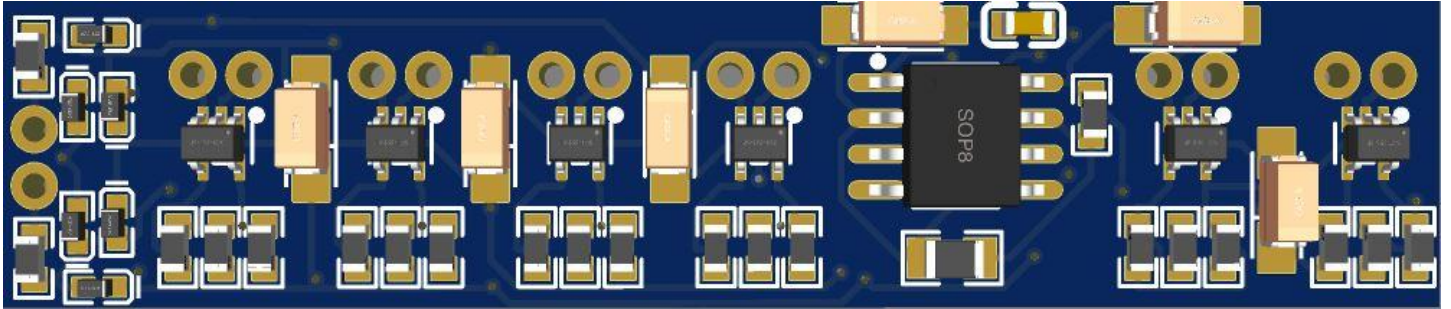


JTElectronics

Locomotive LED Lighting Control Board

Model: JTELED1



The JTELED1 is a board used to control LED lighting on a model railroad locomotive. It connects across the track pickup or motor terminals and detects forward and reverse directions to light various LEDs depending on how you have configured it.

The JTELED1 has connections for up to four LEDs which could be used for front and rear lighting, as well as connections for two additional LEDs that flash alternately which may suit some lighting arrangements. The LEDs can be configured to light up in either forward, reverse or both directions to allow versatile control of front and rear lighting depending on the direction the locomotive is travelling.

All LED connections are current limited, so you don't need to wire in external current limiting resistors – you just connect the required LEDs directly to the JTELED1 board. Apart from simplifying wiring, the current limiting ensures a steady LED brightness independent of a varying voltage applied due to changing locomotive speed. As supplied, the JTELED1 is configured for 15mA current to all LEDs and is configurable by simply removing resistors as detailed later in this document.

You must configure the correct LED current for the type of LEDs you are using, or the LED won't last very long.

See "SETTING LED CURRENT" section later in this document.

You must configure the direction solder bridges correctly or the LEDs won't light at all.

