

# Chesterfield Model Making & Miniature Electronics Prima



## Introduction

Chesterfield model making and miniature electronics (CMMME) Has a passionate interest for model railways and associated hobbies.

Having taken part in the hobby we are understanding of the challenges and opportunities that fellow modelers and end users have.

Costs of late; there has been a trend of inflation and lack of value across the range of products needed to make your model railway as good as can be.

Being fellow hobbyist who are part of a large OO layout, we found ourselves soon looking for other solutions that were far more cost effective whilst maintaining best in class functionality.

Prima is our third product to market that aims to address this. Currently there are no other commercial solutions that allow you to operate 32 outputs for as little as £2.50 each. Our previous two were based on Arduinos. However, whilst both reliable and cost effective, ease of operation was limited.

Changes to configuration would have to be done via editing code via a computer and uploading via a physical connection - not suitable for layouts where units are mounted underneath a layout.

Our easy-to-use web interface allows you to connect to it via its own WIFI access point, or alternatively connect Prima to your own WIFI network.

Once you have made your changes using the guide below, saved and restarted your decoder, you're ready to go!

Prima allows for both physical and DCC control of these outputs which can be assigned to either a LED, Relay or Servo, with the ability to have a physical button or DCC command, giving the ability to control multiple outputs with the same input.

An example of this would be to push a button, changing the servos direction to change a turnout, at the same time the relay would change the polarity of the track and illuminate a led for a control board. All done with one button push or dcc command.

### Caution:

**This is not a toy. It is intended for use by adults, with the understanding that Prima is an electrical device, containing exposed live connections.**

**The device power inputs (5v & USB) are not polarity protected or regulated. Do not use both inputs at the same time as this may cause damage to Prima and the connected device.**

**Do not use any power supply other than 5v DC. Amperage may vary as discussed on page 8.**

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## Overview

### Hardware

Prima is made up of four components.

- An Esp32 development board, providing the processing power and connectivity for all interfaces.
- (2) PCA9685 12 bit PWM drivers.
- An in-house designed PCB. Allowing for the above to be interfaced together. Including a DCC interface, 5v input and 16 terminals for physical buttons. The DCC input is opto isolated protecting the decoder from higher voltage track power.
- A 3d printed mount.



### Software

A key focus in the development of the Prima was to ensure ease of control and setup.

Previous hardware developments by ourselves have involved editing Arduino code, whilst we ensured this was easy to do, we understand this can be overwhelming and time consuming.

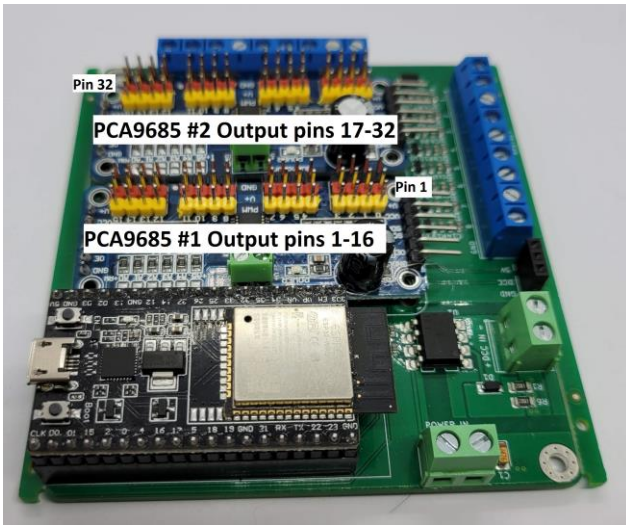
With Prima all configuration can be done via a web browser, simply by connecting your phone, tablet, laptop or computer to the WIFI network created by Prima.

Once connected, you have the ability to configure each of the 32 outputs.

## Connections

Ensure the hardware is in good condition with no damage to any of the components listed on page 4.

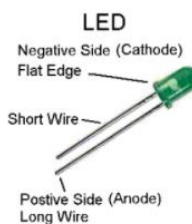
Connect your choice of LED's, relays or servos to the 32 ports using the diagrams below.



