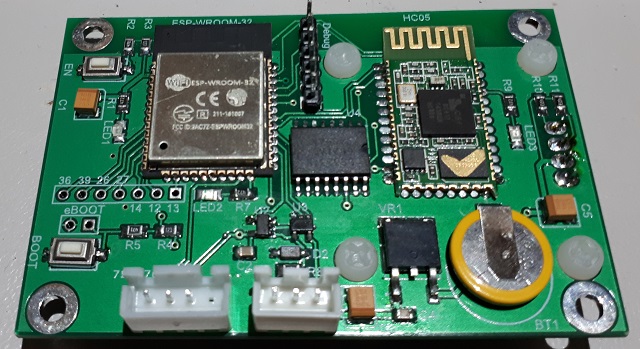
*The Afterburner* *(powered by chilly)*

**USER MANUAL**



**A Bluetooth / Wi-Fi enabled controller for Chinese Diesel Heaters**

Congratulations on your acquisition of The Afterburner.  
This device allows you unprecedented remote controllability of your compatible Chinese diesel heater, and detailed examination of the run time conditions.

**DISCLAIMER**

The software of this design is released under the GPL V3 licence and is offered under the following disclaimer:  
  
*This program is free software: you can redistribute it and/or modify it under the terms of the GNU General Public License as published by the Free Software Foundation, either version 3 of the License, or (at your option) any later version.*

*This program is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details.*

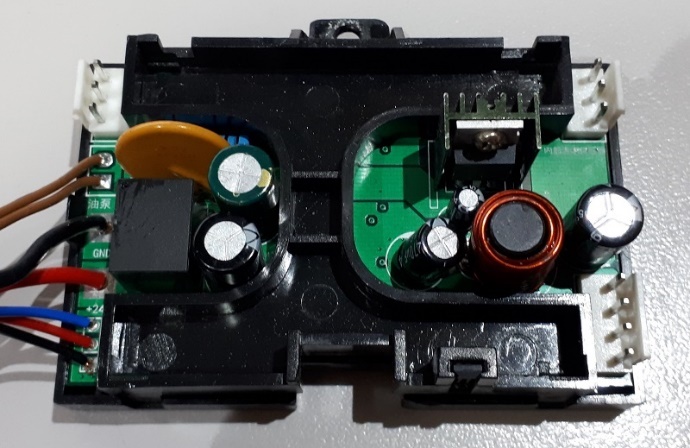
*You should have received a copy of the GNU General Public License along with this program. If not, see <https://www.gnu.org/licenses/>.*

No responsibility will be taken for any damages caused by operating the Afterburner with your diesel heater system.

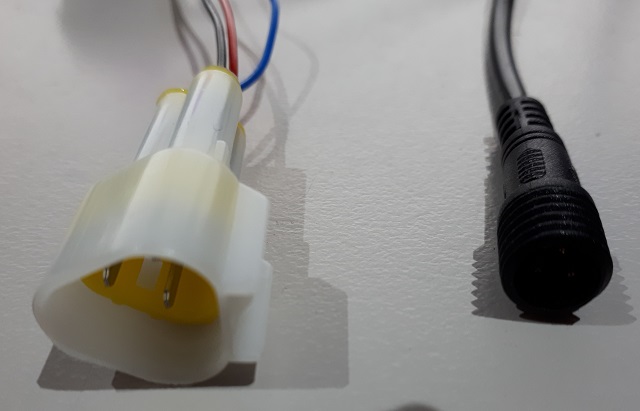
**COMPATIBILITY**

The Afterburner only works with compatible digitally controlled Chinese Diesel heaters.  
Not all heaters are digitally controlled.

The best discriminator is to inspect the control board housed within the heater unit.  
If it looks like either of the following, then your heater is compatible and will work with this controller.



Note that both only have 3 wires to the head control unit, typically being red black and blue, which ultimately terminate in either a triangular or round waterproof connector:



# **OLED Menu Structure**

The Afterburner hosts a local user interface comprising of a 13.3” 128x64 resolution OLED display, and a 5 button keypad beneath the OLED display.

The keypad buttons are logically referred to in this document as LEFT, RIGHT, UP, DOWN & CENTRE.

The OLED display can present several menus used to monitor/control the heater, or alter settings such as fuel mixture, timers etc.

The general topology of the menu flow is as follows:



When first powered, the initial menu is always the Basic Control menu.  
This menu provides basic control of the heater and will be described later.

## Menu Navigation

The Basic Control menu lies within the Root Menu Loop.

Each screen in the loop can be navigated to by using the LEFT or RIGHT keys.  
From some screens, navigation can move away from the Root Menu Loop, and enter a different loop.   
e.g.: pressing DOWN from the **Clock** menu will shift control to the Timer Menu Loop. Pressing LEFT and RIGHT now will select the available menus within that loop.

If values need to be applied, this is generally achieved by pressing the CENTRE keypad button.

## Inactivity timeout

If the user has not pressed a keypad button within the last minute, the display is dimmed.  
Additionally if the currently selected menu is not associated with one of the core root menus (**Detailed Control**, **Basic Control**, or **Clock**), control will revert to the **Basic Control** menu.

Once the display has dimmed, the initial press of any button is not passed onto the user interface.  
Instead the display is immediately restored to normal brightness. Consequential keystrokes will then be delivered to the user interface, unless the next inactivity timeout elapses.