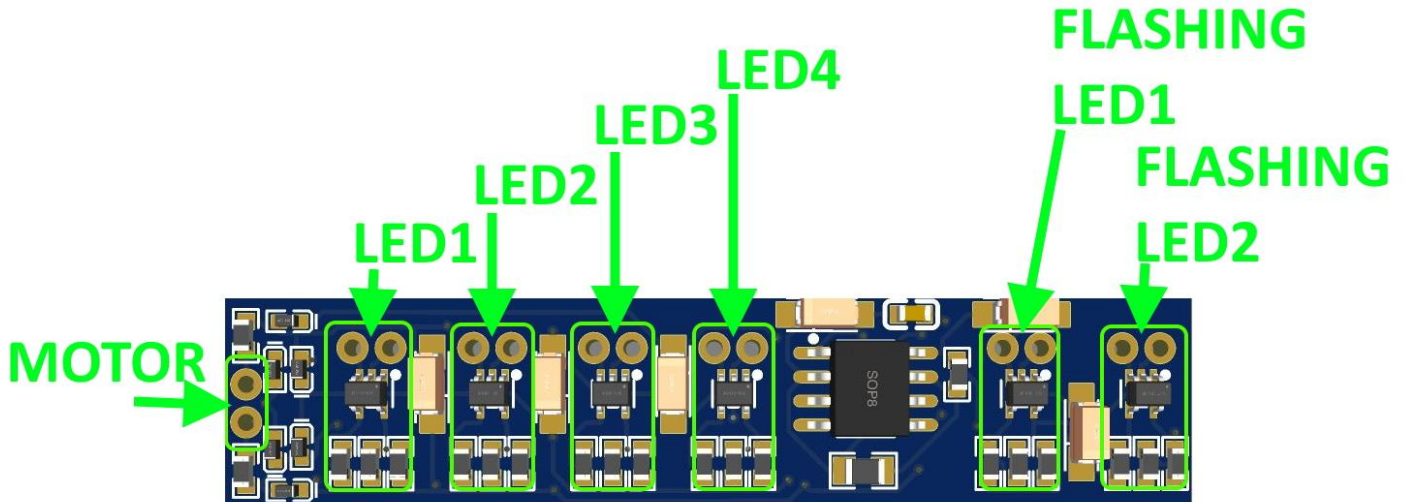
See "SETTING LIGHTING DIRECTIONS" section later in this document.

Please note that **when using the JTELED1 Locomotive LED Lighting Control Board, the connected LEDs will NOT light when there is no power going to the motor - which is when the locomotive is not moving.** Often when your track speed controller is set to a low speed, it can supply a small amount of power to the locomotive before the locomotive actually starts to move. Once the JTELED1 board sees more than about 4 volts on the motor terminals, it will light the LEDs and low track controller speed settings may achieve this – it is dependent on your locomotive and track speed controller.

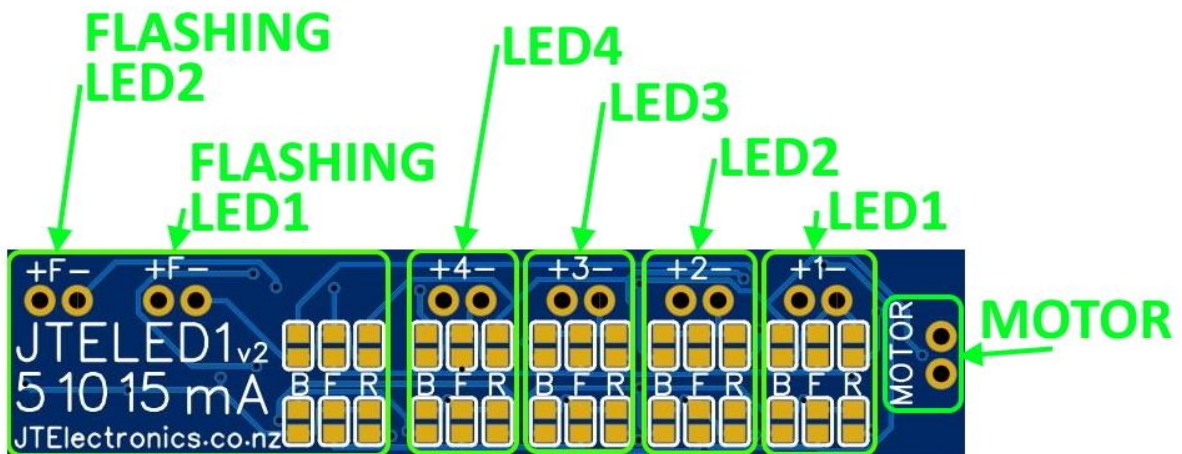
BOARD SPECIFICATIONS

LENGTH	51.5 mm
WIDTH	11.5 mm
HEIGHT	5.5 mm
MAX TRACK VOLTAGE	18 Volts DC – The JTELED1 board is NOT suitable for AC motor systems
DEFAULT LED CURRENT	15mA
MAX LED CURRENT	50mA 😊 configurable by changing the 0603 type surface mount resistors

Front of JTELED1 board



Rear of JTELED1 board



This document is updated from time to time as new information becomes available – usually due to people asking relevant questions regarding usage or configuration. The “Document Updated” date in the bottom-right corner of each page shows what document date you have. The latest version of this datasheet document can be downloaded from <http://www.jtelectronics.co.nz/products/documents/> or Google “JTELED1” ...

