White LED Driver ICs
Monolithic IC MM3097

Outline

This IC is a white LED driver IC. It is a step-up DC-DC converter IC designed to drive up to 7 LEDs and suitable for backlight drivers. Feedback voltage is as low as 95mV, which can reduce power consumption in a current set resistor. A small 0.22µF capacitor can be used, so that not only space but costs can be reduced.

Features

1. Enables to drive up to 7 white LEDs in a series connection
2. Input voltage range 2.5 to 6V
3. Shutdown current 0.1µA typ.
4. High efficiency 85% typ.
5. Luminance control PWM system
6. Feedback voltage 95mV

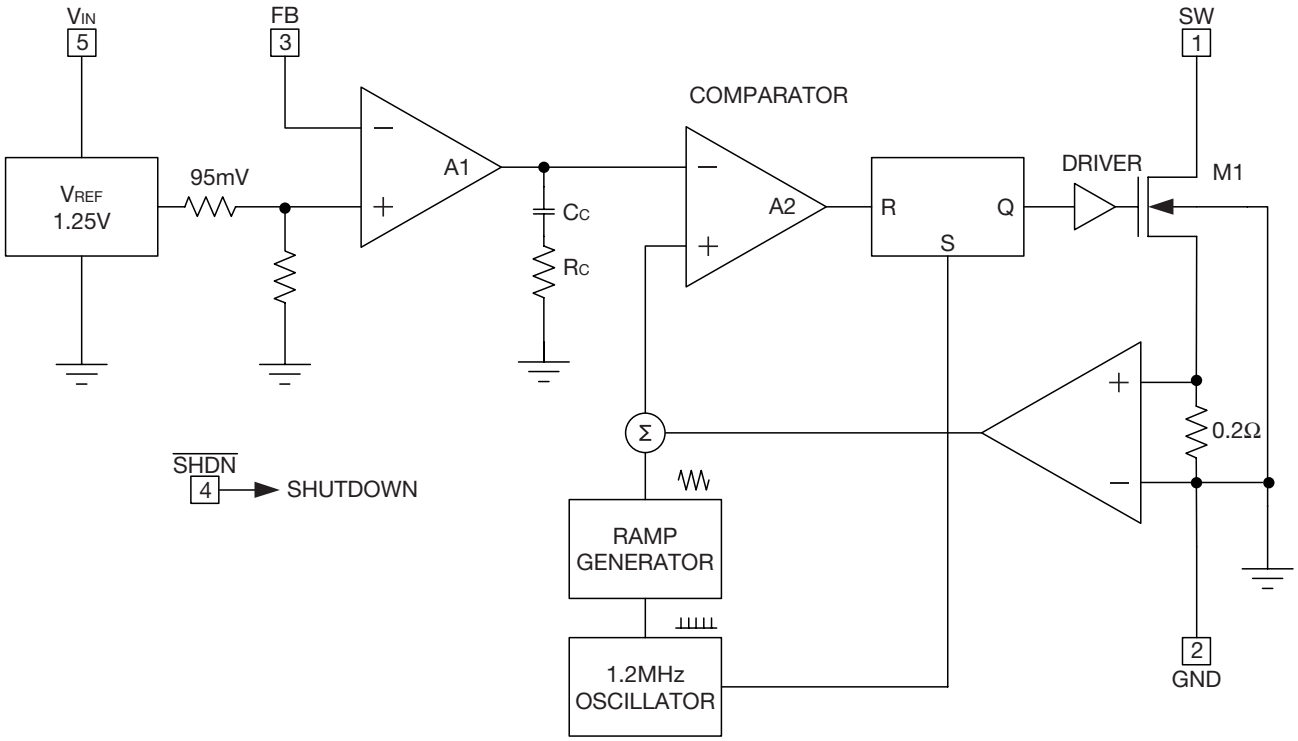
Package

SOT-25A

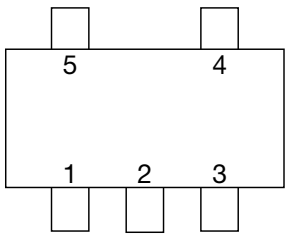
Applications

1. Cell phones
2. Digital video cameras
3. Digital still cameras
4. Portable game devices
5. PDA

Block Diagram



Pin Assignment



SOT-25A
(TOP VIEW)

1	SW
2	GND
3	FB
4	$\overline{SHND}$
5	VIN

Pin Description

Pin No.	Pin name	Functions
1	SW	Switch pin. Connect inductor/diode here. Minimize trace area at this pin to reduce EMI.
2	GND	GND pin.
3	FB	Feedback pin. Reference voltage is 95mV. Connect cathode of lowest LED and resistor.
4	SHDN	Shutdown pin. Tie to 1.5V or higher to enable device; 0.4V or less to disable device.
5	V_{IN}	Input supply pin. Must be locally bypassed.

