Pocket Money Kit of the Month September 2020

Automatic coach lights

This is an automatic lighting system where the coach lights only come on when the train is moving. When movement is detected, the LED lights come on and stay on during the train's journey. If the train stops at a station or at a signal, a built-in delay keeps the lights on for a couple of minutes. However, if the coach is left parked, its lights will go out after those couple of minutes. This process is automatic, the only control being a small power 'switch' that is set at the start of a session.

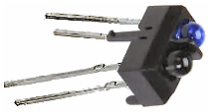
This little 18mm x 16mm module is suitable for both DC and DCC users, as it uses a small battery (DCC users see the end of the article on suggestions for adapting for DCC use).

A group of individual white LEDs is powered from a 3V coin cell battery CR2032. The example shows both cool white and warm white LEDs, although you would decide which looks best for your stock of coaches.
The battery is external allowing for easy changing. There is no need to open the coach to change the battery (or to flick an on/off switch).

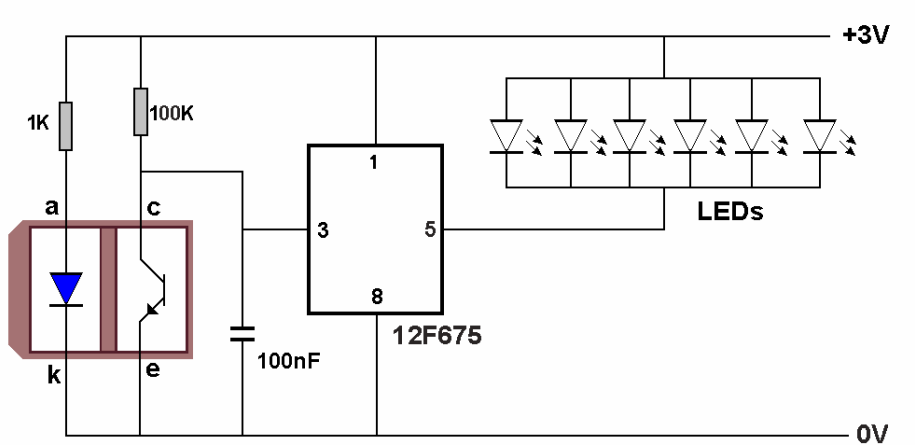
The photograph above tends to exaggerate the brightness. The lights are not as bright as commercial offerings but I think that makes them more realistic.
If you want very bright lights, you probably want to use a 12V LED strip and a 12V supply (using either a 12V battery or taking power from the DCC supply).

How it works

The project uses only a handful of components, based around a infra-red detection component and a pre-programmed PIC chip.
The image shows a TCRT5000 reflective optical sensor. This is mounted under the coach, pointing downwards towards the track.



The infrared LED emits infra-red light down towards the track. The phototransistor senses the amount that is reflected back upwards.
If the train is stationary, the light that is reflected will remain fairly constant, regardless of whether the TCRT5000 is sitting over a sleeper or over the ballast (or even in between).

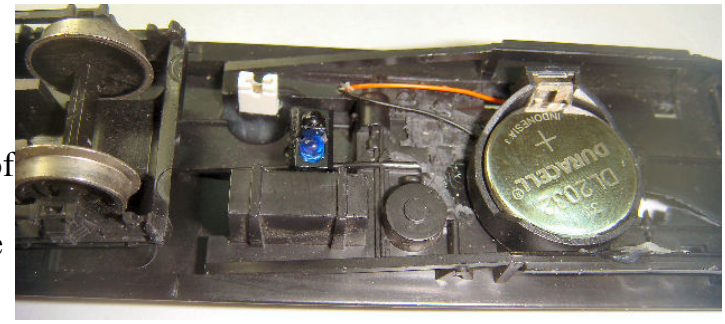


When the train starts to move, there will be noticeable changes in the intensity of the reflected infra-red. This is detected by the PIC chip which switches on the LEDs.
When the train stops, the level of reflection will return to being fairly constant. If there is no further light changes after a few minutes, the chip switches the LEDs off.