SETTING LIGHTING DIRECTIONS

You can configure the various LEDs to light in either forward, reverse, or “both” directions. Configuration is done by soldering “bridges” of solder between the various configuration solder bridge pads on the back of the JTELED1 board. You will need to perform this configuration very carefully as incorrect configuration could damage the JTELED1 board or damage your locomotive.

The direction options are written on the board between the required pair of solder bridge pads to help you find them. The directions are labelled B, F, and R corresponding to the Both (that’s both forward and reverse directions), Forward (forward only), and Reverse (reverse only) directions. The group of configuration solder pads for a particular LED are adjacent to the corresponding LED connections. If you require an LED to light in both Forward (F) and Reverse (R) direction, use the Both (B) direction configuration solder pads.

You must join both the upper and lower pair of configuration solder bridges corresponding to your desired direction, for each required LED to operate.

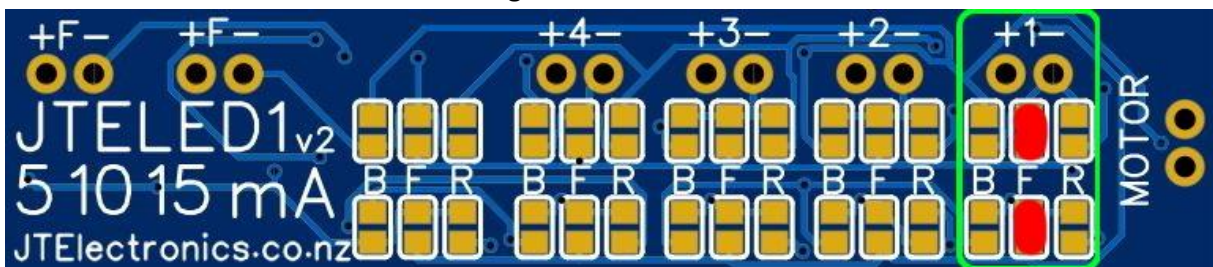
You must only bridge ONE pair of direction configuration solder bridges for each LED - either “forward”, “reverse”, or “both” direction. NEVER configure the same LED with 2 or more direction configuration options. Soldering Forward (F) and Reverse (R) and/or Both (B) configuration solder pads for the same LED configuration will damage the JTELED1 board, and possibly damage your locomotive.

If you make a mistake or decide to change the lighting direction for a particular LED by removing solder bridges from the solder pads, make sure you have carefully **removed all solder** (by using desoldering braid etc.) and **check with your multimeter that there is no solder connection remaining** between the solder pads. **Failure to remove the unwanted solder bridge connection will result in damage to the JTELED1 board, and possibly damage your locomotive.**

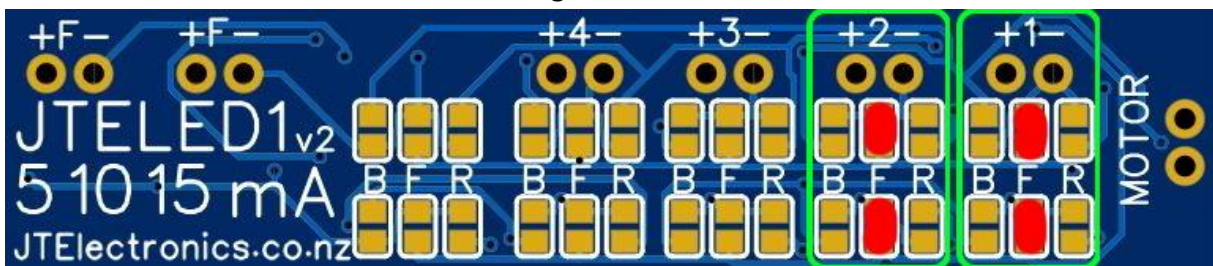
Refer to the following pictures for examples of various lighting direction and LED combinations. Solder bridge connections are **shown in red** in the pictures below – join these small pairs of solder pads with a blob of solder.