## Basic Control menu



This menu is always the first presented upon powering up the controller, and the default timeout menu unless another core root menu is active.  
The **Basic Control** menu allows basic operation of the heater to take place:

* Heater On/Off
* Temperature adjustment
* Basic status and fault monitoring
* Thermostat or Fixed power modes
* Celsius or Fahrenheit display

### Heater On / Off

The heater can be set to run, or stop, by holding down the CENTRE keypad button for around 1 second.

#### Starting the heater

If the heater is off, hold down the CENTRE keypad button.  
A "***Starting***" message will then appear at the bottom of the screen.  


Once fully ignited and running, this will change to "***Running***", which indicates the heater is now obeying the user's desired thermostat setting, or fixed power demand.

#### Stopping the heater

If the heater is off, hold down the CENTRE keypad button.  
A "***Shutting down***" message will then appear at the bottom of the screen.  
  
During this time, the heater will stop the fuel delivery and heat the glow plug to expel unburnt fuel. The fan will continue to run and may speed up.   
This process takes about a minute to complete.

The message then changes to "***Cooling***" and the fan will continue to run until the heater has cooled sufficiently *(about 55°C body temperature)*.

Finally, the messages will disappear once the heater has completed the shutdown sequence.

### Temperature adjustment

The desired thermostat temperature, or fixed power setting, can be altered by pressing UP or DOWN to increase or decrease the setting.  
The current setting can also be observed by briefly pressing the CENTRE button.   


### Thermostat or Fixed power selection

### Pressing and holding the DOWN keypad button will enable the selection of Thermostat or Fixed power modes. The active mode will be surrounded by a loop, and can then be changed by using the LEFT or RIGHT keypad buttons. If Fixed mode is selected, the demanded power is then presented by showing the frequency the pump will run at, in Hertz. eg: Fahrenheit or Celsius

The displayed temperature can be shown as degrees Fahrenheit, or degrees Celsius.  
Toggle the presentation by holding the UP button for around 1 second.  


### Fault reporting

Should a fault be detected by the heater, an error message will be presented at the bottom of the screen, in two lines.  
The 1st line will indicate the error code, eg E-03, the 2nd line a description of the fault, eg: Glow Plug Fault:  


## Detailed Control menu

The detailed control menu allows the operation of the heater to be monitored in close detail.  
Here the actual pump speed, fan RPM, heat exchanger temperature and glow plug activity can be observed.

The heater can be turned on or off by holding the CENTRE keypad button.  
The desired temperature, or fixed heat demand can be altered by pressing the UP / DOWN keys.

If in thermostat mode, the desired value is placed as a small triangle to the left of the measured "temperature bulb" on the lefthand side of the screen.  
The actual temperature is shown below the bulb.

Once started, the desired setting is reported beneath the "target" icon as °C,°F or Hz, depending upon thermostat or fixed demand modes.

With the heater idle, the menu will look something like below:  


### Starting the heater

Hold the CENTRE key for a second or so, the heater should then start and this is reflected in the status message:  


Shortly thereafter, the fan will begin spinning, and the glow plug will be gently raised in temperature as can be observed by the steady rise in power applied to it.  
Note that the fan icon rotates to indicate the fan is running, along with the measured RPM!:  


It takes about a minute for the glow plug to receive full power, at which point the pump then starts.  
The Pump being active is indicated by an animated fuel droplet, along with the actual pump rate:  


The pump starts at a slow speed and steadily rises, along with fan speed to get the heater ignited.  
Ignition tends to be sensed once the body temperature of the heat exchanger has risen by about 5-10°C.  
The heat exchanger temperature being reported in the right hand side "thermometer bulb", and the actual value below.

Once the body temperature rises over about 65 degrees or so, the glow plug is shut down, all the while the fuel pump and fan speeds are progressively increased until at full speed.  
The heater runs in this state for quite a few minutes getting the internals nice and hot.  


After running at full speed for a while, the heater transitions to the running state, and now obeys the desired setting being either a thermostat setting, or a fixed heat demand.  
This happens about 5 minutes after the initial start was demanded:  


### Thermostat or Fixed demand modes

Hold the DOWN key to toggle from Thermostat to Fixed demand modes.

The changed operating mode is reflected in the units reported below the target icon.  
°C or °F for thermostat, Hz for fixed demand.  
The set temperature indicator also disappears from the lefthand side thermometer when in fixed demand mode:  


### Stopping the heater

Heater shutdown is initiated by holding the CENTRE key for a second or so.  
The status will then change to Shutting down:  


The pump speed is quickly lowered and eventually shut off, the glow plug is gently re-powered to assist in drying the heat exchanger of unburnt fuel.

About a minute later the glow plug is un-powered and the heater then transitions to cooldown mode.  
Only the fan is now running:  


It stays in cooldown mode until the heat exchanger is observed to have dropped below 55°C, at which point it then returns to the initial idle state.

## Clock menu



This menu presents the current time and date, as maintained by the Real Time Clock (RTC).  
This time is non-volatile, time is maintained if the power is out by an integrated lithium coin cell.

This menu is basically passive, just showing the time, but from here the clock can be set, or timers defined by pressing the Up or Down keypad buttons respectively.

### Set Time

Pressing the UP keypad button from the Clock menu will leave the Root Menu Loop and present the Set Time menu.  


Pressing CENTRE will return to the Root Loop’s Clock menu.   
Press UP to enter the clock setting mode.

The day field will first be surrounded by a loop.  
  
Pressing UP or DOWN adjusts the selected value.  
Pressing LEFT or RIGHT will move to another edit field.  
Pressing CENTRE will abort the clock setting mode.

### Applying the new Time and Date

Once happy with the new time/date setting, press LEFT or RIGHT until SET is selected.  
  
Pressing the CENTRE button will then upload the new settings into the RTC chip.