## LED connection

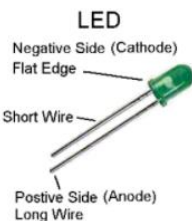
We recommend using 3v LED's.

This can be purchased here: <https://chesterfield-models.co.uk/product/led-multipack/>



LED pin connected to	PCA9685 port pin
LED + (long)	V+
LED - (short)	PWM

Command Type: DCC Switch	Output Type: <input type="radio"/> Servo <input type="radio"/> Relay <input checked="" type="radio"/> LED	Btn. #: 5
Addr: 103 Event: 103 Th	Mode: <input checked="" type="radio"/> 5V <input type="radio"/> GND <input type="radio"/> ind.	on: Btn Down do: none
<a href="#">Run as template</a>		Btn. #: 6 on: Btn Down do: none



LED pin connected to	PCA9685 port pin
LED + (long)	PWM
LED - (short)	GND

Command Type: DCC Switch	Output Type: <input type="radio"/> Servo <input type="radio"/> Relay <input checked="" type="radio"/> LED	Btn. #: 5
Addr: 103 Event: 103 Th	Mode: <input type="radio"/> 5V <input checked="" type="radio"/> GND <input type="radio"/> ind.	on: Btn Down do: none
<a href="#">Run as template</a>		Btn. #: 6 on: Btn Down do: none

## Relay connection

We recommend using 5v 1,4,8 or 16 way relays, these are found to be cost effective and reliable.

This can be purchased here: <https://chesterfield-models.co.uk/product/relay-module/>

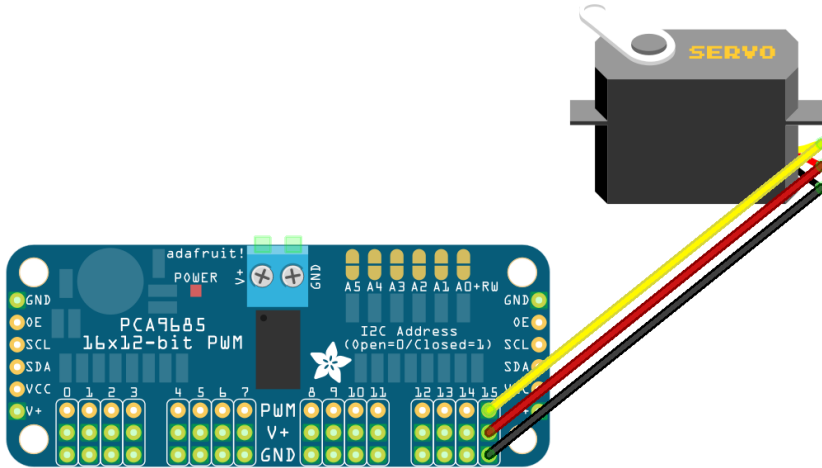


Relay pin connected to	PCA9685 port pin
Vcc	V+
GND	GND
IN	PWM

## Servos

We recommend using SG 90 micro servos, these are found to be cost effective and reliable.

This can be purchased here: <https://chesterfield-models.co.uk/product/sg90-9g-mini-micro-servo-pack-of-10/>