- Remember:
1. Join **both the top AND bottom pairs** of solder bridge pads for each LED configuration.
 2. **NEVER** configure more than one pair of “direction” solder bridge connections for the same LED!

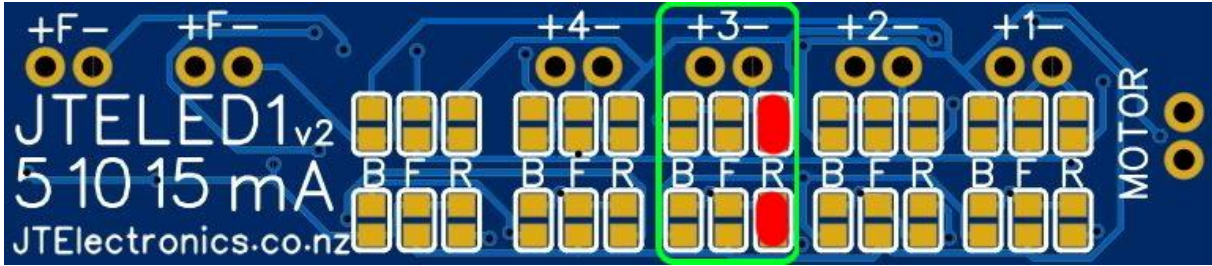
LED 1 configured for Forward direction



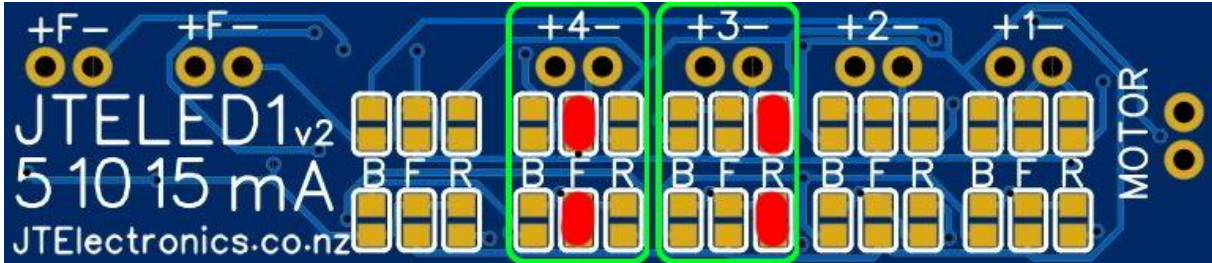
LEDs 1 and 2 configured for Forward direction



