INSTALLATION INSTRUCTIONS

Mac•five3-SP

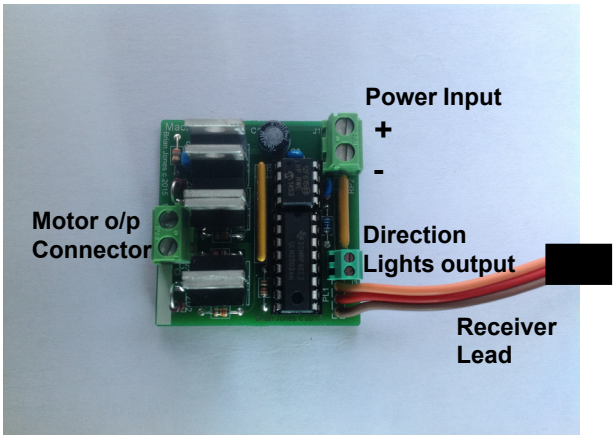
- All versions -

GENERAL PROCEDURE

Mac•five3 controllers can be installed at any angle, but installation with the power transistor tabs face up is best. ALWAYS ALLOW PLENTY OF FREE AIR SPACE ABOVE THE CONTROLLER FOR VENTILATION.

If the transistors get very hot due to high motor current, then the motors being used are probably unsuitable for battery powered locomotives, or the motor is faulty. Try a "dry run" with the various components, including the Mac•five3, prior to wiring up your loco. Permanent fixing can be made with self-adhesive Velcro. DO NOT drill any holes through the controller to fix it in place. Do not remove the sleeve as this protects the controller from short circuits,

STANDARD CONNECTIONS - See Figure 1 below.



The '+' power input terminal is marked with a red spot. **'Tin' all multi-stranded wire connections with solder, before clamping in the terminals.** Do not over-tighten the terminals. *Note that the clamps in the screw terminals rise when tightened, so put wires above the clamps, not below.*

White or yellow >Receiver signal }
Red > Receiver power (+) } On plug-in receiver lead
Black > Receiver power (-) }

N.B. It will be necessary to cut off the tab on the side of the receiver plug, if you are using a Hitec or Spektrum receiver. Use a pair of sharp side cutters to do this NOT scissors. If necessary clean up the side with a needle file afterwards.

The Direction Light outputs *MUST NOT* be shorted together or to the power lines**.**
The receiver is powered by the Mac•five3. ***A receiver battery must not be used!***
The power inputs are protected against reverse connection.

OVERLOAD PROTECTION

A fuse or cut-out must be fitted to protect the Mac•five3 from short circuits or motor faults. Fuses or cutouts should be 4 amps, or less, for the H (High Profile) type, or 1.6 amps for the L (Low Profile) type. They can be chosen to suit the motor stall current if this is less than these maximum ratings, and so protect the loco motor too.
Regardless of type, most equipment fuses blow, and cutouts open, at about twice their marked current rating. E.g. A 4 amp fuse will blow at 8 amps, but will remain intact at 6 amps.

TESTING AND DRIVING

Double check the wiring against the circuit diagram in Figure 2. Make sure there are no loose connections, including on/off switches with faulty contacts. Intermittent power connection will cause the Mac•five3 to lose the 'centre-off' reference. Once satisfied that the wiring is correct, switch on the transmitter power first, and then the loco/controller power.
N.B. *Ensure that the joystick is at the centre of its travel so that equal forward and reverse speeds can be obtained, and centre any joystick trimmer controls***.**

Make sure the transmitter and loco are well away from large metal structures e.g. metal gates or fencing, and that the transmitter aerial is pointing towards the sky. This ensures that the Mac•five3 locks on to your transmitter's proper signal and not a reflection or another false signal source. No adjustments are needed, as the Mac•five3 automatically aligns to the transmitter joystick. Make sure you do not move the transmitter joysticks whilst switching on, or else the Mac•five3 will select an incorrect reference to stop the locomotive. To drive the loco, move the joystick in the required direction of travel. The further it is moved from centre, the faster the loco goes in that direction. The traction control software will prevent sudden changes in speed, and hence wheel-slip, however an emergency stop can still be performed by allowing the joystick to return to centre by its return spring.
One final point - if the loco power is turned off, allow 10 seconds before switching back on.