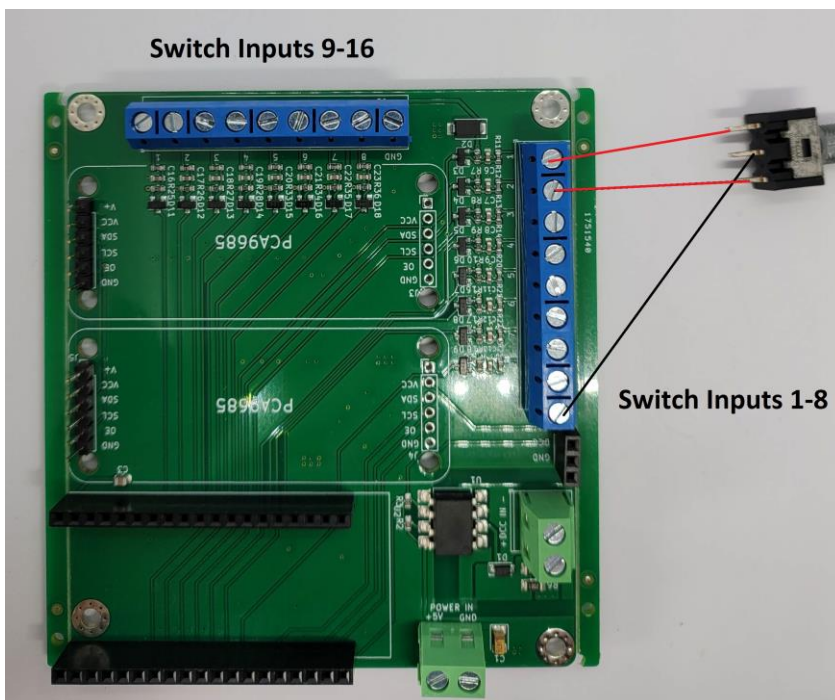


Optional - Connect hardware switches, we recommend using 2 pole toggle switches as sold here:

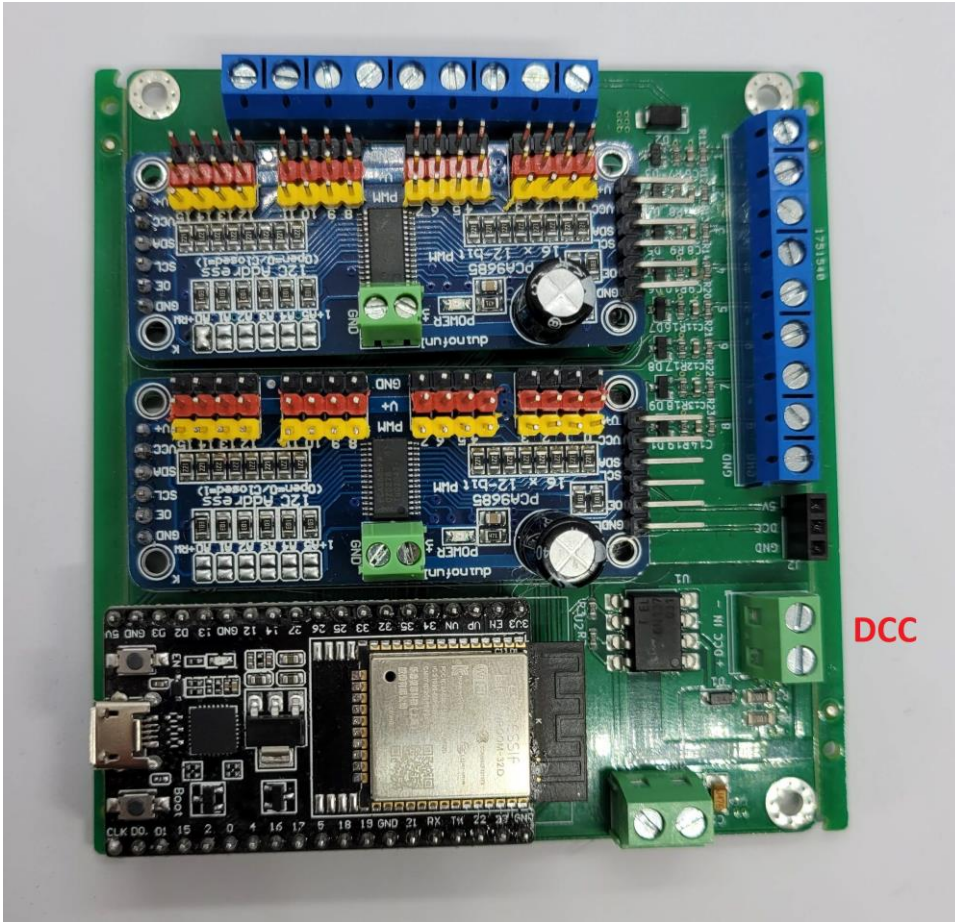
<https://chesterfield-models.co.uk/product/switches/>

In the example below we have connected a 2-pole switch to inputs 1 & 2, with ground going to ground.

This allows you to control 2 inputs with 1 switch. Alternatively, you could just use 1 input and have an individual switch per input.



