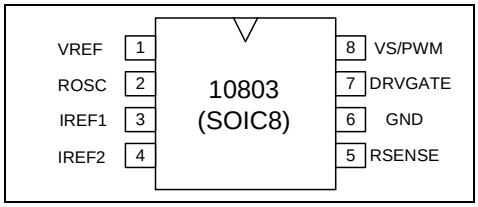
Features



General

- Low cost power LED driver for external n-channel MOSFET switching transistor
- 6V to 32V DC input range
- Applications from mA to several Ampere LED current
- Possible temperature dependent regulation using external Negative Temperature Coefficient (NTC) resistor
- Small package allows compact module design with minimised wire runs and short connections to achieve improved EMC performance
- Built-in randomiser for improved EMC performance
- High temperature operation capable
- Load dump protected to 80V

LED driver

- High energy efficiency
- PWM dimming via VS/PWM pin
- Light output has minimised dependency on supply and temperature variations
- LED regulation parameters set with external resistors

Ordering Information

Part Nr	***Temperature Code***	***Package Code***
MLX10803	K (-40℃ to 125℃)	DC (SOIC8)

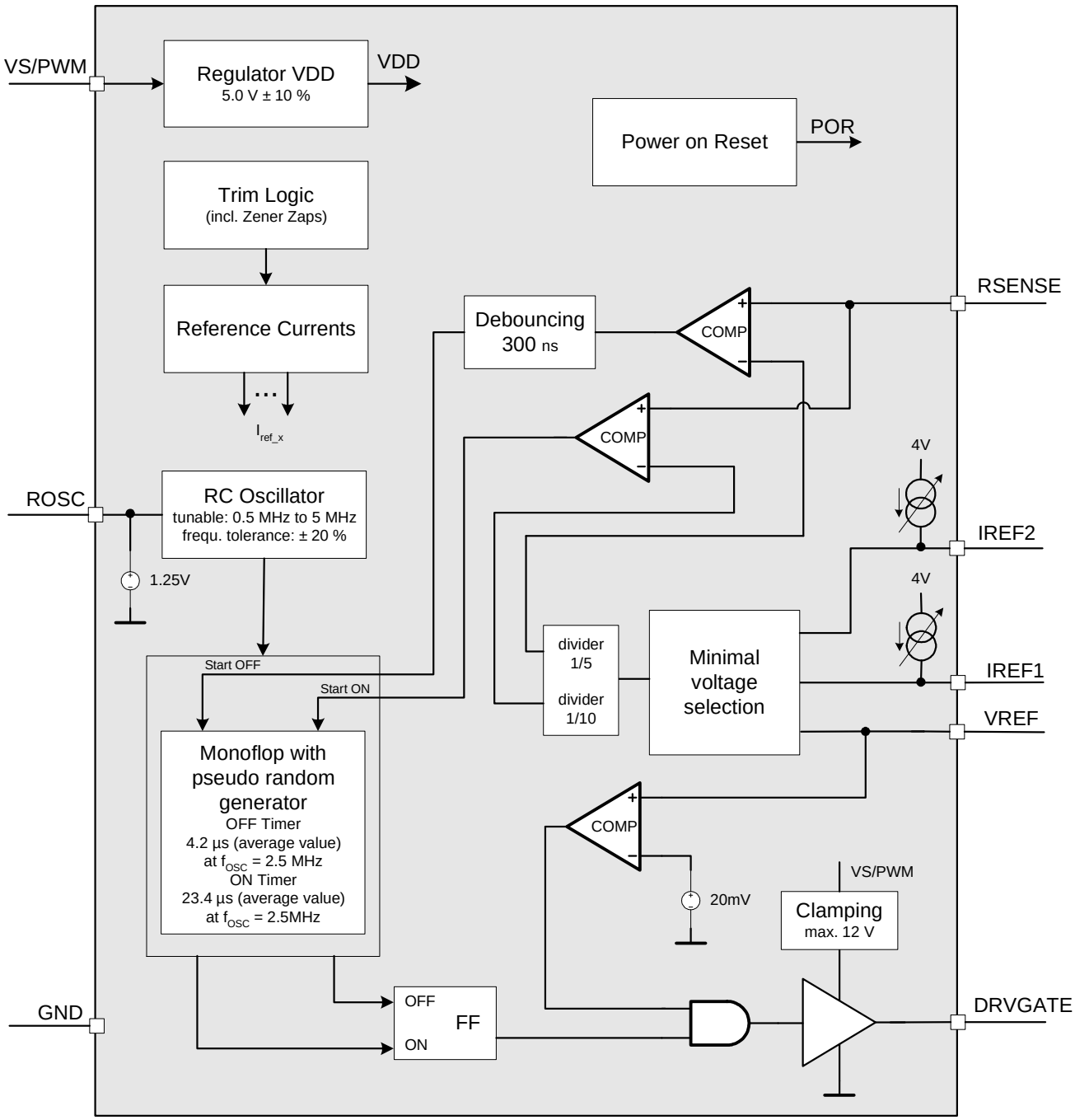
General Description

The MLX10803 is a multi-purpose LED driver for high power LEDs designed for high current and high voltage applications. The circuit is designed for demanding automotive applications and therefore suitable in all other high intensity LED applications.
Numerous adjustment possibilities allow for the design of different LED applications using only a few external components.
The circuit is load dump protected for 80V load dump pulse.

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Block diagram



1. Typical application data

1.1. LED driver applications

1.1.1. Principle complete schematic LED driver diagram

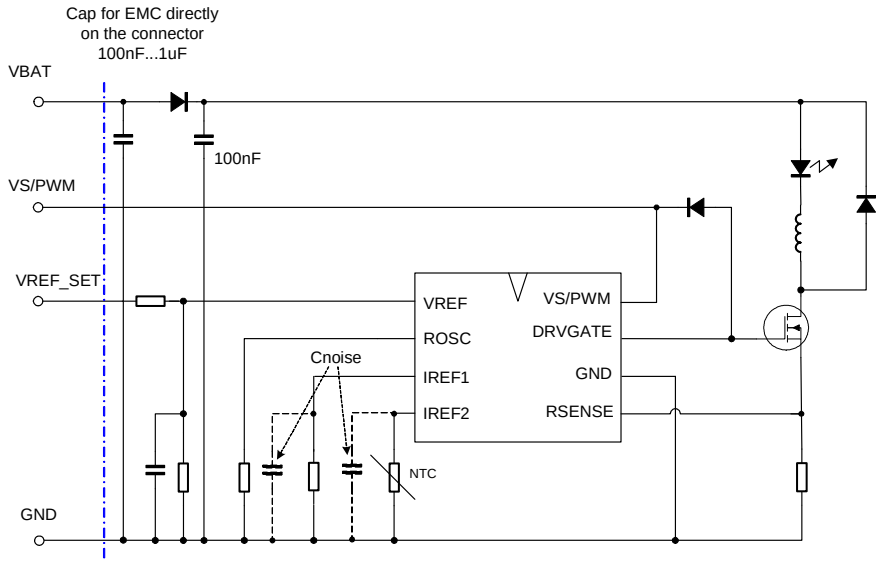


Figure 1: Application with PWM dimming via VS/PWM pin. Amplitude of LED's current is set by an analogue voltage on input VREF_SET. Temperature regulation of LED's current is realized by external resistors on pins IREF1 and IREF2

