1 Scope

This application note gives some examples how to emulate multiple lamps using one MLX10803 LED driver.

2 Introduction

By modifying the current that is controlled by one LED driver, multiple lamps can be emulated.

A first type of application requires **changing the average current** through the LED(s)

Typical examples:

- Rear combination lamp (see also Ultra low noise demo application note: 390111080321) that realizes stop and tail lamp and blinker function with 1 LED lamp.
- Combined Daylight Running Lamp (DRL) / Position lamp

A second application range requires **switching on/off one or more LEDs** whilst keeping the average current constant.

Typical examples:

- Roof console: 10803 can control from 1 up to 3 LEDs in combination
- Motor cycle Blinker: left and right blinker controlled by the same LED driver

Essential to these applications is that the connector contains multiple supply inputs. These inputs are decoded to modify the average LED current and/or to switch on/off the applicable LEDs.

3 Buck Stop/Tail lamp by changing the Average current

The "Ultra low noise demo" application note (390111080321) explains how to realize the STOP/TAIL/BLINKER functionality in a Rear Combination Lamp (RCL) using one MLX10803 using 555 timers.

The light intensity control of the STOP and TAIL functionality in the RCL can also be realized by simply changing the resistance value on the IREF pin.

The peak voltage over the RSENSE pin is modified from

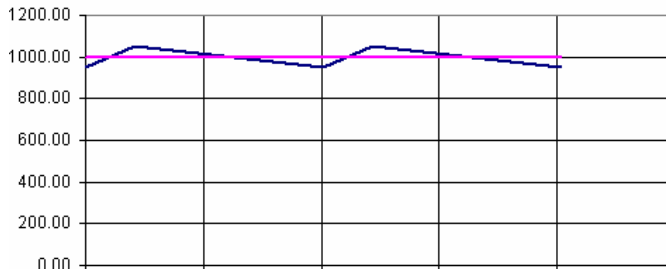
- 70 mV for the 100mA Tail function (R_IREF = 7kΩ)
- 520 mV for the 1000 mA Stop function (R_IREF = 52kΩ)

INPUT DATA	
Supply, V	13
LED threshold, V	2.3
Number of LEDs in chanel	1
Feed back diode threshold, V	0.5
Rsense, Ohm	0.5
Vpeak at Rsense, mV	520
Ipeak, A	1.050
Tmonoflop, uS	8
L (the Coil), uH	220

OUTPUT DATA	
The regulation is working	**good**
Coil's voltage drop	
- during charge, V	10.7
- during discharge, V	2.8
Lowest level of current, A	0.948
Time of discharging to 0, uS	never
Time of charging, uS	2.1
Frequency of switching, kHz	99.1
Average current: LED , A	1.00
Avg. current MLX10801 or FET	**0.21**

MLX10803 ROSC value (kOhm)	138
MLX10803 IREF value (kOhm)	52

Evaluative I*led* diagram

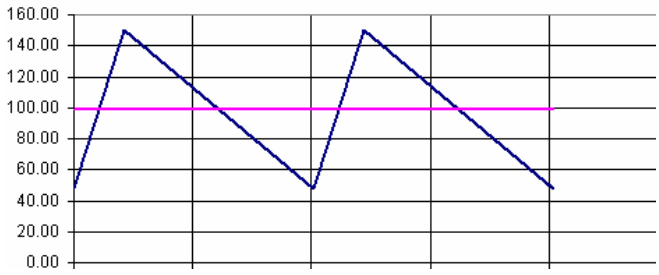


INPUT DATA	
Supply, V	13
LED threshold, V	2.3
Number of LEDs in chanel	1
Feed back diode threshold, V	0.5
Rsense, Ohm	0.5
Vpeak at Rsense, mV	70
Ipeak, A	0.150
Tmonoflop, uS	8
L (the Coil), uH	220