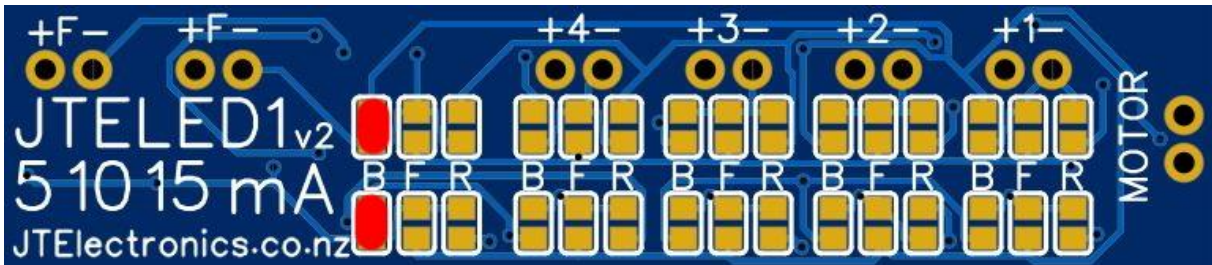
LED3 configured for Reverse direction



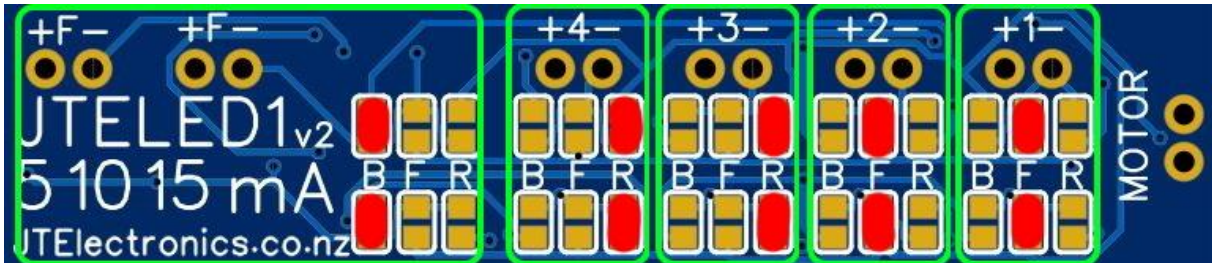
LEDs 3 and 4 configured for Reverse direction



Flashing LEDs configured for "Both" direction



LEDs 1 and 2 (maybe for headlights) configured for Forward direction,
LEDs 3 and 4 (maybe for tail lights) configured for Reverse direction,
Flashing LEDs configured for "Both" direction



And an actual photo of the solder bridges for the above configuration

SETTING LED CURRENT

All LEDs require an optimal current for good brightness and long life. As a guide, smaller LEDs require smaller current to operate safely with recommended LED current listed in the following table.

LED TYPE	TYPICAL OPERATING CURRENT
0402	5mA
0603	10mA
0805	15mA
3mm Round	15mA
5mm Round	20mA

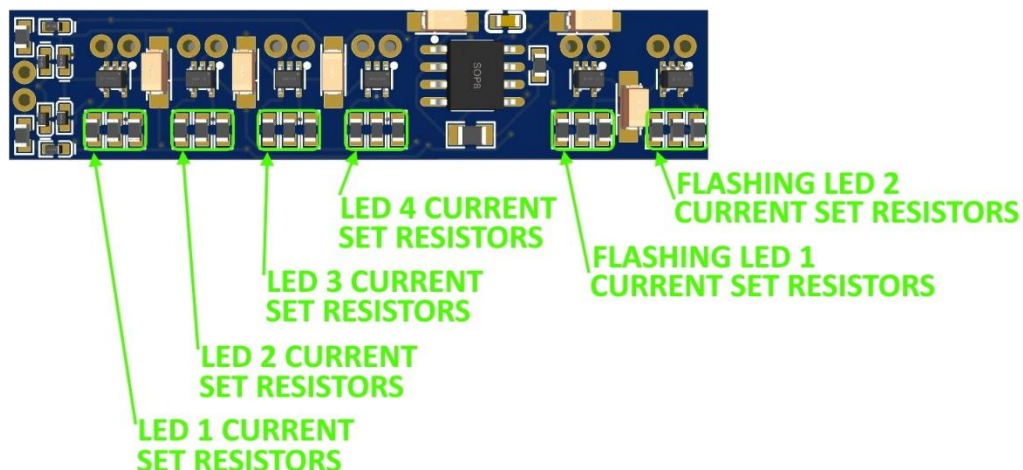
As supplied on the JTELED1, each LED section has three 120 Ohm resistors connected in parallel to lower the total resistance to 40 ohms. These resistors are what sets the LED current and an effective resistance value of 40 ohms sets the LED current to 15mA. You can remove or change the resistors to change the LED current but there must always be at least one resistor connected!