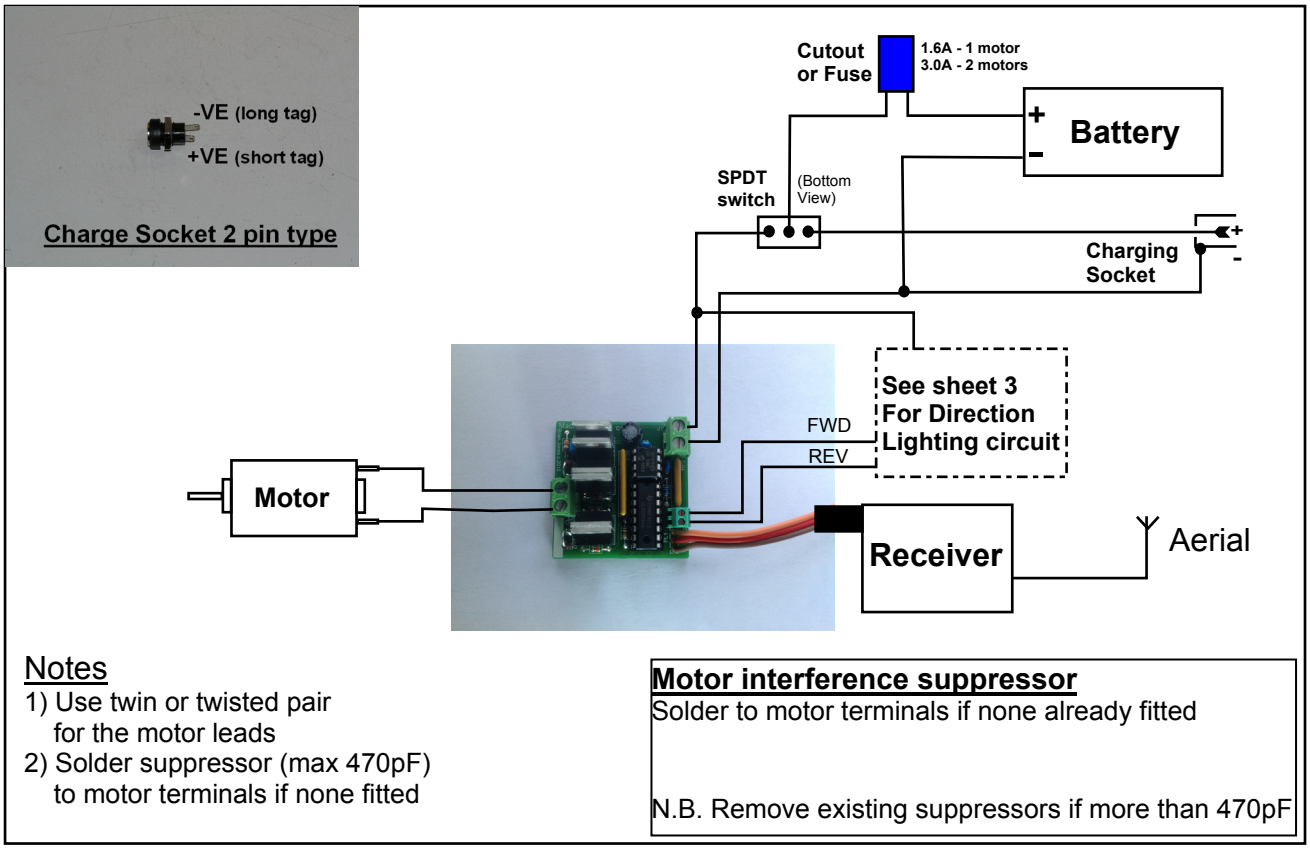
AUTODRIVE™

Mac•five3 controllers are fitted with bi-directional Autodrive™ as standard. Run the loco up to speed in the required direction and smartly switch off the transmitter. The Mac•five3 will then take over running in the same direction. To regain transmitter control, move the joystick to the position at switching off, and turn on the transmitter power.

