

## **1.4A Boost for White LED Driver**

### **❖ GENERAL DESCRIPTION**

The MA2001 is a high frequency, asynchronous boost converter. The internal MOSFET can support up to 8 White LEDs for backlighting and OLED power application, and the internal soft start function can reduce the inrush current.

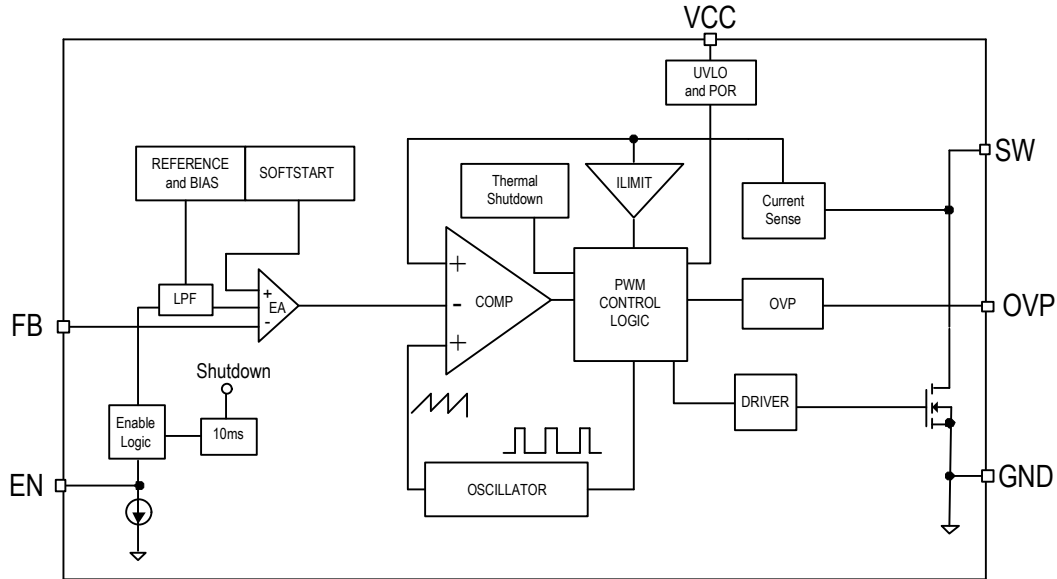
The MA2001 uses current mode, 1.0MHz fixed frequency architecture to regulate the LED current, which is set through an external current sense resistor. Its low 300mV feedback voltage reduces power loss and improves efficiency. The OVP pin monitors the output voltage and turns off the converter if an over-voltage condition is present due to an open circuit condition. The MA2001 includes under-voltage lockout, current limiting and thermal shutdown protection preventing damage in the event of an output overload. The driver is available in small 6-pin SOT23 & TSOT23 packages.

### **❖ FEATURES**

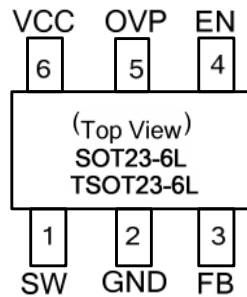
- 2.5V to 5.5V operating input voltage range
- Drives up to 8 series White LEDs
- 1.0MHz Fixed Switching Frequency
- Wide range for PWM dimming (200Hz to 200KHz)
- Internal 1.4A switching current limit
- Over Voltage Protection (OVP)
- Internal Soft-start Function
- Current limit and Thermal shutdown protection
- Under voltage Lockout

### **❖ APPLICATIONS**

- Cellular Phones
- Digital Cameras
- Tablet PC and Handheld Computers
- PDA, DVD and GPS Receivers
- Portable Instruments

**❖ BLOCK DIAGRAM**

**❖ PIN ASSIGNMENT**

The package of MA2001 are SOT23-6L & TSOT23-6L ; the pin assignment is given by:



Name	Description
<b>VCC</b>	Power Input Pin
<b>GND</b>	Ground Pin.
<b>FB</b>	Feedback Pin.
<b>EN</b>	Chip Enable & Dimming pin. Active high. Internal pull low.
<b>OVP</b>	Over voltage detect pin
<b>SW</b>	Switching Pin

