Evaluation board EVB10801

Power LED driver for automotive applications

1. Scope

This document describes the design and use of the MLX10801 evaluation board. For a general description about the functionality of the MLX10801 please refer to the MLX10801 data sheet. Please consult the MLX10801 internet product page at http://www.melexis.com for the latest updates.

2. Applications

The MLX10801 evaluation board is intended to be used as an application example of the MLX10801 Power LED driver. It was developed to demonstrate the features of the circuit and is suitable to be used in prototypes and mock ups to allow quick implementation of the MLX10801 in a LED lighting application.

3. Other Components Needed

LED(s): - all High Brightness LEDs up to 1W, e.g.:

- Lumileds Luxeon®
- Cree XLamp™ 7090 series
- OSRAM (Advanced) Power TOPLED® ,OSRAM Golden Dragon®
- Nichia POWER LED Series

4. Application Circuit

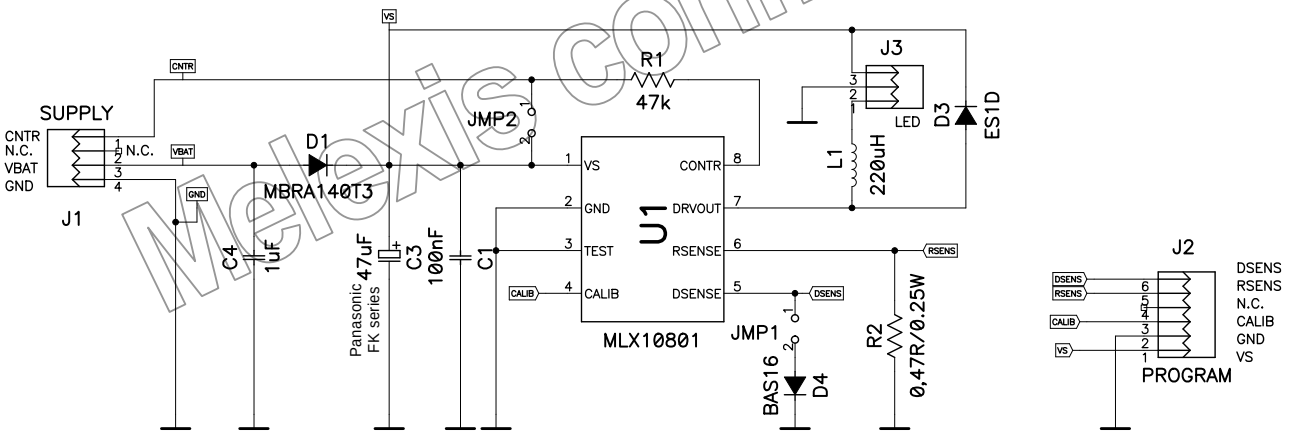


Figure 1: Evaluation board schematic

5. Connector Pin Definitions

Connector J1 (Supply)	Signal	Connection
Pin1	CNTR	Control Pin for PWM and sleep mode
Pin2	N.C.	not connected, can be used as polarisation pin
Pin3	**VBAT**	**Supply voltage 6..28V DC**
Pin4	**GND**	**Supply return**
Connector J2 (Program)	Signal	Connection
Pin1	VS	Supply voltage 6..28V DC, only in programming mode
Pin2	GND	Supply return, 0V
Pin3	CALIB	Communication for EEPROM programming
Pin4	N.C.	not connected, can be used as polarisation pin
Pin5	RSENS	Peak current Information
Pin6	DSENS	Forward bias voltage of temperature sensor
Connector J3 (LED)	Signal	Connection
Pin1	**LED-**	**Cathode LED**
Pin2	GND	Supply return, 0V, can be used for shielding
Pin3	**LED+**	**Anode LED**