Optional - Once you have connected your hardware connect your dcc bus to the dcc input terminals.



Note: whilst both input methods above are optional, one is required to operate your desired setup.

Connect a 5v DC supply to the terminals as below.

Typically, we recommend using a 5v 2a power supply. This offers enough for a good combination of connected devices.

However, typical sg90 servos can draw up to 600ma upon starting a movement, meaning if you have more than 3 servos moving at a time the power supply may be insufficient.

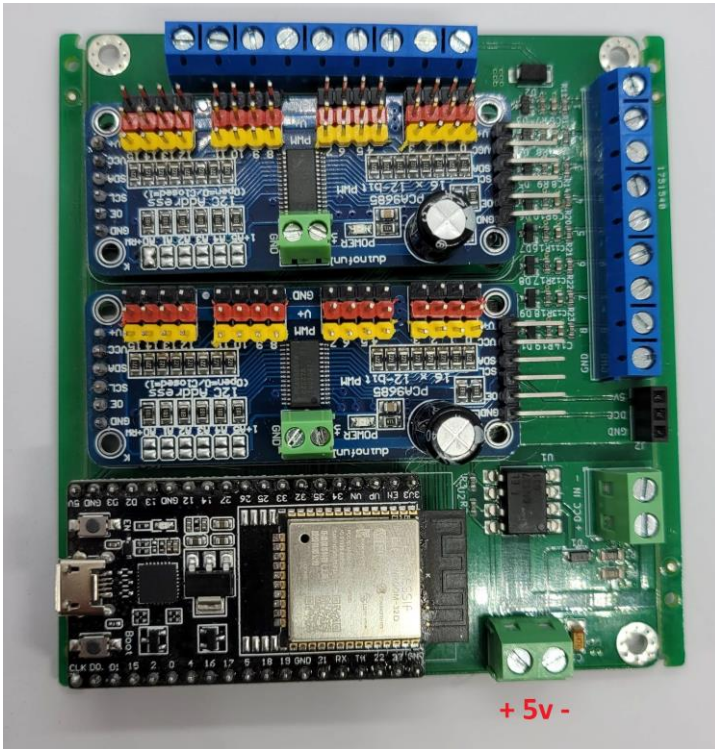
If you intend to move more than 3 servos together, we would recommend using a higher amperage power supply.

We have tested Prima with a 10a supply.

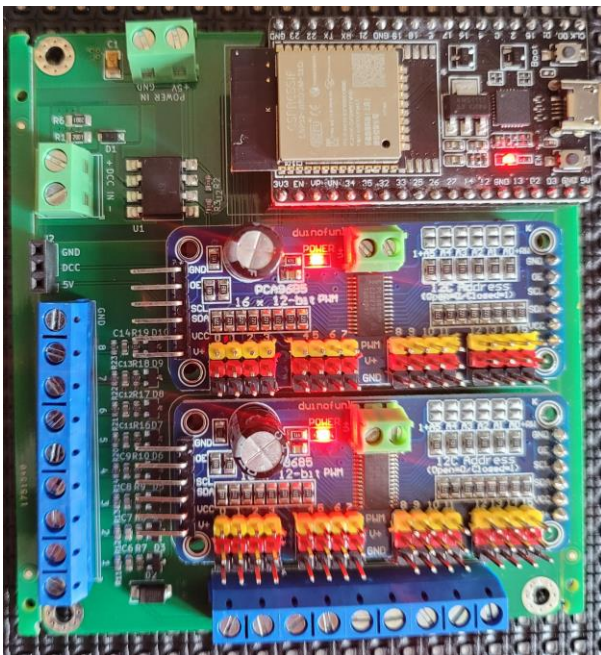
**Caution: These inputs are not polarity protected, Ensure the polarity is correct prior to turning on the power supply.**

**Additionally, ensure there is no USB cable plugged into the ESP32.**





Turn power on. Once turned on, you should see three LEDs light up as per below:

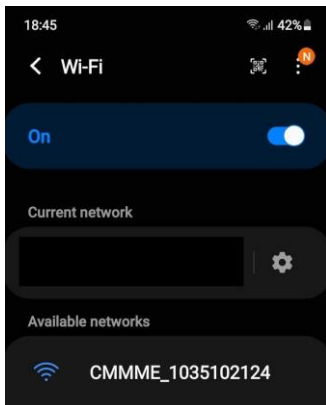


**Initial setup.**

**Note: The device's WiFi will turn off automatically if not used within 5 minutes. This is only applicable when the device is in its initial setup mode, to prevent unauthorized changes.**

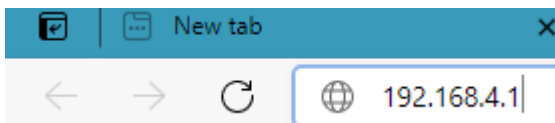
Using a device with WiFi, go to your devices available WiFi networks. After a WiFi scan has completed you will see a network called CMMME\_\*\*\*\*\*

Connect to the WIFI network using password: **MyCMMME**

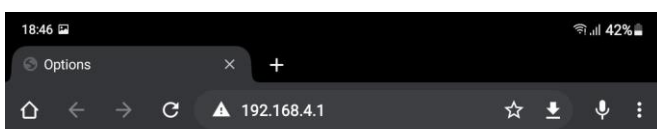


Your device may warn you there is no internet connection upon connecting. Please continue to connect to the decoder.

Once connected go to your Web browser and type the following Web address: 192.168.4.1



Once loaded you will be greeted with the following page:



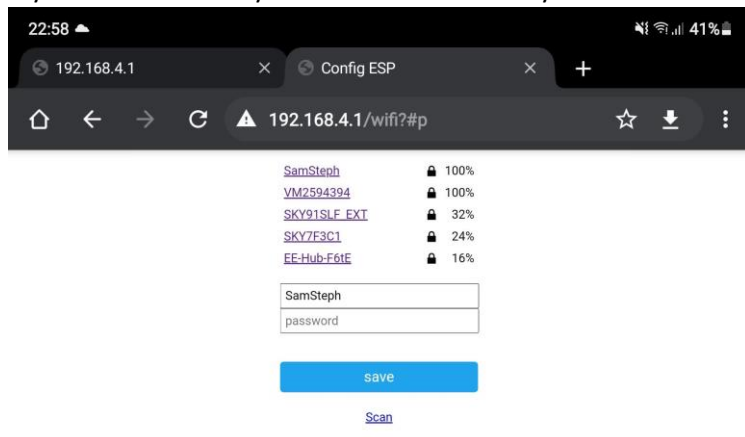
## CMMME\_1035102124

AsyncWiFiManager

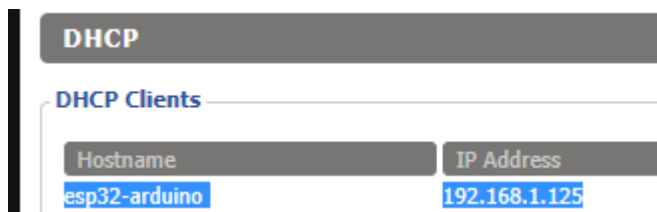
- Configure WiFi
- Configure WiFi (No Scan)
- Info
- Reset

From here you can choose to have the decoder connect to a WiFi network, for example your home network or a dedicated WiFi network for your modelling needs.

If you choose to use your own WIFI network you will need to enter your WIFI password on the following page:



**Note: If connecting to your own WIFI network you will need to find the IP address your router assigns to the decoder. This can be found in your router's settings, the IP address for this can normally be found on the router itself.**



Alternatively you can choose to keep the decoder to provide its own network.

Once you have completed your desired WIFI setup, you will be able to change the devices name / time zone if desired.

Additionally you can configure the name of the decoder, this is particularly useful if operating more than one.

## Node Configuration

### Wifi Setup

Node Name:  Add MAC Address Connect to WiFi  Device A/P on Demand

### DHCP Configuration

 Use Static IP

### Network Time Setup

 Use Internet TimeNTP Server: Timezone:

## Configuration

Once you have completed the initial setup above, change tab to configuration.

This is the page you will predominantly be using.

On the left hand side, you will see outputs 1-32.