**❖ ORDER/MARKING INFORMATION**

Order Information	Top Marking
<b>MA2001XX X</b> Package Type C: SOT23-6L CT: TSOT23-6L Packing Blank : Bag A : Taping	<b>A 1 Y W X</b> → ID Code: Internal → Week: 01~26(A~Z) 27~52(a~z) → Year : 3 = 2013 4 = 2014

**❖ ABSOLUTE MAXIMUM RATINGS** (at  $T_A=25^{\circ}\text{C}$ )

Characteristics	Symbol	Rating	Unit
VCC pin voltage	$V_{IN}$	-0.3 to 6	V
SW pin voltage	$V_{SW}$	-0.3 to 33	V
OVP pin voltage	$V_{OVP}$	-0.3 to 33	V
EN, FB pins voltage		-0.3 to $V_{IN}+0.3$	V
Continuous Power Dissipation	PD	$(T_J-T_A) / \theta_{JA}$	mW
Operating Junction Temperature	Top	-40 to 125	$^{\circ}\text{C}$
Storage Temperature Range		-65 to 150	$^{\circ}\text{C}$
Thermal Resistance from Junction to case	$\theta_{JC}$	180	$^{\circ}\text{C}/\text{W}$
Thermal Resistance from Junction to ambient	$\theta_{JA}$	250	$^{\circ}\text{C}/\text{W}$

Note:  $\theta_{JA}$  is measured with the PCB copper are (need connect to GND of the MA2001) of approximately 1 in<sup>2</sup> (Multi-layer).

**❖ ELECTRICAL CHARACTERISTICS**

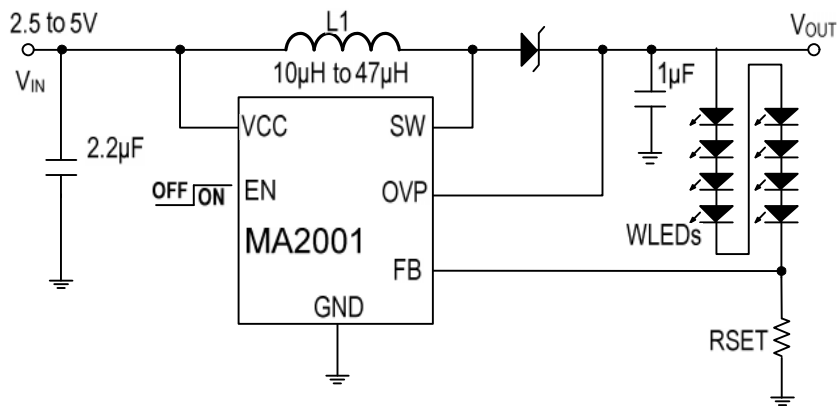
( $V_{IN} = 5\text{V}$ ,  $V_{EN} = 5\text{V}$ ,  $I_{OUT} = 20\text{mA}$ ,  $T_A = 25^{\circ}\text{C}$ )

Characteristics	Symbol	Conditions	Min	Typ	Max	Units
Input Voltage Range	$V_{IN}$		2.5	-	5.5	V
Input UVLO	UVLO	Rising	-	2.25	2.45	V
UVLO Hysteresis			-	0.1	-	V
OVP Sense Voltage	$V_{OV}$		27.5	29	-	V
Quiescent Current	$I_{CCQ}$	$V_{FB} = 0.5\text{V}$ , $I_{OUT} = 0\text{mA}$	-	200	400	$\mu\text{A}$
Supply Current	$I_{IN}$	$V_{FB} = 0\text{V}$ , Switching	-	1	2	mA
Shutdown Current	$I_{SD}$	$V_{EN} = 0\text{V}$ , $T_{EN} > 20\text{mS}$	-	1	4	$\mu\text{A}$
FB Pin Voltage	$V_{FB}$		0.285	0.300	0.315	V
FB Pin Current	$I_{FB}$		-	-	$\pm 100$	nA
Load Regulation		$1\text{mA} < I_{OUT} < 20\text{mA}$	-	1	-	%
Line Regulation		$3\text{V} < V_{IN} < 4.3\text{V}$	-	1	-	%
EN Pin Voltage High	$V_{ENH}$		1.4	-	-	V
EN Pin Voltage Low	$V_{ENL}$		-	-	0.4	V
EN Hysteresis			-	0.1	-	V