USEFUL HINTS

Having converted the loco to battery power, make sure ALL the track pickups have been removed. Otherwise, the Mac•five3 could be damaged if the loco is run on a track power system.
DO NOT SHORTEN RECEIVER AERIAL LEADS. It will degrade the performance of the receiver. On 27MHz and 40MHz receivers, reception can be enhanced by soldering the end of the aerial lead to an electrically isolated cab roof plate, up to about 3" (75mm) square.
Do not use the whole metal body of a locomotive as the

Figure 2



aerial. Reflections from various surfaces will confuse the receiver. Tender coal rails are not usually very good either ! **2.4GHz receiver aerials should be left as they are supplied. *DO NOT MODIFY THEM!!***
Never point the transmitter aerial at the loco. There is a dead spot in line with the aerial. Holding or setting the aerial at 45 degrees will emit the best signal.
Don't fit a flywheel to the motor(s). It may damage the controller and is not needed as a 'flywheel effect' is produced electronically by the Mac•five3.

MOTOR SUPPRESSION
Use twisted pairs for the power wiring between the battery pack, controller, and motor, to reduce interference.
If not already suppressed, motors should be fitted with a 100pF capacitor (max. 470pF) soldered directly across the motor terminals. If it is not fitted directly on the motor it will not be effective.

SPECIFICATIONS
Working Voltage
Mac•five3-SP/H 24v: 9 to 24 volts DC.
Mac•five3-SP/H 18v: 6 to 18 volts DC
Mac•five3-SP/L : 6 to 18 volts DC

Maximum Current
Mac•five3-SP/L 3 Amps (Starting), 1 Amp (Running)
Mac•five3-SP/H 12 Amps (Starting), 4 Amps (Running)
Mac•five3-SP/H-UHC 25A (Starting), 7 Amp (Running)

WARNING! ***Fully charged batteries will reach a voltage higher than their nominal rating!***

N.B. If you need to return your Mac•five3 please return it in the anti-static bag in which it was supplied, or wrapped in aluminium foil before packing.

If you decide at any time to sell your Mac•five3 controller, please ensure that you pass this instruction sheet to the new owner and tell them to contact BRIAN JONES, so that we may update our records.

Mac•five3 controllers are not suitable for locos fitted with MTS or DCC decoders. No liability is accepted for damage to either a controller or decoder used in this situation as the Mac•five3 was not designed for this purpose.

Issue 1

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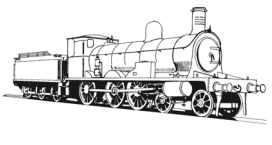

Direction Lighting - Electrical Connections

Strip and 'tin' all multi-stranded wire connections with solder, before clamping in the screw terminals. Do not over-tighten them. Note that the clamps in the screw terminals rise when tightened. The cover flap can be flattened over the terminals during use to help prevent any short circuits through the screw heads.

The outputs *MUST NOT* be shorted together or to the negative or positive supply lines.

Figure 3 (overleaf) shows how lamps and/or LEDs are connected to the Mac•five3 wiring.

USING LEDs (Light Emitting Diodes)
The number of LEDs that can be driven from each output depends upon the battery voltage. If the battery voltage does not allow sufficient LEDs to be connected in one chain, then a second chain of LEDs can be connected to an output terminal provided it is fitted with its own current limit resistor i.e. Another R1 or R2. The maximum current that can be drawn from each output is 500mA or 0.5 amps.

The number of LEDs in a particular chain is determined by the type of LED and the battery voltage. The higher the battery voltage the more LEDs can be fitted in one chain. White LEDs drop more voltage than coloured LEDs. White LEDs typically drop 3v to 3.5v. Red, Yellow or Green LEDs only drop 1.5v to 1.7v.

Most LEDs give the optimum light output between 10 and 20 milliamps (mA). Each chain of LEDs must have its own current limiting resistor (R1 or R2) fitted or else the lighting outputs, and thus the controller, will be damaged. The value of R1 or R2 can be calculated from the formula :-

$V_b - V_{leds}$ divided by LED Current, where V_b is the loco battery voltage, V_{leds} is the total voltage dropped by the LEDs

For Example :- Battery Voltage 12v, Four Red LEDs 1.5v each, LED current to be 10mA

$$= \frac{12 - (4 \times 1.5)}{0.01}$$

$$= \frac{12 - 6}{0.01} = \frac{6}{0.01} = 600 \text{ Ohms}$$

The nearest practical value to this would be 560 Ohms, or 680 Ohms.