### Returning to parent menu (Clock)

To return to the Root Loop’s Clock menu, we must not be in edit mode. Exit will the selected at the bottom of the screen.  
To leave edit mode without altering the actual time, press the CENTRE key when on any edit field.  
To set the time, you must press CENTRE when the SET field is selected.

Either usage of the CENTRE key will then select the "Exit" field, press the CENTRE keypad button once again to return the Root Loop’s Clock Menu.

## Timers

Pressing the DOWN keypad button from the Root Loop’s Clock menu will enter the Set Timer Menu Loop.

The initial menu is a graphic chart showing the coverage of any timers that are enabled for the entire week.  


In this example, Timer 1 is enabled for Monday and Wednesday, starting around 19:00, stopping around 23:00.  
The bar being solid indicates this timer repeats.  
The numeric within the bar shows which timer definition applies.

There are 14 timers available.   
They can be navigated to by pressing the LEFT or RIGHT keypad buttons.

### Selecting and setting fields

After navigating to a timer, a screen like the following will appear. The actual timer being identified in the **Set Timer** header.  


To return to the Root Menu’s Clock menu, press the CENTRE button.  
To start editing the timer, press the UP button.



Use the LEFT and RIGHT keys to select the field to be edited.  
Use the UP or DOWN keys to alter the value. Note that holding these buttons down will enable auto repeat mode.

### Enabling or Disabling the timer

Using the Up/Down keys, navigate to the Timer Enable field.  


The timer can operate in simple or advanced mode.  
Simple mode allows you to just enable or disable the timer by using the UP/DOWN keys.

Advanced mode allows you to select which specific days the timer will be enabled for.  
Advanced mode is entered by holding down the UP key until a list of days appears instead of **Enabled** or **Disabled**:  
  
Once per day mode is enabled the selection loop shrinks to only select one day. The days can then be selected by using the LEFT or RIGHT keys.  
A day is enabled or disabled by using the UP / DOWN keys. A day is enabled when shown in inverse text.

Leave this edit mode by pressing the CENTRE key.  
Assuming specific days were selected, in future the selection menu indicate there are days defined.

### Timer Repeat or One Shot

Timers can be set to repeat every day, or self-cancel once expired.  
Navigate to the bottom right edit field then press UP or DOWN to toggle the setting.

### Saving the timer

Once satisfied with the settings, press the CENTRE key.

Before accepting the new timer settings, a check is made against all other timers that have been enabled.   
**It is illegal for two timers to overlap.**If the new setting does conflict with another timer, the timer being set is forcibly disabled, and a notification appears about which timer was in conflict.  


Irrespective of the timer being accepted, the settings are always stored to non-volatile memory, it may however end up being disabled due to a conflict.

If no conflict occurs the following message appears:  


### Returning to Root Menu Loop (Clock menu)

When the navigation line is selected, press the CENTRE key to return to the Clock menu.  
*If the keypad is not touched for minute, the Root Menu Loop Clock menu will be activated.*

If any timers have been set, the next timer that is scheduled to run will appear at the top of the screen, the embedded numeric being the ID of the specific timer:  


If the timer is set to repeat, the icon will gain an arrow looping about the icon.  
The number within the icon indicates which timer is defined, not how many times it will repeat.

## Mode Selection menu



The Mode Selection menu allows the Thermostat / Fixed Hx mode to be toggled, temperature reported as °C or °F, or fuel pump to be primed.

Initially enter the options by pressing UP.  
The selected option can then the altered by pressing LEFT or RIGHT.  
The other options can be selected by using UP or DOWN.



If the selection reaches the top line, fuel pump priming becomes possible.



This is always disabled by default and can only be enabled if the heater is **not already running**.

Enable the fuel pump by pressing RIGHT, the current pump speed is then reported.  
The pump can be manually stopped by pressing UP, DOWN or LEFT.  
The pump will also be automatically stopped after 1 minute, and control will be returned to the **Basic Control** menu.



## WiFi Mode menu



The WiFi mode menu presents the current operating state of the Wifi Interface and the associated web server interface.

### IP addresses

The WiFi interface host’s its own Access Point (AP).  
It can also connect to another network via that network’s Access Point. This known as Station mode (STA).

ie **AP only**, or **STA+AP** modes.

If Wifi is enabled, the IP address for the inbuilt Access Point is shown, usually always 192.168.4.1.  
If also connected to another network, the IP address for that network is shown against **STA**.

### Web Server

Two possible web pages can be presented when a user browses to port 80 (default HTTP port):

* Heater control page
* A configuration page to connect to an existing WiFi network.

There are 4 possible web server modes:

1. **CFG AP** **only:** STA configuration portal. Only available on 192.168.4.1.
2. **AP only**: Heater control. Only available on 192.168.4.1.
3. **CFG STA+AP:** STA configuration portal. Available on both IP addresses.
4. **STA+AP:** Heater control. Available on both IP addresses.

### Selecting WiFi operation mode

To change the WiFi operation mode, and whether STA mode is used, press the UP key.  
Then use the LEFT/RIGHT keys to select which mode to use in future.

To disable WiFi entirely, keep pressing left until **DISABLED** appears.

|  |
| --- |
| **NOTE:**  You cannot select **STA** mode if no stored credentials to connect to another network exist.  An **AP only** mode will erase any stored credentials required to connect to another network  (i.e. STA ability will be lost). |

If you wish to connect to another network, or change existing credentials, you must select a **CFG** enabled mode.

To enable the selected mode, press the CENTRE key.   
The new settings will be saved to non-volatile memory and the system will reboot after 5 seconds.

