

FLASH An auxiliary lighting unit for LEDs

White LEDs are excellent light sources for model locos as they are extremely bright at low currents, do not get hot and are available in very small packages. The price is now comparable with small bulbs and is likely to fall further. One disadvantage is they turn on and off virtually instantly, unlike incandescent bulbs which have a definite time lag. In situations where lights are required to 'flash', simply turning LEDs on and off results in a quite unrealistic effect. Some DCC decoders have 'effects' including 'MARS' lights, alternating 'ditch' lights and 'dimming'. If used with LEDs, these usually give a disconcerting flicker or too sharp an on / off appearance.

FLASH is a small 'add - on' unit for use with DCC decoders to give realistic ditch lights, gyalights and dimming. This is achieved by high frequency pulse width modulation of the LED current and look-up tables for the varying brightness with time.

This enables a much slower apparent increase and decrease in brightness or a dimming without flicker.

The present version of FLASH is intended for US or similar diesels having DCC decoders with the facility for directional lighting and at least one other function output. It is powered and controlled by the decoder alone. It uses a simple microcontroller (PIC 12C508A or 509A) and can be built on a small PCB which is easy to fit in HO scale locos.

It gives the following lighting effects.

1. All lights off
2. Headlight full, ditch / gyalights on full, tail light off.
3. Headlight full, ditch lights alternating, tail light off
4. Headlight full, two gyalights oscillating out of phase, tail light off
5. Headlight dim, ditch / gyalights off, tail light on.

The power is taken from the decoder +12v (blue wire) and control is from the FI, Fr and F1 outputs. These must be open collector or open drain devices as used by all decoders I know of.

Operation is as follows.

FLASH has five input pads and five output pads. There is space on the PCB for the resistors needed by the LEDs. The LEDs attach to FLASH and not to the decoder.

The inputs are

1. 12v (blue wire)
2. +5v (used for in-circuit programming only)
3. input 2 (the wire from another function, e.g. F1)
4. input 1 (suggest the yellow wire e.g. F0r or Fr)
5. common (usually the white wire e.g. F0f or FI)

Connecting pad 5 to the decoder 0v is accomplished by turning that decoder output on. Effect is now 2. Connect input 1 to 0v gives gyralights (effect 3). Input 1 off and input 2 on is ditch lights (effect 4) and both inputs 1 and 2 on (at 0v) gives effect 5.

If FI is off, all lights are off and no power is applied to FLASH. FI is the common return for the device and must handle all the LED currents. At 20mA, a white LED is almost blinding so the maximum current FI will ever need to draw is 60mA, well within the capability of all decoders. With just FI on, the three front lights will be fully on. With F1 controlling output1, turning F1 on will give flashing ditch lights with realistic speed and fade. With F1 controlling the Fr output, it will give a dual gyralight effect as used in Rio Grande and some other lines. The Fr function should be set up to turn on both the usual Fr output and the F1 output. If the loco is reversed, this will set the two outputs low and give the dim headlight, full reverse light mode. Alternatively, if the decoder has two spare function outputs (F1 and F2), it is possible to have one enabling the ditch light effect and the other the gyralight effect.

Suggested CV settings

decoder output 1 to pad 5

decoder output 2 to pad 4

decoder output 3 to pad 3 (pad 1 is 12v, pad 2 is not used)

| | | |
|------|----------|--|
| CV33 | 00000001 | F0(f) controls pad 5 |
| CV34 | 00000111 | F0(r) controls pads 3 , 4 and 5 |
| CV35 | 00000101 | F1 controls pad 3 and pad 5 (ditch lights) |
| CV35 | 00000011 | F1 conrols pad 4 and pad 5 (gyralights) |
| CV49 | 00000000 | F0(f) toggle on / off |
| CV50 | 00001000 | F0(r) on when reverse |
| CV51 | 00010000 | F1 on when forward |

The PCB layout allows for the LED series resistors to be included on the board. These are SM resistors size 1206, chosen so even with LEDs at 20 mA, the power rating is adequate. For headlights I have used 560 ohm and for ditch lights, 1K but the value will depend on the brightness required and the type of LED used.

The circuit is extremely simple. The decoder 12v output (blue wire) powers the LEDs and is reduced to 5v by the zener diode D2 for the PIC. C1 provides some smoothing for the 5v and D1 prevents discharge of C1 if the +12v drops. The PIC has four outputs driving two dual MOSFETs which switch the LEDs. These are rated 0.5 amps each and the use of MOSFET switches reduces the current load in the PIC outputs to zero. Two PIC input lines are decoded to give 4 possible states. These PIC inputs have the active pullup set so assume a logic high if the decoder function output is off.

The PIC has an internal clock of about 4 Mhz but in this application exact timing is not critical. The PIC code is quite simple and uses look-up tables to set the brightness. For simplicity, the ditch light table is 32 steps long and is scanned both

up and down giving 64 steps for a full brightness cycle. The scan for one light is out of phase with the other so the effect alternates. For the gyralight, the whole cycle is 32 steps so the gyralight flashes at twice the ditch light rate. The gyralight table gives a short graded pulse with full brightness at maximum with a brief intermediate flash at half cycle. This main bright pulse with intermediate short dimmer pulse gives the impression of a rotating beacon. (I had observed this on videos of Rio Grande locos)

The overall flash rate can be changed in the program, but not by the user. Anyone with PIC assembly code experience can change this or modify the look-up tables to suit, maybe for other effects.

The 12C580/509 devices are in SN packages (SM packages can be used if the legs are bent under). These do not fit the usual PIC programmers so the PCB has been arranged for 'in circuit' programming. Solder the PIC to the board and then program it afterwards.

I would welcome comments or suggestions for improvements - it is early days for this device.

Tip for white LEDs. Wipe over the LED housing with yellow and / or orange 'highlighter' pens. This lessens the blueness to give a warmer white without reducing the light output significantly.

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