OUTPUT DATA	
The regulation is working	**good**
Coil's voltage drop	
- during charge, V	10.7
- during discharge, V	2.8
Lowest level of current, A	0.048
Time of discharging to 0, uS	never
Time of charging, uS	2.1
Frequency of switching, kHz	99.1
Average current: LED , A	0.10
Avg. current MLX10801 or FET	**0.02**

MLX10803 ROSC value (kOhm)	138
MLX10803 IREF value (kOhm)	7

Evaluative I*led* diagram

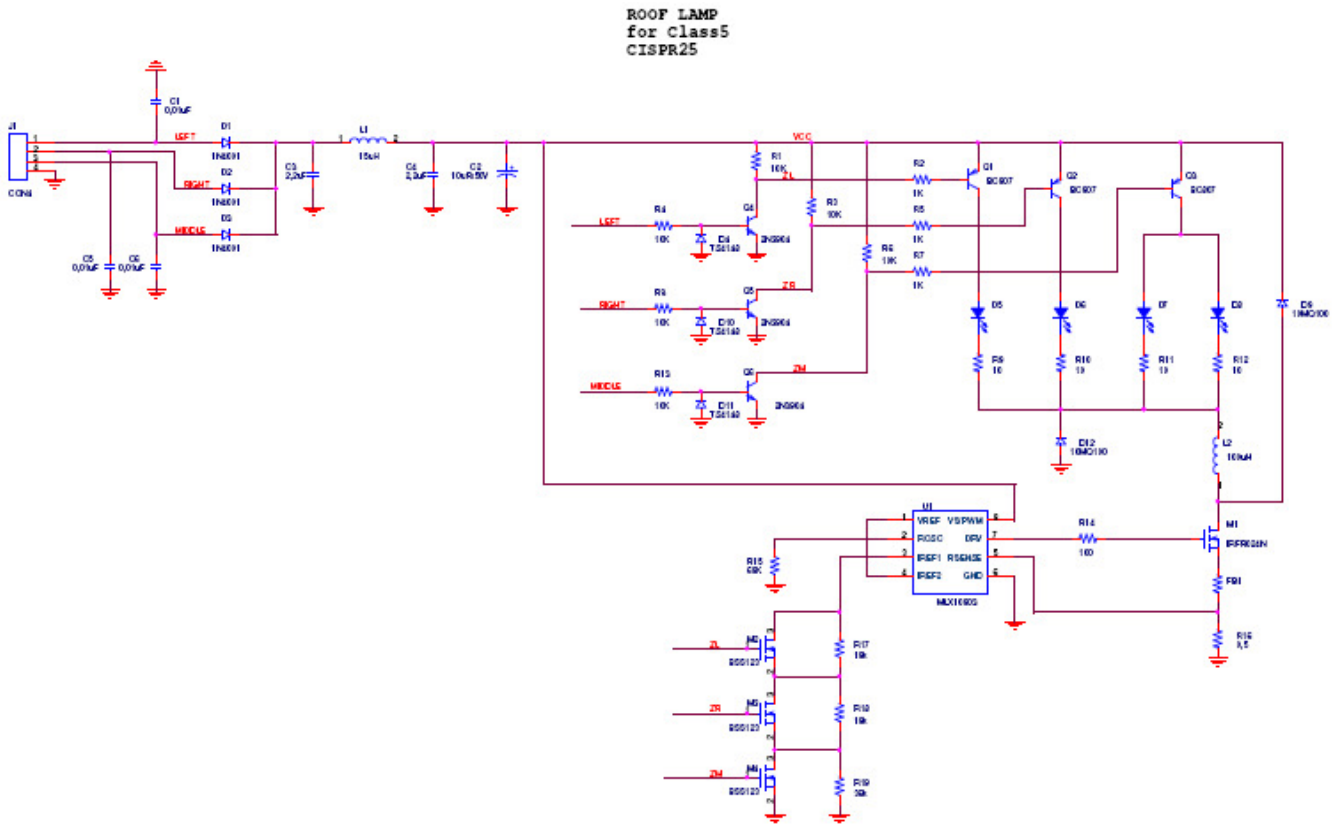


Remarks:

- The switching frequency is independent from the selected R_IREF resistor value.
- The ripple on the LED current is for the tail functionality is relatively large. For Red LEDs this usually isn't a problem.
- This ripple can be reduced by using a larger inductor value. If current ripple has to be limited it is recommended to use a 555 timer as explained in the "Ultra low noise demo" application note: 390111080321.