Absolute Maximum Ratings (Ta=25°C)

Item	Symbol	Ratings	Units
Storage temperature	T_{STG}	–65~+150	°C
Operating temperature	T_{OPR}	–40~+85	°C
Input voltage	V_{INMAX}	8	V
SW voltage	V_{SWMAX}	36	V
FB voltage	V_{FBMAX}	8	V
SHDN voltage	$V_{SHDNMAX}$	8	V
Allowable loss	P_D	150	mW

Note: Absolute Maximum Ratings are those values beyond which the life of the device may be impaired.

Recommended Operating Conditions

Item	Symbol	Ratings	Units
Operating voltage	V_{OP}	2.5~6	V

Electrical Characteristics 1 (Except where noted otherwise Ta=+25°C, V_{IN}=3V, V_{SHDN}=3V)

Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Units
Feedback voltage	V_{FB}	3LEDs, ILED=15mA	86	95	104	mV
FB pin bias current	I_{FB}		10	45	100	nA
Supply current	I_{SS}			1.0	2.0	mA
		SHDN=0V		0.1	1.0	µA
Switching frequency	fsw		0.8	1.2	1.6	MHz
Maximum duty cycle	MaxDuty		85	90		%
Switch current limit	I_{SWLMT}			320		mA
Switch V_{CESAT}	V_{CESAT}	I_{SW}=250mA		350		mV
Switch leakage current	I_{SWLEAK}	V_{SW}=5V		0.01	5	µA
SHDN voltage high	V_{SHDNH}		1.5			V
SHDN voltage low	V_{SHDNL}				0.4	V
SHDN pin bias current	I_{SHDN}			6		µA

Note: The MM3097 is guaranteed to meet specifications from 0°C to 70°C.
Specifications over the −40°C to 85°C operating temperature range are assured by design, characterization and correlation with statistical process controls.

Electrical Characteristics 2 (Except where noted otherwise Ta=+25°C, V_{IN}=3V, V_{SHDN}=3V)

Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Units
Feedback voltage	V_{FB}	3LEDs, feedback resistor=6.3Ω	86	95	104	mV
FB pin bias current	I_{FB}		10	45	100	nA
Supply current	I_{SS}			1.0	2.0	mA
		SHDN=0V		0.1	1.0	µA
Switching frequency	fsw		0.8	1.2	1.6	MHz
Maximum duty cycle	MaxDuty		85	90		%
Switch current limit	I_{SWLMT}			320		mA
Switch V_{CESAT}	V_{CESAT}	I_{SW}=250mA		350		mV
Switch leakage current	I_{SWLEAK}	V_{SW}=5V		0.01	5	µA
SHDN voltage high	V_{SHDNH}		1.5			V
SHDN voltage low	V_{SHDNL}				0.4	V
SHDN pin bias current	I_{SHDN}			6		µA