1.1.2. Principle minimum schematic LED driver diagram

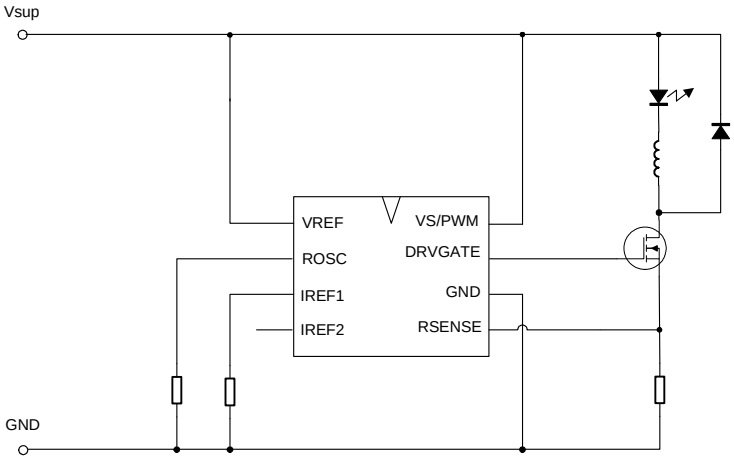


Figure 2: Minimum application without temperature and external EMC protection

1.1.3. Principle soft start up LED driver diagram

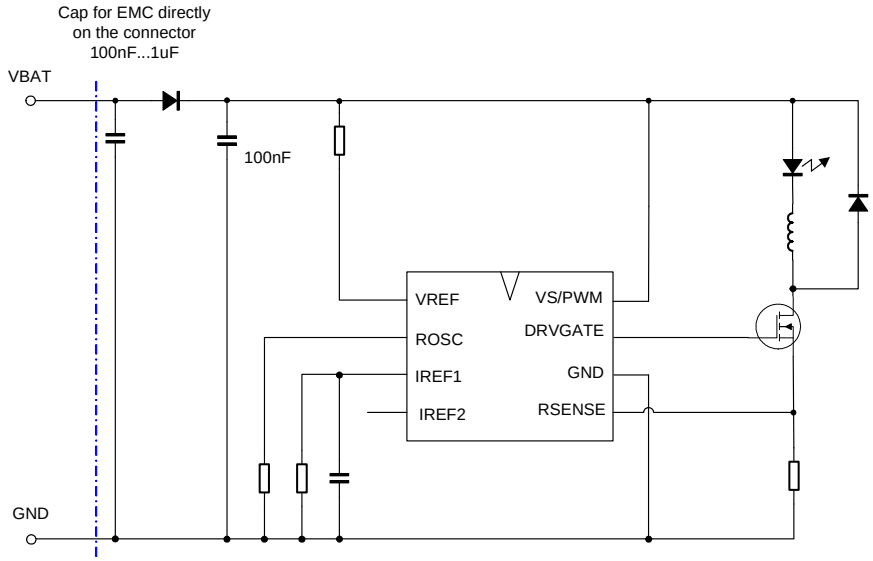


Figure 3: Application with gradual increase of light intensity after power up (soft start)

1.1.4. LED driver application notes

The MLX10803 is optimised for the use of low cost coils and n-channel MOSFETs. For a standard application with 1 LED and an average current of 350mA, a coil of about 100µH…220µH and ≤ 1Ω DC resistance should be chosen. The sense resistor should have a value between 0.27Ω…0.47Ω / 250mW.

As a general rule: for higher load current lower inductance of the coil is needed because higher currents lengthen the charging time of the coil. Thus, switching frequencies may become lower than 20kHz which is often not desired. It is possible to set the peak current and the average current of the LED by variation of the RSENSE resistor, the coil value and the internal oscillator frequency (ROCS resistor).

The flyback diode that carries the load current during the passive state (driver OFF) should be a fast switching and low intrinsic capacitance diode like ES1D or BYG80 in order to avoid parasitic spikes on RSENSE. The diode must be able to carry the LED current flowing during the OFF time of the driver.

The n-channel MOSFET should have low intrinsic capacitances, a drain-source voltage suitable for the application and must be able to carry the current flowing through the LED(s) during the ON time. To decrease the time of transistor switching and to improve the thermal behaviour of the module, the lines between transistor and IC should be minimised.

For applications that use an NTC resistor for temperature sensing, the NTC value has to be selected according to the application requirements. For most applications, a NTC value up to 470kΩ will be suitable.

In case of longer lines between the IC and the coil (which should be avoided because of EMI), a capacitor might be placed in parallel to RSENSE to avoid crosstalk and parasitic switching. Well chosen parameters for external components can help to avoid such conditions. The goal should be to unload the coil as much as possible during the selected off time (see also chapter 7).

To reduce an influence of noise which can be coupled to sensitive reference pins IREF1, IREF2 it is possible to connect noise-filtering capacitors in parallel to IREF1 and IREF2 resistors (see Figure 1, Cnoise capacitors). The coupling also should be reduced as much as possible by proper routing of IREF1 and IREF2 stripes on PCB. IREF2

resistor should be placed as close as possible to IREF2 pin and stripe from IREF1 pin to NTC resistor should be shielded by GND stripe.

The schematic diagram under Figure 1 is used in applications where the LED is controlled by external control electronics. A PWM with a frequency between 30Hz..5kHz can be applied to the VS/PWM pin in order to dim the light output. This frequency is limited by the time needed for recharging the coil and monoflop time selected by the resistor connected to ROSC as well as by the IC settling time after POR. This function can be used to achieve different light outputs or also be used in a temperature down regulation.
It is recommended to have the PWM frequency at least 5-10 times lower than the selected driver switching frequency.
Diode is placed between DRVGATE and VS/PWM IC pins serves as discharger of gate of FET transistor. Thus, having switched off IC at VS/PWM voltage=0 DRVGATE turns to Z-state. Charge that was stored in gate capacitor runs down to VS/PWM module pin via the diode.

The minimum schematic diagram under Figure 2 is sufficient for all applications with a constant light output.

We also recommend to compare with our other circuits in the MLX108xx family and study these application notes for suitable solutions.

2. Application pins

Nr.	Name	Function
1	VREF	Analogue input, setting of LED peak current
2	ROSC	External resistor sets internal Oscillator frequency. Sets the average discharge time of the coil
3	IREF1	External NTC resistor for temperature down regulation
4	IREF2	External resistor sets the temperature breakpoint when the NTC resistor starts down regulation
5	RSENSE	External sense resistor pin for peak current detection
6	GND	Ground
7	DRVGATE	Pin driving the gate of the switching transistor
8	VS/PWM	Supply Voltage / PWM signal

3. Absolute maximum ratings

Parameter	**Symbol**	**Condition**	**Min**	**Max**	**Unit**
Power supply (VS/PWM)	vs	DC max. 2h	-0.3 -0.3	32 36	V V
Power supply, non operational function max. 0.5s (Load dump)	vsmax	max 0.5s	36	80	V
Input current in protection circuitry on any pin	iprot	In case of maximum supply ratings	-10	10	mA
Input voltage on RSENSE pin	virsense	normal operation	-0.3	11	
Input voltage on IREF1, IREF2, VREF pins	vrefmax	without external resistor protected by external 47k resistor	-0.3 -80 (0.5s)	40 80 (0.5s)	V V
Input voltage on ROSC pin	vroscmax	normal operation	-0.3	Vdd+0.3	V
Input voltage on DRVGATE pin	vdrvgatmax	idrvgatemax current must not be exceeded	-0.3	22	V
Input/output current on DRVGATE pin	idrgatemax	pulse mode		500	mA
Junction temperature Lifetime Dynamic Storage temperature	Tjunc	 normal operation. max. 100h	 -40 -40 -55	 140 150 150	℃
Ambient temperature range	Tambient	normal operation	-40	125	℃
Thermal resistance junction to ambient	rth	SOIC8		128.4	K/W

4. Electrical characteristics

Following characteristics are valid
- for the full temperature range of Tambient = -40℃ to +125℃,
- a supply range of 32V ≥ vs > 6V

unless other conditions noted.