TOTAL RESISTANCE	LED CURRENT
40 ohms (3x 120 ohm in parallel)	15mA
60 ohms (2x 120 ohm in parallel)	10mA
120 ohms (1x 120 ohm resistor)	5 mA

The effective total resistance of resistors connected in parallel can be calculated using the standard “Ohms Law” formula for resistors connected in parallel:

$$R_{total} = 1 / \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \dots \right) \quad \text{Where } R_1, R_2 \text{ and } R_3 \text{ are the resistors connected in parallel for a particular LED}$$

Location of groups of resistors to set the LED current

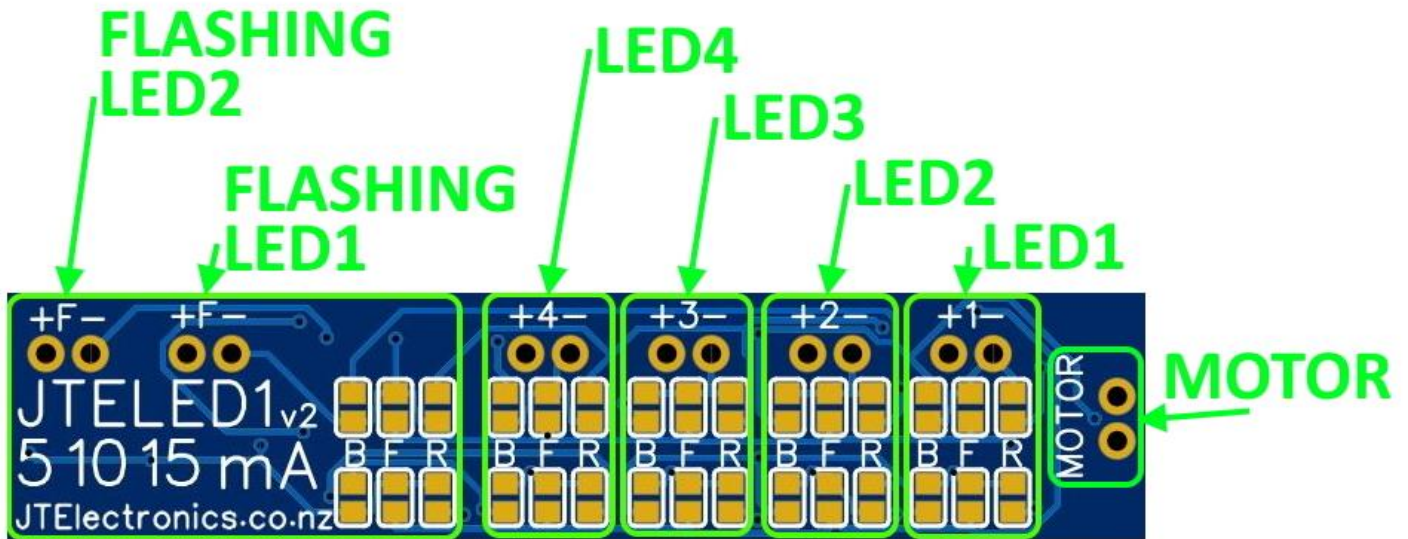


If you use 0603 or 0402 LEDs, you can remove one or two current set resistors from the group of 3 resistors to increase the effective total resistance and lower the current to that LED. Just remember one remaining resistor will give 5mA LED current, two remaining resistors will give 10mA current, three remaining resistors will give 15mA LED current. If you want to install your own 0603 resistor(s) to get a custom LED current, use the formula:

$$I_{out} = \left(\frac{0.617}{R_{ext}} \right) + 15\mu A \quad \text{Where } I_{out} = \text{LED current and } R_{ext} = \text{effective total resistance of the current set resistor(s)}$$