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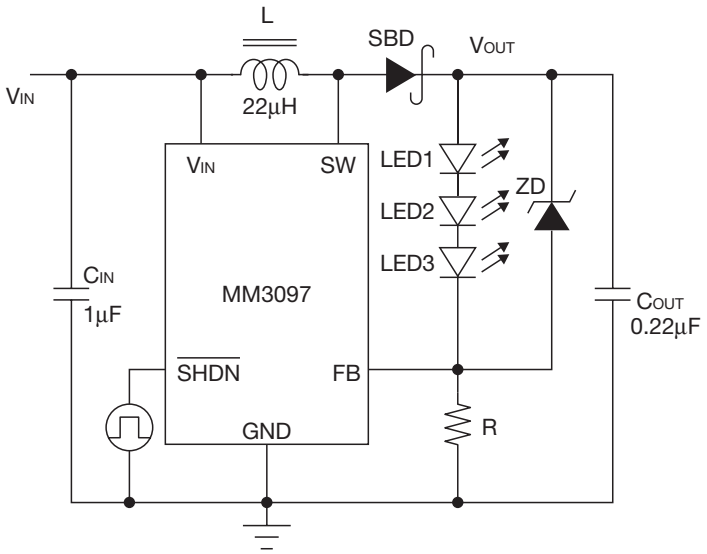
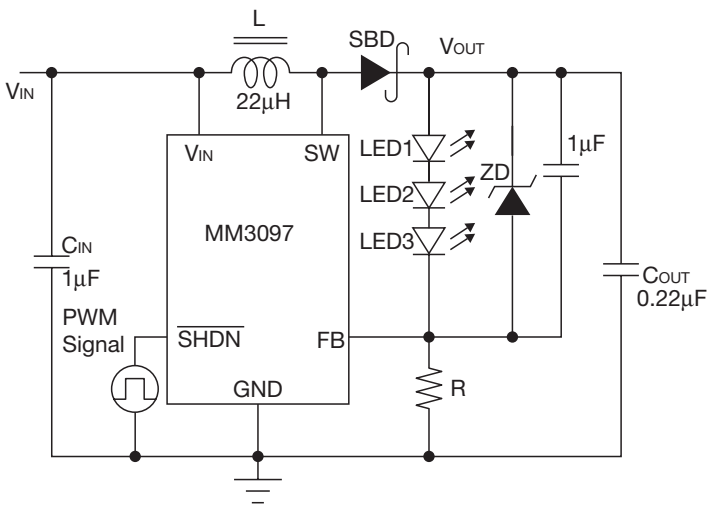
Measuring Circuit



The following is recommended application for MM3097.

Recommend application
L: MITSUMI ELECTRIC C3-Y1.5R (22µH)
SBD: PHILIPS PMEG4005AEA
ZD: ROHM UDZS□B (zener voltage > VOUT)
LED: NICHIA NSCW215

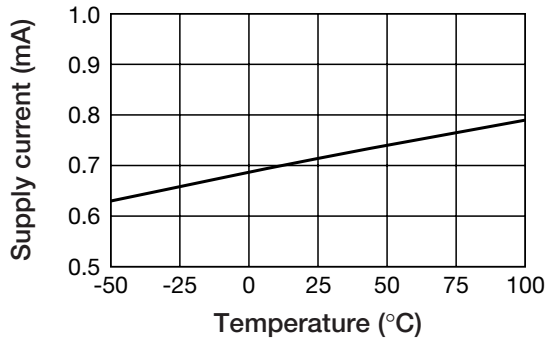
Application Circuit



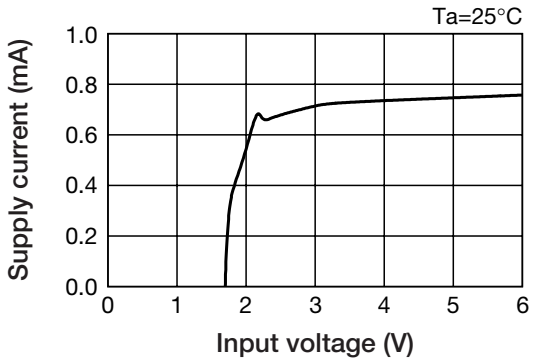
No internal soft-start circuit is included in MM3097.
The capacitor in left figure is recommended for MM3097 if necessity. Dimming control is possible with the PWM signal applied to the SHDN pin.
The magnitude of the PWM signal should be higher than the SHDN voltage high.