With 6V ≥ vs > vporh analogue parameters can not be guaranteed.

Note: The correct operation of the MLX10803 as a switching mode power supply for voltages lower than the nominal supply voltage is dependent on the forward bias voltage of the used LED.
The user must ensure that at low supply voltage the peak current threshold voltage on the RSENSE pin can be reached in order to keep the switching principle working.

If several pins are charged with transients above VS/PWM and below GND, the sum of all substrate currents of the influenced pins should not exceed 10mA for correct operation of the device.

Normal operating supply voltage is supposed to be 13.8V.

Parameter	Symbol	Conditions		Limits		Units
			Min	Typ	Max	
Global parameters						
Maximum current during 80V load dump	ihv	vs=80V			10	mA
Normal supply current at highest DC voltage	inomdch	vs=32V			2	mA
Normal supply current	inom	vs=13.8V	400		700	µA
IC settling time						
IC settling time after power on reset	tsettle				10	µs
Oscillator related parameters The min/max specification influences inversely all derived timings						
Min oscillator frequency	foscmin	For a selected external resistor of 440kΩ and room temperature	0.4	0.5	0.6	MHz
Max oscillator frequency	foscmax	For a selected external resistor of 40kΩ and room temperature	4.0	5.0	6.0	MHz

RESET related parameters						
Power on reset level, if VS/PWM is ramped up	vporh	Reset is connected to the internal Vdd, but vporh is measured on pin VS/PWM	1.5		4	V
Power on reset hysteresis, if VS/PWM is drawn down	vporhyst	Reset is connected to the internal Vdd, but vporhyst is measured on pin VS/PWM	0.1		0.7	V
Vdd related parameters (Vdd used internally only)						
Internal supply voltage range	vdd	vs=13.8V	4.5		5.5	V
RSENSE related parameters						
Input leakage current	ileakrsense	vs=13.8V, vrsense=0V, 5V	-20		20	µA
Debounce time after switching on	tdeb	vs=13.8	200		500	ns
VREF related parameters						
Leakage current	ileakvref	vs=13.8V, vvref=0V, 5V	-20		20	µA
DRVGATE cessation voltage	vswoff[1]	vs=13.8V	15	20	25	mV
Sensitive voltage range	vvrefrng[1]	vs=13.8V	vswoff		3.8	V
Linear voltage range	vvreflinrng[1]	vs=13.8V	0.1		3.8	V
IREF1 related parameters						
Output current for external reference measurement	iiref1	vs=13.8V, viref1=viref1rng	46.5	50	52.5	µA
Temperature drift of the current	iiref1drift			-0.1		%/°C
Sensitive voltage range	viref1rng[1]	vs=13.8V	vswoff		3.6	V
Linear voltage range	viref1linrng[1]	vs=13.8V	0.1		3.6	V
IREF2 related parameters						
Difference of iiref2 to iiref1	difiref12	vs=13.8V, viref1=viref2rng	-10		+10	%
Temperature drift of the current	iiref2drift			-0.1		%/°C
Sensitive voltage range	viref2rng[1]	vs=13.8V	vswoff		3.6	V
Linear voltage range	viref2linrng[1]	vs=13.8V	0.1		3.6	V
DRVGATE related parameters						
Max output voltage in ON state	vmaxdrv	Load current 1µA to GND, vs=13.8V	10		13	V
Output resistance of push-pull output	Rdrvgateout	To GND pin To VS/PWM pin, vs=13.8V	3.5 20	7.8 40	15 60	Ω Ω

ROSC related parameters[ii]						
Output voltage	vrosc	vs=13.8V	1		1.5	V
Resistance on pin to GND for 0.5MHz	Roscmin			440		kΩ
Resistance on pin to GND for 1MHz	Roscmid			220		kΩ
Resistance on pin to GND for 5MHz	Roscmax			40		kΩ
Monoflop related parameters						
Minimum OFF time due to the implemented jitter	toffmin1mhz	Oscillator is set to 1 MHz, in case the oscillator is put to an other frequency, toffmin1mhz scales accordingly		9		µs
Maximum OFF time due to the implemented jitter	toffmax1mhz	Oscillator is set to 1 MHz, in case the osc is put to an other frequency, toffmax1mhz scales accordingly		16		µs
Average monoflop time for ON state of transistor	ton1mhz	Oscillator is set to 1 MHz		60.5		µs

5. ESD/EMI recommendations for MLX10803

- In order to minimise EMI, the PCB has to be designed according to EMI guidelines. Additional components may be needed, other than what is shown in the application diagrams, in order to comply with the EMI requirements.
- The MLX10803 is an ESD sensitive device and has to be handled according to EN100015 part 1.
- The MLX10803 will fulfil the requirements in the application according to the specification and to DIN 40839 part 1.
- The MLX10803 is designed with ESD protection >1000V HBM according to MIL883D.

6. Automotive test pulses

The following chapter is valid for a completely assembled module. That means that automotive test pulses are applied to the module and not to the single IC.

In the recommended application according to chapter 1.1, the reverse polarity diode together with the capacitors on the supply and the load dump protected IC itself protect the module against the automotive test pulses listed below.
The exact values of the capacitors for the application have to be figured out according to the automotive and EMI requirements.

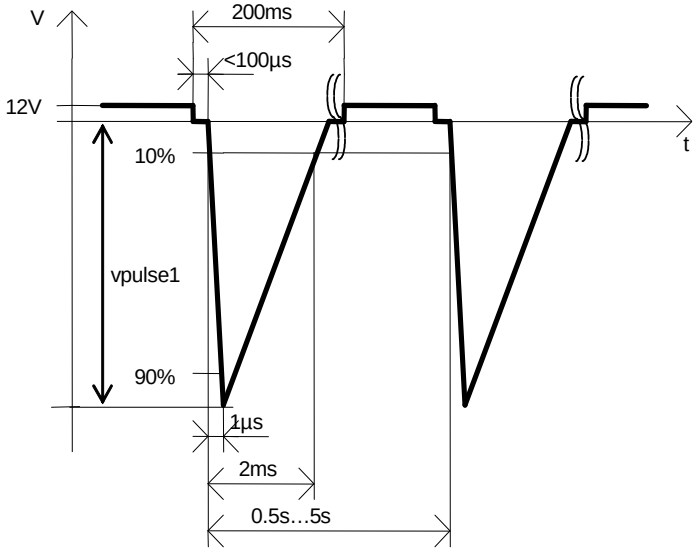
No damage occurs for any of the test pulses. A deviation of the IC's characteristics is allowed during pulse 1, 2, 4; the module returns to normal operation after the pulse without any additional action.
During test pulse 3a, 3b, 5 the module operates within characteristic limits.