### Enabling / Disabling “Over The Air” (OTA) firmware updates.

The standard method of uploading new firmware uses the embedded processor default serial port.  
Firmware can also be updated via the WiFi Interface if the OTA feature is enabled.

By default, OTA mode is enabled, but in the interests of security it is preferable to only enable OTA mode when new firmware is to be uploaded.   
Always leaving OTA enabled runs the risk of a 3rd party uploading unwanted firmware rendering the Afterburner unserviceable. *Firmware can always be installed using the serial port option.*

Note that the “OTA” is reported against the WiFi icon at the top of the screen when it is enabled.

To change the OTA setting, press UP from the Wifi Mode selection mode:  


Press:

* RIGHT to enable OTA
* LEFT to disable OTA
* CENTRE to save the OTA mode to non-volatile memory, the system will reboot in 5 seconds.
* DOWN to return to the WiFI Mode selection mode.

### MAC address discovery

In some circumstances it is useful to know the MAC address of the TCP/IP interfaces.  
Especially useful if you wish to configure a fixed IP address on another network for the Afterburner controller.



## Heater Settings menu



The heater settings menu is the gateway to being able to edit the heater’s settings.  
It also enables access to advanced thermostat modes.

The currently active heater tuning settings are shown on the display.  
To de-mystify SN-x and PF-x, the actual effect is toggled into view on a regular basis.

To edit the heater settings, you need to enter a password to gain access.  
The password is “1688”.

Press UP, a password entry menu is then presented:  

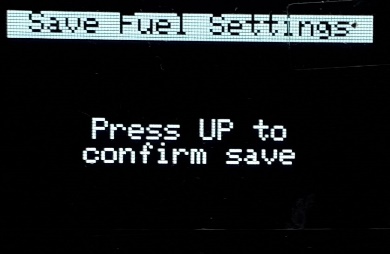

Use UP and DOWN keys to adjust each digit to the correct value.  
Select the next digit by using LEFT or RIGHT keys.  
Once 1688 is displayed, press the CENTRE key.

We have now left the Root Menu Loop and gained access to the Heater Settings Loop.  
The first menu is the Fuel Mixture settings menu:

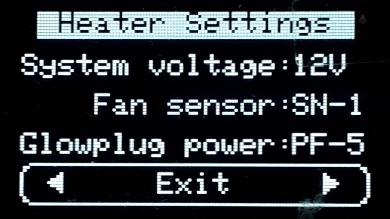
### Fuel Mixture edit menu

Press UP to enable edit mode.  
Use LEFT or RIGHT to adjust each setting.  
Use UP or DOWN to select another setting.

Abort by pressing DOWN until the navigation line is selected and move away using LEFT or RIGHT.

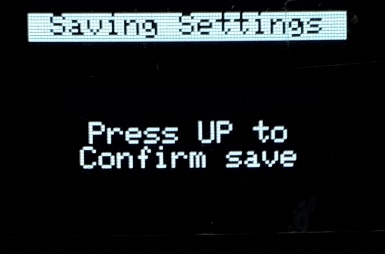
To set and save the settings, the CENTRE key must first be pressed whilst one of the settings is selected.   
You must then confirm the changes by pressing the UP key.  
**STORING** will then appear as the settings are saved to non-volatile memory:  
 

### Heater Settings edit menu

When at the navigation line of the Fuel Mixture menu, press LEFT or RIGHT to access the Heater Settings menu:  


Press UP to enter edit mode.  
Press LEFT or RIGHT to adjust the selected setting.  
Press UP or DOWN to select another setting.

Abort by pressing DOWN until the navigation line is selected and move away using LEFT or RIGHT.

To set and save the settings, the CENTRE key must first be pressed whilst one of the settings is selected.   
You must then confirm the changes by pressing the UP key.  
**STORING** will then appear as the settings are saved to non-volatile memory:  
 

## Advanced Thermostat modes

The standard thermostat employed by the heater uses the set point defined by the controller.

Starting from cold, the heater will run at the maximum fuel rate until the room temperature exceeds the setpoint by 1°C.   
Once this threshold is crossed, the heater then runs at the minimum fuel rate.  
When the temperature drops 1°C below the setpoint, the heater once again runs at the maximum fuel rate.

i.e. a 2 degree hysteresis.

**Standard thermostat mode**



The Afterburner can modify this behaviour in one of two ways:

1. Modify the actual temperature sent to the heater, controlling the dead-band.
2. Operating the heater in a linear Fixed Hz mode.

### Dead-band mode - modified hysteresis

Dead-band mode keeps using the heater’s internal thermostat, but the Afterburner modifies the room temperature advertised to the heater.   
If the current room temperature lies within a user definable window about the setpoint, the setpoint temperature is sent to the heater.   
If outside the window, the temperature will be at least 1 degree higher or lower than the setpoint.  
Thereby the dead-band, or hysteresis of the thermostat is controlled.

**Dead-band thermostat mode**



### Linear Hz

Linear Hz mode is a cunning method to remove the thermostat function entirely from the heater. The heater is told to run using Fixed Hz, or “heat demand” mode.  
If the room temperature is below the limits of the user defined window about the setpoint, the maximum fuel rate is requested by the Afterburner.  
If the room temperature is above the window limit, the minimum fuel rate is requested.  
Within the window, the fuel rate demand is linearly adjusted between the maximum and minimum fuel rates according to the deviation from the setpoint.