WIRING DIAGRAM

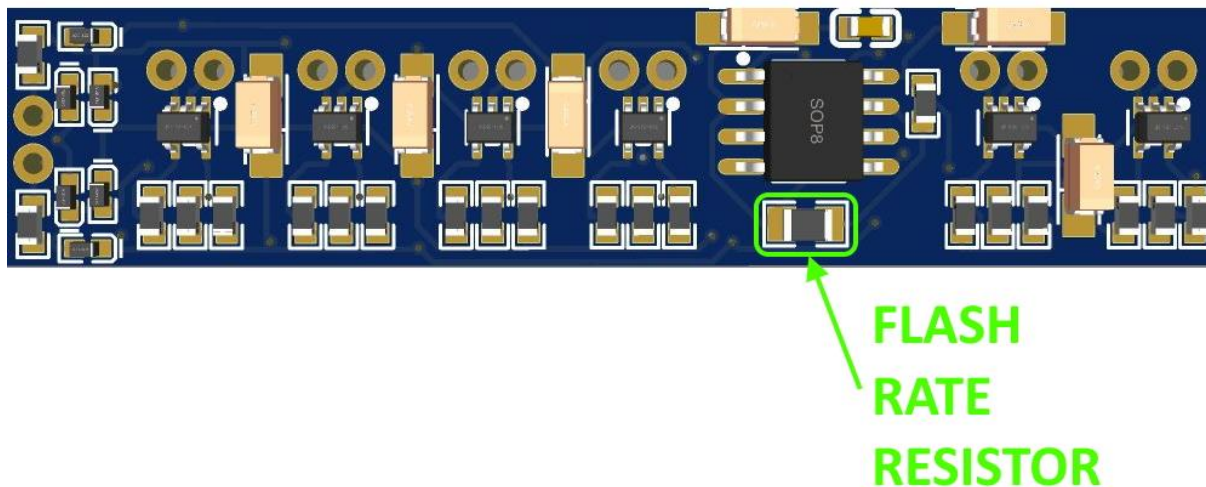
Once you've got the LED direction and current configured for your requirements, go ahead and wire in connections to the LEDs and motor... A wiring guide is written on the back of the JTELED1 board for quick reference, so it is probably best if you connect the wires to this side of the board to avoid mistakes.



- **MOTOR** Connect to the locomotive motor. The motor connections supply required power to the JTELED1 board. If the "Reverse" configured lights come on in the forward direction and "Forward" configured lights come on in reverse direction, swap the motor wires and the LED "direction" configuration will now match the locomotive movement direction.
- **LED1** Connect to your LED as required, + to the LED +/Anode connection. Remember that no resistor in series with the LEDs is needed when using the JTELED1 board.
- **LED2** Connect to another LED as required, + to the LED +/Anode connection.
- **LED3** Connect to another LED as required, + to the LED +/Anode connection.
- **LED4** Connect to another LED as required, + to the LED +/Anode connection.
- **FLASHING LED1** Connect to your first flashing LED as required, + to the LED +/Anode connection.
- **FLASHING LED2** Connect to your second flashing LED as required, + to the LED +/Anode connection. If you only need one flashing LED, you can leave this second flashing LED disconnected.

CHANGING THE FLASHING LED SPEED

Speed of the flashing LEDs should mostly be independent of supply voltage (i.e. motor speed). They will flash about once per second. If you really want to adjust the flash rate, you can change the flash rate resistor. The supplied value is 100k ohm. A 200k ohm resistor will slow the flash rate to about once every 2 seconds and a 47k ohm resistor will speed up the flash rate to about once every 0.5 seconds.



The flash rate frequency can be calculated with the following formula:

$$\text{Flash Rate} = 1.1 \times R_1 \times C_1 \quad \text{where } R_1 \text{ is the flash rate resistor in ohms and } C_1 \text{ is the timing capacitor in Farads}$$

Since the timing capacitor is 10uF (0.000 010 Farads) and the supplied flash rate resistor is 100k (100 000 ohms) we can substitute these values into the flash rate formula:

$$\begin{aligned} T &= 1.1 \times 100000 \times 0.000010 \\ &= 1.1 \text{ seconds} \end{aligned}$$