Parameter	Symbol	Min	Max	Dim	Test condition, Functional status
Transient test pulses in accordance to ISO7637 part 1 & 3. Pin VREF goes outside of module via resistor of 47kΩ. Module schematic is according to application notes mentioned in 1.1.1.					
Test pulse #1 at module pins VBAT, VS/PWM. VREF_SET, IC pin IREF1 -> GND	vpulse1	-100		V	5000 pulses, functional state C
Test pulse #2 at module pins VBAT, VS/PWM. VREF_SET, IC pin IREF1 -> GND	vpulse2		100	V	5000 pulses functional state C
Test pulse #3a at module pins VBAT, VS/PWM. VREF_SET, IC pin IREF1 -> GND	vpulse3a	-150		V	1h, functional state A
Test pulse #3b at module pins VBAT, VS/PWM. VREF_SET, IC pin IREF1 -> GND	vpulse3b		100	V	1h, functional state A
Test pulse #4 at module pin VBAT, VS/PWM, VREF_SET -> GND	vspulse4 vapulse4	-6 -5	-4 -2.5	V V	1 pulse, functional state C
Test pulse #5 at IC pin VS/PWM -> GND	vpulse5	45	85	V	functional state C

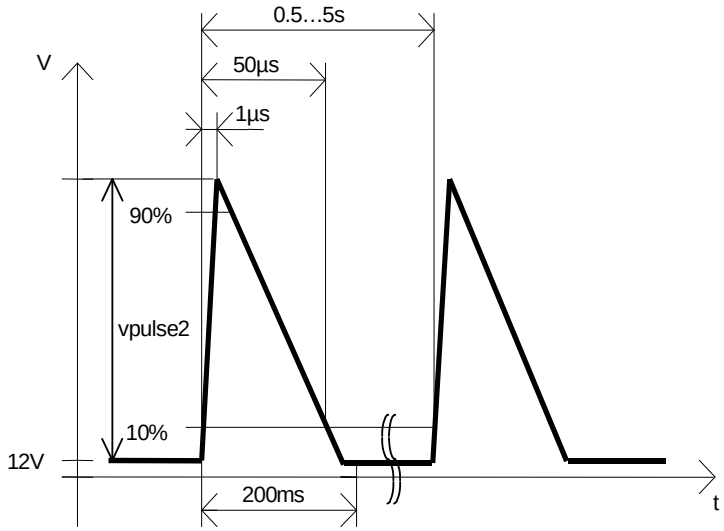
Description of functional status:
A: All functions of the module are performed as designed during and after the disturbance.
B: All functions of the module are performed as designed during and after the disturbance: However, one or more can deviate from specified tolerance. All functions return automatically to normal limits after exposure is removed. Memory functions shall remain class A.
C: A function of the module is not performed as designed during disturbance but returns automatically to a normal operation after the disturbance.

6.1. Test pulse definition

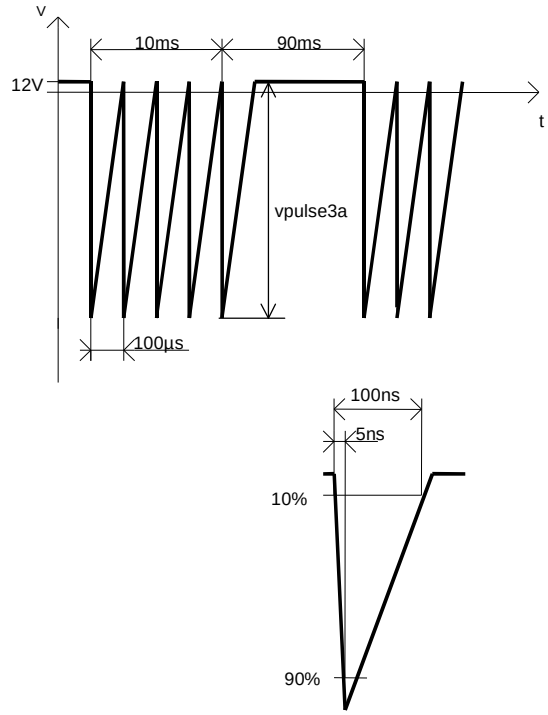
Test Pulse 1
Ri = 10 Ω



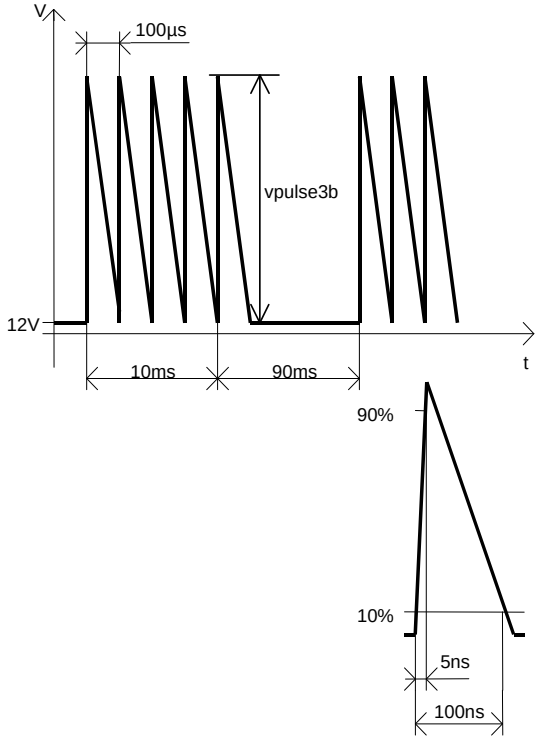
Test Pulse 2
Ri=10 Ω



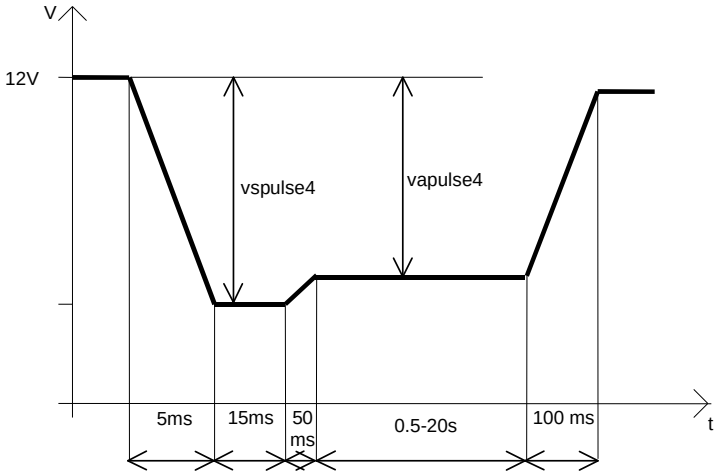
Test Pulse 3a
Ri = 50 Ω



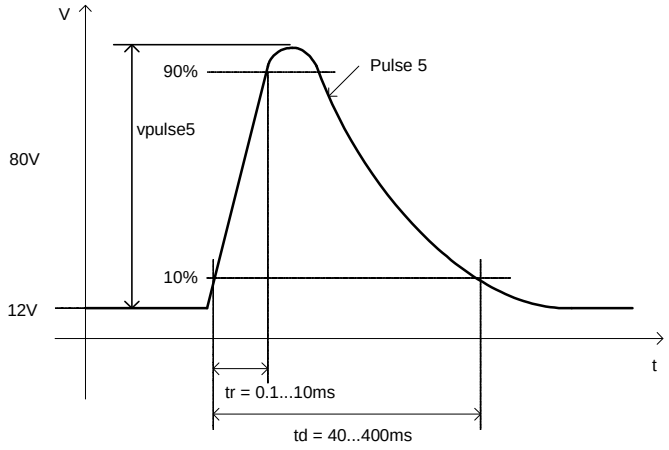
Test Pulse 3b
Ri = 50 Ω



Test Pulse 4 (Cranking)
Ri = 0.01Ω



Test Pulse 5 (Load Dump)
Ri = 0.5…4Ω



7. LED driving principle

7.1. General

The LED is driven by a switched mode power supply using an inductor as the energy storage element. This method has several advantages. The supply voltage has to be set down to the forward bias voltage of the LED. In ordinary applications this is achieved by a resistor with the following drawbacks:

- A resistor dissipates power which is transformed to heat
- Efficiency is reduced drastically
- The light output of the LED is dependent on the supply and the temperature of the resistor

The MLX10803 avoids these disadvantages as shown by the following calculation with L=220µH, R_{SENSE} = 0.1 Ω:

Supposed:
V_{bat} = 13.8V
V_{fLED} ≈ 3.4V *example 1*; 8V *example2*;
I_{fLED} ≈ 4A
V_{f1} ≈ 0.9V (reverse polarity diode)
V_{f2} ≈ 0.9V (free wheel diode)
V_{RSENSE} ≈ 0.4V (@I_{fLED}, R_{SENSE}=0.1 Ω)
$V_{RDS\ ON}$ ≈ 0.04V (@I_{fLED})
V_{Coil} ≈ 0.2V (@I_{fLED})

Efficiency using a simple resistor or load dump regulation:

Efficiency n: $$n = \frac{V_{fLED}}{V_{BAT}} \approx 29\%\ example1;\ \approx 58\%\ example2;$$

Efficiency using the MLX10803:

The following calculation is an approximation only, due to the fact that coil current is not constant. It is therefore calculated with average currents.