EN Pin sink Current	$I_{IH}$		-	1	-	$\mu A$
Switching Frequency	$F_{OSC}$		0.75	1	1.25	MHz
N-Channel MOSFET Current Limit (Note1)	$C_L$		-	1.4	-	A
	$C_L$	Duty on 50%	-	1.9	-	A
Switching Maximum Duty	$D_{max}$		-	92	-	%
Dimming clock rate			0.2	-	200	KHz
N-Switch $R_{DS(ON)}$	$R_{DS(ON)-N}$	$V_{in}=3.6V$	-	0.5	1.0	$\Omega$
Thermal Shutdown	$T_{SD}$		-	155	-	$^{\circ}C$
Thermal Shutdown Protection hysteresis	$T_{SH}$		-	25	-	$^{\circ}C$

Note1: Guaranteed by design.

### ❖ APPLICATION CIRCUIT



### ❖ FUNCTION DESCRIPTION

#### Setting the $I_{LED}$ Current

Application circuit item shows the basic application circuit with MA2001 adjustable output version. The external resistor sets the LED output current according to the following equation:

$I_{LED}$	RSET	
20mA	15 $\Omega$	6mW
350mA	0.857 $\Omega$	105mW

### **Under Voltage Lockout (UVLO)**

To avoid mis-operation of the device at low input voltages an under voltage lockout is included that disables the device, if the input voltage falls below (2.25V-100mV).

### **Over Voltage Protection**

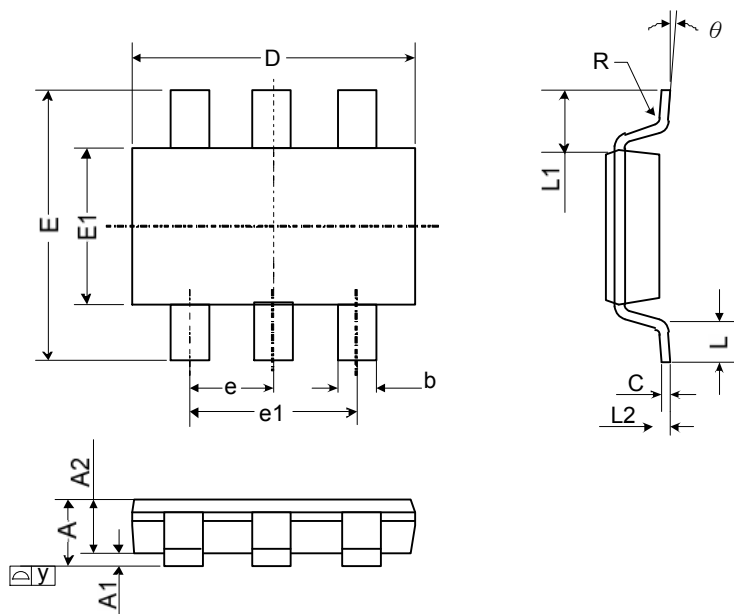
OVP measure the output voltage for open circuit protection. Connect OVP pin to the output at the top of the LED string. If  $V_{OUT}$  above 36V, the OVP protection is happened that stops the internal driver until  $V_{OUT}$  below 36V.

### **Input Capacitor Selection**

The input capacitor reduces the surge current drawn from the input and switching noise from the device. The input capacitor impedance at the switching frequency shall be less than input source impedance to prevent high frequency switching current passing to the input. A low ESR input capacitor sized for maximum RMS current must be used. Ceramic capacitors with X5R or X7R dielectrics are highly recommended because of their low ESR and small temperature coefficients. A 2.2 $\mu$ F ceramic capacitor for most applications is sufficient. For a lower output power requirement application, this value can be decreased.