An easy way of remembering the formula to calculate the resistor value at a LED current of 10mA is :-

$V_b - V_{leds} \times 100$.

If a LED chain was to have a mix of 1 White LED (3v drop) and 2 red LEDs (1.5v each) on a loco powered by a 14.4v battery at 10mA LED current, then the limit resistor value would be :-

$$14.4v - \frac{(3 + 1.5 + 1.5)}{0.01} = \frac{14.4 - 6}{0.01} = 8.4 \times 100 = 840 \text{ Ohms}$$

The nearest practical resistor values would be 820 ohms or 1000 ohms. In practice try the higher resistor first as this will reduce the LED current. If it's not bright enough then decrease it to the lower value. In any case don't let it go above 20mA. Also note that a fully charged 14.4v battery will charge to around 16.5v. So calculate your resistor values with that in mind!

USING FILAMENT BULBS
Current limit resistors are not needed when using filament bulbs provided that the bulb voltage is suited to the battery voltage being used i.e. Use 12v bulbs with a 12v battery. A pair of lower voltage bulbs may be used in series. Bulbs and LEDs can be used together provided they are in separate (i.e. parallel) chains. Be careful not to exceed the maximum output current when using bulbs.

Maximum Output Current (Each output): 200mA continuous.
Maximum terminating voltage (Each output) 26 volts

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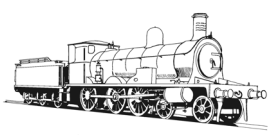
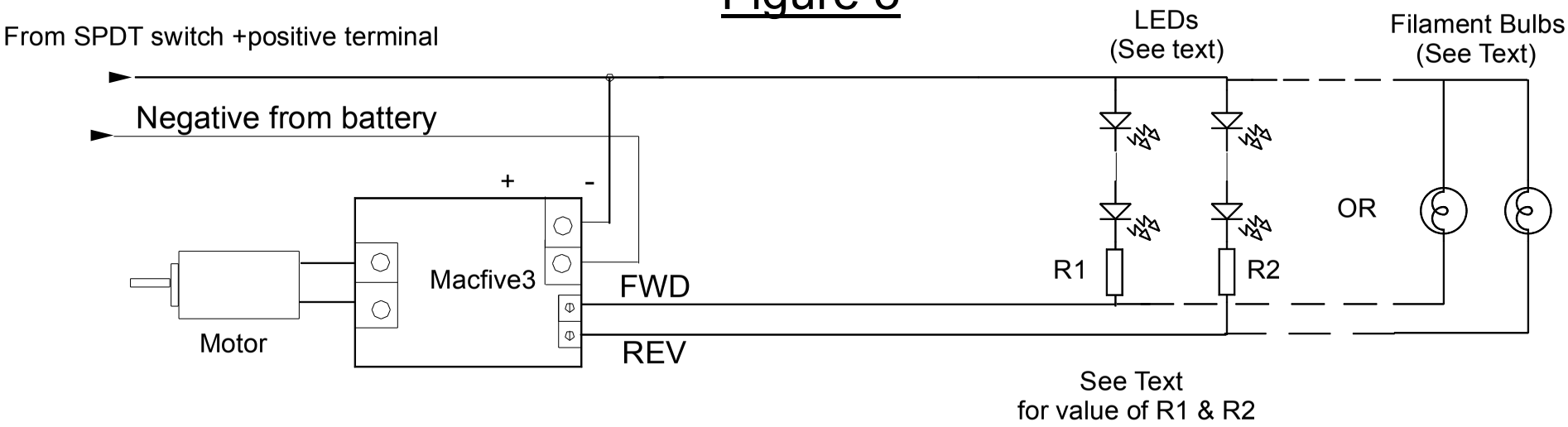


Figure 3



N.B. LEDs MUST NOT be used
without R1 or R2

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