1) During OFF time, the coil acts as the storage element and delivers its energy to the flyback diode and the LED:
$$n_1 = \frac{V_{fLED}}{V_{fLED} + V_{f2} + V_{Coil}} \approx 75\%\ example1;\ \approx 88\%\ example\ 2;$$

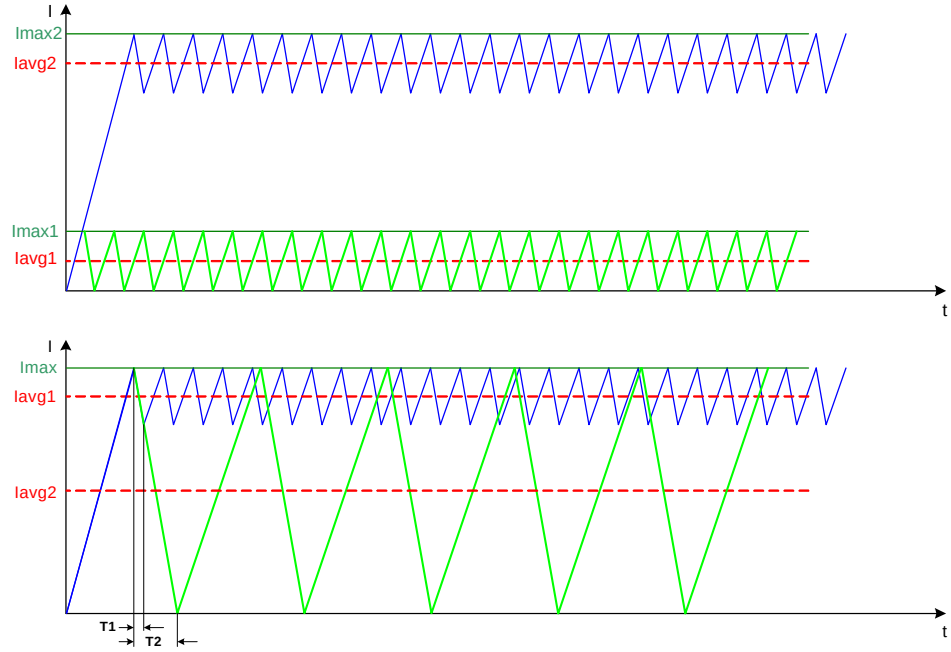
2) During ON time, current flows through the reverse polarity diode, LED, coil , FET driver and RSENSE, which causes the following voltage drops:
$$n_2 = \frac{V_{fLED}}{V_{fLED} + V_{f1} + V_{Coil} + V_{RDSon} + V_{RSENSE}} \approx 69\%\ example1;\ \approx 84\%\ example\ 2;$$

3) ON and OFF times are in ratio of roughly 30:70 for example 1 and 65:35 for example 2:
Efficiency n: $n = n_1 \cdot 0.7 + n_2 \cdot 0.3 \approx 73\%\ example1;\ \approx 87\%\ example2;$

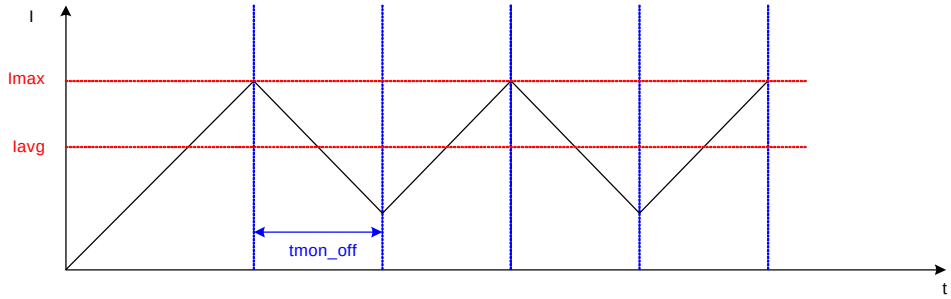
7.2. The principle in detail

After powering on the MLX10803 the switch becomes open and the current through the LED starts to rise. The rate of current raise is limited by the value of the coil. When the current through the LED reaches half of a maximum value, the ON timer is started, and if during 58.5 clocks of the internal oscillator the maximum current value through the LED is not reached, the driver switches off. This maximum current is adjusted by the resistors on the IREF2, IREF1 or voltage applied to VREF pins (voltage on these pins is divided by 5). The minimum of these voltages is taken as a reference. The driver is switched off for a monoflop time, which is equal to 9…16 pulses of oscillator. The frequency of the oscillator can be set by the customer using the Rosc value using such formula:
$Fosc[MHz] = 222.2/(Rosc[k\Omega] + 4.44)$.

Both parameters, the peak current threshold voltage and the monoflop time, create an ON/OFF period to form an average current through the LED. By adjusting these parameters, an adjustment of the average load current is possible in a wide range.



Note: The current sense comparator has a typical debouncing time of 300ns as shown in the block diagram. This delay time prevents the driver from being switched off due to short term switching oscillations. When working with very short monoflop times, this time has to be taken into account for calculations.



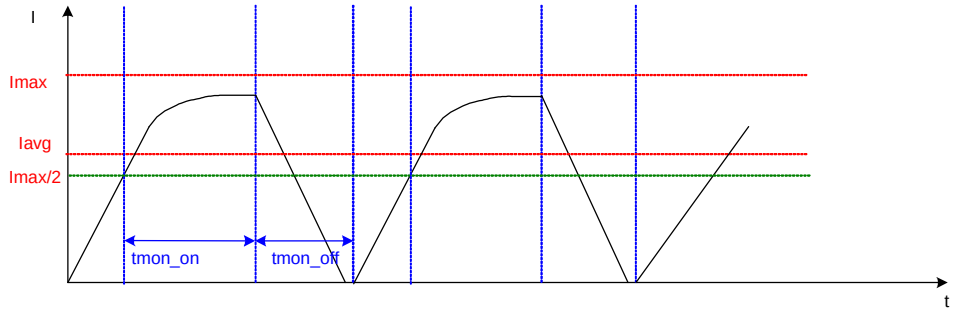
By applying a PWM signal on VS/PWM, the LED can be dimmed from 0% to 100%.