**Linear Hz thermostat mode**



### Settings Adjustment

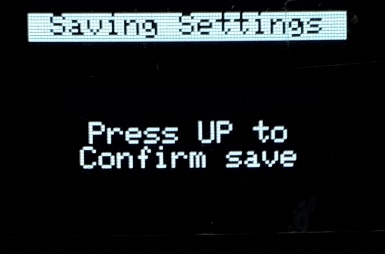
From the Root Loop Heater Settings menu, press the DOWN key.

This presents the Experimental settings menu:  


Press UP to enter edit mode.  
Adjust the setting by pressing LEFT or RIGHT.  
Select another setting by pressing UP or DOWN.

Window limits are 0.2°C – 6.3°C.  
Selectable thermostat modes are: Standard, Controlled Dead-band, Linear Hz.

Abort by pressing DOWN until the navigation line is selected and then press the CENTRE key.

To set and save the settings, the CENTRE key must first be pressed whilst one of the settings is selected.   
You must then confirm the changes by pressing the UP key.  
**STORING** will then appear as the settings are saved to non-volatile memory:  
 

# Bluetooth Connectivity

Using an Android application, you can readily control and monitor your heater via a Bluetooth connection.

To do so, you must:

1. Pair your Android device with the Afterburner.
2. Launch the Diesel Heater application on your Android device.

## Bluetooth pairing

1. Using your Android device’s Settings menu, locate the Connections menu.
2. If not already turned on, enable Bluetooth.
3. Press upon the Bluetooth text header.
4. The device will now typically scan for any Bluetooth devices, also showing previously paired devices.
5. Scroll to the bottom of the Android display and select the Diesel Heater device from the Available Devices list.
6. To pair you need to enter the correct passcode, which is “1234”.
7. The Afterburner device should now appear in the paired devices list.

## Android Application

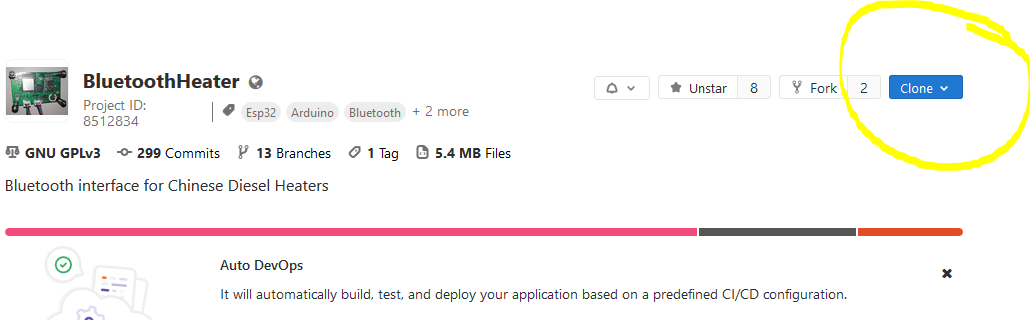
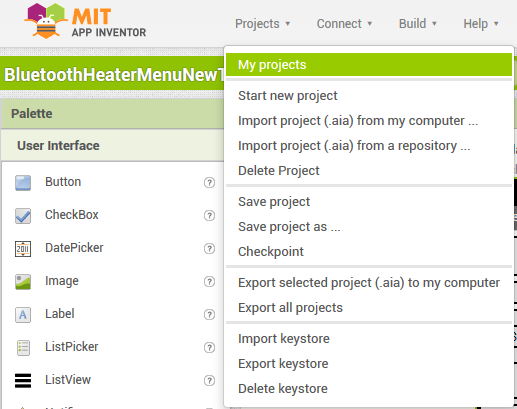
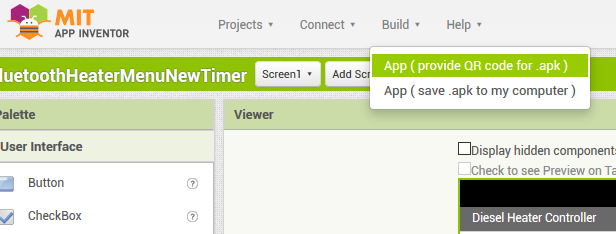
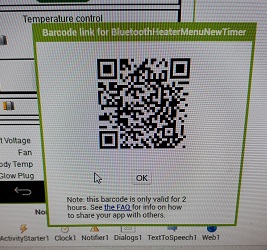
The Android application is a custom design, created using MIT App Inventor 2:  
<http://ai2.appinventor.mit.edu/>

The Android application itself is available as part of the Open Source repository hosted on GitLab:  
<https://gitlab.com/mrjones.id.au/bluetoothheater>