Note: signals in **bold** are compulsory

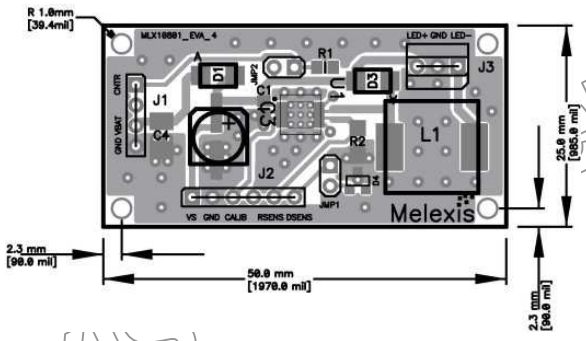
6. PCB Layout

J1 Pinout (Supply)

Pin1	CNTR
Pin2	N.C.
Pin3	VBAT
Pin4	GND

J2 Pinout (Program)

Pin1	VS
Pin2	GND
Pin3	CALIB
Pin4	N.C.
Pin5	RSENS
Pin6	DSENS



J3 Pinout (LED)

Pin1	LED-
Pin2	GND
Pin3	LED+

Figure 2: Evaluation board dimensions and locations

7. Minimal Board Connections

For normal operation only the following connections are necessary. It is not recommended to use the connector J2 (VS, Pin1) for supplying the board as there is no reverse polarity diode on that pin.
The LED is connected to the board via a polarised plug to avoid incorrect connection.

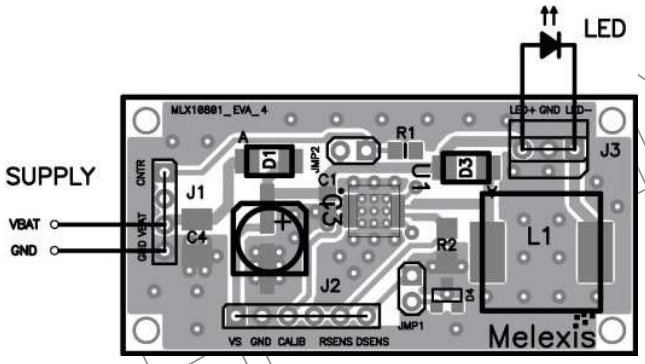


Figure 3: Minimal board connections

8. Description

For details on the function of the LED driver circuit, please refer to the MLX10801 IC specification.

8.1. General

Supply voltage (6..28V DC) is applied to J1, Pin3 while Pin4 is the corresponding GND connection. The LEDs have to be connected to J3, anode to LED+ (Pin3), Cathode to LED- (Pin1). Pin2 (GND) can optionally be used to shield LED signals if desired.

8.2. Dimming via PWM

Dimming can be achieved via the digital input CNTR that is accessible via J1 (Pin1). The Jumper JMP2 must be removed (it is set by default) for PWM dimming. Any TTL input signal with a frequency of 30Hz..4kHz can be used as PWM input.

8.3. Temperature Sensing

In order to avoid destruction of the IC and/or the LED due to overheating, a temperature shut off was implemented. Generally there are two different modes for temperature sensing, internal and external. For details please refer to the MLX10801 IC specification.
The evaluation board contains of a temperature sensor (diode BAS16) on-board. In case a direct temperature sensing of the LED is desired, an external temperature sensor (Dext) can be placed close to the LED.

Virtually any small signal switching diode with dUF/dT ≈ -2mV/K can be used for that. Connection for such a temperature sensor is available on J2, Pin6. If used, the on-board temperature sensor D2 must be switched off. This is achieved by removing Jumper JMP1 (set by default). The following schematic shows the connection of an external temperature sensor:

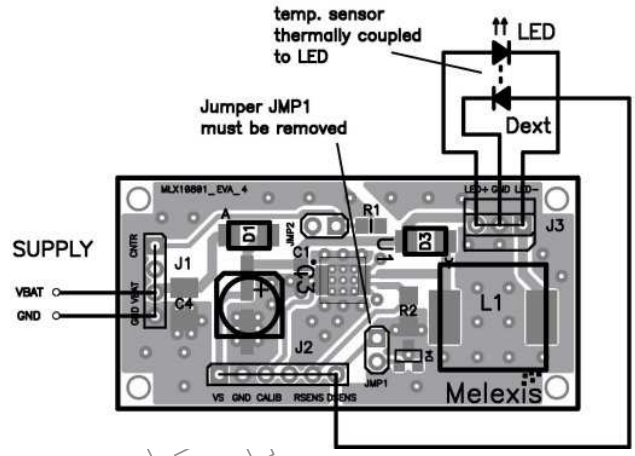


Figure 4: External temperature sensor connections

8.4. Programming the IC

Any programming of the circuit is accomplished via the calibration pin CALIB. It is accessible at connector J2, Pin 3. A jumper that is set by default between CALIB and GND (to protect the CALIB pin from voltages that could result in faulty programming) has to be removed before programming.
Supply (VS) and GND have to be applied at this connector too as shown below in figure 4. Only these three wires are necessary for programming. For details about the calibration interface and procedure please refer to the MLX10801 IC specification.

<u>Note:</u> Do not use VBAT at connector J1 (Pin3) to supply the board in programming mode! Due to the additional voltage drop caused by the reverse polarity diode D1, the voltage levels of the multilevel CALIB interface may shift in a way that proper programming can not be guaranteed anymore (however it will function properly in most cases).

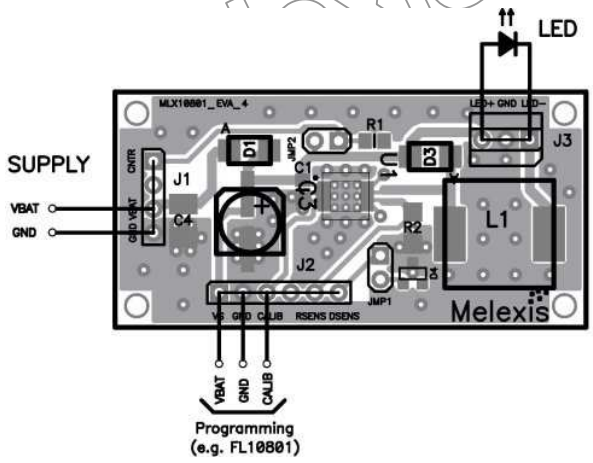


Figure 5: Programming interface

8.4.1. Evaluation board and Fileloader FL10801

The FL10801 output connector consists of all necessary lines VS, GND and CALIB. They have to be connected to their respective counterparts on the evaluation board. In that case, the evaluation board is completely driven by the supply of the FL10801. No additional supply for the evaluation board is necessary.
If a LED is connected to the evaluation board, the result of a programming cycle can directly be observed without the need of disconnecting it from the FL10801.
For details about the FL10801 and its software please refer to the FL10801 description.

9. Used Components

Board Part Number	Type	Category	Part Name (Manufacturer)	Alternative Part(s) (Manufacturer)	Data Sheet Download
D1	Rectifier	Fast Recovery	RS1D (GS,FCH)	many	www.vishay.com
D2	Diode	Switching Diode	BAS16 (PHI)	many	www.semiconductors.philips.com
D3	Rectifier	Ultrafast Recovery	ES1D (GS,FCH)	BYG22D (TFK) BYG80D (PHI) BYD 77D (PHI)	www.gensemi.com www.semiconductors.philips.com www.semiconductors.philips.com
L1	Inductor		WE-PD220µH (WE)	unshielded: ELC08D221E (PS) 8RHB 220µH (TK) shielded: MSS1260-224KXB (CC)	www.wuerth-elektronik.de www.panasonic.com/industrial www.toko.com www.coilcraft.com
C1	Capacitor 100nF/50V	Ceramics X7R	B37941 (Epcos)	many	www.epcos.com
C2	not populated				
C3	Capacitor 47µF/35V	Electrolytic FK series	EEEFK1V470P (PS)	many, preferably low ESR type	www.panasonic.com/industrial
C4	Capacitor 1µF/50V	Ceramics Z5U	B37951 (Epcos)	many	www.epcos.com
R1	Resistor 47k	Standard 0805	D12CRCW (Vishay)	many	www.vishay.com
R2	Resistor 0.47R/ 0.25W	MiniMELF type	MMA0204 (BC components)	many	www.bccomponents.com

manufacturer codes:

GS= General Semiconductor FCH=Fairchild Semiconductor PHI= Philips Semiconductor
PS=Panasonic TFK=Vishay-Telefunken WE=Würth Elektronik
CC=Coilcraft

10. Practical EMC results

The EVB10801 is designed for a good electromagnetic emission behaviour. Please refer to the MLX10801 IC specification as well as to the available application notes for EMC considerations. The conducted electromagnetic emission measurement (according to IEC 61967-4) was performed using the following setup for the EVB10801:

Components:
R2 = 0.47R
L1 = 220µH

Supply/Load:
V_{bat} =13,0V
LED: Luxeon LXHL-BWO I

MLX10801 Trimming:
I_{max} = 1 0 0 1 (=360mV)
t_{mon} = 0 1 1 0 0 0 (=24µs)
- jitter enabled

This is equivalent to the following switching frequency:
f_{sw_9V} =18kHz
$f_{sw\_13.8V}$ =24kHz
f_{sw_16V} =26kHz

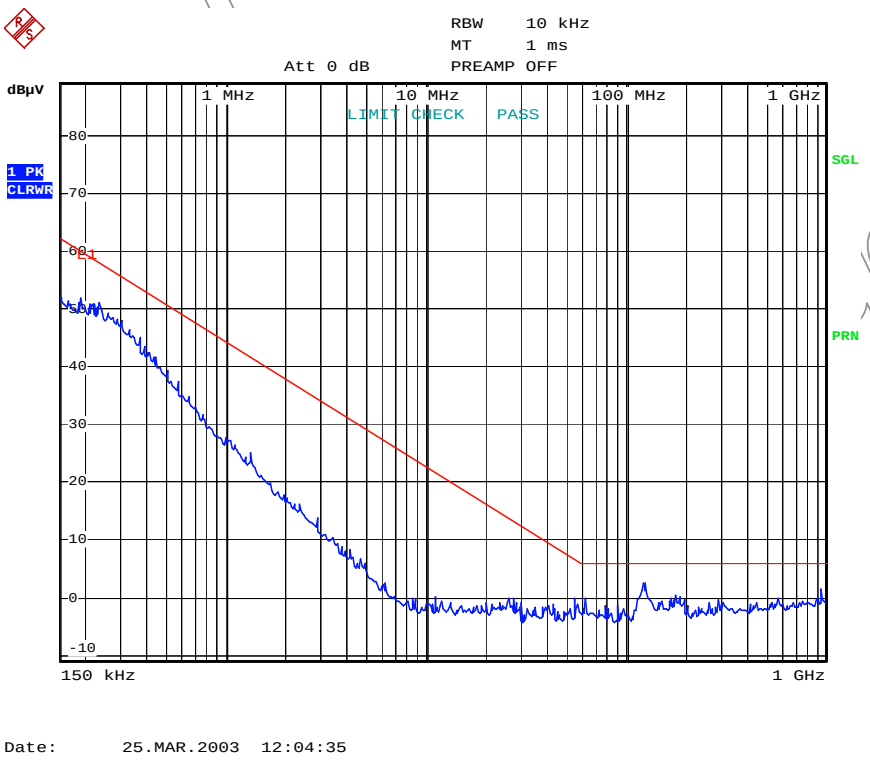


Figure 6: Conducted electromagnetic emission

11. Conclusion

The MLX10801 evaluation board was designed to provide an easy solution for demonstrating the use of high brightness LEDs in many applications as well as demonstrate the use of the MLX10801 LED driver chip. It is suitable to be driven under automotive supply conditions (12V board systems) and is optimised in terms of electromagnetic emission behaviour to be able to fulfil automotive standards.
If good emission behaviour is not an issue (e.g. industrial/consumer applications), smaller caps (for C3/C4) as well as an unshielded coil can be used. Thus, size and cost can be reduced once more.

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