The far left column allows you to configure the dcc input address. This can be configured to either a standard dcc switch command or a dcc signal command, the latter offering the ability for multi aspect signals or servo positions within one dcc address.

More information on dcc signal commands can be found on PAGE 15.

Adjoining each of the 32 outputs is the middle column; from here you can assign the desired function of the corresponding output.

Once you have made changes to the configuration, click the 'save' button found at the bottom, a dialog will appear showing the status of the changes being made. Prima will restart once these changes have been made. You may need to reconnect your device to its WIFI if using Prima AP mode.

## LED

LED's can be configured with multiple options.

Mode: This allows you to configure the connection type to Primas output pins.

Speed: This allows the LED to become brighter / dimmer over a gradual time, a higher value will provide a faster transition.

Bottom slider: This is the brightness of the LED. A lower value will result in a brighter LED. This can be adjusted in real time.

Pos	IF THIS: (Input Event Selector)	THEN THAT: Servo Movement	Input Setup
1	Command Type: DCC Switch Addr: 101 Event: 101 Th <a href="#">Run as template</a>	Output Type: <input type="radio"/> Servo <input type="radio"/> Relay <input type="radio"/> LED Mode: <input type="radio"/> 5V <input type="radio"/> GND <input type="radio"/> ind. Speed Up: 0 Speed Down: 0 <input checked="" type="checkbox"/> Enable 0 <input type="range"/>	Btn. #: 1 on: Btn Down do: 101 Th Btn. #: 1 on: Btn Up do: 101 Cl

## Relay

Relays have a simple on / off action, no further configuration is required.

Pos	IF THIS: (Input Event Selector)	THEN THAT: Servo Movement	Input Setup
1	Command Type: DCC Switch Addr: 101 Event: 101 Th <a href="#">Run as template</a>	Output Type: <input type="radio"/> Servo <input type="radio"/> Relay <input type="radio"/> LED	Btn. #: 1 on: Btn Down do: 101 Th Btn. #: 1 on: Btn Up do: 101 Cl

## Servo

There is a multitude of configurations that can be done with servos.

For basic setups, you can choose to move the servo +90, -90 or a full 180 sweep. Note this movements are based on using standard SG90 servos. If using another type, you will need to define the servo min and servo max values at the top of the page.

More advanced setups can include custom movements with definition of speed and hesitation points, including a bounce action for semaphore signals.

### Advanced Configuration

Speed up / down – the speed of the servo when throwing / closing.

Accel / Decel – the time it takes for the servo to reach the speed defined above.

Frequency - This defines the frequency of the oscillation for overshooting and bounce back.

Lambda - The Lambda value controls the dampening of the oscillation when overshooting or bouncing back:

Hesitation: The point at which the servo hesitates / slows, for example to mimic a mechanic pinch point.

Hesitation min speed: the minimum speed at which the servo will slow to at the point defined above.

Slider: The starting position of the servo. The end position is defined in the global max value at the top of the page

Soft Start / Stop, Hard, Soft, Bounce: All these choices control how the servo reacts when it gets to its finish position.

For a semaphore bounce action, select “Bounce”. Generally speaking, a very small movement is required to move a semaphore signal, on the slider, set the value to 600. Ensure you try this movement before connecting your signal so as not to cause damage by overshooting.