Conclusions:
By modifying the Reference input voltage on IREF or VREF pins it is possible to dim the light intensity.

4 Roof console with 3 lamps



Roof console principle schematic

The above application example targets a roof console with

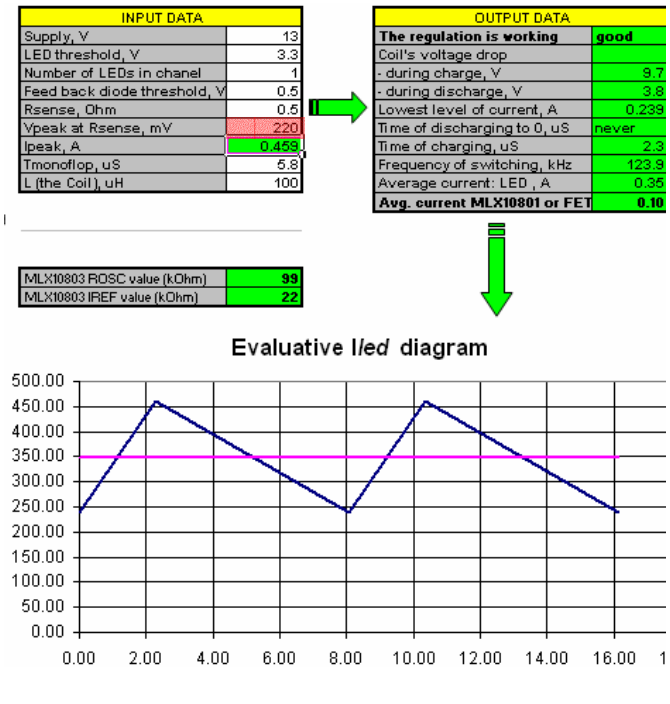
- Two 1W reading lamps at 350mA
- One 2W ambient light realized as 2 parallel LEDs

These 4 lamps are controlled with the same driver.
Any PWM applied on the supply lines gets also applied on the individual strings, to allow to retrofit on existing bulb based roof consoles.
Remark that in this case the PWM frequency for LED lamps should be at least 200Hz to avoid annoying stroboscopic effects.

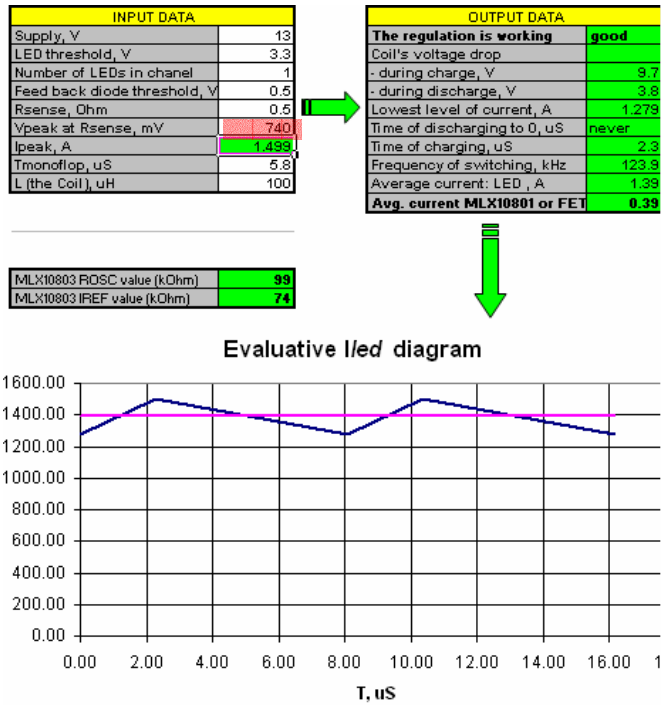
The input signals are decoded into 3 signals that select the appropriate reference resistor on IREF for the appropriate string.