VS/PWM = L	LED permanent OFF
VS/PWM = PWM	LED dimmed with PWM between 0% to 100%
VS/PWM = H	LED permanent ON

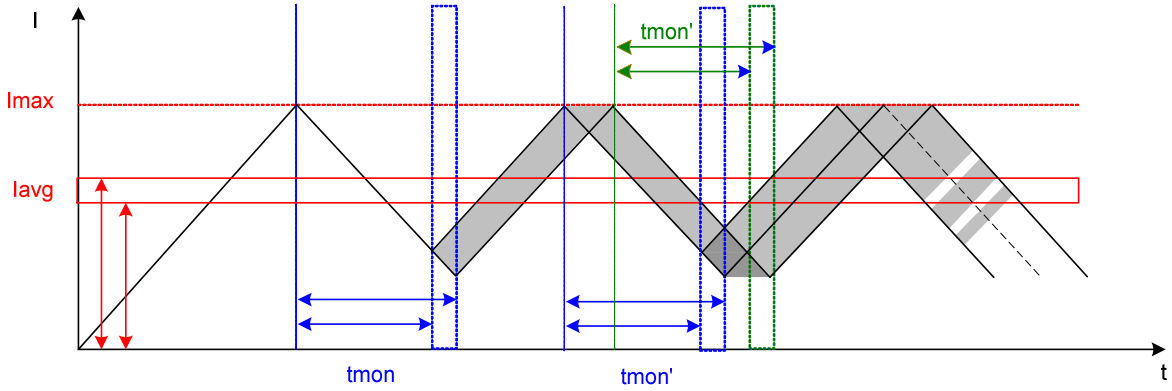
Dimming is achieved by applying a PWM directly to the module supply or by changing the reference voltage on pin VREF or the resistor's value on IREF2 pin.

IC settling times must always be considered in PWM mode. Please refer also to chapter 1.1.4 for additional PWM frequency considerations.

Limitation of the ON time prevents from exceeding the allowed average current when the power supply voltage is not sufficient for the current to reach its peak value and restricts in this case duty cycle of switching to 68%.



A pseudo random generator is applied to the monoflop time. The pseudo random generator runs with the clock derived out of the monoflop time and adds a random distribution on these 3 LSBs. Therefore, the monoflop time gets a **random** variation from its value. The EMI behaviour of the complete module is improved due to the variation of the otherwise fixed switching frequency.



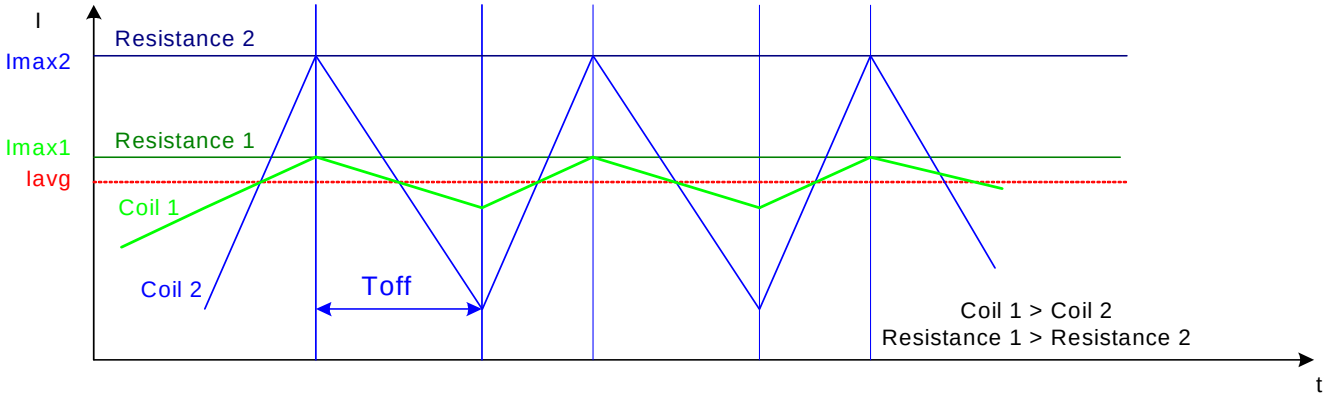
The inductance L of a coil describes the amount of magnetic energy that can be stored in it. Consequently, high inductive coils will be discharged less than low inductive coils in a given time.

Generally the coil can be driven in two different ways:

1) The coil is discharged partially only. That means the coil still carries a significant amount of energy when going from discharging to charging. In that moment the charging current rises immediately to the coil current that was flowing just before switching. This is connected with large dI/dt transients on the RSENSE pin that have a negative impact on EMI. This is mostly preferred way of regulation because of low influence of supply voltage and coil value on output current. Fast flyback diode is recommended and extra important in this case.

2) The coil discharged completely. Thus, at the end of a discharging cycle, the coil doesn't carry energy anymore. With the next charging cycle, current increases steadily from around zero. This way, large dI/dt transients are completely avoided.

Because of randomisation, the discharging time is not constant but varies within a certain range. It must be ensured that only the longest possible monoflop time completely discharges the coil. Otherwise the coil is discharged before the monoflop time ends which results in a loss of accuracy.



Conclusion: In most cases the coil is driven in a combination of both ways. A trade off has to be made between EMI behaviour and maximum allowed LED current. By varying these parameters, an optimum can be found for every application.

Below are some examples for typical parameter sets given for a 4A LED current and the following application data:

- RSENSE = 0.1 Ω/ 2 watt
- ROSC = 270kΩ
- L = 47µH, 4A minimum, 0.05 Ω
- Normal nFET switch transistor, rds on < 0,01 Ω

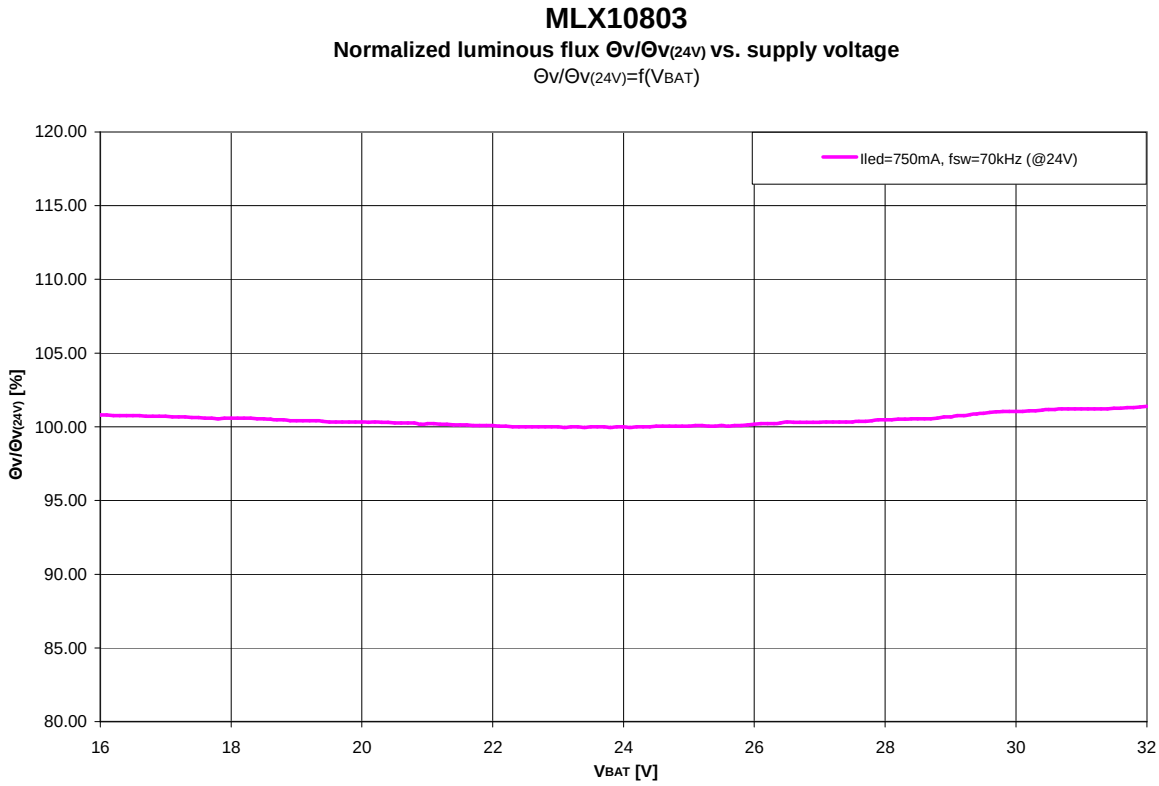
Remarks:
- 4A and 0.05 Ω results in 0.8 watt power dissipation over the coil.
- 4A and 0.1 Ω for the RSENSE resistor results in 1.6 watt, but only for 50% of the time in average.
- The LED(s) with this current will dissipate 32 watt if they have 8V forward voltage.

