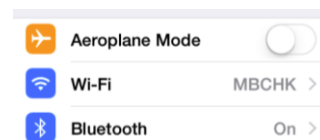


Figure 3.2.2.2

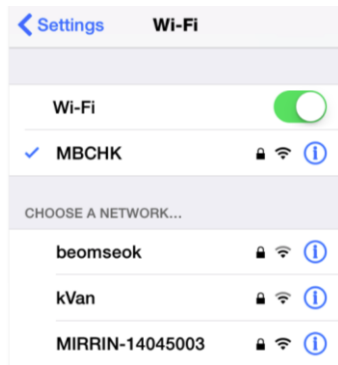


Figure 3.2.2.3

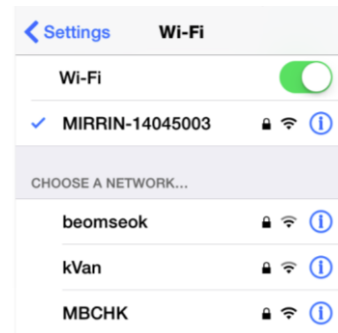


Figure 3.2.2.4

Step 5: Close 'Settings' and go to the desktop and click on the 'Citrus Lite' icon shown in figure 3.2.1.8.

Step 6: Click on the 'Connect WiFi' button. Upon a successful connection all other buttons become active and status information read back from the MLL, as shown in figures 3.2.2.5 and 3.2.2.6.

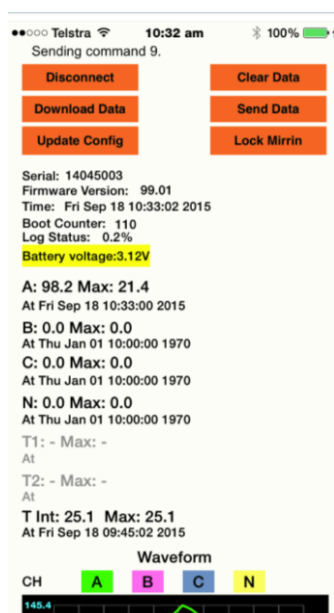


Figure 3.2.2.3a

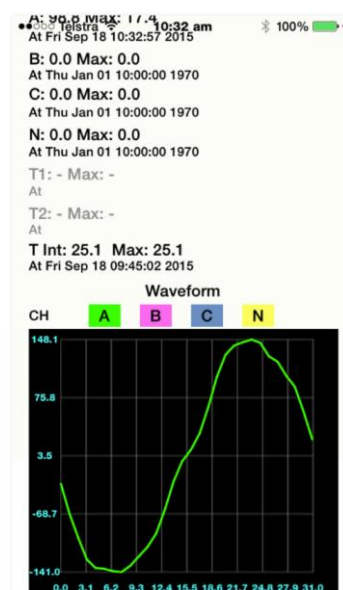


Figure 3.2.2.3b

4 Operation

4.1 Field installation procedure

The MLL should be installed in accordance with appropriate Live Installation instructions and procedures.



Step 1: Please install the MLL according to section 4.1.1 or section 4.1.2. Mount the MLL on a pole pin when used on overhead mains and on a hook in kiosks or sub-stations. In both cases secure the MLL with a lanyard.

Step 2: You can connect any current sensor to any of the four input channels at any time. The MLL will automatically detect the type of current sensor to produce the correct current reading.

Step 3: Activate the LCD and Bluetooth or WiFi by pressing down on the 'Press' button until the display is shown. This takes approximately one second. Check that the heartbeat LED is flashing blue. Also check that the instantaneous current readings on the display correspond to expected readings.

4.1.1 Flanged enclosure

Where the MLL is supplied with a flanged enclosure, holes exist at the top and bottom of the flange as shown in figure 4.1.1.1 for pole pin or hook mounting.