Characteristics

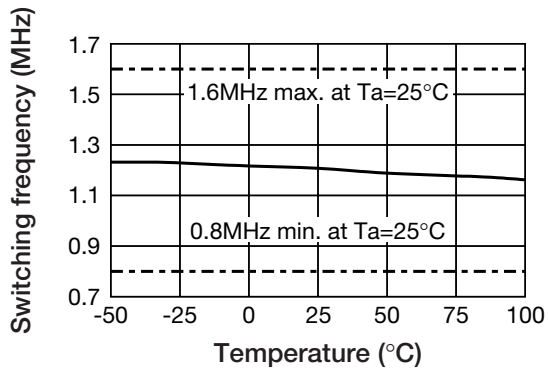
Quiescent current



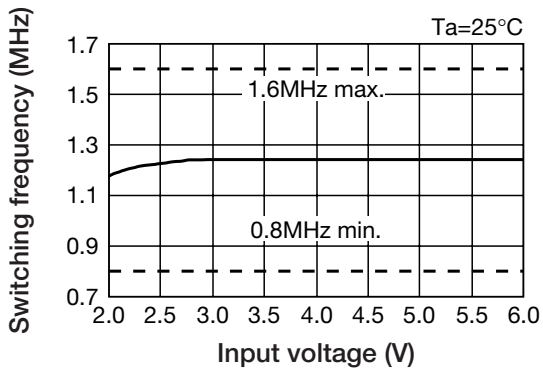
Quiescent current



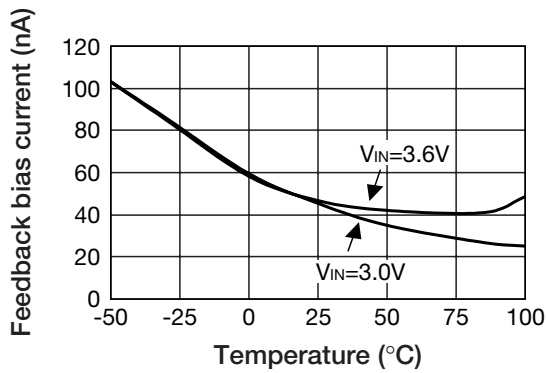
Switching frequency



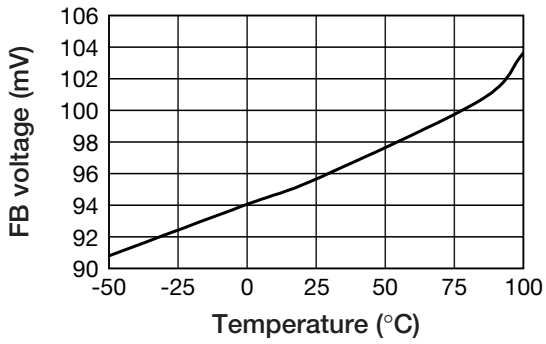
Switching frequency



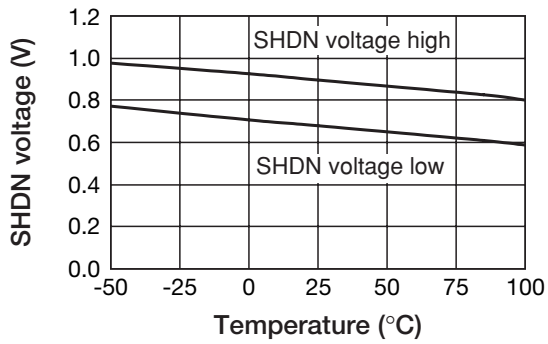
Feedback bias current



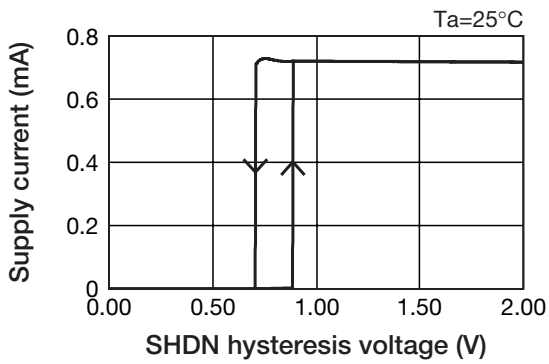
FB voltage



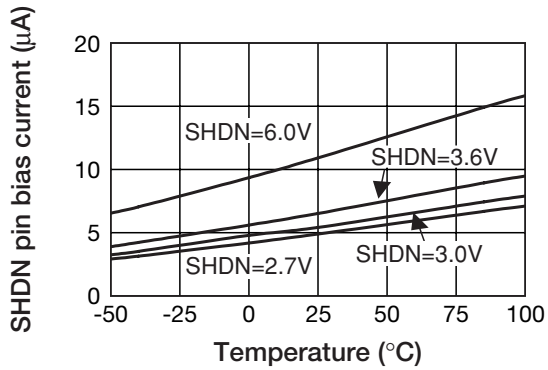
SHDN voltage



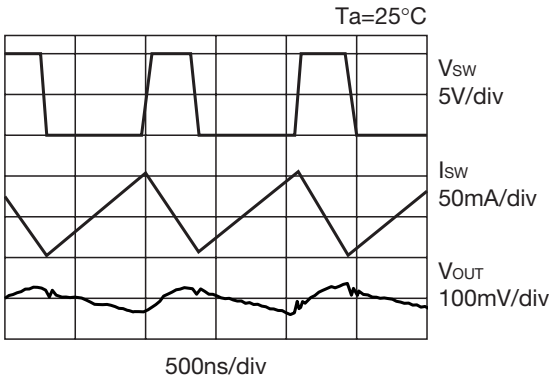
SHDN hysteresis voltage



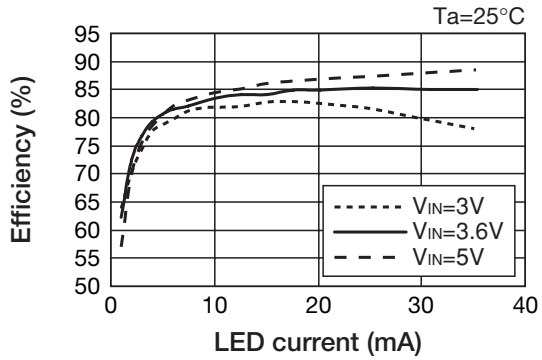
SHDN pin bias current



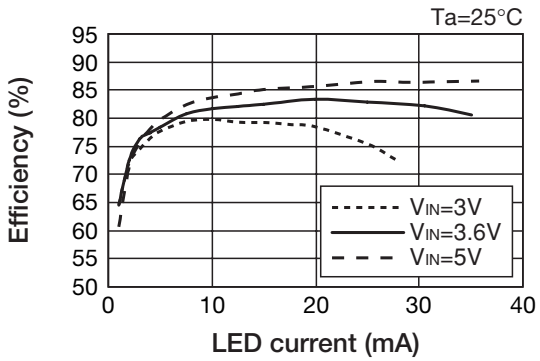
Switching waveform



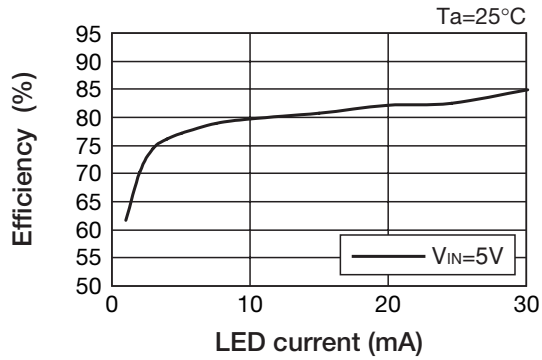
Efficiency (3LEDs)



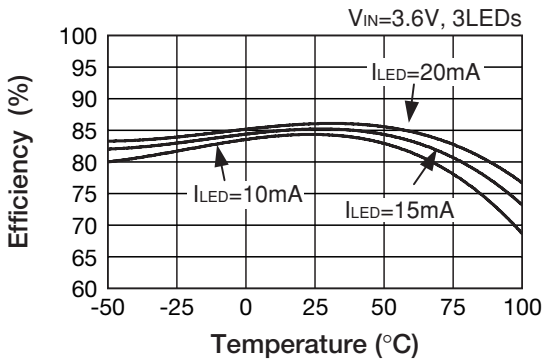
Efficiency (4LEDs)



Efficiency (7LEDs)



Efficiency



LED Current Control

The LED current is controlled by the feedback resistor (R in Measuring Circuit).
The feedback reference is 95mV, so the LED current is 95mV/R.

I_{LED}=95mV/R

The relation between LED current and resistance R is shown in Table.1.

Table.1 Selection of Resistance R

I_{LED} (mA)	R (Ω)
5	19
10	9.5
12	8.0
15	6.3
20	4.5

Applications Information

Inductor Selection
A 22µH inductor is recommended for MM3097 applications.
Small size and high efficiency are the major concerns for most applications.
Inductors with low core losses and small DCR (copper wire resistance) at 1.2MHz are good choices for applications.
Some inductors in this category with small size are listed in Table.2.
The efficiency comparison of different inductors is shown in Figure.1.

Table.2 Recommend Inductors

Part number	DCR (mΩ)	Current rating (mA)	Manufacturer
C3-Y1.5R 22µH	660	550	Kyushu Mitsumi
C3-Y1.5R 10µH	275	900	
C3-Y1.5R 33µH	995	500	
C3-Y1.5R 47µH	1220	430	

Figure.1 Efficiency comparison of different inductors