Pos	IF THIS: (Input Event Selector)	THEN THAT: Servo Movement	Input Setup
1	Command Type: <input type="text" value="DCC Switch"/> Addr: <input type="text" value="101"/> Event: <input type="text" value="101 Th"/> <a href="#">Run as template</a>	Output Type: <input type="radio"/> Servo <input type="radio"/> Relay <input type="radio"/> LED Angle: <input type="radio"/> 90+ <input type="radio"/> 90- <input type="radio"/> 180 <input type="radio"/> ind. <input checked="" type="checkbox"/> Power off	Btn. #: <input type="text" value="1"/> on: <input type="text" value="Btn Down"/> do: <input type="text" value="101 Th"/> Btn. #: <input type="text" value="1"/> on: <input type="text" value="Btn Up"/> do: <input type="text" value="101 Cl"/>
2	Command Type: <input type="text" value="DCC Switch"/> Addr: <input type="text" value="101"/> Event: <input type="text" value="101 Th"/> <a href="#">Run as template</a>	Output Type: <input type="radio"/> Servo <input type="radio"/> Relay <input type="radio"/> LED Angle: <input type="radio"/> 90+ <input type="radio"/> 90- <input type="radio"/> 180 <input type="radio"/> ind. <input checked="" type="checkbox"/> Power off Speed Up: <input type="text" value="320"/> Speed Down: <input type="text" value="320"/> Accel: <input type="text" value="1500"/> Decel: <input type="text" value="1500"/> Frequency: <input type="text" value="5"/> Lambda: <input type="text" value="3"/> <input type="checkbox"/> Hesitation at <input type="text" value="0"/> Min. Speed: <input type="text" value="0"/> <input checked="" type="checkbox"/> Enable <input type="text" value="185"/> <input checked="" type="checkbox"/> Soft Start/Stop: <input type="radio"/> Hard <input type="radio"/> Soft <input type="radio"/> Osc. <input checked="" type="radio"/> Bounce	Btn. #: <input type="text" value="1"/> on: <input type="text" value="Btn Down"/> do: <input type="text" value="101 Th"/> Btn. #: <input type="text" value="1"/> on: <input type="text" value="Btn Up"/> do: <input type="text" value="101 Cl"/>
3	Command Type: <input type="text" value="DCC Switch"/> Addr: <input type="text" value="101"/> Event: <input type="text" value="101 Th"/> <a href="#">Run as template</a>	Output Type: <input type="radio"/> Servo <input type="radio"/> Relay <input type="radio"/> LED Mode: <input type="radio"/> 5V <input type="radio"/> GND <input type="radio"/> ind.	Btn. #: <input type="text" value="1"/> on: <input type="text" value="Btn Down"/> do: <input type="text" value="101 Th"/> Btn. #: <input type="text" value="1"/> on: <input type="text" value="Btn Up"/> do: <input type="text" value="101 Cl"/>

Once you have configured the output you can then configure a physical button and its action.

### DCC signal commands.

Above we have focussed on the configuration with simple DCC & push button throw and close commands.

In addition to this some DCC systems support signal commands. These allow for multiple commands to be sent within one dcc address, allowing for mult aspect signals or multi position servos.

### DCC viewer

Coming soon.

## Software updates.

The current release is a beta release, meaning there may be features missing or bugs we are yet to find or fix.

Upon a new software release being made available you will be able to update your decoder by plugging the ESP32 into your computer via a micro USB cable.

**\*\*\* Disconnect both DCC & 5v input wires before connecting a USB cable \*\*\***

Download the .zip file and follow the instructions on the website.

Latest releases can be found here: <https://chesterfield-models.co.uk/prima/>

## Support.

Chesterfield model making and miniature electronics will provide lifetime support for your Prima purchase.

Support can be obtained via the following methods:

Email: [contact@chesterfield-models.co.uk](mailto:contact@chesterfield-models.co.uk)

Facebook: <https://www.facebook.com/ChesterfieldModels/>

Phone: Telephone number available upon request.

## Warranty

A 12 month warranty is provided from the date of purchase.

Warranties are transferable, however original invoice must be provided.

Any hardware or software modifications will make this warranty void.

## 30 day money back guarantee

If for any reason you are not happy with your purchase we will accept your order back with no quibbles.

Your order must be as new condition without any modifications.

Return postage to be paid by the buyer.

## Troubleshooting

The web page is showing 64 output options, I only have 32?

This can happen after several changes are made to configurations. Please refresh the web page.

**Revisions:****Hardware**

Current v h1.0

**Software**

Current

v s1.0 Fixed DCC Offset, included branding, Increased AP timeout

Previous:

v s0.5 - Beta release.

**Manual**

Current

V m1.0 updated branding in pictures, added warnings for voltage regulation and polarity protection

Previous

V m0.6 included WIFI setup guide and inclusion of Prima

Both hardware and software are open source.

Full details and downloads can be found on our website.

Credit to Hans Turner for his development of the software.