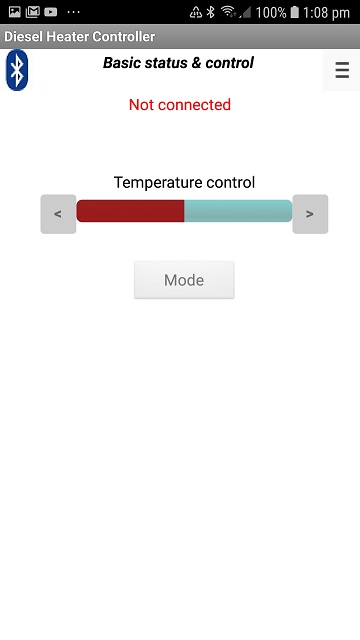
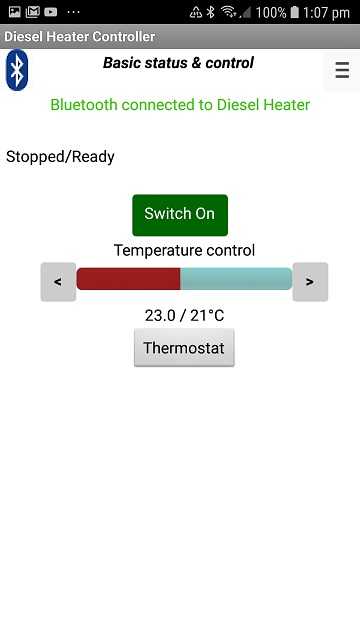
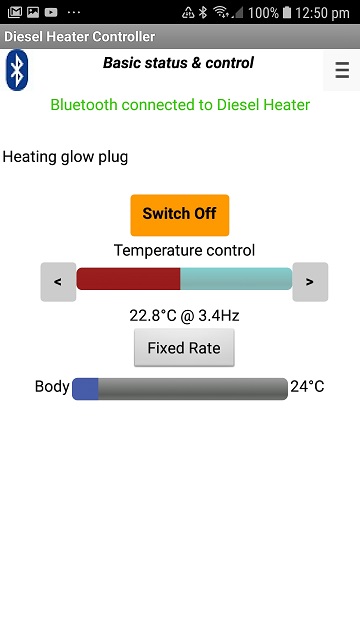
It is not available via Google Play.

You must Clone the repository, open MIT App Inventor (requires Google login), upload the design from the repository to your App Inventor login, then upload to your Android device.

Whilst this may seem tedious, remember this is an Open Source design and you are free to make changes as you see fit! A word of caution though, the block based design is a mongrel to come to grips with, especially with the number of code blocks already present.  
Rest assured though to just upload the design to your device the process is not all that difficult:

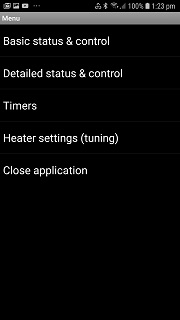
1. Clone the GitLab repository from <https://gitlab.com/mrjones.id.au/bluetoothheater>  
   
2. Unless you want to push back proposed design changes, it may be easiest to clone as a ZIP file.
3. In the downloaded repository, locate the “AppInventor” subdirectory which is under the repository’s root directory.
4. The file for the Android design will have a “.aia” extension, presently it is BluetoothHeaterMenuNewTimer.aia
5. Log into MIT App Inventor; <http://ai2.appinventor.mit.edu/>
6. Select a Google account to use, preferably the one associated with your Android device!
7. Once logged into App Inventor, select the “Projects” menu, then click upon “Import project (.aia) from my computer…”  
   
8. You will now need to install the App Inventor Companion on your Android device.
9. Visit Google Play, and search for “MIT AI2 Companion”.
10. Select and install the MIT AI2 Companion.
11. Open the AI2 Companion application once installed.
12. **IMPORTANT: your Android device must be connected to the same network as your PC.**
13. Click upon the “Scan QR Code” on the AI2 Companion.
14. On your PC, in App Inventor, select; “Build”, “App (provide QR code for .apk)”  
    
15. The design will then be compiled, and eventually a unique QR code for this instance will then be presented on your PC’s screen.  
    This QR code must be scanned using AI2 Companion on your Android device.  
    
16. The application will then be uploaded to your Android device, but first you must authorise.  
    
17. The application will now be installed to your Android device.

## Using the Bluetooth Application

1. Once installed on your Android device, the application can now be opened:
2. You now need to connect to the previously paired Diesel Heater connection:
   1. Press upon the Bluetooth icon at the top left of the screen.
   2. Select the Diesel Heater connection from the provided list
3. A connection with the Afterburner should now be established and the screen will fill in with further information.  
       
   Go on, Press the big green button!  
   

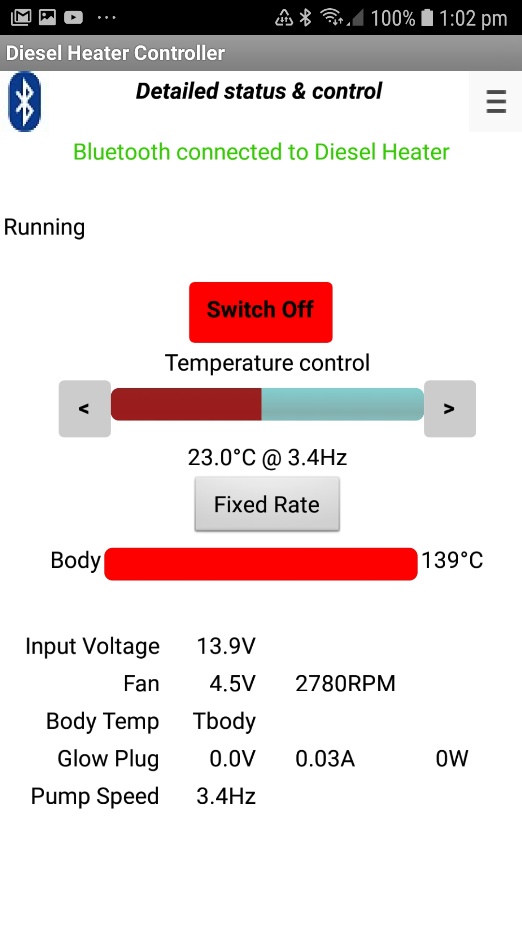
## Menus

The application always starts in Basic Status & Control mode

To change the mode, press the menu at the top right corner:  


## Detailed Status & Control mode

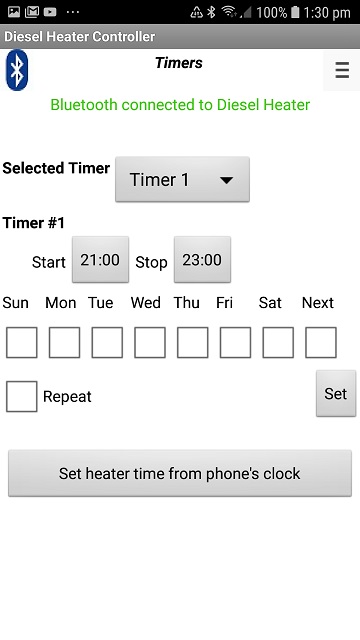
This mode allows the detailed information about the heater to be presented.  
Below the basic control information, a table of the running state is additionally shown.  
This information should be useful for fault diagnosis, and heater tuning.