7.3. Switching frequency considerations and constant light output

As already shown, the switching frequency depends on the peak current as well as on the monoflop time for a given coil. Furthermore it depends on the coil inductance itself.

Due to the principle of switch mode power supplies, the current through the LED is kept constant for any supply change. The parameter that changes in order to keep the current constant is the switching frequency itself. The lower the supply voltage, the lower the switching frequency. Furthermore, the supply current is affected by supply changes: with an increasing supply voltage the average supply current decreases.

The graph below shows the normalised luminous flux versus the power supply for a standard application with one white Luxeon III LED driven at 750mA. The parameters are optimised for the 24V board net.
The luminous flux at 24V has been set to 100%. The graph indicates that the light output is minimally dependent on supply changes over the whole range from 16 to 32V.



8. Temperature regulation

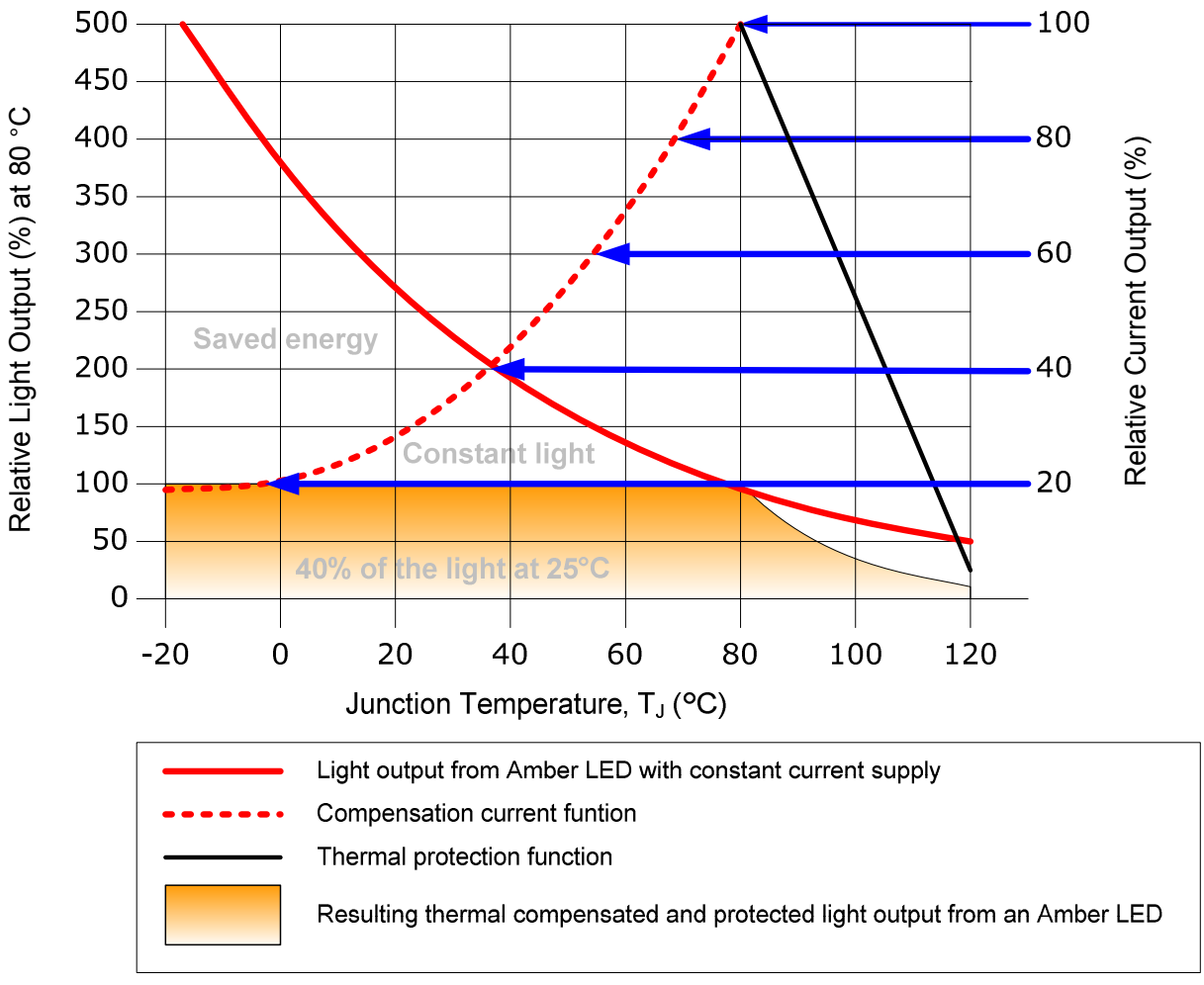
In normal mode the peak current threshold voltage is defined by the lowest voltage on pins VREF, IREF2 and IREF1. Usually the resistor connected to IREF2 pin has a small thermal coefficient and the resistor on IREF1 pin has a big negative temperature coefficient (but they also can be connected vice versa). Both of these pins have an output current of 50 µA. When the voltage on pin IREF1 falls below the voltage on pin IREF2 or VREF, the voltage reference for the actual maximum current is taken from pin IREF1. This makes the value of the peak current sensitive to temperature and prevents overheating of LED or IC. When the voltage on pin IREF1 becomes higher than voltage on IREF2 or VREF, the reference switches back to IREF2 or VREF pin.

The thermal behaviour of the system should be characterised during the design-in of the product by the user.

For a system that is designed for thermal conditions, temperature down regulation may not be needed. In this case, It is enough to leave the IREF1 or IREF2 pin unconnected and the internal current source will pull it up to the voltage Vdd – 0.7V.

System behaviour can be configured to compensate the dependency of LED light output versus temperature. The example of such compensation is depicted below.

