

Loco Controller 'Quick Start' guide

Introduction

This guide gives a quick overview of choosing a battery, installation of the Loco Controller in Dapol and non Dapol modes and the operation of the default firmware. There is much more detail in the User Guide and other documentation but if nothing else please read Appendix 1 of the user guide for more information on battery care and safety.

Battery Selection

It's necessary to source a battery as one is not provided with the controller since the choice of battery is dependent on the particulars of the installation.

The controller is designed to work only with a 1S Li-Po cell with a 2mm JST style connector. The battery MUST contain a protection circuit and should be sourced from a reliable manufacturer. It is important to use a battery that can safely sustain a continuous current draw of 1A.

An example of a suitable battery is the [LP602248](#) from EEMB.

LP602248

UN38.3

UL 1642 for Cell

- Typical Capacity: 620 mAh
- Nominal Voltage: 3.7 V
- Weight: 12g
- BMS Overcharge Voltage: 4.28 ± 0.05 V
- BMS Overdischarge Voltage: 3.0 ± 0.1 V
- Max Charge Current: 620 mA
- Max Loading Current (peak value): 2A
- Max Loading Current (constant): 1A
- Charge Temperature: $0 \sim 45^{\circ}\text{C}$
- Discharge Temperature: $-20 \sim +60^{\circ}\text{C}$
- Battery Protection Circuit (PCM) included

Connector JST-PHR-02

50.0 \pm 3.0

50.0Max

22.5Max

6.3Max

Wire : red(+) UL 1571 AWG28

Wire : black(-) UL 1571 AWG28

(Unit: mm)

Adhesive tape (绝缘胶布)

Ni-Tap (镍带)

PCM

Wire引线: black黑(-): UL1571 AWG28

Wire引线: red红(+): UL1571 AWG28

Cell(电芯): LP602248 with date code(喷码)

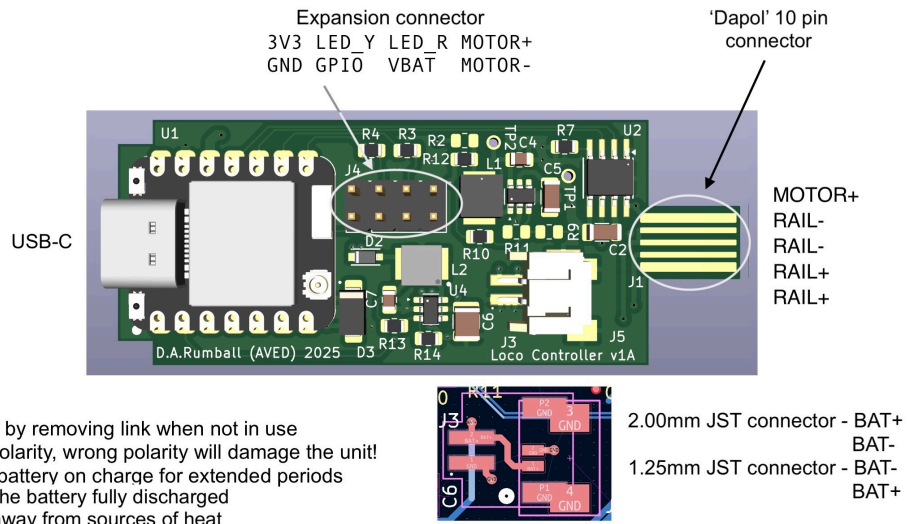
Adhesive tape Kapton (金手指)

Connector(插头): JST-PHR-02

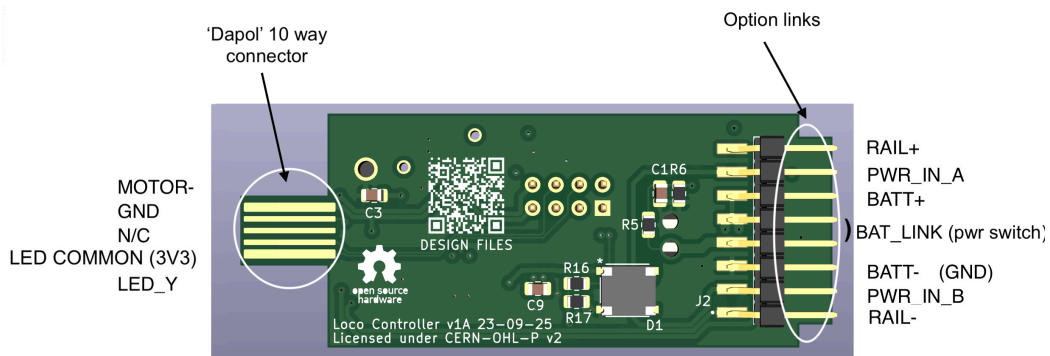
Model#: A21371-LP602248-PCM-LD

Connections

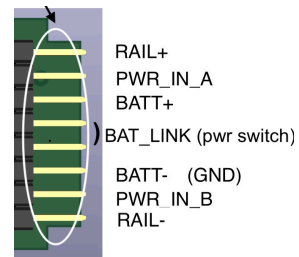
The PCB has five main connectors, a USB-C socket that can be used for charging and loading firmware, the Li-Po battery connector, an 'edge' style connector that plugs into a Dapol locomotive's 10 pin internal socket, a set of 2.54mm header pins under the front of the PCB with options for powering the device and a 2.54mm header auxiliary connector that provides access to internal power, motor, LED and servo drive in models that don't use the Dapol connector.