## Timers mode

The timers provided by the Afterburner are extremely flexible.   
14 individual timers can be defined. Each timer can be associated with any day desired, be a one-shot affair or repeat on a regular basis.

Essentially a Start and Stop time is defined, then which day of the week it should run.  
The concept of next day becomes every day if repeat is enabled.

Select Timers from the menu list:  
Which timer is to be programmed is selected from the “Selected Timer” drop-list.

Pressing the “Start“ or “Stop” times brings up a time setting dialog where the time can be adjusted.

The days the timer operates can be selected from the row of check boxes.   
If none are selected the timer is disabled.   
“Next” means the timer runs the next time the selected time occurs.

If we want the timer to always operate using the selected days, select the “Repeat” checkbox.  
If “Next” and “Repeat” are selected the timer runs every day.

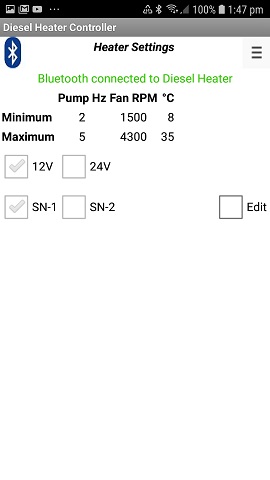
Importantly you must save you new timer definition into the Afterburner.

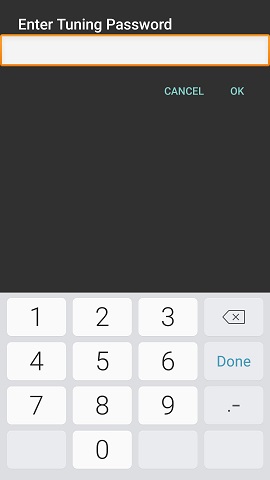
Press the “Set” button.  
The proposed timer parameters are then sent to the Afterburner. It checks that the defined interval does not conflict with any other defined timer.   
If OK the timer is set.  
If in conflict, the timer is disabled (all days are cleared), and the timer that caused the conflict is advised via a popup message.

You can examine that timer by selecting it from the “Selected Timer” drop-list to determine the cause of the conflict.

## Heater Settings mode

Heater settings mode allows the fuel mixture and running conditions to be observed and optionally altered.

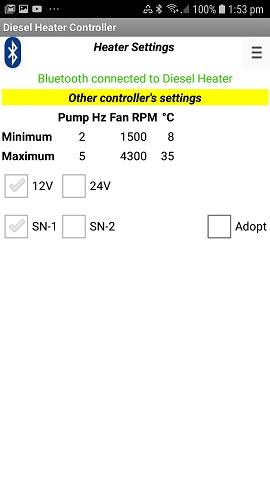
Upon initial entry the display is purely passive, simply reporting the settings as observed from the communications protocol.

To change the settings you select the “Edit” checkbox, upon which you will then need to enter a password to gain access.   
The password required is “1688”.

If entered correctly, the settings now appear in text edit boxes.  
  
The values can now be changed by selecting and entering new values.

New settings are saved into the Afterburner by pressing the “Apply” button.

If another controller is in parallel with the Afterburner, the settings of that controller are shown instead, as they are dominant.

In such a situation, it becomes possible to inherit those settings by pressing the “Adopt” button checkbox.

Once again the password “1688” needs to be entered to allow the inheritance to take place.

# Arduino Environment

## ESP32 build settings

### Arduino Board Configuration

The ESP32 processor we are targeting in this design is housed within a ESP-WROOM-32 module.  
Select the standard ESP32 Dev kit board configuration from the Arduino IDE.

This important so we can select the correct partition scheme.

### Minimal SPIFFS Partition Scheme

The compiled binary size with WiFi code approaches 1Mbyte, for some weird obtuse reason the Default Partition Scheme produces weird behaviour (despite 1.4MB being available); eg:

* Watchdog timeouts during reboot, causing a constant reboot cycle (visible via serial port debug)
* Web pages not being served
* TelnetSpy not responding to telnet connections

**For reliable operation, you must select the Minimal SPIFFS Partition Scheme from the Arduino board configuration options.**

## Required libraries to be added to Arduino environment.

**ESP32 environment package**

<https://github.com/espressif/arduino-esp32> or  
<https://dl.espressif.com/dl/package_esp32_index.json> (V1.0.1)

* WifiManager : The one from stock library manager didn't work with esp32, try <https://github.com/tzapu/WiFiManager/tree/development>
* TelnetSpy : <https://github.com/yasheena/telnetspy>
* OneWire: <https://github.com/stickbreaker/OneWire> (for ESP32)
* DallasTemperature: <https://github.com/milesburton/Arduino-Temperature-Control-Library>
* WebSockets: <https://github.com/Links2004/arduinoWebSockets>
* RTClib: <https://github.com/adafruit/RTClib>
* ArduinoJSON: <https://github.com/bblanchon/ArduinoJson>

|  |
| --- |
| **The Arduino IDE insists upon installing the latest version. This will not work properly.** Please refer to <https://arduinojson.org/v5/faq/> |