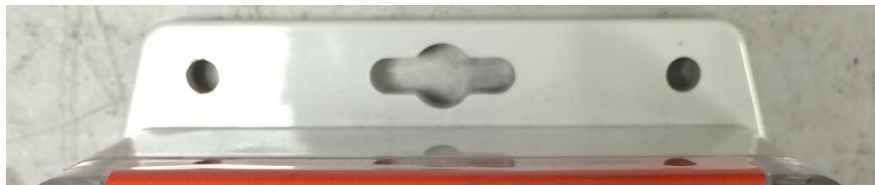


Figure 4.1.1.1

4.1.2 Backplane

Step 1: Where the MLL is supplied without a flanged enclosure. Turn the MLL shown in figure 4.1.2.1 upside down as shown in figure 4.1.2.2.



Figure 4.1.2.1



Figure 4.1.2.2



Ensure the four holes contain brass inserts as shown in figure 4.1.2.2.

Step 2: Screw the provided backplane with four stainless steel M5 x 16mm pan screws as shown in figure 4.1.2.3 and turn the MLL over as shown in figure 4.1.2.4.



Figure 4.1.2.3



Figure 4.1.2.4

4.2 Battery replacement

The batteries are accessed by unscrewing the four stainless steel screws on the top of the unit shown in figure 4.1.2.1 and removing the lid. The battery holder is fitted on to the bottom PCB.

After replacing the batteries please check that the gasket is in good condition and seated correctly in the groove of the lid before re-fitting the lid.



5 Service and Support

5.1 Calibration

The MLL is factory calibrated. Calibration of the MLL is recommended every thirty six (36) months.

5.2 Equipment maintenance

Enclosure of the MLL should be inspected for mechanical damage leading to cracking in the case. The integrity of the lid seal should also be inspected.

5.3 Cleaning and decontamination

The case of the MLL can be cleaned with a cloth moistened with Isopropyl Alcohol. There are no decontamination issues.

5.4 Technical support

We provide complementary technical support. Please contact our Technical Services Manager at:

sales@chkpowerquality.com.au



6 Specifications

PARAMETER	MIRRIN MULTI-CHANNEL LOAD LOGGER
Input Channels Current Inputs (AC RMS) Temperature Inputs (optional)	4 channels - Phases A, B, C and Neutral 2 x PT100 RTD
Communications Serial Data (standard) Wireless (optional)	TTL serial; Baud Rate: 230400 Bluetooth or WiFi enabled
Sampling A to D Conversion Sampling Rate Instantaneous measurement Maximum measurement	12 bits 1600Hz (1600 samples per second) RMS aggregation of four cycles 250ms apart and updated every second Based on the instantaneous measurements using a 60-second exponential time constant.
Logging Logged Data Memory Logging Interval Measurements Accuracy System Accuracy	256KB; expandable to 8GB (SD card) Programmable from 1 second Current (RMS), Max. Current (RMS), Current Unbalance (not yet implemented), Temperature (not yet implemented) $\pm 0.5\%$ (excludes current sensor) $\pm 1\%$ (clamp-on current sensor)
Outputs Visual Tools Data File Visual Indicator	Graphical Interface Mirrin format binary with CSV export 2 x Status LED
General Display (optional) Current Sensors Battery Supply External Supply Battery Life	LCD: Time-stamped current and max. current Flexible current sensors or clamp-on current probes - Automatic detection Two non-rechargeable 'AA' cells. Energizer® Ultimate Lithium AA batteries recommended. 5V dc adaptor. Four months typical. Extended to twelve months in Power Saving Mode
Environment Use Altitude Operating Temperature Relative Humidity Degree of Protection Safety Category	Indoor and outdoor Up to 2000m. -20°C to 70°C 80% for temperatures up to 70°C IP65 IEC 61010-1, CAT IV 600V defined by CT
Electromagnetic Compatibility Emissions Immunity	AS/NZS CISPR 22: 2002 Class A EN61000-4-3:1995, including Amdt 1:1998
Physical Dimensions (H x W x L) Weight Case Material and Colour	55 x 90 x 145 mm 400g (battery included) Polycarbonate, moulded in light grey