The extreme cases are:

- 1 reading lamp: one 350mA LED
- All lamps on together: 1.4 A



Plot 4: Only 1 reading lamp: 350mA average current



Plot 5: 2 reading lamps + ambient lights: 1.4A

From the above calculation plots it can be found that

- Resistance on IREF = 220 Ω for 350mA
- Resistance on IREF = 740 Ω for 1400mA

This leaves only 300 Ω for the ambient light only, yielding only 510 mA. In order to realize 700 mA R_IREF should be 390 Ω.

Remark:
The reason for this non linear behavior lies in the losses that do not scale proportionally.

Below a compromise is proposed by setting

- Resistance on IREF = 200 Ω => 310 mA per reading lamp
- Resistance on IREF = 350 Ω => 610mA for the ambient lamp
- Resistance on IREF = 750 Ω => 1410mA for all 4 LEDs

INPUT DATA	
Supply, V	13
LED threshold, V	3.3
Number of LEDs in chanel	1
Feed back diode threshold, V	0.5
Rsense, Ohm	0.5
Vpeak at Rsense, mV	200
Ipeak, A	0.419
Tmonoflop, uS	5.8
L (the Coil), uH	100

OUTPUT DATA	
The regulation is working	**good**
Coil's voltage drop	
- during charge, V	9.7
- during discharge, V	3.8
Lowest level of current, A	0.199
Time of discharging to 0, uS	never
Time of charging, uS	2.3
Frequency of switching, kHz	123.9
Average current: LED , A	0.31
Avg. current MLX10801 or FET	**0.09**

MLX10803 ROSC value (kOhm)	99
MLX10803 IREF value (kOhm)	20

Plot 6: Only 1 reading lamp: 310mA average current

INPUT DATA	
Supply, V	13
LED threshold, V	3.3
Number of LEDs in chanel	1
Feed back diode threshold, V	0.5
Rsense, Ohm	0.5
Vpeak at Rsense, mV	350
Ipeak, A	0.719
Tmonoflop, uS	5.8
L (the Coil), uH	100

OUTPUT DATA	
The regulation is working	**good**
Coil's voltage drop	
- during charge, V	9.7
- during discharge, V	3.8
Lowest level of current, A	0.499
Time of discharging to 0, uS	never
Time of charging, uS	2.3
Frequency of switching, kHz	123.9
Average current: LED , A	0.61
Avg. current MLX10801 or FET	**0.17**

MLX10803 ROSC value (kOhm)	99
MLX10803 IREF value (kOhm)	35

Plot 7: Only 1 ambient lamp: 610mA average current

INPUT DATA	
Supply, V	13
LED threshold, V	3.3
Number of LEDs in chanel	1
Feed back diode threshold, V	0.5
Rsense, Ohm	0.5
Vpeak at Rsense, mV	750
Ipeak, A	1.519
Tmonoflop, uS	5.8
L (the Coil), uH	100

OUTPUT DATA	
The regulation is working	**good**
Coil's voltage drop	
- during charge, V	9.7
- during discharge, V	3.8
Lowest level of current, A	1.299
Time of discharging to 0, uS	never
Time of charging, uS	2.3
Frequency of switching, kHz	123.9
Average current: LED , A	1.41
Avg. current MLX10801 or FET	**0.40**

MLX10803 ROSC value (kOhm)	99
MLX10803 IREF value (kOhm)	75

Plot 8: All 4 lamps on: 1410mA average current

Conclusion:
This concept has its limitations, especially when combining lamps with a large difference between the minimum and the maximum total current.

5 Topology

The above discussed concepts are applicable for Buck as well as for Buck-Boost topologies.