* Adafruit\_GFX: <https://github.com/adafruit/Adafruit-GFX-Library>
* Adafruit SH1106 (for ESP32): <https://github.com/nhatuan84/esp32-sh1106-oled>

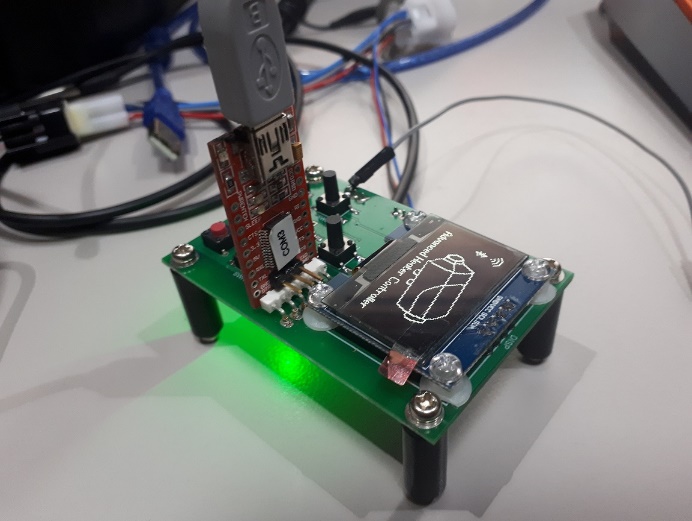
# Firmware updates

## Introduction

The Afterburner PCB does not have the bootloader assistance hardware as fitted to many dev boards.   
The PCB provides pushbuttons for the EN and BOOT pins. The serial boot load preparation is quite simple to deal with once the process is understood.

## Required Hardware

No USB support is available on the PCB.   
To provide a USB to serial connection, a **FTDI232 USB adapter** (or similar) is required.  
Only the GND, power, Tx & Rx pins are connected on the Afterburner PCB.   
**Note that the ESP32 is a 3.3V processor, so ensure the USB to Serial adapter board is set to 3.3V mode.**



## Arduino IDE

The Arduino IDE is required to compile and subsequently upload firmware to the ESP32 module.

Load the BTCDieselHeater.ino project into the Arduino IDE.

Compile and upload the design in the usual manner, ensuring the correct COM port for the USB to serial adapter is selected.

## Bootload Process

### Prepare the ESP for bootload.

The ESP32 processor needs to be prepared for bootloading by following the following sequence:

1. Press and HOLD the EN button.
2. Press and HOLD the BOOT button.
3. Release the EN button.
4. Release the BOOT button.

The above sequence can be performed at any time prior to the upload.   
It does not need to happen when the upload is being attempted.   
The ESP32 will simply wait in the bootloader until triggered by ESPtool.

If a serial debug session is active, the following message should then appear:

|  |
| --- |
| rst:0x1 (POWERON\_RESET),boot:0x3 (DOWNLOAD\_BOOT(UART0/UART1/SDIO\_REI\_REO\_V2)) waiting for download |

|  |
| --- |
| **IMPORTANT** Bootloading will fail if a serial debug session remains active. ESPtool will be unable to use the already occupied serial port. Ensure the serial debug session is closed before the upload takes place. |

### Upload

After completion of code compilation, the Arduino environment automatically launches ESPtool.exe to upload the generated binary file to the ESP32.  
An example (automatic) sequence follows:

|  |
| --- |
| Uploading...  esptool.py v2.5.0  Serial port COM11  Connecting......  Chip is ESP32D0WDQ6 (revision 1)  Features: WiFi, BT, Dual Core  MAC: 30:ae:a4:8c:a6:3c  Uploading stub...  Running stub...  Stub running...  Changing baud rate to 921600  Changed.  Configuring flash size...  Auto-detected Flash size: 4MB  Compressed 8192 bytes to 47...  Writing at 0x0000e000... (100 %)  Wrote 8192 bytes (47 compressed) at 0x0000e000 in 0.1 seconds (effective 1092.3 kbit/s)...  Hash of data verified.  Compressed 16720 bytes to 10825...  Writing at 0x00001000... (100 %)  Wrote 16720 bytes (10825 compressed) at 0x00001000 in 0.2 seconds (effective 727.0 kbit/s)...  Hash of data verified.  Compressed 989520 bytes to 546155...  Writing at 0x00010000... (2 %)  Writing at 0x00014000... (5 %)  Writing at 0x00018000... (8 %)  Writing at 0x0001c000... (11 %)  Writing at 0x00020000... (14 %)  Writing at 0x00024000... (17 %)  .  .  .  Writing at 0x0008c000... (94 %)  Writing at 0x00090000... (97 %)  Writing at 0x00094000... (100 %)Wrote 989520 bytes (546155 compressed) at 0x00010000 in 9.9 seconds (effective 803.1 kbit/s)...  Hash of data verified.  Compressed 3072 bytes to 144...  Writing at 0x00008000... (100 %)  Wrote 3072 bytes (144 compressed) at 0x00008000 in 0.0 seconds (effective 522.9 kbit/s)...  Hash of data verified.  Leaving...  Hard resetting via RTS pin... |

### Completion of upload

Despite ESPtool advising it has rebooted the processor, this did not happen because only the data lines are connected. RTS is not brought through.  
Once uploading is completed, YOU finally need to **press and release the EN button** to reboot the ESP32 processor.  
**The BOOT switch should not be operated at this time.**