The battery is connected via a standard 'JST' style 2mm connector. The PCB is NOT protected from reverse connection of the battery so it is important to check polarity before insertion. The battery negative is connected to GND on the PCB and the connection diagram above shows the polarity of the battery connector.



The links at the front of the PCB allow for the isolation of the battery which can be used as a power switch (or alternatively used for connecting an external switch) and provide for the isolation of external track power by removing the two outer links. When these links are removed the battery can still be charged via the USB connector and external power can be supplied through the from header pins.



Status LEDs

There are two LEDs on the ESP32 module which are visible from the front if the smokebox door is open. Viewed from the front on the left hand side is a yellow flashing LED that indicates normal operation of the firmware and on the right hand side is a red LED that indicates charging status :-



- When no battery is connected:
 - The red light turns on when the Type-C cable is connected and turns off after 30 seconds.
- When a battery is connected and the Type-C cable is plugged in for charging:
 - The red light flashes.
- When the battery is fully charged via the Type-C connection:
 - The red light turns off.

Battery Charging

The controller has an on board charger which provides a maximum battery charge current of approximately 100mA, a limit set for thermal dissipation reasons in the charger and to provide safe charging for low capacity cells. The charger is designed for Li-Po cells with high-precision linear constant-current and constant-voltage charging. It can automatically complete the processes of pre-charge, fast-charge, trickle floating charge, voltage fold-back holding, resistive voltage drop compensation and recharge. For more information please see the SGM40567 data sheet included as part of the documentation.

The supply for the charger can be either via the USB-C socket (500mA @ 5V) or via the connections for external power. External power can be between 12V and 50V DC, is protected from inductive spikes above 54V and is insensitive to polarity. The current draw will depend on the applied voltage. The buck regulator used in the power conditioning stage has a maximum input voltage of 70V which is well above the clipping voltage.

The controller can switch seamlessly between internal battery power and external charging without operator intervention. Note that external power and USB power should not be applied at the same time.

With the current firmware the firebox LEDS of the 58XX and B4 locomotives will illuminate if external charging power is detected providing an easy way to check on charging status from outside the locomotive. Additionally the UI will show a 'charging' indicator although note that this is an indicator of external power rather than the actual charging status. However the battery voltage can be used to estimate the actual state of charge.

Installation in Dapol models with the internal 10 pin connector

This installation method has been tested with the current (2025) versions of the Dapol 14/58XX and B4 models which are fitted with a 10 way 'card edge' style connector. There may be other compatible models in the future but you should check that the connector pin out is the same before installation.

The installation process itself is simple, open the smokebox door and remove the factory fitted DCC decoder carrier PCB then replace this with the loco controller and battery. Check that the PCB slides in without any force required, the battery is a loose fit and clear of the underneath of the controller PCB and the battery or it's connecting wire aren't fouling any parts of the locomotive. Check that the links are set as desired and the 'alive' yellow LED is flashing.

That's it! You can now connect to the controller's WiFi access point as described in the 'Operation' section below.

Installation in other models

As the installation in other locomotives will be varied it's not possible to give exact instructions but instead here are some general hints and tips:-

- If not using the 'Dapol' connector insulate it with a wrap of tape or heat shrink.
- All the required signals and power for a typical installation should be available on the link and expansion header pins.
- ALWAYS arrange for the battery to be isolated via a power switch connected to the battery link pins.
- If there are metal parts in the vicinity of the controller it may be necessary to insulate the bottom of the PCB.
- The controller should not get hot during normal operation but air should be allowed to circulate around the PCB to remove any generated heat.
- Take great care with in positioning and installation of the battery, it should not be exposed to any sources of heat or subjected to mechanical bending or pressure.

Operation

The default firmware that is shipped with the controller gives a semi realistic set of controls implementing a very simple (and not quite correct) 'physics' model that simulates the characteristics of a steam locomotive including momentum and friction etc.

The firmware instantiates a 2.4GHz WiFi access point capable of supporting four simultaneous connections together with a simple Web server appearing on port 80. This server provides a page defined by files stored in the ESP32's flash based file system.

To use the controller connect your device's WiFi to the locomotives AP, which defaults to 'LocoController'. Once connected open a browser and navigate to the IP address 192.168.4.1 whereupon a page of controls will appear in the browser

The current interface offers three sliders which provide a simple emulation of a steam locomotive's controls. To startup set the Reverser to 50% and with the brake off advance the regulator to about 33% and after a short delay the locomotive should move. The firmware implements a very simple 'physics' model that takes account of momentum and friction such that if the regulator is shut off the locomotive will coast, gradually slowing down. Applying the brake will increase friction thus increasing the rate of slowing. To reverse repeat the above but set the reverser to -50%

To emulate a traditional 'direct' controller first set the regulator to 100% after which the reverser will act as an analogue control directly setting the locomotive speed.

As an aid to judging the charge state of the battery the battery voltage is displayed. Empty corresponds to approx 5.5V and full 4.1V. When track power is detected then the battery voltage will be prepended with a 'charging' message. Note that this is a proxy for the battery charging state as it isn't directly possible to sense charging.