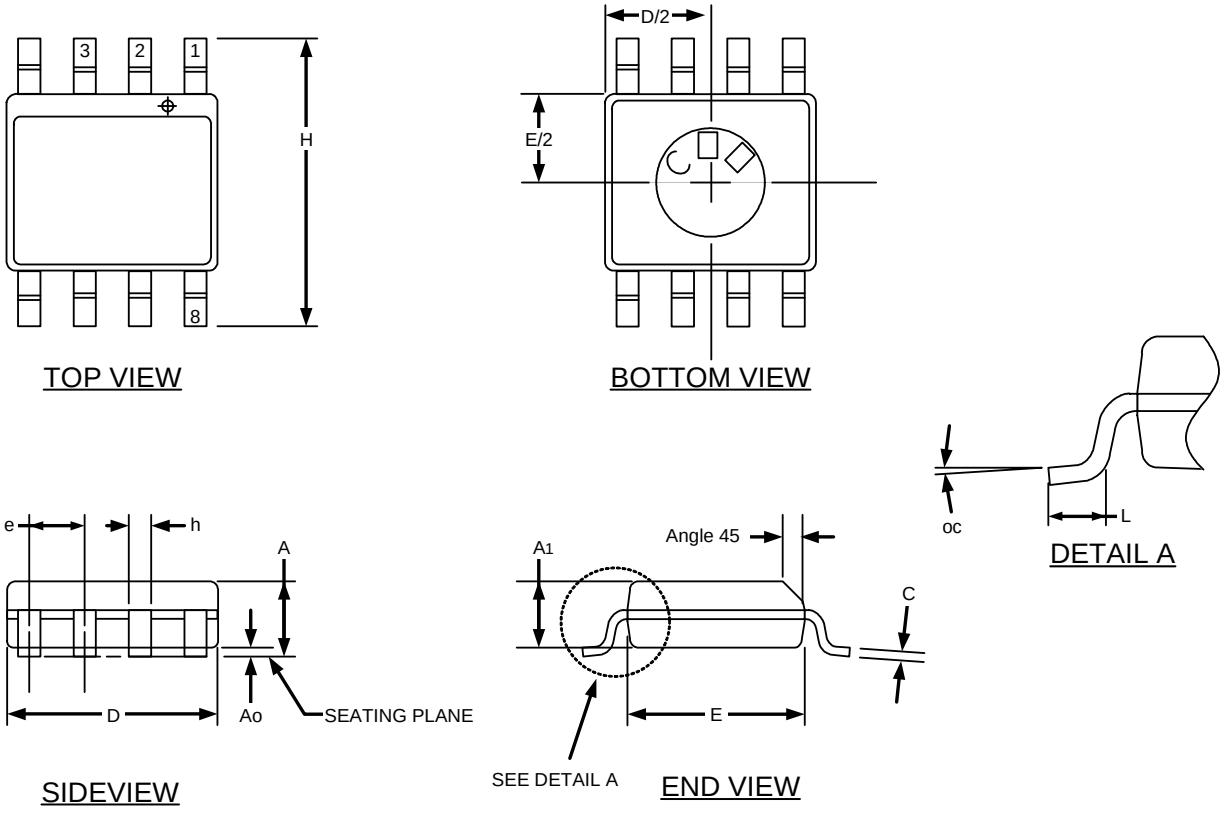
Illustration of a possible temperature regulation



9. Mechanical Data

9.1. Mechanical data of the MLX10803 package

Package of the MLX10803: SOIC8 in accordance to the JEDEC standard.



	DIMENSIONS						Note
	INCHES			MILLIMETERS			
	MIN.	NOM.	MAX	MIN.	NOM.	MAX	
A	.061	.064	.068	1.55	1.63	1.73	
A1	.004	.006	.0098	0.127	0.15	0.25	
A0	.055	.058	.061	1.40	1.47	1.55	
B	.0138	.016	.0192	0.35	0.41	0.49	
C	.0075	.008	.0098	0.19	0.20	0.25	
D	.189	.194	.196	4.80	4.93	4.98	
E	.150	.155	.157	3.81	3.94	3.99	
e		.050			1.27		
H	.230	.236	.244	5.84	5.99	6.20	
h	.010	.013	.016	0.25	0.33	0.41	
L	.016	.025	.035	0.41	0.64	0.89	
oc	0°	5°	8°	0°	5°	8°	Degrees
X	.085	.093	.100	2.16	2.36	2.54	

10. Standard information regarding manufacturability of Melexis products with different soldering processes

Our products are classified and qualified regarding soldering technology, solderability and moisture sensitivity level according to following test methods:

Reflow Soldering SMD's (Surface Mount Devices)

- IPC/JEDEC J-STD-020
  Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices
  (classification reflow profiles according to table 5-2)
- EIA/JEDEC JESD22-A113
  Preconditioning of Nonhermetic Surface Mount Devices Prior to Reliability Testing
  (reflow profiles according to table 2

Wave Soldering SMD's (Surface Mount Devices) and THD's (Through Hole Devices)

- EN60749-20
  Resistance of plastic- encapsulated SMD's to combined effect of moisture and soldering heat
- EIA/JEDEC JESD22-B106 and EN60749-15
  Resistance to soldering temperature for through-hole mounted devices

Iron Soldering THD's (Through Hole Devices)

- EN60749-15
  Resistance to soldering temperature for through-hole mounted devices

Solderability SMD's (Surface Mount Devices) and THD's (Through Hole Devices)

- EIA/JEDEC JESD22-B102 and EN60749-21
  Solderability

For all soldering technologies deviating from above mentioned standard conditions (regarding peak temperature, temperature gradient, temperature profile etc) additional classification and qualification tests have to be agreed upon with Melexis.

The application of Wave Soldering for SMD's is allowed only after consulting Melexis regarding assurance of adhesive strength between device and board.

Based on Melexis commitment to environmental responsibility, European legislation (Directive on the Restriction of the Use of Certain Hazardous substances**, RoHS**) and customer requests, Melexis has installed a Roadmap to qualify their package families for **lead free** processes.

For more information on the lead free topic please see quality page at our website:
http://www.melexis.com/quality_leadfree.asp

11. History record

Rev.	No.	Change	Date
1	1	Creation with MLX10801 specifications as base	25.07.04
2	1	Gone through document VAR,ALX,RAH,LIW	02.08.04
3	1	4-th pin recast from TEST to VREF - linear dimming	07.08.04
4	1	Revision of kick off meeting	
5	1	Revision before release RAH	
6	1	Improved packing information RAH	
7	1	Improved block diagram	7.10.04
8	1	Design implementation review	15.01.05
9	1	Updated schematic diagrams	16.01.05
10	1	Pin order changed	3.02.05
11	1	Temperature code changed to “K”, Vmaxdrv changed, Oscillator related parameters changed, VREF related parameters changed, ROSC related parameters changed	13.06.05
12	1	Cosmetic changes	17.06.05
13	1	Cosmetic changes	21.06.05
14	1	VREF related parameters are changed	12.07.05
15	1	Pins’ names changed: RE_REF → VREF, NTC → IREF1, SETNTC → IREF2, VS → VS/PWM. Corresponding parameters’ names changed. RSENSE related parameters changed	3.08.05
16	1	LED driver applications changed	18.08.05
17	1	Block diagram changed, Electrical characteristics: Global parameters, Monoflop related parameters, RSENSE related parameters, IREF1 related parameters, IREF2 related parameters, VREF related parameters changed, LED driving principle: The principle in detail changed	21.09.05
	2	Internal review	23.09.05
18	1	Chapter 7.3. changed: graph added, cosmetic changes	23.09.05
	2	Cosmetic changes	28.09.05
	3	Soldering information is changed	31.10.05
19	1	Internal review	28.11.05
20	1	Monoflop related parameters changed, IREF1, IREF2, VREF related parameters changed	6.01.06
21	1	Figure1, Figure2 changed, 4. Electrical characteristics: changed, 8. Temperature regulation: figure added	23.03.06
22	1	“TBD” removed, cosmetic changes	6.04.06
	2	RESET related parameters changed, ROSC related parameters changed	6.04.06
	3	Cosmetic changes	14.04.06
	4	Chapter 8, Illustration of a possible temperature regulation changed	16.08.06
	5	Cosmetic changes	17.08.06
23	1	Chapter 4 (parameters table) changed	25.09.06
24	1	Iref1 related parameters changed, Iref2 related parameters changed, DRVGATE related parameters changed, Absolute maximum ratings changed	7.12.06

12. Disclaimer

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ISO/TS16949 and ISO14001 certified

[i] Guaranteed by design

[ii] Value for the resistor *Rosc* to be connected to ROSC pin is derived from the needed monoflop time *Tmon* according to the following expression: $Rosc[k\Omega] = 222.2 \cdot (\frac{Tmon[\mu s]}{12.5} - 0.02)$