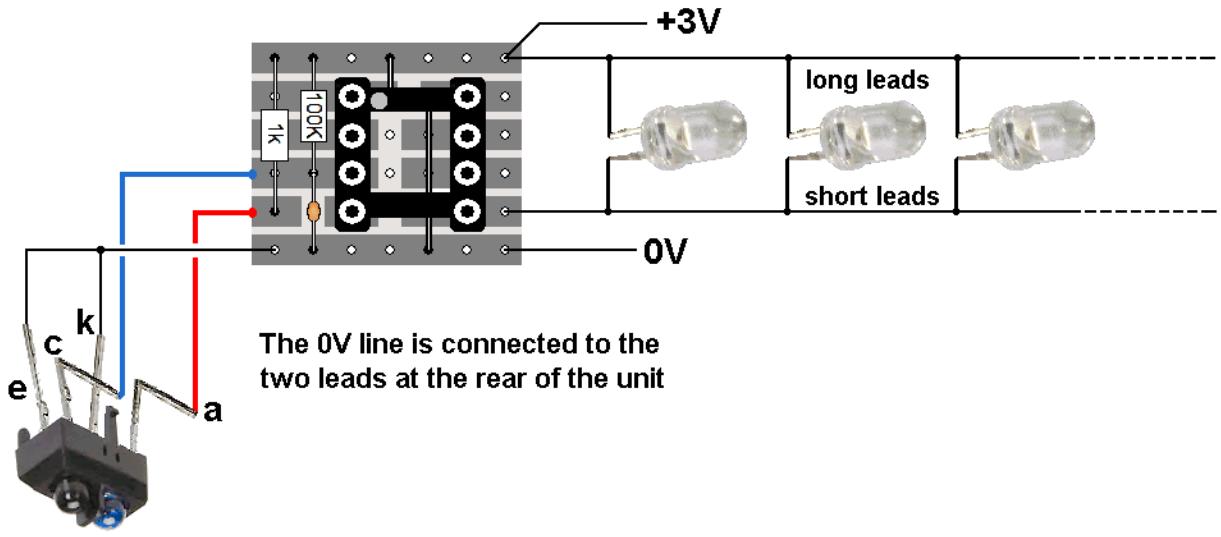
The PIC chip's output pin 5 switches the LEDs on and off.
The code inside the PIC chip is self-adjusting for different sleeper and ballast colours. It 'learns' the difference between your sleep and ballast reflections, regardless of their levels of lightness/darkness. As a result, there is so need for any external sensitivity controls.

Fitting to coach

The board is fitted inside the coach, in as inconspicuous place as possible (in the toilet or standing on its end?). The other parts are fitted under the coach largely out of site from most viewing points,



Before fitting, check where you want to fit the sensor, the on/off switch and the battery holder. To make battery changing easy (save dismantling the roof etc.) and to prevent any components being seen inside the coach, I placed the battery holder and switch under the coach.



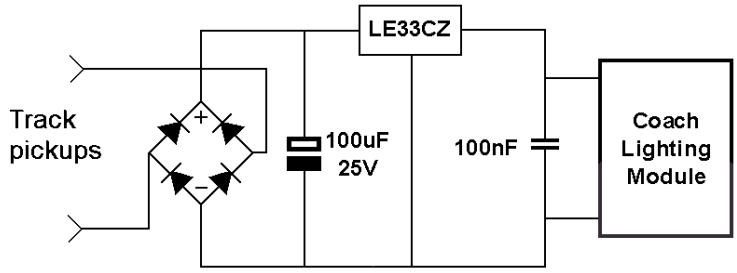
I found no need to alter the sensor height above the track sleepers but you can experiment for optimum height before securing the sensor in place.
I found no problems with unwanted light affecting the module's performance and therefore did not fit any type of hood around the sensor.

Rear light

You may want this circuit to also illuminate a red light at the rear of the coach.
Beware that a red LED illuminates at a lower voltage than white LEDs, so a dropper (say 1k) should be placed in series with the LED and then wires across the two copper wires of the light assembly. Again, ensure that this addition does not take the total current consumption of all your LEDs to above 25mA.

DCC version

With DCC you have the advantage of having a permanent power source available at all times. This dispenses with the need to use batteries for coach lighting.



There are a few requirements:

- You must be able to get the DCC from the track to this module. You can use pickups in each coach or use wired connections between locos and coaches (this is discussed in another chapter).
- You need to convert the DCC signal to suitable voltage to drive the lighting module. This circuit shows a 3.3V voltage regulator circuit that could be used.
- This converter will take up additional space inside the coach. Of course, you can also use surface mount components (e.g. an AMS1117-3.3V voltage regulator) to create a smaller unit. With DCC you have the advantage of having a permanent power source available at all times. This dispenses with the need to use batteries for coach lighting.

Footnote

This project is unlike many of the previous Pocket Money Kits. In addition to building the module, you are required to make alterations and additions to your coaches.
The prototype for this project was taken to exhibitions and run on a variety of layouts with different track constructions (different ballast colours and shades, cork underlay, bare MDF, etc.). It performed equally in all the tests but I would recommend you make and test one on your own layout before committing to converting a quantity of coaches.
A number of factors could potentially affect the project's sensitivity:

- The height above the sleepers (alterable by you)
- The voltage voltage to the emitter (alter the value of the 1K resistor)
- The switching threshold inside the chip (involves reprogramming the PIC chip)
- Possible ambient light disturbance (fit a hood round the TRCT5000).

The kit is available at all West of Scotland activities (for £1.10) or can be purchased from the national MERG website as PMP 819.