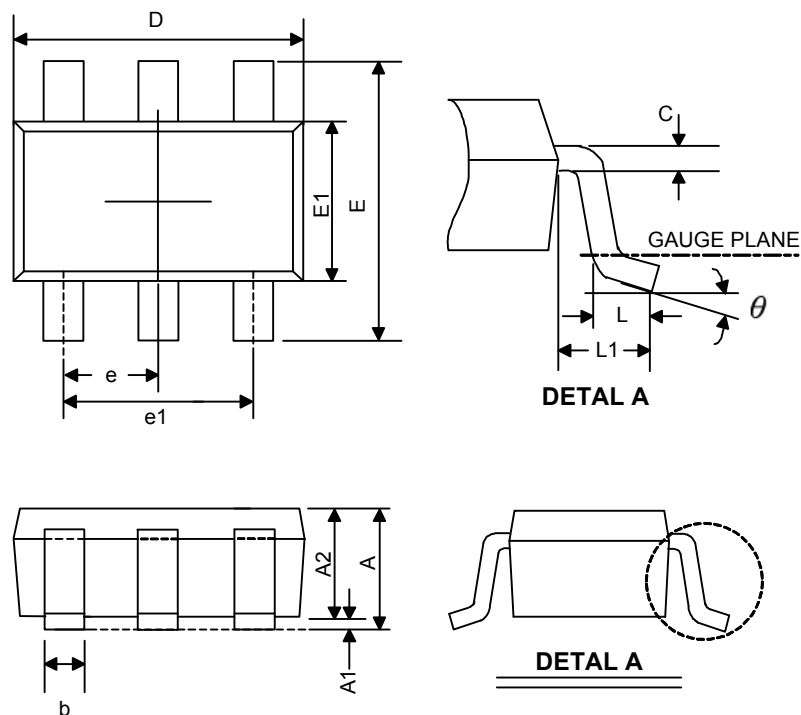
### **Output Capacitor Selection**

The output capacitor is required to keep the output voltage ripple small and to ensure regulation loop stability. The output capacitor must have low impedance at the switching frequency. Ceramic capacitors with X5R or X7R dielectrics are recommended due to their low ESR and high ripple current. A 1 $\mu$ F ceramic capacitors works for most of the applications. Higher capacitor values can be used to improve the load transient response.

**❖ PACKAGE OUTLINES**
**(1) TSOT23-6L**


Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	-	-	1.10	-	-	0.043
A1	0.00	-	0.10	0	-	0.004
A2	0.70	0.90	1.00	0.028	0.035	0.039
b	0.30	0.40	0.50	0.012	0.016	0.020
C	0.08	0.14	0.20	0.003	0.006	0.008
D	2.80	2.90	3.00	0.110	0.114	0.118
E	2.60	2.80	3.00	0.102	0.110	0.118
E1	1.50	1.60	1.70	0.059	0.063	0.067
e	0.95 BSC.			0.037 BSC.		
e1	1.90 BSC.			0.075 BSC.		
L	0.30	0.45	0.60	0.012	0.018	0.024
L1	0.60 REF.			0.024 REF.		
L2	0.25 BSC.			0.010 BSC.		
y	-	-	0.10	-	-	0.004
R	0.10	-	-	0.004	-	-
θ	0°	-	8°	0°	-	8°

JEDEC outline: MO-193 AA

**(2) SOT23-6L**


Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	1.05	-	1.45	0.041	-	0.057
A1	0.05	-	2.15	0.002	-	0.085
A2	0.90	1.10	1.30	0.035	0.043	0.051
b	0.30	-	0.50	0.012	-	0.020
C	0.08	-	0.22	0.003	-	0.009
D	2.70	2.90	3.10	0.106	1.114	0.122
E1	1.40	1.60	1.80	0.055	0.063	0.071
E	2.60	2.80	3.00	0.102	0.110	0.118
L	0.30	-	0.60	0.012	-	0.024
L1	0.50	0.60	0.70	0.020	0.024	0.028
e1	1.80	1.90	2.00	0.071	0.075	0.079
e	0.85	1.00	1.15	0.033	0.037	0.045
$\theta$	0°	4°	8°	0°	4°	8°